

**General explanation of meaning of output from Geomorphic and Aquatic Organism  
Passage compatibility tools  
New Hampshire Geological Survey  
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Geomorphic compatibility tool output

Several parameters are collected in the field as part of the NH Stream Crossing Assessment Protocol that allow for a stream crossing to be scored for geomorphic compatibility. This score represents a stream crossing's (culvert or bridge) "fit" with natural stream channel form and sediment transport processes. Channel form refers to the overall shape of a river or stream channel in its floodplain and is determined by the slope of the channel and historical flow patterns. In the context of a stream crossing, the form of a channel refers to such features as the angle of entry approaching the crossing (is the channel relatively straight, or does it have bends), and integrity of the banks (held in place by vegetation, or exposed material able to be further eroded away). Sediment refers to the rock and sand that moves on the bed of a stream. Undersized stream crossings or crossings that are located on a sharp bed in the stream increase the potential for a stream's sediment load or other debris to accumulate in front of the culvert thereby reducing the ability to pass flow, and in the worst case, lead to a blowout during a storm. During floods in recent years in the Granite State, blowouts often occurred where stream crossings were incapable of sufficiently passing flood flows. Field data quantifies these parameters and allows for crossings to be rated on a scale from "fully compatible" to "fully incompatible," with three intermediate levels of partial compatibility. It is important to note that these ratings can be used as a planning tool to help prioritize where replacements or culvert upsizing activities may want to be focused on a river, in a town, or across a watershed. Refer to the *Geomorphic and Aquatic Organism Passage Screening Tool Summary* document for an in depth explanation of what parameters are used for the scoring

Determination of geomorphic compatibility categories applies to stream crossings that are on flowing waterbodies (i.e., rivers and streams). The compatibility determination protocols do not apply to crossings with wetlands on one or both sides of a crossing. A total of 5557 stream crossings have been scored for geomorphic compatibility.

**Fully Compatible**

These structures are fully compatible with river channel form and process, and are at a low risk of failure. Culvert replacement is not expected over the lifetime of the structure. When replaced, a structure similar to the current one is recommended. Culverts that rank in this category typically provide examples of the proper sizing and construction at sites where replacements are required to ensure compatibility with flow and sediment transport processes.

Based on the total number of crossings assessed in New Hampshire to date that have been scored for geomorphic compatibility, 10%, or 562 structures, fall into this category.

**Mostly Compatible**

These structures are mostly compatible with river channel form and process, and are at a low risk of failure. Culvert replacement is not expected over the lifetime of the structure. When replaced, minor design adjustments are recommended to make the culvert fully compatible with river form and process.

Based on the total number of crossings assessed in New Hampshire to date that have been scored for geomorphic compatibility, 36%, or 1999 structures, fall into this category.

**Partially Compatible**

These structures are either compatible with current form or process, but not both, with any compatibility only likely in the short term. Culvert replacement may be needed, given the moderate risk of failure during its design lifetime. When replaced, a redesign of the culvert installation is suggested to improve the compatibility of the culvert with river form and process.

Based on the total number of crossings assessed in New Hampshire to date that have been scored for geomorphic compatibility, 30%, or 1655 structures, fall into this category.

**Mostly Incompatible**

These structures are typically undersized for the river or stream channel that contains them, and/or are poorly aligned with the channel form, creating a condition where the structures are mostly incompatible with river form and process. As a result, these structures are at a moderate to high risk of structural failure. When replaced, a redesign of the culvert should be initiated to improve the geomorphic compatibility, and is a factor to be considered in long-term stream crossing replacement planning.

Based on the total number of crossings assessed in New Hampshire to date that have been scored for geomorphic compatibility, 22%, or 1216 structures, fall into this category.

**Fully Incompatible**

These structures are typically undersized for the river or stream channel that contains them, and/or are typically poorly aligned with the upstream channel form, while also showing a reduced ability to pass sediment through the crossing and an increased risk

for erosion. Crossings ranking in this category are not compatible with river form and process and are at a high risk of failure. Culverts ranking in this category should be prioritized for replacements to improve river process compatibility.

Based on the total number of crossings assessed in New Hampshire to date that have been scored for geomorphic compatibility, 2%, or 125 structures, fall into this category. Structures that fall into this category are primarily, located on tributary streams, toward the headwaters of a watershed. These are smaller streams that typically have steeper slopes and a greater potential for a stream crossing to experience increased material accumulation on the upstream side. Several other fully incompatible crossings are located in urban areas on highly modified streams.

### **Aquatic organisms passage (AOP) compatibility tool output**

Each culvert is designated an Aquatic Organism Passage score based on the analysis of the culvert data parameters. A crossing is assigned to one of four categories: “Full Passage,” “Reduced Passage,” “Passage Only for Adult Trout” and “No Passage.” This criterion is designed to assess a crossing’s overall ability to pass aquatic organisms (particularly fish). While the exact site situation of each culvert will influence specific features that impact the ability of a culvert to efficiently pass aquatic organisms, in general, the information below provides guidance on what each category indicates regarding the long-term compatibility. A total of 7551 crossings have been scored for Aquatic Organism Passage.

#### **Full Passage**

Stream crossings in this category have one culvert with an outlet that is at grade with the channel bed downstream with no drop, or the culvert is backwatered, such that aquatic organisms can freely swim through it; have sediment throughout the structure; and, have an upstream structure opening that is not obstructed. Essentially, the crossing is functionally no different than the river/stream channel, thereby allowing aquatic organisms to fully pass through. All of the above features are required to allow all fish and aquatic species to pass through a crossing. Obstruction at the upstream end of the culvert constrains the passage of some aquatic organisms. Additionally, multiple culvert pipes or cells cannot be present as crossings with more than one cell can increase the presence of obstructions and confuse fish.

Based on the total number of crossings assessed in New Hampshire to date that have been scored for aquatic organism passage compatibility, 22%, or 1643 structures, fall into this category.

#### **Reduced Passage**

Stream crossings in this category can have any of the following conditions, either individually or in combination with each other: (1) have a culvert outlet where flow cascades into the river/stream channel directly downstream of it; (2) have more than

one culvert at a crossing; (3) have an upstream structure opening that has some type of obstruction; or (4) a culvert where sediment is not present throughout the structure. These are factors that work to potentially limit AOP for some species or life stages. Culverts in this category might pass strong and moderate swimming fish in certain flow conditions.

Based on the total number of crossings assessed in New Hampshire to date that have been scored for AOP compatibility, 50%, or 3742 structures, fall into this category, showing that half of all crossings fall into a reduced condition for aquatic organism passage.

**Passage Only for Adult Trout**

Stream crossings in this category have a free fall outlet and a measureable drop directly downstream of the culvert that is less than or equal to 1 foot as adult salmonid species can generally leap up to this height. Additionally, cases where a deep pool exists directly downstream of the culvert are placed into this category since salmonid species could jump into the culvert.

Based on the total number of crossings assessed in New Hampshire to date that have been scored for aquatic organism passage compatibility, 3%, or 225 structures, fall into this category.

**No Passage**

Stream crossings in this category have a free fall outlet and a measureable drop directly downstream of the culvert that is greater than 1 foot, or have no downstream pool present. Crossings are also placed into this category if the downstream pool has a depth at the point of entry that is less than the outlet drop height, or if the water depth in the culvert at the outlet is less than 0.3 feet.

Based on the total number of crossings assessed in New Hampshire to date that have been scored for aquatic organism passage compatibility, 26%, or 1941 structures, fall into this category.