Stream Dynamics and Geomorphology

Understand Lane's Balance and the interaction of sediment discharge (Q_s), sediment particle size (D_{50}), streamflow (Q_w) and stream slope (S) and the situational degradation or aggradation of stream beds and banks, the streams bedload, and channel meandering.

$$Q_s * D_{50} \text{ is proportional to } Q_w * S$$

https://www.youtube.com/watch?v=yyvT0wOuS2c

Stream and Forest Interactions

Think about how the forest impacts: 1) stream dynamics and geomorphology; and 2) flood resilience, fish production and nutrient retention.

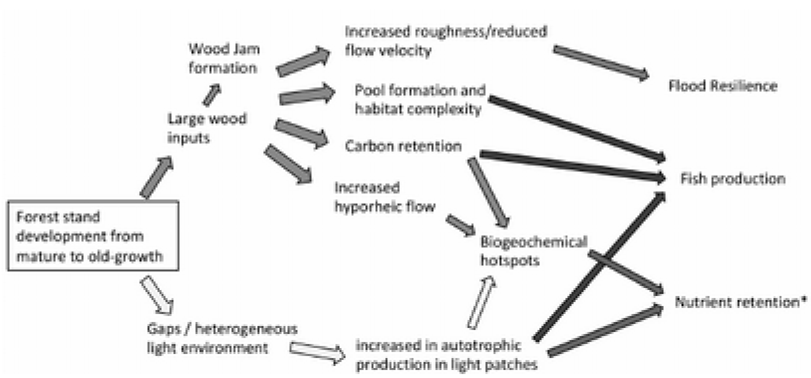


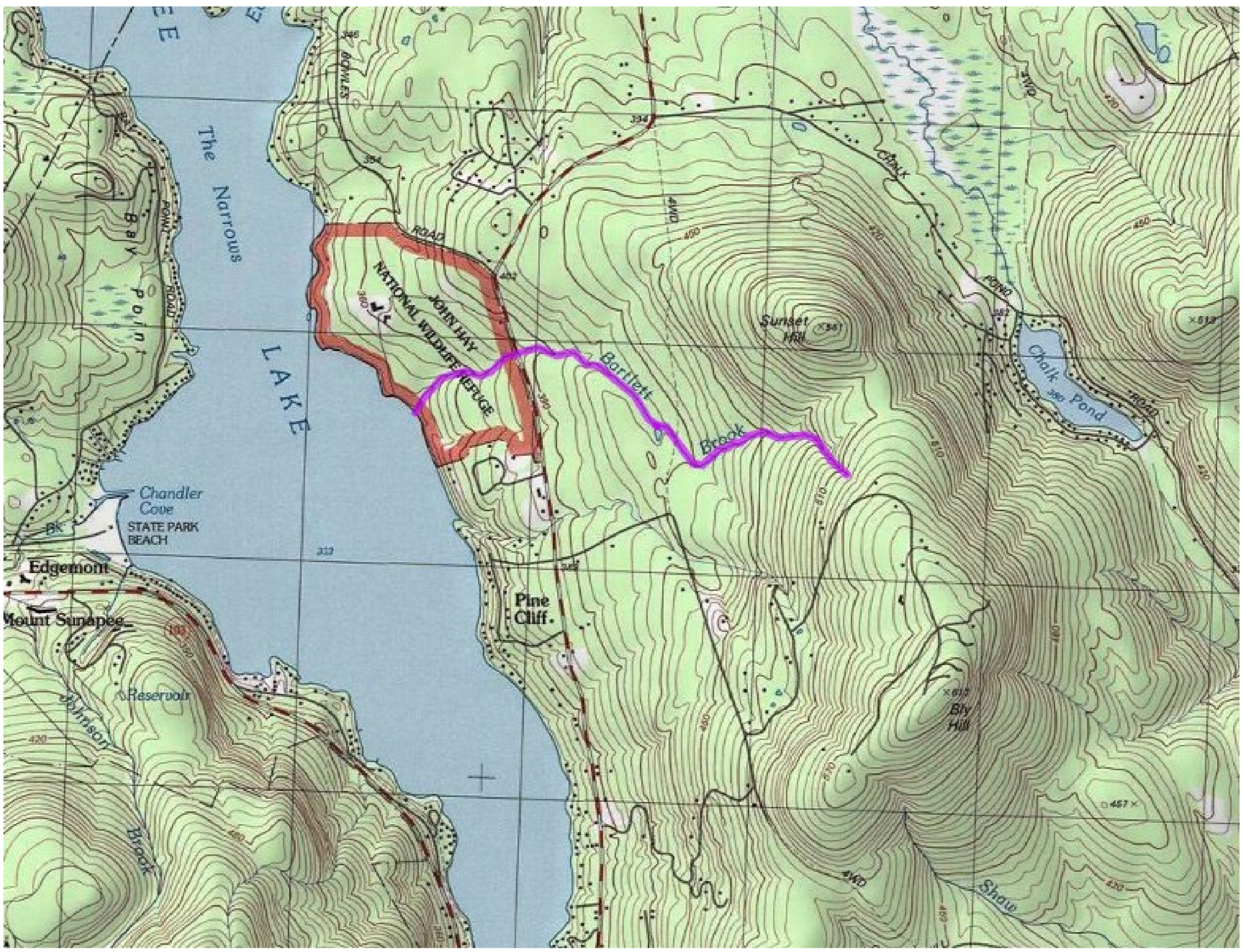
FIGURE 9-3. Pathways by which the transition from mature to old-growth riparian forests can affect physical and ecological processes in streams, with associated implications for stream ecosystem services. Empirical studies provide support for greater inorganic phosphorous uptake in older forest streams; results are equivocal for inorganic nitrogen uptake.

This diagram comes from: https://www.researchgate.net/publication/327917394_Forest-Stream_Interactions_in_Eastern_Old-Growth_Forests. You can refer to that article in order to better understand the relationships shown in this Figure.

Delineate the Watershed of Bartlett Brook

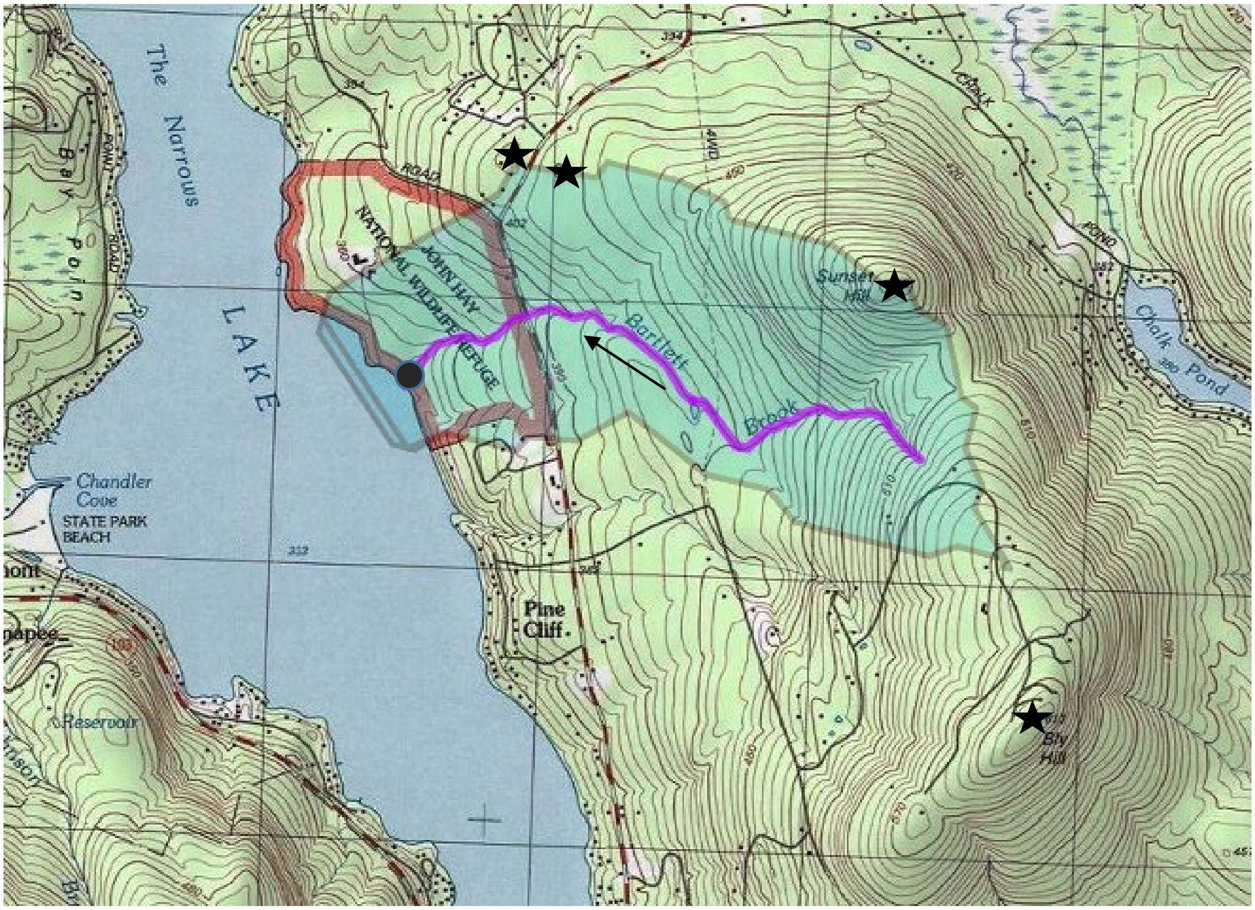
Show the watershed boundary for Bartlett Brook (purple highlighted brook) on this map. Follow the steps to help guide you. These instructions will not be present if there were a question like this on the exam. You would need to know the process.

1) Mark the outlet of the brook with a dot
2) Show the direction of water flow with an arrow
3) Mark the peaks with an X
4) Start at the outlet and work your around the peaks to delineate the boundary of the watershed.



Answer-Watershed for Bartlett Brook

This was created using a mapping program and not done "by hand" so it will look slightly different than one done by hand, but the general outline should match.



Interpreting VRAP Water Quality Monitoring Parameters

Chemical Parameters

Dissolved Oxygen (DO)

- **Unit of Measurement:** concentration in milligrams per liter (mg/L) and percent saturation (%).
- **Description:** A measure of the amount of oxygen in the water: Concentration is a measure of the amount of oxygen in a volume of water; saturation is a measurement of the amount of oxygen in the water compared to the amount of oxygen the water can actually hold at full saturation. Both of these measurements are necessary to accurately determine whether New Hampshire surface water quality standards are met.
- **Importance**: Oxygen is dissolved into the water from the atmosphere, aided by wind and wave action, or by rocky, steep, or uneven stream beds. The presence of dissolved oxygen is vital to bottom-dwelling organisms as well as fish and amphibians. Aquatic plants and algae produce oxygen in the water during the day, and consume oxygen during the night. Bacteria utilize oxygen both day and night when they process organic matter into smaller and smaller particles.

Class A NH Surface Water Quality Standard: 6 mg/L at any place or time, or 75% minimum daily average – (unless naturally occurring).

Class B NH Surface Water Quality Standard: 5 mg/L at any place or time or 75% minimum daily average – (unless naturally occurring).

Several measurements of oxygen saturation taken in a 24-hour period must be averaged to compare to the 75 percent daily average saturation standard. The concentration of dissolved oxygen is dependent on many factors including temperature and sunlight, and tends to fluctuate throughout the day. Saturation values are averaged because a reading taken in the morning may be low due to respiration, while a measurement that afternoon may show that the saturation has recovered to acceptable levels. Water can become saturated with more than 100 percent dissolved oxygen.

pH

- **Unit of Measurement:** units (no abbreviation).
- **Description:** A measure of hydrogen ion activity in water, or, in general terms, the acidity of water. pH is measured on a logarithmic scale of 0 to 14, with 7 being neutral. A high pH indicates alkaline (or basic) conditions and a low pH indicates acidic conditions. pH is influenced by geology and soils, organic acids (decaying leaves and other matter), and human-induced acids from acid rain (which typically has a pH of 3.5 to 5.5).
- **Importance:** pH affects many chemical and biological processes in the water and this is important to the survival and reproduction of fish and other aquatic life. Different organisms flourish within different ranges of pH. Measurements outside of an organism's preferred range can limit growth and reproduction and lead to physiological stress. Low pH can also affect the toxicity of aquatic compounds such as ammonia and certain metals by making them more "available" for uptake by aquatic plants and animals. This can produce conditions that are toxic to aquatic life.

Class A NH Surface Water Quality Standard: Between 6.5 and 8.0 (unless naturally occurring).

Class B NH Surface Water Quality Standard: Between 6.5 and 8.0 (unless naturally occurring).

Sometimes, readings that fall below this range are determined to be naturally occurring. This is often a result of wetlands near the sample station. Wetlands can lower pH because the tannic and humic acids released by decaying plants can cause water to become more acidic.

pH Units	Category
<5.0	High Impact
5.0 – 5.9	Moderate to High Impact
6.0 – 6.4	Normal; Low Impact
6.5 – 8.0	Normal
6.1 – 8.0	Satisfactory

Specific Conductance or Conductivity

- **Unit of Measurement:** micromhos per centimeter (umhos/cm) or microsiemens per centimeter (uS/cm).
- **Description:** The numerical expression of the ability of water to carry an electrical current at 25° C and a measure of free ion (charged particles) content in the water. These ions can come from natural sources such as bedrock, or human sources such as stormwater runoff. Specific conductance can be used to indicate the presence of chlorides, nitrates, sulfates, phosphates, sodium, magnesium, calcium, iron, and aluminum ions. There is a difference between conductivity and specific conductance. Specific conductance measures the free ion content of water at a *specific* water temperature, whereas conductivity measures the free ion content of water at 25° C. VRAP uses the term "specific conductance" because our conductivity measurements account for temperature. In some studies and programs, the term "conductivity" is used. This term should only be used when the measurement *does not* adjust to a specific temperature.
- **Importance:** Specific conductance readings can help locate potential pollution sources because polluted water usually has a higher specific conductance than unpolluted waters. High specific conductance values often indicate pollution from road salt, septic systems, wastewater treatment plants, or urban/agricultural runoff. Specific conductance can also be related to geology. In unpolluted rivers and streams, geology and groundwater are the primary influences on specific conductance levels.

Class A/B NH Surface Water Quality Standard: No numeric standard.

Although NH surface water quality standards do not contain numeric criteria for specific conductance, the NH Consolidated Assessment and Listing Methodology (CALM) allows for instantaneous specific conductance measurements to be used as a surrogate to predict compliance with numeric water quality criteria for chloride. NHDES has developed a statewide specific conductance to chloride relationship based on simultaneous measurement of specific conductance and chloride.

The Class B New Hampshire surface water quality standard for chloride and corresponding specific conductance measurements are as follows:

Freshwater chronic criterion	230 mg/l	835 uS/cm
Freshwater acute criterion	860 mg/l	2755 uS/cm

Specific Conductance *(uS/cm)*	Category
0 – 100	Normal
101 – 200	Low Impact
201 – 500	Moderate Impact
> 501	High Impact
>835	Exceeding chronic chloride standard

Turbidity

- **Unit of Measurement:** Nephelometric Turbidity Units (abbreviated at NTU).
- **Description:** A measurement of the amount of suspended material in the water. This material, which is comprised of particles such as clay, silt, algae, suspended sediment, and decaying plant material, causes light to be scattered and absorbed, rather than transmitted in straight lines through the water.
- **Importance:** Higher turbidity increases water temperatures because suspended particles absorb more heat. This, in turn, reduces dissolved oxygen (DO) concentrations because warm water holds less DO than cold water. Higher turbidity also reduces the amount of light that can penetrate the water, which reduces photosynthesis and DO production. Suspended materials can clog fish gills, reducing disease resistance, lowering growth rates, and affecting egg and larval development. As the particles settle, they can blanket the stream bottom, especially in slower waters, and smother fish eggs and benthic macroinvertebrates. Clean waters are generally associated with low turbidity, but there is a high degree of natural variability involved. Rain events can increase turbidity in surface waters by flushing sediment, organic matter and other materials into the water. Human activities such as vegetation removal and soil disruption can also lead to dramatic increases in turbidity levels.

Class A NH Surface Water Quality Standard: As naturally occurs.

Class B NH Surface Water Quality Standard: Shall not exceed naturally occurring conditions by more than 10 NTU.

Physical Parameters

Temperature

- **Unit of Measurement:** Degrees Celsius (° C)
- **Importance:** Water temperature is a critical parameter for aquatic life and has an impact on other water quality parameters such as dissolved oxygen concentrations, and bacteria activity in water. Water temperature controls the metabolic and reproductive processes of aquatic species and can determine which fish and macroinvertabrate species can survive in a given river or stream.

  A number of factors can have an impact on water temperature including the quantity and maturity of riparian vegetation, the rate of flow, the percent of impervious surfaces contributing stormwater, thermal discharges, impoundments and groundwater.

Class A NH Surface Water Quality Standard: No numeric standard; as naturally occurs.

Class B NH Surface Water Quality Standard: No numeric standard

Although there is currently no numerical water quality criteria for water temperature, NHDES is in the process of collecting biological and water temperature data that will contribute to the development of a procedure for assessing rivers and stream based on water temperature and its corresponding impact to the biological integrity of the waterbody.

Chlorophyll-a (Chlor a)

- **Unit of Measurement:** Milligrams per liter (mg/L).
- **Description:** An indicator of the biomass, or abundance, of planktonic algae in the river. The technical term "biomass" is used to represent "amount by weight." Chlorophyll-a can be strongly influenced by phosphorus, which is derived by natural and human activities.
- **Importance:** Because algae is a plant and contains the green pigment chlorophyll-a, the concentration of chlorophyll-a found in the water gives an estimation of the concentration of algae. If the chlorophyll-a concentration increases, this indicates an increase in the algal population.

Class A NH Surface Water Quality Standard: No numeric standard.

Class B NH Surface Water Quality Standard: No numeric standard.

Chlorophyll-a *(mg/L)*	**Category**
< 3	Excellent
3 – 7	Good
7 – 15	Less than desirable
> 15	Nuisance

Total Phosphorus (TP)

- **Unit of Measurement:** Milligrams per liter (mg/L).
- **Description:** A measure of all forms of phosphorus in the water, including inorganic and organic forms. There are many sources of phosphorus, both natural and human. These include soil and rocks, sewage, animal manure, fertilizer, erosion, and other types of contamination.
- **Importance:** Phosphorus is a nutrient that is essential to plants and animals. However, excess amounts can cause rapid increases in the biological activity in water. Phosphorus is usually the "limiting nutrient" in freshwater streams, which means relatively small amounts can increase algae and chlorophyll-a levels. Algal blooms and/or excessive aquatic plant growth can decrease oxygen levels and make water unattractive. Phosphorus can indicate the presence of septic systems, sewage, animal waste, lawn fertilizer, road and construction erosion, other types of pollution, or natural wetlands and atmospheric deposition.

Class A/B NH Surface Water Quality Standard: There is no numeric standard for total phosphorus for Class A/B waters. The narrative standard states that "unless naturally occurring, shall contain no phosphorus in such concentrations that would impair any existing or designated uses." New Hampshire's surface water regulations (Env-Wq 1700) for Class B waters include narrative criteria for phosphorus which state that "unless naturally occurring, shall contain no phosphorus in such concentrations that would impair any existing or designated uses". New Hampshire does not currently have numeric nutrient criteria for rivers and streams, but is in the process of developing them. Draft numeric nutrient criteria developed for Vermont and Maine surface waters indicate a maximum allowable summer mean phosphorus level of approximately 0.035 mg/L. Although this value is approximately two to three times typical natural background levels in many rivers and streams, it is considered protective of all designated uses (i.e., swimming, aquatic life, etc) in Vermont and Maine. It's possible that phosphorus criteria for New Hampshire rivers and streams will be similar.

Total Phosphorus *(mg/L)*	**Category**
< 0.010	Ideal
0.011 – 0.025	Average
0.026 – 0.049	More than desirable
≥ 0.050	Potential nuisance concentration

Total Kjeldahl Nitrogen (TKN)

- **Unit of Measurement:** Milligrams per liter (mg/L).
- **Description:** A measure of the amount of ammonia and organic nitrogen in the water.
- **Importance:** High nitrogen levels can increase algae and chlorophyll-a levels in the river, but is generally less of a concern in fresh water than phosphorus. Nitrogen can indicate the presence of sewage, animal waste, fertilizer, erosion, or other types of pollution.

Class A NH Surface Water Quality Standard: No numeric standard; as naturally occurs.

Class B NH Surface Water Quality Standard: No numeric standard; as naturally occurring, shall contain no nitrogen in such concentrations that would impair any existing or designated uses.

TKN *(mg/L)*	**Category**
< 0.25	Ideal
0.26 – 0.40	Average
0.41 – 0.49	More than desirable
≥ 0.50	Excessive (potential nuisance concentration)

Other Parameters

Chloride

- **Unit of Measurement:** Milligrams per liter (mg/L).
- **Description:** The chloride ion (Cl-) is found naturally in some surface waters and groundwater. It is also found in high concentrations in seawater. Higher-than-normal chloride concentrations in freshwater is detrimental to water quality. In New Hampshire, applying road salt for winter accident prevention is a large source of chloride to the environment. Unfortunately, this has increased over time due to road expansion and increased vehicle traffic. Road salt (most often sodium chloride) readily dissolves and enters aquatic environments in ionic forms. Although chloride can originate from natural sources, most of the chloride that enters the environment is associated with the storage and application of road salt. As such, chloride-containing compounds commonly enter surface water, soil, and groundwater during late-spring snowmelt (since the ground is frozen during much of the late winter and early spring). Sodium chloride is also used on foods as table salt, and consequently is present in human waste. Thus, sometimes chloride in water can indicate sewage pollution. Saltwater intrusion can also elevate groundwater chlorides in drinking water wells near coastlines. Chloride ions are conservative, which means they are not degraded in the environment and tend to remain in solution, once dissolved. Chloride ions that enter ground water can ultimately be expected to reach surface water and, therefore, influence aquatic environments and humans.
- **Importance:** Research shows elevated chloride levels can be toxic to freshwater aquatic life. Among the species tested, freshwater aquatic plants and invertebrates tend to be the most sensitive to chloride. In order to protect freshwater aquatic life in New Hampshire, the state has adopted acute and chronic chloride criteria.

Acute Standard: 860 mg/L.

Chronic Standard: 230 mg/L.

Escherichia Coliform Bacteria *(E. coli)*

- **Unit of Measurement:** Counts per 100 milliliter (cts/100 mL).
- **Description:** An indicator of the potential presence of pathogens in fresh water. *E. coli* bacteria is a normal component in the large intestines of humans and other warm-blooded animals, and can be excreted in their fecal material. Organisms causing infections or disease (pathogens) are often excreted in the fecal material of humans and other warm-blooded animals.
- **Importance:** *E.coli* bacteria is a good indicator of fecal pollution and the possible presence of pathogenic organisms. In freshwater, *E. coli* concentrations help determine if the water is safe for recreational uses such as swimming.

  Several factors can contribute to elevated *E. coli* levels, including, but not limited to rain storms, low river flows, the presence of wildlife, and the presence of septic systems along the river.

Class A NH Surface Water Quality Standard: Unless naturally occurring, shall contain not more than either a geometric mean of 47 *E.coli* cts/100 mL based on at least three samples obtained over a sixty-day period, or greater than 153 *E.coli* cts/100 mL in any one sample.

Class B NH Surface Water Quality Standard: Unless naturally occurring, shall contain not more than either a geometric mean of 126 *E.coli* cts/100 mL based on at least three samples obtained over a sixty-day period, or greater than 406 *E.coli* cts/100 mL in any one sample.

Metals

Depending on the metal concentration, its form (dissolved or particulate), and the hardness of the water, trace metals can be toxic to aquatic life. Metals in dissolved form are generally more toxic than metals in the particulate form. The dissolved metal concentration is dependent on pH, as well as the presence of solids and organic matter that can bind with the metal to render it less toxic.

Hardness is primarily a measure of the calcium and magnesium ion concentrations in water, expressed as calcium carbonate. The hardness concentration affects the toxicity of certain metals. New Hampshire water quality regulations include numeric criteria for a variety of metals. Since dissolved metals are typically found in extremely low concentrations, the potential contamination of samples collected for trace metals analyses has become a primary concern of water quality managers. To prevent such contamination and to ensure reliable results, the use of "clean techniques" is becoming more and more frequent when sampling for dissolved metals. Because of this, sampling for metals may be more costly and require additional effort than in the past.

New Hampshire Volunteer River Assessment Program

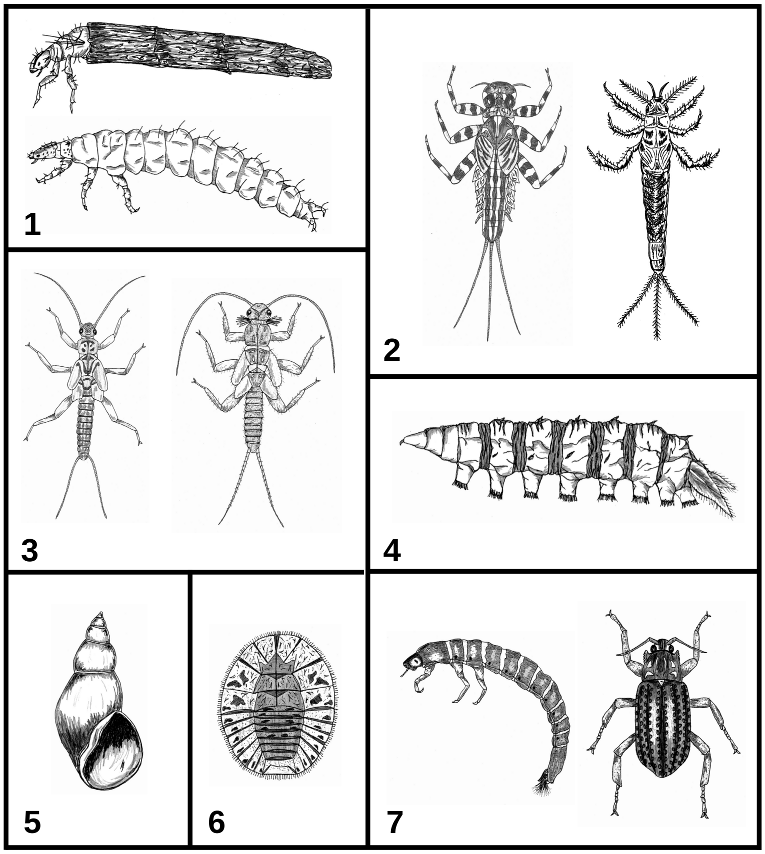
29 Hazen Drive – PO Box 95
Concord, NH 03302-0095
p (603) 271-0699 – f (603) 271-7894
http://des.nh.gov/organization/divisions/water/wmb/vrap/index.htm

2008 (Revised 2011)

Aquatic Macroinvertebrate Identification & Pollution Sensitivities

Sensitive to Pollution

These organisms are sensitive to pollution and indicate good water quality.



1 **Most Caddisflies: Order Trichoptera.** Up to 1”, 6 hooked legs on upper 1/3 of body, may be in stick, rock, or leaf case, no gill tufts on abdomen, intolerant of impairment.

2 **Mayfly: Order Emphemeroptera.** ¼” – 1”, plate-like or feathery gills on abdomen, 6 hooked legs, 2 or 3 long hair-like tails, tails may be webbed together, very intolerant of impairment.

3 **Stonefly: Order Plecoptera.** ½” – 1 ½”, 6 legs with hooked tips, antennae, 2 hair-like tails, no gills on abdomen, very intolerant of impairment.

4 **Watersnipe Fly: Order Diptera.** ¼” – 2”, body plump and maggot-like, caterpillar-like “legs” along body, feathery "horns" on end, intolerant of impairment.

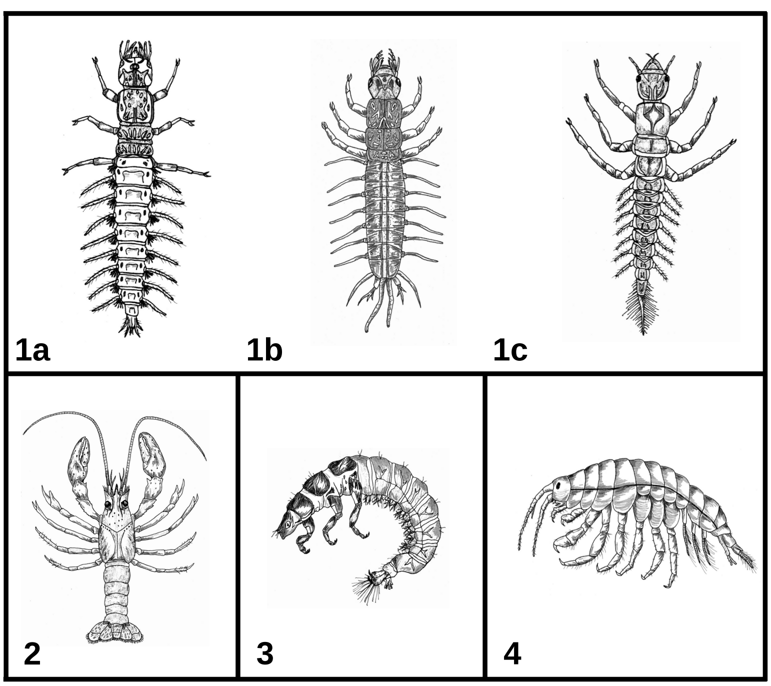
5 **Gilled Snails: Class Gastropoda.** Up to ¾”, shell opening covered by a thin plate called an operculum, with helix pointed up shell opens to the right, intolerant of impairment.

6 **Water Penny: Order Coleoptera.** ¼” – 1”, disk-like oval body with 6 small legs and gill tufts on underside, intolerant of impairment.

7 **Riffle Beetle: Order Coleoptera.** Small black beetle crawling on streambed OR comma-like brown “crunchy” body with 6 legs on upper 1/3 and possibly gill tuft on back end, intolerant of impairment.

Less Sensitive to Pollution

These organisms are somewhat sensitive to pollution and indicate fair water quality.

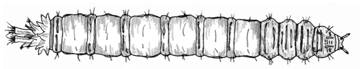


1 **Hellgrammite, Fishfly, and Alderfly: Order Megaloptera.** ¾” – 4”, 6 legs, large pinching jaws. **a)** 8 pairs of fleshy appendages along abdomen with gill tufts, 2 hooks on tail end, **b)** 8 pairs of fleshy appendages along abdomen without gill tufts, 2 tube-like appendages on tail end, **c)** 7 pairs of fleshy appendages without gill tufts, 1 single spiky tail; somewhat tolerant of impairment.

2 **Crayfish: Order Decapoda**. Up to 6”, 2 large claws, 8 legs, resembles a small lobster, somewhat tolerant of impairment.

3 **Common Netspinners: Family Hydropsychidae.** Up to ¾”, 6 hooked legs on upper 1/3 of body, 2 hooks at back end, white gill tufts on underside of abdomen, somewhat tolerant of impairment.

4 **Scud: Order Amphipoda.** ¼”, white to gray, body higher than it is wide, swims sideways, more than 6 legs, resembles small shrimp, somewhat tolerant of impairment.



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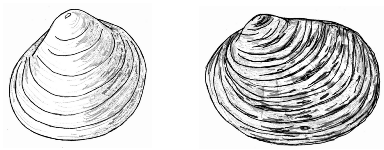

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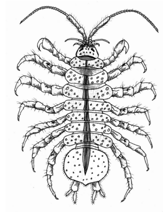

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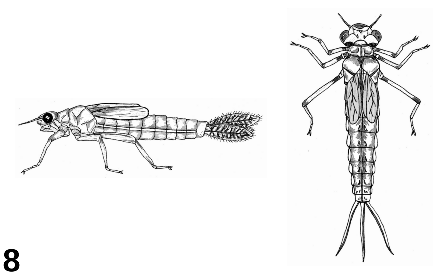

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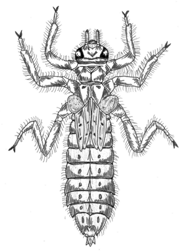

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5 **Crane Fly: Order Diptera.** ¼" – 2", bodies plump and maggotlike, caterpillar like "legs" along body, four lobes one end, tolerant of impairment.

6 **Clams and Mussels: Class Bivalvia.** Up to ¾", fleshy body enclosed between two clamped together shells (if clam is alive, shells cannot be pried apart without harming clam), somewhat tolerant of impairment.

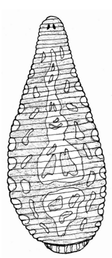
7 **Sowbug: Order Isopoda.** ¼" – ¾", gray oblong body wider than it is high, more than 6 legs, long antennae, somewhat tolerant of impairment.

8 **Damselfly: Order Odonata**. ½ " – 2", large eyes, 6 hooked legs, large protracting lower jaw, 3 broad oar-shaped tails, somewhat tolerant of impairment.

9 **Dragonfly: Order Odonata.** ½ " – 2", large eyes, 6 hooked legs, large protracting lower jaw, wide oval to round abdomen, somewhat tolerant of impairment.

Pollution Tolerant

These organisms are tolerant to pollution and indicate poor water quality.



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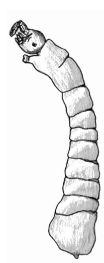

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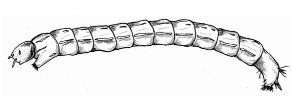

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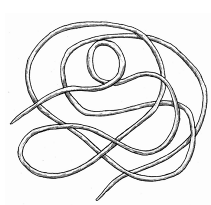

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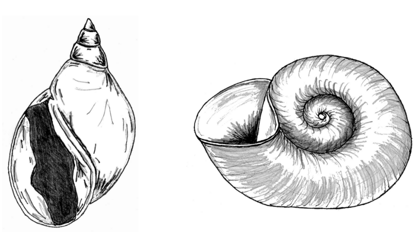

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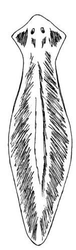

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1 **Leech: Order Hirudinea.** ¼" – 2", segmented body, suction cups on both ends, tolerant of impairment.

2 **Black Fly: Family Simuliidae.** Up to ¼", end of body wider (like bowling pin), distinctive head, sucker on end, tolerant of impairment.

3 **Midges: Family Chironomidae.** Up to ¼", distinct head, worm-like segmented body, 2 leg-like projections on each side, often whitish to clear, occasionally bright red, tolerant of impairment.

4 **Aquatic Worm: Class Oligocheata.** ¼" – 2", can be very tiny; thin, wormlike body, tolerant of impairment.

5 **Lunged Snails: Class Gastropoda.** Up to ¾", no operculum, with helix pointed up shell opens to the left, tolerant of impairment.

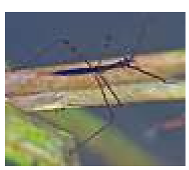
6 **Flat Worm: Family Planaridae.** Up to ¼", soft body, may have distinct head with eyespots, tolerant of impairment.

Aquatic Macroinvertebrate Fact Sheet

Coleoptera: Whirligig Beetle

Description: These oval metallic/black beetles are named because of the technique in which they swim when alarmed. Usually found in groups that swim together in quick circular movements on the waters surface. Whirligig beetles are also special because of the way in which they can see both on and below the surface of the water. Each one of their eyes are separated into two halves; one upper half to see above the water and one lower half to see below.
Distribution and Habitat: Whirligigs are commonly found swimming on calm waters like on lakes and ponds and sometimes hide within aquatic vegetation on the shoreline. However, adults may also swim below the surface to avoid predation.
Habits: These beetles feed mostly on smaller organisms, which make them predacious, but they also feed on floating material on the surface of the water.

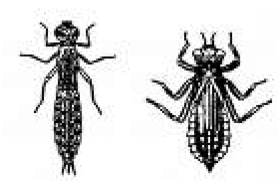
Hemiptera: Water scorpion



Description: These long thin insects have three pairs of legs but the foremost pair are modified to grasp prey. These specialized pair of legs is the reason they are called water scorpions; their front legs look similar to the stinger on land scorpions. The tail of the water scorpion, however, is a long tube that can bend over the back of the insect to get air from above the waters surface (like a snorkel!). They also have large round eyes on each side of their heads.
Distribution and Habitat: Widely distributed along North America. Water Scorpions tend to cling to aquatic vegetation in streams and ponds to have access to oxygen.

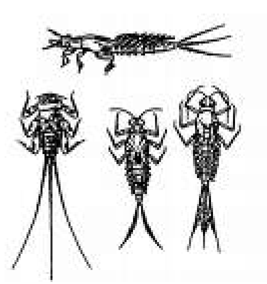
Habits: these insects are also predacious, feeding on other insects and sometimes small fish. They catch their prey by grasping onto vegetation with their second and third legs while keeping the first pair out until their prey comes by and with one quick strike they have their meal. Water Scorpions are pollution tolerant, which means that they can live in poorly oxygenated and polluted areas and are usually found in dense vegetation.

Odonata: Dragonfly Nymph

 Dragonfly Nymphs  Adult

Description: Dragonfly Nymphs have large eyes similar to the adult forms and short abdomens with a flat underside. Also they have their gills internally and expand and contrast their abdomen to obtain oxygen.
Distribution and Habitat: Widely distributed along North America. Dragonfly nymphs are usually found amongst aquatic vegetation or decaying organic material, resting on sandy bottoms or in between rocks, or burrowing in sand or mud of streams, ponds, marshes, lakes, or slow moving parts of rivers.
Habits: Dragonfly nymphs are predacious, preying primarily on mosquitoes, snails, tadpoles, and small fishes. The duration of the nymph stage may take 36 or up to a year before maturity.

Ephemeroptera: Mayfly Nymph

 Mayfly Nymphs  Adult

Description: Mayfly nymphs are usually dark colored, small and long to help them stay stationary in fast moving waters. They have two to three tails projection from the abdomen and gills located on the side of the abdomen that sometimes look like feathers.
Distribution and Habitat: Abundant in cool, clear streams and rivers. They tend to favor waters with high or medium oxygen levels. The vast differences in species

create a wide variety of life styles, for instance some species like to borrow in the mud while others prefer a more active life.
Habits: Mayfly nymphs tend to primarily feed on algae, organic debris, aquatic plants. However some have been found to be predaceous.

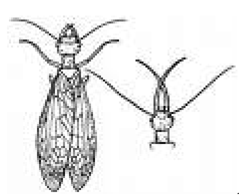
Trichoptera: Caddisfly

Caddisfly larva with cases


Adult and Juvenile

Description: Most larval forms of caddisflies build cases out of available materials such as sand, small pebbles, sticks, other organic materials; to provide protection from swift running water and predators. When out of their cases they have segmented worm like bodies connected to and abdomen with three pairs of legs, and head.
Distribution and Habitat: Larvae can be collected from various places from marshes and ponds to lakes and rivers, however they do like cold, unpolluted areas.
Habits: Cases are held together with silken strands to keep their structures stable. The larvae have chewing mouthparts to graze on aquatic plants and algae but also feed on diatoms, crustaceans, and other aquatic immature insects.

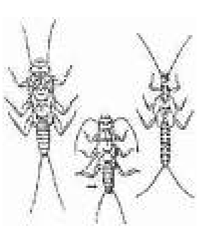
Neuroptera: Dobsonfly Larva


Adult

Description: Dobsonfly larvas are usually dark colored with three pairs of legs but eight pairs of feelers on the lower half of the body. They have large pinching jaws and two pairs of both tails and hooks at their back ends.

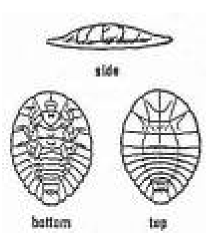
Distribution and Habitat: The larval forms of dobsonflies are often found underneath rocks and debris in fast flowing streams and rivers.
Habits:

Plecoptera: Stonefly Nymph

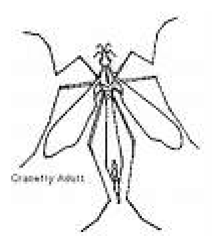
 Stonefly nymphs  Adult

Description: Stonefly nymphs are commonly flat bodied with long distinct antennae, two tails, and chewing mouthparts. Species common to the Northeast have yellow and dark brown to black markings.
Distribution and Habitat: Nymphs usually prefer to live along stream or river bottoms clinging to rocks. These insects are highly susceptible to the oxygen levels in the water; if the oxygen levels become too low then it is no longer suitable habitat for these insects.
Habits:

Coleoptera: Water Penny



Diptera: Cranefly Larva

 Cranefly larva 

Adult