Mountain Valley Pipeline, LLC
Mountain Valley Pipeline Project
Docket No. CP16-10-000

Implementation Plan
Dated October 2017

Attachment IP-21

WATER RESOURCES IDENTIFICATION AND TESTING PLAN

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1.0 WATER RESOURCES IDENTIFICATION AND TESTING PLAN

Mountain Valley LLC (Mountain Valley) proposes to construct the Mountain Valley Pipeline (MVP), an approximately 303-mile, 42-inch-diameter natural gas pipeline to provide timely, cost-effective access to the growing demand for natural gas for use by local distribution companies, industrial users and power generation facilities in the Mid-Atlantic and southeastern markets, as well as potential markets in the Appalachian region.

The proposed MVP will extend from the existing Equitrans L.P. transmission system and other natural gas facilities in Wetzel County, West Virginia to Transcontinental Gas Pipe Line Company, LLC's (Transco) Zone 5 compressor station 165 in Pittsylvania County, Virginia. In addition to the pipeline, MVP components will include approximately 171,600 horsepower of compression at three compressor stations along the route, as well as measurement, regulation, and other ancillary facilities required for the safe and reliable operation of the pipeline. The MVP is designed to transport up to 2.0 million dekatherms per day (MMDth/d) of natural gas.

1.1 Introduction to Water Resources Identification and Testing Plan

There are negligible risks for impact to a water source from pipeline construction. Nonetheless, out of an abundance of caution, Mountain Valley prepared and is executing the terms of this Water Resources Identification and Testing Plan (Plan) in order to document pre-construction (baseline) and post-construction water quality and quantity of privately owned water supply systems, and to address concerns of public water suppliers to ensure there is no interruption of water service during construction or final land reclamation.

This Plan summarizes protocols for identifying and assessing water supplies in the vicinity of the proposed MVP and related components. Mountain Valley documented locations and characteristics of private water supplies within 150 feet (500 feet in karst terrain) of the proposed alignment or a related MVP component and offered water quality and quantity testing. Mountain Valley also addressed public water supplies that are located within 1) a U.S. Geological Survey (USGS) Hydrologic Unit Code (HUC) HUC-10 watershed that is traversed by the proposed alignment or contains a MVP component, and / or 2) has a surface water intake located within three (3) miles downstream of the proposed alignment water body crossing (FERC criterion), and / or 3) has a surface water intake in West Virginia where the proposed alignment or a related

Project component is located within 0.5-mile of a Zone of Critical Concern defined by the West Virginia Department of Health and Human Services (WVDHHR) (FERC request).

The broad criterion of addressing public water supplies within a HUC-10 watershed represents a conservative approach in terms of maximizing the number of public water supplies to be addressed because the HUC 10-unit code applies to an entire watershed, with an average 227 square miles.

This Plan discusses the outreach methodology followed by Mountain Valley, and the general plan for testing.

Private water resources identified for water quality and quantity testing within 150 feet or 500 feet in karst terrain are summarized in **Table 1**. The private water supply owners were contacted by Mountain Valley via certified mail to confirm the location and characteristics of water resource(s) on the owner's property and to request permission for Mountain Valley to conduct water quality and quantity sampling.

Field confirmation of private water sources has not been completed on some parcels because property access permission has not been granted. Therefore, this Plan is subject to change following the completion of field environmental investigations.

Public water suppliers identified within a HUC 10 watershed that contains a MVP component are shown in **Figure 1** (West Virginia) and **Figure 2** (Virginia) and summarized in **Table 2**. Mountain Valley contacted these public water suppliers (which incorporate the other criteria identified above) to confirm their water supply system and address any concerns that the owner or operator had regarding the project.

2.0 IDENTIFYING WATER RESOURCES

2.1 Private wells and springs

Unlike public water supplies, Mountain Valley is not aware of publically available data that can be reliably used to identify the location of privately owned water resources. Private wells and springs located within 150 feet of Mountain Valley work areas, and within 500 feet in karst terrain, were identified by route alignment civil surveying, as well as desktop review and field observation (where property access was granted). The private water supply sources were confirmed through pre-construction water supply testing (**see Table 1**) as described in this Plan.

As part of the desktop review for potential drinking water sources an indirect method was employed to supplement the civil survey to identify potential private wells. GIS data taken from the various counties were used to identify if a structure was present on the parcel. To maximize the potential for identifying private water resources all structures were assumed to have one or more private wells.

As discussed in this Plan, the property owners identified by civil survey, and desktop review, along the entire proposed MVP alignment and Project components were contacted by Mountain Valley via certified mail to confirm drinking water sources on the identified property and to request permission to conduct water quality and quantity testing.

If a private property owner did not respond to the certified mail request for information within approximately four (4) weeks of submittal by Mountain Valley, a second request was sent. If no response was provided to Mountain Valley through the second submittal, no further contacts were initiated with the property owner regarding water resources.

Private well and spring locations identified as described above, and updated as of the date of this Plan, are listed in **Table 1**. **Appendix A** provides a list of information requested from the water supply owners during the initial contact along with the request for permission to sample the water supply.

2.2 Public Water Supplies

Public water suppliers in West Virginia and Virginia were identified from publicly available data sources (WVDEP, 2016; VDEQ, 2016). Specific locations and conditions of the water supply sources (wells, springs or surface water intakes) were confirmed through contacts with the public supply owner or operator (discussed below).

Public water suppliers in West Virginia and Virginia were incorporated into this Plan if a supplier is located within a USGS HUC-10 watershed that also contains one or more MVP component (regardless if the supply is upgradient or downgradient of the MVP component). Public suppliers that have a surface water intake located within three (3) miles downstream of a water body crossing are also included in this Plan.

A West Virginia public water supply was also included in the Plan if one or more MVP components (e.g., the alignment, temporary work space, etc.) is located within 0.5-mile of a Zone of Critical Concern (ZCC) associated with the public supply surface water intake (there is no corresponding ZCC designation in Virginia).

Figure 1 shows the proposed MVP alignment, HUC 10 watersheds, and corresponding public water supplies in West Virginia. **Figure 2** shows these features and public water supply locations in Virginia. Refer to **Table 2** for a summary listing of public water supplies.

3.0 WATER RESOURCE EVALUATION

The following discussion outlines protocols water supply testing activities. The testing results will be documented by Mountain Valley and provided directly to the water supply owner.

3.1 Private Water Supplies

1. Mountain Valley plans to conduct two (2) baseline pre-construction, and one post-construction water resource testing events at each private water source identified in this Plan. Mountain Valley proposes to collect one sample approximately six (6) months before construction, and a second sample within three (3) months prior to construction, and conduct a well yield test (protocol described below).

2. All private property owners with a known or suspected water source (see earlier discussion) were contacted as discussed below:

    a. Send contact by mail to mailing address listed for the property owner;

    b. If no response is received within approximately 4 weeks of sending the first letter, a second follow-up letter will be sent;

c. If no response is provided by property owner after two (2) attempts this result will be documented and Mountain Valley will suspend further contact to the property owner regarding water quality testing;

d. If a property owner declines permission for Mountain Valley to conduct water quality testing, this will be documented and Mountain Valley will suspend further contact with the property owner regarding water quality testing;

3. Mountain Valley completed one of two (2) pre-construction baseline water quality and quantity testing events at the identified private water supplies. Mountain Valley is currently conducting the second of two (2) pre-construction events. Mountain Valley intends to conduct one pre-construction event during a relatively wet period, and one during a relatively dry period, to better characterize natural variation in water quality and quantity at the private supplies.

4. Property and water supply access approval documentation was secured by Mountain Valley before entering the property. The property / supply owner was notified prior to Mountain Valley entering the property for sampling. See **Appendix A** for information to be collected from the water supply owner during initial and follow-up contact.

5. A two-person field crew was deployed to collect water samples at the identified locations.

6. The sampling location coordinates were collected using GPS (1-meter resolution) and recorded.

7. Field testing, sample collection and sample management techniques were implemented consistent with industry standards and approved guidance (U.S. EPA, West Virginia Department of Environmental Protection, and Virginia Department of Environmental Quality).

8. For surface water resources, a decontaminated or new one-time-use sample collection device suitable for the surface water resource was inserted in a flowing portion of the spring or stream and the water sample transferred directly to the appropriate sample container provided by the laboratory.

9. A decontaminated field meter was inserted in a flowing portion of the spring or stream, and the field parameters recorded along with date and time.

10. For water well testing, a water sample was collected from a flowing spigot (after a minimum of 10 minutes purging) upstream of any treatment system (if applicable) in order to collect a raw water sample in the appropriate laboratory-prepared sample bottle with appropriate preservatives. Field parameters were analyzed at the time of water sample collection.

    a. If the well does not have a pump installed, or does not demonstrate artesian flow, a new, disposable one-time use bailer and clean nylon string was used to collect the water sample. There will be limited ability to purge the well bore of water using the bailer.

11. Water samples were kept cool and transported \ to the analytical laboratory(ies) under Chain of Custody.

12. The target analyte list is comprised of a general water quality analyte suite and pollutant-specific suite (**Table 3**). The baseline target analyte list includes field parameters, coliform bacteria, major elements and water quality parameters. The expanded target analyte list adds a full suite of Volatile Organic Compounds and Semivolatile Organic Compounds included in USEPA drinking water testing methods EPA 524.2, EPA 525.2, respectively, and Total Petroleum Hydrocarbons buy EPA SW846 8015C.

    a. The first pre-construction sampling event comprised analysis of the full expanded target analyte list (**Table 3**). The second pre-construction sampling event (currently underway as of the date of this Plan) will include the baseline water quality (reduced list, **Table 3**) suite, unless there is a concern noted by the property owner, or if Mountain Valley observers a verified detection of a VOC or SVOC or TPH from the first sampling event.

    b. National Environmental Laboratory Accreditation Program (NELAP)-accredited laboratories were utilized for water sample analyses. For samples collected in Virginia the laboratories have current Virginia (V)ELAP accreditation.

13. Water resources testing activities (including the condition of the water resource and equipment) were photo-documented. All field activities and meter calibration for each water resources sampling event were documented.

14. The first pre-construction sampling event provided Mountain Valley with the opportunity to evaluate the condition of each well, spring or intake, surrounding topography and land characteristics and land-use, and generally assess the overall vulnerability of the water supply to existing or future sources of impact.

15. Mountain Valley will provide the water supply owner with the water supply testing results. Concurrent with providing the owner these results, Mountain Valley will discuss with the owner any conditions that were observed at the water supply that represent potential for existing or future sources of impacts.

16. The second sampling event (currently underway as of the date of this Plan) will also include well yield testing. The water supply owner will be apprised of the well yield testing procedure, and Mountain Valley will request permission to access the well for the quantity testing, at the owner's discretion. See **Appendix B** herein for private well yield testing protocol (PDEP, 2007; PDEP 2009a).

17. Mountain Valley will consult with an owner who appears to have a compromised water supply based on pre-construction sampling results. Mountain Valley will tailor an evaluation protocol for the second round of water quality testing as appropriate to evaluate the integrity of the water supply and ensure a comprehensive pre-construction assessment is completed.

3.2 Public Water Suppliers

Mountain Valley contacted and discussed the Project with public water suppliers, and addressed specific concerns. Project components that are hydrologically upgradient, or separated by significant distance alleviated concerns of most public suppliers. In other cases, alignment adjustments alleviated the concerns of public suppliers. Mountain Valley is completing water supply contingency planning efforts for public suppliers that have a surface water intake within three (3) miles downgradient of a pipeline water body crossing, or in West Virginia for suppliers with a surface water intake(s) located within 0.5-mile of a Project component. Mountain Valley has communicated directly with the pubic suppliers, and is working directly with specific suppliers for contingency planning as of the date of this Plan.

4.0 POST-CONSTRUCTION BASELINE WATER RESOURCE TESTING

Mountain Valley will offer to each private water supply that participated in the pre-construction testing program, post-construction water quality (full target analyte list in **Table 3**) and quantity (i.e., well yield) testing. Mountain Valley will follow the same procedures described above for water supply sampling, comprehensive target analyte list laboratory analysis and water quantity testing. Mountain Valley will provide the post-construction monitoring results directly to the property owner.

Mountain Valley will maintain water supply contingency planning efforts that are specified in the respective supplier's Contingency Plan, through the construction period and until final land reclamation is completed.

5.0 COMPLAINT RESOLUTION PROCESS

Mountain Valley believes that the potential for impacts to private water supplies and springs is negligible. Nonetheless, if a claim of impact is made by a water supply owner, a thorough investigation of the alleged impact will be conducted by qualified groundwater and surface water scientists and engineers using industry-standard hydrogeologic investigative practices. This will include a review of the timing of the claim relative to the construction schedule, detailed interview with the supply owner, mechanical evaluation of the water system, possible resampling and analysis of the supply, performance of a hydrogeologic assessment, and other pertinent evaluations. Because each water supply system and hydrogeologic setting is unique, the only means to establish a clear link between a water supply quality or quantity issue and Project activities is through a comprehensive evaluation leading to complaint resolution.

If Mountain Valley determines that the impact was related to its pipeline construction, then the investigations described above will provide valuable information concerning the appropriate remedies. Restoration of a water supply could include:

- temporary supplied water until the water quality returns to baseline;
- connection to secondary on-site sources, if available; and/or
- temporary treatment to establish baseline quality (or better).

If the hydrogeologic assessment indicates that a long term solution is needed, Mountain Valley would provide the following as appropriate to restore water quality and quantity to pre-construction conditions:

- a permanent treatment system; or
- a new on-site source (new water well); or a combination of source replacement and treatment options.

6.0 REFERENCES

National Environmental Laboratory Accreditation Program (NELAP), 2016. http://www.nelac-institute.org/content/NELAP/index.php

PDEP, 2007. Water Supply Replacement and Permitting, Document number 563-2112-605. Pennsylvania Department of Environmental Protection, Bureau of Mining Programs, Volume 12, Tab 74 (BMP PGM Section II, Part 6, Subpart 5). October 24, 2007.

PDEP, 2009a. Procedures for Establishing the Quantity of Water in Low-Yield Wells, Document number 563-2112-605. Pennsylvania Department of Environmental Protection, Bureau of Mining Programs, Volume 12, Tab 74 (BMP PGM Section II, Part 6, Subpart 5). October 24, 2007.

U.S. Geological Survey. 2016. Hydrologic Unit Code 10-digit maps (HUC-10) and data https://water.usgs.gov/GIS/huc.html

VDEQ, 2016. Virginia Public Water Supplies, Water Supply Planning Regulation, Plans along MVP were prepared by Draper Aden Associates. http://www.deq.virginia.gov/Programs/Water/WaterSupplyWaterQuantity/WaterSupplyPlanning.aspx

Virginia Environmental Laboratory Accreditation Program (VELAP), 2016. http://www.dgs.state.va.us/DivisionofConsolidatedLaboratoryServices/Services/EnvironmentalLaboratoryCertification2/tabid/1503/Default.aspx

WVDEP, 2016. West Virginia Department of Environmental Protection, Public Water Resources. http://tagis.dep.wv.gov/WVWaterPlan.

Tables

Table 1. Private Water Supplies for Water Quality and Quantity Testing

Project Mile Post	MVP Parcel Number	Water Source	Latitude	Longitude
13.7	WV-HA-027	Spring	39.42267	-80.47739
13.7	WV-HA-027	Spring	39.42241	-80.47676
13.7	WV-HA-3909	Well	39.42241	-80.47857
13.7	WV-HA-029	Well	39.42241	-80.47816
20.8	WV-HA-065.01	Well	39.34159	-80.51141
22.3	WV-HA-080	Spring	39.32512	-80.52914
22.3	WV-HA-080	Well	39.32579	-80.52921
22.5	WV-HA-080	Well	39.32394	-80.52845
44.1	WV-LE-036	Spring	39.10320	-80.58838
44.4	WV-LE-042	Spring	39.09694	-80.58769
44.4	WV-LE-3947	Well	39.09639	-80.58953
58.9	WV-LE-117	Well	38.93066	-80.57423
58.9	WV-LE-117	Well	38.93006	-80.57437
59.5	WV-LE-3953	Spring	38.91988	-80.59112
61.3	WV-LE-133	Spring	38.90201	-80.56544
61.3	WV-LE-133	Well	38.89967	-80.56852
61.9	WV-LE-133	Well	38.89268	-80.56563
67.2	WV-BR-002.04	Well	38.84206	-80.51576
67.7	WV-BR-002.07	Well	38.83148	-80.51395
67.8	WV-BR-002.07	Well	38.82892	-80.51369
69.9	WV-BR-009	Well	38.81010	-80.54137
71.3	WV-BR-014.02	Spring	38.79137	-80.53199
73.7	WV-BR-032	Well	38.76258	-80.51891
74.5	WV-BR-036	Well	38.75433	-80.51537
75.3	WV-BR-5214	Well	38.74226	-80.52715
80.6	WV-BR-046.17	Well	38.69035	-80.47962
80.6	WV-WB-001.04	Well	38.69019	-80.47964
81.7	WV-WB-001.09	Spring	38.67617	-80.47630
83.8	WV-WB-001.18	Well	38.64978	-80.48260
83.9	WV-WB-001.211	Well	38.64780	-80.48573
84.2	WV-WB-3991 (AR WB-117)	Spring	38.65258	-80.49857
93.1	WV-WB-001.40	Spring	38.54831	-80.53957
109.3	WV-WB-093	Spring	38.37201	-80.61146
111.2	WV-NI-002	Spring	38.35674	-80.63223
114.7	WV-NI-025.01	Well	38.32687	-80.66998
115.8	WV-NI-031	Spring	38.31332	-80.67369
116.9	WV-NI-4036	Well	38.29734	-80.67165
124.3	WV-NI-064	Spring	38.20971	-80.71832
124.4	WV-NI-4237	Well	38.20747	-80.72074
130.5	WV-NI-089	Spring	38.13614	-80.73122
133.2	BW-NI-14	Well	38.10644	-80.72493
137.3	WV-GR-007	Well	38.05957	-80.73022
137.4	WV-GR-007.02	Well	38.05802	-80.73088
137.4	WV-GR-007.03	Well	38.05743	-80.73096
139.7	WV-GR-012	Spring	38.03088	-80.73486

Table 1. Private Water Supplies for Water Quality and Quantity Testing

Project Mile Post	MVP Parcel Number	Water Source	Latitude	Longitude
140.5	WV-GR-014	Spring	38.02171	-80.74554
140.5	WV-GR-014	Spring	38.02166	-80.74554
140.5	WV-GR-014	Spring	38.02203	-80.74667
140.5	WV-GR-014	Spring	38.02166	-80.74409
140.5	WV-GR-014	Spring	38.02185	-80.74342
145.0	WV-GR-030	Spring	37.97346	-80.74545
145.4	WV-GR-031.01	Well	37.96917	-80.73914
146.2	WV-GR-033	Spring	37.96078	-80.73267
149.5	WV-GR-047	Well	37.92360	-80.73991
150.4	WV-GR-051.01	Spring	37.91400	-80.73080
150.5	WV-GR-051.01	Spring	37.91150	-80.72924
150.5	WV-GR-4069	Well	37.91029	-80.72680
150.5	WV-GR-4069	Spring	37.91060	-80.72660
150.6	WV-GR-051.01	Spring	37.91187	-80.73000
151.4	WV-GR-056	Well	37.90292	-80.73971
151.8	WV-GR-056	Well	37.89928	-80.74438
152.6	WV-GR-057	Well	37.88973	-80.74717
154.7	WV-FA-003	Well	37.86527	-80.75796
156.6	WV-GR-071	Well	37.84287	-80.75190
157.0	UNKNOWN	Well	37.84072	-80.75336
158.8	WV-SU-5891	Spring	37.81528	-80.74714
159.4	WV-SU-006	Spring	37.80742	-80.74577
159.5	WV-SU-006	Spring	37.80625	-80.74549
169.6	WV-SU-036	Well	37.69634	-80.73811
191.4	WV-MO-012.285	Well	37.45721	-80.66269
202.3	VA-GI-019	Spring	37.34759	-80.65521
204.1	VA-GI-030	Well	37.34357	-80.62491
204.3	VA-GI-032	Well	37.34155	-80.62222
204.4	VA-GI-034	Spring	37.34151	-80.62125
208.9	VA-GI-058	Spring	37.31929	-80.55470
209.0	VA-GI-058	Well	37.31791	-80.55369
217.5	VA-CR-200.050	Well	37.32534	-80.43136
218.1	VA-CR-200.052	Spring	37.32909	-80.42115
223.1	VA-MO-5521	Well	37.29771	-80.36041
229.3	VA-MO-5356	Well	37.25028	-80.28696
235.1	VA-MO-3715	Well	37.23673	-80.19895
235.1	VA-MO-3715	Spring	37.23672	-80.20008
245.1	VA-RO-5220	Well	37.13766	-80.12716
260.0	VA-FR-057	Well	37.07446	-79.94061
260.3	VA-FR-058	Well	37.07190	-79.93851
260.3	VA-FR-5422	Well	37.07111	-79.93964
261.2	BVFR-24	Well	37.06791	-79.92473
261.5	VA-FR-070	Well	37.06513	-79.92264
270.2	VA-FR-4277	Well	37.04292	-79.82255
271.7	VA-FR-140.01	Spring	37.03690	-79.80006

Table 1. Private Water Supplies for Water Quality and Quantity Testing

Project Mile Post	MVP Parcel Number	Water Source	Latitude	Longitude
271.9	VA-FR-5429	Well	37.03946	-79.79637
274.6	VA-FR-153	Spring	37.01513	-79.75793
278.5	VA-FR-4145	Well	36.98998	-79.70378
278.6	BVFR-54	Well	36.98967	-79.70258
289.9	VA-PI-029	Spring	36.92969	-79.52667
298.2	VA-PI-73.031	Well	36.87249	-79.40799
298.7	VA-PI-087.01	Well	36.86653	-79.40394

Table 2. Public Water Suppliers within a HUC-10 Watershed

Public Supply Name	PWS ID#	Locality	State
New-Martinsville Water Department	WV3305203	New Martinsville	WVa
Pine Grove	WV3305205	Pine Grove	WVa
West Union Municiple Water Plant	WV3300901	West Union	WVa
Lumberport Water	WV3301714	Lumberport	WVa
Salem Water Board	WV3301720	Salem	WVa
Clarksburg Water Board	WV3301705	Clarksburg	WVa
Jane Lew Public Service District	WV3302103	Jane Lew	WVa
West Virginia American Water - Weston WTP	WV3302104	Weston	WVa
Glenville Water Plant	WV3301104	Glenville	WVa
Burnsville Public Utility	WV3300408	Burnsville	WVa
West Virginia American Water- Gassaway	WV3300406	Gassaway	WVa
Flatwoods Canoe Run PSD	WV3300402	Sutton	WVa
Sugar Creek PSD	WV3300404	Frametown	WVa
Clay Municipal Water	WV3300801	Clay	WVa
West Virginia American Water - Webster Springs	WV3305104	Webster Springs	WVa
Craigsville PSD	WV3303402	Craigsville	WVa
Nettie-Leivasy PSD	WV3303403	Nettie	WVa
Summersville Municipal Water	WV3303404	Summersville	WVa
Wilderness PSD	WV3303405	Mt. Nebo	WVa
Greenbrier County PSD #2	WV3301302	Quinwood	WVa
Rainelle Water Department	WV3301309	Rainelle	WVa
Rupert Water Department	WV3301311	Rupert	WVa
Town of Meadow Bridge Water Dept.	Town Clerk	Meadow Bridge	WVa
City of White Sulphur Springs Water Plant	WV3301314	White Sulphur Springs	WVa
City of Lewisburg Water Plant	WV3301307	Lewisburg	WVa
Ronceverte Water Department	WV3301310	Ronceverte	WVa
Big Bend PSD	WV3304507	Talcott	WVa
Red Sulphur Public Service District	WV3303206	Peterstown	WVa
Town of Union	WV3303207	Union	WVa

Table 2. Public Water Suppliers within a HUC-10 Watershed

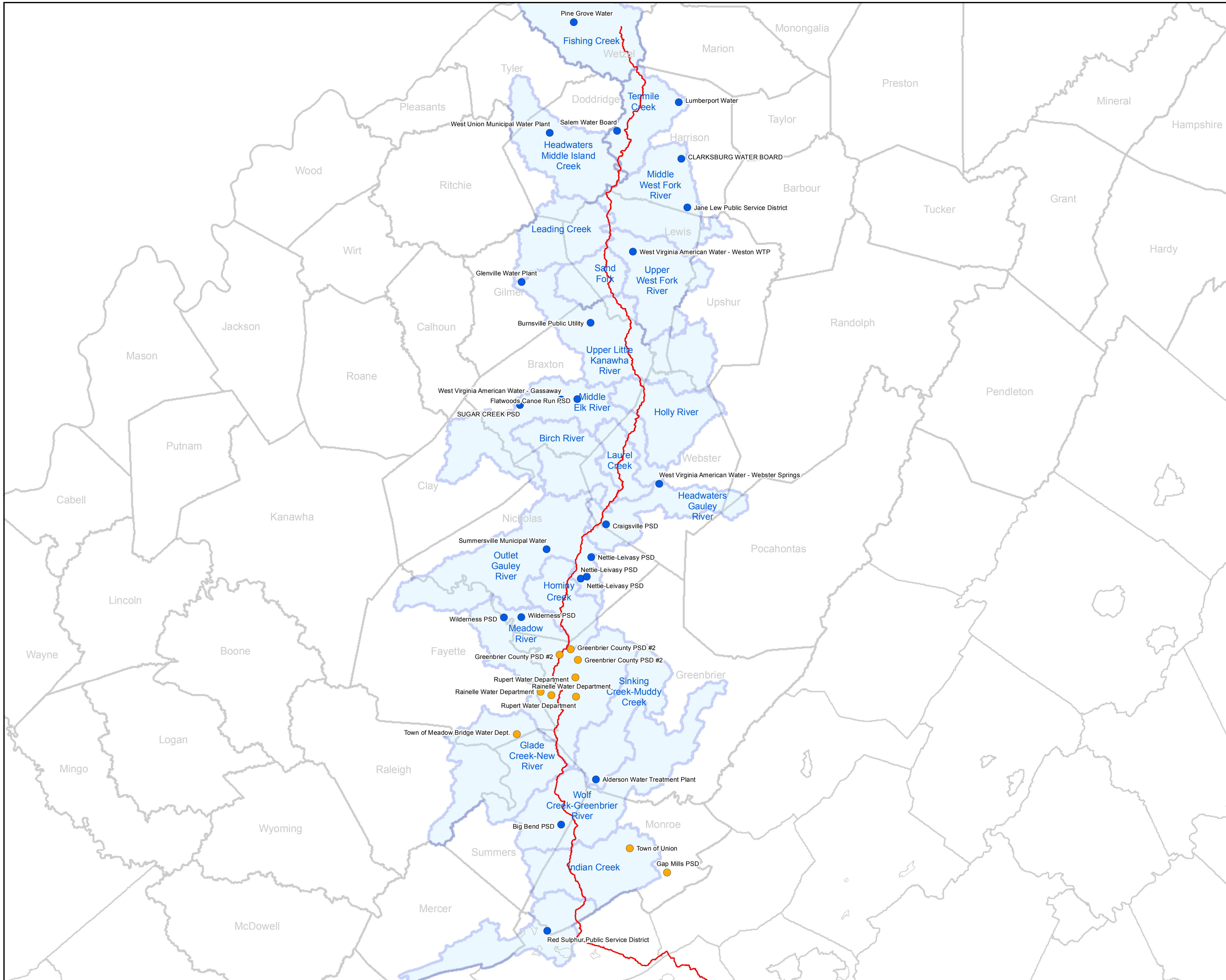
Public Supply Name	PWS ID#	Locality	State
Gap Mills Public Service District	WV3303204	Gap Mills	WVa
Green Valley/Glenwood PSD - Bulltail Water Plant	WV3302813	Bluefield	WVa
West Virginia American Water- Bluefield	WV3302835	Bluefield	WVa
Giles County PSA	1071455	Pearisburg	Va
NRV Regional Water Authority	1121057	Radford	Va
Western Virginia Water Authority (WVWA)	2770900	Roanoke	Va
City of Salem	2775300	Salem	Va
Town of Boones Mill	5067043	Boones Mill	Va
Town of Rocky Mount	5067840	Rocky Mount	Va
Franklin County	5067137	Rocky Mount	Va
Town of Ferrum	5067120	Ferrum	Va
Town of Gretna	5143210	Gretna	Va
Town of Chatham	5143114	Chatham	Va
Pittsylvania County Service Authority - Robin Court	5143690	Pittsylvania	Va

Table 3. Target Analytes for Private Water Supply Testing	
Target Analyte (baseline water quality)	**Notes / Rationale for Testing**
pH	Field-measured indicator parameter characterizing the relative acid-base nature of water and a major indicator of overall water quality.
Specific conductivity (mS/cm)	Field-measured indicator parameter characterizing the dissolved ion content of water and a major indicator of overall water quality.
Temperature (^oC)	Field-measured indicator parameter that is a general water quality descriptor.
Turbidity (turb. units)	Field-measured indicator parameter characterizing the suspended solids content of water.
Total and Fecal coliform bacteria (MPN/100 ml)	Measures bacteria content of water. Indicator of surface water and / or septic field impact to the water well.
Total dissolved solids (TDS) (mg/L)	Measures amount of charged ions that are dissolved in water. Indicative of dissolved mineral content of the water.
Total suspended solids (TSS) (mg/L)	Measures amount of solid material suspended in water. Similar to turbidity field indicator, but provides a quantitative assessment of suspended solids mass.
Hardness (mg/L)	Major water quality indicator. Hardness is commonly used to measure dissolved calcium and magnesium. "Hard" water is high in dissolved minerals. Hardness, TDS and Specific conductivity are evaluated in common to characterize the relative mineralization of groundwater. Report in CaCO3 equivalent (mg/L).
Alkalinity (mg/L)	Measures the ability of water to neutralize acid (buffering capacity) and is part of an overall water quality indicator. Report in CaCO3 equivalent (mg/L)
Sulfate (mg/L)	Common major anion (negatively-charged compound) in groundwater and at high concentrations may lead to scaling of plumbing and impart poor taste to potable water. This is also used to evaluate charge balance (balanced anions and cations) of the overall water quality data set for each well.
Chloride (mg/L)	Common major anion (negatively charged) that is an indicator of overall salt content of water. This is also used to evaluate charge balance (balanced anions and cations) of the overall water quality data set for each well.
Nitrate (total) (mg/L)	Common major anion (negatively charged compound) that is typically used as an indicator of surface water or septic influence on groundwater. Nitrate and bacteria analyses are evaluated in tandem to identify potential impacts to groundwater sources. This is also used to evaluate charge balance (balanced anions and cations) of the overall water quality data set for each well.

Table 3. Target Analytes for Private Water Supply Testing	
Target Analyte (baseline water quality)	**Notes / Rationale for Testing**
Bicarbonate (mg/L)	Common major anion (negatively charged compound) used to evaluate charge balance (balanced anions and cations) of the overall water quality data set for each well. Evaluating bicarbonate content along with alkalinity assists in understanding overall water quality.
Calcium and Magnesium (mg/L)	Common major cation (positively charged element) that will assist in characterizing overall water quality and Hardness, and will be used to evaluate charge balance (balanced anions and cations) of the overall water quality data set for each well.
Sodium and Potassium (mg/L)	Common major cation (positively charged element) that will assist in characterizing overall water quality and to evaluate charge balance (balanced anions and cations) of the overall water quality data set for each well. High levels of sodium may also have health effects for persons with high blood pressure.
Iron and Manganese (mg/L)	Common major cation (positively charged element) that will assist in characterizing overall water quality and to evaluate charge balance (balanced anions and cations) of the overall water quality data set for each well. These major elements, when dissolved in water at a high enough concentration, can have aesthetic concerns for staining home fixtures or affecting laundry.
Target Analyte (Expanded Pollutant-specific)	**Notes / Rationale for Testing**
Volatile Organic Compounds (VOCs); EPA Method 524.2	Volatile organic compounds such as petroleum products, chlorinated compounds, solvents and degreasers, industrial chemicals, etc.
Semivolatile Organic Compounds (SVOCs); EPA Method 525.2	Semivolatile organic compounds potentially derived from industrial activity and materials.
Total Petroleum Hydrocarbons (TPH) EPA Method 1664	Range of petroleum products (see Note 1, below)

Note 1: Total Petroleum Hydrocarbon (TPH) Method 1664 captures a broad range of petroleum related hydrocarbons (including oil-range, diesel-range, gasoline-range and lighter-range). FERC suggested including Oil and Grease, but this analysis would capture fats and greases from animals, fry oils, waxes, soap, etc. There is no reasonable expectation that these types of substances will be associated with pipeline construction. The target analyte list in Table 3, including Method 1664 TPH, will provide a comprehensive analysis of potential contaminants in groundwater that would have a reasonably-expected potential derivation from pipeline construction.

Figures



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Service Layer Credits:

Mountain Valley Pipeline Project

Mountain Valley PIPELINE

FIGURE NUMBER 1
Public Community Water Systems
West Virginia

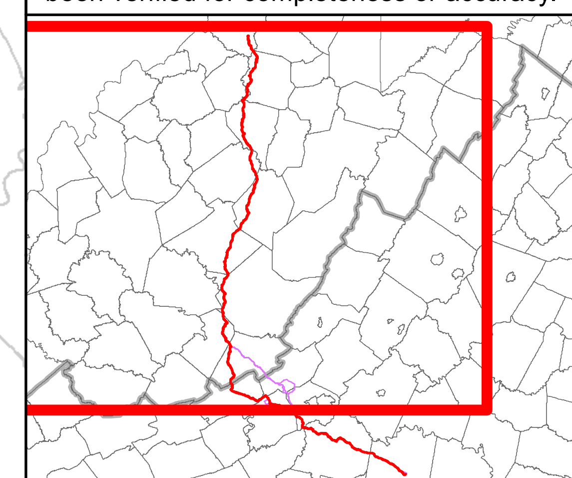
10-2017

Draper Aden Associates
Engineering • Surveying • Environmental Services

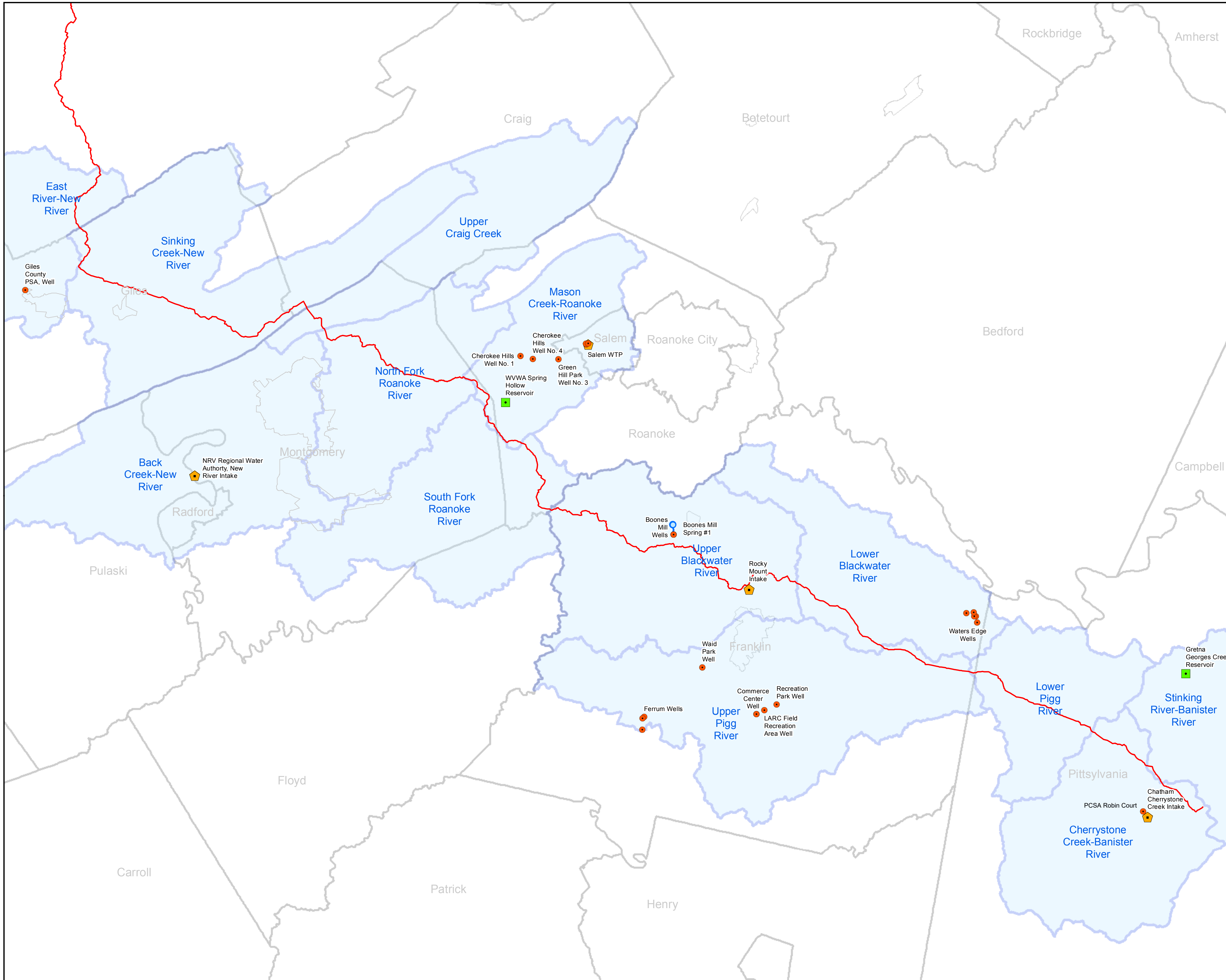
Legend

- Surface Water
- Ground Water
- USGS HUC-10 Watersheds
- MVP Proposed Route

Public Water resources:
http://tagis.dep.wv.gov/WVWaterPlan
Locations are approximate and data has not been verified for completeness or accuracy.



Document Path: P:\B14100\B14188B\B14188B-00\GIS\Water Utilities\Fig5-4 West Virginia Pub-Comm Water Source v2.mxd



Mountain Valley Pipeline Project

Mountain Valley PIPELINE

FIGURE NUMBER 2
Public Community Water Systems
Virginia

10-10-16

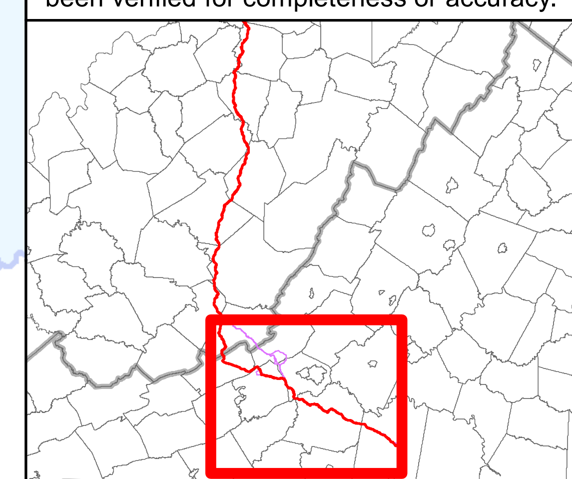
Draper Aden Associates
Engineering • Surveying • Environmental Services

Legend

Water Supply Sources

- Well
- Reservoir
- Stream
- Spring
- USGS HUC-10 Watersheds
- MVP Proposed Route

Public Water resources:
Virginia Regional Water Supply Plans
Locations are approximate and data has not been verified for completeness or accuracy.



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NAD 1983 UTM 17N

0 1 2 4 6 8 10 Miles

Service Layer Credits:

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Appendices

Appendix A Information Collected from Water Supply Owners

1 Route Specific Sort Order
2 Parcel Number(s)
3 APN(s)
4 Name (Last, First or Company)
5 Permission to Enter
6 Date on Form
7 Signed
8 Address Line 1
9 Address Line 2
10 City, State, Zip
11 Telephone Number
12 Email Address
13 Preferred Day/Time of Contact
14 Community or Municipal Water
15 Water Wells
16 Drilled or Dug
17 Used for Drinking
18 Well Depth
19 Treatment System or Filter
20 Other Water Wells
21 Number of Other Wells
22 Drilled or Dug
23 Used for Drinking
24 Well Depth
25 Treatment system
26 Springs
27 Number of Springs
28 Used for Livestock/Irrigation
29 Streams
30 Number of Streams
31 Used for Livestock/Irrigation
32 Other Bodies of Water
33 Number of Other Bodies of Water
34 Description
35 Used for Livestock/Irrigation
36 Comments

Appendix B Private Well Yield Testing Protocol

The following outlines the methodology for measuring pre-construction well yield at private water supply wells. Public water supplies have documented production data and this will be used for pre-construction baseline data. The private water well yield testing methods described below were taken from The Pennsylvania Department of Environmental Protection, Bureau of Mining Programs, Document 563-2112-605 (Water Supply Replacement and Permitting; Appendix B, Section C), and Document 563-2112-606 (Procedures for establishing the quantity of water in low-yield wells) (PDEP 2007, PDEP 2009a).

There are two (2) procedures discussed below. The first is well yield testing when the well is accessible for measuring water level during pumping and recovery. The second is a flow testing protocol when the well is not accessible, or the property owner does not authorize Mountain Valley to access the well but requests a well yield test.

If the property owner requests a post-construction well yield test, it is critical that the test be conducted under the same conditions as the pre-construction test, to the extent possible, in order to provide as accurate a comparison as possible. Since pumping rate and the test duration both affect the well yield estimate, these parameters need to be nearly the same to compare results of post-construction to pre-construction tests. If possible, the two tests should be conducted during the same season of the year because seasonal variation of well recharge can influence the yield estimate.

<u>Yield Testing Protocol for Accessible Wells - Specific Capacity</u>

The "specific capacity" of a well is the number of gallons of water produced per minute for each foot of well drawdown.

A test duration of 1 hour at a pumping rate of 5 gallons per minute (gpm) will be conducted to estimate well specific capacity.

Procedure

Request that the well owner not operate the well for as long as practical prior to conducting the test. Record when the owner last used the water system.

Well plumbing fixtures, such as the pressure shutoff switch, sediment filter and pressure tank may need to be by-passed or disconnected to maintain a stable, steady pumping rate.

Ensure that the discharged water is collected, or discharged away from the well so that it does not artificially recharge the well.

Measure and record the depth to water from the top of the well casing.

Measure and record the depth to the pump from the top of the well casing, if possible. Record any pump installation data that are available.

Record time that flow testing begins.

The following measurements should be taken during the pumping period:

> Pumping rate – measure at the start of the test; at five minute intervals during the initial stages of the test; at 10 minute intervals during the latter stages of the test; and at the conclusion of pumping. Adjust flow controls as necessary to maintain the optimal 5 gpm pumping rate.
>
> Water level – measure at the start of the test; at one or two minute intervals during the first 10 to 20 minutes; at five minute intervals during the remainder of the pumping period; and at the conclusion of pumping.

Terminate pumping if the water level drops within 5 feet of the pump, so the pump is not damaged by running it dry.

Record time that flow testing ends.

At the conclusion of the pumping test, commence recovery measurements in accordance with the following guidelines:

> 0 – 5 minute interval: every 30 seconds
>
> 5 - 10 minute interval: every 60 seconds
>
> 10 - 20 minute interval: every two minutes
>
> 20 - 60 minute interval: every five minutes

If after one hour the level of recovery is less than 50% of the depth of drawdown, continue to measure water levels at five minute intervals until water level has recovered to 90% of the depth of drawdown or until three hours since the start of recovery, whichever occurs first.

Tabulate pumping rate, drawdown and recovery data, and prepare a graph of water level vs. time.

Well yield can be calculated from specific capacity by multiplying the available drawdown in the well (the distance between the static water level and the normal pump setting in feet) with the specific capacity (units in gallons per minute per feet of drawdown), the result having the units of gpm. This calculated yield takes into consideration both the storage capacity of the well and the aquifer performance under the limited conditions of the specific capacity test.

SC=R/D

Where: SC = specific capacity (gpm/ft), R = adjusted discharge rate (gpm), and D = total drawdown (ft.)

R = (Vt - Vs) / t

Where: Vt = total volume of water discharged during test (gallons), Vs = volume of water discharged from borehole storage (gallons), and t = duration of the test (minutes).

$Vs = 23.5D\ r^2$

Where: Vs = volume of water discharged from borehole storage (gallons), D = total drawdown (feet), r = well radius in feet.

(Note, for a standard 6-1/2 inch diameter well, Vs = 1.72 gal./ft. X D)

Yield (gpm) = AD x SC

Where: AD = available drawdown (ft) = depth to pump intake - static water level - 5 ft.

Well storage may be overemphasized in specific capacity tests. Unlike a long-duration test of a high-performance, industrial well, a short-duration test of a low-yielding well, especially a deep well, may result in borehole storage water representing most of the water discharged during the test. A borehole storage problem becomes significant if the specific capacity is then multiplied by the available drawdown to calculate a yield. A poor-performing, unreliable well can appear to have a relatively good yield when borehole storage is large relative to the specific capacity. Mountain Valley will document both specific capacity from the test, and calculated well yield.

Yield Testing Protocol for Inaccessible Wells - Peak Demand Test

The Peak Demand Test (PDT) will be used if a well is inaccessible for direct monitoring of water level during pumping and recovery. The PDT is used to simulate well usage during peak demands, and does not provide an actual yield value. It only tests a delivery system's ability to provide water to the user.

Procedure

The test will be performed by running the water from an outdoor spigot or indoor faucet.

If possible, well plumbing fixtures, such as the pressure shutoff switch, sediment filter and pressure tank may need to be by-passed or disconnected to maintain a stable, steady flow rate.

Ensure that the discharged water is collected, or discharged away from the well so that it does not artificially recharge the well.

Open spigot or faucet for flow at 5 gpm for 15 minutes and then stop flow for recovery for 15 minutes.

The on/off pumping cycles are repeated for 4 hours or until the well fails, whichever comes first.

Record time at the beginning and end of each cycle.

The discharge rate (flow rate) will be recorded every 5 minutes (three times per pumping cycle).

If the pump intake breaks suction and the discharge rate drops noticeably, record the time when this occurs.

The parameters of the PDT must be carefully recorded. Maintaining a constant discharge rate can be difficult to achieve because an in-place water delivery system for a home can be difficult to control and the discharge rate may decline as the test advances.

Because the PDT does not require entry to the well bore, liability concerns from well damage are less. The test also provides a means of testing water supplies not physically accessible for water level measurements. A disadvantage of the test is that the PDT takes longer to perform than the short-duration specific capacity test. Because of the on-and-off cycles, the PDT will not adequately test the well if its duration is shortened to less than 4 hours. The PDT should only be allowed where borehole access requires an extraordinary effort, or the well owner does not authorize entry.