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Memorandum

To:	Megan Stahl, EQT
From:	Billy Newcomb, Draper Aden Associates
Date:	February 7, 2017
Project Name:	Mountain Valley Pipeline, DEIS
Project Number:	B14188B-01
Subject:	USFWS Response on Canoe Cave and Tawneys Cave
cc:	Dave Allison, EQT

The following information and corresponding graphics address comments regarding Canoe Cave and Tawneys Cave hydrology and biological resources that were provided by the U.S. Fish and Wildlife Service (USFWS) in a January 18, 2017 letter to Mountain Valley regarding a draft Biological Assessment for the proposed alignment of the Mountain Valley Pipeline (MVP). Canoe Cave is located in Giles County, Virginia near milepost [redacted] of the proposed MVP alignment (see enclosed Sheet 23 of 37 taken from Mountain Valley's Karst Features Assessment). Tawneys Cave is located in Giles County, Virginia near milepost [redacted] of the proposed alignment (see enclosed Sheet 19 of 37 taken from Mountain Valley's Karst Features Assessment).

The USFWS noted concerns about potential impacts to biological resources at these two caves from pipeline construction. In response, Mountain Valley presents the following desktop review and field reconnaissance on the hydrogeology of Canoe Cave and Tawneys Cave relative to the proposed MVP construction, conducted by the Mountain Valley Karst Specialist Team (KST). The KST includes scientists with more than 160 years cumulative experience in assessing karst terrain in southern West Virginia and southwestern Virginia. The Mountain Valley KST completed detailed desktop analysis and field reconnaissance, and supported these activities with the KST's decades of experience in assessing karst hydrology in the area of Canoe Cave and Tawneys Cave to demonstrate that there is negligible risk to karst features, hydrology and biological resources of the Canoe Cave and Tawneys Cave.

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Based on several mitigating factors, including the nature and scale of construction, the separation between each cave and the proposed construction right-of-way, and importantly the relative position of the proposed alignment compared to each cave and upland catchments (i.e., karst watershed), Mountain Valley considers the potential risk for impact to Canoe Cave and Tawneys Cave hydrology and biological resources to be so remote as to be negligible.

Canoe Cave

The proposed MVP alignment follows the northwest flank of Sinking Creek Mountain, in the lowland valley underlain by dolomite or limestone depending upon its position, and is generally 100 to 200 feet in elevation above Sinking Creek (i.e., the localized groundwater discharge zone) (see Sheet 23 of 37). The exception to this relative positioning of the proposed alignment is the major alignment adjustment that avoids the Canoe Cave and associated spring near milepost [redacted] (Sheet 23 of 37). Mountain Valley followed the recommendation of the Federal Energy Regulatory Commission (FERC) and adopted a major re-route of the proposed alignment centerline to avoid Canoe Cave by 950 feet (Sheet 23 of 37).

There is effectively no risk for disturbing the physical portions of the cave since the construction right of way is separated by approximately 800 feet from the mapped extent of the cave (Figure 1). The extent of Canoe Cave was confirmed as recently as 2016 by field mapping conducted by the Virginia Department of Conservation and Recreation. The Cave trends northeast and along bedrock strike approximately 600 feet (Figure 1). A large buffer of undisturbed land (approximately 800 feet) will be maintained between the edge of the construction right-of-way and the Canoe Cave. Furthermore, the proposed alignment in the vicinity of Canoe Cave is situated on previously cleared farmland such that additional tree-clearing will not be necessary near the cave and spring and this greatly reduces the potential for impact to the local hydrology.

The Cave encounters subsurface pools of standing water at the approximate elevation of the spring (Figure 1). These pools located in Canoe Cave are at the elevation of the spring, appear to represent the local water table, and are likely connected to the subterranean karst flow regime of the localized

catchment for Canoe Cave. The air-filled section of Canoe Cave (i.e., between the entrance and the above-referenced water pools) does not host perennial flowing water.

The proposed route is topographically lower than the spring associated with Canoe Cave and crosses the spring outflow approximately 370 feet downstream of the spring itself (see Figure 1). As with numerous springs along Sinking Creek, it represents the local groundwater base level or water table of the local karst drainage networks. Allogenic recharge to the karst system(s) in the vicinity of Canoe Cave is typically found topographically higher on Sinking Creek Mountain, at the upper limestone contact (Figure 1). The proposed alignment construction entails an approximately 7-foot to 10-foot narrow excavation that is downslope and downgradient hydrologically from Canoe Cave and spring and as such will not affect the Cave and spring (see enclosed Figure 1).

The Mountain Valley KST understands the degree to which karst hydrology is complicated, and that a thorough assessment of potential impacts to Canoe Cave must extend beyond the near vicinity of the Cave. The following discussion presents an assessment of the larger karst catchment and potential allogenic recharge to Canoe Cave and the associated spring. While the surficial karst features observed in the area of Canoe Cave and its catchment (i.e., sink holes, losing streams) are important contributors to the local groundwater hydrology and possible recharge to the cave, there is a larger groundwater hydrologic system underlying this area that receives recharge from the catchment (i.e., not all precipitation that falls on the catchment necessarily recharges Canoe Cave and spring).

Based on the nature of construction, controls to be implemented by Mountain Valley, and on the nature of karst terrain, Mountain Valley considers the primary risk to karst hydrology (this is generally applied to all karst terrain, for any construction project) to be potential sediment release and transport along autogenic recharge pathways. In the vicinity of the valley floor northwest and parallel to Sinking Creek Mountain (the larger karst catchment is shown in Figure 1), several alignment adjustments were made to avoid sinkholes, swalletts, and losing streams to the extent possible. Where a flowing stream is crossed by the proposed alignment that may subsequently sink

into karst terrain, stringent stream crossing measures will be taken to ensure that the stream is not degraded (this applies to any location in karst terrain). The Mountain Valley Karst Mitigation Plan, and karst-specific Erosion and Sediment Control Plan specify avoidance and mitigation measures to prevent sediment release to karst features. To put this in the proper perspective, sediment migration in karst terrain occurs routinely with every precipitation event, regardless of the presence of the pipeline. Mountain Valley will take all reasonable and necessary actions to prevent any additional sediment migration in karst terrain from construction beyond what is already naturally occurring.

The following discussion summarizes the KST's hydrogeologic assessment of the karst terrain northwest of Sinking Creek Mountain that is part of the Canoe Cave catchment.

Approximately 6,400 feet northeast of Canoe Cave, along bedrock strike, there is a small insurgence cave in the limestone approximately 240 feet southeast of the alignment near MP-[redacted] (Figure 1). This feature was discovered during field reconnaissance completed as part of Mountain Valley's Karst Features Assessment (Resource Report #6). It is most likely the primary source of water for the spring near Canoe Cave. This area is potentially near the upstream edge of the majority catchment for the spring near Canoe Cave because just further northeast is another spring near [redacted] Presumably, this spring near [redacted] would drain the catchment that is further northeast of the Canoe Cave and spring catchment (i.e., a separate catchment) and includes an insurgence near MP-[redacted] (Figure 1), which is near the point where the alignment turns southeast to cross Sinking Creek Mountain. With this understanding of the larger karst catchment relative to Canoe Cave, the proposed pipeline construction is topographically and hydrologically lower than the primary (allogenic) water sources that feed the springs along the flank of the mountain. Therefore, the location of the proposed alignment relative to the catchment results in negligible risks to karst features and hydrology related to Canoe Cave and spring.

Additional contribution to the spring below Canoe Cave comes from several small sinkholes along the upper limestone contact between the general area of Canoe Cave and the aforementioned insurgence at MP-[redacted] (Figure 1). These sinkholes were observed during initial field

reconnaissance for Mountain Valley's Karst Features Assessment. No sink openings or surface water flow to the sinks was observed during field reconnaissance, however, the geographic and geologic location suggests that these are points of infiltration for precipitation (allogenic recharge) that may contribute to Canoe Cave and spring. However, these sinkhole locations are topographically and hydrologically above the proposed alignment (i.e., pipeline construction will not adversely affect hydrology recharging the Canoe Cave and spring) (Figure 1).

Other sinkholes in the Canoe Cave catchment and adjacent areas were considered for this analysis. Near milepost [redacted], and continuing along just north of the Canoe Cave and spring are a few sinkholes (Figure 1). The largest sinkhole, which is also the one closest to the Canoe Cave spring contains farm refuse, apparently deposited in the sinkhole over many years. The other sinkholes are much smaller and are situated well away from the proposed alignment. Sinking stream #2 near [redacted] (Figure 1) also contains many years of farm refuse, scrap metal, and old tires. However, a constructed ditch (presumably for farm use) directs water away from Stream sinks #2 (Figure 1). Sinkholes further to the northeast, toward the Giles and Montgomery County line at milepost [redacted] (Figure 1) likely take wet weather recharge and will be avoided or mitigated as specified in the Karst Mitigation Plan. Another karst feature of note is the insurgence at milepost [redacted] (Figure 1), located approximately 50 feet lower in elevation and down a steep ravine just beyond the point where the alignment turns south to cross Sinking Creek mountain. As a sinking stream feature, water flowing underground near this location will rapidly seek the local water table, which is approximately 100 to 200 feet lower than the ground surface and will not be affected by pipeline construction.

The Mountain Valley KST's detailed understanding of Canoe Cave karst hydrology means that in the highly unlikely event of construction-related release of fluid or sediment the likely receptors to be monitored and mitigated are known. In addition to understanding the local karst hydrology, Mountain Valley will conduct pre-construction outreach directly to property owners along the alignment to request information on springs and wells in the local catchments, and request permission to conduct pre-construction water quality and quantity testing. Through these measures, Mountain Valley will possess an accurate accounting of water supply locations for

future monitoring in needed. Furthermore, in the unlikely event of a release, Mountain Valley will immediately implement mitigation measures specified in the Karst Mitigation Plan, SPCC Plan, and E&S Plan to prevent infiltration or migration of construction related fluid or sediment from the limit of disturbance and entering the karst or a karst feature, thus protecting the subsurface karst environment.

Furthermore, Mountain Valley will deploy the KST as construction inspectors in karst terrain, experts in the local karst terrain and hydrology of Canoe Cave, during all phases of construction karst terrain traversed by the proposed pipeline. The KST will monitor construction to ensure that karst features are protected during construction and in the highly unlikely event of a construction-related fluid or sediment release.

In summary, the proposed alignment poses negligible risk for impacts to Canoe Cave and spring, and likewise other karst features and resources, due to the location of the proposed alignment being topographically and hydrologically below these karst features.

Tawneys Cave

Tawneys Cave is located above [redacted] At MP-[redacted] the proposed alignment descends a small hill paralleling a high voltage power line (Figure 2 and Sheet 19 of 37). At MP-[redacted] the route crosses [redacted] at the junction with [redacted]. In the vicinity of these locations the route is approximately 550 feet from any passage in Tawneys Cave. Furthermore, located between the two are the draw (small valley) which contains [redacted], and an old limestone quarry at the northeast corner of [redacted] and [redacted]. The headwall of the quarry is 30 to 40 feet tall and provides a visual profile of the strata.

Tawneys Cave has three entrances. Two on the hillside above [redacted] and a third in a large sinkhole about 1,000 feet to the northeast. The western of these hillside entrances is the closest point to the proposed pipeline alignment on the north and the south side of [redacted] The cave is characterized by large passages and may represent a paleo flow path for the large stream

that now exits from Smokehole Cave. Tawneys Cave is very well known to the local community and recreational cavers. Note that Mountain Valley made a major alignment adjustment to the originally proposed route in order to avoid these caves and related springs. The proposed alignment does not cross the karst water catchment for Tawneys and Smokehole Cave Springs (Figure 2). The alignment traverses a hillside to the west of Tawneys Cave, and where the alignment is closest to the cave, is separated by the local groundwater divide at [redacted]. The catchment is situated to the northeast, and is generally defined by the Virginia Department of Conservation and Recreation (VDCR) Clover Hollow Conservation site.

The 5 mile long Clover Hollow valley to the northeast of Tawneys Cave is an anticlinal valley with the Knox dolomite exposed in the middle and Undifferentiated limestone dipping into the mountains on the valley sides. Numerous sinking streams and caves formed along the limestone flanks of Clover Hollow valley have been dye traced to Smokehole Cave and Smokehole Spring, which is approximately 1400 feet east northeast of the Tawneys Cave hillside entrances, and also along [redacted] (Figure 2). A small stream continues through to Tawneys Cave and out at Tawneys Spring along [redacted] below the entrances. This represents the downstream end of the Clover Hollow karst hydrologic network. As such, the associated VDCR Conservation site boundary ends at these caves and springs. Hence, MVP construction activities will not occur within the boundary of the Conservation site that contains Tawneys (or Smokehole) Cave.

The route next crosses [redacted] to a flood terrace currently farmed as a hay field, then up a hill and onward to the southeast. At this location on the opposite side of the road and creek, the route passes within approximately 400 feet of the cave entrances. During the dry Summer [redacted] disappears in its bed approximately 3 miles downstream and shortly after crossing under US Route 460. The resurgence for the creek is located on the New River about a mile upstream of its surface flow channel.

Based on the nature of construction, and the relative location of the alignment to Tawneys cave, there is negligible risk for impacts to Tawneys Cave hydrology and biological resources.

1) Saunders, J.W.; Ortiz, R.K.; and Koerschner III, W.F., 1981, Major groundwater flow directions in the Sinking Creek and Meadow Creek drainage basins of Giles and Craig Counties, Virginia, USA., in Beck, B.F. (editor), Proceedings of the Eighth International Congress of Speleology, Bowling Green, Kentucky, July 18-24, 1981.