DO3 FISH PASSAGE CULVERTS

a. If a stream reach is determined to harbor fish, as determined by the Alaska Department of Fish and Game, then stream crossing structures shall be designed, constructed, and maintained so as to maintain the full hydrologic functioning of the water body they are crossing.

b. All stream crossing structures shall be designed using stream simulation methodologies. Stream simulation means that the crossing structure is designed using reference data from a representative section (reference reach) of the specific water body being crossed. Stream simulation is a crossing design technique that attempts to replicate the natural stream channel conditions found upstream and downstream of the crossing. Sediment transport, flood and debris conveyance, and fish passage are designed to function as they do in the natural channel.

c. Reference data shall include, at a minimum; channel width at the Ordinary High Water Mark (OHWM), cross-sectional area, gradient, substrate, and ability to pass floating debris.

d. Under normal flow conditions, the channel within and/under the crossing structure shall not differ from the reference reach condition in regards to the channel width at OHWM, cross-sectional area, gradient, substrate, and ability to pass floating debris.

e. Substrate material within/under the crossing structure shall remain dynamically stable at all flood discharges up to and including a fifty-year flood. For culverted crossings, this may require the placement of oversized material that can resist the predicted critical shear forces or the use of substrate retention baffles that allow bed load to continuously recruit within the culvert barrel.

f. The width of crossing structures shall not be less than one hundred and twenty percent (120%) of the channel width at the OHWM or use 1.0 times the bankfull width, whichever is greater.

g. Crossing structures shall be placed within/over the pre-existing channel alignment. Road alignment shall be as close to perpendicular to the channel as possible.

h. Crossing structures shall maintain the connectivity of wetlands adjacent to stream channels and shall accommodate sheet flow within such wetlands.

i. Crossing structures shall not interfere with the functioning of floodplains and shall be designed to accommodate at least the 100-year flood flow. If the crossing structure is not designed to accommodate the one hundred-year flow, a route must be established to safely convey flows exceeding the design flow without causing damage to property, endangering human life or public health, or causing significant environmental damage.

j. Design Standards

1. Culverted stream crossings shall be composed of a single oversize pipe or arch a minimum of one hundred and twenty percent (120%) of the channel width measured at the OHWM or use 1.0 times the bankfull width, whichever is greater.

2. Matanuska-Susitna Borough (MSB) *Bridge Criteria Manual* shall be used for design and construction of all new bridges, including buried structures such as culverts, in MSB public property and subdivision streets.

3. Culverts shall have a minimum diameter of three feet (3').

4. The use of multiple-pipe culvert batteries is discouraged. The use of trash racks or debris interceptors is prohibited.

5. Culvert pipes and arches shall be constructed of metal. The use of smooth wall culverts is prohibited except where the pre-development stream channel gradient is less than one-half percent (<0.5%).

6. Round culvert pipes shall have a minimum invert burial depth of forty percent (40%) of the culvert diameter into the substrate. Arch culvert pipes (i.e. "squash" pipes), shall have a minimum invert burial depth of twenty percent (20%) of the culvert's rise into the substrate, unless scour analysis shows less fill is acceptable. The minimum depth is 1 foot.

7. Substrate material within the culvert barrel shall incorporate a low flow channel.

8. If substrate retention baffles are used, they shall have a maximum weir height of one half (0.5) of the culvert invert burial depth (i.e. 20% of diameter for round pipes and 10% of rise for arch pipes). Substrate retention baffles shall be spaced so that the maximum drop between weirs is four inches (4"). The use of baffles without substrate is not allowed.

9. Culverts shall be aligned in a direction as nearly parallel to the pre-existing direction of water flow as possible.

10. Culvert outlet aprons and inlet protection shall be used as necessary to reduce the risk of scour and perching. If needed, culvert outlet aprons should extend approximately three (3) channel widths downstream from the culvert outlet, and shall be modeled to ensure fish passage if fish are present.

11. Hydraulically designed culverts are acceptable, in creeks without fish present, or in cases approved by the Borough engineer.

DO4 HYDRAULIC METHODS

a. The hydraulic method uses the swimming capability and migration timing of target design species and sizes of fish to create favorable hydraulic conditions throughout the culvert crossing. Information on this methodology is available at Alaska Fish and Game Sport Fish division (http://www.sf.adfg.state.ak.us/SARR/fishpassage /fishpass.cfm), the Federal Highway Administration (http://www.fhwa.dot.gov) and the USDA Forest Service Stream Systems Technology Center (http://www.stream.fs.fed.us/fishxing/).

b. The design fish shall be a 55 mm (2.16 in.) juvenile coho salmon for anadromous streams and a 55 mm (2.16 in) Dolly Varden char for nonanadromous streams. These criteria may change based on ongoing research by federal and state agencies.

c. Fish passage high flow design discharge will not exceed the 5% annual exceedance flow or 0.4 times the 2-year peak flow, whichever is lower and has the most supporting hydrologic data.

d. Fish passage low flow design discharge shall ensure a minimum 6-inch water depth or natural low flow and depth within the reach the crossing occurs. In cases where local conditions preclude natural low flow characteristics, backwatering or in-culvert structures shall be considered.

e. In cases where flared end sections with aprons are necessary and fish passage is required, water depths and velocities that satisfy fish passage criteria must be demonstrated across the apron in addition to within the culvert.

f. Fish passage criteria for all culvert design options must be satisfied 90 percent of the time during the migration season for the design species and age class pursuant to Alaska Statute 41.14.840. Tidally-influenced streams may sometimes be impassable due to insufficient depth at low flow and low tide. If the tidal area immediately downstream of a culvert is impassable for fish at low tide, the 5-percent exceedance criterion shall apply only to the time during which fish can swim to the culvert. Tidally-influenced fish passage structures shall satisfy Alaska Statute 41.14.840 for an average of at least 90% of the tidal cycles, excluding periods when the stream channel is not accessible to fish because of natural conditions at low tide.