

## **IRST Responses to AMPC Questions Regarding Sediment Modeling Accuracy**

### **AMPC Question 1:**

**In an absolute sense, what would be an estimate of the level of confidence (or any other appropriate form of error analysis) of the modeled sediment delivery to streams (either in total volume or density) as put forth in the IRST proposal? In other words, how much confidence could one place in those results to develop public policy and/or rules pertaining to sediment delivery?**

### **IRST Response:**

- We only found a handful of studies that compared modeled to locally measured values. Faubion reported a 95% underestimation of annual sediment yield by the WEPP:Road model in one locale, Skaugset et al. (2010) reported a 200-800% overestimation among several models and locations, and Bohle and Dube (2016) reported a 5,700%-8,900% overestimate by the WARSEM model in one locale.
- Based on these studies, modeled estimates of road sediment delivery to streams are generally not reliable in an absolute sense at the site (road segment) scale nor at broader scales as well. Therefore confidence in using these absolute values for public policy or rules pertaining to sediment delivery is low.
- Absolute quantity modeling may be inaccurate because modeled precipitation events, road slope, substrate and other factors do not precisely fit local conditions.
- Absolute sediment quantities from road-stream hydrologic connectivity (RSHC) are not practically obtainable, except by measuring rather than modeling. This is done by catching eroded sediment in buckets, sediment troughs, or behind silt fences. However these methods are too expensive and labor-intensive to be conducted at a statewide scale. Further, measured amounts would be accurate for the time period sampled, but sediment yield varies strongly with the distribution and intensity of runoff-producing storms and snowmelt and traffic intensity, and these factors can vary greatly over days to decades.

### **AMPC Question 2:**

**In a relative sense (e.g. between streams within a common watershed or across different watershed exhibiting differing soil and geological characteristics or across different landowner types or geographic regions) how much confidence, as described above, can one place in the results of a sediment analysis? In other words, if one was comparing different watersheds, or even portions of the same watershed with differing soil and/or geological characteristics, could one draw any**

**substantive conclusions about sediment delivery? In what ways could such conclusions be effectively utilized with a high level of confidence?**

IRST Response:

- Based on the limited literature available, it appears that models should be able to provide reliable relative estimates of road sediment delivery for the same set of sites monitored over time, and models may also provide reliable relative estimates for sites within a particular geographic locale. Models do not appear to be able to provide reliable relative estimates between different geographic locales.
- Dubé et al (2010) stated that “...models are useful for comparing trends in sediment production through time in response to changes in road conditions.” This statement appears to be based on a logical deduction that if the same set of sites are compared over time, essentially holding most environmental factors constant, models should be able to provide reliable *relative* estimates of the impacts of changes in road conditions.
- Dubé et al (2011) compared modeled to measured sediment delivery using 4 models across 6 locales and concluded that the models generally did a good job of predicting relative differences among segments in a single locale. Looking at the relationship between modeled and measured values, where an ideal slope would be 1, the GRAIP model had slopes of 0.88-0.99 for 4 of 6 locales (0.38 and 0.46 for the other two). The other 3 models (SEDMODL2, WEPP:Road, WEPP:Watershed) had slopes better than  $\pm 0.5$  for 3-4 locales.
- Skaugset et al. (2011) did not look at slope consistency but rather ranked sites modeled versus measured sediment delivery within each of their 2 locales. They found that “...the erosion models could not consistently identify the road segments that were the top sediment producers [and they] hypothesized that the regionalized parameters used as inputs for the models do not adequately characterize the hydrology of the individual road segments.”

AMPC Question 3:

**For our proposed modified Option 1 (Hydrologic Connectivity only + gathering data for sediment delivery), is gathering the additional data that would be needed for sediment delivery informative for other aspects of the hydrologic connectivity study if a sediment delivery computer model is not run? In other words, is that data worthwhile to gather for either present or future use? (It is common to gather data as part of an initial study, archive that data, and then use it in a future study when funding, time, expertise, and/or technology are available to be brought to bear on**

**such an analysis.) However, if minimal benefit is seen, then we should not pursue this additional data collection and incur additional cost.**

IRST Response:

- Sediment modeling data provides valuable insights into RSHC beyond the simple “length of connected road,” including factors such as road width, surfacing, gradients, cut and fill heights, traffic levels, and so on, that can affect the degree of connectivity, runoff erosion, and sediment delivery. These variables and the sediment estimates derived from them may help demonstrate that not only is connectivity being reduced through time, but the road segments in a watershed that are likely to generate and deliver the most sediment are being addressed.
- The incremental cost to collect data for modeling is expected to be low, but it is difficult to estimate without a pilot field-data gathering exercise. The bulk of the cost difference described for Option 1 vs. Option 2 in our scoping proposal related to the time needed to set up and run the selected sediment estimation model.

AMPC Question 4:

**If AMPC decides to recommend Option 2, are there limitations, and if so, what are they for how the sediment results can be interpreted and utilized?**

IRST Response:

- Modeled estimates of the amount of sediment delivered by roads in watersheds of each landowner category and geographic area will be suitable for establishing the current status (baseline conditions) of road sediment delivery after the first sampling event, and trends over time after subsequent sampling events. Results will be best suited for describing trends over time in a relative sense (e.g., the amount of delivered sediment is decreasing in proportion to the reduction in RSHC), and poorly suited for attributing absolute amounts and fate of eroded sediments, and minimally effective for predicting impacts to fish and amphibian habitats and populations.
- Because of the potential inaccuracy of sediment models, particularly without local calibration to measured values, we believe it is inadvisable to use their results to establish specific performance targets for all forest roads.