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Watershed Briefing Paper for the Mid-Columbia Basin Watershed

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WASHINGTON STATE DEPARTMENT OF ECOLOGY

Watershed Briefing Paper for the Mid-Columbia Basin Watershed

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Executive Summary

Purpose

The Department of Ecology Environmental Investigations and Laboratory Services Program (EILS) has reviewed water quality information on the Mid-Columbia Watershed. The Mid-Columbia consists of Water Resource Inventory Area (WRIA) 41. This review describes what is known about this region and identifies water quality issues that may require monitoring or intensive study over the next two years.

Content

This report contains individual briefing papers with information on the following subjects about the Mid-Columbia Watershed.

Freshwater Ambient Monitoring

Data was collected at three stations on lower Crab Creek and one station on Upper Crab Creek in WRIA 41. However, recent data (last 10 years) exist for only two stations, Crab Creek near Beverly (near the mouth of Lower Crab Creek) and Crab Creek near Moses Lake (near the mouth of Upper Crab Creek). Crab Creek near Beverly is the only station in the basin with sufficient data for a statistical trend assessment. Two streams, Lower Crab Creek and Sand Dunes Creek, were also surveyed for their general biological condition. In addition to streams, several lakes in WRIA 41 were monitored for conventional water quality, toxics contamination, and invasive aquatic plants.

Watershed, Trophic Status, and TMDL Assessments

This section focused on Moses Lake, the City of Quincy wastewater treatment plant, and conservation districts (CD). Efforts to improve the water quality of Moses Lake have been ongoing since about 1962. Historically, the lake was hypereutrophic with blue-green algae dominant. The principal nutrient sources identified were sewage discharges from the City of Moses Lake, irrigated agriculture in the Crab Creek basin, urban runoff, livestock operations, septic systems, and aquaculture. Extensive water quality monitoring was conducted between 1982 and 1988. However, it appears that Moses Lake has not been monitored since 1988. At that time, irrigation BMPs were being implemented on only about 20% of tributary acreage and implementation was not complete. Also, the effectiveness of the detention pond on Rocky Ford Creek was unknown. Moses Lake, Crab Creek, and Rocky Ford Creek are included on the 1996 Section 303(d) list of waters requiring TMDLs.

The Quincy industrial wastewater treatment system (Quincy WWTP) discharges to CBIP irrigation wasteways. Several alternative DO and BOD Wasteload Allocations were recommended for the Quincy WWTP discharge that would allow water quality standards for DO to be met in the receiving water.

The Warden Conservation District developed the Lind Coulee Water Quality Control Project (SCS, 1990), and the Adams CD developed the Weber Coulee Watershed Management Plan (Bain, 1992). Severe problems with sediment loading were found. Lind Coulee is on the Section 303(d) list for temperature, pH, and DO, but not for suspended sediments.

Surface Water Investigations

Pesticides has been identified as the primary issue in the Mid-Columbia Watershed. Many different crops are grown in this watershed, and most receive irrigation water from canals within the Columbia Basin Irrigation Project (CBIP). Numerous pesticides are used on the various crops, and some make their way into the water and are carried throughout the watershed by the canal system. A number of organochlorine pesticides were heavily used in the past and are still being found in high concentrations in fish and sediment.

Ground Water Investigations

Investigations by EILS, the United States Geological Survey, and the Department of Health have concentrated on contamination from agriculture. Concerns are changes to the hydrologic regime, increased nitrate concentrations and contamination by pesticides. Ground water in the Mid-Columbia region is greatly influenced by irrigation, especially in the western portion of WRIA 41 (Grant County). The Columbia Basin Irrigation Project brings more than 2,500,000 acre-feet per year from the Columbia River, through Banks Lake to the Quincy-Pasco area. In the eastern portion of WRIA 41 (Adams County), deep ground water is the only source of irrigation water and much of the agriculture is non-irrigated.

Compliance Investigations

In the Mid-Columbia Basin, there are currently seven dischargers that have permits under the National Pollution Discharge Elimination System (NPDES) and 33 dischargers that are permitted under the State Waste Discharge Permit Program (WAC 173-216). No facility has had an EILS enhanced or limited Class II Inspections over the last ten years. Data from studies more than ten years old are not representative of current treatment facility effluent characteristics and these studies are not referenced. It should be noted that data from Class II Inspections more than five years old may also not represent current facility effluent discharge or operation.

Conclusions and Recommendations

Freshwater Ambient Monitoring

- Crab Creek near Beverly has historically exceeded water quality standards for pH and temperature. Standards violations do not appear to be directly related to irrigation return flows. Conductivity was very high, but has been declining, possibly due to a reduction in leachable salts in the soils. Nutrients are generally lower than might be expected in a small stream in an irrigated agricultural area. One exception is nitrate plus nitrite-nitrogen, which may be high due to groundwater influences. Water quality at Crab Creek near Moses Lake was generally better than at Beverly. No standards violations were observed in WY 1994. Ambient monitoring stations should be placed on major wasteways which are not already being monitored by the US Bureau of Reclamation.

- Eurasian water-milfoil was identified in Evergreen, Moses, Babcock Ridge, and Stan Coffin Lakes and Potholes Reservoir. The spread of invasive plant communities in these lakes should be monitored. Purple loosestrife is also present around many lakes and wetlands in the basin. Because there are many waterbodies where invasive aquatic plants are present, waterbodies without invasive plant populations should be monitored regularly in order to control new populations in the early stages of invasion. Unaffected lakes near affected lakes are particularly good candidates (for example, Quincy Lake near Evergreen Lake).

- Water quality was extremely poor in Moses Lake in 1993. Water quality may be better in years when dilution by irrigation water diversion is greater. Diversion was low in 1993 compared to other recent years. Moses Lakes should be monitored for conventional water quality, both because the 1993 assessment was not based on a year of typical diversion flows and because regular monitoring is required to remove the lake from Ecology's 303(d) list. Routine monitoring should be conducted on tributary streams to Moses Lake. Two stations are suggested: the historical station at Crab Creek near Moses Lake (41A110) and a new station on Rocky Ford Creek.

- Dieldrin in fish tissue from Potholes Reservoir exceeded EPA's health criterion. As a result, Potholes Reservoir was listed in Ecology's draft 1996 303(d) list. Fish from Potholes Reservoir should be re-sampled for dieldrin to confirm earlier results. Potholes Reservoir should also be a candidate for monitoring by the Lake Water Quality Assessment Program.

- Water quantity in stream channels is a high priority issue in the Mid-Columbia WQMA and other parts of the Columbia Plateau. Regulated high flows in these stream channels during summer months appear to be as destructive to macroinvertebrate assemblages as naturally occurring low flows. Biological surveys of streams with intermittent and depressed summer flow should be conducted in the Columbia Plateau.

This information will be the reference for comparison to flow alterations facilitated by: 1) irrigation return, or 2) wastewater discharge.

Watershed, Trophic Status, and TMDL

- The Moses Lake Clean Lakes Project made significant gains in the water quality of Moses Lake, and recommended a number of activities for future work (Welch *et al.*, 1989; Bain, 1990b) including monitoring, BMP's, and additional regulations. However, there is a lack of information about current water quality in Moses Lake and efforts to expand and improve BMPs since 1990. Efforts to protect Moses Lake and monitor its quality should not be allowed to lapse, and preferably should be established as a permanent institution. Specifically:

  1. Conduct a monitoring study in Moses Lake to assess current conditions and trends compared to previous studies.

  2. Develop TMDLs for Moses Lake, Crab Creek, and Rocky Ford Creek building on past studies.

  3. Explore a long-term, permanent program to protect and improve Moses Lake, Crab Creek, and Rocky Ford Creek water quality, which could possibly be part of a TMDL for those water bodies.

- Revision of the water quality standards may result in different criteria for DO in the Quincy WWTP receiving water. Also, additional monitoring may be necessary to better estimate critical conditions in the receiving water. Ecology should conduct a monitoring program in the Quincy WWTP receiving water to better estimate critical conditions and evaluate beneficial uses. After completion of the water quality standards triennial revisions, review the Quincy WWTP WLAs for compliance with the new standards and with critical conditions.

- Severe sediment problems in Weber and Lind Coulees and Potholes Reservoir should be addressed through implementation of watershed plans. Lind Coulee is on the Section 303(d) list for pH, temperature, and DO. Water quality data are lacking for other parameters in these waterbodies. Ecology should support the Adams and Warden CDs in their implementation of the Lind Coulee and Weber Coulee Watershed Plans; monitor Lind and Weber Coulees and Potholes Reservoir for compliance with the water quality standards; and evaluate whether BMP implementation in these watersheds could be expanded or enhanced to address other problem parameters.

- There is lack of information about the impacts of rotenone treatment on the water quality of eastern Washington lakes. A detailed study of the impacts of rotenone treatment on water quality for selected lakes in the Mid-Columbia WQMA should be conducted in cooperation with WDFW.

- No detailed studies were found for nine of the waterbodies that are on the Section 303(d) list. Prioritize problems in these waterbodies, and work cooperatively with USBR, CDs, and other agencies to determine how best to address these problems. Conduct TMDL studies and develop management plans as appropriate.

Surface Water Investigations

- Pesticides in surface waters of the Mid-Columbia Watershed were a problem 20 years ago and continue to be today. The persistent organochlorine compounds that are no longer used have been widely distributed and are accumulating in fish inhabiting the lakes and canals throughout the watershed. The currently used pesticides are less persistent, but are much more toxic, and are commonly found in irrigation return flows at concentrations above criteria set to protect wildlife.

- Effects of pesticides on fauna within the canals and drainage ditches are probably not a major concern. However, these canals and ditches often flow through lakes that have become important habitat for fish and wildlife. Concentrations of currently used pesticides should be monitored in selected lakes to assess the potential impact on lake fauna.

- Even high concentrations of currently used pesticides in the ditches and canals are probably quickly diluted to levels below criteria when they are discharged into the Columbia River. In the river these pesticides will probably break down within a month or two. Return water flowing into the Columbia River also carries low concentrations of chlorinated pesticides. Chlorinated pesticides break down slowly and accumulate in fish and sediment in the river. Pesticide loads in discharges to the river from the CBIP are no doubt a significant portion of the total load going into the river. Alternatives should be explored for reducing the load of long-lived chlorinated pesticides that are making their way to the Columbia River.

- Many of these lakes are stocked with fish, and are popular fishing and recreation destinations. Trout that are stocked in the lakes do not reproduce and are generally quickly caught by sport fishermen before there is time for the fish to accumulate appreciable levels of contaminants. However, bass, crappie, perch, and carp appear to do fairly well in the lakes, and are present long enough to accumulate very high concentrations of some pesticides. Bass in particular are heavily fished in some lakes. Data show that levels of contaminants in some fish from these lakes are high enough to adversely impact human health if the fish are regularly consumed. Carp in Mid-Columbia lakes contain extremely high levels of some pesticides. A thorough investigation should be performed to assess the impact to human health from consumption of resident sport fish taken from lakes within the Mid-Columbia Watershed. The study should include a survey to determine local fish consumption patterns.

- Fish-eating wildlife may also be adversely impacted by high concentrations of pesticides in fish from lakes in the Mid-Columbia Watershed. Gulls and white pelicans are two obvious fish consumers in this area, and there are probably several more. An intensive survey should be performed to assess the impact of fish contamination on fish-eating wildlife in the watershed.

Ground Water Investigations

- The withdrawal of Columbia River water for irrigation and the pumping of ground water for irrigation have caused different, but nevertheless drastic, changes to the hydrology of the region. In the first case, excess irrigation water has caused ground water levels to rise throughout most of the Columbia Basin Project. Higher ground water levels, especially during the irrigation season, maintain the surface drainage system (streams and drains) at a higher than natural flow. In the second case, where ground water is used for irrigation, ground water levels have fallen. The result has been a decline in surface water flows, especially during the critical low flow period. Ecology should continue to study the relationship between irrigation, ground water levels, and resultant streamflows.

- Agricultural use of nitrogen fertilizer has resulted in increased concentrations of nitrate in ground water. Nitrate concentrations in shallow ground water vary greatly, but have generally increased since the 1950's. Nitrate in drinking water has become a health issue in parts of the Central Columbia Plateau. Nitrate increases have been greatest in the irrigated areas (Columbia Basin Project) where the availability of irrigation water has allowed a greater use of fertilizers. Although Ecology should continue to collect nitrate data whenever general ground water studies are performed, additional studies designed only to document nitrate concentrations in ground water are not useful. Development and implementation of BMPs that reduce the agricultural loss of nitrogen are necessary. Additional nitrate monitoring will have the greatest value as part of an investigation into developing workable BMPs and in assessing the results of BMPs in place.

- The agricultural use of pesticides, especially fungicides, has resulted in the contamination of ground water. Pesticides have been detected in about 30 percent of the wells tested. However, with the exception of EDB, banned from use in the early 80's, pesticide contamination is not currently a health risk. The concentration of most detected pesticides are several orders of magnitude lower than concentrations set as health related maximum contaminant levels. EDB, the exception to these findings, has been detected in several areas at concentrations greater than the drinking water standard. However, it is not clear from studies to date whether contamination of ground water by pesticides is an important issue. In any case, Ecology should continue to collect pesticide data from this area as the opportunity arises in order to develop a background of data from which to compare from future monitoring;

atrazine is a good example. It is the most commonly detected herbicide throughout the state, including the Mid-Columbia watershed. Presently, detected concentrations are well below health related levels. However, only continual monitoring will show whether this remains true in the future.

Compliance Investigations

Lack of data for a particular facility highly recommends that it should be investigated. Some results from previous Class II Inspections indicate a need for follow-up or further study. Priorities have been determined from the number and severity of factors noted in the issues section - i.e. last inspection, activity, expiration date, population served, discharge parameters, receiving water status, etc. Class II Inspections are suggested for the following facilities.

Industrials

Quincy Industrial (major), Schaake Feedlot (Quincy), El Oro Feeders (Agri Beef)

Municipals

Lind STP (minor), Othello STP (minor), Moses Lake STP (sprayfield),
Ephrata STP (sprayfield), Quincy WWTP (sprayfield), Ritzville STP (sprayfield),
Warden STP (sprayfield)

Acknowledgements

This report draws on data collected by many of EILS field staff. Most of the sample analyses were conducted by EILS and EPA chemists at the Manchester Environmental Laboratory.

Ken Dzinbal, Larry Goldstein, and Will Kendra reviewed the report. Final formatting was done by Joan LeTourneau.

Freshwater Ambient Monitoring

by

Dave Hallock
Ambient Monitoring Section

Existing Ambient Monitoring Data

Ecology's Ambient Monitoring Section (AMS) has collected data at three stations on lower Crab Creek and one station on Upper Crab Creek in WRIA 41 (Table 1). However, recent data (last 10 years) exist for only two stations, Crab Creek near Beverly (near the mouth of Lower Crab Creek) and Crab Creek near Moses Lake (near the mouth of Upper Crab Creek). Crab Creek near Beverly is the only AMS station in the basin with sufficient data for a statistical trend assessment. Samples were usually collected monthly. Water quality constituents measured included temperature, pH, conductivity, dissolved oxygen, discharge, turbidity, total suspended sediment, fecal coliform bacteria, and five nutrients. Macroinvertebrates have also been sampled in the basin.

In addition to stream stations, AMS has monitored several lakes in WRIA 41 for conventional water quality, toxics contamination, and invasive aquatic plants (Table 1).

Table 1. Stations in the mid-Columbia Basin (WRIA 41) monitored by Ecology's Ambient Monitoring Section.

Station Number	Name	Water Years Sampled	Type of Monitoring
41A070	Crab Creek nr Beverly	1960-91, 1994-96	Routine River and Streams
41A075	Crab Creek nr Smyrna	1963-65	Routine River and Streams
41A090	Crab Creek nr Othello	1971	Routine River and Streams
41A110	Crab Creek nr Moses Lake	1962-83, 1994	Routine River and Streams
	Evergreen Lake	1993	Conventional, plants
	Moses Lake (three stations)	1993	Conventional, toxics, plants
	Nunnally Lake	1990	Conventional
	Potholes Reservoir	1993	Conventional, toxics, plants
	Babcock Ridge Lake	1995	Plants
	Burke Lake	1994	Plants
	Canal Lake	1995	Plants
	Corral Lake	1995	Plants
	Long Lake	1995	Plants
	Quincy Lake	1994, 1995	Plants
	Soda Lake	1995	Plants
	Stan Coffin Lake	1994	Plants
	Warden Lake	1995	Plants

Evaluation of Ambient Monitoring Data

Most analyses were conducted with WQHYDRO® and for Crab Creek near Beverly were based on the period from October, 1979 through May, 1994 for trends and correlations and through May 1996 for percentiles and comparisons to water quality criteria. For other stations, the period of record was used. Data on aquatic plants are summarized separately.

Crab Creek near Beverly, 41A070

Discharge ranged from a low monthly median of about 160 cfs in March to a high of about 330 cfs in October, based on monthly instantaneous measurements. There was no overall trend in discharge during the period evaluated, however, high flows have been getting higher and low flows lower. The high-flow months (April through October) have shown a significant increasing trend of 1.7 cfs/year on average ($p=0.065$) and the low-flow months have been decreasing the same amount, 1.7 cfs/year, although the trend was not significant ($p=0.109$). The source(s) of these trends are unknown, but may be related to changes in crop types and irrigation methods.

Fecal coliform bacteria concentrations have rarely been a source of water quality standards violations in Crab Creek and have generally been well under the Class B criterion of 400 colonies/100 mL. The highest result by far, 2000 colonies/100 mL, occurred this April (1996). The 90th percentile at Crab Creek near Beverly was 170 colonies/100 mL, below even the Class A criterion of 200 colonies/100 mL for primary contact recreation. There was no significant trend between October 1979 and May 1994 ($p>0.10$).

The pH criteria, on the other hand, has exceeded water quality criteria almost 50 percent of the time. Historically, violations have occurred during every month except October, but were most frequent from January through April. Usually, pHs are highest during late summer when flows are low and primary productivity is high. However, in Crab Creek, which is dominated by irrigation returns during the summer and fall, low flow occurs in the winter months when primary productivity would be expected to be lower. It is possible that the high pHs, particularly in winter, represent background conditions to some degree and are a result of the geochemistry of the region. The high winter pHs do not necessarily indicate degraded water quality and anthropogenically increased primary productivity. There was no reliable trend in pH.

The Class B criteria for dissolved oxygen was exceeded once in the last six years (5.9 mg/L on Sept. 9, 1995). However, the Class B criteria for temperature are exceeded regularly with temperatures approaching 25°C during some years. Violations were most common in July and August. While high temperatures could be a result of warm irrigation return flows, discharge (and presumably irrigation returns) was still fairly low in July. Furthermore, temperature was not significantly correlated with discharge during July and August ($p>0.20$). It is more likely that high temperatures were due to natural influences or possibly riparian clearing. Crab Creek drains a hot arid region. Also, several lakes discharge warm epilimnial water to Crab Creek. There were no apparent statistically significant trends in the temperature data.

Electrical conductivity (a measure primarily of dissolved ions) in Crab Creek was very high, with median values of 655 μmhos/cm^2. Conductivity was highest during the low-flow months of November through March but has been decreasing at an average rate of 10 μmhos/cm^2/year since 1978 ($p<0.001$). A decreasing trend during this period is somewhat surprising given the decreasing trend in discharge because conductivity was negatively correlated with discharge ($r=-0.30$, $p<0.001$). One possible explanation is that the amount of leachable salts in irrigated soils is declining.

As expected, suspended solids and turbidity were strongly correlated ($r=0.572$, $p<0.001$). However, neither was positively correlated with discharge (solids: $r=-0.075$, $p=0.194$; turbidity: $r=-0.103$, $p=0.075$). Suspended materials were highest in May through July when discharge was moderate, but began to drop in August as discharge increased. This pattern is not entirely a result of dilution of a baseline solids load by irrigation return flows. The flux of solids (weight per unit time) shows a similar pattern to concentration indicating that the sediment load carried by the stream was lowest in the fall and winter, in spite of the high October flows. This pattern and the unexpected relationship between discharge and solids could be a result of agricultural practices: sediment runoff may be highest in the late spring-early summer when irrigation water is applied to bare soil and decline during the summer as the soil is stabilized by crop root growth. Both suspended solids and turbidity showed a small but statistically significant decreasing trend during the period evaluated.

In general, nutrient concentrations in Crab Creek were somewhat higher than ecoregional means but lower than might be expected for a small stream in an irrigated agricultural area. Ammonia-nitrogen concentrations were relatively low and were not highly seasonal. Nitrate plus nitrite-nitrogen, however, tended to be very high during the low-flow months. High nitrates are not unusual in groundwater in eastern Washington; these concentrations are consistent with groundwater concentrations in nearby areas. Total phosphorus concentrations were moderate, negatively correlated with discharge ($p<0.001$) and positively correlated with total suspended solids ($p=0.027$). Increasing discharge from August through October may dilute background phosphorus concentrations in Crab Creek. Nitrate plus nitrite-nitrogen concentrations have declined significantly during the period evaluated ($p=0.028$) but this trend is in part due to trends in discharge. Phosphorus concentrations trended slightly downward ($p=0.06$), but the trend can be explained by trends in discharge and is not directly due to changes in watershed practices.

Crab Creek near Moses Lake, 41A110

Data are available from upper Crab Creek (near Moses Lake) from July 1980 through September 1983 and from October 1993 through September 1994. In comparison to data from lower Crab Creek (near Beverly) from the same period, the Moses Lake station had much better water quality. There were no water quality standards violations in 1994. Over the period of record at Crab Creek near Moses Lake (about 48 samples), there have been no oxygen or fecal coliform bacteria water quality standards violations and only one temperature and four pH violations.

Electrical conductivity was high, although not quite as high as at the Beverly station. The high conductivity was probably due to the geochemistry of the region. Both solids and turbidity were much lower at the Moses Lake station than at the Beverly station. Nutrients were also lower at the upper Crab Creek station and, with the exception of nitrate plus nitrite-nitrogen, were similar to ecoregion averages. The high nitrate plus nitrite-nitrogen is most likely due to the groundwater influences discussed earlier.

Evergreen Lake

Nutrient data, chlorophyll data, Secchi data, and oxygen profiles all suggest that Evergreen Lake was mesotrophic to meso-eutrophic in 1993. Total nitrogen to total phosphorus ratios were quite low (5.4 in May and 8.5 in August) indicating that nitrogen was more likely than phosphorus to be limiting to algal growth.

Moses Lake

Ecology's LWQA program sampled three stations on Moses Lake on June 6 and August 25, 1993. Results were similar to those reported by others (e.g., see Cook and others, 1986, "Lake and Reservoir Restoration" for a summary). Chlorophyll *a* and especially nutrient concentrations were mostly in the eutrophic range even in early June and concentrations were much higher in August. The high August concentrations may be a result of lower diversion flows. Conductivity, a conservative parameter which is low in the Columbia River diversion water, was also somewhat higher in August, especially in Parker Horn. In 1993, most diversion occurred in April through May, although a small amount of irrigation water was diverted through the lake in July and August. The total amount of water diverted through Moses Lake in 1993 was about half that diverted in other recent years. For this reason, water quality in 1993 may have been worse than is usual, particularly in Parker Horn and Pelican Horn.

Except at the main lake station in August, total nitrogen to total phosphorus ratios indicated that nitrogen was more likely than phosphorus to be limiting algal growth. The lake was not stratified at the time of sampling.

Ecology's LWQA program sampled sediments and fish tissue from Moses Lake in 1989 for EPA priority pollutants (except volatiles), herbicides, and organophosphorus pesticides. Fish were collected from one site just south of the state park, and sediments from two sites, one in Parker Horn and one in Pelican Horn. The only significant finding was low concentrations of DDT compounds in the fish samples.

Nunnally Lake

Nunnally Lake was sampled by Ecology's LWQA program in June and September 1990 and was evaluated as mesotrophic. Total nitrogen to total phosphorus ratios were relatively high (59 in June and 40 in September), indicating that phosphorus was more likely than nitrogen to be limiting to algal growth.

Potholes Reservoir

Potholes Reservoir was sampled by Ecology's LWQA program in June and August 1993. These data and data from earlier studies indicated that Potholes Reservoir was generally meso-eutrophic to eutrophic. Ecology's LWQA program also sampled sediments and fish tissue from Potholes Reservoir in 1992 for a variety of organic compounds and metals. Overall contamination was low, although low concentrations of chlorinated pesticides and DDT compounds were detected. The most significant finding was that concentrations of dieldrin in fish tissue exceeded the EPA health criterion. Dieldrin is an insecticide which is considered carcinogenic. As a result, Potholes Reservoir was classified as "water quality limited" and included in Ecology's draft 1996 303(d) list.

Aquatic Plants

The Ambient Monitoring Section surveys waterbodies statewide for invasive aquatic plants. Findings from Mid-Columbia basin surveys are tabulated, below:

Waterbody Name	Date Surveyed	Summary of Findings
Babcock Ridge Lake	7/24/95	*Myriophyllum spicatum* (Eurasian watermilfoil) and *Lythrum salicaria* (purple loosestrife) present, though not dominating their respective plant communities. The dominant submersed plant was *P. crispus* (curly-leaf pondweed), emergent was *Typha* (cattail). There was heavy filamentous algal growth on the plants and as a scum (Secchi = 1.1 m.) Most of the macrophytes were in the western 2/3 of the lake, bare sediment in eastern part. Receives irrigation return.
Burke Lake	6/28/94	No invasive aquatic plants were found, diverse native plant community where habitat is suitable, dominated by Chara.
Canal Lake	8/30/95	*Lythrum salicaria* fairly well established near the south end. No other weedy exotics observed. Dominant macrophytes are Chara and *Potamogeton pectinatus*(sago pondweed). Secchi depth was 1.1 m, water pea green.
Corral Lake	7/25/95	Scattered patches of *Lythrum salicaria* along the margins. Heavy macrophyte growth, dominated by Chara and *Myriophyllum sibiricum* (northern watermilfoil).
Evergreen Lake	1994, 1995	Has scattered patched of *Lythrum salicaria* that the WDFW is spraying each year. *M. spicatum* is the dominant macrophyte, though there is also a robust population of native plants. This lake is being monitored annually to assess any changes in plant populations over time.
Long Lake (17N-29E-32)	8/31/95	No weedy plants found. Lake is mostly like a wide spot in the canal, low water visibility
Potholes Reservoir	8/7/94	Patch of *M. spicatum* among the northern islands. Most of the shoreline doesn't support macrophytes (very sandy sediment)
Quincy Lake	1994, 1995	*Lythrum salicaria* on shore. Very alkaline lake, no *M. spicatum* in spite of the proximity of Stan Coffin and Evergreen Lakes. This lake is also being monitored annually (along with Evergreen)

Soda Lake	7/25/95	No weedy aquatic plants found. Also like a wide spot in the canal
Stan Coffin Lake	6/29/94	*M. spicatum* and *Lythrum salicaria* present in scattered patches.
Warden Lake	7/25/95	*L. salicaria* in scattered patches on shore.

Biology

The Mid-Columbia Watershed is dominated by crop production. This drainage predominantly contains intermittent streams, but alterations to stream quality through control of flow has influenced biological assemblages. Two streams surveyed in this basin, Lower Crab Creek and Sand Dunes Creek, received irrigation return flow during the agricultural season (April-September). Environmental variables that were either influenced by water use or were characteristic of regional water quality are: temperature, pH, conductivity, and riparian condition.

Increased flow volume in the stream channels surveyed carried high concentrations of suspended solids. The biological macroinvertebrate assemblages contained species that remove suspended organic particulates from the water column and from the streambed. Presence of water in greater volumes than is normally characteristic of these streams has masked the effect of minimal riparian zone and high water temperature. Biologically, the streams are in poor condition.

Stream	Stream Condition
Lower Crab Creek (WA-41-1010)	Poor
Sand Dunes Creek (WA-41-9280)	Poor

Conclusions

- Crab Creek near Beverly has historically exceeded water quality standards for pH and temperature. Standards violations do not appear to be directly related to irrigation return flows. Conductivity was very high, but has been declining, possibly due to a reduction in leachable salts in the soils. Nutrients are generally lower than might be expected in a small stream in an irrigated agricultural area. One exception is nitrate plus nitrite-nitrogen, which may be high due to groundwater influences.

- Water quality at Crab Creek near Moses Lake was generally better than at Beverly. No standards violations were observed in WY 1994.

- Eurasian water-milfoil was identified in Evergreen, Moses, Babcock Ridge, and Stan Coffin Lakes and Potholes Reservoir. Purple loosestrife is present around many lakes and wetlands in the basin.

- Water quality was extremely poor in Moses Lake in 1993. Water quality may be better in years when dilution by irrigation water diversion is greater. Diversion was low in 1993 compared to other recent years.

- Dieldrin in fish tissue from Potholes Reservoir exceeded EPA's health criterion. As a result, Potholes Reservoir was listed in Ecology's draft 1996 303(d) list.

- Water quantity in stream channels is a high priority issue in the Mid-Columbia WQMA and other parts of the Columbia Plateau. Regulated high flows in these stream channels during summer months appear to be as destructive to macroinvertebrate assemblages as naturally occurring low flows.

Recommendations

- Moses Lakes should be monitored for conventional water quality, both because the 1993 assessment was not based on a year of typical diversion flows and because regular monitoring is required to remove the lake from Ecology's 303(d) list.

- Fish from Potholes Reservoir should be re-sampled for dieldrin to confirm earlier results. Potholes Reservoir should also be a candidate for monitoring by the Lake Water Quality Assessment Program.

- Routine monitoring should be conducted on tributary streams to Moses Lake. Two stations are suggested: the historical station at Crab Creek near Moses Lake (41A110) and a new station on Rocky Ford Creek.

- Ambient monitoring stations should be placed on major wasteways which are not already being monitored by the US Bureau of Reclamation.

- Because there are many waterbodies where invasive aquatic plants are present, waterbodies without invasive plant populations should be monitored regularly in order to control new populations in the early stages of invasion. Unaffected lakes near affected lakes are particularly good candidates (for example, Quincy Lake near Evergreen Lake).

- The spread of invasive plant communities in Evergreen, Moses, Babcock Ridge, and Stan Coffin Lakes and Potholes Reservoir should be monitored.

- Biological surveys of streams with intermittent and depressed summer flow should be conducted in the Columbia Plateau. This information will be the reference for comparison to flow alterations facilitated by: 1) irrigation return, or 2) wastewater discharge. An evaluation on impact to stream biology would be determined.

Watershed, Trophic Status, and TMDL Assessments

by

Paul J. Pickett
Watershed Assessment Section

Introduction

In this chapter, existing water quality data from watershed and trophic status assessments in the Mid-Columbia WQMA (WRIA 41) are reviewed. From this review potential information and study needs are identified.

Moses Lake

Moses Lake has been the focus of efforts to improve its water quality since about 1962. Historically, the lake was hypereutrophic with blue-green algae dominant. Initial efforts focused on diverting dilution flows from the Columbia Basin Irrigation Project (CBIP) in the lake. The Moses Lake Clean Lake Project (MLCLP) began in 1982 and proceeded through 3 phases: nutrient source identification, identification of nutrient controls, and implementation of nutrient control practices.

The principal nutrient sources identified were sewage discharges from the City of Moses Lake, irrigated agriculture in the Crab Creek basin, urban runoff, livestock operations, septic systems, and aquaculture. Control strategies included: diversion of city sewage to a land application system, implementation of an irrigation management program, restriction of livestock access to tributary creeks, development of a septic tank policy for local governments, and construction of a retention pond on Rocky Ford Creek (Bain, 1990a).

Extensive water quality monitoring was conducted during the MLCLP. Ecology conducted sampling in 1982 as part of an effort to evaluate lake water quality changes due to diversion of the city sewage discharge (Kendra, 1986). However, most of the sampling was done by Dr. Eugene Welch of University of Washington and associated researchers. A total of about 12 years of data were collected from Moses Lake (Welch, 1996).

Welch, *et al.* (1989) reported on lake monitoring from 1986 through 1988. As a result of nutrient controls, substantial improvement was seen in Moses Lake quality. Total phosphorus (TP) and chlorophyll *a* levels dropped to about 20% of historic levels, and the limiting nutrient shifted from nitrogen to phosphorus. However, the lake still exhibited eutrophic characteristics (TP >25 µg/L, chl *a* >10 µg/L), and was still dominated by blue-green algae.

It appears that Moses Lake has not been monitored since 1988. At that time, irrigation BMPs were being implemented on only about 20% of tributary acreage and implementation was not complete. Also, the effectiveness of the detention pond on Rocky Ford Creek was unknown.

Moses Lake, Crab Creek, and Rocky Ford Creek are included on the 1996 Section 303(d) list of waters requiring TMDLs.

Quincy

The City of Quincy operates an industrial wastewater treatment system (Quincy WWTP) that discharges to CBIP irrigation wasteways. One of these wasteways (W645) is on the Section 303(d) list for dissolved oxygen (DO). Pelletier (1994) used the QUAL2E model to analyze the impact of effluent biochemical oxygen demand (BOD) on the DO of the receiving water. Data used from modeling were collected by CH2M Hill during 4 surveys in 1991 and 1992. Several alternative DO and BOD Wasteload Allocations were recommended for the Quincy WWTP discharge that would allow water quality standards for DO to be met in the receiving water.

Weber Coulee, Lind Coulee, and Potholes Reservoir

The Warden Conservation District (CD) developed the Lind Coulee Water Quality Control Project (SCS, 1990), and the Adams CD developed the Weber Coulee Watershed Management Plan (Bain, 1992). These projects focused on suspended sediment problems in the Weber and Lind Coulees that were impacting beneficial uses in the Potholes Reservoir.

Severe problems with sediment loading were found. Suspended solids levels in Lind Coulee were over 300 mg/L during summer monitoring. During run-off events in the winter, solids levels exceeded 40,000 mg/L in Weber Coulee, and 80,000 mg/L in upper Lind Coulee. Nutrients were also measured, with nitrate levels exceeding 5 mg/L in Lind Coulee near irrigated areas during winter baseflow periods. Low solids levels (down to 4 mg/L) were associated with releases of CBIP water into the coulees, while high levels were associated with run-off from agricultural lands. The complete data set for sediments and nutrients was not reported.

Lind Coulee is on the Section 303(d) list for temperature, pH, and DO, but not for suspended sediments.

Other Waterbodies

Nine other waterbodies were listed on the Section 303(d) list for various parameters. No detailed studies were found for these waterbodies.

Issues and Problems

Moses Lake

This review found no data collected since 1988 to evaluate whether improvements in Moses Lake have been sustained or whether BMPs have been effective. It is important to maintain the improvement in water quality resulting from the MLCLP and document current conditions and trends, if past efforts are to be built upon. (Dr. Welch concurs with the lack of current data and the need to continue monitoring [Welch, 1996].) The current status of the MLCLP and whether it has been established as a permanent program is unknown.

More fundamentally, an assessment should be made as to whether additional improvements in Moses Lake quality are possible and desirable. Improved controls in irrigation management, urban run-off, and other nutrient sources were identified in MLCLP documents (Welch *et al.*, 1989; Bain, 1990b) and may be attainable and worthwhile.

Moses Lake Clean Lake Project has not been submitted as a TMDL to EPA. Implementing long-term protections through the TMDL process may be desirable. In addition, a Moses Lake TMDL could include Rocky Ford Creek and Crab Creek for the 303(d)-listed parameters in those streams.

Quincy

Class AA water quality standards apply to the irrigation wasteways that the Quincy WWTP discharges into. Because "natural conditions" appear to be far lower than the standards criterion, the anti-degradation policy was applied. The appropriateness of the current water quality standards for irrigation ditches in eastern Washington is questionable. Implementation of "use-based standards" being considered for the triennial revision of the state water quality standards may provide an opportunity to revisit this issue.

The data base used for development of the Quincy WWTP WLAs was limited to 4 surveys. Whether the analysis adequately addressed worst-case critical conditions in the receiving water is unknown. A more detailed survey could better estimate critical conditions and determine whether the recommended WLAs are sufficiently protective.

Weber Coulee, Lind Coulee, and Potholes Reservoir

Severe sediment problems need correction through implementation of the recommendations in the Lind Coulee Water Quality Control Project and Weber Coulee

Watershed Management Plan. Resources available to the Adams and Warden CDs for implementation are uncertain.

Water quality data from the Lind Coulee and Weber Coulee projects were limited to suspended sediments and some nutrients. Problems with pH, temperature, and DO that were found in Lind Coulee and resulted in the 303(d) listing have not been addressed. No data are available for other water quality parameters in the coulees or in Potholes Reservoir.

Rotenone Treatment

In 1996 the Washington Department of Fish and Wildlife (WDFW) proposed "lake rehabilitation", i.e. rotenone treatment and restocking, for 36 lakes in Washington, including 3 of the Sun Lakes currently the subject of an EILS study, and several lakes in the Mid-Columbia WQMA (WDFW, 1996). WDFW's goal is to eliminate "undesirable" species such as bass, sunfish, perch, and carp, and then restock the lakes with trout.

Of the lakes in Washington that WDFW treated in the 1980's, approximately three-quarters (in terms of surface area) lie with the Eastern Regional Office boundaries (Hueckel, 1990). Continued annual rotenone treatment can be expected, which would include lakes in the Mid-Columbia WQMA (Zook, 1996) and throughout Ecology's Eastern Region.

A literature review on the environmental effects of rotenone treatment (Bradbury, 1986) identified several major impacts on the ecosystems of treated lakes. Benthic biota can be reduced by up to 75%, and zooplankton are typically completely destroyed. The elimination of grazers and release of nutrients from dead fish often result in a phytoplankton bloom. Other water quality parameters may be affected, including turbidity, taste, and odor. Most of the studies of the impact of rotenone treatment on water quality have been done outside Washington state.

WDFW has issued a Programmatic Supplemental Environmental Impact Statement for Lake and Stream Rehabilitation (PSEIS), and issues an annual Supplemental EIS (SEIS) for its proposed projects. In its review of the PSEIS, Ecology took the position that it is "fundamentally opposed to the use of aquatic pesticides, including piscicides, other than as part of an integrated, watershed or waterbody management plan" (Saunders, 1992). Specifically, Ecology recommended that "nutrient levels, particularly phosphorus, should be monitored and reported as part of the post-treatment procedures...Having only one study, that being in Texas, is inadequate for assessing impacts to water quality ...(and)...points out the need for more detailed monitoring and comprehensive studies of rotenone's impacts on water quality." To date these recommendations have not been acted upon.

During the comment period for the FY1997 SEIS, Ecology and WDFW discussed the possibility of studying the effects of rotenone treatment as part of EILS' Sun Lakes study.

The logistics of this appeared to be unreasonable, but the possibility of a future joint Ecology/WDFW study was discussed. The Mid-Columbia WQMA Needs Assessment appeared to be the most appropriate mechanism to evaluate the possibility of such a study (Zook, 1996).

Conclusions and Recommendations

Moses Lake

The Moses Lake Clean Lakes Project made significant gains in the water quality of this eutrophic lake, and recommended a number of activities for future work (Welch *et al.*, 1989; Bain, 1990b):

- Conduct a monitoring study of the effectiveness of irrigation BMPs on nutrient loading to Crab Creek.

- Conduct a monitoring study of the effectiveness of nutrient controls on Rocky Ford Creek.

- Conduct an aquatic weed survey in Moses Lake.

- Expand irrigation BMPs to all acreage tributary to Moses Lake.

- Obtain written commitments for dilution water from the CBIP.

- Strengthen local policies concerning near-shore development.

In addition, there is a lack of information about current water quality in Moses Lake and efforts to expand and improve BMPs since 1990. Efforts to protect Moses Lake and monitor its quality should not be allowed to lapse, and preferably should be established as a permanent institution.

- Conduct a monitoring study in Moses Lake to assess current conditions and trends compared to previous studies.

- Develop TMDLs for Moses Lake, Crab Creek, and Rocky Ford Creek building on past studies.

- Explore a long-term, permanent program to protect and improve Moses Lake, Crab Creek, and Rocky Ford Creek water quality, which could possibly be part of a TMDL for those water bodies.

Quincy

Revision of the water quality standards may result in different criteria for DO in the Quincy WWTP receiving water. Also, additional monitoring may be necessary to better estimate critical conditions in the receiving water.

- Conduct a monitoring program in the Quincy WWTP receiving water to better estimate critical conditions and evaluate beneficial uses. After completion of the water quality standards triennial revisions, review the Quincy WWTP WLAs for compliance with the new standards and with critical conditions.

Weber Coulee, Lind Coulee, and Potholes Reservoir

Severe sediment problems in Weber and Lind Coulees and Potholes Reservoir should be addressed through implementation of watershed plans. Lind Coulee is on the Section 303(d) list for pH, temperature, and DO. Water quality data are lacking for other parameters in these waterbodies.

- Support the Adams and Warden CDs in their implementation of the Lind Coulee and Weber Coulee Watershed Plans.

- Monitor Lind and Weber Coulees and Potholes Reservoir for compliance with the water quality standards.

- Evaluate whether BMP implementation in the Weber and Lind Coulee watersheds could be expanded or enhanced to address other problem parameters.

Rotenone Treatment

There is lack of information about the impacts of rotenone treatment on the water quality of eastern Washington lakes.

- A detailed study of the impacts of rotenone treatment on water quality should be conducted in cooperation with WDFW of selected lakes in the Mid-Columbia WQMA.

Other Waterbodies

No detailed studies were found for nine of the waterbodies that are on the Section 303(d) list.

- Prioritize problems in these waterbodies, and work cooperatively with USBR, CDs, and other agencies to determine how best to address these problems. Conduct TMDL studies and develop management plans as appropriate.

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Surface Water Investigations

by

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Existing Data

The primary surface water issue of concern in the Mid-Columbia Watershed is pesticides. Many different crops are grown in this watershed, and most receive irrigation water from canals within the Columbia Basin Irrigation Project (CBIP). Numerous pesticides are used on the various crops, and some make their way into the water and are carried throughout the watershed by the canal system. A number of organochlorine pesticides were heavily used in the past and are still being found in high concentrations in fish and sediment.

Fish from several of the lakes in the watershed were sampled by the U.S. Bureau of Reclamation (USBR) and the U.S. Fish and wildlife Service (USFWS) from 1977 to 1985 (Block, 1993). Fish were also sampled from Winchester Wasteway in 1989 for the Basic Water Monitoring Program (BWMP) (Hopkins, 1991). Fish were collected from Potholes Reservoir in 1992 as a part of the Department of Ecology's Lake Water Quality Assessment Project (LWQAP) (Serdar *et al.*, 1994). Water, fish, and sediment were collected from sites within the Mid-Columbia Watershed by the U.S. Geological Survey (USGS) as a part of the Central Columbia Plateau National Water Quality Assessment Program (Wagner, 1996). Three sites have been sampled for water and five for fish for the Washington State Pesticide Monitoring Program (WSPMP) (Davis, 1996a, 1996b).

USBR and USFWS

The USBR and USFWS collected whole fish and fillet samples from many of the larger lakes within the watershed and Lower Crab Creek between 1977 and 1985. These samples were analyzed for a variety of organochlorine pesticides, including DDT and its metabolites, and dieldrin. Metabolites of DDT were found in nearly all samples and dieldrin was found in almost half the samples.

Concentrations of these contaminants were compared to U.S. Food and Drug Administration (FDA) criteria, and only a few samples exceeded the criteria. More recent Toxics Rule criteria set by the U.S. Environmental Protection Agency (EPA) are much lower than the FDA criteria. Many of the fillet samples exceed Toxics Rule criteria. Concentrations in whole fish often exceeded proposed criteria for protection of fish eating wildlife (Newell *et al.*, 1987).

BWMP

Whole fish and fillets were collected from Winchester Wasteway in 1989 for Ecology's BWMP. Again dieldrin and DDT metabolites were detected, but levels did not exceed Toxics Rule or wildlife criteria.

LWQAP

Whole fish and fillets were collected from Potholes Reservoir in 1992 as a part of the LWQAP. Levels of DDT metabolites in whole fish were not excessively elevated and did not exceed wildlife criteria, but the concentration of dieldrin in fillets was higher than the Toxics Rule criterion.

USGS

The Central Columbia Plateau National Water Quality Assessment Program is currently ongoing, and most of the results have not been released. However, maximum concentrations of detected pesticides in surface water samples has been summarized in a fact sheet released by the USGS (Wagner *et al.*, 1996), and selected results have been presented at liaison committee meetings. These results indicate that several currently used insecticides were found in water at concentrations above criteria, and persistent organochlorine compounds found in fish samples exceeded wildlife criteria.

WSPMP

Water was collected from a site near the mouth of Crab Creek in 1992 (Davis, 1993) and 1993 (Davis and Johnson, 1994a) for the WSPMP. Only one pesticide, azinphos-methyl, was found above criteria in these samples, but numerous other pesticides were detected. Fish were also collected near the mouth of Crab Creek in 1992 (Davis and Johnson, 1994b), whole fish exceeded wildlife criteria and fillets exceeded human health screening levels.

Water was collected at two sites in 1995, at the end of the Crab Creek Lateral and at a drainage ditch. Fish were collected at four sites in 1995, Canal Lake, Red Rock Lake, Royal Lake, and Scooteney Reservoir. Reports for these data are in preparation. Concentrations in water samples were generally higher than in Crab Creek, and many more pesticides exceeded water quality criteria for protection of wildlife. Pesticide levels in fish samples were variable depending on the species of fish, size class, and body of water, but numerous compounds were detected in most samples, including three currently used pesticides, and some concentrations were very high. Many detections were above human health screening levels or proposed wildlife criteria.

Conclusions and Recommendations

The data reviewed for this briefing paper clearly indicates that pesticides in surface waters of the Mid-Columbia Watershed were a problem 20 years ago and continue to be today. The persistent organochlorine compounds that are no longer used have been widely distributed and are accumulating in fish inhabiting the lakes and canals throughout the watershed. The currently used pesticides are less persistent, but are much more toxic, and are commonly found in irrigation return flows at concentrations above criteria set to protect wildlife.

- Effects of pesticides on fauna within the canals and drainage ditches is probably not a major concern. However, these canals and ditches often flow through lakes that have become important habitat for fish and wildlife. Concentrations of currently used pesticides should be monitored in selected lakes to assess the potential impact on lake fauna.

- Even high concentrations of currently used pesticides in the ditches and canals are probably quickly diluted to levels below criteria when they are discharged into the Columbia River. In the river these pesticides will probably break down within a month or two. Return water flowing into the Columbia River also carries low concentrations of chlorinated pesticides. Chlorinated pesticides break down slowly and accumulate in fish and sediment in the river. Pesticide loads in discharges to the river from the CBIP are no doubt a significant portion of the total load going into the river. Alternatives should be explored for reducing the load of long-lived chlorinated pesticides that are making their way to the Columbia River.

- Many of these lakes are stocked with fish, and are popular fishing and recreation destinations. Trout that are stocked in the lakes do not reproduce and are generally quickly caught by sport fishermen before there is time for the fish to accumulate appreciable levels of contaminants. Bass, crappie, perch, and carp appear to do fairly well in the lakes, and are present long enough to accumulate very high concentrations of some pesticides. Bass in particular are heavily fished in some lakes. Data show that levels of contaminants in some fish from these lakes are high enough to adversely impact human health if the fish are regularly consumed. Carp contain extremely high levels of some pesticides. A thorough investigation should be performed to assess the impact to human health from consumption of resident sport fish taken from lakes within the Mid-Columbia Watershed. The study should include a survey to determine local fish consumption patterns.

- Fish-eating wildlife may also be adversely impacted by high concentrations of pesticides in fish from lakes in the Mid-Columbia Watershed. Gulls and white pelicans are two obvious fish consumers in this area, there are probably several more. An intensive survey, coordinated with the Department of Wildlife, should be performed to assess the impact of fish contamination on fish-eating wildlife in the watershed.

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Ground Water Investigations

by

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Existing Data

Ground water in the Mid-Columbia region is greatly influenced by irrigation, especially in the western portion of WRIA 41 (Grant County). The Columbia Basin Irrigation Project brings more than 2,500,000 acre-feet per year from the Columbia River, through Banks Lake to the Quincy-Pasco area. In the eastern portion of WRIA 41 (Adams County), deep ground water is the only source of irrigation water and much of the agriculture is non-irrigated.

Investigators from the United States Geological Survey (USGS) have completed several ground water studies that include information about this area. Steinkampf (1989) noted that agricultural water uses have noticeably affected the ground water system. Extensive large-scale ground water withdrawals in the region adjacent to the east boundary of the Columbia Basin Irrigation Project have caused water-level declines of as much as 165 feet, whereas water levels beneath surface water irrigation areas had risen as much as 310 feet by 1971. Numerous uncased wells also greatly affect the hydrologic system by allowing the rapid vertical movement of ground water.

Nitrate in Ground Water

The USGS, as part of its National Water Quality Assessment (NAWQA) Program, found nitrate concentrations for 19% of the 573 wells sampled in the Central Columbia Plateau exceeded the 10 mg/L maximum contaminant level (MCL) for drinking water (Ryker and Jones, 1995). Elevated nitrate concentrations were mostly found in the western portion of the Plateau, in Grant and Franklin counties. Land use has the greatest influence over nitrate concentrations, with nitrate concentrations related in general to fertilizer and water usage. In the areas irrigated from the Columbia River in Grant County, nitrogen fertilizer is applied at 120 pounds/acre/yr; while in drier Adams County the rate is 68 lbs/acre/yr. Nitrate concentrations in shallow ground water vary greatly, but have generally increased since the 1950's. Nitrate in drinking water has become a health issue in parts of the Central Columbia Plateau.

In addition to fertilizers, there is a concern about nitrate contamination of ground water from the large potato processing plants in Grant County (Bean and Runsten, 1993). This process-related nitrate contamination often occurs in the same areas where there are elevated nitrate levels attributable to fertilizers. Successfully treating wastewater from these processing plants by the usual means of land application requires extensive land areas and control of the rate of application. In some areas, nitrate is being overloaded on the land. In some cases, processing plants have no onsite storage to retain wastewater during time periods when land application and related vegetation uptake of nitrogen is not feasible.

Pesticides in Ground Water

A number of investigators have studied the contamination of ground water by pesticides. In May 1991, Ecology, as part of the statewide monitoring of pesticides in ground water, implemented a study near Quincy (Larson and Erickson, 1993). Twenty-seven wells and two field drains were tested for 76 agricultural pesticides. One or more pesticides were detected in 26 of the wells and both drains. The compound 1,2-dichloropropane was detected most often (66 percent of sites) followed by ethylene dibromide (EDB) (62 percent of sites). EDB concentrations in nine wells and one drain exceeded the MCL for drinking water in public water supply systems.

EDB was detected throughout the study area (although not in all wells) with the two highest concentrations within one-mile of each other near the center of the study area. Dichloropropane was also detected throughout the study area, but again no pattern in the location of wells was apparent. Both pesticide products were found over the full range of well depths, from 44 to 110 feet.

In 1993, the USGS, as part of its NAWQA program, sampled ground water underlying irrigated row crops in the Central Columbia Plateau (Roberts and Jones, 1996). Their results were similar to those of Ecology. Low concentrations of pesticides were found in most ground water samples collected from 49 randomly chosen wells (30 shallow domestic wells and 19 monitoring wells). A total of 21 compounds (pesticides +degradation products or impurities) were detected. EDB, a discontinued fumigant, was detected at three sites at concentrations ranging from near the MCL to over 20 times the MCL.

In 1994, the Washington State Department of Health, in cooperation with the USGS, implemented a statewide sampling of Public Supply Wells (Class A drinking water wells) for the 25 pesticides required by the EPA (USGS, 1996). A number of these wells were located in WRIA 41. The WDOH, using a contract laboratory, detected pesticides in 4% of the sampled public supply wells in the Central Columbia Plateau. The USGS also collected duplicate samples from many of these wells for analysis by their own laboratory. Because the USGS lab had generally lower detection limits than the contract lab, they detected pesticides in 39% of the sampled wells in the Central Columbia Plateau. Atrazine and simazine were two the more commonly detected pesticides.

The USGS, as part of their NAWQA Program, has recently completed a report on Pesticides in ground water in the Palouse Area of Washington (Roberts and Wagner, 1996). The Palouse, primarily an area of dryland farming, is not within WRIA 41, but the farming practices are similar to those of the dryland areas of Adams County within WRIA 41.

Fifteen shallow monitoring wells, and 38 deeper public supply and domestic wells were sampled for 85 pesticides and 60 volatile organic compounds. All wells were sampled only once. Seven pesticides and 5 volatile organic compounds were detected in ground water. Twenty-five percent of the sampled wells had detections of pesticides; mostly in the public-supply and domestic wells. No pesticides were found at concentrations that exceeded human health criteria. The authors determined the 20 most commonly used pesticides in the area and found that none of these were detected in ground water. Atrazine, which is little used in the area, was one of the most frequently detected compound in ground water.

Conclusions and Recommendations

- The importation of Columbia River water for irrigation and the pumping of ground water for irrigation have caused different, but nevertheless drastic, changes to the hydrology of the region. In the first case, excess irrigation water has caused ground water levels to rise throughout most of the Columbia Basin Project. Higher ground water levels, especially during irrigation season, maintain the surface drainage system (streams and drains) at higher than natural flow. In the second case, where ground water is used for irrigation, ground water levels have fallen. The result has been a decline in surface water flows, especially during the critical low flow period. Ecology should continue to study the relationship between irrigation, ground water levels, and resultant streamflows.

- Agricultural use of nitrogen fertilizer has resulted in increased concentrations of nitrate in ground water. Nitrate concentrations in shallow ground water vary greatly, but have generally increased since the 1950's. Nitrate in drinking water has become a health issue in parts of the Central Columbia Plateau. Nitrate increases have been greatest in the irrigated areas (Columbia Basin Project) where the availability of irrigation water has allowed a greater use of fertilizers. Although Ecology should continue to collect nitrate data when ever general ground water studies are performed, additional studies designed only to document nitrate concentrations in ground water are not useful. Development and implementation of BMPs that reduce the agricultural loss of nitrogen are necessary. Additional nitrate monitoring will have the greatest value as part of an investigation into developing workable BMPs and in assessing the results of BMPs in place.

- The agricultural use of pesticides, especially fungicides, has resulted in the contamination of ground water. Pesticides have been detected in about 30 percent of the wells tested. However, with the exception of EDB, banned from use in the early 80's, pesticide contamination is not currently a health risk. The concentration of most detected pesticides are several orders of magnitude lower than concentrations set as health related maximum contaminant levels. EDB, the exception to these findings, has been detected in several areas at concentrations greater than the drinking water standard. However, it is not clear from studies to date whether contamination of ground water by pesticides is an important issue. In any case, Ecology should continue to collect pesticide data from this area as the opportunity arises in order to develop a background of data from which to compare future monitoring. Atrazine is a good example. It is the most commonly detected herbicide throughout the state, including the Mid-Columbia watershed. Presently, detected concentrations are well below health related levels. However, only continual monitoring will show whether this remains true in the future.

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Compliance Investigations

by

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Existing Data

In the Mid-Columbia Basin, there are currently seven dischargers that have permits under the National Pollution Discharge Elimination System (NPDES) and 33 dischargers that are permitted under the State Waste Discharge Permit Program (WAC 173-216). These include:

- NPDES Major Permits - 1 Industrial
- NPDES Minor Permits - 3 Industrial, 3 Municipal
- State Discharge to Publicly Owned Treatment Works (POTW) - 14 Industrial
- State Discharge to Ground Permits - 11 Industrial, 8 Municipal

There have been no facilities in the Mid-Columbia that have had EILS enhanced or limited Class II Inspections over the last ten years. Data from studies more than ten years old are not representative of current treatment facility effluent characteristics and these studies are not referenced. It should be noted that data from Class II Inspections more than five years old may also not represent current facility effluent discharge or operation.

Summary of Issues

1. Major dischargers who have not received an enhanced Class II Inspection during the last five years include:

Facility Name	**Type**	**Facility Status**	**City**	**County**	**Permit**	**Expire Date**	**Permit Status**	**Last EILS Class II**
Quincy (Industrial)	Industria l	Active	Quincy	Grant	WA0021067B	2001	ACTIVE	

2. Minor industrial dischargers who have not received an enhanced Class II Inspection during the last five years include:

Facility Name	Facility Status	City	County	Permit	Expire Date	Permit Status	Last EILS Class II
Advanced Silicon Materials Inc	Active	Moses Lake	Grant	WA0045241A	1995	Extended	
El Oro Feeders (Agri Beef)	Active	Moses Lake	Grant	WA0045381A	1999	Active	
Schaake Feedlot (Quincy)	Active	Quincy	Grant	WA0045411A	2000	Active	

3. Minor municipal dischargers who have not received an enhanced Class II Inspection during the last five years:

Facility Name	Facility Status	City	County	Permit	Expire Date	Permit Status	Last EILS Class II
Lind (STP)	Active	Lind	Adams	WA0021237A	1994	Extended	
Othello (STP)	Active	Othello	Adams	WA0022357A	1997	Active	1971
Wanapum Dam	Active	Beverly	Grant	WA0045365A	1998	Active	

4. State to ground dischargers who have not received an enhanced Class II Inspection during the last five years include:

Facility Name	Facility Status	City	County	Permit	Expire Date	Permit Status	Last EILS Class II
Crescent Bar Inc	Active	Quincy	Grant	ST0005277C	2001	Active	
Ephrata (STP)	Active	Ephrata	Grant	ST0008031A	1995	Extended	1974
Moses Lake (Larson STP)	Active	Moses Lake	Grant	ST0008024A	1997	Active	1974
Moses Lake (WWTP)	Active	Moses Lake	Grant	ST0008012A	1990	Extended	1986
Quincy (WWTP)	Active	Quincy	Grant	ST0005278A	1997	Active	
Ritzville (STP)	Active	Ritzville	Adams	ST0008028A	1992	Extended	
Royal City (STP)	Active	Royal City	Grant	ST0005294A	1994	Extended	
Warden (STP)	Active	Warden	Grant	ST0005380A	1999	Active	

5. Several receiving water bodies have known impairments of designated uses. Causes include pH, Dissolved oxygen (DO), pesticides, temperature, and fecal coliform. Facilities which are located on impaired receiving waters (303d list) and their tributaries, who are

limited in their permit by one or more of the preceding parameters, and whose discharge characteristics may impact the receiving water include:

Majors

(1) Potholes Reservoir, WA-41-9280

Quincy (Industrial) - (Pesticides)

Minor Industrials

(1) Columbia River, WA-CR-1040

Wanapum Dam - (Temp, pH)

(2) French Hills Waterway, WA-41-1120

Schaake Feedlot (Quincy) - (Temp, pH)

(3) Lind Coulee, WA-41-3500

El Oro Feeders (Agri Beef) - (Temp, pH, DO)

Minor Municipals

(1) Lind Coulee, WA-41-3500

Lind (STP) - (Temp, pH, DO)

Conclusions and Recommendations

Lack of data for a particular facility highly recommends that it should be investigated. Some results from previous Class II Inspections indicate a need for follow-up or further study. Priorities have been determined from the number and severity of factors noted in the issues section - i.e. last inspection, activity, expiration date, population served, discharge parameters, receiving water status, etc. Class II Inspections are suggested for the following facilities:

Industrials (high priority)

Quincy Industrial (major), Schaake Feedlot (Quincy), El Oro Feeders (Agri Beef)

Municipals

Lind STP (minor), Othello STP (minor), Moses Lake STP (sprayfield), Ephrata STP (sprayfield), Quincy WWTP (sprayfield), Ritzville STP (sprayfield), Warden STP (sprayfield)