CLARK FORK RIVER

VOLUNTARY NUTRIENT REDUCTION PROGRAM

(VNRP)

THREE-YEAR EVALUATION REPORT

The Progress of a Voluntary Program in Reducing the Nitrogen, Phosphorus and Nuisance Algae in the Mainstem of the Clark Fork River in Montana

Final: September 10, 2002

By: VNRP Sub-Committee of the
Tri-State Water Quality Council

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Executive Summary:

The Clark Fork Voluntary Nutrient Reduction Program (VNRP) is a landmark program in Montana—a locally-developed, locally-controlled water quality improvement plan, developed through consensus of the local governments, industry and environmental groups in lieu of Federally-mandated Clean Water Act requirements. It specifies water quality targets and allocates reductions of nitrogen and phosphorus from point source and non-point dischargers to reduce nuisance algae growth in the upper 200 miles of the Clark Fork River. This reports documents the first three years of progress of the VNRP.

Since the agreement was signed in 1998, the signatories—including Butte-Silver Bow government, City of Deer Lodge, Missoula County, City of Missoula, Stone Container, Montana Dept. of Environmental Quality, Clark Fork Coalition, and Tri-State Water Quality Council—have made substantial progress in implementing their commitments to the VNRP. Among the highlights of the work accomplished to date, Butte-Silver Bow and the City of Deer Lodge have installed irrigation systems for land application of a portion of their treated wastewater effluent, the City of Missoula has funded and begun final design of an upgraded wastewater treatment plant with state-of-the-art biological nutrient removal capability, and Stone Container has significantly reduced the total volume and the nutrient content of their process wastewater.

In the area of non-point source controls, the Missoula City-County Health Department, Missoula Valley Water Quality District, and City of Missoula have collaborated to reduce the total number of homes using septic systems, and continue an aggressive program to connect valley homes to the soon-to-be upgraded Missoula wastewater treatment plant. The Montana Department of Environmental Quality and the Tri-State Water Quality Council have initiated a number of projects designed to reduce the nutrient discharge from prioritized agricultural watersheds in the basin.

Comparison of nutrient and algae data from the years 1988 through 1990 with the Tri-State Council's recent 1998-2000 data indicates that nutrient levels have declined at most sites on the river. Algae data, though more limited, is also encouraging—data from 1998 and 1999 showed lower algae levels at most river sampling sites than in 1987.

Although both signatory project implementation and river water quality data indicate that the VNRP has made substantial progress in the first three years of this 10-year effort, significant challenges remain in the technical, policy and funding arenas before the VNRP can be called a success.

I) Introduction:

The purpose of this report is to review progress made over the first three years of the Clark Fork River Voluntary Nutrient Reduction Program (VNRP), a voluntary effort to control nutrients (nitrogen & phosphorus) and nuisance algae growth in the Montana segments of the mainstem of the Clark Fork River. The VNRP is a collaborative effort among municipalities, industry, environmental groups, municipal and county governments, and the State of Montana's Department of Environmental Quality. In 1998, members signed a formal agreement which included specific measures each signatory would implement to reduce the discharge of nitrogen and phosphorus to the Clark Fork River. In addition, the VNRP document identifies essential monitoring requirements, both for the individual discharges and in-stream monitoring, that would be used to monitor the long-term effectiveness of the program. This report spans the first three years since the program's implementation, and will address the following:

1) Review the specific commitments of each signatory to the VNRP agreement.
2) List the progress each signatory has made in meeting its commitments.
3) Evaluate the effectiveness of the VNRP as measured by the levels of nutrients and algae growth in the mainstem of the Clark Fork River after three years of effort.
4) Identify emerging issues relative to the VNRP.

II) Background:

The Nutrient/Algae Problem: A 1988 study commissioned by Montana Governor Ted Schwinden identified excess nutrients and high levels of attached algae resulting from excess nutrients as one of two major water quality issues in the Clark Fork River (heavy metals was the other). Higher levels of nitrogen and phosphorus in the Clark Fork result in summer blooms of filamentous algae (*Cladophora* sp.) in the upper river, and heavy growth of diatom algae below Missoula.

Excessive growth of algae degrades aquatic habitats, depletes dissolved oxygen levels, alters invertebrate communities, and stresses fish populations. Low summertime oxygen levels have been measured in the Clark Fork where heavy algae growths occur. This algae, known locally as "moss" or "slime," is also a nuisance to irrigation systems, fishermen, and boaters and reduces the aesthetic value of the river.

Studies funded by the 1987 reauthorization of the Clean Water Act quantified the nutrient problems in the Clark Fork River. These studies, completed in 1992, identified the upper Clark Fork from Warm Springs downstream to Clinton, and below Missoula as stream segments with high levels of nutrients and excessive growth of algae (Ingman, 1992). Sources of nutrients identified included the larger municipal wastewater treatment plants, septic systems, industry, and nonpoint sources (i.e., agriculture).

History of the Nutrient Clean-Up Effort: In 1993, the Environmental Protection Agency published a Clark Fork-Pend Oreille Basin Water Quality Report (the 525 Report) based on studies conducted separately by Montana, Idaho, and Washington. This report included a management plan for nutrient control and other related problems in the Clark Fork River Basin. The Tri-State Water Quality Council (TSWQC) was formed to implement the management plan's recommendations. The TSWQC is a non-profit organization uniting citizens, business, industry, government, tribes, and environmental groups in efforts to improve water quality in the Clark Fork River, Lake Pend-Oreille, and other water bodies using consensus, science, and education.

Beginning in 1994, the Council facilitated discussions among interested stakeholders who would be potentially affected by then-proposed mandatory in-stream nutrient levels. The goal was to achieve consensus for support of the scientific research and seek voluntary controls in the mainstem of the Clark Fork River above the Flathead confluence to lower the levels of nitrogen, phosphorus, and nuisance algae. In 1998, these discussions culminated in the Clark Fork Voluntary Nutrient Reduction Program (VNRP).

The VNRP is a landmark agreement in Montana—in that it is a locally-developed, locally-controlled plan, developed through consensus of the local governments and industry in lieu of Federally-mandated Clean Water Act requirements. It specifies water quality targets for 200 miles of the Clark Fork River and allocates reductions of nitrogen and phosphorus from individual point source discharges. Signatories to the VNRP have until 2008 to fulfill their commitments, which are intended to reduce algae growth (measured as chlorophyll-a) below nuisance levels (that have been accepted as desirable targets) for the entire reach of the mainstem of the river.

III) Signatory Commitments to the VNRP

The In-Stream Water Quality Targets: The VNRP is based on "targets" or goals for water quality in the Clark Fork river. Those targets are identified in Table 1.
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Table 1:

VNRP Targets for Clark Fork River mainstem:

Algae: 100 milligrams/meter^2 chlorophyll-a (summertime mean), and
150 milligrams/meter^2 as chlorophyll-a (peak),

Nutrients: 20 micrograms/Liter of Total Phosphorus (upstream of Missoula)
39 micrograms/Liter of Total Phosphorus (downstream of Missoula)
300 micrograms/Liter of Total Nitrogen (anywhere in river)

The goal of the VNRP is to achieve these targets through actions (when appropriate) by the signatories in additional nutrient controls. Once these targets have been achieved, it is anticipated that nuisance algae will not be a major problem and the aquatic habitat, aquatic life, and aesthetic quality of the river should be enhanced.

The Signatories and their Roles: The VNRP was agreed to and a Memorandum of Understanding signed by eight stakeholders. Each stakeholder has unique and specific commitments identified within the document. The major signatories and their respective commitments are listed in Table 2:

TABLE 2: VNRP Signatories and their Specific Commitments in VNRP:

Butte-Silver Bow government/ Butte Metro Sewer wastewater treatment plant:

- Reduce summer phosphorus and nitrogen discharge loads well below 1991 levels.

In to accomplish this, Butte will:
--pump effluent to land application sites;
--augment flow in WS Creek with Silver Lake water (to re-establish historic flows);
--develop other measures as necessary to meet target levels of nutrients at the point of compliance in the Clark Fork just below Warm Springs Creek.

City of Deer Lodge/ Deer Lodge wastewater treatment plant:

- Meet in-stream nutrient and algae targets by constructing a land application system for wastewater effluent.
- Implementation of a phosphate laundry detergent ban.

Missoula County/ City-County Health Department/City of Missoula: septic and subdivision policies

- Address septic effluent impact on surface water by:

--offering incentives to connect to public sewer for existing homes and new subdivisions.
--Connecting 50% of the 6,780 existing septic systems in the Missoula urban area to sewer.
--Continue to connect existing septic systems to sewers in the Missoula area to achieve no net growth of septic systems.

City of Missoula/ Missoula wastewater treatment plant:

- Continue experimentation with biological nutrient removal using existing facility until the plant upgrade comes online;
- Reduce nutrient loading to the river by constructing aa new Biological Nutrient Removal plant;
- Collaborate with Missoula County on hooking up septic systems to sewer;
- Continue investigation of land application of effluent.

Stone Container Corporation:

- Reduce nutrient loading to meet in-stream nutrient and algae targets by:

--Use of color removal plant if necessary (Note that this facility is no longer in service since the closure of the bleach plant in February 1999;
--No direct discharge to river during July-August if river flow is less than 4000 cfs;
--Summer use of storage ponds remote from river to minimize seepage contribution of N & P;
--Continued research on nutrient removal technologies and techniques.

- Continued Participation on VNRP committee

Montana Department of Environmental Quality:

- Address new and existing discharge permits.
- Implement subdivision review procedures to reduce water quality impacts.
- Work with Missoula agencies of septic issues.
- Work with Council on a nonpoint prioritization and strategy.
- Repository of the Clark Fork model.
- Coordinate with VNRP sub-committee.

Tri-State Water Quality Council • Provide coordination/administration of VNRP • Oversee implementation/evaluation of VNRP. • Coordinate in-stream data with monitoring subcommittee. • Hire a VNRP Coordinator to work with other parties in watershed. • Report to EPA and the public.
Clark Fork Coalition • Continue participation on VNRP sub-committee to monitor and evaluate program.

IV) Signatories Progress on Implementing the VNRP

Butte-Silver Bow County: In the period 1998 to 2001 Butte-Silver Bow has made substantial progress implementing the infrastructure and programs which will allow it to dramatically reduce the nutrient load it discharges into Silver Bow Creek, one of the principal tributaries of the upper Clark Fork. Its progress includes:

- A center pivot irrigation system is now installed on city-county land west of Butte for effluent irrigation. In 2001, Butte pumped over 500,000 gallons per day of effluent to the site, irrigating over 100 acres of sod. The city is using this sod on restoration and park projects near Silver Bow Creek and elsewhere. This project has been installed and operated by the wastewater treatment plant staff. Butte could use more of its 5.5 million gallon/day of effluent on this site, but will first need to install more pipeline capacity from the wastewater treatment plant.

- Butte has installed large diameter pipe from the wastewater plant to the site of a golf course and future park so that effluent can also be used to irrigate those sites.

- Several stormwater diversion channels and four storm water catch basins were installed by ARCO and the City of Butte to capture heavy metals in surface runoff and to capture nutrients before they reach Silver Bow Creek.

- Starting in year 2000, Butte-Silver Bow has been diverting up to 24 million gallons/day of clean water from Silver Lake into the Warm Springs Creek drainage. This water helps reestablish historical flows of Warm Springs Creek and reduces river nutrient concentrations.

- Butte is also conducting a study of nutrient sources upstream of the wastewater treatment plant, and continues to monitor a successful voluntary ban on phosphate laundry detergents.

City of Deer Lodge: Deer Lodge completed the infrastructure for a land application system for its wastewater effluent in April 2000. This system allows Deer Lodge to pump 1.1 million gallons/day of effluent to the Grant Kohrs Ranch National Historic Site, a working cattle ranch managed by the National Park Service. This project has now functioned for two summers, with the Park Service operating the irrigation system and paying the pumping bills. Currently, the City and the Park Service are negotiating terms for the City to assume more of the operation and maintenance costs.

- The land application of irrigation effluent project is functioning up to five months per year (May-September).

- Measurements indicate that in June and early July the high quantity of groundwater inflow into the City's wastewater collection ponds overwhelms the pumping capacity for the irrigation effluent project, resulting in discharges of diluted treated effluent to the Clark Fork River during peak runoff. It is estimated that about 41% of the summer effluent was discharged to the river in 2001, mostly in early summer.

Missoula County (Environmental Health Div. of City-County Health Dept.):
The City County Health code regulates septic systems and subdivisions, and the Missoula Valley Water Quality District does monitoring and research on surface and groundwater quality. Together with the City of Missoula's Public Works Division they are aggressively implementing a program to transfer existing septic systems to sewer, and to sewer new subdivisions and growth areas. Specifically, since 1997:

- The County has managed to "hold the line" with no net increase in the total number of septic systems in the Missoula Valley—there has been in fact a net reduction of 629 residences on septic since 1997.

- Since 1997, over 1700 new residences have been put on sewer.

- Ongoing sewer extension projects in outlying areas (East Missoula, East Reserve projects I and II, etc.) could connect up to 1,697 residences formerly on septic to sewer, over 600 of these have already connected.

- Created a new Rural Special Improvement District (sewer project) for $7.26 million in the Mullan Rd. area.

- Plans exist for about $10 million of new sewer projects in the next three years to be designed and built in the Missoula area, so that areas that are receiving the brunt of the subdivision and infill pressure can be sewered.

City of Missoula Wastewater Treatment Facility: The City of Missoula's Wastewater Division has been involved in nutrient reduction efforts for a number of years. In 1989, their staff documented a 30% decrease in the total phosphorus content of raw wastewater after the laundry detergent phosphate ban. In 1994, their staff developed a method for further reducing phosphorus in their effluent by altering their treatment process using existing facility infrastructure. This "experiment" reduced effluent phosphorus concentrations from 4.3 mg/L in 1989 to between 1.5 and 2.1 mg/L, levels that they have maintained since that time. However, the City's plant is reaching its flow capacity as growth continues in Missoula. Meanwhile, the following progress has been made since 1998:

- The City has funded an upgraded and expanded treatment facility with "biological nutrient removal"—a form of tertiary treatment which will further reduce discharges of nitrogen by 60% and phosphorus by 50% —and an expansion in capacity from 9 to 12 million gallons/day. This new plant, at a cost of $15 million, is in final design and is scheduled to be built and on-line by 2004.

- The City of Missoula is also doing small-scale experimentation with constructed wetlands, and is investigating land application of some effluent.

- The City of Missoula will be funding an expansion of the Clark Fork River computer model.

- The City of Missoula's wastewater laboratory staff participate in the Clark Fork in-stream monitoring program.

Stone Container Corporation: The Stone Container Corporation's linerboard mill (the Mill) near Frenchtown has been a participant in the Tri-State Water Quality Council since its inception, and an active member of the VNRP sub-committee since 1994. From the mid-1980's through 2001, the Mill has continuously reduced the amount of supplemental nitrogen and phosphorus added to the wastewater treatment system to optimize performance, which in turn reduced nutrient loading to the river from its treated wastewater. The Mill has also accomplished its objectives identified in the VNRP, including:

- The Mill's bleach plant was shut down in February 1999, reducing the volume and strength (i.e. Color) of process wastewater, including nutrients, thus eliminating the need for the operation of the Color Removal Plant.

- Continued its long-term efforts to optimize supplemental nutrients added to wastewater. Total Nitrogen discharged to the river has declined from over 800 lbs/day in 1986 to 130 lbs/day in 2001. Total Phosphorus has declined from over 300 lbs/day in 1985 to 57 lbs/day in 2001.

- Preliminary research has been conducted on the possible use of artificial wetlands and/or conversion of the color removal facility for additional nutrient removal.

- In-plant process controls further reduced mill process wastewater strength, including a reduction in nitrogen and phosphorus.

- The Mill's current 2-machine operating status has also reduced the volume and strength of the process wastewater. The Mill may return to a 3-machine operation in the future.

- The Mill does extensive in-stream monitoring above and below its plant site. Self-monitoring data indicates that its total nitrogen loading to the river varied from about 1% to 3%, and total phosphorus loading (mostly through seepage) varied from about 9% to 10%of the total river loading during the summers of 1999-2001.

Montana Department of Environmental Quality: The Montana DEQ funds non-point source control projects, included projects aimed at nutrient issues, primarily through its Clean Water Act Section 319 grants from EPA. The Department has funded a number of projects since 1998 which are intended to reduce nutrients in the VNRP area of the basin (e.g., 319 projects at Lost Creek, Ambrose-Three Mile Creek, Upper Lolo, Little Blackfoot, Nine Mile, East Deer Lodge). The State is currently promulgating nitrogen and phosphorus standards for Montana surface waters, and has devoted substantial attention to this effort in the Clark Fork basin during 2001. At this point, DEQ has made no known significant changes to MPDES permit policy for non-signatory dischargers to support the VNRP.

Tri-State Water Quality Council: The Tri-State Water Quality Council (the TSWQC) has been responsible for coordination and facilitation of the VNRP since 1994. In 1998, the Council hired a VNRP Coordinator to oversee the implementation of the VNRP. The TSWQC, working through the VNRP subcommittee and the VNRP coordinator, have achieved significant accomplishments relative to the VNRP, including:

- Implementation of five mini-grants to small communities for nutrient diagnostic studies, grant writing, or wastewater project designs.

- Initiation of manure management assessments or projects on six dairy farms in the Bitterroot valley, with a focus on water quality improvements compatible with good agricultural practices. This effort leveraged funds from Natural Resource Conservation Service and the State of Montana, which resulted in the implementation of new dairy waste management systems.

- Support of the Bitterroot Water Forum, a citizen-based group doing education and project development around watershed and water quality issues in the fastest-growing county in Montana. The VNRP Coordinator has co-developed several successful grant proposals with the Forum, and works closely with their committees, as well as the Bitterroot Watershed Partnership.

- Obtaining watershed restoration grants for Lost Creek (with Montana Fish, Wildlife and Parks), Ambrose-Three Mile Creek, and the Bitterroot Headwaters, totaling over $400,000. These projects are now in the assessment or implementation phase.

- Assisting HDR Engineering with the development of a new Clark Fork computer model for evaluating the fate of nutrients in the Clark Fork River.

- Researching the impact on phosphorus loads at municipal wastewater treatment plants from dishwasher detergents containing phosphates.

V) Historical Changes in Clark Fork Water Quality:

Nutrient Concentrations: The Tri-State Water Quality Council has monitored the concentration of nutrients (nitrogen and phosphorus) in the Clark Fork River since 1998. The baseline studies done in 1988-1990 documented that the point source discharges

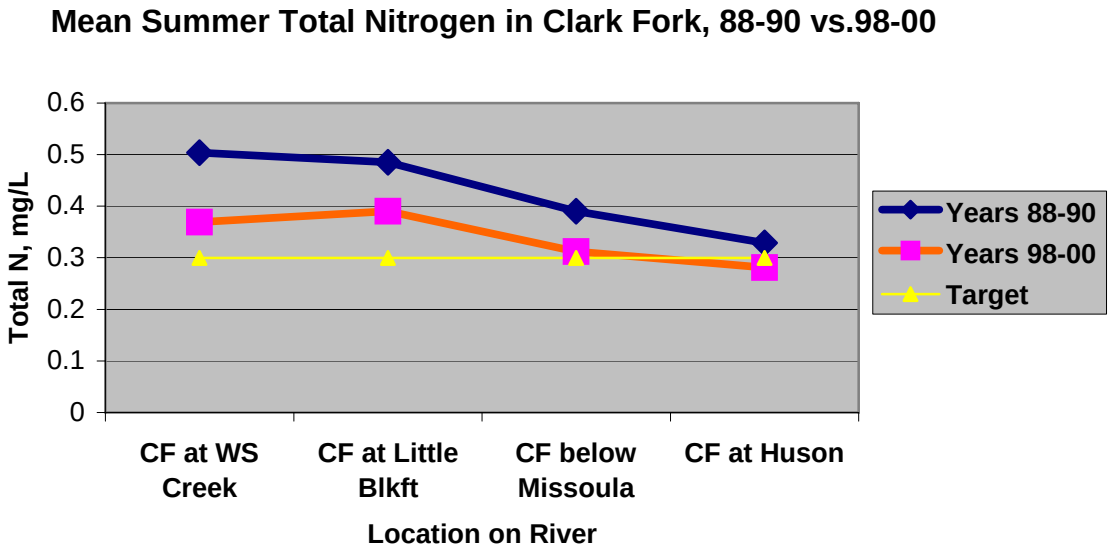
from VNRP signatories were a major contributor to the high levels of nutrients in the Clark Fork. An important premise of the VNRP is that reductions in these nutrient discharges will reduce nutrient concentrations in the river.

This report compares nutrient data collected by TSWQC over the three summer periods (1998-2000) to historical nutrient data from the summer 1988-1990 studies in Montana's Section 525 report to Congress. Since some of the signatories to the VNRP were improving their nutrient management from the late 1980's through the 1990's, it is worthwhile to look for signs of improvement in the river's water quality during the 1988-2000 13-year time period. Both three-year data sets pertain to low-flow years, with mean summer flows below long-term averages at most river locations. The similarity in flow conditions during these two periods of record supports the approach used in this evaluation.

The VNRP target for total nitrogen is 0.30 mg/L. Graph 1 indicates that the mean summer total nitrogen concentrations in 1998-2000 are lower than the mean concentrations in 1988-1990 at all four monitoring stations:

- Clark Fork at Warm Springs Creek,
- Upstream of the Little Blackfoot River,
- below Missoula, and
- Huson.

Graph 1:

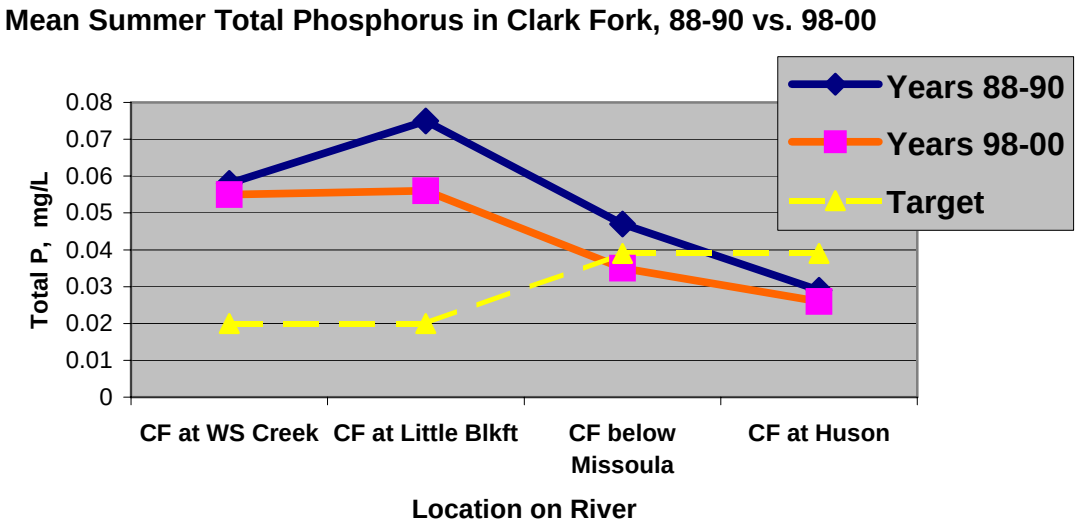


Total nitrogen is at distinctly lower concentrations at the upper river stations in 1998-2000 than in 1988-90, but does not generally achieve the targets in that portion of the river. The "above Little Blackfoot River" and "below Missoula" stations routinely have the highest nutrient concentrations and algae growth, so any improvement at these sites is

particularly encouraging. The Clark Fork below Missoula and the Huson monitoring stations are near or below the 0.30 mg/L target level in recent summers.

For Total Phosphorus, there are also areas on the River where improvement is apparent.

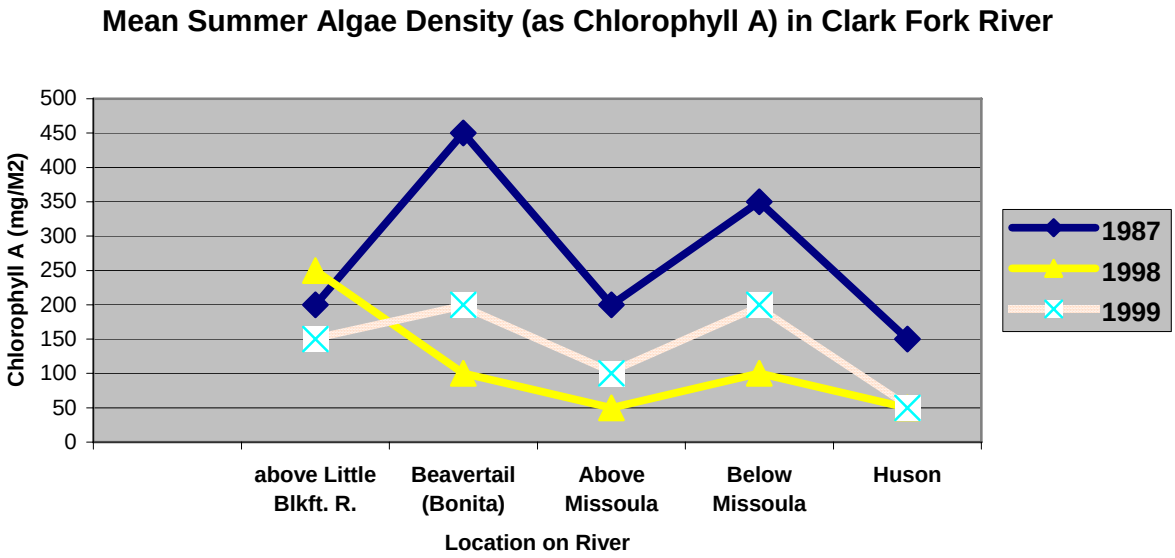
Graph 2:



Graph 2 demonstrates that in recent years the mean summertime total phosphorus concentration is measurably lower at the "above Little Blackfoot" (just below Deer Lodge) and the "below Missoula" monitoring station than for the 1988-1990 period of record. The decrease in mean total phosphorus at the " Little Blackfoot" station is also encouraging in that, as previously mentioned, this site routinely has the highest concentrations of nutrients and algae. However, even the improved 1998-2000 conditions at this site and others in the upper river are still well above the VNRP target levels.

Lower Clark Fork monitoring stations below Missoula and at Huson both averaged below the target levels (0.39 mg/L total P) during the 1998-2000 period. The Huson station was below the in-stream targets levels in the 1988-1990 period of record also.

Algae Levels: Algae (as chlorophyll-a) is not as easy to measure as nutrients and there is less data from the earlier period of record to compare the data recently collected by the TSWQC monitoring program. The data that does exist is presented in Graph 3.



The limited algae data indicate that levels in 1998 and 1999 were substantially lower than in 1987. Given the multiple variables which regulate algae density, including nutrients, it is not confirmed that this decrease in algae is due solely to a decline in in-stream nutrients. However, it is important to note that the algae levels in 1998 and 1999 met VNRP targets (<100 mg/M2 Chlorophyll a) at several locations.

Summary of Water Quality Data: In summary, nutrient and algae data collected to date generally indicate the following about the Clark Fork River in the last 13 years:

- Nutrient levels have declined at most sites in the upper and lower river.
- Phosphorus levels were above targets in the upper river but were frequently achieved in the lower river, though not by a significant margin.
- Algae targets were achieved at some sites during 1998 and 1999, but most samples remained above the VNRP algae targets.
- Given that this is a report on the first three years of a ten-year program, the river water quality improvements noted to date are encouraging.

VI) Issues for the Future

The VNRP Sub-committee is encouraged by the progress made by all signatories in reducing nutrient discharges. The measures taken by municipalities and industries have made a difference in the river. Both nutrient concentration and algae levels have been reduced in the last decade, and continued improvement in the river is anticipated as measures now in the design phase are put in place.

However, new challenges in the effort to reduce algae and nutrients in the river include:

- At this point in time, it is unclear how the MPDES permitting process will deal with proposed increases in nutrients discharged to the Clark Fork and its tributaries. Failure to implement adequate controls could undermine water quality improvements.

- Population growth continues to be strong in Ravalli, Missoula, and Mineral counties. Thousands of new septic permits have been granted in recent years in Ravalli County, and development there also may affect the integrity of riparian areas and watersheds, both of which could affect nutrient levels in the Bitterroot River, a key tributary.

- The need to explore nutrient removal treatments for septic systems.

- Non-point sources of nutrients continue to contribute a disproportionately large share of the total nutrient load to the Clark Fork. Non-point sources are difficult to locate and manage. Outreach to landowners in the vast rural areas of the basin is always challenging.

- State nutrient standards are currently being developed, and while these may help manage nutrient loadings from sources outside the VNRP program, they may have unforeseen effects on voluntary nutrient control efforts of the signatories to the VNRP.

- Municipal signatories have additional large capital investments ahead of them, and political issues relative to costs and revenue are a challenge for local governments.