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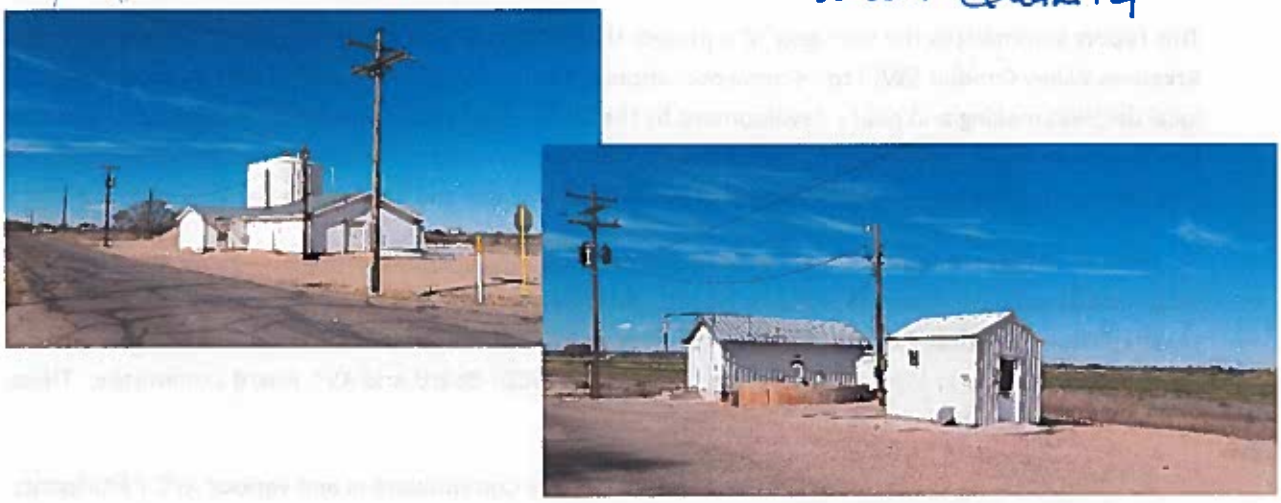
Water Quality



# Lower Arkansas River Water Quality and Efficiency Working Group

## Progress Report #1

## December 2015

**Sustainable Practices**
**Swarthmore, PA 19081**

*Funded by a generous grant from the Arkansas River Basin Round Table and the Colorado Water Conservation Board*

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# Project Summary and Recommendations

This report summarizes the first year of a project that will continue throughout the preparation for the Arkansas Valley Conduit (AVC) to become operational. To this end, this project focuses on supporting the local decision making and policy development by the 39 AVC Participants as they prepare to operate new and/or adjusted water production, treatment, and distribution systems in compliance with the applicable and relevant regulations – most notably the State drinking water and solid waste regulations.

To date, the efforts completed have included developing formal and informal communication channels with the Colorado Department of Public Health and the Environment (CDPHE), the AVC Participants, and selected Otero and Bent County Commissioners, as well as the Arkansas River Basin Round Table and the Southeastern Colorado Water Conservancy District (SECWCD) Board and AVC Board Committee. These communications have included the following:

- Two Working Group meetings attended the County Commissioners and various AVC Participants,
- Individual meetings with all 39 of the AVC Participants,
- Numerous meetings with personnel from both the CDPHE Drinking Water and Hazardous Materials and Waste Management Divisions, and
- Various briefings with the Southeastern District management and Board committee.

All of these communication events were attended by SECWCD Staff.

This progress report documents the salient results of the meetings, with a specific focus on how the communications supported achieving the goals of this phase of the ongoing project, which included the following:

- Identify potential solutions to the compliance issues facing the AVC Participants,
- Broadly estimate costs related to those actions that will need to be funded by the local community above and beyond the Federal components of the AVC[1] to achieve and maintain compliance once the AVC is operational, and
- Identify priority actions for the Working Group over the coming years.

To facilitate completion of this portion of the project, in part to achieve the goals listed above, the AVC Participants were segregated into groups with like characteristics associated with size of organization, geography, source of water, source water quality and current operations. The groups that were established as a result of this effort are listed below:

- Large Water Providers (representing 69% of the population)
- Those water providers that are associated with the Crowley County Commissioners production wells (9% of the population)
- Small independent providers with limited future operational changes (6% of the population)

[1] The Federal components of the AVC include all portions of water storage, treatment and conveyance of project and non-project water related to those activities contained in the EIS, up to the point of delivery to each of the individual AVC Participants including those piping, valving, metering and related appurtenances which will tie into local piping prior to local treatment and distribution.

- Entities with recent Groundwater Under the Direct Influence of Surface Water (GUDI) actions issued by the CDPHE Drinking Water Division (4% of the population)
- Small providers with radium[2] in their source water (12% of the population)

In general, it was found, that the costs to make the expected changes to local water supply systems which are needed to operate in conjunction with the AVC for the first three groups of water providers, representing about 84% of the population, are estimated to be modest - in the range of tens of dollars per customer connection. For those entities with GUDI actions, costs are much higher for local compliance to occur, perhaps in the range of $2,000 to $4,000 per customer connection.

Finally, for those entities with radium in their source water, numerous options exist to achieve future compliance; however, only two were evaluated within the limitations of this phase of the project. Those two options, which to some extent were dictated by the articulated interests of the interviewed small AVC Participants to utilize their current assets to the extent practical, hinged on creating and maintaining facilities that blended local groundwater supplies with AVC deliveries in such a way that drinking water and solid water regulatory compliance was achieved. Costs for the two options, which included use of current iron filtration systems and replacing the iron filtration systems with radium and metals treatment systems, ranged from about $2,400 to $5,100 per customer connection.

For those entities that may be facing costs in the thousands of dollars per customer connection, there are many concerns, not the least of which is the overall affordability of future compliant operations. And given that there are a number of key issues that have yet to be resolved for the small water providers with radium in their source water, it is possible that future costs could vary significantly from the current estimates (even though it is unlikely that costs will be substantially less). However, the path to future sustainable potable water supply will not be inexpensive for these organizations and the communities that they serve. To this point, there are a number of key issues that need to be evaluated and assessed to support Board level decision making and policy development in the next few years such that long-lead time programs and processes can be planned for and implemented.

Even for the AVC Participants that constitute 84% of the population, there are a number of key issues that will need to be addressed for the transition from current operations to operations in conjunction with AVC deliveries to proceed smoothly. Coincidently (but not necessarily surprisingly) the key issues are basically the same for all the groups of AVC Participants – reliable future water supply created by more robust water supply portfolios and appropriate investment in infrastructure and programs to maintain regulatory compliance.

To this point, there are two key areas that have been identified through the past year of the Working Group as priorities for the next phase of the project:

- Evaluate and strengthen future water supply portfolios to support more reliable future compliance with the prevailing regulations, as well as to achieve other local goals; and

[2] The radium is 226/228 radium which is naturally occurring and is considered a NORM, which is naturally occurring radioactive materials.

- Characterize future treatment facility related costs – including the impacts of past operations - on required permitting and compliance.

These two priorities were identified as the focus of future Working Group efforts for the following reasons:

- These priority issues are best approached through a collaboration between the AVC Participants, rather than as a group of uncoordinated individual efforts, due to the complexity of the issues and the importance of developing a consistent methodology that can be utilized reliably for decision making by the AVC Participant membership.
- Addressing these listed priorities will likely require the use of resources that are not within the extended reach of those impacted and in need, which is one of the key reasons why the Working Group was established in the first place (to help bring outside resources to bear on characterizing local issues and developing solutions for local consideration).
- These issues will likely require prolonged attention to develop workable remedies and/or resolutions to the satisfaction or need of local Boards and decision-makers.
- These are issues that influence and/or dictate numerous other business decisions for each of the impacted organizations.

It is, therefore, recommended that the next steps for this project include:

- Continuing the formal and informal communications between the stakeholder groups;
- Conducting additional Working Group meetings;
- Conducting "breakout" sessions on water supply portfolio development and solid waste compliance with interested and/or effected organizations, especially those small providers impacted by radium; and
- Developing an additional progress report for grant compliance and to inform funders.

## Background and Objectives

The Lower Arkansas River Water Quality and Efficiency Working Group (hereafter the "Working Group") was created through the collaboration of the Southeastern Colorado Water Conservancy District (hereafter the "District"), the participants in the Arkansas Valley Conduit (AVC) Project, the Arkansas Basin Round Table and the Lower Arkansas Valley Water Conservancy District (hereafter "LAVWCD"). The goals of the Working Group were established in the original scope submitted to the Round Table in December 2014. The goals include:

- Identifying potential solutions related to ongoing and future Colorado Department of Public Health and the Environment (CDPHE) compliance issues;
- Supporting local water companies in their efforts to achieve and maintain compliance; and
- Developing solutions that allow for the consistent application of the pertinent regulations related to drinking water and water supply, solid waste and residuals management (i.e., hazardous radioactive materials) which are all regulated and managed by the CDPHE.

Based on numerous meetings, both with the District and members of the regulated public[3], the Working Group has taken on a number of key tasks to support performance of these goals. The tasks include:

- Understanding current regulatory issues for each of the AVC participants.
- Understanding the nature of future operations for each of the AVC participants, including identifying potential options for delivery of potable drinking water to members of the community served by currently non-compliant water suppliers.
- Developing a regulatory strategy to bring all communities into compliance with the pertinent CDPHE regulations.
- Developing cost estimates for alternative solutions for local regulatory compliance, including establishing and maintaining future sustainable operations once the AVC is operational.
- Developing funding strategies to address and support local investments and cost shares to achieve compliance with the relevant regulations.

This memorandum is an overview of the current situation. It has been developed based on information collected over the past 6 months during which time interviews were conducted with all of the 39 AVC participants. In addition, one Working Group meeting was held in La Junta. The memorandum is further informed by conservations and discussions with CDPHE staff, District management, and members of the participants.

## Characterization and Differentiation of the AVC Participants

The 39 AVC participants have developed into a community of water users sharing in the planning for a new, important piece of infrastructure that will support future water supply needs in a substantial and

[3] For purposes of this white paper, the regulated public includes those public and private utilities and companies that provide potable water to private citizens and commercial entities within the Lower Arkansas River basin and are in line to receive filtered (i.e., treated, unchlorinated) water deliveries through the Arkansas Valley Conduit.

sustainable manner. For this reason, the 39 AVC Participants are linked in their efforts to support the design and construction, and the future the operation, of the AVC.

However, the future delivery of potable water supply by the various AVC participants to their customers will be substantially varied from location to location, even though there are groups of participants with many similarities. For this reason, and to help simplify the discussion that follows, this section of the memorandum will present a characterization of the AVC participants segregated by key circumstance, geography and challenges. By lumping together entities that share circumstance and geography, emphasize can be made on those conditions that exist that require substantial planning and action to occur in coming months and years such that a smooth transition from pre- to post-AVC operations can be assured. Estimates of potential costs for compliance (for those entities currently out of compliance) and future operations can also be made within the limits of currently available information.

The one key attribute that has the most profound impact on the future operations of any single AVC participant relates to whether or not naturally occurring radioactive materials (NORMs) are present in the source water for the entity. NORMs not only potentially compromise the safety of the community's drinking water, but they also complicate the management of water treatment wastes. Therefore the categorization presented herein is differentiated by those with and those without NORMs (specifically radium 226/228[4]), in their source water.

The categories proposed for use in this memorandum are as follows:

- Those entities that <u>do not</u> have radium in their source water including:
    - Large Municipalities/Special Districts (La Junta, Las Animas, Lamar, Rocky Ford, and St. Charles Mesa)
    - Entities with Continued Connections to Crowley County Commissioners (CCC) Water Supplies (96 Pipeline, Crowley County Water Association, the of Town of Crowley and the Town of Ordway)
    - Other small entities with local water supplies (Bents Fort and South Side (in Otero County) and the Town of Eads (in Kiowa County), the Towns of Olney Springs and Sugar City (in Crowley County), and McClave Water Association and Hasty Water Company (in Bents County))
    - Entities currently under recently classification as "Groundwater Under the Direct Influence of Surface Water (GUDI)" (the Towns of Boone and Fowler)
- Those entities that <u>do</u> have radium in their source water
    - Small entities in Otero County
        - Those that operate iron filter systems without backwash and sludge waste treatment facilities (Eureka, Fayette, Hilltop, Newdale-Grand Valley, Patterson Valley, South Swink, Valley, Vroman, and West Grand Valley)

[4] Radium 226/228 is contained naturally within the Cheyenne and Dakota aquifers from which many small water providers draw their source water. These aquifers are considered non-tributary, and are significantly deeper than the shallow alluvial wells operated by many of the larger AVC participants. Some of the shallow wells contain uranium at concentrations below the MCL such that the focus of the NORMs related compliance issues by CDPHE has been the radium I the deep aquifer systems.

- Those that operate iron filter systems with backwash and sludge waste treatment facilities (the Towns of Cheraw and Manzanola)
- Those that do not operate iron filter systems (Beehive, East End, Holbrook Center, North Holbrook, West Holbrook)
  - May Valley and the Town of Wiley (both in Prowers County)

A discussion of each of these categories of AVC participants will be presented below for purposes of describing the current understanding of how each will operate once the AVC has been constructed.

## Large Municipalities/Special Districts

The four large municipalities and one special district - **The City of La Junta, the City of Lamar, the City of Las Animas, the City of Rocky Ford,** and **St. Charles Mesa Water District** - all operate sophisticated water supply systems and maintain diverse water rights portfolios. Each organization produces and treats water supplies from shallow wells that require augmentation and/or ditches, and each organization except St. Charles Mesa operates a wastewater treatment plant that treats domestic sewerage and receives return flow credits for the treated discharge which is placed back into the Arkansas River and/or a local tributary.

**Table 1**
**Customers and Population Served**
**Large Municipalities/Special District**

| AVC Participant | County | Number of Customer Taps[a] | Estimated Population served[b] |
|---|---|---|---|
| La Junta, City of | Otero | 3,200 | 7,100 |
| Lamar, City of | Prowers | 3,400 | 8,200 |
| Las Animas, City of | Bent | 1,090 | 4,400 |
| Rocky Ford, City of | Otero | 1,650 | 4,000 |
| St. Charles Mesa Water | Pueblo | 4,060 | 11,000 |
| | **Totals** | **13,400** | **34,700** |

[a] provided to SECWCD during 2012 water audits (Great Western Institute, 2013)
[b] From Appendix A.1 Final EIS (USBR, 2013)

The future connection of the AVC to the works of these organizations, while not fully evaluated and characterized, is expected to be fairly straightforward, given that each has numerous options that allow for variable rates and volumes of water delivery, equalization and treatment. In general, each organization is looking at AVC delivery points that take advantage of current configuration of treatment, especially chlorination, as well as how treated water is placed into distribution. Another key operational consideration is how each organization will utilize their current tankage to equalize, allow for disinfectant contact time, and maintain treated water freshness within the requirements and needs of their own systems.

Regardless of these considerations, each organization anticipates having minor fiscal impacts related to the placement and implementation of the AVC connection.

Two points are important to note at this point. First, Rocky Ford has struggled in the past with its infrastructure and in particular its surface water treatment facility and its water loss management. With respect to its surface treatment facility, which was constructed and designed to treat ditch water delivered by the Catlin Canal and thus was placed on a topographically high spot on the south end of Town; the current plant does not function cost efficiently even though the City continues to pay debt service on upgrades completed in 2013. It is simply too expensive for the City to run the surface water

treatment plant versus using its alluvial wells. The City's groundwater production wells are north of the City near the Arkansas River, and it may make sense to locate the AVC delivery point near the wells, utilizing new tankage and chlorination, rather than continue to run water through the surface water treatment facility. The decision regarding how to best operate the City's system will unfold as new evaluations and studies are conducted by and for the City; however, for the purposes of this document, it is assumed that the AVC connection to Rocky Ford will require additional storage to support blending and disinfection in the vicinity of the City's well field.

Rocky Ford's water loss management, not dissimilar to water loss management for the other large providers, will be addressed through the development and implementation of local CWCB approved water conservation plans. Las Animas and La Junta have recently completed theirs, and Lamar and Rocky Ford are in the process of completing and/or updating their water conservation plans. St. Charles Mesa's plan is due for updating in 2017.

Table 2 presents a summary of estimated costs for the large AVC participants to connect to the AVC.

**Table 2**
**Estimated Costs for the Large AVC Participants to Connect to the AVC**

| Entity | Operational Plan After AVC Operational | Engineering Plan[a] | Connection[b] | Current Storage Available (gallons) | Storage Needed (gallons) | Cost |
|---|---|---|---|---|---|---|
| La Junta, City of | Blend | $ 5,000 | $ 5,000 | 6,750,000 | 0 | $ 10,000 |
| Lamar, City of | Blend | $ 5,000 | $ 5,000 | 8,000,000 | 0 | $ 10,000 |
| Las Animas, City of | Blend | $ 5,000 | $ 5,000 | 2,250,000 | 0 | $ 10,000 |
| Rocky Ford, City of[c] | Blend | $ 10,000 | $ 10,000 | 1,000,000 | 0 | $ 20,000 |
| St. Charles Mesa WD | Blend | $ 5,000 | $ 5,000 | 8,000,000 | 0 | $ 10,000 |
| | **Total Costs** | **$ 30,000** | **$ 30,000** | | **$ 0** | **$ 60,000** |

[a] Engineering Plans will be required for submittal to CDPHE describing operations once AVC water is delivered if new or revised treatment and/or storage is implemented
[b] Connection costs include valving and related appurtenances installed by the entity In addition to the meter and valving to be installed by Reclamation
[c] Storage needs for Rocky Ford will be determined under separate cover based on relocating the AVC connection to a new location north of the City near the existing wells.

## Entities with Continued Connections to Crowley County Commissioners Water Supplies

The Crowley County Commissioners (CCC) have long operated a series of five groundwater production wells for the purposes of providing potable wholesale water supplies to those entities in Crowley County that provide retail water sales to local customers including the **96 Pipeline Company, Crowley County Water Association**, the **Town of Crowley**, and the **Town of Ordway**. In the future, the AVC is expected to provide supplemental water supply to these organizations, in varying degrees according to need and resources. For example, three of these entities (CCWA, Town of Crowley and 96 Pipeline) will receive 100% of their potable water from either CCC or the AVC, depending on costs and availability. CCWA and 96 Pipeline also have the option to use both project water and non-project water through the AVC.

The other entity, the Town of Ordway, currently maintains eight wells (i.e., the FAW Wells) which are 18 miles northeast of the Town limits. These wells are plumbed through CCC owned and maintained water tanks north of Town. The 96 Pipeline Water Company has been using the majority of the FAW well production for water supply in the past; however, in the future this water will be redirected to Ordway, reducing the importance of CCC supplied water for the Town. Ordway also maintains shares in Twin Lakes and Lake Meredith that may be utilized through the excess capacity Master Contract with the District. Although the Town will likely maintain a connection with the CCC source, it is interested in becoming independent from the CCC to the extent that it is able.

**Table 3**
**Customers and Population Served**
**AVC Participants Connected to Crowley County Commissioner Wells**

| AVC Participant | County | Number of Customer Taps[a] | Estimated Population served[b] |
|---|---|---|---|
| 96 Pipeline Company | Crowley | 66 | 160 |
| Crowley County Water Association[c] | Crowley | 362 | 3,310 |
| Crowley, Town of | Crowley | 110 | 200 |
| Ordway, Town of | Crowley | 546 | 1,270 |
| | **Totals** | **1,084** | **4,940** |

[a] provided to SECWCD during 2012 water audits (Great Western Institute, 2013)
[b] From Appendix A.1 Final EIS (USBR, 2013)
[c] Includes two prisons

Each organization will utilize current connections with the CCC to locate AVC delivery points even though Ordway will operate separately from the CCC. In essence, the CCC connection with each organization will dictate the location between each organization and the AVC, since each organization's distribution system is built for customer delivery from these locations. Therefore, the delivery points will require separate metering, valving and pressure reduction (costs to be provided by the Federal Government) prior to chlorination and blending with the CCC provided water. Ordway is considering two chlorination systems to separate the connection between the 96 Pipeline and the Town below the CCC Water Tank, and to allow for deliveries from both the north and south sides of the Town.

Connections with these organizations will therefore be relatively simple, as compared to the connection and other operational issues facing the small Otero County entities. For example, there are no regulatory compliance issues related to NORMs and radionuclides in Crowley County. Each organization will need to develop operations plans of course to maintain compliance with CDPHE Drinking Water requirements; however, the source water provided through the CCC, the Town of Ordway Wells, and/or the AVC are not expected to have any compounds or analytes out of range with compliance.

Costs for each organization to become operational are provided in Table 4. These costs total about $80,000, or about $70 per tap for the four entities combined.

**Table 4**
**Estimated Costs for Crowley County Entities Receiving Water from the CCC to Connect to the AVC**

| Entity | Operational Plan After AVC Operational | Engineering Plan[a] | Connection[b] | Current Storage Available (gallons) | Storage Needed (gallons) | Cost |
|---|---|---|---|---|---|---|
| 96 Pipeline Company[c] | Blend/Interconnect with CCC (6 connections) | $ 5,000 | $ 18,000 | 200,000 | 0 | $ 23,000 |
| Crowley County Water Authority | Blend/Interconnect with CCC | $ 5,000 | $ 3,000 | 400,000 | 0 | $ 8,000 |
| Crowley, Town of[c] | Blend/Interconnect with CCC | $ 5,000 | $ 3,000 | 200,000 | 0 | $ 8,000 |
| Ordway, Town of | Blend/ Interconnect with Town Wells[d] | $ 5,000 | $ 3,000 | 140,000 | 0 | $ 8,000 |
| Crowley County Commissioners | Continue Operations (upgrade master meters)[e] | $ 5,000 | $25,000 | 500,000 | 0 | $ 30,000 |
| | **Total Costs** | **$ 25,000** | **$ 52,000** | | **$ 0** | **$ 77,000** |

[a] Engineering Plans will be required for submittal to CDPHE describing operations once AVC water is delivered if new or revised treatment and/or storage is implemented
[b] Connection costs include valving and related appurtenances installed by the entity in addition to the meter and valving to be installed by Reclamation
[c] 96 Pipeline uses the Crowley County Commissioners storage tank north of Ordway; the Town of Crowley uses the Crowley County Commissioners storage tank north of Crowley.
[d] Town of Ordway will maintain a connection with the CCC for emergency purposes only.
[e] The Crowley County Commissioners will need to update their Master Metering of wholesale water deliveries to support wholesale billings and local water loss management efforts (see data gaps below).

### Data Gaps

Note that there has been a long-standing issue regarding the accuracy of the CCC master meters used to track the volume of water deliveries to each of the local water providers. The placement of the meters and the methods used to verify meter accuracy will need to be evaluated and documented as a cost to the CCC prior to receiving and blending local groundwater production with AVC deliveries. The cost to address this data gap is estimated to be between $15,000 and $25,000 which relates to the testing and assessment of the current meters; and the development of a standard operating procedure to maintain and verify future meter accuracy.

## Other Small Entities with Local Water Supplies

The **Town of Eads**, the **Town of Olney Springs**, the **Town of Sugar City**, and the **McClave Water Association**, and the **Hasty Water Company** are small water providers that are, in general, geographically and/or organizationally separate from the majority of the other AVC Participants. For example, the Town of Olney Springs operates its own water system even though the CCC has distribution lines adjacent to the Town service area. The Town of Sugar City and the Town of Eads, on the other hand, are a substantial distance from any other water providers, and therefore they exist for the most part in isolation, relying on their own supplies and resources to support treatment, storage and distribution costs to meet customer demands.

**Table 5**
**Customers and Population Served**
**Small Entities with No Radium in their Source Water**

| AVC Participant | County | Number of Customer Taps[a] | Estimated Population served[b] |
|---|---|---|---|
| Hasty Water Company | Bent | 119 | 285 |
| McClave Water Association | Bent | 167 | 440 |
| Olney Springs, Town of | Crowley | 242 | 390 |
| Sugar City, Town of | Crowley | 175 | 280 |
| Eads, Town of | Kiowa | 418 | 626 |
| Bents Fort Water Company | Otero | 331 | 900 |
| South Side Water Association | Otero | 24 | 48 |
| | **Total** | **1,476** | **2,969** |

[a] provided to SECWCD during 2012 water audits (Great Western Institute, 2013)
[b] From Appendix A.1 Final EIS (USBR, 2013)

McClave and Hasty are also isolated from other water providers; however, these two organizations share an interconnection that provides for some flexibility in times of emergency.

Future operations once the AVC is operational for these entities involves the blended use of the AVC to the extent that it is available during any given year, based on customer demand and the cost of the AVC delivered water. Given that each organization does not currently have water supplies that exceed drinking water standards; each organization has limited treatment needs.

The two exceptions are McClave and Olney Springs. For McClave, one of their production wells has concentrations of radium 226/228 that exceed drinking water standards. McClave effectively provides drinking water that meets the drinking water standards by blending this well water with water produced by other production wells, thereby reducing the concentration of radium 226/228 delivered to the McClave customers to below the maximum contaminant level (MCL) without treatment[5].

Olney Springs, on the other hand, suffers from source water with elevated levels of iron and magnesium. Olney Springs has selected to inject sequestering agents into the potable water supply to control the taste and odor issues related to the presence of these metals in the source water; however, this solution has proven to produce water that is unsatisfactory in quality and expensive to produce (due to the cost of the chemicals). Whereas, McClave can continue to operate its system without concern; Olney Springs' water quality issues strictly limit the overall effectiveness and long-term viability of its current supplies.

The delivery of AVC transmissions is expected to improve the potable water quality in all locations that receive it; Olney Springs is particularly pressed to utilize AVC deliveries such that their water supply quality can be greatly improved and the challenges of operating the sequestering agent can be eliminated. With this point in mind, all of the entities listed in this subsection will continue to use their own local groundwater supplies augmented by the AVC in an amount and percentage that makes economic sense, based on yet to be determined cost of AVC deliveries and OM&R. The exception is Olney Springs which plans to accept and utilize AVC deliveries associated with both Project Water and non-project water[6]

[5] McClave does not operate an iron filter treatment system or generate TENORMs such that it does not currently have any compliance issues with the CDPHE regulations; however it is possible that at some point in the futre McClave will be required to characterize and assess any residuals management that may occur.
[6] Non-project water deliveries will be made possible through the Town's excess capacity Master Contract with the District and its current water rights portfolio, which will allow it to store water in Pueblo Reservoir and take deliveries through the AVC once it is operational.

deliveries for 100% of their water supply to the extent possible. Olney Springs will evaluate options to utilize CCC water supplies to support any emergency needs that occur after the AVC is operational.

To these points, each organization has one option related to future operations once the AVC is operational; which is operate as is with augmentation of AVC as available and if cost-effective with the exception of Olney Springs which will utilize 100% AVC deliveries. Table 6 presents estimates of the cost to connect and operate for these organizations.

**Table 6**
**Estimated Costs for Other Small AVC Participants (Not in Otero County) to Connect to the AVC**

| Entity | Operational Plan After AVC Operational | Engineering Plan[a] | Connection[b] | Current Storage Available (gallons) | Storage Needed (gallons) | Cost |
|---|---|---|---|---|---|---|
| Eads, Town of | Blend | $ 5,000 | $ 3,000 | 1,180,000 | 0 | $ 8,000 |
| Hasty Water Company | Blend/Interconnect with McClave | $ 5,000 | $ 3,000 | 195,000 | 0 | $ 8,000 |
| McClave Water Association | Blend/Interconnect with Hasty | $ 5,000 | $ 3,000 | 750,000 | 0 | $ 8,000 |
| Olney Springs, Town of | 100% AVC/ Interconnect with CCC[c] | $ 8,000 | $ 5,000 | 1,000,000 | 0 | $ 13,000 |
| Sugar City, Town of | Blend | $ 5,000 | $3,000 | 435,000 | 0 | $ 8,000 |
| | **Total Costs** | **$ 28,000** | **$ 17,000** | | **$ 0** | **$ 45,000** |

[a] Engineering Plans will be required for submittal to CDPHE describing operations once AVC water is delivered if new or revised treatment and/or storage is implemented
[b] Connection costs include valving and related appurtenances installed by the entity in addition to the meter and valving to be installed by Reclamation
[c] Town of Olney Springs will maintain a connection with the CCC for emergency purposes only.

The two other entities, **Bents Fort Water Company** and **South Side Water Association**, are both private water companies serving nearly 1,000 people (combined) in Otero County. Both of these entities are fortunate to not have radionuclides at detectable levels in their source water, such that future operations for these entities appear to be somewhat simple. Each can use their groundwater production wells, or AVC deliveries, or La Junta provided water (in the case of Bents Fort) for potable supply dependent on price and quality. In general, both entities would prefer to utilize groundwater resources only to the minimum extent needed due to the power cost and the relative quality of the water. However, in times of drought and/or AVC supply interruption, it may be necessary to utilize groundwater production to support local demand. Therefore, neither of these entities is expecting future operations to exist independent of their current groundwater supplies, to the extent feasible.

As for future costs related to operating once the AVC is constructed, given the flexibility in their current operations, only connection costs are relevant to these two private entities. Neither operates any treatment process that included a compliance nexus with the State Solid Waste Regulations. In addition, neither have a drinking water compliance issue. Costs for these two entities are summarized in Table 7.

**Table 7**
**Estimated Costs for Small Otero County Water Providers Without Radium in Their Source Water**

| Entity | Operational Plan After AVC Operational | Engineering Plan[a] | Connection[b] | Current Storage Available (gallons) | Storage Needed (gallons) | Cost |
|---|---|---|---|---|---|---|
| Bents Fort | Blend/Interconnect with La Junta | $ 5,000 | $ 3,000 | 86,000 | 0 | $ 8,000 |
| South Side | Blend | $ 5,000 | $ 3,000 | Not available | 0 | $ 8,000 |
| | **Total Costs** | **$ 10,000** | **$ 6,000** | | **$ 0** | **$ 16,000** |

[a] Engineering Plans will be required for submittal to CDPHE describing operations once AVC water is delivered if new or revised treatment and/or storage is implemented
[b] Connection costs include valving and related appurtenances installed by the entity in addition to the meter and valving to be installed by Reclamation

## Entities currently under recently classification as "Groundwater Under the Direct Influence of Surface Water (GUDI)"

Two entities – The **Town of Boone** and the **Town of Fowler** – have recently received orders from the CDPHE to address their GUDI; which requires that the two entities either replace their water supplies with non-surface water sources or they make plans to construct and operate surface water treatment facilities within an 18-month horizon, which started in November 2014 (meaning that by April 2016 they must have alternative water supplies or a plan for surface water treatment).

**Table 8**
**Customers and Population Served**
**Entities with GUDI Orders from the CDPHE**

| AVC Participant | County | Number of Customer Taps[a] | Estimated Population served[b] |
|---|---|---|---|
| Boone, Town of | Pueblo | 153 | 324 |
| Fowler, Town of | Otero | 700 | 1,700 |
| | **Total** | **853** | **2,024** |

[a] provided to SECWCD during 2012 water audits (Great Western Institute, 2013)
[b] From Appendix A.1 Final EIS (USBR, 2013)

These orders may require that these two organizations invest **$1.5 to 3 million dollars** in new water treatment infrastructure to control potential health impacts related to surface water borne pathogens. In the interim, both organizations are required to maintain high levels of chlorine residual in their delivered drinking water, creating taste and odor issues, and requiring increased chemical usage and cost. This is particularly challenging for Boone because of recent investments (in 2006 and 2010) that were made as a result of CDPHE requirements to both their water treatment and wastewater treatment facilities – they currently are carrying $35,000 per year in debt service on about $800,000 in loans. Fowler is also challenged with the amount of these capital costs, but they carry no debt service and have successfully utilized special assessments to fund large capital projects.

Of additional concern is the value of AVC deliveries to these entities if they are required to build new treatment facilities before the AVC is operational. It will become a question of the cost of AVC deliveries

and OM&R costs versus the cost of local water treatment operations – neither of which has yet to be characterized.

Noteworthy is that Boone townspersons have a history of using bottled water to meet their drinking and cooking needs. Fowler, on the other hand, operates two water systems – a potable and a non-potable system, using different water sources to separate irrigation and toilet flushing supplies from potable supplies.

The options for Boone and Fowler involve either replacing their current groundwater supplies or constructing new water treatment facilities. It may be possible to delay new construction until the AVC deliveries are available; however, it is likely not acceptable given the EPA's Long-Term 1 Enhanced Surface Water Treatment Rules. Boone has more than enough AVC allocation to meet its demands on an average year, and Boone also maintains a deep well that with sufficient storage may be able to prevent the need for future surface water treatment. Fowler on the other hand only has shallow groundwater supplies such that future operations without surface water treatment would require the coordinated use of new deep wells blended with AVC supplied water. Fowler also has 50 AF of requested storage of non-project water under the excess capacity Master Contract that could be delivered via the AVC.

If the AVC option is viable and accepted by the CDPHE, both entities will require some additional storage to allow for appropriate management of project and/or non-project water deliveries; however, valving and chlorination will likely be performed using existing land and existing facilities to the extent practical.

Noteworthy is that Boone and Fowler are the two entities closest to Pueblo Reservoir and the Whitlock Treatment Plant, such that these two locations will be the first reached by the AVC construction. However, it is currently unclear as to the timing of future water deliveries through the AVC and whether or not the CDPHE will allow for a multi-year delay in compliance for Boone and Fowler. To this point, costs are included for both Boone and Fowler to construct new surface water treatment facilities since this option is the one with the most predictable compliance outcome, albeit expensive.

## Those Entities with Radium in their Source Water

Small water providers in Otero and Prowers County constitute a large number of the AVC participants, even though they only provide service to a small percentage of the community to be served by future AVC deliveries (about 12%). These organizations are nearly all private, non-for-profit entities that serve less than 2,000 persons, averaging about 300 persons per entity and about 150 customer taps per entity. Even the municipalities are small. In addition, the private organizations, until recently, have been ineligible to receive funds through the Colorado state revolving fund programs, strictly limiting their ability to fund needed capital improvements. For this reason, some of the small water provider infrastructure in Otero and Prowers Counties has fallen into a state of disrepair, for a portion of the organizations have not been able to keep up with improvements that should otherwise have been invested in such as customer meter replacement, replacement of poorly performing water lines, etc. since loans and grants have not been available for these projects (whereas municipalities have these kind of funding sources). Future funding of capital projects related to the interconnection to the AVC and the operation of CDPHE compliant programs has been identified as a key concern for many of these organizations.

**Table 9**
**Customers and Population Served**
**Small Providers in Otero County with Radium in Their Source Water**

| AVC Participant | Number of Customer Taps[a] | Estimated Population served[b] | Status of Organization[c] |
|---|---|---|---|
| ***With Iron Filters and No Formal Backwash Management*** | | | |
| Eureka Water Co. | 134 | 330 | EO and Co-RADs List |
| Fayette Water Association | 26 | 60 | EO and Co-RADs List |
| Hilltop Water Co. | 119 | 284 | |
| Newdale-Grand Valley Water Co. | 193 | 463 | |
| Patterson Valley Water Co. | 40 | 96 | |
| South Swink Water Co. | 220 | 610 | EO and Co-RADs List |
| Valley Water Co. | 115 | 325 | EO and Co-RADs List |
| Vroman Water Co. | 59 | 150 | EO and Co-RADs List |
| West Grand Valley Water Inc. | 36 | 84 | EO and Co-RADs List |
| **Total** | **942** | **2,402** | |
| ***With Iron Filters and Formal Backwash Management*** | | | |
| Cheraw, Town of | 100[d] | 193 | EO |
| Manzanola, Town of | 187 | 476 | EO and Co-RADs List |
| **Total** | **287** | **669** | |
| **Without Iron Filters** | | | |
| Beehive Water Assoc. | 88 | 165 | |
| East End Water Assoc. | 30 | 75 | Co-RADs List |
| Holbrook Center Soft Water Co. | 27 | 50 | EO |
| Homestead Improvement Assoc. | 27 | 67 | Co-RADs List |
| North Holbrook Water Co. | 24 | 40 | EO |
| Swink, Town of[e] | 288 | 664 | |
| West Holbrook Water Co. | 12 | 23 | |
| **Total** | **496** | **1,084** | |

[a] provided to SECWCD during 2012 water audits (Great Western Institute, 2013)
[b] From Appendix A.1 Final EIS (USBR, 2013)
[c] EO – Under current Enforcement Order from CDPHE regarding radium 226/228 present in potable water supply above the maximum contaminant level (MCL); Co-RADs is the Colorado Radionuclide Abatement and Disposal Strategy initiative.
[d] estimated from conversations with the Town
[e] The Town of Swink had iron filters up to about one year ago when they added an interconnection with La Junta and removed their iron filters from operation.

**Table 10**
**Customers and Population Served**
**Small Providers in Prowers County with Radium in Their Source Water**

| AVC Participant | Number of Customer Taps[a] | Estimated Population served[b] | Status of Organization[c] |
|---|---|---|---|
| May Valley | 581 | 1,500 | EO and Co-RADs List |
| Wiley, Town of | 225 | 434 | Co-RADs List |
| **Total** | **806** | **1,934** | |

[a] provided to SECWCD during 2012 water audits (Great Western Institute, 2013)
[b] From Appendix A.1 Final EIS (USBR, 2013)
[c] EO – Under current Enforcement Order from CDPHE regarding radium 226/228 present in potable water supply above the maximum contaminant level (MCL); Co-RADs is the Colorado Radionuclide Abatement and Disposal Strategy initiative.

## Data Gaps

### Related to NORMS

These entities are all subject to the same regulations that govern the operations and delivery of potable water as all other water companies and municipalities in Colorado. However, the combination of the NORMs being present in the source water and the small size of these organizations, especially the small non-profit organizations, creates unusual challenges for these AVC participants. The challenges are further compounded for those entities that utilize **iron filters** to remove iron and other taste and odor related minerals from the source water prior to delivery to their customers. NORMs that are concentrated through the use of technology (in this case through treatment filters) are called Technologically Enhanced NORMS (or TENORMs), and there are additional regulations that dictate how wastes are to be managed in association with these materials under Section 9 of the State Solid Waste Regulations.

Since the group of AVC Participants with NORMs in their source water have opportunity to create TENORMS through the actions of producing, treating and distributing potable water, these entities will need to comply with the regulations administered by the Hazard Materials and Waste Management Division of the CDPHE. Of specific importance are the following:

- Residuals management of TENORMS (including sludges, spent filter media, etc.); and
- Section 9 of the Solid Waste regulations that regulate the operations of filter backwash systems.

Future operations for those entities with known NORMs in their source water will require that all facilities and operations are in compliance with the various applicable regulations, **before the AVC deliveries are made available.**

Developing estimates of local, non-federal, costs to become compliant with these regulations is not currently possible without substantial guess work, since information is not readily available characterizing past disposal practices for both residuals and backwash materials. Therefore, all entities that currently operate systems that have NORMs in their source water will be required to develop and implement field sampling plans to characterize source water and TENORM related discharges (e.g., backwash water volumes and chemical composition (including both water and sludge components), iron filter characterization and disposal practices, cistern and tank sludge disposal practices); as well as collect those data that are relevant to assessing potential clean-up and /or remedial efforts (e.g., meets and bounds of water production and treatment facilities, locations of backwash discharge areas, location and use of neighboring properties, etc.).

For those organizations that plan on operating iron treatment facilities in the future, they have additional data gaps related to the design and construction of evaporation ponds, or similar permissible facilities, to manage future backwash and sludge discharges.

To this point, one of the tasks that need to be accomplished prior to the development of operations plans for each of the AVC participants with iron filters and NORMs is a formal proposal of work, and if accepted by the CDPHE, implementation of the work plan to characterize and address residuals management as regulated by the Hazardous Materials and Waste Management Section. The work plan would detail

sampling protocols and sample locations, and identify calculations that would be used as the basis of the planning and conducting remediation of residuals related to past and current treatment activities. The work plan would also identify the strategy that would be used to develop engineering plans for those entities that wished to continue operation of their iron filter treatment systems as regulated by Section 9 of the State's Solid Waste Regulations.

**Cost of creating the work plan and conducting the work would likely range from $350,000 to $500,000 for the twenty communities. These costs include planning and developing the work plan, and conducting meetings, and performing sampling, data collection and assessment, negotiations and report writing to implement the work plan and establish results.** Note that one key component of any future permitted treatment operation will likely be for all future backwash water and related sludges to be contained within the property owned and controlled by the private water company. To ensure this is occurring, a property survey may be required to verify meets and bounds. For those entities that do not currently own the property that receive their discharges, costs will likely be incurred to purchase the subject property and/or revise their current operations. Note that costs to conduct site remediation, deep recordation, and/or engineering design of a permitted facility are not included in the estimated cost for this task.

**It is important to note that it is best if all the impacted communities worked together to fund, develop and implement the proposed work plan such that data collection, as well as the resulting analyses and recommendations are consistent for all entities.**

### Related to Future Water Supply

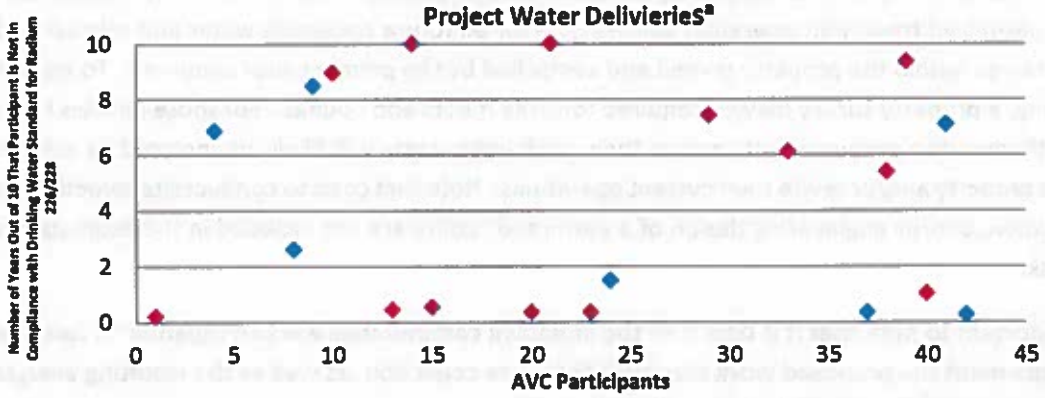
These small entities all plan to utilize the AVC deliveries to blend with their existing groundwater supplies, to the extent practical, such that water delivered to their customers meets the primary drinking water standards. However, the AVC deliveries by their very nature are supplemental and variable. This is particularly evident looking at the variability in the delivery of water related to the Fry-Ark Project, since the allocation to each AVC participant is based on water availability in any given year. To this point, based on the imports to the Project over the past 20 years, the average Project Water allocation to the AVC participants is estimated to be 12% of 44,456 AF, with a standard deviation of over 20,000 AF[7]. With this in mind, the different AVC participants that have NORMs in their water supply that are planning on using blending to be compliant with the drinking water standards may find themselves out of compliance during lean allocation years. Figure 1 illustrates this point showing the percentage of time that the 20 AVC

[7] To predict future project water allocations, it is necessary to establish if past allocations are normally distributed. To do this, past Project Water imports and deliveries to entities east of Pueblo were evaluated for normality. Based on the past record, the annual deliveries east of Pueblo is not completely normally distributed, due to the dynamics of the way in which water is stored and released based on weather conditions, available storage and project yield. To this point, the past record is skewed to the right (i.e., a negative skew factor), or toward more "higher yield" years than "lower yield" years. However, the last 20 years of record produces a skew factor of 0.00, indicated a closer fit to the normal distribution. Therefore, the predictions of future Project Water deliveries were developed based on the past 20 years of data (i.e., 1996 through 2015).

participants with radium 226/228 would be out of compliance if blending with Fry-Ark Project water is the only option for them to achieve the target concentration of 3 pCi/L[8].

Based on this graphic, ten of the 20 entities will be out of compliance at least half of the time, if only Project Water deliveries are available based on the 12% allocation model, and 5 of the entities will be out of compliance more than 80% of the time. None of the shown AVC participants will be in compliance 100% of the time.

**Figure 1 - Drinking Water Compliance for Participants with Radium 226/228 based on Estimated Project Water Delivieries[a]**

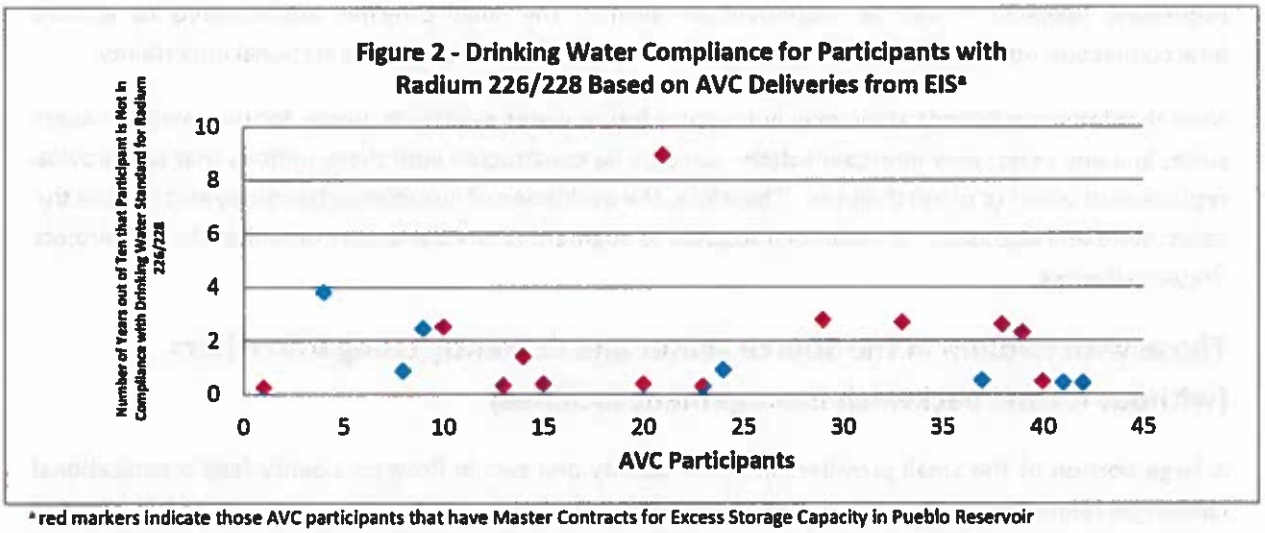



[a] red markers indicate those AVC participants that have Master Contracts for Excess Storage Capacity in Pueblo Reservoir

However, the District foresaw this situation and developed the excess capacity Master Contract component of the EIS, allowing participating entities (shown in red on Figure 1) to store non-project water in excess storage capacity of Pueblo Reservoir, and the subsequent treatment and delivery of that stored water through the AVC to selected project proponents. In addition, the District has created two additional accounts associated with the 12% of Project Water allocated for use east of Pueblo – including not previously allocated non-irrigation water (NPANIW) sources (2.18% of project yield) and a reserve of 3%. These allocations may be used to improve the reliability of drinking water compliance for those participants in need.

To this point, Figure 2 presents that the timing of drinking water compliance for the AVC participants based on AVC deliveries, which include Project and non-project water sources. Based on this figure,

[8] This value, which is below the MCL of 5 pCi/L for radium 226/228, represents a reasonable safety factor accounting for water quality variability in the water source.




[a] red markers indicate those AVC participants that have Master Contracts for Excess Storage Capacity in Pueblo Reservoir

there are still entities that are not in compliance for more than 3 out of ten years, however only one is out of compliance more than half the time, illustrating the importance of these accessory programs that were developed and will be administered by the District.

It is vital to note that the actual future yield of Project and non-project water which will be delivered through the AVC to the various participants will vary dependent upon any number of conditions and that it is likely that, especially for those participants with Master Contracts, that non-compliance will occur at less, and perhaps significantly less, occasions than have be predicted in Figure 2. However, the specific conditions and circumstances that would exist for each participant utilizing both Project and non-project water sources is substantially different, such that further consideration and assessment is a known data gaps for each of the AVC participants and is beyond the scope of this current work authorization. Clearly, at some point in the future, a more rigorous assessment of each of the radium affected AVC participants will have to be made.

## Consideration of Local Interconnections with Large Water Providers

For those small water providers in Otero County and Prowers County that have NORMs impacting the quality of their groundwater sources, costs for storage, Section 9 and other solid waste compliance requirements, and/or alternative water treatment may be cost prohibitive – perhaps as a capital cost, a reoccurring operational cost, or both. For this reason, interconnections with large local water providers may give the small provider an option to reduce concerns related to future operations for potable water deliveries. In many situations, interconnections may be prohibitively expensive due to the combination of tap fees (which can be up to and over $100,000) and the challenges of distance and topography (since most of the private companies are strategically positioned in the top of local high points) may leave local treatment as the most cost effective option. However, the viability of investment needed to create interconnections, which are based on construction costs, operational costs (e.g., pumping), and delivery rates, are negotiated on a case-by-case basis related to each organization and circumstance. The Working Group can assist in the discussions providing information and expertise to the extent reasonable and

requested; however, it will be incumbent on each of the small provider organizations to explore interconnection options individually as a means to control future costs and operational uncertainty.

Note that interconnections alone may not resolve future water availability needs for the small providers since, in many cases, new interconnections can only be constructed with those entities that can provide replacement water to offset their use. Therefore, the evaluation of interconnections may also require the assessment and acquisition of additional supplies to augment future demands not fulfilled by AVC Project Water deliveries.

## Those with Radium in the Source Water and Currently Using Iron Filters (without formal backwash management facilities)

A large portion of the small providers in Otero County and two in Prowers County face organizational challenges related to the management of backwash water, sludge, and residuals management, in part due to the requirements of Section 9 of the State Solid Waste Regulations associated with the operation of iron filters used to satisfy taste and odor and staining concerns of the customers. As with most of the small providers in this area, the deep groundwater withdrawn from the Cheyenne and Dakota formations contain naturally occurring radioactive materials (NORMs) in the form of radium 226 and 228. The combination of iron and radium in the groundwater used by these various organizations dictate future treatment and solid waste management requirements for each of these organizations.

For these organizations, including both those under enforcement orders and those not, continuing to maintain their groundwater production well(s) is an important feature of their future operations. These wells represent not only an important asset associated with past and current investments, but they also provide additional water supply security in times when the AVC is either not delivering water (e.g., short term maintenance, line breakage) or the Fry-Ark Project yield is low. In addition, continuous operation of the wells and the treatment systems are advisable to keep the facilities operationally competent, which includes avoiding upsets related to starting and stopping the pumping and treatment systems. For these reasons, these small water providers impacted by radium are currently expecting to continue their operations much as they do today, taking delivery of the AVC transmissions at their current treatment facilities using existing tankage and/or cisterns to blend the two waters to achieve and maintain compliance with the drinking water standards. The blended water will then be chlorinated and placed into distribution.

To develop a broad estimate of future local costs[9] related to the needs of each of these small water providers, it was assumed that one of three likely options will occur. These options are as follows;

> **Option 1** (use the iron filter systems) – the small providers will achieve drinking water compliance through blending AVC deliveries with local groundwater sources; continuing to use local iron filter systems; and achieving compliance with residuals management requirements and the Section 9 solid water regulations. Under this option, substantial cost is required to create local storage that

[9] Excluding the costs for the federal portion of the AVC, which includes a portion of the connection pipe and the meter and related appurtenances at the connection with each of the AVC Participants.

provides adequate volumes of AVC deliveries during periods of planned AVC maintenance and unplanned line breakage. This option assumes that the small providers will develop adequate future water supplies to allow for blending to accomplish whatever is needed to achieve the primary drinking water standards.

**Option 2** (use radium treatment locally) – the small providers will achieve drinking water compliance through blending AVC deliveries with local groundwater resources and through construction and operation of local radium and iron removal treatment facilities. Local storage is not needed; however, new local treatment facilities will be needed. This option does not necessarily require the individual provider to find additional water for future supplies.

A third option maybe valuable to consider for some, if not all of the AVC participants in this category. This option involves constructing and operating an interconnection between the small water provider and a large local water provider that can provide reliable potable supplies of water for future use. This option was not explored within the limits of this memorandum, due to a number of internal and external factors; however, future efforts to estimate local costs for operations after the AVC becomes operational may benefit from an assessment of interconnection options.

**Option 1 – Blend with the Use of Current Treatment (e.g., Iron Filter Systems)**

This option assumes that blending AVC delivered water with local groundwater supplies will allow all the small water providers to achieve compliance with the primary drinking water standards. **It will be incumbent on each entity to commit the resources needed to fill those data gaps related to residuals management and development of adequate water supply portfolios to ensure that future compliance can be maintained. It is also incumbent on each provider that full compliance with the solid waste regulations occurs such that operations of local iron filter systems are permitted.**

Under this option, additional storage will be required locally to help support local operations in case of a short-term outage – planned or otherwise (e.g., 3 to 7 days) - longer outages or delivery reductions associated with scheduled pipeline maintenance can only be handled with the use of either increased local groundwater production and/or interconnections with larger utilities that have adequate supplies and storage to overcome AVC delivery shortfalls. For those organizations that do not have radionuclides over the MCL, increased groundwater production does not create any compliance issues, as long as the entity can continue to use its iron filters.

For the organizations that do have radionuclides in their source water over the MCL, additional pumping of groundwater may not allow for compliance with the primary drinking water standards. For these organizations, additional storage appears to be the most viable option to address short-term planned pipeline outages (e.g., for maintenance) such that blending needed to maintain compliance with the drinking water standards can continue uninterrupted.

Another possible tact would be for these organizations to operate for some period of time knowingly out of compliance, much as they do today, notifying the State when the conditions occur; however, this option is unsavory for both the State and the local community, and should be avoided if possible.

The cost for these small water providers to connect to the AVC and receive deliveries is not substantial (i.e., $4,000 to 11,000 per organization), depending on the number of connections, the nature of the current infrastructure, and the complexity of the system for most entities have space for the connection and utilize current treatment facilities and such that allow for the ready acceptance and use of the raw water supplied through the pipeline. For those without space and/or without adequate blending storage and contact time for the chlorination, additional costs in the range of $1 per gallon for storage and $1,000 per acre for land may be expected. Some may also have costs related to the removal and upgrading of existing facilities that have outlived their useful life.

The solid waste regulations require that the "impoundments" control storm water run on/runoff, and ensure that the infiltration of backwash water and the impacts of sludge disposal; however slight, do not exceed Basic Standards for Groundwater at the point of compliance (which would be set at the property line of the private water company). The best management practice to achieve this type of requirement is most likely the system that the Town of Cheraw operates – that being an evaporation pond that has zero discharge. Such a pond would need to be sized for the backwash water volume and related storm water impacts; and would require the development and implementation of an Engineering and Design Operations Plan (EDOP). Other options for the impoundment may be available on a case-by-case basis; however, for the purposes of this report, evaporation ponds were considered to support the cost estimating effort.

An estimate of costs to connect and operate storage needed to support future operations in conjunction with the operation of the AVC for those small providers in Otero County and Prowers County are presented in the Tables 11 and 12, respectively. The costs for this option for those small entities in Otero and Prowers Counties are about $4.4 million, with additional storage accounting for about $2.6 million.

Costs related to the appropriate closure of old, non-compliant facilities and the installation of new, compliant facilities will generally require local earthwork and the installation of yard piping, backwash metering, and installation of monitoring wells and HDPE liners based on the pan evaporation rate of about 74 inches per year on average, with a safety factor of 1.5 assuming water would not pool greater than 1 foot on average and 3 feet in extreme wet conditions. The estimated cost for the evaporation ponds and related expenses are provided in Tables 11 and 12.

**Option 2 – Alternative Treatment for Radium**

If the delivery of AVC water with the combined use of one week of storage is not sufficient to keep the small water companies in compliance with the primary and/or secondary drinking water standards, then alternative treatment and disposal facilities may need to be constructed and operated unless interconnections can be constructed and operated. Given that in many situations interconnections may

**Table 11**
**Estimated Costs for Small Otero County Water Providers With Radium in Source Water and Iron Filters to Connect to the AVC - Option 1 (Blend with Use of Iron Filters)**

| Entity | Operational Plan After AVC Operational | Data Gaps | | | Option 1 – Drinking Water and Solid Waste Compliant Operations with Blending | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Work Plan | Data Collection and Assessment[a] | Water Supply Portfolio Assessment | Land Purchase[b] | Engineering Plan[c] | Connection[d] | Current Storage Available (gallons) | Storage Needed (gallons)[e] | Closure Plan/ Implementation[f] | Evaporation Pond[g] | Total |
| Eureka | Blend for Compliance | | $ 20,000 | n/a | $ 1,000 | $ 5,000 | $ 3,000 | 100,000 | 270,000 | $ 20,000 | $ 70,000 | $ 389,000 |
| Fayette | Blend for Compliance | | $ 20,000 | n/a | $ 1,000 | $ 5,000 | $ 3,000 | 32,000 | 36,000 | $ 20,000 | $ 19,000 | $ 104,000 |
| Hilltop | Blend | | $ 20,000 | n/a | $ 1,000 | $ 2,000 | $ 2,000 | 265,000 | 0 | $ 12,000 | $ 56,000 | $ 93,000 |
| Newdale-Grand Valley | Blend | | $ 20,000 | n/a | $ 1,000 | $ 2,000 | $ 2,000 | 450,000 | 0 | $ 12,000 | $ 54,000 | $ 91,000 |
| Patterson | Blend for Compliance | | $ 30,000 | n/a | $ 1,000 | $ 5,000 | $ 3,000 | 28,600 | 49,000 | $ 20,000 | $ 13,000 | $ 121,000 |
| South Swink | Blend for Compliance | | $ 40,000 | n/a | $ 2,000 | $ 8,000 | $ 6,000 | 30,000 | 400,000 | $ 40,000 | $ 112,000 | $ 608,000 |
| Valley | Blend for Compliance | | $ 20,000 | n/a | $ 1,000 | $ 5,000 | $ 3,000 | 120,000 | 74,000 | $ 20,000 | $ 35,000 | $ 158,000 |
| Vroman | Blend for Compliance | | $ 20,000 | n/a | $ 1,000 | $ 5,000 | $ 3,000 | 23,000 | 128,000 | $ 20,000 | $ 28,000 | $ 205,000 |
| West Grand Valley | Interconnect with Newdale-Grand Valley | | $ 20,000 | n/a | $ 0 | $ 5,000 | $ 3,000 | 40,000 | 0 | $ 20,000 | $ 0 | $ 49,000 |
| | | $ 35,000 | $ 210,000 | n/a | $ 9,000 | $ 42,000 | $ 28,000 | | $ 957,000 | $ 184,000 | $ 387,000 | $ 1,818,000 |

[a] Includes collecting soil and backwash samples to characterize nature and extent of residuals from past disposal practices.
[b] Land purchase may be required for those organizations that do not currently have space to operate future treatment facilities including evaporation ponds ($1,000 per acre).
[c] Engineering Plans will be required for submittal to CDPHE describing operations once AVC water is delivered if new or revised treatment and/or storage is implemented
[d] Connection costs include valving and related appurtenances installed by the entity in addition to the meter and valving to be installed by Reclamation
[e] Storage needs based on 7-day supply for planned outages related to pipeline flushing and maintenance based on annual average daily use for those entities requiring blending for compliance, estimated cost at $1 per gallon (adjusted based on percent of AVC water needed to blend with local groundwater supply and achieve 3 pCi/L radium 226/228 in water to customers.
[f] Includes approximately 100 cubic yards of soil removal and placement with compaction, survey, deep recordation, legal, and sampling and analytical costs, assuming no soil requires offsite disposal.
[g] Based on $1.40 per square foot for HDPE Geomembrane Liner and related earthwork plus 25% contingency and 25% cost for yard piping, etc.

**Table 12**
**Estimated Costs for Small Prowers County Water Providers With Radium in Source Water and Iron Filters to Connect to the AVC - Option 1 (Blend with Use of Iron Filters)**

| Entity | Operational Plan After AVC Operational | Data Gaps | | | Option 1 – Drinking Water and Solid Waste Compliant Operations with Blending | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Work Plan | Data Collection and Assessment[a] | Water Supply Portfolio Assessment | Land Purchase[b] | Engineering Plan[c] | Connection[d] | Current Storage Available (gallons) | Storage Needed (gallons)[e] | Closure Plan/ Implementation[f] | Evaporation Pond[g] | Total |
| May Valley | Blend for Compliance | | $ 120,000 | n/a | $ 8,000 | $ 25,000 | $ 6,000 | 720,000 | 1,627,000 | $ 120,000 | $ 560,000 | $ 2,466,000 |
| Wiley, Town of | Blend for Compliance | | $ 20,000 | n/a | $ 1,000 | $ 5,000 | $ 3,000 | 100,000 | 10,000 | $ 20,000 | $ 33,000 | $ 92,000 |
| | | **$ 35,000** | **$ 140,000** | n/a | **$ 9,000** | **$ 30,000** | **$ 9,000** | | **$ 1,637,000** | **$ 140,000** | **$ 593,000** | **$ 2,558,000** |

[a] includes collecting soil and backwash samples to characterize nature and extent of residuals from past disposal practices.
[b] Land purchase may be required for those organizations that do not currently have space to operate future treatment facilities including evaporation ponds ($1,000 per acre).
[c] Engineering Plans will be required for submittal to CDPHE describing operations once AVC water is delivered if new or revised treatment and/or storage is implemented
[d] Connection costs include valving and related appurtenances installed by the entity in addition to the meter and valving to be installed by Reclamation
[e] Storage needs based on 7-day supply for planned outages related to pipeline flushing and maintenance based on annual average daily use for those entities requiring blending for compliance, estimated cost at $1 per gallon (adjusted based on percent of AVC water needed to blend with local groundwater supply and achieve 3 pCi/L radium 226/228 in water to customers.
[f] Includes approximately 100 cubic yards of soil removal and placement with compaction, survey, deep recordation, legal, and sampling and analytical costs, assuming no soil requires offsite disposal.
[g] Based on $1.40 per square foot for HDPE Geomembrane Liner and related earthwork plus 25% contingency and 25% cost for yard piping, etc.

be prohibitively expensive due to the combination of tap fees (which can be up to and over $100,000) and the challenges of distance and topography (since most of the private companies are strategically positioned in the top of local high points), local treatment may be the most cost effective option. A more detailed assessment of interconnections is warranted; however due to the various issues related to evaluating and costing interconnections, an estimate of costs was excluded from this effort.

Past studies have been conducted for all the private water companies that were placed on the Colorado Radionuclide Abatement and Disposal Strategy (CO-RADs) list in 2007. As a result of these past engineering assessments, numerous cost estimates were created to estimate capital and operational costs for each entity. Since those entities that conducted these studies in 2009 do not current have these reports readily available to support this effort, we have based the cost estimate on the report provided to South Swink[10]. Based on the South Swink report, capital costs for cation exchange and evaporation ponds for radium removing treatment system were about $2.1 million. This cost estimate appears high however, given that the evaporation pond is concrete lined. High density polyethylene (HDPE) is substantially more cost effect, reducing the cost to closer to $600,000 which is similar to costs of a recently installed Hydrous Manganese Oxide Filtration (HMOx) system for radium removal in Park County, Colorado. Operational costs are estimated to be about $90,000 per year. Using these costs, it is estimated that capital costs to replace treatment for all 3,000 persons served by the eleven[11] small water providers contained in this category would be in the range of about $7.9 million dollars (see Tables 13 and 14 for a summary of costs). Operational costs would be in the range of $720,000 per year, in additional to the groundwater and distribution pumping costs currently included in the operational budget of each of these organizations.

### Notes on May Valley and the Town of Wiley

Both of these entities are situated in Prowers County north of Lamar. Both organizations have deep groundwater production wells that provide for their drinking water; and in this area, NORMs impact the water produced from the groundwater supply aquifers. These two entities are unique in part based on their geography (since their service areas are immediately adjacent to each other and they both could be connected whole or in part to the City of Lamar's distribution system). May Valley is distinctive due to its large distribution system, which contains nearly 170 mile of distribution pipe, and its large number of production wells (9 in operation, and 10 to 12 available for operation). Wiley on the other hand, has within the last ten years replaced all of its production wells with 2 new wells that are located on the south side of the City of Lamar. These new wells were installed to eliminate the impact of naturally occurring radionuclides in the Town's source water. Although the new wells contain radium 226/228, the levels of radium are below the MCLs.

[10] Future working group efforts should consider collecting these past reports and performing an evaluation of their accuracy and use for future assessments of local conditions and needs.

[11] Costs were included for treatment at all nine small water providers in this category, even though three have radium at levels currently beneath the MCL. Design of the blending (and treatment) facilities would attempt to produce finished water with radium below the MCL due allow for a margin of safety. Since all nine entities have radium above the goal of 3 pCi/L, all three were evaluated for future water treatment systems.

**Table 13**
**Estimated Costs for Small Otero County Water Providers With Radium in Source Water and Iron Filters to Connect to the AVC - Option 2 (Use of Radium Treatment)**

| Entity | Operational Plan After AVC Operational | Data Gaps (same as for Option 1) | | | Option 2 – Drinking Water and Solid Waste Compliant Operations with Radium Treatment | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Work Plan | Data Collection and Assessment[a] | Water Supply Portfolio Assessment | Land Purchase[b] | Engineering Plan[c] | Connection[d] | Current Storage Available (gallons) | Closure Plan/ Implemen-tation[e] | Evaporation Pond[f] | Radium Treatment[g] | Total |
| Eureka | Blend for Compliance | | $ 20,000 | n/a | $ 1,000 | $ 5,000 | $ 3,000 | 100,000 | $ 20,000 | $ 70,000 | $ 385,000 | $ 504,000 |
| Fayette | Blend for Compliance | | $ 20,000 | n/a | $ 1,000 | $ 5,000 | $ 3,000 | 32,000 | $ 20,000 | $ 19,000 | $ 285,000 | $ 353,000 |
| Hilltop | Blend | | $ 20,000 | n/a | $ 1,000 | $ 2,000 | $ 2,000 | 265,000 | $ 12,000 | $ 56,000 | $ 385,000 | $ 478,000 |
| Newdale-Grand Valley | Blend | | $ 20,000 | n/a | $ 1,000 | $ 2,000 | $ 2,000 | 450,000 | $ 12,000 | $ 54,000 | $ 450,000 | $ 541,000 |
| Patterson | Blend for Compliance | | $ 30,000 | n/a | $ 1,000 | $ 5,000 | $ 3,000 | 28,600 | $ 20,000 | $ 13,000 | $ 285,000 | $ 357,000 |
| South Swink | Blend for Compliance | | $ 40,000 | n/a | $ 2,000 | $ 8,000 | $ 6,000 | 30,000 | $ 40,000 | $ 112,000 | $ 600,000 | $ 812,000 |
| Valley | Blend for Compliance | | $ 20,000 | n/a | $ 1,000 | $ 5,000 | $ 3,000 | 120,000 | $ 20,000 | $ 35,000 | $ 385,000 | $ 469,000 |
| Vroman | Blend for Compliance | | $ 20,000 | n/a | $ 1,000 | $ 5,000 | $ 3,000 | 23,000 | $ 20,000 | $ 28,000 | $ 335,000 | $ 412,000 |
| West Grand Valley | Interconnect with Newdale-Grand Valley | | $ 20,000 | n/a | $ 0 | $ 5,000 | $ 3,000 | 40,000 | $ 20,000 | $ 0 | $ 0 | $48 ,000 |
| | | $ 35,000 | $ 210,000 | n/a | $ 9,000 | $ 42,000 | $ 28,000 | | $ 184,000 | $ 387,000 | $ 3,410,000 | $ 3,974,000 |

[a] includes collecting soil and backwash samples to characterize nature and extent of residuals from past disposal practices.
[b] Land purchase may be required for those organizations that do not currently have space to operate future treatment facilities including evaporation ponds ($1,000 per acre).
[c] Engineering Plans will be required for submittal to CDPHE describing operations once AVC water is delivered if new or revised treatment and/or storage is implemented
[d] Connection costs include valving and related appurtenances installed by the entity in addition to the meter and valving to be installed by Reclamation
[e] Includes approximately 100 cubic yards of soil removal and placement with compaction, survey, deep recordation, legal, and sampling and analytical costs, assuming no soil requires offsite disposal.
[f] Based on $1.40 per square foot for HDPE Geomembrane Liner and related earthwork plus 25% contingency and 25% cost for yard piping, etc.
[g] Based on HMOx ion exchange system with evaporation ponds for backwash waste management.

**Table 14**
**Estimated Costs for Small Prowers County Water Providers With Radium in Source Water and Iron Filters to Connect to the AVC - Option 2 (Use of Radium Treatment)**

| Entity | Operational Plan After AVC Operational | Data Gaps (same as for Option 1) | | | Option 2 – Drinking Water and Solid Waste Compliant Operations with Radium Treatment | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Work Plan | Data Collection and Assessment[a] | Water Supply Portfolio Assessment | Land Purchase[b] | Engineering Plan[c] | Connection[d] | Current Storage Available (gallons) | Closure Plan/ Implementation[e] | Evaporation Pond[f] | Radium Treatment[g] | Total |
| May Valley | Blend for Compliance | | $ 160,000 | n/a | $ 8,000 | $ 25,000 | $ 6,000 | 720,000 | $ 160,000 | $ 560,000 | $ 1,725,000 | $ 3,465,000 |
| Wiley, Town of | Blend for Compliance | | $ 20,000 | n/a | $ 1,000 | $ 5,000 | $ 3,000 | 100,000 | $ 20,000 | $ 33,000 | $ 420,000 | $ 502,000 |
| | | $ 35,000 | $ 180,000 | n/a | $ 9,000 | $ 30,000 | $ 9,000 | | $ 180,000 | $ 593,000 | $ 2,145,000 | $ 3,967,000 |

[a] includes collecting soil and backwash samples to characterize nature and extent of residuals from past disposal practices.
[b] Land purchase may be required for those organizations that do not currently have space to operate future treatment facilities including evaporation ponds ($1,000 per acre).
[c] Engineering Plans will be required for submittal to CDPHE describing operations once AVC water is delivered if new or revised treatment and/or storage is implemented
[d] Connection costs include valving and related appurtenances installed by the entity in addition to the meter and valving to be installed by Reclamation
[e] Includes approximately 100 cubic yards of soil removal and placement with compaction, survey, deep recordation, legal, and sampling and analytical costs, assuming no soil requires offsite disposal.
[f] Based on $1.40 per square foot for HDPE Geomembrane Liner and related earthwork plus 25% contingency and 25% cost for yard piping, etc.
[g] Based on HMOx ion exchange system with evaporation ponds for backwash waste management.

Both organizations have in the past operated iron filter systems for at least some of their production wells; removing iron prior to sending the water to distribution. May Valley has five of nine operating groundwater production wells that exceed the MCL for radium 226/228. For this reason, May Valley is unable to comply with the primary drinking water standards for radium in the water that is delivered to many of its customers. These wells are distributed widely over the organization's service area in such a way that only a few of the wells are tied together for treatment, storage or distribution. May Valley operates five iron filter systems, all of which are backwashed regularly and discharged to local roadside ditches.

Wiley's new wells are pumped to the Town for chlorination and iron filtration prior to distribution. Backwash water from the iron filter system is discharged to the Town's wastewater treatment system's evaporation ponds. The integrity of the evaporation ponds with respect to stormwater run on and leakage is currently being evaluated.

Future operations by both May Valley and Wiley once the AVC is operational will require the additional water supplies are available to each to augment AVC deliveries; however, the AVC will provide for only about ½ of the May Valley demand on average, whereas, Wiley on average will be able to meet their needs completely with AVC projected deliveries.

For May Valley, future operational challenges are substantial; given the widespread nature of their distribution system, the lack of radionuclide compliant groundwater sources, and the need for iron removal to allow their source water to adhere to secondary drinking water standards. In addition, the organization maintains chiefly small diameter distribution piping since it is not responsible for fire protection. Therefore, use of current distribution piping to transmit AVC deliveries widely within its distribution system is not feasible. New distribution piping in conjunction with new treatment facilities may be required. For these reasons, connecting to the AVC at two locations, as planned and blending selected well water with AVC deliveries will not completely resolve the enforcement order issues that the organization currently must address.

Developing options for May Valley with respect to future operations once AVC deliveries are occurring such that drinking water and solid waste regulatory compliance is maintained is a complex process that is still being assessed. Past engineering studies performed for May Valley have evaluated local and regional treatment solutions, and direct connections with the Town of Wiley and the City of Lamar; however those evaluations were not necessarily conceived with 100% compliance as a goal. To this point, costs for May Valley's future connection to the AVC included connections, piping, storage and treatment, like the other entities discussed herein, will require additional analysis. What is known for May Valley, which is different than the circumstance at every other location, is that substantial subsurface infrastructure, including piping and interconnections will most likely be required to bring this organization's system into compliance; even if blending is possible for all the wells that are currently out of compliance.

For Wiley, operations with the AVC should be fairly straightforward now that the Town is in compliance with the radionuclides. The bigger issue for the Town will involve balancing the cost of AVC water,

including OM&R and delivery costs, with the cost of installing an interconnect with the City of Lamar to meet the Town's potable water needs. The Town currently has somewhat expensive water since it is pumped from wells in the southern portion of Lamar and treated in Wiley prior to delivery. In addition, the wells that Wiley has recently installed have detectable levels of radium 226/228, such that a slight increase from current levels may take the wells out of compliance. To create a more sustainable water supply, a combination of AVC water with an interconnection with Lamar may be the best opportunity for the Town.

## Those with Radium in the Source Water and Currently Using Iron Filters (with wastewater treatment facilities receiving the filter backwash)

The Towns of Cheraw and Manzanola have more sophisticated operations than the previously listed group of private water providers, in part because they are required to collect and treat domestic wastewater. For this reason, iron filters used to treat produced groundwater are backwashed to the two Town's wastewater treatment facility – which for Manzanola is an engineered wetland, and for Cheraw is a set of evaporation lagoons. Because these wastewater treatment facilities are in use to manage the backwash and related sludge from the iron filters, the need for an evaporation pond, as indicated in Option 1 for the previous group is considered unnecessary. Option 2, which includes the cost for local radium treatment also relies on these existing facilities to reduce implementation costs.

All future options for both Manzanola and Cheraw the site assessment and closure plan for residuals management that may be relevant based on the State's residuals management requirements. The costs for these two entities are summarized in Tables 15 and 16 for Options 1 and 2, respectively.

## Those with Radium in the Source Water but Not Currently Using Iron Filters

There are six small private water providing organizations in Otero County plus the Town of Swink that do not currently utilize iron filters or any other water treatment beyond chlorination prior to pumping the produced groundwater to distribution[12]. They are typically located in areas north and west of La Junta, but not necessarily in locations that are easily connected to the La Junta distribution system (noting that both the Town of Swink and Homestead will rely upon an interconnection with La Junta to address their current and future water supply quality concerns). Therefore, these organizations are expected to look to use AVC deliveries to blend with current groundwater supplies to achieve compliance and improve the quality of their water deliveries. Some of these organizations do not currently provide their customers with water for drinking and cooking due to the lack of available high quality sources and the cost of treatment. In all, the six private water organizations provide water to about 460 persons; whereas the Town of Swink provides water to about 660 persons.

Tables 17 and 18 present the estimated costs for each of these entities to come into compliance in the future with the pertinent regulations assuming that blending will occur continuously without interruption. Note that due to the current interconnections that Homestead and the Town of Swink have with La Junta,

[12] Note that the Town of Swink had operated iron filters in the past, but recently changed to blend its well water with City of La Junta water to achieve compliance with the drinking water regulations and eliminate the solid waste compliance issues.

**Table 15**
**Estimated Costs for Cheraw and Manzanola to Connect to the AVC - Option 1 (Blend with Current Treatment)**

| Entity | Operational Plan After AVC Operational | Data Gaps | | | Option 1 – Drinking Water and Solid Waste Compliant Operations with Blending | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Work Plan | Data Collection and Assessment[a] | Water Supply Portfolio Assessment | Land Purchase[b] | Engineering Plan[c] | Connection[d] | Current Storage Available (gallons) | Storage Needed (gallons)[e] | Closure Plan/ Implementation[f] | Evaporation Pond[g] | Total |
| Cheraw, Town of | Blend for Compliance | | $ 20,000 | n/a | $ 0 | $ 5,000 | $ 3,000 | 196,000 | 36,000 | $ 20,000 | $ 0 | $ 84,000 |
| Manzanola, Town of | Blend for Compliance | | $ 20,000 | n/a | $ 0 | $ 5,000 | $ 3,000 | 272,000 | 0 | $ 20,000 | $ 0 | $ 48,000 |
| | | $ 35,000 | $ 40,000 | n/a | $ 0 | $ 10,000 | $ 6,000 | | $ 36,000 | $ 40,000 | $ 0 | $ 132,000 |

[a] includes collecting soil and backwash samples to characterize nature and extent of residuals from past disposal practices.
[b] Land purchase may be required for those organizations that do not currently have space to operate future treatment facilities including evaporation ponds ($1,000 per acre).
[c] Engineering Plans will be required for submittal to CDPHE describing operations once AVC water is delivered if new or revised treatment and/or storage is implemented
[d] Connection costs include valving and related appurtenances installed by the entity in addition to the meter and valving to be installed by Reclamation
[e] Storage needs based on 7-day supply for planned outages related to pipeline flushing and maintenance based on annual average daily use for those entities requiring blending for compliance, estimated cost at $1 per gallon (adjusted based on percent of AVC water needed to blend with local groundwater supply and achieve 3 pCi/L radium 226/228 in water to customers.
[f] Includes approximately 100 cubic yards of soil removal and placement with compaction, survey, deep recordation, legal, and sampling and analytical costs, assuming no soil requires offsite disposal.
[g] Based on $1.40 per square foot for HDPE Geomembrane Liner and related earthwork plus 25% contingency and 25% cost for yard piping, etc.

**Table 16**
**Estimated Costs for Cheraw and Manzanola to Connect to the AVC - Option 2 (Use of Radium Treatment)**

| Entity | Operational Plan After AVC Operational | Data Gaps (same as for Option 1) | | | Option 2 – Drinking Water and Solid Waste Compliant Operations with Radium Treatment | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Work Plan | Data Collection and Assessment[a] | Water Supply Portfolio Assessment | Land Purchase[b] | Engineering Plan[c] | Connection[d] | Current Storage Available (gallons) | Closure Plan/ Implementation[e] | Evaporation Pond[f] | Radium Treatment[g] | Total |
| Cheraw, Town of | Blend for Compliance | | $ 20,000 | n/a | $ 0 | $ 5,000 | $ 3,000 | 196,000 | $ 20,000 | $ 0 | $ 320,000 | $ 368,000 |
| Manzanola, Town of | Blend for Compliance | | $ 20,000 | n/a | $ 0 | $ 5,000 | $ 3,000 | 272,000 | $ 20,000 | $ 0 | $ 380,000 | $ 428,000 |
| | | $ 35,000 | $ 40,000 | n/a | $ 0 | $ 10,000 | $ 6,000 | | $ 40,000 | $ 0 | $ 700,000 | $ 796,000 |

[a] includes collecting soil and backwash samples to characterize nature and extent of residuals from past disposal practices.
[b] Land purchase may be required for those organizations that do not currently have space to operate future treatment facilities including evaporation ponds ($1,000 per acre).
[c] Engineering Plans will be required for submittal to CDPHE describing operations once AVC water is delivered if new or revised treatment and/or storage is implemented
[d] Connection costs include valving and related appurtenances installed by the entity in addition to the meter and valving to be installed by Reclamation
[e] Includes approximately 100 cubic yards of soil removal and placement with compaction, survey, deep recordation, legal, and sampling and analytical costs, assuming no soil requires offsite disposal.
[f] Based on $1.40 per square foot for HDPE Geomembrane Liner and related earthwork plus 25% contingency and 25% cost for yard piping, etc.
[g] Based on HMOx ion exchange system with evaporation ponds for backwash waste management.

**Table 17**
**Estimated Costs for Small Providers in Otero with Radium in Source Water but Without Iron Filters to Connect to the AVC - Option 1 (Blend with Current Treatment)**

| Entity | Operational Plan After AVC Operational | Data Gaps | | | Option 1 – Drinking Water and Solid Waste Compliant Operations with Blending | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Work Plan | Data Collection and Assessment[a] | Water Supply Portfolio Assessment | Land Purchase[b] | Engineering Plan[c] | Connection[d] | Current Storage Available (gallons) | Storage Needed (gallons)[e] | Closure Plan/ Implementation[f] | Evaporation Pond[g] | Total |
| Beehive | Blend | | $ 20,000 | n/a | $ 0 | $ 5,000 | $ 6,000 | 42,000 | 0 | $ 20,000 | $ 0 | $ 51,000 |
| East End | Blend for Compliance | | $ 20,000 | n/a | $ 0 | $ 5,000 | $ 3,000 | 6,000 | 29,000 | $ 20,000 | $ 0 | $ 77,000 |
| Holbrook Center | Blend for Compliance | | $ 20,000 | n/a | $ 0 | $ 5,000 | $ 3,000 | 15,000 | 61,000 | $ 20,000 | $ 0 | $ 109,000 |
| Homestead | Blend/Interconnection with La Junta | | $ 20,000 | n/a | $ 0 | $ 5,000 | $ 3,000 | n/a | 0 | $ 20,000 | $ 0 | $ 48,000 |
| North Holbrook | Blend for Compliance | | $ 20,000 | n/a | $ 0 | $ 5,000 | $ 3,000 | 14,000 | 13,000 | $ 20,000 | $ 0 | $ 61,000 |
| Swink, Town of | Blend/Interconnection with La Junta | | $ 20,000 | n/a | $ 0 | $ 5,000 | $ 3,000 | 225,000 | 0 | $ 20,000 | $ 0 | $ 48,000 |
| West Holbrook | Blend | | $ 20,000 | n/a | $ 0 | $ 5,000 | $ 3,000 | 5,000 | 0 | $ 20,000 | $ 0 | $ 48,000 |
| | | $ 35,000 | $ 140,000 | n/a | $ 0 | $ 35,000 | $ 24,000 | | $ 103,000 | $ 140,000 | $ 0 | $ 442,000 |

[a] Includes collecting soil and backwash samples to characterize nature and extent of residuals from past disposal practices.
[b] Land purchase may be required for those organizations that do not currently have space to operate future treatment facilities including evaporation ponds ($1,000 per acre).
[c] Engineering Plans will be required for submittal to CDPHE describing operations once AVC water is delivered if new or revised treatment and/or storage is implemented
[d] Connection costs include valving and related appurtenances installed by the entity in addition to the meter and valving to be installed by Reclamation
[e] Storage needs based on 7-day supply for planned outages related to pipeline flushing and maintenance based on annual average daily use for those entities requiring blending for compliance, estimated cost at $1 per gallon (adjusted based on percent of AVC water needed to blend with local groundwater supply and achieve 3 pCi/L radium 226/228 in water to customers.
[f] Includes approximately 100 cubic yards of soil removal and placement with compaction, survey, deep recordation, legal, and sampling and analytical costs, assuming no soil requires offsite disposal.
[g] Based on $1.40 per square foot for HDPE Geomembrane Liner and related earthwork plus 25% contingency and 25% cost for yard piping, etc.

**Table 18**
**Estimated Costs for Small Providers in Otero with Radium in Source Water but Without Iron Filters to Connect to the AVC - Option 2 (Use Radium Treatment)**

| Entity | Operational Plan After AVC Operational | Data Gaps (same as for Option 1) | | | Option 2 – Drinking Water and Solid Waste Compliant Operations with Radium Treatment | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Work Plan | Data Collection and Assessment[a] | Water Supply Portfolio Assessment | Land Purchase[b] | Engineering Plan[c] | Connection[d] | Current Storage Available (gallons) | Closure Plan/ Implementation[e] | Evaporation Pond[f] | Radium Treatment[g] | Total |
| Beehive | Blend | | $ 20,000 | n/a | $ 0 | $ 5,000 | $ 6,000 | 42,000 | $ 20,000 | $ 0 | $ 285,000 | $ 336,000 |
| East End | Blend for Compliance | | $ 20,000 | n/a | $ 0 | $ 5,000 | $ 3,000 | 6,000 | $ 20,000 | $ 0 | $ 285,000 | $ 333,000 |
| Holbrook Center | Blend for Compliance | | $ 20,000 | n/a | $ 0 | $ 5,000 | $ 3,000 | 15,000 | $ 20,000 | $ 0 | $ 285,000 | $ 333,000 |
| Homestead | Blend/Interconnection with La Junta | | $ 20,000 | n/a | $ 0 | $ 5,000 | $ 3,000 | n/a | $ 20,000 | $ 0 | Not needed | $ 48,000 |
| North Holbrook | Blend for Compliance | | $ 20,000 | n/a | $ 0 | $ 5,000 | $ 3,000 | 14,000 | $ 20,000 | $ 0 | $ 285,000 | $ 333,000 |
| Swink, Town of | Blend/Interconnection with La Junta | | $ 20,000 | n/a | $ 0 | $ 5,000 | $ 3,000 | 225,000 | $ 20,000 | $ 0 | Not needed | $ 48,000 |
| West Holbrook | Blend | | $ 20,000 | n/a | $ 0 | $ 5,000 | $ 3,000 | 5,000 | $ 20,000 | $ 0 | $ 285,000 | $ 333,000 |
| | | $ 35,000 | $ 140,000 | n/a | $ 0 | $ 35,000 | $ 24,000 | | $ 140,000 | $ 0 | $ 1,425,000 | $ 1,764,000 |

[a] includes collecting soil and backwash samples to characterize nature and extent of residuals from past disposal practices.
[b] Land purchase may be required for those organizations that do not currently have space to operate future treatment facilities including evaporation ponds ($1,000 per acre).
[c] Engineering Plans will be required for submittal to CDPHE describing operations once AVC water is delivered if new or revised treatment and/or storage is implemented
[d] Connection costs include valving and related appurtenances installed by the entity in addition to the meter and valving to be installed by Reclamation
[e] Includes approximately 100 cubic yards of soil removal and placement with compaction, survey, deep recordation, legal, and sampling and analytical costs, assuming no soil requires offsite disposal.
[f] Based on $1.40 per square foot for HDPE Geomembrane Liner and related earthwork plus 25% contingency and 25% cost for yard piping, etc.
[g] Based on HMOx ion exchange system with evaporation ponds for backwash waste management.

they do not need to consider developing local radium treatment to achieve compliance under Option 2. **It will incumbent on each entity to commit the resources needed to fill those data gaps related to residuals management and development of adequate water supply portfolios to ensure that future compliance can be maintained.**

Given that none of these organizations utilize iron filters currently to treat water, none of the organizations need to be concerned with compliance with Section 9 of the Solid Waste Regulations, unless new treatment systems are need to maintain system compliance. Therefore, Option 1 involves each organization making connections to existing cisterns and tankage to allow for chlorination (Beehive has three connections), blending with existing production wells, and pumping to distribution.

## Summary of Costs

The cost estimates presented in this memorandum have been characterized in discussions with the AVC participants as 'book-ends" relating to how the estimates can be used to provide a range of potential costs that the AVC participants will need to provide or find independent of the federal funding needed to design and construct the AVC. Although the values contained herein do provide a range of sorts related to potential costs, the more instructive use of the estimates relates to the impact of the various applicable regulations on the local costs to implement. Depending on the manner in which the primary drinking water standards and the Solid Waste Regulations are interpreted and incorporated into the compliance requirements for the AVC participants – especially those with NORMs – the range of costs could possibly double or triple.

A summary of the cost estimates provided in this memorandum are summarized in Table 19, followed by a discussion of various relevant topics that may impact, potentially dramatically, the outcome of the ongoing investigations and assessment into those costs needed for the AVC participants to operate in conjunction with the AVC deliveries at some point in the future.

Note that the costs presented in this document are rough costs that have been developed to support a broad assessment of potential future costs external to those cost that will be incurred and covered by the Federal Government in constructing the AVC. The cost estimates presented herein and summarized in Table 19 have been developed using placeholders and estimated costs from various noted sources to help establish a sense of the order of magnitude of the potential future costs for local entities to be prepare for and to connect to the AVC. Operational costs have not been included at this time; however, there are occasions within this document when operational costs have been alluded to in support of the narrative. Once a better understanding of the regulatory circumstances has been ascertained, a more rigorous cost estimate of capital and operational costs can be developed.

**Table 19**
**Summary of Estimated Costs**

| Entity | Operational Option | Basic Connection Option | Option 1 Cost | Option 2 Cost | % AVC required to meet MCL for radium 226/228 | |
|---|---|---|---|---|---|---|
| | | | Blend With Current Treatment[1] | Alternative treatment for Radium 226/228 | w/ safety margin | w/o safety margin |
| **Large Water Providers** | | | | | | |
| La Junta, City of | Blend | $ 10,000 | | | | |
| Lamar, City of | Blend | 10,000 | | | | |
| Las Animas, City of | Blend | 10,000 | | | | |
| Rocky Ford, City of | Blend | 20,000 | | | | |
| St. Charles Mesa WD | Blend | 10,000 | | | | |
| | subtotal | **$ 60,000** | | | | |
| | | | | | | |
| **Connections with Crowley County Commissioners Wells** | | | | | | |
| 96 Pipeline Company | Blend/Interconnect with CCC (6 connections) | $ 23,000 | | | | |
| Crowley County Water Authority | Blend/Interconnect with CCC | 8,000 | | | | |
| Crowley, Town of | Blend/Interconnect with CCC | 8,000 | | | | |
| Ordway, Town of | Blend/ Interconnect with Town Wells | 8,000 | | | | |
| | subtotal | **$ 47,000** | | | | |
| | | | | | | |
| **Small AVC Participants Without Radium in Source Water** | | | | | | |
| Eads, Town of | Blend | $ 8,000 | | | | |
| Hasty Water Company | Blend/Interconnect with McClave | 8,000 | | | | |
| McClave Water Association | Blend/Interconnect with Hasty | 8,000 | | | | |
| Olney Springs, Town of | 100% AVC/ Interconnect with CCC[2] | 8,000 | | | | |
| Sugar City, Town of | Blend | 8,000 | | | | |
| Bents Fort | Blend/Interconnection with La Junta | 8,000 | | | | |
| South Side | Blend | 8,000 | | | | |
| | subtotal | **$ 56,000** | | | | |
| | | | | | | |
| **Participants under GUDI Orders** | | | | | | |
| Boone | Blend once Surface Water Treatment Compliant | $ 1,500,000 | | | | |
| Fowler | Blend once Surface Water Treatment Compliant | 2,000,000 | | | | |
| | subtotal | **$ 3,500,000** | | | | |

**Table 19 (continued)**
**Summary of Estimated Costs**

| Entity | Operational Option | Basic Connection Option | Option 1 Cost | Option 2 Cost | % AVC required to meet MCL for radium 226/228 | |
|---|---|---|---|---|---|---|
| | | | Blend With Current Treatment[1] | Alternative treatment for Radium 226/228 | w/ safety margin | w/o safety margin |
| **Small Water Providers in Otero County with Radium in Source Water and Iron Filters** | | | | | | |
| Eureka | Blend for Compliance | | $ 389,000 | $ 504,000 | 80% | 67% |
| Fayette | Blend for Compliance | | $ 104,000 | $ 353,000 | 81% | 69% |
| Hilltop | Blend | | $ 93,000 | $ 478,000 | 14% | |
| Newdale Grand Valley | Blend | | $ 91,000 | $ 541,000 | 14% | |
| Patterson | Blend for Compliance | | $ 121,000 | $ 357,000 | 83% | 71% |
| South Swink | Blend for Compliance | | $ 608,000 | $ 812,000 | 77% | 62% |
| Valley | Blend for Compliance | | $ 158,000 | $ 469,000 | 73% | 55% |
| Vroman | Blend for Compliance | | $ 205,000 | $ 412,000 | 77% | 62% |
| West Grand Valley | Blend/Interconnect with Newdale Grand Valley | | $ 49,000 | $48 ,000 | 14% | |
| | subtotal | | **$ 1,818,000** | **$ 3,974,000** | | |
| | | | | | | |
| **Small Water Providers in Prowers County with Radium in Source Water and Iron Filters** | | | | | | |
| May Valley | Blend for Compliance | | $ 2,466,000 | $ 3,465,000 | 85% | 74% |
| Wiley, Town of | Blend for Compliance | | $ 92,000 | $ 502,000 | 25% | |
| | subtotal | | **$ 2,558,000** | **$ 3,967,000** | | |
| | | | | | | |
| **Small Water Providers in Otero County with Radium in Source Water and Iron Filters and Waste Treatment Facilities** | | | | | | |
| Cheraw, Town of | Blend for Compliance | | $ 84,000 | $ 368,000 | 54% | 23% |
| Manzanola, Town of | Blend for Compliance | | $ 48,000 | $ 428,000 | 25% | |
| | subtotal | | **$ 132,000** | **$ 796,000** | | |
| | | | | | | |
| **Small Water Providers in Otero County with Radium in Source Water and No Iron Filters** | | | | | | |
| Beehive | Blend | | $ 51,000 | $ 336,000 | 14% | |
| East End | Blend for Compliance | | $ 77,000 | $ 333,000 | 45% | |
| Holbrook Center | Blend for Compliance | | $ 109,000 | $ 333,000 | 63% | 38% |
| Homestead | Blend/Interconnection with La Junta | | $ 48,000 | $ 48,000 | 25% | |
| North Holbrook | Blend for Compliance | | $ 61,000 | $ 333,000 | 45% | 9% |
| Swink, Town of | Blend/Interconnection with La Junta | | $ 48,000 | $ 48,000 | 33% | |
| West Holbrook | Blend | | $ 48,000 | $ 333,000 | 14% | |
| | subtotal | | **$ 442,000** | **$ 1,764,000** | | |
| | | | | | | |
| | **Totals** | **$ 3,663,000** | **$ 4,950,000** | **$ 10,501,000** | | |

[1] includes use of current treatment. For the case of small providers that have radium in the source water and currently utilize iron filters, costs under Option 1 includes installing evaporation ponds to maintain compliance with the State Solid Waste Regulations.

# Attachment Addressing Other Considerations

## Point of Use/Point of Entry Treatment Options

Point-of-entry/point-of-use (POE/U) treatment for removal of radium 226/228 has not received support from the CDPHE given that it is difficult to administer and operate in such a way that guarantees effective and appropriate installation and maintenance of the technology (i.e., under kitchen sink treatment systems in all customer homes). Nonetheless, EPA guidance indicates that for very small water systems (those serving fewer than ca. 500 persons), POE/U may provide a low-cost alternative to centralized treatment. However, POE/U devices have disadvantages to their use and so are generally used only when a centralized treatment facility is not technically or financially feasible for a water system. POE/U units are required by the Safe Drinking Water Act (SDWA) to be "owned, controlled, and maintained by the public water system or by a person under contract with the public water system to ensure proper operation and maintenance and compliance with the MCL or treatment technique and equipped with mechanical warnings to ensure that customers are automatically notified of operational problems."

## Operational Costs

The implementation of the AVC will, in many cases, remove and/or substantially reduce the need for groundwater pumping to support local water supply needs. The reduction in groundwater pumping will reduce the energy required to meet local water demands, as long as the AVC conveyed water is delivered to the local water provider in a manner consistent with current distribution system requirements. For example, many small private water providers pump groundwater to cisterns and/or other tankage prior to either treatment or distribution or both. For these systems, AVC deliveries that are placed into the cisterns and/or tankage essentially eliminate the cost of producing groundwater, to the extent that the AVC water is available. On the other hand, some small systems pump directly to distribution, without tankage or cisterns. For these systems, new costs related to storing and pumping the AVC deliveries will occur offsetting the saving in groundwater production.

Another, costlier issue relates to those entities that will need to install water treatment facilities in order to maintain drinking water compliance once the AVC is operational. These organizations will have increased operational costs in spite of the AVC deliveries. Future analyses conducted as part of the Working Group will evaluate operational cost impacts related to the AVC once a better understanding of future drinking water and solid waste regulatory compliance has been developed.

## Impact of Transitioning from Ground Water to Surface Water Treatment Monitoring for AVC Participants

For large water providers that are AVC participants, and for many of the mid to small water providers, current standard operating procedures include daily water sample collection and analysis (typically colorimetric for chlorine) and weekly, if not monthly for other water quality parameters. However, there are a number of small private water providers that operate using volunteer labor that do not currently sample daily, and will find that the future requirement to do so once the AVC is operational is onerous. This is due to the fact that the small providers that are operating groundwater systems have one set of sampling requirements and once they begin receiving AVC deliveries, they will be operating a surface water system, which require daily sampling of at least chlorine residuals in the distribution system.

There will be an additional cost for the sampling and for many of the small private organizations, not only are financial resources tight, available skilled labor is non-existent and is therefore unavailable. Therefore, the new sampling and reporting requirements for many small private water providers will become a future compliance issue as the AVC becomes operational.

## Potential for Ground Water under the Influence of Surface Water to Impact Others in Lower Arkansas River Valley

Recently (November 2014), the CDPHE issued enforcement orders to the Towns of Boone and Fowler related to the operation of their current groundwater production wells. These wells, like a number of other water supply wells in the Lower Arkansas River valley, are located in the alluvial aquifer situated close to the river (and/or its tributaries). Due to the well's proximity to the river, and the known presence of cryptosporidium and other water borne pathogens in the river, the CDPHE has required that both Towns install and operate new water treatment systems to remove known pathogens, with planning required to be underway by first Quarter 2016 (see previous discussion of Boone and Fowler).

It is possible that the CDPHE will find similar concerns with other alluvial systems (e.g., Crowley County Commissioner wells, Rocky Ford) in the future given the proximity of those community's wells to the river and its tributaries. Such findings may require that new treatment facilities be built in addition to the construction and operation of the AVC.