Final Performance Report

Project Title: Understanding the Effects of Roadways on the Movement of Groundwater through Peatland Habitat.

F13AC00360

Recipient Project Officer: Jean M. Bahr, University of Wisconsin – Madison.

Project Title: Understanding the Effects of Roadways on the Movement of Groundwater through Peatland Habitat.

The overall results and conclusions of this project are detailed in the M.S. Thesis by Megan Haserodt, sent as a separate attachment along with this report. Also sent as separate attachments are 1) a technical memorandum summarizing project conclusions, prepared by Megan for the Kenai Peninsula Fish Habitat Partnership and 2) copies of the powerpoint slides from her thesis defense.

A comparison of the project goals and objectives is summarized below.

1) Goal: Quantify the basic hydraulic and water chemistry parameters above and below the road crossing and at various depths at in the groundwater profile.
   Accomplishments: Extensive hydraulic and water chemistry data were collected at two sites (N and P) described in the thesis and these data were used to constrain conceptual models of the groundwater flow systems at the sites and the impacts of the roads. Close to fifty wells were installed between both of the sites. These wells were regularly sampled for field chemistry parameters. Groundwater and stream water samples were submitted for stable isotope and major ions analysis.
2) Goal: Relate stream discharge at the study site to variability in groundwater flow.
   Accomplishments: Stream flow and stage records as well as water level records were collected at the two sites and used to constrain conceptual and numerical models of the interactions between the groundwater system and stream flow. Additional seepage measurements in the streambed were attempted. The peat substrate did not provide an adequate seal and the seepage data were not accurate. However, the modeling results did provide groundwater flux estimates for each stream segment (5 – 10 ft long) modeled. The model results confirmed the field results for road impacts to stream discharge.
3) Goal: Monitor water level and stream flow response to precipitation.
   Accomplishments: Stream state and water level records were compared to precipitation measured at the two sites to assess the responses of both streamflow and groundwater to precipitation events.
4) Goal: Create a numerical groundwater model of the shallow flow regime.
   Accomplishments: Numerical models were developed for each site and calibrated using field data.
5) Goal: Quantify the extent of impact due to a road crossing.

Accomplishments: The modeling and field results suggested that the type and extent of road impacts was a function of the relationship between stream and road orientations and valley geometry. The field data and models results confirmed that groundwater inputs were reduced directly under a road when the road and stream were in a perpendicular configuration. Overall, impacts are relatively limited where the road crosses perpendicular to the stream. More significant impacts occur when the road is oriented parallel to the stream. The groundwater flux to the stream was reduced when the parallel stream was within a certain proximity to the road. Field data showed a substantial warming of ditched water along the road. The subsequent transport of this water across the road was a source of thermal pollution to the stream.

6) Goal: Model possible mitigation options.
   Accomplishments: The mitigation options suggested could not be modeled, per se. The mitigation measures focused more on reducing the thermal impact of the ditches capturing groundwater. The groundwater flow models only predicted changes to the groundwater flow system. These changes were interpreted within the context of field data to understand what that meant for stream temperature. The mitigation ideas discussed included vegetating the ditch to reduce direct sunlight, using a more porous roadbed, making the ditch more like a French drain, and simply allowing a large enough buffer between the culvert outlet and stream to eliminate direct input of ditch water to the stream and allow for re-infiltration into the groundwater system.
7) Goal: Increase local interest in groundwater issues at the college level through student involvement and educational materials.
   Accomplishments: A University of Alaska Anchorage student was hired as a field assistant to Megan Haserodt during the 2013 summer field season. The experience counted toward an internship requirement for her program. A local Sterling resident was hired to help during the 2014 summer field season. The Sterling resident was involved for promoting outdoor education in Peninsula schools. He was provided with several of the well construction materials and a rain gauge to use in local elementary schools. Megan Haserodt discussed possibilities for using the wells for an educational experience and also provided him with a USGS groundwater publication for children.