Review of Emission Limits for Two Titan 130 Turbines at Proposed Cane Ridge Compressor Station

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October 25, 2017

I. Summary

This analysis provides my professional opinion on the appropriate air emission control levels for the two Titan 130 turbines at the proposed Cane Ridge Compressor Station. I have reviewed the Cane Ridge "Draft/Proposed Part 70 Operating Permit" and the "Draft Permits to Construct or Modify an Air Pollutant Source" related to the two Solar Titan 130 natural gas-fired compressor turbines, each rated at 160.98 MMBtu per hour (19,799 hp), that will be utilized at the compressor station.

There is no analysis in the Columbia Gulf Transmission, LLC application or the Metro Nashville draft permit documents of air emission limits proposed for similar compressor stations in the region. A number of such proposed compressor stations will use nitrogen oxide (NO_x) and carbon monoxide (CO) catalytic control systems on all gas turbines to minimize air pollutant emissions. These limits are described as "best-in-class" industry practice and are much lower than the NO_x and CO limits proposed for the Cane Ridge gas turbines.[2]

These proposed "best in class" compressor stations have sufficiently low air emissions that they do not require Title V major source air permits, do not trigger PSD BACT requirements, and are located far from population centers in clean air (attainment) regions. The Metro Nashville/ Davidson County Air Pollution Control Division draft Title V operating permit for the Cane Ridge Compressor Station includes no analysis of air emission limits and control systems being proposed for comparable compressor stations in the region, and therefore provides no context to assess the adequacy of the proposed air emission limits.

Specifically, an industry "best-in-class" standard has been advanced for three compressor stations included in the proposed Atlantic Coast Pipeline project. These compressor stations, located in West Virginia, Virginia, and North Carolina, will be limited to 5 ppm NO_x using selective catalytic reduction (SCR). Oxidation catalyst is also specified for these gas turbines to minimize CO and volatile organic compound (VOC) emissions.

The Cane Ridge Compressor Station has a proposed NO_x emission rate of 15 ppm, three times higher than the industry "best-in-class" NO_x emission rate voluntarily proposed by the developers of the Atlantic Coast Pipeline project. In contrast to Cane Ridge, the Atlantic Coast Pipeline compressor stations are not subject to Title V major source permitting requirements.

[1] Resume for Bill Powers, P.E. is provided as **Attachment A**.

[2] My analysis does not assume that what industry describes as "best-in-class" is equivalent to the lowest emission level achievable, only that industry has described the emission level as "best-in-class."

Titan gas turbines can achieve NO_x limits as low as 1.5 ppm.[3] At minimum, the Cane Ridge gas turbines should be subject to the same proposed industry "best-in-class" standard being applied to the gas turbines at the Atlantic Coast Pipeline compressor stations. SCR should be required to control NO_x emissions and oxidation catalyst should be required to control CO and VOC emissions.

Electric motor drive is also a technically and economically feasible alternative to gas turbines at Cane Ridge. Use of electric motor drive would eliminate the air and noise emissions associated with the gas turbines. Selection by Columbia Gulf Transmission of electric motor drive would also eliminate the additional expense of "best in class" SCR and oxidation catalyst air emission control systems. Metro Nashville should encourage Columbia Gulf Transmission to substitute the proposed gas turbines with electric motor drive to most effectively address air and noise emission issues associated with the proposed Cane Ridge compressor station.

II. Project Description

A Part 70 air operating permit application prepared by Columbia Gulf Transmission for the Cane Ridge Compressor Station in Davidson County, Tennessee was received on June 1, 2016 by the Air Pollution Control Division of the Metro Nashville/Davidson County Health Department. The proposed natural gas compressor station will consist of two Solar Titan 130 natural gas-fired turbines and ancillary equipment, including one small process heater, numerous small catalytic heaters, and a back-up internal combustion engine.[4] Table 1 lists the annual air emissions potential of the two Titan 130 turbines at the Cane Ridge Compressor Station.

Table 1. Draft Permit Annual Air Emissions Limits – Two Titan 130 Turbines, Cane Ridge Compressor Station[5]

Pollutant	Annual emission limit (tpy), 12-month rolling average
NO_x	78.2
VOC	10.18
CO	200.8
PM_{10}	9.3
SO_2	1.0

NO_x = nitrogen oxides; VOC = volatile organic compounds; CO = carbon monoxide; PM_{10} = particulate matter with aerodynamic diameter less than 10 microns; SO_2 = sulfur dioxide.

The Cane Ridge Compressor Station is classified as a Title V major source under the Clean Air Act and Metro Nashville/Davidson County air quality regulations, due to its potential to emit more than 100 tons per year (tpy) of CO.[6]

[3] Bill Powers, P.E. – Powers Engineering, *Selective Catalytic Reduction (SCR) at 2.5 ppm NO_x and Dry Low NO_x Combustion at 9 ppm and 15 ppm are Cost-Reasonable RACT Alternatives for Two Titan Turbines at Proposed Joelton, Tennessee Compressor Station*, , January 4, 2017, p. 3, footnote 13 and Attachment B.

[4] B. McClain – Air Pollution Control Division, Cane Ridge Compressor Station Construction Permit Review, June 2016, pdf p. 11.

[5] Metro Nashville/Davidson County Health Department Air Pollution Control Division, *Draft/Proposed Part 70 (Title V) Operating Permit, Permit Number 70-0XXX, Columbia Gulf Transmission, LLC – Cane Ridge Compressor Station, Antioch, TN*, July 2017, p. 13.

The proposed compressor station is not currently identified as a major NO_x or CO source under the Prevention of Significant Deterioration (PSD) program, even though the same turbines installed in an electric generation application would be a classified as a major source under the PSD program. The PSD program was established as a component of the 1977 Clean Air Act Amendments. The PSD program identifies twenty-eight specific source categories that are classified as major PSD sources if they have the potential to emit 100 tpy or more of regulated air pollutants, including NO_x, sulfur dioxide (SO_2), and CO.[7] All other sources are subject to a 250 tpy major source PSD threshold.[8] Major PSD sources must apply Best Available Control Technology (BACT) to minimize emissions of the pollutants that exceed the major source trigger level.[9]

Fossil fuel steam electric generator facilities with a heat input of 250 million British Thermal Units per hour (MMBtu/hr) or greater are one of the twenty-eight source categories identified by the EPA as subject to the 100 tpy major PSD sources threshold for NO_x and CO.[10]

Gas turbines were not subject to a federal New Source Performance Standard (NSPS) at the time the 1977 Clean Air Act Amendments were passed into law. The original NSPS for gas turbines, Subpart GG, was promulgated in 1979, two years after the twenty-eight specific source categories were subject to a 100 tpy major source PSD threshold.[11] However, the EPA determined in 1993 that gas turbines, specifically when used in electric generation applications, would be subject to the same 100 tpy PSD major source threshold as fossil fuel steam generators.[12]

Metro Nashville is applying a major source threshold of 250 tpy to the gas turbines at Cane Ridge that drive compressors. However, the Cane Ridge gas turbines have a combined heat input capacity of 322 MMBtu/hr and have the potential to emit more than 100 tpy of CO.[13] The Cane Ridge gas turbines will not be in electric generation service. However, Cane Ridge will use the same turbines as gas turbine electric generation plants that must comply with PSD BACT requirements at the 100 tpy major source trigger level. While gas turbines driving compressors

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[6] Metro Nashville/Davidson County Health Department Division of Air Pollution Control, Regulation No. 13 - Part 70 Operating Permit Program, Section 13-1: Definitions, (p)(2), as amended December 2, 2010, p. 3.

[7] EPA, *New Source Review Workshop Manual – Prevention of Significant Deterioration and Nonattainment Area Permitting* (Draft), October 1990, Table A-1, p. 11 and p. A.22: https://www.epa.gov/sites/production/files/2015-07/documents/1990wman.pdf.

[8] Ibid, p. A.22.

[9] Clean Air Act § 165, 42 U.S.C. § 7475.

[10] 40 C.F.R. 60 New Source Performance Standard Subpart D was promulgated in 1971 and addressed only steam generators (boilers) in electric generation service. At the time, use of gas turbines for baseload electric power generation had not yet occurred at a significant scale. In 1993, at a time when gas turbines had been in common use for baseload electric power generation for a number of years, EPA issued a determination that Subpart D was also applicable to gas turbines in electric power generation applications. See footnote 6.

[11] 40 C.F.R. 60, *Subpart GG—Standards of Performance for Stationary Gas Turbines*, 44 FR 52798, Sept. 10, 1979 [Note that Subpart GG has been superseded by Subpart KKKK.]

[12] EPA, *Memorandum - Determining Prevention of Significant Deterioration (PSD) Applicability Thresholds for Gas Turbine Based Facilities*, February 2, 1993. All other sources are subject to a 250 tpy major source PSD threshold.

[13] Draft Cane Ridge Title V air permit, p. 13.

have not yet been expressly identified by EPA as subject to the same PSD major source thresholds as gas turbines in electric generation service,[14] using EPA's logic as reflected in the 1993 EPA guidance memorandum, the proposed Cane Ridge facility is a de facto major PSD source of CO emissions and should be considered as subject to BACT requirements for CO.

III. The Cane Ridge Compressor Station Will Add Significantly to Air Emissions in Metro Nashville

A. NO_x and VOC Emissions

The Cane Ridge Compressor Station will add a significant quantity of additional NO_x and VOC emissions from point sources of fuel combustion in Davidson County when the compressor station becomes operational. NO_x emissions from point sources of fuel combustion are estimated to increase 14 percent, from 549.7 tpy to 627.9 tpy.[15] VOC emissions from point sources of fuel combustion will also increase 93 percent, from 11.0 tpy to 21.18 tpy.[16,17]

NO_x and VOC are ozone precursors, meaning these are necessary ingredients, in the presence of sunlight, to the formation of ozone in ambient air. Ozone is a lung irritant, and inhalation of ground-level ozone can trigger a range of health effects. EPA revised the primary and secondary ozone standards to 0.070 ppm in 2015, a decrease from the 2008 ozone standard of 0.075 ppm. The 2008 standards will be revoked in 2018–2019, and the 0.070 ppm standard will be incorporated into State Implementation Plans shortly thereafter.[18] Although Davidson County remains in attainment based on the 2008 ozone standard, the three-year average from 2012–2014 of the fourth highest concentration exceeded 0.070 ppm for both the Percy Priest Dam and the Old Hickory Dam-Sumner air quality monitors.[19] This indicates that Davidson County may face challenges achieving continuous compliance with the 0.070 ppm ozone standard, even at the current emissions rate.[20]

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[14] Gas turbines began to be used in natural gas pipeline compressor station applications in the 1960s and 1970s. See: Interstate Natural Gas Association of America, *Interstate Natural Gas Pipeline Efficiency*, October 2010, p. 15: http://www.ingaa.org/file.aspx?id=10929. Fossil-fuel steam electric generators had been in common use for many decades at that time.

[15] Metro Nashville/Davidson County Health Department Pollution Control Division, *Air Pollution Control – 2014 Annual Report*, Table 1 – 2014 Davidson County Annual Emission Inventory, p. 5. 78.2 tpy/549.7 tpy = 0.14 (40 percent).

[16] *Ibid.* 10.18 tpy/11.0 tpy = 0.925 (93 percent).

[17] Another pipeline compressor station, Joelton Compressor Station, has been proposed for location in Davidson County. Joelton will consist of two Titan 250 gas turbines with combined potential NO_x emissions of 167.4 tpy and VOC emissions of 11.5 tpy. The proposed NO_x limit for the Joelton Titan 250 turbines is bifurcated, applying a 15 ppm standard when operating at 40–80% capacity and 9 ppm at rated capacity. See: Metro Nashville final Title V Joelton Compressor Station air permit, June 2017.

[18] EPA. "2015 Ozone NAAQS Timelines." *Ozone Pollution.* Accessed at: https://www.epa.gov/ozone-pollution/2015-ozone-naaqs-timelines.

[19] Metro Nashville/Davidson County Health Department Air Pollution Control Division, *Air Pollution Control – 2014 Annual Report.*

[20] *Id.*

B. Carbon Monoxide Emissions

The draft Cane Ridge air permit would allow over 20 tons per day of CO emissions during low-load operating conditions.[21] Assuming roughly equivalent daily CO emissions in Nashville, this permit would represent an over 2,000 percent increase in daily CO emissions from point sources of fuel combustion in the Metro Nashville airshed on days when Cane Ridge is in low-load operating mode.[22] No similar "low-load" emissions are included in the Title V operating permit for Joelton Compressor Station.[23] No explanation is provided as to why this low-load operating scenario is included in the draft permit for the Cane Ridge Compressor Station.

The very high short-term CO emissions associated with the low-load operating profile, which result in Cane Ridge being classified a major source of air pollution, can be minimized by inclusion of an oxidation catalyst on the Titan gas turbines. The Joelton Titan gas turbines will be equipped with oxidation catalysts as part of the 9 ppm NO_x control package on those units. Best-in-class CO air emissions control for gas turbines in natural gas pipeline compressor service is oxidation catalyst.[24] To resolve these issues, the draft Cane Ridge permit can be modified to either: 1) eliminate the 100 hours authorized for low-load operation, or 2) require use of oxidation catalysts on the Cane Ridge gas turbines.

IV. NO_x and VOC limits in Contemporaneous Compressor Station Permit Applications Are Lower than Cane Ridge

The turbine types, turbine NO_x and VOC concentration limits, and the turbine NO_x and VOC control technologies proposed in the contemporaneous compressor station permit applications evaluated by Powers Engineering are shown in Table 2. Table 3 lists NO_x and VOC concentration limits only for each compressor station.

Table 2. NO_x and VOC Emission Limits in Compressor Station Air Permit Applications Contemporaneous to the Cane Ridge Compressor Station Application

Permittee/project/state	Date of application	Turbine type and number	NO_x/VOC limits (ppm)	NO_x/VOC control systems
Spectra, NextEra, Duke / Sabal Trail - GA	5/30/14	Titan 130 (2)	NO_x = 9 VOC[25] = 2–3	DLN3 + OxCat
Dominion/ Mockingbird Hill - WV	9/16/15	Titan 130 (2)	NO_x = 9 VOC = 1.3	DLN3 + OxCat

[21] Draft Cane Ridge Compressor Station Title V air permit, p. 14. Up to 100 hours per year of low-load operation allowed with CO emissions of 851 lb/hr per turbine. Over a 24-hour period for both turbines, this represents a daily CO emission rate of: (851 lb/hr x 2 x 24 hr) ÷ 2,000 lb/ton = 20.2 tons per day.
[22] Metro Nashville/Davidson County Health Department Pollution Control Division, *Air Pollution Control – 2014 Annual Report*, Table 1 – 2014 Davidson County Annual Emission Inventory, p. 5. 336.2 tons point source CO per year / 365 days = 0.921 tons CO per day (approx.). 20 tons-day / 0.921 tons-day = 21.7155 tons-day (2,017 percent).
[23] Joelton Title V air permit, May 2017.
[24] Atlantic Coast Pipeline, *Fact Sheet - Proposed Compressor Station No. 2: Buckingham County*, February 2016.
[25] Trinity Consultants, *PSD Permit Application – Sabal Trail Transmission, LLC*, May 2014, Table 5.1 on p. 5-1 (VOC limit = 0.0035 lb/MMBtu) and Table 5.6 on p. 5-39 (VOC limit = 2-3 ppm).

TGP (Kinder-Morgan)/ NE Energy Direct/ Supply Path Head - PA	11/1/15	Titan 130 (1) Mars 100 (2)	$NO_x = 9$ VOC = 1.5	DLN3 + OxCat
Dominion/Duke Energy Lewis County - WV	9/16/15	Titan 130 (1) Mars 100 (1) Taurus 70 (1) Taurus 60 (1)	$NO_x = 5$ VOC = 1.3	SCR + OxCat
Dominion/Duke Energy Buckingham County – VA [has not received air permit or started construction as of October 25, 2017]	9/16/15	Mars 100 (1) Taurus 70 (1) Taurus 60 (1) Centaur 50L (1)	$NO_x = 5$ VOC = 1.3	SCR + OxCat
Dominion/Duke Energy Northampton County – NC [has not received air permit or started construction as of October 25, 2017]	9/16/15	Taurus 70 (1) Centaur 50L (1) Centaur 40 (1)	$NO_x = 5$ VOC = 1.3	SCR + OxCat

MW equivalent capacity of turbines listed: Titan 250 = 21.7 MW; Titan 130 = 15.0 MW; Mars 100 = 11.4 MW; Taurus 70 =8.0 MW; Centaur 50 = 4.6 MW.

Table 3. Draft Cane Ridge Air Emission Concentration Limits Compared to NO_x and VOC Concentration Limits in Contemporaneous Applications[26]

Pollutant	Cane Ridge[27]	Sabal Trail	Mockingbird Hill	Supply Path Head	Lewis County	Buckingham County	Northampton County
NO_x	15	9	9	9	5	5	5
VOC	~5	2–3	1.3	1.5	1.3	1.3	1.3

NO_x = nitrogen oxides; VOC = volatile organic compounds; CO = carbon monoxide; PM_{10} = particulate matter with aerodynamic diameter less than 10 microns; SO_2 = sulfur dioxide.

The Sabal Trail, LLC May 30, 3014 air permit application (Albany, GA) proposed a NO_x limit of 9 ppm on two Titan 130 turbines using advanced dry-low NO_x technology offered by the turbine manufacturer, Solar Turbines. This was the first instance of the 9 ppm NO_x limit being proposed by a compressor station applicant using the Titan turbine.[28] The Sabal Trail application notes that, "*Sabal Trail will be the first customer of Solar to receive the 9 ppm NO_x vendor guarantee for a Solar Titan 130 turbine, all previous units have been guaranteed at 15 ppm NO_x.*"[29] The Sabal Trail application, with a 9 ppm NO_x limit on two Titan turbines, was filed two years before Columbia Gulf Transmission filed the Cane Ridge Compressor Station application with a proposed Titan 130 turbine NO_x limit of 15 ppm. In other words, the same turbines from the same manufacturer could meet a 9 ppm NO_x limit two years before Columbia Gulf Transmission proposed the Cane Ridge Compressor Station.

The specification of SCR for NO_x control on gas turbines at proposed natural gas compressor stations is a common practice. All eleven compressor drive gas turbines, including the Titan 130

[26] Metro Nashville/Davidson County Health Department Air Pollution Control Division, *Draft/Proposed Part 70 (Title V) Operating Permit, Permit Number 70-0XXX, Columbia Gulf Transmission, LLC – Cane Ridge Compressor Station, Antioch, TN*, July 2017, p. 13.
[27] The normal operation VOC emission factor is 1.01 lb/hr for 160.98 MMBtu/hr, or (1.01 lb/hr ÷ 160.98 MMBtu/hr) = 0.0063 lb/MMBtu (~5 ppm). *Id.*
[28] Sabal Trail application, p.5-34.
[29] Ibid, 5-34.

gas turbine, included in the proposed Atlantic Coast Pipeline project will utilize SCR for NO_x control.[30] The three compressor stations where these SCR-equipped gas turbines will be installed – sited in in West Virginia, Virginia, and North Carolina – will be located in attainment areas,[31] and will not be Title V major sources for NO_x.[32] These compressor stations will be unmanned.[33] Table 4 lists the location of proposed compressor station in the region, the air quality attainment status of each location, and whether the proposed compressor station or is not a major Title V source or a major PSD source.

Dominion and Duke Energy, developers of the Atlantic Coast Pipeline project, selected SCR and oxidation catalyst as what they identified as the industry "best-in-class" air emission control package for each Atlantic Coast Pipeline gas turbine.[34] SCR is an economically reasonable NO_x control alternative for the Cane Ridge Titan 130s, with an estimated NO_x control cost-effectiveness of less than $5,000 per ton of NO_x removed.[35,36]

Metro's analysis also lacks any discussion of the Titan 130 turbines that have been equipped with SCR and oxidation catalyst in combined heat and power (CHP) applications to limit NO_x emissions to 2.5 ppm. Titan turbines in CHP applications at Cornell University (NY) and Kimberly-Clark (CT) that each have NO_x limits of 2.5 ppm are equipped with SCR and oxidation catalyst.[37,38] The exhaust gas temperature of gas turbines in compressor drive applications can be significantly higher than in CHP applications, as compressor drive applications do not have heat recovery systems upstream of the SCR catalyst. The higher exhaust gas temperature can shorten the useful life of the SCR catalyst. To overcome the potential for high exhaust gas temperature to damage a standard temperature SCR catalyst in a compressor drive application, a dilution air blower is added to reduce peak exhaust gas temperature.[39,40]

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[30] Atlantic Coast Pipeline, LLC, Dominion Transmission, Inc. Supply Header Project, FERC Docket No. CP15-554-000, Resource Report 9 Air and Noise Quality, September 2015, p. 9-24. See **Attachment B.**

[31] Ibid, p. 9-12.

[32] Ibid, p. 9-28.

[33] Farmville (VA) Herald, *No action taken on permit: Subcommittee created to look at station conditions*, October 25, 2016: http://www.farmvilleherald.com/2016/10/no-action-taken-on-permit-subcommittee-created-to-look-at-station-conditions/. "Kevin Zink, Dominion's director of operations for compressor stations and pipelines . . said the station (Buckingham Compressor Station) would use its own microwave communications system, using towers, to remote control the facility from another location, he said, with nine full-time positions. . . Zink said Dominion has many unmanned facilities." Powers Engineering assumes each of the three compressor stations will be operated in the same manner as Buckingham Compressor Station (Compressor Station No. 2).

[34] Dominion/Duke Energy, *Atlantic Coast Pipeline - Buckingham Compressor Station*, PowerPoint presentation to Buckingham County Planning Commission, August 22, 2016, p. 9.

[35] Bill Powers, P.E. – Powers Engineering, *Selective Catalytic Reduction (SCR) at 2.5 ppm NO_x and Dry-Low NO_x Combustion at 9 ppm and 15 ppm are Cost-Reasonable RACT Alternatives to Two Titan Turbines at Proposed Joelton, Tennessee Compressor Station*, January 2017.

[36] Bill Powers, P.E. – Powers Engineering, *Comments on Proposed Joelton Compressor Station Air Permit Conditions and the Reasonably Available Control Technology Analysis Relied On by Metro Nashville to Justify Its NO_x RACT Determination*, June 2017.

[37] Combined Cycle Journal, *Pacesetter Plants: Class of 2009/2010 Cornell Combined Heat and Power Plant*, 2nd Quarter 2010. "Emissions limits for the CHP facility are 10 ppm CO, 2.5 ppm NO_x, and 5 ppm ammonia slip. Annual limit on NOx is 40 tons."

[38] Connecticut Department of Energy & Environmental Protection - Bureau of Air Management, New Source Review Permit Numbers 130-0070 and 130-0071, Kimberly-Clark Corporation, New Milford, CT, August 15, 2012.

[39] Sabal Trail Transmission, Albany Compressor Station, Application, May 30, 2014, Table C-12, pdf p. 84.

[40] Dominion, Buckingham Compressor Station Application, September 16, 2015, p. 26.

Table 4. Contemporaneous Compressor Station Air Permit Applications –Compressor Station Location, Turbine Types, and Source Status

Permittee/project	Date of application	State	County	Attainment area status for the 8-hour ozone (2008) NAAQS	Turbine type and number	Title V Major Source? (>100 tpy)	PSD Major Source? (>250 tpy)
Spectra Energy, NextEra, Duke Energy/ Sabal Trail Compressor Station	5/30/14	GA	Dougherty	In attainment	Titan 130 (2)	Y (Ref. 2)	Y (Ref. 2)
Dominion/ Mockingbird Hill Compressor Station	9/16/15	WV	Wetzel	In attainment	Titan 130 (2)	Y	N
TGP (Kinder-Morgan)/ NE Energy Direct/ Supply Path Head Compressor Station	11/1/15	PA	Susquehanna	In attainment	Titan 130 (1) Mars 100 (2)	N	N
Dominion/Duke Energy Buckingham Compressor Station	9/16/15	VA	Buckingham	In attainment	Mars 100 (1) Taurus 70 (1) Taurus 60 (1) Centaur 50L (1)	N	N
Dominion/Duke Energy Lewis County Compressor Station	9/16/15	WV	Lewis	In attainment	Titan 130 (1) Mars 100 (1) Taurus 70 (1) Taurus 60 (1)	N	N
Dominion/Duke Energy Northampton County Compressor Station	9/16/15	NC	Northampton	In attainment	Taurus 70 (1) Centaur 50L (1) Centaur 40 (1)	N	N

References:

1. 2008 National Ambient Air Quality Standards (NAAQS): EPA. "8-Hour Ozone (2008) Area Information." Green Book Nonattainment Areas. Accessed at: https://www.epa.gov/green-book/green-book-8-hour-ozone-2008-area-information.
2. Sabal Trail Compressor Station: Trinity Consultants, *Sabal Trail Transmission – Construction and Operating Permit Application, Volume I*, May 30, 2014, p. 1-2 and p. 1-3. Note – at the time the application was filed, the projected CO_2 emissions from the projected exceeded

the CO_2 PSD major source threshold. This triggered classification of NO_x and VOC as PSD pollutants subject to BACT for exceeding the PSD Significant Emission Rate (SER) for these pollutants of 40 tpy. Subsequent to the filing of the application, on June 23, 2014, the Supreme Court issued a decision that vacated the PSD applicability interpretation that resulted in Sabal Trail being classified as a PSD source for NOx based on CO_2 PSD major source status only: https://www.epa.gov/nsr/clean-air-act-permitting-greenhouse-gases.

3. Mockingbird Hill Compressor Station: Dominion Resources Services, Inc., *Construction/Major Modification (45CSR13), Mockingbird Hill Compressor Station (Facility ID#017-00003)*, September 16, 2015, p. 3, p. 16, Table 4-2, p. 17. The two proposed Titan 130 turbines will be elements of an expansion project at the existing Mockingbird Hill Compressor Station. The existing Mockingbird Hill Compressor Station operates under Title V operating permit number R30-10300006-2011. The operating permit covers emission sources at the Mockingbird Hill Compressor Station, Lewis Wetzel Compressor Station, and Hastings Compressor Station.
4. Harris Compressor Station: Trinity Consultants, *R13 Permit Application – Mountain Valley Pipeline, L.L.C. – Harris Compressor Station*, October 2015, Attachment D – Regulatory Applicability; Attachment N – Supporting Emission Calculations, Table 11.
5. Supply Path Head Compressor Station: TetraTech, Inc., *Tennessee Gas Pipeline Company, L.L.C. Northeast Energy Direct Project - Plan Approval Permit Application Supply Path Head Compressor Station*, November 2015, p. 4, Table 1, p. 9.
6. Buckingham Compressor Station: Dominion Resources Services, Inc., *Buckingham Compressor Station – Article 6 New Source Permit Application*, September 16, 2015, p. 21. The Buckingham Compressor Station is subject to state-level BACT only as it triggers state rule 9 VAC 5-50-260 B. "Virginia's regulations establish that a BACT review must be completed for certain sources that are not otherwise exempt and whose total emissions exceed Uncontrolled Emission Rate (UER) thresholds." Table 6.1, p. 24: NO_x UER exemption level = 40 tpy; VOC UER exemption level = 25 tpy.

V. Electric Motor Drive is a Cost-Effective Alternative to Eliminate Air Emissions from Gas Turbines at Cane Ridge

I have previously submitted comments to the Metro Public Health Department on the feasibility and cost-effectiveness of electric motor drive, as a substitute for the proposed gas turbines, to eliminate gas turbine air emissions from the Joelton Compressor Station.[41] Electric motor drive is a technologically and economically feasible alternative to the Titan 130 gas turbines proposed at Cane Ridge. Electric motor drive has been utilized at numerous natural gas compressor stations around the country and is a common industry practice. Use of electric motor drive at Cane Ridge would eliminate the added expense of SCR and oxidation catalyst to achieve industry-identified "best-in-class" air emissions performance. Columbia Gulf Transmission should be encouraged by Metro to utilize electric motor drive at Cane Ridge to minimize air emissions at the compressor station.

VI. Hourly Mass Emission Standards Must Be Defined for Normal Operation and Not Low-Load Operation

Condition 4.1(a) defines hourly mass emission standards only for the worst-case low-load condition, which the draft permit indicates will occur a maximum of 100 hours per year. Condition 4.1(a) must also define hourly mass emission standards for normal operation and start-up/shutdown. These standards must be in pounds per hour and parts per million.

VII. NO_X and CO Continuous Emissions Monitors Must Be Utilized on the Cane Ridge Gas Turbines

NO_X and CO continuous emissions monitors (CEM) must be utilized on each gas turbine, and Columbia Gulf Transmission must file quarterly excess emission reports. A daily log of operating hours and fuel consumption, as defined in Condition 4.1(b), is insufficient to assure continuous compliance, as required for Title V sources, with the draft air permit emission limits.

[41] Bill Powers, P.E. – Powers Engineering, *Electric Motor Drive Is Viable RACT Alternative to Two Titan Turbines at Proposed Joelton, Tennessee Compressor Station*, November 18, 2016.

APPENDIX IV

AERMOD EMISSIONS MODELING SUMMARY

Emissions Modeling

National Ambient Air Quality Standards

The National Ambient Air Quality Standards, or NAAQS, were established by the U.S. EPA under the authority of the Clean Air Act. The NAAQS set maximum concentrations for various pollutants, known as "criteria pollutants", that provide an adequate margin of safety for public health and welfare. The NAAQS applicable to potential pollutants emitted from the pipeline compressor station are as follows:

Table 1 – National Ambient Air Quality Standards

Pollutant*	NAAQS**	Averaging Time	Notes
PM_{10}	150 $\mu g/m^3$	24-hour	Not to be exceeded more than once per year on average over 3 years.
$PM_{2.5}$	35 $\mu g/m^3$	24-hour	98th percentile (7th highest daily), averaged over 3 years
$PM_{2.5}$	12 $\mu g/m^3$	Annual	Annual mean, averaged over 3 years.
SO_2	75 ppb	1-hour	99th percentile of daily maximum 1-hour concentrations (4th highest daily maximum 1-hour concentration), averaged over 3 years.
SO_2	0.5 ppm	3-hour	Not to be exceeded more than once per year.
NO_2	100 ppb	1-Hour	98th percentile of daily maximum 1-hour concentrations (7th highest daily maximum 1-hour concentration), averaged over 3 years.
NO_2	53 ppb	Annual	Annual mean.
CO	35 ppm	1-hour	Not to be exceeded more than once per year.
CO	9 ppm	8-hour	Not to be exceeded more than once per year.

* PM_{10} = particulate matter less than or equal to 10 microns in diameter; $PM_{2.5}$ = particulate matter less than or equal to 2.5 microns in diameter; SO_2 = sulfur dioxide; NO_2 = nitrogen dioxide; CO = carbon monoxide.

** $\mu g/m^3$ = micrograms per cubic meter; ppb = parts-per-billion; ppm = parts-per-million.

Emission Rates and Stack Parameters

According to the permit application, the proposed pipeline compressor station will consist of three air pollutant sources: two 19,799-hp natural gas-fired turbines, one 880-hp natural gas-fired emergency generator, and fugitive emissions from equipment leaks and venting of the turbines and process equipment. The fugitive emission leaks consist of volatile organic compounds (VOC), for which there is no NAAQS, and so no modeling was performed for these emissions.

The turbines and the emergency generator will have the following maximum potential emission rates (listed below in pounds per hour (lb/hr) and converted to grams per second (g/s), which were used as inputs for the modeling analyses):

Table 2 – Proposed Compressor Station Potential Emission Limits

		PM_{10}		SO_2		NO_x		CO	
Source	Designation	lb/hr	g/s	lb/hr	g/s	lb/hr	g/s	lb/hr	g/s
Turbine 1	T01	1.06	0.13	9.19	1.16	25.8	3.25	851	107
Turbine 2	T02	1.06	0.13	9.19	1.16	25.8	3.25	851	107
Generator	G1	0.07	0.01	0.39	0.05	3.88	0.49	7.76	0.98

* The conversion from lb/hr to g/s was performed by multiplying lb/hr by 453.59 (the number of grams in one pound) and dividing by 3,600 (the number of seconds in one hour).

The parameters for the exhaust stacks for the emission sources are as follows. The units for the parameters are as presented in the application (feet, feet per second, and degrees Fahrenheit) and converted into the units used in the modeling analyses (meters, meters per second, and degrees Kelvin):

Table 3 – Proposed Compressor Station Stack Parameters

		Stack Height		Stack Diameter		Stack Velocity		Exit Temperature	
Source	Designation	ft	m	ft	m	ft/s	m/s	°F	K
Turbine 1	T01	55	16.76	10.16	3.10	50.1	15.27	916	764
Turbine 2	T02	55	16.76	10.16	3.10	50.1	15.27	916	764
Generator	G1	15	4.57	1	0.305	130.95	39.91	839	721

The PCD modeled emissions from the proposed source using the AERMOD model, which the U.S. Environmental Protection Agency (EPA) has promulgated as their preferred regulatory model for atmospheric dispersion modeling in 40 CFR Part 51, Appendix W. To make analyzing the model inputs and outputs easier, the PCD ran AERMOD using *Beest for Windows 11.07*, a modeling suite published by Oris Solutions, LLC, which includes graphical interfaces for several EPA models, including AERMOD, AERMET (a meteorological data pre-processor for AERMOD), and AERMAP (a terrain data pre-processor for AERMOD).

The PCD developed source data inputs for the AERMOD model by using the stack parameters and maximum emission rates given in the Title V permit application. A table summarizing the model inputs is included in **Appendix A** of this document.

Since the proposed emergency generator at the site will only operate intermittently, and have a maximum operating schedule of 100 hours per year, modeling the generator as if it were capable of operating 8,760 hours per year would be excessively conservative and could result in a large overestimate of the impact of emissions from the generator. In order to determine how to best model the emergency generator, the PCD referred to the EPA memorandum, *Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard*, dated March 1, 2011. The memorandum states that, "EPA believes that existing modeling guidelines provide sufficient discretion for reviewing authorities to exclude certain types of intermittent emissions from compliance demonstrations for the 1-hour NO_2 standard…" While

this would allow the emergency generator emissions to be ignored in the modeling analysis, the PCD wanted to account for impacts from the emergency generator in the modeling analysis. To accomplish this, the PCD decided to use an alternate approach recommended in the EPA memorandum, in which the maximum hourly emission rate of NO_x from the generator was multiplied by 500/8760 to obtain an average hourly emission rate. This approach accounts for potential worst-case meteorological conditions by assuming continuous operation of the emergency generator, while the use of the average hourly emission rate accounts for the probability of the emergency generator actually operating in a given hour. Additionally, the annual emissions from the generator were modeled using the hourly emission rate multiplied by 500/8760. This is because AERMOD assumes continuous operation for sources when calculating air quality impacts. Since the EPA memorandum recommends using 500 hours per year of operation for emergency generators, using the average hourly emission rate allows us to obtain a more accurate annual air quality impact from the generator without overestimating by assuming that it operates 8,760 hours per year.

The location of each source was obtained from the Universal Transverse Mercator (UTM) coordinates provided in the application. The model was run using the non-urban dispersion options, since the site will be located well away from any built-up areas. No gas deposition was modeled, and the standard regulatory defaults for AERMOD were used. For modeling $PM_{2.5}$ emissions, all of the PM_{10} emissions were conservatively assumed to be in the form of $PM_{2.5}$. Also, 100 percent of the NO_x emissions were assumed to be NO_2 for the purpose of this modeling demonstration (Tier 1 analysis). The three buildings indicated on the facility site plans were input into the model, and building downwash effects were calculated using BPIP-Prime, which produced an input file that was used in each of the AERMOD runs (included in **Appendix B** of this document). BPIP-Prime calculates projected building widths and downwash values that are used in downwash calculations in the AERMOD model.

Coordinates for the boundaries of the site were obtained by measuring 12 points around the edges of the site on the Metro Maps website (http://maps.nashville.gov/propertykiva/site/main.htm) and converting the coordinates into UTM coordinates (data is included in **Appendix C** of this document). Terrain elevations were obtained by importing digital U.S. Geological Survey (USGS) data for the areas out to a 5-kilometer radius from the site (the USGS maps imported into AERMAP are listed in **Appendix D** of this document). The AERMAP program was used to calculate receptor elevations, using a grid with receptors spaced at 100-meter intervals, centered on the turbine designated T01 in the application. Receptors were also placed along the fenceline of the proposed facility at 100-meter intervals. Receptors which fell within the site boundaries were excluded from the model. A map showing the area included in the modeling analysis is included in **Appendix E**.

Meteorological data for the Nashville area was obtained from data files provided by the State of Tennessee, Department of Environment and Conservation. The data files consist of surface (.sfc) and upper air data (.pfl) collected by the National Weather Service (NWS) for Nashville, Tennessee for calendar years 2009 through 2013. The data files were in a format readily usable by AERMOD, and did not require processing through AERMET before use.

One model run was conducted for each pollutant for each of the five years (2009-2013) that was examined. Additionally, the annual average $PM_{2.5}$ and NO_2 concentrations were modeled with the same emission rates from the generator being set to 500/8760 times their hourly average emission rates, in accordance with the EPA memorandum.

Summaries of the model outputs are included in **Appendix F** of this document. The results of these modeling runs are summarized in the table below:

Table 6 – AERMOD Modeled Concentrations Compared to NAAQS					
Pollutant	Averaging Period	Modeled Concentration ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)*	Total Impact ($\mu g/m^3$)**	NAAQS ($\mu g/m^3$)
PM_{10}	24-Hour	0.98	37	37.98	150
$PM_{2.5}$	24-Hour	0.75	20.5	21.25	35
	Annual	0.11	10.06	10.17	12
SO_2	1-Hour	5.42	25.29	30.71	196.2
SO_2	3-Hour	13.62	25.29*	38.91	1,308
NO_2	1-Hour	39.17	73.96	113.1	188.0
	Annual	2.05	17.98	20.02	99.65
CO	1-Hour	1,654	1,793	3,447	40,058
	8-Hour	1,016	1,450	2,465	10,301

* Background concentrations are 3-year design values obtained from Davidson County monitoring sites. The 3-hour SO_2 NAAQS is a secondary standard, so there is no design value. The 1-hour SO_2 design value has been used as a surrogate.
** Total Impact = Modeled Concentration + Background Concentration.

Secondary $PM_{2.5}$ formation was also evaluated to determine if it could contribute to any issues with compliance. The NACAA/EPA recommendation for qualitative/quantitative assessment of secondary $PM_{2.5}$ formation (*Guidance for $PM_{2.5}$ Permit Modeling*, page D-6, EPA-454/B-14-001, May 2014) was followed. This method assumes that the main precursors to secondary $PM_{2.5}$ formation are sulfur dioxide (SO_2) and nitrogen oxides (NO_x). The potential emissions of SO_2 and NO_x are divided by an offset ratio, and added to the primary $PM_{2.5}$ emissions to obtain the total equivalent $PM_{2.5}$ emissions. To determine total $PM_{2.5}$ impacts, the modeled $PM_{2.5}$ concentrations are multiplied by the ratio of total equivalent $PM_{2.5}$ to primary $PM_{2.5}$. The formulas below show how these impacts were calculated:

<u>Potential Facility-Wide Emissions</u>
Primary $PM_{2.5}$: 9.303 tons/yr (potential PM_{10} emissions – conservatively used to estimate $PM_{2.5}$)
SO_2: 1.005 tons/yr
NO_x: 78.39 tons/yr

<u>Offset Ratios</u>
SO_2: 40
NO_x: 100 (The recommended value for eastern states is 200. The recommended value for western states is 100. We used the value for western states because it will give more conservative results.)

<u>Calculation of Total $PM_{2.5}$ to Primary $PM_{2.5}$ Ratio</u>
Total Equivalent $PM_{2.5}$ = Primary $PM_{2.5}$ + (SO_2/40) + (NO_x/100)

Total Equivalent $PM_{2.5}$ = 9.303 + (1.005/40) + (78.39/100) = 10.11 tons/yr

Total Equivalent $PM_{2.5}$ / Primary $PM_{2.5}$ = 10.11/9.303 = 1.087

Modeled $PM_{2.5}$ Impacts
24-Hr $PM_{2.5}$: 0.75 $\mu g/m^3$ x 1.087 = 0.82 $\mu g/m^3$
Annual $PM_{2.5}$: 0.11 $\mu g/m^3$ x 1.087 = 0.12 $\mu g/m^3$

Total $PM_{2.5}$ Impacts (modeled impacts + background concentrations)
24-Hr $PM_{2.5}$: 0.82 + 20.5 = 21.32 $\mu g/m^3$ (NAAQS = 35 $\mu g/m^3$)
Annual $PM_{2.5}$: 0.12 + 10.1 = 10.22 $\mu g/m^3$ (NAAQS = 12 $\mu g/m^3$)

Conclusions
The AERMOD modeling results show that none of the pollutants have modeled impacts that exceed their respective NAAQS. Therefore, according to the refined modeling, the proposed pipeline compressor station will not cause any adverse air quality impacts, and the source, if operated in accordance with the permit application, will comply with the National Ambient Air Quality Standards.

Prevention of Significant Deterioration (PSD) Cumulative Impact Analysis
Prevention of Significant Deterioration (PSD) is a program established under 40 CFR 52.21, which is designed to protect air quality from suffering "significant" impacts from new or modified large industrial sources. In regards to the proposed compressor station, the PSD regulations apply to major sources or major modifications which have the potential to emit more than 250 tons per year of any regulated pollutant for which National Ambient Air Quality Standards have been established.

Although the proposed compressor station will only be a major source for carbon monoxide (CO), and the potential CO emissions will be well below 250 tons per year, the PCD has elected to take a conservative approach and perform a cumulative impact analysis to examine potential air quality impacts from "nearby" sources on CO concentrations around the site. According to the Tennessee Department of Environment and Conservation (TDEC), a screening technique that can be used to determine which "nearby" sources should be included in the cumulative impact analysis is the Q/d method. The Q/d method involves taking the potential emissions of nearby sources, Q, in tons, and dividing this by the distance from the nearby source to the proposed compressor station, d, in kilometers. If Q/d for any source is greater than or equal to 20, then that source's impact on air quality around the compressor station should be taken into account in the air quality modeling.

In order to perform this analysis, the seven permitted sources with the highest potential CO emissions were evaluated. Distances between each source and the proposed compressor station site were measured using Google Earth. Only these seven sources were considered, because all other permitted sources have potential CO emissions below 60 tons per year, and there are no permitted sources with CO emissions within 3 kilometers of the proposed compressor station. Thus, no other sources could have a Q/d ratio of 20 or higher. The table below lists the sources included in the evaluation:

Table 7 – Q/d Ratios for Sources in Davidson County			
Source	**CO Limit (tons)**	**Distance (km)**	**Q/d**
Vanderbilt University*	292.62	16.84	17.38
Vanderbilt University Medical Ctr.*	28.82	16.73	1.72
Combined – University + Med. Ctr.	321.44	16.73**	19.21
Triumph Aerostructures, LLC	142.70	10.84	13.16
Nashville District Energy System	120.20	16.57	7.25
Carlex Glass America, LLC	111.12	23.74	4.68
AVINTIV (A Berry Plastics Company)	105.16	27.16	3.87
Ryman Hospitality Properties, Inc.	83.85	19.94	4.21
Metro Water Services – Central WWTP	71.25	19.76	3.61

* According to EPA guidance, sources within 2 km of one another should be considered as a single source for purposes of the cumulative impact analysis.

** For the University and Medical Center, the minimum distance was conservatively used.

Since none of the Q/d values are 20 or higher, the impacts from these sources upon airborne CO concentrations at the proposed compressor station site are effectively insignificant, and no further modeling is required. From a practical standpoint, the potential impact upon the site from all surrounding sources, permitted or otherwise, is accounted for in the background concentration, which was included in the modeling analysis above.

APPENDIX A

Proposed Cane Ridge Compressor Station

AERMOD Stack Parameters

Source	Stack	Description	Height (ft)	Velocity (ft/s)	Diameter (ft)	Temperature (F)	Pollutant	(lb/hr)	Zone	Easting	Northing	Elev (ft)
CRCS	T01_MAX	Solar Titan 130 Turbine #1 - Maximum Hourly Emission Rates	55	50.10	10.160	916	PM10	1.06	16 S	528223	3986748	673
							SO2	9.19				
							NOx	25.8				
							CO	851				
	T02_MAX	Solar Titan 130 Turbine #2 - Maximum Hourly Emission Rates	55	50.10	10.160	916	PM10	1.06	16S	528194	3986798	667
							SO2	9.19				
							NOx	25.8				
							CO	851				
	T01_NORMAL	Solar Titan 130 Turbine #1 - Normal Operation Emission Rates	55	50.10	10.16	916	PM10	1.06	16S	528223	3986748	673
							SO2	9.19				
							NOx	8.69				
							CO	8.82				
	T02_NORMAL	Solar Titan 130 Turbine #2 - Normal Operation Emission Rates	55	50.10	10.16	916	PM10	1.06	16S	528194	3986798	667
							SO2	9.19				
							NOx	8.69				
							CO	8.82				
	G1	880-hp Emergency Generator	15	130.95	1	839	PM10	0.07	16S	528253	3986745	674
							SO2	0.39				
							NOx	0.22				
							CO	7.76				

APPENDIX B

BPIP-Prime Input File

Building Name	Description	Base Elevation (ft)	# of Tiers	Tier Height (ft)	# of Corners	Corner 1		Corner 2		Corner 3		Corner 4	
						East (ft)	North (ft)	East (ft)	North (ft)	East (ft)	North (ft)	East (ft)	North (ft)
N_OFF	Office Building	667.13	1	25.03	4	1733052	13079692	1733125	13079735	1733103	13079773	1733030	13079730
N_AUX	Auxiliary Control Building	672.87	1	23.65	4	1733052	13079813.32	1733104	13079844	1733084	13079878	1733032	13079848
N_COMP	Compressor Building	671.42	1	46.49	4	1732956	13079893.04	1733029	13079936	1732973	13080031	1732900	13079988

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2013.PIP"
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2013.TAB"
"C:\Beework\Cane Ridge Compressor Station\042617_CRCS_BPIP_PM10_2009-
2013.SUM"
"C:\Beework\Cane Ridge Compressor Station\042617_CRCS_BPIP_PM10_2009-
2013.SO"
"C:\Beework\Cane Ridge Compressor
Station\042617_Cane_Ridge_Compressor_Station_PM10_2009_thru_2013.BST"
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"N_OFF                                  Office Building
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3986714.8      528227.5       3986701.6      "
"N_AUX                                  Auxiliary Control Building
0         1    205.09         1         7.21           4
528234.3       3986727.1      528250.0       3986736.4      528243.9
3986746.9      528228.1       3986737.6      "
"N_COMP                                 Compressor Building
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528205.0       3986751.4      528227.3       3986764.6      528210.3
3986793.5      528188.0       3986780.3      "
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3.0968
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3.0968
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052229183.2507453182947107.2241963515
"
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3.0968
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"
"T02_NORM                               0              528194.
3986797.6      203.35         16.764         764.26         15.27048
3.0968
0000000000000000000000000000000000000.13355775338730.13355775338731.15792
052229181.09492158201481.1113013064868
"
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"
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APPENDIX C

SITE BOUNDARY COORDINATES

Cane Ridge Compressor Station

Main Site Coordinates (the portion that the emission sources will be located on, not counting parcels that lie across roadways)

Easting	Northing
528092	3987010
528348	3987022
528361	3987269
528632	3987268
528704	3987061
528815	3986835
528782	3986505
528092	3986597
528069	3986612
528050	3986638
528006	3986776
528055	3986802

APPENDIX D

USGS MAPS INCLUDED IN AERMOD RUNS

USGS Maps Used in AERMOD Runs

F6-OakHill.DEM

F7-Antioch.DEM

G6-Franklin.DEM

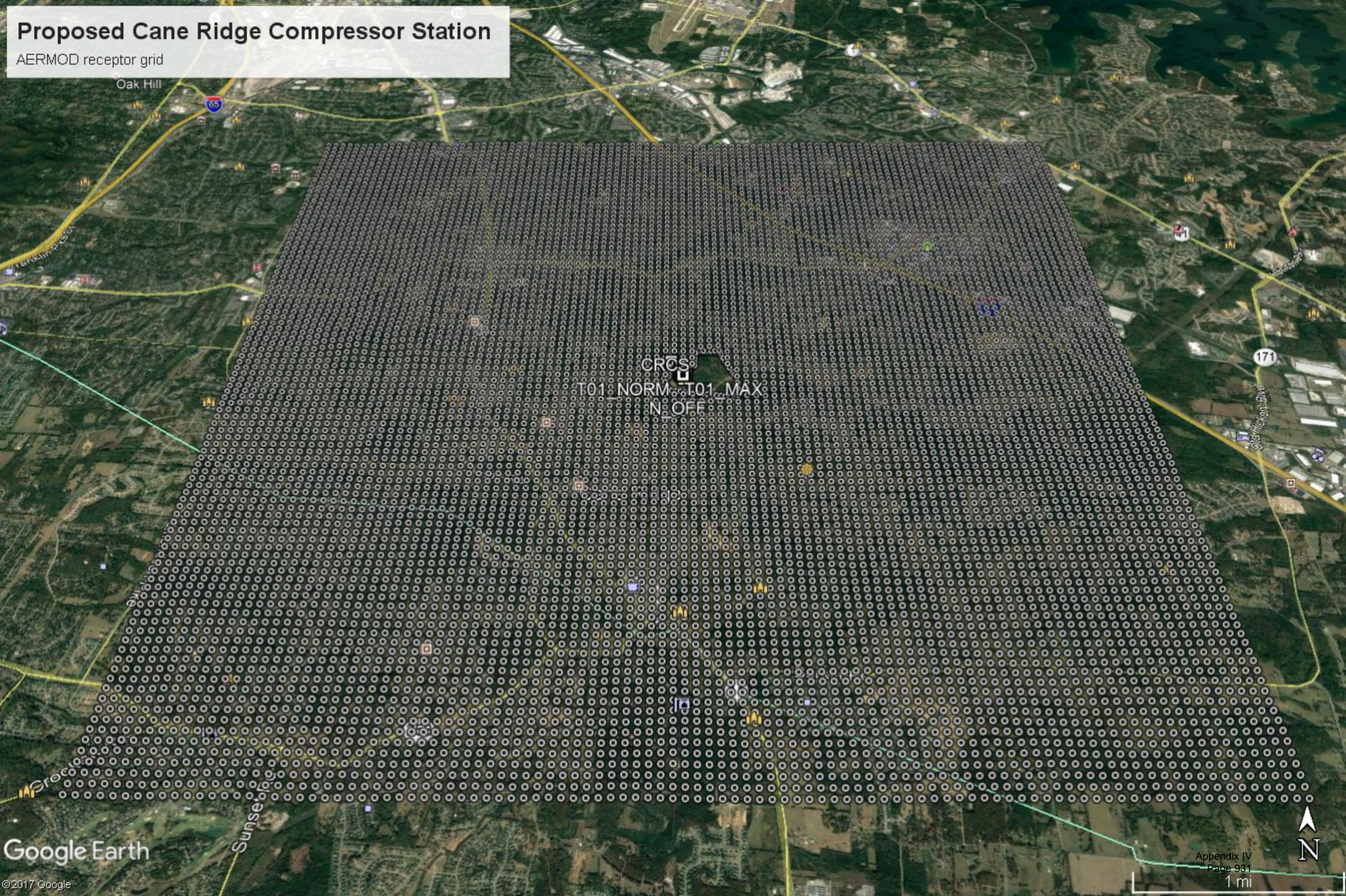
G7-Nolensville.DEM

APPENDIX E

MAP OF AERMOD RECEPTOR GRID

Proposed Cane Ridge Compressor Station

AERMOD receptor grid



APPENDIX F

AERMOD OUTPUT SUMMARIES

AERMOD modeling conducted using BEEST Version 11.07 (AERMOD version 16216r)

Pollutant	Averaging Period	Model Output µg/m³	PSD Increment µg/m³	Background* µg/m³	Total Impact** µg/m³	NAAQS µg/m³	Compliance?		
PM10	24-Hour	0.98	30	37.0	37.98	150	**YES**	Not to be exceeded more than once per year	H2H
PM2.5	24-Hour	0.75	N/A	20.5	21.25	35	**YES**	35 ug/m3 - 98th %ile max. daily, averaged over 3 y	H7H
	Annual	0.11	N/A	10.1	10.17	12	**YES**	12 ug/m3 - Annual Mean, averaged over 3 years	Max
SO2	1-Hour	5.42	N/A	25.29	30.71	196.2	**YES**	75 ppb - 99th %ile max. daily, averaged over 3 yea	H4H
	3-Hour	13.62	512	25.29	38.91	1,308	**YES**	0.5 ppm - Not to be exceeded more than once per	H2H
NO2	1-Hour	39.17	N/A	73.96	113.1	188.0	**YES**	100 ppb - 98th %ile max. daily, averaged over 3 ye	H7H
	Annual	2.05	25	17.98	20.02	99.65	**YES**	53 ppb - Annual Mean	Max
CO	1-Hour	1,654	N/A	1,793	3,447	40,058	**YES**	35 ppm - Not to be exceeded more than once per	H2H
	8-Hour	1,016	N/A	1,450	2,465	10,301	**YES**	9 ppm - Not to be exceeded more than once per y	H2H

* Background concentrations are 3-year design values obtained from Davidson County monitoring sites

** Total Impact = Model Output + Background

*** The PM10 Annual NAAQS was abandoned in 2006, and is not reported here.

PM2.5 values were obtained by assuming 100% of PM10 is PM2.5.

All pollutants are for all sources combined (2 turbines, emergency generator, boiler)

Conversion of ug/m3 to ppm (at 25°C)

SO2	1 ppm =	2616.025	µg/m³
NO2	1 ppm =	1880.268	µg/m³
CO	1 ppm =	1144.511	µg/m³

SO2	75	196.2
	500	1308
NO2	100	188.0
	53	99.65
CO	35,000	40058
	9,000	10301

µg/m3 = (ppb)*(12.187)*(M) / (273.15 + °C)

No Urban Terrain used in model

Comparison of 1-hour NO2 to Near-Roadway Background: 142.59 µg/m³

Background - From Tiffany Lanh data (11-30-16)

SO2	1-Hour	0.010	ppm	25.29	µg/m³
	3-Hour	0.010	ppm	25.29	µg/m³
NOx	1-Hour	0.039	ppm	73.96	µg/m³
	Annual	0.010	ppm	17.98	µg/m³
CO	1-Hour	1.57	ppm	1793	µg/m³
	8-Hour	1.27	ppm	1450	µg/m³

Design Values

PM2.5	24-Hour	--	--	19.7	µg/m³	Lockeland			
	Annual	--	--	9.76	µg/m³	Lockeland			
SO2	1-Hour	0.007	ppm	18.31	µg/m³				
	3-Hour	Secondary	ppm	18.31	µg/m³	Use 1-hr SO2 design value			
NOx	1-Hour	0.039	ppm	73.33	µg/m³	East Health Center	0.055 ppm	103.41	µg/m³
	Annual	0.009	ppm	16.13	µg/m³	East Health Center			
CO	1-Hour	1.8	ppm	2060	µg/m³				
	8-Hour	1.6	ppm	1831	µg/m³				

Appendix W, Section 7.2.1.1 uses the following procedure to determine design values:

PM10: High 2nd High value for each year (allows for one exceedance)
Conservatively looked at High 1st High value and found no exceedances

In the U.S. EPA Document, "*Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO2 National Ambient Air Quality Standard* ", it states that modeling of intermittent emission units, such as emergency generator may impose an additional level of stringency beyond that intended by the level of the standard itself, by assuming continuous operations for the intermittent units. As such, EPA feels it is, "*acceptable to limit the emission scenarios included in the modeling compliance demonstration for the 1-hour NO2 NAAQS to those emissions that are continuous enough or frequent enough to contribute significantly to the annual distribution of daily maximum 1-hour concentrations* ." Since the emergency generator (Aux-01) is being permitted to operate up to 500 hours per year, and will likely operate significantly fewer hours per year, on an unpredictable basis, we feel that the generator will not operate "*continuous[ly] or frequent[ly] enough to contribute significantly to the annual distribution of daily maximum 1-hour concentrations", and thus the generator does not need to be included in the modeling analysis* for the 1-hour NO2 impacts from this source.

However, the generator was included in the 1-hour modeling for this source

1-Hour NO2 Modeling with Building Downwash

Pollutant	Averaging Period	Model Output µg/m³	PSD Increment µg/m³	Background* µg/m³	Total Impact** µg/m³	NAAQS µg/m³	Compliance?
NO2	1-Hour	20.73	N/A	73.33	94.06	163.5	**YES**

Monitored Concentrations

Design Values		2013	2014	2015	3-yr DV			
PM10		29	37	45	**37.0**	**ug/m3**	2nd Max concentrations	
PM2.5	24-hr	19.7	21.9	19.9	**20.5**	**ug/m3**	98th %ile concentrations	
	Annual	10.1	10.5	9.6	**10.1**	**ug/m3**	Arith. Mean	
SO2	1-hr	9	13	7	**9.67**	**ppb**	99th %ile concentrations	
	3-hr	-	-	-	**9.67**	**ppb**	Use SO2 1-hr	
NO2	1-hr	39	40	39	**39.3**	**ppb**	98th %ile concentrations	Used East, not Near Road
	Annual	10.38	9.72	8.58	**9.56**	**ppb**	Arith. Mean	Used East, not Near Road
CO	1-hr	1.6	1.4	1.7	**1.57**	**ppm**	2nd Max concentrations	
	8-hr	1.2	1.2	1.4	**1.27**	**ppm**	2nd Max concentrations	

Cane Ridge Compressor Station AERMOD PM10 Run Results
Run Conducted 6/16/2017
BUILDING DOWNWASH INCLUDED
PM10/PM2.5 NAAQS

24-Hour	150 ug/m3 - Not to be exceeded more than once per year over a 3-year average		(Primary and Secondary Standard for PM10)
24-Hour	35 ug/m3 - 98th percentile, averaged over 3 years	(Primary Standard for PM2.5)	
Annual	15 ug/m3 - Annual mean averaged over 3 years	(Secondary Standard for PM2.5)	

24-Hour Maximum Values

CY	Max. Conc. (ug/m3)		
2009	0.9161	Compliance?	**YES**
2010	0.9496		All 24-hour results are well below the 150 ug/m3 standard.
2011	0.9810		Source will comply with the Primary and Secondary PM10 NAAQS.
2012	0.8751		
2013	0.8150		

24-Hour results run with all sources as defined in the permit application (MAX_HRLY).

Annual results run with generator emission rate at 500/8760 of the maximum rates in the application, because the generator will not be permitted to run more than 500 hours per year.

AERMOD Results
24-Hour Average

2009 *** THE SUMMARY OF HIGHEST 24-HR RESULTS ***
** CONC OF PM10 IN MICROGRAMS/M**3 **

MAX_HRLY HIGH 1ST HIGH VALUE IS 0.91607 ON 09030124: AT (528239.90, 3986577.30, 183.47, 208.10, 0.00) DC
HIGH 2ND HIGH VALUE IS 0.71005 ON 09111124: AT (528141.30, 3986590.40, 190.53, 205.10, 0.00) DC

NORMAL HIGH 1ST HIGH VALUE IS 0.91607 ON 09030124: AT (528239.90, 3986577.30, 183.47, 208.10, 0.00) DC
HIGH 2ND HIGH VALUE IS 0.71005 ON 09111124: AT (528141.30, 3986590.40, 190.53, 205.10, 0.00) DC

2010 *** THE SUMMARY OF HIGHEST 24-HR RESULTS ***
** CONC OF PM10 IN MICROGRAMS/M**3 **

MAX_HRLY HIGH 1ST HIGH VALUE IS 0.94961 ON 10043024: AT (528177.30, 3987014.00, 176.89, 211.60, 0.00) DC
HIGH 2ND HIGH VALUE IS 0.79567 ON 10040724: AT (528262.70, 3987018.00, 176.15, 211.60, 0.00) DC

NORMAL HIGH 1ST HIGH VALUE IS 0.94961 ON 10043024: AT (528177.30, 3987014.00, 176.89, 211.60, 0.00) DC
HIGH 2ND HIGH VALUE IS 0.79567 ON 10040724: AT (528262.70, 3987018.00, 176.15, 211.60, 0.00) DC

2011 ***** THE SUMMARY OF HIGHEST 24-HR RESULTS *****
** CONC OF PM10 IN MICROGRAMS/M**3 **

MAX_HRLY HIGH 1ST HIGH VALUE IS 0.98099 ON 11090524: AT (528190.60, 3986583.90, 186.87, 208.10, 0.00) DC
HIGH 2ND HIGH VALUE IS 0.97423 ON 11041924: AT (528262.70, 3987018.00, 176.15, 211.60, 0.00) DC

NORMAL HIGH 1ST HIGH VALUE IS 0.98099 ON 11090524: AT (528190.60, 3986583.90, 186.87, 208.10, 0.00) DC
HIGH 2ND HIGH VALUE IS 0.97423 ON 11041924: AT (528262.70, 3987018.00, 176.15, 211.60, 0.00) DC

2012 ***** THE SUMMARY OF HIGHEST 24-HR RESULTS *****
** CONC OF PM10 IN MICROGRAMS/M**3 **

MAX_HRLY HIGH 1ST HIGH VALUE IS 0.87513 ON 12011624: AT (528262.70, 3987018.00, 176.15, 211.60, 0.00) DC
HIGH 2ND HIGH VALUE IS 0.72374 ON 12031224: AT (528220.00, 3987016.00, 176.66, 211.60, 0.00) DC

NORMAL HIGH 1ST HIGH VALUE IS 0.87513 ON 12011624: AT (528262.70, 3987018.00, 176.15, 211.60, 0.00) DC
HIGH 2ND HIGH VALUE IS 0.72374 ON 12031224: AT (528220.00, 3987016.00, 176.66, 211.60, 0.00) DC

2013 *** THE SUMMARY OF HIGHEST 24-HR RESULTS ***
** CONC OF PM10 IN MICROGRAMS/M**3 **

MAX_HRLY HIGH 1ST HIGH VALUE IS 0.81501 ON 13041824: AT (528220.00, 3987016.00, 176.66, 211.60, 0.00) DC
HIGH 2ND HIGH VALUE IS 0.76352 ON 13122124: AT (528220.00, 3987016.00, 176.66, 211.60, 0.00) DC

NORMAL HIGH 1ST HIGH VALUE IS 0.81501 ON 13041824: AT (528220.00, 3987016.00, 176.66, 211.60, 0.00) DC
HIGH 2ND HIGH VALUE IS 0.76352 ON 13122124: AT (528220.00, 3987016.00, 176.66, 211.60, 0.00) DC

Cane Ridge Compressor Station AERMOD PM10 Run Results
Run Conducted 6/16/2017
BUILDING DOWNWASH INCLUDED
PM10/PM2.5 NAAQS

24-Hour	150 ug/m3 - Not to be exceeded more than once per year over a 3-year average	(Primary and Secondary Standard for PM10)
24-Hour	35 ug/m3 - 98th percentile, averaged over 3 years	(Primary Standard for PM2.5)
Annual	15 ug/m3 - Annual mean averaged over 3 years	(Secondary Standard for PM2.5)

24-Hour 98th Percentile Values 98th %ile = 7th Highest

CY	Max. Conc. (	3-Yr Avg.		
2009	0.6524	--	Compliance?	YES
2010	0.7803	--		All 24-hour results are well below the 35 ug/m3 standard.
2011	0.8108	0.7478		Source will comply with the Primary PM2.5 NAAQS.
2012	0.6141	0.7351		
2013	0.7497	0.7249		

Annual Values

CY	Max. Conc.	3-Yr Avg.		
2009	0.0854	--	Compliance?	YES
2010	0.1111	--		All annual results are well below the 15 ug/m3 standard.
2011	0.1139	0.1035		Source will comply with the Secondary PM2.5 NAAQS
2012	0.0998	0.1083		
2013	0.0922	0.1020		

For conservative comparison, the emission rate for the Annual calculations was not multiplied by 500/8760
For both 24-hour and Annual calculations, the maximum hourly emission rate was used

AERMOD Results
24-Hour Average

2009 *** THE SUMMARY OF MAXIMUM 1ST-HIGHEST 24-HR RESULTS AVERAGED OVER 1 YEARS ***
** CONC OF PM2.5 IN MICROGRAMS/M**3 **

MAX_HRLY 1ST HIGHEST VALUE IS 0.91607 AT (528239.90, 3986577.30, 183.47, 208.10, 0.00) DC
2ND HIGHEST VALUE IS 0.83061 AT (528190.60, 3986583.90, 186.87, 208.10, 0.00) DC
3RD HIGHEST VALUE IS 0.79673 AT (528223.00, 3986548.00, 180.90, 208.10, 0.00) DC
4TH HIGHEST VALUE IS 0.76154 AT (528077.20, 3986926.80, 189.96, 202.10, 0.00) DC
5TH HIGHEST VALUE IS 0.72679 AT (528141.30, 3986590.40, 190.53, 205.10, 0.00) DC
6TH HIGHEST VALUE IS 0.71243 AT (528084.60, 3986968.40, 182.61, 206.10, 0.00) DC
7TH HIGHEST VALUE IS 0.65244 AT (528177.30, 3987014.00, 176.89, 211.60, 0.00) DC
8TH HIGHEST VALUE IS 0.64338 AT (528220.00, 3987016.00, 176.66, 211.60, 0.00) DC
9TH HIGHEST VALUE IS 0.64120 AT (528289.10, 3986570.70, 183.33, 208.10, 0.00) DC
10TH HIGHEST VALUE IS 0.63248 AT (528262.70, 3987018.00, 176.15, 211.60, 0.00) DC

NORMAL 1ST HIGHEST VALUE IS 0.91607 AT (528239.90, 3986577.30, 183.47, 208.10, 0.00) DC
2ND HIGHEST VALUE IS 0.83061 AT (528190.60, 3986583.90, 186.87, 208.10, 0.00) DC
3RD HIGHEST VALUE IS 0.79673 AT (528223.00, 3986548.00, 180.90, 208.10, 0.00) DC
4TH HIGHEST VALUE IS 0.76154 AT (528077.20, 3986926.80, 189.96, 202.10, 0.00) DC
5TH HIGHEST VALUE IS 0.72679 AT (528141.30, 3986590.40, 190.53, 205.10, 0.00) DC
6TH HIGHEST VALUE IS 0.71243 AT (528084.60, 3986968.40, 182.61, 206.10, 0.00) DC
7TH HIGHEST VALUE IS 0.65244 AT (528177.30, 3987014.00, 176.89, 211.60, 0.00) DC
8TH HIGHEST VALUE IS 0.64338 AT (528220.00, 3987016.00, 176.66, 211.60, 0.00) DC
9TH HIGHEST VALUE IS 0.64120 AT (528289.10, 3986570.70, 183.33, 208.10, 0.00) DC
10TH HIGHEST VALUE IS 0.63248 AT (528262.70, 3987018.00, 176.15, 211.60, 0.00) DC

2010 *** THE SUMMARY OF MAXIMUM 1ST-HIGHEST 24-HR RESULTS AVERAGED OVER 1 YEARS ***
** CONC OF PM2.5 IN MICROGRAMS/M**3 **

MAX_HRLY 1ST HIGHEST VALUE IS 0.94961 AT (528177.30, 3987014.00, 176.89, 211.60, 0.00) DC
2ND HIGHEST VALUE IS 0.93456 AT (528220.00, 3987016.00, 176.66, 211.60, 0.00) DC
3RD HIGHEST VALUE IS 0.86957 AT (528262.70, 3987018.00, 176.15, 211.60, 0.00) DC
4TH HIGHEST VALUE IS 0.86527 AT (528305.30, 3987020.00, 175.27, 211.60, 0.00) DC
5TH HIGHEST VALUE IS 0.85780 AT (528223.00, 3987048.00, 176.50, 211.60, 0.00) DC
6TH HIGHEST VALUE IS 0.79200 AT (528134.70, 3987012.00, 176.48, 211.60, 0.00) DC
7TH HIGHEST VALUE IS 0.78025 AT (528323.00, 3987048.00, 174.37, 211.60, 0.00) DC
8TH HIGHEST VALUE IS 0.69804 AT (528348.00, 3987022.00, 173.42, 211.60, 0.00) DC
9TH HIGHEST VALUE IS 0.69732 AT (528223.00, 3987148.00, 187.49, 211.60, 0.00) DC
10TH HIGHEST VALUE IS 0.69718 AT (528123.00, 3987048.00, 178.28, 235.30, 0.00) DC

NORMAL 1ST HIGHEST VALUE IS 0.94961 AT (528177.30, 3987014.00, 176.89, 211.60, 0.00) DC
2ND HIGHEST VALUE IS 0.93456 AT (528220.00, 3987016.00, 176.66, 211.60, 0.00) DC
3RD HIGHEST VALUE IS 0.86957 AT (528262.70, 3987018.00, 176.15, 211.60, 0.00) DC
4TH HIGHEST VALUE IS 0.86527 AT (528305.30, 3987020.00, 175.27, 211.60, 0.00) DC
5TH HIGHEST VALUE IS 0.85780 AT (528223.00, 3987048.00, 176.50, 211.60, 0.00) DC
6TH HIGHEST VALUE IS 0.79200 AT (528134.70, 3987012.00, 176.48, 211.60, 0.00) DC
7TH HIGHEST VALUE IS 0.78025 AT (528323.00, 3987048.00, 174.37, 211.60, 0.00) DC
8TH HIGHEST VALUE IS 0.69804 AT (528348.00, 3987022.00, 173.42, 211.60, 0.00) DC
9TH HIGHEST VALUE IS 0.69732 AT (528223.00, 3987148.00, 187.49, 211.60, 0.00) DC
10TH HIGHEST VALUE IS 0.69718 AT (528123.00, 3987048.00, 178.28, 235.30, 0.00) DC

2011 *** THE SUMMARY OF MAXIMUM 1ST-HIGHEST 24-HR RESULTS AVERAGED OVER 1 YEARS ***
** CONC OF PM2.5 IN MICROGRAMS/M**3 **

MAX_HRLY 1ST HIGHEST VALUE IS 0.98099 AT (528190.60, 3986583.90, 186.87, 208.10, 0.00) DC
2ND HIGHEST VALUE IS 0.97797 AT (528305.30, 3987020.00, 175.27, 211.60, 0.00) DC
3RD HIGHEST VALUE IS 0.97650 AT (528262.70, 3987018.00, 176.15, 211.60, 0.00) DC
4TH HIGHEST VALUE IS 0.96614 AT (528177.30, 3987014.00, 176.89, 211.60, 0.00) DC
5TH HIGHEST VALUE IS 0.92056 AT (528141.30, 3986590.40, 190.53, 205.10, 0.00) DC
6TH HIGHEST VALUE IS 0.85599 AT (528323.00, 3987048.00, 174.37, 211.60, 0.00) DC
7TH HIGHEST VALUE IS 0.81082 AT (528220.00, 3987016.00, 176.66, 211.60, 0.00) DC
8TH HIGHEST VALUE IS 0.78123 AT (528123.00, 3986548.00, 185.54, 205.10, 0.00) DC
9TH HIGHEST VALUE IS 0.76288 AT (528134.70, 3987012.00, 176.48, 211.60, 0.00) DC
10TH HIGHEST VALUE IS 0.75021 AT (528223.00, 3987048.00, 176.50, 211.60, 0.00) DC

NORMAL 1ST HIGHEST VALUE IS 0.98099 AT (528190.60, 3986583.90, 186.87, 208.10, 0.00) DC
2ND HIGHEST VALUE IS 0.97797 AT (528305.30, 3987020.00, 175.27, 211.60, 0.00) DC
3RD HIGHEST VALUE IS 0.97650 AT (528262.70, 3987018.00, 176.15, 211.60, 0.00) DC
4TH HIGHEST VALUE IS 0.96614 AT (528177.30, 3987014.00, 176.89, 211.60, 0.00) DC
5TH HIGHEST VALUE IS 0.92056 AT (528141.30, 3986590.40, 190.53, 205.10, 0.00) DC
6TH HIGHEST VALUE IS 0.85599 AT (528323.00, 3987048.00, 174.37, 211.60, 0.00) DC
7TH HIGHEST VALUE IS 0.81082 AT (528220.00, 3987016.00, 176.66, 211.60, 0.00) DC
8TH HIGHEST VALUE IS 0.78123 AT (528123.00, 3986548.00, 185.54, 205.10, 0.00) DC
9TH HIGHEST VALUE IS 0.76288 AT (528134.70, 3987012.00, 176.48, 211.60, 0.00) DC
10TH HIGHEST VALUE IS 0.75021 AT (528223.00, 3987048.00, 176.50, 211.60, 0.00) DC

2012 *** THE SUMMARY OF MAXIMUM 1ST-HIGHEST 24-HR RESULTS AVERAGED OVER 1 YEARS ***
** CONC OF PM2.5 IN MICROGRAMS/M**3 **

MAX_HRLY 1ST HIGHEST VALUE IS 0.87513 AT (528262.70, 3987018.00, 176.15, 211.60, 0.00) DC
2ND HIGHEST VALUE IS 0.79106 AT (528220.00, 3987016.00, 176.66, 211.60, 0.00) DC
3RD HIGHEST VALUE IS 0.73341 AT (528223.00, 3987048.00, 176.50, 211.60, 0.00) DC
4TH HIGHEST VALUE IS 0.65399 AT (528305.30, 3987020.00, 175.27, 211.60, 0.00) DC
5TH HIGHEST VALUE IS 0.64072 AT (528141.30, 3986590.40, 190.53, 205.10, 0.00) DC

AERMOD Results
Annual Average

2009 *** THE SUMMARY OF MAXIMUM ANNUAL RESULTS AVERAGED OVER 1 YEARS ***
** CONC OF PM2.5 IN MICROGRAMS/M**3 **

MAX_HRLY 1ST HIGHEST VALUE IS 0.08541 AT (528190.60, 3986583.90, 186.87, 208.10, 0.00) DC
2ND HIGHEST VALUE IS 0.07928 AT (528262.70, 3987018.00, 176.15, 211.60, 0.00) DC
3RD HIGHEST VALUE IS 0.07880 AT (528239.90, 3986577.30, 183.47, 208.10, 0.00) DC
4TH HIGHEST VALUE IS 0.07631 AT (528220.00, 3987016.00, 176.66, 211.60, 0.00) DC
5TH HIGHEST VALUE IS 0.07257 AT (528223.00, 3986548.00, 180.90, 208.10, 0.00) DC
6TH HIGHEST VALUE IS 0.07128 AT (528223.00, 3987048.00, 176.50, 211.60, 0.00) DC
7TH HIGHEST VALUE IS 0.07093 AT (528305.30, 3987020.00, 175.27, 211.60, 0.00) DC
8TH HIGHEST VALUE IS 0.06500 AT (528141.30, 3986590.40, 190.53, 205.10, 0.00) DC
9TH HIGHEST VALUE IS 0.06448 AT (528177.30, 3987014.00, 176.89, 211.60, 0.00) DC
10TH HIGHEST VALUE IS 0.06345 AT (528323.00, 3987048.00, 174.37, 211.60, 0.00) DC

NORMAL 1ST HIGHEST VALUE IS 0.08541 AT (528190.60, 3986583.90, 186.87, 208.10, 0.00) DC
2ND HIGHEST VALUE IS 0.07928 AT (528262.70, 3987018.00, 176.15, 211.60, 0.00) DC
3RD HIGHEST VALUE IS 0.07880 AT (528239.90, 3986577.30, 183.47, 208.10, 0.00) DC
4TH HIGHEST VALUE IS 0.07631 AT (528220.00, 3987016.00, 176.66, 211.60, 0.00) DC
5TH HIGHEST VALUE IS 0.07257 AT (528223.00, 3986548.00, 180.90, 208.10, 0.00) DC
6TH HIGHEST VALUE IS 0.07128 AT (528223.00, 3987048.00, 176.50, 211.60, 0.00) DC
7TH HIGHEST VALUE IS 0.07093 AT (528305.30, 3987020.00, 175.27, 211.60, 0.00) DC
8TH HIGHEST VALUE IS 0.06500 AT (528141.30, 3986590.40, 190.53, 205.10, 0.00) DC
9TH HIGHEST VALUE IS 0.06448 AT (528177.30, 3987014.00, 176.89, 211.60, 0.00) DC
10TH HIGHEST VALUE IS 0.06345 AT (528323.00, 3987048.00, 174.37, 211.60, 0.00) DC

2010 *** THE SUMMARY OF MAXIMUM ANNUAL RESULTS AVERAGED OVER 1 YEARS ***
** CONC OF PM2.5 IN MICROGRAMS/M**3 **

MAX_HRLY 1ST HIGHEST VALUE IS 0.11109 AT (528262.70, 3987018.00, 176.15, 211.60, 0.00) DC
2ND HIGHEST VALUE IS 0.10532 AT (528220.00, 3987016.00, 176.66, 211.60, 0.00) DC
3RD HIGHEST VALUE IS 0.10022 AT (528190.60, 3986583.90, 186.87, 208.10, 0.00) DC
4TH HIGHEST VALUE IS 0.09911 AT (528239.90, 3986577.30, 183.47, 208.10, 0.00) DC
5TH HIGHEST VALUE IS 0.09756 AT (528223.00, 3987048.00, 176.50, 211.60, 0.00) DC
6TH HIGHEST VALUE IS 0.09703 AT (528305.30, 3987020.00, 175.27, 211.60, 0.00) DC
7TH HIGHEST VALUE IS 0.08928 AT (528223.00, 3986548.00, 180.90, 208.10, 0.00) DC
8TH HIGHEST VALUE IS 0.08623 AT (528141.30, 3986590.40, 190.53, 205.10, 0.00) DC
9TH HIGHEST VALUE IS 0.08566 AT (528177.30, 3987014.00, 176.89, 211.60, 0.00) DC
10TH HIGHEST VALUE IS 0.08516 AT (528323.00, 3987048.00, 174.37, 211.60, 0.00) DC

NORMAL 1ST HIGHEST VALUE IS 0.11109 AT (528262.70, 3987018.00, 176.15, 211.60, 0.00) DC
2ND HIGHEST VALUE IS 0.10532 AT (528220.00, 3987016.00, 176.66, 211.60, 0.00) DC
3RD HIGHEST VALUE IS 0.10022 AT (528190.60, 3986583.90, 186.87, 208.10, 0.00) DC
4TH HIGHEST VALUE IS 0.09911 AT (528239.90, 3986577.30, 183.47, 208.10, 0.00) DC
5TH HIGHEST VALUE IS 0.09756 AT (528223.00, 3987048.00, 176.50, 211.60, 0.00) DC
6TH HIGHEST VALUE IS 0.09703 AT (528305.30, 3987020.00, 175.27, 211.60, 0.00) DC
7TH HIGHEST VALUE IS 0.08928 AT (528223.00, 3986548.00, 180.90, 208.10, 0.00) DC
8TH HIGHEST VALUE IS 0.08623 AT (528141.30, 3986590.40, 190.53, 205.10, 0.00) DC
9TH HIGHEST VALUE IS 0.08566 AT (528177.30, 3987014.00, 176.89, 211.60, 0.00) DC
10TH HIGHEST VALUE IS 0.08516 AT (528323.00, 3987048.00, 174.37, 211.60, 0.00) DC

2011 *** THE SUMMARY OF MAXIMUM ANNUAL RESULTS AVERAGED OVER 1 YEARS ***
** CONC OF PM2.5 IN MICROGRAMS/M**3 **

MAX_HRLY 1ST HIGHEST VALUE IS 0.11390 AT (528262.70, 3987018.00, 176.15, 211.60, 0.00) DC
2ND HIGHEST VALUE IS 0.10271 AT (528305.30, 3987020.00, 175.27, 211.60, 0.00) DC
3RD HIGHEST VALUE IS 0.10013 AT (528220.00, 3987016.00, 176.66, 211.60, 0.00) DC
4TH HIGHEST VALUE IS 0.09450 AT (528223.00, 3987048.00, 176.50, 211.60, 0.00) DC
5TH HIGHEST VALUE IS 0.09103 AT (528323.00, 3987048.00, 174.37, 211.60, 0.00) DC
6TH HIGHEST VALUE IS 0.08041 AT (528348.00, 3987022.00, 173.42, 211.60, 0.00) DC
7TH HIGHEST VALUE IS 0.07918 AT (528223.00, 3987148.00, 187.49, 211.60, 0.00) DC
8TH HIGHEST VALUE IS 0.07889 AT (528350.60, 3987071.40, 176.74, 211.60, 0.00) DC
9TH HIGHEST VALUE IS 0.07819 AT (528323.00, 3987148.00, 183.62, 211.60, 0.00) DC
10TH HIGHEST VALUE IS 0.07571 AT (528177.30, 3987014.00, 176.89, 211.60, 0.00) DC

NORMAL 1ST HIGHEST VALUE IS 0.11390 AT (528262.70, 3987018.00, 176.15, 211.60, 0.00) DC
2ND HIGHEST VALUE IS 0.10271 AT (528305.30, 3987020.00, 175.27, 211.60, 0.00) DC
3RD HIGHEST VALUE IS 0.10013 AT (528220.00, 3987016.00, 176.66, 211.60, 0.00) DC
4TH HIGHEST VALUE IS 0.09450 AT (528223.00, 3987048.00, 176.50, 211.60, 0.00) DC
5TH HIGHEST VALUE IS 0.09103 AT (528323.00, 3987048.00, 174.37, 211.60, 0.00) DC
6TH HIGHEST VALUE IS 0.08041 AT (528348.00, 3987022.00, 173.42, 211.60, 0.00) DC
7TH HIGHEST VALUE IS 0.07918 AT (528223.00, 3987148.00, 187.49, 211.60, 0.00) DC
8TH HIGHEST VALUE IS 0.07889 AT (528350.60, 3987071.40, 176.74, 211.60, 0.00) DC
9TH HIGHEST VALUE IS 0.07819 AT (528323.00, 3987148.00, 183.62, 211.60, 0.00) DC
10TH HIGHEST VALUE IS 0.07571 AT (528177.30, 3987014.00, 176.89, 211.60, 0.00) DC

2012 *** THE SUMMARY OF MAXIMUM ANNUAL RESULTS AVERAGED OVER 1 YEARS ***
** CONC OF PM2.5 IN MICROGRAMS/M**3 **

MAX_HRLY 1ST HIGHEST VALUE IS 0.09983 AT (528262.70, 3987018.00, 176.15, 211.60, 0.00) DC
2ND HIGHEST VALUE IS 0.09128 AT (528220.00, 3987016.00, 176.66, 211.60, 0.00) DC
3RD HIGHEST VALUE IS 0.08767 AT (528305.30, 3987020.00, 175.27, 211.60, 0.00) DC
4TH HIGHEST VALUE IS 0.08594 AT (528223.00, 3987048.00, 176.50, 211.60, 0.00) DC
5TH HIGHEST VALUE IS 0.07798 AT (528190.60, 3986583.90, 186.87, 208.10, 0.00) DC

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6TH HIGHEST VALUE IS     0.64046 AT (  528092.00, 3986597.00,  194.14,  202.80,   0.00)  DC
7TH HIGHEST VALUE IS     0.61412 AT (  528177.30, 3987014.00,  176.89,  211.60,   0.00)  DC
8TH HIGHEST VALUE IS     0.60130 AT (  528223.00, 3987148.00,  187.49,  211.60,   0.00)  DC
9TH HIGHEST VALUE IS     0.59102 AT (  528190.60, 3986583.90,  186.87,  208.10,   0.00)  DC
10TH HIGHEST VALUE IS    0.56514 AT (  528223.00, 3987248.00,  208.49,  209.60,   0.00)  DC

NORMAL   1ST HIGHEST VALUE IS    0.87513 AT (  528262.70, 3987018.00,  176.15,  211.60,   0.00)  DC
2ND HIGHEST VALUE IS     0.79106 AT (  528220.00, 3987016.00,  176.66,  211.60,   0.00)  DC
3RD HIGHEST VALUE IS     0.73341 AT (  528223.00, 3987048.00,  176.50,  211.60,   0.00)  DC
4TH HIGHEST VALUE IS     0.65399 AT (  528305.30, 3987020.00,  175.27,  211.60,   0.00)  DC
5TH HIGHEST VALUE IS     0.64072 AT (  528141.30, 3986590.40,  190.53,  205.10,   0.00)  DC
6TH HIGHEST VALUE IS     0.64046 AT (  528092.00, 3986597.00,  194.14,  202.80,   0.00)  DC
7TH HIGHEST VALUE IS     0.61412 AT (  528177.30, 3987014.00,  176.89,  211.60,   0.00)  DC
8TH HIGHEST VALUE IS     0.60130 AT (  528223.00, 3987148.00,  187.49,  211.60,   0.00)  DC
9TH HIGHEST VALUE IS     0.59102 AT (  528190.60, 3986583.90,  186.87,  208.10,   0.00)  DC
10TH HIGHEST VALUE IS    0.56514 AT (  528223.00, 3987248.00,  208.49,  209.60,   0.00)  DC

2013  *** THE SUMMARY OF MAXIMUM   1ST-HIGHEST 24-HR RESULTS AVERAGED OVER   1 YEARS ***
                    ** CONC OF PM2.5    IN MICROGRAMS/M**3                    **

MAX_HRLY  1ST HIGHEST VALUE IS    0.81501 AT (  528220.00, 3987016.00,  176.66,  211.60,   0.00)  DC
2ND HIGHEST VALUE IS     0.80348 AT (  528262.70, 3987018.00,  176.15,  211.60,   0.00)  DC
3RD HIGHEST VALUE IS     0.79894 AT (  528177.30, 3987014.00,  176.89,  211.60,   0.00)  DC
4TH HIGHEST VALUE IS     0.77728 AT (  528223.00, 3986548.00,  180.90,  208.10,   0.00)  DC
5TH HIGHEST VALUE IS     0.76510 AT (  528190.60, 3986583.90,  186.87,  208.10,   0.00)  DC
6TH HIGHEST VALUE IS     0.76034 AT (  528239.90, 3986577.30,  183.47,  208.10,   0.00)  DC
7TH HIGHEST VALUE IS     0.74972 AT (  528223.00, 3987048.00,  176.50,  211.60,   0.00)  DC
8TH HIGHEST VALUE IS     0.63021 AT (  528223.00, 3987148.00,  187.49,  211.60,   0.00)  DC
9TH HIGHEST VALUE IS     0.62915 AT (  528141.30, 3986590.40,  190.53,  205.10,   0.00)  DC
10TH HIGHEST VALUE IS    0.61943 AT (  528223.00, 3986448.00,  170.79,  208.10,   0.00)  DC

NORMAL   1ST HIGHEST VALUE IS    0.81501 AT (  528220.00, 3987016.00,  176.66,  211.60,   0.00)  DC
2ND HIGHEST VALUE IS     0.80348 AT (  528262.70, 3987018.00,  176.15,  211.60,   0.00)  DC
3RD HIGHEST VALUE IS     0.79894 AT (  528177.30, 3987014.00,  176.89,  211.60,   0.00)  DC
4TH HIGHEST VALUE IS     0.77728 AT (  528223.00, 3986548.00,  180.90,  208.10,   0.00)  DC
5TH HIGHEST VALUE IS     0.76510 AT (  528190.60, 3986583.90,  186.87,  208.10,   0.00)  DC
6TH HIGHEST VALUE IS     0.76034 AT (  528239.90, 3986577.30,  183.47,  208.10,   0.00)  DC
7TH HIGHEST VALUE IS     0.74972 AT (  528223.00, 3987048.00,  176.50,  211.60,   0.00)  DC
8TH HIGHEST VALUE IS     0.63021 AT (  528223.00, 3987148.00,  187.49,  211.60,   0.00)  DC
9TH HIGHEST VALUE IS     0.62915 AT (  528141.30, 3986590.40,  190.53,  205.10,   0.00)  DC
10TH HIGHEST VALUE IS    0.61943 AT (  528223.00, 3986448.00,  170.79,  208.10,   0.00)  DC
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6TH HIGHEST VALUE IS     0.07756 AT (  528323.00, 3987048.00,  174.37,  211.60,   0.00)  DC
7TH HIGHEST VALUE IS     0.07682 AT (  528239.90, 3986577.30,  183.47,  208.10,   0.00)  DC
8TH HIGHEST VALUE IS     0.07213 AT (  528223.00, 3987148.00,  187.49,  211.60,   0.00)  DC
9TH HIGHEST VALUE IS     0.06969 AT (  528223.00, 3986548.00,  180.90,  208.10,   0.00)  DC
10TH HIGHEST VALUE IS    0.06913 AT (  528177.30, 3987014.00,  176.89,  211.60,   0.00)  DC

NORMAL   1ST HIGHEST VALUE IS    0.09983 AT (  528262.70, 3987018.00,  176.15,  211.60,   0.00)  DC
2ND HIGHEST VALUE IS     0.09128 AT (  528220.00, 3987016.00,  176.66,  211.60,   0.00)  DC
3RD HIGHEST VALUE IS     0.08767 AT (  528305.30, 3987020.00,  175.27,  211.60,   0.00)  DC
4TH HIGHEST VALUE IS     0.08594 AT (  528223.00, 3987048.00,  176.50,  211.60,   0.00)  DC
5TH HIGHEST VALUE IS     0.07798 AT (  528190.60, 3986583.90,  186.87,  208.10,   0.00)  DC
6TH HIGHEST VALUE IS     0.07756 AT (  528323.00, 3987048.00,  174.37,  211.60,   0.00)  DC
7TH HIGHEST VALUE IS     0.07682 AT (  528239.90, 3986577.30,  183.47,  208.10,   0.00)  DC
8TH HIGHEST VALUE IS     0.07213 AT (  528223.00, 3987148.00,  187.49,  211.60,   0.00)  DC
9TH HIGHEST VALUE IS     0.06969 AT (  528223.00, 3986548.00,  180.90,  208.10,   0.00)  DC
10TH HIGHEST VALUE IS    0.06913 AT (  528177.30, 3987014.00,  176.89,  211.60,   0.00)  DC

2013  *** THE SUMMARY OF MAXIMUM ANNUAL RESULTS AVERAGED OVER   1 YEARS ***
                    ** CONC OF PM2.5    IN MICROGRAMS/M**3                    **

MAX_HRLY  1ST HIGHEST VALUE IS    0.09218 AT (  528262.70, 3987018.00,  176.15,  211.60,   0.00)  DC
2ND HIGHEST VALUE IS     0.09126 AT (  528220.00, 3987016.00,  176.66,  211.60,   0.00)  DC
3RD HIGHEST VALUE IS     0.08547 AT (  528223.00, 3987048.00,  176.50,  211.60,   0.00)  DC
4TH HIGHEST VALUE IS     0.07882 AT (  528239.90, 3986577.30,  183.47,  208.10,   0.00)  DC
5TH HIGHEST VALUE IS     0.07797 AT (  528190.60, 3986583.90,  186.87,  208.10,   0.00)  DC
6TH HIGHEST VALUE IS     0.07612 AT (  528305.30, 3987020.00,  175.27,  211.60,   0.00)  DC
7TH HIGHEST VALUE IS     0.07470 AT (  528177.30, 3987014.00,  176.89,  211.60,   0.00)  DC
8TH HIGHEST VALUE IS     0.07200 AT (  528223.00, 3987148.00,  187.49,  211.60,   0.00)  DC
9TH HIGHEST VALUE IS     0.07063 AT (  528223.00, 3986548.00,  180.90,  208.10,   0.00)  DC
10TH HIGHEST VALUE IS    0.06801 AT (  528223.00, 3987248.00,  208.49,  209.60,   0.00)  DC

NORMAL   1ST HIGHEST VALUE IS    0.09218 AT (  528262.70, 3987018.00,  176.15,  211.60,   0.00)  DC
2ND HIGHEST VALUE IS     0.09126 AT (  528220.00, 3987016.00,  176.66,  211.60,   0.00)  DC
3RD HIGHEST VALUE IS     0.08547 AT (  528223.00, 3987048.00,  176.50,  211.60,   0.00)  DC
4TH HIGHEST VALUE IS     0.07882 AT (  528239.90, 3986577.30,  183.47,  208.10,   0.00)  DC
5TH HIGHEST VALUE IS     0.07797 AT (  528190.60, 3986583.90,  186.87,  208.10,   0.00)  DC
6TH HIGHEST VALUE IS     0.07612 AT (  528305.30, 3987020.00,  175.27,  211.60,   0.00)  DC
7TH HIGHEST VALUE IS     0.07470 AT (  528177.30, 3987014.00,  176.89,  211.60,   0.00)  DC
8TH HIGHEST VALUE IS     0.07200 AT (  528223.00, 3987148.00,  187.49,  211.60,   0.00)  DC
9TH HIGHEST VALUE IS     0.07063 AT (  528223.00, 3986548.00,  180.90,  208.10,   0.00)  DC
10TH HIGHEST VALUE IS    0.06801 AT (  528223.00, 3987248.00,  208.49,  209.60,   0.00)  DC
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Cane Ridge Compressor Station AERMOD SO2 Run Results
Runs Conducted 6/16/2017
BUILDING DOWNWASH INCLUDED
SO2 NAAQS

1-Hour	75 ppb	99th %ile of daily maximum concentrations, averaged over 3 years	99th %ile = 4th highest value
3-Hour	0.5 ppm	Not to be exceeded more than once per year	

1-Hour Values

	99th %ile Conc.		
CY	$\mu g/m^3$	ppb	3-yr avg
2009	**13.6366**	**5.205**	
2010	**15.8724**	**6.058**	
2011	**13.0768**	**4.991**	**5.42**
2012	12.8262	4.895	5.31
2013	13.5003	5.153	5.01

Complianc **YES**
All 1-hour 3-year averages are well below the 75 ppb standard.
Source is in compliance with the SO2 NAAQS.

3-Hour Values

*****Examine maximum values rather than H2H to be more conservative*****

	Max. Conc.	
CY	$\mu g/m^3$	ppb
2009	**13.6189**	**5.198**
2010	12.4466	4.751
2011	11.3494	4.332
2012	11.9410	4.558
2013	13.5002	5.153

Complianc **YES**
All 3-hour results are well below the 0.5 ppm (500 ppb) standard.
Source is in compliance with the SO2 NAAQS.

Conversion of ug/m3 to ppb

SO2	1 ppb =	2.62	$\mu g/m^3$
NO2	1 ppb =	1.88	$\mu g/m^3$
NO	1 ppb =	1.25	$\mu g/m^3$
O3	1 ppb =	2	$\mu g/m^3$
CO	1 ppb =	1.145	$\mu g/m^3$

µg/m3 = (ppb)*(12.187)*(M) / (273.15 + °C)

AERMOD Model Outputs

1-hour Results

2009
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*** THE SUMMARY OF HIGHEST  1-HR RESULTS ***
                 ** CONC OF SO2     IN MICROGRAMS/M**3                **

MAX_HRLY HIGH   1ST HIGH VALUE IS     17.10917  ON 09122416: AT (  528077.20,  3986926.80,   189.96,   202.10,    0.00)  DC
         HIGH   2ND HIGH VALUE IS     13.91052  ON 09032817: AT (  528077.20,  3986926.80,   189.96,   202.10,    0.00)  DC
         HIGH   3RD HIGH VALUE IS     13.80831  ON 09122413: AT (  528077.20,  3986926.80,   189.96,   202.10,    0.00)  DC
         HIGH   4TH HIGH VALUE IS     13.63662  ON 09122417: AT (  528077.20,  3986926.80,   189.96,   202.10,    0.00)  DC

NORMAL   HIGH   1ST HIGH VALUE IS     17.10917  ON 09122416: AT (  528077.20,  3986926.80,   189.96,   202.10,    0.00)  DC
         HIGH   2ND HIGH VALUE IS     13.91052  ON 09032817: AT (  528077.20,  3986926.80,   189.96,   202.10,    0.00)  DC
         HIGH   3RD HIGH VALUE IS     13.80831  ON 09122413: AT (  528077.20,  3986926.80,   189.96,   202.10,    0.00)  DC
         HIGH   4TH HIGH VALUE IS     13.63662  ON 09122417: AT (  528077.20,  3986926.80,   189.96,   202.10,    0.00)  DC
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2010
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*** THE SUMMARY OF HIGHEST  1-HR RESULTS ***
                 ** CONC OF SO2     IN MICROGRAMS/M**3                **

MAX_HRLY HIGH   1ST HIGH VALUE IS     18.68524  ON 10042414: AT (  528055.00,  3986802.00,   201.22,   201.22,    0.00)  DC
         HIGH   2ND HIGH VALUE IS     16.60258  ON 10082116: AT (  528055.00,  3986802.00,   201.22,   201.22,    0.00)  DC
         HIGH   3RD HIGH VALUE IS     16.15661  ON 10082815: AT (  528062.40,  3986843.60,   200.58,   201.30,    0.00)  DC
         HIGH   4TH HIGH VALUE IS     15.87237  ON 10052011: AT (  528062.40,  3986843.60,   200.58,   201.30,    0.00)  DC

NORMAL   HIGH   1ST HIGH VALUE IS     18.68524  ON 10042414: AT (  528055.00,  3986802.00,   201.22,   201.22,    0.00)  DC
         HIGH   2ND HIGH VALUE IS     16.60258  ON 10082116: AT (  528055.00,  3986802.00,   201.22,   201.22,    0.00)  DC
         HIGH   3RD HIGH VALUE IS     16.15661  ON 10082815: AT (  528062.40,  3986843.60,   200.58,   201.30,    0.00)  DC
         HIGH   4TH HIGH VALUE IS     15.87237  ON 10052011: AT (  528062.40,  3986843.60,   200.58,   201.30,    0.00)  DC
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2011
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*** THE SUMMARY OF HIGHEST  1-HR RESULTS ***
                 ** CONC OF SO2     IN MICROGRAMS/M**3                **

MAX_HRLY HIGH   1ST HIGH VALUE IS     18.21243  ON 11072114: AT (  528062.40,  3986843.60,   200.58,   201.30,    0.00)  DC
         HIGH   2ND HIGH VALUE IS     13.60335  ON 11060513: AT (  528141.30,  3986590.40,   190.53,   205.10,    0.00)  DC
         HIGH   3RD HIGH VALUE IS     13.16093  ON 11060513: AT (  528190.60,  3986583.90,   186.87,   208.10,    0.00)  DC
         HIGH   4TH HIGH VALUE IS     13.07677  ON 11091509: AT (  528190.60,  3986583.90,   186.87,   208.10,    0.00)  DC

NORMAL   HIGH   1ST HIGH VALUE IS     18.21243  ON 11072114: AT (  528062.40,  3986843.60,   200.58,   201.30,    0.00)  DC
         HIGH   2ND HIGH VALUE IS     13.60335  ON 11060513: AT (  528141.30,  3986590.40,   190.53,   205.10,    0.00)  DC
         HIGH   3RD HIGH VALUE IS     13.16093  ON 11060513: AT (  528190.60,  3986583.90,   186.87,   208.10,    0.00)  DC
         HIGH   4TH HIGH VALUE IS     13.07677  ON 11091509: AT (  528190.60,  3986583.90,   186.87,   208.10,    0.00)  DC
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2012
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*** THE SUMMARY OF HIGHEST  1-HR RESULTS ***

                 ** CONC OF SO2     IN MICROGRAMS/M**3                **

                                DATE                           NETWORK
GROUP ID          AVERAGE CONC    (YYMMDDHH)       RECEPTOR  (XR, YR, ZELEV, ZHILL, ZFLAG)   OF TYPE  GRID-ID
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

MAX_HRLY HIGH   1ST HIGH VALUE IS     16.72307  ON 12122521: AT (  528035.30,  3986684.00,   197.16,   197.16,    0.00)  DC
         HIGH   2ND HIGH VALUE IS     15.55246  ON 12082514: AT (  528030.50,  3986789.00,   200.20,   200.20,    0.00)  DC
         HIGH   3RD HIGH VALUE IS     14.58653  ON 12051109: AT (  528030.50,  3986789.00,   200.20,   200.20,    0.00)  DC
         HIGH   4TH HIGH VALUE IS     12.82616  ON 12060516: AT (  528141.30,  3986590.40,   190.53,   205.10,    0.00)  DC

NORMAL   HIGH   1ST HIGH VALUE IS     16.72307  ON 12122521: AT (  528035.30,  3986684.00,   197.16,   197.16,    0.00)  DC
         HIGH   2ND HIGH VALUE IS     15.55246  ON 12082514: AT (  528030.50,  3986789.00,   200.20,   200.20,    0.00)  DC
         HIGH   3RD HIGH VALUE IS     14.58653  ON 12051109: AT (  528030.50,  3986789.00,   200.20,   200.20,    0.00)  DC
         HIGH   4TH HIGH VALUE IS     12.82616  ON 12060516: AT (  528141.30,  3986590.40,   190.53,   205.10,    0.00)  DC
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2013
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*** THE SUMMARY OF HIGHEST  1-HR RESULTS ***
                 ** CONC OF SO2     IN MICROGRAMS/M**3                **

MAX_HRLY HIGH   1ST HIGH VALUE IS     15.00318  ON 13011714: AT (  528190.60,  3986583.90,   186.87,   208.10,    0.00)  DC
         HIGH   2ND HIGH VALUE IS     14.14159  ON 13111214: AT (  528141.30,  3986590.40,   190.53,   205.10,    0.00)  DC
         HIGH   3RD HIGH VALUE IS     14.10857  ON 13111211: AT (  528141.30,  3986590.40,   190.53,   205.10,    0.00)  DC
         HIGH   4TH HIGH VALUE IS     13.50034  ON 13011715: AT (  528141.30,  3986590.40,   190.53,   205.10,    0.00)  DC

NORMAL   HIGH   1ST HIGH VALUE IS     15.00318  ON 13011714: AT (  528190.60,  3986583.90,   186.87,   208.10,    0.00)  DC
         HIGH   2ND HIGH VALUE IS     14.14159  ON 13111214: AT (  528141.30,  3986590.40,   190.53,   205.10,    0.00)  DC
         HIGH   3RD HIGH VALUE IS     14.10857  ON 13111211: AT (  528141.30,  3986590.40,   190.53,   205.10,    0.00)  DC
         HIGH   4TH HIGH VALUE IS     13.50034  ON 13011715: AT (  528141.30,  3986590.40,   190.53,   205.10,    0.00)  DC
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3-hour Results

2009
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*** THE SUMMARY OF HIGHEST  3-HR RESULTS ***
                 ** CONC OF SO2     IN MICROGRAMS/M**3                **

MAX_HRLY HIGH   1ST HIGH VALUE IS     13.61894  ON 09122418: AT (  528077.20,  3986926.80,   189.96,   202.10,    0.00)  DC
         HIGH   2ND HIGH VALUE IS     11.92818  ON 09031215: AT (  528141.30,  3986590.40,   190.53,   205.10,    0.00)  DC

NORMAL   HIGH   1ST HIGH VALUE IS     13.61894  ON 09122418: AT (  528077.20,  3986926.80,   189.96,   202.10,    0.00)  DC
         HIGH   2ND HIGH VALUE IS     11.92818  ON 09031215: AT (  528141.30,  3986590.40,   190.53,   205.10,    0.00)  DC
```

2010
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*** THE SUMMARY OF HIGHEST  3-HR RESULTS ***
                 ** CONC OF SO2     IN MICROGRAMS/M**3                **

MAX_HRLY HIGH   1ST HIGH VALUE IS     12.44658  ON 10123024: AT (  528177.30,  3987014.00,   176.89,   211.60,    0.00)  DC
         HIGH   2ND HIGH VALUE IS     11.64581  ON 10112921: AT (  528134.70,  3987012.00,   176.48,   211.60,    0.00)  DC

NORMAL   HIGH   1ST HIGH VALUE IS     12.44658  ON 10123024: AT (  528177.30,  3987014.00,   176.89,   211.60,    0.00)  DC
         HIGH   2ND HIGH VALUE IS     11.64581  ON 10112921: AT (  528134.70,  3987012.00,   176.48,   211.60,    0.00)  DC
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2011
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*** THE SUMMARY OF HIGHEST  3-HR RESULTS ***
                 ** CONC OF SO2     IN MICROGRAMS/M**3                **

MAX_HRLY HIGH   1ST HIGH VALUE IS     11.34937  ON 11090509: AT (  528141.30,  3986590.40,   190.53,   205.10,    0.00)  DC
         HIGH   2ND HIGH VALUE IS     10.77349  ON 11112612: AT (  528220.00,  3987016.00,   176.66,   211.60,    0.00)  DC

NORMAL   HIGH   1ST HIGH VALUE IS     11.34937  ON 11090509: AT (  528141.30,  3986590.40,   190.53,   205.10,    0.00)  DC
         HIGH   2ND HIGH VALUE IS     10.77349  ON 11112612: AT (  528220.00,  3987016.00,   176.66,   211.60,    0.00)  DC
```

2012
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*** THE SUMMARY OF HIGHEST  3-HR RESULTS ***

                 ** CONC OF SO2     IN MICROGRAMS/M**3                **

                                DATE                           NETWORK
GROUP ID          AVERAGE CONC    (YYMMDDHH)       RECEPTOR  (XR, YR, ZELEV, ZHILL, ZFLAG)   OF TYPE  GRID-ID
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

MAX_HRLY HIGH   1ST HIGH VALUE IS     11.94097  ON 12062618: AT (  528092.00,  3986597.00,   194.14,   202.80,    0.00)  DC
         HIGH   2ND HIGH VALUE IS     11.17303  ON 12030712: AT (  528262.70,  3987018.00,   176.15,   211.60,    0.00)  DC

NORMAL   HIGH   1ST HIGH VALUE IS     11.94097  ON 12062618: AT (  528092.00,  3986597.00,   194.14,   202.80,    0.00)  DC
         HIGH   2ND HIGH VALUE IS     11.17303  ON 12030712: AT (  528262.70,  3987018.00,   176.15,   211.60,    0.00)  DC
```

2013
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*** THE SUMMARY OF HIGHEST  3-HR RESULTS ***
                 ** CONC OF SO2     IN MICROGRAMS/M**3                **

MAX_HRLY HIGH   1ST HIGH VALUE IS     13.50023  ON 13011715: AT (  528190.60,  3986583.90,   186.87,   208.10,    0.00)  DC
         HIGH   2ND HIGH VALUE IS     11.62172  ON 13111209: AT (  528190.60,  3986583.90,   186.87,   208.10,    0.00)  DC

NORMAL   HIGH   1ST HIGH VALUE IS     13.50023  ON 13011715: AT (  528190.60,  3986583.90,   186.87,   208.10,    0.00)  DC
         HIGH   2ND HIGH VALUE IS     11.62172  ON 13111209: AT (  528190.60,  3986583.90,   186.87,   208.10,    0.00)  DC
```

Cane Ridge Compressor Station AERMOD NO2 Run Results

Run Conducted 6/16/2017

Run Performed with individual stacks in AERMOD (all sources) and site buildings

Fenceline receptors at 100 m spacing; receptor grid out to 5,000 m in rectangular grid with 100 m spacing.

Generator NOx emissions multiplied by 500/8760 per Appendix W

NO2 NAAQS

1-Hour	100 ppb	98th %ile (7th Highest) of highest daily values, averaged over 3 years
Annual	53 ppb	Annual Mean

Conversion of ug/m3 to ppb (at 25°C)

SO2	1 ppb =	2.62	$\mu g/m^3$
NO2	1 ppb =	1.88	$\mu g/m^3$
NO	1 ppb =	1.25	$\mu g/m^3$
O3	1 ppb =	2	$\mu g/m^3$
CO	1 ppb =	1.145	$\mu g/m^3$

µg/m3 = (ppb)*(12.187)*(M) / (273.15 + °C)

1-HOUR MODELING

Tier 1 - Assume 100% conversion of NO to NO2 (Appendix W)

1-Hour Values

		98th %ile				
WITH	CY	$\mu g/m^3$	ppb	-yr avg (ppb)		**Max emission rates for all sources**
DOWNWASH	2009	38.6219	20.54		Compliance **YES**	**Generator emissions multiplied by 500/8760**
(With Gen)	**2010**	**39.8955**	**21.22**			Source is in compliance with the NO2 NAAQS by Tier 1 analysis.
	2011	**37.7287**	**20.07**	20.61	38.7487	No need to apply Tier 2 NO2/NOx ratio for analysis.
	2012	**39.8869**	**21.22**	20.84	**39.1704**	
	2013	37.2781	19.83	20.37	38.2979	

In evaluating the potential 1-hour NOx impacts from the proposed pipeline compressor station, this office is referencing the EPA memorandum, "Additional Clarification Regarding Application of Appendix W Modeling Guidance *for the 1-Hour NO2 NAAQ* ", dated March 11, 2011, which provides modeling guidance involving emergency diesel-fired engines. The document states that emergency diesel-fired engines, such as that operated at this facility, should not be considered continuous, due to it only operating during episodes of power loss, which would be considered intermittent operation. EPA "believes the most appropriate data to use for compliance demonstrations for the 1-hour NO2 NAAQS are those based on emission scenarios that are continuous enough or frequent enough to contribute significantly to the annual distribution of daily maximum 1-hour concentrations."

ANNUAL MODELING

Tier 1 - Assume 100% conversion of NO to NO2 (Appendix W)

Annual Values

WITH		Max. Conc.		Compliance **YES**	
DOWNWASH	CY	$\mu g/m^3$	ppb		All annual results are below the 53 ppb standard.
(With Gen)	2009	1.2746	0.68		Source is in compliance with the NO2 NAAQS by Tier 1 analysis.
	2010	1.8873	1.00		No need to apply Tier 2 NO2/NOx ratio for analysis.
	2011	**2.0478**	**1.09**		
	2012	1.6736	0.89		
	2013	1.6101	0.86		

Since the emergency generator powered by a diesel-powered reciprocating internal combustion engine (RICE) will only be permitted to operate a maximum of 500 hours per year, the potential hourly emissions from the generator have been multiplied by 500/8760 in the modeling runs, to account for the fact that the generator will not be operated year-round.

2009

*** THE SUMMARY OF MAXIMUM ANNUAL RESULTS AVERAGED OVER 1 YEARS ***
** CONC OF NO2 IN MICROGRAMS/M**3 **

MAX_HRLY 1ST HIGHEST VALUE IS 1.27462 AT (528262.70, 3987018.00, 176.15, 211.60, 0.00) DC
2ND HIGHEST VALUE IS 1.26189 AT (528220.00, 3987016.00, 176.66, 211.60, 0.00) DC
3RD HIGHEST VALUE IS 1.21909 AT (528223.00, 3987048.00, 176.50, 211.60, 0.00) DC
4TH HIGHEST VALUE IS 1.19851 AT (528305.30, 3987020.00, 175.27, 211.60, 0.00) DC
5TH HIGHEST VALUE IS 1.13956 AT (528177.30, 3987014.00, 176.89, 211.60, 0.00) DC
6TH HIGHEST VALUE IS 1.12248 AT (528323.00, 3987048.00, 174.37, 211.60, 0.00) DC
7TH HIGHEST VALUE IS 1.11174 AT (528223.00, 3987148.00, 187.49, 211.60, 0.00) DC
8TH HIGHEST VALUE IS 1.09375 AT (528223.00, 3987248.00, 208.49, 209.60, 0.00) DC
9TH HIGHEST VALUE IS 1.05486 AT (528323.00, 3987248.00, 203.80, 207.80, 0.00) DC
10TH HIGHEST VALUE IS 1.03939 AT (528348.00, 3987022.00, 173.42, 211.60, 0.00) DC

NORMAL 1ST HIGHEST VALUE IS 0.49406 AT (528262.70, 3987018.00, 176.15, 211.60, 0.00) DC
2ND HIGHEST VALUE IS 0.48390 AT (528220.00, 3987016.00, 176.66, 211.60, 0.00) DC
3RD HIGHEST VALUE IS 0.46160 AT (528223.00, 3987048.00, 176.50, 211.60, 0.00) DC
4TH HIGHEST VALUE IS 0.45585 AT (528305.30, 3987020.00, 175.27, 211.60, 0.00) DC
5TH HIGHEST VALUE IS 0.42631 AT (528177.30, 3987014.00, 176.89, 211.60, 0.00) DC
6TH HIGHEST VALUE IS 0.41976 AT (528323.00, 3987048.00, 174.37, 211.60, 0.00) DC
7TH HIGHEST VALUE IS 0.40812 AT (528223.00, 3987148.00, 187.49, 211.60, 0.00) DC
8TH HIGHEST VALUE IS 0.39608 AT (528223.00, 3987248.00, 208.49, 209.60, 0.00) DC
9TH HIGHEST VALUE IS 0.39560 AT (528190.60, 3986583.90, 186.87, 208.10, 0.00) DC
10TH HIGHEST VALUE IS 0.38945 AT (528348.00, 3987022.00, 173.42, 211.60, 0.00) DC

2009

*** THE SUMMARY OF MAXIMUM 1ST-HIGHEST MAX DAILY 1-HR RESULTS AVERAGED OVER 1 YEARS ***
** CONC OF NO2 IN MICROGRAMS/M**3 **

MAX_HRLY 1ST HIGHEST VALUE IS 47.89079 AT (528077.20, 3986926.80, 189.96, 202.10, 0.00) DC
2ND HIGHEST VALUE IS 42.61695 AT (528239.90, 3986577.30, 183.47, 208.10, 0.00) DC
3RD HIGHEST VALUE IS 39.89398 AT (528084.60, 3986968.40, 182.61, 206.10, 0.00) DC
4TH HIGHEST VALUE IS 39.85183 AT (528289.10, 3986570.70, 183.33, 208.10, 0.00) DC
5TH HIGHEST VALUE IS 39.36595 AT (528141.30, 3986590.40, 190.53, 205.10, 0.00) DC
6TH HIGHEST VALUE IS 39.21533 AT (528069.80, 3986885.20, 195.05, 202.10, 0.00) DC
7TH HIGHEST VALUE IS 38.62185 AT (528177.30, 3987014.00, 176.89, 211.60, 0.00) DC
8TH HIGHEST VALUE IS 37.55193 AT (528134.70, 3987012.00, 176.48, 211.60, 0.00) DC
9TH HIGHEST VALUE IS 37.12088 AT (528190.60, 3986583.90, 186.87, 208.10, 0.00) DC
10TH HIGHEST VALUE IS 36.49841 AT (528055.00, 3986802.00, 201.22, 201.22, 0.00) DC

NORMAL 1ST HIGHEST VALUE IS 16.15439 AT (528077.20, 3986926.80, 189.96, 202.10, 0.00) DC
2ND HIGHEST VALUE IS 14.41675 AT (528239.90, 3986577.30, 183.47, 208.10, 0.00) DC
3RD HIGHEST VALUE IS 13.47847 AT (528289.10, 3986570.70, 183.33, 208.10, 0.00) DC
4TH HIGHEST VALUE IS 13.45637 AT (528084.60, 3986968.40, 182.61, 206.10, 0.00) DC
5TH HIGHEST VALUE IS 13.31901 AT (528141.30, 3986590.40, 190.53, 205.10, 0.00) DC
6TH HIGHEST VALUE IS 13.29470 AT (528069.80, 3986885.20, 195.05, 202.10, 0.00) DC
7TH HIGHEST VALUE IS 13.12109 AT (528055.00, 3986802.00, 201.22, 201.22, 0.00) DC
8TH HIGHEST VALUE IS 13.03069 AT (528177.30, 3987014.00, 176.89, 211.60, 0.00) DC
9TH HIGHEST VALUE IS 12.79636 AT (528190.60, 3986583.90, 186.87, 208.10, 0.00) DC
10TH HIGHEST VALUE IS 12.66853 AT (528134.70, 3987012.00, 176.48, 211.60, 0.00) DC

2010

*** THE SUMMARY OF MAXIMUM ANNUAL RESULTS AVERAGED OVER 1 YEARS ***
** CONC OF NO2 IN MICROGRAMS/M**3 **

MAX_HRLY 1ST HIGHEST VALUE IS 1.92211 AT (528262.70, 3987018.00, 176.15, 211.60, 0.00) DC
2ND HIGHEST VALUE IS 1.88728 AT (528220.00, 3987016.00, 176.66, 211.60, 0.00) DC
3RD HIGHEST VALUE IS 1.78482 AT (528223.00, 3987048.00, 176.50, 211.60, 0.00) DC
4TH HIGHEST VALUE IS 1.73662 AT (528305.30, 3987020.00, 175.27, 211.60, 0.00) DC
5TH HIGHEST VALUE IS 1.62394 AT (528177.30, 3987014.00, 176.89, 211.60, 0.00) DC
6TH HIGHEST VALUE IS 1.57671 AT (528323.00, 3987048.00, 174.37, 211.60, 0.00) DC
7TH HIGHEST VALUE IS 1.52823 AT (528223.00, 3987148.00, 187.49, 211.60, 0.00) DC
8TH HIGHEST VALUE IS 1.42141 AT (528348.00, 3987022.00, 173.42, 211.60, 0.00) DC
9TH HIGHEST VALUE IS 1.40542 AT (528223.00, 3987248.00, 208.49, 209.60, 0.00) DC
10TH HIGHEST VALUE IS 1.39964 AT (528350.60, 3987071.40, 176.74, 211.60, 0.00) DC

NORMAL 1ST HIGHEST VALUE IS 0.72468 AT (528262.70, 3987018.00, 176.15, 211.60, 0.00) DC
2ND HIGHEST VALUE IS 0.70251 AT (528220.00, 3987016.00, 176.66, 211.60, 0.00) DC
3RD HIGHEST VALUE IS 0.65946 AT (528223.00, 3987048.00, 176.50, 211.60, 0.00) DC
4TH HIGHEST VALUE IS 0.64672 AT (528305.30, 3987020.00, 175.27, 211.60, 0.00) DC
5TH HIGHEST VALUE IS 0.59254 AT (528177.30, 3987014.00, 176.89, 211.60, 0.00) DC
6TH HIGHEST VALUE IS 0.58010 AT (528323.00, 3987048.00, 174.37, 211.60, 0.00) DC
7TH HIGHEST VALUE IS 0.55354 AT (528223.00, 3987148.00, 187.49, 211.60, 0.00) DC
8TH HIGHEST VALUE IS 0.53417 AT (528190.60, 3986583.90, 186.87, 208.10, 0.00) DC
9TH HIGHEST VALUE IS 0.52329 AT (528348.00, 3987022.00, 173.42, 211.60, 0.00) DC
10TH HIGHEST VALUE IS 0.51819 AT (528239.90, 3986577.30, 183.47, 208.10, 0.00) DC

2010

*** THE SUMMARY OF MAXIMUM 1ST-HIGHEST MAX DAILY 1-HR RESULTS AVERAGED OVER 1 YEARS ***
** CONC OF NO2 IN MICROGRAMS/M**3 **

MAX_HRLY 1ST HIGHEST VALUE IS 50.09333 AT (528055.00, 3986802.00, 201.22, 201.22, 0.00) DC
2ND HIGHEST VALUE IS 49.65492 AT (528062.40, 3986843.60, 200.58, 201.30, 0.00) DC
3RD HIGHEST VALUE IS 46.80271 AT (528023.00, 3986848.00, 202.09, 202.09, 0.00) DC
4TH HIGHEST VALUE IS 44.60549 AT (528030.50, 3986789.00, 200.20, 200.20, 0.00) DC
5TH HIGHEST VALUE IS 44.10334 AT (528239.90, 3986577.30, 183.47, 208.10, 0.00) DC
6TH HIGHEST VALUE IS 42.95556 AT (528077.20, 3986926.80, 189.96, 202.10, 0.00) DC
7TH HIGHEST VALUE IS 39.89553 AT (528223.00, 3986548.00, 180.90, 208.10, 0.00) DC
8TH HIGHEST VALUE IS 39.88703 AT (528006.00, 3986776.00, 199.05, 199.05, 0.00) DC
9TH HIGHEST VALUE IS 39.62992 AT (528190.60, 3986583.90, 186.87, 208.10, 0.00) DC
10TH HIGHEST VALUE IS 39.53640 AT (528069.00, 3986612.00, 196.27, 196.27, 0.00) DC

NORMAL 1ST HIGHEST VALUE IS 17.26893 AT (528055.00, 3986802.00, 201.22, 201.22, 0.00) DC
2ND HIGHEST VALUE IS 17.05463 AT (528062.40, 3986843.60, 200.58, 201.30, 0.00) DC
3RD HIGHEST VALUE IS 16.09645 AT (528023.00, 3986848.00, 202.09, 202.09, 0.00) DC
4TH HIGHEST VALUE IS 15.49981 AT (528030.50, 3986789.00, 200.20, 200.20, 0.00) DC
5TH HIGHEST VALUE IS 14.91750 AT (528239.90, 3986577.30, 183.47, 208.10, 0.00) DC
6TH HIGHEST VALUE IS 14.49105 AT (528077.20, 3986926.80, 189.96, 202.10, 0.00) DC
7TH HIGHEST VALUE IS 14.06999 AT (528006.00, 3986776.00, 199.05, 199.05, 0.00) DC
8TH HIGHEST VALUE IS 13.53756 AT (528190.60, 3986583.90, 186.87, 208.10, 0.00) DC
9TH HIGHEST VALUE IS 13.51783 AT (528141.30, 3986590.40, 190.53, 205.10, 0.00) DC
10TH HIGHEST VALUE IS 13.48280 AT (528223.00, 3986548.00, 180.90, 208.10, 0.00) DC

2011

*** THE SUMMARY OF MAXIMUM ANNUAL RESULTS AVERAGED OVER 1 YEARS ***
** CONC OF NO2 IN MICROGRAMS/M**3 **

MAX_HRLY 1ST HIGHEST VALUE IS 2.04777 AT (528262.70, 3987018.00, 176.15, 211.60, 0.00) DC
2ND HIGHEST VALUE IS 1.91967 AT (528305.30, 3987020.00, 175.27, 211.60, 0.00) DC
3RD HIGHEST VALUE IS 1.81795 AT (528220.00, 3987016.00, 176.66, 211.60, 0.00) DC
4TH HIGHEST VALUE IS 1.76101 AT (528323.00, 3987048.00, 174.37, 211.60, 0.00) DC
5TH HIGHEST VALUE IS 1.76047 AT (528223.00, 3987048.00, 176.50, 211.60, 0.00) DC
6TH HIGHEST VALUE IS 1.59036 AT (528323.00, 3987148.00, 183.62, 211.60, 0.00) DC
7TH HIGHEST VALUE IS 1.57621 AT (528223.00, 3987148.00, 187.49, 211.60, 0.00) DC
8TH HIGHEST VALUE IS 1.57535 AT (528323.00, 3987248.00, 203.80, 207.80, 0.00) DC
9TH HIGHEST VALUE IS 1.57001 AT (528350.60, 3987071.40, 176.74, 211.60, 0.00) DC
10TH HIGHEST VALUE IS 1.55046 AT (528348.00, 3987022.00, 173.42, 211.60, 0.00) DC

NORMAL 1ST HIGHEST VALUE IS 0.76134 AT (528262.70, 3987018.00, 176.15, 211.60, 0.00) DC
2ND HIGHEST VALUE IS 0.70394 AT (528305.30, 3987020.00, 175.27, 211.60, 0.00) DC
3RD HIGHEST VALUE IS 0.67353 AT (528220.00, 3987016.00, 176.66, 211.60, 0.00) DC
4TH HIGHEST VALUE IS 0.64631 AT (528223.00, 3987048.00, 176.50, 211.60, 0.00) DC
5TH HIGHEST VALUE IS 0.63808 AT (528323.00, 3987048.00, 174.37, 211.60, 0.00) DC
6TH HIGHEST VALUE IS 0.56659 AT (528323.00, 3987148.00, 183.62, 211.60, 0.00) DC
7TH HIGHEST VALUE IS 0.56559 AT (528223.00, 3987148.00, 187.49, 211.60, 0.00) DC
8TH HIGHEST VALUE IS 0.56341 AT (528350.60, 3987071.40, 176.74, 211.60, 0.00) DC
9TH HIGHEST VALUE IS 0.56242 AT (528348.00, 3987022.00, 173.42, 211.60, 0.00) DC
10TH HIGHEST VALUE IS 0.55592 AT (528323.00, 3987248.00, 203.80, 207.80, 0.00) DC

2011

*** THE SUMMARY OF MAXIMUM 1ST-HIGHEST MAX DAILY 1-HR RESULTS AVERAGED OVER 1 YEARS ***
** CONC OF NO2 IN MICROGRAMS/M**3 **

MAX_HRLY 1ST HIGHEST VALUE IS 49.19577 AT (528062.40, 3986843.60, 200.58, 201.30, 0.00) DC
2ND HIGHEST VALUE IS 46.08201 AT (528023.00, 3986848.00, 202.09, 202.09, 0.00) DC
3RD HIGHEST VALUE IS 40.00357 AT (528239.90, 3986577.30, 183.47, 208.10, 0.00) DC
4TH HIGHEST VALUE IS 38.98501 AT (528177.30, 3987014.00, 176.89, 211.60, 0.00) DC
5TH HIGHEST VALUE IS 38.35213 AT (528084.60, 3986968.40, 182.61, 206.10, 0.00) DC
6TH HIGHEST VALUE IS 38.34605 AT (528077.20, 3986926.80, 189.96, 202.10, 0.00) DC
7TH HIGHEST VALUE IS 37.72869 AT (528141.30, 3986590.40, 190.53, 205.10, 0.00) DC
8TH HIGHEST VALUE IS 37.52027 AT (528023.00, 3986648.00, 195.93, 195.93, 0.00) DC
9TH HIGHEST VALUE IS 36.83546 AT (528190.60, 3986583.90, 186.87, 208.10, 0.00) DC
10TH HIGHEST VALUE IS 36.63570 AT (528134.70, 3987012.00, 176.48, 211.60, 0.00) DC

NORMAL 1ST HIGHEST VALUE IS 16.89452 AT (528062.40, 3986843.60, 200.58, 201.30, 0.00) DC
2ND HIGHEST VALUE IS 15.84787 AT (528023.00, 3986848.00, 202.09, 202.09, 0.00) DC
3RD HIGHEST VALUE IS 13.54013 AT (528239.90, 3986577.30, 183.47, 208.10, 0.00) DC
4TH HIGHEST VALUE IS 13.15301 AT (528177.30, 3987014.00, 176.89, 211.60, 0.00) DC
5TH HIGHEST VALUE IS 12.93955 AT (528077.20, 3986926.80, 189.96, 202.10, 0.00) DC
6TH HIGHEST VALUE IS 12.93707 AT (528084.60, 3986968.40, 182.61, 206.10, 0.00) DC
7TH HIGHEST VALUE IS 12.80597 AT (528190.60, 3986583.90, 186.87, 208.10, 0.00) DC
8TH HIGHEST VALUE IS 12.78521 AT (528141.30, 3986590.40, 190.53, 205.10, 0.00) DC
9TH HIGHEST VALUE IS 12.68509 AT (528023.00, 3986648.00, 195.93, 195.93, 0.00) DC
10TH HIGHEST VALUE IS 12.53177 AT (528020.70, 3986730.00, 196.59, 196.59, 0.00) DC

2012

*** THE SUMMARY OF MAXIMUM ANNUAL RESULTS AVERAGED OVER 1 YEARS ***
** CONC OF NO2 IN MICROGRAMS/M**3 **

MAX_HRLY 1ST HIGHEST VALUE IS 1.67360 AT (528262.70, 3987018.00, 176.15, 211.60, 0.00) DC
2ND HIGHEST VALUE IS 1.56843 AT (528220.00, 3987016.00, 176.66, 211.60, 0.00) DC
3RD HIGHEST VALUE IS 1.52843 AT (528305.30, 3987020.00, 175.27, 211.60, 0.00) DC
4TH HIGHEST VALUE IS 1.51700 AT (528223.00, 3987048.00, 176.50, 211.60, 0.00) DC
5TH HIGHEST VALUE IS 1.41183 AT (528323.00, 3987048.00, 174.37, 211.60, 0.00) DC
6TH HIGHEST VALUE IS 1.37386 AT (528223.00, 3987148.00, 187.49, 211.60, 0.00) DC
7TH HIGHEST VALUE IS 1.34291 AT (528223.00, 3987248.00, 208.49, 209.60, 0.00) DC
8TH HIGHEST VALUE IS 1.33505 AT (528323.00, 3987248.00, 203.80, 207.80, 0.00) DC
9TH HIGHEST VALUE IS 1.31407 AT (528323.00, 3987148.00, 183.62, 211.60, 0.00) DC
10TH HIGHEST VALUE IS 1.26450 AT (528350.60, 3987071.40, 176.74, 211.60, 0.00) DC

NORMAL 1ST HIGHEST VALUE IS 0.63845 AT (528262.70, 3987018.00, 176.15, 211.60, 0.00) DC
2ND HIGHEST VALUE IS 0.59285 AT (528220.00, 3987016.00, 176.66, 211.60, 0.00) DC
3RD HIGHEST VALUE IS 0.57464 AT (528305.30, 3987020.00, 175.27, 211.60, 0.00) DC
4TH HIGHEST VALUE IS 0.56777 AT (528223.00, 3987048.00, 176.50, 211.60, 0.00) DC
5TH HIGHEST VALUE IS 0.52259 AT (528323.00, 3987048.00, 174.37, 211.60, 0.00) DC
6TH HIGHEST VALUE IS 0.50048 AT (528223.00, 3987148.00, 187.49, 211.60, 0.00) DC
7TH HIGHEST VALUE IS 0.48400 AT (528223.00, 3987248.00, 208.49, 209.60, 0.00) DC
8TH HIGHEST VALUE IS 0.47774 AT (528323.00, 3987248.00, 203.80, 207.80, 0.00) DC
9TH HIGHEST VALUE IS 0.47598 AT (528323.00, 3987148.00, 183.62, 211.60, 0.00) DC
10TH HIGHEST VALUE IS 0.46289 AT (528177.30, 3987014.00, 176.89, 211.60, 0.00) DC

2012

*** THE SUMMARY OF MAXIMUM 1ST-HIGHEST MAX DAILY 1-HR RESULTS AVERAGED OVER 1 YEARS ***
** CONC OF NO2 IN MICROGRAMS/M**3 **

MAX_HRLY 1ST HIGHEST VALUE IS 46.33281 AT (528035.30, 3986684.00, 197.16, 197.16, 0.00) DC
2ND HIGHEST VALUE IS 45.60550 AT (528050.00, 3986638.00, 196.66, 196.66, 0.00) DC
3RD HIGHEST VALUE IS 43.94778 AT (528069.00, 3986612.00, 196.27, 196.27, 0.00) DC
4TH HIGHEST VALUE IS 41.88666 AT (528055.00, 3986802.00, 201.22, 201.22, 0.00) DC
5TH HIGHEST VALUE IS 40.74724 AT (528030.50, 3986789.00, 200.20, 200.20, 0.00) DC
6TH HIGHEST VALUE IS 40.11208 AT (528020.70, 3986730.00, 196.59, 196.59, 0.00) DC
7TH HIGHEST VALUE IS 39.88694 AT (528141.30, 3986590.40, 190.53, 205.10, 0.00) DC
8TH HIGHEST VALUE IS 38.92843 AT (528177.30, 3987014.00, 176.89, 211.60, 0.00) DC
9TH HIGHEST VALUE IS 38.70138 AT (528006.00, 3986776.00, 199.05, 199.05, 0.00) DC
10TH HIGHEST VALUE IS 38.08212 AT (528069.80, 3986885.20, 195.05, 202.10, 0.00) DC

NORMAL 1ST HIGHEST VALUE IS 15.70913 AT (528035.30, 3986684.00, 197.16, 197.16, 0.00) DC
2ND HIGHEST VALUE IS 15.39242 AT (528050.00, 3986638.00, 196.66, 196.66, 0.00) DC
3RD HIGHEST VALUE IS 14.96790 AT (528069.00, 3986612.00, 196.27, 196.27, 0.00) DC
4TH HIGHEST VALUE IS 14.47440 AT (528055.00, 3986802.00, 201.22, 201.22, 0.00) DC
5TH HIGHEST VALUE IS 14.23624 AT (528030.50, 3986789.00, 200.20, 200.20, 0.00) DC
6TH HIGHEST VALUE IS 13.70124 AT (528006.00, 3986776.00, 199.05, 199.05, 0.00) DC
7TH HIGHEST VALUE IS 13.57729 AT (528141.30, 3986590.40, 190.53, 205.10, 0.00) DC
8TH HIGHEST VALUE IS 13.54175 AT (528020.70, 3986730.00, 196.59, 196.59, 0.00) DC
9TH HIGHEST VALUE IS 13.13396 AT (528177.30, 3987014.00, 176.89, 211.60, 0.00) DC
10TH HIGHEST VALUE IS 13.08599 AT (528023.00, 3986648.00, 195.93, 195.93, 0.00) DC

2013

*** THE SUMMARY OF MAXIMUM ANNUAL RESULTS AVERAGED OVER 1 YEARS ***
** CONC OF NO2 IN MICROGRAMS/M**3 **

MAX_HRLY 1ST HIGHEST VALUE IS 1.61005 AT (528220.00, 3987016.00, 176.66, 211.60, 0.00) DC
2ND HIGHEST VALUE IS 1.55866 AT (528262.70, 3987018.00, 176.15, 211.60, 0.00) DC
3RD HIGHEST VALUE IS 1.54807 AT (528223.00, 3987048.00, 176.50, 211.60, 0.00) DC
4TH HIGHEST VALUE IS 1.40154 AT (528223.00, 3987148.00, 187.49, 211.60, 0.00) DC
5TH HIGHEST VALUE IS 1.39274 AT (528177.30, 3987014.00, 176.89, 211.60, 0.00) DC
6TH HIGHEST VALUE IS 1.36296 AT (528223.00, 3987248.00, 208.49, 209.60, 0.00) DC
7TH HIGHEST VALUE IS 1.32597 AT (528305.30, 3987020.00, 175.27, 211.60, 0.00) DC
8TH HIGHEST VALUE IS 1.21145 AT (528323.00, 3987048.00, 174.37, 211.60, 0.00) DC
9TH HIGHEST VALUE IS 1.20164 AT (528323.00, 3987248.00, 203.80, 207.80, 0.00) DC
10TH HIGHEST VALUE IS 1.15676 AT (528323.00, 3987148.00, 183.62, 211.60, 0.00) DC

NORMAL 1ST HIGHEST VALUE IS 0.60272 AT (528220.00, 3987016.00, 176.66, 211.60, 0.00) DC
2ND HIGHEST VALUE IS 0.59271 AT (528262.70, 3987018.00, 176.15, 211.60, 0.00) DC
3RD HIGHEST VALUE IS 0.57403 AT (528223.00, 3987048.00, 176.50, 211.60, 0.00) DC
4TH HIGHEST VALUE IS 0.51116 AT (528177.30, 3987014.00, 176.89, 211.60, 0.00) DC
5TH HIGHEST VALUE IS 0.50674 AT (528223.00, 3987148.00, 187.49, 211.60, 0.00) DC
6TH HIGHEST VALUE IS 0.49868 AT (528305.30, 3987020.00, 175.27, 211.60, 0.00) DC
7TH HIGHEST VALUE IS 0.48798 AT (528223.00, 3987248.00, 208.49, 209.60, 0.00) DC
8TH HIGHEST VALUE IS 0.44892 AT (528323.00, 3987048.00, 174.37, 211.60, 0.00) DC
9TH HIGHEST VALUE IS 0.43003 AT (528323.00, 3987248.00, 203.80, 207.80, 0.00) DC
10TH HIGHEST VALUE IS 0.41925 AT (528323.00, 3987148.00, 183.62, 211.60, 0.00) DC

2013

*** THE SUMMARY OF MAXIMUM 1ST-HIGHEST MAX DAILY 1-HR RESULTS AVERAGED OVER 1 YEARS ***
** CONC OF NO2 IN MICROGRAMS/M**3 **

MAX_HRLY 1ST HIGHEST VALUE IS 40.39617 AT (528190.60, 3986583.90, 186.87, 208.10, 0.00) DC
2ND HIGHEST VALUE IS 39.00975 AT (528141.30, 3986590.40, 190.53, 205.10, 0.00) DC
3RD HIGHEST VALUE IS 38.29255 AT (528062.40, 3986843.60, 200.58, 201.30, 0.00) DC
4TH HIGHEST VALUE IS 37.90636 AT (528239.90, 3986577.30, 183.47, 208.10, 0.00) DC
5TH HIGHEST VALUE IS 37.77515 AT (528092.00, 3986597.00, 194.14, 202.80, 0.00) DC
6TH HIGHEST VALUE IS 37.33313 AT (528069.00, 3986612.00, 196.27, 196.27, 0.00) DC
7TH HIGHEST VALUE IS 37.27811 AT (528223.00, 3986548.00, 180.90, 208.10, 0.00) DC
8TH HIGHEST VALUE IS 36.20870 AT (528134.70, 3987012.00, 176.48, 211.60, 0.00) DC
9TH HIGHEST VALUE IS 36.20556 AT (528177.30, 3987014.00, 176.89, 211.60, 0.00) DC
10TH HIGHEST VALUE IS 35.80923 AT (528077.20, 3986926.80, 189.96, 202.10, 0.00) DC

NORMAL 1ST HIGHEST VALUE IS 13.89540 AT (528190.60, 3986583.90, 186.87, 208.10, 0.00) DC
2ND HIGHEST VALUE IS 13.44213 AT (528062.40, 3986843.60, 200.58, 201.30, 0.00) DC
3RD HIGHEST VALUE IS 13.29680 AT (528141.30, 3986590.40, 190.53, 205.10, 0.00) DC
4TH HIGHEST VALUE IS 12.88182 AT (528092.00, 3986597.00, 194.14, 202.80, 0.00) DC
5TH HIGHEST VALUE IS 12.83365 AT (528239.90, 3986577.30, 183.47, 208.10, 0.00) DC
6TH HIGHEST VALUE IS 12.66713 AT (528069.00, 3986612.00, 196.27, 196.27, 0.00) DC
7TH HIGHEST VALUE IS 12.60367 AT (528223.00, 3986548.00, 180.90, 208.10, 0.00) DC
8TH HIGHEST VALUE IS 12.21972 AT (528177.30, 3987014.00, 176.89, 211.60, 0.00) DC
9TH HIGHEST VALUE IS 12.21509 AT (528134.70, 3987012.00, 176.48, 211.60, 0.00) DC
10TH HIGHEST VALUE IS 12.09041 AT (528077.20, 3986926.80, 189.96, 202.10, 0.00) DC

Cane Ridge Compressor Station AERMOD CO Run Results
Run Conducted 6/16/2017
BUILDING DOWNWASH INCLUDED
CO NAAQS

	1-Hour	35 ppm	Not to be exceeded more than once per year
	8-Hour	9 ppm	Not to be exceeded more than once per year

Conversion of ug/m3 to ppb (at 25°C)

SO2	1 ppb =	2.62
NO2	1 ppb =	1.88
NO	1 ppb =	1.25
O3	1 ppb =	2
CO	1 ppb =	1.145

µg/m3 = (ppb)*(12.187)*(M) / (273.15 + °C)

Maximum 1-Hour Values (MAX_HRLY) *****Examine maximum values rather than H2H to be more conservative*****

CY	Max. Conc. µg/m^3	ppm		
2009	#########	1.380	Compliance?	YES
2010	**#########**	**1.444**		All 1-hour results are well below the 35 ppm NAAQS.
2011	#########	1.418		Source will comply with the CO NAAQS.
2012	#########	1.335		
2013	#########	1.165		

8-Hour Values (MAX_HRLY)

CY	Max. Conc. µg/m^3	ppm		
2009	951.4955	0.831	Compliance?	YES
2010	**#########**	**0.887**		All 8-hour results are well below the 9 ppm NAAQS.
2011	939.3126	0.820		Source will comply with the CO NAAQS.
2012	985.9191	0.861		
2013	942.3911	0.823		

H2H

CY	Max. Conc. µg/m^3	ppm		
2009	#########	1.112	Compliance?	YES
2010	**#########**	**1.262**		All 1-hour results are well below the 35 ppm NAAQS.
2011	#########	1.090		Source will comply with the CO NAAQS.
2012	#########	1.136		
2013	#########	1.092		

8-Hour Values (MAX_HRLY)

CY	Max. Conc. µg/m^3	ppm		
2009	941.9664	0.823	Compliance?	YES
2010	**944.5126**	**0.825**		All 8-hour results are well below the 9 ppm NAAQS.
2011	832.4186	0.727		Source will comply with the CO NAAQS.
2012	837.5212	0.731		
2013	874.1580	0.763		

2009

```
*** THE SUMMARY OF HIGHEST  1-HR RESULTS ***
                    ** CONC OF CO      IN MICROGRAMS/M**3                 **

MAX_HRLY HIGH  1ST HIGH VALUE IS   1579.72984  ON 09122416: AT (  528077.20,  3986926.80,   189.96,   202.10,    0.00)  DC
         HIGH  2ND HIGH VALUE IS   1273.17866  ON 09032817: AT (  528077.20,  3986926.80,   189.96,   202.10,    0.00)  DC

NORMAL  HIGH  1ST HIGH VALUE IS    220.56515  ON 09040419: AT (  528020.70,  3986730.00,   196.59,   196.59,    0.00)  DC
        HIGH  2ND HIGH VALUE IS    219.71540  ON 09040204: AT (  528020.70,  3986730.00,   196.59,   196.59,    0.00)  DC
```

2010

```
*** THE SUMMARY OF HIGHEST  1-HR RESULTS ***
                    ** CONC OF CO      IN MICROGRAMS/M**3                 **

MAX_HRLY HIGH  1ST HIGH VALUE IS   1653.57558  ON 10042414: AT (  528055.00,  3986802.00,   201.22,   201.22,    0.00)  DC
         HIGH  2ND HIGH VALUE IS   1445.00853  ON 10093021: AT (  528239.90,  3986577.30,   183.47,   208.10,    0.00)  DC

NORMAL  HIGH  1ST HIGH VALUE IS    137.18592  ON 10112403: AT (  528020.70,  3986730.00,   196.59,   196.59,    0.00)  DC
        HIGH  2ND HIGH VALUE IS    132.76944  ON 10052001: AT (  528006.00,  3986776.00,   199.05,   199.05,    0.00)  DC
```

2011

```
                    *** THE SUMMARY OF HIGHEST  1-HR RESULTS ***
                    ** CONC OF CO      IN MICROGRAMS/M**3                 **

MAX_HRLY HIGH  1ST HIGH VALUE IS   1623.73868  ON 11072114: AT (  528062.40,  3986843.60,   200.58,   201.30,    0.00)  DC
         HIGH  2ND HIGH VALUE IS   1248.05126  ON 11030824: AT (  528177.30,  3987014.00,   176.89,   211.60,    0.00)  DC

NORMAL  HIGH  1ST HIGH VALUE IS    189.93913  ON 11083006: AT (  528020.70,  3986730.00,   196.59,   196.59,    0.00)  DC
        HIGH  2ND HIGH VALUE IS    186.38307  ON 11032505: AT (  528020.70,  3986730.00,   196.59,   196.59,    0.00)  DC
```

2012

```
*** THE SUMMARY OF HIGHEST  1-HR RESULTS ***
                    ** CONC OF CO      IN MICROGRAMS/M**3                 **

MAX_HRLY HIGH  1ST HIGH VALUE IS   1528.59566  ON 12122521: AT (  528035.30,  3986684.00,   197.16,   197.16,    0.00)  DC
         HIGH  2ND HIGH VALUE IS   1300.35315  ON 12082514: AT (  528030.50,  3986789.00,   200.20,   200.20,    0.00)  DC

NORMAL  HIGH  1ST HIGH VALUE IS    220.02866  ON 12053023: AT (  528020.70,  3986730.00,   196.59,   196.59,    0.00)  DC
        HIGH  2ND HIGH VALUE IS    217.32029  ON 12081519: AT (  528006.00,  3986776.00,   199.05,   199.05,    0.00)  DC
```

2013

```
                    *** THE SUMMARY OF HIGHEST  1-HR RESULTS ***
                    ** CONC OF CO      IN MICROGRAMS/M**3                 **

MAX_HRLY HIGH  1ST HIGH VALUE IS   1333.37524  ON 13011714: AT (  528190.60,  3986583.90,   186.87,   208.10,    0.00)  DC
         HIGH  2ND HIGH VALUE IS   1249.92808  ON 13111214: AT (  528141.30,  3986590.40,   190.53,   205.10,    0.00)  DC

NORMAL  HIGH  1ST HIGH VALUE IS    189.75984  ON 13012702: AT (  528006.00,  3986776.00,   199.05,   199.05,    0.00)  DC
        HIGH  2ND HIGH VALUE IS    180.61310  ON 13092621: AT (  527923.00,  3986748.00,   194.87,   194.87,    0.00)  DC
```

2009

```
*** THE SUMMARY OF HIGHEST  8-HR RESULTS ***
                    ** CONC OF CO      IN MICROGRAMS/M**3                 **

MAX_HRLY HIGH  1ST HIGH VALUE IS    951.49552  ON 09122424: AT (  528077.20,  3986926.80,   189.96,   202.10,    0.00)  DC
         HIGH  2ND HIGH VALUE IS    941.96643  ON 09021108: AT (  528177.30,  3987014.00,   176.89,   211.60,    0.00)  DC

NORMAL  HIGH  1ST HIGH VALUE IS     83.27059c ON 09041624: AT (  528190.60,  3986583.90,   186.87,   208.10,    0.00)  DC
        HIGH  2ND HIGH VALUE IS     79.08511c ON 09051824: AT (  528190.60,  3986583.90,   186.87,   208.10,    0.00)  DC
```

2010

```
*** THE SUMMARY OF HIGHEST  8-HR RESULTS ***
                    ** CONC OF CO      IN MICROGRAMS/M**3                 **

MAX_HRLY HIGH  1ST HIGH VALUE IS   1015.50996  ON 10112508: AT (  528262.70,  3987018.00,   176.15,   211.60,    0.00)  DC
         HIGH  2ND HIGH VALUE IS    944.51257  ON 10112216: AT (  528262.70,  3987018.00,   176.15,   211.60,    0.00)  DC

NORMAL  HIGH  1ST HIGH VALUE IS     70.38247c ON 10103124: AT (  528190.60,  3986583.90,   186.87,   208.10,    0.00)  DC
        HIGH  2ND HIGH VALUE IS     63.12518c ON 10121908: AT (  528239.90,  3986577.30,   183.47,   208.10,    0.00)  DC
```

2011

```
*** THE SUMMARY OF HIGHEST  8-HR RESULTS ***
                    ** CONC OF CO      IN MICROGRAMS/M**3                 **

MAX_HRLY HIGH  1ST HIGH VALUE IS    939.31259  ON 11030424: AT (  528177.30,  3987014.00,   176.89,   211.60,    0.00)  DC
         HIGH  2ND HIGH VALUE IS    832.41857  ON 11090524: AT (  528141.30,  3986590.40,   190.53,   205.10,    0.00)  DC

NORMAL  HIGH  1ST HIGH VALUE IS     69.55643c ON 11061308: AT (  528190.60,  3986583.90,   186.87,   208.10,    0.00)  DC
        HIGH  2ND HIGH VALUE IS     67.92113  ON 11020824: AT (  528190.60,  3986583.90,   186.87,   208.10,    0.00)  DC
```

2012

```
*** THE SUMMARY OF HIGHEST  8-HR RESULTS ***
                    ** CONC OF CO      IN MICROGRAMS/M**3                 **

MAX_HRLY HIGH  1ST HIGH VALUE IS    985.91908  ON 12122008: AT (  528134.70,  3987012.00,   176.48,   211.60,    0.00)  DC
         HIGH  2ND HIGH VALUE IS    837.52124  ON 12011616: AT (  528262.70,  3987018.00,   176.15,   211.60,    0.00)  DC

NORMAL  HIGH  1ST HIGH VALUE IS     77.21845c ON 12121224: AT (  528239.90,  3986577.30,   183.47,   208.10,    0.00)  DC
        HIGH  2ND HIGH VALUE IS     67.81362m ON 12051408: AT (  528190.60,  3986583.90,   186.87,   208.10,    0.00)  DC
```

2013

```
*** THE SUMMARY OF HIGHEST  8-HR RESULTS ***
                    ** CONC OF CO      IN MICROGRAMS/M**3                 **

MAX_HRLY HIGH  1ST HIGH VALUE IS    942.39108  ON 13111216: AT (  528141.30,  3986590.40,   190.53,   205.10,    0.00)  DC
         HIGH  2ND HIGH VALUE IS    874.15803  ON 13012924: AT (  528177.30,  3987014.00,   176.89,   211.60,    0.00)  DC

NORMAL  HIGH  1ST HIGH VALUE IS     67.80430  ON 13071424: AT (  528055.00,  3986802.00,   201.22,   201.22,    0.00)  DC
        HIGH  2ND HIGH VALUE IS     60.31168c ON 13012024: AT (  528223.00,  3986548.00,   180.90,   208.10,    0.00)  DC
```

APPENDIX V

FERC FINAL ENVIRONMENTAL IMPACT STATEMENT (EIS)

JULY 2017

Office of Energy Projects

July 2017

FERC/FEIS-0275F

FINAL ENVIRONMENTAL IMPACT STATEMENT
FOR
Columbia Gas Transmission, LLC – Mountaineer XPress Project
Columbia Gulf Transmission, LLC – Gulf XPress Project

Docket Nos. CP16-357-000 and CP16-361-000

Volume I

Federal Energy Regulatory Commission
Office of Energy Projects
888 First Street, NE, Washington, DC 20426

FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON, D.C. 20426

OFFICE OF ENERGY PROJECTS

In Reply Refer To:
OEP/DG2E/Gas 4
Columbia Gas Transmission, LLC
Mountaineer XPress Project
Docket No. CP16-357-000
Columbia Gulf Transmission, LLC
Gulf XPress Project
Docket No. CP16-361-000

TO THE PARTY ADDRESSED:

The staff of the Federal Energy Regulatory Commission (FERC or Commission) has prepared a final environmental impact statement (EIS) for the Mountaineer XPress Project (MXP), proposed by Columbia Gas Transmission, LLC (Columbia Gas), and the Gulf XPress Project (GXP), proposed by Columbia Gulf Transmission, LLC (Columbia Gulf), in the above-referenced dockets. Columbia Gas requests authorization to construct and operate a total of 170.9 miles of natural gas transmission pipeline and ancillary facilities in West Virginia, and to modify one existing compressor station and two approved/pending compressor stations. The MXP would provide about 2,700,000 dekatherms per day (Dth/d) of available capacity for transport to Columbia Gas' TCO Pool[1] for delivery to markets across Columbia Pipeline Group's system, including the Columbia Gulf Leach interconnect with Columbia Gulf. Columbia Gulf requests authorization to construct and operate seven new natural gas-fired compressor stations and to upgrade one approved compressor station and one existing meter station in Kentucky, Tennessee, and Mississippi. The GXP would provide about 860,000 Dth/d of natural gas delivery to markets in the Gulf Coast region.

The EIS assesses the potential environmental effects of the construction and operation of the MXP and GXP in accordance with the requirements of the National Environmental Policy Act (NEPA). The FERC staff concludes that approval of the proposed projects would result in some adverse and significant environmental impacts. However, if the projects are constructed and operated in accordance with applicable laws and regulations, the mitigation measures discussed in this EIS, and our recommendations, these impacts would be reduced to acceptable levels.

The U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, West Virginia Division of Natural Resources, and West Virginia Department of Environmental Protection participated as cooperating agencies in

[1] The TCO Pool is the main natural gas pooling point for gas pricing and trading on Columbia Gas' system. Shippers may make deliveries into the TCO Pool from any source of delivery into Columbia Gas' system.

the preparation of this EIS. Cooperating agencies have jurisdiction by law or special expertise with respect to resources potentially affected by the proposal and may participate in the NEPA analysis. The U.S. Army Corps of Engineers would adopt and use the EIS to comply with the requirements of NEPA before issuing permits for the projects under section 404 of the Clean Water Act, which governs the discharge of dredged or fill material into waters of the United States (including wetlands). Although the cooperating agencies provided input to the conclusions and recommendations presented in the EIS, the agencies would present their own conclusions and recommendations in their respective records of decision (where applicable) for the projects.

The EIS addresses the potential environmental effects of the construction and operation in West Virginia of the following MXP facilities:

- about 164.5 miles of new 36-inch-diameter natural gas pipeline from Marshall County to Cabell County (MXP-100);
- about 6.0 miles of new 24-inch-diameter natural gas pipeline in Doddridge County;
- three new compressor stations in Doddridge, Calhoun, and Jackson Counties (one that also includes a new regulator station);
- two new regulating stations in Jackson and Cabell Counties;
- about 296 feet of new, 10-inch-diameter natural gas pipeline at the Ripley Regulator Station to tie Columbia Gas' existing X59M1 pipeline into the MXP-100 pipeline in Jackson County;
- an approximately 0.4-mile-long replacement segment of 30-inch-diameter natural gas pipeline in Cabell County;
- upgrades to one existing compressor station (Wayne County) and two compressor stations (Marshall and Kanawha Counties) that are approved or pending, respectively, under separate FERC proceedings; and
- related facilities in various West Virginia counties.

The EIS also addresses the potential environmental effects of the construction and operation of the following GXP facilities:

- seven new compressor stations in Kentucky (Rowan, Garrard, and Metcalfe Counties), Tennessee (Davidson and Wayne Counties), and Mississippi (Union and Granada Counties);
- upgrades to one approved compressor station in Carter County, Kentucky; and
- upgrades at one existing meter station in Boyd County, Kentucky.

The FERC staff mailed copies of the EIS to federal, state, and local government representatives and agencies; elected officials; environmental and public interest groups; Native American tribes; potentially affected landowners and other interested individuals and groups; and newspapers and libraries in the project areas. Paper copies of this EIS were mailed to those specifically requesting them; all others received a CD version. In addition, the EIS is available for public viewing on the FERC's website (www.ferc.gov) using the eLibrary link. A limited number of copies are available for distribution and public inspection at:

Federal Energy Regulatory Commission
Public Reference Room
888 First Street NE, Room 2A
Washington, DC 20426
(202) 502-8371

Additional information about the projects is available from the Commission's Office of External Affairs, at **(866) 208-FERC**, or on the FERC website (www.ferc.gov) using the eLibrary link. Click on the eLibrary link, click on "General Search," and enter the docket number excluding the last three digits in the Docket Number field (i.e., CP16-357 and CP16-361). Be sure you have selected an appropriate date range. For assistance, please contact FERC Online Support at FercOnlineSupport@ferc.gov or toll free at (866) 208-3676; for TTY, contact (202) 502-8659. The eLibrary link also provides access to the texts of formal documents issued by the Commission, such as orders, notices, and rulemakings.

In addition, the Commission offers a free service called eSubscription which allows you to keep track of all formal issuances and submittals in specific dockets. This can reduce the amount of time you spend researching proceedings by automatically providing you with notification of these filings, document summaries, and direct links to the documents. Go to www.ferc.gov/docs-filing/esubscription.asp.

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µg/m3	micrograms per cubic meter
3PCM	third-party compliance monitoring
ACHP	Advisory Council on Historic Preservation
AEO	annual energy outlook
AMM	Avoidance and Minimization Measures
APE	area of potential effect
AQCR	air quality control region
ATWS	additional temporary workspace
BA	biological assessment
BCC	Birds of Conservation Concern
BCR	Bird Conservation Region
BGEPA	Bald and Golden Eagle Protection Act
BLS	Bureau of Labor Statistics
BMP	best management practice
BTEX	benzene, toluene, ethylbenzene, and xylene
CAA	Clean Air Act
CEQ	Council on Environmental Quality
Certificate	Certificate of Public Convenience and Necessity
CFA	Core Forest Area
CFR	Code of Federal Regulations
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalents
Columbia Gas	Columbia Gas Transmission, LLC
Columbia Gulf	Columbia Gulf Transmission, LLC
Commission	Federal Energy Regulatory Commission
Contingency Plan	Horizontal Directional Drill Contingency Plan
CPG	Columbia Pipeline Group
CSR	Code of State Rules
CUI	Controlled Unclassified Information
CWA	Clean Water Act
CZMA	Coastal Zone Management Act of 1972
dBA	A-weighted decibels
DBNF	Daniel Boone National Forest
DHS	U.S. Department of Homeland Security
Director of OEP	Director of the Office of Energy Projects
Dominion	Dominion Transmission Inc.
Dth/d	dekatherms per day
E&SC Plan	Erosion and Sediment Control Plan
ECS	Environmental Construction Standards

EFH	essential fish habitat
EI	Environmental Inspector
EIA	Energy Information Administration
EIS	Environmental Impact Statement
EM&CP	Environmental Management and Construction Plan
EO	Executive Order
EPA	U.S. Environmental Protection Agency
EPAct	Energy Policy Act of 2005
ESA	Endangered Species Act of 1973
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FHWA	Federal Highway Administration
FR	Federal Register
g	gravity (when discussing seismic hazard mapping)
GHG	greenhouse gas
GIS	geographic information system
gpm	gallons per minute
GWP	global warming potential
GXP	Gulf XPress Project
GXP NOI	*Notice of Intent to Prepare an Environmental Impact Statement for the Planned Gulf XPress Project, Request for Comments on Environmental Issues, and Notice of Public Scoping Meeting*
HAP	hazardous air pollutants
HCA	high-consequence areas
HDD	horizontal directional drilling
hp	horsepower
HQW	high-quality waters
HUC	Hydrologic Unit Code
IBA	Important Bird Area
INGAA	Interstate Natural Gas Association of America
IPaC	Information Planning and Conservation System
ISO	International Standards Organization
KAR	Kentucky Administrative Regulations
KDEP	Kentucky Department of Environmental Protection
KDFWR	Kentucky Department of Fish and Wildlife Resources
lb/hr	pounds per hour
L_{dn}	day-night sound level
L_{eq}	equivalent sound level
LEX	Leach XPress Project
LUST	Leaking Underground Storage Tank
MAC	Mississippi Administrative Code

Magnuson-Stevens Act	Magnuson-Stevens Fishery Conservation and Management Act
MAOP	maximum allowable operating pressure
MarkWest	MarkWest Energy Partners
MBTA	Migratory Bird Treaty Act
MBTA MOU	*Memorandum of Understanding Between the Federal Energy Regulatory Commission and the U.S. Department of the Interior United States Fish and Wildlife Service Regarding Implementation of Executive Order 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds"*
MDEQ	Mississippi Department of Environmental Quality
MDOT	Mississippi Department of Transportation
MDWFP	Mississippi Department of Wildlife, Fish, and Parks
MLRA	Major Land Resource Areas
MLV	mainline valve
MP	milepost
MSA	Metropolitan Statistical Area
MSHCP	Multi-Species Habitat Conservation Plan
MXP	Mountaineer XPress Project
MXP NOI	*Notice of Intent to Prepare an Environmental Impact Statement for the Planned Mountaineer XPress Project, Request for Comments on Environmental Issues, and Notice of Public Scoping Meetings*
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NGA	Natural Gas Act
NHP	Natural Heritage Program
NHPA	National Historic Preservation Act
NLEB	northern long-eared bat
NMSZ	The New Madrid Seismic Zone
NO_2	nitrogen dioxide
NOAA Fisheries	National Oceanic and Atmospheric Administration's National Marine Fisheries Service
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NRI	Nationwide Rivers Inventory
NSA	noise-sensitive area
NSPS	New Source Performance Standards
NSR	New Source Review

NWI	National Wetlands Inventory
O_3	ozone
PADEP	Pennsylvania Department of Environmental Protection
pCi/L	picocuries per liter
PEM	palustrine emergent wetlands
PERT	Program Evaluation Review Technique
PF	pre-filing
PFO	palustrine forested wetlands
PGA	peak ground acceleration
PHMSA	Pipeline and Hazardous Materials Safety Administration
Plan	Upland Erosion Control, Revegetation, and Maintenance Plan
PM	particulate matter
PM_{10}	particulate matter with a diameter less than 10 microns
$PM_{2.5}$	particulate matter with a diameter less than 2.5 microns
POR	Point of Receipt
PRIV	Privileged Information
Procedures	Wetland and Waterbody Construction and Mitigation Procedures
PSD	Prevention of Significant Deterioration
PSS	palustrine scrub-shrub wetlands
PTE	potential-to-emit
PUB	palustrine unconsolidated bottom
PWS	public water supply
RHA	Rivers and Harbors Act
RPX	Rayne XPress Expansion Project
Secretary	Secretary of the Commission
SER	significant emission rate
SGCN	West Virginia Species of Greatest Conservation Need
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
SO_2	sulfur dioxide
SPCC	Spill Prevention, Control, and Countermeasure
SSA	sole source aquifer
SSURGO	Soil Survey Geographic
Tcf	trillion cubic feet
TDEC	Tennessee Department of Environment and Conservation
TDOT	Tennessee Department of Transportation
TETCO	Texas Eastern Transmission, LP
TGP	Tennessee Gas Pipeline Company
the Applicants	Columbia Gas Transmission, LLC and Columbia Gulf Transmission, LLC (collectively)

the Companies	Columbia Gas Transmission, LLC and Columbia Gulf Transmission, LLC (collectively)
tpy	tons per year
TSS	total suspended solids
TWS	temporary workspace
UDP	Unanticipated Discovery Plan
USACE	U.S. Army Corps of Engineers
USC	United States Code
USDA	U.S. Department of Agriculture
USUSDOT	U.S. Department of Transportation
USFWS	U.S. Fish and Wildlife Service
USGCRP	U.S. Global Change Research Program
USGS	U.S. Geological Survey
VOCs	volatile organic compounds
WBX	WB XPress Project
WEG	wind erodibility group
WHPA	wellhead protection areas
WMA	Wildlife Management Area
WVBPH	West Virginia Bureau for Public Health
WVCSR	West Virginia Code of State Regulations
WVDEP	West Virginia Department of Environmental Protection
WVDHHR	West Virginia Department of Health and Human Resources
WVDNR	West Virginia Division of Natural Resources
WVDOT	West Virginia Department of Transportation
WVGES	West Virginia Geological and Economic Survey
ZCC	Zones of Critical Concern
ZPC	Zones of Peripheral Concern

EXECUTIVE SUMMARY

On April 29, 2016, Columbia Gas Transmission, LLC (Columbia Gas), an indirect wholly-owned subsidiary of Columbia Pipeline Group, filed an application with the Federal Energy Regulatory Commission (Commission or FERC) under sections 7(c) and 7(b) of the Natural Gas Act (NGA) as amended. Columbia Gas is seeking a Certificate of Public Convenience and Necessity (Certificate) to construct, operate, and maintain a new interstate natural gas pipeline and ancillary facilities in West Virginia. Columbia Gas' application was assigned Docket No. CP16-357-000. Also on April 29, 2016, Columbia Gulf Transmission, LLC (Columbia Gulf), an indirect wholly-owned subsidiary of Columbia Pipeline Group, filed an application with FERC under the NGA seeking a Certificate to construct, operate, and maintain new and upgraded natural gas ancillary facilities in Kentucky, Tennessee, and Mississippi. Columbia Gulf's application was assigned Docket No. CP16-361-000. We[1] issued a Notice of Application for each project on May 13, 2016, and the notices appeared in the *Federal Register* (FR) on May 20, 2016.

The purpose of this environmental impact statement (EIS) is to inform FERC decision-makers, the public, and the permitting agencies about the potential adverse and beneficial environmental impacts of the projects, as well as alternatives, and recommend mitigation measures that would reduce adverse impacts to the extent practicable. We prepared this EIS to assess the environmental impact associated with the construction and operation of the projects, in accordance with the requirements of the National Environmental Policy Act of 1969, as amended. Our analysis was based on information provided by Columbia Gas and Columbia Gulf and further developed from data requests; field investigations; public scoping; literature research; contacts with or comments from federal, state, and local agencies; and comments from individual members of the public.

FERC staff prepared a single EIS for the two projects because we are completing the environmental review for the two projects within the same general timeframe and because they are being proposed by the same applicant (Columbia Pipeline Group). Also, our consideration of company-proposed construction techniques and mitigation measures is facilitated by a combined analysis. However, any Certificate(s) the Commission may issue for these projects would be individual and separate for each project.

The U.S. Environmental Protection Agency, U.S. Army Corps of Engineers (USACE), West Virginia Department of Environmental Protection, and West Virginia Division of Natural Resources (WVDNR) are participating as cooperating agencies in the preparation of this EIS because they have jurisdiction by law or have special expertise with respect to environmental impacts associated with the proposals.

PROPOSED ACTION

Columbia Gas proposes to construct and operate the Mountaineer XPress Project (MXP) in West Virginia, and Columbia Gulf proposes to construct and operate the Gulf XPress Project (GXP) in Kentucky, Tennessee, and Mississippi. According to Columbia Gas, the primary purpose

[1] The pronouns "we," "us," and "our" refer to the environmental staff of the FERC's Office of Energy Projects.

of the MXP is to add pipeline infrastructure to support the increased transportation demand for natural gas in the Utica and Marcellus basins by increasing the capacity of Columbia Gas' system by up to 2,700,000 dekatherms per day. According to Columbia Gulf, the purpose of the GXP is to expand the capacity of Columbia Gulf's existing system to allow for an additional 860,000 dekatherms per day of natural gas delivery to high-demand markets in the Gulf Coast region.

The MXP would include the following facilities in West Virginia:

- about 164.5 miles of new 36-inch-diameter natural gas pipeline (MXP-100);
- about 6.0 miles of new 24-inch-diameter natural gas pipeline (MXP-200);
- three new compressor stations (one that also includes a new regulator station)
- two new regulator stations;
- additional compression at one existing compressor station and two new compressor stations that are approved/pending under separate proceedings;
- replacement of a 0.4-mile-segment of 30-inch-diameter natural gas pipeline on Columbia Gas' existing system; and
- other appurtenant facilities;

The GXP would include the following facilities:

- seven new compressor stations in Kentucky, Tennessee, and Mississippi;
- additional compression and/or improvements at one approved compressor station under a separate proceeding in Kentucky; and
- additional compression and/or improvements at one existing meter station in Kentucky.

PUBLIC INVOLVEMENT

On September 16, 2015, FERC staff began its pre-application review of the MXP and established a pre-filing (PF) docket number (PF15-31-000) to place information related to the planned MXP into the public record. Prior to entering PF, Columbia Gas began initial outreach activities with stakeholders via notification letters in April 2015. Columbia Gas began making contact with governmental stakeholders and tribal representatives in August 2015. Between October 5 and 13, 2015, after entering into PF, Columbia Gas hosted six informal open house meetings in Wetzel, Doddridge, Ritchie, Jackson, and Putnam Counties, West Virginia.

On November 18, 2015, FERC issued a *Notice of Intent to Prepare an Environmental Impact Statement for the Planned Mountaineer XPress Project, Request for Comments on Environmental Issues, and Notice of Public Scoping Meetings* (MXP NOI). This notice was published in the FR on December 1, 2015, and mailed to more than 1,300 interested parties, including federal, state, and local government representatives and agencies; elected officials; environmental and public interest groups; Native American Tribes; affected property owners; other interested parties; and local libraries and newspapers. The notice established a 30-day public comment period for the submission of comments, concerns, and issues related to the environmental aspects of the MXP.

Between December 7 and 10, 2015, we conducted four public scoping meetings in New Martinsville, West Union, Ripley, and South Charleston, West Virginia. The scoping meetings provided an opportunity for agencies, stakeholders, and the general public to learn more about the MXP and participate in the environmental analysis by commenting on the issues to be addressed in the EIS. On December 10, 2015, we also conducted a meeting in Charleston, West Virginia, for cooperating agencies to discuss coordination of agency review, permit requirements and status, and specific resource concerns to be addressed in the EIS. On October 11, 2016, and subsequent to its official application filing, Columbia Gas incorporated several route modifications into its proposed MXP-100 and MXP-200 pipeline routes. Thus, on October 21, 2016, the Commission mailed a copy of the MXP NOI along with an informational cover letter to 31 newly affected landowners and opened a limited scoping period for these route modifications.

On June 2, 2016, the Commission issued a *Notice of Intent to Prepare an Environmental Impact Statement for the Proposed Gulf XPress Project, Request for Comments on Environmental Issues, and Notice of Public Scoping Meeting*. This notice was published in the FR on June 9, 2016, and mailed to more than 960 interested parties, including federal, state, and local government representatives and agencies; elected officials; environmental and public interest groups; Native American tribes; affected property owners; other interested parties; and local libraries and newspapers. The notice established a July 5, 2016, closing date for a public comment period for the submission of comments, concerns, and issues related to the environmental aspects of the GXP. On June 21, 2016, we held a public scoping meeting in Antioch, Tennessee in close proximity to the proposed Cane Ridge Compressor Station. The scoping meeting provided an opportunity for the public to learn more about the proposed GXP and to provide comments on environmental issues to be addressed in the EIS. The transcripts of the public scoping meetings and all written comments are part of FERC's public record for each project and are available for viewing in the Commission's eLibrary at www.ferc.gov using the appropriate docket number.

We issued a *Notice of Availability of the Draft Environmental Impact Statement for the Proposed Mountaineer XPress and Gulf XPress Projects* on February 27, 2017. The draft EIS was sent to all parties on our environmental mailing list. The draft EIS was filed with the EPA and a formal notice of availability was issued in the Federal Register, which established a 45-day comment period on the draft EIS that ended on April 24, 2017. We held five public comment sessions for the draft EIS in West Virginia and Tennessee between March 20 – 28, 2017.

In response to our notice and at our comment sessions, we received over 100 comments from landowners, public officials, non-government organizations, and government agencies regarding the projects. Each comment, along with our response, is provided in appendix Q and discussed, if applicable, in the corresponding EIS resource text.

PROJECT IMPACTS AND MITIGATION

In chapter 3 of the EIS, we summarize the evaluation of alternatives to the projects, including the no-action alternative, system alternatives, major pipeline route alternatives, minor pipeline route variations, and GXP compressor station site alternatives for the Cane Ridge facility. In chapter 4, we evaluate the potential impacts of construction and operation of the projects on geology; soils; water resources; wetlands; vegetation; wildlife and wildlife habitat; threatened, endangered, and other special status species; land use, special interest areas, and visual resources;

socioeconomics; cultural resources; air quality and noise; reliability and safety; and cumulative impacts. Where necessary, we recommend additional mitigation measures to minimize or avoid these impacts. Chapter 5 of the EIS presents our conclusions and a compilation of our recommended mitigation measures.

Geology

The MXP and GXP effects to geology would be highly localized and limited primarily to the period of construction.

For the MXP, these potential impacts would occur in areas of shallow bedrock, where blasting may be required, or where construction occurs on steep slopes that would be highly susceptible to landslides. Construction on steep slopes would require contouring of the slope for safe construction practices and to accommodate heavy equipment. Columbia Gas would implement permanent drainage controls on steep slopes, or other landslide-prone areas, to help stabilize the construction work areas. Columbia Gas would also implement its Blasting Plan and Environmental Construction Standards (ECS) to minimize the potential impacts from construction on steep slopes and blasting. Overall, impacts from the construction and operation of the MXP on topography and existing geological conditions is anticipated to be minor and temporary.

The GXP impacts on geology would occur in areas of karst terrain or areas with shallow bedrock where blasting may be required. Where karst terrain may be a potential hazard, Columbia Gulf would construct foundations that are supported by competent bedrock to mitigate the risk of foundation disturbance due to seismic activity or sinkhole development. To minimize the potential impacts from blasting, Columbia Gulf would implement its ECS and Blasting Plan. Overall, impacts on topography and existing geological conditions from the construction and operation of the GXP are anticipated to be minor and temporary. To further reduce impacts on steep slopes, we recommend that Columbia Gas prepare both a Phase II Landslide Hazard Assessment and a Landslide Mitigation Plan.

Soils

Construction activities such as clearing, grading, trenching, backfilling, and movement of heavy construction equipment would cause direct impacts on soil resources in the MXP and GXP work areas. Direct impacts could include erosion, compaction, rutting, and reduction of soil quality by mixing topsoil with subsoil or bringing excess rocks to the surface. These soil impacts could also slow the revegetation process in the disturbed areas and disrupt surface and subsurface drainage systems.

The construction of MXP aboveground facilities would result in approximately 41 acres of permanent impacts on soils. Columbia Gas would use areas within existing fenced facilities or previously disturbed areas adjacent to the facilities for the majority of the modifications and upgrades. Most of the soil impacts at existing aboveground facilities are expected to be minor and temporary. Approximately 30 acres of soil at the Sherwood, White Oak, and Mount Olive Compressor Stations would be permanently converted from agricultural, forest, and open land use to developed uses, including permanent access roads. Permanent access roads are necessary to safely operate and maintain the MXP facilities.

Preparation of the 40 MXP contractor yards would consist of minor grading and leveling. Once construction is complete, these temporary facilities would be restored to pre-construction conditions or in accordance with landowner agreements. Soil impacts are expected to be minor and temporary due to the minor grading activities to level the areas. Unless specified in landowner agreements, any area where aggregate is placed over geotextile fabric (e.g., roadway aprons) would be returned to its original condition during cleanup activities, and all materials would be removed.

For the GXP, construction of aboveground facilities and the associated permanent access roads would result in approximately 82 acres of permanent impacts on soils. Permanent access roads are necessary for the safe operation of the GXP facilities.

The degree to which soils would be directly affected by construction and operation of GXP facilities would vary depending on the nature of the activities and whether the soils are located in designated temporary workspaces (TWS) or the operational footprint of GXP facilities. The subsurface profile of soils overlain by permanent facilities may be altered by the addition of surface fill material to increase ground elevation, addition of aggregate to provide a suitable foundation surface, or mixing with a stabilizer to increase strength and cohesion. Deep excavations and drillings, including those required for pile installation, could disrupt soil profiles. In TWS areas, soil profiles may remain undisturbed beneath an aggregate overlay.

To minimize impacts on soils during the construction of GXP facilities, Columbia Gulf would implement mitigation and would follow the best management practices (BMPs) identified in the GXP ECS. After construction is complete, the TWS would be returned to pre-construction conditions or in accordance with landowner agreements. Soil impacts are expected to be minor and temporary within the TWS due to the minor grading activities performed to level work areas. There would also be placement of geotextile fabric followed by gravel, all of which would be removed upon completion of construction on the GXP facilities.

During MXP and GXP operation, minimal impacts on soil resources are expected beyond occasional ground inspections of the pipeline rights-of-way and the areas occupied by aboveground facilities. Any impacts on soil resources associated with standard operations would be minor and infrequent. Potential impacts from maintenance of the MXP and GXP would include soil displacement, compaction, and erosion caused by machinery necessary to maintain or repair any portions of the pipelines or aboveground facilities. Impacts would be avoided or minimized by implementation of each ECS, as applicable to operation.

Water Resources

Two primary activities could result in adverse impacts on groundwater resources: accidental spills of hazardous liquids used during facility construction or operations, and blasting to fracture rock in the pipeline trench or for construction of aboveground facility foundations. Secondary activities (work area clearing and grading, trenching, and trench dewatering) typically result in temporary and localized impact.

Columbia Gas would use standard industry practices for construction of the MXP facilities. Clearing, grading, trenching, dewatering, and blasting activities associated with pipeline, compressor, regulator, and tie-in facilities construction could each temporarily alter overland flow

and groundwater recharge or could result in minor fluctuations in groundwater levels and/or increased turbidity. Excavation associated with compressor facilities would be fewer than 6 feet deep, and pipeline trench depths would be typically less than 10 feet. While these activities may encounter surficial groundwaters (i.e., the "water table"), the pipeline would not be expected to substantially alter the flow or quality of shallow subsurface water. Further, construction would occur well above the depth of regional aquifers. In addition, near-surface soil compaction caused by heavy construction vehicles could reduce the soil's ability to absorb water. Columbia Gas would implement measures from both its ECS and Spill Prevention, Control, and Countermeasure (SPCC) Plan to limit potential impacts on groundwater. For these reasons, we do not expect the construction of the MXP to substantially impact groundwater resources.

Columbia Gas has agreed to offer pre- and post-construction monitoring for well yield and water quality for private wells within 150 feet of the proposed construction workspace. If testing results indicate any significant differences in water quality between initial testing and post-construction as a result of MXP construction activities, Columbia Gas would compensate the landowner for repairs, installation of a new well, or other options as agreed upon with the landowner. Columbia Gas would implement a landowner complaint resolution process to document and track landowner problems and their resolution.

For the GXP, construction activities also are not likely to impact groundwater resources because construction would involve shallow, temporary, and localized excavation. Temporary erosion and sediment control measures would be installed following initial ground disturbance in accordance with Columbia Gulf's ECS to minimize erosion during trenching operations and construction activities.

After construction is completed, both Columbia Gas and Columbia Gulf (the Companies) would grade construction work areas to match pre-construction contours and drainage patterns. All areas disturbed by construction would be restored to their original contours, as practicable, and revegetated (if not within areas covered by buildings, concrete, asphalt, or aggregate), including topsoil replacement (where applicable) in accordance with the relevant ECS or landowner agreements. Permanent erosion control measures would be installed in accordance with each Companies' ECS. Vegetation restoration and periodic mowing of the pipeline right-of-way would help to control overland flow and restore groundwater recharge.

The greatest threat posed to groundwater resources would be a hazardous material spill or leak into groundwater supplies. We have reviewed both Companies' ECS and SPCC Plans and conclude that they adequately address strategies and methods to prevent or limit such contamination should a spill occur. We do not anticipate any significant, long-term impacts on aquifers or groundwater supplies from construction or operation of the projects given the relatively shallow excavation depths required for construction.

No long-term impacts on surface water quality or quantity are anticipated as a result of the MXP. Columbia Gas would not significantly or permanently affect any designated water uses; it would bury the pipeline beneath the bed of all waterbodies, implement erosion controls, and restore the streambanks and streambed contours as close as practical to pre-construction conditions. Virtually all flowing streams (including those containing sensitive mussel species) would be crossed using a dry crossing method. This would largely avoid or limit impacts on water quality

and aquatic species, even when crossing waterbodies identified as impaired. Columbia Gas also would revegetate disturbed areas, and implement the measures contained in its ECS and SPCC Plan to avoid contamination from spills of fuels and other hazardous materials. Further, Columbia Gas' waterbody crossing restoration procedures, described in its ECS, have been reviewed and approved by the WVDEP. Columbia Gas has provided proposed hydrostatic test water withdrawal mitigation measures to protect downstream flow and instream habitat. Operation of the MXP would not impact surface waters, unless maintenance activities involving pipe excavation and repair in or near streams are required in the future. If maintenance activities were required, Columbia Gas would employ protective measures similar to those proposed for use during construction.

Only minor impacts on ephemeral channels and impoundments/stocked ponds are anticipated as a result of the construction and operation of the new GXP compressor stations. Through consultation with the USACE, Columbia Gulf would determine the jurisdictional status of water features at its compressor station sites, and would avoid or mitigate impacts as required by permit conditions. Columbia Gulf would implement BMPs, as specified in its ECS, and would revegetate temporary work areas not encumbered by permanent facilities after construction. During GXP station operations, very limited volumes of fuels, lubricants, and other hazardous materials would be present. Preventive measures outlined in Columbia Gulf's ECS and SPCC Plan would be implemented and would be adequate to reduce this concern to less-than-significant levels. During maintenance activities, Columbia Gulf would employ protective measures similar to those proposed for use during construction.

Wetlands

The MXP would result in temporary and permanent impacts on wetlands. Construction of the MXP would temporarily affect about 7.5 acres of wetlands. The majority of MXP construction impacts are to palustrine emergent wetlands (almost 7 acres), which would recover quickly following right-of-way restoration (typically within 1 to 3 years). No permanent impacts are anticipated on palustrine emergent wetlands within the pipeline easement. Long-term temporary and permanent impacts would occur within palustrine scrub-shrub wetlands (about 0.3 acre) and palustrine forested wetlands (about 0.6 acre). Trees in forested wetlands would be removed from the permanent right-of-way. Columbia Gas would maintain a 10-foot-wide corridor in palustrine forested wetlands, with selective removal of trees within 15 feet of the pipeline, resulting in only 0.2 acre of permanent impacts on palustrine forested wetlands for the MXP. The 0.2 acre would, however, convert to palustrine emergent or scrub-shrub wetlands and not result in a loss of wetlands. Less than 0.1 acre of palustrine emergent wetlands would be permanently altered at the White Oak Compressor Station site.

Columbia Gas would mitigate for unavoidable wetland impacts by implementing the procedures specified in its ECS, and by complying with the conditions of its pending section 404 and 401 permits. In accordance with a MXP-specific wetland restoration plan and its ECS, Columbia Gas would conduct routine wetland monitoring for a minimum of 3 years (or until revegetation is deemed successful). Where revegetation is not successful at the end of 3 years, Columbia Gas would develop and implement remedial revegetation plans, in consultation with a professional wetland ecologist, to actively revegetate any wetland and continue revegetation

efforts. Conversion of palustrine forested and palustrine scrub-shrub wetlands would require a USACE-approved form of mitigation that satisfies the requirements of the CWA.

About 0.12 acre of wetland impacts from the construction and operation of the GXP would occur, including one wetland at the Leach C Meter Station, one wetland at the Morehead Compressor Station, and three wetlands at the New Albany Compressor Station. We expect that wetland impacts would be considered by the USACE under its Nationwide Permit Program; if so, compensatory mitigation would not be required.

Based on the types and amounts of wetlands that would be impacted and the Companies' measures to avoid, minimize, and mitigate wetland impacts (as described in their construction and restoration plans) as well as compliance with USACE section 404 and state permit requirements, we conclude that impacts on wetlands would be effectively minimized or mitigated.

Vegetation

Construction of the MXP would impact about 3,397[2] acres of vegetated lands, including about 2,400 acres of forest and about 674 acres of agricultural land. The primary impact from project construction and operation would be on forested lands. Due to the prevalence of forested habitats within the project area, the ability to co-locate the MXP pipeline adjacent to existing rights-of-way, and eventual regrowth of prior forested areas outside of the permanent right-of-way, some forest impacts would be mitigated; however, we conclude that the permanent conversion of upland forested lands would result in a significant impact. Columbia Gas would minimize forested impacts by co-locating the proposed workspace with other existing rights-of-way in certain areas (approximately 22 percent of the proposed alignment) to reduce the amount of additional clearing required. Impacts on forested and non-forested vegetation types would be further mitigated through adherence to the measures described in Columbia Gas' ECS.

Interior forest impacts were assessed by identifying Core Forest Areas based on the acreage of contiguous habitat. MXP construction would result in about 1,311 acres of Core Forest Areas impact. Permanent impacts on Core Forest Areas, for operation of facilities, would total about 490 acres. Interior forest tracts would not be affected by GXP construction and operation. We recommend that Columbia Gas consult with the WVDNR to identify further mitigation measures to reduce impacts to forested areas.

The removal of existing vegetation and disturbance of soils during MXP construction would create conditions conducive to the spread and establishment of noxious and invasive weeds, particularly where new corridors are established in previously vegetated areas. The risk of invasive species introduction decreases once revegetation of native species is successful; although mowing during project operation could introduce invasive species. To limit the potential spread of invasive species, we recommend that Columbia Gas develop a noxious and invasive weed management plan in consultation with appropriate agencies. This plan would identify

[2] Total acres of vegetation impacted by MXP represents total project impacts minus developed land and open water impacts.

locations where invasive species are present and would require Columbia Gas to develop appropriate treatment options for each location.

Construction of the GXP would result in impacts on about 184[3] acres of vegetated lands, including about 149 acres of agricultural land, 22 acres of upland forested land, and 13 acres of open land. The primary impact from construction and operation would be on agricultural lands. Impacts would be mitigated through adherence to the measures described in Columbia Gulf's ECS.

Columbia Gulf would minimize vegetation removal to the extent necessary to construct the project, and either burn, chip, or haul cleared vegetation to a commercial disposal facility. Additionally, Columbia Gulf would implement the measures in its ECS (e.g., temporary and permanent seeding, mulch application, erosion control blanket installation), which would promote the establishment of desirable plant species and deter the spread of unwanted plant species. Based on these measures, we conclude that the potential spread of noxious or invasive weeds would be avoided or effectively mitigated.

Wildlife

The MXP and GXP could have both direct and indirect impacts on wildlife species and their habitats, including the displacement of wildlife, potential individual mortality, and reduction in habitat. Forest fragmentation would increase in certain locations due to clearing, thus reducing the amount of habitat available for interior forest species (i.e., movement and dispersal corridors). The effect to species that rely on open land habitats would be short-term, and vegetation in these areas would likely recover within 1 to 3 years after construction. Cleared scrub-shrub vegetation would likely require several years to regain its woody composition; however, we expect species that rely on shrub or edge habitats to move into the abundant similar habitat available in the project area. Species that rely on forested lands, which could take decades to return to pre-construction condition, would also move into nearby available forested habitat. This would not result in a significant impact for general wildlife, but could have greater impacts on species that rely on undisturbed interior forest.

A variety of migratory bird species are associated with habitats that would be affected by the MXP. Columbia Gas has consulted with the U.S. Fish and Wildlife Service (USFWS) and WVDNR to take appropriate steps, such as implementation of the ECS and timing restrictions on clearing, to avoid and minimize the potential for the unintentional take of migratory birds during construction and operation. Columbia Gas would attempt to complete vegetation clearing in forested areas before the nesting season begins in April; however, limited vegetation clearing activities may continue into May, with some risk of affecting active nests of migratory birds.

The West Virginia *2015 State Wildlife Action Plan* identifies certain migratory bird species that should be the focus of conservation efforts. Species that are determined to have the greatest need for conservation efforts in the state are assigned Priority 1 status. Eight Priority 1 bird species were noted as being observed in the MXP area. The cerulean warbler was specifically identified as a Priority 1 species of special concern in the MXP area due to its need for undisturbed,

[3] Total acres of vegetation impacted by GXP represents total project impacts minus residential, developed, and open water land use types.

unfragmented interior forest habitat. We conclude that MXP impacts on cerulean warbler habitat would be significant, although we do not expect any adverse impacts on individual warblers or their nests. The measures proposed by Columbia Gas in addition to the implementation of a Migratory Bird Plan (prepared in cooperation with USFWS and WVDNR) could help reduce impacts on migratory birds. We recommend that Columbia Gas continue to consult with the WVDNR and USFWS to further reduce impacts, particularly on the large Core Forest Areas preferred by the cerulean warbler.

For the GXP, Columbia Gulf would implement tree-clearing timing restrictions that would protect migratory birds and habitat as well as protected bat species. No bald eagle nests or eagles were identified during site surveys in the vicinity of the GXP compressor station sites in Kentucky, Tennessee, and Mississippi. Based on the results of biological field surveys conducted by Columbia Gulf and agency consultations, we conclude that construction and operation of the GXP would be in compliance with National Bald Eagle Management Guidelines and would not affect the bald eagle.

The MXP and GXP would cross freshwater waterbodies, including perennial, intermittent, and ephemeral streams. The MXP and GXP would result in minor impacts on aquatic resources, but these impacts would be adequately mitigated through adherence to the measures described in the Companies' ECS, timing of construction activities, implementation of instream blasting plans, as well as the conditions and requirements of water resource agencies with jurisdiction over resources affected by the projects.

Overall, general wildlife resources would not be significantly impacted due to construction and operation of MXP and GXP aboveground facilities based on the small amount of habitat disturbed, the criteria considered when siting the compressor stations, the amount of similar adjacent habitat available for use, and the proposed clearing windows for avoidance of the migratory bird nesting season. In addition, the Companies would minimize impacts to the extent possible through adherence to their respective ECSs and in consideration of any recommendations provided by wildlife management agencies. Based on the presence of suitable adjacent habitat available for use and given the impact avoidance, minimization, and mitigation measures proposed by the Companies, as well as our recommendations, we conclude that the construction and operation of the MXP and GXP would not have a significant adverse effect to most wildlife and aquatic species.

Threatened, Endangered, and Other Special Status Species

To comply with section 7 of the Endangered Species Act of 1973 (ESA), we consulted either directly or indirectly with the USFWS and state resource agencies regarding the presence of federally listed, proposed for listing, or state-listed species in the MXP and GXP areas. Based on these consultations, we identified 13 federally listed or proposed species as potentially occurring in the MXP area and 31 federally listed or proposed species as potentially occurring in the GXP area.

The MXP could potentially affect special status bats and special status mussel species. We determined that suitable habitat for the Indiana bat and the northern long-eared bat is present within all counties affected by the MXP. In those areas covered by the USFWS-approved Multi-Species Habitat Conservation Plan (MSHCP), Columbia Gas would implement the applicable Avoidance

and Minimization Measures (AMM) for these species, including prohibiting clearing activities during certain times of year to protect maternity colonies. In non-covered MSHCP lands, Columbia Gas would submit survey information to the USFWS, which would work with Columbia Gas to address any species-specific issues and develop AMMs for federally protected species occurring on non-MSHCP lands. No known roosting habitat for the Virginia big-eared bat is within 6 miles of the project area, and no AMMs for this species would be required.

To avoid disturbance of the diamond darter population known to exist in the Elk River, Columbia Gas would not perform instream work at the Elk River Compressor Station site. No direct impacts are anticipated on this species, and applicable AMMs for this species (as identified in the MSHCP) would be implemented by Columbia Gas. For any activity within 100 feet of the Elk River with potential effects, Columbia Gas would include special procedures within its Environmental Management and Construction Plan. Based on these measures and the fact that the project would not directly impact the Elk River, we concluded that the project impacts are *not likely to adversely affect* the diamond darter. The USFWS has concurred with this determination.

With USFWS and WVDNR approval, Columbia Gas conducted initial surveys for protected mussel species in 2015 and 2016. In consultation with the USFWS and WVDNR, Columbia Gas is performing additional surveys in 2017. If presence is identified during surveys, Columbia Gas and the USFWS will determine the appropriate AMMs to be implemented outside of MSHCP-covered lands. It is anticipated that the AMMs for mussels located outside of MSHCP lands would be consistent with the requirements of the MSHCP. Columbia Gas anticipates completing the remaining mussel surveys in summer 2017. To ensure compliance with the ESA, we recommend that Columbia Gas file updated information on consultation with the USFWS regarding stream crossing locations and construction methodologies where federally protected mussels may be present.

For GXP facilities in Kentucky, the existing Leach C Meter and Grayson Compressor Stations, and the Morehead, Paint Lick, and Goodluck Compressor Station sites occur in counties with the potential for gray bats, Indiana bats, and the northern long-eared bat. Virginia big-eared bats potentially could occur in the vicinity of the existing Grayson and proposed Morehead compressor stations. General biological surveys conducted in June 2015 at the project sites identified suitable habitat for Indiana bats and the northern long-eared bat. No hibernacula or roost caves were identified for the gray bat at any of the project locations. No suitable habitat was identified at project locations for the Virginia big-eared bat and federally listed mussels (northern riffleshell, pink mucket, running buffalo clover, or Short's bladderpod). No instream work is proposed for any of the GXP sites in Kentucky, and Columbia Gulf would implement all required and non-mandatory mitigation measures. In addition, to minimize indirect impacts on streams in the vicinity of the project, Columbia Gulf would implement measures in its ECS, which meet BMPs for erosion and sediment control in Kentucky. In correspondences dated February 16 and May 24, 2016, the USFWS Kentucky Ecological Services Field Office concurred that the project is consistent with the MSHCP, and the requirements of section 7 of the ESA have been fulfilled for the project. The federally endangered snuffbox, however, was not included in Columbia Gulf's November 25, 2015 project-specific request for concurrence from the USFWS Kentucky Ecological Services Field Office, nor was this species referenced in the February 16, 2016 response from USFWS, in which it provided effect determinations for federally listed species. We have independently assessed the habitat needs for this mussel species along with the habitat in and

around the proposed Grayson Compressor Station, and conclude that required habitat for the snuffbox is not present. Accordingly, we conclude that the GXP would have no effect on the snuffbox mussel. In correspondence dated April 24, 2017, the USFWS concurred with our determination of no effect for the snuffbox mussel.

For GXP facilities in Tennessee, project sites occur in counties with the potential for gray bats, Indiana bats, and the northern long-eared bat. General biological surveys conducted in June 2015 at the project sites identified suitable habitat for Indiana bats and the northern long-eared. There is no winter habitat at either compressor station site in Tennessee, and the project is not within any known swarming habitat buffers around a hibernaculum. No hibernacula or roost caves were identified for the gray bat at either of the project sites in Tennessee.

We received comments from the public regarding the potential for the Nashville crayfish to occur in the vicinity of the Cane Ridge Compressor Station. In a letter response to Columbia Gulf dated February 15, 2016, the USFWS Ecological Services Tennessee Field Office stated that project activities are consistent with the USFWS-approved MSHCP and the resulting programmatic Section 7 consultation. The USFWS stated that it does not anticipate the Nashville crayfish to be present at the Cane Ridge Compressor Station site; however, due to the proximity of the site to Mill Creek where there are known occurrences, the USFWS recommends that strict sediment and contaminant runoff prevention measures should be in place during construction and operation of the facility. The USFWS concurred that mitigation measures required in the MSHCP are sufficient for covering potential impacts on the Nashville crayfish, Indiana bat, and northern long-eared bat. Additionally, the USFWS concurred that the project facilities in Tennessee would have no adverse impacts on the Baker Station cave beetle, gray bat, Price's potato bean, spotfin chub, rare freshwater mussels, or bald eagle and migratory birds.

For GXP facilities in Mississippi, in a letter to Columbia Gulf dated June 18, 2015, the USFWS Ecological Services Mississippi Field Office indicated that the Indiana bat, northern long-eared bat, and Price's potato bean could occur in project vicinities in Mississippi. General biological surveys conducted in June 2015 at the project sites identified suitable summer habitat for the northern long-eared bat at both compressor station sites. There is no winter habitat at either of the sites for this species, and no known hibernacula in counties where the project is located. Suitable habitat for Price's potato bean was not identified at either of the project sites. Project activities would be consistent with the MSHCP, and Columbia Gulf would implement the mitigation measures required in the MSHCP for the northern long-eared bat and Indiana bat. A letter dated December 9, 2015, from USFWS Ecological Services Mississippi Field Office provided concurrence with Columbia Gulf's findings and determined that no further consultation would be required.

Although a number of other candidate, state-listed, or special concern species were identified as potentially present in the GXP areas, none were detected during surveys, and we do not expect any adverse effects given Columbia Gulf's proposed measures and our recommendations. Based on implementation of these measures, communications with state agencies, and our recommendations, we conclude that impacts on special-status species would be adequately avoided or minimized during construction and operation of the GXP.

Land Use, Special Interest Areas, and Visual Resources

Land use-related impacts associated with the MXP would include the disturbance of existing uses within the rights-of-way during construction and maintenance of new permanent rights-of-way for operation of the pipelines. Additional land would be disturbed by construction of the aboveground facilities, and land within the facility footprints would be permanently retained for operation. The primary land use types impacted would be forested, agricultural land, and open lands. In forested areas, trees and shrubs would be removed from the construction work areas, and the maintained portion of the rights-of-way would be permanently converted to a non-forested condition. Impacts on agricultural lands would be short-term and limited to the growing season concurrent with construction. Following construction, agricultural practices within the pipeline rights-of-way would be allowed to resume. Impacts on open land areas would be temporary and short-term, and would be minimized by the implementation of Columbia Gas' ECS. Open land areas within the temporary and permanent rights-of-way are expected to revert to their pre-construction land use after completion of construction. However, some activities, such as the building of new commercial or residential structures, would be prohibited on the permanent rights-of-way.

Columbia Gas' proposed construction work areas would be located within 50 feet of 49 houses. To address impacts on residences, Columbia Gas developed site-specific construction plans for each of the residences. These plans identify the mitigation measures to be implemented by Columbia Gas to promote safe and efficient installation of the pipelines with minimal impacts on landowners. If any damages to residential property result from construction, Columbia Gas would repair the damaged property or provide appropriate compensation to the landowner.

In general, MXP impacts on recreational and special interest areas would be temporary and limited to the period of active construction. These impacts would be minimized by implementation of Columbia Gas' ECS.

The primary visual effects of constructing the MXP facilities would include the removal of existing vegetation and the storage of machinery and tools. After construction, disturbed areas would be revegetated in accordance with Columbia Gas' ECS. There would be a permanent change in the visual appearance to forested lands within the permanent easement, because they would be maintained in an herbaceous state for pipeline surveillance and operations purposes. The new aboveground structures would result in a permanent visual impact throughout the operational life of the project. The impacts on visual resources from each individual facility would depend on the pre-construction condition and the visibility from the surrounding area.

Land use-related impacts associated with the GXP would include temporary and permanent disturbance at new and existing aboveground facilities. Once construction is complete, land within the facility footprints would be permanently retained for operation. The primary land use types impacted during construction would be agricultural, forested, and open land. Areas used for TWS at each facility would be restored and maintained as open land or allowed to revert to pre-construction land use cover. No permanent impacts would occur as a result of the modifications at the existing stations, as the facility footprints would not be expanded. There are no houses located within 50 feet of either the temporary or permanent workspace of any of the facilities.

GXP facilities would be constructed within 0.25 mile of two publicly owned lands, the Daniel Boone National Forest and the Malmaison Wildlife Management Area. The Morehead Compressor Station would not affect the recreational use or experience of the Daniel Boone National Forest. The Holcomb Compressor Station could result in temporary and permanent visual impacts on the Malmaison Wildlife Management Area; however, the presence of forested areas between the compressor station site and the wildlife management area would provide visual screening.

The new aboveground facilities would result in a permanent visual impact throughout the operational life of the MXP and GXP. The Companies have designed aboveground facilities to preserve existing tree buffers within purchased parcels to the extent practicable. To further mitigate visual impacts, the Companies would install perimeter fences and directionally controlled lighting.

Socioeconomics

Construction of the MXP and GXP would temporarily increase the population in the general vicinity of the project. No significant impacts on the local housing markets are expected from this temporary population increase. Existing public services are adequate to meet the anticipated needs of the construction and operational workforce for the MXP and GXP.

Staging and delivery of construction personnel, equipment, and materials to project sites may temporarily impact the transportation system in the project area, but no long-term impacts are anticipated. The Companies would implement appropriate measures and notifications to minimize these impacts on residents or businesses along these local roads. Further, we recommend that Columbia Gas prepare a final traffic management plan to address measures for implementing detours on public roadways, timing shifts and worker commutes to avoid heavy traffic periods, and measure to restore roadways damaged during project-related activities.

Columbia Gas would compensate landowners for the acquisition of new property for aboveground facilities and for easements, including compensation for construction-related damages and for damages associated with residential properties, crops, pasture, and timber. Construction of the MXP and GXP would result in minor beneficial socioeconomic impacts due to increases in construction jobs, payroll taxes, purchases made by the workforce, and expenses associated with the acquisition of material goods and equipment. Operation of the MXP and GXP would have a minor to moderate positive effect to the local governments' tax revenues due to the increase in property taxes that would be collected from Columbia Gas and Columbia Gulf.

Construction and operation of the MXP and GXP would not cause impacts that are expected to adversely affect the health or welfare of the population living in the project areas. The MXP and GXP would not cause disproportionately high and adverse environmental or socioeconomic effects to any minority or low-income populations.

Overall, we conclude that the MXP and GXP would not have a significant adverse effect to the socioeconomic conditions of the MXP and GXP areas.

Cultural Resources

Columbia Gas completed cultural resources surveys for all the accessible project areas. To date, of 56 archaeological sites identified, only 1 is eligible for the National Register of Historic Places (NRHP). Columbia Gas would avoid this site. Of 188 architectural resources and 4 cemeteries identified, 1 is listed on the NRHP. Columbia Gas recommended 6 resources as eligible for the NRHP and 2 as "contributing." The remaining are recommended as not eligible for the NRHP. Columbia Gas has recommended that the project would have no adverse effect to the listed property. The State Historic Preservation Office (SHPO) has not yet concurred with Columbia Gas' recommendations; therefore, compliance with section 106 of the National Historic Preservation Act is not complete. Once cultural resources surveys and evaluations are complete, a treatment plan would be prepared if any historic properties would be adversely affected by the MXP.

Columbia Gulf has completed cultural resources surveys for the GXP and did not document any historic (NRHP-eligible or listed) properties. The FERC and SHPOs agree for Tennessee, Mississippi, and Kentucky.

Air Quality and Noise

Air quality impacts associated with construction of the MXP and GXP would include short-term construction impacts and long-term operational impacts from aboveground facilities.

Pipeline construction activities move through an area relatively quickly, and therefore construction emissions associated with the MXP pipeline would be intermittent and short-term. Similarly, emissions from the construction of the new and modified compressor stations would be intermittent and short-term. Particulate emissions would be spread over a relatively large area, and the dust control measures described in Columbia Gas' Fugitive Dust Control Plan would help decrease these emissions. Once construction activities in an area are completed, fugitive dust and construction equipment emissions would subside, and the impact on air quality due to construction would go away completely. Further, construction emissions are not estimated to exceed the General Conformity thresholds in areas of degraded air quality. Therefore, we conclude that the MXP's construction-related impacts would not result in a significant impact on local or regional air quality.

Emissions generated during operation of the pipeline portion of the MXP would be minimal, limited to those from maintenance vehicles and equipment, and fugitive emissions. Columbia Gas submitted applications for construction and operation of each compressor station to the West Virginia Department of Environmental Protection. All new compressor stations associated with the MXP would require Title V permits for operation. The existing compressor stations would be required to update their Title V permits to include any changes. The White Oak, Lone Oak, Mount Olive, Elk River, and Sherwood Compressor Stations would be minor sources with respect to New Source Review and would not be subject to Prevention of Significant Deterioration (PSD) permitting. The Ceredo Compressor Station is a PSD major source, but the changes proposed at this station are below the significant emission rate thresholds. All combustion turbines would use SoLoNOx technology to reduce nitrogen oxide emissions. The emergency engines would meet all New Source Performance Standard JJJJ emission limits. Minimization of

other pollutant emissions would be achieved with the use of natural gas fuel. Modeled impacts at the MXP compressor stations were all below applicable National Ambient Air Quality Standard standards. As with pipeline operations, any emissions resulting from operation of MXP's compressor stations would not have significant impacts on local or regional air quality. Increases in emissions during the operating phase of the MXP would be minimal and would not have significant impacts on local or regional air quality.

For the GXP, Columbia Gulf submitted applications for the construction and operation of each compressor station to the appropriate state agencies. All compressor stations associated with the GXP would require Title V permits for operation. The GXP compressor stations would also be minor sources with respect to New Source Review and would not be subject to PSD permitting. All combustion turbines would use the SoLoNOx technology to reduce nitrogen oxide emissions. The emergency engines would meet all New Source Performance Standard JJJJ emission limits. Minimization of other pollutant emissions would be achieved with the use of natural gas fuel. Modeled impacts from the GXP compressor stations were all below applicable standards. Emissions resulting from operation of GXP's compressor stations would not have significant impacts on local or regional air quality.

Regarding noise, noise would be generated during construction of the MXP pipelines and MXP and GXP aboveground facilities.

For MXP construction, noise-sensitive areas (NSAs) near the construction areas may experience an increase in perceptible noise, but the effect would be temporary and local. Noise mitigation measures during construction would include the use of sound-muffling devices on engines and the installation of barriers between construction activity and NSAs. Generally, nighttime noise would not increase during construction, except for horizontal directional drill (HDD) activity. Proposed mitigation would reduce noise levels from HDD activity. Based on modeled noise levels, mitigation measures proposed, our recommendation regarding noise from HDDs, and the temporary nature of construction, we conclude that the MXP would not result in significant noise impacts on residents and the surrounding communities during construction with one exception. The HDD entry point location activities associated with the Kanawha River Crossing at NSA #1 requires additional mitigation measures to reduce the noise impacts at NSA #1. Alternatively, to mitigate noise impact on this NSA, Columbia Gas has indicated it may offer compensation or the option of temporary relocation during nighttime HDD activities. However, because drilling operations may require more than 1 week to complete, we recommend that Columbia Gas prepare a drilling noise mitigation plan to reduce the projected noise level.

Noise impacts also would result from operation of the MXP. Based on the analyses conducted, mitigation measures proposed, and our recommendations, we conclude that operation of MXP would not result in significant noise impacts on residents and the surrounding communities. Operation of the Columbia Gas' compressor and regulator stations would not exceed thresholds, except for the existing Ceredo Station; however, the proposed modifications to the Ceredo Station would result in a reduction of noise levels at the NSAs. Noise from planned or unplanned blowdown events could exceed the noise criteria but would be infrequent and of relatively short duration.

Construction equipment for the GXP would be operated on an as-needed basis. NSAs near the GXP construction areas may experience an increase in perceptible noise, but the effect would be temporary and local. Noise mitigation measures during construction would include the use of sound-muffling devices on engines and the installation of barriers between construction activity and NSAs. Generally, nighttime noise would not increase during construction. The GXP does not have any planned HDD drilling operations. Based on modeled noise levels, mitigation measures proposed, and the temporary nature of construction, we conclude that the GXP would not result in significant noise impacts on residents and the surrounding communities during construction.

Operation of the Columbia Gulf's GXP compressor and meter stations would not exceed our noise criterion, and we recommend noise surveys for these stations to ensure this conclusion. Noise from planned or unplanned blowdown events could exceed the noise criteria but would be infrequent and of relative short duration. We performed additional CadnaA noise modeling in response to comments submitted from residents in areas surrounding the proposed site of the Cane Ridge Compressor Station. The modeling, which also considered surrounding topography, resulted in lower anticipated noise levels than what was predicted by Columbia Gulf.

Based on modeled noise levels, mitigation measures proposed, our recommendations, and the temporary nature of construction, we conclude that construction and operation of the MXP and GXP would not result in significant noise impacts on residents or the surrounding communities.

Reliability and Safety

The MXP pipelines and MXP and GXP aboveground facilities would be designed, constructed, operated, and maintained to meet U.S. Department of Transportation Minimum Federal Safety Standards in title 49 of the Code of Federal Regulations, Part 192 (49 CFR 192) and other applicable federal and state regulations. These regulations include specifications for material selection and qualification; minimum design requirements; and protection from internal, external, and atmospheric corrosion. Each compressor station would be enclosed within a chain-linked fence and equipped with security cameras, an alarm system, ventilating equipment, automatic shutdown systems, and relief valves.

Safety standards specified in 49 CFR 192 also require that each operator establish and maintain liaison with appropriate fire, law enforcement, and public officials to learn the resources and responsibilities of each organization that may respond to a natural gas pipeline emergency, and to coordinate mutual assistance in responding to emergencies. The operator must also establish a continuing education program to enable customers, the public, government officials, and those engaged in excavation activities to recognize a gas pipeline emergency and report it to appropriate public officials. Columbia Gas would utilize the emergency procedures contained in its *Emergency Operating Procedures Manual*, which requires communication with emergency responders on an annual basis. Local contact phone numbers, external contact information, equipment or resources available for mobilization, and any specific procedures to be followed for the MXP would be incorporated into the *Emergency Operating Procedures Manual* prior to commencement of pipeline operations.

Based on the Companies' compliance with federal design and safety standards and their implementation of safety measures, we conclude that constructing and operating the MXP and GXP facilities would not significantly impact public safety.

Cumulative Impacts

We analyzed past, present, and reasonably foreseeable projects or actions that occur within the same geographic scope as the MXP or GXP and whose construction, operation, and/or restoration will take place within all or part of the temporal scope of the MXP or GXP. The MXP or GXP, combined with one or more of these other projects, could contribute to a cumulative impact on resources that would be affected by the construction and/or operation of the MXP and GXP. These projects include FERC-jurisdictional natural gas pipelines; non-jurisdictional facilities associated with the MXP and GXP facilities, other natural gas facilities that are not under the Commission's jurisdiction, including oil and gas wells; and other actions including electric transmission projects, transportation projects, and residential and commercial developments.

The majority of cumulative impacts would be temporary and minor when considered in combination with past, present, and reasonably foreseeable activities. Minor or negligible cumulative impacts could occur on geological resources, soils, water resources, land use, visual resources, air quality, and noise. However, some long-term cumulative impacts would occur on upland forested vegetation and associated wildlife habitats. Some short- and long-term cumulative benefits to the communities in and around the MXP and GXP project areas would be realized through jobs, wages, purchases of goods and materials, and annual property taxes paid by the Companies.

ALTERNATIVES

We evaluated the no-action alternative, system alternatives, MXP pipeline major route alternatives, minor pipeline route variations, and alternative locations for the proposed GXP Cane Ridge Compressor Station. We also discussed the emissions associated with the use of electric motor-driven compressors. While the no-action alternative would eliminate the short- and long-term environmental impacts identified in the EIS, the stated objectives of the Companies' proposals would not be met.

We compared each alternative to the proposed action using three key criteria:

1. Does the alternative have the ability to meet the objectives of the proposed action?
2. Is the alternative technically and economically feasible, reasonable, and practical?
3. Does the alternative offer a significant environment advantage over the proposed action?

For the purpose of analyzing system alternatives, we evaluated potential impacts associated with using other gas suppliers to transport an equivalent volume of gas to meet the MXP purpose and need and provide firm transportation service to Columbia Gas' TCO Pool, as well as more southerly markets accessible from Columbia Gulf's pipeline. None of the other pipeline systems in the vicinity of the MXP have the capacity to transport the large volumes of gas that would be carried by the MXP, and none of the existing systems would be able to expand their facilities within the schedule required by the MXP's shippers. Because other pipeline carriers in the MXP

area would be required to construct new pipeline segments and other appurtenances to reach the receipt and delivery points required by MXP, we do not consider the use of other existing pipeline systems to be a viable alternative to the MXP. Therefore, these alternatives were eliminated from further analysis.

We considered two alternatives for the GXP involving using Columbia Gulf's existing system to meet the purpose and need of the GXP: a loop-intensive alternative that would include modifications to an existing facility and seven new pipeline looping sections, and a separate alternative that involved a combination of looping and horsepower increases at five existing compressor stations. We do not consider the looping and addition of compression at Columbia Gulf's existing compressor stations to be preferable to or provide a significant environmental advantage over the GXP. Therefore, they were eliminated from further analysis.

We analyzed two major pipeline route alternatives to the MXP, one that involved looping/upgrades to existing Columbia Gas pipeline systems and one that included modifications to an approved Columbia Gas project currently under construction (the Leach XPress Project; Docket No. CP15-514). The alternatives reviewed were determined to be not environmentally preferable to the proposed action due to the additional length of pipe that would be required and the corresponding additional impacts on the environment. Additionally, the constructability issues associated with all the major pipeline route alternatives and the potential impacts on an increased number of landowners make the alternatives less viable and preferable than the MXP. The MXP, as proposed, is preferable to any of the major route alternatives we considered.

During pre-filing, we considered three major route variations (Maxwell Ridge, Sherwood Lateral, and Hurricane Creek) and 21 minor route variations associated with the MXP corridor. The route variations were either identified as areas that required further evaluation in comments received during the project scoping period or resulted from landowner requests during Columbia Gas' public outreach. Columbia Gas adopted all three route variations in its application. Additionally, after Columbia Gas filed its application on April 29, 2016, it adopted and incorporated 20 additional route variations and 28 minor modifications into the proposed MXP pipeline route. These changes resulted from the identification of sensitive environmental resources during the 2016 environmental field surveys and were designed to address landowner concerns, avoid crossing certain parcels and landmarks, and minimize or avoid constructing in areas with constructability constraints.

Columbia Gas proposes to construct three new compressor stations, and Columbia Gulf proposes to construct seven new compressor stations. We received additional letters and mapping during the public comment period for the draft EIS regarding alternative locations for the Cane Ridge Compressor Station; therefore, we reviewed 13 additional alternative sites for this proposed facility. We did not find a substantial environmental advantage over the proposed site.

MAJOR CONCLUSIONS

We determined that construction and operation of the MXP and GXP would result in some adverse environmental impacts, but impacts would be reduced to less-than-significant levels with the implementation of the Companies' proposed and our recommended mitigation measures, with one exception. The MXP's impacts on upland interior forest habitat and large Core Forest Areas

(including habitat for the cerulean warbler) would be significant. These determinations are based on a review of the information provided by the Companies and further developed from data requests, site visits, scoping, literature research, alternative analysis, and contacts with federal, state, and local agencies as well as Native American tribes and individual members of the public.

Although many factors were considered in these determinations, the principal reasons are:

- The Companies would minimize impacts on natural and cultural resources during construction and operation of the projects by implementing, as required, their respective *ECS, E&SCPs, SPCC Plan, Blasting Plan, HDD Contingency Plan, Wetland Mitigation Plan, Invasive Species Management Plan, Visual Screening Plan, Site-specific Residential Construction Plans, Fugitive Dust Control Plan, and Public Awareness Program.*
- FERC staff would complete the process of complying with section 7 of the ESA prior to construction.
- FERC staff would complete consultation under section 106 of the National Historic Preservation Act.
- The Companies would comply with all applicable U.S. Department of Transportation safety standards for transportation of natural gas by pipeline.
- The Companies would comply with all applicable air and noise regulatory requirements during construction and operation of the projects.
- An environmental inspection program would be implemented to ensure compliance with the mitigation measures that become conditions of the FERC's authorization.

In addition, we recommend 34 project-specific mitigation measures that the Companies should implement to further reduce the environmental impacts that would otherwise result from construction and operation of the projects. We conclude that these measures are necessary to either augment the environmental record for the projects or to reduce adverse impacts associated with the projects; and, in part, we are basing our conclusion on the successful implementation of these measures. Therefore, we recommend that these mitigation measures be attached as conditions to any authorization issued by the Commission. These recommended mitigation measures are presented in section 5.2 of the EIS.

1.0 INTRODUCTION

The Federal Energy Regulatory Commission (Commission or FERC) is the federal agency responsible for authorizing applications to construct, operate, and maintain interstate natural gas transmission pipeline facilities. As part of its decision-making process, the Commission is required by the National Environmental Policy Act (NEPA) of 1969, as amended, and its implementing regulations to assess the environmental impact associated with the construction and operation of a proposed project. The Commission's environmental staff prepared this Environmental Impact Statement (EIS) to assess the potential environmental impacts that could result from the construction and operation of two separate interstate natural gas transmission pipelines and facilities proposed by Columbia Gas Transmission, LLC (Columbia Gas) and Columbia Gulf Transmission, LLC (Columbia Gulf).

FERC staff prepared one EIS for the new facilities proposed by Columbia Gas and Columbia Gulf (collectively referred to as "the Companies") because the Mountaineer XPress Project (MXP), proposed by Columbia Gas, and the Gulf XPress Project (GXP), proposed by Columbia Gulf, have similar timelines, as well as other interrelated aspects. Also, the project sponsors are affiliated companies (both Columbia Gas and Columbia Gulf are subsidiaries of Columbia Pipeline Group [CPG][4]) and our consideration of company-proposed construction techniques and mitigation measures is facilitated by a combined analysis.

The vertical line in the margin identifies text that is new or modified in the final EIS and differs materially from corresponding text in the draft EIS. Changes were made to address comments from cooperating agencies and other stakeholders on the draft EIS, incorporate modifications to the MXP and GXP proposed by the Companies after publication of the draft EIS, and incorporate information filed by the Companies in response to our recommendations in the draft EIS. As a result of the changes, 10 of the recommendations identified in the draft EIS are no longer applicable to the Companies and do not appear in the final EIS. Additionally, 4 recommendations identified in the draft EIS have been substantively modified in the final EIS, and 3 new recommendations have been added in the final EIS.

On April 29, 2016, Columbia Gas filed an application with the Commission under sections 7(b) and 7(c) of the Natural Gas Act (NGA), as amended. Columbia Gas is seeking authorization and a Certificate of Public Convenience and Necessity (Certificate) to construct, install, replace, own, operate, and maintain a new interstate natural gas pipeline and ancillary facilities in West Virginia. Columbia Gas' application was assigned Docket No. CP16-357-000. Also on April 29, 2016, Columbia Gulf filed an application with FERC under the NGA seeking a Certificate to construct, install, own, operate, and maintain new and upgraded natural gas ancillary facilities in Kentucky, Tennessee, and Mississippi. Columbia Gulf's application was assigned Docket No. CP16-361-000. We[5] issued a Notice of Application for each project on May 13, 2016, and the notices appeared in the *Federal Register* (FR) on May 20, 2016.

[4] On July 1, 2016, TransCanada Corporation acquired Columbia Pipeline Group, Inc.

[5] The pronouns "we," "us," and "our" refer to the environmental staff of FERC's Office of Energy Projects.

Columbia Gas' proposal, referred to in this EIS as the Mountaineer XPress Project (MXP), would involve the construction and operation in West Virginia of the following:

- about 164.3 miles of new 36-inch-diameter natural gas pipeline from Marshall County to Cabell County;
- about 5.9 miles of new 24-inch-diameter natural gas pipeline in Doddridge County;
- three new compressor stations in Doddridge, Calhoun, and Jackson Counties (compressor station in Doddridge County also includes a new regulator station);
- two new regulating stations in Jackson and Cabell Counties;
- installation of about 296 feet of new, 10-inch-diameter natural gas pipeline at the Ripley Regulator Station to tie Columbia Gas' existing X59M1 pipeline into the MXP-100 pipeline; and
- related facilities in various West Virginia counties.

Additionally, Columbia Gas would replace a 0.4-mile-long segment of 30-inch-diameter natural gas pipeline on its existing system (Cabell County), add compression at one existing compressor station (Wayne County), and add compression at two compressor stations that are approved and pending for construction under separate FERC proceedings (Marshall and Kanawha Counties[6]).

Columbia Gulf's Gulf XPress Project (GXP) would involve the construction and operation of seven new compressor stations and upgrades at one existing meter station and one existing compressor station[7], spread across Kentucky (Carter, Boyd, Rowan, Garrard, and Metcalfe Counties), Tennessee (Davidson and Wayne Counties), and Mississippi (Union and Grenada Counties). The new and existing facilities would all be sited along Columbia Gulf's existing system (the 30-inch-diameter Mainlines 100 and 200, and the 36-inch-diameter Mainline 300). Both the MXP and the GXP are described in more detail in section 2.0, below.

1.1 PROJECTS PURPOSE AND NEED

1.1.1 Mountaineer XPress Project

According to Columbia Gas, the primary purpose of the MXP is to provide up to 2.7 million dekatherms per day (Dth/d) of firm transportation service from receipt points in the Appalachian Basin to markets in the Midwest, Northeast, Mid-Atlantic, South, and Gulf Coast. The MXP would transport natural gas from receipt points in the towns of Oak Grove, Majorsville, Goodwin,

6 The Lone Oak Compressor Station, in Marshall County, is an approved new Columbia Gas compressor station certificated by the Commission (January 19, 2017) under the Leach XPress Project (Docket No. CP15-514-000). The Elk River Compressor Station, in Kanawha County, is a pending new compressor station proposed by Columbia Gas under the WB XPress Project (Docket No. CP16-38-000).

7 The Grayson Compressor Station, in Carter County, Kentucky, is a Columbia Gulf compressor station certificated by the Commission (January 19, 2017) under the Rayne XPress Expansion Project (CP15-539).

Sherwood, and Stonewall, West Virginia and Clarington, Ohio; and Waynesburg, Pennsylvania to markets on the CPG system. The MXP would increase deliverability by approximately 1,800,000 Dth/d to Columbia Gas' TCO Pool[8], which serves multiple Midwest, Northeast, and Mid-Atlantic markets across CPG's system. The MXP would also add an additional 900,000 Dth/d of capacity to Columbia Gas' Leach Interconnect with Columbia Gulf's existing system, which serves markets in the South and Gulf Coast. Columbia Gas has executed eight precedent agreements for long-term transportation with shippers that, collectively, represents more than 96 percent of the MXP's proposed capacity. We received a comment during public scoping questioning if there was an "economic need" for the MXP. The Commission's role in reviewing the details of any project is to make a determination of public convenience and necessity. If such a determination is made in the affirmative, then "need" for the project is affirmed. All factors bearing on the public convenience and necessity are considered as part of the Commission's decision. However, determining project need is beyond the scope of the EIS.

1.1.2 Gulf XPress Project

According to Columbia Gulf, the purpose of the GXP is to expand the capacity of Columbia Gulf's existing system to allow for an additional 860,000 Dth/d of natural gas delivery to high-demand southern markets in Mississippi and Louisiana with deliveries to receipt points in Humphreys County, Mississippi, and Acadia, Evangeline, Lafayette, and Saint Mary Parishes, Louisiana. During the GXP scoping period, we received a comment questioning where Columbia Gulf would be shipping natural gas transported by the proposed facilities. Columbia Gulf has executed four precedent agreements for long-term transportation with shippers to the receipt points noted above. These precedent agreements collectively represent 100 percent of the GXP's proposed capacity.

1.2 PURPOSE AND SCOPE OF THE EIS

Our principal purposes for preparing an EIS are to:

- identify and assess the potential direct, indirect, and cumulative impacts on the natural and human environment that would result from the implementation of the proposed actions;
- identify and evaluate reasonable alternatives to the proposed actions that would avoid or substantially lessen any significant adverse effects to the environment;
- identify and recommend specific mitigation measures, as necessary, to avoid or minimize environmental effects; and
- encourage and facilitate involvement by the public and interested agencies in the environmental review process.

The topics addressed in this EIS include project alternatives; geology; soils; water resources; wetlands; vegetation; wildlife and aquatic resources; special status species; land use,

[8] The TCO Pool is the main pooling point on Columbia Gas' system. Specifically, the TCO Pool refers to Columbia Gas' highly liquid trading pool. Shippers may make deliveries into the TCO Pool, i.e., Columbia Gas' Interruptible Paper Pool, from any source delivered into Columbia Gas' system. The TCO Pool is a daily and monthly pricing point listed by S&P Global Platts as "Columbia Gas, Appalachia."

recreation, special interest areas, and visual resources; socioeconomics; cultural resources; air quality and noise; reliability and safety; and cumulative impacts. This EIS describes the affected environment as it currently exists, discusses the environmental consequences of the proposed projects, and compares the projects' potential impact on that of the alternatives. This EIS also presents our conclusions and recommended mitigation measures.

Our description of the affected environment is based on a combination of data sources, including desktop resources such as scientific literature and regulatory agency reports, information from resource and permitting agencies, scoping comments, field data collected by the Companies, and our own site visits. Columbia Gas has field surveyed all the pipeline facilities along the MXP route. Additionally, all proposed facilities associated with the GXP have been field surveyed.

The U.S. Environmental Protection Agency (EPA), U.S. Army Corps of Engineers (USACE), U.S. Fish and Wildlife Service (USFWS), West Virginia Department of Environmental Protection (WVDEP), and West Virginia Division of Natural Resources (WVDNR) are "cooperating agencies" who participated in the preparation of the EIS because they have jurisdiction by law or special expertise with respect to the environmental impacts associated with the proposals. The roles of FERC and the cooperating agencies in the project review processes are described in the sections below.

1.2.1 Federal Energy Regulatory Commission

FERC is the lead federal agency for the preparation of this EIS in compliance with the requirements of NEPA (title 42 of the United States Code, sections 4321–4345 [42 USC 43221-4345]), the Council on Environmental Quality (CEQ) regulations for implementing the procedural provisions of NEPA (title 40 of the Code of Federal Regulations, parts 1500–1508 [40 CFR 1500-1508]), and FERC's regulations implementing NEPA (18 CFR 380).

As the lead federal agency for the projects, FERC is required to comply with section 7 of the Endangered Species Act of 1973 (ESA), the Magnuson-Stevens Fishery Conservation and Management Act[9], the Bald and Golden Eagle Protection Act (BGEPA) of 1940 (16 USC 668–668c), the Migratory Bird Treaty Act (MBTA) of 1918 (16 USC 703–712), section 106 of the National Historic Preservation Act (NHPA), and section 307 of the Coastal Zone Management Act of 1972.[10] Each of these statutes has been taken into account in the preparation of this EIS.

FERC will use the EIS to consider the environmental impacts that could result if it issues Columbia Gas and/or Columbia Gulf Certificates under section 7 of the NGA. FERC will also

[9] The Magnuson-Stevens Fishery Conservation and Management Act is the primary law governing marine fisheries management in U.S. federal waters for the purpose of ending and preventing overfishing in federally-managed fisheries, rebuild overfished stocks, increase long-term economic and social benefits from commercial and recreational fishing, and ensure a safe and sustainable supply of seafood. Neither the MXP nor the GXP involve construction or operation of project facilities in or near marine fisheries; therefore neither project would affect Essential Fish Habitat.

[10] The Coastal Zone Management Act provides for the management of the nation's coastal resources by calling for the "effective management, beneficial use, protection, and development" of the nation's coastal zone. Neither the MXP nor the GXP involve construction or operation of project facilities in or near coastal zones; therefore, neither project would be subject to a Federal Consistency Determination.

consider non-environmental issues in its review of the Columbia Gas and Columbia Gulf applications. Authorizations will be granted only if FERC Commission finds that the evidence produced on financing and rates; market demand; gas supply; existing facilities and services; environmental impacts; long-term feasibility; and other issues demonstrates that a project is required by the public convenience and necessity. The assessment of environmental impacts and mitigation development discussed herein are important factors in this determination.

In accordance with the CEQ regulations implementing NEPA, no agency decision on a proposed action may be made until 30 days after the EPA publishes a Notice of Availability of the final EIS in the FR. However, the CEQ regulations provide an exception to this rule when an agency decision is subject to a formal internal appeal process that allows other agencies or the public to make their views known. In such cases, the agency decision may be made at the same time the notice of the final EIS is published by the EPA, allowing both periods to run concurrently. The Commission's decisions for the proposed actions discussed in this EIS will be subject to a 30-day rehearing period.

1.2.2 U.S. Environmental Protection Agency

The EPA is an independent federal agency responsible for protecting human health and safeguarding the natural environment. The EPA has delegated water quality certification, under section 401 of the Clean Water Act (CWA), to the jurisdiction of individual state agencies. The EPA may assume section 401 authority if no state program exists, if the state program is not functioning adequately, or at the request of the state. The EPA also oversees the issuance of a National Pollutant Discharge Elimination System (NPDES) permit by the state agency, under section 402 of the CWA, for point-source discharge of water used for hydrostatic testing of pipelines into waterbodies. In addition, the EPA has the authority to review and veto USACE decisions on section 404 permits. The MXP is within EPA Region 3, and the GXP is within Region 4. Staff from each regional office participated in the NEPA review, and each region will evaluate its portion of the MXP and GXP for region-specific issues.

The EPA also has jurisdictional authority to regulate air pollution under the Clean Air Act of 1970, as amended in 1977 and 1990 (CAA) (42 USC 85), by developing and enforcing rules and regulations for all entities that emit pollutants into the air. Under this authority, the EPA has developed regulations for major sources of air pollution. The EPA has delegated authority to implement these regulations to state and local agencies, who are also allowed to develop their own regulations for non-major sources. The EPA also establishes general conformity applicability thresholds, with which a federal agency can determine whether a specific action requires a general conformity assessment.

In addition to its permitting responsibilities, the EPA is required under section 309 of the CAA to review and publicly comment on the environmental impacts of major federal actions, including actions that are the subject of draft and final EISs, and is responsible for implementing certain procedural provisions of NEPA (e.g., publishing the Notices of Availability of the draft and final EISs in the FR) to establish statutory timeframes for the environmental review process.

1.2.3 U.S. Army Corps of Engineers

The USACE has jurisdictional authority pursuant to section 404 of the CWA (33 USC 1344), which governs the discharge of dredged or fill material into waters of the United States (including wetlands). Because the USACE must comply with the requirements of NEPA before issuing permits under this statute, it has elected to participate as a cooperating agency in the preparation of this EIS. The USACE would adopt the EIS per 40 CFR 1506.3 if, after an independent review of the document, it concludes that its comments and suggestions have been satisfied. The MXP crosses both the Huntington and Pittsburgh Districts of the USACE Great Lakes and Ohio River Division. The GXP is within the Louisville and Nashville Districts of the Great Lakes and Ohio River Division and the Vicksburg District of the Mississippi Valley Division. Staff from each USACE district office participated in the NEPA review, and each district will evaluate its portion of the MXP and GXP for district-specific USACE authorizations, as applicable.

As an element of its review, the USACE must consider whether the proposed projects represent the least environmentally damaging practicable alternative pursuant to the CWA section 404(b)(1) guidelines. The term "practicable" means available and capable of being done after taking into consideration cost, existing technology, and logistics, in light of the overall purposes of both projects.

Although this document addresses environmental impacts associated with the proposed projects as they relate to section 404, it does not serve as a public notice for any of the USACE's permits.

Based on its participation as a cooperating agency and its consideration of the final EIS (including responses to public comments), the USACE would issue a Record of Decision to formally document its decision on each of the proposed actions, including section 404(b)(1) analyses and required environmental mitigation commitments.

1.2.4 U.S. Fish and Wildlife Service

The USFWS is responsible for the conservation, protection, and enhancement of fish, wildlife, plants, and their habitats. Pursuant to a number of environmental laws (ESA, Marine Mammal Protection Act, MBTA, BGEPA, and Fish and Wildlife Coordination Act,), the USFWS has a principal trust responsibility. As the lead federal agency for authorizing the projects, FERC is required to consult with the USFWS to determine whether federally listed endangered or threatened species or designated critical habitat are found in the vicinity of the project, and to evaluate the proposed action's potential effects on those species or critical habitat.

For actions involving major construction activities with the potential to affect listed species or designated critical habitat, FERC must report its findings to the USFWS in a Biological Assessment (BA) for those species that may be affected. If it is determined the action is likely to adversely affect listed species or designated critical habitat, FERC is required to initiate formal consultation with the appropriate agency. In response, the USFWS would issue a Biological Opinion as to whether the action would likely jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat.

The USFWS also collaborates with other federal agencies pursuant to Executive Order 13186 (66 Federal Register 3853) to identify where unintentional take is likely to have a measurable negative effect on migratory bird populations and to avoid or minimize adverse impacts on migratory birds. On March 30, 2011, the USFWS and the Commission entered into a MBTA Memorandum of Understanding that focuses on avoiding or minimizing adverse impacts on migratory birds and strengthening migratory bird conservation through enhanced collaboration between the two agencies. This voluntary MBTA Memorandum of Understanding does not waive legal requirements under the MBTA, Bald and Golden Eagle Protection Act, ESA, Federal Power Act, NGA, or any other statutes and does not authorize the take of migratory birds.

Since the issuance of the draft EIS, the USFWS West Virginia Field Office elected to participate as cooperating agency due to its responsibilities under the ESA, MBTA, and BGEPA. The USFWS also has special expertise regarding effects on fish and wildlife and other environmental values and works to conserve, protect, and recover species under the ESA.

1.2.5 West Virginia Department of Environmental Protection

The WVDEP is the state agency responsible for implementing and enforcing West Virginia's environmental regulations with respect to managing the state's air, land, and water resources. The WVDEP has authority (through delegation from the EPA) for section 401 of the CWA Water Quality Certification. Additionally, the WVDEP reviews and approves all applications for NPDES permits. The WVDEP has agreed to be a cooperating agency in order to lend its experiences and insight with environmental impacts relative to this type of activity and provide recommendations on assessment, minimization, and mitigation of potential environmental impacts.

1.2.6 West Virginia Division of Natural Resources

The statutory mission of the WVDNR is to provide and administer a long-range comprehensive program for the exploration, conservation, development, protection, enjoyment, and use of the natural resources of the State of West Virginia. The WVDNR is composed of Wildlife Resources, State Parks and Forests, and Law Enforcement Sections and the Office of Lands and Streams.

The Wildlife Resources Section is responsible for management of the state's wildlife resources. The primary objective of the Wildlife Resources Section is to maintain and perpetuate fish and wildlife at levels compatible with the available habitat while providing maximum opportunities for recreation, research, and education. The Wildlife Resources Section comprises the Game Management, Fisheries, Wildlife Diversity, Technical Support, and Environmental Coordination Units.

Currently, the Wildlife Resources Section Game Management Unit conducts management activities on 105 Wildlife Management Areas and 8 State Forests totaling more than 1.4 million acres. Impacts on property managed by the Wildlife Resources Section may be subject to review by the USFWS for concurrence under the authority established in 50 CFR 80.

Fisheries management programs consist of efforts focused on warmwater species (e.g., walleye and channel catfish), and coldwater species (e.g., trout), that are stocked in rivers, lakes,

reservoirs, and streams throughout the state. Research, stocking, public access development, regulations, and outreach combined with habitat protection, improvement, and restoration form the foundation of management of the state's fishery resources.

The Wildlife Diversity and Natural Heritage Program is responsible for those species listed by the federal government as threatened or endangered; and nongame wildlife, nongame fish, mussels, birds, and their habitats. It also administers outreach programs and provides vital assessment information.

The Environmental Coordination Unit reviews numerous projects that potentially impact wildlife, fisheries, and their respective habitats. Primary concerns are road construction, stream alteration, hydropower projects, power line rights-of-way, gas line construction, oil/gas well sites, surface mines, and other construction projects.

The State Parks and Forests Section promotes conservation by preserving and protecting natural areas of unique or exceptional scenic, scientific, cultural, archaeological, or historical significance and provides outdoor recreational opportunities. The system is composed of 35 parks, 7 forests, 5 wildlife management areas, the Greenbrier River Trail, and the North Bend Rail Trail.

The Office of Lands and Streams preserves, protects, and enhances the state's title to its recreation lands. The Office of Lands and Streams holds title to the beds of the state's rivers, creeks, and streams totaling some 34,000 miles across about 5,000 named waterways in the state. It grants right-of-entry letters to governmental agencies, companies, and individuals to conduct construction activities in the state's rivers, creeks, and streams as well as right-of-way licenses for pipelines, underground or underwater cables, and overhead power and telephone lines crossing the state's waterways.

1.3 PUBLIC REVIEW AND COMMENT

1.3.1 Mountaineer XPress Project

On August 26, 2015, Columbia Gas filed a request with FERC to use the Commission's pre-filing (PF) review process for the MXP. At that time, Columbia Gas was in the preliminary design stage of the project, and no formal application had been filed with FERC. On September 16, 2015, FERC granted Columbia Gas' request and established a PF docket number (PF15-31-000) to place information related to the planned project into the public record. The purpose of the PF review process is to encourage the early involvement of interested stakeholders, facilitate interagency cooperation, and identify and resolve issues before a formal application is filed with FERC.

Prior to entering PF, Columbia Gas began initial outreach activities with stakeholders via notification letters in April 2015. Columbia Gas began contacting governmental stakeholders and tribal representatives in August 2015. Between October 5 and 13, 2015, after entering into PF, Columbia Gas hosted six informal open house meetings along the planned MXP pipeline route. The purpose of the open houses was to provide affected landowners, elected and agency officials, and the general public with information about the project and to give them an opportunity to ask questions and express their concerns. We participated in the open houses to provide information regarding the Commission's environmental review process to interested stakeholders and to listen

to comments about the pipeline project and potential alternatives. We also conducted site visits of various portions of the planned MXP pipeline route.

In conjunction with the PF review process, Columbia Gas implemented a Stakeholder Outreach Plan to identify stakeholders, share information regarding the project, seek input on environmental and other issues, and provide opportunities for public comment. As part of this plan, Columbia Gas established a website with information about the MXP, provided a toll-free project information line, and identified a point of contact to answer questions and provide information.

On November 18, 2015, the Commission issued a *Notice of Intent to Prepare an Environmental Impact Statement for the Planned Mountaineer XPress Project, Request for Comments on Environmental Issues, and Notice of Public Scoping Meetings* (MXP NOI). The notice was published in the FR on December 1, 2015, and mailed to more than 1,300 interested parties, including federal, state, and local government representatives and agencies; elected officials; environmental and public interest groups; Native American tribes; affected property owners; other interested parties; and local libraries and newspapers. The notice briefly described the project and the EIS process, provided a preliminary list of issues we identified, invited written comments on the environmental issues that should be addressed in the EIS, listed the date and location of public scoping meetings to be held in the project area, and established a December 17, 2015, closing date for receipt of environmental scoping comments.

In early December 2015, we held four public scoping meetings in the MXP area. The meetings were held in West Virginia in New Martinsville (December 7), West Union (December 8), Ripley (December 9), and South Charleston (December 10). The scoping meetings provided an opportunity for the public to learn more about the MXP and to provide comments on environmental issues to be addressed in the EIS. A combined total of 24 individuals provided oral comments at the scoping meetings. Transcripts of the meetings, as well as written comment letters, were entered into the public record and are available for viewing on FERC's eLibrary website (www.ferc.gov).[11] Excluding representatives of CPG, FERC staff, and FERC's third-party contractor staff, about 19 people attended the meeting in New Martinsville, 15 in West Union, 92 in Ripley, and 40 in South Charleston.

In total, 45 written comments were received during the scoping process for the MXP and placed in the public record for this project.[12] Of the combined comments received for the project, over half dealt with non-environmental issues such as general project support or opposition, or non-project-related issues such as requests for new public water utilities service in the project area.

[11] Using the "eLibrary" link, select "General Search" from the eLibrary menu and enter the docket number excluding the last three digits in the "Docket Number" field (i.e., PF15-31 or CP16-357). Be sure to select an appropriate date range.

[12] The Commission uses various means to collect public comments, including written comments submitted via the U.S. Postal Service, oral and written comments collected at public scoping and comment meetings, and comments submitted electronically via FERC Online at www.ferc.gov. It is important to note that comments submitted by any of these means carry equal weight; i.e., written comments submitted on paper are given the same consideration as oral comments collected at a public meeting.

Although we recognize that these statements are of interest to the commentors, they are beyond the scope of this EIS.

The majority of comments on specific environmental concerns were about the impacts on future use of land (i.e., for future developments or hunting), recreational areas, wetlands, tree clearing, emissions from the operation of compressor stations, and plausible system alternatives. Table 1.3-1 summarizes the environmental issues and concerns identified during scoping for the MXP. Table 1.3-1 also includes comments received after the formal scoping period ended on December 17, 2015, including relevant environmental comments raised by individuals requesting to be intervenors in the Commission's MXP proceeding.[13]

[13] FERC's *Notice of Application* for the MXP, issued on May 13, 2016, opened the 21-day period for interventions. To date, a total of 26 groups, individuals, and/or companies have requested intervenor status. Intervenors are official parties to the proceeding and have the right to receive copies of case-related Commission documents and filings by other intervenors. Likewise, each intervenor must provide a copy of its own filings to the Secretary and must send a copy of its filings to all other intervenors. Only intervenors have the right to seek rehearing of the Commission's decision.

Table 1.3-1 Issues Identified and Comments Received During the 2015 and 2016 Public Scoping Process for the Mountaineer XPress Project	
Issue/Concern	**EIS Section Addressing Comment**
Geology	
Safety of mining land beneath pipeline	4.1.4.6.1
Impacts from karst topography	4.1.4.7.1
Soils	
Potential for erosion; impacts on soil stability and soil integrity	4.2.2.1
Impacts of the pipeline traversing a Superfund site	4.2.10.1
Water Resources and Wetlands	
Protection of aquatic resources	4.6.4.1
Minimization of impacts on wetlands	4.4.2.1
Wildlife and Vegetation	
Impacts on old-growth interior forested areas	4.5.4.1
Land Use	
Loss of privacy around residences from clearing mature trees.	4.8.1.3
Impacts on recreational areas used for hunting	4.8.2.2.1
Socioeconomics	
Economic need for the project	1.1.1
Impacts on property values and local tax losses due to reduced property values	4.9.7
Air Quality and Noise	
Potential impacts on air quality from the operation of compressor stations	4.11.1.3.5
Potential noise impacts from construction activities and the operation of compressor stations	4.11.2.2
Health and Safety	
Risk of pipeline rupture near homes	4.12.2
Alternatives	
System alternatives with available capacity to meet the MXP's purpose and need	3.2.1
Minor alternative routes filed by landowners requesting consideration for variations contained within their properties	3.4
Cumulative Impacts	
Effects to climate change	4.11.1 and 4.13.2.11

On December 10, 2015, we also conducted an interagency meeting in Charleston, West Virginia, to discuss roles and responsibilities of participation as a cooperating agency, coordination of agency review, permit requirements and status, and specific resource concerns to be addressed in the EIS. The participating agencies included the USACE, West Virginia State Historic Preservation Office (SHPO), WVDNR, and WVDEP. A summary of the interagency scoping meeting is available for viewing on FERC's website.

On October 11, 2016, and subsequent to its official application filing, Columbia Gas incorporated several route modifications into its proposed MXP-100 and MXP-200 pipeline routes. Thus, on October 21, 2016, the Commission mailed a copy of the MXP NOI along with an informational cover letter to 31 newly affected landowners and opened a limited scoping period.

The notice briefly described Columbia Gas' proposed modifications, invited written comments on the environmental issues regarding the route modifications that should be addressed in the EIS, and established a November 21, 2016, closing date for receipt of environmental scoping comments. No electronic nor written comments were received during the additional scoping period.

On February 27, 2017, we issued a *Notice of Availability of the Draft Environmental Impact Statement for the Proposed Mountaineer XPress and Gulf XPress Projects*. This notice, which was published in the FR, listed the dates and locations of public comment sessions and established a closing date of April 24, 2017, for receiving comments on the draft EIS. Copies of the draft EIS were mailed to over 2,000 stakeholders.

We held four public comment sessions in the area of the MXP to solicit and receive comments on the draft EIS. The West Virginia sessions were held between March 20 – 23, 2017, in Hurricane, Ripley, West Union, and New Martinsville. The sessions provided the public an opportunity to present oral comments on the analysis of environmental impacts described in the draft EIS. A combined total of about 100 individuals attended the West Virginia sessions, including 8 who provided oral comments. We also received about 115 comment letters/comment forms/oral comments from federal/state agencies, non-government organizations/community groups, and individuals in response to the draft EIS. While the draft EIS comment period closed on April 24, 2017, we continued to accept comments past the closing date. Transcripts from the public comment sessions, as well as written comment letters/forms are posted to the MXP docket on FERC's eLibrary. The leading topics submitted by commentors on the draft EIS were mostly focused on air quality and cumulative impacts. We received several comments from individuals who are concerned with the future growth of oil and gas exploration activities within the Marcellus and Utica shale formations. Natural gas production including drilling, exploring, and recovery of existing supplies are not regulated by FERC and are outside the scope of this EIS. Further, the purpose of the MXP is defined by Columbia Gas, is not evaluated by Staff as part of the EIS; and therefore, is not addressed further. Appendix Q provides a copy of each comment filed on the draft EIS as well as our corresponding response.

This EIS has been mailed to agencies, individuals, and organizations on the mailing list in appendix A and was filed with the EPA for issuance of a Notice of Availability in the FR.

1.3.2 Gulf XPress Project

On June 2, 2016, the Commission issued a *Notice of Intent to Prepare an Environmental Impact Statement for the Proposed Gulf XPress Project, Request for Comments on Environmental Issues, and Notice of Public Scoping Meeting* (GXP NOI). The notice was published in the FR on June 9, 2016, and mailed to more than 960 interested parties, including federal, state, and local government representatives and agencies; elected officials; environmental and public interest groups; Native American tribes; affected property owners; other interested parties; and local libraries and newspapers. The notice briefly described the project and the EIS process, provided a preliminary list of issues we identified, invited written comments on the environmental issues that should be addressed in the EIS, listed the date and location of a public scoping meeting to be held within the project area, and established a July 5, 2016 closing date for receipt of environmental scoping comments.

On June 21, 2016, we held a public scoping meeting at the Cane Ridge High School in Antioch, near Nashville, Tennessee, near the proposed site for one of the new GXP compressor stations. The scoping meeting provided an opportunity for the public to learn more about the proposed GXP and to provide comments on environmental issues to be addressed in this EIS. A total of 28 individuals provided oral comments during the scoping meeting. Transcripts of the meeting, as well as written comment letters, were entered into the public record and are available for viewing on FERC's eLibrary website (www.ferc.gov). Excluding representatives of CPG, FERC staff, and third-party contractor staff, about 145 people attended the public scoping meeting.

In total, 149 written comments were received during the scoping process and placed in the public record for the GXP. Approximately 30 percent dealt with non-environmental issues such as those described above in section 1.3.1. The majority of the remaining comments related to specific environmental concerns associated with the proposed Cane Ridge Compressor Station and potential impacts on surrounding residences and the public due to noise and air emissions, and conflicting land use. Table 1.3-2 summarizes the environmental issues and concerns identified during the GXP scoping process. Table 1.3-2 also includes comments received after the formal scoping period ended on July 5, 2016, including relevant environmental comments raised by individuals requesting to be intervenors in the Commission's GXP proceeding.[14] Unless otherwise noted, the comments in table 1.3-2 are specific to the proposed Cane Ridge Compressor Station.

Table 1.3-2
Issues Identified and Comments Received during the Public Scoping Process for the Gulf XPress Project

Issue/ Concern	EIS Section Addressing Comment
General	
Future plans to expand the compressor station or the existing Columbia Gulf pipeline	2.8
Gas would be shipped overseas; not for domestic consumption	1.1.2
Concerns for impacts of the compressor station running 24 hours per day, 7 days per week	4.11.2.3.1 and 4.11.1.3.5
Soils	
Potential for soil contamination	4.2.10.2
Water Resources	
Potential for toxic runoff to surrounding properties and Mill Creek	4.3.2.4.2
Impacts on water quality and groundwater from spills of hazardous materials	4.2.10.2
Operating the compressor station would require huge amounts of water	4.3.2.8.2
Holcomb Compressor Station may impede flow of ephemeral drainage that crosses the site, negatively affecting upstream properties	4.3.2.4.2
Protected Species	
Impacts on the Nashville crayfish in Mill Creek	4.7.8.2
Restrictions on seasonal tree-cutting at the Kentucky compressor station facilities	4.6.3.2
Potential impacts from construction of the Kentucky compressor stations on threatened, endangered, and special-status species	4.7.3.2 and 4.7.11.2.1
Land Use	

[14] FERC's *Notice of Application* for the GXP, issued on May 13, 2016, opened the 21-day period for interventions. To date, a total of 17 groups, individuals, and/or companies have requested intervenor status on the GXP.

Table 1.3-2 Issues Identified and Comments Received during the Public Scoping Process for the Gulf XPress Project	
Issue/ Concern	**EIS Section Addressing Comment**
Proximity of the Cane Ridge Compressor Station to dense suburban area; conflict between proposed use and existing land use zoning	3.6.2
Proximity of Cane Ridge Compressor Station to residential communities and schools	3.6.2
Adherence of the new facility to all applicable land use/zoning regulations	4.8.1.4.2
Concern with light pollution	4.8.3.2
Concern with nighttime lights and noise at Leach C Meter Station, and workers trespassing on private property	4.8.3.2 and 4.11.2.3.2
Impacts on user experience at nearby Mill Creek Greenway	4.8.2.2.2
Potential visual impacts at proposed compressor stations (Cane Ridge, Morehead, and Paint Lick)	4.8.3.2
Socioeconomics	
Impacts on home values and potential loss of all future developments in the Cane Ridge area	4.9.7
Increase in property taxes	4.9.7
Compressor station would not provide jobs or revenue to the community	4.9.8.2
Potential increase in traffic congestion during construction of compressor station	4.9.5.2
Cultural Resources	
Concern for completion of tribal consultations for all proposed compressor stations	4.10.2.2
Concern that Clifton Junction Compressor Station would have a negative impact on the Trail of Tears National Historic Trail	4.10.1.2.1
Air Quality	
Quantify construction and operational air emissions	4.11.1.3.3 and 4.11.1.3.4
Assessment of health issues associated with radon and air quality	4.11.1.3.5
Concern with exposure to hazardous and toxic air pollutants and cancer-causing chemicals; effect to area residents' health	4.11.1.3.5
Assessment of increased health risks to sensitive groups (e.g., asthmatics)	4.11.1.3.5
Concern that the compressor station would emit odors; the neighborhood would smell/be impacted by gas odorant	4.11.1.3.5
Air quality impacts during operation of compressor station, specifically on residents living within 2 miles, the Henry Maxwell Elementary School students, and users of the Mill Creek Greenway	4.11.1.3.5
Noise	
Concern with compressor station construction noise at the Cane Ridge site.	4.11.2.2.1
Concern with noise pollution from compressor station operation and truck traffic; use of noise attenuation measures	4.11.2.3.2
Concern with intermittent loud noise; frequency and duration of blowdowns	4.11.2.3.2
Concern with citizen recourse if compressor station operational noise is louder than allowable threshold (55 decibels)	5.2 (condition #37)
Potential health-related impacts resulting from compressor station operation noise and vibrations	5.2 (condition #37)
Reliability and Safety	
Concern about station accident, risk of explosion, disaster	4.12.2
Concern with the age of the existing Columbia Gulf pipelines	4.12.2

Table 1.3-2 Issues Identified and Comments Received during the Public Scoping Process for the Gulf XPress Project	
Issue/ Concern	**EIS Section Addressing Comment**
Cumulative Impacts	
Analysis of cumulative impacts on air for the middle Tennessee region when combining the Cane Ridge Compressor Station with Kinder Morgan's station #563 at Joelton, TN	4.13.2.9.2
Alternatives	
Alternative sites for the Cane Ridge Compressor Station	3.6.2

We held one public comment session in the GXP area to solicit and receive comments on the draft EIS. The comment session was held in Cane Ridge, Tennessee on March 28, 2017. Approximately 60 individuals attended the session, including 14 who provided oral comments. Transcripts from the public comment session, as well as written comment letters/forms are posted to the GXP docket on FERC's eLibrary. The leading topics submitted by commentors on the draft EIS were mostly focused on alternatives to the proposed Cane Ridge Compressor Station site as well as noise, air, and cumulative impacts. The purpose of the GXP is defined by Columbia Gulf, is not evaluated by Staff as part of the EIS; and therefore, is not addressed further. Appendix Q provides a copy of each comment filed on the draft EIS as well as our corresponding response.

1.4 NONJURISDICTIONAL FACILITIES

Under section 7 of the NGA, FERC is required to consider, as part of its decision to authorize interstate natural gas facilities, all factors bearing on the public convenience and necessity. Occasionally, proposed projects have associated facilities that do not come under the jurisdiction of the Commission. As such, FERC has no authority or jurisdiction over the siting, permitting, licensing, construction, or operation of these facilities. These "non-jurisdictional" facilities may be integral to the need for the proposed facilities (e.g., a power plant at the end of a FERC-jurisdictional pipeline), or they may be merely associated as minor, non-integral components of the jurisdictional facilities that would be constructed and operated as a result of Certification of the proposed facilities. These facilities are addressed below.

1.4.1 Mountaineer XPress Project

Five non-jurisdictional facilities are associated with the MXP in West Virginia. These facilities are the MarkWest Energy Partners (MarkWest) Pipeline Tie-in at milepost (MP) 50.5 (at the proposed Sherwood Compressor Station), the Mon Power, FirstEnergy electric transmission line for service to the proposed White Oak Compressor Station at MP 81.9, and three other single-phase power lines that would provide electricity to MXP facilities.

The MarkWest Pipeline would consist of an approximately 2.4-mile-long pipeline from the existing MarkWest Sherwood natural gas processing plant to the proposed Sherwood Compressor Station. The pipeline, which will be designed and constructed by MarkWest Energy Partners, L.P., is expected to be between 24 and 36 inches in diameter. The existing MarkWest Sherwood natural gas processing plant is in Doddridge County and is subject to federal and state permitting and maintenance requirements. Construction and operation of the new MarkWest Pipeline will also

be subject to federal and West Virginia permits and clearances for the protection of water resources, threatened and endangered species, and other federal, state, and local regulations.

Based on similar pipelines, the MarkWest Pipeline is expected to require a 100-foot-wide construction right-of-way and 50-foot-wide permanent right-of-way between the gas processing plant and the MXP Sherwood Compressor Station. Based on this assumption, the MarkWest Pipeline would impact 29 acres during construction (not including additional temporary workspaces [ATWS] needed at waterbody crossings, etc.) and 14.5 acres for permanent operation.

The Mon Power, a First Energy Company, three-phase electric transmission line required to supply electricity to Columbia Gas' White Oak Compressor Station would require installation of approximately 1,400 feet of new three-phase power line, the conversion of approximately 7.5 miles of existing single phase to three-phase power line (with a portion being rerouted), the conversion of approximately 2.9 miles of existing two-phase to three-phase power line (with a portion being rerouted), and potential upgrades to an additional 2.6 miles of existing Mon Power three-phase power line. Because routing of this powerline has not been finalized, associated environmental impacts cannot be fully assessed at this time; however, several assumptions can be made. Any new powerlines would likely require a 30-foot-wide construction corridor. While waterbodies and wetlands would be spanned, large woody vegetation would be cut to ground level to avoid interfering with the new powerline. Impacts on vegetation, wildlife, and land use would be similar (although to a much less degree) to those discussed in section 4. Otherwise, impacts on geology, soils, and cultural resources would largely be limited to where new support structures would be located and would be expected to be minor and temporary. This non-jurisdictional electrical powerline would be a private project constructed under state and local jurisdiction. The federal government would have no financial or regulatory involvement.

Three single-phase power lines would be constructed along a 30-foot-wide right-of-way (15 feet on each side) to provide service to the following MXP facilities:

- MXP-100 Tie-in with LEX at MP 0.0 (approximately 340 feet);
- MXP-200 Tie-in with Line 1983 at MP 6.0 (approximately 1,500 feet); and
- Ripley Regulator Station at MP 124.9 (approximately 1,600 feet).

Columbia Gas would also require electric service at its proposed Sherwood and Mount Olive Compressor Stations. At this time, we assume that service is available at the site property lines and that any disturbance associated with extending overhead power to the compressor buildings would be contained within the sites themselves. Further details regarding the above-mentioned non-jurisdictional facilities are included in our cumulative impacts discussion in sections 4.13.1 and 4.13.2 of this EIS.

1.4.2 Gulf XPress Project

Three proposed non-jurisdictional facilities are associated with the proposed GXP, one in Kentucky and two in Tennessee. All three facilities would involve the extension of electric lines to deliver power to the GXP compressor stations. In Metcalfe County, Kentucky, the Tri County Electric Company would install approximately 380 feet of new electric line to serve the proposed Goodluck Compressor Station. The new electric line would commence at the Tri County Electric

Company substation and end within the fenceline of the Goodluck Compressor Station. In Davidson County, Tennessee, the Nashville Electric Service would install approximately 200 feet of new electric line to the proposed Cane Ridge Compressor Station. In Wayne County, Tennessee, the Tennessee Valley Electric Cooperative would extend electric lines for approximately 3,500 feet from U.S. Highway 64/Tennessee State Route (SR) 15 to the proposed Clifton Junction site. Further details regarding the above-mentioned non-jurisdictional facilities are included in our discussion of cumulative impacts in sections 4.13.1 and 4.13.2.

1.5 PERMITS, APPROVALS, CONSULTATIONS, AND REGULATORY REQUIREMENTS

As the lead federal agency for reviewing the MXP and GXP, FERC is required to comply with section 7 of the ESA, the MBTA, the Rivers and Harbors Act (RHA), the CWA, the CAA, and section 106 of the NHPA. These and other statues are addressed in this EIS.

Tables 1.5-1 and 1.5-2 list the major federal, state, and local permits, approvals, and consultations for construction and operation of the MXP and GXP, respectively. The tables also provide the dates or anticipated dates when Columbia Gas and Columbia Gulf commenced or anticipate commencing formal permit and consultation procedures. Columbia Gas and Columbia Gulf are responsible for all permits and approvals required to implement the proposed projects prior to construction, regardless of whether these permits and approvals appear in the tables. However, any state or local permits issued with respect to jurisdictional facilities must be consistent with the conditions of any authorization the Commission may issue. Although FERC encourages cooperation between applicants and state and local authorities, this does not mean that state and local agencies, through application of state and local laws, may prohibit or unreasonably delay the construction or operation of facilities approved by FERC. Any state or local permits issued with respect to jurisdictional facilities must be consistent with the conditions of any authorization issued by FERC.

Table 1.5-1 Major Permits, Approvals, and Consultations for the Mountaineer XPress Project		
Agency	**Permit/Approval/ Consultation**	**Status**
Federal		
Federal Energy Regulatory Commission	Section 7(c) NGA, Certificate of Public Convenience and Necessity	Application filed April 29, 2016
U.S. Army Corps of Engineers Huntington District Pittsburgh District	Section 404, CWA Permit	Applications filed July 8, 2016 (Huntington District) July 8, 2016 (Pittsburgh District)
	Section 10 RHA Permit	Application filed July 8, 2016 (only applicable to Huntington District)
U.S. Environmental Protection Agency Region 3	Section 404, CWA	Consultation through the USACE process
	CAA	Delegated to WVDEP, Division of Air Quality
U.S. Fish and Wildlife Service – West Virginia Field Office	Section 7 ESA, MBTA, and BGEPA Consultation	Ongoing
U.S. Department of Agriculture Natural Resources Conservation Service	Farmland Protection Policy Act, Conservation Reserve Program, and Wetland Reserve Program	Ongoing
West Virginia		
West Virginia Division of Culture and History (SHPO)	Section 106 NHPA Consultation	Ongoing
West Virginia Department of Environmental Protection – Division of Air Quality	Air Permit – Title V Permit	Application submitted on April 29, 2016
West Virginia Department of Environmental Protection – Division of Water and Waste Management	Section 401, CWA	Application filed on July 21, 2016
	General Water Pollution Control Permit	Application filed April 27, 2017
	NPDES, Water Pollution Control Permit for Hydrostatic Testing	Anticipated application date: August 2017
	Large Quantity Water User Registration	Anticipated application date: August 2017
West Virginia Department of Natural Resources– Natural Heritage Program	Consultation	Consultations began July 2015; Ongoing
West Virginia Department of Natural Resources– Office of Land and Streams	Stream Activity Permit (Joint Application with the Public Lands Corporation)	Anticipated application date: August 2017
Local		
All affected counties **a**/	Floodplain Ordinance Permit	Anticipated application date: August 2017

a Floodplain Ordinance Permits are only required in FEMA designated floodplains; therefore, they may not be required at all facilities.

Table 1.5-2 Major Permits, Approvals, and Consultations for the Gulf XPress Project		
Agency	**Permit/Approval/ Consultation**	**Status**
Federal		
Federal Energy Regulatory Commission	Section 7(c) NGA, Certificate of Public Convenience and Necessity	Application filed April 29, 2016
U.S. Army Corps of Engineers Louisville District Nashville District Vicksburg District	Section 404, CWA Permit	Pre-construction notification submitted on June 22, 2017 **a/**
U.S. Environmental Protection Agency Region 4	Section 404, CWA	Consultation through the USACE process
	CAA	Ongoing
U.S. Fish and Wildlife Service – Kentucky, Tennessee, and Mississippi Field Offices	Section 7 ESA, MBTA, and BGEPA Consultation	Consultation complete
U.S. Department of Agriculture Natural Resources Conservation Service	Farmland Protection Policy Act, Conservation Reserve Program, and Wetland Reserve Program	Consultation complete
Kentucky		
Kentucky Department of Environmental Protection	Section 401, CWA	Not applicable **b/**
	Air Permit – Title V Permit	Permit issued.
	General Permit No. KYR100000 for Stormwater Discharges	Anticipated application date: September 2017
	NPDES Permit for Hydrostatic Test Water Discharge	Anticipated application date: Summer 2017
	Erosion and Sediment Control – Stormwater Pollution Prevention Plan (SWPPP)	Anticipated application date: September 2017
Kentucky Heritage Council (SHPO)	Section 106 NHPA Consultation	Consultation complete
Kentucky Department of Fish and Wildlife Resources	Natural Heritage/Protected Species Consultation	Consultation complete
Tennessee		
Tennessee Department of Environment and Conservation	Section 401, CWA Permit	Not applicable **b/**
	Air Permit – Title V Permit	Application filed May 26, 2016
	Hydrostatic Test Water Discharge General Permit	Anticipated application date: Summer 2017
	Construction Stormwater General Permit No. TNR 100000	Anticipated application date: September 2017
	SWPPP	Anticipated application date: September 2017
Tennessee Department of Environment and Conservation, Tennessee Historical Commission (SHPO)	Section 106 NHPA Consultation	Consultation complete
Tennessee Department of Environment and Conservation, Natural Heritage Inventory Program	Natural Heritage/Protected Species Consultation	Consultation complete

Table 1.5-2 Major Permits, Approvals, and Consultations for the Gulf XPress Project		
Agency	**Permit/Approval/ Consultation**	**Status**
Mississippi		
Mississippi Department of Environment Quality	Section 401, CWA Permit	Not applicable **b**/
	Air Permit – Title V Permit	Permit issued
	Hydrostatic Test Water Discharge General Permit	Anticipated application date: Summer 2017
	Construction Stormwater General Permit	Anticipated application date: September 2017
	SWPPP	Anticipated application date: September 2017
Mississippi Department of Archives and History (SHPO)	Section 106 NHPA Consultation	Consultation complete
Mississippi Department of Wildlife, Fish, and Parks – Museum of Natural Science	Consultation	Consultation complete
Local		
Carter County, Kentucky	Floodplain Permit	Anticipated application date: September 2017
Metropolitan Government of Nashville & Davidson County	Air Permit - Title V Permit	Anticipated application date: Summer 2017
Granada County, Mississippi	Floodplain Permit	Anticipated application date: September 2017
a Assumes automatic coverage under Nationwide 12 Permit. b Assumes automatic coverage under Nationwide 12 Permit.		

1.5.1 Endangered Species Act

Section 7 of the ESA, as amended, states that any project authorized, funded, or conducted by any federal agency (e.g., FERC) should not "…jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined… to be critical…" (16 USC section 1536(a)(2) (1988)). FERC, or Columbia Gas/Columbia Gulf as our non-federal representative, is required to consult with the USFWS and/or the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries) to determine whether federally listed endangered or threatened species or designated critical habitat are found in the vicinity of the proposed projects. If FERC determines that such species or habitats may be impacted by the projects, FERC is required to prepare a BA to identify the nature and extent of adverse impact, and to recommend measures to avoid or reduce potential impacts on habitat and/or species. If, however, FERC determines that no federally listed or proposed endangered or threatened species or their designated critical habitat would be impacted by the projects, no further action is necessary under the ESA. See section 4.7 for the status of our compliance with section 7 of the ESA.

1.5.2 Migratory Bird Treaty Act

Migratory birds are species that nest in the United States and Canada during the summer and then migrate south to the tropical regions of Mexico, Central and South America, and the Caribbean for the non-breeding season. Migratory birds are protected under the MBTA (16 USC 703–711; MBTA). Executive Order (EO) 13186 (66 FR 3853) directs federal agencies to, among other things, identify where unintentional take is likely to have a measurable negative effect on migratory bird populations. The goal is to work with the USFWS in avoiding or minimizing adverse impacts on migratory birds, with emphasis placed on species of concern, priority habitats, and key risk factors. Particular focus is given to addressing population-level impacts.

On March 30, 2011, the USFWS and the Commission entered into a *Memorandum of Understanding Between the Federal Energy Regulatory Commission and the U.S. Department of the Interior United States Fish and Wildlife Service Regarding Implementation of Executive Order 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds"* (MBTA MOU) that focuses on avoiding or minimizing adverse impacts on migratory birds and strengthening migratory bird conservation through enhanced collaboration between the two agencies. See section 4.6.3 of this EIS for the status of our consultations regarding the MBTA.

1.5.3 Rivers and Harbors Act

The RHA pertains to activities in navigable waters as well as harbor and river improvements. Section 10 of the RHA prohibits the unauthorized obstruction or alteration of any navigable water of the United States. Construction of any structure or the accomplishment of any other work affecting course, location, condition, or physical capacity of waters of the United States must be authorized by the USACE. The Kanawha River (MP 146.6) is a section 10 navigable water that would be crossed using horizontal directional drilling (HDD). Although direct impacts would be avoided, Columbia Gas would still need to obtain a section 10 authorization from the USACE. Details regarding HDD crossings of waterbodies are included in section 2.4.4.2 of this EIS.

1.5.4 Clean Water Act

The CWA, as amended, regulates the discharges of pollutants into waters of the United States and regulates quality standards for surface waters. To enact this goal, both the EPA and the USACE have regulatory authority under this statute. The EPA has implemented pollution control programs including setting wastewater standards for industry and creating water quality standards for all contaminants in surface waters. Under the CWA, it is unlawful to discharge any pollutant from a point source into waters of the United States without a permit. The EPA operates the NPDES permit program that regulates discharges by industrial, municipal, and other facilities, if discharges directly enter surface waters. Section 404 of the CWA regulates the discharge of dredged or fill material into waters of the United States and is under jurisdiction of the USACE. The status of NPDES and section 404 permitting requirements are further addressed in sections 4.3.1.1.1 (for MXP) and 4.3.2.4.2 (for GXP) of this EIS, respectively.

Section 401 of the CWA requires that a federal permit applicant who conducts any activity that may result in a discharge to waters of the United States must provide the federal regulatory

agency with a section 401 certification. Section 401 certifications are made by the state in which the discharge originates and declare that the discharge would comply with applicable provisions of the act, including the state water quality standards. The WVDEP Division of Water and Waste Management is the applicable regulatory authority delegated with section 401 certification for West Virginia. The Kentucky Department of Environmental Protection (KDEP), Tennessee Department of Environment and Conservation (TDEC), and Mississippi Department of Environment Quality (MDEQ) are the applicable regulatory authorities delegated with section 401 certification for Kentucky, Tennessee, and Mississippi, respectively.

1.5.5 Clean Air Act

The CAA defines the EPA's responsibilities for protecting and improving the nation's air quality and the stratospheric ozone (O_3) layer. Under the CAA, the EPA sets limits on certain air pollutants and grants them the authority to limit emissions of air pollutants coming from sources such as industrial facilities. The EPA has delegated authority to implement these regulations to state and local agencies. The WVDEP Division of Air Quality, KDEP, TDEC and MDEQ are responsible for enforcement of air quality standards at a state level as well as enforcement of the State Implementation Plan (SIP) required under the CAA in their respective states.

The EPA issued a rule in 2010 finalizing greenhouse gas (GHG) reporting requirements for the petroleum and natural gas industry (40 CFR 98). West Virginia, Kentucky, Tennessee, and Mississippi have modified their SIPs to regulate GHGs and issue permits for GHGs for large and modified sources under the Prevention of Significant Deterioration (PSD) program. See section 4.11.1 of this EIS for additional information regarding the status of project compliance with the CAA and SIPs.

1.5.6 National Historic Preservation Act

Section 106 of the NHPA, as amended, requires FERC to consider the effects of its undertakings on historic properties, and afford the Advisory Council on Historic Preservation (ACHP) an opportunity to comment. Historic properties include pre-contact or historic sites, districts, buildings, structures, objects, or properties of traditional religious or cultural importance listed in or eligible for listing in the National Register of Historic Places (NRHP). In accordance with the ACHP's regulations for implementing section 106, at 36 CFR 800.2(a)(3), FERC is using the services of Columbia Gas and Columbia Gulf and its consultants to prepare information, analyses, and recommendations. Section 4.10.4 of this EIS summarizes the status of our compliance with the NHPA.

2.0 DESCRIPTION OF THE PROPOSED ACTION

2.1 MOUNTAINEER XPRESS PROPOSED FACILITIES

Under the MXP, Columbia Gas proposes to construct and operate buried natural gas pipelines and related aboveground facilities in West Virginia. An overview map showing the MXP location is provided as figure 2.1-1. Detailed maps showing the proposed pipeline routes and aboveground facility locations are provided in appendix B-1. Details regarding construction procedures and different pipeline installation methodologies are discussed in section 2.4.

2.1.1 Pipeline Facilities

The MXP includes about 170.7 miles of pipeline composed of the following facilities, all in West Virginia:

- installation of approximately 164.3 miles of 36-inch-diameter natural gas transmission pipeline (MXP-100) located in Marshall, Wetzel, Tyler, Doddridge, Ritchie, Mason, Calhoun, Wirt, Roane, Jackson, Putnam, Mason, and Cabell Counties, with two of the proposed contractor yards located in Wood County;
- installation of about 5.9 miles of 24-inch-diameter natural gas pipeline (MXP-200) in Doddridge County;
- installation of approximately 296 feet of new 10-inch-diameter natural gas pipeline at the Ripley Regulator Station to tie Columbia Gas' existing X59M1 pipeline into the MXP-100; and
- replacement of approximately 0.4 mile of 30-inch-diameter natural gas pipeline on segments of Columbia Gas' SM80 and SM80 Loop pipelines (approximately 0.2-mile continuous segments on each pipeline) with new 30-inch-diameter natural gas pipeline in Cabell County.

Most of the proposed pipelines (95.5 percent) would be constructed on privately owned land. Approximately 22 percent would be co-located with existing utilities.

According to Columbia Gas, the MXP-100 pipeline would provide an additional 2,700,000 Dth/d of available capacity for firm transportation service to Columbia Gas' TCO Pool for delivery to markets across CPG's system, including the Columbia Gulf Leach interconnect with Columbia Gulf (located in Leach, Kentucky). The MXP-100 pipeline would begin at a tie-in site (MP 0.0) with Columbia Gas' Leach XPress Project (LXP)[15] pipeline in Marshall County, West Virginia, and would end in Cabell County, West Virginia, at MP 163.9.

[15] On June 8, 2015, Columbia Gas filed its application under sections 7(b) and 7(c) of the NGA and part 157 of the Commission's regulations to construct, operate, and maintain certain interstate natural gas pipeline facilities in Ohio, Pennsylvania, and West Virginia. Columbia Gas' proposed facilities, referred to as the LXP, were assigned Docket No. CP15-514-000. We issued the final EIS for LXP and the Rayne XPress Project on September 1, 2016. The Commission issued Certificates and approved both projects on January 19, 2017.

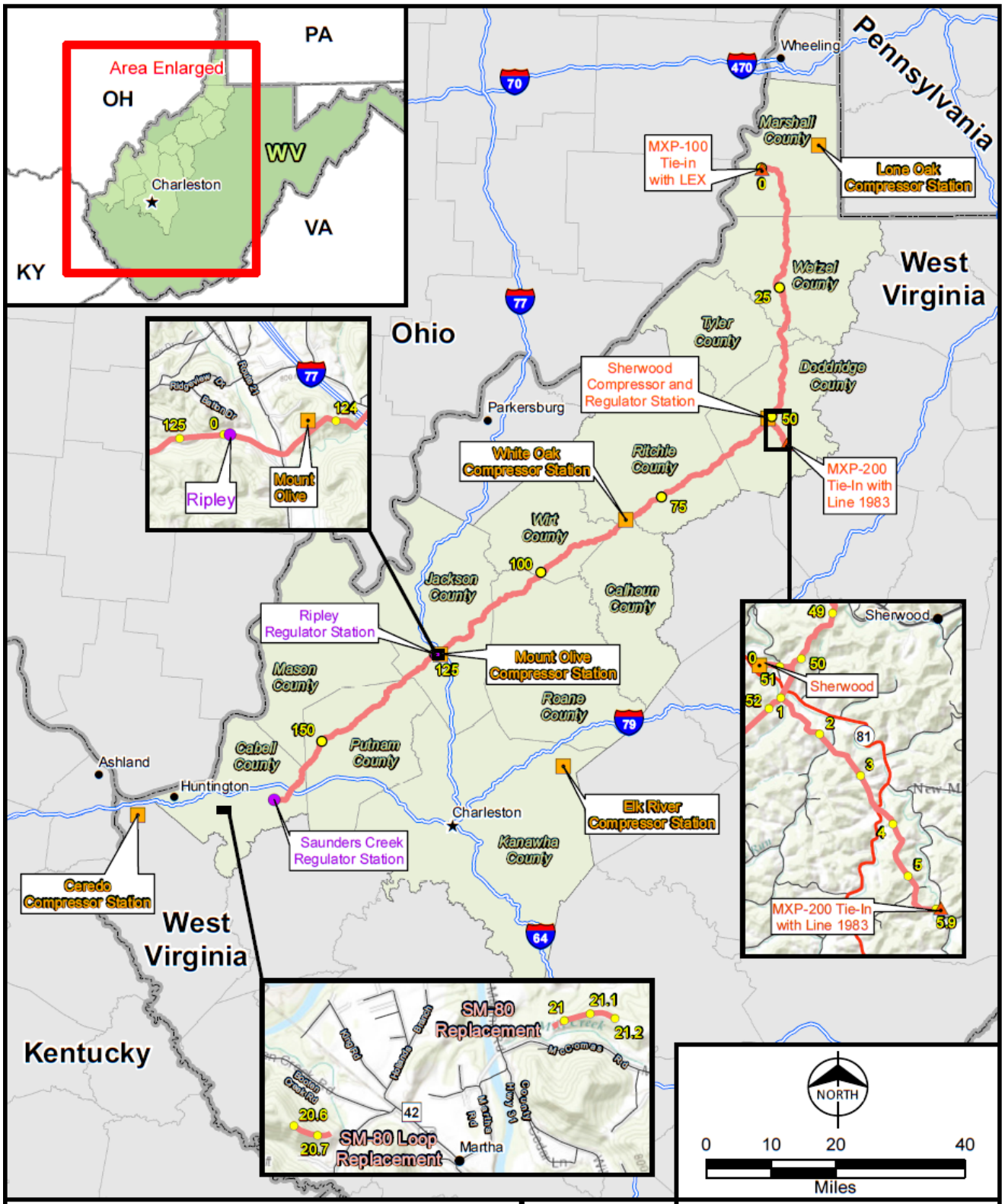


Figure 2.1-1
Project Location Map
Mountaineer XPress Project
Columbia Gas Transmission

Source: ESRI and Burns & McDonnell Engineering Co., Inc.

Issued: 3/9/2017

The proposed MXP-200 line would connect the proposed MXP-100 line with Columbia Gas' existing Line 1983. Columbia Gas states that connecting the two transmission pipelines would give it greater flexibility in scheduled operation and maintenance activities and enable the option of delivering and/or receiving natural gas from Line 1983.

Pursuant to section 7(b) of the NGA, Columbia Gas would replace a 0.4-mile-long section of its SM80/SM80 Loop pipeline system to restore the maximum allowable operating pressure (MAOP) of these lines. The segments of pipeline to be replaced would be removed, and the replacement pipe would be installed in the original ditch and alignment. The replacement pipe, referred to as a class change replacement, would have a heavier wall thickness and would be used because of the increased number of residences/homes in these areas.

2.1.2 Aboveground Facilities

Columbia Gas proposes to modify facilities at one existing compressor station (Ceredo), one recently approved new compressor station (Lone Oak — approved as part of the LXP, FERC Docket No. CP15-514-000), and one new compressor station pending under a separate proceeding (WB XPress Project [WBX], FERC Docket No. CP16-38-000). In addition, Columbia Gas proposes to construct three new compressor stations, three new regulator stations, and other appurtenant facilities (see table 2.1-1).

Table 2.1-1
Proposed Aboveground Facilities for the Mountaineer XPress Project

Facility Name	Milepost	Horsepower	Diameter (inches)	County
New Aboveground Facilities				
MXP-100 Tie-in with LEX a/	0.0	N/A	36	Marshall
MXP-1 Valve Site	10.2	N/A	36	Marshall
MXP-2 Valve Site	20.4	N/A	36	Wetzel
MXP-3 Valve Site	29.5	N/A	36	Wetzel
MXP-4 Valve Site	38.3	N/A	36	Doddridge
Sherwood Compressor and Regulator Station (includes MXP-200 tie-in)	50.5	47,000	N/A	Doddridge
MXP-200 Tie-in with Line 1983	6.0	N/A	24	Doddridge
MXP-5 Valve Site	60.4	N/A	36	Doddridge
MXP-6 Valve Site	72.3	N/A	36	Ritchie
White Oak Compressor Station	82.3	44,800	N/A	Calhoun
MXP-7 Valve Site	96.6	N/A	36	Wirt
MXP-8 Valve Site	113.3	N/A	36	Jackson
Mount Olive Compressor Station	124.3	61,500	N/A	Jackson
Ripley Regulator Station	124.9	N/A	36	Jackson
X59M1 Tie-in	124.9	N/A	10	Jackson
MXP-9 Valve Site	134.9	N/A	36	Putnam
MXP-10 Valve Site	148.4	N/A	36	Putnam
Saunders Creek Regulator Station	164.5	N/A	36	Cabell
Modifications to Aboveground Facilities				
Lone Oak Compressor Station b/	N/A	15,900	N/A	Marshall
Ceredo Compressor Station	N/A	43,000	N/A	Wayne
Elk River Compressor Station c/	N/A	15,900	N/A	Kanawha

a LEX is an approved pipeline operational name associated with LXP (Docket No. CP15-514-000, Order issued 1-19-17).
b Approved Columbia Gas compressor station under the LXP (Docket No. CP15-514-000, Order issued Jan. 19, 2017).
c Pending compressor station proposed by Columbia Gas under the WBX (Docket No. CP16-38-000).

Proposed MXP modifications at the approved Lone Oak Compressor Station (LXP), and the pending Elk River Compressor Station (under the WBX) do not rely solely on the completion of either the LXP or the WBX. If these projects do not receive the required approval from FERC to proceed, Columbia Gas states it would alter the scope of the MXP, and potentially amend its application, to meet the purpose and need of the project by expansion of existing Columbia Gas facilities elsewhere. See section 3.0 for a discussion of alternative configurations.

2.1.2.1 Tie-in and Regulator Facilities

MXP-100 Tie-in: This new tie-in with the LXP pipeline, referred to as "LEX" would enable bi-directional flow and include a pig launcher/receiver to receive/deliver natural gas from Columbia Gas' proposed LEX pipeline.[16] This tie-in facility would be located at MP 0.0 in Marshall County.

MXP-200 Tie-in: This new tie-in with Line 1983 would enable bi-directional flow and include a pig launcher/receiver to connect the proposed MXP-200 pipeline with Columbia Gas' existing Line 1983. This tie-in facility would be located at the end of MXP-200 pipeline (MP 6.0) on property owned by Columbia Gas in Doddridge County.

Saunders Creek Regulator Station: This new regulator station would include a pig launcher/receiver and associated equipment to deliver natural gas to Columbia Gas' existing SM80 and SM80 Loop pipelines. The tie-in and regulating station would be sited where the MXP-100 pipeline terminates at Columbia Gas' existing system (MP 164.3) in Cabell County.

Ripley Regulator Station: This new regulator station with associated equipment, would deliver natural gas to Columbia Gas' existing X59M1 pipeline, via a new tie-in, at MXP-100 pipeline near milepost 124.9.

2.1.2.2 New Compressor Stations

Sherwood Compressor and Regulator Station: This new compressor station would consist of four natural gas-fired compressor units totaling 47,000 International Standards Organization (ISO) horsepower (hp) and be constructed at the beginning of the MXP-200 pipeline (on the MXP-100 at MP 50.7). The station would also include three pig launcher/receivers and pressure regulation for interconnections with the MXP-100 and MXP-200 pipelines. Additionally, Columbia Gas proposes to connect at this facility with a planned non-jurisdictional pipeline to be constructed, owned, and operated by MarkWest. The Sherwood Compressor and Regulator Station and all associated equipment would be constructed on property purchased by Columbia Gas in Doddridge County.

White Oak Compressor Station: This new compressor station would include two natural gas-fired compressor units totaling 44,800 ISO hp to be constructed on the MXP-100 pipeline at

[16] A pipeline "pig" is a device that internally cleans or inspects the pipeline. A pig launcher/receiver is an aboveground facility where pigs are inserted into or retrieved from the pipeline.

MP 82.2. It also would include two pig launcher/receivers. The station and associated equipment would be constructed on property purchased by Columbia Gas in Calhoun County.

Mount Olive Compressor Station: This new compressor station would include three natural gas-fired compressor units totaling 61,500 ISO hp and be constructed on the MXP-100 pipeline at MP 124.2. It also would include two pig launcher/receivers. The station and associated equipment would be constructed on property purchased by Columbia Gas in Jackson County.

2.1.2.3 Compressor Station Modifications

Lone Oak Compressor Station: Columba Gas proposes adding one 15,900 ISO-hp natural gas-fired compressor unit and other related equipment to its Lone Oak Compressor Station in Marshall County (associated with the approved LXP).

Ceredo Compressor Station: Columbia Gas is proposing to add two compressor units, one natural gas-fired unit (30,000 ISO hp) and one electric motor-driven unit (13,000 ISO hp) and other related equipment at its existing Ceredo Compressor Station in Wayne County.

Elk River Compressor Station: Columbia Gas would add one gas-fired compressor unit (approximately 15,900 ISO hp) and other related equipment to its pending Elk River Compressor Station in Kanawha County (associated with the proposed WBX).

2.2 GULF XPRESS PROJECT

The GXP would involve construction of seven new midpoint compressor stations on Columbia Gulf's system in Kentucky, Tennessee, and Mississippi. The existing system includes Columbia Gulf's existing 30-inch-diameter Mainline 100, existing 30-inch-diameter Mainline 200, and existing 36-inch-diameter Mainline 300. Columbia Gulf would also add compression and/or improvements at one recently certificated compressor station and one meter station on Columbia Gulf's system in Kentucky. One of these compressor stations is the Grayson Compressor Station recently certificated (January 19, 2017) as part of the Rayne XPress Expansion Project (RXP) under Docket No. CP15-539-000. The Commission issued the Order for LXP and the RXP on January 19, 2017. Table 2.2-1 provides an overview of the proposed GXP facilities. An overview map showing the proposed GXP facility locations is provided as figure 2.2-1. Detailed maps showing the aboveground facility locations are provided in appendix B-2.

Table 2.2-1 Proposed Aboveground Facilities for the Gulf XPress Project		
Facility Name	**Horsepower**	**County**
New Compressor Stations		
Kentucky		
Morehead Compressor Station	44,800	Rowan
Paint Lick Compressor Station	41,000	Garrard
Goodluck Compressor Station	31,800	Metcalfe
Tennessee		
Cane Ridge Compressor Station	41,000	Davidson
Clifton Junction Compressor Station	31,800	Wayne
Mississippi		
New Albany Compressor Station	31,800	Union
Holcomb Compressor Station	31,800	Grenada
Modifications to Existing Facilities		
Kentucky		
Grayson Compressor Station **a**/	15,900	Carter
Leach C Meter Station	N/A	Boyd
Total Horsepower	**269,900**	
a Columbia Gulf certificated compressor station under the RXP (Docket No. CP15-539-000).		

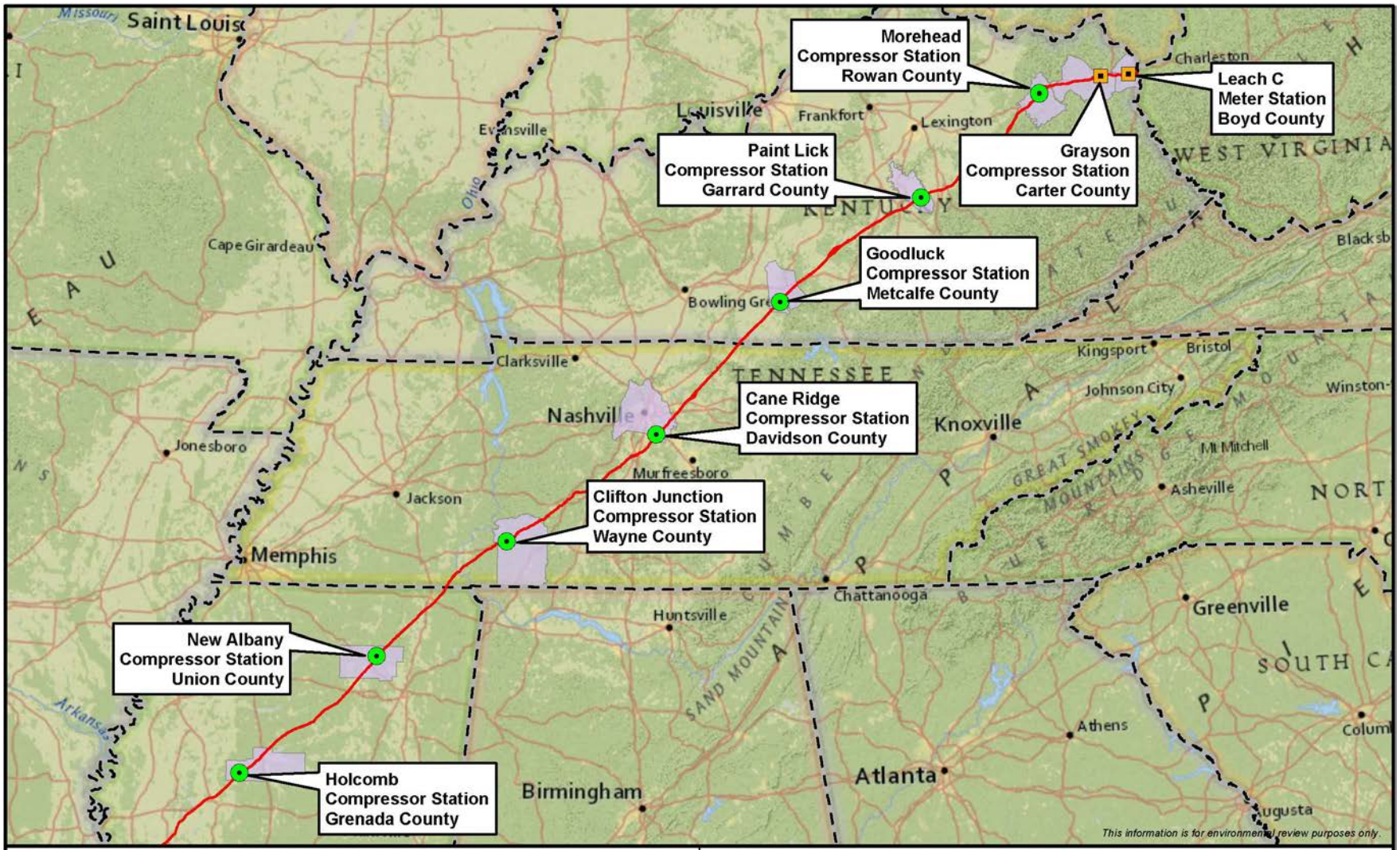


Figure 2.2-1
Project Overview Map
Gulf XPress Project

2.2.1 Aboveground Facilities

2.2.1.1 New Compressor Stations

Morehead Compressor Station: This new 44,800-hp station would be constructed on property owned by Columbia Gulf in Rowan County, Kentucky. The Morehead Compressor Station would include two Solar Turbines Titan 130E natural gas-fired turbine-driven compressors housed in one compressor building, filter/separators, gas cooling bays, and suction and discharge piping. The station would have bidirectional capabilities to compress gas north or south on Columbia Gulf's existing Mainline 200 and 300, and flow gas into the existing Mainline 100. All facilities would be fenced. A new paved permanent access road would extend 104 feet from Kentucky State Highway 377 (Cranston Road) to the fenced facility.

Paint Lick Compressor Station: This new 41,000-hp station would be constructed on property owned by Columbia Gulf in Garrard County, Kentucky. The Paint Lick Compressor Station would include two Solar Turbines Titan 130 natural gas-fired turbine-driven compressors housed in one compressor building, filter/separators, gas cooling bays, and suction and discharge piping. The station would have bidirectional capabilities to compress gas north and south on Lines 200 and 300 and flow gas into Line 100. All facilities would be fenced. A new paved permanent access road would extend 1,126 feet from Richmond Road to the fenced facility.

Goodluck Compressor Station: This new 31,800-hp compressor station would be constructed on property owned by Columbia Gulf in Metcalfe County, Kentucky. The Goodluck Compressor Station would include two Solar Turbines Mars 100 natural gas-fired turbine-driven compressors housed in one compressor building, filter/separators, gas cooling bays, and suction and discharge piping. The suction and discharge piping would extend roughly 350 feet west from the compressor station area, across property owned by Columbia Gulf, to tie into Columbia Gulf's existing system (Lines 100, 200, and 300). The station would compress gas south on Lines 200 and 300 and flow gas into Line 100. All facilities would be fenced. A new paved permanent access road would extend 183 feet from Earl Shives Road to the new fenced facility.

Cane Ridge Compressor Station: This new 41,000-hp compressor station would be constructed on property owned by Columbia Gulf in Davidson County, Tennessee. The Cane Ridge Compressor Station would include two Solar Turbines Titan 130 natural gas-fired turbine-driven compressors housed in one compressor building, filter/separators, gas cooling bays, and suction and discharge piping. The suction and discharge piping would extend roughly 870 feet southeast from the compressor station area, across property owned by Columbia Gulf, to tie into Columbia Gulf's existing system. Due to the length of the suction and discharge piping, an approximately 16-foot-wide by 700-foot-long permanent asphalt access road would parallel the suction and discharge piping to provide access to the mainline valve (MLV) pad located within the permanent easement for Columbia Gulf's existing system. The station would compress gas south on Lines 200 and 300 and flow gas into Line 100. All facilities would be fenced. A new paved permanent access road would extend for 192 feet from Barnes Road to the fenced facility.

Clifton Junction Compressor Station: This new 31,800-hp station would be constructed on property owned by Columbia Gulf in Wayne County, Tennessee. The Clifton Junction Compressor Station would include two Solar Turbines Mars 100 natural gas-fired turbine-driven

compressors housed in one compressor building, filter/separators, gas cooling bays, and suction and discharge piping. The suction and discharge piping would extend roughly 620 feet east and north from the compressor station area, across property owned by Columbia Gulf, to tie-into Columbia Gulf's existing system. The station would compress gas south on Lines 200 and 300 and flow gas into Line 100. All facilities would be fenced. A new paved permanent access road would extend 2,096 feet from U.S. Route 64 to the fenced facility.

New Albany Compressor Station: This new 31,800-hp station would be constructed on property owned by Columbia Gulf in Union County, Mississippi. The New Albany Compressor Station would include two Solar Turbines Mars 100 natural gas-fired turbine-driven compressors, filter/separators, gas cooling bays, and suction and discharge piping. The station would compress gas south on Lines 200 and 300 and flow gas into Line 100. All facilities would be fenced. A new paved permanent access road would extend for 64 feet from County Road 137 to the fenced facility.

Holcomb Compressor Station: This new 31,800-hp station would be constructed on property owned by Columbia Gulf in Grenada County, Mississippi. The Holcomb Compressor Station would include two Solar Turbines Mars 100 natural gas-fired turbine-driven compressors, filter/separators, gas cooling bays, and suction and discharge piping. The station would compress gas south on Lines 200 and 300 and flow gas into Line 100. All facilities would be fenced. A new paved permanent access road would extend 463 feet from Ferguson Road to the fenced facility.

At each new compressor station, Columbia Gulf would install two new 30-inch MLVs on Lines 100 and 200, and one new 36-inch MLV on Line 300. The MLVs would be located inside the fenced boundary of each compressor station site.

2.2.1.2 Modifications to Existing Aboveground Facilities

Grayson Compressor Station: Columbia Gulf proposes to add a 15,900-hp compressor to the recently approved 36,400-hp Grayson Compressor Station in Carter County, Kentucky, as part of Columbia Gulf's RXP. The upgrade would include one Solar Turbines Mars 100 natural gas-fired turbine-driven compressor and associated piping within the existing compressor building. A majority of the workspace would be within the fenceline of the existing facility; however, Columbia Gulf proposes to use some temporary workspace (TWS) outside the facility fenceline on land owned by Columbia Gulf that would be disturbed during the initial construction of the station. The facility would be accessed via an access road associated with the RXP that would extend from Beckwith Branch Road.

Leach C Meter Station: Columbia Gulf proposes to upgrade flow control capabilities at the existing Leach C Meter Station in Boyd County, Kentucky to accommodate an increase in capacity on Line 300. The existing flow control building would be demolished and replaced with a new flow control building. Piping and instrumentation upgrades would occur as necessary within the existing facility fenceline. TWS would be required outside the existing facility fenceline. The site is accessed via an existing access road that extends 420 feet to Bethel Lane, which connects to Dog Fork Laurel Road.

2.3 LAND REQUIREMENTS

2.3.1 Mountaineer XPress Project

Construction of the MXP would require disturbance within existing facilities, existing permanent rights-of-way, TWS, ATWS, pipe yards, staging areas, and temporary access roads. New permanent rights-of-way and access roads would be required for the pipelines and new aboveground facilities. These areas are collectively referred to as the construction work area. Land requirements for construction and operation of the MXP are summarized in table 2.3-1. Construction activities would require about 3,647 total acres. Of the construction acreage, operational activities would retain about 1,076 acres; including about 1,028 acres of proposed new permanent pipeline rights-of-way, and about 42 acres of new proposed aboveground facilities (including permanent facility access roads) that would be retained for operational activities. Approximately 2,570 acres (total construction impacts minus total operational impacts) of TWS, ATWS, staging areas, and access roads would be used temporarily during construction and would revert to preconstruction conditions and use. Appendix F identifies access roads for the MXP. The MLVs would be sited within the 50-foot-wide permanent pipeline easement as much as possible; however, several MLVs would require a permanent footprint that would extend slightly beyond the 50-foot-wide permanent pipeline easement (discussed further in section 2.3.1.2).

The temporary access roads would be either newly constructed, existing roads requiring improvements, or existing roads used in their present condition. Improvements may include widening, grading, addition of gravel, replacement/installation of culverts with crushed-stone fill, and removal of overhanging vegetation. Overall, the MXP would require 303 access roads — comprising 57 new roads (41 during construction, 16 for permanent use), 220 existing roads requiring modification (210 during construction, 10 for permanent use), and 26 existing roads used as-is. New road construction would total about 4.7 miles, primarily the result of temporary access along the MXP-100. Columbia Gas would minimize impacts by installing and maintaining erosion control devices and removing mud from paved road surfaces.

Table 2.3-1
Land Requirements for the Mountaineer XPress Project a/

Project Facility	Land Affected During Construction (acres)	Land Affected During Operation (acres)
New Pipeline Facilities		
Pipeline Right-of-Way		
MXP-100 b/	2,459.4	994.4
Cathodic Protection	3.0	3.0
MXP-200 c/	59.9 d/	30.1 d/
Cathodic Protection	0.4	0.4
X59M1 Line	0.0 e/	0.0 e/
Pipeline Right-of-Way Subtotal	2,522.6	1,027.9
Additional Temporary Workspace		
MXP-100 ATWS	190.0	0.0
MXP-200 ATWS	2.8	0.0
X59M1 Line ATWS	0.2	0.0

Table 2.3-1 Land Requirements for the Mountaineer XPress Project a/		
Project Facility	**Land Affected During Construction (acres)**	**Land Affected During Operation (acres)**
ATWS Subtotal	193.0	0.0
Access Roads		
MXP-100 Access Roads	273.5	1.6
MXP-200 Access Roads	25.9	0.0
Access Roads Subtotal	299.4	1.6
Contractor/Pipe Yards and Staging Areas		
Pipe Yards (40)	291.7	0.0
Staging Areas (90)	204.0	0.0
Contractor/Pipe Yards and Staging Areas Subtotal	495.7	0.0
Replacement Pipeline Facilities e/		
Pipeline Right-of-Way		
SM80 Line	2.8	1.9 **f/**
SM80 Loop Line	2.3	1.4 **f/**
Replacement Pipeline Right-of-Way Subtotal	5.1	3.3 **f/**
Additional Temporary Workspace		
SM80 Line	1.1	0.0
SM80 Loop Line	0.8	0.0
ATWS Subtotal	1.9	0.0
Access Roads		
SM80 Line Access Road	0.3	0.3
SM80 Loop Line Access Roads	2.1	1.8
Access Roads Subtotal	2.4	2.1
Total for All Pipeline Facilities	**3,520.1**	**1,034.9**
New Aboveground Facilities g/, h/		
Compressor Stations (including new permanent access roads at facility)		
Sherwood Compressor and Regulator Station	29.7	11.8
White Oak Compressor Station	16.6	8.7
Mount Olive Compressor Station	31.3	9.2
New Compressor Stations Subtotal	77.6	29.7
Mainline Valves (MLV) **g/**		
MLV-1	1.5	1.6
MLV-2	0.2	0.3
MLV-3	0.1	0.2
MLV-4	0.0	0.1
MLV-5	0.0	0.2
MLV-6	0.1	0.1
MLV-7	0.0	0.1
MLV-8	0.0	0.1
MLV-9	<0.1	0.1
MLV-10	0.2	0.4

Table 2.3-1
Land Requirements for the Mountaineer XPress Project a/

Project Facility	Land Affected During Construction (acres)	Land Affected During Operation (acres)
MLV Subtotal	2.1	3.2
Delivery/Receipt Points i/		
MXP-100 Tie-in with LEX pipeline	2.8	0.3
MXP-200 Tie-in with Line 1983	0.7	0.4
MXP-100 Tie-in with Line X59M1	0.0	<0.1
Ripley Regulator Station	1.0	1.0
Saunders Creek Regulator Station	10.7	7.0
Delivery/Receipt Points Subtotal	15.2	8.7
Additional Temporary Workspace		
Ripley Regulator Station	0.1	0.0
ATWS Subtotal	0.1	0.0
Existing Aboveground Facilities		
Lone Oak Compressor Station	10.3	0.0
Ceredo Compressor Station	14.3	0.0
Elk River Compressor Station	7.4	0.0
Existing Aboveground Facilities Subtotal	32.0	0.0
Total Aboveground Facilities	**127.0**	**41.6**
TOTAL PROJECT LAND AFFECTED	**3,647.1**	**1,076.5**

a The numbers in this table have been rounded for presentation purposes. Thus, the totals may not reflect the exact sum of the addends in all cases.

b Based on a typical 125-foot-wide construction right-of-way in uplands and a 75-foot-wide right-of-way in wetlands. Operation acreage is based on a 50-foot-wide permanently maintained right-of-way in uplands, a 30-foot-wide permanently maintained right-of-way in forested wetlands, and a 10-foot-wide permanently maintained right-of-way in non-forested wetlands. Acreage includes lands affected during construction and operation of cathodic protection systems.

c Based on a typical 100-foot-wide construction right-of-way in uplands and a 75-foot-wide right-of-way in wetlands. Operation acreage is based on a 50-foot-wide permanently maintained right-of-way in uplands, a 30-foot-wide permanently maintained right-of-way in forested wetlands, and a 10-foot-wide permanently maintained right-of-way in non-forested wetlands. Acreage includes lands affected during construction and operation of cathodic protection systems. Maintenance of permanent rights-of way would be in accordance with the Plan and Procedures.

d Temporary and permanent workspace acreages in areas where the three pipelines share a 155-foot-wide temporary workspace (MXP-100 in to station, MXP-100 out of station, and the MXP-200 pipelines) would be co-located have been included in acreages listed for the MXP-100 pipeline.

e Pipeline replacement facilities would require a 75-foot-wide construction right-of-way that would include the existing 50-foot-wide permanent easement. The existing permanent easement would remain 50 feet wide.

f Acreage listed for operation following replacement of short segments of the SM80 Line and SM80 Loop Line would remain within the respective pipeline's existing permanent easements.

g Each fenced valve site would be constructed within the 125-foot-wide construction right-of-way and operated within the 50-foot-wide permanent easement. Acreages associated with permanent access roads for mainline valves have been included in the 'Land Affected During Operations' acreages column. Access roads and gravel parking areas may extend outside of the permanent easement.

h Acreages identified as 'Land Affected During Construction' are associated with facility access roads where the road extends outside of the pipeline construction right-of-way. Acreages within the pipeline construction right-of-way have been accounted for in the associated pipeline acreage. This additional acreage has been included in the 'Land Affected During Operations' for each valve, where applicable.

i The tie-in locations would be constructed and operated within the area associated with the temporary and permanent pipeline right-of-way or Columbia Gas acquired property.

2.3.1.1 Pipeline Right-of-Way

MXP-100: Columbia Gas would utilize a 125-foot-wide temporary right-of-way for construction of the 36-inch-diameter pipeline in non-agricultural uplands. The construction right-of-way would consist of a 50-foot-wide spoil side and a 75-foot-wide working side, except where site conditions require specific workspace configurations that differ. A 125-foot-wide construction workspace was proposed by Columbia Gas due to the space required for topsoil segregation, spoil storage, and the establishment of safe travel lanes through mountainous terrain, which is characteristic of the majority of the proposed route. Columbia Gas would use an additional 25 feet of ATWS in certain areas within residential and agricultural upland areas, as identified on project alignments, for full-width topsoil segregation. In wetlands, Columbia Gas would reduce the construction right-of-way width to 75 feet, with 25 feet on the spoil side and 50 feet on the working side.

In most areas, Columbia Gas would retain a 50-foot-wide permanent easement centered on the pipeline following completion of construction for operation of the pipeline. Columbia Gas would maintain the pipeline rights-of way in accordance with its ECS, which is consistent with FERC's *Upland Erosion Control, Revegetation, and Maintenance Plan* (Plan) and *Wetland and Waterbody Construction and Mitigation Procedures* (Procedures).[17]

In the location where Columbia Gas intends to install three pipelines at the Sherwood Compressor Station (the MXP-100 entering the station, the MXP-100 leaving the station, and the MXP-200 leaving the station), a 155-foot-wide temporary construction workspace would accommodate the installation of all three pipelines. The permanent easement in this area would be 80 feet wide to include all three pipelines spaced approximately 15 feet apart.

Typical right-of-way configuration diagrams for the proposed MXP are provided in appendix C.

MXP-200: Columbia Gas proposes to use a 100-foot-wide temporary right-of-way with a 35-foot-wide spoil side and a 65-foot-wide working side for construction of the 24-inch-diameter pipeline. In areas where full width topsoil segregation is required, Columbia Gas would use an additional 25 feet of temporary construction workspace width to provide sufficient space to store topsoil. Columbia Gas would reduce the construction right-of-way to 75 feet wide in wetlands, with 25 feet on the spoil side and 50 feet on the working side. Following construction in uplands, a 50-foot-wide permanent easement would be maintained for operation of the pipeline. Columbia Gas would maintain the pipeline rights-of way in accordance with FERC's Plan and Procedures.

SM80 Line and SM80 Loop Line: Pipeline replacement facilities would require a 75-foot-wide construction right-of-way that would include the existing 50-foot-wide permanent

[17] The FERC Plan and Procedures are documents that comprise the best management practice standards for pipeline construction. FERC's Plan can be viewed online at https://www.ferc.gov/industries/gas/enviro/plan.pdf. FERC's Procedures can be viewed online at https://www.ferc.gov/industries/gas/enviro/procedures.pdf.

easement. The existing permanent easement would remain 50 feet wide after replacement is complete and the pipelines are operational.

Additional Temporary Workspace: Columbia Gas would require ATWS at select areas along the pipeline route based on site-specific conditions that warrant the use of additional space to construct the pipeline in a safe manner. These site-specific conditions include: road crossings, steep slopes, existing utility line crossings, HDD locations, truck turnaround areas, full right-of-way topsoil segregation areas, wetland and waterbody crossings, and at the beginning and ending of construction spreads[18] to allow for mobilization of construction equipment. Except where topographic or other factors limit the workspace, where adjacent uplands consist of actively cultivated or rotated cropland, or where otherwise specifically approved by FERC, ATWS would be set back at least 50 feet from the edge of waterbodies and wetlands. A discussion of Columbia Gas' request for ATWS within 50 feet from the edge of waterbodies and wetlands is provided in section 2.4. Although Columbia Gas has identified areas where extra workspace would be required, additional or alternative areas could be identified in the future due to changes in site-specific construction requirements. Columbia Gas would be required to file information on each of those areas for review and approval prior to use.

2.3.1.2 Aboveground Facilities

The MXP aboveground facilities would include modifications at one existing compressor station, as well as one approved compressor station and one pending compressor station proposed for construction under separate proceedings. It also would include construction of three new compressor stations. In addition, Columbia Gas proposes to construct three regulator stations and other appurtenant facilities. Construction and operational land requirements for the aboveground facilities are provided in table 2.3-1. Following construction, each station would be fenced and graveled for operation.

New compressor stations would be constructed on land purchased by Columbia Gas. Columbia Gas would maintain the property, and all facility components would be operated and maintained within the station fenceline. The TWS not permanently maintained for operation would be restored in accordance with Columbia Gas' Environmental Construction Standards (ECS), which we have reviewed and found to be generally consistent with FERC's Plan and Procedures; however, we've made recommendations for Columbia Gas to modify in accordance with the 2013 version of FERC's Plan. Columbia Gas' ECS is available in appendix D-1.

Columbia Gas would construct all the MLVs within the pipeline construction right-of-way except for MLVs 3, 8, and 10. At these sites, Columbia Gas would require slightly larger TWS to accommodate parking, construction of permanent access, and MLV fabrication. Following construction, an approximately 30-foot by 40-foot area would be fenced, graveled, and maintained within the permanent pipeline easement for each MLV site. Except for new access roads to each MLV site, no additional land beyond Columbia Gas' permanent right-of-way would be affected by operation of the MLVs.

[18] A "spread" is an individual segment of the overall project staffed by its own labor and equipment. The MXP would consist of nine construction spreads.

2.3.1.3 Contractor Yards, Pipe Storage, and Staging Areas

Columbia Gas would need temporary pipe storage and contractor yards for office trailers, parking, vehicle maintenance, and storage of materials and equipment. Land requirements for contractor yards and staging areas proposed for temporary use during construction are provided in table 2.3-1. Columbia Gas selected sites with level terrain in mostly cleared areas to limit the need for clearing, grading, and filling at each site. Following construction, yards and staging areas would be restored to pre-construction conditions and uses unless otherwise specified by the landowners.

2.3.1.4 Access Roads

To the extent feasible, Columbia Gas proposes to use existing public and private road crossings along the proposed MXP route as the primary means of accessing pipeline rights-of-way and aboveground facilities. Columbia Gas selected existing access roads that would limit congestion of construction vehicles and equipment on the right-of-way; congestion could increase the duration of construction, create unsafe conditions for workers, and potentially disrupt public use of the roads. Improvements to public and private access roads include grading, placement of gravel for stability, replacing or installing culverts, minor widening, and clearing of overhead vegetation to safely accommodate construction equipment and vehicles.

In addition to the access available via public roads, some new roads would be required to facilitate construction in remote areas, as well as to access new aboveground facilities (i.e., compressor and regulator stations, MLVs, and pig launcher/receiver assemblies) during operation. Acreages for access roads are provided in table 2.3-1. Modifications or improvements to public roads would conform to the State of West Virginia's design standards or county agency standards.

2.3.2 Gulf XPress Project

The GXP would result in new temporary and permanent impacts at each of the new compressor station sites. At the approved Grayson Compressor Station, no additional land would be permanently required beyond that used to construct the facility; however, new temporary impacts would occur outside of the current fenceline at the existing Leach C Meter Station to accommodate storage, vehicles, equipment, and construction. No contractor yards would be required for the construction of the additional facilities at the Grayson or Leach C stations. A breakdown of total land requirements for construction and operation of the GXP are summarized in table 2.3-2.

Columbia Gulf would use about 198 acres of TWS for the construction activities associated with all the GXP aboveground facilities, and about 82 acres would be permanently maintained for operations (see table 2.3-2).

Columbia Gulf proposes to construct new permanent access roads that would extend from the nearest public road to the newly fenced facilities. For existing facilities, Columbia Gulf would use the existing access roads for construction and operation. The acreages for construction of access roads were included in the construction acreages for each facility. Table 2.3-2 provides the acreages for each access road by facility.

New compressor stations would be constructed on land purchased by Columbia Gulf. Columbia Gulf would maintain the property, and all facility components would be operated and maintained within the station fenceline. The TWS not permanently maintained for operation would be restored in accordance with Columbia Gulf's ECS, which we have reviewed and found to be generally consistent with FERC's Plan and Procedures; however, we've made recommendations for Columbia Gulf to modify in accordance with the 2013 version of FERC's Plan. Columbia Gulf's ECS is available in appendix D-2.

Although Columbia Gulf has identified areas where construction workspace would be required, additional or alternative areas could be identified in the future due to changes in site-specific construction requirements. Columbia Gulf would be required to file information on each of those areas for review and approval prior to use.

Table 2.3-2
Land Requirements for the Gulf XPress Project a/

Project Facility	Land Affected During Construction (acres)	Land Affected During Operation (acres)
Kentucky		
Morehead Compressor Station	17.2	11.2
Access Road b/	--	0.1
Paint Lick Compressor Station	30.2	9.6
Access Road b/	--	0.5
Goodluck Compressor Station	25.7	13.9
Access Road b/	--	0.1
Grayson Compressor Station (existing)	11.9	0.0
Access Road b/	--	0.0
Leach C Meter Station (existing)	1.4	0.0
Access Road b/	0.1	0.0
Tennessee		
Cane Ridge Compressor Station	23.0	10.3
Access Road b/	--	0.1
Clifton Junction Compressor Station	29.0	15.1
Access Road b/	--	1.0
Mississippi		
New Albany Compressor Station	26.4	10.3
Access Road b/	--	<0.1
Holcomb Compressor Station	33.3	9.0
Access Road b/	--	0.2
Project Totals		
Compressor and Meter Stations	198.0	79.4
Access Roads b/	0.1	2.2
TOTAL PROJECT LAND AFFECTED	**198.1**	**81.6**

a The numbers in this table have been rounded for presentation purposes. As a result, the totals may not reflect the exact sum of the addends in all cases.

b Temporary impacts associated with access roads are included within the "land affected during construction" of each new facility workspace. The impact number associated with permanent access road acreages represents only the portion of the access road that is located outside of the fenced stations.

2.4 CONSTRUCTION PROCEDURES

The projects would be designed, constructed, tested, and operated in accordance with all applicable requirements included in the U.S. Department of Transportation (USDOT) regulations in 49 CFR 192, *Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards,* and other applicable federal and state regulations, including the U.S. Department of Labor's Occupational Safety and Health Administration requirements. These regulations are intended to ensure adequate protection for the public. Among other design standards, part 192 specifies pipeline material and qualification; minimum design requirements; and protection from internal, external, and atmospheric corrosion.

To reduce construction impacts, Columbia Gas and Columbia Gulf would each implement their respective ECS document for their projects. Each ECS is the Companies' comprehensive environmental manual; it provides the minimum requirements that must be followed by all personnel working on the Companies' projects. The ECSs provide personnel and contractors with instructional information to conduct work in a safe manner while limiting impacts on streams and wetland ecosystems, wildlife habitat, agricultural land, cultural resources, and the human environment. Columbia Gas' ECS was developed specifically for projects in West Virginia, and Columbia Gulf's ECS was developed specifically for the GXP and the areas where disturbances would occur. Each of the ECSs adopts and incorporates the requirements of FERC's Plan and Procedures. Additionally, the MXP ECS also adopts West Virginia-specific environmental standards established in the West Virginia *Erosion and Sediment Control Best Management Practice Manual*. Elements of the Companies' ECSs also include: construction and restoration specifications; noise impact mitigation and dust control; hydrostatic testing requirements; spill prevention, containment and control measures; environmental construction management and inspection practices; environmental training standards; and winter construction procedures. The following sections outline the general procedures proposed by the Companies for construction of their respective facilities. We have reviewed the respective ECS' and find them acceptable.

While each of the ECSs adopt and incorporate FERC's Plan and Procedures, both of the Companies have requested modifications to certain requirements. The Procedures require that prior to construction, the following information be filed with the Secretary of the Commission (Secretary) for review and written approval:

- site-specific justifications for extra work areas that would be closer than 50 feet from a waterbody or wetland (section II.A.1); and
- site-specific justifications for the use of a construction right-of-way greater than 75 feet wide in wetlands (section II.A.2).

The Procedures also require:

- where pipelines parallel a waterbody, at least 15 feet of undisturbed vegetation must be maintained between the construction right-of-way and the waterbody (and any adjacent wetland), except where maintaining this offset will result in greater environmental impact (section V.B.3.c).

Columbia Gas has submitted site-specific justifications for deviating from each of these three requirements at numerous locations (although at only one location ATWS would be needed within a wetland). Given the terrain crossed by the proposed right-of-way, it is likely that the MXP would need this flexibility. Columbia Gulf's requested modification involved siting temporary work areas within 50 feet of a wetland or waterbody and included site-specific justifications. The locations where these modifications would be located for the MXP and GXP are identified in appendices E-1 and E-2, respectively. We have reviewed the requests and find that site-specific conditions at each location support the Companies' requests.

2.4.1 General Pipeline Construction Procedures

Columbia Gas' primary pipeline construction technique for the MXP in upland areas would be standard, sequential-assembly-line installation (described below). Columbia Gas would have nine of these assembly lines or "spreads" that would each be simultaneously completing construction activities at different locations along the route. The Companies' construction at the compressor station sites would entail standard site and industrial-development-type activities.

Specialized construction methods, such as two-tone cut-and-fill methods used on steep side-slopes, HDD and Direct Pipe® methods used to cross under sensitive resources, residential-specific methods, and procedures for crossing waterbodies and wetlands would also be employed, as appropriate. These specialized construction methods are described in section 2.4.4.

2.4.1.1 Survey and Staking

After land or easement acquisitions have been finalized and before the start of construction, crews would mark the limits of the approved work areas (i.e., the construction right-of-way boundaries and extra workspace, the pipeline centerline, and approved access roads). Property owners would be notified prior to surveying and staking activities. Wetland boundaries and other environmentally sensitive areas identified in easement agreements or by federal and state agencies would be clearly marked with visible signage and fenced with erosion control devices for protection. Each project-specific ECS assigns duties to the Companies' Environmental Inspectors (EI) including "verifying the location of signs and highly visible flagging marking the boundaries of sensitive resource areas, waterbodies, wetlands, or areas with special requirements along the construction work area." Orange safety fencing would also be installed to identify wetlands, if required by USACE permitting requirements.

2.4.1.2 Clearing Operations

Clearing would be performed to remove trees, brush, and other existing vegetation from approved work areas. This would occur using a mechanical harvester. Hand cutting with chain saws may also be used in specific areas as needed, such as between HDD entry and exit sites. Timber would be removed from the right-of-way and sold for lumber or pulp if suitable, disposed of at an appropriate receiving facility, or chipped on the right-of-way. Columbia Gas does not anticipate burning of cleared woody vegetation; however, burning may be utilized in select areas at the discretion of the construction contractor and under the direction of Columbia Gas' construction team. If burning is necessary, Columbia Gas would obtain the necessary burn permits from the West Virginia Division of Forestry. In Tennessee, the TDEC Division of Natural Areas

has recommended that Columbia Gulf give special consideration to wood transported from project sites to protect against the spread of the emerald ash borer (*Agrilus planipennis*), a federally regulated invasive species. Any ash trees onsite at GXP facilities in Tennessee should be checked for infestations or other indicators that may be present to prevent the spread of the emerald ash borer. A recommendation to help prevent the spread of the emerald ash borer has been added to section 4.5.5.2 in response to TDEC's comment. The transportation of any wood materials would comply with the state regulations intended to prevent the spread of invasive species. Methods to control the spread of invasive species are discussed further in section 4.5.5. Timber may also be cut and stacked at the edge of the right-of-way in an accessible area, if requested by the landowner. Wood chips would not be placed in agricultural areas, wetlands, or waterbodies. Timber would not be left in piles or stacks on the right-of-way.

In uplands, tree stumps and rootstock would be removed from the entire width of the permanent right-of-way. Additional stump pulling would be conducted in upland extra workspaces if deemed necessary for safety reasons. In wetlands, the pulling of stumps would be limited to the trench line and other areas where deemed necessary for safety reasons (see section 2.4.4.1 for a description of stump removal in wetlands). Elsewhere in wetlands, stumps and rootstock would be left intact to promote revegetation following construction. Excavated stumps would be removed from the right-of-way for disposal at approved locations or made available to landowners upon request.

Shortly after clearing and before beginning grading activities, crews would install erosion control devices at the locations outlined in the ECS. The ECS also include specifications for the installation and maintenance of temporary erosion controls such as silt fence, straw bales, temporary slope breakers (interceptor dikes); as well as permanent erosion controls such as permanent trench plugs, slope breakers, restoration methods, and revegetation measures. The EI would be responsible for verifying that the erosion controls are installed correctly, inspected, and maintained in accordance with the ECS.

2.4.1.3 Grading

Grading of the construction right-of-way would be scheduled to limit the amount of time between clearing and the installation of the pipeline. Where necessary, the entire width of the construction right-of-way, including the temporary construction workspace, would be rough graded with bulldozers to allow for safe passage of equipment and to prepare the work surface for pipeline installation activities. Backhoes may be used in conjunction with bulldozers in areas where tree stumps, rock outcrops, and uneven topographic features need to be removed. A travel lane would be utilized to allow for the passage of daily traffic.

Topsoil stripping would occur in agricultural and residential lands, and in other areas as requested by landowners. Up to 12 inches of topsoil would be removed and kept segregated from subsoil until replacement. Topsoil would be stripped from the full right-of-way in agricultural lands.

2.4.1.4 Trenching

The trench would be excavated with a backhoe or track-mounted excavator to provide at least the minimum cover as required by 49 CFR 192. Typically, the trench would be sufficiently deep to provide for a minimum of 3 feet of cover over the pipeline. In areas with consolidated rock, the minimum amount of cover would be 24 inches. In certain areas, such as at crossings of foreign pipelines and utilities, deeper burial would be required resulting in an increased trench depth. Where HDD and/or Direct Pipe methods are used, the pipeline would be installed deep below the ground surface.

In areas where the MXP crosses underground utilities, the construction contractors would contact the "Call Before You Dig" or "One Call" system, or state or local utility operators, to verify and mark all underground utilities (e.g., cables, conduits, and pipelines) along the pipeline route to limit the potential for accidental damage during construction. In areas where the location is not apparent, utility lines would be located by field instrumentation and test pits. The proposed route has been designed to avoid existing utility lines to the extent possible. However, relocation of utilities may be necessary in some circumstances. All required utility relocations would be coordinated with the appropriate utility owner.

Spoil material excavated from the trench would be temporarily piled to one side of the right-of-way, adjacent to the trench. Columbia Gas would avoid the mixing of topsoil and subsoil in compliance with its ECS and FERC's Plan. Where trench dewatering is needed, water would be discharged off the right-of-way into a well-vegetated upland area and/or into an approved filter. Columbia Gas developed an Unanticipated Discovery Plan (UDP), which would be implemented should features such as cultural resources or human remains be discovered during trenching or construction. We find this plan acceptable (see section 4.10.3).

2.4.1.5 Shallow Bedrock and Blasting

The MXP would cross numerous areas of shallow bedrock distributed along portions of the route, as discussed in detail in section 4.1.4.9.1. Where bedrock is encountered along the pipeline route, it would be broken up and removed using one of the following methods. Where practicable, conventional, non-explosive methods would be used, including ripping or hammering the rock with a pointed backhoe attachment before excavating it with a backhoe. If rock cannot be removed by these techniques, blasting may be required to fracture the rock prior to its removal. Blasting would be performed under strictly controlled conditions designed to prevent damage to people and property (such as homes and wells). Columbia Gas would offer both pre- and post-construction testing of water quality and quantity in wells and mitigate any damages caused by construction on wells within 150 feet of the construction right-of-way. Minimum charges needed to perform the blasting would be used. Heavy mats are also typically used to prevent the scattering of debris, and blast monitoring would be conducted. Columbia Gas has developed a Blasting Plan to address potential issues and impacts related to blasting (see section 4.1.4.9). We have reviewed this plan and find it acceptable.

During restoration, rock would be returned to a level no higher than the existing rock profile. In agricultural areas, rock would not be used for backfill closer than 24 inches in mesic soil or 30 inches in frigid soils from the construction surface of the right-of-way, and any excess

would be disposed of at a landfill or recycling facility or used for other approved purposes within the right-of-way as allowed by the landowner and applicable permits.

2.4.1.6 Pipe Stringing, Bending, and Welding

Once the trench is excavated, the next process in conventional pipeline construction is stringing the pipe along the trench. Stringing involves initially hauling the pipe by tractor-trailer, generally in 40-foot lengths (joints), from a contractor yard or staging area onto the right-of-way. The pipe would be off-loaded from trucks and placed next to the trench using a sideboom tractor. Typically, several pipe joints are lined up end-to-end, or "strung," to allow for welding into continuous lengths known as strings. Individual joints would be placed on temporary supports or wooden skids and staggered to allow room for work on the exposed ends.

Bending of the pipe onsite would be required to enable the pipeline to follow the natural grade and direction changes of the right-of-way. Selected joints would be bent by track-mounted hydraulic bending machines as necessary prior to line-up and welding. Manufacturer supplied induction bends and pre-fabricated elbow fittings may be used in certain circumstances as needed. Following stringing and bending, the individual joints of pipe would be aligned and welded together. All welding would be performed according to applicable American National Standards Institute, American Society of Mechanical Engineers, and American Petroleum Institute standards as well as the Companies' specifications. Only welders qualified to meet the standards of these organizations would be used during construction.

Every completed weld would be examined by a welding inspector to determine its quality using radiographic or other approved methods as outlined in 49 CFR 192. Radiographic examination is a non-destructive method of inspecting the inner structure of welds and determining the presence of defects. Welds that do not meet the regulatory standards and the Companies' established specifications would be repaired or removed. After a weld is approved, the joint would be cleaned and epoxy coated. The coating on the remainder of the completed pipe section would be inspected and any damaged areas repaired.

Special tie-in crews would be used at some locations, such as at waterbody and road crossings, changes in topography, and other selected locations as needed. A tie-in is typically a relatively small segment of pipeline specifically used to cross certain features as needed. Once the pipeline segment is installed across the feature, the segment is then welded to the rest of the pipeline.

2.4.1.7 Lowering-in and Backfilling

Before the pipeline is lowered-in, the trench would be inspected to verify that it is free of rocks and other debris that could damage the pipe or protective coating. Typically, any water that is present in the trench would be removed and pumped to a vegetated upland area through an approved filter. After the pipe is lowered into the trench, final tie-in welds would be made and inspected, and then the trench would be backfilled. During backfill, the excavated subsoil would be replaced in the trench using bladed equipment or backhoes and would surround the pipe along the bottom, along both sides, and at the top. A padding machine would be used so rocks mixed with subsoil do not damage the pipe. If rock is excavated from the trench and subsequently used

as backfill, it would not be allowed to extend above the soil horizon where it naturally is found. No topsoil would be used as padding material. Where there is not sufficient padding material onsite or when the native material that was excavated from the trench is not suitable backfill material (i.e., rocky), Columbia Gas would acquire subsoil from other approved sources as necessary. The top of the trench may be slightly crowned to compensate for settling.

2.4.1.8 Cleaning and Hydrostatic Testing

After burial, the inside of the pipeline would be cleaned to remove any dirt, water, or debris inadvertently collected in the pipe during installation. A manifold would be installed on one end of the pipeline section and a cleaning "pig" (typically a large soft plug used to swab the inside of the pipeline) would be propelled by compressed air through the pipeline.

After cleaning, the pipe would be hydrostatically tested to verify that the system can withstand the operating pressure for which it was designed. Hydrostatic testing involves filling the pipeline with water and pressurizing the water in the pipeline for several hours to confirm the pipeline's integrity. The testing would be done in segments according to the Companies' requirements and the USDOT's specifications in 49 CFR 192.

Water for hydrostatic testing would be obtained from surface water and/or municipal sources located along the pipeline route and in accordance with state regulations and required permits. Additional information regarding sources used for hydrostatic testing is available in section 4.3.2.4. Test water would be reused as much as possible by transferring water from one test segment to another where practicable. Following testing, the water would be discharged in vegetated upland areas through a dewatering structure designed to slow the flow of water. All testing activities would be conducted within the parameters of the applicable water withdrawal and discharge permits.

Once the hydrostatic test water is discharged from the test segment, a "squeegee" pig would be pushed through the segment to remove as much remaining water as possible. This would be followed by air ventilation to further dry the interior of the pipe. Columbia Gas may use methanol to scavenge moisture from the pipeline following hydrostatic testing. Any remaining trace water would be collected and removed by the gas stream.

2.4.1.9 Cleanup and Restoration

The Companies would initiate cleanup and stabilization within 7 days of backfilling the trench, weather permitting. All work areas would be final graded and restored to pre-construction contours and natural drainage patterns. Permanent slope breakers or diversion berms would be constructed and maintained in accordance with the ECS as needed. Fences, sidewalks, driveways, and other structures would be restored or repaired as necessary. If seasonal or other weather conditions prevent compliance with these timeframes, temporary erosion controls would be maintained until conditions allow completion of final cleanup.

Restoration activities would be conducted in accordance with state and municipal permit requirements. Soils that supported vegetation prior to construction would be revegetated using seed mixes, application rates, and timing windows recommended by local soil conservation authorities or other duly authorized agencies (such as the Natural Resources Conservation Service

[NRCS]), landowner requests, and in accordance with the ECS. The right-of-way would be seeded within 7 working days following final grading, weather and soil conditions permitting, unless otherwise directed by local soil conservation authorities. Additionally, monitoring of revegetation after construction would be conducted to evaluate and correct areas requiring remediation.

2.4.1.10 Cathodic Protection and Alternating Current Mitigation

Columbia Gas would install cathodic protection equipment along the pipelines to prevent the corrosion of metal surfaces over time. Cathodic protection equipment could consist of underground negative connection cables, linear anode cable systems, aboveground junction boxes, and rectifiers. An alternating current mitigation plan also may be developed for areas where the pipelines parallel adjacent power lines. The alternating current mitigation plan would be designed to verify safety and prevent corrosion facilitated by the presence of nearby high voltage power lines. Cathodic protection would include at least five ground beds on the MXP-100 and one on the MXP-200, to be installed in areas measuring 25 feet wide by 1,000 feet long and situated perpendicular to the permanent rights-of-way. The anticipated location of the cathodic protection equipment was identified on project alignments provided by Columbia Gas in its October 11, 2016, supplemental filing.

2.4.2 Pipeline Replacement Procedures

As part of the MXP, Columbia Gas would replace 0.4 mile of existing 30-inch-diameter natural gas pipeline on its SM80 and SM80 Loop pipelines (0.2-mile-long contiguous segments on each line). The existing pipe replacement is part of a Pipeline and Hazardous Materials Safety Administration (PHMSA) Special Permit (PHMSA-2008-0331, Special Permit Segment #1 and #2), dated April 13, 2010. For the replacement segments, Columbia Gas would segregate topsoil in accordance with the ECS and landowner requirements. The existing pipeline segments would be excavated to expose the pipe. Temporary bypass equipment would be installed to isolate the segments of the two pipelines to be removed and replaced. The lines would be replaced one segment at a time, with natural gas flow temporarily rerouted through the other line during the replacement process. The existing pipe segments would be cut out, capped, and hauled away for proper disposal. The coating of the removed segments of pipe would be tested for asbestos prior to disposal. If asbestos or polychlorinated biphenyls are detected, Columbia Gas would implement special handling and disposal procedures in accordance with CPG procedures and applicable federal rules and regulations. New segments of pipe would be lowered into the excavation and tied into the existing pipelines. Once installed, the replacement pipes would be backfilled and the areas restored in accordance with Columbia Gas' ECS, permits, and applicable landowner agreements.

2.4.3 Aboveground Facility Construction Procedures

Both Columbia Gas and Columbia Gulf are proposing aboveground facilities as part of their projects. Columbia Gas would construct the aboveground facilities concurrently with pipeline installation using special fabrication crews that would generally work separately from the pipeline construction crews. Aboveground facilities would be constructed or modified in accordance with CPG's specifications and the USDOT requirements.

Columbia Gulf would construct the suction and discharge pipelines from the proposed compressor stations to the existing mainline pipelines using the same general pipeline construction procedures described in section 2.4.1.

Construction of compressor stations would proceed in a fashion similar to construction of any facility associated with utilities. Sites would be surveyed, cleared, and graded; foundations established; flooring, walls, and roofing added; compressors and related equipment installed; outside and inside piping connected; outside equipment tied-in; and site cleanup and fencing completed. All control equipment and safety systems would be tested.

The first step in construction of aboveground facilities would be to clear the sites of vegetation, grade the terrain as necessary to accommodate movement of construction vehicles, and prepare the area for building and equipment foundations. After clearing is completed, erosion and sediment controls would be installed to limit eroded soil from leaving the construction area.

For new compressor facilities, building construction would commence after level foundations are prepared. Typically, the building frame would be erected, followed by the installation of the roof, exterior finish, insulation, and interior finish. After that, the air inlet and exhaust facilities would be added. Construction of structures located outside of buildings would begin after concrete footings and/or foundations are prepared. Installation of suction and discharge piping would follow typical pipeline construction techniques described in section 2.4.1. The piping work may occur either in a fabrication shop offsite, or onsite, subject to size and weight considerations. Piping installed below grade would be coated for corrosion protection prior to backfilling.

Before the facilities are placed in service, the gas piping system (both above and below ground) would be pressure-tested. Hydrostatic pressure testing procedures are described in sections 2.4.1.8 and 4.3.2.4. Controls and safety devices such as the emergency shutdown system, relief valves, gas and fire detection facilities, overspeed, vibration, as well as other on- and off-engine protection and safety devices would be tested during the commissioning phase of construction.

After the completion of start-up and testing, the disturbed areas would undergo final grading. Cleanup and restoration of various parts of the site would be completed as work on the area is finished. A security fence would be extended around the perimeter of the new facilities. Roads and parking areas would be graveled or paved.

Many of the procedures used in construction of meter stations would be similar to those described above for compressor stations and would include clearing and grading, preparing foundations, installing electric service, installing underground piping, erecting meter buildings, installing piping inside the meter buildings, testing the piping, testing the control equipment, cleaning up the work area, graveling the site, and fencing the facilities.

Valve and pig launcher/receiver construction would be similar to construction of meter stations, but without buildings, foundations, and associated facilities. These sites also would be graveled and fenced.

The Companies developed state-specific UDPs, which would be implemented should features such as cultural resources or human remains be discovered during trenching or construction. We found these plans acceptable (see section 4.10.3).

2.4.4 Specialized Construction Procedures

Construction across wetlands and waterbodies, or construction across or within roads, highways, railroads, and on steep terrain, would require techniques that differ from the standard measures implemented for routine cross-country pipelines. The Companies' special construction techniques are summarized below.

2.4.4.1 Wetland Crossings

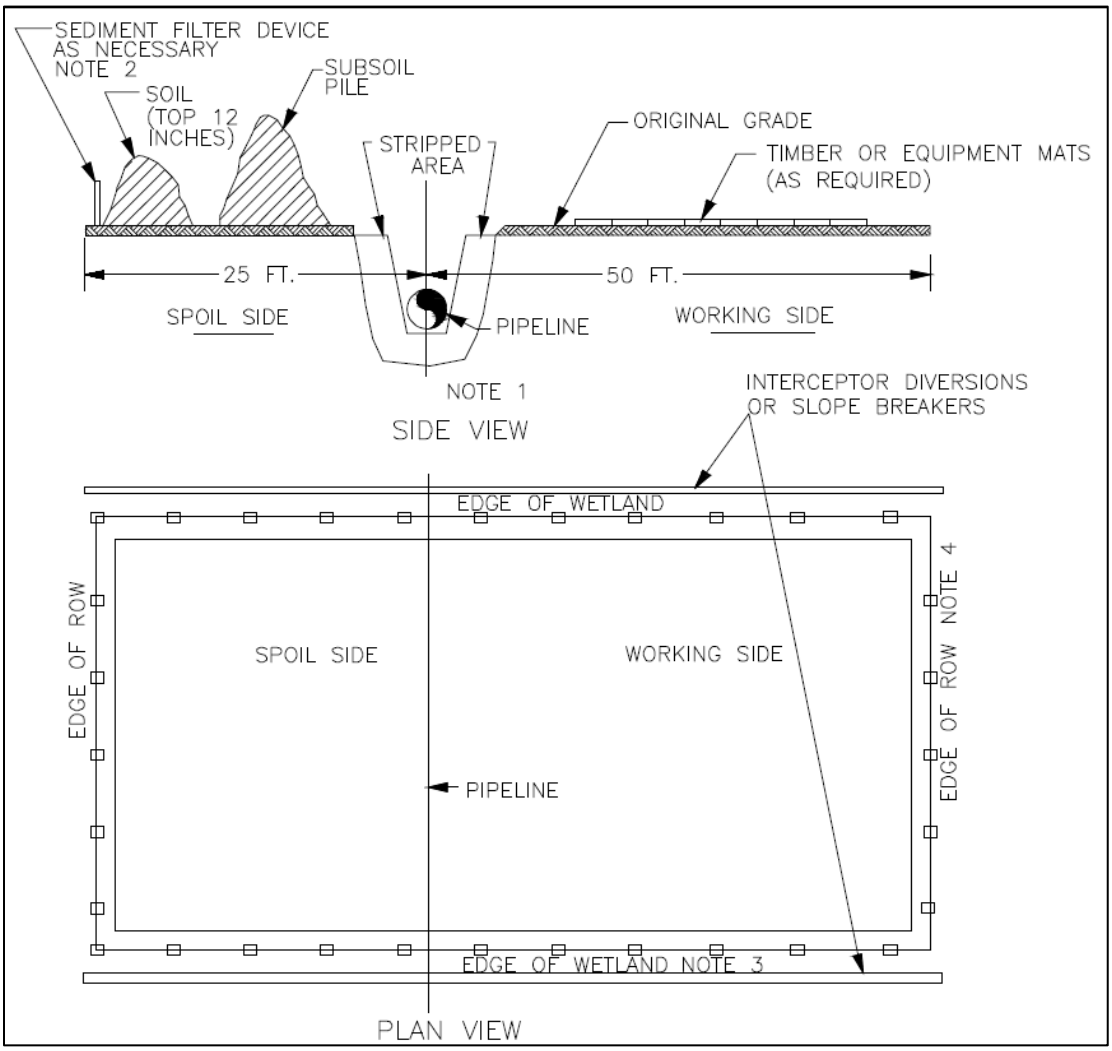
The MXP pipelines and workspaces would cross or otherwise affect 153 palustrine forested (PFO), palustrine scrub-shrub (PSS), and palustrine emergent (PEM) wetlands (see table 4.4-1). Wetland resources are discussed in detail in section 4.4. Construction within and restoration of wetlands would be performed in accordance with the wetland construction and mitigation measures contained in the ECS and FERC's Procedures.

Vegetation clearing in wetlands would be limited to trees and shrubs, which would be cut flush with the ground surface and removed from the wetland. Stump removal, grading, topsoil segregation, and excavation would be limited to the area immediately over the trenchline to avoid excessive disruption of wetland soils and the native seed and rootstock within the wetland. A limited amount of stump removal and grading may also be conducted in other areas if dictated by safety-related concerns.

During clearing, sediment barriers such as silt fence and staked straw bales would be installed and maintained adjacent to wetlands and within ATWS, as necessary, to minimize the potential for sediment runoff. Sediment barriers would be installed across the full width of the construction right-of-way at the base of slopes adjacent to wetland boundaries. If trench dewatering is necessary in wetlands, the trench water would be discharged into stable, vegetated, upland areas and/or a filter bag or hay bale structure to limit siltation, in accordance with the ECS. No heavily silt-laden water would be allowed to flow into a wetland.

Construction equipment working in wetlands would be limited to that essential to clear the right-of-way, excavate the trench, fabricate and install the pipeline, backfill the trench, and restore the right-of-way. The specific method of construction used in wetlands would depend on the stability of the soils at the time of construction. Figure 2.4-1 illustrates a typical wetland crossing (from Figure 19 of Columbia Gas' ECS).

Figure 2.4-1
Typical Wetland Crossing



Columbia Gas would determine its wetland crossing methods based on soil stability and the current saturation levels at the time of construction. For wetland crossings without standing water or saturated soils, the construction method would be similar to construction methods described for uplands, with the exception that the top 12 inches of topsoil would be removed and stockpiled separately from the remaining excavated material and the duration the pipeline trench is left open would be limited. In areas of saturated soils or standing water, low-ground-pressure construction equipment and/or timber mats would be used to reduce rutting and the mixing of topsoil and subsoil. In unsaturated wetlands and unfrozen wetlands, the top 12 inches of topsoil from the trenchline would be stripped and stored separately from the subsoil.

Because little or no grading would occur in wetlands, restoration of contours would be accomplished during backfilling. Prior to backfilling, trench breakers would be installed where necessary to prevent the subsurface drainage of water from wetlands. Where topsoil has been segregated from subsoil, the subsoil would be backfilled first, followed by the topsoil. Generally,

equipment mats, terra mats, and timber riprap used for equipment support would be removed from wetlands immediately following backfilling. However, if after backfilling, access along a travel lane is still necessary for maintaining erosion controls or accessing other areas along the right-of-way, temporary matting may be left in place until access is no longer required.

For wetlands at the base of slopes, permanent interceptor dikes and trench plugs would be installed in upland areas adjacent to the wetland boundary. Temporary sediment barriers would be installed where necessary until revegetation of adjacent upland areas is successful. Once revegetation is successful, sediment barriers would be removed from the right-of-way and properly disposed of.

2.4.4.2 Waterbody Crossings

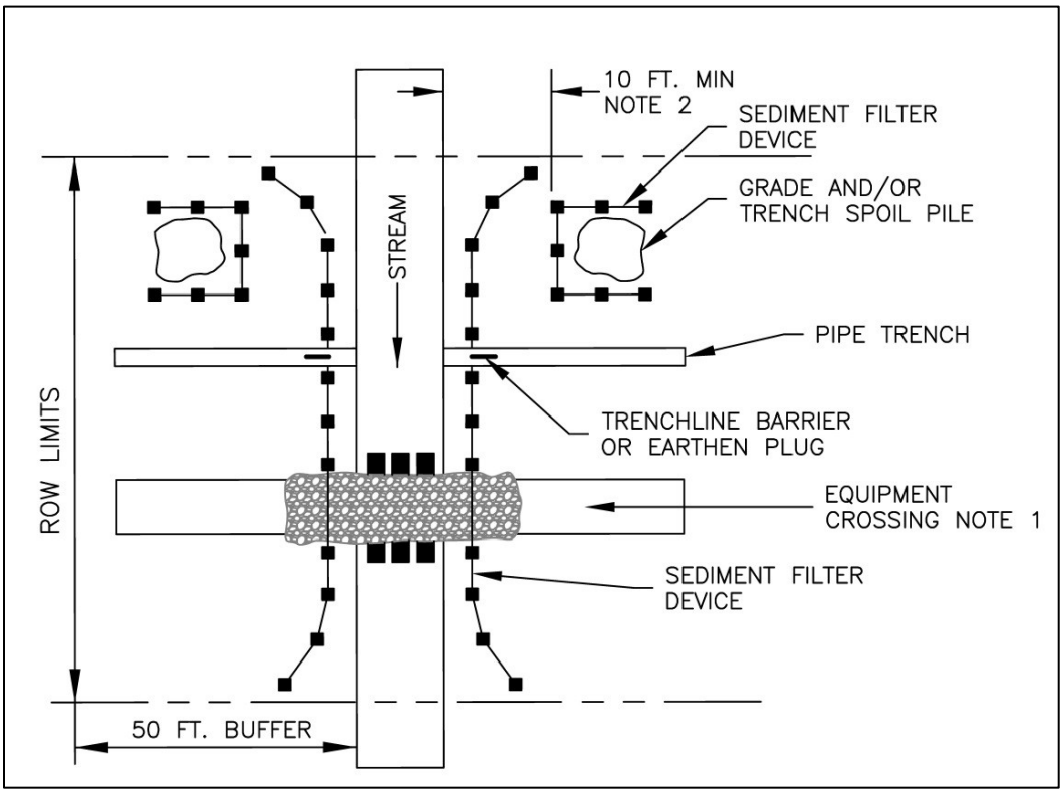
Construction of the MXP would affect over 1,200 ephemeral, intermittent, and/or perennial waterbodies (including 5 ponds; see table 4.3-4). Waterbody crossings would be constructed in accordance with federal, state, and local permits and the ECS. Surface water resources are discussed further in section 4.3. Aquatic resources and a discussion of potential impacts on fisheries resources, including agency consultations regarding construction timing restrictions, is presented in section 4.6.4.

Columbia Gas would cross waterbodies using one of the following methods: open-cut (wet-trench), flume or dam-and-pump (dry-ditch), or HDD. Each of these crossing methods is described in more detail, below. Where standing water is present within a channel, but flow is not discernible, a wet crossing method (e.g., open cut) would be used to cross the waterbody. Illustrations of typical wet and dry waterbody crossings are presented in figures 2.4-2 and 2.4-3 (Figures 15 and 16, respectively, from Columbia Gas' ECS).

The MXP pipeline crossings would typically require ATWS on each side of the waterbody to stage construction, fabricate an adequate length of pipeline, and store materials. These ATWS would be set back a minimum of 50 feet from the waterbody edge, except where the adjacent upland consists of actively cultivated or rotated cropland or other disturbed land, or where site-specific conditions require a reduced setback (as presented in the MXP ECS filed by Columbia Gas).

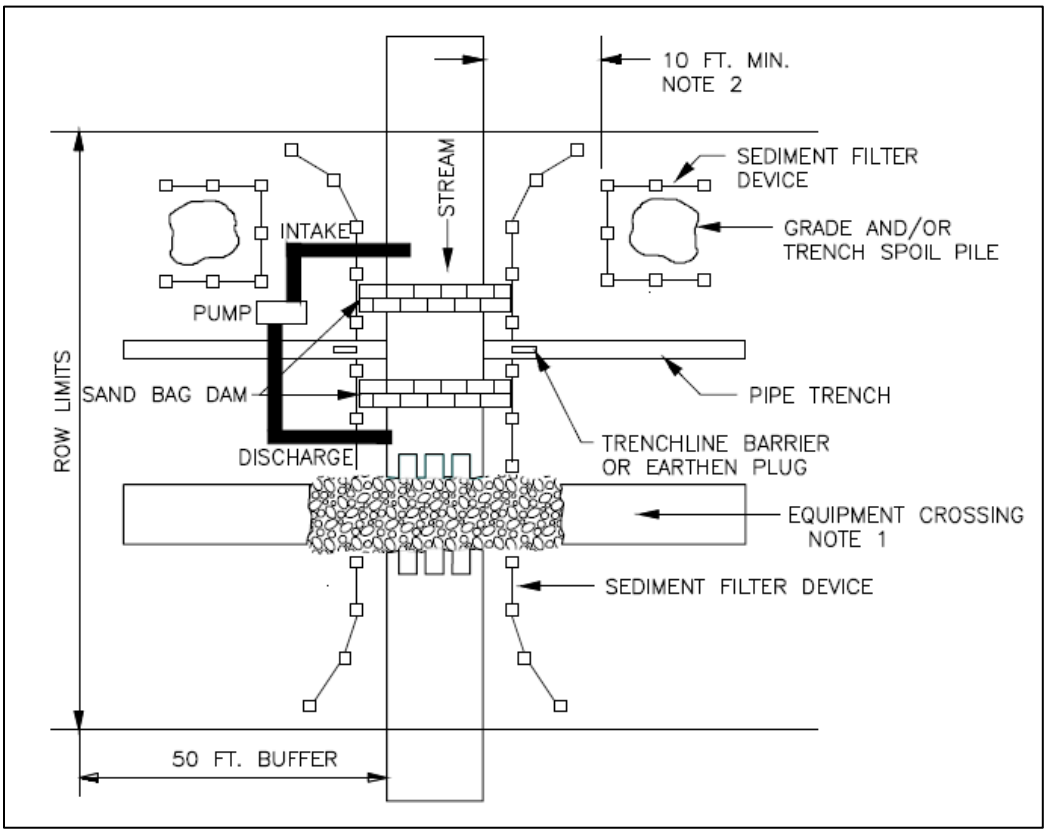
Columbia Gas would install temporary equipment bridges over intermittent and/or perennial stream crossings. Bridges may include clean rock fill over culverts, equipment pads supported by flumes, railcar flatbeds, flexi-float apparatus, and other types of spans. These bridges would remain in place throughout construction until they are no longer needed. Each bridge would be designed to accommodate normal-to-high stream flows and would be maintained to prevent soil from entering the waterbody. All construction equipment would be required to use the bridges, except for the clearing equipment needed for installation of the equipment bridges. Equipment crossing waterbodies would be limited to that which is necessary for clearing and the installation of bridges, as applicable. Sediment barriers would be installed immediately after initial disturbance of the waterbody or adjacent upland.

Figure 2.4-2
Typical Stream Crossing Wet Ditch



Note: ROW = right-of-way

Figure 2.4-3
Typical Stream Crossing Dam and Pump



Note: ROW = right-of-way

2.4.4.2.1 Dry Crossing Construction Methods

The dry crossing method (flume or dam-and-pump) is used at waterbodies with perceptible flow that require flow to be diverted for a dry-ditch pipe installation. This method is appropriate only for waterbody crossings where pumps or flumes can adequately transfer streamflow volumes around the work area.

A flume crossing is a standard dry waterbody crossing technique that involves diverting the flow of water across the construction work area through one or more flume pipes. The first step involves placing a sufficient number of adequately sized flume pipes in the waterbody to accommodate the highest anticipated flow during construction. After the flume pipe(s) are placed in the waterbody, sand bags or equivalent dam diversion structures are installed in the waterbody at the upstream entrance and downstream exit of the flumes. These devices serve to force the stream flow through the flume pipe(s), thereby isolating the flow from the construction area between the dams. The flume pipe(s) and dams remain in place during trenching and pipeline installation, and until final cleanup of the stream bed and bank is completed.

The dam-and-pump method is another standard dry waterbody crossing technique that may be used as an alternative to the fluming. This method is similar to the flume crossing method except that pumps and hoses are used instead of flumes to move water across or around the construction work area. The technique involves installing a pump upstream of the crossing and running a discharge hose from the pump across the construction area to a discharge point downstream. After the pump is installed and operational, sandbags or equivalent dam diversion structures are installed upstream and downstream of the construction area to isolate the water flow from the area between the dams. An energy dissipation device is typically used to prevent scouring of the stream bed at the discharge location. Waterbody flow is maintained throughout the dam-and-pump operation until the pipeline is installed and banks are restored and stabilized.

2.4.4.2.2 Wet Open-Cut Crossing Method

The open-cut crossing technique is a "wet" crossing method that is completed while the waterbody continues to flow across the work area. The open-cut crossing method involves excavating a pipeline trench across the waterbody, installing a section of pipe, and then backfilling the trench with material excavated from the stream bed. Excavation and backfilling of the trench is typically accomplished using backhoes or other excavation equipment operating from one or both banks of the waterbody. Trench spoil is required to be stored at least 10 feet from the stream banks (topographic conditions permitting), per the Procedures. Sediment barriers, such as silt fence and staked straw bales, are then installed to prevent spoil and sediment-laden water from entering the stream. FERC's Procedures require that open-cut crossings be completed and backfilled within 24 hours for minor water bodies (less than 10 feet wide) and within 48 hours for intermediate waterbodies (10 to 100 feet wide).

2.4.4.2.3 Trenchless Crossing Methods

The HDD construction method would be used at one location to cross under the Kanawha River and an associated wetland at MP 146.9. The HDD method avoids disturbing surface and shallow subsurface features (such as waterbodies, wetlands, vegetation, manmade structures, public use, and protected areas) between two construction points. The HDD method typically involves establishing workspaces in upland areas on both sides of the feature(s) to be avoided/crossed and confining the work and equipment to these areas. For the proposed HDD crossing, electric grid guide wires would be laid by hand on the ground along the pipeline drill path to create an electromagnetic sensor grid. The grid would be used by the HDD operator to steer the drill head during drilling. The sensor grid would be fabricated by stringing an insulated coil wire along either side of the drill path. The wire would be energized with a portable generator, which would create a magnetic field used to track the drilling head. No ground or subsurface-disturbing activities would be required for installation of the guide wires except for minor hand clearing of a 2- to 3-foot-wide path for the wires in thickly vegetated areas.

The HDD process begins with drilling a pilot hole in an arced path beneath the feature using a drill rig positioned on the "entry" side of the crossing. When the pilot hole is completed, reamers are attached and are used to enlarge the hole in one or more passes until its diameter is sufficient to accommodate the pipeline. As the hole is being reamed, a pipe pull-back section, or a pipe section long enough to span the entire crossing, is fabricated (staged and welded) on one side of the crossing (typically the "exit" side) and then coated and hydrostatically tested to confirm

the integrity of the welds. When the reaming is complete, the prefabricated pipe section is pulled through the drilled hole back to the entry side of the crossing.

During the drilling process, drilling fluid consisting of bentonite clay and water would be circulated through the hole to power and lubricate the cutting bit, move cuttings to the surface, and maintain the integrity of the hole. Water for the mixture is generally pumped from the waterbody to the drill site through a hose or temporary network of irrigation-type piping. (If a waterbody is not available, water may be trucked in from another source.) The pump intake is appropriately screened to prevent entrainment of aquatic species. Small pits are typically dug at or near the HDD entry and exit points to temporarily store the drilling fluid and cuttings. The fluid and cuttings are then pumped from the pits to an onsite recycling unit where the fluid is processed for reuse.

Although the HDD method typically avoids impacts on water quality by precluding disturbance of the waterbody bed and banks, an inadvertent release of drilling fluid could occur if fluid were to escape the drill hole and be forced through the overlying substrate to the ground surface. To minimize potential impacts of inadvertent releases of drilling fluid, Columbia Gas would implement measures identified in its HDD Inadvertent Return Contingency Plan (see appendix G). This plan describes procedures to monitor, contain, and clean up any inadvertent releases of drilling fluid. It also identifies contingency measures to be implemented if an HDD is unsuccessful.

Columbia Gas has created (and filed to the docket) a site-specific HDD crossing plan for the Kanawha River crossing. We find this plan to be acceptable. Any deviations from this plan would require additional authorization(s) from FERC and the USACE.

2.4.4.3 Road and Railroad Crossings

The MXP pipelines would cross numerous public or private roads and railroads. Most two-lane (or wider) paved roads, highways, and railroads would be crossed by boring methods. Roads and railroads that would be crossed by the MXP are shown on alignments in appendix B-1, along with the proposed crossing method. Road crossings would either be conventionally bored, open-cut, or crossed by Direct Pipe. The use of conventional boring and/or Direct Pipe methods would avoid road and rail surface impacts. All railroad crossings would be conventionally bored.

At least one lane of traffic would typically be kept open when constructing an open-cut crossing of local or residential streets. However, detouring may be utilized in some areas. During the brief period when a road is completely cut, steel plates maybe used to cover the open area to permit travel by emergency vehicles. Traffic lanes and residential access would be maintained except for the temporary periods essential for installing the pipeline. Following pipeline installation at open-cut roadways, the trench would be backfilled and the roadbed would be restored.

Road crossing permits would be obtained from applicable federal, state, and local agencies. These permits would dictate the specific requirements for the day-to-day construction activities and methods at each crossing.

The Direct Pipe method is proposed for the MXP crossing of U.S. Highway 50 (U.S. 50) at MP 48.5. It would combine installation processes used in microtunneling and HDD installation

methods. A single, continuous process would allow the trenchless installation of a pre-fabricated pipeline simultaneously with development of the bore hole. A Direct Pipe installation is different from an HDD because a much larger initial cutterhead is used, eliminating the reaming process. Excavation and hole boring is performed with a navigable microtunnelling machine and cutterhead. Temporary flushing pipes located inside the pipeline are used to transport the drilling fluid to the cutterhead and earthen cuttings to the surface. The pressure used to advance the boring process and simultaneously install the pipeline is applied directly to the pipeline by a piece of equipment called a "pipe thruster." The force applied on the pipeline pushes the cutting head forward. Reliable installation and monitoring methods allow for accurate measurement of the pipe's location along the intended pathway. Direct Pipe installations may be shorter and shallower than HDD installations because the bore hold is continuously cased, thereby limiting the risk of hole collapse and the inadvertent release of drilling fluid.

2.4.4.4 Residential Areas

The proposed MXP-100 pipeline route crosses numerous residential properties and would pass within 50 feet of at least 29 homes. Residential structures within 50 feet of the construction work areas are discussed in section 4.8.1.3 and are shown in table 4.8-4. Columbia Gas has developed site-specific residential construction plans for these homes (see appendix B-1). These plans identify the mitigation measures to be implemented by Columbia Gas to further reduce impacts on residents during the construction period.

Temporary impacts on residential areas from MXP pipeline construction may include disturbance of lawns; removal of fences, mailboxes, and other minor residential accessory structures; removal of ornamental shrubs; loss of shade trees; disturbance of streets, driveways, and sidewalks; disruption of household utilities; altered traffic patterns; and the noise and general annoyance of construction activities. Columbia Gas would implement the following measures to reduce potential impacts in residential areas:

- Mature trees and landscaping would not be removed from within the edge of the construction work area unless necessary for safe operation of construction equipment, or as specified in landowner agreements.
- Safety fencing would be installed along the construction work area to discourage non-workers from entering the area. At a minimum, fencing would be installed adjacent to residences for a distance of 100 feet on either side of the residence.
- The trench would be secured with safety fencing at the end of each work day.
- Immediately after backfilling the trench, all lawn and landscaping would be restored to final restoration conditions, or temporarily restored pending weather and soil conditions or as specified in landowner agreements. If seasonal or other weather conditions prevent restoration within these time frames, temporary erosion controls would be maintained and monitored until conditions allow restoration.
- Landowners/occupants of each residence within 50 feet of construction work areas would be notified of construction activities prior to the commencement of construction work.

During extremely dry conditions, the construction work area would be sprayed with water to reduce fugitive dust in residential areas. Construction activities would be expedited to the extent practical while maintaining safety.

The Companies would implement an environmental complaint resolution procedure for implementation during construction. The procedures included in this resolution are outlined in section 4.8.1.3.

2.4.4.5 Agricultural Lands

Agricultural lands crossed by the MXP include active croplands, pastures, rangeland, or hayfields. In agricultural areas, Columbia Gas would strip and segregate topsoil from the full right-of-way in accordance with the ECSs. Following pipeline installation, the subsoil would be returned to the ditch and the topsoil replaced in the area from which it was stripped. As necessary, the working side of the right-of-way would be de-compacted prior to final grading and restoration.

Where livestock fences (including electric fences) would need to be cut to access the construction right-of-way, Columbia Gas would brace and secure the fencing prior to construction, and would repair the fences to preconstruction condition or better during the restoration phase of the project. Further, Columbia Gas would work with landowners either to remove livestock to alternate fields during construction or maintain adequate fencing in grazing areas. If livestock are present during construction, Columbia Gas would install temporary fencing around the right-of-way in areas where the pipe trench is left open overnight. Columbia Gas would negotiate with landowners regarding a potential grazing deferment to allow vegetation to establish within the right-of-way after construction is complete.

No existing drainage tiles were identified during surveys. Prior to construction, Columbia Gas would consult with landowners to locate existing drainage tiles crossed by the MXP. If drainage tiles were exposed or damaged during construction activities, Columbia Gas would implement appropriate measures to repair/replace them through coordination with the landowner and in accordance with the ECS.

Impacts on agricultural lands associated with the GXP would result from the permanent conversion of agricultural land to permanent facility or access road. Columbia Gulf would compensate landowners through easement negotiations for any crop removal or loss from construction activities within temporary workspaces that are not owned by Columbia Gulf.

2.4.4.6 Rugged Topography

Rugged topography, such as steep (greater than 30 percent), vertical slopes and steep side slopes (i.e., slopes running parallel to the proposed route), is present in numerous areas along the proposed MXP pipeline routes. Where possible, Columbia Gas would use conventional overland pipeline construction techniques to construct the MXP facilities. However, construction in the mountainous West Virginia terrain may require special construction techniques.

Columbia Gas attempted to route the pipeline along ridges and hills running perpendicular to the slope (i.e., along the natural fall of the slope) to provide a flat surface for vehicles and other equipment during construction. Except for short distances and in unique circumstances, pipelines

are not typically routed laterally along the sides of ridges and hills (i.e., on side-slopes). As described in more detail below, construction on side-slopes requires cut-and-fill grading to create a flat surface for construction vehicles and equipment. Relative to construction along the natural fall of a slope, cut-and-fill grading typically requires more workspace and is more challenging to restore. Because steep- and side-slope construction requires wider rights-of-way, the construction footprint is larger, and more tree clearing, soil stabilization, and restoration effort is required, all of which increase environmental impact and soil stabilization risk. Additionally, and especially over longer distances, the potential for slips or slope failure is greater in areas of side-slope construction relative to construction along the natural fall of a slope. Further details are discussed in section 4.1.4.

Pipe installation and construction activities across steep slopes would be similar to standard upland construction methods, but equipment would be tethered via winch lines to other equipment at the top of slopes. Equipment used to prepare the construction corridor and excavate the trench would be secured with a series of winch tractors to maintain control of the equipment and provide an additional level of safety. Appendix C, drawings A6987-TYP-5 and A6987-TYP-6, includes a construction drawing depicting operating equipment on steep slopes. All construction equipment and winch lines would be inspected daily prior to operation. Spoil piles adjacent to the trench would be stabilized with temporary sediment barriers, including reinforced silt fence, to keep excavated soils on the construction work area. Erosion controls, including anchored erosion control matting and temporary slope breakers, would be installed in accordance with Columbia Gas' ECS, and project-specific Erosion and Sediment Control (E&SC) Plan (to be prepared as part of its Stormwater Permit), to reduce runoff velocity and divert water off the construction corridor into stable, well-vegetated areas or through energy dissipation devices.

Pipeline construction along ridgelines may require the pipe to be buried deeper than normal (i.e., with greater than the typical 3 feet of cover over the pipeline required in non-agricultural uplands) due the techniques needed to construct along narrow ridgelines. The surface of ridgelines may be temporarily lowered to create a level construction right-of-way. Graded materials would be stored within the construction right-of-way and ATWS. Excavation of the trench would begin from the leveled work area. When the temporary right-of-way is restored to preconstruction contours, the depth of cover over the pipeline could exceed the minimum of 3 feet by an additional 7 feet or more.

Pipe joints would be staged at the top or bottom of each slope along the construction right-of-way and in approved ATWS. A side-boom tractor suspended from a winch would carry one joint at a time up or down the slope and place the joint along the trench line. The joint would then be lowered into the ditch by a tractor. Welders would connect the joint to the previous joint within the trench to assemble the pipeline. Once welding is complete, the welds would be visually and radiographically inspected. The weld joints would be hand coated with fusion bonded epoxy in accordance with required specifications. The coating would be inspected for defects, and repaired, if necessary.

Permanent trench breakers consisting of sandbags, gravel, cement, cement-filled sacks, or other approved materials would be installed within the ditch over and around the pipe in areas of steep slopes to control water channeling downslope along the pipeline. Placement of permanent slope breakers and trench breakers would be in accordance with Columbia Gas' ECS and project-

specific E&SC Plan. Once the pipeline is installed and backfilled, the surface of the right-of-way would be restored as near as practicable to original contours, and permanent slope breakers would be installed in accordance with Columbia Gas' ECS. During restoration, seed would be applied at an increased application rate to enhance rapid stabilization. Mechanically fastened erosion control blankets, in lieu of mulch, may be installed on steep slopes to promote revegetation while inhibiting erosion. Grades in excess of 3:1 would be stabilized with degradable blanket mulch such as jute mesh, wood excelsior, or fibers, until vegetation is re-established. The area would be monitored until revegetation is successful and temporary erosion control devices can be removed.

In areas where the pipeline crosses side-slopes, cut-and-fill grading may be necessary to create a safe, flat work terrace. Soil from the upper side of the construction work area would be excavated and moved to the lower side of the construction work area. Cut-and-fill operations in side-slope areas involve the excavation and movement of large volumes of soil. These activities require a construction right-of-way footprint upwards of 150 feet wide. After installation of the pipeline, the cut-and-fill area must be restored to preconstruction conditions and stabilized through soil packing, seeding, and other soil stabilization measures. Springs or seeps present in the work area would be diverted off the construction workspace to stable areas or carried downslope through drain pipes and/or graveled French drains installed during restoration.

In addition to the construction measures described above, Columbia Gas would develop and implement additional measures in areas where slopes exceed 30 percent to control land movement, surface erosion, backfill erosion, and general stability when backfilling the trench and restoring the right-of-way. The following are some of the special design and construction measures that would be implemented during construction:

- targeted management and diversion of surface water around potential landslide sites, including the use of ditches, berms, slope breakers, and/or grading;
- mitigation of surface erosion by armoring or otherwise stabilizing surface soils using riprap, coir cloth (coconut fiber), hydroseeding, mulching, and/or tracking;
- targeted management of water sources along the trench, including the use of trench breakers and/or added drainage piping in the trench; and
- targeted mitigation of seeps, springs, or other subsurface water encountered along the right-of-way using subsurface drains or other special drainage measures.

2.4.4.7 Winter Construction Procedures

Columbia Gas would typically initiate its Winter Season Construction Plan for the MXP on or after November 1 of each year of active construction, as well as in areas along the MXP where all construction activities, including restoration, have not been completed prior to November. Columbia Gas' Winter Construction Plan, found in section VII of its ECS, addresses winter-specific procedures for snow removal and storage, temporary erosion and sediment controls, topsoil segregation, backfilling, restoration, wetland and waterbody crossings, and dewatering.

During winter months, Columbia Gulf may need to implement measures outlined in its Winter Season Construction Plan for facilities and improvements at existing facilities in Kentucky.

Columbia Gulf's Winter Season Construction Plan, found in section VIII of its ECS, addresses concerns associated with construction and reclamation activities that would be conducted during winter, including site stabilization, snow storage, and measures to be implemented if reclamation activities are delayed due to winter conditions.

2.4.4.8 Karst Areas

Based on U.S. Geological Survey (USGS) mapping, no karst would be crossed or found in proximity to the MXP. Mapping indicated the possible presence of karst topography at five of the seven new GXP compressor station sites, and subsequent geotechnical investigations found such topography at the Paint Lick, Goodluck, Cane Ridge, and Clifton Junction sites. However, soil materials at these four sites did not exhibit typical signs of karst. As such, we believe karst is unlikely to be present at these locations.

In areas where karst terrain is encountered, both Companies would exercise appropriate measures to avoid or limit the potential impact of karst on the proposed facilities. Columbia Gas would implement guidance provided by the WVDEP in conjunction with a karst mitigation plan Columbia Gas recently developed for a project in Kentucky. If sinkholes or other karst drainage features are encountered at either the Cane Ridge or Clifton Junction sites in Tennessee, modification of these features would require approval from the TDEC Division of Water Resources, since these features are regulated under the Underground Injection Control Program. If Columbia Gulf determines that subsurface karst presents a potential hazard, it would construct foundations supported by competent bedrock to mitigate the risk of foundation disturbance.

2.4.4.9 Overhead Powerlines

CPG has developed a set of minimum requirements that both Companies would follow when construction activities occur in proximity to overhead power lines. These requirements include:

- construction contractors must have personnel dedicated to electrical safety;
- adequate warning signs of possible electric hazards must be posted at each access to the right-of-way;
- each piece of equipment used to handle pipe in any way must be grounded and equipped with a cable assembly capable of grounding the joints of pipe to the piece of the equipment handling the pipe; and
- work must be suspended in areas of overhead power lines during any thunderstorm activity.

Contractors would also be required to develop a site-specific safety plan consistent with CPG's safety policies.

2.5 CONSTRUCTION SCHEDULE AND WORKFORCE

In their applications, Columbia Gas and Columbia Gulf propose to begin construction of the MXP and GXP in October 2017, and to commence service in November 2018. This schedule depends on many factors, including the following:

- whether the Commission issues a Certificate for each proposal;
- subsequent acquisition of any outstanding survey access and completion of any remaining easement agreements;
- completion of any outstanding field surveys and submittal of permit applications;
- receipt of all necessary federal, state, and local authorizations;
- other project-specific requirements such as stream, migratory bird, and/or protected bat construction window restrictions (see sections 4.6.3, 4.6.4, and 4.7.6);
- satisfaction of all pre-construction conditions of any Certificate issued for the projects;
- FERC's completion of all necessary federal consultations, such as section 7 of the ESA and section 106 of the NHPA; and
- FERC staff's separate, post-Certificate authorization that construction may begin (i.e., Notice to Proceed with Construction).

Columbia Gas anticipates construction of the proposed MXP would be accomplished using eight construction spreads with a peak temporary workforce of about 4,200 workers. Table 2.3-1 identifies the location of each spread. Construction of the MXP facilities would be performed in a phased sequence with some facility construction occurring concurrently. Restoration activities would continue after the project is placed in-service and until disturbed areas are stabilized in accordance with the ECS and applicable permit requirements. Columbia Gas anticipates hiring 29 new permanent employees to operate the MXP facilities.

Columbia Gulf would utilize multiple contractors to facilitate project construction activities. Construction of the proposed GXP facilities would be conducted concurrently. At any given time, the temporary workforce for construction of the GXP facilities would range from 372 to 471 individuals divided among the 9 facilities. Fourteen new permanent employees (two persons for each of the seven new compressor stations) would be required for operation and maintenance of the GXP facilities.

2.6 ENVIRONMENTAL COMPLIANCE AND MONITORING

2.6.1 Environmental Training and Inspection

The Companies would incorporate into their construction drawings and specifications the mitigation measures identified in their permit applications and additional requirements of federal, state, and local agencies. Columbia Gas and Columbia Gulf would also provide copies of applicable environmental permits and construction drawings and specifications to their construction contractors.

The Companies would develop environmental training programs tailored to the proposed MXP and GXP and their requirements. The programs would be designed to require:

- qualified environmental training personnel provide thorough and focused training sessions regarding the environmental requirements applicable to trainees' activities;
- all individuals receive environmental training before they begin work on any construction workspaces;
- adequate training records are kept; and
- refresher training is provided as needed to maintain high awareness of environmental requirements.

The Companies also would conduct training for construction personnel regarding proper field implementation of the project-specific ECS and other project-specific plans and mitigation measures.

The Companies would assign at least two EIs per construction spread to the MXP and one per GXP facility site, with additional inspectors as necessary to monitor environmental compliance. The role of the EI would be to verify compliance with the environmental mitigation and construction procedures included in all permits issued for the respective projects. The EI would be required to adhere to the project-specific ECS, which incorporates FERC's Plan and Procedures. The EI would have authority to stop construction activities that violate the measures set forth in the documents and permit authorizations for both MXP and GXP, as well as authority to order corrective actions. At a minimum, the EIs would be responsible for:

- verifying compliance with the measures set forth in the project-specific ECS and all other environmental permits and approvals, as well as environmental requirements in landowner agreements;
- identifying, documenting, and overseeing corrective actions as necessary to bring an activity back into compliance;
- verifying that the limits of authorized construction work areas and locations of access roads are properly marked before clearing;
- verifying the location of signs and highly visible flagging marking the boundaries of sensitive resource areas, waterbodies, wetlands, or areas with special requirements along the construction work area;
- identifying erosion/sediment control and stabilization needs in all areas;
- locating dewatering structures and slope breakers to confirm they would not direct water into sensitive areas such as known cultural resource sites or sensitive species habitat;
- verifying that trench dewatering activities do not result in the deposition of sand, silt, and/or sediment near the point of discharge in a wetland or waterbody. If such deposition is occurring, the EI would stop the dewatering activity and take corrective action to prevent a reoccurrence;
- advising the Resident Engineer/Chief Inspector when conditions (such as wet weather) make it advisable to restrict construction activities to avoid excessive rutting;

- determining the need for and checking that erosion controls are properly installed, as necessary, to prevent sediment flow into wetlands, waterbodies, sensitive areas, and onto roads;
- inspecting and verifying the maintenance of temporary erosion control measures at least daily in areas of active construction or equipment operation, or a weekly basis in areas with no construction or equipment operation, and within 24 hours of each qualifying rain event;
- checking restoration of contours and topsoil;
- checking the repair of all ineffective temporary erosion control measures as soon as possible but not longer than 24 hours after identification;
- checking that the Companies' contractors implement and comply with their spill prevention and mitigation plans;
- keeping records of compliance with conditions of all environmental permits and approvals during active construction and restoration; and
- identifying areas that should be given special attention to achieve stabilization and restoration after the construction phase.

Columbia Gas and Columbia Gulf would maintain sufficient oversight of construction, stabilization, and restoration activities via the EIs; if additional inspectors are required for specific areas or situations, the Companies would provide additional inspectors.

In addition to the Companies' EIs, Columbia Gas and Columbia Gulf would require the construction contractors to provide at least one Environmental Foreman per spread or facility site. Environmental Foremen would be responsible for the contractor's efforts to correctly install and maintain environmental controls as well as implementing specific controls for construction in environmentally sensitive areas. They also would be available at all times during the duration of the projects and have a sufficient number of employees to implement the MXP's and GXP's compliance standards.

2.6.2 Compliance Responsibility

CPG's Project Delivery and Natural Resource Permitting Departments, consisting of a Project Manager, Construction Superintendent, Environmental Compliance Manager, Permitting Manager, and EIs, would be responsible for project environmental compliance on behalf of the Companies. As such, each of the individuals would receive copies of pertinent compliance materials and documents in a project-specific Environmental Management & Construction Plan prior to the commencement of construction. All environmental noncompliance issues would be reported by the EIs to the CPG Construction Superintendent, Permitting Manager, Environmental Compliance Manager, and the MXP or GXP Project Manager for resolution.

CPG would maintain records for the MXP and GXP, identifying by milepost or facility site, where soil additives, mulch, and seed is used and documenting the method of application, rate, and acreage treated. The dates of backfilling and seeding would be kept as part of the MXP and GXP record. Where special landowner requests concerning restoration are made, the names of landowners, tracts affected, and description of specialized methods would be documented.

Records would also include the location of any subsurface drainage repairs or improvement made during restoration and any problem areas encountered and how they were addressed.

In addition to CPG's compliance inspection program, the Commission will conduct independent inspections throughout construction and restoration to audit CPG's compliance program and independently verify project compliance with the Commission's certificate (and other pertinent requirements). As part of its inspection activities, the Commission may use a third-party compliance monitoring (3PCM) program. As the name implies, the program involves the use of a third party to assist us in compliance inspections and oversight.[19] A typical 3PCM program involves a compliance manager and several compliance monitors who represent our "eyes and ears" along the construction right-of-way. This program has the benefit of keeping us informed, on a daily basis, of the level of compliance on the project and can be a useful tool for project proponents to ensure a higher level of compliance. Another benefit that accrues for projects that implement a 3PCM program is efficient review of post-approval variances (discussed in the next section). Columbia Gas has determined that the MXP would benefit from a 3PCM program.

2.6.3 Post-Approval Variance Process

The pipeline alignments and work areas identified in this EIS should be sufficient for construction and operation (including maintenance) of the projects. However, minor workspace refinements sometimes continue past the project planning phase and into the construction phase due to unforeseen conditions in the field. These changes could involve minor route realignments, shifting or adding new ATWS or staging areas, adding additional access roads, or modifications to construction methods. We have developed a procedure for assessing impacts on the areas that have not been evaluated in this EIS and for approving or denying their use following any Certificate issuance. In general, biological and cultural resources surveys were conducted using a survey corridor larger than that necessary to construct the facilities. Where survey access was denied, the Companies would complete the required surveys following a Certificate issuance. If Columbia Gas or Columbia Gulf request shifting an existing workspace or require a new ATWS subsequent to issuance of a Certificate, these areas would typically be within the previously surveyed area. Such requests would be reviewed using a variance request process.

A variance request for route realignments or extra workspace locations along with a copy of the survey results would be documented and filed with FERC in the form of a "variance request" in compliance with recommended condition number 5 in section 5.2 of this EIS. We would take the lead on reviewing the request. Typically, no further resource agency consultation would be required if the requested change is within previously surveyed areas and no sensitive environmental resources are affected. The procedures used for assessing impacts on work areas outside the survey corridor and for approving their use are similar to those described above, except that additional surveys, analyses, and resource agency consultations may be necessary to assess the extent of any impacts on biological, cultural, and other sensitive resources and identify any avoidance or minimization measures necessary. Variance requests are required to include a statement of landowner approval for the requested activity. All variance requests for the MXP and

[19] Like the Commission's use of consultants to assist in the analysis and preparation of environmental impact documents, a 3PCM program is funded by the project proponent but is completely under the guidance and direction of the Commission staff.

GXP and their approval status would be documented according to the process described above. Any variance activity by either of the Companies (whether submitted through the 3PCM program or directly to FERC) and subsequent FERC action would be available on FERC's eLibrary webpage under the docket number for the respective project (CP16-357 for the MXP and CP16-361 for the GXP).

2.6.4 Post-Construction Monitoring

After construction, the Companies would conduct follow-up inspections of all disturbed upland areas after the first and second growing seasons to determine the success of restoration. Restoration of upland areas would be considered successful if the right-of-way vegetation is visually successful in density and cover, surface conditions are similar to adjacent undisturbed lands, construction debris is removed, and proper drainage has been restored. For at least 2 years following construction, the Companies would submit quarterly reports to FERC that document any problems identified by Columbia Gas, Columbia Gulf, or landowners and describe the corrective actions taken to remedy those problems. FERC would also continue to conduct oversight inspection and monitoring to assess the success of restoration for at least two growing seasons. If it is determined that the success of any of the restoration activities are not adequate at the end of the respective timeframes, the Companies would be required to extend their post-construction monitoring programs. Columbia Gas proposed to perform monitoring for invasive plant species on at least an annual basis for 3 years following construction. However, we are recommending in section 4.5 that Columbia Gas extend the monitoring of invasive species for a period of 3 years following successful revegetation, as determined by the Commission's post-construction inspections. The monitoring period for invasive species would be extended as needed or as required by permits or regulatory agencies.

In accordance with their ECSs, the Companies would monitor the success of wetland revegetation annually for the first 3 years (or as required by the projects' permits) after construction or until wetland revegetation is successful. Wetland revegetation would be considered successful when the cover of herbaceous and/or woody species is at least 80 percent of the type, density, and distribution of the vegetation in adjacent undisturbed wetland areas or as compared to documented, pre-project conditions. In accordance with the ECSs, if revegetation is not successful at the end of 3 years, the Companies would develop and implement (in consultation with a professional wetland ecologist) a plan to actively revegetate the wetland with native wetland herbaceous and woody plant species.

2.7 OPERATION AND MAINTENANCE

Columbia Gas and Columbia Gulf would operate and maintain the proposed pipelines and/or aboveground facilities in compliance with the USDOT's regulations provided in 49 CFR 192, the Commission's guidance at 18 CFR 380.15, and the maintenance provisions of their respective ECSs. The Companies would operate and maintain the newly constructed facilities in the same manner as they currently operate and maintain their existing systems. Right-of-way maintenance would be conducted in accordance with FERC's Plan and Procedures. The new MXP pipelines and facilities would be patrolled by either aerial flyovers or ground surveys on a schedule as described in table 2.7-1, although additional ground surveys would be conducted as necessary.

Table 2.7-1 Maximum Scheduled Intervals between Patrols for the Proposed Mountaineer XPress Project Pipelines		
Class Location of Line a/	**At All Highway and Railroad Crossings (inspection interval)**	**At All Other Locations (inspection interval)**
1 and 2	No longer than every 7.5 months, and at least twice each calendar year.	No longer than every 15 months, and at least once each calendar year.
3	No longer than every 4.5 months, and at least four times each calendar year.	No longer than every 7.5 months and at least twice each calendar year.
4	No longer than every 4.5 months, and at least four times each calendar year.	No longer than every 4.5 months, and at least four times each calendar year.

a As defined by the USDOT's Pipeline and Hazardous Materials Safety Administration at 49 CFR 192.5:
Class 1: offshore areas and areas within 220 yards of a pipeline with ≤10 buildings intended for human occupancy.
Class 2: areas within 220 yards of a pipeline with >10 but <46 buildings intended for human occupancy.
Class 3: areas within 220 yards of a pipeline with >46 buildings intended for human occupancy; and areas within 100 yards of either a building or a small, well defined outside area (such as a playground, recreation area, outdoor theater, or other place of public assembly) that is occupied by 20 or more persons on at least five days a week for 10 weeks in any 12-month period.
Class 4: areas within 220 yards of a pipeline where buildings with four or more stories are prevalent.

In its 7(c) application to the Commission, Columbia Gas identified, by milepost, the results of its class location study. Section 4.12.1 contains further discussions regarding the different class locations along the MXP.

Vegetation on the permanent 50-foot-wide right-of-way (and 80-foot-wide right-of-way where the three pipelines would be parallel going in and out of Sherwood Compressor Station) in uplands would be periodically maintained no more than once every 3 years by mowing and trimming to prevent the establishment of trees or deep-rooted shrubs over the pipeline that could damage its protective coating, obscure surveillance, or interfere with routine maintenance activities.

Columbia Gas may maintain a cleared corridor within the permanent easement portion of a wetland not exceeding 10 feet in width centered on the pipeline in all areas, as frequently as necessary to maintain an herbaceous state, and to facilitate periodic corrosion and leak detection surveys. In wetlands, trees within 15 feet of the pipeline may be cut and removed from the permanent right-of-way. No vegetation maintenance activities would be conducted in riparian areas between HDD and Direct Pipe entry and exit points. Use of herbicides for vegetation management would not be allowed within 100 feet of a waterbody or wetland without prior written approval from appropriate agencies.

The Companies would also inspect and maintain the proposed compressor station facilities, including calibrating equipment; assessing cathodic protection systems; checking safety systems; and monitoring pressures, temperature, and vibration data. The Companies also would mow and maintain the landscaping around the compressor stations.

The Companies would not conduct vegetation clearing for maintenance between April 15 and August 1 (i.e., during the general nesting season for migratory birds) unless written approval from the USFWS is obtained prior to commencing clearing activities. Vegetation maintenance would normally not be required in agricultural or pasture areas. Vegetation within the fenced portions of aboveground facilities would be mowed as often as needed.

2.8 FUTURE PLANS AND ABANDONMENT

During public scoping, a comment was submitted regarding the potential for Columbia Gulf to request an expansion at one of its new compressor stations, proposed under the GXP, or an expansion of the Columbia Gulf Transmission pipeline system. Neither Columbia Gas nor Columbia Gulf has identified any plans for future expansion of their systems or abandonment of any of the projects' facilities. If in the future, Columbia Gas or Columbia Gulf proposes any expansion or abandonment of the MXP or GXP facilities, then the applicable company would have to seek specific authorization for that action from FERC. An appropriate environmental review would be conducted, and the public would have the opportunity to comment on the Company's proposal. Likewise, any proposed abandonment of any facilities approved in these dockets would require additional environmental and regulatory review under section 7(b) of the NGA.

3.0 ALTERNATIVES

In accordance with NEPA and Commission policies, we evaluated alternatives to the MXP and GXP to determine whether an alternative would be environmentally preferable, reasonable, and/or technically and economically feasible to the proposed actions. We evaluated the no-action alternative, system alternatives (including the use of electric driven compressors), major route alternatives, route variations, and alternative locations for the proposed compressor station facilities. We compared each alternative to the proposed action using three key criteria:

1. Would the alternative meet the objectives of the proposed action?
2. Would the alternative offer a significant environmental advantage over the proposed action?
3. Would the alternative be technically and economically feasible, reasonable, and practical?

Regarding the first criterion and for the purposes of NEPA, Columbia Gas' stated objectives for the MXP are to increase firm transportation service from receipt points in the Appalachian Basin to markets in the Midwest, Northeast, Mid-Atlantic, South, and Gulf Coast; specifically to increase natural gas deliverability by approximately 1,800,000 Dth/d to Columbia Gas' TCO Pool, as well as up to an additional 900,000 Dth/d to Columbia Gas' Leach Interconnect with Columbia Gulf's existing system.

The MXP is supported by binding Precedent Agreements with eight shippers[20], all of whom are anchors (shippers that have made long-term capacity commitments), collectively representing more than 96 percent of the project's capacity. The project is designed to transport natural gas from the Oak Grove, Majorsville, Goodwin, Sherwood, and Stonewall receipt points in West Virginia (up to about 2,300,000 Dth/d); the Clarington receipt point in Ohio (up to about 300,000 Dth/d); and the Waynesburg receipt point in Pennsylvania (up to about 100,000 Dth/d) through the MXP facilities to markets on the CPG system.

Columbia Gulf's stated objective for the GXP is:

- to provide an additional 860,000 Dth/d of natural gas supplies to southern markets in Mississippi and Louisiana with deliveries to receipt points in Humphreys County, Mississippi, and Acadia, Evangeline, Lafayette, and Saint Mary Parishes, Louisiana.

Our analysis of each alternative as described in the subsections below is based on information provided by the Companies; our review of aerial photographs, USGS topographic maps, and other publicly available information; input from cooperating and other agencies; public interactions that occurred during the scoping portion of our PF review for the MXP, public comment meetings on the draft EIS for the projects; and our site visits, including both aerial and terrestrial reconnaissance of specific segments of the MXP and GXP. Where environmental data are presented within this alternatives analysis, it is data collected from desktop (e.g., maps, literature, aerial photography, and agency databases) sources. The Companies collected field

[20] "Shippers" are defined as the individual companies who are paying for natural gas to be transported on CPG's system.

survey data for their proposed pipeline route and compressor station sites and some (but not all) alternatives. Therefore, to present the most consistent comparisons of potential impacts on environmental resources, this section presents data obtained from desktop sources only, for both the proposed route and facility sites and alternatives, even when field data may exist.

For the proposed MXP, Columbia Gas participated in our PF process (see section 1.3.1) during the preliminary design stage of its project. This process emphasizes identification of potential stakeholders early in the development of a project, identification and resolution of issues before a formal application is filed with the Commission, and identification and evaluation of alternatives that may avoid or minimize environmental impact. During this process, Columbia Gas made multiple modifications to its proposed pipeline route and other MXP components to address the concerns of stakeholders or landowners who would be directly affected by the project facilities. The majority of the route changes were made to avoid conflicts with existing or planned land uses or to address the distance of the pipeline route from residences or commercial businesses, recreation areas, or other infrastructure. These changes were subsequently made a part of Columbia Gas' proposed route when it filed its formal application and supplements, and as such are evaluated in section 4 of this EIS.

Using the evaluation criteria discussed above and subsequent environmental comparisons, each alternative was considered to the point where it was clear that the alternative could not meet the projects' objectives, offered no significant environmental advantage over the proposed action, or was not reasonable from a technical or economic standpoint. Alternatives that appeared to result in less than or similar levels of environmental impact were reviewed in greater detail. It is important to recognize that not all conceivable alternatives are technically or economically feasible or practical. Some alternatives may be impracticable because they are unavailable and/or incapable of being implemented after taking into consideration costs, existing technologies, or logistics in light of the overall project purpose. It is also important to consider the environmental advantages and disadvantages of the proposed actions and to focus the analysis on those alternatives that may reduce impacts and/or offer a significant environmental advantage rather than merely shifting impacts from one location to another. The following sections discuss and analyze each of the alternatives we evaluated in sufficient detail to explain why they were eliminated from further consideration or are recommended for adoption into the respective project.

3.1 NO-ACTION ALTERNATIVE

Our evaluation of the no-action alternative primarily addresses the effects and actions that may result if the MXP and GXP facilities are not constructed.

Under the no-action alternative, the environmental impacts identified in this EIS would not occur; however, the stated purposes of the Companies' proposals would not be met. The MXP would not be available to increase the capacity of Columbia Gas' system by up to 2,700,000 Dth/d, would not increase deliverability by approximately 1,800,000 Dth/d of natural gas to Columbia Gas' TCO Pool, and would not deliver an additional 900,000 Dth/d capacity to Columbia Gas' Leach Interconnect with Columbia Gulf's system. The GXP would not provide an additional 860,000 Dth/d of natural gas capacity to southern markets at identified locations in Mississippi and Louisiana.

Under the no-action alternative, existing natural gas transportation systems would continue to provide natural gas service to these regions; however, the projects' customers would likely seek natural gas and transportation services from other sources. Over the past several years, natural gas production in the Marcellus and Utica regions in the Northeast, which includes West Virginia, has grown significantly: their combined growth of 12 billion cubic feet per day since 2011 accounts for 89 percent of the U.S. total growth in natural gas production. The U.S. Energy Information Administration (EIA) annual energy outlook predicts that natural gas production will rise steadily, reaching 35.5 trillion cubic feet per year by 2040, an increase of 45 percent over 2012 levels (EIA, 2015). Because of this growth, both domestic natural gas consumption and exports of natural gas by pipeline have increased. However, because infrastructure projects often have longer lead times than production projects, infrastructure growth in the Northeast has not kept pace with production growth, and capacity has been insufficient to move natural gas out of the Northeast (EIA, 2016).

To increase capacity or to provide access to new sources of natural gas, the Companies may need to construct additional and/or new gas pipeline facilities and appurtenances in other locations (i.e., system alternatives) to provide the volumes of natural gas contracted through the projects' binding precedent agreements with the respective shippers. Alternatively, customers of the projects' shippers could seek to use other energy alternatives, such as alternative fuel or renewable energy sources, which could also require new facilities. If other new natural gas pipeline facilities or other energy infrastructure were approved and constructed, each project would result in specific environmental impacts that could be less than, similar to, or greater than the current proposals.

For these reasons, the no-action alternative is not preferable to or provide a significant environmental advantage over the proposed actions, and we do not recommend it.

3.2 SYSTEM ALTERNATIVES

To analyze system alternatives, we evaluated potential impacts associated with using other interstate natural gas pipelines to transport an equivalent volume of gas to meet customer requirements set forth in the binding precedent agreements, and to provide firm transportation service to Columbia Gas' TCO Pool, as well as more southerly markets accessible from Columbia Gulf's pipeline. As discussed in section 1.1.1, one of the primary purposes of the MXP is to increase deliverability by approximately 1,800,000 Dth/d to the TCO Pool. Columbia Gas' TCO Pool is the main pooling point on its system (i.e., the main hub to major markets across Columbia Gas' system and to the Columbia Gulf system by way of the Leach Interconnect in Boyd County, Kentucky). Therefore, the TCO Pool is an essential delivery point, and delivering gas to this point is critical to achieving the purpose of the MXP. We received comments asking us to discuss the process the projects used for identifying route segments and for evaluating and selecting compressor station sites. To meet the projects' objectives of increasing the capabilities of the CPG system to transport up to an additional 2,700,000 Dth/d of natural gas, including delivery of 860,000 Dth/d of natural gas supplies to southern markets in Mississippi and Louisiana, Columbia Gas and Columbia Gulf reviewed their systems' existing capabilities and evaluated several options for increasing capacity through increased compression, looping, and construction of new pipeline segments, as well as consideration of using existing systems with or without modifications to transport the load.

The Columbia Gas system transports an average of 3 billion cubic feet of natural gas per day through a nearly 12,000-mile pipeline network, with 92 compressor stations in 10 states. The company also has 600 billion cubic feet of natural gas storage capacity, including 37 underground storage fields in West Virginia, Ohio, Pennsylvania, and New York. Columbia Gulf operates nearly 3,400 miles of pipeline and 11 compressor stations in Louisiana, Mississippi, Tennessee, and Kentucky. Columbia Gulf interconnects with nearly every major pipeline system operating in the Gulf Coast. The MXP would aggregate supply from diverse receipt areas in the Marcellus and Utica Basins and transport approximately 2,700,000 Dth/d of natural gas from Columbia Gas' LXP in Marshall County, West Virginia, to an interconnect with its TCO Pool in Cabell County, West Virginia.

3.2.1 System Alternatives for the Mountaineer XPress Project

We received comments during public scoping regarding the availability of a system alternative to provide the capacity necessary to meet the purpose and need of the MXP. West Virginia has a broad network of high-pressure, high-volume, natural gas pipelines that provide transportation services to delivery points in the Northeast, Mid-Atlantic, and Southeast. These existing systems provide transportation services near MXP, and include facilities owned and operated by Dominion Transmission Inc. (Dominion), Texas Eastern Transmission, LP (TETCO), and Tennessee Gas Pipeline Company (TGP) (see figure 3.2-1).

Near the proposed MXP, Dominion has an extensive existing system of natural gas pipelines, including infrastructure in West Virginia, Ohio, and Kentucky. Additionally, Dominion has recently proposed several new projects and is currently completing upgrades to its system in the MXP area. None of the planned, current, or recently completed Dominion projects meet the capacity needs or in-service schedule of the MXP, however. In areas where the Dominion system provides access to the same supply areas as the Columbia Gas system, new pipelines and associated facilities would be required to reach all the supply and delivery points associated with the MXP. For example, Dominion would be required to construct approximately 40 miles of new pipeline to connect with Columbia Gas' SM80 Line at the Saunders Creek Regulating Station in Cabell County, West Virginia. Additional infrastructure would be expected to be constructed by Dominion to reach other delivery points on the MXP. For this reason, and the fact that the current Dominion system does not meet MXP's purpose and need, modification of the existing Dominion system is not considered a viable alternative to the MXP.

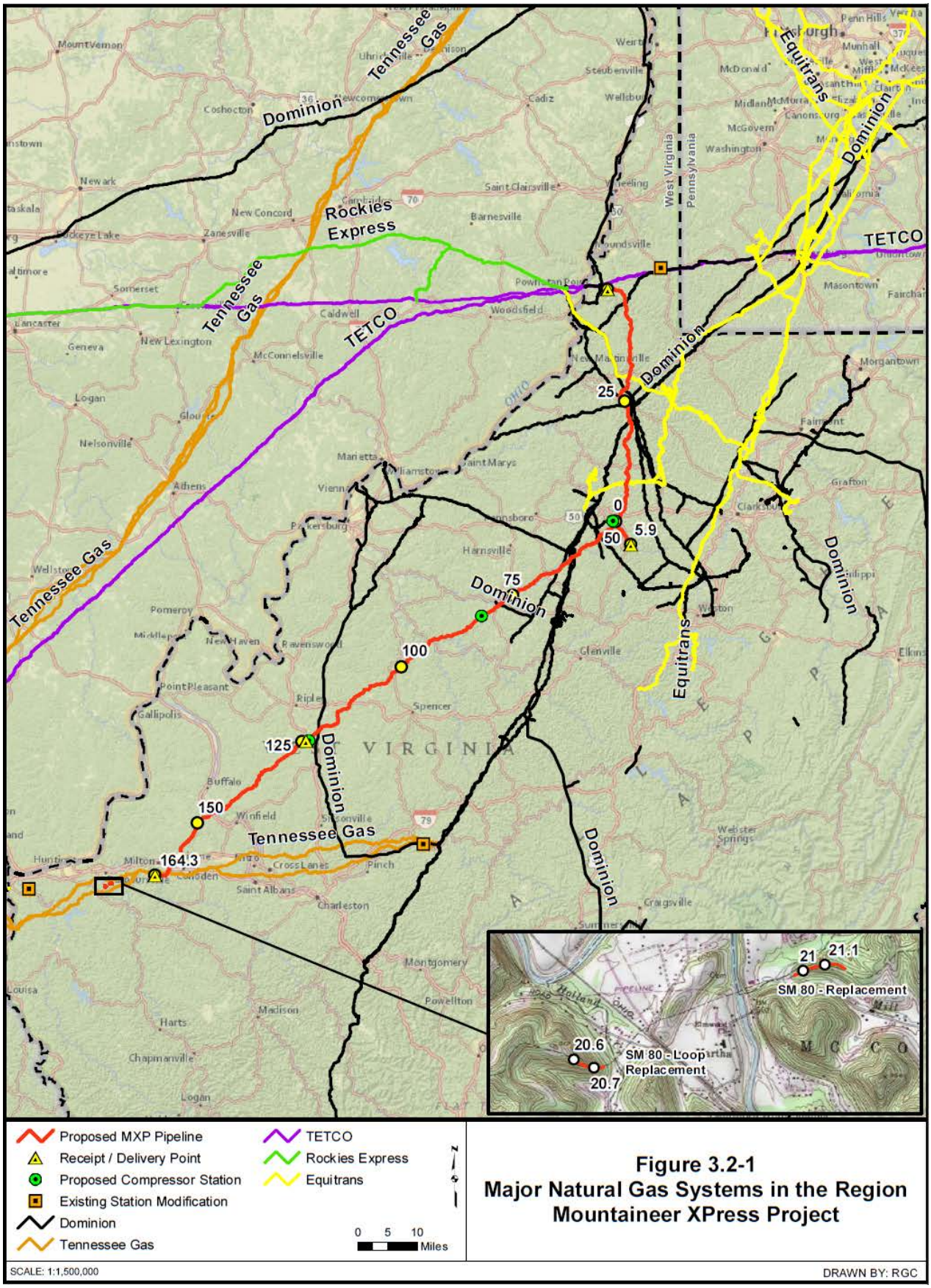


Figure 3.2-1
Major Natural Gas Systems in the Region
Mountaineer XPress Project

Near the MXP, TETCO's mainline roughly parallels the MXP's Line 100 route approximately 40 miles to the west; however, TETCO's system reaches different supply and delivery points than does MXP. TETCO recently completed two system upgrades (the U2GC and Ohio Pipeline Energy Network Projects) that allow for bi-directional flow to increase natural gas supply diversity to downstream Midwest markets. However, it is unlikely that TETCO's system could transport the volumes required by MXP's shippers, as the entire volume of TETCO's recently completed upgrades in the area is fully subscribed. Additional infrastructure (i.e., new pipelines, looping[21], and compression) would be required to reach the MXP receipt and delivery points and to create sufficient capacity to carry the load required by the MXP shippers. We do not have access to specific information related to the TETCO system, but using aerial photography to determine straight-line distances from the TETCO system to MXP delivery points, it is about 65 miles to the tie-in with the Columbia Gas Line 1983 and about 45 miles each to the Columbia Gas X59M1 pipeline tie-in in Jackson County, the tie-in with the Columbia Gas SM80 system in Cabell County, and the Ceredo Compressor Station in Wayne County. Each of these laterals would require a crossing of the Ohio River. In addition to the estimated 200 miles of laterals to the MXP delivery/receipt points, we assume that TETCO would be required to construct additional pipeline or looping segments and add compression to move the additional natural gas volume. Further, it is unlikely that the TETCO system could be upgraded to transport the same volume of natural gas as MXP by the requested in-service date of November 2018. For these reasons, we do not consider modification to the TETCO system a reasonable alternative to the MXP.

The TGP mainline roughly parallels the MXP route approximately 50 miles to the west. A TGP lateral intersects MXP Line 100 near MP 164 and the Saunders Creek Regulator Station and tie-in. For TGP to transport MXP's required capacity from Marshall County to Cabell County, West Virginia, approximately 55 miles of new pipeline would be required to connect the TGP system in Ohio to the northernmost point of the MXP. For TGP to access the additional MXP tie-in sites, a number of additional facilities would need to be constructed, including a new lateral from the closest point on the TGP system near McConnelsville, Ohio to the MXP delivery points in Doddridge County, West Virginia, a straight-line distance of about 75 miles. However, even if these connections were made, TGP's existing system and proposed upgrades would not have the capacity needed to transport the natural gas volumes associated with the MXP. TGP currently is undertaking an expansion of its system in the area of the MXP to transport 200,000 Dth/d of firm incremental transportation services (Broad Run Expansion Project, FERC Docket No. CP15-77). That project includes piping modifications and increasing horsepower at existing stations, and construction of new compressor facilities in West Virginia, Kentucky, and Tennessee. Given the fully subscribed nature of the Broad Run Expansion Project, we assume that considerable new pipeline, looping, and compression would be required on the TGP system to transport the load proposed for the MXP, which is more than 10 times the volume of the Broad Run Expansion. We do not have access to the design details necessary to determine all of the probable environmental impacts from assumed modifications to TGP's system to reach the same delivery/receipt points as the MXP, but considering a minimum of 130 miles of laterals to connect the TGP system to the MXP receipt/delivery points, the construction of additional pipeline and/or looping segments on the TGP system, and additional compression that may be required, it can be reasonably assumed

[21] "Looping" is one pipeline laid parallel to another and connected at both ends, often used to increase capacity along a right-of-way)

that the environmental impacts associated with such expansion would be equal to or greater than the proposed action. Additionally, TGP would not be able to permit and construct the necessary upgrades to its system in time to meet the November 2018 MXP requested in-service date. Therefore, we do not find any significant advantage to the TGP system over the MXP.

None of the other pipeline systems near the MXP have the capacity to transport the large volumes of gas that would be carried by the MXP, and none of the existing systems would be able to expand their facilities within the schedule required by the MXP's shippers. Because other pipeline carriers in the MXP area would be required to construct new pipeline segments and other appurtenances to reach the receipt and delivery points required by MXP, we do not consider the use of these other existing pipeline systems a viable alternative to the MXP. Therefore, these system alternatives were eliminated from further analysis.

3.2.2 System Alternatives for the Gulf XPress Project

The GXP would compress gas received from the Leach C interconnect in Boyd County, Kentucky, and deliver it to southern markets in Mississippi and Louisiana, with significant deliveries to Columbia Gulf's mainline pool south of Inverness, Mississippi. TETCO's mainline passes through Kentucky about 10 miles northwest of the GXP Morehead and Paint Lick Compressor Station sites, crosses Columbia Gulf's system northeast of the Goodluck Compressor Station, roughly parallels the system south of the Cane Ridge Compressor Station, and passes the Clifton Junction Compressor Station about 28 miles to the south. In Mississippi, TETCO's mainline is about 40 miles southeast of the New Albany Station and 55 miles southeast of the Holcomb Compressor Station. Recently authorized upgrades to the TETCO system will provide 650,000 Dth/d of firm transportation service to the Gulf Coast region of Louisiana and Texas from natural gas basins in the Northeast and Texas (Spectra, 2016). TETCO plans to install bidirectional compressor stations in Ohio, Kentucky, Tennessee, Mississippi, and Louisiana. TETCO has entered into firm agreements for the entire capacity of its upgrades; therefore, use or modification of the TETCO system is not considered a viable alternative to the GXP.

The TGP mainline roughly parallels Columbia Gulf's system from 0.25 to 25 miles west through Kentucky, Tennessee, and Mississippi. A 30-inch-diameter TGP pipeline is within 250 feet of the Morehead Compressor Station site. The TGP system would require expansion to transport the additional volumes associated with the GXP from Kentucky to Mississippi. TGP's proposed Broad Run Expansion Project's entire capacity has already been subscribed. Therefore, TGP would require significant upgrades to its system (including new pipeline and compressor station construction) to meet the purpose and need of the GXP. For these reasons, and the fact that TGP's current system does not meet the GXP's purpose and need, use or modification of the TGP system is not considered a viable alternative to the GXP.

During project development, two alternatives were evaluated using the existing Columbia Gulf system to meet the purpose and need of the GXP: a loop-intensive alternative that would include modifications to an existing facility and seven new pipeline looping sections, and a separate alternative that involved a combination of looping and horsepower increases at five existing compressor stations. The first alternative would require approximately 600 miles of new pipeline and would require all affected compressor stations to operate at 100 percent utilization. Because the affected compressor stations use older turbines, operating at full utilization could

affect the reliability of the units, and the resulting air emissions from these older compressor units would potentially be greater than the proposed emissions from the GXP facilities. In addition, the environmental impacts associated with 600 miles of new pipeline would be substantially greater than those for the GXP. For these reasons, we determined this alternative would not provide a significant environmental advantage over the proposed action and thus we did not engage in further evaluation of a loop-intensive alternative.

Columbia Gulf also conducted hydraulic modeling to identify how its existing system might be upgraded to meet the GXP's purpose and need. One alternative we evaluated involves adding compression at six existing compressor stations and significant looping of Columbia Gulf's system (as depicted in table 3.2-1). This alternative would require 228 miles of new looping, an additional 279,492 hp of compression, and an operational footprint of about 40 acres for each of the six compressor stations (240 acres total) to accommodate the construction of gas cooling bays.

Table 3.2-1
Compression-Intensive Alternative Loop Beginning and End Points

Facility	Upstream Point a/	Downstream Point	Length (miles)
Loop 1			
Ceredo to Stanton	Ceredo Compressor Station	Stanton Compressor Station	92
Loop 2			
Clementsville to Hartsville	MLV 308-2, MLV 308-3	Hartsville Compressor Station	12.6
Loop 3			
Hartsville to Hampshire	MLV 408-2, MLV 408-3	Hampshire Compressor Station	13.2
Loop 4			
Hampshire to Corinth	MLV 508-2, MLV 508-3	Corinth Compressor Station	11.7
Loop 5			
Corinth to Banner	MLV 608-2, MLV 608-3	Banner Compressor Station	11.5
Loop 6			
Banner to Inverness	Banner Compressor Station	Inverness Compressor Station	87
		Total	**228**

MLV = Mainline Valve
a Upstream Points may start at compressor station or a MLV located between two compressor stations

The combination of looping and increased horsepower would result in a greater number of landowners impacted, and would have greater potential to impact sensitive environmental resources than would the GXP. Additionally, the increase in horsepower at the existing compressor stations would result in greater air emissions than estimated for the GXP. We do not consider the looping and addition of compression at Columbia Gulf's existing compressor stations to be preferable to or to provide a significant environmental advantage over the facilities proposed for the GXP, and we eliminated this alternative from further analysis.

3.3 MAJOR PIPELINE ROUTE ALTERNATIVES

We received comments from the public and other federal agencies regarding the use of co-location opportunities with other utilities to reduce MXP impacts on landowners, communities,

and the environment. A pipeline is considered co-located with an existing corridor if the new right-of-way is adjacent to or overlaps the existing right-of-way. A pipeline can parallel an existing linear facility without being co-located (i.e., there is a separation between the rights-of-way), but this can result in multiple clear-cuts along similar paths with limited benefit in reducing impacts on environmental and other resources. Parallel configurations are typical for a gas pipeline where the corridor being followed is a foreign pipeline or utility, or where the company does not have multiple line rights within its existing right-of-way. In either scenario, whether truly co-located or simply paralleling another utility, construction within or adjacent to existing rights-of-way can minimize impacts on visual sightlines and intrinsic value, depending on how the new pipeline is configured in relation to the existing corridors. Because co-location usually minimizes vegetation clearing, it subsequently reduces fragmentation of forested habitats. Conversely, multiple corridors can have negative impacts on landowners, and studies have shown there can be detrimental effects on certain species of wildlife in areas with multiple co-located pipelines, as corridors can expand to the point that they create barriers to wildlife passage, and in some cases, effectively isolate populations. The extent of this effect depends on the species, life cycles, the geography of an area, and the cleared corridor width (USFS, 2013).

Columbia Gas' route review during the MXP pipeline siting process considered co-location opportunities where practicable, with several caveats. The co-location opportunity had to follow a reasonably direct path between the receipt and delivery points to avoid adding length to the pipeline. The terrain had to be conducive to allowing multiple pipelines without constraints such as steep side slopes or other factors that could jeopardize the safety and integrity of the pipeline during construction and operation. Also, the overall benefits from co-location to the types of properties and landforms crossed was to be considered, as Columbia Gas determined that attempting to co-locate through certain types of developed areas could add unnecessary length to the pipeline with little or no environmental or land use benefit.

The topographic setting of the MXP is characterized by steep slopes, narrow ridgetops and valleys, and shallow soils. Construction of the pipeline would require creating a corridor wide enough to allow for equipment and personnel to deliver, assemble, and install the pipeline safely. Other utilities (e.g., powerlines and pipelines) have taken advantage of ridgetops in the MXP area and are already sited to avoid side slopes and narrow valleys, which may be prone to extensive erosion during heavy rainfall events. Co-location opportunities on ridgetops and in the narrow valleys, which are prominent within the project setting and often contain waterbodies, limits the availability of workspace needed to safely construct and operate the proposed facilities. Even with the limited opportunities available, Columbia Gas could co-locate with other utility corridors about 38 miles, or about 22 percent, of the MXP route.

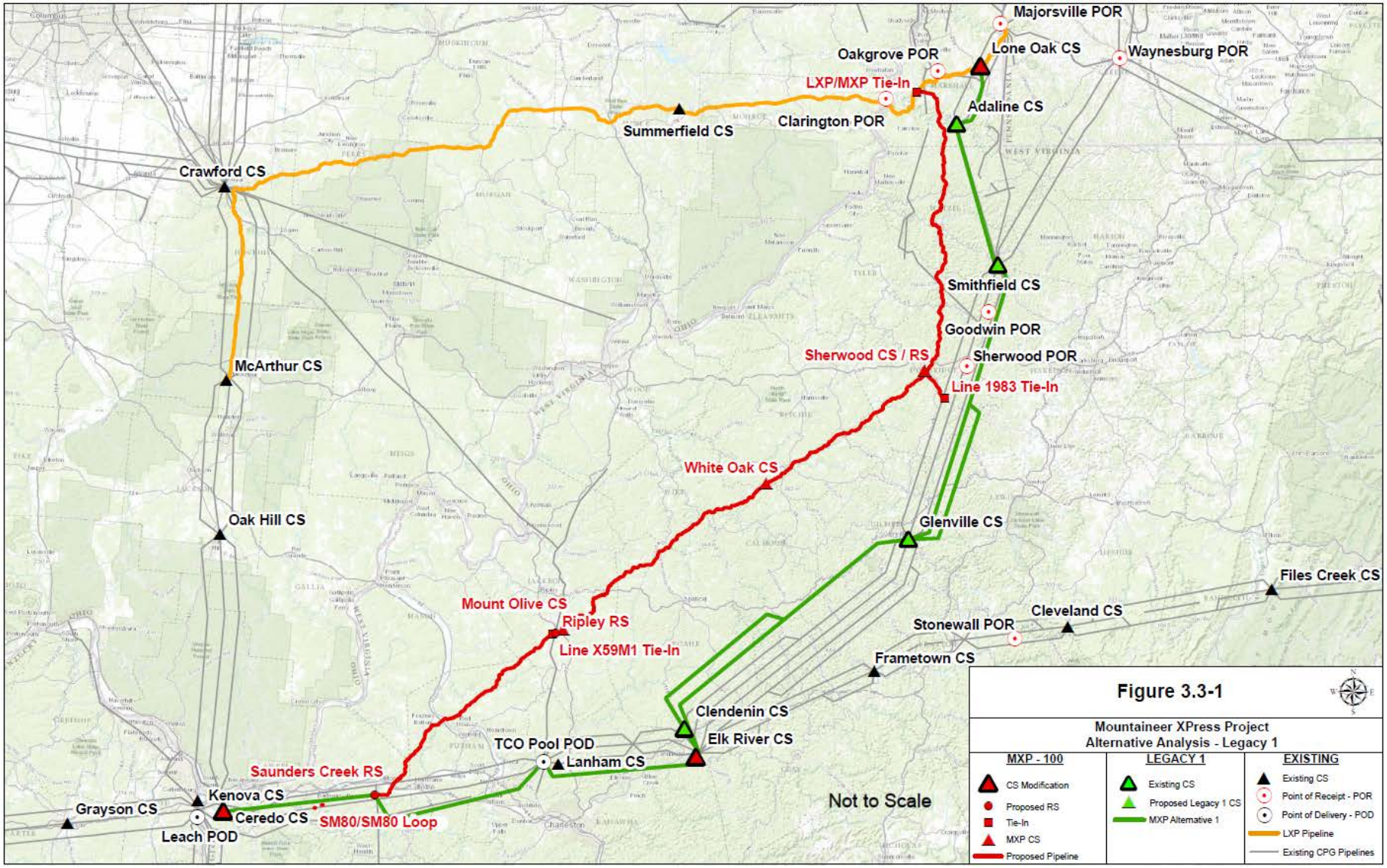
We analyzed two major route alternatives to the MXP that involved looping/upgrades to the existing Columbia Gas pipeline systems with greater ability to co-locate pipelines (Legacy 1 and Legacy 2 Alternatives), and one major route alternative (LXP Alternative) that included modifications to a recently approved Columbia Gas project (the LXP; Docket No. CP15-514). These alternatives are substantially different from the proposed MXP route and from each other. A comparison of environmental factors pertinent to each major route alternative is provided in table 3.3-1, and the locations of these alternatives are shown on figures 3.3-1 and 3.3-2.

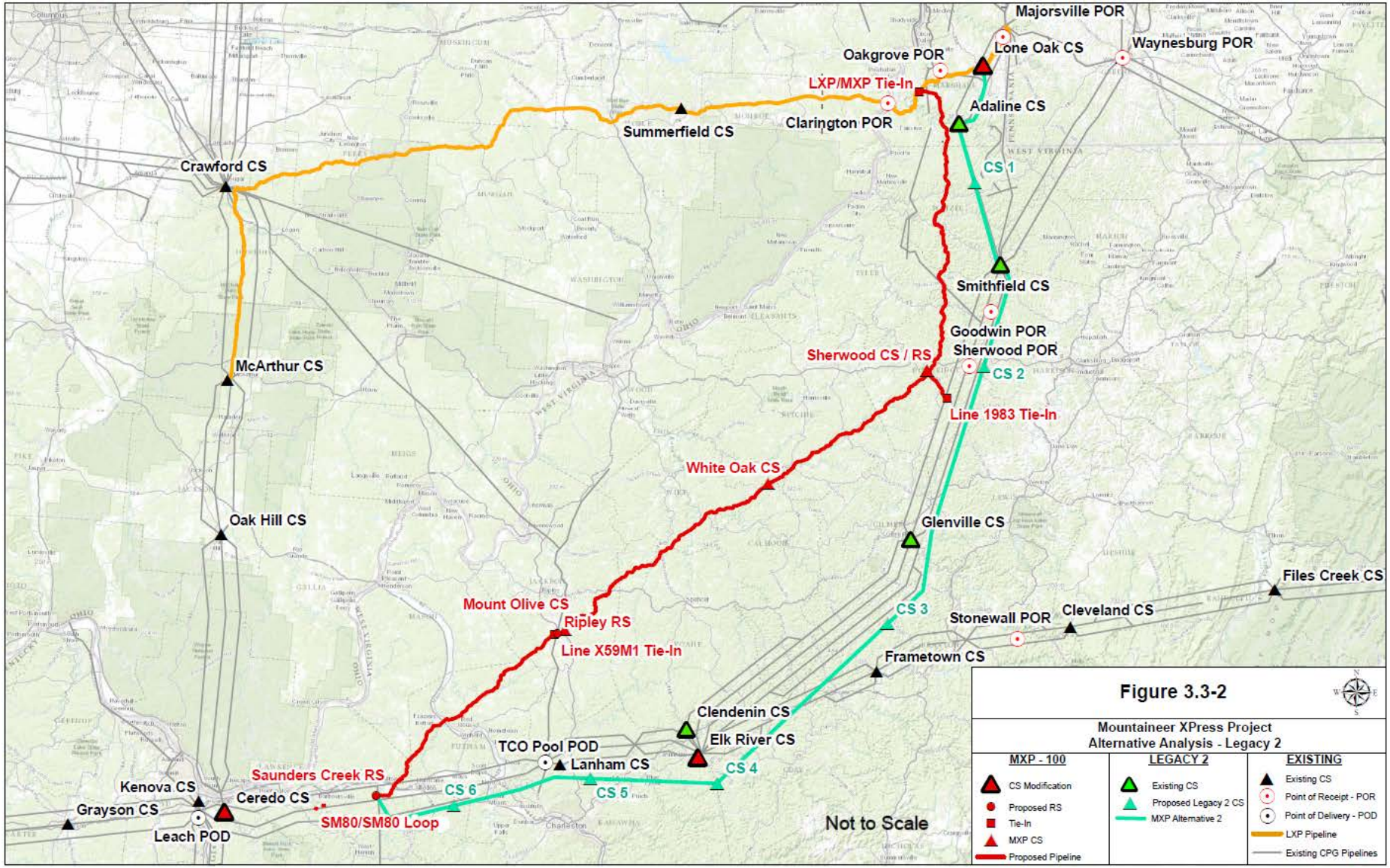
Table 3.3-1
Comparison of MXP with Major Route Alternatives

Component	MXP	Legacy 1 Alternative		Legacy 2 Alternative		LXP Alternative	
		Total	Increase (Decrease) from MXP	Total	Increase (Decrease) from MXP	Total	Increase (Decrease) from MXP
Pipeline (miles)	170	281	111	195	25	236	66
New Compressor Stations (number)	3	0	(3)	6	3	4	1
Modifications to Existing Compressor Stations (number of units)	3	7	4	1	(2)	6	3
Compression (hp)	228,000	226,200	(1,800)	282,500	54,500	315,600	87,600
Temporary right-of-way (acres) **a**/	2,575	3,406	831	2,364	(211)	2,860	285
Permanent right-of-way (acres) **b**/	1,030	1,703	673	1,181	151	1,430	400

a Assumes 125-foot-wide construction right-of-way for MXP and 100-foot right-of-way for alternatives (if co-location were achieved for the entirety of the route).

b Assumes 50-foot-wide permanent right-of-way for MXP and all alternatives.


Majorsville POR
Lone Oak CS
Waynesburg POR
Oakgrove POR
LXP/MXP Tie-In
Adaline CS
Clarington POR
Summerfield CS
Crawford CS
Smithfield CS
Goodwin POR
Sherwood CS / RS
Sherwood POR
Line 1983 Tie-In
McArthur CS
White Oak CS
Oak Hill CS
Glenville CS
Files Creek CS
Mount Olive CS
Ripley RS
Line X59M1 Tie-In
Cleveland CS
Stonewall POR
Frametown CS
Clendenin CS
Elk River CS
TCO Pool POD
Lanham CS
Saunders Creek RS
Kenova CS
Grayson CS
Ceredo CS
SM80/SM80 Loop
Leach POD
Not to Scale
Figure 3.3-1
Mountaineer XPress Project
Alternative Analysis - Legacy 1
MXP - 100
CS Modification
Proposed RS
Tie-In
MXP CS
Proposed Pipeline
LEGACY 1
Existing CS
Proposed Legacy 1 CS
MXP Alternative 1
EXISTING
Existing CS
Point of Receipt - POR
Point of Delivery - POD
LXP Pipeline
Existing CPG Pipelines


Majorsville POR
Lone Oak CS
Waynesburg POR
Oakgrove POR
LXP/MXP Tie-In
Adaline CS
Clarington POR
Summerfield CS
Crawford CS
CS 1
Smithfield CS
Goodwin POR
Sherwood POR
Sherwood CS / RS
CS 2
McArthur CS
Line 1983 Tie-In
White Oak CS
Oak Hill CS
Glenville CS
Files Creek CS
Mount Olive CS
Ripley RS
Line X59M1 Tie-In
CS 3
Stonewall POR
Cleveland CS
Frametown CS
Clendenin CS
Elk River CS
TCO Pool POD
Lanham CS
CS 4
Saunders Creek RS
Kenova CS
Ceredo CS
CS 6
CS 5
Grayson CS
SM80/SM80 Loop
Leach POD
Not to Scale
Figure 3.3-2
Mountaineer XPress Project
Alternative Analysis - Legacy 2
MXP - 100
CS Modification
Proposed RS
Tie-In
MXP CS
Proposed Pipeline
LEGACY 2
Existing CS
Proposed Legacy 2 CS
MXP Alternative 2
EXISTING
Existing CS
Point of Receipt - POR
Point of Delivery - POD
LXP Pipeline
Existing CPG Pipelines

3.3.1 Legacy 1 Alternative

We evaluated looping Columbia Gas' existing pipeline system between the approved LEX pipeline/MXP tie-in in Marshall County, West Virginia and the proposed MXP Line 100 terminus at the Saunders Creek Regulator Station in Cabell County, West Virginia (via Columbia Gas' Majorsville, Adaline, Smithfield, Glenville, Clendenin, and Lanham Compressor Stations, collectively referred to as Columbia Gas' "Legacy 1" system) (see figure 3.3-1). This alternative would require approximately 281 miles of new pipeline (compared to 170 miles for the proposed route) and approximately 226,200 hp of additional compression at several existing stations. If Columbia Gas could overlap its existing right-of-way by 25 feet during construction and reduce the overall corridor width to 100 feet, the added length of the Legacy 1 Alternative would still disturb considerably more acreage than the MXP (3,406 acres versus 2,575 acres) (see table 3.3-1).

The MXP involves modifications at three compressor stations: one currently in operation (Ceredo), a new station approved for construction as part of the LXP (Lone Oak), and a new station proposed as part of Columbia Gas' WBX (Elk River). Construction of the WBX- and MXP-specific components for the Elk River Compressor Station would have overlapping and sequential schedules. The Legacy 1 Alternative also would require compression to be added to five existing compressor stations (Adaline, Smithfield, Glenville, Clendenin, and Lanham).

Columbia Gas estimates that the increased horsepower at or near the five existing compressor stations, in addition to Ceredo and Elk River, would result in an increase in air quality and noise impacts at nearby receptors. Several existing compressor stations (specifically, Smithfield, Glenville, and Lanham) along this portion of Columbia Gas' system are space constrained and cannot readily accommodate the required expansions. Additionally, Columbia Gas does not have multiple-line-right agreements in areas where it would need to loop its system; therefore, a new corridor would need to be established to construct a parallel pipeline (although Columbia Gas could potentially use portions of its existing right-of-way to reduce impacts). In addition, the narrow ridges and valleys associated with the topography along this alternative presents challenges for co-location. Since this alternative would require over 110 more miles of pipeline construction than the MXP, it is reasonable to assume that a greater number of landowners would be affected by paralleling the existing system and expanding the existing compressor stations, in addition to the acreage impacts.

We also evaluated a variation to this alternative, which involved replacing all or a portion of the existing pipeline facilities along this route with a larger-diameter pipeline capable of transporting both the existing volumes of gas and the planned volumes associated with the MXP. To serve existing customers and meet the needs of the MXP customers, we considered replacement of the existing 20- and 24-inch-diameter pipelines with a 42-inch-diameter pipeline, but determined that a 42-inch-diameter pipeline would not have sufficient capacity to serve all customers, and new pipeline segments would be needed to meet both the existing and new service requirements. In addition, it would not be possible for Columbia Gas to take the existing lines out of service to install a larger-diameter pipeline in the same rights-of-way given Columbia's significant ongoing delivery requirements. Therefore, construction of a parallel pipeline would be required, resulting in substantially more impacts than the MXP. Columbia Gas estimates that the

cost to construct the Legacy 1 Alternative would increase project costs by $1 billion. Because the Legacy 1 Alternative would be longer than the proposed MXP route, result in greater environmental impacts, potentially affect more landowners, and increase construction costs substantially, we do not view this alternative as providing a significant environmental advantage over the proposed action. Therefore, this alternative was eliminated from further analysis.

3.3.2 Legacy 2 Alternative

We also evaluated a second major route alternative to the MXP between the approved LEX pipeline/MXP tie-in in Marshall County, West Virginia and the proposed MXP terminus at the Saunders Creek Regulator Station in Cabell County, West Virginia, referred to as Columbia Gas' "Legacy 2" system. This alternative would parallel Columbia Gas' existing system, but unlike the Legacy 1 Alternative, this alternative would operate independently of the existing system (see figure 3.3-2). This alternative would require approximately 195 miles of new pipeline (25 miles longer than the proposed route), approximately 282,500 hp of additional compression at six new compressor stations, and upgrades to one existing compressor station. Assuming a reduction of the construction corridor width to 100 feet (if co-location were achieved for the entirety of the route), impacts from construction of this alternative would be only slightly less than those of the MXP (2,363 acres versus 2,575 acres), but the permanent right-of-way impact would still be 151 acres greater than that of the MXP (see table 3.3-1). Columbia Gas estimates that this alternative would add $300 million to the cost of the project.

A new pipeline along this corridor would expand Columbia Gas' easement to include up to seven pipelines in some areas, with at least four lines through most of the route. Such a corridor could inhibit wildlife crossings and further reduce interior forested areas. The narrow ridges and valleys associated with the topography along this alternative presents challenges for co-location, and several existing compressor stations (specifically, Smithfield, Glenville, and Lanham) along this portion of Columbia Gas' system are space constrained and cannot readily accommodate the required expansions. We assume that a greater number of landowners would be affected with the Legacy 2 Alternative than with the MXP, considering that it is 25 miles longer than the MXP and would require a new corridor paralleling the existing Columbia Gas system. Further, construction of an additional pipeline corridor adjacent to areas where several pipelines currently exist could result in adverse land use restrictions on individual affected properties.

Constructing the proposed MXP system and retaining Columbia's existing pipelines offers much greater flexibility to shippers than constructing a new pipeline corridor adjacent to the existing system. The TCO Pool was designed to provide system flexibility; a need established by shippers. Without MXP and its intermediate delivery/receipt points, the TCO Pool would lose some ability to provide variable shipper options, a major factor in the current design of the MXP.

Given the potential impacts on landowners through right-of-way expansions and the construction of six new compressor stations; the resulting increase in environmental, air, and noise impacts; the construction challenges associated with constructing this alternative; the reduced flexibility on the CPG system to accommodate shippers; and additional costs, we conclude the Legacy 2 Alternative would offer no environmental benefits over the MXP. Therefore, this alternative was eliminated from further analysis.

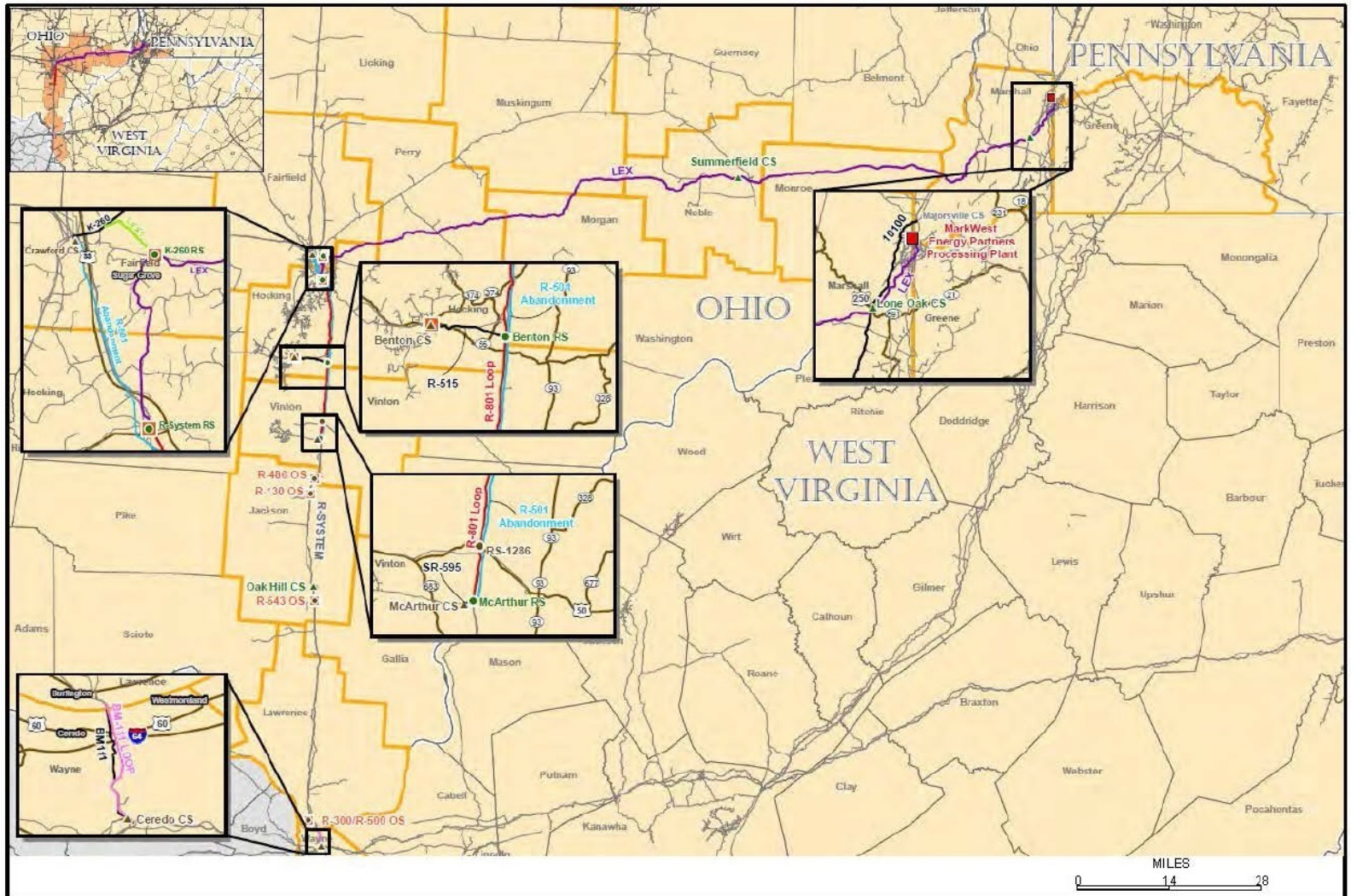
3.3.3 Leach XPress Alternative

On June 8, 2015, in Docket No. CP15-514, Columbia Gas filed an application with the Commission to construct and operate facilities located in West Virginia, Pennsylvania, and Ohio to transport natural gas produced in these states to its existing pipeline system in central Ohio (i.e., the LXP). The LXP consists of four new natural gas pipeline segments totaling approximately 160 miles, as well as the abandonment in place of a segment of an existing line (see figure 3.3-3).

In addition to new pipelines, the LXP would include the construction and operation of three new compressor stations (Lone Oak in Marshall County, West Virginia; Summerfield in Noble County, Ohio; and Oak Hill in Jackson County, Ohio) and four new regulator stations in Ohio (K-260 and R-System in Fairfield County; Benton in Hocking County; and McArthur in Vinton County). The LXP also consists of modifications at two existing compressor stations (Crawford in Fairfield County, Ohio and Ceredo in Wayne County, West Virginia) and one existing regulator station (RS-1286 in Vinton County, Ohio). The LXP began construction in the first quarter of 2017.

We evaluated an alternative that would loop portions of the LXP between Columbia Gas' existing Crawford Compressor Station and the terminus of the LXP at the McArthur Compressor Station as an option to deliver the proposed capacity of the MXP (see figure 3.3-4); this is the LXP Alternative shown in table 3.3-1. To meet the objectives of the MXP using the LXP, Columbia Gas would need to loop portions of the existing and proposed pipeline rights-of-way between the Lone Oak and Crawford Compressor Stations via the Summerfield Compressor Station, as well as loop the route between the McArthur Compressor Station and the Kenova Compressor Station via the Oak Hill Compressor Station. Looping the LXP pipeline between the Crawford and McArthur Compressor Stations would require about 25 miles of pipeline. Portions of Columbia Gas' existing system between the Smithfield and Lanham Compressor Stations would need to be looped as well.

Overall, approximately 236 miles of new pipeline and about 315,000 hp of compression would be required for the LXP alternative. This would be accomplished through modifications to several existing stations and construction of new stations. Table 3.3-1 provides a comparison of the MXP and LXP requirements and impacts. If Columbia Gas were to overlap its existing right-of-way by 25 feet during construction, the remaining 100-foot-wide construction corridor would impact about 2,860 acres, still 285 acres greater than the impacts for the MXP as proposed. As with the other route alternatives considered, co-locating the MXP with the LXP would result in a loss of system flexibility. The two projects ultimately serve different markets, and linking the two project routes would result in the construction of substantially more pipeline and ensuing environmental impacts. Additionally, the MXP is proposed to connect with the MarkWest Sherwood Facility, which is about 5.7 miles from Columbia Gas' existing system. As currently designed, the LXP would not provide natural gas pipeline service in the area of MarkWest's Sherwood facility; therefore, additional pipeline and compression would be required to receive gas from this facility. More landowners would be affected under this alternative than those affected by the MXP because of the increased amount of pipeline, expansion of approved, pending, and existing compressor stations, as well as the construction of four new compressor stations. Thus, we did not view this alternative as providing a significant environmental advantage over the proposed action. Therefore, this alternative was eliminated from further analysis.



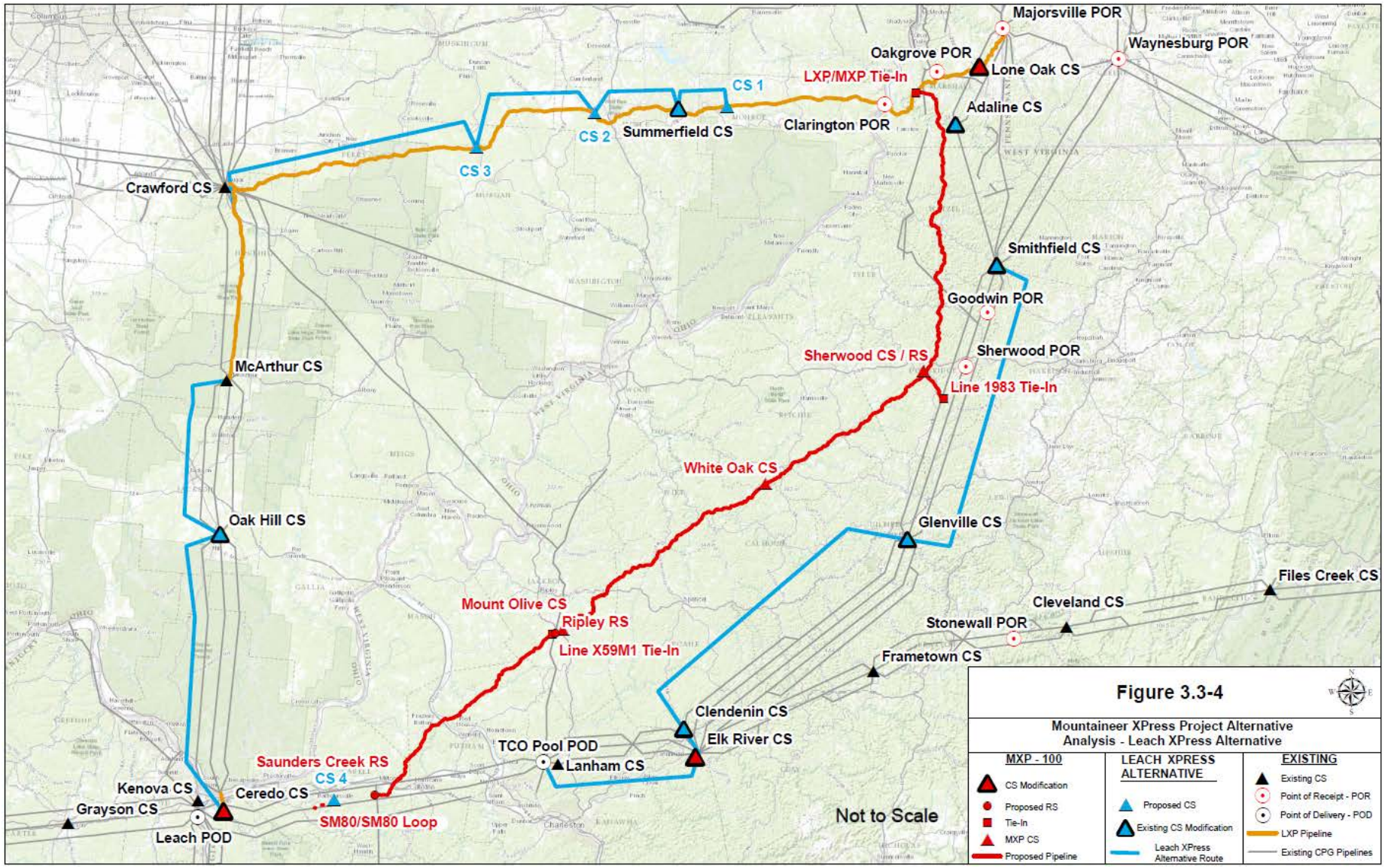
LEX
LEX1
R-801 Loop
BM-111 Loop
R-501 Abandonment
Existing Columbia Pipeline
Existing Columbia Pipeline Associated With Project

Existing Regulator Station (RS)
Existing Compressor Station (CS)
Odorization Site (OS)
New Regulator Station (RS)
New Compressor Station (CS)

Figure 3.3-3

Leach XPress Project

Columbia Gas Transmission, LLC


Majorsville POR
Waynesburg POR
Oakgrove POR
Lone Oak CS
LXP/MXP Tie-In
CS 1
Adaline CS
Clarington POR
CS 2
Summerfield CS
CS 3
Crawford CS
Smithfield CS
Goodwin POR
Sherwood CS / RS
Sherwood POR
Line 1983 Tie-In
McArthur CS
White Oak CS
Oak Hill CS
Glenville CS
Files Creek CS
Cleveland CS
Mount Olive CS
Ripley RS
Stonewall POR
Line X59M1 Tie-In
Frametown CS
Clendenin CS
Elk River CS
TCO Pool POD
Lanham CS
Saunders Creek RS
CS 4
Kenova CS
Ceredo CS
Grayson CS
SM80/SM80 Loop
Leach POD
Not to Scale
Figure 3.3-4
Mountaineer XPress Project Alternative
Analysis - Leach XPress Alternative
MXP - 100
CS Modification
Proposed RS
Tie-In
MXP CS
Proposed Pipeline
LEACH XPRESS ALTERNATIVE
Proposed CS
Existing CS Modification
Leach XPress Alternative Route
EXISTING
Existing CS
Point of Receipt - POR
Point of Delivery - POD
LXP Pipeline
Existing CPG Pipelines

3.3.4 Major Route Alternatives Conclusions

Constructing the MXP system and retaining Columbia Gas' existing pipelines would offer greater flexibility to shippers and overall less environmental impact than looping or constructing a new pipeline corridor adjacent to portions of the existing system. The TCO Pool was designed to provide system flexibility, a need established by shippers. Without the MXP and its intermediate delivery/receipt points, the TCO Pool would lose some ability to provide variable shipper options, a major consideration in the design of the MXP. The alternatives we reviewed were determined not to be environmentally preferable to the proposed action. Additionally, all the major pipeline route alternatives involve constructability issues and potential impacts on a larger number of landowners when compared to the MXP. Therefore, we conclude that the MXP, as proposed, is preferable to the major route alternatives considered.

3.4 PIPELINE ROUTE VARIATIONS

Route variations differ from system or major route alternatives in that they are designed to reduce impacts on specific localized features, are typically shorter than major route alternatives, and do not result in a significant departure from the original alignment.

During development of the MXP, Columbia Gas identified and evaluated numerous route variations and alignment modifications as additional information became available. In its application filing, Columbia Gas identified and provided its rationale for adopting 21 minor variations and 3 more significant route modifications (the Maxwell Ridge, Sherwood Lateral, and Hurricane Creek Alternatives) that were considered during PF.[22] Two of the modifications (the Sherwood Lateral at approximately MP 49.0 to MP 54.4 and Hurricane Creek at approximately MP 146.3 to MP 158.4) were specifically developed in response to comments received during project scoping.

In its October 13, 2016 supplemental filing, Columbia Gas identified an additional 48 route changes, which resulted from further project refinements in consideration of its 2016 field surveys, stakeholder comments, input from FERC staff, and other considerations. These route adjustments were adopted to address landowner concerns, design changes, and constructability constraints, as well as to avoid certain parcels and landmarks.

On March 2, 2017, Columbia Gas filed an application supplement, which included modifications and refinements to the MXP pipeline route, associated workspaces, off right-of-way work areas (access roads, staging areas, and contractor yards), and aboveground facilities. Columbia Gas continues to assess route variations in its response to landowner or agency concerns. These changes to the originally planned alignment were incorporated into the proposed route to minimize or avoid areas with engineering constraints and constructability issues, and to reduce impacts on environmentally sensitive features (e.g., water resources and cultural resources), existing structures (e.g., water wells, residences, and barns), and other land uses. Because these routes became part of the filed proposed project, the environmental impacts are assessed in section 4 of this EIS. Any route variations requested by an applicant and filed after the issuance of a

[22] Columbia Gas' application referred to the Maxwell Ridge, Sherwood Lateral, and Hurricane Creek Alternatives as "Major Route Alternatives."

Commission Order must be submitted for our review and approval in accordance with our variance process, as described in section 2.6.3, above.

We received four comment letters in December 2016 from affected landowners asking us to consider specific route variations to the currently proposed MXP-100 alignment. In each case, the proposed pipeline route would be shifted to a different location while remaining on the respective landowners' property. Columbia Gas met with each of the landowners requesting a route variation and filed a response with the Secretary on April 21, 2017 in which they provided details of correspondences with each of the landowners, mapping of the current route and proposed variation, as well as a comparative analysis of environmental impacts from both options.

- On the Hall property in Wirtz County between MPs 96.8 and 97.3, Mr. Hall requested a variation to increase the setback of the MXP-100 from his house, to avoid traversing his driveway, and to avoid crossing two tributaries near his drinking water well. The requested variation would move the centerline to the southern boundary of the Hall property, which would result in an approximate 300-foot-long increase in the length of the pipeline. The variation would reduce the number of waterbody crossings and the amount of agricultural area impacts, but would result in about 2.6 acres of additional tree clearing. Overall, the variation would result in approximately 1 acre of additional impact over the original route. Further, the route variation would comply with an agency recommendation to minimize impacts on sensitive mussel species. Pending further discussions with Mr. Hall and regulatory agencies, Columbia Gas has stated it would adopt a variation that is acceptable to all parties. Final proposed design of any route variation would be contingent on the results of environmental and cultural surveys.
- On the Elliot property in Putnam County between MPs 144.0 and 144.3, Ms. Elliot requested a variation to increase the setback of the MXP-100 from her home and to allow for construction of a new house on the property. The variation would move the route further east, away from the existing residence and planned future residence. Shifting the route to the requested location would result in a reduction of approximately 112 feet in overall length of the pipeline, but would require about 0.5 acre of additional tree clearing. No wetlands or waterbodies would be affected by either route option. Pending the outcome of cultural and biological surveys of the requested variation, Columbia Gas has stated it would propose a route that is acceptable to Ms. Elliot.
- On the Cobb property in Putnam County, the requested variation between MPs 144.9 and 145.3 was proposed to shift the centerline southeast of the currently proposed route to increase the distance of the pipeline from the Cobb residence; however, the requested variation would have moved the route closer to the residence. The landowners' legal representative and several representatives from Columbia Gas conducted a field visit to the property to discuss the design and construction techniques to be implemented on the property. After the landowners were made aware of the location of the proposed route, and understood the design and construction techniques to be used, they agreed to Columbia Gas' original design as opposed to their requested variation.
- On the Umstead property in Ritchie County, the requested variation between MPs 69.3 and 69.4 and between MPs 69.5 and 69.6 would preserve desired building sites while moving the pipeline toward the property boundary. In response to the request, Columbia Gas

representatives visited the property to meet with the landowner to discuss various options for the final pipeline route. An acceptable variation was identified that would have similar environmental impacts as the original route. Columbia Gas is further evaluating minor adjustments to the variance to accommodate the crossing of a foreign utility line that is in proximity to the proposed variance. Negotiations have not been finalized for a route variation, but Columbia Gas anticipates that it would propose a variation that would be acceptable to the landowners.

Columbia Gas has reached an acceptable resolution regarding the Cobb property; the remaining route adjustments would require further investigations. Columbia Gas states that it is working toward an amicable resolution with each of the remaining landowners. We are generally inclined to support minor reroutes requested by property owners (especially those that don't involve other properties) absent significant environmental resource or engineering issues. To ensure that the concerns raised by Mr. Hall, Ms. Elliot, and Mr. and Mrs. Umstead are appropriately addressed, **we recommend that**:

- **<u>Prior to construction</u>, Columbia Gas should finalize the design for and adopt the route variations on the Umstead (MP 68.0), Hall (MP 97.1), and Elliot (MP 145.8) properties into its final proposed route for MXP-100. Columbia Gas should file with the Secretary, for review and written approval by the Director of OEP:**
  - **a. aerial and/or topographic maps identifying the route variations that address the identified landowner issue(s);**
  - **b. documentation of landowner consultation; and**
  - **c. documentation of any required surveys and agency consultations for each route variation.**

It is possible that additional minor (i.e., property-specific) refinements to the MXP route could be identified before construction. Any such refinements or modifications that are identified after a Certificate is issued would be evaluated as per our variance approval process (see section 2.6.3, above) and the procedures described in recommended environmental condition no. 5 (see section 5.2).

3.5 MOUNTAINEER XPRESS PROJECT ABOVEGROUND FACILITY SITE ALTERNATIVES

Columbia Gas proposes to modify facilities at one existing compressor station (Ceredo), one recently approved new compressor station (Lone Oak — approved as part of the LXP, FERC Docket No. CP15-514-000), and one new compressor station pending under a separate proceeding (WB XPress Project [WBX], FERC Docket No. CP16-38-000). In addition, Columbia Gas proposes to construct three new compressor stations, three new regulator stations, and other appurtenant facilities (see figure 2.1-1). Columbia Gas selected the proposed compressor station locations to optimize gas flow hydraulics, integrate with other pipelines on the Columbia Gas system, and to minimize construction challenges given that much of the terrain where compression is required is mountainous and rugged. The three new compressor station sites proposed by Columbia Gas are privately owned parcels for which Columbia Gas has obtained purchase rights.

During public scoping for the MXP, we received comments requesting a description of the criteria used for selection of compressor station sites. The factors considered for selecting a potential site for a compressor station are different than those considered for a pipeline route because an aboveground facility is a fixed location rather than a linear facility. In general, factors considered for assessing potential sites for a new compressor station include required system hydraulics and engineering (including the need for additional lateral or suction/discharge pipelines); amount of available land for purchase or lease; constructability and land use; site access; proximity to noise-sensitive areas (NSA); proximity to electrical service; local and regional air emissions; wetland disturbance; presence of threatened or endangered species or their critical habitat; presence of NRHP-eligible cultural resources; and other resource concerns.

We did not evaluate alternative locations for the three proposed compressor stations (Sherwood, White Oak, or Mount Olive) as our review found no significant resource conflicts at any of the three sites and we received no public comments requesting us to evaluate any specific alternate sites. We did not evaluate alternative locations for the proposed modifications at existing compressor stations because the modifications are largely determined by hydraulic modeling to meet the contracted capacity of the MXP and would occur within the boundaries of existing facilities. We also did not evaluate alternative locations for regulator stations because the locations of those facilities are largely determined by interconnections with other pipeline systems and delivery points; additionally, the facilities have a relatively small footprint. Similarly, the locations of other proposed appurtenant aboveground facilities (valves) are based in part on PHMSA regulations and would occupy a small footprint within the proposed pipeline rights-of-way.

According to information provided by Columbia Gas, the general location of the Sherwood Compressor Station is integral to the overall project design as this site is where three separate gas streams (receipts from the LEX pipeline tie-in, MarkWest gas processing facility, and the MXP-200 connection to CPG's legacy system) are joined. At this anchor location, gas would be regulated, comingled, and compressed from the three sources for shipment. Based on the Sherwood Compressor Station location, Columbia sited the White Oak and Mount Olive Compressor Stations as necessary to meet the required system hydraulics. See section 2.1.2 for a description of MXP aboveground facilities.

3.6 GULF XPRESS PROJECT COMPRESSOR STATIONS

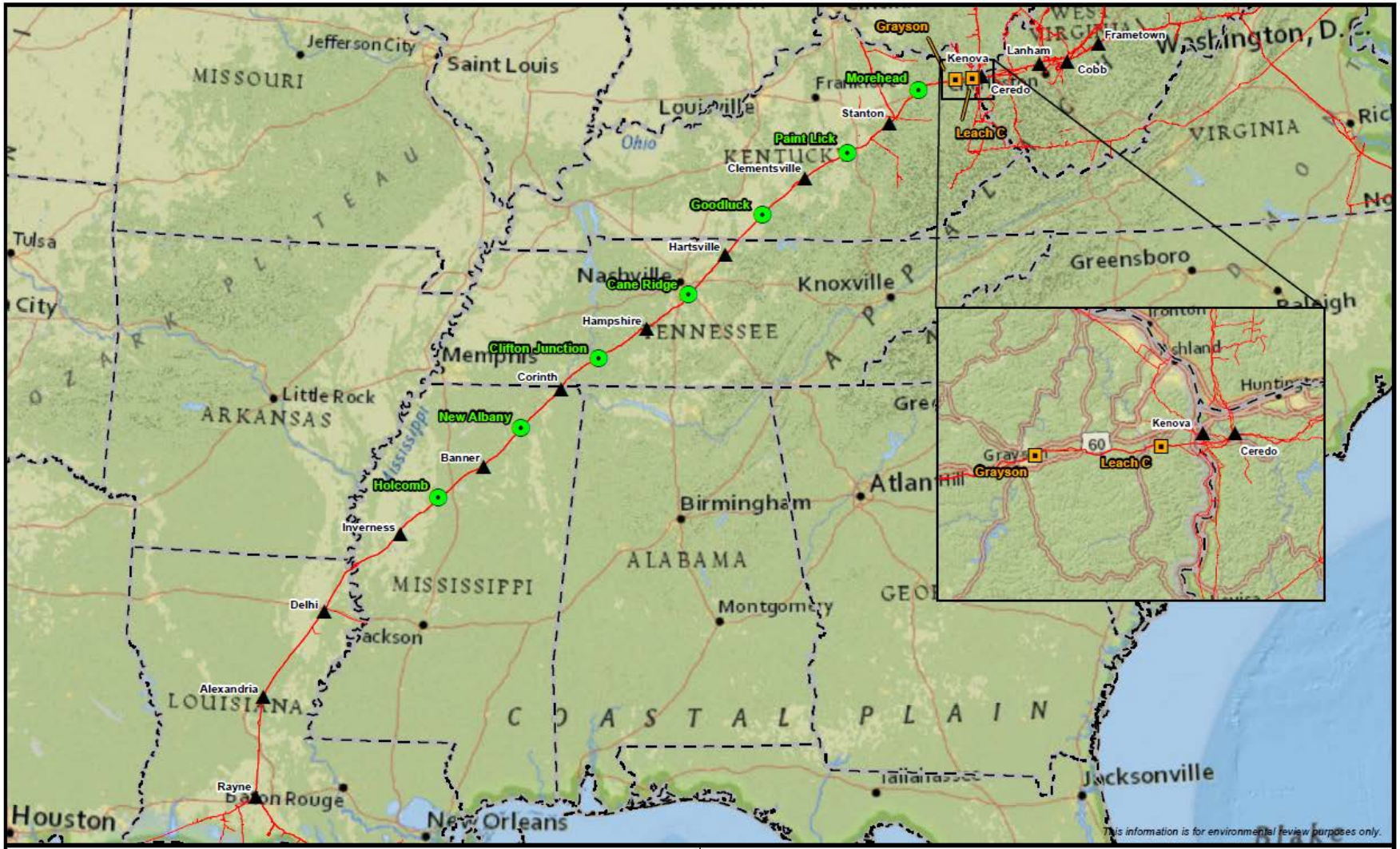
For the GXP, Columbia Gulf proposes to construct seven greenfield compressor stations in Kentucky, Tennessee, and Mississippi, and to upgrade one recently authorized compressor station and one existing meter station (see figure 3.6-1).

In Kentucky, three new compressor stations are proposed. Additionally, Columbia Gulf proposes to upgrade its recently-approved Grayson Compressor Station (authorized as part of the RXP under Docket No. CP15-539-000) in Carter County and its existing Leach C Meter Station in Boyd County.

In Tennessee and Mississippi, Columbia Gulf proposes to construct and operate four new compressor stations (two in each state). The new stations, located at midpoints between existing compressor stations, would compress gas on Columbia Gulf's existing 30-inch-diameter Line 200 and 36-inch-diameter Line 300, and flow gas into its existing 30-inch-diameter Line 100.

The number and locations of the compressor stations proposed for the GXP considered the existing flow dynamics of natural gas on Columbia Gulf's system and the requirements of the additional volumes associated with the GXP. To determine the amount of compression needed by the GXP and the location of compressor stations, Columbia Gulf used a combination of factors, including compression ratios, fuel consumption, and compressor suction and discharge pressures.

Columbia Gulf proposed the new compressor stations to meet the volumetric and pressure requirements of the GXP shippers while maintaining service to its existing customers and minimizing environmental impacts. Applying the results of hydraulic modeling led Columbia Gulf to determine that each compressor station must be located within approximately 1 to 2 miles (upstream or downstream) of the optimal compression location. This would achieve the hydraulic efficiency necessary to meet the required project shipper volume while optimizing facility requirements.



Proposed Compressor Station Site

Existing Facility Modification

Existing Compressor Station

CGT Pipelines

0 50 100 Miles

Figure 3.6-1
Project Overview
Gulf XPress Project

SCALE: 1:7,500,000

DRAWN BY: TG

Columbia Gulf identified potentially suitable land parcels within the acceptable hydraulic ranges at each of the seven compressor locations. In selecting the new station sites, Columbia Gulf considered alternatives when specific resource or engineering issues were identified at a proposed site. The criteria used in Columbia Gulf's site selection process generally included available sites on or immediately adjacent to its existing lines, land use, sensitive environmental resources (streams, wetlands, sensitive species considerations), and factors related to constructability (e.g., slope). Columbia Gulf also considered the distance of the parcel boundary from NSAs, NRHP-eligible cultural resources, and where possible, selected sites that would provide a buffer against future encroachment from outside development. Site selection also prioritized parcels that would require minimal clearing of forested areas to limit impacts on species that are dependent on arboreal habitats.

Columbia Gulf evaluated several compressor station sites that potentially would meet the purpose and need of the GXP using the criteria described above. Because active agricultural fields were sought for the compressor station sites, the environmental characteristics (e.g., limited forest, few wetlands and waterbodies, absence of critical habitat) were generally similar for all sites. At several locations, suitable parcels were identified and then removed from consideration because the landowner was not interested in selling the property or the property was not otherwise available.

We received several comments questioning how the location of the proposed Cane Ridge Compressor Station was selected. Columbia Gulf used its existing pipeline and compression facilities as the basis for determining the optimal locations of its new compressor stations; however, siting a compressor station involves more than just finding an open or available parcel on which to construct. There are a host of factors that need to be considered, beginning with system hydraulics.

A hydraulic model uses a computer program to replicate the flow of gas through a pipeline system. The model reflects the current flow characteristics found on Columbia Gulf's pipeline system by considering factors such as elevation, pressure gradient, and pipe characteristic (e.g., diameter, internal roughness). In order to transport a larger volume of gas between two points on the system, the model identifies the optimum locations where additional compression would be required to keep the larger volume flowing. To achieve a high level of hydraulic efficiency, the additional compressors must be installed within approximately 1 to 2 miles, upstream or downstream, of the locations identified (i.e., a 4-mile interval). The 4-mile interval along the system allows location-specific information (land use, environmental resources, constructability) to be considered in the decision of where to install new compression while maintaining the level of hydraulic efficiency necessary to meet the proposed new flow requirements (in this case, transportation of an additional 2,700,000 Dth/d). Additionally, as compression is moved laterally away from the mainline system, additional lengths of connecting suction/discharge lateral piping must be constructed. This affects both hydraulic and non-hydraulic considerations (including impacts on additional landowners). Further information regarding our review of Columbia Gulf's hydraulic modeling for the Cane Ridge Compressor Station is available in section 3.6.2.

Other than the Cane Ridge site, we received no public comments requesting us to evaluate other alternative sites and our review identified no significant resource conflicts with any of the proposed sites. As such, we did not evaluate alternative sites for the Morehead, Good Luck, Paint

Lick, Clifton Junction, New Albany, or Holcomb Compressor Stations. Additionally, we did not receive comments or evaluate alternatives for modifications at the existing Leach C meter and approved Grayson compressor facilities.

The EPA requested Staff to further evaluate the use of electric-driven compressors as an alternative to the gas fired compressors currently proposed by the Companies. The following information pertains to all compressor stations evaluated in this EIS, with a focus on the GXP Cane Ridge Compressor Station in Davidson County, Tennessee.

As stand-alone pieces of equipment, electric-driven compressors can be more efficient than compressors driven by gas turbines. However, they require the availability of a suitable high-voltage electric power supply that often results in additional construction and environmental impacts. In addition, electric-driven compressors are subject to the reliability of the electric power transmission grid. Severe weather can damage transmission lines and interrupt electrical service. While electric motors have advantages over gas turbines in terms of their carbon footprint, this advantage is offset by high energy losses in the transmission of electric power and the potentially higher carbon footprint of the electric generation power source (e.g., electricity from coal) (INGAA, 2010).

Coal is used to generate most of the electricity in Kentucky, and it fuels more than 40 percent of the electricity produced in Tennessee (EIA, 2017). In Mississippi, natural gas is the primary fuel source used to produce electricity (EIA, 2016), and in West Virginia, almost all electricity is produced using coal. Table 3.6-1 provides information on resources used to produce electricity in each of the states where Columbia Gas and Columbia Gulf propose compressor facilities.

Table 3.6-1
Electricity Production Resources by State

State	Nameplate capacity (MW)	Net generation (MWh)	Generation Resource Mix (percent)										
			Coal	Oil	Gas	Other Fossil	Nuclear	Hydro	Biomass	Wind	Solar	Geothermal	Other unknown/p
KY	29,648	90,896,435	92.0	1.3	2.8	0.1	0.0	3.5	0.5	0.0	0.0	0.0	0.0
MS	19,439	55,127,092	19.5	0.0	59.1	0.0	18.6	0.0	2.7	0.0	0.0	0.0	0.0
TN	27,143	79,506,886	45.1	0.2	7.8	0.0	34.8	10.6	1.3	0.1	0.0	0.0	0.0
WV	19,025	80,357,568	95.6	0.2	0.8	0.0	0.0	1.5	0.0	1.8	0.0	0.0	0.0

Source: EPA, 2014b

Our evaluation found that the use of electric-driven compressors in West Virginia, Kentucky, Tennessee, and Mississippi would not be expected to reduce air emissions related to the projects. Rather, it would shift the emissions from the compressor station site to the power generation site and introduce new inefficiencies from generating and transporting that electricity. As described above, most of the generating capacity (especially non-baseload capacity) in the

region is produced by coal, which may result in more emissions than those predicted at the proposed gas-fired compressor stations. As an example, Columbia Gulf is proposing two gas-fired compressors at Cane Ridge that would, in total, generate 41,000 horsepower. If the gas-fired compressors were replaced with electric-motor-driven compressors, they would require approximately 61,150 kilowatts (kW) of electricity to generate 41,000 horsepower from the compressors. Operation of these electric-driven compressors would consume approximately 535,600 megawatts (MW) of electricity annually. Based on the regional electricity production sources in the SERC Tennessee Valley subregion from which the Cane Ridge Compressor Station would receive power, the GHG annual total and non-baseload output emission rates resulting from such a high demand for electricity would range from 360,440 to 518,000 short tons of carbon dioxide equivalents (expressed as "CO_2e") per year. This is 50-65 percent higher, annually, than the GHGs that would be generated from the proposed gas-fired compressor units (EPA, 2014b). Additional impacts would also be realized from construction of the high-voltage transmission powerline required to transport electricity to the compressor station.

Electric-driven compressors are typically selected to reduce air emissions in areas of nonattainment with the National Ambient Air Quality Standards (NAAQS). Most of the areas crossed by the MXP and all the GXP areas are in attainment; therefore, the Companies' decision to incorporate gas turbine compressors into the respective project designs primarily was based on the additional impacts and cost to construct transmission lines to their facilities, and because electric reliability would therefore not be an issue during operations. As shown for the Cane Ridge Compressor Station example, in some instances use of electric-driven compressors could have a higher carbon footprint than gas turbine compressors. From our analysis, we have not found electric-driven compressors to be preferable to or as providing a significant environmental advantage over the specific natural gas fired compressors, as proposed.

3.6.1 Kentucky

We evaluated the information provided by Columbia Gulf for the Morehead, Paintlick, and Goodluck Compressor Stations, performed our own reviews, and found the proposed sites to be acceptable. Additionally, as discussed previously, we received no comments requesting us to evaluate alternate sites for the Morehead, Paint Lick, or Goodluck stations. As such, we did not evaluate alternative sites for these three facilities.

3.6.2 Tennessee

Cane Ridge Compressor Station

The Cane Ridge Compressor Station is proposed for construction on an approximately 31-acre site zoned AR2A (Agricultural) in Antioch Township, Davidson County, Tennessee (see figure 3.6-2). Approximately 23 acres would be affected during construction and 10.3 acres permanently affected for operation of the facility. The site is pasture and forest with a general topographic gradient toward the southeast. Approximately 49 percent of the soils at the site are classified as prime farmland. The property is adjacent to the north side of Barnes Road and surrounded by woodlands and residences. The closest NSA is about 690 feet south of the proposed compressor building location. Columbia Gulf purchased the land surrounding the site as a buffer from noise-sensitive receptors and against future encroachment that could result from outside

development. Columbia Gulf has no plans to develop this land beyond construction of the proposed station.

Columbia Gulf initially selected four alternatives to the proposed site for evaluation (figure 3.6-2), but two sites (Alternative Site 2 and Alternative Site 4) were excluded from further analysis early in the planning process. Columbia Gulf's research documented that Alternative Site 4, which is zoned SP (Specific Plan District), was already under contract to be sold, and the land is currently undergoing commercial development. Alternative Site 2, which is zoned partially AR2A and partially City of Brentwood OSRD (Open Space Residential), was not evaluated because the landowner was not interested in selling the property.

We evaluated the remaining two alternatives proposed by Columbia Gulf for the Cane Ridge Compressor Station to determine if there were environmental advantages associated with either of the sites over the proposed site. Table 3.6-2 provides a comparison between the proposed Cane Ridge Compressor Station site and the two alternatives.

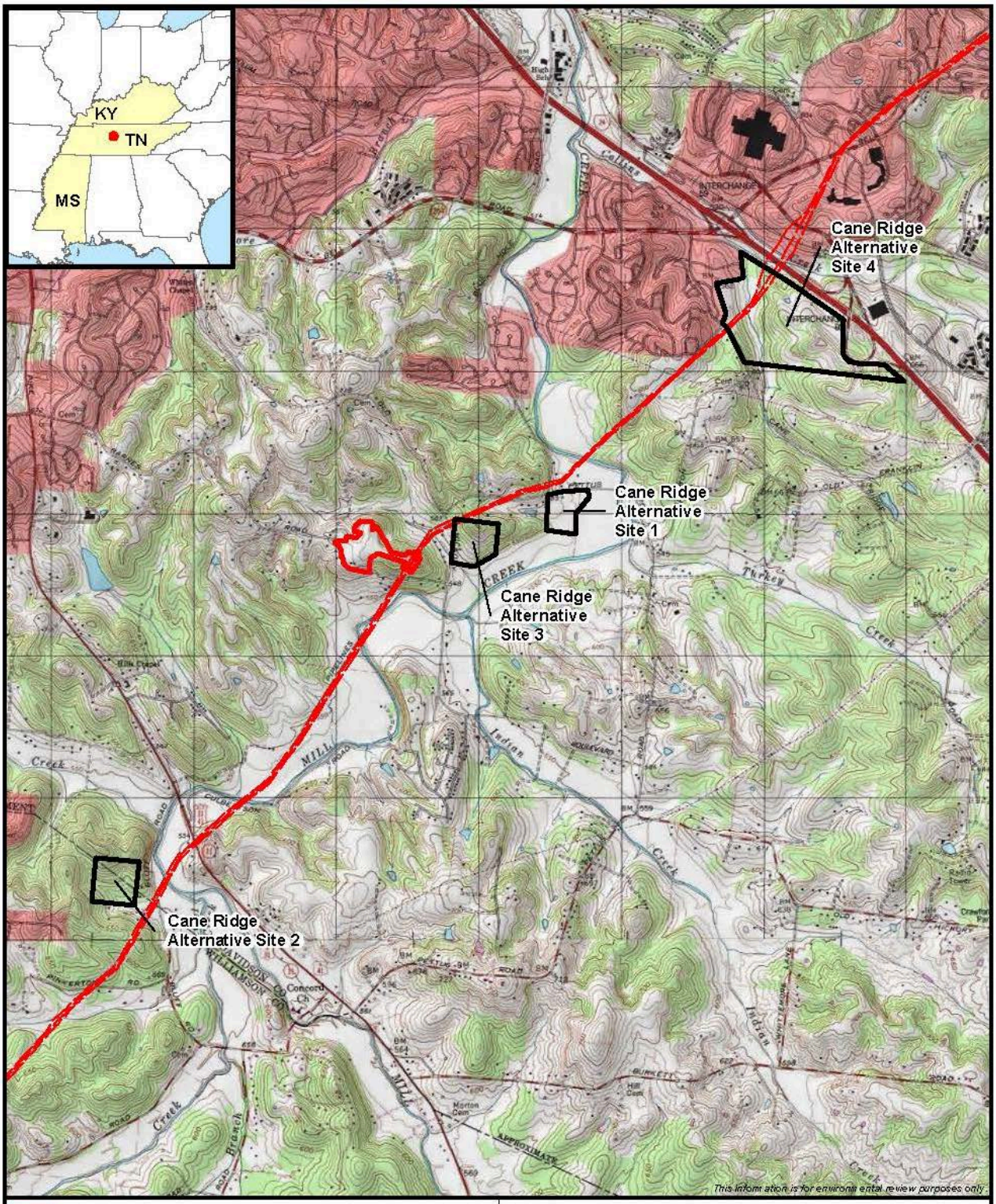
Table 3.6-2
Cane Ridge Compressor Station Alternatives Comparison a/ for the Gulf XPress Project

Category	Proposed Site	Alternative 1	Alternative 3
Property Size (acres)	31.2	16.2	21.9
Closest Public Road	Barnes Road	Pettus Road	Old Hickory Blvd.
Land Use (approximate percent of property)			
Agriculture	41	--	--
Forest	50.6	30.9	100
Floodplain	--	61.1	--
Developed	8.4	8.0	--
Open water	--	--	--
Prime farmland (approximate percent of property)	49	90	6
Tree clearing required (yes or no)	Yes	Yes	Yes
NSAs within 1 mile (count)	20	23	17
Distance to nearest NSA (feet) b/	83	33	169
NHD Waterbody c/ (length in feet)	--	--	158
NWI wetlands c/ (approximate percent of property)			
Pond	--	<0.1	--
Non-forested (PEM/PSS) Wetland c/	--	4.3	--
Forested Wetland	--	--	--

a The proposed and alternative sites have similar vegetation and habitat characteristics due to their proximity and the general land uses of the project areas. Therefore, impacts associated with the construction of a compressor station on fisheries, vegetation, wildlife, and/or threatened and endangered species would be similar at the proposed and alternative sites.

b Measured from property boundary.

c PEM = Palustrine Emergent; PSS = Palustrine Scrub/Shrub; NHD = National Hydrography Dataset; NWI = National Wetlands Inventory.



Proposed Site

Alternative Site

Mainline Pipeline System

0 1,750 3,500 Feet

Figure 3.6-2
Cane Ridge Compressor Station
Alternative Sites
Davidson County, Tennessee
Gulf XPress Project

SCALE: 1:42,000

DRAWN BY: TG

Alternative Site 1 is located south of Pettus Road, which separates the site from Columbia Gulf's mainline system. A road crossing would be required to construct the suction and discharge piping to the site. The closest NSA is 33 feet west, and the Maxwell Henry Elementary School is about 800 feet north of the property boundary. The site is zoned AR2A, and approximately 90 percent of the site soils are classified as prime farmland. This site is situated within the Davidson County Flood Overlay Zone and has a high risk for flash flooding of Mill Creek. After a historic rainfall event in 2010, Mill Creek flooded, causing so much damage that the Metropolitan Council of Nashville approved the buyout of flooded houses in cases where it was cost prohibitive to elevate and rebuild, including properties adjacent to this site (Metropolitan Government of Nashville and Davidson County, 2016; USACE, 2014). Columbia Gulf determined that Alternative Site 1 was not a preferable option for construction of the compressor station. We agree, due to the potential for site flooding and a higher potential for impacts on Mill Creek.

Alternative Site 3, located east of Old Hickory Boulevard and north of Mill Creek, is entirely within upland forest. This site also is zoned AR2A. The closest NSA is 169 feet west of the site. Approximately 6 percent of the site soils are classified as prime farmland. The slope of the land between the northern and southern site boundaries is about 40 degrees, which is a drop in elevation from approximately 640 feet at the north end of the site to 530 feet at the southern boundary. A tributary to Mill Creek crosses the southwest corner of the property. Extensive tree removal and substantial grading would be required to construct and operate a compressor station on this steep hillside. Additionally, Columbia Gulf was unsuccessful in its attempt to contact the owner of this property. Due to these factors, we do not recommend this location.

In its responses to our July 29, 2016 request for additional information, Columbia Gulf provided answers to comments received during scoping. Among other concerns raised, Columbia Gulf addressed comments from several area residents regarding the siting of the Cane Ridge Compressor Station within a residential area. Specifically, Columbia Gulf stated that siting this station was based on the need to maximize the hydraulic efficiency necessary to meet required shipper volume. To achieve maximum utilization at existing compressor stations, Columbia Gulf proposed that each new compressor station be sited equidistant along its pipeline system between the eight existing compressor stations. Columbia Gulf reported that, based on its hydraulic studies, each new compressor station must be located within approximately 1 to 2 miles, upstream or downstream, of the locations identified (i.e., a 4-mile interval) to meet the new flow requirements. Columbia Gulf's hydraulic studies showed that additional pipeline looping or additional compression would be required to move the Cane Ridge Compressor Station to an alternative site beyond this interval along its system.

On January 23, 2017, we asked Columbia Gulf to provide its hydraulic models used to determine the optimal compressor station locations, as well as data to support the siting restriction of locating the stations no more than 1 to 2 miles (upstream or downstream) from the proposed locations. In its response, Columbia Gulf examined four hydraulic scenarios for the Cane Ridge Compressor Station: (1) move 1 mile south of the optimal location; (2) move 2 miles north of the optimal location; (3) move 5 miles south of the optimal location; and (4) move 5 miles north of the optimal location. In each case, Columbia Gulf's models confirmed its claim that additional facilities would be required if the Cane Ridge station is sited outside the 4-mile interval determined by its studies. Specifically, Columbia Gulf's hydraulic models show that between 1,000 and 7,000

hp of additional compression or 3 to 11 miles of new 36-inch-diameter pipeline loop would be needed to return the system to optimal hydraulic operating conditions.

FERC engineering staff reviewed Columbia Gulf's hydraulic modeling, flow diagrams, and infrastructure data. Based upon this review, we agree that Columbia Gulf's proposed location for the new Cane Ridge Compressor Station would maximize the hydraulic efficiency of the system. Therefore, we accept that Columbia Gulf's design constraint of limiting the siting of this station to a 1- to 2-mile distance from the optimal location along the existing pipeline system is reasonable.

Of the sites initially considered by Columbia Gulf, we found the proposed site to be an acceptable location for the Cane Ridge Compressor Station due to the availability of a large buffer to mitigate noise and visual impacts, an existing (relatively level) cleared area to accommodate construction, the need for only limited tree removal, and its location in an upland area. Further, due to the limitations and other factors discussed above (e.g., hydraulic modeling; topography; site availability; flooding potential), we conclude that none of the other originally considered sites offer significant environmental advantages over the proposed site.

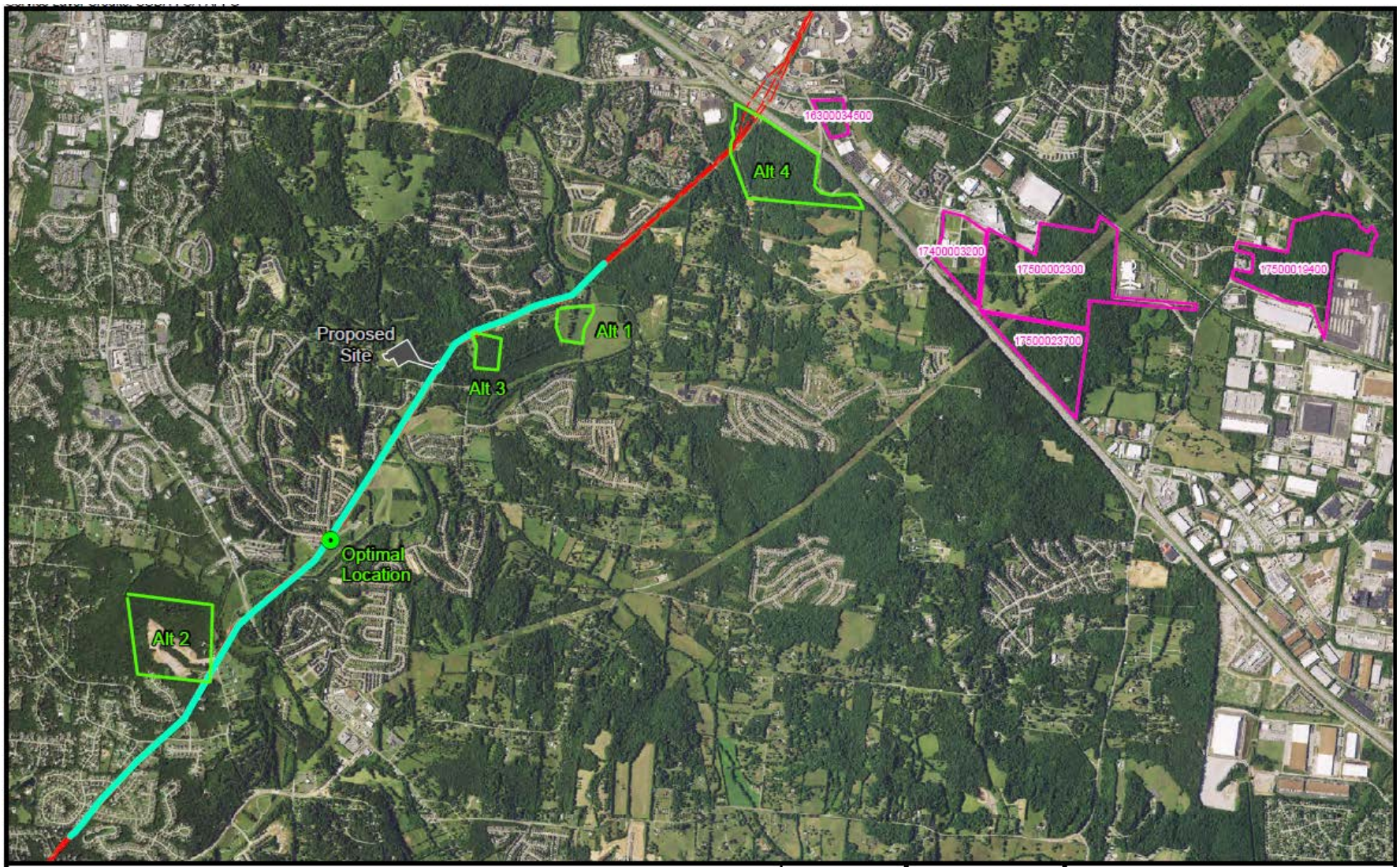
We again received comments on the draft EIS recommending the Cane Ridge Compressor Station be moved to an industrially zoned area, in accordance with Davidson County Substitute Ordinance BL2015-1210. The Friends of Mill Creek Greenway provided information obtained from the Nashville Planning Department Development Tracker on 12 additional sites for further investigation. These sites, along with an additional parcel we identified, are listed in table 3.6-3 and discussed below.

Table 3.6-3 Alternative Sites on Industrial-Zoned Parcels, Antioch, Tennessee				
Parcel ID	**Address**	**Acreage**	**Land Use Description**	**Comments**
16300034500	0 Crossings Blvd.	13.52	Vacant Commercial Land	Additional parcel identified by FERC staff
17400003200	5900 Crossings Blvd.	54.74	Small Warehouse	Parcel flagged for further review
17500002300	0 Old Hickory Blvd.	187.82	Vacant Commercial Land	Parcel flagged for further review
17500012600	0 Old Hickory Blvd.	20.00	Vacant Rural Land	Parcel eliminated due to closer proximity to school than proposed site
17500013700	0 Old Hickory Blvd.	30.57	Vacant Commercial Land	Parcel eliminated due to closer proximity to school than proposed site
17500018100	0 Old Hickory Blvd.	5.25	Vacant Commercial Land	Parcel eliminated due to insufficient size
17400023700	0 Old Franklin Rd.	21.38	Mortuary/Cemetery	Parcel flagged for further review
17500021400	0 Old Hickory Blvd.	6.29	Vacant Commercial Land	Parcel eliminated due to insufficient size
17500014000	12872 Old Hickory Blvd.	4.99	Single Family	Parcel eliminated due to insufficient size
17500019400	12575 Old Hickory Blvd.	118.19	Vacant Industrial Land	Parcel flagged for further review
16200001400	0 Blue Hole Rd.	32.02	Vacant Commercial Land	Antioch Park - Parcel eliminated due to direct impacts on Mill Creek and Mill Creek Greenway
14800003800	0 Blue Hole Rd.	51.33	Vacant Commercial Land	Antioch Park - Parcel eliminated due to direct impacts on Mill Creek and Mill Creek Greenway
14800003700	0 Blue Hole Rd.	9.91	Vacant Commercial Land	Antioch Park - Parcel eliminated due to direct impacts on Mill Creek and Mill Creek Greenway
Highlighted rows identify the five parcels that were considered for further evaluation.				

All 12 sites provided by the Friends of Mill Creek Greenway (available for viewing in appendix Q) were located outside the feasible location interval (the 4-mile interval) identified by Columbia Gulf's hydraulic model (see figure 3.6-3). Nevertheless, we reviewed each location to determine if it might have potential, with system modifications, as an alternate site. We eliminated eight sites that had immediately identifiable reasons for dismissal (i.e., insufficient size) or the presence of features that commentors identified as objectionable for the proposed site (i.e., proximity to schools, churches, subdivisions, parks, and other NSAs--see comments in appendix Q). Three of the parcels (parcels 16200001400, 14800003800, and 14800003700) were within Antioch Park and would have direct impacts on Mill Creek and the Blue Hole Trail/Mill Creek Greenway. Two of the sites (parcels 17500012600 and 17500013700) were closer to schools than the proposed site. Proximity to a school is not in and of itself a disqualifying factor, but we note for this project "proximity to schools" was cited by commentors as a major factor to select a new

site for the compressor station; therefore, further evaluation of an alternative that does not solve this stated concern is not warranted. We also found that three of the sites were crossed by high-voltage transmission lines, which would constrain siting of the compressor facilities at these locations as the large transmission line towers could not reasonably be expected to be moved. During our review of the parcels identified by Friends of Mill Creek, we identified an additional site (parcel 16300034500) that we believed could be suitable and included it in our list for further evaluation. Thus, of these thirteen sites identified, five were considered for further evaluation (highlighted parcels in table 3.6-3; figure 3.6-3).

On May 9, 2017, we requested that Columbia Gulf provide an engineering and environmental analysis of the remaining five sites that we considered potentially suitable. On May 16, 2017, Columbia Gulf filed a comparative analysis of the five sites. In the analysis summary table provided in its response, Columbia Gulf listed the lengths of additional suction/discharge piping needed to connect each site with Colombia Gulf's mainline system. Furthermore, Columbia Gulf listed the mileage of system looping required for each alternative location. Columbia Gulf also provided information on the estimated number of additional landowners that would be affected, the distance to the nearest NSA, the number of stream crossings required, acres of wetlands impacted, and acres of forest that would be cleared for each alternative (table 3.6-4).



Proposed Cane Ridge Site
Optimal Location
Existing Columbia Gulf System
Feasible Location Interval
Alternatives Previously Evaluated
Additional Alternatives Identified during DEIS Comment Period

NORTH

3,500 1,750 0
Scale in Feet

Figure 3.6-3
Feasible Location Interval for Cane Ridge Compressor Station Davidson County, Tennessee Gulf XPress Project

We then requested (May 25, 2017) that Columbia Gulf provide hydraulic modeling data to support its comparative analysis of the five sites. Columbia Gulf's hydraulic studies show that for each of the sites, additional mainline looping north of the existing Hampshire Compressor Station in Maury County, Tennessee (downstream of the Cane Ridge area), would be required to maintain optimal hydraulic operating conditions. The length of the required 36-inch-diameter pipeline looping would range from 9 to 17 miles, depending on the site location.

We reviewed the information provided by Columbia Gulf to verify accuracy, and performed further independent evaluations of each site to determine if any of the sites would provide a significant environmental advantage over the proposed Cane Ridge location. Before evaluating the five alternate sites, we wanted to establish that the information provided by Columbia Gulf regarding the amount of additional pipe necessary for each alternate site was a reasonable calculation, so that we would be evaluating actual impacts associated with each alternate location. Based on our review of the flow diagrams and corresponding hydraulic modeling, we have confirmed that Columbia Gulf accurately identified the additional facilities which would be necessary to relocate the Cane Ridge Compressor Station to each of the five alternate sites.

All five sites would require considerable additional suction/discharge piping (ranging from 1.6 to 4.0 miles) to interconnect with Columbia Gulf because the sites are not crossed by or immediately adjacent to its system. Additionally, because the alternate sites are located beyond the feasible location interval of the optimal compressor station site, between 9 and 17 miles of additional 36-inch-diameter pipeline loop (depending on the alternate site) would be necessary to meet the hydraulic requirements of the project. Construction of additional pipelines (mainline looping and suction/discharge piping) for any of the alternate sites would result in additional impacts on landowners, forested areas, wetlands and waterbodies, and potential impacts on federal and state-protected species. Additional information from our analysis is provided in table 3.6-4. Figure 3.6-4 shows the alternate sites and the routes of the additional rights-of-way required for suction/discharge piping to each site.

Our review determined that none of the five alternate sites reviewed in detail would provide a significant environmental advantage over the proposed location for the Cane Ridge Compressor Station. As such, we do not recommend them.

Table 3.6-4
Detailed Evaluation of Industrial-Zoned Alternative Parcels /a

Parcel ID	Address	Parcel Size (acres) /b	Area of Impact (acres) /c	Land Use Description	Length of Suction/ Discharge Route and/or Additional Loop (miles)	Impacts					Comments/Constraints
						No. of Landowners	Nearest NSA (feet) /d	Acres of forest clearing	Acres of Wetlands /e	Number of Waterbodies /f	
16300034500	0 Crossings Blvd.	13.5	13.5	Vacant Commercial Land	--	355	904	5.7	0	1	Small parcel would require use of adjacent parcels during construction. Would require a railroad crossing and a potential HDD under a major road crossing. Impacts related to new right-of-way and additional easements due to new pipeline rights-of-way.
Associated 42-inch OD Suction Discharge Pipelines		--	29.4	--	1.6	--	--	19.4	0	4	
Additional 36-inch OD Loop Pipeline		--	82.2	--	9.0	--	--	35.9	0.25	11	
17400003200	5900 Crossings Blvd.	54.7	24.0	Small Warehouse	--	198	209	3.8	0	1	A Tennessee Valley Authority (TVA) 161 kV overhead utility line crosses the parcel and an existing building occupies the site. Would require HDD under interstate and potentially under 3 additional road crossings. Impacts related to new right-of-way and additional easements due to new pipeline rights-of-way.
Associated 42-inch OD Suction Discharge Pipelines		--	37.5	--	2.1		--	15.2	0.18	2	
Additional 36-inch OD Loop Pipeline		--	113.3	--	11.0		--	42.9	0.25	20	
17500002300	0 Old Hickory Blvd.	187.8	24.0	Vacant Commercial Land	--	667	1,026	24.0	0	0	Two TVA overhead utility ROWs bisect this parcel, limiting siting options. Would require HDD under interstate and potentially under 3 additional road crossings. Impacts related to new right-of-way and additional easements due to new pipeline rights-of-way.
Associated 42-inch OD Suction Discharge Pipelines		--	43.6	--	2.4	--	--	16.7	0.18	3	
Additional 36-inch OD Loop Pipeline		--	113.3	--	11.0	--	--	42.9	0.25	20	

Table 3.6-4
Detailed Evaluation of Industrial-Zoned Alternative Parcels /a

Parcel ID	Address	Parcel Size (acres) /b	Area of Impact (acres) /c	Land Use Description	Length of Suction/ Discharge Route and/or Additional Loop (miles)	Impacts					Comments/Constraints
						No. of Landowners	Nearest NSA (feet) /d	Acres of forest clearing	Acres of Wetlands /e	Number of Waterbodies /f	
17500023700	0 Old Franklin Rd.	21.4	16.3	Mortuary/ Cemetery	--	108	1,346	16.3	0	1	Parcel too small and would require adjacent parcels to construct compressor station. Parcel identified as cemetery site. Bisected by TVA 500 kV powerline corridor. Closer to public school than proposed site (approximately 0.5 mile from school). Would require HDD under interstate and potentially under 3 additional road crossings. Impacts related to new right-of-way and additional easements due to new pipeline rights-of-way.
Associated 42-inch OD Suction Discharge Pipelines		--	39.8	--	2.2	--	--	17.0	0.12	2	
Additional 36-inch OD Loop Pipeline		--	113.3	--	11.0	--	--	42.9	0.25	20	
17500019400	12575 Old Hickory Blvd.	118.2	24.0	Vacant Industrial Land		443	904	24.0	0	0	Privately owned parcel closer to residential area, churches, and public schools (Cane Ridge High School and Mountainview Elementary School) than proposed site. Would require HDD under interstate and potentially under 3 additional road crossings, in addition to a 500 kV powerline corridor crossing. Impacts related to new right-of-way and additional easements due to new pipeline rights-of-way.
Associated 42-inch OD Suction Discharge Pipelines		--	71.9	--	4.0	--	--	38.5	0.07	5	
Additional 36-inch OD Loop Pipeline		--	176.5	--	17.1	--	--	69.7	0.25	40	

Table 3.6-4
Detailed Evaluation of Industrial-Zoned Alternative Parcels /a

Parcel ID	Address	Parcel Size (acres) /b	Area of Impact (acres) /c	Land Use Description	Length of Suction/ Discharge Route and/or Additional Loop (miles)	Impacts					Comments/Constraints
						No. of Landowners	Nearest NSA (feet) /d	Acres of forest clearing	Acres of Wetlands /e	Number of Waterbodies /f	

a. Values are based on a generic 24-acre construction footprint for each compressor station. The construction footprints were located to avoid streams, wetlands, and forest to the extent practicable. Approximately 12 acres would be required for the permanent compressor station footprint. Values for the suction and discharge piping are based on a 150-foot-wide construction right-of-way to construct two 43-inch-diameter pipelines; a 75-foot-wide permanent right-of-way would be required during operations. Values for the additional 36-inch-diameter loop pipeline are based on an 85-foot-wide construction corridor to construct a 36-inch-diameter pipeline. A 50-foot-wide permanent right-of-way would be required during operations. Additional temporary workspace and access road needs have not been determined and are not included in any of the posted values.
b. Parcel acreage listed is the total acres within the parcel boundary; as noted in footnote a above, a 24-acre construction footprint is assumed.
c. The nearest NSA was measured from the edge of the construction footprint.
d. Wetland impacts are based on a review of NWI data.
e. Waterbody crossings are based on a review of NHD data.

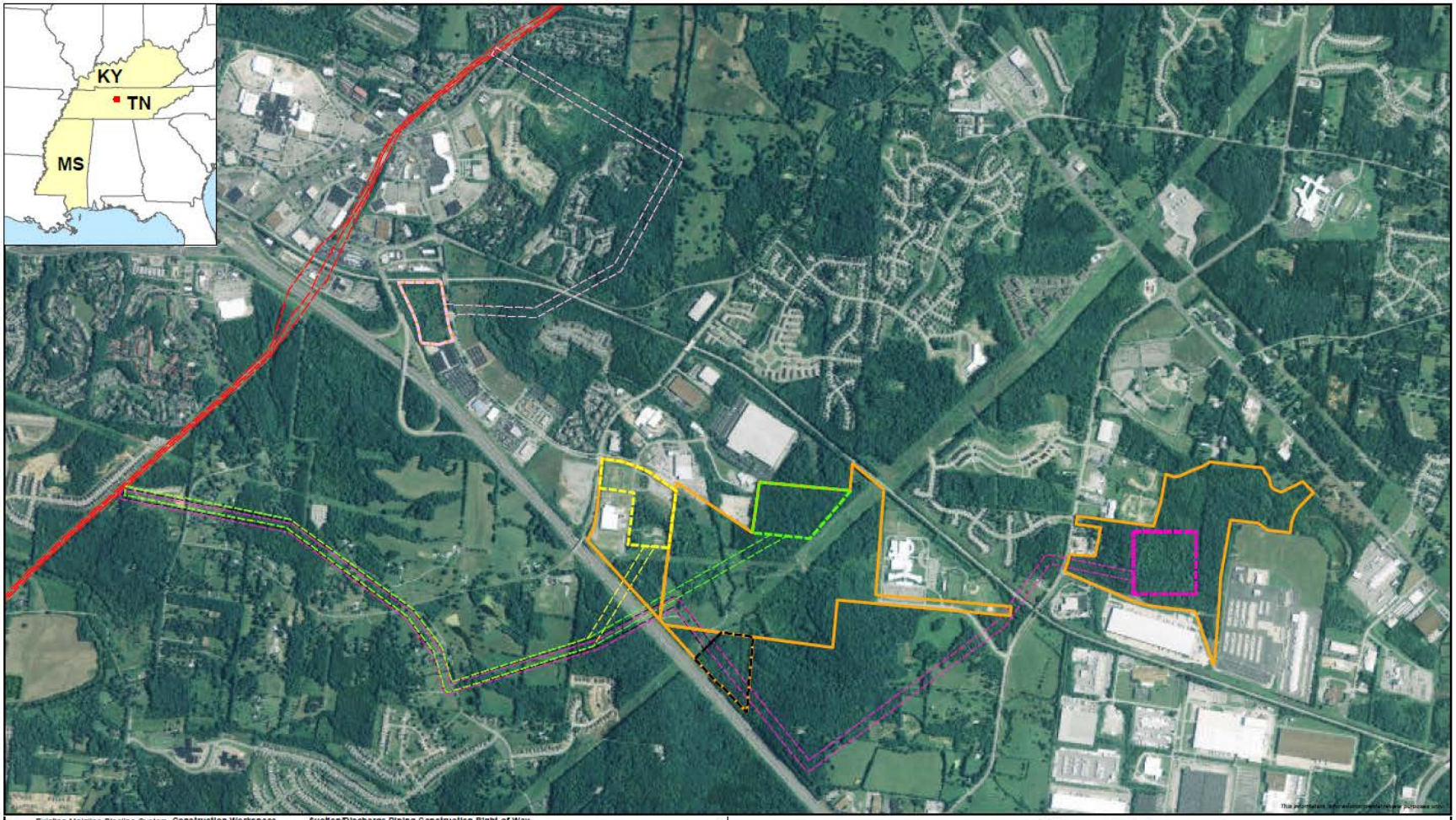


Figure 3.6-4
Potential Compressor Station Alternative Sites
Davidson County, Tennessee
Gulf XPress Project

Clifton Junction Compressor Station

Columbia Gulf proposes to construct the Clifton Junction Compressor Station in Waynesboro, Wayne County, Tennessee, on the north side of U.S. 64/Savannah Highway (see section 2.2.1). We evaluated the information provided by Columbia Gulf, performed our own review, and found the proposed site to be acceptable. We received no comments requesting us to evaluate alternate sites for the Clifton Junction station. As such, we did not evaluate alternative sites for this facility.

3.6.3 Mississippi

We evaluated the information provided by Columbia Gulf for the New Albany and Holcomb Compressor Stations, performed our own reviews, and found the proposed sites to be acceptable. Additionally, we received no comments requesting us to evaluate alternate sites for the New Albany or Holcomb stations. As such, we did not evaluate alternative sites for these two facilities.

4.0 ENVIRONMENTAL ANALYSIS

4.1 GEOLOGY

4.1.1 Geologic Setting

The United States is divided into 8 physiographic divisions, 25 provinces, and 86 sections based on common topography, rock types and structure, and geologic and geomorphic history.

4.1.1.1 Mountaineer XPress Project

The MXP is located within a single physiographic province known as the Appalachian Plateaus. The Appalachian Plateaus province consists of sedimentary rocks comprised of elevated and horizontal strata that extend continuously from the Adirondacks in northern New York to the coastal plain in Alabama. Much of the plateau is composed of Pennsylvanian and Permian sedimentary strata, including sandstone, siltstone, shale, limestone, and coal, of which the upper strata are more resistant to weathering, resulting in decreased erosional processes (Fenneman and Johnson, 1946; USGS, 2014a; West Virginia Geological and Economic Survey [WVGES], 1969). Topographically, the MXP is within the Kanawha section of the Appalachian Plateaus, which is characterized by relatively flat-lying rocks with elevation ranging from 500 to 3,700 feet (Gesch, 2007). The Kanawha section features undulating low, broad ridges and swells parallel to the mountains to the east, reducing in amplitude as the plateau slopes to the west.

4.1.1.2 Gulf XPress Project

The GXP facilities are located within three physiographic provinces: the Appalachian Plateaus, Interior Low Plateaus, and Coastal Plain (Fenneman and Johnson, 1946). Table 4.1-1 provides a summary of the characteristics of the physiographic sections within these three physiographic provinces.

Table 4.1-1 Characteristics of the Physiographic Provinces Affected by the GXP Facilities			
Facility	**Province**	**Section**	**Geologic Characteristics**
Morehead Compressor Station, Grayson Compressor Station, Leach C Meter Station	Appalachian Plateaus	Kanawha	Relatively flat-lying rocks with elevation ranging from 500 to 3,700 feet. Features undulating low, broad ridges and swells parallel to the mountains to the east, reducing in amplitude as the plateau slopes to the west.
Paint Lick Compressor Station	Interior Low Plateaus	Lexington Plain	Primarily underlain by limestone and has rolling upland dissected by streams. Erosion of limestone bedrock has created rolling hills with deep soil.
Goodluck Compressor Station, Clifton Junction Compressor Station	Interior Low Plateaus	Highland Rim	Landforms were formed by platform deposition of continental sediments into a shallow inland sea, followed by uplifting to form a level-bedded plateau, which has been shaped by differential erosion to form a moderate to deeply dissected area.
Cane Ridge Compressor Station	Interior Low Plateaus	Nashville Basin	Oval depression with a gently rolling surface in central Tennessee, which is low-lying and surrounded by the Highland Rim. The basin was formed by the differential erosion of more erodible rock that had been uplifted during the creation of the Nashville Dome.
New Albany Compressor Station	Coastal Plan	East Gulf Coastal Plain	Subtle topography, soils derived primarily from unconsolidated sands, silts, and clays transported to the region by the weathering of the Appalachian Mountains.
Holcomb Compressor Station	Coastal Plan	Mississippi Alluvial Plain	Mostly a broad, flat alluvial plain with river terraces, swales, and levees providing the main elements of relief.

The GXP involves nine discrete sites spread across nearly 520 miles. Because of the distances among the nine facilities, there is geological variability among the locations, ranging from the inland side of the Appalachian Mountains in Kentucky to the relatively flat sedimentary layers of Mississippi.

In Kentucky, the GXP includes three new compressor station facilities and upgrades at two existing facilities. The overburden material above bedrock at the Morehead Compressor Station site consists of Quaternary Alluvium that is primarily a silty sand. This Quaternary Alluvium is underlain by Mississippian Period shales. The Paint Lick and Goodluck Compressor Station sites are located on carbonate bedrock that is karst susceptible. The Paint Lick Compressor Station site has bedrock of the Ordovician Period Ashlock Formation, which has a dominant lithology of limestone and shale. The Goodluck Compressor Station site has bedrock of the Mississippian Period Salem, Warsaw, and St. Louis limestones. The existing Leach C Meter Station is located above bedrock of the Monongahela and Conemaugh Formations (undivided siltstones), and the approved Grayson Compressor Station is positioned above Breathitt Formation bedrock which is predominantly a shale, but does contain some siltstone (Kentucky Geologic Survey, 2016; USGS, 2015a).

In Tennessee, the GXP includes the Cane Ridge Compressor Station, located within the Nashville Basin, and the Clifton Junction Compressor Station, located in the western Highland Rim (see table 4.1-1). The Cane Ridge Compressor Station and the Clifton Junction Compressor

Station have bedrock that consists of limestone from the Ordovician and Silurian Periods, respectively (USGS, 2015b).

In Mississippi, the GXP includes the New Albany Compressor Station and the Holcomb Compressor Station. Mississippi is completely underlain by sedimentary rocks dating as far back as the Paleozoic Era. The combined thickness of all the formations is approximately 50,000 feet. Many of the formations extend to the surface, but others are completely covered by younger sediments and have been identified by wells drilled in the area (Rainwater, 1961). The New Albany Compressor Station lies above the Ripley Formation, an Upper Cretaceous Period sandstone with some intermixed clay and sandy limestone. The Ripley Formation overlies units containing limestone and chalk. The Holcomb Compressor Station lies just east of the Mississippi Alluvial Plain and consists of the Kosciusko bedrock formation, which contains irregularly bedded sandstone intermixed with clay and some quartz (MDEQ, 2016a; USGS, 2015c).

4.1.2 Mineral Resources

The following sections describe the mineral resources identified near the MXP and GXP facilities.

4.1.2.1 Mountaineer XPress Project

Columbia Gas investigated the possible presence of wells, mines, or mining areas within 0.25 mile of the MXP facilities through the review of publicly available data from the WVDEP.

The proposed MXP facilities are within 0.25 mile of several known oil or gas wells, mines, and quarries. A summary of the known mineral resources within 0.25 mile of the facilities, as depicted in the publicly available datasets, is provided in table 4.1-2. Of the 1,658 oil and gas wells identified within 0.25 mile, 1,015 are active wells or under construction; 79 wells have an unknown status; and the remaining 564 are inactive. Inactive wells are either plugged and abandoned or were permitted and never drilled (WVDEP, 2015a and 2015b).

Table 4.1-2
Summary of Mineral Resources within 0.25 mile of MXP Facilities

Project Facility	Number of Oil and Gas Wells	Number of Active Oil and Gas Wells	Number of Active Oil and Gas Wells within Workspace	Number of Mines or Quarries
MXP-100	693	451	26	4
MXP-200	32	16	1	0
SM80 Line	0	0	0	0
SM80 Loop Line	0	0	0	0
Aboveground Facilities	38	26	1	0
Yards/Staging Areas	137	73	5	0
Access Roads	750	429	11	0
Total	**1,650**	**995**	**44**	**4**

Source: WVDEP 2015a; WVDEP, 2015b

Existing operating or non-operating wells have been identified within the MXP footprint. These production wells vary in age, size, and condition. Construction activity would be limited and avoided in proximity to these wells (regardless of operational status), and workspace would be reduced around the demarcated area and any maintained well pads. Signs and safety fencing would be installed so that Columbia Gas' activities would not damage the well or holding tank. Columbia Gas would attempt to identify the owners of the wells to locate associated pipelines as well as coordinate the MXP construction schedule. If the owners cannot be identified, Columbia Gas would mark all lines identified through owner and/or landowner consultations, county records searches, permitting records, and West Virginia 811 (One-Call), as well as field identifications prior to construction.

Four known subsurface coal mines are within 0.25 mile of MXP workspaces, as described in table 4.1-3. There are documented inaccuracies in the publicly available datasets; thus, the locations are only approximations. Based on review of coal mining operations near the MXP, two of these mines have the potential to impact MXP facilities. Columbia Gas has been meeting regularly with the mine operator representatives and has determined that the MXP would not be undermined by longwall methods at the active mines for at least 6 years (see section 4.1.4.6 for additional details regarding longwall mining). Columbia Gas would continue communications with local mine operators regarding mining operations near the MXP. No mines are within 0.25 mile of the proposed MXP compressor station sites.

Table 4.1-3
Coal Mines Within 0.25 mile of MXP Workspaces

Proposed Facility/ Nearest Milepost	Status	Owner	Direction from Workspace	Distance from Workspace (feet)
MXP-100				
1.4	Active	McElroy Coal Company	In workspace	0
2.9	Active	McElroy Coal Company	Northeast	814
4.4	Active	McElroy Coal Company	West	1,247
4.9	Active	McElroy Coal Company	In workspace	0

Source: WVDEP, 2015a and 2015b

If mineral resources are encountered on or near the pipeline or facility locations, the information would be used to make route adjustments, as necessary. Any mineral resources discovered by Columbia Gas in the MXP workspaces would be avoided on a case-by-case basis and as reasonably practicable, including but not limited to rerouting or reducing the width of the workspace to avoid the resource or as defined by the terms of the landowner agreement or coordination with the operator. The MXP would not have an effect to these mineral resources or disrupt any future reclamation activities. However, once the MXP easement is acquired, no future mineral resource surface excavation would be allowed to occur within the easement.

4.1.2.2 Gulf XPress Project

Columbia Gulf investigated the possible presence of wells, mines, or mining areas within 0.25 mile of the GXP facilities through the review of publicly available data from the USGS and Hart Energy (USGS, 2003a; Hart Energy, 2013). Only the existing Leach C Meter Station is within

0.25 mile of any known oil or gas wells, and none of the GXP work sites are within 0.25 mile of a mine or quarry. The Leach C Meter Station boundary is approximately 33 feet south-southwest from an active oil well; however, the well would not be disturbed by GXP activities. No wells were identified within the boundaries of any GXP facility sites. Any mineral resources discovered in the GXP workspace during construction would be avoided on a case-by-case basis and as reasonably practicable, including but not limited to adjusting the GXP workspace to avoid the resource.

4.1.3 Paleontology

4.1.3.1 Mountaineer XPress Project

Based on a review of the project by the WVGES, no significant paleontological resources are known to occur within the vicinity of the MXP work areas. Although the WVGES has no legal authority to control access to any potential paleontological sites, Columbia Gas would consult with the WVGES if any paleontological resources are discovered during MXP construction.

4.1.3.2 Gulf XPress Project

Columbia Gulf does not anticipate encountering scientifically significant paleontological resources within the proposed project areas. The New Albany and Holcomb Compressor Station sites are not located in areas with shallow bedrock. The modifications proposed for the GXP at the approved Grayson Compressor Station and the existing Leach C Meter Station would take place within the permanent footprint of these facilities or on previously disturbed land and would result in no new impacts on paleontological resources. The remaining five sites (Morehead, Paint Lick, Goodluck, Cane Ridge, and Clifton Junction) were assessed as having low potential for significant paleontological resources. Columbia Gulf would consult with the appropriate state agencies if paleontological resources are uncovered during GXP construction.

4.1.4 Geologic Hazards

The MXP facilities would be designed and constructed to provide adequate protection from geologic hazards that may cause infrastructure to move or sustain abnormal loads. Such hazards include seismicity (e.g., earthquakes), surface faults, soil liquefaction, landslides, flash flooding, karst terrain, steep slopes, and mine subsidence. The overall effects of MXP construction and operation on topography and existing geologic conditions would be minor. Primary impacts would be limited to construction activities and would include temporary disturbance of slopes at facilities or within pipeline corridors resulting from grading and trenching operations. During construction activities, some slopes within the construction workspaces would be contoured to safely accommodate construction equipment operation (see section 2.4.4.6). However, after completion of construction activities, topography and associated drainageways would be returned to pre-construction contours and elevations to the extent practicable.

The overall effects of GXP construction and operation on topography and existing geologic conditions would be negligible. Primary impacts would be limited to construction activities, including the potential need for blasting to remove shallow bedrock. During construction activities, some slopes within the construction workspaces may require minor contouring to level

the site for the station facilities. However, this would not substantially alter the topography of the sites.

The followings sections discuss the geologic hazards that could potentially occur at MXP and GXP work areas and the mitigation measures that would be implemented to limit or avoid impacts on project facilities. Conditions necessary for the development of other geologic hazards, including avalanches and volcanism, are not present in the region crossed by the projects and, therefore, are not discussed. In addition, conditions necessary for the development of landslides, soil liquefaction, and mine subsidence are not present in the GXP work areas; therefore, these hazards were not evaluated for the GXP.

4.1.4.1 Earthquakes

Most significant earthquakes around the world are associated with tectonic zones where one crustal plate is overriding another, where tectonic plates are sliding past each other, or where tectonic plates are converging. The size of an earthquake can be measured using three descriptions: intensity, magnitude, and acceleration (U.S. Atomic Energy Commission, 1963).

Earthquake intensity is an observed measure of the extent to which man-made structures are damaged by a seismic event and generally depends on a structure's distance from the epicenter of that event. The Modified Mercalli Intensity Scale ranges from an earthquake intensity of I to XII, with increasing severity from "not felt" to "total damage," respectively (see table 4.1-4) (Cargo and Mallory, 1977).

Table 4.1-4
Range of Earthquake Intensities

Modified Mercalli Intensity Value	Description of Intensity (Severity) Factors
I	Not felt except by a very few people under especially favorable circumstances.
III	Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing automobiles may rock slightly. Vibration like a passing truck.
V	Felt by nearly everyone; many awakened. Some dishes, windows, etc., broken; a few instances of cracked plaster; unstable objects overturned. Disturbances of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop.
VI	Felt by all; many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster or damaged chimneys. Damage slight.
VII	Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate damage in well-built ordinary structures; considerable damage in poorly built or badly designed structures. Some chimneys broken. Noticed by persons driving automobiles.
XII	Damage total. Waves seen on ground surfaces. Lines of sight and level distorted. Objects thrown upward into the air.

Source: Modified from Cargo and Mallory, 1977

The magnitude of an earthquake can be measured using the Richter Magnitude Scale, among other scales. The Richter Magnitude Scale measures the velocity of the seismic waves of energy released by the earthquake. The scale is logarithmic; an increase of one unit of magnitude

means that the amount of energy released has increased by a factor of approximately 30 (U.S. Atomic Energy Commission, 1963). Depending upon its size and location, an earthquake can cause ground shaking, surface fault rupture, and ground failure. Four characteristics influence the damage that can be caused by ground shaking: size, attenuation, duration, and site response. Surface faulting is the offset or tearing of the ground surface by differential movement along a fault during an earthquake. Surface faulting is rare in earthquakes of Richter Scale magnitude 5.5 or less. However, earthquakes can induce landslides and liquefaction of susceptible soils.

4.1.4.1.1 Mountaineer XPress Project

The east coast of the United States is a passive tectonic plate boundary located on the "trailing edge" of the North American continental plate, which is relatively seismically quiet. Earthquakes do occur in the region where the MXP would be constructed, but are generally less severe and less damaging than those occurring at plate boundaries (Virginia Department of Mines, Minerals, and Energy, 2013).

The USGS probabilistic seismic hazard mapping model (2014) characterizes potential earthquake ground shaking from future earthquakes. The model allows for the calculation of peak ground acceleration (PGA) measured in percent gravity (g) for various return periods and for specific locations. The MXP work areas have a PGA of 0 to 4 percent g for the northern portion of the pipeline route and a PGA of 5 to 8 percent g for the southern portion of the pipeline route with a 2-percent probability of exceedance in a 50-year period. For a 10-percent probability of exceedance in a 50-year period, the entire pipeline corridor has a PGA of 0 to 2 percent g (USGS, 2014b and 2014c). As indicated in table 4.1-5, earthquake ground shaking resulting from the predicted PGAs within the MXP work areas could be expected to result in light-to-moderate perceived shaking and very light-to-no damage (Wald et al., 2006).

Table 4.1-5
Comparison of Earthquake Peak Ground Acceleration, Perceived Shaking Effects, and Potential Damage

PGA (percent gravity)	Perceived Shaking	Potential Damage
< 0.17	Not felt	None
0.17 - 1.4	Weak	None
1.4 - 3.9	Light	None
3.9 - 9.2	Moderate	Very light
9.2 - 18	Strong	Light
18 - 34	Very strong	Moderate
34 - 65	Severe	Moderate to heavy
65 - 124	Violent	Heavy
> 124	Extreme	Very heavy

Source: Wald et al., 2006

According to the USGS, the largest magnitude and most intense earthquake in West Virginia occurred in 1969 in Mercer County, approximately 95 miles southeast of MP 163. The earthquake registered a Richter Scale magnitude of 4.5 (VI on the Modified Mercalli Intensity Scale) and resulted in minor damage to structures, including cracked and fallen plaster and broken windows (Stover and Coffman, 1993). The WVGES reported a magnitude 4.7 earthquake occurring in 1976 in McDowell County, approximately 70 miles southeast of MP 163 (WVGES,

2014). The largest recorded earthquake in counties crossed by MXP facilities was in 1824, centered in Wetzel County, West Virginia, with a magnitude of 4.1 (WVGES, 2014).

Based on the low probability of localized earth movements near the MXP work areas, we do not anticipate any significant impacts attributable to earthquakes. Activities typically associated with the installation and maintenance of pipelines and associated aboveground facilities are considered low impact, as they disturb only limited areas of surface soil and shallow bedrock, and would not be expected to induce earthquakes. In addition, natural gas pipelines and associated aboveground facilities constructed using modern welding techniques have performed well in seismically active areas of the United States, such as California (O'Rourke and Palmer, 1996).

4.1.4.1.2 Gulf XPress Project

Seismically, the region containing the GXP work areas is relatively quiet. However, earthquakes are possible in the region, largely due to trailing edge tectonics and residual stress release. The New Madrid Seismic Zone (NMSZ) (located in southeastern Missouri, northeastern Arkansas, western Tennessee, western Kentucky, and southern Illinois) is approximately 80 miles from the nearest GXP facility (Clifton Junction site) and is the most active seismic area in the United States east of the Rocky Mountains (Missouri Department of Natural Resources, 2015). The NMSZ experienced a series of major earthquakes in 1811 and 1812 that were Richter magnitudes 7 to 8 and have an average recurrence time of 500 years (USGS, 2009).

In 2011, the USGS created modeling scenarios to depict the geographic extent and effects of a magnitude 7.7 earthquake in the NMSZ. These scenarios indicate that the shaking from a magnitude 7.7 earthquake would have a Modified Mercalli Intensity Value of VII across the GXP work areas and a PGA of 25 percent g or less (USGS, 2014d). Columbia Gulf would design its facilities to withstand potential seismic activities anticipated in the NMSZ.

As previously mentioned, the USGS probabilistic seismic hazard mapping model (2014) characterizes potential earthquake ground shaking from future earthquakes. PGAs for each GXP facility are listed in table 4.1-6 (USGS, 2014b and 2014c).

Table 4.1-6
Peak Ground Acceleration per GXP Facility

Facility	10 Percent Probability of Exceedance in a 50-year Period (percent gravity)	2 Percent Probability of Exceedance in a 50-Year Period (percent gravity)
Morehead Compressor Station	3-5	5-8
Paint Lick Compressor Station	3-5	5-8
Goodluck Compressor Station	3-5	5-8
Grayson Compressor Station	0-2	5-8
Leach C Meter Station	0-2	5-8
Cane Ridge Compressor Station	3-5	9-14
Clifton Junction Compressor Station	6-7	15-20
New Albany Compressor Station	6-7	15-20
Holcomb Compressor Station	3-5	9-14

Source: USGS, 2014b, 2014c

As indicated in tables 4.1-5 and 4.1-6, earthquake ground shaking resulting from the predicted PGAs within GXP work areas could be expected to range from shaking that is not felt and no damage to very strong perceived shaking with moderate damage (Wald et al., 2006).

Based on the low probability of localized earth movements near the GXP work areas, we do not anticipate any damage attributable to such movements. Activities typically associated with facility construction and maintenance are considered low impact, as they disturb only limited areas of surface soil and shallow bedrock. In addition, Columbia Gulf would design and construct the facilities to withstand the anticipated seismic activity at each site.

4.1.4.2 Faults

Faults are fractures in the earth's crust where displacement has occurred. Tectonic movement along faults can cause seismic events. The USGS maintains a database containing information on faults and folds in the United States believed to be sources of earthquakes greater than Richter magnitude 6 in the past 1.8 million years (Quaternary age) (USGS, 2006).

4.1.4.2.1 Mountaineer XPress Project

No Quaternary-aged faults in the USGS database are located beneath or near MXP facilities. The nearest areas of potential concern to the MXP facilities are at least 100 miles away: The Central Virginia Seismic Zone, approximately 190 miles southeast of MP 150; the Eastern Tennessee Seismic Zone, approximately 100 miles southwest of MP 163; and Virginia's Giles County Seismic Zone, approximately 100 miles southeast of MP 163.

4.1.4.2.2 Gulf XPress Project

No Quaternary-aged faults in the USGS database are located beneath or near GXP facilities.

4.1.4.3 Soil Liquefaction

Soil liquefaction is a phenomenon often associated with seismic activity in which saturated, non-cohesive soils temporarily lose their strength and behave like a viscous liquid when subjected to forces such as intense and prolonged ground shaking. Areas susceptible to liquefaction generally include sandy or silty soils along rivers, streams, lakes, and shorelines, or in areas with shallow groundwater.

4.1.4.3.1 Mountaineer XPress Project

Soil conditions necessary for liquefaction to occur would likely be present within MXP work areas. However, due to the low potential for a seismic event that would cause strong and prolonged ground shaking, the potential for soil liquefaction to occur within the MXP work areas is considered very low.

4.1.4.3.2 Gulf XPress Project

Soil conditions necessary for liquefaction to occur are not anticipated to be present within GXP work areas.

4.1.4.4 Landslides

Landslides are the down slope movement of rock, debris, or soil under the force of gravity due to natural or man-made causes. Slope failure causing a landslide can be initiated by precipitation, seismic activity, slope disturbance due to construction or other activity, or a change in groundwater conditions, such as a seasonal high groundwater table. Construction factors that may increase the potential for slope failure could include trenching along slopes and the burden of construction equipment on unstable surfaces. Earthquake-induced landslides occur under a broad range of conditions: in steeply sloping to nearly flat land; in bedrock, unconsolidated sediments, fill, and mine dumps; and under dry and very wet conditions. The principal criteria for classifying landslides are types of movement and types of material. The types of landslide movement that can occur are falls, slides, spreads, flows, and combinations of these. Materials are classified as bedrock and engineering soils, with the latter subdivided into debris (mixed particle size) and earth (fine particle size) (Campbell, 1984).

4.1.4.4.1 Mountaineer XPress Project

The Radbruch-Hall Landslide Incidence and Susceptibility Maps summarize geologic, hydrogeologic, and topographic data (Radbruch-Hall, 1982). Based on Radbruch-Hall data, the MXP is entirely within areas with a high incidence and high susceptibility to future landslides. Columbia Gas would implement monitoring and mitigation for slope hazards as described in section 2.4.4.6.

If a significant landslide hazard is identified during MXP construction, Columbia Gas would implement mitigation measures intended to stabilize the area. Measures could include burial of the infrastructure below the potential landslide depth, if feasible, and/or drainage control. Drainage control may include frequent permanent erosion controls, subsurface gravel or cobble drains, or culverts and drainage ditches to divert water away from the pipeline corridors. Construction techniques described in section 2.4.4.6 would minimize the potential of slope failure, erosion, and other potential impacts from construction on steep slopes. These techniques may include both temporary and permanent erosion control measures and other best management practices (BMP), as outlined in Columbia Gas' ECS.

On April 21, 2017, Columbia Gas filed with the Secretary its Phase I Geohazard Assessment Report. Using publicly available information, Columbia Gas identified locations along the proposed MXP pipeline route where there is potential for a landslide to occur. About 68 percent of the proposed MXP pipeline route has been preliminarily described as having a "moderate to high" or "high" landslide hazard index rating. Based on the results of the Phase I Geohazard Assessment, Columbia Gas has initiated a Phase II Landslide Hazard Assessment. Part of the Phase II assessment includes field verification of the areas of interest that were identified in the Phase I assessment.

To further refine our assessment of proposed mitigation measures in areas characterized by steep slopes or slip-prone soils and to provide location-specific information to aid during compliance inspections, **we recommend that:**

- **<u>Prior to construction</u>, Columbia Gas should file with the Secretary, for review and written approval by the Director of OEP, the results of a Phase II Landslide Hazard Assessment, which includes the results of all field activities to investigate and document the status of all potential landslide areas, and provide a Landslide Mitigation Plan that includes site-specific mitigation measures Columbia Gas will implement during construction and operation of the project on steep slopes and slip-prone soils. The Landslide Mitigation Plan should include:**

  a. a description of how construction activities would be conducted on steep slopes and in areas prone to instability;

  b. safety protocols for personnel working on steep slopes or areas prone to instability;

  c. measures Columbia Gas would implement if project-related activities result in instability/landslides during, and after, MXP construction; and

  d. steps to be taken to stabilize and restore such areas affected by project-related activities.

  Columbia Gas shall develop the Phase II Landslide Hazard Assessments and the Landslide Mitigation Plan in consultation with the WVDEP and WVDNR.

4.1.4.4.2 Gulf XPress Project

Conditions necessary for the development of landslides are not present in the GXP work areas.

4.1.4.5 Steep Slopes

Steep slopes are defined as slopes 30 percent and greater. Steep slopes are a concern due to the specialized construction techniques required on these slopes and due to the increased risk of construction equipment losing stability.

4.1.4.5.1 Mountaineer XPress Project

The MXP would be constructed in areas with steep slopes. MXP pipelines would cross about 58.2 miles of greater than 30 percent slopes, including 55.6 miles along MXP-100, 2.4 miles along MXP-200, less than 0.1 mile along the SM80 Line, and 0.1 mile along the SM80 Loop Line.

On steep slopes, or other areas of special concern that may be prone to landslides, the spacing of the permanent erosion controls would be reduced to 100 feet (or even to 50 feet if the area contains a steep slope and is highly susceptible to landslides). Additional erosion control measures approved by the EI may be used on steep slopes to help stabilize the construction work areas, including soil stabilization/retainment methods such as soil anchors, gabion baskets, soil blending, etc., and/or including engineering systems, as required.

4.1.4.5.2 Gulf XPress Project

Slopes greater than 30 percent are present, in small acreages, at the Cane Ridge Compressor Station site (1.51 acres), the Clifton Junction Compressor Station site (1.93 acres), the existing Leach C Meter Station site (0.26 acre) and the Goodluck Compressor Station site (0.39 acre); although the permanent facility footprints, specifically the structures, would be constructed on the more level portions of the area. Additional erosion control measures approved by the EI may be used on steep slopes to help stabilize the construction work areas, including soil stabilization/retainment methods such as soil anchors, gabion baskets, soil blending, etc., and/or including engineering systems, as required.

4.1.4.6 Mine Subsidence

Mine subsidence is a shift in the ground surface due to a collapse or failure of underground mine workings. Subsidence can range from small, localized areas of collapse, including sinkholes or troughs, to a broad, regional lowering of the ground surface.

4.1.4.6.1 Mountaineer XPress Project

We received a comment during public scoping regarding the safety risk of mining land beneath a pipeline. Underground mining for coal has occurred in West Virginia since the 1800s. In the United States, the traditional method used for coal extraction is room-and-pillar mining. This consists of excavating an area ("room") while leaving pillars of coal in place to support the mine roof. The other basic method of underground coal mining is longwall mining. Longwall mining involves the complete removal of coal contained in a large rectangular block or "panel." Following removal of the coal, the mined-out area is allowed to collapse. Longwall mining coal production has grown rapidly over the past 50 years and is now one of the principal underground mining methods in the United States (EIA, 1995).

One impact of underground mining, especially longwall mining, is subsidence at the surface when the mine collapses. The potential damage of subsidence on structures (e.g., building, roads, utility lines) at or near the surface depends on the structure's orientation and position within the subsided area (EIA, 1995). Based on a review of the publicly available data from the WVDEP, four known coal mine sites are within 0.25 mile of MXP facilities (WVDEP, 2015a and 2015b). There are known and documented inaccuracies in the publicly available datasets that have a margin of error as to the exact location of the mineral resources.

Columbia Gas has active working relationships with the local mining companies that conduct longwall mining in the area. Columbia Gas would coordinate with the mining companies in advance of any proposed mining so that appropriate planning for subsidence can occur. Once a mining schedule has been finalized, Columbia Gas would strip the overlaying topsoil from its pipeline(s) to reduce the downward pressure created by subsidence in the area to be mined. If subsidence is detected in the vicinity of the pipeline, and as necessary, Columbia Gas would coordinate with FERC to mitigate any potential effects on the pipeline. Any mineral resources discovered in the MXP workspace during construction would be avoided on a case-by-case basis, including but not limited to rerouting or narrowing the right-of-way width to avoid the resource.

Columbia Gas would continue to coordinate with the mining companies for the duration of operation.

4.1.4.6.2 Gulf XPress Project

None of the GXP work sites are within 0.25 mile of a mine or quarry.

4.1.4.7 Karst Terrain

Karst is a landscape type or terrain characterized by the presence of sinkholes, caverns, and in some cases a highly irregular, pinnacled bedrock surface. Karst develops from the dissolution of soluble bedrock (limestone, dolomite, marble, or gypsum) by groundwater. Karst terrain often has unique hydrology and highly productive aquifers; however, these aquifers are very susceptible to contamination. Additionally, sinkhole features can present a risk of ground collapse that can damage structures.

Sinkholes, which are a major feature of karst terrain, fall into two broad categories: vault-collapse sinkholes and cover-collapse sinkholes. Vault-collapse sinkholes are characterized by the sudden catastrophic failure of a subterranean cavern vault (i.e., a roof), causing the rapid displacement of surface materials into the resulting void. The more common sinkhole type, a cover-collapse sinkhole, forms from the transport of soil materials from the surface into the bedrock through pre-existing voids or conduits. The resulting voids from this process are filled with the surrounding soil materials (a process called piping), and over time, form a noticeable depression on the land surface. This natural process can be exacerbated by disturbances such as:

- precipitation events;
- an increase or redirection of overland or subsurface hydrology (i.e., surficial grading), which may accelerate the transportation of soil materials;
- removal of vegetation cover and topsoil (e.g., stripping or grubbing), which can reduce the cohesive strength of soils; and
- sudden changes in the elevation of the water table (e.g., due to drought, over-pumping of wells, or quarry dewatering), which can remove the natural buoyancy of the water supporting a soil plug in a bedrock channel.

4.1.4.7.1 Mountaineer XPress Project

Based on mapping from the USGS, the nearest known karst to the MXP is approximately 7.5 miles north of MP 0 (Weary and Doctor, 2014). Because known karst is not present in or in proximity to the MXP workspace, karst is not considered a risk to the MXP facilities, and the MXP would not pose a risk of contamination to karst aquifers. If Columbia Gas encounters a sinkhole, notification would be made to the WVDEP – Groundwater/Underground Injection Control Department, and Columbia Gas would follow the WVDEP's Sinkhole Mitigation Guidance document in addition to the Karst Mitigation Plan that was developed for the E Systems Project (FERC Docket No. CP15-160), a recent Columbia Gas project in Kentucky.

4.1.4.7.2 Gulf XPress Project

Based on karst topography mapping from the USGS on a national scale, karst terrain may be present at the locations of the Paint Lick, Goodluck, Cane Ridge, Clifton Junction, and New Albany Compressor Station sites (Weary and Doctor, 2014). Columbia Gulf conducted geotechnical studies at each of the new facilities and found that there was no karst terrain present at the New Albany site. However, karst terrain was found at the remaining four sites. During the geotechnical exploration of the four sites, the encountered soil materials with karst terrain did not exhibit typical signs of active features, such as soft overburden soils, elevated moisture contents, thick weathered zone of bedrock, or voids/clay-filled seams within the bedrock. The existing Leach C Meter Station and approved Grayson Compressor Station are not located in karst terrain. At sites where karst topography is determined to be a potential hazard, Columbia Gulf would construct foundations that are supported by competent bedrock to mitigate the risk of foundation disturbance due to seismic activity or sinkhole development.

4.1.4.8 Flash Flooding

Flash floods can occur very rapidly, during periods of extremely heavy rain or when levees, dams, or water systems break. The greatest potential for flash flooding to impact the project areas is at a wetland or waterbody crossing during or after a large storm event with significant precipitation over a short period.

4.1.4.8.1 Mountaineer XPress Project

Flooding associated with heavy rainfall can occur throughout most MXP work areas. However, the potential for flash flooding to occur and significantly impact construction or operation of MXP facilities is low. Potential effects associated with high rainfall events during construction would be mitigated by implementing the measures in Columbia Gas' ECS. These measures include using additional equipment (e.g., stand-by pumps) during high rainfall events. We do not anticipate impacts on construction due to flooding within the MXP work areas. MXP facilities located within FEMA's 100-year floodplain would be built according to county floodplain ordinances; therefore, we do not anticipate impacts on project operation due to flooding within the MXP work areas.

4.1.4.8.2 Gulf XPress Project

Portions of the approved Grayson Compressor Station site as well as portions of the TWS for the New Albany Compressor Station are located within the 100-year floodplain. At the Holcomb Compressor Station site, a portion of the TWS is within the 100-year floodplain, and two small corners of permanent workspace encroach into the 100-year floodplain along the western fenceline. GXP facilities located within FEMA's 100-year floodplain would be built according to county floodplain ordinances; therefore, we do not anticipate impacts on project operation due to flooding within the GXP work areas. The potential for flash flooding to occur and significantly impact construction or operation of the GXP facilities is low.

4.1.4.9 Blasting

MXP and GXP construction may require blasting if shallow bedrock is encountered, as discussed in section 2.4.1.5.

4.1.4.9.1 Mountaineer XPress Project

Based on analysis of the U.S. Department of Agriculture (USDA) NRCS Soil Survey Geographic (SSURGO) database, approximately 80 percent of the MXP workspace contains bedrock within 60 inches of the ground surface (USDA, 2015). The absence of recorded shallow bedrock does not preclude the potential of encountering shallow bedrock in other areas.

If paralithic (soft) bedrock is encountered at depths less than 60 inches along the MXP pipeline corridors, the technique used for bedrock removal would depend on such factors as strength and hardness of the rock. Columbia Gas would attempt to use mechanical methods, such as ripping, hydraulic hammers, or conventional excavation, to remove the bedrock. The method(s) chosen would depend upon the conditions encountered at the time of construction. If dense, consolidated bedrock without fractures (lithic bedrock) is encountered and the use of hydraulic hammers or other mechanical methods are found to be ineffective, blasting may be required.

Columbia Gas has prepared a Blasting Plan, which would be implemented during construction. As part of this plan, contractors would be required to submit site-specific blasting plans to Columbia Gas for approval prior to blasting activities for each location requiring blasting.

General blasting precautions would include, but not be limited to:

- inventorying public and private drinking-water wells and potable springs in proximity to the construction work area (typically within 150 feet) and completing pre- and post-blast (within 2 months of construction work restoration) water quality and flow rate testing, if requested by the landowner;
- completing pre-blast inspections and, if necessary, seismographic monitoring of nearby residences (within 150 feet of construction area) and other structures by an independent contractor;
- installing blasting mats in congested areas, in shallow waterbodies, or near structures that could be damaged by fly-rock;
- posting visual and audible warning signals, flags, and barricades for personnel safety;
- notifying occupants of nearby buildings, stores, residences, places of business, and places of public gathering, as well as farmers, at least 48 hours in advance of blasting activities;
- notifying the local fire marshal of blasting activities prior to blasting; the fire marshal would be notified the day of blasting via phone or email;
- following procedures for safe storage, handling, transportation, loading, firing, and disposal of explosive materials;
- conducting a three-axis seismic survey for each blast event within 300 feet of a Columbia Gas pipeline, unless otherwise permitted by appropriate Columbia Gas personnel; and

- monitoring ground vibration and air-blast using peak-particle-velocity measurements when seismographic monitoring is necessary.

The blasting specifications would meet or exceed applicable federal, regional, state, and local requirements, limits, permits, and guidelines governing the use of explosives. Explosive material would only be brought onsite the day of its intended use. Unused explosive material would be inventoried and transported to a designated storage facility.

A pre-blasting survey would be conducted, with landowner permission, to assess the conditions of structures and wells within 150 feet of the blasting area. The survey may include the following:

- discussions with adjacent property owners to familiarize them with blasting effects and planned precautions to be taken by Columbia Gas;
- identification of site-specific structures, utilities, and water wells and potable springs;
- collection of pre-blast photographs and/or video of adjacent structures and utilities; and
- detailed mapping and measurement of large cracks, crack patterns, and other evidence of structural stress observed in specific structures.

The results of the pre-blasting survey would be summarized in a report to be completed prior to the initiation of blasting in the specific area. If property owners were to identify damage or change to properties, or if excessive peak-particle velocities were recorded during the blasting operations, Columbia Gas would perform an additional post-blasting survey of the affected properties to verify the damage. Once confirmed, Columbia Gas would either repair the damage or compensate the owner for blast-related damages.

4.1.4.9.2 Gulf XPress Project

Facility construction may require blasting if shallow bedrock is encountered. Based on analysis of the SSURGO database, approximately 36 percent of the GXP workspace contains bedrock within 60 inches of the surface (USDA, 2016c). Shallow bedrock is present at the Morehead, Paint Lick, Goodluck, Cane Ridge, and Clifton Junction stations sites, as well as at the existing Leach C Meter and approved Grayson Compressor Stations. The New Albany and Holcomb sites do not have identified shallow bedrock. The absence of recorded shallow bedrock does not preclude the potential for encountering it. In areas with potentially shallow bedrock, Columbia Gulf would attempt to utilize ripping or hammering techniques, where possible, to break through the bedrock. If the bedrock proves too hard for these techniques, blasting may be necessary. The specific method(s) chosen would be dependent upon the conditions encountered at the time of construction.

Columbia Gulf has prepared a Blasting Plan, which would be followed by Columbia Gulf and its contractors. As with the MXP, contractors would be required to submit a site-specific blasting plan to Columbia Gulf for approval prior to blasting activities. The blasting precautions and procedures previously addressed for the MXP, including pre- and post-blasting surveys, would also be applicable to the GXP. Potential impacts associated with blasting activities would be minor and temporary.

4.1.5 Conclusion

4.1.5.1 Mountaineer XPress Project

The MXP impacts on geology would be highly localized and limited primarily to the period of construction. These potential impacts would occur in areas of shallow bedrock, where blasting may be required, or where construction occurs on steep slopes that would be highly susceptible to landslides. Construction on steep slopes would require contouring of the slope for safe construction practices and to accommodate heavy equipment.

Columbia Gas would implement permanent drainage controls on steep slopes, or other landslide-prone areas, to help stabilize the construction work areas. Columbia Gas would also implement its Blasting Plan and ECS to minimize the potential impacts from performing construction on steep slopes and any blasting that would occur. Overall, impacts related to topography and existing geological conditions from the construction and operation of the MXP are anticipated to be minor and temporary.

4.1.5.2 Gulf XPress Project

The GXP effects on geology would be highly localized and limited primarily to the period of construction. These impacts would occur in areas of karst terrain or areas with shallow bedrock where blasting may be required. At sites where karst topography is determined to be a potential hazard, Columbia Gulf would construct foundations that are supported by competent bedrock to mitigate the risk of foundation disturbance due to seismic activity or sinkhole development. To minimize the potential impacts from blasting, Columbia Gulf would implement measures contained in its ECS and Blasting Plan. Overall, impacts related to topography and existing geological conditions from the construction and operation of the GXP are anticipated to be minor and temporary.

4.2 SOILS

At the broadest scale, soil interpretations in the United States are based on Major Land Resource Areas (MLRA).

The MXP facilities are located entirely in the Central Allegheny Plateau (MLRA No. 126). The physiography of this MLRA is characterized by a dissected plateau with narrow valleys and ridgetops separated by long and steep side slopes. The dominant soil orders are Alfisols, Ultisols, and Inceptisols, which are characterized as shallow to very deep, skeletal to clayey soils with a mesic (moderate) temperature regime, an udic (high or humid) moisture regime, and mixed mineralogy (USDA NRCS, 2006).

The GXP facilities would be located within six MLRAs recognized by the NRCS: Western Allegheny Plateau, Kentucky Bluegrass, Highland Rim and Pennyroyal, Nashville Basin, Southern Coastal Plain, and Southern Mississippi River Alluvium. A general summary of each MLRA crossed by GXP sites is provided in table 4.2-1.

Table 4.2-1 MLRA Characteristics within the GXP Area			
MLRA	**Aboveground Facility**	**Landforms**	**Soil Characteristics**
Western Allegheny Plateau (No. 124)	Morehead Compressor Station, Leach C Meter Station, Grayson Compressor Station	Narrow, level valley floors, rolling ridgetops, and hilly to steep ridge slopes.	Soils generally are moderately deep to very deep, excessively drained to somewhat poorly drained, and loamy.
Kentucky Bluegrass (No. 121)	Paint Lick Compressor Station	Gently rolling terrain with some isolated hills and ridges.	Soils are shallow to very deep, generally well drained, and loamy or clayey.
Highland Rim and Pennyroyal (No. 122)	Goodluck Compressor Station, Clifton Junction Compressor Station	Low, rolling hills, upland flats, and narrow valleys.	Soils are moderately deep to very deep, moderately well drained or well drained, and loamy or clayey.
Nashville Basin (No. 123)	Cane Ridge Compressor Station	Steep slopes between narrow, rolling ridgetops, and narrow valleys.	Soils are moderately deep to very deep, well drained, clayey, and formed in limestone residuum.
Southern Coastal Plain (No. 133A)	New Albany Compressor Station	Nearly level and gently undulating valleys and gently sloping to steep uplands.	Soils are very deep, somewhat excessively drained to poorly drained, and loamy.
Southern Mississippi River Alluvium (No. 131A)	Holcomb Compressor Station	Level or depressional to very gently undulating alluvial plains, backswamps, oxbows, natural levees, and terraces.	Soils are very deep, poorly drained and somewhat poorly drained, and loamy or clayey.
Source: USDA NRCS, 2006			

In addition, soil types and characteristics in the MXP and GXP areas were identified and assessed using the SSURGO database. The SSURGO database is a digital version of the original county soil surveys developed by the NRCS for use with geographic information systems (GIS). The SSURGO database is linked to an attribute database that gives the proportionate extent of the component soils and their properties for each soil map unit. SSURGO attribute data consist of physical properties, chemical properties, and interpretive groupings. Attribute data can apply to the whole soil (e.g., hydric soils, prime farmland soils, and slope class) or to layer data for soil horizons (e.g., texture and permeability). The soil attribute data can be used in conjunction with spatial data to describe soils in an area. The SSURGO database provides the most detailed level of publicly available soils information for natural resource planning and management.

The SSURGO database was queried to determine the physical and chemical properties for the soil types disturbed by the MXP and GXP facilities. The following soil characteristics and limitations were evaluated for the MXP and GXP: erosion potential (wind and water), revegetation potential, designation as prime farmland, compaction potential, stony and rocky soils, depth to shallow bedrock, hydric soils, topsoil depth, and soil contamination. Additional information about the soils was obtained from the Official Soil Series Descriptions (Soil Survey Staff, 2015a).

4.2.1 Soil Disturbance

Activities associated with the construction of pipeline and facility infrastructure for the MXP and GXP, such as clearing, grading, trench excavation, backfilling, and the movement of construction equipment, affect soil resources. Clearing removes protective vegetation cover and exposes soil to the effects of wind and rain, which increase the potential for soil erosion and sedimentation of surface waters and wetlands. Grading, spoil storage, and equipment traffic can compact soil, thus reducing porosity and increasing runoff potential. Information regarding impacts from non-jurisdictional facilities for both MXP and GXP is discussed in section 1.4.

4.2.1.1 Mountaineer XPress Project

A breakdown of the land requirements by acreage, including total construction impacts by facility type and permanent operational impacts is included in section 2.3.1.

Columbia Gas would use 40 contractor yards and 95 staging areas for the storage of materials and equipment necessary for MXP construction. Approximately 496 acres of soil would be temporarily disturbed through the use of staging areas and contractor yards for the MXP. Preparation of these areas would consist of minor grading and leveling. Once construction is complete, the staging areas and contractor yards would be restored to pre-construction conditions and uses or in accordance with landowner agreements.

A total of 306 access roads would be used for construction and operation of the MXP facilities. Existing access roads may require widening or improvements to accommodate construction equipment, or new access roads may need to be constructed. As detailed in table 2.3-1, approximately 302 acres of soils would be temporarily affected by the use, maintenance of, improvements to, or construction of access roads for the new MXP-100 and MXP-200 pipelines and SM80 pipeline replacement segments. An additional 3.7 acres would be permanently impacted by access roads used for facility operations.

To avoid or minimize impacts on soils during MXP construction, Columbia Gas would implement the soil mitigation measures outlined in its ECS. Columbia Gas' ECS adopts and incorporates the requirements included in FERC's Plan and Procedures with some modifications as discussed in section 2.4, as well as many of the environmental standards established in the WVDEP's 2006 *West Virginia Erosion and Sediment Control Best Management Practice Manual*. Columbia Gas' ECS meets and/or exceeds West Virginia-specific environmental requirements, which are typically as stringent as FERC's Plan and Procedures.

4.2.1.2 Gulf XPress Project

Approximately 198 acres of soil would be temporarily disturbed during construction of the GXP facilities. Of this acreage, approximately 82 acres would be permanently disturbed for project operation. Table 4.2-2 provides additional information about the extent of soil disturbance for each GXP facility.

Table 4.2-2 Soil Disturbance for the GXP Facilities a/			
Aboveground Facility	State	Construction Impacts (acres)	Permanent Impacts (acres)
New Aboveground Facilities b/			
Morehead Compressor Station	KY	17.2	11.3
Paint Lick Compressor Station	KY	30.2	10.1
Goodluck Compressor Station	KY	25.7	14.0
Cane Ridge Compressor Station	TN	23.0	10.4
Clifton Junction Compressor Station	TN	29.0	16.1
New Albany Compressor Station	MS	26.4	10.4
Holcomb Compressor Station	MS	33.3	9.2
Existing Aboveground Facilities b/			
Leach C Meter Station	KY	1.4	0.0
Grayson Compressor Station	KY	11.9	0.0
	Total	**198.1**	**81.6**

a The numbers in this table have been rounded for presentation purposes. As a result, the totals may not reflect the sum of the addends.

b Includes the temporary and permanent access road impacts at each of the facilities.

To minimize or avoid potential impacts on soils during GXP construction, Columbia Gulf would implement the measures in its ECS, as well as state and local regulations or guidelines.

4.2.2 Erosion Potential

Erosion is a natural process in which surface soils are worn away, typically by wind or water, but which can be accelerated by human disturbance. Factors such as soil texture, structure, slope, vegetation cover, rainfall intensity, and wind intensity can influence the degree of erosion. Soils prone to erosion are typically bare or sparsely vegetated, non-cohesive, fine textured, and located on moderate to steep slopes. Soils typically more resistant to erosion occupy low relief areas, are well vegetated, and are well structured with high percolation rates. Clearing, grading, and equipment movement can accelerate the erosion process. Without adequate protection, these activities can result in topsoil loss, reduced soil fertility, and erosion of sediment into sensitive areas, including wetlands and surface waters.

Highly erodible soils were identified based on three soil parameters present in the SSURGO database that are directly related to the susceptibility of a soil to erosion by water or wind: land capacity subclass, slope, and wind erodibility group (WEG). Map units with a land capacity subclass designation of 4e through 8e, which are considered to have severe to extreme erosion limitations for agricultural use, and/or an average slope greater than 8 percent, were identified as susceptible to water erosion. Wind erodibility was assessed based on WEG designations. A WEG is a grouping of soils that have similar surface-soil properties affecting their resistance to being blown, including texture, organic matter content, and aggregate stability. Soils in WEG 1 and 2 include sandy-textured soils with poor aggregation that are particularly susceptible to wind erosion.

4.2.2.1 Mountaineer XPress Project

Approximately 3,045 acres (84 percent) of the soils that would be disturbed by MXP activities are susceptible to water erosion. Only about 2 acres of soils to be disturbed by MXP activities are classified as highly susceptible to wind erosion (see table 4.2-3).

We received comment during scoping regarding concerns with the potential for erosion resulting in impacts on soil stability and soil integrity. To limit soil erosion and sedimentation, Columbia Gas would implement a site-specific E&SC Plan and its ECS for each MXP facility. Some of the measures include the following:

- Temporary and permanent erosion controls, including interceptor diversions and sediment filter devices (e.g., straw bales, super silt fences, erosion control blankets, seed, and mulch) would be installed following initial ground disturbance, and as required.
- Temporary erosion control devices would be inspected near the end of each work day or within 24 hours of each storm event of 0.5 inch of rain or greater to monitor proper functioning.
- Any devices damaged beyond functioning would be repaired promptly.
- Temporary erosion and sediment control measures would be removed after final site stabilization or after they are no longer needed.

As outlined in the ECS, final grading would be completed within 20 calendar days (10 days in residential areas) of backfilling, weather and soil conditions permitting. Permanent erosion control devices would be installed during final grading. When conditions require a delay, the time frame would not start until conditions are suitable for grading. Should unsuitable soil conditions persist, or be expected to persist, for more than 10 calendar days, final grading and restoration would be delayed and the EI would record the conditions and require the installation of temporary stabilization measures. In no case would final grading be delayed beyond the end of the next recommended seeding season. If final grade can be established, but conditions are not ideal for permanent seeding, the EI would specify the application of temporary stabilization measures (including temporary seeding and mulching) and may also consider a concurrent application of final seed mix and mulch. Typical upland grading methods would be used on steep slopes to restore the areas of disturbance.

Table 4.2-3
Acreage of Various Soil Characteristics Affected by the MXP Facilities a/, b/

Pipeline Facility	Total Acreage c/	Prime Farmland d/	Hydric Soils d/	Compaction Prone e/	Highly Erodible		Revegetation Concerns h/	Rocky i/	Shallow to Bedrock j/
					Water f/	Wind g/			
New Pipeline Facilities									
MXP-100	2,2651.4	131.0	8.8	10.4	2,410.6	0.0	2409.0	345.1	2329.7
MXP-200	63.1	4.9	0.0	0.0	57.9	0.0	57.9	9.9	54.1
Subtotal	**2714.5**	**135.9**	**8.8**	**10.4**	**2468.5**	**0.0**	**2466.9**	**355.0**	**2383.9**
Replacement Pipeline Facilities									
SM80 Line	3.9	<0.1	0.0	0.0	3.9	0.0	3.9	1.8	3.2
SM80 Loop Line	3.1	0.0	0.0	0.0	3.1	0.0	3.1	1.1	2.7
Subtotal	**7.0**	**<0.1**	**0.0**	**0.0**	**7.0**	**0.0**	**7.0**	**2.9**	**5.9**
Access Roads									
MXP-100	273.4	19.7	1.1	1.3	243.6	0.0	243.1	23.6	233.8
MXP-200	25.9	1.6	0.0	0.0	24.4	0.0	24.2	2.6	23.2
SM80 Line	0.3	0.1	0.0	0.0	<0.1	0.0	<0.1	0.0	0.0
SM80 Loop Line	2.1	0.5	0.0	0.0	1.6	0.0	1.6	0.4	1.3
Subtotal	**301.7**	**21.9**	**1.1**	**1.3**	**269.6**	**0.0**	**268.9**	**26.6**	**258.3**
New Aboveground Facilities									
MXP-100 Tie-in with LEX	2.8	0.0	0.0	0.0	2.8	0.0	2.8	1.4	1.6
Sherwood Compressor and Regulator Station	29.8	9.4	0.0	0.0	20.4	0.0	20.4	9.6	14.7
MXP-200 Tie-in with Line 1983	0.7	0.1	0.0	0.0	0.6	0.0	0.6	0.5	0.6
White Oak Compressor Station	16.7	0.0	0.0	0.0	16.7	0.0	16.7	0.0	16.7
Mount Olive Compressor Station	31.3	<0.1	0.0	0.0	29.6	0.0	29.6	4.8	29.0
Ripley Regulator Station	1.3	1.0	0.0	0.0	0.3	0.0	0.3	0.0	0.2
Saunders Creek Regulator Station	10.7	0.0	0.0	0.0	10.7	0.0	10.7	6.2	10.7
MXP Valve Sites	3.0	0.2	0.0	0.0	2.6	0.0	2.6	1.1	2.6
Subtotal	**96.3**	**10.7**	**0.0**	**0.0**	**83.7**	**0.0**	**83.7**	**23.6**	**76.1**
Existing Aboveground Facilities									
Lone Oak Compressor Station l/	10.3	0.0	0.0	0.0	10.3	0.0	10.3	5.4	7.8
Ceredo Compressor Station	14.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 4.2-3
Acreage of Various Soil Characteristics Affected by the MXP Facilities a/, b/

Pipeline Facility	Total Acreage c/	Prime Farmland d/	Hydric Soils d/	Compaction Prone e/	Highly Erodible		Revegetation Concerns h/	Rocky i/	Shallow to Bedrock j/
					Water f/	Wind g/			
Elk River Compressor Station m/	7.4	5.6 k/	0.0	0.0	1.0	0.0	1.0	0.0	1.0
Subtotal	**32.0**	**5.6**	**0.0**	**0.0**	**11.3**	**0.0**	**11.3**	**5.4**	**8.8**
Staging Areas and Contractor Yards									
Staging Areas	204.0	72.1	4.5	4.5	109.9	0.0	109.9	22.4	96.8
Contractor Yards	291.7	73.3	12.7	16.8	94.7	1.7	75.9	17.9	48.4
Subtotal	**495.7**	**145.4**	**17.2**	**21.3**	**204.6**	**1.7**	**185.8**	**40.3**	**145.2**
Total a/	**3,647.2**	**319.5**	**27.1**	**33.0**	**3044.7**	**1.7**	**3023.6**	**453.8**	**2878.2**

Sources: Soil Survey Staff, 2015a and 2015b

a The numbers in this table have been rounded for presentation purposes. As a result, the totals may not reflect the sum of the addends.
b The values in each facility area do not add up to the total acreage because the soils may occur in more than one characteristic class or may not occur in any class listed in the table.
c Includes all land disturbance activities associated with project workspace. Specifically, the tie-ins and compressor stations contain the total permanent facility area and additional temporary workspace acreage associated with these facilities.
d As designated by the NRCS. Prime farmland includes those soils that are considered prime if a limiting factor is mitigated (e.g., artificial drainage).
e Soils in somewhat-poor-to-very-poor drainage classes with surface textures of sandy clay loam and finer.
f Soils in land capability subclasses 4E through 8E and soils with an average slope greater than 8 percent.
g Soils with a WEG classification of 1 or 2.
h Soils with a surface texture of sandy loam or coarser that are moderately well to excessively drained, and soils with an average slope greater than 8 percent.
i Soils with one or more horizons that have a cobbley, stony, bouldery, channery, flaggy, very gravelly, or extremely gravelly modifier to the textural class and/or contain greater than 5 percent by weight rocks larger than 3 inches.
j Soils identified as having bedrock within 60 inches of the soil surface.
k Although the majority of the soils associated with the Elk River Compressor Station site are considered prime farmland, the site is currently being used for industrial purposes. No significant conversion of land currently being used for agricultural purposes is anticipated.
l Approved compressor station proposed by Columbia Gas under the LXP (Docket No. CP15-514-000).
m Pending compressor station proposed by Columbia Gas under the WBX Project (Docket No. CP16-38-000).

4.2.2.2 Gulf XPress Project

Approximately 47 acres (24 percent) of the soils that would be affected by the GXP facilities are considered susceptible to erosion by water (see table 4.2-4). None of the soils that would be affected by the facilities have a WEG classification of 2 or less and, therefore, none are considered highly wind-erodible.

To minimize or avoid potential impacts due to soil erosion and sedimentation, Columbia Gulf would implement the measures in its ECS, as well as state and local regulations or guidelines. Some of these measures include the following:

- Temporary slope breakers would be installed across the GXP suction/discharge pipeline rights-of-way, as necessary, to slow the velocity of runoff and move water offsite.
- Permanent slope breakers, typically earthen berms, would be installed across the suction/discharge rights-of-way, as necessary, during final grading.
- Sediment barriers (e.g., silt fences, straw bales, and straw logs) would be used to protect surface waters and roadways, as necessary, by controlling the movement of sediment on the sites and by preventing the transport of sediment offsite.
- Mulch consisting of straw, hay, erosion-control fabric, or other equivalent, would be used to protect the soil surface from water and wind erosion and optimize soil moisture for successful revegetation.
- Wind erosion and fugitive dust emissions would be controlled by applying water to exposed work areas.

Temporary erosion controls would be installed following initial ground disturbance and maintained throughout construction. Columbia Gulf would attempt to complete final cleanup and installation of permanent erosion control measures in an area within 20 days after final grading in that area, weather and soil conditions permitting. In no case would restoration of an area be delayed beyond the next available seeding season.

During construction, the effectiveness of temporary erosion control devices would be monitored by Columbia Gulf's EIs and Environmental Health and Safety Staff. The effectiveness of revegetation and permanent erosion control devices would be monitored by Columbia Gulf's operating personnel during the operation and maintenance of each aboveground facility. Temporary erosion control devices would be maintained until the site is revegetated successfully. Following successful revegetation of construction areas, temporary erosion control devices would be removed.

Table 4.2-4
Acres of Soil Characteristics Affected by GXP Facilities a/, b/

Facility	Total Acres	Prime Farmland c/	Hydric Soils c/	Compact. Prone d/	Water Erosion e/	Wind Erosion f/	Revegetation Concerns g/	Rocky h/	Shallow Bedrock i/
New Aboveground Facilities j/									
Morehead Compressor Station	17.2	17.2	0.0	9.5	0.0	0.0	0.0	17.2	16.7
Paint Lick Compressor Station	30.2	17.0	0.0	0.0	13.2	0.0	13.2	30.2	13.2
Goodluck Compressor Station	25.7	11.4	0.0	0.0	14.0	0.0	14.0	20.4	0.3
Cane Ridge Compressor Station	23.0	15.2	0.0	0.0	7.8	0.0	7.8	0.2	23.0
Clifton Junction Compressor Station	29.0	5.8	0.0	0.0	9.1	0.0	22.8	16.9	18.2
New Albany Compressor Station	26.4	23.7	0.0	9.3	0.0	0.0	0.0	0.0	0.0
Holcomb Compressor Station	33.3	21.1	12.3	33.3	0.0	0.0	0.0	0.0	0.0
Subtotal	**184.7**	**111.3**	**12.3**	**52.1**	**44.1**	**0.0**	**57.8**	**84.8**	**71.4**
Existing Aboveground Facilities j/									
Leach C Metering Station	1.5	0.9	0.0	0.9	0.6	0.0	0.6	0.1	0.6
Grayson Compressor Station k/	11.9	9.6	0.0	0.0	2.3	0.0	2.3	2.3	0.2
Subtotal	**13.4**	**10.5**	**0.0**	**0.9**	**2.9**	**0.0**	**2.9**	**2.4**	**0.8**
Total	**198.1**	**121.8**	**12.3**	**53.0**	**47.0**	**0.0**	**60.7**	**87.2**	**72.2**

Sources: Soil Survey Staff, 2016a and 2016b

a The area affected includes the permanent facility site, temporary workspace, and additional temporary workspace. The soils in the table do not include areas of open water.
b The numbers in this table have been rounded for presentation purposes. As a result, the totals may not reflect the sum of the addends. The values in each row do not add up to the total acreage for each facility because the soils may occur in more than one characteristic class or may not occur in any class listed in the table.
c As designated by the NRCS. Prime farmland includes those soils that are considered prime if a limiting factor is mitigated (e.g., through artificial drainage).
d Soils in somewhat-poor-to-very-poor drainage classes with surface textures of sandy clay loam and finer.
e Soils in land capability subclasses 4E through 8E and soils with an average slope greater than 8 percent.
f Soils with a WEG classification of 1 or 2.
g Soils with a surface texture of sandy loam or coarser that are moderately well to excessively drained, and soils with an average slope greater than 8 percent.
h Soils with one or more horizons that have a cobbley, stony, bouldery, channery, flaggy, very gravelly, or extremely gravelly modifier to the textural class and/or contain greater than 5 percent by weight rocks larger than 3 inches.
i Soils identified as having bedrock within 60 inches of the soil surface.
j Includes the temporary and permanent access roads (totaling approximately 2.2 acres) at each of the facilities.
k Pending compressor station proposed by Columbia Gulf under the Rayne XPress Project (Docket No. CP15-539-000).

4.2.3 Revegetation Potential

The revegetation potential of soils is based on several characteristics including topsoil thickness, soil texture, available water-holding capacity, susceptibility to flooding, soil temperature, pH, and salinity. Soils that are somewhat excessively or excessively drained have less water to aid in the germination and eventual establishment of new vegetation. Coarser-textured soils also have a lower water-holding capacity following precipitation, which can result in moisture deficiencies in the root zone creating unfavorable conditions for many plants. In addition, steep slopes make the establishment of vegetation difficult due to high runoff potential.

Plant species that can invade natural areas and displace native species are called invasive species. Noxious weeds are plants officially deemed destructive to agriculture, wildlife, property, recreation, and public health. These plants tend to out-compete other plant species and therefore could possibly cause environmental harm. Construction activities include clearing of surface vegetation and grading the ground surface within the designated construction work areas. Removal of plants and disturbance to root systems would occur during this process. Indirect impacts from this activity may include increased exposure to elements such as wind, sun, and precipitation, which could alter plant viability and reproduction. Plants not adapted to different environmental conditions may not survive, while some plants may experience increased growth or reproduction due to altered exposure.

4.2.3.1 Mountaineer XPress Project

Clearing and grading of soils with poor revegetation potential can result in a lack of adequate vegetation following construction and restoration of the MXP pipeline right-of-way. This could cause increased erosion, a reduction in wildlife habitat, and adverse visual impacts. For the MXP, soils with limited potential for the reestablishment of vegetation were identified by querying the SSURGO database for component soil series that have (1) a surface texture of sandy loam or coarser and are moderately well to excessively drained, and/or (2) an average slope greater than 8 percent.

Approximately 3,024 acres (83 percent) of the soils that would be disturbed by the MXP are characterized as having revegetation concerns. Prompt, successful restoration and revegetation are important for maintaining productivity by preserving topsoils and protecting the underlying soil from potential damage, such as erosion. In accordance with its ECS, Columbia Gas would implement measures to create a favorable environment for the re-establishment of vegetation. Restoration would begin within 6 days of final grading, weather and soil conditions permitting. Fertilizer and lime would be disked into the soil (except rocky soils) to a depth of 3 to 4 inches to prepare the seedbed. In rocky soils, fertilizer and lime may be incorporated into the soil with tracked equipment. Seeding and mulching of the construction work area would promptly follow seedbed preparation. To minimize the loss of soil, the mulch would be checked to verify it is adequately anchored. Mulch tackifiers may be used as an alternative, but liquid mulch binders would not be used within 100 feet of wetlands or waterbodies. Additionally, during temporary restoration, mulching on slopes greater than 8 percent and within 100 feet of waterbodies and wetlands would be applied at a rate of 6,000 pounds per acre. Columbia Gas would seed areas to be revegetated in accordance with written recommendations for seed mixes, rates, and dates obtained from the appropriate soil conservation authorities or land management agencies as

outlined in Columbia Gas' ECS. Revegetation in non-agricultural areas would be considered successful if, upon visual survey, the density and cover of non-nuisance vegetation are similar in density and cover to adjacent undisturbed lands.

In addition, Columbia Gas would mitigate for invasive plants and noxious weeds by using BMPs identified by agencies or based on MXP-specific requirements, and would work in accordance with its ECS to minimize the spread of these species on all project-related disturbed areas.

4.2.3.2 Gulf XPress Project

For GXP, soils with limited potential for the reestablishment of vegetation were identified by querying the SSURGO database for component soil series that (1) have a surface texture of sandy loam or coarser, (2) are moderately well to excessively drained, and (3) have an average slope greater than 9 percent.

Approximately 31 percent (60.7 acres) of the soils affected by the GXP facilities were identified as having a poor revegetation potential based on the surface texture, drainage class, and slope. Of the approximately 198 acres of soil disturbance that would be required for construction of the GXP aboveground facilities, about 117 acres would be revegetated (i.e., areas that are not paved, graveled, or covered by buildings). Those facilities that would require some revegetation and have soils with poor revegetation potential include the Paint Lick, Goodluck, Cane Ridge, and Clifton Junction compressor stations.

Successful restoration and revegetation is important to protect the underlying soil from potential damage, such as erosion. Columbia Gulf would promote the rapid, successful establishment of vegetation on areas requiring revegetation as described in its ECS. Following final grading and cleanup, Columbia Gulf would condition the temporary construction areas for planting, including the preparation of a seedbed and the application and incorporation of soil amendments at rates agreed to by the land-managing agency or as specified in writing by an appropriate soil conservation authority. Columbia Gulf completed consultations with the NRCS District Conservationists for each of the GXP facilities. Columbia Gulf would seed areas in accordance with written recommendations for seed mixes, rates, and dates obtained from the appropriate soil conservation authorities or land-managing agencies.

Columbia Gulf conducted noxious and invasive weed surveys at each of the facility sites. The results of this survey and further discussion is available in section 4.5.5.2 and table 4.5-7.

4.2.4 Prime Farmland

According to the NRCS, prime farmland soils are classified as those best suited for the production of food, feed, forage, fiber, and oilseed crops (Soil Survey Division Staff, 1993). This designation includes cultivated land, pasture, woodland, or other lands that are either used for food or fiber crops or are available for these uses. Urbanized land and open water are excluded from prime farmland. Prime farmland typically contains few or no rocks, is permeable to water and air, is not excessively erodible or saturated with water for long periods, and is not subject to frequent or prolonged flooding during the growing season. Soils that do not meet the above criteria may be considered prime farmland if the limiting factor is mitigated (e.g., by draining or irrigating).

4.2.4.1 Mountaineer XPress Project

Approximately 9 percent (320 acres) of the lands that would be disturbed by the MXP (including rights-of-ways, aboveground facilities, access roads, contractor yards, and temporary staging areas) are classified as prime farmland (see table 4.2-3). To limit mixing of the soil horizons or incorporation of additional rock into the topsoil, topsoil segregation would be performed within pipeline rights-of-way and TWS that would be revegetated. Topsoil segregation would not occur in areas that would be permanently occupied by the aboveground facilities. Topsoil would be segregated from the subsoil and would be replaced in the proper order during final grading. Implementation of proper topsoil segregation would promote post-construction revegetation success, thereby minimizing loss of vegetation productivity and the potential for long-term erosional issues.

4.2.4.2 Gulf XPress Project

Because the GXP would permanently alter the land use at each new compressor station site, protecting the soil productivity for crop production is not a concern. However, topsoil segregation would be performed in TWS that would be revegetated to limit the loss of topsoil or the mixing of topsoil with other soil horizons.

4.2.5 Compaction Potential

Soil compaction occurs when the soil structure is modified and the bulk density is increased, resulting in a reduction in the porosity and moisture-holding capability of the soil and potentially increased runoff. Construction equipment traveling over wet or saturated soils can disrupt soil structure, reduce pore space, and cause compaction. The degree of compaction depends on the soil texture and moisture content. Fine-grained soils with poor drainage characteristics have the greatest propensity for compaction. Soil compaction can limit revegetation potential by hindering seed germination, root establishment, and water uptake by plants. Compaction-prone soils were identified by querying the SSURGO database for soil components that have (1) a surface texture of sandy clay loam or finer, and (2) a drainage class of somewhat poorly, poorly, or very poorly drained.

4.2.5.1 Mountaineer XPress Project

Approximately 33 acres (0.9 percent) of the soils that would be disturbed by MXP activities are prone to compaction. The susceptibility of the soils to compaction would be dependent on the soil moisture content during construction. Columbia Gas would minimize compaction impacts in soft or saturated soils by using the measures outlined in its ECS. Columbia Gas would test topsoil and subsoil for compaction at regular intervals in agricultural and residential areas disturbed by construction activities. Where compaction has been identified, Columbia Gas would use deep tillage implements, such as a paraplow, prior to topsoil replacement. In addition to tilling, arrangements may be made with landowners to plant and plow under a “green manure” crop, such as alfalfa, to improve soil structure and reduce bulk density. Construction activities may also be restricted during unusually wet conditions, as necessary, to limit compaction and rutting.

4.2.5.2 Gulf XPress Project

Approximately 53 acres (27 percent) of the soils that would be affected by the GXP are prone to compaction. Compaction would only be a concern in TWS that would be revegetated. Columbia Gulf would minimize compaction and rutting impacts in TWS by using measures outlined in its ECS during construction in soft or saturated soils. In addition, Columbia Gulf's EIs could recommend restricted construction activities during unfavorable conditions (e.g., wet weather) to further reduce the potential for compaction and rutting. Compaction impacts would be mitigated using deep tillage operations during restoration activities using a paraplow or similar implement. In areas where topsoil segregation occurs, plowing with a paraplow or other deep tillage implement to alleviate subsoil compaction would be conducted before replacement of the topsoil.

4.2.6 Stony and Rocky Soils

Introducing stones and other rock fragments into surface soil layers may reduce the soil moisture-holding capacity (resulting in a reduction in soil productivity) and inhibit revegetation efforts. Soil fragments at the surface and in the surface layer may be encountered during grading, trenching, and backfilling. Soils with significant quantities of rock were identified by querying the SSURGO database for component soil series that have one or more soil horizons that (1) have a cobbley, stony, bouldery, shaly, channery, flaggy, very gravelly, or extremely gravelly modifier to the textural class and/or (2) contain greater than 5 percent (by weight) of rocks larger than 3 inches.

4.2.6.1 Mountaineer XPress Project

About 454 acres (12 percent) of the soils that would be disturbed by MXP construction activities are characterized as stony or rocky soils. The introduction of subsoil rocks into agricultural topsoil would be minimized by segregating topsoil from trench spoil and returning topsoil as the surface layer during cleanup and restoration. Columbia Gas would make diligent efforts to remove excess rock from at least the top 12 inches of soil, to the extent practicable, in cultivated and rotated croplands, hayfields, pastures, and residential areas, as well as other areas agreed upon between the landowner or land-managing agency and Columbia Gas. In other locations, Columbia Gas would remove excess rocks from surface soils disturbed by construction such that the size, density, and distribution of rock on the construction right-of-way would be similar to adjacent non-right-of-way areas.

4.2.6.2 Gulf XPress Project

Approximately 87 acres (44 percent) of the soils that would be disturbed by the GXP facilities are considered stony or rocky soils. For those areas that would be revegetated following construction activities at the facility sites, Columbia Gas would make diligent efforts to remove excess rock from at least the top 12 inches of soil, to the extent practicable, to facilitate revegetation. Columbia Gas would remove excess rocks from surface soils disturbed by construction such that the size, density, and distribution of rock in the construction area would be similar to adjacent non-construction areas.

4.2.7 Depth to Shallow Bedrock

Construction through soils with shallow bedrock could result in the incorporation of bedrock fragments into surface soils. Shallow-to-bedrock soils were identified by querying the SSURGO database for component soil series that have a bedrock contact within 60 inches of the soil surface. The analysis also identified whether the near-surface bedrock is lithic (hard/unweathered) and could require blasting to excavate (see sections 2.4.1.5 and 4.1.4.9), or is paralithic (soft/weathered) and could likely be ripped and dug without blasting.

4.2.7.1 Mountaineer XPress Project

Approximately 2,878 acres (79 percent) of the soils that would be disturbed by MXP activities contain bedrock within 60 inches of the surface. If paralithic bedrock is encountered at depths less than 60 inches along the MXP pipeline corridor, bedrock removal would be attempted using conventional excavation or other methods. If dense, lithic bedrock without fractures is encountered and conventional excavation or other methods are ineffective, blasting may be required.

Where lithic rock is encountered during construction, Columbia Gas' construction contractor would attempt to use hydraulic hammers or other mechanical methods to fragment the rock, where feasible. Rock that is not returned to the trench is considered construction debris, unless approved for use as mulch or for some other use on the construction work area by the landowner or land-managing agency. Disposal of excess rock debris would be in accordance with Columbia Gas' ECS and applicable regulatory requirements. Should Columbia Gas have to dispose of excess rock, an approved landfill or alternate permitted location would be used.

4.2.7.2 Gulf XPress Project

Approximately 72 acres (36 percent) of the soils that would be disturbed by GXP activities contain bedrock within 60 inches of the surface. If paralithic (soft) bedrock is encountered at depths less than 60 inches at a facility site, bedrock removal would be attempted using conventional excavation or other methods. If dense, lithic bedrock is encountered and conventional excavation or other methods are ineffective, blasting may be required.

4.2.8 Hydric Soils

Hydric soils are those that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions and support the growth and regeneration of hydrophytic vegetation (FR, 1994). These soils are typically found in areas with a high mean water table and wetlands; however, agricultural lands can contain hydric soils that are no longer saturated due to managed hydrology for crop development.

Due to extended periods of saturation, hydric soils can be prone to compaction and rutting. In addition, high groundwater levels associated with hydric soils can create a buoyancy hazard for pipelines.

4.2.8.1 Mountaineer XPress Project

Approximately 27 acres (0.7 percent) of the soils that would be affected by MXP construction are considered hydric. If high groundwater levels are encountered in hydric soil areas, creating a buoyancy hazard for pipelines, buoyancy control measures would be implemented to maintain the pipeline at the required depth.

4.2.8.2 Gulf XPress Project

Approximately 12 acres (6 percent) of the soils that would be affected by the GXP facilities are considered hydric. Along with hydrophytic vegetation and wetland hydrology, hydric soils are one of the three parameters required to be present for an area to be designated as a wetland under USACE methodology. Information about wetlands within the GXP work areas is provided in section 4.4.

4.2.9 Topsoil Depth

During construction activities, topsoil and subsoil can be disturbed as a result of topsoil removal, grading, trench excavation, and by heavy equipment moving along the right-of-way and within approved construction workspaces. The potential mixing of topsoil or surface soil with the subsoil from these activities could result in a reduction in soil productivity.

4.2.9.1 Mountaineer XPress Project

Topsoil depths were quantified for MXP by querying the organic matter content of the surface soil horizons. Near-surface soils with 2 percent or more organic matter were considered topsoil. Topsoil thicknesses were then assigned to one of five classes: 0 to 3 inches, 3 to 6 inches, 6 to 12 inches, 12 to 18 inches, and greater than 18 inches. Table 4.2-5 provides a summary of topsoil depths along the MXP pipeline routes.

Table 4.2-5
Topsoil Depths along the MXP Pipeline Routes a/, b/

Pipeline Facility	Total Mileage	Topsoil Thickness (inches) c/				
		0-3	>3-6	>6-12	>12-18	>18
New Pipeline Facilities						
MXP-100	164.3	15.3	127.1	21.8	0.1	0.0
MXP-200	6.0	0.3	5.3	0.4	0.0	0.0
X59M1 Line	0.1	0.1	<0.1	0.0	0.0	0.0
Subtotal	**170.4**	**15.7**	**132.4**	**22.2**	**0.1**	**0.0**
Replacement Pipeline Facilities						
SM80 Line	0.2	0.0	0.2	0.0	0.0	0.0
SM80 Loop Line	0.2	0.0	0.2	0.0	0.0	0.0
Subtotal	**0.4**	**0.0**	**0.4**	**0.0**	**0.0**	**0.0**
Total a/	**170.7**	**15.7**	**132.8**	**22.0**	**0.1**	**0.0**

Sources: Soil Survey Staff, 2015a and 2015b

a The numbers in this table have been rounded for presentation purposes. As a result, the totals may not reflect the sum of the addends.

b The mileages calculated are based on the soils crossed by the pipeline centerlines.

c Topsoil includes all surface horizons with 2 percent or more organic matter content.

To limit mixing of the soil horizons or incorporation of additional rock into the topsoil, Columbia Gas would segregate topsoil (as specified in its ECS) in trench and spoil storage areas, cultivated or rotated croplands, pastures, hayfields, residential areas, and in other areas agreed upon between the landowner and Columbia Gas. Topsoil would be segregated, as appropriate, from the subsoil and would be replaced in the proper order during backfilling and final grading.

In deep soils where the topsoil is greater than 12 inches, at least 12 inches of topsoil would be segregated. In soils with fewer than 12 inches of topsoil, the entire topsoil layer would be segregated, when possible. As described in Columbia Gas' ECS, segregated topsoil would not be used for padding the pipe, constructing temporary slope breakers or trench plugs, improving or maintaining roads, or as fill material. The topsoil would be stockpiled separately from all subsoil and would be replaced last (as the surface layer) during backfilling and final grading. In residential areas, topsoil replacement would be an acceptable alternative to topsoil segregation. Implementation of proper topsoil segregation would promote post-construction revegetation success, thereby minimizing the loss of crop productivity and the potential for long-term problems with erosion. Upon completion of construction activities, all MXP workspaces would be returned, to the extent practicable, to pre-construction contours. All disturbed areas would be stabilized during final grading and restoration. If final restoration is delayed due to weather or soil conditions, Columbia Gas would install temporary erosion control measures to minimize erosion and sediment transport until final grading and restoration can occur.

4.2.9.2 Gulf XPress Project

Topsoil depth was not evaluated for the GXP because the majority of disturbed areas would be overlain by permanent facilities, and the soil profile may be significantly altered by the addition of surface fill material to increase ground elevation, the addition of aggregate to provide a suitable foundation surface, or mixing with a stabilizer (e.g., cement or lime) to increase strength and cohesion. Where feasible, topsoil would be removed during grading from those areas where permanent facilities would be constructed. In areas used for TWS, Columbia Gulf would strip and windrow up to 12 inches of available topsoil for spreading across the TWS during site cleanup and restoration.

4.2.10 Soil and Spill Contamination

Contamination from spills or leaks of fuels, lubricants, and coolant from construction equipment can adversely affect soils. However, the impacts of such contamination are typically minor because of the low frequency and volumes of spills and leaks and the effectiveness of cleanup measures. Measures to reduce potential impacts on soils from spills of fuels and hazardous materials are addressed in Columbia Gas' and Columbia Gulf's ECSs and Spill Prevention, Control, and Countermeasure Plans (SPCC Plans).

4.2.10.1 Mountaineer XPress Project

Potential sources of soil contamination, including hazardous waste sites, underground storage tanks, production wells, and gathering lines, were identified near the MXP facilities. Additional information on subsurface mines in the MXP vicinity is presented in section 4.1.

A review of the EPA's Envirofacts database identified three facilities permitted to generate, transport, treat, or dispose of hazardous waste within 0.25 mile of MXP work spaces. The facilities include a hospital, a material fabricating business, and a technical school. None of the facilities have reported an uncontrolled release to the environment. An additional site is 0.3 mile northwest of MP 77 in Ritchie County. The site is hydraulically down-gradient of the MXP; therefore, it is unlikely that contamination from the site would affect soil in the MXP work area.

A review of the WVDEP's Leaking Underground Storage Tank (LUST) database identified two contaminated sites within 0.25 mile of MXP facilities (WVDEP, 2015c). One LUST site is approximately 0.2 mile west of MP 160.3. Columbia Gas reviewed the WVDEP LUST database and identified a confirmed petroleum release at the facility in 1991, with completed cleanup reported in 2003. The site is estimated to be down-gradient from MXP facilities. Due to the distance, gradient, and site history, this site is unlikely to have contributed to soil contamination in the MXP work area.

The second LUST site is approximately 0.1 mile east of MP 18.2 in Wetzel County, West Virginia. Based upon a review of the WVDEP database, petroleum releases were confirmed to have occurred in 1995 and 1998. Cleanup activities are reported to have been completed in 1998 and 2001, respectively. The site is estimated to be located hydraulically up-gradient from the MXP; however, due to the site history, the site is unlikely to have contributed to soil contamination in the MXP work area.

Other potential sources of soil contamination include nearby production wells and/or gathering lines. Gas, oil, and water well location data were reviewed by Columbia Gas, and 1,650 650 oil and gas wells (995 active wells) were documented within 0.25 mile of proposed MXP work areas; no active oil and gas wells are located within any MXP workspaces. Given the proximity of these wells to the project, drilling mud recirculation pits with residual hydrocarbons that have not been properly remediated before abandonment may potentially occur within the project alignment. If contaminated soils are encountered during construction, Columbia Gas would implement measures outlined in its Unexpected Contamination Discovery Plan (appendix H) that include proper handling, agency notification, and disposal methods. If unexpected contaminated soil is encountered, Columbia Gas would contact the WVDEP and other local agencies, as appropriate, to develop and implement mitigation measures and procedures to address the contamination. Contaminated materials would be characterized, collected, removed from the work site promptly, and disposed of or recycled in a proper manner. Further, spill prevention measures from Columbia Gas' ECS would reduce the potential impacts on soils from spills of hazardous materials used during construction. These measures include regularly inspecting equipment to verify it is in good working order and properly training employees regarding the storage and handling of fuels and other hazardous materials, including spill cleanup procedures.

We received a comment during public scoping asking about the effects of a pipeline traversing a Superfund site. The MXP does not cross any hazardous or contaminated sites listed in the federal or state databases. However, five sites listed in the EPA database were identified within 0.25 mile of MXP facilities (see table 4.2-6).

Table 4.2-6 Hazardous or Contaminated Sites within 0.5 Mile of the MXP							
Site Number a/	**Type b/**	**Managing Agency**	**County**	**Classification**	**ID#**	**Milepost**	**Distance from Work Area (feet)**
1	RCRA	No data records	Ritchie	Unspecified	110007877253	77.4	174
2	RCRA	No data records	Ritchie	Unspecified	110007334517	77.2	249
3	RCRA	No data records	Putnam	Small Quantity Generator	110063001996	147.1	359
4	RCRA	State	Cabell	Unspecified	110020573459	161.4	1,167
5	RCRA	No data records	Doddridge	Unspecified	110012604020	48.7	1,826

a Site names have been withheld since the sites are listed as hazardous waste generators, but are not necessarily contaminated sites.

b RCRA = Resource Conservation and Recovery Act

There is no indication that construction or operation of the MXP would be affected by any of the facilities listed in table 4.2-6. However, if contaminated materials are encountered during construction, Columbia Gas would implement measures outlined in its Unexpected Contamination Discovery Plan that includes proper handling, agency notification, and disposal methods. In addition, wastes would be collected and removed from the work site promptly and would be disposed in a proper manner and recycled, where appropriate.

4.2.10.2 Gulf XPress Project

None of the GXP facilities would be within 0.25 mile of any hazardous waste sites (AGES, 2015a-g). One hazardous waste generator site owned by Columbia Gulf is 0.3 mile southeast of the existing Leach C Meter Station. While a LUST site was identified approximately 0.8 mile northeast of the proposed New Albany Compressor Station, the distance separating the two areas and the limited extent of the excavation associated with the new facility make it unlikely that contaminated soil would be encountered at the station site.

If contaminated soils are encountered during construction, Columbia Gulf would implement measures outlined in its Unexpected Contamination Discovery Plan (appendix H) that includes proper handling, agency notification, and disposal methods. Additionally, Columbia Gulf would contact state and local agencies, as appropriate, to develop and implement mitigation measures and procedures to address the contamination. Contaminated materials would be characterized, collected, removed from the work site promptly, and disposed of or recycled in a proper manner.

During scoping, we received a comment expressing concern that the Cane Ridge Compressor Station would pollute the ground. Spill prevention measures from Columbia Gulf's ECS would avoid or reduce the potential impacts on soils from spills of hazardous materials used during station construction and operation. These measures include regularly inspecting equipment to verify it is in good working order and properly training employees regarding the storage and handling of fuels and other hazardous materials, including spill cleanup procedures. One of the

advantages of natural gas is its gaseous state, meaning it cannot spill; therefore, it cannot contaminate soil, groundwater, or surface waters.

4.2.11 Drain Tiles and Irrigation Systems

Drain tiles are subsurface structures used in agricultural areas to improve the productivity of the land by increasing soil drainage. Excavation activities as well as rutting and/or crushing due to the operation of heavy construction equipment in wet soils can damage tiles.

4.2.11.1 Mountaineer XPress Project

Columbia Gas would implement measures to avoid and/or minimize any potential damage to drainage tiles and restore/repair any damaged tiles to their original or better condition. Prior to construction, Columbia Gas would contact landowners and/or tenants to attempt to locate existing drain tile lines. Identified tile lines would be flagged prior to construction to alert construction crews. During construction, the location of any tile that is damaged, cut, or removed would be marked. Temporary measures would be taken to provide suitable drainage until permanent repairs can be made, as described in the ECS. Qualified drain tile specialists from the MXP area would be employed to conduct or monitor repairs to drain tile systems.

Columbia Gas would also engage landowners and/or tenants in identifying and locating existing irrigation systems and wells. Water flow to irrigation systems would be maintained throughout construction, unless shutoff is coordinated with affected parties. Should any irrigation systems be affected during construction, Columbia Gas would restore/repair the damaged irrigation systems to their original or better condition.

4.2.11.2 Gulf XPress Project

Columbia Gulf is currently not aware of any drain tiles or irrigation systems within its proposed compressor station sites. However, it is possible that drain tiles or irrigation systems are present in areas where the current land use is agricultural. Any drainage tiles or irrigation systems that are present would be permanently disabled or removed as needed for the safe operation of the GXP.

4.2.12 Conclusion

Construction activities such as clearing, grading, trenching, backfilling, and traffic by heavy construction equipment would cause direct impacts on soil resources in the MXP and GXP work areas. Direct impacts could include erosion, compaction, rutting, and reduction of soil quality by mixing topsoil with subsoil or bringing excess rocks to the surface. These soil impacts could also slow the revegetation process in the disturbed areas and disrupt surface and subsurface drainage systems.

4.2.12.1 Mountaineer XPress Project

Construction and operation of the MXP facilities are expected to have a direct but temporary impact on soils from ground-disturbing activities. Table 4.2-3 provides a summary of the soil limitations present in the MXP area.

To minimize impacts on soils during construction, Columbia Gas would implement the mitigation procedures and measures previously mentioned and would follow the BMPs identified in its ECS. After completion of construction, the pipeline corridors and temporary access roads would be returned to pre-construction conditions or in accordance with landowner agreements. Soil impacts within the pipeline rights-of-way and along these access roads would be minor and temporary.

The construction of aboveground facilities would result in approximately 41 acres of permanent impacts on soils. Columbia Gas would use areas within existing fenced facilities or previously disturbed areas adjacent to the facilities for the majority of the modifications and upgrades. Most of the soil impacts at existing aboveground facilities are expected to be minor and temporary. Approximately 30 acres of soil at the Sherwood, White Oak, and Mount Olive Compressor Stations would be permanently converted from agricultural, forested, and open land uses to developed uses. The permanent access roads would result in 3.5 acres of permanent impacts. Permanent access roads are necessary for the safe operation of the MXP facilities.

Preparation of staging areas and contractor yards would consist of minor grading and leveling. Once construction is complete, the acreage within the staging areas and contractor yards would be restored to pre-construction conditions and uses or in accordance with landowner agreements. Soil impacts are expected to be minor and temporary due to the limited grading activities to level the areas. Unless specified in landowner agreements, any area where aggregate is placed over geotextile fabric (e.g., roadway aprons) would be returned to its original condition during cleanup activities and all materials removed.

During MXP operation, minimal impacts on soil resources are expected beyond occasional ground inspections of the pipeline rights-of-way and the areas occupied by aboveground facilities. Any impacts on soil resources associated with standard operations would be minor and infrequent. Potential impacts from maintenance of the MXP include soil displacement, compaction, and erosion caused by machinery necessary to maintain or repair any portions of the pipelines or aboveground facilities. Impacts would be avoided or minimized by implementation of Columbia Gas' ECS, as applicable to operation.

4.2.12.2 Gulf XPress Project

Construction and operation of the GXP facilities is expected to have a direct but temporary impact on soils from ground-disturbing activities. Table 4.2-4 provides a summary of the soil limitations present in the GXP area.

The degree to which soils are directly affected by construction and operation of GXP facilities would vary depending on the nature of the activities and whether the soils are in designated TWS or the operational footprint of GXP facilities. The subsurface profile of soils overlain by permanent facilities may be significantly altered by the addition of surface fill material to increase ground elevation, addition of aggregate (e.g., gravel or crushed stone) to provide a suitable foundation surface, or mixing with a stabilizer (e.g., cement or lime) to increase strength and cohesion. Deep excavations and drillings, including those required for pile installation, could disrupt soil profiles. In areas used for TWS, Columbia Gulf would strip and windrow up to 12 inches of available topsoil for spreading across the TWS during site cleanup and restoration.

To minimize impacts on soils during the construction of GXP facilities, Columbia Gulf would implement the mitigation procedures and measures previously mentioned and would follow the BMPs identified in its ECS. After construction has been completed, the TWS would be returned to pre-construction conditions. Soil impacts are expected to be minor and temporary within the TWS due to the minor grading activities to level the areas and placement of gravel over geotextile fabric, all of which would be removed upon completion of the GXP facilities, unless otherwise specified in landowner agreements.

The construction of aboveground facilities and the associated permanent access roads would result in approximately 95 acres of permanent impacts on soils. Permanent access roads are necessary for the safe operation of the GXP facilities.

During operation, minimal impacts on soil resources are expected. Any impacts on soil resources associated with standard operations would be minor and infrequent. Potential impacts from maintenance of the GXP would include soil displacement, compaction, and erosion caused by machinery necessary to maintain or repair any portions of the aboveground facilities. Impacts would be avoided or minimized by implementation of GXP's ECS, as applicable to project operation.

4.3 WATER RESOURCES

4.3.1 Groundwater Resources

4.3.1.1 Aquifers

The MXP is in the Appalachian Plateaus Physiographic Province, which extends over most of West Virginia. Aquifers in this province consist of alternating sequences of fractured sandstone, siltstone, shale, limestone, and coal in Permian-, Pennsylvanian-, and Mississippian-rock formations (McCoy et al., 2015).

The principal aquifers underlying GXP project facilities include the Pennsylvanian, Mississippian, Ordovician, Silurian-Devonian, Mississippian River Valley Alluvial, and the Southeastern Coastal Plain aquifers (USGS, 2003b).

The EPA defines a sole source aquifer (SSA) as an "aquifer that supplies at least 50 percent of the drinking water for its service area" and that has "no reasonably available alternative drinking water sources should the aquifer become contaminated" (EPA, 2016a). In addition to the EPA-designated SSA program, individual states may enact regulations protecting significant aquifer recharge areas, critical areas where excessive use of groundwater poses a threat to the long-term integrity of a water supply source, or preservation areas to protect natural resources, including public water supply (PWS) sources.

4.3.1.1.1 Mountaineer XPress Project

The Upper Pennsylvanian aquifer is the only principal aquifer crossed by the MXP. Pennsylvanian aquifers are characterized by water-yielding sandstones, although coal beds and limestones also yield water (USGS, 1997). The sandstones are not very porous; compaction and cementation during rock formation greatly reduced primary intergranular pore space. Therefore,

secondary openings, such as joints, fractures and bedding planes, contain and transmit most of the groundwater in sandstone. Accordingly, the hydraulic conductivity of sandstone aquifers is low to moderate, but because they extend over large areas, these aquifers provide large amounts of water (USGS, 1999). Some of these aquifers, however, are very local in extent, and can be perched and isolated under individual hilltops (Puente, 1985).

Typical depth-to-groundwater ranges from 50 to 300 feet in Upper Pennsylvanian aquifers, and common yields are from 1 to 30 gallons per minute (gpm) (Puente, 1985). As of 2005, total water withdrawals from Pennsylvanian aquifers in West Virginia were approximately 18.3 million gallons per day (Maupin and Barber, 2005). No specific information is available regarding local water withdrawals or aquifer depths along the project route.

Unconsolidated alluvial deposits are also found locally in large-river valleys across the far western portion of West Virginia (Puente, 1985; USGS, 2003b), and the project may cross these aquifers over relatively short distances. Primarily found along the Kanawha and Ohio Rivers, unconsolidated alluvial aquifers supply significant amounts of groundwater for public supply and industrial use (McCoy et al., 2015). Variable yields from these aquifers are dependent on permeability, areal extent, and saturated thickness of the sand and gravel materials and their proximity to rivers (Puente, 1985; USGS, 1997). Typical depth-to-groundwater ranges from 25 to 100 feet in alluvial aquifers, and they can yield water from 50 to 1,500 gpm (Puente, 1985).

Shallow, surficial groundwaters (the “water table”) would be encountered at numerous locations along the route. Small “perched” groundwaters can be encountered on slopes, and the pipeline trench would often be within the water table zone, especially on valley floors and in floodplains. However, the pipeline would not be expected to significantly alter the flow or quality of surficial groundwaters.

According to EPA sources, there are no EPA-designated SSAs in West Virginia (EPA, 2011a). No West Virginia state agency designates SSAs on the state level.

4.3.1.1.2 Gulf XPress Project

Principal aquifers are often multi-layered and may extend underground beyond their mapped boundaries. The mapped boundaries typically represent the extent of the principle aquifer nearest the surface (USGS, 1997). For example, the Mississippian aquifer is exposed as narrow north-south bands across Kentucky and Tennessee, but underlies most of the Pennsylvanian aquifer. Because construction of the seven compressor stations would generally occur within the upper 10 feet of the soil surface, only the mapped principle aquifers nearest the surface are described below. Refer to table 4.3-1 for a summary of each principle aquifer within the project areas.

Table 4.3-1 Aquifers Within the Gulf XPress Project Areas				
State/ Facility	**Aquifer a/**	**Geology a/**	**Range of Depth to Aquifer (feet)**	**Well Yield (gpm)**
Aboveground Facilities (Proposed)				
Kentucky				
Morehead Compressor Station	Mississippian	Sandstone and carbonate	100 to 500	1 to 50
Paint Lick Compressor Station	Silurian-Devonian	Limestone and shale	50 to 200	2 to 300
	Other Rocks	N/A	Unavailable b/	Variable
Goodluck Compressor Station	Mississippian	Limestone	100 to 500	2 to 500
Tennessee				
Cane Ridge Compressor Station	Ordovician	Limestone	50 to 200	5 to 300
Clifton Junction Compressor Station	Southeastern coastal plain	Limestone	3 to 215 c/	Variable
	Other Rocks	N/A	Unavailable b/	Variable
Mississippi				
New Albany Compressor Station	Southeastern coastal plain	Unconsolidated sands, silts, and clays	3 to 215 c/	Variable
Holcomb Compressor Station	Mississippi River Valley Alluvial	Unconsolidated sandstone intermixed with clay and some quartz	25 to 150	50 to 5,000
Aboveground Facilities (existing)				
Kentucky				
Grayson Compressor Station d/	Pennsylvanian	Shale	75 to 400	1 to 200
Leach C Meter Station	Pennsylvanian	Undivided siltstones	75 to 400	1 to 200

a USGS, 2003b.
b Unavailable – reliable depth to aquifer data are unavailable.
c Potentiometric Map of the Ripley Aquifers in Northeastern Mississippi, August, Mississippi Department of Environmental Quality (MDEQ, 1992).
d Pending compressor station proposed by Columbia Gulf under the Rayne XPress Project (Docket No. CP15-539-000).

In addition to principal aquifers, the project facilities lie within areas mapped as "other rocks." These areas consist of areas underlain by crystalline rocks of minimal permeability. Areas mapped as other rocks are considered minor aquifers.

There are no SSAs in Kentucky, Tennessee, or the northern half of Mississippi. The nearest EPA-designated SSA, the Southern Hills Regional Aquifer, is approximately 90 miles southwest of the southernmost project site (Holcomb Compressor Station) in southwestern Mississippi (EPA, 2016b). There are no state-designated aquifers in the GXP areas.

4.3.1.2 Wellhead and Aquifer Protection Areas

Under the Safe Drinking Water Act, as amended, each state is required to develop and implement a Wellhead Protection Program to identify the land and recharge areas contributing to public supply wells and prevent the contamination of drinking water supplies. Programs such as the NPDES are implemented at a state level to protect wellhead areas. The act also requires the development of a broader-based Source Water Assessment Program, which includes the assessment of potential contamination to both groundwater and surface water through a watershed approach. Impacts on drinking water wells as a result of construction activities is unlikely, but could include reduction to production or yield, increases in total dissolved solids or total suspended solids, and fluctuations in pH.

4.3.1.2.1 Mountaineer XPress Project

In West Virginia, wellhead protection areas (WHPA) are administered by the West Virginia Department of Health and Human Resources (WVDHHR), Bureau for Public Health (WVBPH). The WVBPH oversees West Virginia's Wellhead Protection Program, as well as the state's Source Water Assessment Program, which set standards and implement programs that aid in the protection of areas that contribute groundwater or surface water to a PWS system. Columbia Gas consulted with the WVDHHR to obtain location data for WHPAs within 3 miles of the MXP pipeline centerlines. Four WHPAs were identified within the 3-mile search radius of the MXP-100 pipeline, and an additional 30 were identified within a 3-mile radius of other construction work areas (access roads, contractor yards) and are summarized in table 4.3-2 (WVDHHR, 2016a).

Table 4.3-2
Wellhead Protection Areas within 3 Miles of the Mountaineer XPress Project

Facility Associated with WHPA a/ (County)	Public Water System Identification	Closest Milepost	Wellhead Protection Area	Distance from Workspace b/ (feet)
New Pipeline Facilities				
MXP-100				
Doddridge	WV9909004	50.5	Doddridge County Park Well #1	144
Jackson	WV9918002	113.9	Roane-Jackson Technical Center Well #1	725
	WV9918002	113.9	Roane-Jackson Technical Center Well #2	591
	WV9918002	113.9	Roane-Jackson Technical Center Well #3	501
Aboveground Facility – Sherwood CS				
Doddridge	WV9909004	50.5	Doddridge County Park Well #1	144
Access Roads				
ARPY116.1				
Marshall	WV9925054	--	Nick's Lounge Primary Well	11,477
Marshall	WV3302607	--	Marshall County PSD 2 Well 1	15,459
Marshall	WV3302607	--	Marshall County PSD 2 Well 2	15,459
ARPY137.1				
Wood	WV3305404	--	Lubeck PSD Well #A	3,675
Wood	WV3305404	--	Lubeck PSD Well #G	3,675
Wood	WV3305404	--	Lubeck PSD Well #D	3,675

Table 4.3-2 Wellhead Protection Areas within 3 Miles of the Mountaineer XPress Project				
Facility Associated with WHPA a/ (County)	**Public Water System Identification**	**Closest Milepost**	**Wellhead Protection Area**	**Distance from Workspace b/ (feet)**
Wood	WV3305404	--	Lubeck PSD Well #C	3,675
Wood	WV3305404	--	Lubeck PSD Well #E	3,675
Wood	WV3305404	--	Lubeck PSD Well #B	3,675
Wood	WV3305404	--	Lubeck PSD Well #F	3,675
Pipe/Contractor Yards				
Yard 122				
Wood	WV3305410	--	Union Williams PSD Well 1	7,995
Wood	WV3305410	--	Union Williams PSD Well 2	7,995
Wood	WV3305410	--	Union Williams PSD Well 3	7,995
Yard 137				
Wood	WV9954007	--	Chemours Company – Washington Works Well #331	5,430
Wood	WV9954007	--	Chemours Company – Washington Works Well #332	5,750
Wood	WV9954007	--	Chemours Company – Washington Works Well #336	5,017
Yard 116				
Marshall	WV3302611	--	Moundsville – Well 8	15,525
Marshall	WV3302611	--	Moundsville – Well 9	15,525
Marshall	WV3302611	--	Moundsville – Well 11	15,525
Marshall	WV3302611	--	Moundsville – Well 12	15,525
Marshall	WV3302611	--	Moundsville – Well 12A	15,525
Marshall	WV3302611	--	Moundsville – Well 13	15,525
Marshall	WV3302611	--	Moundsville – Well 14	15,525
Marshall	WV3302611	--	Moundsville – Well 15	15,525
Yard 128				
Jackson	WV3301804	--	Cottageville PSD Well 1	3,704
Jackson	WV3301804	--	Cottageville PSD Well 2	3,704
Jackson	WV9918012	--	Century Aluminum of WV Deep Well No. 9	9,609
Jackson	WV9918012	--	Century Aluminum of WV Deep Well No. 8	10,078
Jackson	WV9918011	--	Constellium Rolled Products LLC Deep Well 9	9,609
Jackson	WV9918011	--	Constellium Rolled Products LLC Deep Well 8	10,075

a No WPAs were identified within 3 miles of the MXP-200 pipeline, compressor stations, or SM80 and SM80 Loop replacement sections.
b No WPAs are crossed by the project facilities. Distance listed in the table is the distance from the edge of the nearest project workspaces to the edge of the well buffer area.

The closest WHPA to the MXP-100 corridor is the Doddridge County Park Well #1, located near the proposed project work area at MP 50.5. The project workspace is approximately 90 feet outside of the designated 500-foot well buffer area, and the project centerline is

approximately 170 feet outside of the buffer zone. MXP also passes near three WHPAs at approximately MP 113.9, where the edge of the closest wellhead protection buffer is approximately 640 feet away from the project workspace. All three WHPAs at MP 113.8 are associated with wells at the Roane-Jackson Technical Center. Due to the proximity of these WHPAs to the MXP, **we recommend that:**

- **Prior to commencing construction activities between MP 50 – 51 and MP 113.3 – 114.3, Columbia Gas should consult with the Doddridge County Park and Roane-Jackson Technical Center to establish pre- and post-construction notification protocols and identify any special measures that may be needed to further reduce the potential for impacts on water quality and/or yield of Doddridge County Park Well #1 and Roane-Jackson Technical Center Wells #1, #2, and #3. Columbia Gas should file with the Secretary documentation of its consultations, and proposed notification and mitigation measures, for review and written approval by the Director of OEP.**

Columbia Gas would minimize the potential for impacts on wellhead and source water protection areas. While these areas are largely avoided by the proposed route, Columbia Gas' general construction practices (including specific techniques for blasting, installation of trench breakers, trench dewatering, equipment refueling, and hazardous materials storage) as specified in its ECS and SPCC Plan would provide additional security for wellhead and source water protection areas.

4.3.1.2.2 Gulf XPress Project

No WHPAs or Source Water Protection Areas are within 3 miles of the project facilities in Kentucky, and no WHPAs were identified within 3 miles of the compressor station sites in Tennessee. Four PWS wells were identified within 3 miles of the New Albany station site in Mississippi, including PWS well 730008-1, 730008-2, 730008-3, and 730013-1 (MDEQ, 2016b). All of them are greater than 2 miles from the site.

4.3.1.3 Water Supply Wells and Springs

Water supply wells can be public wells, serving a larger population and managed through a water provider or supplier, or private wells, providing a limited number of connections and permitted privately.

Springs result when an aquifer is filled to the point that water overflows onto the land surface. The amount of water flowing from springs depends on many factors, including the size of caverns within the rock, water pressure in the aquifer, size of the spring basin, and amount of rainfall. Springs can range in size from intermittent seeps to huge pools discharging hundreds of millions of gallons daily (USGS, 2015b). Relative to springs, seeps have a lower flow rate and generally emerge over a larger, less-defined area.

4.3.1.3.1 Mountaineer XPress Project

Columbia Gas consulted with the WVDHHR to obtain location data for PWS wells within 150 feet of project workspaces. Additionally, Columbia Gas sought to identify private supply wells through landowner discussions and civil survey. The respective county health departments were also consulted regarding well records, but little information was available. The current

results are summarized in table 4.3-3. All active wells[23] listed in table 4.3-3 are assumed to produce water for human consumption and would be treated as such during construction. As surveys and landowner discussions progress, Columbia Gas continues to determine whether wells identified within 150 feet of project workspaces are potable water sources.

Table 4.3-3
Private Water Supply Wells Within 150 Feet of the Mountaineer XPress Project

Facility / County	Nearest Approximate Milepost	Well Use	Distance (feet) and Direction from Workspace
Pipeline Facilities a/			
MXP-100			
Marshall	5.2	Unknown **b**/	33, SW
	5.2	Unknown **b**/	43, SW
	11.0	Abandoned **c**/	14, SE
	11.0	Abandoned **c**/	8, E
	11.0	Abandoned **c**/	8, N
	11.0	Abandoned **c**/	8, N
Wetzel	14.2	Unknown **b**/	38, N
	19.4	Abandoned **c**/	12, W
	24.5	Abandoned **c**/	48, SW
	24.5	Abandoned **c**/	43, SW
	24.5	Abandoned **c**/	41, SW
	24.5	Abandoned **c**/	45, SW
Doddridge	39.5	Human consumption	12, NE
Ritchie	72.2	Unknown b/	14, N
	76.1	Human consumption	9, SW
	80.7	Pending **d**/	94, SE
Calhoun	83.8	Pending **d**/	1, NW
Wirt	94.2	Plugged **e**/	Within workspace
Roane	107.3	Human consumption **f**/	Within workspace
	107.4	Unknown **b**/	33, N
	108.6	Human consumption	6, N
	110.5	Pending **d**/	118, W
	110.6	Unknown **b**/	52, NW
Jackson	111.2	Unknown **b**/	21, S
	113.3	Unknown **b**/	109, W
	124.4	Unknown **b**/	Within workspace
	124.4	Unknown **b**/	Within workspace
	124.9	Unknown **b**/	Within workspace
Putnam	134.7	Unknown **b**/	30, N
	134.7	Unknown **b**/	33, N
	134.7	Unknown **b**/	21, N

23 "Active wells" are those in table 4.3-3 not listed as abandoned or plugged.

Table 4.3-3 Private Water Supply Wells Within 150 Feet of the Mountaineer XPress Project			
Facility / County	**Nearest Approximate Milepost**	**Well Use**	**Distance (feet) and Direction from Workspace**
	134.7	Unknown **b**/	23, NW
	146.3	Unknown **b**/	7, NE
Cabell	156.6	Unknown **b**/	1, NW
	157.6	Abandoned **c**/	35, W
	164.5	Unknown **b**/	92, SW
	164.5	Unknown **b**/	35, SW
	164.5	Unknown **b**/	88, SW
	164.5	Unknown **b**/	31, SW
	164.5	Unknown **b**/	Within workspace **g**/
	164.5	Unknown **b**/	Within workspace **g**/
MXP-200			
Doddridge	6.0	Abandoned **c**/	Within workspace **g**/

a None of the SM80 Line and SM80 Loop Line facilities are within 150 feet of a known private well.
b Either the county health department was unable to identify the use of the well or was unable to search county records for private water well use. Columbia Gas would assume the well is used for potable purposes and implement appropriate precautions during construction.
c Field data indicate this well has been abandoned.
d Consultation with county health departments regarding use of private wells is ongoing.
e Field data indicate that this well has been plugged.
f Field data indicate that this well is hand dug, approximately 24 feet deep. Columbia Gas is currently in consultation with this landowner to identify a route variation that would avoid this drinking water well.
g Well is on property either owned or leased by Columbia Gas.

In West Virginia, springs commonly mark the intersection of the water table with a valley wall. Low-permeability rocks retard the vertical movement of water, forcing lateral movement in permeable layers until water discharges as a spring (Puente, 1985). Localized seeps are common throughout the project area; however, most are low-flowing, ephemeral, or seasonal in surface discharge. Data identifying known seeps with a flow of greater than or equal to 100 gpm are available as a GIS layer from the West Virginia GIS Technical Center. During the 2015 and 2016 field seasons (June to October 2015 and April to October 2016), Columbia Gas' environmental field teams conducted surveys along a 300-foot-wide survey corridor that was centered over the proposed pipeline centerline, a 100-foot-wide corridor centered over proposed access roads, and the construction footprints at proposed aboveground facility sites. Based on a review of the publicly available data, no springs crossed by the project reach a 100 gpm flow rate (West Virginia GIS Technical Center, 1986). Seventy-eight seeps were identified within the pipeline workspaces during field surveys. Most were frequently found along stream banks and hill slopes and did not supply notable flow.

Columbia Gas has agreed to offer pre- and post-construction monitoring for well yield and water quality for private wells within 150 feet of construction workspaces. If testing results indicate the integrity of any water supply well has been impacted during construction, Columbia Gas would provide a temporary water supply source and compensate the landowner for repairs, installation of a new well, or other options as agreed upon with the landowner. As discussed in

section 4.8.1.3, Columbia Gas would implement a landowner complaint resolution process to document and track landowner problems and their resolution.

Columbia Gas has neither completed identification of all private water wells and potable springs in proximity to project work areas, nor has it identified any specific protection measures that would be implemented for wells located inside the construction work areas. Therefore, **we recommend that:**

- **<u>Prior to construction</u>, Columbia Gas should:**

  a. **file with the Secretary the location of all water wells and potable springs within 150 feet of all areas of disturbance associated with the MXP pipelines and related aboveground facilities;**

  b. **provide the status (active, abandoned, capped, etc.) of the two water wells located at MP 164.3 and, if active, identify measures to protect these water wells during construction, for review and written approval by the Director of OEP.**

4.3.1.3.2 Gulf XPress Project

Columbia Gulf consulted with the KDEP, TDEC, and MDEQ to obtain location data for PWS wells within 150 feet of station workspaces. No public wells are located within 150 feet of the project workspaces. Information about private wells and springs near the station sites was obtained through discussions with landowners and field surveys. One private well was identified approximately 32.6 feet south-southwest of the existing Leach C Meter Station. No springs were identified within 150 feet of any project facilities, nor were any springs identified during field surveys at the new compressor station sites.

Columbia Gulf has agreed to offer pre- and post-construction monitoring for well yield and water quality for private wells within 150 feet of the proposed construction workspace. If testing results indicate any significant differences in water quality between initial testing and post-construction because of Columbia Gulf's construction activities, Columbia Gulf would compensate the landowner for repairs, installation of a new well, or other options. Columbia Gulf would also provide a temporary water source until a permanent source is available. However, no wells have been identified within 150 feet of any of the GXP workspaces.

As discussed in section 4.8.1.3, Columbia Gulf would implement a landowner complaint resolution process to document and track landowner problems and their resolution.

4.3.1.4 Contaminated Groundwater

Areas of previous contamination, LUST, and Resource Conservation and Recovery Act/Superfund sites that have potentially degraded or contaminated groundwater near MXP and GXP workspaces are discussed in section 4.2.10.

4.3.1.4.1 Mountaineer XPress Project

Section 4.2.10.1 includes a discussion regarding the presence of existing sites that are permitted to generate, transport, treat, or dispose of hazardous waste. The WVGES All Mining Interactive Map revealed no active surface mining operations in the project vicinity; however, the MXP-100 alignment from MP 1.4-4.9 is within the boundaries of the subsurface McElroy Mine. The McElroy Mine is actively producing coal under WVDEP Permit No. U003383.

Of the four subsurface mines within 0.25 mile of the MXP route, only one has the potential to impact the pipeline facilities. According to Columbia Gas, the McElroy Mine owners have no immediate plans to develop the areas crossed by the MXP route. As further planning occurs with the regional coal companies, Columbia would take the proper steps to coordinate, and implement the appropriate methods to maintain the integrity of the MXP pipeline. If longwall mine-related subsidence were a possibility, Columbia Gas would excavate the pipeline prior to undermining activities. Erosion controls would be installed and maintained until the right-of-way was restored, typically no sooner than 2 months after the pipeline had been fully undermined. (See discussion in section 4.1.2.1.)

4.3.1.4.2 Gulf Xpress Project

Columbia Gulf reviewed federal and state databases to identify contaminated sites, including sites that may have contributed to contaminated groundwater near the GXP facilities. No Superfund or federal Brownfield sites were mapped within 1 mile of the project facilities. Section 4.2.10.2 provides additional details regarding the presence of hazardous waste and LUST sites that were identified within 1 mile of GXP sites.

4.3.1.5 Impacts and Mitigation

Two primary activities could result in adverse impacts on groundwater resources: accidental spills of hazardous liquids used during facility construction or operations, and blasting to fracture rock in the pipeline trench or for construction of aboveground facility foundations. Additional impacts could occur where longwall mining (MXP) or karst topography (GXP) is encountered. Secondary activities (work area clearing and grading; trenching; and trench dewatering) typically result in only temporary and localized impact.

4.3.1.5.1 Mountaineer XPress Project

As described in section 2.4, Columbia Gas would use standard industry practices for construction of the MXP facilities. Clearing, grading, trenching, dewatering, and blasting activities associated with pipeline construction could each temporarily alter overland flow and groundwater recharge or could result in minor fluctuations in groundwater levels and/or increased turbidity. In addition, near-surface soil compaction caused by heavy construction vehicles could reduce the soil's ability to absorb water. Columbia Gas would implement measures from both its ECS and SPCC Plan to minimize potential impacts on groundwater. For instance, Columbia Gas would:

- pump trench water to nearby vegetated areas where the water would be released to recharge local surficial groundwater sources;

- test for and relieve soil compaction as part of the final recontouring and right-of-way cleanup;
- conduct pre- and post-blasting testing of water wells and springs within 150 feet of the pipeline where blasting has the potential to affect water quality/quantity from domestic or agricultural wells or springs (with landowner permission);
- locate fuel storage at least 200 feet from active private water wells, at least 400 feet from municipal water wells, and outside designated municipal watershed areas; and
- outfit all fuel trucks, pumps, mechanic vehicles, contractor foreman vehicles, and inspector vehicles with spill kits for rapid containment and cleanup of any spills.

During construction, Columbia Gas would control erosion and limit sediment mobilization to disturbed areas within the temporary work areas. After construction is completed, all areas disturbed by construction would be restored to their original contours, as practicable, and revegetated (if not within areas covered by buildings, concrete, asphalt, or aggregate), including topsoil replacement (where applicable) in accordance with Columbia Gas' ECS or landowner agreements.

In areas of steep terrain, trench breakers would be installed in the pipeline trench to restrict groundwater flow along the pipeline. Vegetation restoration and periodic mowing of the pipeline right-of-way would help to control overland flow and restore groundwater recharge. Columbia Gas' SPCC Plan includes measures to avoid or minimize the potential for fuels or other hazardous liquids to contaminate groundwater and provides guidance for the rapid control and cleanup of any spills or leaks.

Columbia Gas would route around existing septic systems and associated leach fields, if possible. If re-routing is not possible, Columbia Gas would work with the landowner to relocate the septic system and compensate the landowner for associated costs and for loss of usable land.

To minimize the chance of accidental spills affecting groundwater resources, Columbia Gas would prohibit construction equipment, vehicles, hazardous materials, chemicals, fuels, lubricating oils, and petroleum products from being parked, refueled, stored, or serviced within a 200-foot radius of any active private water well, and within a 400-foot radius of any public or municipal water well. These buffers would be included in environmental documents prepared prior to construction. Spills would be reported to appropriate regulatory agencies as required. Columbia Gas' ECS and SPCC Plan contain procedures to control, contain, and clean up any released materials during construction. Measures outlined in the SPCC Plan and ECS include, but are not limited to:

- collection and proper disposal of contaminated materials;
- regular inspection of storage areas for leaks;
- replacement of deteriorating containers; and
- use of secondary containment systems around hazardous liquids storage facilities and water pumps.

We have reviewed Columbia Gas' ECS and SPCC Plan and find that these protocols adequately address the storage and transfer of hazardous materials and the response to be implemented in the event of a spill.

Columbia Gas estimates that about 88 percent of the pipeline route crosses bedrock at depths of less than 60 inches where blasting may be required for pipeline installation. Blasting could affect groundwater quality by temporarily changing groundwater levels and increasing groundwater turbidity near the construction right-of-way. Columbia Gas would attempt to utilize specialized excavation methods, including ripping or the use of hydraulic hammers or rock saws, where rock may be encountered during construction. However, blasting may be necessary to achieve the required trench depth if these methods prove to be ineffective or inefficient. Columbia Gas has developed a Blasting Plan to minimize potential adverse impacts on the environment, nearby water sources, structures, or utilities. As stated in this plan, licensed blasting contractors would conduct the blasting activities in accordance with all applicable federal, state, and local regulations. Columbia Gas would obtain all necessary permits prior to initiating blasting activities.

We anticipate that impacts on nearby water wells and springs (such as increases in turbidity) from blasting would be temporary and would likely dissipate shortly after blasting or after a well has been flushed several times. Columbia Gas has committed to contacting affected landowners again regarding the location of any private wells or springs just prior to the start of construction so that a comprehensive list of these features can be compiled. Additionally, Columbia Gas has agreed to test all private water wells within 150 feet of construction workspaces (with landowner consent) for water quality and quantity parameters, including well yield, before and after construction, and provide an alternative water source or a mutually agreeable solution in the event of construction-related impacts.

Proposed compressor, regulator, and tie-in facilities would be in the same general vicinity as the MXP pipelines. The measures Columbia Gas proposes to minimize potential impacts of the pipelines on groundwater (e.g., adherence to the measures included in its ECS and SPCC Plan) would apply to the access roads and pipe/contractor yards, as well. In addition, excavation associated with compressor facilities would be fewer than 6 feet deep in most instances, and therefore impacts on groundwater would be minimal. For these reasons, we do not expect the construction or use of the aboveground facilities to impact groundwater resources.

As discussed in section 2.6.1, Columbia Gas would employ EIs to monitor compliance with its ECS, SPCC Plan, and environmental conditions contained in the Commission's Certificate and as specified in project permits and approvals during construction and restoration. The EIs would have the authority to stop work and order corrective actions for activities that violate the environmental conditions of the Certificate and other permit authorizations.

4.3.1.5.2 Gulf XPress Project

Compressor station construction activities are not likely to impact groundwater resources because construction would involve shallow, temporary, and localized excavation. Tree felling and vegetation removal would only be performed in those areas necessary for installation of structures, piping, property and security fencing, and the access driveways. Temporary erosion

and sediment control measures (e.g., silt fencing) would be installed to isolate disturbed areas from surrounding undisturbed areas during construction.

Post-construction, except where cut-and-fill is required, disturbed construction work areas would be graded to match pre-construction contours and drainage patterns. Areas within the permanent compressor station sites that are not encumbered with buildings, structures, or gravel/asphalt would be reseeded with a turf seed mix. TWS would be seeded in accordance with written recommendations for seed mixes, rates, and dates obtained from the appropriate soil conservation authorities. Permanent erosion control measures would be installed in accordance with the ECS. For these reasons, we do not expect the construction or use of the aboveground facilities to impact groundwater resources.

Accidental spills or leaks of hazardous materials associated with vehicle fueling, vehicle maintenance, and construction materials storage would present the greatest potential contamination threat to groundwater resources. Soil contamination resulting from these spills or leaks could continue to add pollutants to the groundwater long after a spill occurs. Implementation of proper storage, containment, and handling procedures would minimize the chance of such releases. Columbia Gulf's ECS and SPCC Plan address the preventative and mitigation measures that would be implemented to avoid or minimize the potential impacts of hazardous material spills during construction. Measures outlined in Columbia's ECS and SPCC Plan include, but are not limited to:

- regular inspection of equipment, containers, and tanks for leaks;
- prohibition of fueling, lubricating activities, and hazardous material storage in or adjacent to sensitive areas;
- use of secondary containment for storage of fuels, oils, hazardous materials, and equipment;
- implementation of emergency response procedures, including spill reporting procedures; and
- use of standard procedures for excavation and off-site disposal of any soils contaminated by spillage.

We have reviewed the Columbia Gulf ECS and SPCC Plan and find that the measures adequately address the storage, handling, and transfer of hazardous materials and the procedures to be implemented in the event of a spill.

Karst geology was identified at several project sites, including the Paint Lick, Goodluck, Cane Ridge, and Clifton Junction Compressor Stations, although signs of active features were not noted. Refueling, hazardous materials storage, and overnight equipment parking within 100 feet of karst features would be prohibited unless specifically approved by Columbia Gulf's EI/environmental health and safety personnel and additional mitigation measures were implemented (e.g., secondary containment). (See discussion of karst topography in section 4.1.4.7.)

Columbia Gulf anticipates encountering bedrock during construction at several station sites (Moorhead, Paint Lick, Goodluck, Cane Ridge, and Clifton Junction); therefore, blasting may be required if shallow bedrock or boulders cannot be removed by conventional mechanical methods. In these cases, the blasting measures identified in Columbia Gulf's Blasting Plan would be implemented to remove rock from the project workspace. Blasting would be conducted according to guidelines designed to control energy propagation and protect persons and property in the area.

A site-specific blasting plan would be developed for each location where blasting is required. Activities would adhere to federal, state, and local regulations pertaining to blasting and blast vibration limits regarding structures and underground utilities. Care would be taken when blasting near water wells, and blasting within the vicinity of other pipelines would be coordinated with the pipeline operator.

4.3.1.6 Conclusion

4.3.1.6.1 Mountaineer XPress Project

Construction activities are not likely to significantly impact groundwater resources in the long-term because most construction would involve shallow, temporary, and localized excavation. Trench depths are typically less than 10 feet, while the typical depth to groundwater aquifers ranges from 25 feet (alluvial aquifers) to 50 feet (Upper Pennsylvanian aquifers). Shallow, surficial groundwaters (the "water table") would be encountered at numerous locations along the route. Small "perched" groundwaters can be encountered on slopes, and the pipeline trench would often be within the water table zone, especially on valley floors and in floodplains. The pipeline would not be expected to significantly alter the flow or quality of surficial groundwaters. Columbia Gas would avoid or further minimize impacts by using construction techniques described in its ECS, such as using temporary and permanent trench plugs and interceptor dikes. Columbia Gas' use of its Blasting Plan would minimize potential impacts from blasting on groundwater resources. We have also included a recommendation to ensure construction-related impacts on potable wells and springs are adequately minimized.

Following MXP construction, TWS not required for operation of the facilities would be restored as closely as practicable to original contours and revegetated in accordance with the ECS and agency requirements. Restoration and revegetation of exposed soils would return them to pre-construction overland flow and recharge patterns. In accordance with Columbia Gas' SPCC Plan, fuels and other hazardous materials used at compressor stations and other aboveground facilities would be stored in tightly sealed containers and clearly labeled during transportation and storage. Therefore, no significant impacts on groundwater resources would be anticipated from construction or operation of the MXP pipelines, compressor stations, or pipeline ancillary facilities

4.3.1.6.2 Gulf XPress Project

No long-term impacts on groundwater are anticipated from construction or operation of the GXP. Disturbances would be shallow and temporary, erosion controls would be implemented, natural ground contours would be largely restored, and areas of disturbance revegetated. Temporary, minor, and localized impacts could result during trenching activities in areas with shallow groundwater (depth fewer than 10 feet below the ground surface) crossed by the GXP

suction/discharge pipeline. The greatest threat posed to groundwater resources would be a hazardous material spill or leak into groundwater supplies. We have reviewed Columbia Gulf's ECS and SPCC Plans and conclude that they adequately address strategies and methods to prevent or limit such contamination should a spill occur. We do not anticipate any significant, long-term impacts on aquifers or groundwater supplies from construction or operation of the project given the relatively shallow excavation depths required for construction.

4.3.2 Surface Water Resources

Waterbodies are characterized as perennial, intermittent, or ephemeral. Perennial waterbodies contain flowing water for all or most of the year. Intermittent waterbodies flow seasonally or following rainfall events. Ephemeral waterbodies flow during or shortly after precipitation events or spring snowmelt. Waterbodies are designated as ponds if the feature is non-flowing.

The MXP is located entirely within the Ohio River Regional Watershed (USGS, 1994). Major rivers within this watershed include the Ohio, Wabash, Allegheny, Monongahela, Kanawha, and New Rivers. Columbia Gas identified surface water resources throughout the project area during field surveys conducted in 2015 and 2016. Survey areas included the pipeline construction corridors, TWS, ATWS, staging areas, pipe yards, and access roads. For areas where access was denied, information was obtained from the USGS National Hydrography Dataset, aerial photography, and other available GIS-based information.

Waterbodies along the MXP also were characterized as "minor," "intermediate," or "major," according to the definitions provided in FERC's Procedures, which base the classification on the width of the water's edge at the time of crossing. Minor waterbodies are less than or equal to 10 feet wide; intermediate waterbodies are between 10 and 100 feet wide; and major waterbodies are greater than 100 feet wide. Table 4.3-4 below provides a summary of the waterbodies crossed by the MXP.

Table 4.3-4
Waterbodies Crossed by the Mountaineer XPress Project a/

Number of Waterbodies								
	Waterbody Type				FERC Classification			
Facility	Perennial	Intermittent	Ephemeral	Ponds	Major	Intermediate	Minor	Ponds
Pipeline Facilities								
MXP-100	97 (93)	151 (133)	547 (257)	4 (0)	7 (7) b/	104 (103)	684 (373)	4
MXP-200	3 (3)	7 (6)	12 (4)	0	0	6 (6)	16 (7)	0
Line 1983 Tie-in	0	0	1	0	0	0	1	0
X59M1 Tie-in	0	0	1 (1)	0	0	0	1 (1)	0
SM80 Line Replacement	0	0	0	0	0	0	0	0
SM80 Loop Line Replacement	0	0	0	0	0	0	0	0

Table 4.3-4 Waterbodies Crossed by the Mountaineer XPress Project a/								
	Number of Waterbodies							
	Waterbody Type				FERC Classification			
Facility	Perennial	Intermittent	Ephemeral	Ponds	Major	Intermediate	Minor	Ponds
Aboveground Facilities								
Sherwood Compressor Station	0	0	1 c/	0	0	0	1	0
White Oak Compressor Station	0	0	5	0	0	0	5	0
Mt. Olive Compressor Station	0	2	13	0	0	1	15	0
Ripley Regulator Station	0	1 d/	3	0	0	1	3	0
Saunders Creek Regulator Station	0	0	0	0	0	0	0	0
MXP-200 Tie-In with Line 1983	0	0	0	0	0	0	0	0
Lone Oak Compressor Station	0	0	0	0	0	0	0	0
Ceredo Compressor Station	0	0	0	0	0	0	0	0
Elk River Compressor Station	0	0	0	0	0	0	0	0
Ancillary Facilities								
Access Roads	53	76	248	0	0	38	339	0
Pipe Yards and Staging Areas	0	4	11	1	0	0	15	1
Total	**153**	**241**	**842**	**5**	**7**	**149**	**1080**	**5**

a Numbers represent waterbodies within construction workspaces (but not crossed by the pipeline). Numbers in parentheses are waterbodies crossed by the pipeline centerline.
b The South Fork Hughes River would be crossed twice.
c Access to the Sherwood Compressor and Regulator Station would require installation of a permanent bridge/culvert across an ephemeral waterbody.
d Access to the Ripley Regulator Station would require installation of a permanent bridge/culvert across an intermittent waterbody.

Overall, the centerline of the MXP pipelines would directly cross 381 minor waterbodies, 109 intermediate waterbodies, and 7 major waterbodies. The seven major crossings are at Fish Creek, the South Fork Hughes River (crossed twice), Little Kanawha River, Spring Creek, Kanawha River, and Mud River. Columbia Gas has provided a site-specific crossing plan for the Kanawha River, which would be crossed using the HDD method (described in section 2.4.4). For crossing the other three major waterbodies, Columbia Gas proposes to use the dam-and-pump or

flume method. In addition to these 497 crossings, another 326 waterbodies would be within the pipeline construction rights-of-way, but not crossed by the pipeline directly.

The GXP would be constructed within three regional watersheds (Ohio, Tennessee, and Lower Mississippi Regions). Columbia Gulf identified surface water resources in the project area during field surveys conducted in 2015. A total of 15 waterbodies could potentially be affected by the project, including 12 ephemeral streams and 3 impoundments/stock ponds. These features and the nearest perennial waterbodies to each of the new compressor stations are identified in table 4.3-5.

Table 4.3-5 Waterbody Features near the Gulf XPress Project a/			
State/Facility	**On Site Waterbody Feature**	**Ultimate Disposition**	**Nearest Perennial Waterbody to Site**
Kentucky			
Morehead Compressor Station	2 ephemeral streams, 1 stock pond	All three features would be within both the temporary and permanent workspaces. The portions within the permanent workspace would not be restored.	North Fork Triplett Creek lies adjacent to the east and south boundaries of the site, about 300 feet from the southeast corner of the temporary workspace.
Goodluck Compressor Station	1 ephemeral stream	This feature would be within the temporary workspace. A 25-foot buffer would be established around this feature during construction.	Clay-Lick Creek is about 1,900 feet west of the western boundary of the temporary workspace.
Tennessee			
Clifton Junction Compressor Station	5 ephemeral streams, 2 stock ponds	A 25-foot buffer would be established around one stock pond, while the other stock pond (within the permanent workspace) would not be restored. Routing the access road in this location would limit tree clearing at the site. Three of the five ephemeral streams would be within the permanent workspace. One, crossed by the site access road, would be directed through a culvert during restoration; another would be restored to original contours; while the third would not be restored.	Hardin Creek is about 900 feet south of the southernmost corner of the temporary workspace.
Mississippi			
New Albany Compressor Station	3 ephemeral streams	All three features are within both the temporary and permanent workspaces. One feature, crossed by the site access road, would be directed through a culvert during restoration. The portions of the other two features within the permanent workspace would not be restored.	South Branch Wilhite Creek converges with the Little Tallahatchie River along western boundary of the site.
Holcomb Compressor Station	1 ephemeral stream	This feature would be crossed to access temporary workspace. It would be protected during construction by installing a culvert or temporary bridge.	The Yalobusha River is about 4,400 feet west of the western boundary of the site.
a There are no waterbody features on the existing Leach C Meter Station, the approved Grayson Compressor, or the proposed Paint Lick and Cane Ridge Compressor Station sites.			

The following sections describe public water supplies, state water classifications and designated waterbodies, and flood hazard zones. Given the differences between the projects, not all discussion topics are relevant to both projects. For instance, the GXP would have no effect to public water supplies, waterbodies with special designations, impaired streams, or contaminated sediments; additionally, HDD operations are not discussed for the GXP because no perennial waterbodies would be crossed. Furthermore, no GXP facilities would be sited in flood hazard zones.

4.3.2.1 Public Water Supplies

4.3.2.1.1 Mountaineer XPress Project

Columbia Gas consulted with the WVDHHR to obtain location data for public water surface intakes within 3 miles of MXP waterbody crossings. The WVDHHR did not identify any potable water intakes within 3 miles downstream of any MXP crossings. However, the data provided by the WVDHHR identified Zones of Critical Concern (ZCC) and Zones of Peripheral Concern (ZPC) that are considered surface water protection areas (SWPA) in corridors along waterbodies within Source Water Protection Watersheds. The ZCC is based on a protection zone of 5 hours of water travel time above the water intake, while the ZPC is based on a protection zone of 10 hours above the water intake (see table 4.3-6). The ZCCs and ZPCs warrant a more detailed inventory and management due to their proximity to the source water and susceptibility to potential contaminants (WVDHHR, 2016a). Columbia Gas's ECS (Section IV.A.1) states that "Columbia will notify authorities responsible for potable water supply intakes located within 3 miles downstream, at least one week before beginning work in the waterbody, or as required by state or local regulation." However, to ensure the potential for impacts on public and private water supplies is effectively minimized, **we recommend:**

- **<u>Prior to construction</u>, Columbia Gas should consult with the appropriate government entities and/or water utilities to identify any specific protective measures for SWPAs that would be crossed by the MXP. The results of these consultations should be filed with the Secretary.**

4.3.2.1.2 Gulf XPress Project

As previously noted, the GXP would not cross or otherwise impact any perennial surface waters. No surface water reservoir watersheds would be affected.

4.3.2.2 State Water Classifications and Designated Waterbodies

CWA section 303(d) requires that each state review, establish, and revise water quality standards for all surface waters within each state. State classification systems develop monitoring and mitigation programs to verify that water standards are attained as designated. Waters that fail to meet their designated beneficial use are considered impaired and are listed under a state's 303(d) list of impaired waters.

4.3.2.2.1 Mountaineer XPress Project

Pipeline Facilities

In accordance with the CWA, Columbia Gas reviewed the list of 303(d) Impaired Waters for West Virginia to identify waterbody crossings that may contain contaminated sediments and do not meet designated water quality criteria (WVDEP, 2012; 2014). In total, construction of the MXP would result in 78 individual crossings of 303(d)-listed impaired stream segments. Most of the 303(d)-listed waterbody impairments are associated with fecal coliform, biological contaminants, bacteria, or iron. Table 4.3-7 provides a list of impaired waterbodies within the project area.

Table 4.3-6
Zones of Critical and Peripheral Concern Crossed by the MXP Pipeline Facilities

Facility Associated with Protection Area County	Surface Water System Name / Intake	ZCC a/ Milepost Range	Number of ZCC Crossings	ZPC a/ Milepost Range	Number of ZPC Crossings	Total Length of ZCC/Total Length of ZPC Crossed (miles)
Pipeline Facilities						
MXP-100						
Marshall and Wetzel Counties	Covestro (formerly Bayer Materials Science, LLC) (Primary Intake)	0.1 – 6.3	10	0.1 – 15.1	22	2.1/4.9
	Sisterville Municipal Water (Primary Intake)	N/A	0	0.1 – 31.7	44	0.0/10.2
Tyler County	Middlebourne Water Works (Intake #1)	N/A	0	33.0 – 35.9	5	0.0/1.0
	Middlebourne Water Works (Intake #2)	N/A	0	33.0 – 35.9	5	0.0/1.0
Doddridge County	Town of West Union	45.8 – 52.6	7	45.8 – 52.6	7	2.5/2.5
Jackson County	City of Ripley	121.8 – 122.2	1	113.3 – 122.7	11	0.4/3.6
Cabell County	Milton Water	156.0 – 164.1	10	156.0 – 164.1	10	3.1/3.1
	WVAWC – Huntington District (Intake #1)	N/A	0	156.0 – 164.1	10	0.0/2.7
	WVAWC – Huntington District (Intake #2)	N/A	0	156.0 – 164.1	10	0.0/2.7
MXP-200						
Doddridge County	Town of West Union	0 – 2.3	4	0 – 6.0	7	1.5/2.4
SM80 Line						
Cabell County	WVAWC – Huntington District (Intake #1)	21.0 – 21.2	1	21.0 – 21.2	2	0.2/0.2
	WVAWC – Huntington District (Intake #2)	21.0 – 21.2	1	21.0 – 21.2	2	0.2/0.2
SM80 Loop Line						
Cabell County	WVAWC – Huntington District (Intake #1)	20.7 – 20.7	1	20.7 – 20.7	1	<0.1/<0.1
	WVAWC – Huntington District (Intake #2)	20.7 – 20.7	1	20.7 – 20.7	1	<0.1/<0.1

Sources: WVDHHR, 2016a, 2003 a-c
a ZCC = Zone of Critical Concern; ZPC = Zone of Peripheral Concern

Table 4.3-7 Impaired Waterbodies within the Proposed MXP Workspace					
Project Facility/ County a/	**Milepost**	**Stream ID b/**	**Waterbody Name**	**Proposed Crossing Method c/**	**Cause of Impairment d/**
MXP-100 Mainline					
Marshall	7.1	smac035	Fish Creek	Dry	Biological
Wetzel	16.9	swzg012c	Rush Run	Dry	Fecal coliform/bacteria
	18.4	swzf014	Little Fishing Creek	Dry	Biological, fecal coliform/bacteria, iron
	24.5	swzg065	Fishing Creek	Dry	Fecal coliform/bacteria, iron
Tyler	35.0	styh001	Indian Creek	Dry	Biological, fecal coliform/bacteria
Doddridge	38.5	sdoi011	McElroy Creek	Dry	Biological, fecal coliform/bacteria, iron
	43.9	sdog369	Flint Run	Dry	Fecal coliform/bacteria
	48.5	sdoc020	Buckeye Creek	Dry	Fecal coliform/bacteria
	50.3 **e/**	sdoh026	Meathouse Fork	Dry	Biological, fecal coliform/bacteria, iron
	51.6	sdog002	Meathouse Fork	Dry	Biological, fecal coliform/bacteria, iron
	53.8	sdog537	Bluestone Creek	Dry	Fecal coliform/bacteria
	56.8	sdoo302	Left Fork Arnold Creek	Open Cut/Wet Trench	Fecal coliform/bacteria
	59.6	sdog014	South Fork Hughes River	Dry	Biological
Ritchie	65.4	srig022	Middle Fork	Dry	Biological
	72.4	sric044	South Fork Hughes River	Dry	Biological
	72.6	sric043	South Fork Hughes River	Dry	Biological
	77.0	sric012	South Fork Hughes River	Dry	Biological
Wirt	87.6	swif053	Straight Creek	Dry	Biological
	94.9	swif001	Little Kanawha River	Dry	Fecal coliform/bacteria, iron
	96.6	swih010	Spring Creek	Dry	Biological, iron
	97.0	swih012	Spring Creek	Dry	Biological, iron
	97.4	swih014	Spring Creek	Dry	Biological, iron
Roane	102.9	sroc030	Left Fork Reedy Creek	Dry	Biological
	108.9 **f/**	srog021	Buffalo Creek	Open Cut/Wet Trench	Fecal coliform/bacteria
Jackson	113.4 **f/**	sjaa025b	Little Mill Creek	Dry	Biological, fecal coliform/bacteria, iron
	115.3	sjaa014	Frozencamp Creek	Dry	Biological, fecal coliform/bacteria, iron
	118.7	sjah007	Elk Fork	Dry	Biological, fecal coliform/bacteria, iron

Table 4.3-7 Impaired Waterbodies within the Proposed MXP Workspace					
Project Facility/ County a/	**Milepost**	**Stream ID b/**	**Waterbody Name**	**Proposed Crossing Method c/**	**Cause of Impairment d/**
	122.0	sjad040	Tug Fork	Dry	Fecal coliform/bacteria, iron
	127.3	sjaf065	Parchment Creek	Dry	Biological, fecal coliform/bacteria, iron
	128.1	sjac055	Wolfe Creek	Dry	Biological, fecal coliform/bacteria, iron
	129.4	sjac001	Thirteenmile Creek	Open Cut/Wet Trench	Fecal coliform/bacteria, iron
	130.6	sjae011a	Peppermint Creek	N/A	Iron
	130.6	sjae011b	Peppermint Creek	Dry	Iron
Putnam	138.0 f/	spuc053	Spring Valley Branch	Dry	Iron
	138.6	spuc018	Eighteenmile Creek	Dry	Fecal coliform/bacteria, iron
	139.1	spuc015	Eighteenmile Creek	Dry	Fecal coliform/bacteria, iron
	140.2	spuc029	Eighteenmile Creek	Dry	Fecal coliform/bacteria, iron
	140.4	spuc029	Buffalo Branch	Dry	Iron
	142.9	spub015	Isaacs Branch	Dry	Iron
	147.2	spuf001	Kanawha River	HDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin, fecal coliform/bacteria, polychlorinated biphenyls
	147.8	spui011	UNT of Hurricane Creek	Open Cut/Wet Trench	Iron
	152.6	spua084	Five and Twenty Mile Creek	Open Cut/Wet Trench	Fecal Coliform/Bacteria, Iron
	154.9	spug311	Trace Creek	Dry	Fecal coliform/bacteria, iron
Cabell	161.6	scbf019	Indian Fork	Dry	Biological
	163.6	scbh002	Mud River	NA	Biological, selenium
MXP-200 Sherwood Lateral					
Doddridge	1.1	sdog002	Meathouse Fork	Dry	Biological, coliform/bacteria, iron
	2.2	sdog078	Lick Run	Dry	Iron
	3.7	sdoh022	Toms Fork	Dry	Iron
	5.8	sdog008b	Meathouse Fork – Back Channel	Open Cut/Wet Trench	Biological, fecal coliform/bacteria, iron
	5.9	sdog008a	Meathouse Fork	Dry	Biological, fecal coliform/bacteria, iron

Table 4.3-7 Impaired Waterbodies within the Proposed MXP Workspace					
Project Facility/ County a/	**Milepost**	**Stream ID b/**	**Waterbody Name**	**Proposed Crossing Method c/**	**Cause of Impairment d/**
Access Roads Along the MXP-100					
Marshall					
ARMA007	7.0	smac035	Fish Creek	New culvert	Biological
ARMA008.4	11.0	sami035	Bark Camp Run	New culvert	Biological
Wetzel					
ARWZ017	29.0	swzf319	Buffalo Run	Existing culvert	Biological, fecal coliform/bacteria, iron
ARWZ020	30.2	swzf318	Buffalo Run	Existing culvert	Biological, fecal coliform/bacteria, iron
Doddridge					
ARDO003	43.9	sdog369	Flint Run	New culvert	Fecal coliform/bacteria
ARDO009.1	53.9	sdog537	Bluestone Creek	New culvert	Fecal coliform/bacteria
	53.9	sdog537	Bluestone Creek	New culvert	Fecal coliform/bacteria
ARDO009.3	54.4	sdoi204	Bluestone Creek	New culvert	Fecal coliform/bacteria
	54.5	sdoi204	Bluestone Creek	New culvert	Fecal coliform/bacteria
ARDO011	56.2	sdoo313	Left Fork/Arnold Creek	Existing culvert	Fecal coliform/bacteria
ARDO014.2	59.6	sdog014	South Fork Hughes River	New culvert	CNA - Biological
Ritchie					
ARRI008	75.0	srif303	Lick Run	New culvert	Fecal coliform/bacteria, iron
	75.0	srif303	Lick Run	New culvert	Fecal coliform/bacteria, iron
Wirt					
ARWI019.6	95.6	swig515	Spring Creek	New culvert	Biological, iron
Roane					
ARRO002	102.9	sroc030	Left Fork Reedy Creek	New culvert	Biological
Jackson					
ARJA001	112.2	sjaf307	Buffalo Creek	New culvert	Biological, fecal coliform/bacteria
ARJA007.9	129.4	sjac001	Thirteenmile Creek	Existing culvert	Fecal coliform/bacteria, iron
Putnam					
ARPU007	136.2	spuk377	Spring Valley Branch	Existing culvert	Iron

Table 4.3-7
Impaired Waterbodies within the Proposed MXP Workspace

Project Facility/ County a/	Milepost	Stream ID b/	Waterbody Name	Proposed Crossing Method c/	Cause of Impairment d/
ARPU008.1	137.5	spuk357	Spring Valley Branch	New culvert	Iron
ARPU009	138.8	spug504	Eighteenmile Creek	New culvert	Fecal coliform/bacteria, iron
ARPU013	143.1	spuk315	Isaacs Branch	New culvert	Iron
	142.9	spuk315	Isaacs Branch	New culvert	Iron
	142.9	spuk312	Isaacs Branch	New culvert	Iron
ARPY159.1	147.9	NHD 1	UNT Hurricane Creek	New culvert	Iron
Access Roads Along the MXP-200					
Doddridge					
ARDO201	3.2	sdog307	Meathouse Fork	New culvert	Biological, fecal coliform/bacteria, iron
	3.3	sdog307	Meathouse Fork	New culvert	Biological, fecal coliform/bacteria, iron
ARDO201.54	4.6	sdog301	Toms Fork	New culvert	Iron
Contractor Yards Along the MXP-100					
Putnam					
Yard 159	147.9	NHD 2	UNT Hurricane Creek	N/A	Iron

a No impaired waterbodies are within the workspaces for the following facilities: SM80 Line and SM80 Loop Line Replacement; X59M1 Tie-in; proposed Sherwood, White Oak, Mt. Olive, and Ceredo Compressor Stations; approved Lone Oak, and pending Elk River Compressor Stations.

b Stream IDs were assigned by Columbia Gas to each waterbody collected during field surveys. Waterbodies identified as "NHD" represent waterbodies that are based on desktop data from the National Hydrography Dataset.

c N/A indicates construction method is not applicable for features not crossed by the MXP-100 or MXP-200 centerlines. "Dry" refers to a dry-ditch method such as a flume or dam-and-pump crossing.

d WVDEP, 2012.

e Meathouse Fork (sdoh026) would be crossed by the MXP-100 pipeline inbound into Sherwood Compressor and Regulator Station, MXP-100 inbound, MXP-100 outbound from the station, and MXP-200 outbound from the station. All three crossings would be installed concurrently and are therefore counted as 1 crossing.

f GIS shapefiles of 303(d) streams indicated that the MXP would not cross these streams. After review of the data, topographic maps, and aerial photography, Columbia Gas indicated that the MXP crosses these streams upstream of the perceived extent of the GIS shapefile.