

\$2.6 million facility holds 45 million gallons of water, enough to keep all of Orange and Gordonsville happy for a month.

The water is drawn down to the treatment plant as needed. Turbidity tests determine how many solids are in the water...dirt particles basically. In the bad old days before we had the reservoir, after a storm, the raw water coming straight from the river could look like "chocolate milk." But now they just won't pump from the river when the water is so muddy. They'll take it from the reservoir instead. And that water is surprisingly clear, thanks to algaeicide and a slow solar-powered recirculation device.

The reservoir is a large body of water, it naturally attracts geese. But here there are none in sight. Sure, you can see a few feathers, but thanks to two blinking orange lights, the geese, for some reason, stay away. This simple system "works incredibly well," marvels Dwight Baker.

Once the water comes to the treatment plant for clarification, it is subjected to a process that has changed little in decades. Alum and lime are mixed in with the raw water in quantities determined by its turbidity. Because the particulates are negatively charged and the alum is positively charged, the alum acts like a magnet. Ninety nine percent of the dirt in the water "flocks" into little granules that sink to the bottom of the basin. Then the clear top layer of water flows over a wall into another basin and then through a filtration system where the last 1 percent of dirt particles are taken out.

At this point, chlorine is added, killing any bacteria. From there it goes to the "clear well" under the building, given another shot of chlorine, a Ph adjustment and fluoride, "and that's our drinking water," says Baker. From there it is piped along Spicer's Mill Road to Orange and on to the Rapidan Service Authority storage facility where it is sent down Route 15 to Gordonsville.

Orange has storage of its own: a reservoir underneath the 120-foot high standpipe on top of the hill on Blue Ridge Drive and another one behind Prospect Heights. The standpipe's real purpose is to provide water pressure to every house and business in town. All in all, the Town of Orange has the ability to store 3.5 million gallons of clear drinking water. "More importantly, we provide fire protection," points out Dwight Baker.

On a typical day, the Orange Treatment



Blue Run on the left, joins the Rapidan on the right. But the river doesn't get any deeper. Thirty years ago, the water to the left was six feet deep.



Dwight Baker says the five-acre 45 million-gallon emergency raw water storage reservoir can keep the towns of Orange and Gordonsville in water for a month.

Plant treats and pumps a smidge over a million gallons. But it is licensed to withdraw up to 2.6 million per day from the river. That limit is determined by a USGS river flow gauge near Baker's Store where Rt. 522 crosses the Rapidan. So, that meter can only estimate how much water is going past the intake on Spicer's Mill Road, upriver. And on this summer day that estimate is 66 million gallons. The next closest USGS meter to Orange is just below the Rt. 29 bridge near Ruckersville.

If you take the trouble to look up these sites on the internet, you will see real time data that shows the river is way down. On Aug. 2, for example, when I paddled the

river, the Ruckersville gauge measured a scant 11 cubic feet of water per second. Compare that to the median for this time of year of 39 cubic feet per second...about one-third of normal. At the Culpeper site at Route 522 on Aug. 2, between 26 and 58 cubic feet per second was flowing past compared to a median of 158. Again one-third of normal. The Orange intake lies roughly halfway between these two gauges.

One strange anomaly. If you look at the graph of the Culpeper gauge in late July, you will see that it went up and down by 30 cubic feet per second like a roller coaster, pretty much at the same time of day every

day. According to Keith Lambert of the Charlottesville DEQ office, that's the Rapidan Renewable Energy hydro-electric plant in the old mill at Rapidan, drawing water from the river, then releasing it downstream.

Which brings up another thorny topic: irrigation. The law says if you plan on withdrawing a million gallons a month or more for ag purposes, you need a permit. The Wiley/Wilson study says irrigation is not significant, about 1,500 acres total for the whole county. But that does not take into account farms on the Madison and Culpeper sides of the river. And they have just as much right to that water as we do.

There's a saying out west: 'Whiskey's for drinkin'; water's for fightin'.' Here in Orange County, VA it's better than in Orange County, CA, where sometimes violent water wars are still waged. But if push comes to shove...

Frank Walker's letter mentions a third factor in the decreased flow of the Rapidan: water demands of Greene County upstream from Orange. The Rapidan Service Authority is licensed to withdraw 1.2 million gallons per day at its Ruckersville plant. Actually, it is only taking half a million because of demand. And you can make the argument that that water is being returned to the river via the effluent from the sewage treatment plant.

Still the Wiley/Wilson study says, "Greene County may be reluctant to guarantee water for Orange." The same goes for Orange. It may be reluctant to guarantee water for the Wilderness Treatment Plant downstream? And that's the area that's growing the fastest!

Let's rewind to early September 2002, when the Wiley/Wilson study says the Rapidan was at its lowest point ever at the Orange intake: only 590,000 gallons in one day. That's less than one cubic foot per second, and a cubic foot per second equals seven and a half gallons. Ask Dwight Baker about lessons learned from that fateful year. "Never say never," says this 14-year veteran of the Orange Water Treatment Plant. "Because about six months after I said the river will never quit flowing, it stopped."

"Listen to the river," concludes Frank Walker's 2004 letter. "Our future depends on it."

In our next installment we'll talk about the other half of our water supply: groundwater and what we can do to increase our overall supply.

Water, water everywhere...and not a drop to...WASTE

When you get right down to it, the only reason you're alive today is because the sun shines on a layer of topsoil, and every now and then, it rains. Think about it; that trio of factors is pretty much responsible for everything: the food we eat, the atmosphere we breathe, the water we drink. The only problem is the phrase "every now and then, it rains," because this summer, it has rained mostly *then* instead of *now*.

What follows is the first of a two-part series about our planet's most important resource...water. We will follow it locally as it falls from the sky and flows down our rivers and streams, both above and below ground. We will hitch a ride with it up through our wells, along our pipes and out into our soil or back down the river, or up into the sky again. We will talk to a groundwater geologist, a water treatment plant operator, an agricultural researcher, an extension agent, and a well digger. We will consult the Department of Environmental Quality and the United States Geological Service. We will float a kayak down a portion of the Rapidan River; we'll drive all around the county in search of curled corn; and we will wade through a 347-page study in an attempt to make sense of this complex issue.

But if you don't want to do all that and would rather simply cut to the chase, we'll leave you with this simple statement: The county is growing but the water supply isn't. At a moderate growth rate of 3 percent, a significant segment of the population of Orange County will start to run out of water by the year 2014. If nothing else is done, if no new impoundments are built, if no mega wells are drilled, if no withdrawal permits are increased, the folks who today rely on the Rapidan River at the Orange treatment plant; that's everybody in Orange, Gordonsville and some on Rt. 15 in between, will exceed the river's ability to provide for them in

four years.

Actually, if we don't get some rain soon, we might reach that point next month.

What about the other half. When will the 15,000 folks who do not rely on a public water system and are pulling it out of the ground via a well, run out? That's a tougher question to answer. For many of you, it may be never. But for some of you, it might be tomorrow.

We've run out of water before...remember??? Back in 2002, right about this time of year, the porta potties were lined up on Madison Road. We were restricted to a mere 25 gallons of water per household per day. Restaurants were serving food on paper plates. There was talk of trucking water in from Culpeper. It was rough.

But then blessed rains fell that autumn and the following spring, washing away the unpleasant memories and we reverted to simply ignoring the 800-pound gorilla in the room. "Rain Rain Go Away," read the June 3, 2003 headline. "Reservoirs are filled. The drought is over," crowed this newspaper.

Well, the gorilla is back. It's dry again folks. We're not at that 2002 point yet, and thanks to the 45-million gallon raw water storage basin up on a hill behind the water treatment plant, we may never reach that point again. But if it doesn't rain soon, water restrictions are again a possibility.

The problem with the 2002 drought is the deficit was never made up. The extra water that fell in torrents and gushed off roofs and swirled through parking lots and coursed along town streets wound up in the Atlantic, not in the ground. And we continue a persistent pattern of summertime drought at just the time of year when every living thing needs moisture the most. We may be growing at 3 percent per year, but we can't make it rain 3 percent more per year.



The photos above illustrate the complete water process for the town of Orange: from the intake at the Rapidan River, to Tim Hudson and Dwight Baker at the water treatment plant, to a beaker of raw water on the left and a beaker of purified water on the right and finally to the standpipe and the citizens of the town.

Rainfall

Has our climate changed? Are we drier than we were? Has drought become the rule not the exception? Yes and no.

Here in Orange County we receive 41.8 inches of rain every year on average. That number has been pretty consistent since records were first kept back in the early 1940s. Thirty five of the past 69 years, we have been below that average; 34 years we have been at or above it. So, you cannot say that we are generally any drier over a 12 month period than we have been in the past.

But statistics are like a bikini: interesting in what they reveal; vital in what they cover up. For example, we looked at the years when rainfall was six inches or more below the average over the last 20 years. Those years are 1991, 2000, 2001, and 2007. No mention here of 2002 when the Town of Orange ran out of water. No mention here of 1999 when the lowest flow on the Rapidan was ever recorded, according to the USGS. That's because rains later in those years made up part of the deficit.

Now let's look at the wet years from 1990 to 2010, those with six inches or more surplus rainfall: 1990, 1996 (with Hurricane Fran dumping 7.1 inches in three days), 2003 and last year. Again, no mention of 1995, when on June 27, 5.67 inches fell on Orange County in one day. That's the same system that devastated Madison County and scoured and straightened the Rapidan.

These weather measurements have been taken at the Northern Piedmont Agricultural Research Station outside the town of Orange on Rt. 15, next to the jail. The reason this location is so specifically pinpointed in this article is that 90 percent of our summertime moisture comes from thunderstorms. And thunderstorms are fickle. They pour here; they shed nary a drop there. You've heard the story about the 10-inch rain, haven't you. One drop; then move over 10 inches; another drop, and so on.

For example, this past Aug. 4, between the hours of 2:30 and 7:30 a.m, the rain gauge at the research station registered 0.8 of an inch of rain. In the eastern end of the county, that same event produced two inches or more. In the western end only a couple of tenths fell.

It is news to nobody that we have been dry this summer. The records show that between June 1 and Aug. 1, only 3.81 inches of rain fell, which is a smidge less than our average rainfall for the month of June alone. But even though we are dry, other folks are drier.

Extension agent Steve Hopkins said last month, "Stony Point to Keswick is burnt to a crisp. There's a number of farmers who've been feeding six weeks or more; don't have any grass at all." And already in Orange County farmers started chopping silage three weeks to a month early.

Record breaking snows this past winter are a distant mem-

ory. But those snows may have saved our groundwater supply because they melted slowly and didn't run off down the river. The moisture seeped into the ground and snuck past the dormant roots of trees deep in winter sleep.

But for farmers, Hopkins says, the snows were a "double whammy." They exhausted their feed supplies, had reduced pregnancy rates, lighter calves and then had to endure an unusually hot and dry summer. "The extremes for the agriculture and farming community have been devastating," he says.

This summer, that devastating extreme has been record-setting heat. July 25 during the height of the fair set a new record high of 101 for that day, and the all-time highest low temperature of 79 degrees. By the way, the all-time high for any day in Orange County is 106, set twice in the 1950s, which, as a decade, was hot as hell. The three hottest summers on record were 1955, 1953 and 1954 in that order.

Where does 2010 fit into this rogue's gallery of blistering summers? It's tied for eighth. So far this summer, we have experienced temperatures in excess of 90 degrees 20 times though Aug. 6.

Time now to introduce you to a new word: evapotranspiration. Like its name says, it is the process of evaporation into the air and transpiration of moisture by plants. And it is actually something you can measure with a 90 percent degree of accuracy.

Sitting on the ground amongst all the thermometers and rain gauges and anemometers at the Piedmont Research Station, is a five foot diameter evaporation pan. Factoring in humidity, miles (not velocity) of wind that blow across this pan, air temperature, water temperature and cloudiness, it can measure how much moisture is evapotranspiring from a crop of corn.

Are you ready for this? In July, one acre of corn sucks up 14,000 gallons of water every day. If that one acre of corn were a person, it would need a permit to withdraw that amount of water from a well from the DEQ. It is estimated that an acre of mature oak trees will lose 18,000 gallons per day in July! Dave Starner of the research station says normal evapotranspiration at this time of year can be 1-1/4 inches per week. When it's really hot, windy, and dry that number can go to four-tenths of an inch per day! So, even though we are in what's called a "moderate drought," the monitors don't factor in the heat which makes it worse.

Speaking of July, it is also, on average, our wettest month, averaging 4.43 inches, unless of course you're talking about this past July which saw only 1.36 inches of rain. But virtually all that moisture comes from spotty thunderstorms. According to a recent water study conducted by Lynchburg engineering firm Wiley/Wilson, we normally lose almost six inches of moisture to evapotranspiration in July. So, even in a normal year, which this is not, we have a net moisture loss of about an inch and a half!

Wiley/Wilson goes on to say that during the course of a year, almost 30 inches of moisture is lost this way. So, subtract that from the 41.8 inch average, and you get an idea of how much or little is flowing into our rivers and streams and into our groundwater.



Because of dry conditions, farmers are chopping stunted crops three weeks to a month early.



Every day since 1941, official weather data has been recorded at the Northern Piedmont Agricultural Research Station outside of Orange. In the right foreground is the pan that measures evapotranspiration. To the left, station superintendent Dave Starner demonstrates the official rain gauge that has recorded precious little moisture over the past three months. In the background, that thing that looks like a stack of white pancakes is the thermometer that has recorded record-breaking heat this summer.

The Rapidan— "Never say never"

In October of 2004, this newspaper published a letter by historian Frank Walker in response to some new proposed housing developments in and around the Town of Orange. "What is the Rapidan River saying?" he asked rhetorically.

He pointed out that the floods of 1995 (June 27) and 1996 (Fran) "created a river that drains more rapidly than it did before. So many of the obstructions that used to break the stream's flow were eliminated and the runoff now goes downstream more freely and quickly." He also wrote "the increasing amount of upstream development has led to the Rapidan receiving the discharge of more and more roofs and paved areas immediately after a rain, rather than receiving over time the slower percolating runoffs from woods and fields. The result of those first two factors is that the Rapidan is beginning to act more and more like an urban storm drain than a sustainable rural watercourse. Between rains its flow is much lower than it was in the 1990's."

I decided to find out if this was true for myself. I took a kayak down the Rapidan River from Liberty Mills to the intake at the Orange Water Treatment Plant this past Aug. 2. I have done this trip maybe 25+ times since I was a 12-year-old. I wore sturdy shoes because I expected to do a lot of walking.

And I did. At every riffle and rapid I had to get out and tow the kayak across. Where Blue Run comes in, I remember a rock face that you could jump off of and into water just over your head. It's a shoal now. Further down, a massive log obstruction, is long gone. So is the island...all features that slowed and calmed the river's flow.

Instead, the river has straightened. At bends you can see where it gouges the steep banks on its rush from its source at Camp Hoover in Shenandoah National Park to the Rappahannock and the sea. On quiet sections it was just barely deep enough to paddle. Occasionally I had to zig zag across the river in search of deeper water.

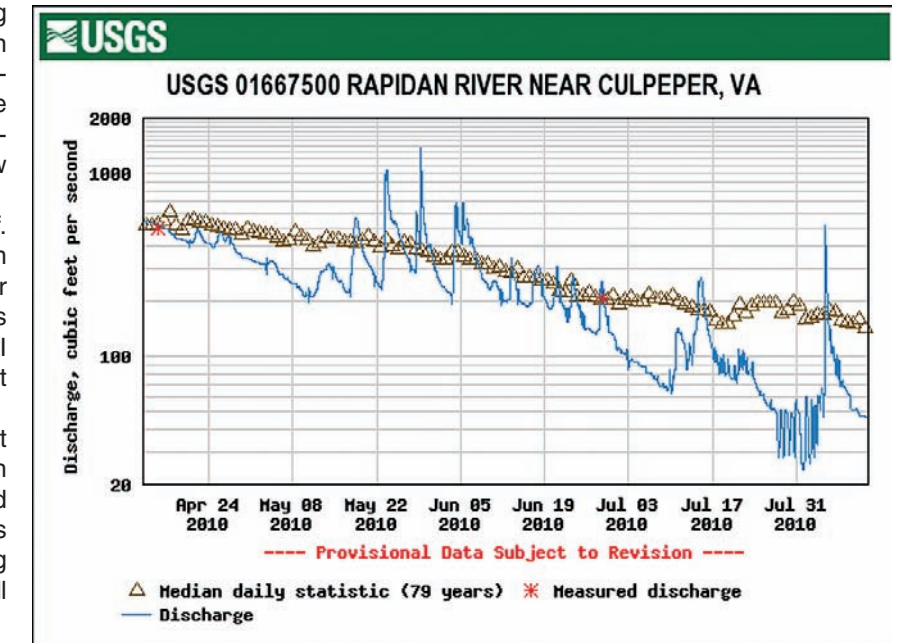
Still, it was a nice nostalgic trip. Kingfishers darted back and forth, a green heron took off in front of me, and a Bald Eagle flew out of a tree and lugubriously ghosted its way downstream. That made the whole trip, the aching shoulders and stubbed toes, worthwhile.

I saw no evidence of irrigation, no examples of the river being drained dry by intake pumps, although I am aware of at least two farms that do this on this stretch. I saw plenty of dry feeder streams, but major tributaries like Blue Run and Poplar Run were still flowing.

The Rapidan is a prized native trout stream at its source. In Greene County it is classified a "Tier 2" river, meaning its water quality exceeds standards. On my trip, I did not see any cattle, but I saw evidence where cattle have done what cattle do when coming down to the river to drink. They pee and poop, and they do this barely a half mile upstream from the water treatment plant

intake.

If you are a public water supply customer and this shocks you, then you need to get over it because this is nothing new. Cattle and wildlife have been urinating and defecating in our drinking water since time began. Storms also sluice agricultural run-off, from manure to pesticides, into our drinking water source. The effluent from Greene County enters the river just a few yards below the Route 29 bridge, some distance upstream from the Orange Water Treatment Plant. The effluent from the Orange Sewage Treatment Plant enters the river just below this plant, but



The USGS gauge on the Rapidan shows a steady decline in the river's flow over 120 days, most of it below the median flow level represented by triangles. The spike at the far right of the graph reflects that storm we had Aug. 4. The rapid ups and downs in front of that spike reflect draw downs and discharges by the hydro-electric plant at the old mill in Rapidan.

upstream of the Wilderness Treatment Plant near Lake of the Woods.

With the exception of a well out by the sheriff's department, all public water systems combined tap the Rapidan for their water at an average rate of 1.4 million gallons per day. About 600,000 goes to the Town of Orange, another quarter of a million to Gordonsville and a half a million plus to Wilderness. Double those numbers for maximum daily demand.

Orange Water Treatment Plant Chief Operator Dwight Baker is an affable bear of a man who looks like he could play lead guitar for ZZ Top. But his real job is to take this somewhat tainted river flow and, with the help of his crew of four, turn it into "good, safe, aesthetically pleasing drinking water."

Here's how it works in Orange. Raw water comes from the river. It is pumped to the emergency reservoir that was built in response to the four-year drought (1998 to 2002). This five-acre