Oregon Department of Environmental Quality
2020 SW Fourth Avenue, Suite 400
Portland, Oregon 97201
503-229-5263 FAX 503-229-6945

Permittee:  
Canby Utility Board  
P.O. Box 1070  
Canby, OR 97013

Facility Location:  
591 North Cedar Street  
Canby, OR 97013

Sources Covered:  
Infiltration Gallery Backwash  
Filter Backwash

Receiving Stream:  
Molalla River

Source Category:  
Minor Industrial

Proposed Action:  
Issuance of renewal permit

File Information:  
WQ-Clackamas County  
File No. 110824  
EPA Reference No.: OR 004064-9

Source Contact:  
Debbie Naab  
Contract Manager/Purchasing Agent  
Canby Utility Board  
503-266-1156  
dnaab@canbyutility.org

Prepared by:  
Rob Burkhart  
Northwest Region – Water Quality  
503-229-5566  
burkhart.robert@deq.state.or.us

Date Prepared:  2/7/2006
1.0 Description of Proposed Action

A National Pollutant Discharge Elimination System (NPDES) permit was issued by the Department of Environmental Quality (Department) to Canby Utility for its domestic water supply treatment plant on July 19, 2000 (2000 NPDES permit). Canby Utility submitted its NPDES permit renewal application for the plant on March 4, 2005. The permit expired on June 30, 2005 and has been administratively extended by the Department. The Department is proposing to renew the NPDES permit for Canby Utility.

The Federal Water Pollution Control Act of 1972 and subsequent amendments require a NPDES for the discharge of wastewater to surface waters. Furthermore, Oregon Revised Statutes (ORS 468B.050) also requires a permit for the discharge of wastewater to surface waters. This proposed permit action by the Department fulfills both federal and state requirements.

2.0 Facility Description

2.1 General

The Canby Utility Board (CUB) Water Treatment Plant (WTP) is a domestic water supply treatment plan located at 591 N. Cedar Street, Canby OR 97013. A site location map is presented in Figure 1.
The plant draws raw water from the Mollala River and treats it for domestic water use. The raw water supply sources for the plant include a river infiltration gallery (RIG) in the Molalla River, a surface water intake structure on the Molalla River, and a spring gallery (groundwater). According to CUB, the RIG in the Molalla River provides the best water supply source compared to the other sources.

The RIG consists of 25.4 cm (10 inch) screened collection pipes buried underneath the riverbed with rocks and grave as fill material. Raw river water is drawn into the infiltration gallery and is pumped to the WTP. River water can also be pumped from the surface water intake structure to the WTP. Raw water is pumped to the upflow clarifiers, filtered with the mixed media and dual filters, and disinfected with ultraviolet. Finally, the treated water is chlorinated and pumped to the plant main storage tank for distribution to the CUB water supply system.

2.2 Wastewater Treatment and Discharge

The CUB treatment plant discharges water from two outfalls. Outfall 001 is the river infiltration gallery (RIG) located in the bottom of the Molalla river. “Finished” (treated) water is used to backflush gravel and sediment that may accumulate in the RIG. Outfall 002 is overflow from the filter backwash ponds. These ponds are used to treat filter backwash water and only discharge on rare occasions.

The RIG requires backwashing after 96 to 500 run-hours to clean out any debris and sediments that collect on the screens and rock/gravel filter media of the gallery. Typically, the discharge is about 56.8 m³/min (33.4 cfs) for about 8 to 15 minutes duration. Finished water (containing chlorine) is used for the backwash. Accordingly, the discharge water contains only chlorine residual and the solids removed from the RIG during the backwash. The backwash is discharged through the infiltration collection pipe in the gallery to the Molalla River.

The mixed media and dual filters of the treatment plant are backwashed intermittently depending on the river water turbidity. Flow is estimated at 7.6 m³/min (4.5 cfs). Finished water is used for the backwash operation. It is discharged to the filter backwash settling ponds, located in the Molalla River flood plain. Most of this water is either evaporated or percolated into the soils. There is minimal overflow, which most of the time soaks into the ground and occasionally may be discharged to the Molalla River.

Currently, the ponds are at capacity for the backwash operation with minimal discharges to the river. It is anticipated that this situation will continue for the life of the permit. The CUB WTP is expected to be expanded in the future, with backwash flow rates increasing.

3.0 Water Quality Issues

3.1 Applicable Water Quality Standards

The water quality standards for Molalla River are found in Oregon Administrative Rule (OAR) 340-041-0345 (Willamette River Basin). They are intended to be protective of the beneficial uses for the basin, which include domestic water supply, industrial water supply, irrigation, livestock watering, fish and aquatic life, wildlife & hunting, fishing, boating, water contact recreation, aesthetic quality, and hydropower. Selected water quality standards for the Molalla River are presented in Table 1.
TABLE 1
SELECTED MOLALLA RIVER WATER QUALITY CRITERIA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>In-stream Water Quality Criteria</th>
</tr>
</thead>
</table>
| Temperature        | No measurable increase (defined as 0.3°C at the edge of the mixing zone or 25% of the stream flow) in the 7-day average maximum water temperature from anthropogenic activities is allowed above the applicable criteria. The applicable criteria are:  
  May 16 – Oct. 14: 18.0°C  
  Oct. 15 - May 15: 13.0°C |
| pH                 | > 6.5 and ≤ 8.5                  |
| Chlorine           | Acute Criterion: 0.019 mg/l     |
|                    | Chronic Criterion: 0.011 mg/l   |
| Turbidity(OAR 340-041-0036) | No more than a ten percent cumulative increase in natural stream turbidities shall be allowed, as measured relative to a control point immediately upstream of the turbidity causing activity. |

3.2 303(d) Listing Status

Section 303(d) of the Clean Water Act requires each state to develop a list of water bodies that do not meet state surface water quality standards after implementation of technology-based controls. The state is then required to complete a Total Maximum Daily Load (TMDL) for water bodies on the 303(d) list. The TMDL must address water quality on a basin-wide scale to ensure that overall water quality standards will be met. The Clean Water Act prohibits new or increased discharges until a TMDL has been established for 303(d) water bodies, unless the discharge does not contribute pollutants that cause the stream to violate water quality standards.

CUB discharges wastewater to the portion of the Molalla River that is listed as being water quality limited in the Department’s 2002 303(d) list of streams. Table 2 includes the parameters for which water quality standards in the Molalla River are not met and the season when standards are exceeded:

TABLE 2
2002 MOLALLA RIVER 303(D) LISTING INFORMATION

<table>
<thead>
<tr>
<th>Stream Segment</th>
<th>Parameter</th>
<th>Season</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molalla River (RM 0 to 25)</td>
<td>Bacteria</td>
<td>Winter, Spring &amp; Fall</td>
</tr>
<tr>
<td></td>
<td>Temperature</td>
<td>Summer</td>
</tr>
</tbody>
</table>

3.3 Mixing Zones

OAR 340-041-0445(4) provides that the Department may suspend all or part of the water quality standards in a designated portion of the receiving water to serve as a zone of dilution for treated wastewaters and receiving waters to mix thoroughly. Water quality standards for all parameters must be met at the edge of the defined regulatory mixing zone.
The mixing zone for discharge from the CUB facility outfall 001 is defined in the current permit as that portion of the Molalla River 30 meters wide (measured from the centerline of the infiltration gallery collection pipe) and extending 15 meters upstream and 45 meters downstream of the discharge point. This mixing zone is considered appropriate for several reasons, including: 1) the dimensions of the mixing zone are just slightly larger than the dimensions of the river bottom (“filter bed”) above the instream infiltration gallery, therefore the mixing zone size is as small as feasible; 2) The discharges are very limited in duration and frequency allowing for passage of fish; and, 3) the mixing zone will be free of materials in concentrations that will cause toxicity to aquatic life (see discussion under “Water Quality Analysis”, below).

3.4 Antidegradation Review
The Department’s antidegradation policy in OAR 340-041-0026 requires that a review of discharges to surface waters be conducted to ensure that existing water quality is not lowered unless there are no reasonable alternatives available and the lowering of water quality is necessary for economic and social benefit.

The NPDES permit for Canby Utility’s discharge is a permit renewal with no increase in discharge load. Permit renewals with the same discharge load as the previous permit are not considered to lower water quality from existing water quality. Thus, the Department finds that the discharge is not subject to an in-depth antidegradation review. (Antidegradation Policy Implementation Internal Management Directive for NPDES Permits and Section 401 Water Quality Certifications, ODEQ March 2001).

4.0 Water Quality Analysis
This section determines pollutants of concern and evaluates each parameter to determine whether the concentration of the pollutant in the discharge represents a “reasonable potential to exceed” water quality standards. If the discharge concentration of a particular pollutant has a reasonable potential to exceed water quality standards, then water quality based effluent limits are established for that pollutant. The water quality analysis is based on the NPDES Permit application data, discharge characteristics, mixing zone information, and reports previously submitted by the applicant.

4.1 Pollutants of Concern
The primary pollutants of concern for discharges from outfall 001 (infiltration gallery backwash) and outfall 002 (filter backwash) are: turbidity, settleable solids and chlorine. Temperature, while not considered to be a primary pollutant of concern, is examined in some detail below because the receiving water is listed as impaired for temperature. Since, the discharges from each outfall originate with chlorinated finished water, bacteria are not expected to be present in either of the discharges.

The Department is required to set effluent limits for pollutants that may be discharged at levels that cause, or have the reasonable potential to cause, an excursion above any numeric or narrative state water quality standard [40 CFR 122.44(d)(1)(i)].

4.1.1 Chlorine
The CUB water treatment plant’s (WTP) discharges utilize finished water with chlorine concentrations of 1.0 mg/L for both RIG and filter backwash operations. For the RIG, the finished water is discharged straight down to the infiltration collection pipes via the main transmission line to the WTP. This precludes the aeration and escape of chlorine. Therefore, the effluent from outfall 001 may have chlorine concentrations of up to 1.0 mg/l at the point of
Permit Evaluation Report
Canby Utility Board

discharge. It must be assured that the instream concentrations and residence time do not result in chlorine toxicity for aquatic organisms. The applicable chlorine toxicity criteria include a one-hour acute toxicity criterion of 0.019 mg/l and a four-day chronic toxicity criterion of 0.011 mg/l. Due to the limited volume and infrequent nature of the discharge, chronic chlorine toxicity is not a concern. Acute chlorine toxicity is of concern.

For the 2000 NPDES permit, a river mixing evaluation for chlorine was prepared for the CUB by Liberte Environmental Associates. This evaluation included model simulations at various river flow rates and various chlorine concentrations, effluent flows and discharge durations. The Department reviewed the evaluation and performed further evaluations to determine the discharge conditions that would ensure compliance with chlorine toxicity criteria. (The memo documenting this review and evaluation is included in Attachment A). The conditions determined to ensure compliance are as follows:

- Below the critical stream flow of 7.5 m$^3$/s (265 cfs), CUB is allowed to discharge for a maximum duration of 12 minutes with an initial chlorine concentration of no more than 0.1 mg/L.
- Between stream flows of 7.5 to 11.3 m$^3$/s (265 – 400 cfs), CUB is allowed to discharge for a maximum duration of 12 minutes with an initial chlorine concentration of no more than 1.0 mg/L.
- Above stream flows of 11.3 m$^3$/s (400 cfs), CUB is allowed to discharge for a duration of 15 minutes or more with an initial chlorine concentration of no more than 1.0 mg/L.

The filter backwash water is not expected to result in any instream chlorine toxicity due to its limited volume and atmospheric exposure in the settling ponds and during overland flow.

### 4.1.2 Turbidity

The Molalla River has a boulder and cobble river bed with little silts or fines in the vicinity of the river infiltration gallery. The river flows swiftly with bends and small rapids both upstream and downstream of the RIG.

As is often typical of river systems, Molalla River turbidity levels increase during wet weather and reach high levels during and after storms. The backwashing operation of the RIG is affected by the river turbidity levels. As the river background turbidity level decreases, the RIG backwash frequency decreases. Conversely, increased turbidity level necessitates more frequent RIG backwash operation.

Since backwashing of the RIG has the potential to exceed the current turbidity criterion of no more than a 10% increase background turbidity levels, the permit contains monitoring requirements and effluent limits to ensure the criterion is attained.

Backwash water from the filter is discharged to settling ponds which contain and treat the flow with very minimal overflow to the river. Therefore the discharges from outfall 002 are not considered to have the potential to exceed the turbidity criterion.

### 4.1.3 pH
Permit Evaluation Report
Canby Utility Board

The pH water quality standard for the Molalla River is 6.5 – 8.5 standard units (S.U.). The federal EPA best practicable control technology currently available (BPT) for water treatment plant backwash discharges is set at a pH of 6.0 – 9.0 S.U.

For outfall 001, discharges with pH in the 6.0 – 9.0 S.U. range are expected to achieve the water quality standard with the available mixing within the mixing zone. Outfall 002 does not have a mixing zone, therefore discharges from this outfall will be required have pH values within the range of 6.5 – 8.5 S.U.

4.1.4 Settleable Solids
The federal EPA best practicable control technology currently available (BPT) for water treatment plant backwash discharges is set at 0.1 ml/L for settleable solids. Therefore, outfall 002 will contain an effluent limit for settleable solids of 0.1 ml/L. There are no BPT’s for infiltration gallery backwash operations.

4.1.5 Temperature
As noted above, the Molalla River is listed as water quality impaired for temperature during the summer (June 1 – September 30). The Molalla River at the point of discharge is also designated for salmon and spawning use from October 15 – May 15. Subsequently, specific portions of the state’s temperature rule (OAR 340-041-0028) and the mixing zone (OAR 340-041-0053) directly apply to the discharge, most notably:

- Since a temperature TMDL for the Molalla River has not been completed, the discharge may not cause the temperature of the water body to increase more than 0.3 degrees Celsius (0.5 Fahrenheit) above the applicable criterion after mixing with either twenty five (25) percent of the stream flow, or the temperature mixing zone, whichever is more restrictive. The applicable criteria are:

  May 16 – Oct. 14: 18.0°C
  Oct. 15 - May 15: 13.0°C

- Since the discharge is into or above a salmon & steelhead spawning reach that is sometimes colder than the spawning criterion, the discharge may not warm the 60 day average water temperature more than the following:

  0.5°C when the rolling 60 day average maximum ambient temperature is 10 to 12.8 °C
  and
  1.0°C when the rolling 60 day average maximum ambient temperature is below 10 °C

- For areas where salmonid spawning redds are located or likely to be located, the fish exposure must be limited to 13°C.

Based on an analysis of stream and effluent flows, and stream and effluent temperatures, there is no reasonable potential for the discharge to exceed the criteria. This is primarily due to the fact that the discharge is comprised of treated river water with minimal or no heat added and the limited duration and frequency of discharge.

However, the proposed permit retains the provision requiring the discharger to monitoring stream temperature upstream and downstream of the regulated mixing zone. In addition, it also contains a provision (Schedule D.3) requiring the discharger to examine finished water and river temperatures and, if practicable, to propose standard operating procedures designed to minimize the thermal impacts of the discharge on the receiving stream.
5.0 Compliance History
A review of the discharge monitoring reports indicates that the facility has had one violation of its NPDES permit. In October of 2000, the discharger had an exceedance of the permit’s flow rate limitation. This exceedance was attributed to equipment malfunction. The problem was corrected and no further exceedances were reported.

6.0 Discussion of NPDES Permit

6.1 NPDES Permit Outline
The proposed NPDES permit is organized into a cover page and several schedules that are discussed further in this section. The schedules include:

- Schedule A - Waste Discharge Limitations
- Schedule B - Minimum Monitoring and Reporting Requirements
- Schedule D - Special Conditions
- Schedule E - Not Applicable (this schedule is reserved for federal pretreatment requirements for publicly owned treatment works and is not applicable to this permit)
- Schedule F - General Conditions

6.2 Cover Page
The cover page of the NPDES permit states that the Canby Utility Board Water Treatment Plant is permitted to discharge backwash water from the facility in accordance with the conditions and limitations of the permit.

6.3 Schedule A – Waste Discharge Limitations
The proposed effluent limits for the discharge at outfall 001 are as follows:

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow Rate</td>
<td>No more than a rate of 56.8 m³/min</td>
</tr>
<tr>
<td>Total Residual Chlorine</td>
<td>When Molalla River flow is greater than or equal to 7.5 m³/s: 1.0 mg/L¹</td>
</tr>
<tr>
<td></td>
<td>When Molalla River flow is less than 7.5 m³/s: 0.1 mg/L</td>
</tr>
<tr>
<td>pH</td>
<td>Within the range of 6.0 – 9.0 S.U.</td>
</tr>
<tr>
<td>Turbidity</td>
<td>The effluent shall not cause the turbidity in the Molalla River to increase</td>
</tr>
<tr>
<td></td>
<td>more than 10% as measured at the edge of the mixing zone.²</td>
</tr>
</tbody>
</table>

¹ Discharge is allowed for up to 12 minutes within any four-day period if the Molalla River flow is between 7.5 and 11.3 m³/s. Discharge is allowed for up to 15 minutes or more within any four-day period if the Molalla River flow is greater than 11.3 m³/s.

² Differences between upstream and downstream turbidity values less than 1 NTU shall be reported as zero.
The proposed effluent limits for the discharge at outfall 002 are as follows:

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Settleable Solids</td>
<td>0.1 ml/L</td>
</tr>
<tr>
<td>Total Residual Chlorine</td>
<td>1.0 mg/L</td>
</tr>
<tr>
<td>pH</td>
<td>Within the range of 6.5 – 8.5 S.U.</td>
</tr>
</tbody>
</table>

The proposed effluent limits for outfalls 001 and 002 are the same as the 2000 NPDES permit limits, with two exceptions:

- The turbidity limit for outfall 001 now includes a footnote stating that differences between upstream and downstream turbidity values less than 1 NTU shall be reported as zero. This is a reflection of measurement precision.
- The pH limitation for outfall 002 has been changed from “within the range of 6.0 – 8.5 S.U.” to “within the range of 6.5 – 8.5 S.U.” to ensure water quality standards are met at the point of discharge (outfall 002 does not have a mixing zone).

This schedule also includes the definition of the mixing zone for outfall 001 and provisions requiring the treatment of filter backwash water and allowing for the land application of the filter backwash water.

### 6.4 Schedule B – Minimum Monitoring and Reporting Requirements

#### 6.4.1 Monitoring Requirements

The parameters to be monitored and the monitoring frequencies for outfall 001 are specified in Table 5 below.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Minimum Frequency</th>
<th>Sample Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number and Date of Discharge Events</td>
<td>Once each discharge event</td>
<td>Observation</td>
</tr>
<tr>
<td>Flow Rate, m³/min</td>
<td>Continuous when discharging</td>
<td>Meter</td>
</tr>
<tr>
<td>Molalla River Flow, m³/s</td>
<td>Once each discharge event</td>
<td>Staff gauge</td>
</tr>
<tr>
<td>Total Residual Chlorine, mg/l</td>
<td>Once each discharge event</td>
<td>Grab</td>
</tr>
<tr>
<td>Discharge period, min</td>
<td>Once each discharge event</td>
<td>Timer Recording</td>
</tr>
<tr>
<td>Effluent Temperature, °C</td>
<td>Once each discharge event</td>
<td>Grab</td>
</tr>
<tr>
<td>Temperature – upstream, °C</td>
<td>Once each discharge event</td>
<td>Grab</td>
</tr>
<tr>
<td>Temperature – downstream, °C</td>
<td>Once each discharge event</td>
<td>Grab</td>
</tr>
<tr>
<td>pH</td>
<td>Once each discharge event</td>
<td>Grab</td>
</tr>
<tr>
<td>Turbidity – upstream, NTU</td>
<td>Once each discharge event</td>
<td>Grab</td>
</tr>
<tr>
<td>Turbidity – downstream, NTU</td>
<td>Once each discharge event</td>
<td>Grab</td>
</tr>
</tbody>
</table>

The requirement to monitor (and record) the number and date of discharge events is the only monitoring requirement that was added to the list from the 2000 NPDES permit. For clarification, the minimum frequency for flow rate was changed from “continuous” to “continuous when discharging”. Also for clarification, the minimum frequency for each of the other parameters (other than flow rate) has been changed from “when discharging” to “once each discharge event”.

The parameters to be monitored and the monitoring frequencies for outfall 002 are specified in Table 6 below.
Table 6: Proposed Monitoring Requirements for Outfall 002

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Minimum Frequency</th>
<th>Sample Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number and Date of Discharge Events</td>
<td>Once each discharge event</td>
<td>Observation</td>
</tr>
<tr>
<td>Average Flow Rate, m³/d</td>
<td>Continuous when discharging</td>
<td>Record</td>
</tr>
<tr>
<td>Settleable Solids, ml/l</td>
<td>Once each discharge event</td>
<td>Grab</td>
</tr>
<tr>
<td>Total Residual Chlorine, mg/l</td>
<td>Once each discharge event</td>
<td>Grab</td>
</tr>
<tr>
<td>pH</td>
<td>Once each discharge event</td>
<td>Grab</td>
</tr>
</tbody>
</table>

As with the outfall 001 monitoring requirements, the requirement to monitor (and record) the number and date of discharge events is the only monitoring requirement that was added to the list from the 2000 NPDES permit. Also, the minimum frequencies were modified for clarification.

6.4.2 Reporting Requirements
The proposed NPDES permit requires monitoring reports to be submitted on a monthly basis. Monthly reports must be submitted by the 15th day of the following month.

6.5 Schedule C – Compliance Conditions and Schedules
There is no Schedule C for this permit.

6.6 Schedule D – Special Conditions
The following Special Conditions are from the 2000 NPDES permit and are included in Schedule D of the proposed NPDES permit.

- Sanitary wastes shall be discharged to the Canby sewage system.

- Solids, sludges, dirt, sand, silt, and bacterial slime removed from the filters, settling basins and reservoirs shall be disposed of in a manner that will prevent discharge to public waters and nuisance conditions.

The third condition under Schedule D of the 2000 NPDES permit, relating to the temperature management plan, is no longer included since these plans are no longer required under current rules.

Schedule D of the proposed permit includes two new provisions, given below:

- In order to minimize the thermal impacts on the receiving stream, within one year of permit issuance the permittee shall submit a brief report providing the results of a study examining possible operating procedures designed to reduce instream temperature increases during discharges from outfall 001. This report shall also propose implementing any effective and practicable procedures. It is expected that the study will examine the relationship between finished water temperatures and instream water temperatures to determine the best times to discharge in order to minimize thermal impacts.

- Along with the permit renewal application to be submitted 180 days prior to the expiration of this permit (see Schedule F.4), the permittee shall submit information regarding the design, construction and operation of new settling ponds designed to minimize filter backwash discharges.

Monitoring data from the plant indicate a wide variation in the temperature differences between outfall 001 discharge temperatures and instream temperatures. The first provision is intended to
provide information on this subject and to possibly implement operating procedures that may limit the thermal impacts of discharges from outfall 001.

The second provision requires CUB to submit plans to minimize future discharges from outfall 002 as treatment plant capacity increases.

6.7 Schedule F – General Conditions
These conditions are standard to all NPDES permits and include language regarding operation and maintenance of facilities, monitoring and record keeping, and reporting requirements. These conditions were recently modified by the Department for all NPDES permits and therefore are different from the 2000 NPDES permit General Conditions.

7.0 Next Steps

7.1 Public Comment Period
The proposed NPDES permit will be made available for public comment. Public notice of the proposed permit will be mailed to parties on the Department’s public notice mailing lists (WQ: PN (public notice) State, WQ: Clackamas County, and WQ: All Permits).

7.2 Response to Comments
The Department will respond to comments received during the comment period. All those providing comment will receive a copy of the Department’s response. Interested parties may also request a copy of the Department’s response. Once comments are received and evaluated, the Department will decide whether to issue the permit as proposed or make changes to the permit or deny the permit.

7.3 Modifications to Fact Sheet and Permit Evaluation Report
Depending on the nature of comment and any changes made to the permit as result of comment, this fact sheet and evaluation report may be modified. The Department may also choose to update the fact sheet and evaluation report through memorandum or addendum.

Attachment A: DEQ memo to file on Canby Utility Board drinking water discharge modeling (excluding attachment to memo)
Attachment A

DEQ memo to file on Canby Utility Board drinking water discharge modeling (excluding attachment to memo)
To: Canby Utility Board File

From: Steve Schnurbusch

Subject: Canby Utility Board drinking water discharge modeling

The Canby Utility Board operates a drinking water intake on the Molalla River. They pump river water via a river infiltration gallery (RIG) into their drinking water plant. This infiltration gallery lies in the bed of the Molalla River (see figures in permit application). Periodically CUB needs to back-flush water through the RIG and into the Molalla River. Water that is discharged is chlorinated water (concentration = 0.8 - 1.0 mg/L). The duration of back-flushes are 8-15 minutes and occur at most every 10 days. The water quality concerns with this discharge are acute chlorine toxicity and turbidity. Chronic chlorine toxicity is not a concern because of the infrequent discharge.

CUB hired Dave LaLiberte, with Liberte Environmental Associates, Inc. to perform the water quality modeling for this discharge. Dave provided DEQ with a technical memorandum discussing his modeling approach and results. His discussion and results can be found in his January 10, 2000, transmittal memorandum.

To simplify the modeling of this discharge, he assumed an instantaneous discharge (i.e. a spill). He used the dispersion equation listed in Thomann and Mueller (2.39). He calculated the mass based on a chlorine concentration of 1.0 mg/l at a discharge rate of 15,000 gpm for 15 minutes. The chlorine decay rate was conservatively assumed to be zero. The resulting 1-hr average chlorine concentration at a river flow rate of 265 cfs was 0.0188 mg/L, below the acute criteria of 0.019 mg/L.

Another approach, which represents the discharge situation more closely is to use equation 2.40 in Thomann and Mueller which considers a continuous input over an interval of time.

\[
s(x,t) = \frac{s_o}{2} \exp \left( -\frac{Kx}{U} \right) \left[ \text{erf} \left( \frac{x-U(t-t)}{\sqrt{4Et}} \right) - \text{erf} \left( \frac{x-U(t+\eta)}{\sqrt{4Et}} \right) \right]
\]

This equation assumes the discharge jumps from zero to a fixed flow rate and concentration for a period of time and then drops back down to zero.

I entered this equation into a spreadsheet and found that it resulted in higher 1-hr average concentrations than equation 2.39. The explanation for this is that equation 2.39 predicts higher
peak concentrations for a shorter duration due to the assumption of an instantaneous spill. Equation 2.40 resulted in lower peak concentrations for a longer period of time because of the assumed rectangular input. When averaged over a 1-hr time period, equation 2.40 resulted in a higher concentration. Equation 2.40 was used for this analysis because it better represented CUB’s discharge.

Equation 2.40 includes a decay component. Initially, chlorine decay was assumed to be zero because I assume it would be insignificant in the short distance downstream from the discharge. I used the data Dave provided describing the river hydraulics for this modeling exercise. A 15-minute discharge was modeled at a stream flow of 265 cfs which resulted in the 60-min average concentration being above the acute criterion. The maximum average concentration occurred about 500 feet downstream. Because the maximum concentration occurred at such a long distance downstream, I thought that chlorine decay could be significant and should be considered. This would better represent the fate and transport of chlorine in the river and not require us to be overly stringent with CUB.

I found a paper that developed a model for chlorine decay on a small stream similar to the Molalla River (Reckhow et al. 1990). The findings from the paper demonstrated that volatilization was by far the primary mechanism for chlorine loss. The simplified (one-dimensional) turbulent diffusion model was used for this case (eq. 19b and 21). This model is still somewhat conservative because it does not consider the fast initial reaction of chlorine that has been modeled in other studies (Bender et al. 1975, Haas and Karra 1984, Qualls and Johnson 1983, in Beckhow et al. 1990.) There is likely an initial loss of chlorine which is not accounted for in the equations used for this analysis. Therefore, I feel comfortable that this modeling exercise is conservative and actual downstream chlorine concentrations will be less than those predicted by this modeling approach.

In the modeling performed by Dave LaLiberte, he determined that the acute chlorine criterion would be met at a river flow rate of 265 cfs. Using the rectangular input model, the model predicted concentrations above the acute criterion at this flow rate (as mentioned above). I sent Dave the spreadsheet model to see what he could come up with and he determined that if CUB limited their discharge to 12 minutes they would meet the acute chlorine criterion. I verified his results as I have shown in figure 1. Figure 1 shows 1-hr average concentrations predicted by the model for various discharge durations. As can be seen, the 12-minute discharge will meet the acute chlorine criterion. Figure 2 shows that at 400 cfs the acute criterion will be met at CUB’s maximum discharge duration of 15 minutes (note: The volatilization rate constant changes because it is dependent upon the depth of the river, which is dependent upon flow rate).
Below are the following permit requirements that will be incorporated into CUB’s permit:

Between flows of 265-400 cfs, CUB is allowed to discharge at a maximum duration of 12 minutes (assuming a chlorine concentration of no more than 1.0 mg/L).

Above stream flows of 400 cfs, CUB is allowed to discharge for a maximum duration of 15 minutes (assuming a chlorine concentration of no more than 1.0 mg/L).

Spreadsheet model used for analysis is on attached floppy disk:
**Discharge Analysis Feb 2000.xls**