The North Fork Initiative: Restoring the North Fork Colorado River to Help Improve Water Quality in Shadow Mountain Reservoir

By Geoffrey S. Elliott, MSc.

"*What's up with all the water weeds in Shadow Mountain Reservoir?"* It's a common question I hear every summer. The weeds reflect a natural process called *Eutrophication* (sounds like "you-tro-fi-KAY-shun" (say it 10 times, it gets easier), and it's what happens when warmer water, combines with increased dissolved nutrients, promotes a bloom of aquatic plants. Think of it as the aquatic equivalent of putting on a few too many pounds – a little too much of this, definitely too much of that, and voila! – the waistline you didn't bargain for. It's particularly significant in Shadow Mountain Reservoir (SMR), tangling fishing lines and propellers, stinking up shorelines (Figures 1 and 2), and causing "*Harmful Algal Blooms*" (HABs) of blue-green algae (cyanobacteria) known to produce dangerous toxins and definitely do not help Grand Lake clarity. And it's safe to say the weeds will get a lot worse.

Figure 1: Photo of shoreline cleanup on Shadow Mountain Reservoir in July 2019, vegetation includes Elodea and Algae

Figure 2: Close up of the shoreline stew in July 2019

North Fork Initiative

The Upper Colorado River Watershed Group (UCRWG) plans to address these water quality problems in SMR by helping improve watershed conditions upstream along the North Fork of the Colorado River (North Fork, see Figure

3). The logic is to reduce water temperatures, dissolved nutrients, metals, and other constituents like arsenic upstream before the North Fork flows into SMR.

"Will we need years of expensive studies and lengthy intergovernmental meetings?" Nope, in fact, our watershed setting and SMR water-quality concerns are already laid out by the US Bureau of Reclamation (USBR), the Federal agency responsible for managing our Three Lakes within the Colorado-Big Thompson system. The USBR Final Environmental Impact Statement (FEIS) for the Windy Gap Firming Project, approved in 2014, is chock full of lists, maps, and diagrams with plenty of pertinent information. Combined with the UCRWG Watershed Resiliency Plan and Roadmap for a Healthier, more Resilient Upper Colorado River Watershed, we have all we need to guide more detailed project assessment and planning in the North Fork. To monitor progress, the Grand County Water Information Network has an ongoing monitoring program in SMR.

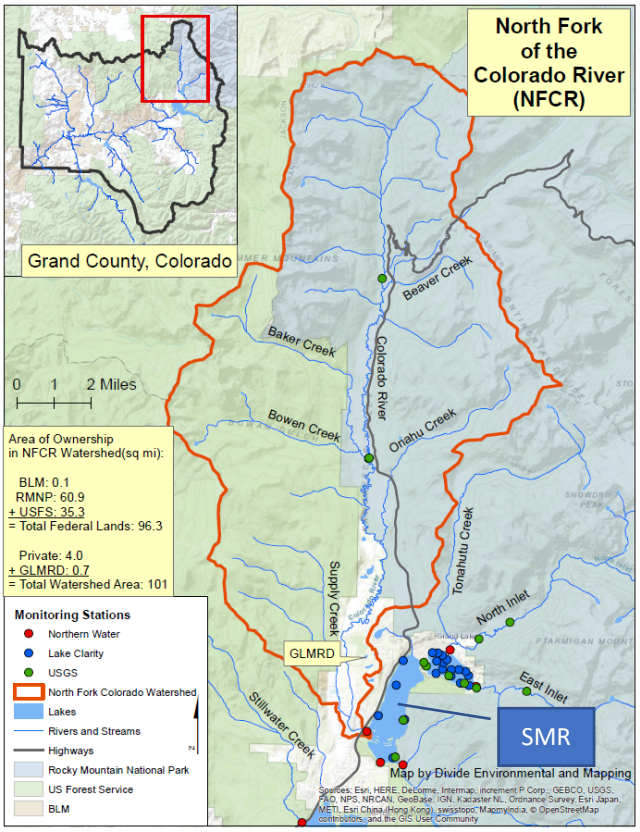

Figure 3: Map of the North Fork Colorado River Watershed extending up into Kawuneeche Valley and flowing down to Shadow Mtn Reservoir (SMR)

Eutrophication is a *Cumulative Effect*

It turns out eutrophication in SMR is a classic example of the cumulative effects (think of effects *accumulating*) of reservoir design and management, general degradation of the North Fork watershed upstream, and climate change. Where's the evidence? Look no further than the FEIS (USBR 2014) which includes discussion of:

1. Eutrophication – SMR ranges from meso-trophic (medium amount of nutrients + vegetation) to eutrophic (lots of nutrients + choked with vegetation) in most years (see USBR 2014 Page 3-166). All that rotting vegetation helps explain low levels of dissolved oxygen (DO) in parts of SMR (healthy plants produce oxygen, but rotting plants use up oxygen), with low-DO zones that won't support trout or their macroinvertebrate prey (bugs). This condition has earned SMR the dubious distinction of being listed as an "impaired water" (not meeting water quality standards) by the Colorado Department of Public Health and Environment (CDPHE 2019 page 104).

Shadow Mtn Reservoir fails to meet water quality standards* for Water Supply or Aquatic Life (trout and their macroinvertebrate prey)

- **Low dissolved oxygen** reflecting eutrophication (rotting vegetation) combined with reservoir operations
- **Elevated dissolved arsenic** likely from leaching minerals from source watersheds including the North Fork

*Colorado Department of Public Health and Environment (CDPHE 2018)

2. Watershed Sources – The North Fork is the major tributary flowing into SMR (USBR 2014 page 3-113). In fact, Shadow Mountain Dam was originally called the *North Fork Diversion Dam* when the Colorado-Big Thompson system was first introduced to the US Congress in Senate Document 80 way back in 1937 (USBR 1937, page 16). So, understanding conditions along the North Fork is a key to understanding why SMR is getting so dang green.

3. Climate Change – The FEIS recognizes "effects of warmer temperatures in the Colorado River basin upstream of Windy Gap" (USBR 2014 page 3-61) likely to drive changes in the North Fork watershed and increase eutrophication in SMR. Warmer temperatures mean less snow, more rain, and increased flooding. Add higher intensity Summer thunderstorms and we get more concentrated runoff and bank erosion sending even more sediment and nutrients in warmer water to SMR in turn feeding lake eutrophication. Classic vicious cycle. The North Fork

gets increasingly out of whack, making life more difficult for those who depend on stream flows including ranchers and fish.

Climate Change Impacts from the Windy Gap Firming Project Final Environmental Impact Statement (USBR 2014, page 3-61)

- A predicted average temperature increase of only 1.8°C translates to more Winter rain and less snow + more intense summer thunderstorms, bringing more intense runoff and erosion all feeding down the North Fork and into SMR.
- Earlier peak runoff (May rather than June) means a shorter irrigation season, and lower flows later in the year which can leave spawning fish high and dry.
- "Droughty" conditions later in the year reduce soil moisture, affecting forests, rangeland, and riparian (streamside) vegetation so critical to stream-bank stability and the fishery food web.
- Higher temperatures and evaporation also increase reservoir concentration of nutrients, metals, and other dissolved constituents.

Not Surprising

None of this should be surprising. In fact, a nationwide trend toward vegetation-clogged lakes was predicted back in 1997 in guidance available to the USBR when the FEIS was being prepared. The report Considering Cumulative Effects under the National Environmental Policy Act, by the President's Council on Environmental Quality (CEQ, 1997) recognizes:

> *Effects arising from multiple sources that affect environmental resources in an interactive (i.e., countervailing, or synergistic) fashion. Example:* ***Discharges of nutrients and heated water to a river that combine to cause an algal bloom and subsequent loss of dissolved oxygen that is greater that the additive effects of each pollutant*** (CEQ 1997, page 9, Cumulative Effects, Type 4, emphasis added).

Further, the US Environmental Protection Agency (USEPA) published more specific guidance on Impacts of Climate Change on the Occurrence of Harmful Algal Blooms (USEPA 2013) also available to USBR before approval of the FEIS:

> ***Blooms of algae can cause damage to aquatic environments by blocking sunlight and depleting oxygen required by other aquatic organisms, restricting their growth and survival. Some species of algae can produce potent toxins which can cause adverse health effects to wildlife and humans, such as damage to the liver and nervous system*** (USEPA 2013 page 1, emphasis added).

This last concern came home to our Grand Lake community in early August 2007 when a health advisory posted by Grand County Public Health called for us to avoid contact with lake water (USBR 2014) presumably until the poisons could be diluted to safe levels. I remember this happening because our boys spent a lot of time at the Grand Lake Beach back then and keeping them out of the water was traumatic. I was also sailing with the Grand Lake Yacht Club at the time and avoiding water contact was impossible, especially when you capsize (oops, sorry Captain Dan).

What to do?

We need to look at the North Fork + Shadow Mountain Reservoir as an inter-related aquatic ecosystem where sustainable management and cost-effective river restoration upstream can reduce water temperatures, nutrients, and other stressors before they feed water weeds and algae in SMR. Again, the FEIS points to watershed sources such as stormwater runoff from roads, developed areas, eroding banks, and irrigation return flows from agricultural lands (USBR 2014 page 3-107), the impacts of which can be mitigated by watershed “Best Management Practices” (BMPs) including conservation practices on ranches and in forests and stream bank restoration (USBR 2014 page 3-201 to 3-203). No need to invent anything – BMPs are already adopted by most industries including agriculture, transportation, forestry, recreation, even river restoration.

What Would the North Fork Initiative Look Like?

I talked with Samantha Bruegger, past Director of the Grand Lake Chamber, during the early stages of UCRWG planning when we were talking about this North Fork-SMR dynamic. She asked me what sorts of watershed improvements would reduce Colorado River temperatures, sediment, and nutrients flowing into SMR. My answer was that our restoration model would be a self-sustaining, meandering river corridor flanked by healthy meadows including hay fields, with healthy riparian (waterside) vegetation armoring the banks, narrow channels with deep, shaded pools protected from the sun, and broad floodplains to capture muddy floodwaters. Samantha smiled thoughtfully and said: "*that sounds like a good place to go fishing!"* Here she put her finger on a watershed truism: good land management, including sustainable agriculture and forestry practices along with river restoration, leads to better water quality AND better fisheries.

Samantha: *"Could the North Fork meet Gold-medal fishery standards?"*

Me: "*Yes, absolutely. We're already talking with landowners along the North Fork including the Grand Lake Metro Recreation District about fishery improvements.*

Samantha: *"So better stream conditions would make every property along the river more valuable! But what about the ranchers and irrigation?"*

Me: *"Modern, fish-friendly diversions significantly reduce maintenance while improving irrigation effectiveness for better crops, and we could probably get grant funding from the Department of Agriculture to help pay for the work.*

Samantha: *"What about wildfire?"*

Me: *"That's a tough question, because a massive, watershed-scale wildfire would pollute SMR and Grand Lake beyond recognition. That said, my Forester friends tell me healthy riparian corridors can slow and even deflect wildfire movement while protecting waterways postfire."*

Win-Win North Fork Initiative

So UCRWG presents a win-win scenario for the North Fork and Shadow Mountain Reservoir – help local land owners and managers improve watershed conditions in the North Fork watershed for a healthier, more resilient Colorado River with more robust fishery and better quality water flowing into Shadow Mountain Reservoir. It's a cost-effective, collaborative approach that can include everyone from ranchers and water-front landowners to boaters, kayakers, standup paddleboarders, students, and families, guests and locals. Help the land and we help the river, and we help Shadow Mountain Reservoir.

References Cited:

CEQ 1997: Considering Cumulative Effects under the National Environmental Policy Act by the President's Council on Environmental Quality, office of the President, January 1997

CDPHE 2018: 2010 303(d) and Integrated Reporting for Impaired Waters, Colorado Department of Public Health and Environment, downloaded December 2019

USBR 2014: Final Environmental Impact Statement for the Windy Gap Firming Project. US Bureau of Reclamation, approved under Record of Decision dated December 19, 2014

USBR 1937: Colorado-Big Thompson Project, Synopsis of Report, Senate Document 80 prepared by the US Bureau of Reclamation, June 15, 1937

USEPA 2013: Impacts of Climate Change on the Occurrence of Harmful Algal Blooms, US Environmental Protection Agency Office of Water, EPA 820-S-13-001, May 2013