

**METHODOLOGY FOR DEFINING PRELIMINARY STREAM FLOW CLASSIFICATIONS PURSUANT TO SECTIONS 26-141B-1 TO 26-141B-8 OF THE REGULATIONS OF CONNECTICUT STATE AGENCIES**

*Revised: 2 May 2016*

**INTRODUCTION**

The State of Connecticut Stream Flow Standards and Regulations (*Sections 26-141b-1 to 26-141b-8 of the Regulations of Connecticut State Agencies*) require that the Department of Energy and Environmental Protection (CT DEEP) in consultation with the Department of Public Health (DPH) prepare a State-wide map of proposed classifications indicative of the degree of human alteration of natural stream flow. The regulations define four stream flow class standards (See Table 1). The regulations include consideration of 18 factors when adopting river or stream system classifications (*Sections 26-141b-5 Adoption of river or stream system classifications*).

The process described below represents the data and methodology used to evaluate those 18 factors to assign stream segments a proposed stream flow class for public comment. The numbers in parentheses below reflect the stream flow classification factor listed under Sec. 26-141b-5(a). Sec. 26-141b-2 defines a stream segment as a discrete, contiguous reach of river or stream channel for which a uniform classification has been adopted. For the purposes of proposing classifications, stream segments were derived from the National Hydrography Dataset (NHD) developed at a 1:24,000 scale (1 inch = 2000ft) by USGS for the State of Connecticut using Wrap Hydro tools (<http://www.crrw.utexas.edu/gis/gishydro03/WRAPhydro/WRAPhydro.htm>), an extension for ArcGIS. There are approximately 36,000 stream segments in the State. The average length of the stream segments is approximately 0.3 miles long.

Stream flow Class	Stream Condition	Narrative Standard
1	Free Flowing Stream	Maintain stream flow and water levels to support and maintain habitat conditions supportive of an aquatic, biological community characteristic typically of free-flowing stream systems
2	Minimally Altered	Maintain stream flow and water levels to support and maintain habitat conditions supportive of an aquatic, biological community characteristic minimally altered from that of typically of free-flowing stream systems
3	Moderately Altered	Maintain stream flow and water levels to support and maintain habitat conditions supportive of an aquatic, biological community characteristic moderately altered from that of typically of free-flowing stream systems
4	Altered	Exhibit substantially altered stream flow conditions caused by human activities to provide for societal needs

**Table 1: Narrative Standard for Each Stream flow Class**

This process will provide all stream segments throughout the state with a class of 1, 2, or 3 designation. CTDEEP is not initially proposing any Class 4 designations; as such designation requires specific information on societal needs, economic costs and environmental impacts that will be considered on a case by case basis.

The process described below entails three steps. The first is to target streams identified in the regulations that shall not be classified as Class 1 or 2. These streams are classified as a Class 3 in this process. Steps 2 and 3 are then used to assign proposed classifications to the remaining streams. The second step involves assigning the remaining streams a classification value based on an index that characterizes current stream flow conditions. The third involves modifying (increasing or decreasing) a stream flow classification based on the additional factors for consideration which describe unique ecological attributes or goals for a particular stream segment.

### **STEP 1: CLASS 3 FACTORS**

**Description:** *Any streams meeting the criteria for the factors described below are assigned a Class 3 designation.*

(1) A river or stream immediately downstream of an existing dam that impounds a public water supply source or intersects a Level A aquifer protection area.

A public water supply source is a water body listed as reservoir in the State of Connecticut DPH database. Immediately downstream of a dam is defined as the stream segments below the reservoir where the annual Q99 flow is less than two times the annual Q99 flow going into the reservoir. The annual Q99 flow is a very low flow where the naturally occurring daily stream flow that is predicted to equal or exceeded on 99 percent of the days in a year. The annual Q99 stream flow is estimated using methods developed by the United States Geological Survey (USGS) (Ahern 2010).

Level A Aquifer Protection Areas for a public water supply well are delineated in accordance with Connecticut General Statutes (CGS) Section 22a-354c or 22a-354z. If the Level A area intersects a portion of a stream segment, the full segment is designation Class 3.

(2) A river or stream immediately downstream of an existing dam.

Dams are defined as consumptive diversions identified as an impoundment in the CT DEEP diversion spatial dataset. Immediately downstream of an existing dam is defined in the same way as in factor (1), see above.

(14) River or stream identified as potential source of water supply with significant investment.

Water supply Plans prepared in accordance with CGS Section 25-32d and 25-33h, as well as the DPH “High Quality Source” list compiled under CGS 25-33q, were reviewed in detail for

potential future sources of public water supply. In order to consider a potential source, a specific location had to be available to associate the potential source with a specific stream segment. Locations for the proposed sources were identified in the referenced planning documents and mapped in ArcGIS for consideration in the classification system. Information on significant investment was also solicited from the DPH and the water companies within the basin of consideration because the Water Supply Plans do not typically contain documentation of investment in the future sources.

To determine which of the proposed sources had a “significant investment”, CT DEEP used any available information on diversion permitting status, capital expenditures, scientific or engineering studies and land acquisition by the water system. In addition to the sources identified by such information, the timeframe within which the proposed source was needed was considered, and even if there was no information on permitting status, etc., it was assumed that sources proposed within the five-year planning period likely had “significant investment”, as use was imminent. Proposed sources with “significant investment” were then given a Class 3 designation under section 26-141b-5(a)(14). The only exception to this were proposed sources that were small (< 0.05 mgd) bedrock wells. These are below the threshold for a diversion permit and are considered unlikely to have a significant impact on stream flow. The proposed sources for which the planning period is further out than five years or for which no information on investment status was available are given consideration in the classification system under the “Other Factors” discussed below in Step 3 of the process.

## **STEP 2: HYDROLOGIC STRESSOR INDEX (HSI) FACTORS**

**Description:** *For all remaining unassigned stream segments (i.e. those not assigned to stream flow class 3 in step 1), a class is assigned based on an index that combines the four factors below. Each factor is given a metric value of 1, 2 or 3. Metric values are assigned based on the potential degree of alteration to natural stream flow conditions. A ‘1’ indicates little or no stress to natural stream flow conditions, a ‘2’ indicates minimally altered stream flow conditions and a ‘3’ indicate high stress and alteration from natural stream flow conditions. The values for each of the four metrics are added together to obtain a Hydrologic Stressor Index (HSI) value. The HSI values ranges from 4 to 12. Analogous to the metrics, lower HSI values indicate that in-stream and surrounding drainage area conditions do not stress or alter natural stream flow, whereas higher index values indicate that conditions significantly stress and alter stream flow. HSI values are partitioned into three groups corresponding to a preliminary stream class. An HSI value of 4 - 5 represents Class 1 or ‘natural conditions’, values of 6 - 8 represent Class 2 or ‘near natural conditions’, and values of 9 - 12 represent Class 3 of ‘altered conditions.’ A description of how each metric was defined and calculated is provided below.*

(3) Size and location of permitted and registered diversions within the watershed.

Registered diversions listed in CT DEEP diversion spatial data layer as ‘consumptive’ and permitted diversion listed as ‘consumptive’ and ‘active’ were included in the analysis. Calculated the maximum withdrawal amount and divided by the annual Q99 to calculate the percent of Q99 flows withdrawn.

<b>Metric Value</b>	<b>Maximum Withdrawal / Q99</b>
1	0
2	0 – 100%
3	>100%

(4) Size and location of dams, reservoirs and other impoundments within the watershed.

Large dams using a combined spatial dataset that included information from CT DEEP database and National Inventory of Dams. Large dams were defined as those that were greater or equal to 15 ft in height or having a storage capacity greater than or equal to 15 acre-feet. The number of large dams was divided by the total number of upstream stream miles.

<b>Metric Value</b>	<b># of Dams / Stream Mile</b>
1	0
2	> 0 – 0.1
3	> 0.1

(5) Size and location of return flows of water within the watershed.

Only municipal NPDES discharges were included in the analysis. Calculated the design flow of the sewage treatment plant divided by annual Q99 to calculate the percent return flow greater than Q99 flows.

<b>Metric Value</b>	<b>Return Flow / Annual Q99</b>
1	0
2	0 – 75%
3	>75%

(6) Existing development and impervious cover in the upstream watershed.

2006 Impervious Cover dataset from the National Land Cover Dataset. Calculated the percent impervious cover in the upstream watershed.

<b>Metric Value</b>	<b>Percent IC</b>
1	0 – 2%
2	2 – 5%
3	> 5 %

### STEP 3: ADDITIONAL FACTORS

**Description:** *Applies to streams that were not classified as a Class 3 in step 1. Includes additional factors in the regulation that can modify (increase the stream flow class (i.e. 1 to 2) or decrease the stream flow class (i.e. 2 to 1)) the classification value calculated using the HSI. The other factors primarily represent a present or future goal for a stream segment or a unique ecological attribute. Each factor is defined as an increaser or decreaser. The total number of increasers and decreasers were added for each stream segment. If there were more increasers than decreasers present in a stream segment than the stream class was increased up by one class (i.e. 2 to 3). If there were more decreasers present in a stream segment than the stream class was decreased by one class (i.e. 2 to 1). Note that the regulations did not provide for any weighting of the factors, so all were given equal weight.*

**(7)** Planned land use in the upstream watershed for future development. (↑ Increaser)

Stream segment that intersects a growth area defined in the Connecticut Plan of Conservation and Development.

**(8)** Available data on species that are dependent upon stream and riparian habitat. (↓ Decreaser)

These were defined as stream segments that where high densities of wild brook trout (> 73 wild brook trout/ hectare) have been sampled.

**(9)** Available data related to the presence or restoration of anadromous fish runs. (↓ Decreaser)

Stream segments that have been identified by CT DEEP where anadromous fish runs occur or are being actively restored or targeted for restoration.

**(10)** Existence of trout management areas. (↓ Decreaser)

Stream segments that have been identified by CT DEEP as trout management areas.

**(11)** The location of stream gages operated by USGS that have been identified as an index station. (↓ Decreaser)

Stream segments within the watershed upstream of USGS gages identified as an index station in Ahern 2007.

**(12)** Areas designated as protected for conservation purposes. (↓ Decreaser)

Stream segments that intersect with the most recent CT DEEP protected open space mapping (POSM) spatial dataset or State conservation area identified in the CT DEEP property spatial dataset.

(13) River or stream segments identified as a potential source of water supply; and (15) River or stream segments identified by the DPH pursuant to Section 59 of Public Act 11-242. (↑ Increaser)

Stream segments containing a potential source identified in a Water Supply Plan or on the “High Quality Source” list by the CT DPH in accordance with CGS 25-33q, and planned for development beyond the five-year planning period. (Sources proposed for development within the five-year planning period were considered a Class 3 under Step 1 above).

(16) Practicality and / or potential for restoring stream flow patterns to achieve consistency with the Stream Flow Standards and Regulations due to the extent of prior channel modification or the impact of development and impervious cover in the watershed as of the date of such mapping. (↓ Decreaser or ↑ Increaser)

Factor number 16 will be evaluated by the Department when adopting classifications on a case by case basis.

(17) Publically available data regarding the impact of stream classification on a community’s water supply’s margin of safety. (↑ Increaser)

Factor number 17 will be evaluated by the Department when adopting classifications on a case by case basis. However, numerous off-ramps to reduce releases when margin of safety is impacted were provided in the regulations to assist water companies, so this has little impact on the stream flow classifications.

(18) Any other factor indicative of the degree of human alteration of natural stream flow. (↓ Decreaser or ↑ Increaser)

Factor number 18 will be evaluated by the Department when adopting classifications on a case by case basis.

## **LITERATURE CITED**

Ahearn, E.A., 2007, Flow durations, low-flow frequencies, and monthly median flows for selected streams in Connecticut through 2005: U.S. Geological Survey Scientific Investigations Report 2007–5270, 33 p.