~ 1. Stream Corridor Assessments ~

This section presents the results of assessments performed in order to:

- *describe the character and condition of the stream corridor*
- *define the nature of problems associated with specific stream reaches*
- *provide the basis for management recommendations, or where needed, additional assessments to resolve problems along the stream*

The geomorphic condition of the East Branch and its sub-basins is a focal point for these assessments. The characteristics and morphology of each sub-basin and the delineated management units are described. Management units are homogenous sections of the stream corridor with management conditions or issues, and are used as the basis for describing the various segments of the stream, its morphology, and its management requirements. These units are numbered from the confluence to the headwaters of the stream. Due to time constraints, not all of the sub-basins within the East Branch Delaware River basin could be assessed as part of this effort. In addition, not all streams that were assessed within a sub-basin have complete data from confluence to headwater. Several levels of increasingly detailed assessments were used to collect data. Further data collection will be necessary in the future.

The East Branch Delaware River (EBDR) is the main drainage channel to the Pepacton Reservoir and delivers flows from northeast to southwest through a relatively narrow, flat-floored valley. Four major tributaries contribute to the mainstem, including the Platte Kill, Batavia Kill, Dry Brook, and Bush Kill (enters into Dry Brook). Terry Clove, Fall Clove, Tremper Kill and Mill Brook are four other tributaries that drain directly into the Pepacton Reservoir. **Table 1.1** shows the drainage areas and stream lengths for each of these identified sub-basins. The geographic extents of these sub-basins include numerous smaller tributaries that flow into the East Branch Delaware River and the Pepacton Reservoir, including but not limited to: Cat Hollow, Holliday Brook, Beech Hill Brook, Barkaboom, Huckleberry Brook, Bull Run, Hubble Hill Hollow, and Bragg Hollow[1].

Table 1.1 East Branch Delaware River Sub-basins

Sub-basin (alphabetical)	Watershed Area (sq. mi.)	Stream Miles
Batavia Kill	19.30	10.4
Bush Kill	47.18	14.2
Dry Brook	35.22	12.5
East Branch Headwaters	49.66	14.7
East Branch Mainstem	25.76	9.8
Fall Clove	11.18	7.6
Mill Brook	25.36	11.2
Pepacton Reservoir	73.38	0.0
Platte Kill	35.36	12.1
Terry Clove	15.08	6.1
Tremper Kill	33.52	10.5
Total	371.00	109.1

[1] The geographic extents of the sub-basins used in this plan are based upon NYC DEP GIS map layers derived from 1:24000 USGS topographic maps.

Stream Assessment Procedures

The collection and analysis of data from stream surveys is required for determining the condition of a stream. The East Branch Delaware River Stream Management assessment process evaluated six of the stream corridors contributing to the Pepacton Reservoir. This evaluation consisted of a tiered set of increasingly detailed assessments and analyses. The first step is a Geographic Information System (GIS) based evaluation of map layers developed from remotely sensed images and topographic maps. This was followed by a second step of targeted field surveys using Global Positioning Systems (GPS) to map the location and condition of critical stream features such as eroding streambanks, revetment, gravel deposits, woody debris obstructions, and other elements of concern. The third step was to perform a Rosgen Level II survey at locations that were deemed representative of longer management unit reaches.

Step I – GIS based Assessment:
The sub-basin streams were too large to assess in their entirety, so each stream was broken into manageable sections. This was done using the Stream Geomorphic Assessment Tools. The information collected helped target problem areas for further assessments. Stream Geomorphic Assessment Tools (SGAT) is a Geographic Information System (GIS)-based analysis that was developed and utilized by the State of Vermont Agency of Natural Resources. SGAT is utilized to determine stream conditions and is completed in the office before any field work is implemented. SGAT was developed to help divide a stream into management units based on five criteria: stream size, valley characteristic, stream confinement, tributary influence and valley slope.

This level of evaluation produced a set of watershed scale geomorphic statistics including valley slope, valley confinement, channel slope, stream geometry, riparian buffer width, and Rosgen Level I stream classification. Additionally, the SGAT included information on the extent of the stream corridor, location of bank erosion and gravel deposition, the potential impact of infrastructure and land use within the stream corridor. While the accuracy of SGAT is limited[2], it provided a rough overview of the factors affecting stream stability within each sub-basin and an indication of reaches where additional assessment may be merited. The results of the information from SGAT can be found in a summary table following each sub-basin description below.

The use of SGAT led to the segmentation of each stream into discrete management units. A management unit is a length of stream having common geomorphic attributes based primarily on five criteria: watershed area, valley characteristic, stream confinement, tributary influence and valley slope. Management units may be further defined by a set of common influences such as a common land use or level of land use pressure, or a distinct beginning and ending point such as a bridge or tributary confluence.

Data sources included 2001 high resolution digital orthophotographs, historic aerial photographs, and helicopter flyover video. The data was used to create a series of map

[2] by the resolution of the GIS data and imagery and the lack of other information such as a record of previous channel modifications

layers and analysis was accomplished using a set of SGAT worksheets. The map layers included:

- Stream Types: including information on stream bed elevations, valley length, valley slope, channel length, channel slope, sinuosity, watershed size, channel width, valley width, and confinement
- Basin Characteristics – Geology and Soils: location of alluvial fans, grade controls, geologic materials, valley side slopes, and soil properties
- Land Cover – Reach Hydrology: watershed land cover/use, stream corridor land cover/use, riparian buffers, groundwater inputs, right and left streambank information (percent of width and dominant width of riparian buffers)
- In-stream Channel Modification: the location of bridges, culverts, bank armoring, and channel modifications
- Floodplain Modifications and Planform Changes: an assessment of the impact or influence of berms, roads, river corridor development, depositional features, meander migration, meander width ratio, and wavelength ratio.
- Bed and Bank Windshield Survey: dominant soil material, bank erosion/ bank height and impacts, and ice and debris jam potential

Historic aerial photographs were scanned into the computer and geo-referenced (oriented to current mapping units). This data was used in mapping previous stream alignments as part of a general assessment of stream stability. Aerial photographs from the following years were processed: 1943, 1963, 1971, and 1983. The scanned historic aerial photograph information was used only during the information-gathering portion of the assessment and is available at the Delaware County Soil and Water Conservation District (DCSWCD) office.

Step II – GPS Walkover Stream feature inventory:
Global Positioning System (GPS) walkovers were completed by going to pre-determined stream locations, photo documenting observed features and mapping those features with a handheld GPS unit. The survey coordinates for the various features and the attributes of each feature were uploaded into the stream geodatabase (a predefined ArcGIS geodatabase) and linked with photographs of the features. The following features were the subject of this field reconnaissance:

- Berms
- Best Management Practice (BMP)
- Bridges
- Control (grade or lateral)
- Crossing
- Culverts
- Depositional Features
- Dumps
- Eroding Streambanks
- Stream Gages
- Large Wood Debris (LWD)
- Monitor Site
- Obstructions
- Pipe Outfalls
- Revetment (Rip rap, stacked wall, etc.)
- Riparian Vegetation
- Stream Features
- Tributary
- Utilities

Reaches were selected for GPS walkover based on representative condition of the watershed as a whole and information gathered could be used to validate the interpretation of aerial photos and maps in the SGAT procedure.

Step III - Rosgen Stream Classification

The selected locations that were deemed representative of longer sections of management units were determined after studying aerial photographs, analysis from SGAT data and GPS walkover. These locations received a Rosgen Level II survey to:

1. Validate our assessment based on the SGAT data and the GPS walkover
2. Derive dimensions and ratios that can be used to classify the stream and describe its condition based on Rosgen's classification system.

Information collected for a Rosgen Level II survey included:

- Surveyed stream bed elevation
- *Thalweg* and water surface profiles
- Documentation of bankfull indicators
- Pebble counts at the surveyed cross-sections
- Bulk gravel samples (bar samples)

At the same locations where Rosgen Level II surveys were conducted, the procedure described in the British Columbia Channel Assessment Procedure Field Guide book was also performed. This procedure measures such features as:

- Channel width and depth
- Channel slope
- Largest sediment size

Use of a nomograph and reference photos provided the type of condition of the reach. The procedure was used primarily to determine the relative degree of aggradation or degradation for the reach. It was a useful check on the condition indicator as determined by the Rosgen Level II survey, as well as staff impressions of the stream condition based on the GPS walkover."

The results of the Step I, II, and III assessments are described further below as part of the sub-basin and management unit descriptions.