Attachments

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Attachment A

Standard Operating Procedure for Habitat Evaluations for Selected Fish Species

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Attachment A. Standard Operating Procedure for Habitat Evaluations for Selected Fish Species

I. Objective

The objective of this Standard Operating Procedure (SOP) is to set forth methods to measure the habitat suitability of River Sections 1, 2, and 3 of the Upper Hudson River for selected fish species. As described in the *Habitat Assessment Report for Candidate Phase 1 Areas* (Phase 1 HA Report) (Blasland, Bouck & Lee, Inc. [BBL] and Exponent, 2005a), the selected fish species are the yellow perch (*Perca flavescens*), largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieui*), bluegill (*Lepomis macrochirus*), and the common shiner (*Luxilus cornutus*). The data collection procedures for evaluating the habitat suitability of the Upper Hudson River for these fish species has been combined in one SOP due to the number of variables common to the habitat suitability index (HSI) models for these species. For example, the HSI models for the selected fish species all require evaluation of pH, water temperature (at various times in their life cycle), and a measure of in-water cover.

The majority of data required for the HSI models have been, or will be, collected under existing programs such as the Habitat Delineation and Assessment Program (BBL, 2003), the Sediment Sampling and Analysis Program (SSAP) (Quantitative Environmental Analysis, LLC [QEA], 2002), the side-scan sonar and bathymetry program (Ocean Surveys, Inc. [OSI], 2003a, b) and the baseline monitoring program (BMP) (QEA, 2004). Data not currently being collected under those programs will either be added to the habitat assessment program stations or calculated directly from existing data generated by those programs as described below.

Within the study area (defined as the Upper Hudson River from the Fort Edward Dam to the Federal Dam at Troy), data will be used to characterize the habitat suitability of each river reach for each species. River reach data will be subsequently used to characterize the habitat suitability of the overall study area for each species. River reaches in the Upper Hudson River are defined by the location of the locks and dams that separate the river into a series of pools of varying sizes.

Water quality data (see Section III. G-K) will be collected at BMP, UCB, SAV and riverine fringing wetland (WET) stations. At BMP stations, water quality data are collected from mid-depth in the water column (i.e., the well-mixed portion of the water column). At UCB and SAV stations, water quality data will be collected 1 meter below the water surface and 10 cm off the bottom. At WET stations, water quality data will be recorded just below the water surface and 10cm off the bottom. These measurements (temperature, dissolved oxygen [DO], pH, specific-conductivity, and turbidity) will be taken using a multiparameter probe (YSI 6920 or equivalent) calibrated at the beginning of each sampling day following the manufacturer's calibration procedure. Data from the BMP stations will be used to represent average water quality conditions to augment the station-specific water quality data collected at the UCB, SAV and WET stations

To meet the requirements for the water quality data (e.g., temperature, dissolved oxygen), measurements will be collected from BMP and habitat assessment stations to provide sufficient temporal and spatial coverage to allow for transformation of the data to subindices for use in completing the HSI models. Water quality data will be collected year-round from BMP stations at Rogers Island, Schulylerville and

Waterford. Water quality data are collected weekly from March to November at Thompson Island and weekly from May to November at Stillwater and Lock 1. In addition, water quality data will be collected daily at the UCB, SAV and WET stations at which habitat assessment activities are being conducted. Spatially, for the application of the riverine HSI models, data are collected from within representative reaches and used to represent larger areas of similar habitat (Terrell et al. 1982). As stated in Terrell et al. (1982), a representative reach should be 10 to 14 times longer than the average channel width in order to include two sequences of channel features. In the Upper Hudson River, this would result in representative reaches from approximately 4000 to 8000 feet in length (based on river width varying from approximately 400 to 800 feet). Therefore, samples collected within the 4000 to 8000 feet long area could be used to provide information for a larger habitat area, that is, the entire river reach. Terrell et al. (1982) recommend that data be collected from at least 10 locations within each representative reach. For the sampling program described in this SHAWP, there are 168 habitat assessment sampling locations within River Sections 1, 2 and 3 at which water quality data will be collected for the riverine models; 67 stations in River Section 1, 34 in River Section 2 and 67 in River Section 3. In addition, there are 6 BMP stations at which water quality data are collected that will be used in the riverine models. Data for other parameters, such as substrate and percent cover of aquatic vegetation, are available for the entire river reach. The scale of the existing data and the sampling effort described below is considered sufficient to complete the HSI models for the study area.

II. HSI Model Requirements for Selected Fish Species

A. Yellow Perch

Three life requisites for the yellow perch - food/cover, water quality, and reproduction - will be evaluated using the procedures described in this SOP.

The food/cover component consists of two variables. The first variable is the percent pool and backwater areas during average summer flow. Yellow perch are most abundant in pools and backwater areas and also use these habitats for spawning. The optimum range for pool and backwater areas is 30 to 70%.The second variable is the percent cover in pools and backwater areas during summer. Perch abundance also varies with the amount of cover present. Cover consists of brush, debris, standing timber, or vegetation which all tend to increase the abundance of forage items. It is assumed that 25 to 50% cover provides optimum habitat suitability (Krieger et al., 1983).

The water quality component consists of three variables. The first variable is temperature within the water column during midsummer. Water temperature of 21 to 23 degrees Celsius (^{o}C) has been found as the optimum temperature for adults, juveniles, and fry (Krieger et al., 1983). The second variable is the minimum DO level. DO levels > 5.0 milligram per liter (mg/l) are considered optimum for perch (Krieger et al., 1983). The third variable is the pH range during the year, assuming the pH never reaches lethal levels (i.e., < 3.5 and > 10.4). Perch are relatively tolerant to low pH, but the optimum pH range for perch is 6.5 to 8.5 (Krieger et al., 1983).

The reproduction component consists of three variables. The first variable is percent cover in pools and backwater areas during summer – the same variable described for the food/cover component above. The second variable is the temperature within pool and backwater areas during spawning and embryo development. Successful reproduction depends on rising temperatures during spawning and early life stages. Water temperature of 9 to 12 ^{o}C has been found as the optimum temperature for embryos

(Krieger et al., 1983). The third variable is the number of degree-days (between 4 and 10 ^{o}C) from October 30 to April 1. It has been shown that perch require winter minimum temperatures to be < 10 ^{o}C for proper gonad maturation (Krieger et al., 1983).

B. Largemouth Bass

The five life requisites for the largemouth bass - food, cover, water quality, reproduction, and other - will be evaluated using the procedures described in this SOP.

The food component consists of two variables. The first variable is percent pools and backwater areas during average summer flow. Largemouth bass inhabit pools and backwater areas of streams. It is assumed that 60% or greater percent pools and backwater areas provide optimum habitat suitability. The second variable is percent bottom cover within pools and backwater areas during summer. Bottom cover provides habitat for aquatic insects, crayfish, and forage fish, which are the predominant food items for largemouth bass. Cover consists of aquatic vegetation, logs, and debris. For adults and juveniles, the optimum percent bottom cover ranges from 40 to 60%, whereas for fry, the optimum ranges from 40 to 80% (Stuber et al., 1982a).

The cover component consists of three variables. The first variable is percent pools and backwater areas during summer – the same variable described for the food component above. The second variable is percent bottom cover – the same variable described for the food component above. The third variable is water level fluctuation. The optimum range of fluctuation for adults and juveniles during the growing season (May to October) is – 3.0 to 0 m. The optimum range of fluctuation for fry during the growing season is –1.0 to 0 m. Measurements for this component will occur in River Sections 1, 2 and 3 which include suitable habitats for largemouth bass.

The water quality component consists of five variables. The first variable is DO. The optimum DO level that largemouth bass prefer during midsummer is > 8.0 mg/l (Stuber et al., 1982a). The second variable is pH. The optimum pH level range that largemouth bass prefer is 6.6 to 8.5 (Stuber et al., 1982a). The third variable is water temperature. The optimum water temperature during the growing season for adults and juveniles is between 24 and 30 ^{o}C, whereas the temperature for fry is between 26 and 30 ^{o}C (Stuber et al., 1982a). The fourth variable is maximum monthly turbidity. The optimum maximum turbidity during the growing season is between 5 and 25 ppm (Stuber et al., 1982a). The fifth variable is salinity. Largemouth bass prefer salinity from 0 to 4 parts per thousand. In the Upper Hudson River, salinity is always within the optimal range (0 to 2.5 ppt) and will not be measured.

The reproduction component consists of six variables. The first variable is percent pools and backwater areas – the same variable described for the cover component above. The second variable is water temperature. Water temperature is to be recorded for embryos during spawning (May to mid-June) and incubation (2 to 7 days after spawning) within pools. The optimum temperature during this period for embryos is a weekly mean of 20- 22 ^{o}C. The third variable is salinity. The optimum maximum salinity during spawning and incubation for embryos is between 0 and 2.5 parts per thousand. The fourth variable is substrate. Largemouth bass prefer a size range of gravel substrate between 0.2 and 6.4 centimeters (cm) for spawning (Stuber et al., 1982a). The fifth variable is water level fluctuation. Largemouth bass prefer little to no water level fluctuation during spawning (Stuber et al., 1982a). The sixth variable is current velocity. The optimum maximum current velocity at 0.8 depth within pools and backwaters during spawning for embryos is between 0 and 3.0 centimeters per second (cm/sec).

The other component consists of two variables. The first variable is current velocity. The optimum average current velocity at 0.6 water depth during summer for adults and juveniles is between 0 and 6.0 cm/sec, whereas for fry, 0 and 0.6 cm/sec is the optimum. Maximum current velocity less than 3 cm/sec at 0.8 depth in May and June is optimum for embryos. The second variable is stream gradient. The optimum stream gradient within each representative reach is between 0 and 1.0 meter per kilometer (m/km).

C. Smallmouth Bass

The five life requisites for the smallmouth bass - food, cover, water quality, reproduction, and "other" – will be evaluated using the procedures described in this SOP.

The food component consists of three variables. The first variable is the dominant substrate type within a pool or backwater area. Smallmouth bass prefer a gravel substrate made up of broken rock of 1.6 and 2.0 cm in size, and boulders with adequate interstitial space for foraging crayfish and forage fish (Edwards et al., 1983). The second variable is percent pools. The optimum percent pools for smallmouth bass is between 50 and 75%. The third variable is percent cover. Percent cover in the form of boulders, stumps, dead trees, and crevices are used for adults, whereas vegetation and rocks are used for fry. The optimum percent cover for smallmouth bass is between 25 and 50% (Edwards et al., 1983).

The cover component consists of four variables. The first variable is the dominant substrate type – the same variable described for the food component above. The second variable is percent pools – the same variable described for the food component above. The third variable is depth of pools. The optimum average depth of pools during midsummer is between 1.5 and 15 m. The fourth variable is percent cover – the same variable described for the food component above.

The water quality component consists of four variables. The first variable is water pH. The optimum pH level that smallmouth bass prefer is 7.9 and 8.1 (Edwards et al., 1983). The second variable is DO. The minimum DO level that smallmouth bass prefer is 6 mg/l. The third variable is turbidity. The optimum maximum monthly average turbidity level during the summer is between 0 and 30 JTUs. The fourth variable is water temperature. Water temperature will be recorded to evaluate suitability for adults, fry, and juvenile bass from May to October. Adults prefer temperature from about 21 to 27 ^{o}C. Based on laboratory studies, the optimal temperature for fry growth is from 25 to 29^{o} C (Edwards et al., 1983). Juveniles prefer temperature from 28 to 31 ^{o}C. These variables all affect growth and survival.

The reproduction component consists of six variables. The first variable is water temperature. Water temperature is to be recorded for embryos during spawning (mid- April to July) and for 45 days afterward. The optimum temperature during this period for embryos is 15 and 25^{o} C. Temperature is critical during spawning because fluctuations can disrupt spawning. The second variable is fluctuations in water levels. Fluctuations during spawning and for 45 days afterwards will be recorded. The optimum conditions are a slow rise in water level of 0.5 and 1 m prior to spawning, with stable water levels during spawning and afterwards. The third variable is substrate type – the same variable described above for the food component. The fourth variable is percent cover – the same variable described above for the food component. The fifth variable is DO – the same variable described above for the water quality component. The minimum DO level that smallmouth bass prefer is 6 mg/l. DO is critical for normal embryo development. The sixth variable is turbidity – the same variable described above for the water quality component.

The “other” component consists of one variable, stream gradient. The optimum stream gradient within each representative reach is between 0.8 and 4.8 m/km.

D. Bluegill

The five life requisites for the bluegill - food, cover, water quality, reproduction, and other – will be evaluated using the procedures described in this SOP.

The food component consists of three variables. Bluegills are opportunistic feeders, taking advantage of whatever is abundant (Stuber et al. 1982b). The first variable is percent cover (logs and other objects providing structure). Logs and other structures provide favorable prey habitat, which provides good habitat for bluegill foraging. The optimum percent cover for bluegill is between 20 and 60% (Stuber et al. 1982b). The second variable is percent vegetative cover. Vegetative cover consists of aquatic vegetation (submersed, dense stands, or finely divided leaves) and is being evaluated since too much vegetation can reduce foraging capabilities. The optimum percent vegetative cover for bluegill is between 15 and 30% (Stuber et al. 1982b). The third variable is percent pools. The optimum percent pool area during average summer flow (approximately 3,400 cfs, based on data from 1976 to 2003 at Ft. Edward gauging station) is between 60 and 100% (Stuber et al. 1982b). Percent pool is used to quantify the amount of food habitat.

The cover component consists of two variables. The first variable is percent cover (logs and other objects), as described above. The second variable is percent vegetative cover, as described above.

The water quality component consists of seven variables. The first variable is turbidity. The optimum maximum monthly average turbidity during average summer flow is between 0 and 50 ppm. The second variable is water pH. The optimum water pH range during the growing season is 6.5 and 8.5 (Stuber et al. 1982b). The third variable is DO. The optimum minimum DO concentration during summer should seldom fall below 5.0 mg/l (Stuber et al. 1982b). The fourth variable is water temperature for adults. The optimum maximum midsummer water temperature within pools for adult bluegill is 27 ^{o}C. The fifth variable is water temperature for fry. The optimum maximum early summer temperature within pools for fry is between 25 and 32 ^{o}C (Stuber et al. 1982b). The sixth variable is water temperature for juveniles. The optimum maximum midsummer temperature within pools for juveniles is 30 ^{o}C (Stuber et al. 1982b). The seventh variable is salinity. The optimum maximum monthly average salinity during the growing season is between 0 and 2 ppt (Stuber et al. 1982b). All 7 variables are crucial parameters that affect development, growth, and survival.

The reproduction component consists of three variables. The first variable is water temperature for embryos. Survival and development during the embryonic stage depends on the water temperature being high enough for incubation and hatching. The optimum average weekly mean water temperature within pools during spawning is between 22 and 27 ^{o}C (Stuber et al. 1982b). The second variable is current velocity for embryos. The optimum average current velocity in spawning areas is between 0 and 8 cm/sec (Stuber et al. 1982b). The third variable is substrate composition. Bluegills have shown a preference for spawning over fine gravel and sand. The optimum substrate composition during spawning consists of substrates with fines and gravel present. Stuber et al. (1982b) do not state a percentage of fines and gravel, but rather that if fines and gravel are present, the subindex is set to 1.0. If fines and gravel are “scarce” (not defined in Stuber et al. 1982b), the subindex is set to 0.7. For the purposes of this SHAWP, “scarce” has been defined as less than 10%.

The “other” component consists of four variables. The first variable is current velocity for adults. The optimum average current velocity in pools and backwater areas during the growing season is between 0 and 8 cm/sec (Stuber et al. 1982b). The second variable is current velocity for fry. The optimum average current velocity in pools and backwater areas during early summer is between 0 and 4.5 cm/sec (Stuber et al. 1982b). The third variable is current velocity for juveniles. The optimum current velocity in pools and backwater areas during the growing season for juveniles is between 0 and 4.8 cm/sec(Stuber et al. 1982b). The fourth variable is stream gradient. The optimal stream gradient is < 0.5 m/km based on the bluegills preference for low gradient, lentic-type waters.

E. Common Shiner

The three life requisites for the common shiner – food/cover, water quality and reproduction – will be evaluated using the procedures described in this SOP.

The food/cover component consists of four variables. The first variable is percent pools. The optimum range for percent pools for common shiners is 46 and 56% (Trial et al., 1983). The second variable is average current velocity. The optimum average current velocity at 60% of depth in pools is between 8 and 13 cm/sec. The third variable is pool class. The optimum predominant pool class has moderate size and depth, commonly found below falls or riffle-run areas; 5 to 30% of bottom obscured by depth or turbulence. Trial et al. (1983) do not define “moderate size and depth.” The other two categories in the model describe pools as large and deep “deadwater” pools found at the mouths of streams; and small or shallow pools or both, with no surface turbulence and little structure. Pools identified at the mouth of tributaries (e.g., the Snook Kill or Moses Kill), are the most likely to fit the large and deep pools category. The final distinction between the shallow/small and moderate sized pools will be made based on professional judgment once all pool data are available. The fourth variable is predominant substrate type. The optimum predominant substrate type in riffles, windy shore, or shoal for the common shiner is sand and gravel (Trial et al., 1983).

The water quality component consists of three variables. The first variable is maximum summer temperature. The optimum maximum summer temperature persisting for longer than 1 week is between 20 and 22 ^{o}C (Trial et al., 1983). The second variable is water pH. The optimum pH level that common shiners prefer is 6.4 and 8.6 (Trial et al., 1983). The third variable is turbidity. The optimum average turbidity for the common shiner is between 0 and 40 JTUs (Trial et al., 1983).

The reproduction component consists of three variables. The first variable is water temperature. The optimum average water temperature during spawning months (May to July) is between 15.8 and 17.7 ^{o}C (Trial et al., 1983). The second variable is the predominant substrate type – the same variable described above for the food/cover component. The third component is current velocity. The optimum average current velocity just above substrate in riffle areas is between 14 and 20 cm/sec.

III. Necessary Materials and Equipment

- Small boat with standard water safety gear (e.g., personal flotation device [PFD]; first aid kit)
- Protective gear for working near/in water (e.g., hip waders, chest waders)
- Foul weather gear
- Differential Global positioning system (DGPS) unit
- Water quality meter (multiparameter, YSI 6920 or equivalent)

- Measuring tape (weighted)
- Optical rangefinder
- Field log book
- Camera
- Binoculars

IV. Methods

Data to complete the HSI models will be obtained in accordance with the methods described below and from existing data sources such as the Phase 1 Habitat Assessment Report (BBL and Exponent, 2005b), Exponent (-1998), Law Environmental, (1991) , the Phase 1 Cultural and Archaeological Resources Report and natural resource agency data to the extent it is available and appropriate. New data, such as revised side scan sonar data, will be incorporated into the HSI models as those data become available and have been accepted by GE and the USEPA.

A. Percent Pool and Backwater Areas

1. Percent pool and backwater area will be estimated from bathymetric data (OSI, 2003a, b) and the 2003 aerial photographs for the Upper Hudson River (BBL and Exponent, 2005a,b). For the purposes of this SOP, pool is defined as an area with direct hydraulic contact with upstream and downstream water and barely perceptible flow. Backwater is defined as a morphologically defined area alongside but physically separated from the channel, connected to it at its downstream end with barely perceptible or no flow.
2. Backwater areas will be identified from the 2003 aerial photographs as those areas along-side of, but physically separated from, the channel and connected at its downstream end.
3. Pools will be identified from bathymetric data and is defined as an area with less than 1% gradient that is normally deeper and wider that the areas immediately above and below it (Armantrout, 1998).
4. Record the percent pool and backwater areas for each river reach.

B. Depth of Pools

1. Depth of each pool will be estimated using bathymetric data (OSI, 2003a, b) for the Upper Hudson River. The average depth of each pool will be calculated from bathymetric maps using geographic information system (GIS) using the average summer flow.
2. Record the average depth of each pool within the river reach.

C. Percent Cover (vegetation, logs, and other objects) in Pool and Backwater Areas

1. Percent cover in the pool and backwater areas will be estimated using data collected from the Habitat Delineation and Assessment Program (BBL and Exponent, 2005a,b), Law Environmental (1991) and Exponent (1998) and from the side scan sonar program (OSI, 2003a, b). The percentage of each pool and backwater area covered by vegetation and debris will be calculated from side scan sonar data and habitat maps using GIS.
2. Record the percent cover of the pool and backwater areas for each river reach.

D. Percent Cover (vegetation, logs, and other objects) Within Each River Reach

1. Percent cover will be estimated using data collected from the Habitat Delineation and Assessment Program (BBL and Exponent, 2005a,b), Law Environmental (1991) and Exponent (1998) and from the side scan sonar program (OSI, 2003a, b). For each river reach, the percentage of the river reach covered by vegetation and debris will be calculated from bathymetric and habitat maps using GIS.
2. Record the percent cover for each river reach.

E. Percent Cover (vegetation) Within Each River Reach

1. Percent vegetative cover will be determined using data collected from the Habitat Delineation and Assessment Program (BBL and Exponent, 2005a), Law Environmental (1991) and Exponent (1998). For each river reach, the percentage of the river reach covered by aquatic vegetation will be calculated from habitat maps using GIS.
2. Record the percent cover (vegetation) for each river reach.

F. Percent Cover (logs and other objects)

1. Percent cover of logs and other objects will be determined using data collected from the side scan sonar program (OSI, 2003a, b). The debris fields delineated under that program will be used to estimate percent cover and logs and other objects. For each river reach, the percentage of the river reach covered by logs and other objects will be calculated from bathymetric maps using GIS.
2. Record the percent cover of logs and other objects for each river reach.

G. Water column Temperature

1. Water temperature will be collected at each BMP, unconsolidated river bottom (UCB), aquatic vegetation bed (SAV) and riverine fringing wetland (WET) station. Year-round water temperature data will be collected at the BMP monitoring stations at Bakers Falls, Rogers Island, Schuylerville and Waterford.
2. At each BMP station, water temperature will be measured at the mid-depth of the water column using a multiparameter probe in accordance with the BMP-QAPP, Appendix 2 (QEA, 2004).
3. At each UCB and SAV station, water temperature will be measured at 1 meter below the water surface and at 10cm off the bottom. At each WET station, water temperature will be measured just below the water surface and 10 cm off the bottom. Lower the probe to the desired depth of the water column and wait at least 30 seconds for readings to stabilize and log the temperature reading.
4. Temperature data from each station within each river reach will be used to calculate the average mean and average maximum temperatures for each river reach.
5. Water temperature requirements vary by species and time of year. The water temperature data will be separated for the following time periods for use in the appropriate HSI models:
   - During midsummer (July to August) (yellow perch)
   - Winter minimum temperature (December to February) (yellow perch)
   - Degree-days (between 4 and 10^{o}C) from October 30 to April 1 (yellow perch)
   - Degree-days (between 4 and 10^{o}C) from October 30 to April 1 (yellow perch)

- Temperature from May to October (largemouth bass growing season, smallmouth bass growing season)
- During spawning and 45 days afterward (mid-April to July) (largemouth bass, smallmouth bass)
- Maximum summer temperature (July to August) (shiner)
- Average water temperature in spawning habitat during May to July (shiner)
- For embryos, the average mean weekly water temperature will be monitored during spawning (bluegill)
- Maximum midsummer temperature within pools (July to August) (bluegill)
- Maximum early summer temperature within pools (June to July) (bluegill)

H. Minimum DO level

1. DO will be measured at each BMP, UCB, SAV and WET station. Only DO recorded during low flow in summer (July to August) will be used for this variable. At BMP stations, DO will be measured at the mid-depth of the water column using a multiparameter probe in accordance with the BMP-QAPP, Appendix 2 (QEA, 2004).
2. At UCB and SAV stations, DO will be measured at 1 meter below the water surface and at 10cm off the bottom. At each WET station, DO will be measured just below the water surface and 10 cm off the bottom. Lower the probe to the desired depth of the water column and wait at least 30 seconds for readings to stabilize and log the DO reading.
3. The average of the minimum DO from each station within a river reach will be used to represent the average daily minimum DO for the river reach.
4. DO requirements vary by species and time of year. The DO data will be separated for the following time periods for use in the appropriate HSI models:
   - Minimum DO during midsummer (July to August) (largemouth bass)
   - Minimum DO throughout the year (smallmouth bass, yellow perch)
   - Minimum DO during summer (June to September) (bluegill)

I. pH

1. pH will be collected at BMP, UCB, SAV and WET stations using a multiparameter probe.
2. At each BMP station, pH will be measured at the mid-depth of the water column using a multiparameter probe in accordance with the BMP-QAPP, Appendix 2 (QEA, 2004).
3. At UCB and SAV stations, pH will be measured at 1 meter below the water surface and at 10cm off the bottom. At each WET station, pH will be measured just below the water surface and 10 cm off the bottom. Lower the probe to the desired depth of the water column and wait at least 30 seconds for readings to stabilize and log the pH reading.
4. The average minimum pH and the average maximum pH from the stations within a river reach will be used to represent the pH range for the river reach.
5. pH requirements vary by species and time of year. The pH data will be separated for the following time periods for use in the appropriate HSI models:
   - Range during the growing season (mid-April to July) (bluegill, largemouth bass)
   - Range during the year (smallmouth bass, yellow perch, shiner)

J. Turbidity

1. Turbidity data will be collected at each BMP, UCB, and SAV station.
2. At each BMP station, turbidity will be measured at the mid-depth of the water column using a multiparameter probe in accordance with the BMP-QAPP, Appendix 2 (QEA, 2004).
3. At UCB and SAV stations, turbidity will be measured at 1 meter below the water surface and at 10cm off the bottom. At each WET station, turbidity will be measured just below the water surface and 10 cm off the bottom. Lower the probe to the desired depth of the water column and wait at least 30 seconds for readings to stabilize and log the turbidity reading.
4. The turbidity data from each station within the river reach will be used to calculate the average monthly maximum turbidity within each river reach.

K. Dominant Substrate Type

The dominant substrate type in each pool and backwater area will be determined using sediment data from the SSAP (QEA, 2002). The percentage of cores within in each SSAP sediment particle size category (e.g., fine gravel [0.2 to 7.6 cm]) will be used to determine the dominant substrate type in each pool and backwater area. Sediments will also be characterized *in situ* at all UCB stations and from samples collected at SAV stations. Sediment data from the UCB and SAV stations, will be used if necessary, to augment the SSAP data.

L. Average Water Depth

The average depth for each river reach will be calculated from existing bathymetric data (OSI, 2002a, b) for June through October. Historical data (i.e., since the removal of the Fort Edward Dam) from the United States Geological Survey (USGS) gage station at Fort Edward will be used to determine the average flow for each month from June through October. The bathymetric data will be recalibrated to the monthly flow conditions to calculate average depth.

M. Water Level Fluctuations

1. Staff gages are located on the upriver and downriver end of each lock in the Upper Hudson River. Gages are read daily by NYS Canal Corporation personnel when the locks are in operation.
2. Daily water level fluctuation data will be used to calculate the average water level fluctuations for the following time periods for use in the appropriate HSI models:
   - During spawning and for 45 days afterward for smallmouth bass (represented by measurements collected from May to July)
   - During spawning for the largemouth bass (May to mid-June)
   - Growing season for the largemouth bass (May to October)

N. Stream Gradient

1. Stream gradient will be determined for each river reach using bathymetric maps.

2. Stream gradient will be quantified by measuring the change in elevation (meters) over distance (km). Bathymetric data will be used in GIS to calculate the stream gradient for each kilometer. Stream gradient will be reported as the average gradient (m/km) for the river reach.

O. Current Velocity

1. Current velocity will be recorded at each UCB, SAV and WET assessment station in accordance with Attachment B, Section IV of the HDA Work Plan (BBL, 2003a), modified as described in the Phase 1 HA Report (BBL and Exponent, 2005a) and below.
2. Collect velocity will be collected using an electromagnetic velocity meter. The instrument will be maintained and calibrated in accordance with the manufacturer's instructions. This equipment will be operated from the boat.
3. Orient the meter head directly parallel with the flow. Flagging or streamers (e.g., from cassette tape material) should be tied to the vertical rod to assist with orientation of the meter.
4. Outside the deep edge of the bed (for aquatic bed stations) or the center of the unconsolidated river bottom station, place the meter 10 cm above the substrate. Record velocity.
5. Raise the meter to 80% water column depth. Wait 30 seconds for the readings to stabilize. Record velocity.
6. Raise the meter to 60% water column depth. Wait 30 seconds for the readings to stabilize. Record velocity.
7. Raise the meter to 20% water column depth. Wait 30 seconds for the readings to stabilize. Record velocity.
8. Raise the meter to 1 m above the substrate. Record velocity.

For aquatic vegetation bed stations, repeat Steps 4 (at placement of the meter) through 8 at the upriver edge, downriver edge, inside edge and approximate center of the SAV bed.

Attachment B

Standard Operating Procedure for Belted Kingfisher Habitat Evaluations

Attachment B. Standard Operating Procedure for Belted Kingfisher Habitat Evaluations

I. Objective

The objective of this Standard Operating Procedure (SOP) is to set forth methods to evaluate the habitat suitability of River Sections 1, 2, and 3 of the Upper Hudson River for the belted kingfisher. This SOP will be used to evaluate breeding season habitat of the belted kingfisher. Winter habitat will not be evaluated due to poor documentation of winter habitat requirements. The three life requisites of the belted kingfisher - water, cover, and reproduction – will be evaluated using the procedures described in this SOP.

The water component consists of four variables. The water component will be evaluated during spring conditions that are most typical for the breeding season (May to June). The first variable is average water transparency. Kingfishers require clear water for foraging. Since most fish are caught in water that is < 60 centimeters (cm) deep and no more than 15 cm below the surface, this area of the water column will be evaluated. The second variable is the percent water surface obstruction. Dense overhanging vegetation along the water's edge can prohibit foraging activity for belted kingfishers. Vegetation, both floating and emergent, along with rocks, logs and similar items on the water's surface can interfere with foraging. These obstacles on the water's surface or overhanging obstacles that are < 1.0 meter (m) above the water are assumed to be obstructive (Prose 1985). The third variable is percent of the water area that is < 60 cm in depth. It is assumed that areas with the highest proportion of water < 60 cm in depth are the most suitable (Prose 1985). The fourth and last variable is percent riffles. The presence of riffles enhances habitat quality by providing more prey for kingfishers. Kingfishers tend to forage in these areas where prey are more abundant. Optimal percent of riffles ranges between 30 and 70 percent (Prose 1985).

The cover component consists of one variable. The variable is the average number of lentic shoreline or stream subsections that contain one or more perches. Belted kingfishers prefer an open perch over the water in which they can locate prey (Prose 1985). Bare, woody limbs are used as well as electrical wires and metal or wooden posts. It has been estimated that > 40 perches per kilometer (perches/km) of shoreline is the optimal amount of perches for kingfisher foraging.

The reproduction component consists of one variable. The variable is the distance to the nearest suitable soil bank from 1 km sections of shoreline. Kingfisher territories during the breeding season commonly are about 1 km in length. Since kingfisher usually nest within 3.0 km of water, 3.0 km is considered the upper limit for nest site suitability (Prose 1985). Suitable soil banks for potential nest sites must be vertical or overhanging; devoid of excessive vegetation, root masses, rocks, etc., on the faces; and > 1.3 m in height for successful nesting. Soils must contain 70 to 96% sand and < 15% clay(Prose 1985).

II. Necessary Materials and Equipment

- Small boat with standard water safety gear (e.g., personal flotation device [PFD]; first aid kit)
- Protective gear for working near/in water (e.g., hip waders, chest waders)
- Foul weather gear

- Differential Global positioning system (DGPS) unit
- Secchi disk
- Optical rangefinder
- Survey measuring tape (100-meter [m] length is recommended)
- Field log book
- Camera
- Binoculars
- Additional field equipment as specified in the *Habitat Delineation and Assessment Work Plan* (HDA Work Plan) (BBL, 2003)

III. Methods

Within the study area (defined as the Upper Hudson River from the Fort Edward Dam to the Federal Dam at Troy), data will be collected to characterize the habitat suitability of each river reach for the belted kingfisher. River reach data are subsequently used to characterize the habitat suitability of the overall study area. River reaches in the Upper Hudson River are defined by the location of the locks and dams that separate the river into a series of pools of varying sizes.

Some of the data necessary to complete the habitat suitability index (HSI) assessments have been, or will be, collected under existing programs such as the Habitat Delineation and Assessment Program (BBL, 2003), the side-scan sonar and bathymetry efforts (Ocean Surveys, Inc. [OSI] 2003a, b) and the avian egg study (New York State Department of Environmental Conservation [NYSDEC] et al., 2004). Data not currently being collected under those programs will either be added to the habitat assessment program stations or calculated directly from existing data generated by those programs, as described below.

A. Water Component

1. Average water transparency

   a. In the channel offshore from the approximate center of each shoreline station, the average Secchi disk depth over five readings will be determined by placing the disk in the water and allowing it to descend to a depth where it is no longer visible. Secchi disk readings will not be collected during or immediately following a storm event that increases the turbidity of the water.
   b. Place secchi disk into water and lower slowly. Record the depth at which the disk is no longer visible.
   c. Repeat five times. Calculate and record the average depth from the five readings.

2. Percent water surface obstruction

   a. At each shoreline station, the station will be broken up into four subsections measuring 25 m each and extending to the midpoint in the river. Within each subsection, visually estimate the percent of the water surface obstructed or covered by emergent and floating vegetation, logs, leaves, or overhanging shore vegetation < 1.0 m above the water's surface.
   b. Use the percent water surface obstruction estimated at each shoreline subsection to calculate the average percent water surface obstruction for each river section.

3. Percent of the water area that is < 60 cm in depth

   a. Within each river reach, bathymetric data (OSI, 2003a, b) will be used to calculate the percent of each river section that is < 60 cm deep. National Geodetic Vertical Datum (NGVD) elevations will be converted to water depth based on an estimate of the mean surface water profile at an average flow rate during the breeding season (May to June) (measured at the United States Geological Survey gage in Fort Edward, New York).
   b. Record the percent water area that is < 60 cm deep for each river reach.

4. Percent riffles

   a. Within each river reach, the length of the water's surface broken into waves by obstructions (wholly or partly submerged) will be determined from the 2003 aerial photographs (BBL and Exponent, 2005a).
   b. Divide the length of the river reach where riffles are present by the length of the river reach.
   c. Record the percent riffles.

C. Cover Component

1. Average number of perches

   a. At each shoreline station, the station will be broken up into 4 subsections measuring 25 m each. At each station, determine the number of perches available. Perches can consist of tree or shrub limbs, electrical wires, metal or wooden posts, or similar perches immediately adjacent to or overhanging the water.
   b. Use the number of perches counted at each shoreline subsection to calculate the average number of perches for each river section.

D. Reproduction Component

1. Distance to Nearest Suitable Soil Bank from Shoreline Stations

   a. Measure the distance from the approximate center of each river reach to the nearest kingfisher nesting site identified by the NYSDEC (NYDEC et al., 2004).
   b. Calculate the average distance to the nesting sites for each river reach.

Attachment C

Standard Operating Procedure for Great Blue Heron Habitat Evaluations

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

Attachment C. Standard Operating Procedure for Great Blue Heron Habitat Evaluations

I. Objective

The objective of this Standard Operating Procedure (SOP) is to set forth methods to evaluate the habitat suitability of River Sections 1, 2, and 3 of the Upper Hudson River for the great blue heron based on Short and Cooper (1985). This SOP will be used to evaluate the Upper Hudson River's ability to provide foraging habitat for the great blue heron. The reproduction component of this habitat suitability index (HSI) will not be evaluated. One life requisite of the great blue heron - foraging - will be evaluated using the procedures described in this SOP.

The food component consists of three variables. The first variable is the distance between potential nest sites and foraging areas. The optimum distance between potential nest sites and foraging area is 0 and 1 kilometer (km). The second variable is the presence of a water body with suitable prey population and foraging substrate. The optimum conditions include shallow (up to 0.5 meter [m] deep), clear water with a firm substrate and a huntable population of small (< 25 centimeters [cm]) fish. The third variable is a disturbance free zone of up to 100 m around potential foraging area. Potential foraging areas need to be free from disturbances for several hours a day to allow herons to feed. The optimum conditions include no disturbances during the 4 hours following sunrise or preceding sunset or the foraging zone is about 100 m from human activities and habitation or about 50 m from roads with occasional, slow moving traffic.

II. Necessary Materials and Equipment

- Small boat with standard water safety gear (e.g., personal flotation device [PFD]; first aid kit)
- Protective gear for working near/in water (e.g., hip waders, chest waders)
- Foul weather gear
- Differential Global positioning system (DGPS) unit
- Aerial maps/photos
- Field log book
- Camera
- Binoculars

III. Methods

Within the study area (defined as the Upper Hudson River from the Fort Edward Dam to the Federal Dam at Troy), data will be collected to characterize the habitat suitability of each river reach for the great blue heron. River reach data are subsequently used to characterize the habitat suitability of the overall study area. River reaches in the Upper Hudson River are defined by the location of the locks and dams that separate the river into a series of pools of varying sizes.

A. Food Component

1. Distance between potential nest sites and foraging areas

   a. The 2003 aerial photographs acquired specifically for the habitat delineation and assessment program (BBL and Exponent, 2005a) will be used to identify the distance from existing, known heronries to the Upper Hudson River Study Area. The quality of the Hudson River as foraging habitat for the great blue heron will be based on the average distance from the heronry to each reach.
   b. Record the average distance.

2. Presence of a water body with suitable prey population and foraging substrate

   a. As indicated by the presence of great blue heron nest sites and foraging herons, the Upper Hudson River supports a suitable fish community and foraging substrate. This variable has been set to 1.0.

3. A disturbance free zone up to 100 m around potential foraging area

   a. The 2003 aerial photographs acquired specifically for the Habitat Delineation and Assessment Program (BBL and Exponent, 2005a) will be used to quantify the portions of each reach with suitable foraging habitat that are surrounded by a disturbance free zone up to 100 m in diameter. The total area of the reach that is determined to be suitable foraging habitat for the great blue heron will be divided by the total area of the reach to evaluate the foraging habitat quality of the reach.
   b. Record the percent of the reach determined to be suitable foraging habitat.

Attachment D

Standard Operating Procedure for Wood Duck Habitat Evaluations

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

Attachment D. Standard Operating Procedure for Wood Duck Habitat Evaluations

I. Objective

The objective of this Standard Operating Procedure (SOP) is to set forth methods to measure the habitat suitability of River Sections 1, 2, and 3 of the Upper Hudson River for the wood duck. This SOP will be used to evaluate the Hudson River's ability to provide breeding (spring and summer) habitat for wood ducks based on Sousa and Farmer (1983). Two life requisites for the wood duck – nesting and brood rearing – will be evaluated using the procedures described in this SOP.

The quality of nesting habitat is a function of the availability of nesting sites. Potential nesting sites may be either naturally occurring tree cavities or artificial nest sites in the form of nest boxes. The nesting component of the model consists of two variables related to the quality of the nesting habitat. The first variable is the number of potentially suitable natural tree cavities/0.4 hectare (ha). Natural tree cavities can be in either live or dead snags and must have a minimum entrance size of 7.6 x 10.0 centimeters (cm). The second variable is the number of manmade nest boxes/0.4 ha. For a manmade nest box to be suitable, it must be predator proof, cleaned and repaired annually by man. The optimum density for potential wood duck nest sites > 5 per 0.4 ha. Either natural tree cavities or manmade nest boxes can provide the nest sites.

The brood rearing component consists of one variable. The variable is the percent of the water surface covered by potential brood cover. Cover for wood duck broods consists of dense vegetative cover in shallow wetlands with water present throughout the period of brood occupancy. Cover includes emergent herbaceous vegetation, emergent shrubs, and trees with crowns within 1 m of the water surface, or woody downfall. Dense cover (50 and 75%) interspersed with small open water channels (approximately 1 to 2 ft wide) provides optimal brood cover. The HSI model assumes that the quality of vegetative and invertebrate foods is indicated by the cover condition. As such, this model may not adequately characterize the suitability of the Upper Hudson River habitats for brood rearing.

II. Necessary Materials and Equipment

- Small boat with standard water safety gear (e.g., personal flotation device [PFD]; first aid kit)
- Protective gear for working near/in water (e.g., hip waders, chest waders)
- Foul weather gear
- Differential Global positioning system (DGPS) unit
- Aerial Maps/Photos
- Measuring stick
- Optical rangefinder
- Survey measuring tape (100-meter [m] length is recommended)
- Binoculars
- Field log book
- Camera

III. Methods

Within the study area (defined as the Upper Hudson River from the Fort Edward Dam to the Federal Dam at Troy), data will be collected to characterize the habitat suitability of each river reach for the wood duck. River reach data are subsequently used to characterize the habitat suitability of the overall study area. River reaches in the Upper Hudson River are defined by the location of the locks and dams that separate the river into a series of pools of varying sizes.

The data necessary to complete the habitat suitability index (HSI) assessments will either be calculated directly from existing data generated by the habitat assessment program (BBL and Exponent, 2005a) or collected in the field using the methods described below.

A. Nesting Component

1. Number of potentially suitable tree cavities/0.4 ha

   a. Tree cavities must have a minimum entrance dimension of 7.6 by 10.0 cm. Cavities may be in live trees or snags.
   b. Tree cavity evaluation belt transects will be established on publicly accessible land immediately adjacent to the Upper Hudson River at a frequency of 1 transect/acre of forested habitat adjacent to the Hudson River. The potential location for these transects are shown on Figures 1 and 15. The boundaries of each 100-m by 10-m transect will be randomly established in forested areas.
   c. Record the number of tree cavities identified in each transect and sum the number of cavities and areas sampled to calculate the density of cavities in forested habitats. Divide the cavity density in forested areas by the total area of the reach to calculate the density of tree cavities in the reach.

2. Number of nest boxes/0.4 ha

   a. Using the transects established under A.1 above, count the number of manmade nest boxes. To be included in this count, the manmade nest boxes must be predator proof and maintained by man.. Record the number of nest boxes identified in each transect and sum the number of boxes and areas sampled to calculate the density of boxes. Divide the box density in forested areas by the total area of the reach to calculate the density of nest boxes in the reach.

B. Brood Rearing Component

1. Percent of the water surface covered by potential brood cover and presence of small open water channels.

   a. The habitat delineation maps for the Upper Hudson River (BBL and Exponent, 2005a) will be used to determine the percent of water surface covered by potential brood cover. The water surface area of each river reach covered by shrubs, overhanging tree crowns, woody downfall, and herbaceous vegetation (i.e., riverine fringing wetlands) within 1 m of the water surface will be calculated from the habitat maps using geographic information system (GIS).

b. Record the percent of water surface covered by potential brood cover for each river reach and whether small open water channels are present.

Attachment E

Standard Operating Procedure for Snapping Turtle Habitat Evaluations

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

Attachment E. Standard Operating Procedure for Snapping Turtle Habitat Evaluations

I. Objective

The objective of this Standard Operating Procedure (SOP) is to set forth methods to measure the habitat suitability of River Sections 1, 2, and 3 of the Upper Hudson River for snapping turtle based on Graves and Anderson (1987). This SOP will be used to evaluate the Upper Hudson River's ability to support snapping turtles throughout the year. The four life requisites of the snapping turtle – food, winter cover, reproduction, and interspersion – will be evaluated using the methods described in this SOP.

The food component consists of three variables. The first variable is the mean water temperature at mid-depth during summer. Snapping turtles body temperature is closely associated with water temperature. Water temperatures must be above 16 degrees Celsius (^{o}C) for snapping turtles to eat. The optimum temperature during summer is between 24 and 33 ^{o}C. The second variable is the mean current velocity at mid depth during summer. It is assumed that snapping turtles can maximize their foraging efficiency by saving energy that would be spent on moving against flowing water. The optimum water velocity during summer is 0 centimeter per second (cm/s). The third variable is the percent canopy cover of aquatic vegetation in the littoral zone. Snapping turtles not only feed on aquatic vegetation but also use it to hide in and ambush prey. The optimum percent canopy preferred by snapping turtles is 100%.

The winter cover component consists of two variables. The first variable is winter water depth in relation to maximum ice depth. For winter survival, water depth must be greater than maximum ice depth. The second variable is the percent silt in the substrate. During winter, snapping turtles often burrow into the mud to hibernate. A substrate with 100% silt is optimal for hibernating snapping turtles.

The reproduction component consists of one variable. The variable is the distance to a small stream. Female snapping turtles migrate up small streams to lay eggs. It is assumed that small feeder streams of wetlands represent optimal snapping turtle nesting habitat. The optimum distance to a small stream is 0 kilometer (km). However, the relationship between the wetland and distance to a small stream is a linear one from 1 to 5 km away (1 km away has 0.9 suitability value) and remains steady for a stream 5 to 8 km away with a suitability value of 0.5.

The interspersion component consists of one variable. The variable is the distance to permanent water. The optimum distance to permanent water for snapping turtles is 0 km.

II. Necessary Materials and Equipment

- Small boat with standard water safety gear (e.g., personal flotation device [PFD]; first aid kit)
- Protective gear for working near/in water (e.g., hip waders, chest waders)
- Foul weather gear
- Differential Global positioning system (DGPS) unit
- Water flow meter
- Water quality meter
- Topographic map

- Aerial Photos
- Field log book
- Camera
- Binoculars

III. Methods

Within the study area (defined as the Upper Hudson River from the Fort Edward Dam to the Federal Dam at Troy), data will be collected to characterize the habitat suitability of each river reach. River reach data are subsequently used to characterize the habitat suitability of the overall study area. River reaches in the Upper Hudson River are defined by the location of the locks and dams that separate the river into a series of pools of varying sizes.

The majority of data necessary to complete the habitat suitability index (HSI) assessments have been, or will be, collected under existing programs such as the Habitat Delineation and Assessment Program (BBL, 2003), the Sediment Sampling and Analysis Program (SSAP) (QEA, 2002), the side-scan sonar and bathymetry efforts (OSI 2003a, b), and the baseline monitoring program (BMP) (QEA, 2003). Data not currently being collected under those programs will either be added to the habitat assessment program stations or calculated directly from existing data generated by those programs as described below.

A. Food Component

1. Mean water temperature during summer

   a. At each BMP station, water temperature will be measured at the mid-depth of the water column using a multiparameter probe in accordance with the BMP QAPP, Appendix 2 (QEA, 2004).
   b. At each UCB and SAV station, water temperature will be measured at 1 meter below the water surface and at 10cm off the bottom. At each WET station, water temperature will be measured at mid-depth (Graves and Anderson, 1987).. Lower the probe to the desired depth of the water column and wait at least 30 seconds for readings to stabilize and log the temperature reading.
   c. The recorded water temperature data will be used to determine summer water temperature.

2. Mean current velocity during summer

   a. Current velocity will be recorded at each UCB and SAV assessment station in accordance with Attachment B, Section IV of the HDA Work Plan (BBL, 2003a), modified as described in the Phase 1 HA Report (BBL and Exponent, 2005a) and below.
   b. Collect velocity will be collected using an electromagnetic velocity meter. The instrument will be maintained and calibrated in accordance with the manufacturer’s instructions. This equipment will be operated from the boat.
   c. Orient the meter head directly parallel with the flow. Flagging or streamers (e.g., from cassette tape material) should be tied to the vertical rod to assist with orientation of the meter.
   d. Outside the deep edge of the bed (for aquatic bed stations) or the center of the unconsolidated river bottom station, place the meter 10 cm above the substrate. Record velocity.

e. Raise the meter to 80% water column depth. Wait 30 seconds for the readings to stabilize. Record velocity.
f. Raise the meter to 60% water column depth. Wait 30 seconds for the readings to stabilize. Record velocity.
g. Raise the meter to 20% water column depth. Wait 30 seconds for the readings to stabilize. Record velocity.
h. Raise the meter to 1 m above the substrate. Record velocity.
i. For aquatic vegetation bed stations, move to the approximate center of the SAV bed and repeat Steps 4 (at placement of the meter) through 8.

3. Percent canopy cover of aquatic vegetation in the littoral zone

   a. Percent canopy cover of aquatic vegetation in the littoral zone will be determined in accordance with Section III. E. of Attachment A – Standard Operating Procedure for Habitat Evaluations for Selected Fish Species.

B. Winter Cover Component

1. Maximum water depth greater than maximum ice depth

   a. The maximum water depth within each river reach will be determined using the bathymetric data (OSI 2003a, b). This depth is anticipated to be greater than ice thickness and this variable is set to 1.0.

2. Percent silt in substrate

   a. Percent silt data were collected in the SSAP (QEA, 2002). Sediment cores with percent silt in top 12 inches will be used.
   b. Use percent silt from the SSAP cores to calculate the average percent silt for each river reach.

C. Reproduction Component

1. Distance to small stream or to an area with an open canopy with little to no vegetation

   a. At each wetland and shoreline station, topographic maps and 2003 aerial photos (BBL and Exponent, 2005a) will be used to determine the distance from the station to the nearest stream or to an area with an open canopy with little to no vegetation. This distance will be calculated using GIS.
   b. Record the average distance from the wetland and shoreline stations to the nearest small stream for each river reach.

D. Reproduction Component

1. Distance to permanent water

   a. The Upper Hudson River is permanent water. As such, this variable is set to 1.0.

Attachment F

Standard Operating Procedure for Muskrat Habitat Evaluations

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

Attachment F. Standard Operating Procedure for Muskrat Habitat Evaluations

I. Objective

The objective of this Standard Operating Procedure (SOP) is to set forth methods to measure the habitat suitability of River Sections 1, 2, and 3 of the Upper Hudson River for the muskrat. Two life requisites – food and cover – for the muskrat will be evaluated using the procedures described in this SOP.

The food component consists of two variables. The first variable is the percent of riverine channel dominated by emergent herbaceous vegetation. The major food source of the muskrat's diet is herbaceous vegetation. Dense stands of emergent vegetation are known to support high-density populations. The optimum percent of riverine channel dominated by emergent vegetation preferred by muskrats is between 25 and 60%. The second variable is the percent herbaceous canopy cover within 10 meters (m) of water's edge. Muskrats in riverine habitats obtain most of their food from terrestrial vegetation along the riverine channel. The optimum percent canopy cover within 10 m of the water's edge is 100%. The abundance of emergent vegetation is assumed to be twice as important as the presence and abundance of terrestrial vegetation in determining potential year-round values of food resources for muskrats in riverine habitats.

The cover component consists of four variables. The first variable is the percent of year with surface water present. The optimum percent of year with surface water present for muskrat is 100%. The second variable is the percent stream gradient. The presence of a dam or rapids may yield an incorrect estimate of habitat quality when long stream reaches (greater than 1.0 km) are evaluated (Allen and Hoffman, 1984). The optimum percent stream gradient for muskrat is between 0 and 1%. The third variable is the percent of riverine channel with surface water present during typical minimum flow. The optimum percent of riverine channel with surface water present during typical minimum flow for muskrat is 100%. The fourth variable is the percent of riverine channel dominated by emergent herbaceous vegetation. The optimum percent of riverine channel dominated by emergent vegetation preferred by muskrat's is between 25 and 60%.

II. Necessary Materials and Equipment

- Small boat with standard water safety gear (e.g., personal flotation device [PFD]; first aid kit)
- Protective gear for working near/in water (e.g., hip waders, chest waders)
- Foul weather gear
- Differential Global positioning system (DGPS) unit
- Optical rangefinder
- Field log book
- Camera
- Binoculars

III. Methods

Within the study area (defined as the Upper Hudson River from the Fort Edward Dam to the Federal Dam at Troy), data will be collected to characterize the habitat suitability of each river reach for the muskrat. River reach data are subsequently used to characterize the habitat suitability of the overall study area. River reaches in the Upper Hudson River are defined by the location of the locks and dams that separate the river into a series of pools of varying sizes. Care will be used when interpreting areas with high gradients (e.g., around locks and dams) to ensure correct habitat characterization.

Some of the data necessary to complete the habitat suitability index (HSI) assessments have been, or will be, collected under the Habitat Delineation and Assessment Program (BBL, 2003). Data not currently being collected under that program will either be added to the habitat assessment program stations or calculated directly from existing data as described below.

A. Food Component

1. Percent of riverine channel dominated by emergent herbaceous vegetation

   a. Percent cover of emergent herbaceous vegetation will be determined using data collected from the Habitat Delineation and Assessment Program to delineate riverine fringing wetlands (BBL and Exponent, 2005a). For each river reach, the percentage of the river reach covered by riverine fringing wetlands will be calculated from habitat maps using geographic information system (GIS).
   b. Record the percent cover of emergent vegetation for each river reach.

2. Percent herbaceous canopy cover within 10 m of water's edge

   a. Herbaceous canopy cover recorded at each habitat assessment shoreline station will be used for this variable. Herbaceous canopy will be visually estimated at three locations for each shoreline station.
   b. Record the percent herbaceous canopy cover for each shoreline station. Average all values to determine the percent herbaceous canopy cover for the river reach.

B. Cover Component

1. Percent of year with surface water present

   a. Surface water is present on the Upper Hudson River for the entire year. As such, this variable is set to 1.0.

2. Percent stream gradient

   a. Stream gradient will be determined for each river reach using bathymetric maps.
   b. Stream gradient will be quantified by measuring the change in elevation (meters) over distance (km). Bathymetric data will be used in GIS to calculate the stream gradient for each kilometer of river. Stream gradient will be reported as the average percent gradient for the river reach.

3. Percent of riverine channel with surface water present during typical minimum flow

   a. Surface water is present on the Upper Hudson River for the entire year, including typical periods of minimum flow. As such, this variable is set to 1.0.

4. Percent of riverine channel dominated by emergent herbaceous vegetation

   a. See A.1. above.

Attachment G

Standard Operating Procedure for Mink Habitat Evaluations

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

Attachment G. Standard Operating Procedure for Mink Habitat Evaluations

I. Objective

The objective of this Standard Operating Procedure (SOP) is to set forth methods to measure the habitat suitability of River Sections 1, 2, and 3 of the Upper Hudson River for mink. The two life requisites for the mink – food and cover – will be evaluated using the procedures described in this SOP.

The food component consists of one variable. The variable is the percent of year with surface water present. Aquatic or wetland associated prey species make up the largest portion of a mink's diet. To provide optimum foraging habitat and prey availability, a minimum of 9 months (75%) of the year must have surface water present.

The cover component consists of two variables (Allen, 1986). The first variable is percent shoreline cover within 1 meter (m) of the water's edge. Shorelines with a high percentage of cover (100%) which includes overhanging or emergent vegetation, exposed roots, debris, log jams, undercut banks, boulders, or rock crevices provide cover for both prey species and mink (Allen, 1986). The second variable is the percent canopy cover of trees and shrubs within 100 m of the water or wetlands edge (Allen, 1986). Vegetative cover adjacent to river channels provides foraging cover, den sites, and cover for prey species. Optimum cover conditions exist when tree and shrub canopy cover singly or in combination account for > 75% canopy cover.

II. Necessary Materials and Equipment

- Small boat with standard water safety gear (e.g., personal flotation device [PFD]; first aid kit)
- Protective gear for working near/in water (e.g., hip waders, chest waders)
- Foul weather gear
- Differential Global positioning system (DGPS) unit
- Optical rangefinder
- Survey measuring tape (100-m length is recommended)
- Field log book
- Camera
- Binoculars

III. Methods

Within the study area (defined as the Upper Hudson River from the Fort Edward Dam to the Federal Dam at Troy), data will be collected to characterize the habitat suitability of each river reach for the mink. River reach data are subsequently used to characterize the habitat suitability of the overall study area. River reaches in the Upper Hudson River are defined by the location of the locks and dams that separate the river into a series of pools of varying sizes.

Some of the data necessary to complete the habitat suitability index (HSI) assessments have been, or will be, collected under the Habitat Delineation and Assessment Program (BBL, 2003). Data not currently being collected under that program will either be added to the habitat assessment program stations or calculated directly from existing data as described below.

A. Food Component

1. Percent of year with surface water present
   a. Surface water is present on the Upper Hudson River for the entire year. As such, this variable is set to 1.0.

B. Cover Component

1. Percent shoreline cover within 1 m of the water's edge

   a. At each wetland station, a line intercept transect will be setup parallel to and within 1 meter of the edge of the shoreline to evaluate the percent shoreline cover within 1 m of the water's edge. The transect will extend the entire length of the wetland stations and percent cover will be visually estimated at 10 equally spaced points along the transect. Cover is provided by herbaceous and shrub vegetation, undercut banks, logjams, debris, exposed roots, boulders or rock crevices.
   b. Record the percent cover for the wetland station. The average percent shoreline cover for the river reach will be calculated using all wetland station data within the reach.

2. Percent canopy cover of trees and shrubs within 100 m of the wetlands edge

   a. The 2003 aerial photographs will be used to determine the percent canopy cover of trees and shrubs within 100 m of all delineated riverine fringing wetlands will be visually estimated using the crown density scale (Paine, 1981). Groundtruthing of the aerial photographs to determine the accuracy of the 2003 photographs for measurements of riparian canopy cover will be completed on publicly accessible lands if necessary.
   b. The average percent shoreline cover for the river reach will be calculated using all data from each wetland within the reach.

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