

Appendix A: Risk Ranking Summary Chart from all Appendices combined with probability/consequence descriptions and color coded by overall risk ranking (no color = low risk; yellow = moderate risk; red = high risk; grey = insufficient info.) Cells marked with NA are not assessed because risks are not anticipated. References are provided to corresponding appendices where risk information is found.

Aspect	Agent/ chemical	Impact on	Phase					Location in Appendices
			Site identification / preparation	Drilling, casing and cementing	HVHF / Well completion	Production	Well abandonment/ reclamation	
Blowout	Contaminat ion of soil, ground water or surface water by surface spill or release	Human	NA	Low/Minor	Low/Minor	Low/Minor	NA	Appendix D Table 1
Blowout	Explosion/f ire/ contaminati on	Human	NA	Low/Minor	Low/Minor	Low/Minor	NA	Appendix B (Tables 15, 18-20)
Combustion from pumps, drill rigs, and compressors	NOx, benzene, PM	Human	NA	High/Minor	High/Minor for Scenario 1 High/ Moderate for Scenario 2	High/ Insufficient data	NA	Appendix B Tables 11, 15, 18-20
Drilling through coalbed	Methane	Ecological and Human	NA	Low/Moderate	NA	NA	NA	Appendix H Pages 5, 6, 13

Aspect	Agent/ chemical	Impact on	Phase					Location in Appendices
			Site identification / preparation	Drilling, casing and cementing	HVHF / Well completion	Production	Well abandonment/ reclamation	
Flaring	CO ₂ , PM	Human	NA	NA	Moderate/Minor	NA	NA	Appendix B Table 15
Non-combustion	VOCs, methane, NGLs	Human	NA	Moderate/ Minor	NA	NA	NA	Appendix B Table 11
Proppant use	Silica	Human	NA	NA	High/Minor	NA	NA	Appendix B Tables 18 and 19
Releases from pipes, valves, fittings	Methane	Community	NA	NA	NA	High/Minor	NA	Appendix B Table 20
Separators and storage tanks	VOCs, methane, NGLs	Human	NA	Moderate/ Minor	NA	NA	NA	Appendix B Table 11
Storage of flowback, venting and separation events	Methane, H ₂ S, VOCs, NGLs, BTEX	Human	NA	NA	High/Minor for Scenario 1	NA	NA	Appendix B Tables 18 & 19
					High/ Moderate for Scenario 2			
Noncombusti on emissions from trucks	Dust/PM	Human	High/Minor	High/ Insufficient data	High/ Insufficient data	High/Minor	N/A	Appendix B Tables 8, 11, 15, 18-20
Combustion emissions from trucks	NO _x , benzene, PM	Human	Low/Minor for Seismic Assessment	High/ Insufficient data	High/ Insufficient data	High/Minor	N/A	Appendix B Tables 8, 11, 15, 18-20

Aspect	Agent/ chemical	Impact on	Phase					Location in Appendices
			Site identification / preparation	Drilling, casing and cementing	HVHF / Well completion	Production	Well abandonment/ reclamation	
			High/Minor for Site Preparation					
Well unloadings	Methane, H ₂ S, VOCs	Human	NA	NA	NA	High/Minor	NA	Appendix B Table 20
Contaminatio n of soil, ground water or surface water by surface spill or release	Cuttings	Ecological and Human	NA	Low/Moderate	NA	NA	NA	Appendix D (Table 1)
Contaminatio n of soil, ground water or surface water by surface spill or release	Drilling additives	Ecological and Human	NA	Low/Moderate	NA	NA	NA	Appendix D (Table 1)
Contaminatio n of soil, ground water or surface water by surface spill or release	Drilling mud	Ecological and Human	NA	Low/Moderate	NA	NA	NA	Appendix D (Table 1)

Aspect	Agent/ chemical	Impact on	Phase					Location in Appendices
			Site identification / preparation	Drilling, casing and cementing	HVHF / Well completion	Production	Well abandonment/ reclamation	
Contaminatio n of soil, ground water or surface water by surface spill or release	Fuel	Ecological and Human	NA	Low/Moderate	Low/ Moderate	NA	NA	Appendix D (Table 1)
Contaminatio n of soil, ground water or surface water by surface spill or release	Stored chemicals	Ecological and Human	NA	Low/Moderate	Low/ Moderate	NA	NA	Appendix E (Table 1, Figure 3, Figure 4, and Figure 5)
Saline intrusion during drilling	Brine	Human	NA	Low/Moderate	NA	NA	NA	Appendix H (Pages 5, 6, 13)
Subsurface releases or migration	Brine	Ecological and Human	NA	Low/Moderate	Low/ Moderate	Low/ Moderate	Low/ Moderate	Appendix H (Pages 9, 10, 13, 14)

Aspect	Agent/ chemical	Impact on	Phase					Location in Appendices
			Site identification / preparation	Drilling, casing and cementing	HVHF / Well completion	Production	Well abandonment/ reclamation	
Gathering Lines	Forest fragmentati on, habitat fragmentati on, harm to aquatic and terrestrial species	Ecological	NA	NA	NA	High/ Moderate to High/Serious depending on #/location of lines and proximity to receptors	Low	Appendix J Page 25-26
Contaminatio n of soil, ground water or surface water by surface spill or release	Flowback	Ecological and Human	NA	NA	Low/ Moderate	NA	NA	Appendix E (Table 1, Figure 5 and Figure 6)
Contaminatio n of soil, ground water or surface water by surface spill or release	Fracturing additives	Ecological and Human	NA	NA	Low/ Moderate	NA	NA	Appendix E (Table 1, Figure 2, and Figure 3)

Aspect	Agent/ chemical	Impact on	Phase					Location in Appendices
			Site identification / preparation	Drilling, casing and cementing	HVHF / Well completion	Production	Well abandonment/ reclamation	
Contaminatio n of soil, ground water or surface water by surface spill or release	Fracturing fluid	Ecological and Human	NA	NA	Low/ Moderate	NA	NA	Appendix E (Table 1, Figure 4, and Figure 5)
Contaminatio n of soil, ground water or surface water by surface spill or release	Produced water	Ecological and Human	NA	NA	Low/ Moderate	NA	NA	Appendix E (Table 1 and Figure 6)
Subsurface releases or migration	Flowback	Ecological	NA	NA	Low/Serious	Low/ Moderate	NA	Appendix H (Pages 9, 10, 14)
Subsurface releases or migration	Flowback	Human	NA	NA	Low/ Moderate	Low/ Moderate	Low	Appendix H (Pages 9, 10, 13)
Subsurface releases or migration	Fracturing fluid	Ecological	NA	NA	Low/Serious	Low/Serious	NA	Appendix H (Pages 9, 10, 14)
Subsurface releases or migration	Fracturing fluid	Human	NA	NA	Low/ Moderate	Low/ Moderate	Low/ Moderate	Appendix H (Pages 9, 10, 13)

Aspect	Agent/ chemical	Impact on	Phase					Location in Appendices
			Site identification / preparation	Drilling, casing and cementing	HVHF / Well completion	Production	Well abandonment/ reclamation	
Subsurface releases or migration	Produced water	Ecological	NA	NA	NA	Low/Serious	NA	Appendix H (Pages 9, 10, 14)
Subsurface releases or migration	Produced water	Human	NA	NA	Low/ Moderate	Low/ Moderate	Low/ Moderate	Appendix H (Pages 9, 10, 13)
Noise / vibration	Casing	Ecological	NA	Medium/Minor	NA	NA	NA	Appendix F (Table 10)
Noise / vibration	Casing	Human	NA	Low/Minor	NA	NA	NA	Appendix F (Table 10)
Noise / vibration	Cementing	Ecological	NA	Medium/Minor	NA	NA	NA	Appendix F (Table 10)
Noise / vibration	Cementing	Human	NA	Low/Minor	NA	NA	NA	Appendix F (Table 10)
Noise / vibration	Compresso rs off the pad	Ecological	NA	N/A	NA	Medium/ Minor	NA	Appendix F (Table 17)
Noise / vibration	Compresso rs off the pad	Human / Community	NA	N/A	NA	Medium/ Moderate	NA	Appendix F (Table 17)
Noise / vibration	Compresso rs on the pad	Ecological	NA	N/A	N/A	Medium/ Minor	NA	Appendix F (Table 16)
Noise / vibration	Compresso rs on the pad	Human / Community	NA	N/A	N/A	Low/Minor	NA	Appendix F (Table 16)
Noise / vibration	Constructio n activity	Ecological and Human	Medium/ Minor	NA	NA	NA	Medium/ Minor	Appendix F (Table 9, 20)

Aspect	Agent/ chemical	Impact on	Phase					Location in Appendices
			Site identification / preparation	Drilling, casing and cementing	HVHF / Well completion	Production	Well abandonment/ reclamation	
Noise / vibration	Drilling	Ecological	NA	Medium/Minor	NA	NA	NA	Appendix F (Table 10)
Noise / vibration	Drilling	Human	NA	Low/Minor	NA	NA	NA	Appendix F (Table 10)
Noise / vibration	Generators and pumps	Ecological and Human	NA	N/A	Medium/ Minor	N/A	NA	Appendix F (Table 13)
Noise / vibration	Generators and pumps	Human	NA	N/A	Low/ Moderate	N/A	NA	Appendix F (Table 13)
Noise / vibration	Vehicle traffic	Ecological	Medium/ Minor	Medium/Minor	Medium/ Minor	N/A	Medium/ Minor	Appendix F (Tables 8, 9, 12, 15, 20)
Noise / vibration	Vehicle traffic	Human / Community	Medium/ Minor	Medium/Mode rate	High/Moderat e	N/A	Medium/ Minor	Appendix F (Tables 8, 9, 12, 15, 20)
Visual	Drill rigs	Community, Ecological and Human	N/A	Medium/Minor	NA	NA	NA	Appendix F (Table 11)
Visual	Land clearing	Community, Ecological and Human	N/A	Medium/Minor	NA	Medium/ Minor	Low/Minor	Appendix F (Tables 11, 18, 19, 21)
Visual	Lighting	Community, Ecological and Human	N/A	N/A	Medium/ Minor	NA	NA	Appendix F (Table 14)
Visual	Well pad before production	Human / Community	N/A	Medium/Minor	N/A	NA	NA	Appendix F (Table 11)

Aspect	Agent/ chemical	Impact on	Phase					Location in Appendices
			Site identification / preparation	Drilling, casing and cementing	HVHF / Well completion	Production	Well abandonment/ reclamation	
Visual	Well pad during production and after reclamation	Human / Community	N/A	N/A	N/A	Medium/ Minor	Low/Minor	Appendix F (Tables 18, 19, 21)
Saline intrusion from casing and cement failure	Brine	Human	NA	Low/Moderate	Low/ Moderate	Low/ Moderate	Low/ Moderate	Appendix H (Pages 6, 7, 13)
Subsurface releases or migration	Methane	Ecological	NA	Low/Moderate	Low/ Moderate	Low/ Moderate	Low/ Moderate	Appendix H (Pages 9, 10, 14)
Subsurface releases or migration (gas well set back 2,000 feet from nearest drinking water well)	Methane	Human	NA	Low/Moderate	Low/ Moderate	Medium/ Moderate	Low/ Moderate	Appendix H (Pages 9, 10, 13)

Aspect	Agent/ chemical	Impact on	Phase					Location in Appendices
			Site identification / preparation	Drilling, casing and cementing	HVHF / Well completion	Production	Well abandonment/ reclamation	
Subsurface releases or migration(gas well set back 1 km from nearest drinking water well	Methane	Human	NA	Low/Moderate	Low/ Moderate	Low/ Moderate	Low/ Moderate	Appendix H (Pages 9, 10, 13)
Traffic, road damage Traffic accidents Cumulative	Injury and death from traffic accidents, injury and death	Community	Low/Serious	Medium/ Serious	High/ Serious	Low/ Serious	Low/ Serious	Appendix C Table 10
Road damage Traffic Cumulative	Cost of repair of road damage	Community	Low/Minor	Medium/ Minor	High/ Minor	Low/ Minor	Low/ Minor	Appendix C Table 10
Road Damage Traffic Cumulative	Damage to resident's vehicles from road damage	Community	Low/Minor	Medium/ Minor	High/Minor	Low/Minor	Low/Minor	Appendix C Table 10

Aspect	Agent/ chemical	Impact on	Phase					Location in Appendices
			Site identification / preparation	Drilling, casing and cementing	HVHF / Well completion	Production	Well abandonment/ reclamation	
Traffic, road damage Traffic Cumulative	Delay of emergency vehicles Delay of emergency vehicles	Community	Low/ Moderate	Medium/ Moderate	High/ Moderate	Low/ Moderate	Low/ Moderate	Appendix C Table 10
Traffic Cumulative, road damage	Delays and inconve- nience (non- emergency vehicles)	Community	Low/Minor	Medium/Minor	High/Minor	Low/Minor	Low/Minor	Appendix C Table 10
Traffic, road damage Cumulative	Increased cost of policing	Community	Low/Minor	Medium/Minor	High/Minor	Low/Minor	Low/Minor	Appendix C Table 10
Traffic Cumulative Road Damage	Increased risk of roll- over, etc. from road damage	Community	Low/Moderate	Medium/ Moderate	High/ Moderate	Low/Moderate	Low/Moderate	Appendix C Table 10
Traffic Cumulative	Interferenc e with outdoor recreation	Community	Low/Minor	Medium/Minor	High/Minor	Low/Minor	Low/Minor	Appendix C Table 10
Traffic Cumulative	Loss of rural character	Community	Low/Minor	Medium/Minor	High/Minor	Low/Minor	Low/Minor	Appendix C Table 10

Aspect	Agent/ chemical	Impact on	Phase					Location in Appendices
			Site identification / preparation	Drilling, casing and cementing	HVHF / Well completion	Production	Well abandonment/ reclamation	
Road construction, traffic, road damage Traffic Cumulative	Sedimentat ion, pollution of surface water Dama ge to wildlife	Ecological	Medium/ Minor	Low/Minor	Low/Minor	Low/Minor	Low/Minor	Appendix C Table 10
Road construction, traffic, road damage	Forest fragmentati on, harm to wildlife	Ecological	Medium/ Moderate	Low/ Moderate	Low/ Moderate	Low/ Moderate	Low/ Moderate	Appendix C Table 10
Disposal of wastewater in UIC wells	Flowback and Produced water	Groundwater	NA	NA	NA in MD; Moderate in States with UIC wells	NA in MD; Moderate in States with UIC wells	NA	Referenced in Appendix I, page 2
Earthquake	UIC wells	Community	NA	NA	NA in MD, High in States with UIC wells	NA	NA	Referenced in Appendix I, page 2
Waste disposal	Drilling mud, brine, cuttings, flowback	Ecological and Human	Low/ Moderate	Low/Moderate	Low/ Moderate	NA	NA	Appendix I Page 14

Aspect	Agent/ chemical	Impact on	Phase					Location in Appendices
			Site identification / preparation	Drilling, casing and cementing	HVHF / Well completion	Production	Well abandonment/ reclamation	
Water appropriation	Withdrawal s from surface or groundwater r	Ecological systems and aquatic species	NA	Low/Minor	Medium/ Moderate	NA	NA	Appendix G (Tables 1 & 2)
Water appropriation	Withdrawal s from surface or groundwater r	Local and regional water supplies and recreational activities	NA	Low/Minor	Low/ Moderate	NA	NA	Appendix G (Tables 1 & 2)