



Forest Service
U.S. DEPARTMENT OF AGRICULTURE

Rocky Mountain Research Station Science You Can Use *Tools*

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GRAIP-Lite: Taking the Easy Street to Road Erosion Estimates

When land managers or planners need to understand how a segment of a forest road is impacting water quality, the Geomorphic Road Analysis and Inventory Package (GRAIP) is the go-to resource, with in-depth tools for intensive analysis. However, GRAIP's use is limited to road segments where detailed field data are available or when analyzing high-risk roads within priority watersheds. With the National Forest System having over 380,000 miles of roads, that's a lot of mileage that can't be easily analyzed with GRAIP. For situations where field data are unavailable or entire watersheds need analysis, GRAIP_Lite is a new go-to resource.

From fine-scale observations to landscape-level

GRAIP_Lite is based upon the work that Charlie Luce, Tom Black, and Nathan Nelson, who are research

scientists with the Rocky Mountain Research Station, have done through their decades-long careers—driving miles and miles of forest roads and observing how roads are delivering sediment to streams.

“GRAIP_Lite is taking the set of road surveys that we did for GRAIP, extrapolating the relationships between roads, streams, and sediment delivery, and expanding it to the landscape-scale,” says Luce. “Instead of seeing the roads at 5- or 1-meter segments, users can get estimates at the watershed or project-scale.”

In the absence of erosion-specific field data, the model uses information in a Forest Service road database, such as road location, engineering standard, and traffic volume along with a digital elevation model to predict sediment delivery to streams, as well as road maintenance needs.

“GRAIP_Lite was designed to predict road sediment delivery to streams in a similar manner to GRAIP without requiring as much field effort,” explains Black. “It was designed to leverage existing road data along with limited calibration to predict sediment delivery quickly and efficiently.”

GRAIP and GRAIP_Lite are designed to be complementary. For example, after running GRAIP_Lite on an entire watershed to identify the roads with erosion issues, managers can conduct field surveys and run GRAIP for a more specific smaller watershed to better prioritize where to concentrate their work.

Additional management applications

Luce and Black anticipated GRAIP_Lite would be used primarily for NEPA, but they've heard that it's useful



In watersheds, reducing road sediment to protect water quality and fish habitat, and extending the life of the road, are management priorities. However, across large-scale watersheds, detailed field data may be lacking for most roads, and managers won't have a complete picture of where erosion is occurring. USDA Forest Service photo by Ian Bell.



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to answer other management questions. “It’s getting used when a new Collaborative Forest Landscape Restoration Program project is started,” Black says. “The collaboratives are using GRAIP_Lite for large-scale assessments. It’s also been used at a broader scale for the watershed condition framework.”

Luce has also been told GRAIP_Lite is being used for forest plan monitoring to evaluate changes over time. “They can take the road coverage from the 1990s and contrast it with current road coverages, then run GRAIP_Lite to look at what’s changed,” he explains. This allows managers to evaluate how well they selected roads to treat and how they responded.

GRAIP_Lite will be updated as needed; for example, landslide risk was added to the model last year. This resource also benefits other agencies with a vested interest in reducing sediment into waterways: The Environmental Protection Agency paid for the programming to turn the researchers’ ideas and data into GRAIP_Lite.

“The questions of how agencies should manage sediment has gone to the Supreme Court during our careers,” Black says. “It’s worth us spending part of our careers investigating this topic that is important to the Forest Service and public as well.”

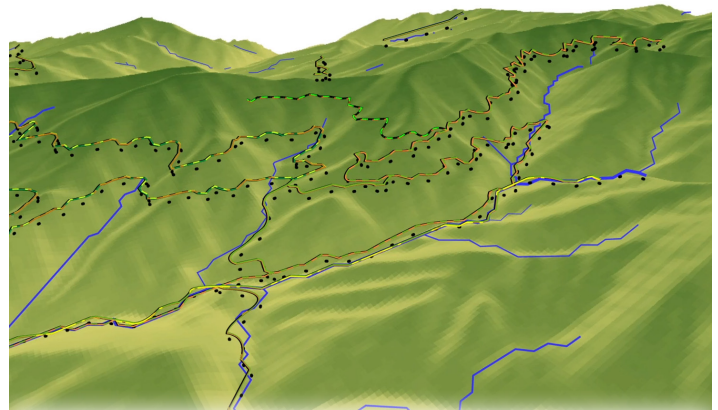
FURTHER READING

Nelson, Nathan; Luce, Charles; Black, Thomas. 2019. [GRAIP_Lite: A system for road impact assessment \(model manual\)](#). 145 p.

Black, Thomas; Luce, Charles; Nelson, Nathan. 2021. [Prioritizing road restoration for aquatic ecosystems using inventories and models](#). Society for Ecological Research News. 35(1): 15–23.

Luce, Charles; Nelson, Nathan; Black, Thomas; Dunham, Jason; Hirsch, Christine; Hockman-Wert, David. 2022. [Evaluating large-scale long-term forest road restoration effects on public lands in the Northwestern United States](#). AGU Fall Meeting; 12–16 December, 2022; Chicago, IL. American Geophysical Union.

Andrea Watts is the author of this Science You Can Use



GRAIP and GRAIP_Lite are complementary tools that can identify which roads have erosion issues. GRAIP_Lite provides coarse level detail of which roads have erosion issues, and GRAIP can provide information on the specific road segment.

KEY MANAGEMENT CONSIDERATIONS

The Geomorphic Road Analysis and Inventory Package (GRAIP) is a manager resource for in-depth and intensive analysis of how a segment of a forest road is impacting water quality. GRAIP can be found at <https://www.fs.usda.gov/research/rmrs/projects/graip>.

- GRAIP_Lite provides an efficient alternative to detailed road inventory methods to analyze large projects or across many basins, at scales where field inventories are not feasible. GRAIP_Lite can be found at <https://www.fs.usda.gov/research/rmrs/projects/graiplite#overview>.
- Road design alternatives can be simulated and compared to minimize sediment impacts on streams.
- Road sediment can be rapidly modeled and visualized for NEPA management alternative analysis.
- The success of management objectives can be monitored by comparing model results from historic road maps versus contemporary road maps.

PROJECT LEADS

Charlie Luce is a Research Hydrologist with the Rocky Mountain Research Station. His research focus is on the effects of climate change, land management, and wildfire on water resources and forest and aquatic ecology.

Tom Black is a Hydrologist with the Rocky Mountain Research Station. Black’s current research focus is investigating how road systems interact with and impact stream networks.

Nathan Nelson is a Geologist with the Rocky Mountain Research Station.

The Rocky Mountain Research Station is one of seven units within USDA Forest Service Research & Development. RMRS maintains 14 field laboratories throughout a 12-state geography encompassing parts of the Great Basin, Southwest, Rocky Mountains, and the Great Plains. While anchored in the geography of the West, our research is global in scale. RMRS also administers and conducts research on 14 experimental forests, ranges and watersheds and maintains long-term research databases for these areas. Our science improves lives and landscapes. More information about Forest Service research in the Rocky Mountain Region can be found here: <https://www.fs.usda.gov/research/rmrs/>.

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