APPLICATION OF UNDERWATER CAMERAS FOR MAIN CHANNEL BED MATERIAL GRADATION DETERMINATION ON A LARGE RIVER SEASONALLY SUPPLIED BY GLACIAL RUNOFF

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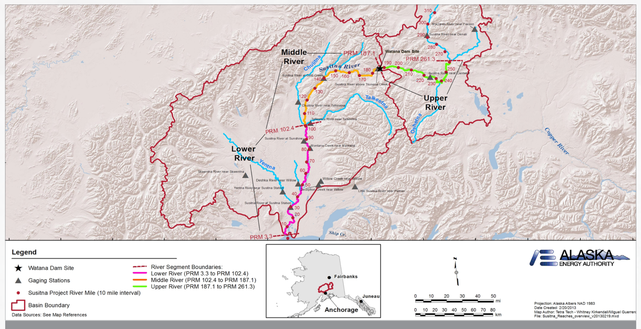
Background

Bed-material sampling was conducted for 300+ miles of the Susitna River's bar heads and banks and its major tributaries as part of the Geomorphology Studies for Alaska Energy Authority's Susitna-Watana Hydroelectric Project.



Map of the study area

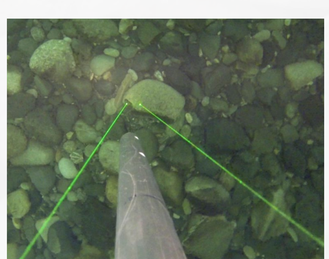
Materials in shallow or non-main channel locations are typically less coarse than those of main channels. Determining main channel grain sizes was previously infeasible due to deep, swift, and turbid summertime glacial inflows, and material sizes too large for physical sample collection.

Main Channel

Exposed Bar

Acquisitions of main channel gradations is important for determining whether bar head gradations collected in the shallower portions of the main channel are characteristic of the deepest portions of main channel material and to support 1-D and 2-D bed evolution models used to further the understanding of river morphologies. In order to obtain main channel bed material gradations, novel winter sampling techniques were developed to obtain bed material images by lowering underwater cameras through augered holes in river ice and post process those images.

High turbidity and low visibility during the open-water period



Low turbidity and high visibility during the ice-covered period

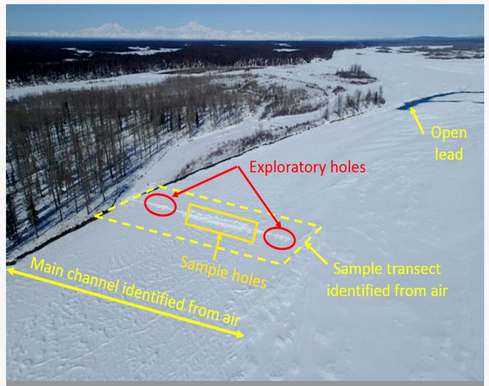
Method

- Sampling conducted March 17 - April 4, 2014 for the main channel of the Susitna River, and at locations on the Chulitna River and Talkeetna River
- Bed material sample videos were obtained at transect locations, at which multiple holes were augered through the river ice and an underwater camera mounted to an aluminum pole was lowered through the holes.
- Extracted video stillframe photographs were rectified by photogrammetric post-processing techniques in order to more precisely determine the size of individual bed material particles by removing camera lens distortion and determining measurement scales for the photographs.
- Particle sizes were measured and used to determine grain size distributions and grain size descriptor (i.e. D16, D50, D84, and D90) values for each transect.

Sample Video

Use the QR code or YouTube link to view a video of bed material samples.

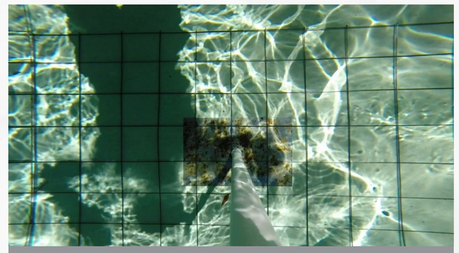
https://youtu.be/v79bMJv4Vfs



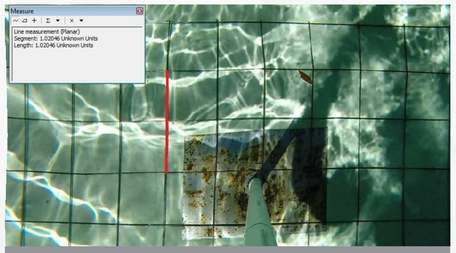
Aerial view of typical sample transect

Underwater camera equipment

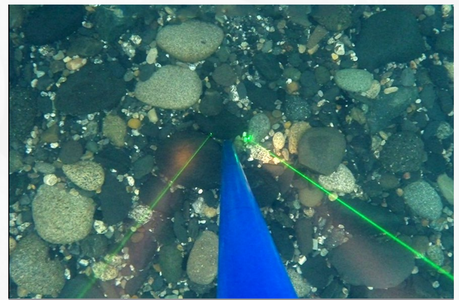
Lowering camera equipment through river ice



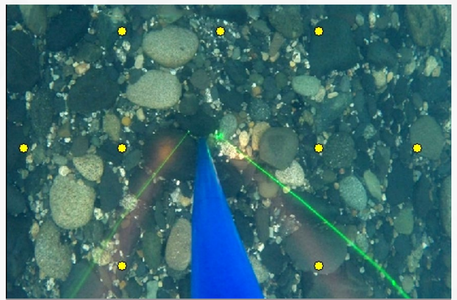
Unrectified photo shows distortion of square calibration grid cells



Rectified photo showing square grid cells



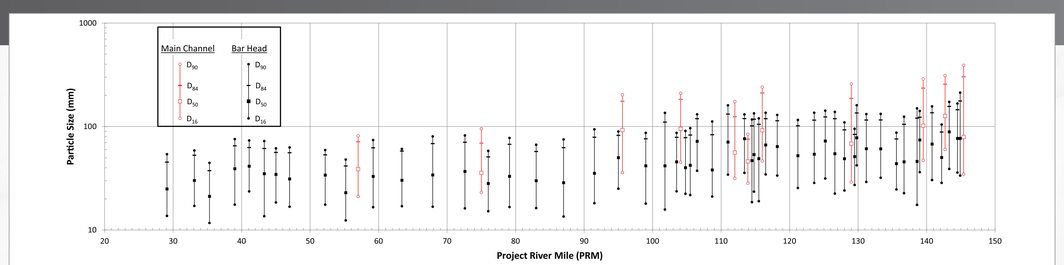
Bed Material Photo



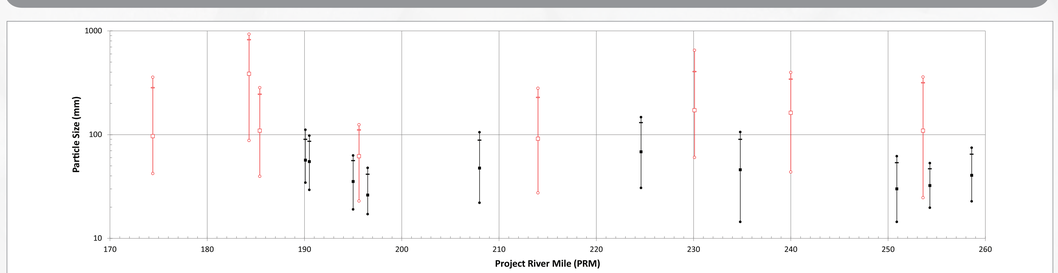
Calibrated and Rectified Bed Material Photo

Results

Main channel bed materials for the Upper, Middle, and upstream-most geomorphic reach of the Lower Susitna River are appreciably larger than those at bar heads and banks. However, main channel bed material further downstream in the Lower River are similar to the bar head and shallower portions of the channel.



Size descriptors for Lower River and Middle River main channel and bar head sample locations



Size descriptors for Middle River and Upper River main channel and bar head sample location

Conclusions

Acquisition and processing of main channel bed material photographic samples during the 2013/14 study period was successful. The grain size distribution data obtained from this task are being incorporated into 1-D and 2-D bed evolution modeling efforts.