State of Oregon

Department of Environmental Quality — Memorandum

Date: June 16, 2003

To: Permit Managers and Permit Staff

From: Sonja Biorn-Hansen

Subject: Methodology for Calculating Permit Limits for Excess Thermal Load

<u>Background</u>

In May of 2001, DEQ issued the document "Temperature Management Plans: Internal Management Directive for Existing Point Source Dischargers". This document provides information on the development of Temperature Management Plans. Appendix D provides examples of what is required for various categories of NPDES dischargers. It also states that "All permits shall include a condition prohbiting an increase[d] discharge of thermal load. Increased thermal load is defined as any increase in effluent temperature and/or volume beyond current permit limitations."

The purpose of this memo is to provide a consistent approach for calculating such permit limits. These permit limits will hereinafter be referred to as Excess Thermal Load (ETL) permit limits.

<u>General Discussion</u>

Excess thermal load (ETL) is defined as the calculated thermal load relative to the applicable numeric criteria. For sources that discharge to streams for which temperature TMDLs are scheduled but have not yet been completed, the purpose of ETLs is to put a cap on existing thermal loads. Such permit limits will be referred to hereinafter as "pre-TMDL ETLs". In effect, they are established to insure that things don't get worse while the TMDL process is underway. The inclusion of such limits in permits is consistent with the Department's Anti-Degradation Policy which states: "In order to maintain the quality of waters in the State of Oregon, it is the general policy of the EQC to require that growth and development be accommodated by increased efficiency and effectiveness of waste treatment and control such that measurable future discharged waste loads from existing sources do not exceed presently allowed discharged loads…"

Once the TMDL is complete and wasteload allocations (WLAs) are established, new ETL limits will be developed based on the WLAs. These will be water quality-based limits. It should be noted that such limits cannot be developed for sources discharging to streams that are water quality-limited and for which a TMDL has not yet been established. The permit writer should compare the water quality-based ETL with the pre-TMDL ETL and include the most stringent of the two in the permit. In the case of a small discharge to a large stream, the most stringent is likely to be the pre-TMDL ETL.

If a discharger wishes to expand their facility and request an increase in their ETL, they may do so, subject to antidegradation review requirements (Division 340-41-026 para. 3). Major sources will have to get EQC approval for such increases, and Minor sources will have to get DEQ approval.

ETLs should be developed for all dischargers, with the following exceptions:

- The discharge is to a stream for which salmonids are not a beneficial use, for example certain basins in the Eastern Region, and
- The discharge is to the ocean, where there is no applicable numeric criteria.

ETLs should be developed for the season or seasons in which the receiving stream is water quality-limited. For most sources, this means summertime ETLs. On a case-by-case basis, it may also be necessary to calculate and include a winter period ETL. Two conditions under which winter ETLs would be necessary are as follows:

1) The receiving stream is water quality-limited in the wintertime; and/or
2) The source is an intermittent industrial discharge with the potential for significant environmental impact.

There may be other conditions as well that could justify the development of a wintertime ETL. Many permittees will also be constrained in the winter by the ESA directives of no measurable increase or no impact on biological integrity.

This memo describes two methods for calculating ETLs for existing point sources prior to TMDL development: a simplistic approach and a more sophisticated statistical approach. Units for ETLs are given as kcal/day which is consistent with the WLAs provided in TMDL reports. Permit writers may wish to employ other units.

<u>**Simplistic Approach**</u>

Municipal Sources

ETLs for municipal sources may be calculated as follows:

$$ETL = \Delta T * Q * C_p * SpGr * 0.2520$$

Where:

ETL	=	Excess heat load (million kcal/day)
ΔT	=	Effluent temperature (see Note A) – applicable applicable numeric criteria
Q	=	Effluent flow rate (mgd) (see Note B)
C_p	=	Specific heat of water (1 Btu/lb °F)
$SpGr$	=	Specific weight of water, 8.34 lbs/gal
0.2520	=	conversion factor from Btu/day to kcal/day

With metric units, the calculation would be:

$$ETL = \rho C_p Q(\Delta T)\left(1000 \frac{L}{m^3}\right)\left(\frac{0.2388 \ calories}{joule}\right)\left(\frac{1 \ kcal}{10^3 \ calories}\right)$$

Where:

ETL	= Excess heat load (kcal/day)
ρ	= Density of water, (1.0 kg/L)
C_p	= Specific heat of water, (4182 joules/kg-ºC)
Q	= Discharge flow, (meters^3/sec) (see Note B)
ΔT	= Eff. Temp. (ºC) (see Note A) minus applicable criterion
0.2388	= conversion factor from joules to calories

Notes:

A. If no effluent temperatures are available for the calculation of the ETL, use 75°F. This is the default value in the permit wizard, and represents the high end of the range of municipal effluent temperatures. If data is available, for summer time (May-October), use maximum recorded temperature. This will most likely take place between late July and October. Monitoring done for the TMP should confirm. Likewise, for winter time, use the highest recorded temperature.

B. For summer time (May-October), use the maximum weekly dry weather design flow. For winter time (November-April), use the maximum weekly wet weather design flow. If weekly values are not available, then they may be determined by multiplying the ADWF and AWWF values for the facility by 1.5.

Here is a recommended monitoring schedule to establish compliance with the ETL.

Item or Parameter	Minimum Frequency	Type of Sample
Total Flow (MGD)	Daily	Measurement
Effluent Temperature, Daily Max	Same frequency as pH monitoring	Grab Note: recommended to be done in the afternoon
Effluent Temperature, Average of Daily Maximums	1/Week	Calculation
Thermal Load	Weekly	Calculation (See Note 1)

Notes:

1. Calculated as follows:
(Weekly average of daily maximum effluent temperatures, °F - applicable numeric criteria, °F) X (Weekly average of daily flow in MGD) X 8.34 lbs/gal X 0.2520 kcal/Btu = Thermal load, in million kcal/day.

For sources that maintain continuous flow and temperature monitors, the weekly thermal load should be calculated as follows: calculate the thermal load on a daily basis and then calculate the 7-day average of the daily thermal loads.

Industrial Sources
The simplistic approach for developing ETLs described for municipal sources may also be used for industrial sources, however the values used for effluent flow and temperature may need to be derived based on past discharge. This is because industrial sources are likely to differ from municipal sources with respect to the following:

- The discharge may be intermittent rather than continuous,
- Thre may be in-plant options for reducing effluent temperature that do not exist for municipal sources, such as re-use of heated wastewater.

Here are some guidelines for developing ETLs for industrial sources.

1. When daily temperature and flow data are available, calculate daily ETLs based on the daily temperature and flow data for the past 2-5 years of data, whatever seems appropriate. Then calculate the maximum 7-day average ETL. It may be necessary to do this for both a summer and winter period depending on the characteristics of their process.
2. When there is daily flow but minimal temperature data available, calculate the maximum 7-day average flow and multiply it by the 99% temperature to develop a 7 day ETL limit.
3. Where there is minimal flow and temperature data: use the 99% temperature and the 99% flow rate to calculate the 7-day ETL limit.
4. When none of the above apply, use BPJ.

Note: these methods would apply when calculating ETL based on current conditions. These ETLs would continue to apply if the discharge does not cause a measurable change at the edge of the mixing zone and is implementing appropriate technology controls. If the discharge is causing a measurable change and/or has not implemented appropriate technology controls, ETLs should be calculated using the capability of the technology.

<u>Statistically-based Approach</u>
The simplistic approach described above only estimates an upper bound and ignores the variablility in effluent and stream temperatures. Therefore, the limits calculated using the simplistic method may be inappropriate. Therefore, in situations where the estimated thermal load is likely to to have a significant detrimental environmental effect on the receiving stream, the additional effort associated with developing statistically-based limits may be warranted. The use of this method requires gathering daily effluent and stream temperature data, calculating stastistical parameters (e.g. mean, standard deviation, coefficient of varience), and then using these parameters to calculation effluent limitations. A step-by-step procedure follows:

1) Gather daily effluent temperature and flow data.
2) Create a datatable with the daily maximum temperature and the associated daily effluent flow.
3) Calculate the mean, standard deviation, and coefficient of varience for the obsterved data.
4) From the statistical parameters, project the effluent flows and temperatures to the design criteria (design year for municipals, design production for industrials).
5) Calculate the daily design ETL assuming the stream temperature is at the water quality criterion (generally 64° F).
6) Calculate the maximum weekly ETL based on the projected dataset.