**Water Plan Alternatives Comparison**

First, lets start by looking at the costs for the existing scheme from the permit support document.

| | |
|---|---|
| Ragged Mountain Dam – 45 foot increase | $36,450,000 |
| SFRR to RMR 36 inch Pipeline, pump stations, pretreatment | $55,350,000 |
| RMR to Observatory Pipeline (30 inch) | $8,550,000 |
| Observatory WTP Upgrade to 10mgd | $21,300,000 |
| South Fork upgrade to 16mgd | $9,000,000 |
| 50-Year Raw Water Pumping Cost (Electricity) | $12,300,000 |
| **Total Project Cost** | **$142,850,000** |

Note there are several major expenses missing from the $142 million estimate [1], including:

- The annual cost of chemicals used for turbidity removal (sodium permanganate, aluminum suIfate, polymer, and caustic soda)
- Annual costs for removing the resulting sludge
- Maintenance for the pumps and pipeline.
- No budget for "maintenance" dredging (even though everyone now says that this will happen)
- Pipeline easement costs may be off by as much as 10-fold. They assume $10 per linear foot (or 40 cents a square foot for a 25' wide permanent easement, plus an additional 15' for construction). Thats an average of $3772 for each of 66 properties.
- It is not assured that the pipeline can be laid across the bypass right of way as assumed in the estimate, especially if the road is not built and VDOT proposes a "sell back"

**So what can we do to create an alternative plan that is less expensive and less environmentally damaging?** Fortunately, we have several better options. We start by looking at the assumptions about the demand goals in the current scheme.

**Gannett Fleming's demand figures are based on several erroneous numbers** [2]

- Population projection for 2055 is 7% higher than the accepted VEC projections
- Demand is based on a 5% conservation target – our adopted local plan uses 10-15%
- Projection used a baseline calculated from 2001 demand data (11.08 mgd). Since then, conservation has caused our water demand to DROP to 9.98 mgd in 2007

**Using the adjusted 'reality based' demand data**

- reduces the 2055 demand from 18.7 mgd to **16.2 mgd**
- reduces the projected 50 year deficit from 9.9 mgd to **7.4 mgd**

This does not require any radical conservation effort. It simply brings our projected demand in line with common sense and historical observations. It would certainly be possible to be a lot more aggressive with conservation, but reducing by 2.5 mgd is simply trimming the fat.

Now we know that by dredging the South Fork Reservoir to its original capacity and keeping it maintained, **we can increase the 2055 safe yield by 5.5mgd**. Even if we just "maintenance" dredge to maintain the reservoir at its current level (which everyone now claims will happen, although there is no money in the current budget) we will increase the 2055 safe yield by 4 mgd.

Given that dredging is an affordable and environmentally responsible way to gain 5.5 mgd of safe yield by 2055, how do we make up the additional 1.9mgd to meet the 2055 demand? Or, if we insist on returning to our water hogging ways of the 1990's (as Gannett Flemming advocates) how do we make up the additional 4.4 mgd?

**Elements which can be used to create additional safe yield**

Most of these elements have been analyzed as part of the alternative analyses and were rejected because they did not by themselves fulfill the 50 year safe yield objective. However, combined with 5.5 mgd from dredging they can meet the need with less cost and less environmental impact

- **Further Demand reduction beyond 2.5mgd** [3] – Cost: $2.5M Yield: 1.5mgd
- **Dead Storage Drawdown from SFFR** [4] – Cost: $1M. Yield: 1.0 to 1.5mgd
- **Release from Beaver Creek** [5] – Cost: $500,000 Yield: 0.8 to 1.3mdg
- **Release from Lake Albemarle** [5] – Cost: $500,000 Yield: 0.7 mgd
- **5 foot drawdown from Chris Green Lake** [5] – Cost: $500,000 Yield: 0.5 mgd
- **Dredge beyond original SFRR contours** [6] – Cost: $7M per mgd Yield: 0.5 to 2.0mgd
- **Raise RMR to 13 feet on existing base** [7] – Cost: $11M Yield: 1.8 mgd
- **Raise RMR to 13 feet on new base** [7] – Cost: $20M Yield: 1.8 mgd
- **Raise RMR to 19 feet on new base** [7] – Cost: $28M Yield: 3.0 mgd

It should be obvious that there are a number of ways that the above options can be combined to provide the additional 1.9 mgd. Choosing the best combination is a matter of prioritizing community values. However any combination of these elements is less expensive and less environmentally damaging than the current scheme.

**Other Elements which would need to be part of a 50 year plan**

- **South Fork WTP upgrade** – The existing scheme anticipates that the SFRR WTP will be upgraded to 16mgd, with a budgeted cost for this project is $9M, which we believe is appropriate. Depending on the options chosen, it may be desirable to increase the capacity to 18mdg at a cost of $12M.
- **Observatory WTP upgrade** – The existing scheme anticipates that this WTP will be upgraded from 4mgd to 10mgd, with a budgeted cost of $21.3M, which we believe is excessive. We believe that the WTP should either be renovated at its current capacity at a cost of $6M or, if RMR is expanded, the WTP should be expanded to either 6mgd at a cost of $10M or to its currently permitted capacity of 7mgd, at a cost of $12M. These figures are based on similar expansions which have occurred at SFRR WTP, and allowing for inflation.
- **RMR to Observatory Pipeline** – The existing scheme anticipates that this pipeline will be upgraded from 18 inches to 30 inches, with a budgeted cost of $8.5M, which we believe is excessive. We believe that the pipeline should either be replaced at its current capacity at a cost of $4M or, if RMR is expanded, the pipeline should be upgraded to 24 inches (to carry up to 7mgd) at a cost of $6M.
- **Pipeline to Fill Ragged Mountain Reservoir** – The existing scheme anticipates that the current pipeline from Sugar Hollow will be replaced with a new 36 inch pipeline, pumps and pretreatment facility with a total capital cost $55M and operational costs of $12.3M. We believe that this is fiscally and environmentally reckless and that these costs do not reflect the true costs of the project [1]. We believe that the pipeline should either be replaced at its current capacity at a cost of $16.2M or expanded to 24 inches (which would carry up to 7mgd) at a cost of $20M. Our cost numbers are based on Gannett Flemming's raw pipeline cost of $13M for an 18 inch pipe. Because the pipeline can be built in existing right of way and is essentially a replacement project which can be put out to bid with little additional engineering, we used a multilipier of 1.25 instead of the usual 1.5 which Gannett Flemming uses for engineering and 'contingencies'.

**What About the Moormans River and other Steam Flows?**

We believe that the current 'voluntary' release of 0.4mgd is not environmentally responsible and we are committed to maintaining at least the minimum flows specified in the DEQ permit of 2mgd. (note - to increase minimum instream flow in the Moormans by 1.6mgd requires that we allocate approximately 0.5mgd of safe yield for this purpose). We also propose that our drought conservation plan should be modified so that during the "voluntary" stages of drought response, half of all community water reduction beyond the 5 percent reduction anticipated by the plan shall be returned to the Moormans River. We believe this will result in a likely additional flow of at least 1mgd to the Moormans as well as greater participation by the community during voluntary drought restrictions.

We do not however believe that the community should take no drinking water at all from the Moormans, as the current scheme anticipates. We have repeatedly been told by the Virginia Department of Health [8] that the Moormans river is by far our cleanest source of water and should be utilized to its maximum extent. All other sources of water in our system except the Moormans are rated "highly susceptible to contamination". By diverting some of the Moormans while it is still clean, we have better quality drinking water and cheaper cost of treatment. It's interesting that during all this debate about preserving the health of aquatic species, the health of human species has been totally ignored. Furthermore, while a stated goal of the current scheme is to restore the natural flow of the Moormans, the reality is a little different. The watershed for the Moormans is high and steep, which means that the natural condition of the river is very flashy. During a storm it becomes a raging flood and then it slows to a trickle. While the current plan keeps the Sugar Hollow dam in place for flood control purposes, in a drought the water behind the dam is released into the river where it augments the natural flow on its way to the South Fork reservoir (picking up e coli, fertilizer, and other contaminants on its way). So rather than providing natural flow to the Moormans, the current scheme is more like a theme park river – not too dangerous when it rains and has an unnaturally elevated amount water when it would normally be dry.

We do believe that flow gauges should be put on the Moormans River and Rivanna Rivers at once. It is outrageous that for the past six years while we have talked about restoring the Moormans River to something closer to its original flow, nothing has been done to actually measure the natural flow. All of our "data" concerning what we think the natural flow of the Moormans ought to be is based on the Mechums river – a river with very different flow characteristics than the Moormans.

**So what are some better alternatives?**

So back to the question of how much does an alternative plan cost? One possible "Best Case" scenario to meet the 50 year need of 16.2 mgd is broken out as follows:

| | |
|---|---|
| Repair Ragged Mountain Dam Spillway at existing height | $4,000,000 |
| Restoration Dredging of initial 2 million yards | $24,000,000 |
| Build forebays and periodic maintenance dredging for 50 years | $15,000,000 |
| Install Flow control valves on Beaver Creek Reservoir | $500,000 |
| Install Flow control valves on Lake Albemarle | $500,000 |
| Install Flow control valves on Chris Green Lake for 5' drawdown | $500,000 |
| Dead Storage drawdown from SFRR | $1,000,000 |
| RMR to Observatory Pipeline replace at 18 inch | $4,000,000 |
| Observatory WTP Renovate at 4mgd | $6,000,000 |
| South Fork WTP upgrade to 16mgd | $9,000,000 |
| Sugar Hollow to RMR pipeline – replace at 18 inch | $16,200,000 |
| **Total Project Cost** | **$80,700,000** |

This combination of projects provides a safe yield of 17.3 mgd. This is enough to meet the 2055 demand, keep at least 2mdg of MIF in the Moormans river and still have 0.6mgd of reserve. Note that Beaver Creek, Lake Albemarle and Chris Green Lake provide a total of 2.0mgd, using the most conservative of the numbers provided in Gannett Fleming's Alternative Analysis. These sources could provide at least an additional 1.0mgd if necessary.

While we call this a "best case" scenario, it is possible that the costs for restoration and maintenance dredging could be substantially less if the sediment quality is good. It is also possible that these project costs can be further reduced by implementing further demand reduction beyond the 16.2mgd target

In a "moderate case" scenario, we assume that the initial dredging costs more than anticipated, that there are no cost savings associated with building forbays and that the dredged material cannot be reused

| | |
|---|---|
| Repair Ragged Mountain Dam Spillway at existing height | $4,000,000 |
| Restoration Dredging of initial 2 million yards | $30,000,000 |
| Build forebays and periodic maintenance dredging for 50 years | $21,000,000 |
| Install Flow control valves on Beaver Creek Reservoir | $500,000 |
| Install Flow control valves on Lake Albemarle | $500,000 |
| Install Flow control valves on Chris Green Lake for 5' drawdown | $500,000 |
| Dead Storage drawdown from SFRR | $1,000,000 |
| RMR to Observatory Pipeline replace at 18 inch | $4,000,000 |
| Observatory WTP Renovate at 4mgd | $6,000,000 |
| South Fork WTP upgrade to 16mgd | $9,000,000 |
| Sugar Hollow to RMR pipeline – replace at 18 inch | $16,200,000 |
| **Total Project Cost** | **$92,700,000** |

In a "worst case" scenario, we assume that not only does the dredging cost more than anticipated, but that the community, for whatever reason, is unwilling to bring its anticipated 2055 demand in line with reality, and so we must reach the current demand target of 18.7mgd (19.1mgd is achieved)

| | |
|---|---|
| Repair Ragged Mountain Dam, increasing height by 13 feet | $11,000,000 |
| Restoration Dredging of initial 2 million yards | $30,000,000 |
| Build forebays and periodic maintenance dredging for 50 years | $21,000,000 |
| Install Flow control valves on Beaver Creek Reservoir | $500,000 |
| Install Flow control valves on Lake Albemarle | $500,000 |
| Install Flow control valves on Chris Green Lake for 5' drawdown | $500,000 |
| RMR to Observatory Pipeline upgrade to 24 inch | $6,000,000 |
| Observatory WTP Upgrade to 6mgd | $10,000,000 |
| South Fork WTP upgrade to 18mgd | $12,000,000 |
| Sugar Hollow to RMR pipeline – upgrade to 24 inch | $20,000,000 |
| **Total Project Cost** | **$111,500,000** |

The cost for the RMR increase assumes that it is done on the existing base. If it is done on a new base, then the cost of RMR increases to $20M and the total project cost becomes **$120,500,000**

Thus even in the "worst case" scenario, which exceeds Gannett Flemmings inflated 2055 demand target of 18.7 mgd, it is a relatively simple exercise to construct a series of water alternatives which meets the projected demand at less cost and much less environmental damage than the current scheme. And that does not even count all of the true costs which are not accounted for in the current scheme!

[1] For a copy of the current scheme cost numbers, see page 56 of the permit support document at
http://www.rivanna.org/documents/community/permitsupportdocument.pdf
For information on some of the costs missing from the pipeline see
http://cvillewater.info/Pretreatment_plant_cost_FOIA.pdf

[2] For a copy of Gannett Fleming's demand analysis, see:
http://www.rivanna.org/documents/community/demandanalysis.pdf

Gannett Flemming's 2055 population figures were criticized by DEQ at a meeting with regulators on April 18, 2005 for being 7 percent higher than VEC projections. They are also based on a 5 percent conservation target, despite the fact that our own drought response and contingency plan anticipates 10 to 15 percent reductions. DEQ has commented that the 5 percent conservation target seems low. See pages 32 and 33 of
http://www.rivanna.org/documents/community/comm_apr18/comm_minutes_apr18.pdf

Finally, the 2055 demand analysis was calculated based on historical demand data through 2001 and assuming this pattern of water usage per capita continues. Since 2001, urban demand has actually DROPPED from 11.2mgd to 10.4mgd, due to water conservation, rather than increasing as Gannett Flemming projected
http://cvillewater.info/Water_use_1999-2008.pdf

[3] From VHB Analysis of alternatives May 16, 2001 pages 11-12
http://cvillewater.info/Summary_of_Recommended_Alternatives_May2001%20(2).pdf

[4] See page 17 of the permit support document. The SFRR was originally designed to have 492 million gallons of dead storage, which is almost 29 percent of the total storage of 1700 million gallons. Originally the idea was that this area would fill with sediment, although most of the actual sedimentation has occurred upstream. Only about 137 million gallons of the dead storage space has been filled with sediment over the past 42 years. With regular maintenance of the reservoir, and allowing for a more typical dead storage of 10 percent, it is possible to recover up to another 280 million gallons by lowering the intake. This could increase the amount of storage gained by dredging from 5.5 mgd to 7.0 mgd. The possibility of lowering the intake has been discussed by Rivanna but has not been studied. During the drought of 2002 we did plan to pump the dead storage area using a pump on a small floating barge if we needed to, but the drought ended long before we needed to take this step. The cost of a floating pump, for use in an emergency would be approximately 1M. See
http://cvillewater.info/Q&A_Water_Supply_3-2-05.pdf

[5] From Gannett Fleming's Water Supply Supplemental Evaluation, which can be found at:
http://cvillewater.info/Recommended_Alternatives_Supplemental_Evaluation_July16_2004.pdf

Note that while 1.3 mgd yield from Beaver Creek could be made available to the urban system in 2055 while still reserving 1.1mgd for Crozet (nearly three times the current demand of 0.4mgd) we elected to use the more conservative number of 0.8mgd which appears in the permit support document. Gannett Fleming assumed that 0.5 mgd would be reserved for some 'future industrial' use. See:

http://cvillewater.info/Q&A_Water_Supply_3-2-05.pdf

[6] The pool of the South Fork reservoir is shaped like a V, corresponding to the original contours of the river valley. By side cutting some of the original valley, it is possible to create a pool that is shaped more like a U, thus creating additional capacity on the side. The cost of dredging this material is 7 dollars per yard or 7M per million yards. Each million yards dredged is equivalent to slightly more than 1mgd of safe yield. Not all of the reservoir is likely to be suitable for expansion, because of the presence of rock.

[7] According to Gannett Fleming, 13 feet is the maximum that RMR can be raised without impacting the embankment of Rt 64. It is also the maximum increase that can be built using the existing base.

At a joint City Council and BOS meeting on March 3, 2005 raising RMR an additional 13 feet as part of the spillway repair was presented as an option with a price of $5.87 million. Allowing for inflation and additional multiplier for engineering and contingencies yields a very conservative number of 11 million dollars

Costs for phasing the RMR dam on a new base are described here:
http://cvillewater.info/cost_phasing_RMR13_and_%20RMR30.pdf

The cost for a 13 foot dam on a new base are calcuated as:
9,382,000 - new dam at 13" elevation increase
1,169,000 - breaching of existing upper and lower RM dams
245,000 – clearing
2,500,000 – environmental mitigation (prorated to one half of estimate for 45 feet)
plus the standard GF multiplier of 1.5 for engineering and contingencies
note – embankment stabalization is not required for a 13 foot dam raise

The cost to raise the dam 19 feet was not calculated, however the cost to raise 30 feet (impacts rt 64 and requires embankment stabilization) is used as a worst case
11,919,000 - new dam at 30" elevation increase
1,169,000 - breaching of existing upper and lower RM dams
610,000 – clearing
1,350,000 – embankment stabilization
3,500,000 – environmental mitigation (prorated to 70% of estimate for 45 feet)
plus the standard GF multiplier of 1.5 for engineering and contingencies

[8] see http://cvillewater.info/DOH%20support%20for%20using%20Moormans%20River.pdf