Technical Report No. 13-03

Alaska Blasting Standard for the Proper Protection of Fish

by

Jackie Timothy

November 2013

Alaska Department of Fish and Game Division of Habitat

ED_004715_00052711-00001

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ALASKA BLASTING STANDARD FOR THE PROPER PROTECTION OF FISH

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This investigation was financed by the Alaska Department of Natural Resources and the Alaska Department of Fish and Game.

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This document should be cited as:
Timothy, J. 2013. Alaska blasting standard for the proper protection of fish. Alaska Department of Fish and Game, Technical Report No. 13-03, Douglas, Alaska.

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ACKNOWLEDGEMENTS

I thank Carol Goularte, U.S.D.A. Forest Service Sitka District Ranger, who first presented the Fish Bay and Duffield Peninsula fish passage restoration projects as an opportunity for federal and state cooperation. Since that day in 2005, her staff and my staff have worked side by side in the field improving fish passage across the Tongass National Forest in southeast Alaska.

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EXECUTIVE SUMMARY

BACKGROUND

The State of Alaska Department of Fish and Game (ADF&G) Division of Habitat reviews and permits, when appropriate, blasting activities in or near anadromous water bodies per AS 16.05.871(b), and in or near resident fish water bodies per AS 16.05.841. In 1991, ADF&G produced a *draft* Blasting Standard for the Protection of Fish (ADF&G 1991) that limited blast-induced pressures in the water column and vibrations in the spawning gravels to levels below those known to be harmful to fish.

In 2005, the ADF&G Division of Habitat Southeast Region began a cooperative fish passage restoration study with the U.S. Forest Service Sitka Ranger District to assess the effects of blasts on fish and fish habitat when explosives are used to remove failed instream structures placed during legacy timber harvests in areas no longer accessible to construction machinery. We wanted to determine if improving access to upstream fish habitat over the long term was worth the short term impact to fish and fish habitat from the blast. At the conclusion of the study, the answer was clearly yes. Vegetation and bank disruption occurred within about a 40 ft blast radius, fish access to upstream habitats was immediate, and pieces of demolished structures began functioning as large woody debris (Edwards 2005). The pulse of suspended sediments in the water column caused by the blast dissipated quickly (R. J. Miller, Fisheries Biologist, U.S.D.A. Forest Service, Sitka, personal communication). ADF&G habitat biologists documented riparian recovery within two years.

During the cooperative study, the Division of Habitat funded a graduate student and participated on the graduate committee with the University of Alaska Fairbanks School of Fisheries and Ocean Sciences to investigate how the ADF&G 1991 *draft* blasting standard could be applied to instream blasting projects. The graduate student developed an attenuation model for log stringer bridge and culvert removal to determine the rate of overpressure and vibration decay in salmonid habitat, and published the results in a 2009 graduate thesis (Dunlap 2009). The thesis includes a literature review, summarizes the effects of blasting on salmonids, and concludes that the 1991 *draft* blasting standard limits are below pressures and vibrations causing mortality to salmonids in other studies.

The Division of Habitat contracted an even more in-depth review in 2012 that describes the physiological effects of blasting on salmonids and salmonid embryos and summarizes empirical studies that examine what pressure and vibration levels cause harm (Kolden and Aimone-Martin 2013). The final report recommends changes to the guidelines in the 1991 *draft* blasting standard and encourages further research in the field.

BEST MANAGEMENT PRACTICES

The following measures to protect fish and embryos from the effects of blasting have been selected from a review of United States and Canadian mitigation techniques and applications.[1]

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[1] Kristen Kolden, Alaska Seismic & Environmental to Jackie Timothy, ADF&G, June 27, 2013, memorandum and management considerations for blasting near fish and fish habitat report.

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During the review of a Fish Habitat Permit application to blast in or near a fish bearing water body, the habitat biologist and applicant, each within their area of expertise, will seek to avoid impacts to fish and embryos.

The habitat biologist will provide a description of the

- location of spawning beds, rearing areas, and migration corridors, and
- species and life stages of fish using the habitat when the blast is proposed.

The applicant will provide a description of the

- blasting locations,
- estimated number of blasts,
- estimated maximum charge weight per delay,
- distance between the blasting locations and each habitat type,
- predicted maximum overpressures in the water column, and
- predicted peak particle velocities that will occur in spawning gravels.

The applicant and habitat biologist will work together to determine the

- methods that will be used to **avoid** the impacts of blasting on fish, including
  - using alternatives to blasting, or
  - scheduling blasting when fish and embryos are not present.
- methods that will be used to **minimize** the impacts of blasting on fish, including
  - scheduling blasting to avoid sensitive life stages,
  - removing fish from the area and blocking them from the zone of impact,
  - waiting until epiboly is complete if embryos are present in the gravel,
  - scheduling blasting to avoid fish migrations,
  - hazing fish from an area prior to blasting,[2]
  - isolating or dewatering the work area,
  - creating pressure wave interference,[3]
  - using controlled blasting techniques following industry best management practices,
  - surveying for debris and stream blocks after blasting and restoring fish passage,
  - resloping, restoring, and revegetating disturbed streambanks, and
  - removing all shock tube, explosive packaging, and wires from the worksite.
- methods that will be used to **mitigate**[4] the impacts of blasting on fish, including

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[2] Audible thresholds for fish can vary between species so sounds may need to be species specific. See footnote 1.

[3] The use of bubble curtains is impractical in some situations. See footnote 1.

[4] The ADF&G definition of mitigation is found at 5 AAC 95.011.

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- monitoring overpressures in the water column, or vibrations in spawning gravels, when blasting in or near a water body and predicted pressures and vibrations might cause fish or embryo injury or mortality.[5]

2013 BLASTING STANDARD

The 2013 blasting standard will be applied to projects where the impacts of blasting on fish and embryos in fish bearing water bodies cannot be avoided and must be minimized and mitigated.

> *Hydrophones used to monitor pressures and geophones used to monitor vibrations will be placed in the appropriate habitats as close to the point of detonation as possible without damaging the equipment. The instantaneous pressure rise in the water column in rearing habitat and migration corridors is limited to no more than **7.3 psi** where fish are present. Peak particle velocities in spawning gravels are limited to no more than **2.0 in/s** during the early stages of embryo incubation before epiboly is complete.*

The 2013 blasting standard is based on 20 years of research and technological advances that provide accurate data on pressures and vibrations generated by an explosion. The standard is below levels that have been shown to cause injury or mortality to salmonids and salmonid embryos and provides a baseline for pressure and vibration monitoring that will aid ADF&G in assessing the effectiveness of the standard to properly protect fish and embryos.

FISH HABITAT PERMIT

The Fish Habitat Permit for a project with a blasting component should require the applicant to notify the habitat biologist at least 48 hours prior to blasting, and allow the habitat biologist access at all reasonable times for the purpose of inspecting work performed under the permit. The Fish Habitat Permit for a qualifying blasting project[6] should also require the submission of monitoring reports at intervals appropriate for the project.

For the monitoring information to be accurate, we recommend the equipment is equal to, or more effective than, triaxial geophones that monitor 1,024 samples per second and hydrophones that monitor 65,000 samples per second. Reports should include

- seismograph serial number, sensor type, and calibration date of all equipment,
- recording mode, trigger level, and sample rate,
- number of blasts,
- upstream and downstream sensor orientation with actual and scaled blast distances,
- date and time of shot,
- maximum charge weight per delay,
- overpressure time-history plot with peak overpressure,
- peak particle velocity, frequency at peak particle velocity, and predominant frequency,

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[5] The applicant can conduct site-specific attenuation modeling in the early stages of large scale blasting activities by measuring overpressures and velocities in a linear array for increasing charge sizes and then use the site-specific attenuation models to predict ground vibration and overpressures to determine the range of impacts on fish (Kolden and Aimone-Martin 2013).

[6] Blasting will occur in fish bearing water bodies and predicted pressures and vibrations might cause fish or embryo injury or mortality.

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- fish mortality, and
- before and after photos.

2013 Blasting Standard Effectiveness Monitoring

Habitat biologists should send a copy of all Fish Habitat Permits with a blasting component and a copy of all monitoring reports to

Director's Office
Alaska Department of Fish and Game
Division of Habitat
PO Box 115526
Juneau, AK 99811-5526

The Division of Habitat will use the information to evaluate blasting standard effectiveness and revise the standard as necessary to ensure the proper protection of fish.

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