



# MEMORANDUM

## Oregon Department of Fish and Wildlife

### Fish Division

**Date:** March 28, 2008

**To:** Art Martin, Statewide Transportation Coordinator

**From:** Tom Stahl, Fish Passage Coordinator

**Subject:** Clarification of Fish Passage Triggers and Guidelines for Bridges

This memo is intended to clarify when bridges trigger fish passage laws (ORS 509-580 through 910; OAR Chapter 635, Division 412). Additionally, new fish passage guidelines for bridges are detailed, which can be used for fish passage approval under the "Alternative Option" for road-stream crossings in ODFW's fish passage criteria (OAR 635-412-0035(3)(b)). This document shall remain in effect until ODFW revises it, passes new administrative rules, or updates fish passage criteria or guidelines and posts these on the ODFW website.

#### DEFINITIONS

The following definitions apply for the purposes of this memo (note: defined words or phrases are in italics throughout):

- "*active channel width*" means the stream width between the ordinary high water (OHW) lines<sup>1</sup>, or at the channel bankfull elevation<sup>2</sup> if the ordinary high water lines are indeterminate (OAR 635-412-0005(2)). Note that in bays and estuaries, the *active channel width* is calculated as the summation of the *active channel widths* of all freshwater streams entering the bay or estuary upstream of the site (per OAR 635-412-0035(4)(b)). Also note that, for fish passage requirement compliance, *active channel width* should be determined outside the influence of artificial structures or impacts and confluent tributaries<sup>3</sup>. See Figure 1.
- "*bed*" or "*bed and banks*" means the physical container of the waters of this state, bounded on freshwater bodies by the ordinary high water line or bankfull stage, and on bays and estuaries by the limits of the highest measured tide (OAR 635-412-0005(6)). Note that the *bed and banks* of a stream determine its *channel*<sup>4</sup>. See Figure 2.
- "*bridge*" means a set of structural *elements* allowing a road and waters-of-the-state to cross which a) is open-bottomed and has a *clear span* greater than 20 feet or b) is open-bottomed, does not have earthen fill on top of it, and has a *clear span* less than or equal to 20 feet<sup>5</sup>.
- "*channel*" means a waterway that periodically or continuously contains moving waters of this state and has a definite *bed and banks* that serve to confine the water (OAR 635-412-0005(7)). Note that, for fish passage trigger determination, the *channel* should be determined outside the influence of artificial structures or impacts and confluent tributaries (see Endnote #3). See Figure 2.

- "*clear span*" means the open distance between *bridge elements* within the horizontal plane of the channel passing below the *bridge*. See Figure 3 for a depiction of the horizontal plane of the channel and Figure 4 for measurement examples.
- "*element*" or "*bridge element*" means any part of a *bridge* that supports or provides a roadway (i.e., is structural) or provides structural protection<sup>6</sup>.

### BRIDGE TRIGGERS

This section only defines when fish passage must be addressed at *bridges*<sup>7</sup>, not whether a new, replacement, or existing *bridge* meets fish passage requirements or is a barrier. If fish passage must be addressed, some form of ODFW fish passage approval will be needed (see next section for more information on passage approval options).

A *bridge* must address fish passage only if all three of the following apply:

1. native migratory fish are currently or were historically present at the location<sup>8</sup>,
2. one of the following will occur (note: these are the potential trigger actions):
  - a. a new *bridge* will be constructed at a location where there is no existing crossing (OAR 635-412-0005(9)(a)),
  - b. a replacement *bridge* will be constructed at a location where there is an existing crossing (OAR 635-412-0005(9)(a)), **or**
  - c. over 50% of an existing *bridge's elements* within, below, or above the *channel* are cumulatively removed, replaced, filled, or added to through time (OAR 635-412-0005(9)(b)(D); see endnotes for more regarding the 50% calculation<sup>9</sup>), **and**
3. any *element* of a new, replacement, or existing *bridge*, or any part of an existing crossing being replaced by a *bridge*, is within or below the *channel* (see Figure 5).

### FISH PASSAGE REQUIREMENTS FOR BRIDGES

Existing criteria in rule for road-stream crossings only describe a Stream Simulation option and an Alternative option (OAR 635-412-0035(3)). *Bridges* and other crossings do not qualify under the Stream Simulation option if a) there is any *bridge element* within the *channel* (including on, or replacing, the *bed and banks*) and b) they do not have a *clear span* greater than or equal to the *active channel width*<sup>10</sup> (see Figure 6). In these cases it is also difficult or time-consuming to show that an Alternative design will meet certain hydraulic conditions in the *channel* that allow for fish passage, based on known or assumed fish swimming abilities (i.e., the "Hydraulic Design" method). Therefore, other Alternative options for fish passage approval of *bridges* are presented here. So, if a) native migratory fish are or were present in a location, b) a new, replacement, or existing *bridge* has any element within or below the *channel*, c) there will be a trigger event, and d) fish passage will be provided, the following design options may be used to obtain fish passage approval for *bridges* from ODFW.

#### Stream Simulation Design<sup>11</sup>

- *beds* or *clear spans* under should be equal to or greater than the *active channel width*, with no *element* within the *active channel*
- *beds* under should be equal to the slope of, and at elevations continuous with, the surrounding long-channel streambed profile
- *beds* under should maintain average water depth and velocities that simulate those in the surrounding stream *channel*

Eligible for Programmatic Approval	Passage Design/ Review Basis
------------------------------------	------------------------------

YES	Structure and Channel Measures
-----	--------------------------------

### Stream Simulation Design (continued)

- *beds* under should be maintained through time
- *beds* under should be composed of material that is similar in size and composition as the surrounding stream, but may be naturally supplemented to address site specific needs including, but not limited to, *bed* retention and hydraulic shadow<sup>12</sup>
- *beds* under, if being placed or replaced, should be mechanically placed during installation
- trash racks shall not extend below the top of the *channel* (i.e., OHW or bankfull elevation) and shall have a minimum of 9 inches clear spacing between vertical members

### Alternative 1: Larger-Scale Crossing Design<sup>13</sup>

- only applies to channels greater than 35 feet wide<sup>14</sup>
- there should be at least one *clear span* of 35 feet within the *channel*
- no more than 25% of the *active channel width* should be filled (see Figure 7)
- no more than 25% of the *bed and banks* should be filled (see Figure 7)
- *bridge elements* should only fill one channel margin (i.e., one bank at the OHW or bankfull lines)<sup>15</sup>, and, where a margin is filled, the fill should not exceed a 1:1 slope or have a Manning's coefficient less than 0.3
- *beds* under should meet Stream Simulation requirements described above, excluding the requirement for being *active channel width*

YES

Structure and Channel Measures

### Alternative 2: Hydraulic Design<sup>16</sup>

- water velocity at the high fish passage design flow should be no greater than 2 feet per second
- water depth at the low fish passage design flow should be at least the lower of: the surrounding stream, 6 inches if only juveniles require passage at a given time, or 12 inches if adults require passage at a given time
- if there is a stream discontinuity (i.e., hydraulic or grade drop), jump height, jump pool depth, and energy dissipation requirements should also be addressed

NO

Hydrologic/ Hydraulic Calculations

### Alternative 3: Future Replacement or Removal<sup>17</sup>

- only applies to **existing** *bridges*
- only applies to *channels* greater than 20 feet wide
- *clear span* should be greater than or equal to ½ of the *active channel width* or 20 feet, whichever is greater
- *beds* under should meet Stream Simulation requirements described above, excluding the requirement for being *active channel width*
- *bridge* shall be placed on a list for future replacement with a *bridge* which meets either the Stream Simulation or Larger-Scale Crossing Design option or for future removal<sup>18</sup>

?

Structure and Channel Measures

If none of these options can be met for a new, replacement, or existing *bridge*, the owner/operator of a crossing should have more detailed discussions with ODFW about how best to meet legal fish passage requirements. Other possible approval options include providing passage under some other Alternative design (which may entail exceptions to criteria or guidelines, some combination of the options noted above, or the use of another entity's criteria or guidelines<sup>19</sup>), waivers, exemptions, or deferrals for structural emergencies that may affect human safety.

As with all temporary construction activities, passage requirements for temporary *bridges* or construction isolation measures shall be approved by ODFW staff on a site-specific basis and do not necessarily have to meet ODFW's full passage criteria or guidelines. Temporary construction activities are those which take place only within an approved in-water work window. An approved in-water work window may include extensions to published dates that are approved by ODFW. Any structure in place outside of an approved in-water work window will require more formal fish passage approval from ODFW. Work *bridges* that are not permanent, but do not meet ODFW's criteria for being temporary, may qualify for approval under "Alternative 3: Future Replacement or Removal" and be covered generally in a programmatic agreement.

---

<sup>1</sup> Defined in OAR 635-412-0005(34).

<sup>2</sup> Defined in OAR 635-412-0005(5).

<sup>3</sup> For locations with an existing artificial structure, the *channel's* delineation and *active channel width* should not be determined at the site. Consult ODFW for appropriate methods to determine these.

<sup>4</sup> Consistent with ODFW's definition of *active channel width* (OAR 635-412-0005(2)), the ordinary high water lines are the primary determinant of a *channel*, and only if they are indeterminate should the secondary determinant, bankfull stage, be used.

<sup>5</sup> Open-bottomed culverts, whether arched, rectilinear, or some other form, are not addressed in this memo and their triggers differ.

<sup>6</sup> This includes both superstructure *elements* (including, but not limited to: decks, girders/beams/stringers, wearing surfaces, diaphragms, trusses, and bearings) and substructure *elements* (including, but not limited to: bents/piers, abutments, footings, caps, piles, drilled shafts, columns, retaining walls, wing walls, approach fills, roadway embankments, impact panels, riprap, and other means of scour protection). This excludes ancillary *bridge* parts, such as signs, lighting, *bridge* rails, guardrails, or other items for vehicular or pedestrian safety.

<sup>7</sup> As currently written, triggers under OAR 635-412-0005(9)(d) for culverts, and roads above them, do not apply to *bridges*.

<sup>8</sup> Unless native migratory fish presence is assumed, ODFW determines current and historic use by native migratory fish (i.e., an owner/operator of an artificial obstruction can assume native migratory fish are or were present, but can't assume they aren't or weren't present without contacting ODFW).

<sup>9</sup> 50% of the structure should be calculated by volume. For irregular or complicated forms (e.g., I-beams, hollow tubes, or other odd shaped *bridge* elements), either a rough outer volume or an actual volume may be calculated, as long as the same type of calculation is used for both the work in question for the trigger and the entire structure to which it will be compared to determine the percentage. Rather than complicated calculations for *bridge element* volumes, ODFW is open to suggestions regarding other means to determine if *bridge* repair/maintenance/modification actions will affect 50% of a *bridge* and constitute a trigger.

<sup>10</sup> If an *element* is within the *channel*, but the *clear span* is greater than the *active channel width*, then the structure would still be considered to meet Stream Simulation requirements. This allows for *channel* migration and assumes at least one naturally-functioning bank is present. See Figure 6.

<sup>11</sup> Criteria for vertical clearance and over-sized rock that are included in OAR 635-412-0035(3)(a) for Stream Simulation designs are not included here; ODFW is establishing a general exception by this memo, per OAR 635-412-0035(1)(d), for *bridges* for these two criteria.

<sup>12</sup> If this condition is met, it is assumed that the *bed* under the *bridge* is stable and there is no hydraulic drop, grade drop, *channel* degradation, or *channel* aggradation being caused by the *bridge*. Rip rap or other *bridge* protection may be placed below the *channel's bed and banks* (i.e., sub-grade). Above this, a top dressing of native material, which may also include over-sized rock, should comprise the *bed and banks*. This *bed and banks* must persist through time. The depth of native top dressing should be determined on a site-specific basis, addressing the risk of losing the native material and exposing the sub-grade, engineered protection (e.g., greater risk of native material degradation would require greater depth of native material).

<sup>13</sup> Guidelines apply to any given stream cross-section through the affected stream length.

<sup>14</sup> 35 feet is an approximate opening through which large wood is expected to pass, allows support for a standard temporary *bridge* span of 40 feet, and is the scale at which ODFW is comfortable that hydraulic constrictions of 25% will not have a significant impact on water velocity and fish passage without further documentation.

<sup>15</sup> ODFW strongly recommends the avoidance of channel margin reduction, as certain native migratory fish species and life history stages may migrate in this area and it provides habitat which is not available in other channel locations. If the guidelines for margin reduction are followed, this should reduce the impact to fish passage, although new information may prove these guidelines inadequate for passage of all native migratory fish and habitat impacts (which may need further habitat mitigation) will still occur.

<sup>16</sup> Hydraulic Design guidelines are contained in other ODFW documentation. The major items are only briefly addressed in this document. For *bridges*, open channel flow models or FishXing can be used to demonstrate hydraulic conditions will be met. In addition, ODFW will consider other information or models that show certain structure and channel conditions will meet hydraulic conditions.

<sup>17</sup> The legal basis for this type of approval is ODFW's authority under OAR 635-412-0020(4)(c) to approve "incremental passage plans", which provide that some level of fish passage is installed or exists at the time of the trigger event and full fish passage is provided at some point in the future.

<sup>18</sup> Timing of replacement will be determined by ODFW with the owner/operator on a site-specific basis, and will likely be based upon when the entity will have funding available and ODFW prioritization for fish passage needs across sites.

<sup>19</sup> NMFS or WDFW Stream Simulation criteria/guidelines are examples.

Figure 1. Delineation of the *active channel width*.

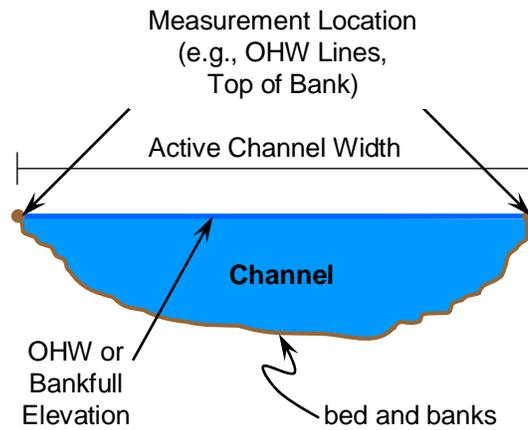


Figure 2. Delineation of a channel.

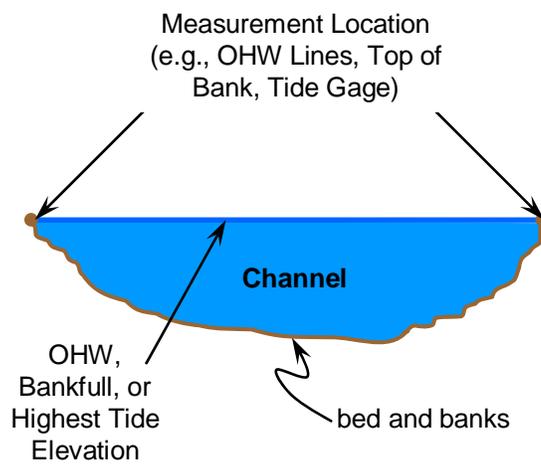


Figure 3. The horizontal plane of the channel (shaded).

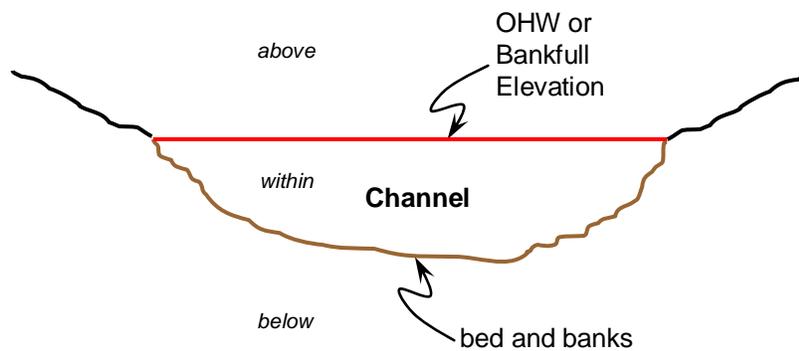


Figure 4. Examples of *clear span* measurements. Note that all situations except Figure 4-a could trigger fish passage laws due the presence of *elements* within or below the *channel* (see Figure 5). Note that new bridges are designed so that footings will not be exposed due to scour. Also note that of the remaining situations only Figure 4-b would meet the *active channel width* criterium for Stream Simulation design (even though in this case the *clear span* is less than the *active channel width*; see Figure 6). Also relative to Figure 4-b, if footings are above the deepest part of a channel that would naturally occur at the site, the *clear span* is the distance between the footings, assuming there are no other closer elements such as rip-rap within the horizontal plane of the channel.

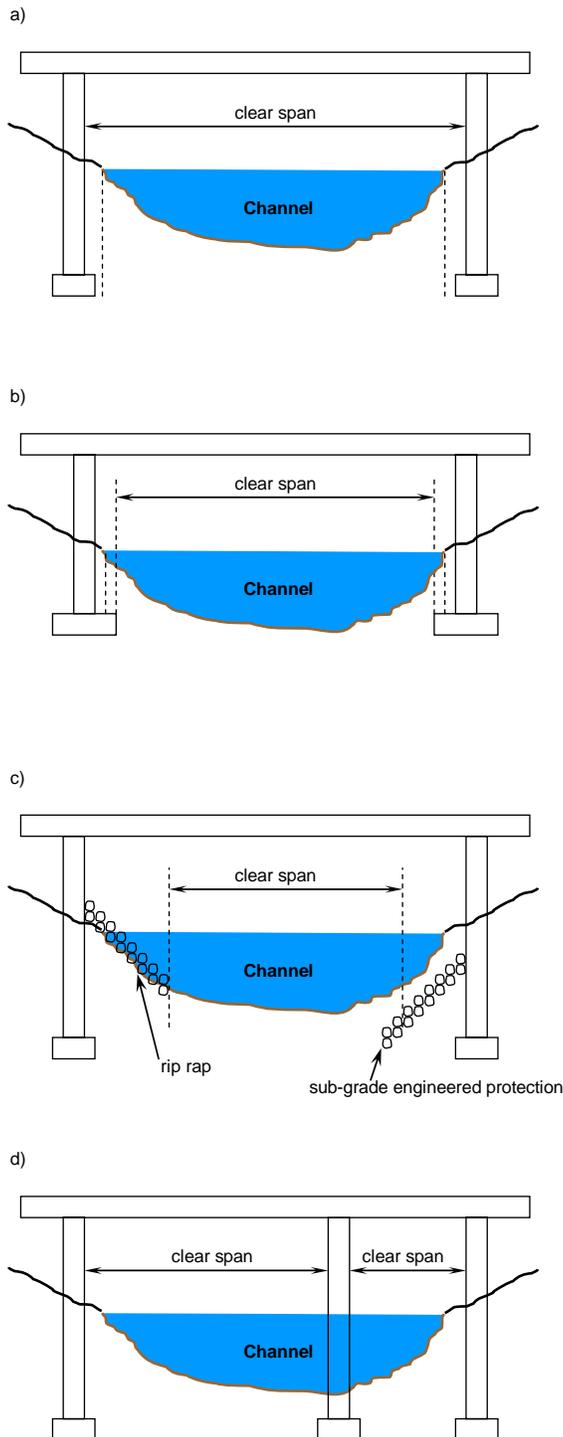


Figure 5. Zones relevant to bridge triggers. Presence of *bridge elements* in the "shaded zone" (i.e., within or below the *channel*) determines whether a trigger is possible. All (and only) *bridge elements* in the vertical plane of the *channel* (i.e., within, below, and above) should be considered for the 50% measure of whether repair/maintenance/modification of an existing *bridge* is a trigger.

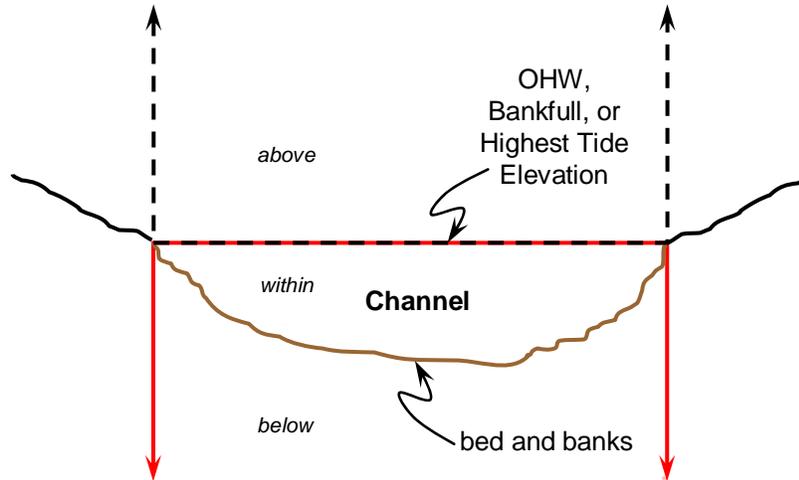


Figure 6. Channel conditions and/or clear span determine whether the Stream Simulation *active channel width* (ACW) criterium is met. The bridge in this diagram meets the Stream Simulation ACW criterium for both channel cases.

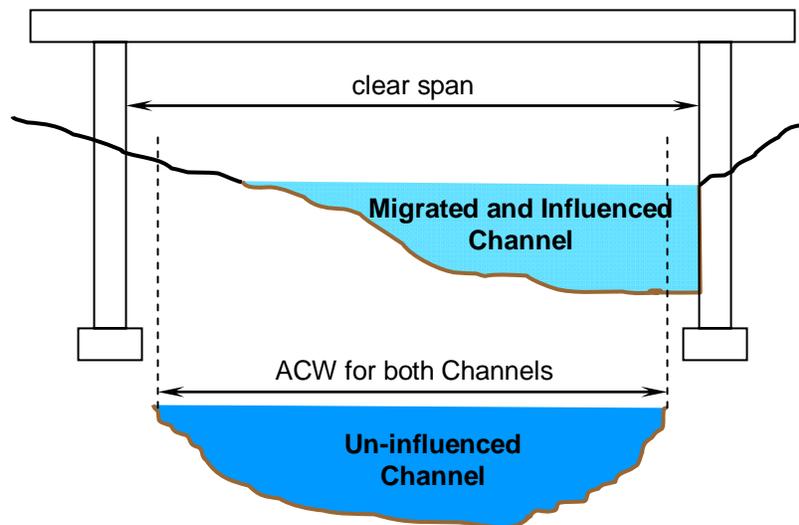
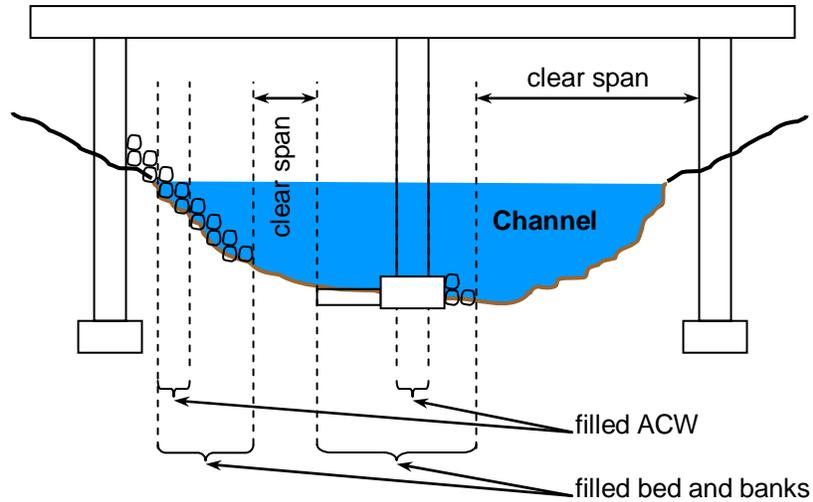


Figure 7. Examples of measurements for Larger-Scale Crossing Guidelines. Note that *active channel width* (ACW) fill is measured at the OHW or bankfull elevation. Anything that replaces or is placed on the *bed and banks* counts toward filled *bed and banks* (e.g., rip rap, exposed footers, poured concrete scour protection).



Appendix 1. Summary of fish passage requirements' applicability to bridges.

