ATTACHMENT A - NCCW General Permit
Example Receiving Water Temperature
Engineering Calculation for Massachusetts Facilities

Example calculation for a facility that uses a river as the receiving water:

The basic equations used for the calculation of river temperature rise are as follows:

$$Q_{plant} = C_p m_p \Delta T_p$$

$$Q_{river} = C_p m_r \Delta T_r$$

$$C_p m_p \Delta T_p = C_p m_r \Delta T_r$$

$$\Delta T_r = m_p / m_r \times \Delta T_p$$

Where

Q_{plant} = heat load discharged from plant (btu)
C_p = heat capacity of water = 1.0 °F x btu/lb
m_p = mass of effluent, lbs (gal. or cubic feet per second if volume is used)
ΔT_p = change in temperature, effluent – influent, °F
m_r = mass of river, lbs (gal. or cubic feet per second if volume is used)
ΔT_r = change in river temperature, °F

Notes:
(1) Since both the effluent mass (m_p) and river mass (m_r) convert to volume by using the same factor of 1 gal/8.34 lbs, a volumetric unit may be substituted for mass in the above equation, as long as same units are consistently used for both the river and plant terms.

(2) The 7Q10 should be used as the mass of the river. Typically, 7Q10 information is given in units of cubic feet per second (cfs).

The state permitting authority must be contacted, via email at
a. Massachusetts facilities: Keohane.Kathleen@state.ma.us
b. New Hampshire facilities: jandrews@des.state.nh.us, ddudley@des.state.nh.us or swilloughby@des.state.nh.us

to confirm the annual 7Q10 low flow for the facility prior to completing the NOI requirements for the permit. Prior to contacting the state permitting authority, new applicants may wish to view the 7Q10 data posted at the USGS StreamStats website at http://water.usgs.gov/osw/streamstats/index.html.

For the convenience of Massachusetts facilities that were granted coverage under the expired NCCW general permit, the 7Q10 estimates for those permits are posted at ***www.epa.gov.to be developed before final issuance*** and can be used by those applicants if re-applying for coverage under this general permit.

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(3) Often, the facility discharge is given in units of gallons per day, or million gallons per day (mgd). Use the conversion factor of 0.645 mgd/cfs or 0.645 mgd per 1 cfs to convert from cfs to mgd.

Therefore, for this equation, we are assuming all of the waste heat from the facility is transferred to the river. The waste heat from the facility can either be calculated using the maximum change in temperature and the maximum effluent flow or it can be determined by plant engineering personnel.

EXAMPLE 1:

A facility has a maximum permitted flow rate of 1 mgd. The maximum amount of heat that needs to be rejected from the plant is 10,000 btu/hr. The 7Q10 of the river has been determined to be 325 cfs. What is the maximum calculated change in river temperature? The plant is located in a Massachusetts Warm Water fishery.

SOLUTION 1:

Since all of the heat rejected by the plant is assumed to be absorbed by the river, $Q_p = Q_r$ and $Q_r = C_p M_r \Delta T_r$ or $\Delta T_r = Q_r/C_p M_r$

Qr = 10,000 btu/hr

Convert 325 cfs to mgd, 325 cfs x 0.645 $\frac{\text{mgd}}{\text{cfs}}$ = 209.6 mgd

ΔT_r = (10,000 btu/hr)/(1 btu/lbs°F) x (24 hrs/day) x (gal/8.34 lbs) / 209.6 x 10^6 gal/day

= $1.37\text{x}10^{-4}$ °F

In this example, the facility has demonstrated that the receiving water will be protected. Therefore, no in-stream monitoring would be required.

EXAMPLE 2:

A facility has a maximum reported ΔT of 35°F. The maximum plant design is 1 mgd. The 7Q10 is determined to be 125 cfs. The plant is located in a Massachusetts Cold Water fishery.

SOLUTION 2:

Convert 125 cfs to mgd, 125 cfs x 0.645 $\frac{\text{mgd}}{\text{cfs}}$ = 80.62 mgd.

$\Delta T_r = m_p/m_r \text{ x } \Delta T_p$

= (1 mgd/80.62 mgd) x 35 °F

= 0.43°F

ATTACHMENT B of the Noncontact Cooling Water General Permit

Dilution Factor Calculations for Massachusetts and New Hampshire

The calculations provided below are for your information to use in calculating and determining your effluent limitations.

The state permitting authority must be contacted, via email at the addresses listed in Appendix 4.3, to confirm the annual 7Q10 low flow for the facility prior to completing the NOI requirements for the permit.

Prior to contacting the state permitting authority, new applicants may wish to view the 7Q10 data posted at the USGS StreamStats website at http://water.usgs.gov/osw/streamstats/index.html.

For the convenience of Massachusetts facilities that were granted coverage under the expired NCCW general permit, the 7Q10 estimates for those permits are posted at ***www.epa.gov.to be developed before final issuance*** and can be used by those applicants if re-applying for coverage under this general permit.

Note that in New Hampshire the Dilution Factor is calculated using two different equations based on the use of the receiving water as the applicant's public water supply.

Massachusetts:

Equation used to calculate the dilution factor at the treatment plant's outfall.

$$\text{Dilution Factor} = \frac{Q_R + (Q_P \times 1.55)}{Q_P \times 1.55}$$

where:

- Q_R = Estimated 7Q10 low flow for the receiving water at the plant's outfall, in cubic feet per second (cfs).
- Q_P = Plant's design flow, in million gallons per day (mgd).
- 1.55 = Factor to convert mgd to cfs.

EXAMPLE

Q_R = 325 cfs

Q_P = 3.2 mgd

$$\text{Dilution Factor} = \frac{Q_R + (Q_P \times 1.55)}{Q_P \times 1.55} = \frac{325 + (3.2 \times 1.55)}{3.2 \times 1.55} = 66.5$$

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For New Hampshire:

Method 1: When the water supply is from outside the drainage basin.

Equation used to calculate the dilution factor at the treatment plant's outfall.

$$\text{Dilution Factor} = \frac{Q_R + (Q_P \times 1.55)}{Q_P \times 1.55} \times 0.9$$

where:

Q_R	=	Estimated 7Q10 low flow for the receiving water at the plant's outfall, in cubic feet per second (cfs).
Q_P	=	Treatment plant's design flow, in million gallons per day (mgd).
1.55	=	Factor to convert mgd to cfs.
0.9	=	Factor to reserve of 10 percent of river's assimilative capacity.

EXAMPLE
Q_R = 325 cfs
Q_P = 3.2 mgd

$$\text{Dilution Factor} = \frac{Q_R + (Q_P \times 1.55)}{Q_P \times 1.55} \times 0.9 = \frac{325 + (3.2 \times 1.55)}{3.2 \times 1.55} \times 0.9 = 59.9$$

Method 2: When the water supply is from the drainage basin.

Equation used to calculate the dilution factor at the treatment plant's outfall.

$$\text{Dilution Factor} = \frac{Q_R}{Q_P \times 1.55} \times 0.9$$

where:

Q_R	=	Estimated 7Q10 low flow for the receiving water at the plant's outfall, in cubic feet per second (cfs).
Q_P	=	Treatment plant's design flow, in million gallons per day (mgd).
1.55	=	Factor to convert mgd to cfs.
0.9	=	Factor to reserve 10 percent of river's assimilative capacity.

EXAMPLE
Q_R = 325 cfs
Q_P = 3.2 mgd

$$\text{Dilution Factor} = \frac{Q_R}{Q_P \times 1.55} \times 0.9 = \frac{325}{(3.2 \times 1.55)} \times 0.9 = 59.0$$