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Watershed Briefing Paper for the Upper and Lower Yakima Watersheds

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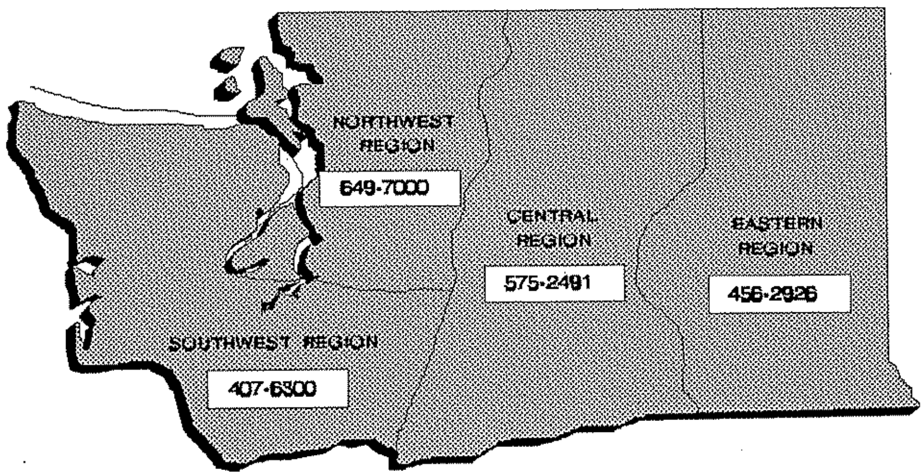

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Watershed Briefing Paper for the Upper and Lower Yakima Watersheds

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WRIAs 37, 38, and 39

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Executive Summary

Ecology's investigative work through the EILS Program in the Yakima River Basin over the past ten years has focused on point source control measures, and characterizing the extent of organochlorine pesticide contamination along the main stem river. Recently, however, EILS' efforts have broadened to nonpoint source issues:

- characterizing forest practice effects on smaller basins in the upper watershed,
- investigating and controlling dairy waste effects on surface and groundwater,
- monitoring macroinvertebrates communities in a variety of watersheds,
- using geographical information system (GIS) tools to identify potential sources of water quality contamination, and
- documenting and controlling suspended sediment and DDT transport from irrigated agriculture in the lower Yakima valley through the total maximum daily load process.

The following set of briefing papers describes the work performed by EILS staff for the Water Quality Program and others over the past ten years in the Upper and Lower Yakima Water Quality Management Areas (WQMAs). Also included are short reviews of other sources of water quality data for the WQMAs. The following issues were highlighted in the reviews for the Yakima River Basin as a whole, and for each of the WQMAs:

Yakima River Basin

- Ambient water quality data suggest the Yakima River suffers from the cumulative effects of sediment and nutrient loading. This appears to be primarily due to irrigation return flow carrying heavy loads from agricultural lands. These data are not sufficient to rule out the effects of high flows on sediment transport from either forest or range land, but these have little effect during the irrigation season. Recommendations include:

  1. estimating the magnitude of nutrient loading from wastewater treatment plants;
  2. monitoring to support investigation and implementation of agricultural management practices which will reduce input of sediment and nutrients to the

river, followed by site-specific monitoring to determine the effectiveness of the treatment;

3. discussing the need for installing a remote water sampler at Kiona so that sediment and total phosphorus loads may be accurately quantified; and
4. intensively analyzing the historic record of water quality, instream flows, and water use in the basin. This should focus on the specific tributaries where the implementation of sediment and nutrient export reduction strategies are employed.

- Future toxics-related work should focus on techniques to reduce vestigial DDT and newly applied organophosphate compounds from entering the river.
- Groundwater investigations are needed to describe and direct responses to:

  1. Groundwater and surface water interaction relative to quantity and quality.
  2. Nitrate and pesticide contamination from agricultural practices, especially in irrigated areas with shallow groundwater.
  3. Leakage from unlined animal waste storage ponds and land application of dairy wastewater in areas of shallow groundwater.

- There have been no regional compliance inspections with sampling for any of the dischargers in the Upper and Lower Yakima WQMAs during the last five years.
- Only one industrial discharger (Seneca Foods) in the Upper or Lower Yakima WQMA has received an EILS Class II inspection during the last ten years.
- Intensive surveys in need of consideration include:

  1. Fecal coliform/bacteria and temperature TMDL evaluations in the lower Yakima Valley and/or Kittitas Valley of the Upper WQMA,
  2. Organophosphate pesticide monitoring and pesticide BMP implementation monitoring during peak use periods,
  3. Water quality monitoring assistance to local conservation and irrigation districts doing BMP evaluations, or subbasin characterization,
  4. Cooperative monitoring and assessment with the second round of NAWQA, and continued cooperative monitoring, and water quality and GIS data sharing with USBR, the Yakama Tribe, local conservation and irrigation districts,

5. Development of GIS/nonpoint models of benefit in irrigated agricultural areas,
6. Development of GIS layers for irrigation water routing, field scale irrigation management method, and land cover, and
7. Instream flow TMDL definition and determination.

Upper Yakima Water Quality Management Area

- Continued biological monitoring of reference sites such as the American River and the Middle Fork Teanaway River is necessary to determine changes over time in the macoinvertebrate community. Simultaneous monitoring of degraded stream reaches (*i.e.*, Little Naches River and Rattlesnake Creek) will indicate how severe an impact must be before it affects the biological community.
- Kittitas STP, Roslyn STP, and Snoqualmie Pass STP have not received EILS Class II inspections during the last five years.
- Cle Elum STP, South Cle Elum STP, Cowiche STP, Ronald STP, and Tieton STP have not received EILS Class II inspections during the past ten years. Class II inspections are recommended for these facilities and for other facilities of concern.
- Intensive surveys in need of consideration include:
    1. Finalize the Cooke Creek and Selah Ditch evaluations as TMDLs for submittal to USEPA, or revisiting their water quality conditions.
    2. Follow-up on the implementation of the Myron Lake restoration for 303(d) assessment.
    3. Conduct a Cherry/Badger Creek TSS/DDT TMDL evaluation based on Phase I Yakima TMDL evaluation, USGS, and USBR data.
    4. Investigate Crystal Creek pH 303(d) listing.
    5. Follow-up on TFW sediment study results.

Lower Yakima Water Quality Management Area

- Continue monitoring waterbodies close to the lower Yakima River for the spread of Eurasian milfoil (Myriophyllum spicatum).

- Continue supporting local weed board efforts to control purple loosestrife along the river corridor through financial support to a cooperative effort by the Yakima and Benton County Noxious Weed Control Boards and the Yakama Indian Nation.
- Buena STP, Benton City STP, and West Richland STP have not received EILS Class II inspections during the past ten years. Class II inspections are recommended for these facilities and other facilities of concern.
- Intensive surveys in need of consideration include:
    1. Evaluating Wide Hollow Creek water quality since the 1987 study to see if measures have been successfully implemented so that 303(d) removal is warranted.
    2. Tributary and main stem monitoring for the Yakima TSS and DDT TMDL implementation, and DDT monitoring to characterize the TSS to DDT relationship in return drains with reduced TSS concentrations.
    3. Monitoring the suspended sediment and residual impacts of polyacrylamide (PAM).
    4. Monitoring support for dairy and CAFO enforcement.
    5. Finalize the South Yakima Conservation District work performed on Giffen Lake for TMDL submittal.

According to trend analyses, there has been some improvement in water quality in the basin over the past twenty years. However, much remains to be done. The Yakima River basin is very rich in water quality data and initial problem definition. Remaining are implementation of solutions for problems that have been evaluated, and a clearer understanding of other problems.

The CRO is embarking on an ambitious project eliciting local support for the implementation phase of the lower Yakima River TMDL, so regional resources for a second TMDL may be limited. The CRO is also interested in maintaining a cooperative spirit in the valley, so EILS will need to make special efforts to coordinate its projects with other groups and agencies. With so many other resource agencies in the basin, coordination and cooperation will go a long way toward gaining public confidence that public funds are being well-spent.

Ambient Monitoring

by
William Ehinger

Rivers and Streams

Water Quality Status

The lower Yakima River basin, WRIA 37, has experienced persistent water quality problems pertaining to chlorinated pesticides in fish tissue and sediment, sediment loading to the river, high summer water temperature, low dissolved oxygen concentration, high ammonia concentration, fecal coliform bacteria, and high pH. Based on ambient monitoring data (does not include pesticides) the worst conditions are related to nutrient and sediment loading to the mainstem Yakima River from irrigation return flow in the lower Yakima Basin. In general, these conditions worsen as one moves downstream from the confluence of the Yakima and Naches Rivers to the mouth. These conditions have been documented in numerous reports (see Rinella *et al.*, 1992; Yakima Valley Conference of Governments, 1993; 303d list of impaired water bodies) and will not be elaborated upon here. Ambient monitoring stations are listed in Table 1.

Data from the Upper Yakima Basin, WRIAs 38 and 39, shows less water quality degradation in either the Naches or Yakima Rivers. However, tributaries with significant water quality problems do exist, such as Wilson Creek near Thrall, indicating that the primary factor affecting water quality is probably the ratio of clean water in the mainstem versus irrigation return flow coming in via the tributaries.

Trend Analysis

Water Quality

Because different variables have been measured for different periods of time, I have broken the data record at the two Ambient Monitoring stations into three overlapping time periods beginning in WY72, WY81 and WY88, and extending to the present. These intervals were based upon: the measurement of one or several variables beginning in these particular years and the resulting length of the data record. Some variables were not sampled for the entire record length. The typical scenario for each analysis was to: 1) test for trend in the raw data using the seasonal Kendall test for linear trend; 2) adjust the data for the effects of flow using linear regression with appropriate data transformations when necessary. If a significant ($P < 0.05$, and $r^2 >$

0.10) statistical relationship was found, then the residuals were tested for trend using the seasonal Kendall test. The reason for flow adjustment was to account for (remove) known sources of variability (flow) in order to detect changes in water quality due to other causes.

Table 1. Station locations, descriptions, and year sampled since WY85.

Station	Description	Years samples (WY)
37A090	Yakima R. at Kiona	85-present
37A095	Yakima R. 2 miles below Prosser	93
37A100	Yakima R. below Prosser	93
37A130	Yakima R. at Mabton	94
37A170	Yakima R. near Toppenish	93
37A190	Yakima R. near Parker	85-93
37A205	Yakima R. at Nob Hill	95-present
37A210	Yakima R. at Terrace Heights	94
37E070	Wide Hollow Creek	92
37F070	Sulfur Creek Wasteway	94
38A050	Naches River @ Hwy. 12	92
38B070	Tieton R @ Oak Creek	92
38F070	Little Naches near Cliffdel	92
39A090	Yakima R. at Cle Elum	90-92, 95-present
39B090	Cle Elum River near Roslyn	92
39C070	Wilson Creek near Thrall	93
39D070	Teanaway River near Cle Elum	92

Two long-term water quality monitoring stations were located on the lower Yakima River; one at Kiona (37A090) and one, upstream, near Parker (37A190). The Parker station was discontinued after water year (WY) 1992 and was replaced in WY 1995 with a station upstream at the Highway 24 bridge near Yakima (Table 2).

One of the most striking results was the consistent decline in the median monthly flow at both stations (Table 2). At the Kiona station flow declined at a rate of 60 to 80 cubic feet per second (cfs) per year for each of the three time periods tested and at Parker flow declined by 38 and 55 cfs per year for the periods since WY72 and WY81, but has remained stable since WY88. Similar decreases in flow were not seen at Yakima River gauging stations upstream from the city of Yakima. Flow records were incomplete for the Naches River and were not examined further. Flow is regulated throughout the basin, and the criteria for management have been adjusted over time to

Table 2. Results of Seasonal Kendall test for linear trend (or Seasonal Wilcoxon-Mann-Whitney test for step trend-indicated by *) at Yakima River near Parker, Ecology Station 37A190, and Yakima River at Kiona, 37A090. Trend magnitudes are presented as units per year. Non-significant results ($P > 0.10$) are given a zero value, missing values below indicate that the test was not performed (*i.e.* test not applicable or data unavailable). Flow adjustment was only done if $r^2 > 0.10$ and $P < 0.05$.

Yakima R. near Parker	Period starting	Flow (cfs)	Temp (C)	DO (mg L^{-1})	% O_2 Sat	Sp Cond (mS)	TSS (mg L^{-1})	Turb (NTU)	Total P (mg L^{-1})	S R P (mg L^{-1})	NO_3 (mg L^{-1})	NH_3 (mg L^{-1})	Fecal coliform
Raw	WY72	-37.8	-0.01	0	-0.25	0	0	-0.13	-2.1	-0.1		-4.3	1.3
FAC	WY72					0	0	-0.09		-0.6			
Raw	WY81	-54.7	-0.1	0		-0.9	-0.3	-0.34	0	0		-4.8	0
FAC	WY81					-1.3		-0.35	0	0		-3.2	
Raw	WY88	0	0	-0.02	0	-6.9	0	0	-7.0	-5.0	0	-5.0	0
FAC	WY88					-5.5	0	0	-6.4	-3.7	0	-3.5	
Yakima R. at Kiona	Period starting	Flow	Temp	DO	% Sat	Sp Cond	TSS	Turb	Total P	Soluble R P	NO_3+N O_2-N	NH_3	Fecal coliform
Raw	WY72	-63.4	0.03	0	0		0	-1.25	-1.4	-11.1*		-3.3	-2.25
FAC	WY72						0		-0.1	-11.0*		-2.2	0
Raw	WY81	-88.9	0	-0.17	-1.3	0	0	0	0	1.1		-0.9	
FAC	WY81					-3.4	0.59			0.9		0	
Raw	WY88	-60.3	-0.23	-0.36	-3.32	0	0				0	0	0
FAC	WY88					-3.18	0				0	0	

account for changes in the water management objectives. On the chance that this may have caused the decreasing trend in median flow, I also examined and found similar decreasing trends in maximum monthly flow, minimum monthly flow, and in annual flow. These findings make it very unlikely that these decreasing trends are a function of minor changes in the timing of flows.

Temperature was generally decreasing to stable at Parker, but showed a long-term increasing trend and short-term decrease (which approximately balanced out) at Kiona. Dissolved oxygen and percent saturation at Parker showed no consistent changes, but decreasing trends were seen at Kiona since WY81 and WY88. Specific conductance consistently showed decreasing trends at both stations for all time periods except the WY72-92 period at Parker. A decreasing trend in turbidity was seen at both stations since WY72 and since WY81 at Parker. Total suspended solids did not reflect this well, except for a decreasing trend seen at Parker since WY81. Perhaps the turbidity values did not reflect true total suspended solids concentration well because the analytical method for turbidity used prior to WY92, which did not discriminate well among samples with high suspended solids concentrations. Total phosphorus, soluble reactive phosphorus (orthophosphate), and ammonia concentrations decreased or remained stable, except for the increasing trend seen in soluble reactive phosphorus at Kiona since WY 81. Nitrate/nitrite nitrogen has only been measured since WY88 and no changes were seen. Since WY72, fecal coliform counts at Parker increased, while at Kiona they decreased. In the shorter term, no significant changes were seen at either site.

The Yakima River basin suffers from the cumulative effects of sediment and nutrient loading to the mainstem river. This appears to be primarily due to irrigation return flow carrying heavy loads from agricultural lands. These data are not sufficient to rule out the effects of high flows on sediment transport from either forest or range land, but these have little effect during the irrigation season. The magnitude of nutrient loading from wastewater treatment plants has not been estimated either. Issues which need attention are:

1. estimating the magnitude of nutrient loading from wastewater treatment plants;
2. monitoring to support investigation and implementation of agricultural management practices which will reduce input of sediment and nutrients to the river, followed by site-specific monitoring to determine the effectiveness of the treatment;
3. discussing the need for installing a remote water sampler at Kiona so that sediment and total phosphorus loads may be accurately quantified; and
4. intensively analyzing the historic record of water quality, instream flows, and water use in the basin. This should focus on the specific tributaries where the implementation of sediment and nutrient export reduction strategies are employed.

Aquatic Plants

Investigations

The listed noxious aquatic weed *Myriophyllum spicatum* (Eurasian milfoil) has been found in the lower part of the Yakima River, where it joins the Columbia River, and in small lakes near the Yakima. The population in Unnamed Ponds (12N-19E-20) is in a group of gravel ponds just south of Union Gap. The USBR has been working to eradicate this plant because they want to use the pond water to augment the Yakima River during periods of low flow. They treated the ponds with a systemic herbicide last summer.

The *Lythrum salicaria* (purple loosestrife) is most dense along the lower Yakima River, with scattered patches extending into Kittitas County. A control program for this plant has been in place for the last three years, and is meeting with good success.

Table 3. Waterbodies that have been surveyed for aquatic plants:

County	Water body Name	WRIA	Date	Noxious Weeds
Yakima	Byron Lake	37	8/30/94	*M. spicatum* *L. salicaria*
Yakima	Giffen Lake	37	7/19/95	
Yakima	Morgan Lake	37	7/19/95	
Yakima	Unnamed Pond (13N-18E-12)	37	8/8/94	
Yakima	Unnamed Ponds (12N-19E-20)	37	7/18/95	*M. spicatum*
Yakima	Yakima River	37	8/8/94 7/19/95	*L. salicaria* *M. spicatum*
Kittitas	Kiwanis Pond	39	8/30/94	
Kittitas	Unnamed Pond (17N-18E-11)	39	8/30/94	
Kittitas	Unnamed Pond (17N-19E-02)	39	8/30/94	
Kittitas	Unnamed Pond (17N-19E-30)	39	8/30/94	
Kittitas	Unnamed Pond (17N-19E-31)	39	8/30/94	
Yakima	Unnamed pond (14N-19E-31)	39	7/18/95	

Also of note, at the time of sampling Giffen Lake and Morgan Lake were covered with *Nymphaea odorata* (fragrant waterlily - a non-native plant that is not on the state noxious weed list). The managers of the Sunnyside Wildlife Refuge are hoping to undertake control measures to increase the open water in Giffen Lake.

Recommendations

Continue monitoring waterbodies close to the lower Yakima River for the spread of Eurasian milfoil (Myriophyllum spicatum). Continue supporting local weed board efforts to control purple loosestrife along the river corridor through financial support to a cooperative effort by the Yakima and Benton County Noxious Weed Control Boards and the Yakima Indian Nation

Lakes

Investigations

Lakes Cle Elum, Leech, Keechelus, and Easton (all from WRIA 39) were most recently sampled in 1993 as basin lakes within the Lake Water Quality Assessment Program. Trophic states for the above mentioned lakes and the years they were sampled are listed in Table 4.

Table 4. Trophic status of surveyed lakes.

Cle Elum	Oligotrophic (1989; 1993)
Leech	Mesotrophic (1989 - 91; 1993)
Keechelus	Oligotrophic (1993)
Easton	Oligotrophic (1993)

Bioassessment

Investigations

Sites surveyed in the Upper Yakima Water Quality Management Area (WQMA) represented a diverse landscape. Streams were monitored in mountainous regions and in semi-arid regions. Influential variables to stream benthic macroinvertebrate assemblages were: temperature, pH, conductivity, and riparian cover. Dominant land uses that influenced stream quality were forest practices and agricultural activity; both animal and crop production

Mountain region streams carried moderate- to high sediment loads. High quality streams contained macroinvertebrate biota that required a cold-water environment and complex physical habitat. Low quality streams lacked riparian vegetation and had obvious signs of sediment shifting. Semi-arid region streams contained biological assemblages that indicated higher concentrations of suspended organic particulates.

Sediment transport in streams occurs naturally and the process is exacerbated with certain physical changes to the surrounding landscape. American River, Middle Fork Teanaway River, and Indian Creek were determined to be reference sites. Benthic macroinvertebrate taxa and physical measurements of stream channels indicated that the American River was the most physically stable of these reference sites. Indian Creek showed signs of dramatic channel substrate movement.

Sediment impacts to stream macroinvertebrates were identified at sites on the Little Naches River, Swauk Creek, Rattlesnake Creek, and Gold Creek. Greatest impact was found at Gold Creek, a channelized stream. Swauk Creek has been affected by regular highway improvement projects while the other streams have had extensive logging activities in their watersheds. Umtanum Creek (spring-fed) and the Upper Yakima River (large river; irrigation return flow) were unique environments that contained distinct stream communities. Biological communities at reference sites of the Upper Yakima WQMA were different from those suffering sediment impacts.

Mid-elevation streams of the Upper Yakima WQMA were sensitive to riparian and physical instream alterations that increased sediment transport. Excessive transport resulted in channel braiding in some of the streams surveyed. Thinning or removal of vegetation resulted in an increase of organic particulates that entered the stream water column.

Recommendations

Continued monitoring of reference sites such as the American River and the Middle Fork Teanaway River is necessary to determine changes over time in the macoinvertebrate community. Simultaneous monitoring of degraded stream reaches (*i.e.*, Little Naches River and Rattlesnake Creek) will indicate how severe an impact must be before it affects the biological community. Definition of biological condition at known reference and degraded sites are a precursor to establishing expectations for aquatic communities in this WQMA.

Table 5. Bioassessment sites and stream condition.

Mountain Region	**Stream Condition**
American River (WA-38-1060)	Good
Middle Fork Teanaway River (WA-39-2200)	Good
Indian Creek (WA-38-9020)	Good
Little Naches River (WA-38-1080)	Moderate
Gold Creek (WA-39-9050)	Poor
Swauk Creek (WA-39-1420)	Poor
Semi-Arid Region	
Rattlesnake Creek (WA-38-1035)	Poor
Upper Yakima River (WA-39-1030)	Moderate
Umtanum Creek (WA-39-1010)	Good

Toxics in Surface Water

by
Jim Cubbage

Introduction

The Toxics Investigations Section (TIS) conducts studies to examine the extent and severity of contamination of surface waters, sediments, and groundwater by metals, organics, and pesticides. Compliance monitoring of NPDES licensed dischargers and State Waste Discharge Permitted Facilities (Class II inspections) is also conducted within TIS and the results of these studies are reviewed elsewhere. Except for pesticides, TIS does not systematically monitor or collect data on toxics in state waters. Rather, the impetus for a study primarily typically comes from the need to further investigate an area considered to have contamination problems. Beyond examination of pesticides or its effects on fish, or stations in statewide monitoring networks, no other studies have been conducted by EILS within either the upper or lower Yakima basin.

Data gathered by TIS on the occurrence of toxic pollutants in the surface waters of the Upper and Lower Yakima Water Quality Management Areas fall into the following broad types of studies:

Comprehensive examination of DDT and other organochlorine pesticides in fish and sediments were examined throughout the river,

Fish histopathology analysis at one site to determine overall health of fish in the river,

At one site in the Yakima basin, as part of a large statewide monitoring network for pesticides, examination of water for all possible pesticides at Moxee Drain, many different pesticides in fish and sediment at Horn Rapids, and

At one site, as part of statewide monitoring, concentrations of four metals in water at Kiona.

Review of Studies

Table 1 reviews the years, number of sites, type of chemicals and media examined for all studies conducted by TIS and one from WAS in the Upper and Lower Yakima Basins. These studies do not include Class II inspections of dischargers that are reviewed elsewhere. Most of the studies were focused on pesticides and examined only one site. Indeed, several studies examined the same site, Moxee Drain, a canal that drains irrigated lands and is often called an "agricultural drain". Though 11 years old, the 1985 study of DDT throughout the river was included in this review because of its comprehensiveness and, illustrated by its being published in a refereed journal, its overall high quality. The following reviews are extracted from the reports listed in Table 6.

Comprehensive examination of DDT in the Yakima River (1)

Results

State-wide monitoring of fish found high concentrations of DDE in fish from the Yakima Drainage between 1979 and 1984, and this discovery prompted a comprehensive survey in 1985 of the Yakima drainage for organochlorine pesticides in water, sediment, and fish.

The major organochlorine pesticides detected in resident fish were DDT compounds (up to 3,000 ug/kg), PCB-1260, and dieldrin. Endosulfan and endrin were also detected in a few samples. Mercury ranged from 32 to 447 ug/kg with the highest concentrations in squawfish. Higher concentrations were found in whole fish samples than found in muscle only. Water samples from 11 tributaries and three mainstem sites had total DDT, dieldrin and endosulfan in decreasing concentrations as the study progressed through the season. In contrast to the fish data where the metabolite DDE makes up the majority of total DDT, DDT isomers in water were equal in concentration to DDE isomers. Diazinon was found in one sample one time at Birchfield Drain. Most all organochlorines were found in tributaries. Total DDT and dieldrin were the predominant organochlorines detected in sediment. Endosulfan, aldrin, and isodrin were also detected, but in only one sample each. Mercury was found above detection limits in all but one sample. Normalized concentrations increased towards the mouth of the river. An extremely high measure of aldrin (1,065 ug/kg) was found at the mouth of Spring/Snipes Creek but was not found in a subsequent study (Johnson, personal communication).

Conclusions

Concentrations of total DDT, dieldrin, PCB-1260, and mercury in edible fish tissue were well below FDA "action levels". US EPA risk assessment methodology, based on animal studies, showed carcinogenic risk from PCB-1260 and dieldrin was greater than for the much more prevalent total DDT compounds. All concentrations were below adverse effects on fish reproduction. Only DDT concentrations were above adverse effects on predators (National Academy of Sciences numbers). The authors conclude that the potential reduction in predator eggshell thickness would still allow stable populations to continue. All compounds in water were below EPA acute toxicity criteria. Total DDT, dieldrin and endosulfan in water from some tributaries exceeded EPA chronic criteria and NAS recommended maximum concentrations for water and thus sensitive aquatic species may be impaired in some of these tributaries, but no such effects probably occur in the main stem of the river.

Table 6. Review of toxics studies in Upper and Lower Yakima Basin conducted by EILS. (N refers to number of sites. RM. is river mile.)

Year	Study	Location	N	Chemicals	Media	Study
1985	**1**	RM. 20-181	11	DDT, other organochlorine pesticides, mercury, diazinon	Fish, Sediment, Water	Johnson et al. 1986, 1988
1987	**2**	RM. 21,129	2	Fish histopathology	Fish	Landolt and Kocan 1987.
1991	**3**	Granger, Kiona	2	DDT and other organochlorine pesticides.	Fish, water	Johnson and Serdar 1991.
1991-1992	**4**	Moxee Drain	1	Organochlorine, organophosphorus pesticides, chlorophenoxy herbicides	Water	Seiders 1993
1992	**5**	Moxee Drain	1	Organochlorine, organophosphorus, and nitrogen containing pesticides, phenoxy herbicides, carbamates, pyrethroid pesticides, glyphosate/diquat/paraquat, EDB	Water	Davis 1993
1992	**6**	Horn Rapids Dam RM. 18	1	Organochlorine, organophosphorus, and nitrogen containing pesticides, phenoxy herbicides	Fish and Sediment	Davis and Johnson 1994a
1992-1993	**7**	Kiona	1	Zinc, Copper, Lead, Cadmium	Water	Johnson 1994
1993	**8**	Moxee Drain	1	Organochlorine, organophosphorus, and nitrogen containing pesticides, phenoxy herbicides, carbamates, pyrethroid pesticides, glyphosate/diquat/paraquat, EDB	Water	Davis and Johnson 1994b

Concentrations of total DDT and dieldrin in Yakima River fish and water have declined since the early 1970s. Most of the transport of DDT and dieldrin to the river occurs during the irrigation season and is probably being mobilized from soils where it degrades very slowly.

Fish Histopathology (2)

To further evaluate the significance of elevated levels of chlorinated pesticides in fish from the lower Yakima River, fish were examined for tissue defects (histopathology). Blood, spleen, liver, kidney, gonad, and gill of carp, large-scale suckers and some miscellaneous species were examined. Carp and large-scale suckers are bottom feeders and could be expected to be in contact with sediment for most of their lives. The extensive examination showed the fish bore no lesions that suggested widespread contaminant effects.

Granger Fish Study (3)

Two water samples collected at Kiona and three composite fish samples collected at Granger were analyzed for organochlorines. No compounds were found in the water samples. The residues in fish varied little from the 1986 study. Johnson summarizes "although the trend may lead one to believe that contamination by chlorinated pesticides is largely a historical problem, the concentrations in water and fish in the Yakima drainage should be viewed as a continuing concern."

Moxee Drain (4, 5, 8)

One report (4) examined the effects of Best Management Practices on irrigated agricultural lands in reducing non-point pollution. It is reviewed in the Watershed Assessments Section by J. Joy.

As part of a statewide network of study sites, water in Moxee Drain was examined for 162 pesticide residues in 1992(5) and 1993(8). Pesticides found above detection limits in 1992 were dacthal (DCPA), gyphosate, malathion, pentachlorophenol, 2,4-D, and DDT compounds. Concentrations of malathion (0.044 ug/l) and DDT compounds (0.061 ug/l) exceeded EPA chronic water quality criteria and were the highest found in the study in 1992. In 1993, 2,4-D, DDT compounds, azinphos-methyl, chlorpyrifos, DCPA, diazinon, dicamba, dimethoate, endosulfan, pentachlorophenol, and propargite were found at least one of four times the site was sampled. Total DDT, azinphos-methyl, chlorpyrifos, diazinon, and endosulfan exceeded water quality criteria at least once. More pesticides were found in June than in August or October, a pattern seen in earlier studies that linked pesticide concentrations to irrigation seasons. Detected Total DDT varied from 0.005 ug/l to 0.057 ug/l. Again, the DDT concentrations found at Moxee Drain were the highest in the study.

Fish and Sediments Metals at Horn Rapids (6)

Whole fish, fillets, and eggs were collected at Horn Rapids Dam and analyzed for chlorinated pesticides and selected organophosphorus pesticides. Sediments were collected and analyzed for these pesticides and urea-based, chlorphenoxy herbicides, and nitrogen containing pesticides. Whole fish replicates ranged from 678-1720 ug/kg total DDT, the highest of six sites. Chlordanes, hexachlorobenzene, pentachloroanisole (metabolite of pentachlorophenol) and PCBs were also found. Eggs and fillets contained the same pesticides except no pentachloroanisole was found. Sediments had low concentrations (18 ug/kg) of total DDT and pentachlorophenol (20 ug/kg). Davis concluded "There are not enough data points for trend analysis is the information, but the data illustrates that concentrations of DDT in the Yakima River continue to be elevated."

Metals at Kiona (7)

Water was collected, from the Yakima River at Kiona, monthly for one year and analyzed for copper, cadmium, lead and zinc. Results show very low levels of the chemicals in dissolved and totals analysis. No sample was above 10% of the chronic criteria for water.

Conclusion and Recommendations

Clearly, the Yakima River water, sediments and biota have relatively high concentrations of persistent organochlorine pesticides. Concentrations in the main stem of the river are linked to the irrigation season. Future Ecology work should focus on techniques to reduce vestigial DDT and newly applied organophosphate compounds from entering the river. WAS is conducting a long-term study to examine water quality in irrigation returns and ways to reduce erosion and accompanying turbidity in the waterbodies. As chlorinated organics are insoluble in water and have a strong affinity for suspended particles and lipids, concentrations of these relic pesticides in the water column would decrease if the erosion and turbidity could be reduced in the Yakima.

Compliance Monitoring

by
Steven Golding

Upper Yakima Basin

There are currently 75 dischargers in the Upper Yakima WQMA that have permits under the National Pollutant Discharge Elimination System (NPDES) and State Waste Discharge Permit Program (WAC 173-216). These include the following:

NPDES Major Permits - 1 Municipal
NPDES Minor Permits - 4 Industrial, 7 Municipal
State Discharge to Publicly Owned Treatment Works (POTW) Permits - 2 Industrial
State Discharge to Ground Permits - 5 Industrial, 3 Municipal, 1 Farm

The following facilities have received EILS Class II Inspections during the last five years:

- Ellensburg WWTP
- Selah WWTP
- Naches STP

The following facilities have received EILS Class II Inspections during the last five to ten years:

- Roslyn WWTP
- Snoqualmie Pass WWTP
- Kittitas WWTP
- Selah WWTP (also inspected in 1992)

Summary of Issues

Past EILS Class II inspection reports indicated the following problems:

Ellensburg WWTP-- The report from the 1994 inspection recommended that the plant flow meter be checked and that infiltration and inflow be reduced. Fecal coliform counts were somewhat elevated during the 1992 and 1994 inspections. The 1994 report recommended that the planned UV disinfection system be operated so as to attain fecal coliform permit limits (Golding, 1995).

Naches STP-- Results of the 1993 inspection found that the receiving water upstream of the Naches STP outfall was lower in dissolved oxygen than the minimum required by Water Quality Standards for Class A waters. Copper concentrations in the receiving water exceeded state acute and chronic criteria. Lead concentrations in the receiving water exceeded state chronic criteria (Golding, 1994).

Snoqualmie Pass WWTP-- The 1988 inspection results indicated that not all discharge for the state to ground permitted facility was to the groundwater. A similar conclusion was reached in the 1984 inspection. Infiltration and inflow coming from the collection system into the lagoon resulted in a greater volume to spray and less discretion in choosing spraying times. Broken sprayfield equipment resulted in poor effluent distribution and concentrated runoff (Heffner, 1989).

Kittitas WWTP-- The 1988 inspection found serious infiltration and inflow problems during the irrigation season. Split samples with the permittee did not compare well. There was an immediate depression of dissolved oxygen in the creek resulting from the discharge (Joy, 1988). The plant discharges to Cooke Creek, WA-39-1034. The water body is 303(d) listed for violations of dissolved oxygen, temperature, and fecal coliform.

Needs and Recommendations

There have been no regional compliance inspections with sampling for any of the dischargers in the Upper Yakima WQMA during the last five years.

In addition to the cited issues, there are a number of dischargers with no current EILS Class II inspections: No industrial dischargers in the Upper Yakima WQMA have received EILS Class II inspections during the last ten years. Kittitas STP, Roslyn STP, and Snoqualmie Pass STP have not received EILS Class II inspections during the last five years. Cle Elum STP, South Cle Elum STP, Cowiche STP, Ronald STP, and Tieton STP have not received EILS Class II inspections during the past ten years. Class II inspections are recommended for these facilities and for other facilities of concern.

Lower Yakima Basin

There are currently 220 dischargers in the Lower Yakima WQMA that have permits under the National Pollutant Discharge Elimination System (NPDES) and State Waste Discharge Permit Program (WAC 173-216). These include the following:

- NPDES Major Permits - 3 Municipal
- NPDES Minor Permits - 24 Industrial, 7 Municipal, 1 Farm
- State Discharge to Publicly Owned Treatment Works (POTW) Permits - 39 Industrial
- State Discharge to Ground Permits - 30 Industrial, 2 Municipal, 2 Farm

The following facilities have received EILS Class II Inspections during the last five years:

- Yakima Regional WWTP
- Grandview STP
- Prosser WWTP
- Toppenish WWTP
- Zillah WWTP
- Sunnyside WWTP
- Mabton WWTP
- Wapato WWTP
- Moxee WWTP
- Granger WWTP

The following facilities have received EILS Class II Inspections during the last five to ten years:

- Yakima STP
- Toppenish STP
- Wapato WWTP
- Seneca Foods WWTP

Summary of Issues

Past EILS Class II inspection reports indicated the following problems:

Yakima Regional Wastewater Treatment Plant-- Ammonia and fecal coliform effluent concentrations were of some concern. Influent loading for BOD_5 exceeded monthly average design criteria included in the NPDES permit. Influent flow exceeded 85% of design criteria. It was suggested that Yakima evaluate the effectiveness of their current practice of sampling only one of the two influent channels for NPDES permit parameters. Effluent concentrations of copper, lead, and silver exceeded EPA chronic water quality criteria for receiving waters. Effluent bioassays provided evidence of toxic effects. The toxicity may have been related to chlorine residual. Sodium adsorption ratio, pH, and coliform concentrations in industrial wastewater were of concern for sprayfield application. The inspection identified high fecal coliform counts and small to moderate organic/metal concentrations in the industrial influent

(Hoyle-Dodson, 1993). The plant discharges to the Yakima River, WA-37-1040. The water body is 303(d) listed for fecal coliform violations.

Yakima River Basin Class II Inspections at Toppenish, Zillah, Sunnyside, Mabton, Wapato, Moxee, Selah, Ellensburg, and Granger Wastewater Treatment Plants-- The common problems occurring at the plants were:

- potential for chlorine toxicity in the receiving water (Zillah and Mabton);
- potential for ammonia toxicity/nutrient enrichment in the receiving water (Sunnyside, Mabton, and Wapato);
- wasteload to WWTP exceeded one or more design criteria (Toppenish, Zillah, Wapato, and Moxee);
- potential for violation of weekly/monthly average fecal coliform counts (Sunnyside, Mabton, Wapato, and Moxee); and
- flow measuring instrumentation needed calibration (Zillah, Mabton, Moxee, and Granger).

Several plant sites needed better maintenance practices; several were understaffed. Two of the WWTPs had considerably more problems than the remaining seven, namely Zillah and Mabton. The potential of receiving water toxicity and plant overloading are two issues which should be addressed in revised permits, specifically by requiring mixing zone evaluations and planning for plant upgrades (Glenn, 1993).

City of Grandview Class II Inspection, October 21-23, 1991-- The treatment system included a primary clarifier, lagoon system, and spray irrigation. The adequacy of treatment was difficult to assess, however, treatment across the lagoons did not appear to be good. Improved flow measurement at the plant was recommended. The facility's operation was periodically outside all of the State Waste Discharge Permit parameters. Significant laboratory deficiencies were identified. Groundwater quality in the vicinity of the treatment lagoons appeared degraded. Differentiation between groundwater impacts due to the treatment plant, a nearby closed landfill, or other causes could not be made. A small wastewater discharge into the Yakima River was noted, although no indicators of gross contamination were observed in the river (Stasch and Heffner, 1993).

Seneca Foods, Wastewater Treatment Plant Class II Inspection-- The aerated lagoon was not adequately pretreating the wastewater prior to slow rate land application. Turbidity, total suspended solids, total nonvolatile suspended solids, and alkalinity were all present in greater concentrations in the effluent stream than in the influent to the aerated lagoon, indicating that minimal treatment was occurring. The effluent stream from the aerated lagoon was characterized as having elevated concentrations of arsenic, lead, zinc, acetone, methyl ethyl ketone, and toluene. The effluent also exhibited high toxicity.

The impact of the waste treatment system was apparent from an inspection of the analytical results obtained from groundwater samples collected from two monitoring wells adjacent to the sprayfield area. The downgradient monitoring well typically contained a higher level of solids, some nutrients, and some metals compared to the upgradient monitoring well. The lagoons were unlined and apparently losing as much as 60% of the wastewater to evaporation and seepage.

Installation of additional monitoring wells, dredging of the settling lagoons and aerated lagoon, installation of a lining in the aerated lagoon, and separating the wastewater from two other dischargers were recommended to provide better treatment of the Seneca effluent generated at this site (Hallinan, *et al.*, 1991).

Needs and Recommendations

There have been no regional compliance inspections with sampling for any of the dischargers in the Lower Yakima WQMA during the last five years.

In addition to the above cited issues, there are a number of dischargers with no current EILS Class II inspections: only one industrial discharger in the Lower Yakima WQMA (Seneca Foods) has received an EILS Class II inspection during the last ten years. Of the municipal dischargers, Buena STP, Benton City STP, and West Richland STP have not received EILS Class II inspections during the past ten years. Class II inspections are recommended for these facilities and other facilities of concern.

Groundwater

by
Denis R. Erickson

Over the last six years EILS has conducted a number of groundwater studies in the Upper and Lower Yakima Watersheds. In most cases these studies consisted of assessments of potential nitrate and pesticide contamination of groundwater due to agricultural practices. These studies are summarized below.

Upper Yakima

Erickson (1992) sampled 27 wells for 74 pesticides and pesticide residues near Gleed, Washington. The study area was underlain by a shallow alluvial aquifer and the predominant land use consisted of fruit orchards. Five wells showed low concentrations of total xylenes (estimated to range between 0.2 to 0.9 g/L) and one well showed one detection of DCPAs (dacthal and metabolites) at a concentration of 0.88 ug/L. The xylene detections are not necessarily related to pesticide use. In addition, samples were tested for arsenic, copper, and lead. Arsenic was detected in 13 wells at concentrations that ranged from an estimated 1.5 to 5.4 ug/L. All arsenic detections exceeded the Washington State groundwater quality standards criterion. None of the observed concentrations for target analytes exceeded drinking water standards for public systems. Nitrate+nitrite-N was detected in all of the wells at concentrations ranging from 0.7 to 4.2 mg/L and a mean concentration of 2.9 mg/L.

In May 1996, Art Larson and Dick Carter sampled 27 wells in the Ellensburg area for 124 pesticides and breakdown products as part of the Washington State Pesticide Monitoring Program for groundwater. Preliminary results show that at least one pesticide was detected in nine of the wells; one well showed five pesticide detections. Pesticides detected and number of detections (in parenthesis) included atrazine (6), atrazine desethyl (6), prometon (1), diphenylamine (1), bentazon (1), simazine (3), bromacil (2), and 2,4-D (1). One nitrate concentration (11.9 mg/L) exceeded the Maximum Contaminant Level for public systems , 10 mg/L.

Carey (1994) conducted vadose zone and groundwater monitoring at a Tree Top land application site near Selah, Washington. Tree Top land applied fruit processing wash water to irrigate pasture grass grazed by cattle. The purpose of the study was to evaluate wastewater treatment in the unsaturated zone and to test two devices for sampling soil pore water. Vadose zone monitoring showed that COD and total N were treated in the top 18 inches. The mean COD treatment was 85% (S.D.=3.8); that for total nitrogen 92% (S.D.=6.8). Biological oxygen demand (BOD5) was estimated from COD concentrations. Estimated BOD5 application rates were two to four times the monthly permit limits. Nitrogen application rates were two to five times higher than monthly permit limits. COD concentrations in monitoring wells adjacent to lysimeters were less than half those in the lysimeters indicating dilution by groundwater.

Lower Yakima

EILS monitored groundwater quality at a new two-stage dairy lagoon (two settling ponds and a main pond) near Sunnyside (Erickson, 1992 and 1994). The study was conducted at the request of the Water Quality Program as part of a larger effort to define the impact of dairy lagoons on groundwater quality at several locations in Washington State. Monitoring wells were installed and sampled quarterly for three years beginning about three months after initial placement of liquid manure. Analytes included chloride, total dissolved solids, total organic carbon, chemical oxygen demand, total phosphorus P, ammonia-N, and nitrate+nitrite-N. Pond leakage and onsite waste handling activities affected groundwater quality downgradient of the main pond. Chloride and TDS concentrations increased downgradient after the pond received wastewater and were still increasing at the end of the monitoring period. Downgradient TOC and COD concentrations were higher than upgradient concentrations but may have stabilized by the end of the study.

As a part of the Washington State Agricultural Chemicals Pilot Study (Erickson and Norton, 1990), 27 wells were tested for 46 pesticides in a study area located about three miles southwest of Sunnyside. Atrazine was detected in one well during initial sampling but was not detected during follow-up sampling. The mean nitrate+nitrite as N concentration for all wells in the study area was 0.7 mg/L.

Twenty-seven wells were sampled in September 1992 for 123 pesticides and nitrate+nitrite-N in the Moxee and Ahtanum Surficial Aquifers near Yakima (Larson, 1993). Eleven wells tapped the Moxee Surficial Aquifer and sixteen wells tapped the Ahtanum Surficial Aquifer. Four pesticides were detected in the initial samples; dacthal, atrazine, simazine, and EDB. One or more of these chemicals were detected in eight wells, however, concentrations were at or below the Lifetime or Health Advisory Levels allowed by the EPA. Neither dacthal nor EDB was detected in verification samples taken in February 1993. Atrazine was detected in four of the verification samples and simazine in two. One well had a nitrate + nitrite as N concentration greater than 10 mg/L.

Issues

The main groundwater quality issues are listed as follows:

- Interaction of groundwater and surface water relative to quantity and quality is a major concern to regional staff.
- Nitrate and pesticide contamination from agricultural practices, especially in irrigated areas with shallow groundwater.
- Leakage from unlined animal waste storage ponds and land application of dairy wastewater in areas of shallow groundwater.

Watershed Assessments

by
Joe Joy

Investigations: 1986 - 1996

A brief annotated bibliography of WAS studies performed over the past ten years for each of the two basins follows:

Upper Yakima Basin

- ***Kittitas Wastewater Treatment Plant Receiving Water Study and Abbreviated Class II Inspection (1988) by J. Joy.*** Water quality in Cooke Creek, the receiving water for the Kittitas wastewater treatment plant (WWTP) and tributary to Town Canal, was impaired by both nonpoint sources and the effluent in terms of nutrient loading and related dissolved oxygen violations. Water chemistry, macroinvertebrate, and fish population evaluations were performed and supported the water quality findings. Fecal coliform bacteria levels were in violation of Class A criteria above and below the outfall. Total residual chlorine was detected in the area of the outfall, and ammonia toxicity was a potential problem. Dilution of receiving water to effluent was marginal at 3.5:1. Total maximum daily load (TMDL) calculations were made on the effect of Kittitas WWTP BOD, ammonia, and chlorine design loads on Cooke Creek. As a result of the findings Cooke Creek was placed on the 303(d) list.

- ***Selah Wastewater Treatment Plant Receiving Water Survey (1990) by J. Joy.*** The water quality of Selah Ditch, the receiving water for the Selah WWTP, was seriously impaired by fruit juice condensate, with a high BOD and an unknown fecal coliform source both of which were outside of the WWTP collection system. Water chemistry and habitat potential evaluations were conducted and indicated impairment was present for the entire one mile of ditch, and also fish passage was blocked to Golf Club Creek. A general TMDL calculation showed the flow in the ditch was seasonally inadequate to protect water quality from typical WWTP effluent BOD and ammonia loads. Upstream water quality was unreliable since the source water was subsurface drainage, industrial cooling water, and urban storm water. Selah Ditch has been placed on the 303(d) list.

- ***Diagnostic Study of Myron Lake, Yakima County, Washington (1990) by G. Pelletier and N. Ekpoom (Ecology) and E. Anderson (Wildlife).*** Investigations of the 1987 fish kill in the lake were made. Anoxic hypolimnion water mixing at fall overturn was determined to be the cause of the 1987 kill and the documented kill in 1988. The eutrophic condition of the lake was caused by phosphorus loading from groundwater and springs, and from hypolimnetic sediment release. Hypolimnetic reaeration was suggested to control dissolved oxygen and prevent future kills. Myron Lake is on the 303(d) list for ammonia.

- ***Roslyn Post-upgrade Wastewater Treatment Plant Class II and Receiving Water Study on Crystal Creek (1991) by R. Willms.*** Water quality in Crystal Creek, the receiving water for the Roslyn WWTP, did not meet fecal coliform criteria upstream of the outfall. Receiving water to effluent dilution was 6:1. The effluent contribution caused chlorine and temperature violations. Macroinvertebrate and fish population surveys indicated slight changes in biota from the effluent. Low flow TMDL calculations projected dissolved oxygen, ammonia, fecal coliform and residual chlorine violations from the permitted discharge loads. A TMDL for these parameters was approved by USEPA February 1993.

- ***Effectiveness of Forest Road and Timber Harvest Best Management Practices with Respect to Sediment-related Water Quality Impacts (1992,1993 and 1994) by E. Rashin et al. Rashin, E., C. Clishe, and A. Loch, 1994.*** A case study approach was used to evaluate the effectiveness of certain forest road and timber harvest best management practices (BMPs). These reports provide the study design, summarize study site information, and state project progress. Four sites were selected from the Eastern Cascade physiographic region in the upper Yakima, Cle Elum, and West Fork Teanaway basins. BMP categories targeted at the sites include: tractor and wheeled skidding, cable yarding, new road construction with stream crossings, and riparian management zone effectiveness. A number of qualitative and quantitative survey techniques are being employed to assess erosion and sediment delivery to streams, characterize stream channel, runoff, and aquatic habitat conditions, and assess biological communities. In most cases, two or more survey techniques are applied to each BMP example studied. The final report is due in Fall 1996.

- ***RE-MAP data collection in the East Cascades/Columbia Basin Ecoregion by G. Merritt (unpublished).*** Thirty-one small streams in the upper and lower Yakima River basin have been visited at least once for biological and basic chemical assessments. Basic data are being compiled for ecoregional analysis. Data collection will resume in 1997.

Lower Yakima Basin

- ***Wide Hollow Creek (1988) by W. Kendra--***. A low flow period survey was conducted on 13.7 miles of Wide Hollow Creek near Yakima in 1987. Fecal coliform, entercocci, dissolved oxygen concentrations, pH, and temperatures in violation of Class A criteria were noted in several areas of the drainage. Livestock access and other nonpoint residential and agricultural sources were potential causes of the violations. Macroinvertebrate evaluations, fish population surveys, and sediment chemistry screening were also performed. Recommendations for source identification and future surveys were made. As a result of this survey and additional data, Wide Hollow Creek was placed on the 303(d) list.

- ***Moxee Drain BMP Implementation Demonstration Project Water Quality Monitoring Report (1992; 1993) by K. Seiders--*** A portion of the Moxee Drain subbasin was intensively monitored for two years to measure the effectiveness of furrow-mulching of hop fields. Sediment and ammonia loads from treated hop fields were reduced compared to the previous year without treatment. However, drought conditions during the treatment year also caused better water conservation measures to be implemented which may have had a greater impact on improved water quality than the furrow-mulching. A pesticide sample collected from drain water, sediment from a sediment basin, and settled sediment from a drain had similar concentrations of DDT metabolites as were found in previous studies. Diazinon was detected in sediment samples, and 2,4-D was detected in water and sediment. As a result of this survey and additional data, Moxee Drain was placed on the 303(d) list. The sediment did not exceed Ontario's "severe effects levels," and had concentrations equivalent to earlier studies.

- ***Water Quality Impacts from Dairies in Washington State: A Literature Review (1995) K. Erickson--*** Three reports in the Granger and Sunnyside subbasins were reviewed and summarized. The reports (see USGS, and Conservation Districts in **Other Studies** below) identified dairies and livestock areas as significant sources of nutrient, bacteria, turbidity, and dissolved oxygen water quality problems.

- ***Lower Yakima River Suspended Sediment and DDT Total Maximum Daily Load Evaluation (1996 in review) by J. Joy and B. Patterson--*** The goal of the Yakima River TMDL project is to recommend effective measures to reduce the impact of sediment and bioaccumulative pesticides (DDT and metabolites) from irrigated areas of the lower Yakima River. Reducing these impacts will benefit fish and fish habitat, and improve other beneficial uses. The project identified irrigated sub-basins with the greatest sediment load effects on the fishery resources. The TMDL evaluation was conducted in two phases. Phase I (1994 irrigation season) provided a general revised assessment of the problem areas within the entire basin. Screening level procedures of landscape analysis (see ***GIS Analysis, Yakima River***

Suspended Sediment TMDL Evaluation below) and water quality data evaluation were used. Phase II (1995 irrigation season) was a more intensive assessment of the lower Yakima River. Turbidity and DDT criteria were linked to TSS concentrations from data collected by Ecology and others. Additional research set TSS and turbidity limits for fisheries protection using the state narrative criterion. TSS targets for the lower Yakima River main stem, and for individual return drains and tributaries in the lower basin were recommended to be phased-in over the next 15 years. A model linking land and water management to water quality was not satisfactorily developed in Phase II because simulation of erosion from furrow irrigation has not been developed. Monitoring data also revealed new pesticide problems which will need attention.

- ***GIS Analysis, Yakima River Suspended Sediment TMDL Evaluation (1995) by J. Tooley***-- A worst case soil erosion analysis of Yakima basin agricultural areas was conducted by using information from geographical information system (GIS) coverages and applying those data to a simplified sediment yield model for furrow irrigated fields. The sediment erosion value was compared to another GIS coverage of soil tolerance values to identify areas at risk from loss of soil productivity caused by soil erosion.

- ***Land Use/Land Cover Spatial Data Layer Development and Update Project (1996) by M. Woodall***-- Efforts were made to update the 1974 USGS land use/land cover spatial data set for the lower Yakima River area using 1991 Landsat Thematic Mapper imagery and land use inventory data. Third level Anderson Classification coding was successful for some areas of the project area.

Other Studies and Data Bases

Several other agencies have been actively monitoring water quality in the Yakima basin over the past ten years. A brief description of some of the major reports or data bases follows:

- The USGS National Water Quality Assessment Program (NAWQA): 1986-1991. The Yakima River basin was one of four surface water pilot projects used by USGS to test and refine water quality and environmental resource assessment methods. After a five year absence, USGS plans to be back in the Yakima basin for a second round of monitoring in 1997. The NAWQA reports for the first round of monitoring the Yakima are still coming out, but to date the following assessment information has been released:

  - ✦ Nitrate-nitrite samples collected along the main stem Yakima in August 1986 showed a six-fold increase in the vicinity of Granger and remained at that level all the way downstream. This increased concentration approximated the concentration of nitrate-nitrite in the return drains, and demonstrated the impact of return drain water on main stem water quality in the lower river during the irrigation season. Data for specific conductance, turbidity and other nutrients showed similar patterns (McKenzie and Rinella, 1987).

- *Escherichia coli* (E. coli) samples collected in the basin in July 1988 showed a wide spatial and temporal variability. Lowest counts were from forested area streams of the upper Yakima and Naches basins; range area streams had higher counts; and streams from areas with confined animal feeding operations (CAFO), high livestock densities, and dairies had the highest concentrations. Several sites exceeded recommended USEPA criteria for casual contact. Fecal coliform data in this report resulted in several waterways being 303(d) listed (Embrey, 1992).

- Historical data from the Yakima River basin were summarized for years 1974 to 1981. Some improvements in water quality were detected at some sites over the eight year period, but water quality standards were not being met at many sites for temperature, pH, fecal coliform, and dissolved oxygen. Turbidity and phosphorus were at levels of concern for aquatic life. Trace elements in whole fish are similar to national baseline concentrations except for arsenic, lead, and zinc, which were substantially higher. Dissolved elements in water of concern were lead, mercury, copper, cadmium, and zinc. Yakima River basin water samples have had concentrations of aldrin/dieldrin, endosulfan, DDT & metabolites, endrin, parathion, and PCBs which exceeded chronic criteria to protect aquatic biota. Fecal coliform bacteria sample results indicated criteria violations in 40% of the main stem samples collected, most of which occurred downstream of Granger. About 14% of the samples from Class AA waters exceeded bacteria criteria. Since 1970, nonpoint sources have been the major controlling factor for bacteria. Anadromous fish populations have remained steady since 1920 when they suffered a devastating decline from previous years because of irrigation system and land development (Rinella, et al., 1992a).

- Summaries of pesticide and trace organic, trace element, and major and minor element data collected during the NAWQA effort were published without interpretation (Rinella *et al.*, 1992b; Ryder *et al.*, 1992; Fuhrer *et al.*, 1994a; Fuhrer *et al.*, 1994b). Interpretations of these data are due out this year (G. Fuhrer, personal communication).

- The South Yakima Conservation District performed a water quality study of the Granger Drain to assess individual contributions from laterals so that priorities could be set to manage BMP efforts. Nutrients, turbidity, TSS, dissolved oxygen, pH, conductivity, and temperature measurements were taken from December 1990 to April 1992. Land use, crop cover, and irrigation method were mapped as well. Data from this study were used with other data for Granger Drain's 303(d) listing (Zaragoza, 1992).

- The South Yakima Conservation District performed a water quality study of the Sulphur Creek Wasteway to assess individual contributions from subdrainages so that priorities could be set to manage BMP efforts (Pelliser, 1995).

- The South Yakima Conservation District has performed studies on Giffen Lake in cooperation with Washington State University. Data resulted in Giffen Lake's placement on the 303(d) list. Restoration recommendations have been made.

- North Yakima Conservation District has monitored TSS, flow, and other water quality parameters from the Moxee Drain system for several years. Some of these data have been used for BMP evaluation (NYCD, 1995).

- The Benton Conservation District has undertaken water quality monitoring in the Spring Creek watershed. Turbidity and other parameters are being measured to target areas in need of BMP education and outreach.

- USBR has collected monthly water samples from Cherry Creek, Wilson Creek, Moxee Drain, Wide Hollow Creek, Granger Drain, and Snipes Creek. Nutrient, TSS, turbidity, temperature, conductivity, dissolved oxygen, chemical oxygen demand, alkalinity, total organic carbon, major ion, and sodium absorption ratio have been analyzed since 1990 and are on the USEPA STORET system. Some of these data were used for 303(d) listing.

- The Yakama Indian Nation Environmental Protection Program has field probe water quality data collected from tributaries and the main stem river. Some of the data were used for the TMDL evaluation, but other data may be available for assessments.

Issues

Primary water quality issues in the Yakima River basin are dependent on dominant land uses in the regions of concern. For example, forest practice impacts on temperature and fine sediment transport are issues in the upper forested regions of the Yakima and Naches basins. Range practices effect bacteria, sediment, and temperature quality in arid areas subjected to seasonal rain storm and rapid snow melt events. Municipal and industrial point sources, and urban/residential nonpoint sources of bacteria, toxics, nutrients, and oxygen demand are of concern in populated areas near the rivers or along urban growth corridors. Adequate dilution of municipal and industrial effluent is of concern for facilities away from larger waterways. Finally, irrigated agriculture in the Kittitas, Naches, and lower Yakima valleys impact suspended sediment, temperature, pesticides, nutrients, and oxygen demand in return drains, tributaries, and the main stem. Agricultural water quality issues are tightly bound to water quantity issues as well because the Yakima River basin is such a severely managed system for irrigation water delivery.

Some of the issues documented by WAS and other reports which will need consideration for further work include:

- Packaging Cooke Creek and Selah Ditch evaluations as TMDLs for submittal to USEPA or revisiting their water quality conditions.
- Evaluating Wide Hollow Creek water quality since the 1987 study to see if measures have been successfully implemented and 303(d) removal is warranted.
- Following-up investigation of the Crystal Creek pH 303(d) listing.
- Following-up on implementation of Myron Lake restoration.
- Packaging Giffen Lake Phase I restoration work for TMDL submittal.
- Monitoring tributary and main stem sites for the Yakima TSS and DDT TMDL implementation assessment.
- Conducting fecal coliform/bacteria and temperature TMDL evaluations.
- Initiating a Cherry Creek/Kittitas Valley TSS/DDT TMDL evaluation based on Phase I Yakima TMDL evaluation, USGS, and USBR data.
- Conducting Organophosphate pesticide monitoring and BMP implementation during peak use periods.
- Assisting local conservation and irrigation districts with water quality monitoring for BMP evaluations or subbasin characterization.
- Participating in cooperative monitoring, data sharing, and assessment with the second round of NAWQA, and with USBR and the Yakama Tribe.
- Developing GIS/nonpoint source evaluation models for irrigated agricultural areas.
- Developing GIS layers for irrigation water routing, field scale irrigation management method, and land cover.
- Monitoring the suspended sediment and residual impacts of polyacrylamide (PAM).
- Providing monitoring support for dairy and CAFO enforcement.
- Defining and conducting instream flow TMDLs.
- Following-up on TFW sediment study results.

Conclusions & Recommendations

There has been some improvement in water quality in the basin over the past twenty years, but much remains to be done. The Yakima River basin is very rich in data and initial problem definition. Remaining are implementation of solutions for problems that have been evaluated, and a clearer understanding of other problems. EILS' technical services can be used to monitor implementation and provide characterization where needed.

The CRO is embarking on an ambitious project eliciting local support for the implementation phase of the lower Yakima River TMDL, so regional resources for a second TMDL may be limited. The CRO is also interested in maintaining a cooperative spirit in the valley, so EILS will need to make special efforts to coordinate its projects with other groups and agencies. With so many other resource agencies in the basin, coordination and cooperation will go a long way toward gaining public confidence that public funds are being well-spent.

If the highest priority of the Water Quality Program is eliminating water bodies from the 303(d) list, then packaging of those areas already evaluated (Cooke Creek, Selah Ditch, Moxee Drain, Giffen & Myron Lakes, Sulphur Creek and Granger Drain) provides an administrative solution to part of the problem. WAS can support technical review of studies or help with summaries of technical information for public presentation. WAS can also perform TMDL evaluations on additional water bodies (Cherry Creek TSS/DDT, Yakima River fecal coliform/temperature) if CRO has the public participation support in hand.

Finally, WAS can continue to build on nonpoint source assessment tools initiated during the Yakima TMDL which will help the CRO in future water quality management decisions.

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