Lower Skagit River
Dissolved Oxygen
Total Maximum Daily Load

Submittal Report

May 2000
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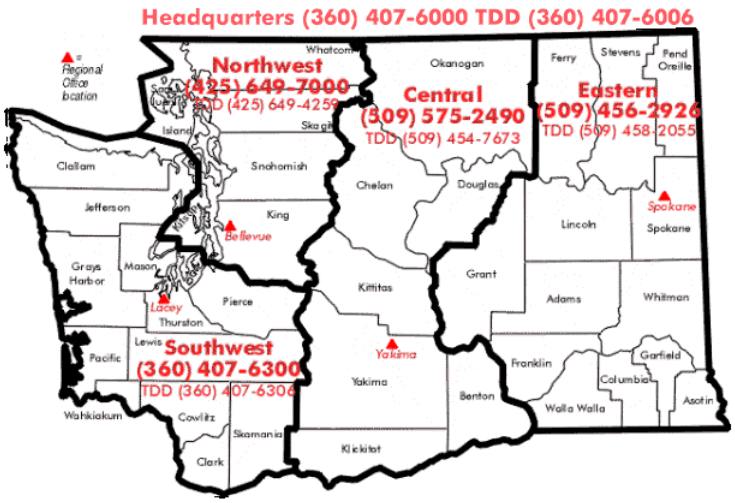

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Lower Skagit River
Dissolved Oxygen
Total Maximum Daily Load

Submittal Report

by
Steve Butkus
Gerald Shervey
Paul J. Pickett

Washington State Department of Ecology
Water Quality Program
Post Office Box 47600
Olympia, Washington 98504-7600

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Introduction

Section 303(d) of the federal Clean Water Act mandates that the state establish Total Maximum Daily Loads (TMDLs) for surface waters that do not meet standards after application of technology-based pollution controls. The U.S. Environmental Protection Agency (EPA) has promulgated new regulations (40 CFR 130.7 (e) and developed guidance (EPA, 1991) for establishing TMDLs.

Under the Clean Water Act, every state has its own water quality standards designed to protect, restore, and preserve water quality. Water quality standards consist of designated uses, such as cold water biota and drinking water supply, and criteria (usually numeric criteria), to achieve those uses. When a lake, river or stream fails to meet water quality standards after application of required technology-based controls, the Clean Water Act requires that the state place the water body on a list of "impaired" water bodies and to prepare an analysis called a **Total Maximum Daily Load (TMDL)**.

The goal of a TMDL is to ensure the impaired water will attain water quality standards. A TMDL includes a written, quantitative assessment of water quality problems and of the pollutant sources that cause the problem. The TMDL determines the amount of a given pollutant that can be discharged to the water body and still meet standards, the **loading capacity,** and allocates that load among the various sources. If the pollutant comes from a discrete source (referred to as a **point source**) such as an industrial facility's discharge pipe, that facility's share of the loading capacity is called a **wasteload allocation** (WLA). If it comes from a diffuse source (referred to as a **nonpoint source**) such as a farm, that facility's share is called a **load allocation**.

The TMDL must also consider seasonal variations and include a **margin of safety** that takes into account any lack of knowledge about the causes of the water quality problem or its loading capacity. The sum of the individual allocations and the margin of safety must be equal to or less than the loading capacity.

The Lower Skagit River Total Maximum Daily Load, developed by the Washington State Department of Ecology (Ecology), is being established for oxygen demanding substances, that is carbonaceous 5-day biochemical oxygen demand ($CBOD_5$) and ammonia. This TMDL is being established to prevent impairments to aquatic life from potential low dissolved oxygen concentrations. Since the lower Skagit River currently meets the state dissolved oxygen standard, this TMDL is a basis for planning by the affected dischargers.

The five elements of a TMDL as required by federal statute and regulation are summarized below:

Loading Capacity: The loading capacity varies with point of discharge of the pollutant. Carbonaceous 5-day biochemical oxygen demand ($CBOD_5$) can be exchanged with ammonia loading. Various sets of discharges and WLAs provide compliance with the state water quality standards. The loading capacity for $CBOD_5$ was estimated to be 14,654 pounds per day. The loading capacity ammonia-nitrogen (NH_3-N) was estimated to be 2,516 pounds per day. The

critical period was established as the July through October period since the lowest flows, lowest dissolved oxygen,and the highest temperatures occur during these months.

Wasteload Allocation: Wasteload allocations for carbonaceous 5-day biochemical oxygen demand ($CBOD_5$) and ammonia nitrogen (NH_3-N) are established for existing permitted dischargers based on 2015 projected flows; $CBOD_5$ effluent concentrations of 40 mg/L; and ammonia nitrogen effluent concentrations of 25 mg/L for the Mount Vernon WWTP and 10 mg/L for the other three point sources for current conditions. An alternative WLA for Mount Vernon will provide for flows and loading projected for future conditions so that the city can modify its wastewater treatment plant to reduce levels of ammonia and increase levels of $CBOD_5$ in the discharge.

Load Allocations: Load allocations are established at the existing loads from the Skagit River at the upstream boundary above Sedro-Woolley and from Nookachamps Creek. Hansen Creek and Kulshan Creek are both expected to be dry during the critical condition period, and as such, have load allocations established at zero.

Margin of Safety: . Several assumptions and critical conditions used in the modeling analysis provide an inherent margin of safety as required by the statute. These conservative assumptions and critical conditions included using low river flows, design capacity for point source effluent flows, and highest measured concentrations of carbonaceous 5-day biochemical oxygen demand ($CBOD_5$) and ammonia nitrogen (NH_3-N) for nonpoint source inputs to model runs, and the use of a 1.2 mg/L factor added to the water quality standards at the downstream point of compliance to account for tidal affects near the mouth of Skagit River. Ambient ammonia levels 50 percent greater than those measured during the TMDL study and later by the dischargers to the river also provides a margin of safety. In addition, the Department has set WLAs with some river capacity kept in reserve.

Seasonal Variation: Dissolved oxygen, temperature, and flow data collected in the Skagit River show a definite pattern of seasonal variation. The critical period is in the summer months from July through October where dissolved oxygen concentrations and river flows are lowest.

Background

The Skagit River basin encompasses a total of 2,730 square miles in Washington and about 400 square miles in Canada. The main stem of the Skagit extends 35 miles in Canada and 127 miles in Washington. On average more than 15 million acre-feet of water cycles through the river basin annually. The Skagit River is regulated by three hydroelectric dams -- Gorge Dam at river mile (RM) 96.6, Diablo Dam at RM 101, and Ross Dam RM 105. The river originates in British Columbia, flows through Ross Lake, by the town of Sedro Woolley, through Burlington and Mount Vernon, divides into the North Fork and South Fork, and empties into the Puget Sound at Skagit Bay. The Skagit River provides hydroelectric power, drinking water, irrigation, fish (including Chinook salmon) and wildlife habitat, and extensive recreational opportunities.

The area covered by this TMDL is the Lower Skagit River and Bay, which is the lowland portion of the river downstream from the lower end of Skiyou Slough near Sedro-Woolley (Figure 1). This area drains about 200 square miles into Skagit Bay. The principal land uses in this area are agriculture, forestry, and urban areas (Entranco, 1993). Much of the area is diked and drained, and several pump stations discharge water from the drainage districts into the Skagit River.

The flows of the Skagit River exhibit complex hydrology influenced by several sources. Summertime flows are maintained by groundwater inflow in the tributary drainages and by glacial outflow and snowmelt, which produce peak flows through mid summer. Wintertime flows are dominated by the timing and amount of rainfall. The North and South Forks, and part of the main stem are subject to a tidal influence extending about 15 miles upstream to near Mount Vernon. Mean daily flows gauged near Mount Vernon are highest in June and lowest in September and October. The mean annual flow is 16,710 cubic feet per second. The 7-day average low flow with a 10 year recurrence (7Q10) is 5,030 cubic feet per second.

There are four permitted discharges to the Lower Skagit River with potential to affect dissolved oxygen or fecal coliform levels: wastewater treatment plants (WWTP) at the city of Sedro-Woolley, the city of Burlington, the city of Mount Vernon, and Skagit County Sewer District # 2 (the Big Lake Facility). A number of potential nonpoint pollution sources also exist in the Lower Skagit River area. Urban stormwater reaches the river from storm drain systems located in densely populated areas. Stormwater runoff and field drainage from agricultural areas drains passively and is pumped through county and drainage district pump stations to the Skagit at various locations. The city of Mount Vernon discharges a dilute mixture of sewage and storm water from two combined sewer overflow points on occasion. The area contains over 50,000 acres of farmland with over 50 commercial dairy operations holding over 20,000 animals. Failing or inadequate septic systems may also contribute pollutants to the river.

A major water quality study of the Lower Skagit river was conducted by Entranco (1993). That study showed that dissolved oxygen standards were not met throughout the basin. As a result, the Skagit River and numerous tributaries were added to the 1994 Section 303(d) list. These waters were removed from the 1996 list based on a re-evaluation of the dissolved oxygen data. These data were judged to be of poor quality, as indicated by inconsistency and high variability. A follow up study conducted by the Department of Ecology (Pickett, 1997) showed all waters were in compliance with dissolved oxygen standards. No Skagit River sample measured below 9

mg/l during the critical period of September and October. The TMDL was developed to prevent future excursions of the dissolved oxygen criteria, not to alleviate a current problem.

The WLAs developed by this study will be incorporated into NPDES permits as the WLAs become more stringent than technology-based or other water quality-based limits. The WLAs here are the maximum available based on Department of Ecology's assessment of the conditions and discharges to the Skagit River. The WLAs are not rights to discharge. They may be changed in the future based on changed conditions, new assessments, or the addition of point sources not considered in this study.

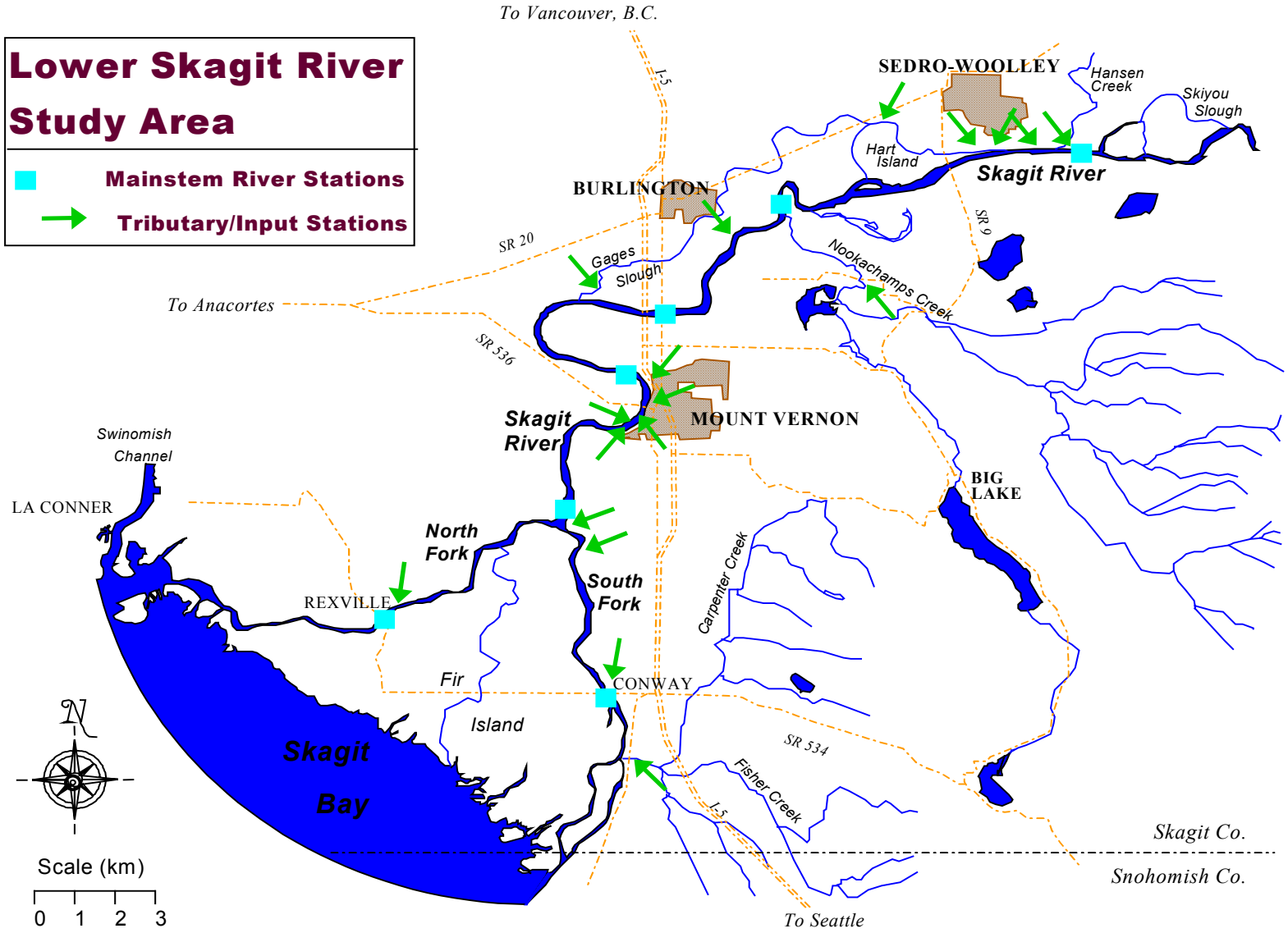

Figure 1: Lower Skagit River TMDL Study Area.

Applicable Criteria

Within the state of Washington, water quality standards are published pursuant to Chapter 90.48 of the Revised Code of Washington (RCW). Authority to adopt rules, regulations, and standards as necessary to protect the environment is vested with the Department of Ecology. Under the federal Clean Water Act, the EPA Regional Administrator must approve the water quality standards adopted by the state (Section 303(c)(3)). Through adoption of these water quality standards, Washington has designated certain characteristic uses to be protected and the criteria necessary to protect these uses [Washington Administrative Code (WAC), Chapter 173-201A). These standards were last adopted in November 1997.

This TMDL is designed to protect against impairments of characteristic uses in Skagit River from potential low dissolved oxygen concentrations. The characteristic uses designated for protection in the Lower Skagit River are as follows:

> *"Characteristic uses. Characteristic uses shall include, but not be limited to, the following:*
> *(i) Water supply (domestic, industrial, agricultural).*
> *(ii) Stock watering.*
> *(iii) Fish and shellfish:*
> *Salmonid migration, rearing, spawning, and harvesting.*
> *Other fish migration, rearing, spawning, and harvesting.*
> *Clam and mussel rearing, spawning, and harvesting.*
> *Crayfish rearing, spawning, and harvesting.*
> *(iv) Wildlife habitat.*
> *(v) Recreation (primary contact recreation, sport fishing, boating, and aesthetic enjoyment).*
> *(vi) Commerce and navigation."*
>
> [WAC 173-201A-030(1)&(2)]

The water quality standards describe criteria for the protection of characteristic uses. The Lower Skagit River and Bay are designated as Class A, excellent waters. The Skagit River upstream of the TMDL study area at the lower end of Skiyou Slough (at River Mile 25.6) is designated as Class AA, extraordinary water.

The water quality standards describe criteria for dissolved oxygen. For Class A freshwaters:

> *"Freshwater - dissolved oxygen shall exceed 8.0 mg/L."*
>
> [WAC 173-201A-030(2)(c)(ii)(A)]

For Class A marine waters:

> *"Marine water - dissolved oxygen shall exceed 6.0 mg/L. When natural conditions, such as upwelling, occur, causing the dissolved oxygen to be depressed near or below 6.0mg/L, natural dissolved oxygen levels may be degraded by up to 0.2 mg/L by human-caused activities."*

[WAC 173-201A-030(2)(c)(ii)(B)]

Different criteria apply to fresh and marine water. The water quality standards describe how to apply the different criteria in an estuary. The boundary between marine and freshwater standards occurs somewhere downstream of the bridges over the North and South Forks.

> *"In Brackish water of estuaries, where the fresh and marine water quality criteria differ within the same classification, the criteria shall be applied on the basis of vertically averaged salinity. The freshwater criteria shall be applied at any point where ninety-five percent of the vertically averaged daily maximum salinity values are less than or equal to one part per thousand. Marine criteria shall apply at all other locations; except that the marine water quality criteria shall apply for dissolved oxygen when salinity is one part per thousand ..."*

[WAC 173-201-060(2)]

Water Quality and Resource Impairments

In 1994, a study conducted by Entranco (1993) was used to list the Skagit River and several of its tributaries for dissolved oxygen. These waters were removed from the 1996 list based on a re-evaluation of the dissolved oxygen data. These data were judged to be of poor quality, as indicated by inconsistency and high variability. The TMDL study conducted by the Department of Ecology (Pickett, 1997) showed all waters were in compliance with dissolved oxygen standards. No Skagit River sample measured below 9 mg/l during the critical period of September and October.

Dissolved oxygen data collected in the Skagit River show a definite pattern of seasonal variation. Data collected monthly by the Department of Ecology at Mount Vernon (Station 03A060) between January 1990 and December 1999 were compiled and descriptive statistics generated (Table 1). The critical period is in the summer months from July through September where dissolved oxygen concentrations are lowest. All of the samples collected at this station during the last decade met the water quality standard for dissolved oxygen.

Table 1: Dissolved Oxygen Statistics of the Skagit River at Ecology ambient monitoring station 03A060 (at Mount Vernon) from Data Collected between January 1990 to December 1999.

Month	Number of Samples	Mean (mg/L)	Median (mg/L)	Minimum (mg/L)	Samples over the Criterion (%)
January	10	12.4	12.4	12.0	0
February	10	12.5	12.6	11.8	0
March	10	12.2	12.3	11.0	0
April	10	11.6	11.5	11.2	0
May	10	11.2	11.3	10.1	0
June	10	11.0	11.1	10.3	0
July	10	10.3	10.4	9.9	0
August	10	10.3	10.2	9.8	0
September	10	10.3	10.2	9.8	0
October	10	11.1	11.1	10.5	0
November	10	11.5	11.5	11.1	0
December	9	12.4	12.4	11.8	0

Modeling Approach

Three models were used to determine loading capacities and allocations for the Lower Skagit River Dissolved Oxygen TMDL. The model HEC-RAS (USACOE, 1996) was used to determine flows, velocities, and channel characteristics. The model MULTI-SMP (LTI, 1992) was used to determine the effect of carbonaceous biochemical oxygen demand (CBOD) and ammonia- nitrogen loading on dissolved oxygen levels in the Skagit River. The model CORMIX (Cornell University, 1995) was used to evaluate the Mount Vernon wastewater treatment plant discharge.

The modeling analysis was based on 24-hour and tidally averaged conditions. However, the datasonde results for both the September and October surveys showed a DO drop at high tide. To estimate critical minimum DO conditions, the maximum observed difference between average and minimum DO from datasonde data at the downstream end of the South Fork (1.2 mg/L) was subtracted from modeled DO results for that location. Since a dynamic model of the effect of tidal conditions on DO was beyond the scope of the technical study, and considering the difficulties of modeling dynamic tidal conditions with a steady-state model, this approach is the best available method to account for critical minimum hourly DO conditions.

Both the HEC-RAS and MULTI-SMP models performed reasonably well. Prediction of flows showed less than 2 percent error for the model calibration and a 15 percent error for the model verification. Likewise, overall prediction of dissolved oxygen concentrations showed less than 4 percent error and less than 2 percent for the calibration and verification runs, respectively.

A synopsis of model inputs and outputs for modeling the effects of point source discharges are listed in the tables in Appendix D.

Study Revisions In Response To Comments

The Department of Ecology revised the findings of the TMDL study substantially in response to comments submitted by the affected dischargers (see Appendix C for comments). Affected dischargers performed ambient monitoring in the study area during 1998 and 1999 in response to the Department of Ecology's findings. That data and comments were submitted in a report (Cosmospolitan Engineering Group, 1999) to the department as a significant part of the comments on the lower Skagit TMDL study.

Comments recommending increasing the 7Q10 river flow and decreasing the ambient ammonia level assumed for modeling critical conditions were incorporated into the TMDL modeling after the study was published in 1997. A request from the sewer commissioners for a larger ammonia allocation for the Big Lake WWTP was incorporated in the study. The Department of Ecology derived alternative WLAs for the city of Mount Vernon in response to comments from that community. The department declined a request to reduce the magnitude of the tidally induced dissolved oxygen drop near the Conway Bridge from 1.2 to 0.6 mg/L. The assessed loading capacity of the lower Skagit River was increased in response to comments.

The Department of Ecology's original estimate of the 7Q10 flow for the Skagit River was based on the period of record from 1941 to 1979. During that period dam construction and changes in flow regulation altered the flow regime in the Skagit River. Based on data obtained from USGS by the city of Mount Vernon, the 7Q10 flow estimate was revised to 5030 CFS. This value is based on the period of 1953-1997.

The modeling for the study was fairly sensitive to ambient ammonia levels used for upstream conditions. Ambient levels measured during the summer months for Ecology's study were all non-detect at 0.01 mg/L. The original estimate of worst-case ambient ammonia levels (0.05 mg/L) for the TMDL Study modeling was based on the worst data point from Ecology's historical record for the monitoring station located in the middle of the study area. Comments received pointed out that this station measures some of the ammonia attributed to the discharge from upriver POTWs in the modeling (e.g. the ammonia output from Burlington and Sedro-Woolley was counted twice). The dischargers conducted ambient monitoring for ammonia daily in the summer of 1998 and measured ambient levels of ammonia that consistently fell below 0.01 mg/L immediately upstream of the study area. Various statistical analyses of ammonia levels from Ecology's ambient monitoring station upriver at Concrete provided worst case values ranging from 0.018 to 0.028 mg/L for the entire year (95% worst case value expected to occur annually). The values derived depend on the statistical approach and the period considered. The TMDL WLAs are applicable to the dry season when ambient ammonia levels in the Skagit tend to be lower. For the additional modeling, Ecology staff used values of 0.015 to 0.020 mg/L for worst case values during the dry season. These values provide a safety factor or reserve allocation.

The city of Mount Vernon (see appendix C, item 2) commented that WLAs should be proportioned to projected populations instead of projected wastewater flows contained in sewer planning documents. That city's planning documents predicted flows based on population projections from the late 1980's; other point sources' projections were derived more recently. The Department of Ecology attempted to answer the concerns of Mount Vernon by accepting a

newly estimated 2015 design flow presented by city staff to the department during meetings (this new set of WLAs is noted as alternate WLA in Table 2). Additional $CBOD_5$ WLA for the city of Mount Vernon is offset by a decrease in the ammonia WLA and creation of a reserve equivalent to 5 mg/L of ammonia discharged from the Mount Vernon WWTP at a flow of 8.14 MGD. This alternative WLA requires ammonia removal on par with that required of the other dischargers.

The Cosmopolitan study commented that the level of dissolved oxygen depression measured by the department was excessive. Cosmopolitan staff installed a dissolved oxygen recorder in the Skagit near the Conway bridge and recorded dissolved oxygen during two months in late summer, 1998. The largest tidally induced oxygen sag recorded was 0.6 mg/L. The department measured a sag of 1.2 mg/L in its earlier field work. The department declined to revise its estimate of worst case conditions, even though the Cosmopolitan data recorded oxygen levels over a two month period. The department is charged with deriving critical conditions for water quality-based NPDES permit derivation. The Cosmopolitan work verified Ecology's findings that high tides induce dissolved oxygen depressions for short periods of the day. The magnitude of that effect may have been underestimated by both data sets; the tidal affects could possibly be worse at some other location in the lower river. Tidal affects may also vary from year to year. The department retained the assumption that tidal influence on dissolved oxygen levels in the lower river should be modeled by reducing the steady state-modeled values for dissolved oxygen at the critical location by 1.2 mg/L.

Loading Capacity Analysis

Identification of the loading capacity is an important step in developing TMDLs. The loading capacity provides a reference for calculating the amount of pollutant reduction needed to bring a water body into compliance with water quality standards (or keep the water body in compliance in this case). By definition, a TMDL is the sum of the allocations. An allocation is defined as the portion of a receiving water's loading capacity that is assigned to a particular source. EPA defines the loading capacity as "the greatest amount of loading that a water can receive without violating water quality standards."

The loading capacity is often figured based on critical conditions. Critical conditions were evaluated in the model to estimate the potential effects of current and future waste loading to the Skagit River. Critical conditions are those possible physical, chemical, and biological characteristics of the receiving water and pollutant loading sources that can increase the adverse effects of a pollutant of concern (e.g., low river flow and increased temperature would increase the effect of a given biochemical oxygen demand load). The water quality standards define critical conditions as the seven-day average low flow with a ten-year recurrence probability (7Q10).

For the Lower Skagit River Dissolved Oxygen TMDL, the critical period was established as the July through October period. The lowest flows and the highest temperatures occur in these months. The loading capacity for carbonaceous five-day biochemical oxygen demand ($CBOD_5$) was estimated to be 14,658 pounds per day. The loading capacity ammonia-nitrogen (NH_3-N) was estimated to be 2,211 pounds per day.

Margin of Safety

The statute requires that a margin of safety be identified to account for uncertainty when establishing a TMDL. The margin of safety can be explicit in the form of an allocation, or implicit in the use of conservative assumptions in the analysis. Several assumptions and critical conditions used in the modeling analysis of the Lower Skagit River Dissolved Oxygen TMDL provide an inherent margin of safety as required by the statute. These conservative assumptions and critical conditions are listed below:

- Critical river flows for the period were estimated as the seven-day average low flow with a recurrence interval of once every ten years (7Q10).

- Point source effluent flows at the design capacity (average flow for the maximum month) were used in the critical condition model runs. These point source effluent flows actually occur during the winter months when the Skagit River flow is higher.

- Carbonaceous five-day biochemical oxygen demand ($CBOD_5$) concentrations representing the highest weekly average for the point sources were used in the critical condition model runs.

- Ammonia-nitrogen (NH_3-N) concentrations representing the highest daily values were used for both point and nonpoint inputs to the critical condition model runs.

- Model DO results at the critical location on the South Fork (the Conway bridge) had 1.2 mg/L subtracted to account for the difference between average modeled conditions and observed daily extremes. The state dissolved oxygen standard is met on an hourly basis using this methodology.

- An upstream ambient ammonia value at least 50% greater than that measured during the study was assumed for critical conditions.

Seasonal Variation:

Dissolved oxygen, temperature, and flow data collected in the Skagit River show a definite pattern of seasonal variation. The critical period is in the summer months from July through October where dissolved oxygen concentrations and river flows are lowest.

Limits based on the TMDL study will be imposed during the low flow season – July 1 through November 15. Dissolved oxygen concentration in the river are lowest during the late summer. River flows are at a minimum and water temperatures are at a maximum. The capacity of river for dissolved oxygen decreases as the temperature increases. Permit limits are derived for *critical conditions*. WAC 173-201A defines critical conditions for a river as the 7Q10 low flow event. This flow event is 5030 cubic feet per second (cfs) on the Skagit River at USGS gauging station number 12200500 at the highway 99 bridge upstream of Mount Vernon[1] based on the period from April 1, 1953 through March 31, 1997.

[1] Correspondence from Luis A. Fuste of the U.S. Geological Survey Washington District to Mr. Walt Enquist of the Mount Vernon WWTP dated April 22, 1998. The 7Q10 flow for the period April 1, 1953 to March 31, 1997 is 5027 CFS, for April 1, 1982 to March 31, 1997 the value is 5030 CFS.

Wasteload and Load Allocations

Allocations for carbonaceous five-day biochemical oxygen demand ($CBOD_5$) and ammonia-nitrogen (NH_3-N) are to established in the lower Skagit River for dry season critical low-flow conditions. The $CBOD_5$ and ammonia nitrogen allocations in the Lower Skagit River are shown in Table 2 and illustrated in Figure 2. The TMDL can be summarized generally as follows:

- The TMDL applies from August through October of each year. The lowest flows and highest temperatures fall in these months.

- Wasteload allocations (WLAs) for $CBOD_5$ and ammonia nitrogen will be provided to existing permitted dischargers calculated from 2015 projected flows. These WLAs provide for $CBOD_5$ effluent concentrations of 40 mg/L (implemented as 45 mg/L of BOD_5); and ammonia nitrogen effluent concentrations of 25 mg/L for the Mount Vernon WWTP, 10 mg/L for the other three point sources at the 2015 design flow. The department calculated alternate WLAs for the city of Mount Vernon WWTP of 10 mg/L of ammonia with an increased mass discharge of BOD_5 in response to comments provided by that entity. The alternate WLAs are available if that facility constructs improvements to reduce ammonia in the discharge. (The department converted a portion of the ammonia WLA to a $CBOD_5$ WLA.)

- Load allocations (LAs) will be provided at current concentrations to the Skagit River at the upstream boundary above Sedro-Woolley and to Nookachamps Creek. Hansen and Kulshan Creeks are expected to be dry during critical conditions.

- Capacity for future growth of $CBOD_5$ and ammonia discharge is provided by using maximum monthly design flows for the year 2015 as the basis for the WLAs. The 2015 design flow is that expected during the wettest part of the year, so capacity beyond 2015 is provided. Permit limitations for BOD_5 will be less than WLAs until the dischargers increase they're plant capacities to accommodate the 2015 flow projections. The WLAs are expressed as mass limitations, so the TMDL limitations can be met by reduction of the concentrations of pollutants or by diverting effluent from the river for reuse in the future.

- An allocation for margin of safety is provided by exceeding the DO criteria by 0.05 mg/L at the critical location. The target DO level is 9.2 mg/L, the selected WLAs sets exceed that target by 0.05 mg/L. (See appendix D, cases 11 & 15)

The Lasand WLAs are listed in Table 2 and illustrated in Figure 2.

Table 2: Lower Skagit River TMDL $CBOD_5$ and Ammonia Allocations

Sources	**Flow**	**$CBOD_5$**		**NH_3-N**	
	(MGD)	**(mg/L)**	**(lbs/day)**	**(mg/L)**	**(lbs/day)**
Point Source WLAs					
Sedro-Woolley WWTP	2.07	40	691	10.0	173
Burlington WWTP	5.05	40	1685	10.0	421
Mount Vernon WWTP (alternative WLAs – not included in totals)	5.70 (8.13)	40 (40)	1902 (2712)	25.0 (10.0)	1188 (678)
Big Lake WWTP	0.22	40	73	10.0	18
Tributary Las					
Hansen Creek	(dry)	--	0	-	0
Nookachamps Creek	1.87	2.00	31.2	0.32	5.0
Kulshan Creek	(dry)	--	0	--	0
Upstream Skagit River	3245	0.38	10276	0.015	406
Totals					
WLA Total			4351		1800
LA Total			10308		411
Grand Total			14659		2211
Loading Capacity			14659		2211

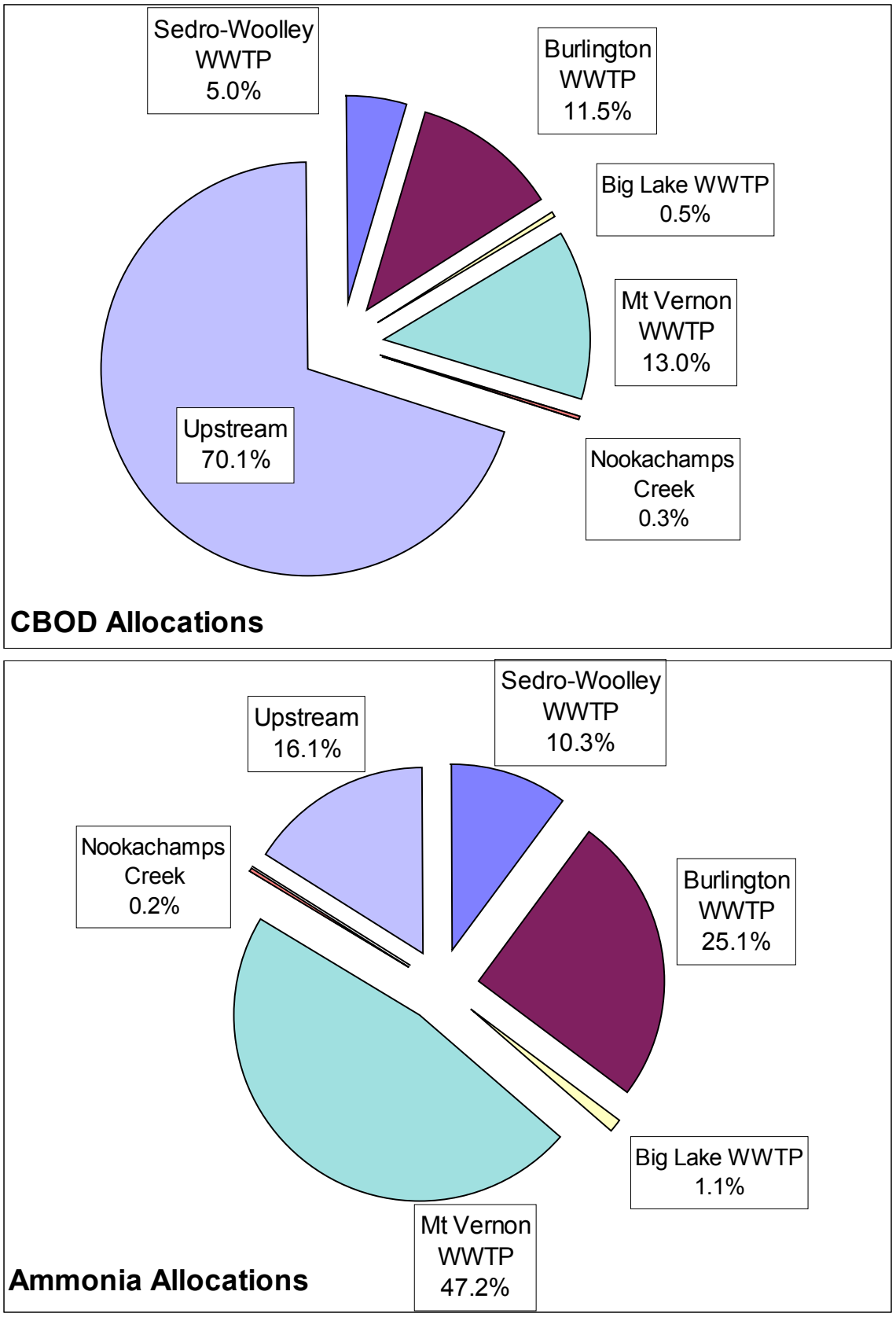

Figure 2. **Lower Skagit River TMDL $CBOD_5$ and Ammonia Allocations**

Summary Implementation Strategy

Overview

The Department of Ecology will provide for compliance with the dissolved oxygen standards in the Skagit River by imposing limitations for ammonia and BOD_5 in the wastewater discharge permits of the Mount Vernon waste water treatment plant (WWTP), the Burlington WWTP, the Sedro Woolley WWTP, and the Skagit Sewer District No. 2 WWTP (AKA Big Lake). The WLAs will be used as maximum daily discharge limits for any day that the Skagit river flow falls below 6,000 CFS. The WLAs are translated into a monthly average permit limitation that will be imposed from July through October. The ongoing requirement to meet the monthly average limitation will assure continued compliance with the daily maximum limit. As WWTP flows increase above 2015 design levels or capacity for other dischargers is needed, the existing dischargers can further reduce ammonia discharge levels or divert wastewater out of the river (effluent reuse). Implementing the findings of this TMDL on a waterbody allows for long range planning by local entities to assure continued compliance with standards in the lower Skagit.

Recent treatment plant upgrades at Sedro-Woolley and Burlington have incorporated the findings of this TMDL study by providing processes for reducing ammonia levels discharged in the effluent. The Big Lake WWTP already provides significant ammonia removal. The WWTP at Mount Vernon has dramatically reduced CSO discharges over the last five years (addressing findings of the lower Skagit TMDL for bacteria). That facility will incorporate the findings of this TMDL in future WWTP upgrades.

Development of the Implementation Plan

The Detailed Implementation Plan for the Lower Skagit River Dissolved Oxygen TMDL required under the Memorandum of Understanding between Ecology and U.S. EPA will be addressed by issuance of NPDES permits or permit modifications . No nonpoint source plans will be needed since the load allocations are established from existing conditions.

Implementation Activities

Ecology will set permit limits for sewage treatment plants at Burlington, Mount Vernon, Sedro Woolley, and Skagit Sewer District No.2 (Big Lake) based on the Lower Skagit River Dissolved Oxygen TMDL. The daily maximum limits for mass discharge of carbonaceous five-day biochemical oxygen demand ($CBOD_5$) and ammonia (NH_3 as N) will be set equal to the final wasteload allocation figures derived for the study. The department will set monthly average permit limits for mass discharge of BOD_5 (surrogate for $CBOD_5$) and ammonia in effect during the dry season. Technology-based permit limitations or other water quality-based limitations will be imposed if they are more stringent than the limitations calculated here.

Derivation of permit limits from the waste load allocations presented here are based on methods described by EPA (1991). The translation of WLAs to permit limitations requires assessment about the statistical distribution of the discharge, variation in the discharge quality and quantity, and statistical confidence levels. Ecology anticipates adjusting the waste load allocations and

permit limits in the future based on new information about the discharges. The NPDES permit limit derivation calculations are normally shown in the Fact Sheet that accompanies the NPDES permit. Permit limits calculated here are water quality-based limits that will be imposed if they are the most stringent limit calculated for a specific parameter. For example, ammonia depletes oxygen in the river and is a toxic substance; limitations based on oxygen depletion are shown here and will be compared to limits calculated to prevent toxic effects for each discharger. These limits are needed to protect the water quality of the Skagit River during the late summer low-flow period. During other seasons technology–based limits will be sufficient to assure compliance with water quality standards.

Limits based on the TMDL study will be imposed during the low flow season – July 1 through November 15. Dissolved oxygen concentration in the river is lowest during the late summer. River flows are at a minimum and water temperatures are at a maximum. The capacity of river for dissolved oxygen decreases as the temperature increases. Permit limits are derived for *critical conditions.* WAC 173-201A defines critical conditions for a river as the 7Q10 low flow event. This flow event is 5030 cubic feet per second (cfs) on the Skagit River at USGS gauging station number 12200500 at the highway 99 bridge upstream of Mount Vernon[2] based on the period from April 1, 1953 through March 31, 1997.

Flows in the river are greatly influenced by the melting of some 167 square miles of glacier that feed the river. During the late summer, the cessation of flow from glacier melt reduces the flow volume in the Skagit River. These low flow events usually occur during September and October. Figure 3 shows the frequency of flow events of 5030 cfs or less since 1960 – none of these events occurred between 1953 and 1960. Low flow events have occurred on 72 days since 1953. The number of events per month over that 47-year period is listed in figure 1. The one time the low flow event occurred in August, the date was August 27 and the two times the low flow event occurred in November was on the 2nd and 3rd day of the month. The lowest flow recorded in July was 6540 cfs. Flows below 6000 cfs have been recorded on 17 days in November and one day in March. While low flows occur in early winter, the low river water temperature provides for greater levels of dissolved oxygen. Critical conditions are most pronounced during low flows and higher water temperatures that occur in September and October.

[2] Correspondence from Luis A. Fuste of the U.S. Geological Survey Washington District to Mr. Walt Enquist of the Mount Vernon WWTP dated April 22, 1998. The 7Q10 flow for the period April 1, 1953 to March 31, 1997 is 5027 CFS, for April 1, 1982 to March 31, 1997 the value is 5030 CFS.

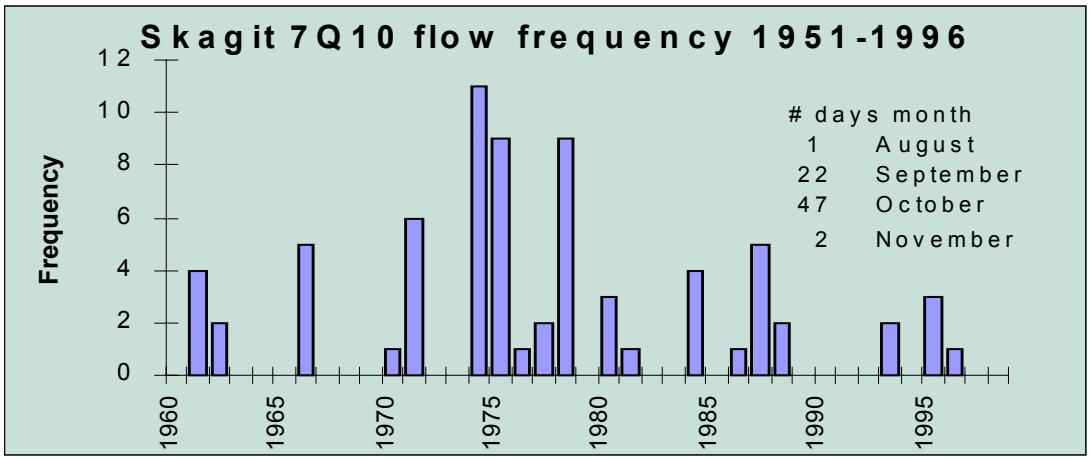

Figure 3: Frequency of daily average flow less than 5030 cfs on the Skagit River at Mount Vernon since 1952.

Based on the information about the Skagit River flow regime, Ecology proposes requiring that the limitations for meeting dissolved oxygen standards in the lower Skagit River be in effect from July 1 to November 15 with some adjustments for administrative purposes. Monthly average limits will be in effect for the months of July through October. Daily maximum limits will be in effect any day the Skagit River flow at Mount Vernon is below 6000 Cubic feet per second. Limitations based on other factors (covered in the individual fact sheet for each permit) will be in effect throughout the year.

The NPDES permit limits based on the TMDL study have been calculated using the procedure provided by EPA in the Technical Support Document for calculating daily maximum and monthly average permit limits (Tables 3 & 4). The WLA allocations generated by the lower Skagit TMDL study were treated as acute WLAs. All confidence levels and probabilities are based on 95 percent confidence intervals. The methodology used is conservative in that the low probability of all four permittees discharging at maximum levels concurrently is not factored in the limits.

The BOD to CBOD ratio of 1.125 (or 45:40) was used to convert from $CBOD_5$ (the modeled parameter) to BOD_5 (the parameter measured by the WWTPs). This value is conservative. Work by Ecology (Brake, 1998) found an average conversion factor of 1.15 from an dataset of 15 WWTPs inspected by the state. In state and federal regulation, technology-based treatment standards for WWTPs set weekly maximums of 40 mg/L $CBOD_5$ as an alternative to the standard of 45 mg/L BOD_5. Affected WWTPS will be provided the option of either measuring $CBOD_5$ for compliance or deriving a site-specific conversion factor.

The monthly average limit is influenced by the coefficient of variation (CV) selected for the permit limit calculations. The department calculated the CV for several facilities where data was available (Table 3 under "Recent CV" column). This measure of variation in the effluent discharge will change in the future as the WWTPs aim to comply with the new limits on ammonia and BOD_5 mass discharge. The CV should be evaluated whenever permits are rewritten. Ecology selected CVs of 0.3 for BOD_5 and 0.4 ammonia for deriving the maximum and average permit limits.

Table 3: Proposed NPDES permit limits in pounds per day derived from the WLAs. Current permit limits are shown in the last column

WWTP	Parameter	Recent CV	Assumed CV	Average monthly limit in LB/day	Max Daily (NH_3) or Weekly Limit (BOD_5) in LB/day	*Current Average Monthly Limit*
Burlington	BOD	0.42	0.3	1402	1896	400
	Ammonia as N	No data	0.4	327	421	None
Mount Vernon	BOD	0.36	0.3	1583	2140	1001
	Ammonia as N	0.12	0.4	922	1188	None
Sedro Woolley	BOD	0.58	0.3	593	777	518
	Ammonia as N	No data	0.4	134	173	None
Big Lake	BOD	0.37	0.3	67	82	50
	Ammonia as N	No data	0.4	14	18	None

Ecology will impose the monthly average limit from July through October to keep plant loading and general treatment capabilities adequate to meet the limits, stay within the waste load allocations, and meet the dissolved oxygen standard when river flows are low. The maximum limit will be in effect when the river flow falls below 6000 cfs to ensure compliance with dissolved oxygen standard during actual critical conditions. These conditions do not necessarily occur every year.

Additional information on effluent variability may necessitate revising permit limits after the next five-year cycle. As the CV decreases the monthly average limit increases. The WLA may be revised based on additional monitoring of the Skagit River, performance observed at individual treatment plants, or both.

Tables 3 and 4 show the calculation of the permit limits based on the waste load allocations and the procedures from EPA (EPA, 1991). The limits are derived as acute limits for a single waste load allocation. The waste load allocations have come from the Lower Skagit River Total Maximum Daily Load Water Quality Study (Pickett, 1997), comments on the study, and response to the comments by the Department of Ecology.

Table 4: Calculation of the permit limits based on the waste load allocations for the POTWs that discharge to the lower Skagit River. This tale shows the calculations for water quality-based permit limits based on the procedures and calculations in Technical Support Document for Water Quality-based Toxics Control, U.S. EPA, March, 1991 (EPA/505/2-90-001) on page 99. The limits are derived for a single Waste Load allocation. The waste load allocations have come from the Lower Skagit River Total Maximum Daily Load Water Quality Study, comments on the study, and response to the comments by the Department of Ecology. BOD to CBOD ratio of 1.125 (or 45:40) was used to convert from CBOD to BOD.

Facility	parameter	**Average Monthly Limit (AML)**	**Maximum Daily (NH3) or Weekly (BOD) Limit**	Waste load allocation(WLA)	Long term average (LTA)	LTA probability BASIS	Coefficient of Variation (CV)	AML probability BASIS	MDL probability BASIS	# of samples per MONTH
		LB/day	**LB/day**	**LB/day**	**LB/day**	*decimal*	*decimal*	*decimal*	*decimal*	*n*
Burlington	CBOD	1247	1685	1685.0	1085.4	0.95	0.30	0.95	0.95	12
	BOD	1402	1896	1895.6	1221.1	0.95	0.30	0.95	0.95	12
	Ammonia as N	327	421	421	240.6	0.95	0.40	0.95	0.95	4
Mount Vernon	CBOD	1407	1902	1902.0	1225.2	0.95	0.30	0.95	0.95	12
	BOD	1583	2140	2139.8	1378.4	0.95	0.30	0.95	0.95	12
	Ammonia as N	922	1188	1188.0	679.0	0.95	0.40	0.95	0.95	4
Sedro Woolley	CBOD	527	691	691.0	445.1	0.95	0.30	0.95	0.95	8
	BOD	593	777	777.4	500.8	0.95	0.30	0.95	0.95	8
	Ammonia as N	134	173	173.0	98.9	0.95	0.40	0.95	0.95	4
Big Lake	CBOD	59	73	73.0	47.0	0.95	0.30	0.95	0.95	4
	BOD	67	82	82.1	52.9	0.95	0.30	0.95	0.95	4
	Ammonia as N	14	18	18.0	10.3	0.95	0.40	0.95	0.95	4

Monitoring Strategy

EPA (1991) guidance calls for a monitoring plan for TMDLs. The monitoring is conducted to provide assurance that the control measures achieve the expected load reductions. Monitoring to assure effectiveness will be required as a condition of the NPDES permit. In addition, long-term monitoring will be important to ensure compliance with the requirements of the Lower Skagit River Dissolved Oxygen TMDL. Ecology conducts long-term monthly ambient monitoring in the Skagit River near Mount Vernon. This is a valuable long-term record, but additional monitoring is needed for TMDL assessment, because the ambient monitoring station is upstream of the critical locations in the river as well as many of the loading sources. To test the effectiveness of the Lower Skagit River Dissolved Oxygen TMDL, Ecology will develop a monitoring plan containing the following elements:

- Ammonia nitrogen in WWTP discharges should be monitored for compliance with WLAs during the July through October TMDL period at all plants where this parameter is not currently monitored.

- DO in the South Fork Skagit River should be monitored at the Conway bridge or just upstream during the July through October TMDL period. Monitoring should occur during neap tide conditions either at high tide or preferably as 24 to 48 hour continuous monitoring with a datalogging meter.

- It is not clear what processes cause the dip in DO in the South Fork observed at high neap tides. If greater understanding of this phenomenon is desired, a detailed study with monitoring and dynamic modeling could be conducted.

- Quality assurance plans should be developed for all monitoring that identify appropriate monitoring objectives, strategies, schedules, and resources. Monitoring can either be conducted by Ecology or by other interested parties such as tribal or local governments, watershed groups, or drainage districts.

References Cited

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USACOE, 1996. HEC-RAS River Analysis System, Version 1.2, April 1996. U.S. Army Corps of Engineers, Hydraulic Engineering Center, Davis, CA.

U.S. Environmental Protection Agency. 1991. Guidance for Water Quality-based Decisions: The TMDL Process. EPA 440/4-91-001. Washington, DC.

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Appendix A

Outreach to Public and Affected Parties

Contacts with the public about the Lower Skagit TMDL are listed below. Other informal contacts with individuals living in Skagit County preceded these official notices. During sampling and reconnaissance work in 1994 and 1995 Ecology personnel contacted WWTP staff, city officials, other government agencies, the Skagit Valley Herald and the Skagit Tribal Cooperative to gather information about monitoring and discharges. These contacts all involved explaining Ecology's work on the TMDL. Listed below are formal notices about the TMDL Study.

- Public advertisement of NPDES permit applications and the TMDL in the Skagit Valley Herald and The Herald (of Everett, November 23 & 30, 1997)
- Posting of information about the TMDL on the Washington Department of Ecology WEB site.
- Mailing of the Lower Skagit River Total Maximum Daily Load Data Summary (Ecology Report #96-345) or notice of its availability to a list of 90 to 100 individuals on January 22, 1997 including members of city, county, state, and federal governments, native American tribes with interest in the area, environmental groups, and individual citizens who requested information.
- Mailing of the Lower Skagit River Total Maximum Daily Load Water Quality Study (Ecology Publication No. 97-326a) on October 6, 1997 to a list of 30 individuals who we expected would have interest in reviewing the TMDL modeling and other technical work. The mailing including members of city and county government, tribes with interest in the area, environmental groups, and individual citizens who requested information.
- Met with affected dischargers (city representatives from Mount Vernon, Sedro Woolley, and Burlington on November 18, 1997. No representatives from Big Lake WWTP or Skagit County attended.
- Mailing of a summary of the Lower Skagit River Total Maximum Daily Load Water Quality Study on November 21, 1997 as an Ecology Focus sheet entitled "The Lower Skagit River TMDL Public Hearing and Comment Period." (Ecology Publication No. 97-2046-WQ).
- Public advertisement of TMDL public hearing and comment period in the Skagit Valley Herald (December 29, 1997 issue) and The Herald (of Everett, December 30, 1997 issue).
- Public meeting at the Skagit Valley community College on January 21, 1998.
- Presentation to the Skagit County citizen volunteer group for implementation of local 400-12 nonpoint basin plans (audience of about 30 local citizens) on January 26, 1998.
- Extension of the public comment period from February 28, 1998 to April 30, 1998 at the request of the mayor of Mount Vernon. Notice mailed to mailing list of 90 to 100 people.

Appendix B

Public Notice Materials

Appendix B contains public notices and mailings related to the TMDL. The department assembled a mailing list based on list of 90 to 110 groups or individuals who were known to have an interest in water quality and environmental issues in Skagit County. The TMDL data set and TMDL study were mailed directly to some of these entities, others received notice of the availability of these documents. The mailing materials were assembled using a mail merge function, so example letters (items 3 and 4) are included here. Item 1, the focus sheet, was mailed to entities in lieu of the TMDL study. Item 2 is the text of a newspaper advertisement

1. The Focus sheet for mailing to the public advertising the public hearing on the TMDL held Skagit Valley college on January 21 1998.
2. Cover sheet for data summary
3. Cover sheet for TMDL study
4. Cover letter for TMDL focus sheet

Focus

Water Quality in Washington State

The Lower Skagit River TMDL Public Hearing and Comment Period

Background

The federal Clean Water Act requires states to conduct statewide water quality assessments to identify and list surface waters that do not meet water quality standards. For listed waters, states must establish maximum limits on the amounts of pollutants that can be discharged to a water body and still allow that water body to meet water quality standards. These limits are called Total Maximum Daily Loads (TMDL).

In 1994 the Department of Ecology (Ecology) selected the lower Skagit River for a TMDL study. Water quality studies performed in the early 1990s suggested that the river was not meeting state standards for dissolved oxygen (DO), which is essential for the health of fish and other creatures in the river. In addition, fecal coliform bacteria levels above state standards have been verified by various studies. In Skagit Bay 13,400 acres of shellfish harvesting areas have been closed or restricted to commercial harvesting due to high bacteria levels. Population growth may worsen these problems.

Both point and nonpoint pollution sources impact the lower Skagit River. Point sources include sewage treatment plants in Mount Vernon, Burlington, Sedro Woolley, and Skagit Sewer District No. 2 (Big Lake) that discharge to the river under National Pollutant Discharge Elimination System (NPDES) permits. The City of Mount Vernon discharges untreated sewage to the Skagit River during rain storms; the city is currently constructing facilities to reduce those discharges. Nonpoint sources of pollution are widely dispersed and not as well defined as point sources. Nonpoint pollution sources in the lower Skagit River basin include runoff from roadways, urban areas, forest roads, and agricultural activities. Both types of sources impact beneficial uses of the river and marine waters in Skagit Bay.

Lower Skagit River TMDL Study

The goal of the lower Skagit River TMDL study was to assure compliance with state standards for dissolved oxygen and fecal coliform bacteria levels in the river and Skagit Bay. The study covered the lower 25 miles of the river, from river mile (RM) 24.6 near Sedro Woolley to the mouths of the North and South Forks at Skagit Bay. Ecology collected data on ambient water quality and treated wastewater discharges in the river in 1994 and 1995. The effects of the discharges on ambient water quality were modeled for worst case river conditions under current and future discharge scenarios. Based on the modeling, the proposed TMDL sets waste load allocations (WLAs) for BOD and ammonia discharged from point sources. To restore compliance with standards for fecal coliform bacteria, the TMDL sets WLAs for point sources and priorities for reducing or eliminating other sources of bacteria discharge to the Skagit and its tributaries. Implementation of these measures will lead to compliance with state water quality standards

Table 1: Proposed WLAs to meet DO criteria in the Skagit River.

	Flow (MGD)	BOD (mg/L)	Ammonia (mg/L)	BOD (lb./d)	ammonia (lb./d)
Sedro-Woolley WWTP	2.07	20	10	345	173
Burlington WWTP	5.05	20	10	842	421
Mt. Vernon WWTP	5.7	20	10	950	475
Big Lake WWTP	0.8	20	1.10	133	7.3

in the river, its tributaries, and Skagit Bay.

The TMDL study concluded that the lower Skagit is currently meeting dissolved oxygen standards. Ecology proposes limitations for ammonia and biochemical oxygen demand (BOD) shown in Table 1 for point sources during late summer and fall to assure continued compliance with the dissolved oxygen standards.

The TMDL study concluded that fecal coliform bacteria levels exceed standards in many tributaries of the lower Skagit River, upstream of Sedro Woolley, and in the marine waters at the mouths of the North and South Forks. The TMDL identifies areas and sources as high priority for reducing discharge of bacteria. The top five correction items are:

- Reduce combined sewage overflows from Mount Vernon to once per year or less.
- Implement the Nookachamps Creek Watershed Action Plan to bring the creek back into compliance with bacteria standards.
- Locate and eliminate an unidentified bacteria source on the Skagit River between Kulshan Creek in Mount Vernon and the I-5 bridge over the Skagit.
- Provide controls to bring Carpenter and Fisher Creeks into compliance with bacteria standards.
- Reduce fecal coliform levels in the discharge from the Rexville pump station (Drainage District 15).

Ecology will apply the TMDL findings to point sources via discharge permits. Control of all nonpoint sources is beyond the capabilities of the Department of Ecology. This agency depends on citizens and local governments to plan and implement controls for nonpoint pollution on a local level. Skagit County, Ecology, and local interests have collaborated on nonpoint pollution control plans for several areas in Skagit County, including the Nookachamps basin. Recommendations in the Nookachamps basin plan are being implemented as funding allows. Comparable efforts in other tributary basins are needed to allow all users of the Skagit River and Skagit Bay to enjoy the benefits of clean water.

The "Lower Skagit Total Maximum Daily Load Data Summary" (November, 1996) contains the data and collection methods for the TMDL study. The "Lower Skagit River Total Maximum Daily Load Water Quality Study" (July, 1997) contains the technical assessments on which the TMDL recommendations are based. Both of these documents are available from the Department of Ecology Northwest Regional Office.

Public Involvement in Lower Skagit TMDL Process

Ecology encourages affected dischargers, local governments, and other interested parties to comment on the Lower Skagit TMDL and to participate in the TMDL process. Ecology invites written comments and suggestions about the TMDLs, WLAs, and the TMDL process for the Lower Skagit**. A public meeting will be held starting at 6 p.m. on January 21, 1998 at Skagit Valley Community College,** 2405 East College Way, Ford Hall Room 101, Mount Vernon, Washington to discuss the TMDL study, proposed TMDLs and WLAs, and to help identify concerns and needs of affected parties. Address written comments to Gerald Shervey at the Department of Ecology, Northwest Regional Office, 3190 - 160th Avenue SE, Bellevue, WA 98008-5452. **Written comments will be accepted until February 28, 1998.**

For More Information

Ecology Focus #F-WQ-93-022, "Maintaining Water Quality Standards" describes the TMDL process in greater detail. If you have questions about the lower Skagit TMDL process, would like copies of information packets, would like to be placed on the mailing list for the lower Skagit TMDL, or have special accommodation needs, contact Carla Skog, Permit Coordinator, Department of Ecology, Northwest Regional Office, 3190 - 160th Avenue SE, Bellevue, WA 98008-5452, (425)649-7201 (voice), (425)649-4259 (TDD), or email at CSKO461@ecy.wa.gov.

[Example of cover letter accompanying a copy of Lower Skagit River Total Maximum Daily Load Data Study, Report No. 96-345]
January 23, 1997

Environmental Affairs
Army Corps of Engineers, US
Seattle District Office
4735 E Marginal Way S - POB 3755
Seattle WA 98124-3755

Dear «PREFIX» «LAST_NAME»:

Re: Transmittal of "Lower Skagit Total Maximum Daily Load Data Summary"

Since 1993 Ecology has been implementing the "Watershed Approach" to the regulation of water pollution sources. The emphasis of this approach is to focus the resources of the agency to specific geographical areas over a five year cycle based on the state's watershed drainage basins. Ecology has grouped the Skagit, Stillaguamish, and Samish rivers basins as one water quality management area (WQMA). In 1993 Ecology staff decided to focus agency resources on the lower Skagit River. The goal was to gather data for establishing a Total Maximum Daily Load (TMDL) of pollutants discharged to the lower Skagit for the protection of Washington's water quality standards for bacteria and dissolved oxygen.

Ecology will publish the following documents over the next year:

- "Lower Skagit Total Maximum Daily Load Data Summary" contains the data collected for the lower Skagit TMDL project by Ecology during 1994 and 1995. This document is enclosed.
- "Lower Skagit Total Maximum Daily Load Report" will contain the recommendations for limiting loading of pollutants to the lower Skagit River. Available spring, 1997.
- "Water Quality Plan of Action for the Skagit/Stillaguamish Water Quality Management Area" will contain the work plan for issuing waste discharge permits in the basin in 1997-98 and guidance for work on other pollutant sources. Available spring, 1997.

These documents are primarily internal guidance documents for Ecology staff. Prior to any final action, the agency will provide public notice and opportunity for public comment on the TMDL and load allocations to dischargers. Wastewater discharge permits are scheduled to be issued to dischargers in this WQMA in 1997 and 1998. In 1999 the agency will hold public meetings and solicit public input for the next five-year cycle.

The first document "Lower Skagit Total Maximum Daily Load Data Summary" has been completed and printed. Because of your involvement with protecting water quality in the Lower Skagit River, we are providing you with this copy.

If you have any questions you can reach me at (206) 649-7215. If you have specific questions about the TMDL study, call Paul Pickett of Ecology's Watershed Assessments Section at (360) 407-6685.

Sincerely,

Gerald Shervey, P.E.
Water Quality Engineer
NWRO Water Quality Section

GS:gs
Enclosure

[*Example of notification letter offering a copy of the Lower Skagit River Total Maximum Daily Load Data Study, Report No. 96-345]*
January 22, 1997

Mr. Ed McMillan - Public Works Director
City of Arlington
238 North Olympic Avenue
Arlington WA 98223

Dear «PREFIX» «LAST_NAME»:

Re: "Lower Skagit Total Maximum Daily Load Data Summary" now available

Since 1993 Ecology has been implementing the "Watershed Approach" to the regulation of water pollution sources. The emphasis of this approach is to focus the resources of the agency to specific geographical areas over a five year cycle based on the state's watershed drainage basins. Ecology has grouped the Skagit, Stillaguamish, and Samish rivers basins as one water quality management area (WQMA). In 1993 Ecology staff decided to focus agency resources on the lower Skagit River. The goal was to gather data for establishing a Total Maximum Daily Load (TMDL) of pollutants discharged to the lower Skagit for the protection of Washington's water quality standards for bacteria and dissolved oxygen.

Ecology will publish the following documents over the next year:

- "Lower Skagit Total Maximum Daily Load Data Summary" contains the data collected for the lower Skagit TMDL project by Ecology during 1994 and 1995. This document is now available.
- "Lower Skagit Total Maximum Daily Load Report" will contain the recommendations for limiting loading of pollutants to the lower Skagit River. Available spring, 1997.
- "Water Quality Plan of Action for the Skagit/Stillaguamish Water Quality Management Area" will contain the work plan for issuing waste discharge permits in the basin in 1997-98 and guidance for work on other pollutant sources. Available spring, 1997.

These documents are primarily internal guidance documents for Ecology staff. Prior to any final action, the agency will provide public notice and opportunity for public comment on the TMDL and load allocations to dischargers. Wastewater discharge permits are scheduled to be issued to dischargers in this WQMA in 1997 and 1998. In 1999 the agency will hold public meetings and solicit public input for the next five-year cycle.

The first document "Lower Skagit Total Maximum Daily Load Data Summary" has been completed and printed. The abstract for this report is as follows:

> As part of the Lower Skagit Total Maximum Daily Load (TMDL) Study, a series of surveys were conducted in 1994 and 1995. This report presents the data collected during

those surveys, as well as a summary of the Quality Assurance and Quality Control analysis of the data. The full report on the Lower Skagit TMDL will be published separately. Preliminary analysis showed widespread elevated levels of FC bacteria and turbidity in tributary streams, stormwater, drainage pump stations, combined sewer overflows, and point sources. In the Skagit River, turbidity and bacteria problems appear to be largely transported from the upper basin in the lower river. Dissolved Oxygen (DO) met the Water Quality Standards throughout the lower Skagit River, but the South Fork Skagit River showed evidence of being the critical location for low DO levels.

If you would like to have a copy of this report contact Carla Skog at (206) 649-7201. If you have any questions you can reach me at (206) 649-7215. If you have specific questions about the TMDL study, call Paul Pickett of Ecology's Watershed Assessments Section at (360) 407-6685.

Sincerely,

Gerald Shervey, P.E.
Water Quality Engineer
NWRO Water Quality Section

GS:gs

November 24, 1997

Dr. Wilbur C. Anderson, Manager/ Horticulturist
WSU Mount Vernon Research Unit
1468 Memorial Highway
Mount Vernon, WA 98273-9788

Dear «PREFIX» «LAST_NAME»:

Re: Lower Skagit River TMDL Water Quality Study, Publication No. 97-326a, July, 1997
The final technical report for the Lower Skagit TMDL was published in July, 1997. You will find enclosed a copy of the "Lower Skagit River Total Maximum Daily Load Water Quality Study." The Department invites your comments on the study and the TMDL proposal.

This report proposes specific measures to restore and protect shellfish resources in Skagit Bay by reducing fecal coliform bacteria levels to meet state standards at the mouth of the Skagit River. The TMDL provides a list priorities for locating and reducing sources of bacteria that pollute the lower Skagit River and Skagit Bay. By meeting the Class A bacteria standards and target values in the lower Skagit River, the use of the river for swimming, fishing and other recreation will be protected. The report also proposes setting new limits on pollutant discharge (5-day carbonaceous biological oxygen demand and ammonia) from permitted municipal wastewater treatment plants to assure compliance with dissolved oxygen standards in the lower Skagit River. Ensuring high dissolved oxygen levels in the river is necessary to protect salmon and other fishery resources. The new pollution limits will eventually require a greater degree of treatment at sewage treatment plants in Burlington, Sedro Woolley, Mount Vernon and Skagit Sewer District No. 2 (Big Lake).

Now that the report is published, here's what happens next:

- The Department is distributing the TMDL or notice of its availability to stakeholders. The Department will advertise that it is preparing to implement this TMDL for the Skagit River and issue wastewater discharge permits to facilities in the Skagit and Stillaguamish River basins.
- The Department will hold a public informational meeting to discuss the study results and discharge permit issues. The meeting will be scheduled for sometime in early 1998 in Mount Vernon. The Department will advertise the meeting in the Skagit Valley Herald and mail notices of the meeting to recipients of the TMDL document. The TMDL proposal may be modified based on public input.
- Pollutant discharges from the cities of Burlington, Sedro Woolley, and Mount Vernon as well as Skagit Sewer District No. 2 (Big Lake) will be limited as recommended in the TMDL. The limitations will be incorporated in new permits for those dischargers when their permits are renewed in 1998. There will be opportunities for public comment on the new permits.
- The findings of the technical report will be part of a TMDL package submitted to the U.S. EPA for their approval. Other elements of the package will include the discharge permits affected by this report and an implementation plan to describe how Ecology will improve

controls on nonpoint source pollution. The Department will provide opportunities for review and comment on the TMDL package prior to its submittal to EPA.

- In about a year, conditions in the Skagit River basin will be reviewed again as part of Ecology's "watershed approach" to water quality protection. This provides an opportunity for a comprehensive scoping of the issues raised by this report and other water quality concerns in the basin. You will be notified when this process begins so we can get your input.

If you have specific questions about the TMDL study, call Paul Pickett of Ecology's Watershed Assessments Section at (360) 407-6685. If you have any questions you can reach me at (425) 649-7215. Comments on the TMDL should be addressed to me at the address shown above.

Sincerely,

Gerald Shervey, P.E.
Water Quality Engineer
NWRO Water Quality Section

Appendix C

Responses to Comments Received (shown in italics)

1. Letter and attachments from Luis Fuste USGS Water Resources Division to Walt Enquist of the City of Mount Vernon dated April 22, 1998.

   1.1. This set of papers derives 7Q10 flows for the lower Skagit River for different time periods and provides a history of dam construction in the upper river. The 7Q10flow calculated for the period of 1953-1997 and 1982-1997 is 5030 CFS.

   The original TMDL study used a value of 4730 CFS for the 7Q10 flow based on a period of 1941 to 1979. The flow regime has been regulated since the mid 1950's by the current dam configuration. The Department has changed the 7Q10 flow to 5030 CFS in response to this information.

2. Letter from the Honorable Skye Richendrfer, Mayor City of Mount Vernon to Gerald Shervey Washington State Department of Ecology on April 29, 1998.

   2.1. The Department failed to provide notice and involve the City in development of waste load allocations (WLAs).

   The Department has attempted to provide all interested parties with equal access to the TMDL process and deriving nonpoint load allocations and WLAs. The Department provided the WLAs to a wide range of parties at the time the Lower Skagit River Total Maximum Daily Load Water Quality Study (Pickett, 1997) was published.

   2.2. Mount Vernon advocated basing WLAs on projected population instead of wastewater flows predicted in the approved comprehensive sewer plans for each affected municipality.

   The City of Burlington has objected to this proposal (letter from Margaret Fleek dated February 13, 1998) noting that only population is directly forecasted by OFM and that other data must be taken into account to forecast wastewater treatment plant loadings. The Department agrees with the comment from Burlington.

   The Department expects that comprehensive sewer plans include population projections contained in each entity's comprehensive plans and thus are based on approved GMA planning by both the County and individual cities. Comprehensive sewer plans refine growth projections to more accurately predict sewered population, commercial contributions, and industrial flows. These plans provide a more definitive projection of wastewater loading than simple population projections. The Department has increased the WLA for ammonia to Mount Vernon in response to the City's concern about growth and its efforts to reduce CSO discharge. The Department is anticipating withholding a reserve WLA for future growth.

   As of January, 2000 the Department has recalculated WLAs using an updated, increased design flow for the Mount Vernon Sewage treatment plant based on influent loading

estimates provided by the City's engineering staff. This revision should satisfy Mount Vernon's concerns over the basis of WLAs

2.3. The Department should delay implementing the findings of the TMDL to allow additional investigation by the affected dischargers and Skagit County.

The Department has delayed the implementation of the TMDL and revised the findings as explained here.

3. Letter from the Honorable Skye Richendrfer, Mayor of Mount Vernon; the Honorable Roger Tjeerdsma, Mayor of Burlington; the Honorable Don Wally, Mayor of Sedro-Woolley; and the Honorable Robert Hart, chairman of the Board of Skagit County Commissioners to Gerald Shervey Washington State Department of Ecology on April 28, 1998.

3.1. The TMDL model predicted only a minor violation (0.2 mg/L below standards) of the State dissolved oxygen standard that would appear to have no practical impact on the use of the river or fish migration.

The TMDL and NPDES permits must be conditioned to meet the State water quality standards. The issue of impacting beneficial uses is considered when the state sets the standard, not for TMDLs, WLAs, and NPDES permits. This comment would be appropriate for the next time the State water quality standards regulation (WAC 173-201A) are revised.

3.2. The findings of the TMDL study will force major upgrades of the treatment facilities for the lower Skagit dischargers. The City and County should be afforded opportunity to verify the TMDL findings.

WLAs have been increased based on comments received. The Department has delayed implementation of the TMDL in permits and made adjustments to the model. The TMDL study and WLAs will set the basis for future treatment plant enhancements needed in response to growth, but the WLAs are sufficient for each plant to continue discharging with current treatment levels at least until 2015.

3.3. Revise the 7Q10 flow. *See 1.*

3.4. Provide the Permittees adequate time to assure themselves the TMDL model is correct. Allow a ten year compliance schedule for meeting the WLAs.

The merits and drawbacks of the Departments TMDL modeling can be debated endlessly. More detailed work seems superfluous considering the revised WLAs provide for growth in flows and loadings through the year 2015. The WLAs provided by the Department can be met with the level of treatment provided by each discharger now. The WLAs require removal of ammonia during treatment. Technology is currently available to meet this requirement, so new requirements can be incorporated into treatment system designs as growth in each city calls for WWTP upgrades. Revisions to the model based on comments and new data should render this comment moot.

3.5. The City and County will collaborate on meeting the requirements of the TMDL. *The Department has no comment.*

3.6. "In essence, we are requesting time to more completely evaluate the Skagit River…"

Revisions to the WLAs allow the affected dischargers to meet proposed permit limits with current technology and incorporate new requirements in future treatment system designs.

4. Copy of letter from Walt Enquist, Wastewater Utility Supervisor for Mount Vernon, to Sky Miller, Skagit County Surface Water Management dated March 16, 1998. *The Department has no comments to address from this letter.*

5. Letter from John Wiseman, City Engineer for Mount Vernon, to Gerald Shervey of Department of Ecology dated January 15, 1998.

5.1. Estimate of BOD_5 loadings upstream of the Lower Skagit River area consists of only one data point. *To be exact, four measurements of BOD_5 were made at the upstream site. All four were below the level of detection. One measurement from an ultimate BOD analysis was used to estimate the BOD_5 value. Although that is a small amount of data to rely on, the value of that parameter is of minor significance compared to upstream ammonia values. The value is our best estimate.*

5.2. Delay implementation of original WLAs. *The Department did this and revised the WLAs based on other comments.*

5.3. Mount Vernon proposes that WLAs be provided based on population projections instead of comprehensive sewer plans. *See 2.2.*

5.4. Provides a table of WLAs based on the Skagit County Comprehensive Plan and growth projections. *See 2.2*

5.5. The major waste loading in the Skagit is coming from upstream of Sedro-Woolley Woolley. Upstream nonpoint loads should be reduced. *Loading from upstream is high because flows are high, but concentrations are very low. Little if any of that loading is controllable. The majority of loading from controllable sources that affects dissolved oxygen during the critical low flow season is from sewage treatment plants.*

5.6. Reduce upstream loading from nonpoint sources. *See 5.5 above.*

5.7. Skagit Bay needs to be studied to ascertain loading *(fecal coliform assumed)* from the periphery of the bay. *The Department of Ecology can consider funding this type of study in the future.*

6. Letter from Margaret Fleek to Department of Ecology (Attn: Gerald Shervey) dated February 13, 1998.

This letter disputes several items from the letter from John Wiseman to Gerald Shervey January 15, 1998. *See 2.2.*

7. Lisa Austin of the Department of Ecology commented by email on January 13, 1998 that some BOD_5 capacity should be reserved for future BOD_5 loads from fruit and vegetable washing, a fish hatchery, and seafood processors. *No existing source of BOD from industrial or commercial permitted dischargers were identified during the TMDL study. A reserve for future dischargers may be available either from the unused capacity of existing point sources, or from the surplus dissolved oxygen at the Conway bridge, should future research find that factor to be overly conservative.*

8. Letter from the Honorable Robert Jonkheer – President, Board of Commissioners Skagit County Sewer District #2 to Gerald Shervey of Department of Ecology dated January 3, 1998.

   This sewer district serves the Big Lake Community and requested that they be provided a WLA for ammonia discharge on the same basis as the other dischargers because the values measured during the TMDL study did not represent the expected output from its treatment plant when it fully loaded. *The Department concurred and increased the WLA for this discharger.*

9. Fax from Walt Enquist of the City of Mount Vernon to Gerald Shervey dated November 17, 1997.

   9.1. Discuss the regulatory status of the lower Skagit River in relation to the TMDL study.

   The Department of Ecology initiated the TMDL study in response to data submitted by Skagit County that showed that lower Skagit failed to meet state dissolved oxygen standards. Ecology staff reviewed the data in greater detail as part of the preliminary work for the TMDL study, and concluded that the data accuracy was questionable. The Department is required to set water quality-based limits for discharges to state waters. The TMDL study fulfills this obligation. Ecology also has the discretionary capability to perform "preventative" TMDLs for potentially threatened waters. The recent rapid growth in the lower Skagit River basin and the potential for continued growth led Ecology to believe that a preventative TMDL was reasonable and timely.

   9.2. How will the TMDL status affect the consent decree between the City of Mount Vernon and the Department of Ecology requires the City to reduce CSO discharges to an average of once per year (required by current state regulations)? If state standards were relaxed to match proposed federal standards of an average of 3-5 overflows per year would the City still be required to meet the standard of once per year?

   The TMDL findings are consistent with the consent decree. If state standards for CSO discharge (a technology-based standard) were relaxed, the City would still be held to the requirement of averaging a single CSO episode per year. The TMDL has set a water-quality based limitation on the CSO discharges. The most stringent requirement takes precedent.

   9.3. How was the load contribution upstream of the study area derived, specifically the ambient BOD_5 level?

See 5.1 for how the upstream BOD_5 level was developed. The alternative would have been to use an assumed value equal to one half of the detection level, which would have resulted in a higher estimated value than the one used. The upstream BOD_5 is insignificant compared to the upstream ammonia level. Upstream ammonia was determined from a statistical evaluation of ambient data. The Department has reduced its estimate of the upstream ammonia level to a range of 0.015 to 0.020 mg/L based on long term monitoring data, data supplied by the dischargers after the study, and omitting the data set from the highway 99 bridge at Mount Vernon. Compare model runs 14 and 16. The ammonia levels discharged from the Mount Vernon WWTP has more effect on the model results than the upstream ammonia levels.

9.4. Explain why the TMDL study identifies CSO abatement as most important action needed to improve Skagit River water quality and protect Skagit Bay from bacteria contamination.

Of the sources studied within the study area, reductions in CSO bacteria levels resulted in the largest reduction in bacteria levels in the Skagit River as compared to proportional reductions from other sources. In addition, fecal coliform is used as an indicator of pathogens from human beings in the river. Since the CSO discharge is of human origin, the discharge of CSO is more significant than bacteria measured from non-human fecal coliform bacteria sources such as manure application runoff.

Appendix D

Summary of Modeling Results

Table 4: Summary of 1997 discharges.

	2015 design flow	ave. daily flow	Max ave monthly BOD5	Highest BOD5 max day	Max ave monthly Ammonia	ammonia max day
	MGD	MGD	lbs/day	lbs/day	lbs/day	lbs/day
Burlington WWTP	5.05	1.82	191	303	~334	ND
Mount Vernon WWTP	5.7	3.71	538	1000	630	883
Sedro Woolley WWTP	2.07	0.91	80	142	8	ND
Skagit Co. SD No. 2 (Big Lake) WWTP	0.22	0.07	7	10	0.6	ND
		1997 dry season discharge summary				

Table 5: Summary of WLAs, model assumptions, and resulting dissolved oxygen values at the critical location. Cases 11 and 15 provide the maximum WLAs while meeting state dissolved oxygen standards.

	2015 flow	**Case 1 - negotiated WLA with reserve**				**Case 2 - original WLA from Ecology Report**				**Case 3 - Col 15, WLA proportioned to sum of current and 2015 design flow.**			
		CBOD WLA		ammonia		CBOD WLA		ammonia		CBOD WLA		ammonia	
	MGD	mg/L	lbs/ day	mg/L	lbs/ day	mg/L	lbs/ day	mg/L	lbs/ day	mg/L	lbs/ day	mg/L	lbs/day
Burlington	5.05	20	842	10	421	20	842	10	421	17	706	15	632
Mount Vernon	5.7	22	1028	25	1188	20	950	10	475	22	1028	25	1188
Sedro Woolley	2.07	20	345	8	138	20	345	10	173	24	421	15	125
Big Lake	0.22	20	37	10	18	20	37	10	18	25	45	10	18
		Main Stem DO @RM 8.7>	9.497	MS flow (cfs)	5030	Main Stem DO @RM 8.7>	9.376	MS flow (cfs)	4730	Main Stem DO @RM 8.7>	9.480	MS flow (cfs)	5030
		S. Fork DO @ RM 4.39>	**9.230**	SF flow (cfs)	1690	S. Fork DO @ RM 4.39>	**9.186**	SF flow (cfs)	1590	S. Fork DO @ RM 4.39>	**9.205**	SF flow (cfs)	1690
		Main Stem temp in C	15.54	amb NH3 (mg/L)	0.03	Main Stem temp in C	16.2	amb NH3 (mg/L)	0.05	Main Stem temp in C	15.54	amb NH3 (mg/L)	0.03
		ambient DO (mg/L)	9.75			ambient DO (mg/L)	9.70			Ambient DO (mg/L)	9.75		

		Case 4 - change CBOD:NH3 ratios				**Case 5 - increase CBOD:NH3 ratio at Sedro Woolley**				**Case 6 - decrease NH3 at Mt Vernon to 10 mg/L**			
		CBOD WLA		ammonia		CBOD WLA		ammonia		CBOD WLA		ammonia	
	MGD	mg/L	lbs/ day	mg/L	lbs/ day	mg/L	lbs/ day	mg/L	lbs/ day	mg/L	lbs/ day	mg/L	lbs/day
Burlington	5.05	20	842	10	421	20	842	10	421	20	842	10	421
Mount Vernon	5.7	20	951	25	1188	20	951	25	1188	20	951	10	834
Sedro Woolley	2.07	24	414	6	103	24	414	8	138	24	414	8	138
Big Lake	0.22	20	36.7	10	18.3	20	36.7	10	18.3	20	36.7	10	18.3
		Main Stem DO @RM 8.7>	9.499	MS flow (cfs)	5030	Main Stem DO @RM 8.7>	9.497	MS flow (cfs)	5030	Main Stem DO @RM 8.7>	9.512	MS flow (cfs)	5030

		S. Fork DO @ RM 4.39>	**9.235**	SF flow (cfs)	1690	S. Fork DO @ RM 4.39>	**9.233**	SF flow (cfs)	1690	S. Fork DO @ RM 4.39>	**9.307**	SF flow (cfs)	1690
		Main Stem temp in C	15.54	amb NH3 (mg/L)	0.03	Main Stem temp in C	15.54	amb NH3 (mg/L)	0.03	Main Stem temp in C	15.54	amb NH3 (mg/L)	0.03
		ambient DO (mg/L)	9.75			ambient DO (mg/L)	9.75			Ambient DO (mg/L)	9.75		

		Case 7 - (Case 5) increase MS flow to 6000 cfs				**Case 8- (Case 7) with Oct-Dec temp, DO**				**Case 9- Case 8 with higher ammonia**			
		CBOD WLA		ammonia		CBOD WLA		ammonia		CBOD WLA		ammonia	
	MGD	mg/L	lbs/ day	mg/L	lbs/ day	mg/L	lbs/ day	mg/L	lbs/ day	mg/L	lbs/ day	mg/L	lbs/day
Burlington	5.05	20	842	10	421	20	842	10	421	25	1053	20	842
Mount Vernon	5.7	20	951	25	1188	20	951	25	1188	25	1188	30	1426
Sedro Woolley	2.07	24	414	8	138	24	414	8	138	25	432	20	345
Big Lake	0.22	20	36.7	10	18.3	20	37	10	18	25	46	20	37
		Main Stem DO @RM 8.7>	9.535	MS flow (cfs)	6000	Main Stem DO @RM 8.7>	10.345	MS flow (cfs)	6000	Main Stem DO @RM 8.7>	10.327	MS flow (cfs)	6000
		S. Fork DO @ RM 4.39>	**9.318**	SF flow (cfs)	2030	S. Fork DO @ RM 4.39>	**10.206**	SF flow (cfs)	2030	S. Fork DO @ RM 4.39>	**10.21**	SF flow (cfs)	2030
		Main Stem temp in C	15.54	amb NH3 (mg/L)	0.03	Main Stem temp in C	11 C	amb NH3 (mg/L)	0.04	Main Stem temp in C	11 C	amb NH3 (mg/L)	0.04
		ambient DO (mg/L)	9.75			ambient DO (mg/L)	10.4			Ambient DO (mg/L)	10.4		

		Case 10- Case 1 with low ambient NH4				**Case 11- crit cond, tech-based cbod, 95% upstream NH4**				**Case 12 - Case 11 w/ increase NH3 discharge**			
		CBOD WLA		ammonia		CBOD WLA		ammonia		CBOD WLA		ammonia	
	MGD	mg/L	lbs/ day	mg/L	lbs/ day	mg/L	lbs/ day	mg/L	lbs/ day	mg/L	lbs/ day	mg/L	lbs/day
Burlington	5.05	20	842	10	421	40	1685	10	421	40	1685	15	632
Mount Vernon	5.7	22	1046	25	1188	40	1902	25	1188	40	1902	25	1188
Sedro Woolley	2.07	20	345	8	138	40	691	10	173	40	691	15	259
Big Lake	0.22	20	37	10	18	40	73	10	18	40	73	15	28
		Main Stem DO @RM 8.7>	9.528	MS flow (cfs)	5030	Main Stem DO @RM 8.7>	9.555	MS flow (cfs)	5030	Main Stem DO @RM 8.7>	9.500	MS flow (cfs)	5030
		S. Fork DO @ RM 4.39>	**9.276**	SF flow (cfs)	1690	S. Fork DO @ RM 4.39>	**9.252**	SF flow (cfs)	1690	**S. Fork DO @ RM 4.39>**	**9.227**	SF flow (cfs)	1690
		Main Stem temp in C	15.5	amb NH3 (mg/L)	0.01	Main Stem temp in C	15.5	amb NH3 (mg/L)	0.015	Main Stem temp in C	15.54	amb NH3 (mg/L)	0.015
		ambient DO (mg/L)	9.75			ambient DO (mg/L)	9.75			Ambient DO (mg/L)	9.75		

		Case 13 - Case 11 w/ increase NH3 ambient & discharge				**Case 14 - increase MV flows to 8.13, same conc**				**Case 15 - increase MV flows, decrease NH3 WLA**			
		CBOD WLA		ammonia		CBOD WLA		ammonia		CBOD WLA		ammonia	
	MGD	mg/L	lbs/ day	mg/L	lbs/ day	mg/L	lbs/ day	mg/L	lbs/ day	mg/L	lbs/ day	mg/L	lbs/day
Burlington	5.05	40	1685	15	632	40	1685	10	421	40	1685	10	421

Mount Vernon	5.7 or 8.13	40	1902	25	1188	40	2712	25	1695	40	2712	15	1017
Sedro Woolley	2.07	40	691	15	259	40	691	10	173	40	691	10	173
Skagit Co. SD No. 2 (Big Lake)	0.22	40	73	15	28	40	73	10	18	40	73	10	18
		Main Stem DO @RM 8.7>	9.500	MS flow (cfs)	5030	Main Stem DO @RM 8.7>	9.500	MS flow (cfs)	5030	Main Stem DO @RM 8.7>	9.500	MS flow (cfs)	5030
		S. Fork DO @ RM 4.39>	**9.215**	SF flow (cfs)	1690	**S. Fork DO @ RM 4.39>**	**9.160**	SF flow (cfs)	1690	**S. Fork DO @ RM 4.39>**	**9.248**	SF flow (cfs)	1690
		Main Stem temp in C	15.54	amb NH3 (mg/L)	0.02	Main Stem temp in C	15.54	amb NH3 (mg/L)	0.02	Main Stem temp in C	15.54	amb NH3 (mg/L)	0.02
		ambient DO (mg/L)	9.75			ambient DO (mg/L)	9.75			Ambient DO (mg/L)	9.75		

Note: This model run shows that the Mount Vernon WLA based on 10 mg/L will meet WQ standards and provide a reserve equivalent to 5 mg/L of ammonia discharged. By 2105 Mount Vernon should be provided a load allocation on the same basis as the other dischargers.

		Case 16 - case 14 w/ lower upstream NH3				
		CBOD WLA		ammonia		
		mg/L	lbs/day	mg/L	lbs/day	
Burlington	5.05	40	1685	10	421	
Mount Vernon	8.13	40	2712	25	1695	
Sedro Woolley	2.07	40	691	10	173	
Skagit Co. SD No. 2 (Big Lake)	0.22	40	73	10	18	
		Main Stem DO @RM 8.7>	9.500	MS flow (cfs)	5030	
		S. Fork DO @ RM 4.39>	**9.173**	SF flow (cfs)	1690	
		Main Stem temp in C	15.54	amb NH3 (mg/L)	0.015	
		ambient DO (mg/L)	9.75			

Appendix E

Quality Assurance Project Plan

APPENDIX F

Technical Report

Bound Separately as:

Ecology Publication Number 96-345
"Lower Skagit Total Maximum Daily Load Data Summary."

APPENDIX G

Ecology Publication Number 97-326
"Lower Skagit River Total Maximum Daily Load Water Quality Study."