

Vermont Agency of Natural Resources
Technical Guidance for Determining Floodway Limits
Pursuant to Act 250 Criterion 1(D)
5/1/03

Pursuant to the *Vermont ANR Procedure on Floodway Determinations in Act 250 Proceedings*, adopted 2/6/03, the following technical guidance will provide Act 250 permit applicants and other statutory parties with a procedure for determination of floodway limits under Criterion 1(D). As this technical procedure is new, interaction with and feedback from users is encouraged. Periodic updates may occur. Users should occasionally visit the web site noted below to check for updates.

The purpose of this analysis is to augment the floodway determinations provided by the National Flood Insurance Program (NFIP) so that fluvial erosion hazards can be assessed and factored into project planning by the project designers and can be considered in the Act 250 regulatory process for the protection of the health, safety and welfare of the public during floods.

This technical guidance relies on assessment protocols for erosion hazard potential associated with fluvial adjustment processes contained within the Phase I-III Vermont Stream Geomorphic Assessment Handbooks (VT DEC, 2002). The *Handbooks* are available from the VT DEC Water Quality Division by calling 802-241-3777 or at <http://www.anr.state.vt.us/dec/waterq/riversgeo.htm>. The *Vermont ANR Procedure on Floodway Determinations in Act 250 Proceedings*, which this *Technical Guidance* supports, and the *Stream Geomorphic Assessment Program Introduction (SGAP)*, which provides informative background information to this technical analysis, are also available at this web site.

The Phase and Step referred to in parentheses refers to the pertinent *Handbook* volume and corresponding assessment step within. The *Handbooks* and the *SGAP Introduction* contain definitions of terms used in this guidance document and provides other technical references and information.

For the purposes of Act 250 Criterion 1(D), the floodway limit shall be determined in consideration of inundation hazards as delineated by NFIP maps **and** in consideration of fluvial erosion hazards as delineated under either Option 1 or Option 2 below. Upon comparison of the two determinations (NFIP and Option 1 or 2), the floodway limit shall be whichever laterally extends further from the stream.

The floodway, as determined under the *Procedure* and this technical guidance is intended to address only the provisions of Act 250 Criterion 1(D). These delineated floodway limits may or may not capture all other Act 250 regulatory considerations for stream buffers depending on site conditions.

Option 1; Default Floodway:

Option 1 simply relies on determination of the channel (bankfull) width, locating the meander centerline and valley walls, and, in some cases, making qualitative observations of bank erosion and landslide indicators.

In the absence of any information submitted by the permit applicant, the agency may rely on the Option 1 Default determination without more detailed analysis.

The rationale supporting the Option 1 Floodway determination is the strong association between stable, sustainable fluvial processes and minimal conflicts with human investments with an unconstrained river corridor which includes a **belt width** approximately 6 channel widths wide. The belt width extends laterally across the river valley from outside meander bend to outside meander bend thereby encompassing the natural plan form variability of the stream channel. Human investments within the belt width inevitably result in structural constraints placed on the channel adjustment process to protect those investments and address associated threats to public safety. These threats will be largely avoided by recognizing the hazards created by development, incompatible with channel adjustments, within the critical belt width.

Basically, the Option 1 Delineation seeks to provide for an unconstrained belt width with a total lateral dimension (measured perpendicular to the meander centerline) equal to 6 times the channel width. Ideally, the belt width can be provided by 3 channel widths either side of the meander centerline. Oftentimes, however, the valley topography or other constraints prohibit channel plan form adjustment such that the full 6 channel widths can only be achieved by providing more width on one side of the stream than the other.

For an illustration of the delineation of the meander centerline and the belt width, refer to Figure 1 below or the *Handbooks* Phase 1, Appendix E. The meander centerline consists of a line drawn connecting the cross-over points between the meander bendways, or in a straight channel, points along the center of the channel spaced longitudinally every 10 channel widths.

Where feasible, the channel width should be associated with the **reference channel** for the reach in question. The reference channel condition may differ from the **existing channel** condition. If a significant departure from the reference condition is known, use the reference channel width. Otherwise, use the existing channel width. Channel width is equal to the bankfull width as referred to in the *Handbooks*. Refer to the *SGAP Introduction*, pg. 7 for a more detailed discussion of reference and existing stream types.

- A. In broad, unconfined valley locations (confinement ratio ≥ 4 ; ratio of valley width to channel width), the floodway limit shall be a minimum of 100 feet from the top of the stream bank or 3 channel widths either side of the meander centerline whichever provides the greater lateral extension of the floodway. In more confined valley locations, (confinement ratio < 4), the floodway limit shall be 3 channel widths either side of the meander centerline.
- B. Where the stream channel impinges on the valley walls:
 - 1) If there is active toe erosion **and** historic evidence of large, mass wasting failures along the valley wall, the floodway limit shall be 100 feet beyond the top of the valley wall; or
 - 2) In all other cases, the floodway limit shall not extend more than 50 feet beyond (away from the stream) the toe of the valley wall.
- C. Wherever the 100 foot from top of stream bank dimension or 3 channel widths measurement, under (A) above, extends more than 50 feet beyond the toe of the valley wall, the floodway limit shall be laterally extended beyond 3 channel widths, or 100 feet whichever is greater, on the opposite side, to provide a floodway measuring 6 channel widths total, or 200 feet plus the channel width, measured from the toe of the valley wall. This extension may, in some cases, be limited by the valley wall on the opposite side of the stream as well.

Option 1 Determination requires:

- 1) Channel width (Phase 2, Step 2.1, or, for reference channel width, from VT DEC Hydraulic Geometry Curves, Phase 3, Appendix C); for watershed sizes that fall above or below the limitations of the curve, apply the regression equation. Where good field measurements of the reference channel width can be obtained, these should be given more weight than the regression equation or curves.
- 2) Confinement Ratio (Phase 1, Step 2.10)
- 3) Topographic map or air photo to plot meander centerline and to locate toe and top of valley wall (Phase 1, Appendix E, Step 2)
- 4) Field observation of active valley wall toe erosion or historic evidence of landslides along the valley wall (Phase 1, Step 7)

Option 2; Stream Sensitivity Assessment:

Option 2 relies on determination of the channel (bankfull) width, locating the meander centerline and valley walls, qualitative observations of bank erosion and landslide indicators, determination of the reference and existing channel type, and adjustment process, if any.

The higher level of fluvial geomorphic assessment associated with Option 2 recognizes the variability of sensitivity to disturbance between stream types that leads to active adjustment of channel dimensions, longitudinal slope and plan form as the system attempts to re-establish balance and stability.

Performing the higher level of assessment to determine reference and existing stream type may allow for the reduction of the floodway limits derived from the Option 1 analysis, depending on the stream type and adjustment process.

- A. The floodway width shall be equal to the reference channel width if the reference stream type has **low to moderate sensitivity** (see table below); or
- B. The floodway width shall be equal to 2 channel widths either side of the meander centerline if the reference stream type has **moderate to high sensitivity and** the existing stream type **does not represent a stream type departure**; or
- C. The floodway width shall be equal to 3 channel widths either side of the meander centerline if the reference stream type has **moderate to high sensitivity and** the existing stream type **represents a stream type departure**; or
- D. The floodway width shall be equal to 3 channel widths either side of the meander centerline if the reference stream type has **high to very high sensitivity**.

Note: In each Option 2 situation (A - D above), the modifiers (A - C) in Option 1 apply; substituting 2 channel widths as appropriate within the moderate to high sensitivity class.

A stream type departure includes not only a shift of stream type, C3 to D3 for instance, but may also be represented by a shift of other stream type parameters such as substrate composition (B4 to B3), entrenchment, or width/depth ratio.

Option 2 Determination requires:

- 1) channel (bankfull) width (Phase 2, Step 2.1)
- 2) topographic map or air photo to plot meander centerline and to locate toe and top of valley wall (phase 1, Appendix E, Step 2)

- 3) reference stream type (Phase 1, Step 1)
- 4) existing stream type (Phase 2, Step 2)
- 5) adjustment process (Phase 3, Step 6)
- 6) entrenchment and width/depth ratio (Phase 2, Step 2.14)

Reference Stream Type Sensitivity Classes:

Sensitivity Class	Reference Stream Type
Low to Moderate	A1, A2, B1, B2, C1, C2, F1, F2, G1, G2
Moderate to High	A3, A4, A5, B3, B4, B5, C3, E3, F3, F4, F5, G3, G4, G5
High to Very High	C4, C5, D3, D4, D5, E4, E5

For additional discussion of stream sensitivity, refer to *Handbooks* Phase 3, Step 6.

Additional Assessment Parameters That May be Considered to Modify the Floodway Determination:

Additional assessment information associated with the physical parameters below may be considered to modify the floodway delineations made under Option 1 or Option 2 above. Permit applicants and other statutory parties may propose modifications to the delineations for review by the ANR. NFIP floodway delineations may not be modified without first obtaining an official Letter of Map Revision from the NFIP. For additional information on these parameters, refer to *Handbooks* Phase 3, Step 6.

1. **Existence of other facilities within the floodway:** In consideration of and in relation to existing structures, the proposed development may not create or increase the level of fluvial erosion hazard. Example: Other structures or a public highway are located between the proposed development and the river channel within the floodway limits determined under Option 1 or Option 2. In such case, the floodway delineation should conform to the NFIP delineation.
2. **Flow Modifications:** Large watershed storage elements, hydroelectric facilities, water withdrawals, etc. which result in a significant decrease in peak discharges, may be considered to **reduce** the level of fluvial erosion hazard and stream sensitivity where downstream channel adjustments associated with alterations to the hydrologic and sediment regime have occurred, in both a spatial and temporal sense, and dynamic equilibrium substantially re-established. Watershed level hydrologic modification associated with, for example, land use conversion which raises peak discharges may be considered to **increase** the level of erosion hazard and stream sensitivity.
3. **Boundary Conditions:** The resistance of the channel boundary materials to the erosive power of the stream, as influenced by material type, size and gradation, cohesiveness, vegetation or lack thereof, etc., may significantly influence the anticipated range of adjustment of channel geometry and may therefore increase or decrease the level of erosion hazard and channel sensitivity. Bedrock, for example, will likely limit extent of lateral adjustment regardless of stream type departure or adjustment process.

Unconsolidated sand and gravel bank stratigraphy with no mature bank vegetation is typically associated with very high sensitivity. Care must be exercised in assessing the significance of human constructed channel stabilization treatments (such as rock rip rap). Because bank revetments commonly are associated with channel constraints or flood plain encroachments that are incompatible with stable fluvial processes, the actual reach-level response can be a higher rate of adjustment of dimension, longitudinal slope or plan form.

4. **Sediment Transport Limited/Storage Reach:** Stream reaches that adjust readily and frequently in response to sediment influxes and function primarily as sediment storage reaches shall be characterized as exhibiting a very high level of erosion hazard and sensitivity. This condition is emphasized in transition zones from source or transport reaches to storage or response reaches in high bed load systems.
5. **Sediment Regime:** Imbalances in sediment regime wherein the stream reach exhibits a significantly higher or lower capacity to transport sediment in relation to the sediment supply (quantity and/or size) shall increase the level of erosion hazard and sensitivity. Sediment transport capacity imbalances may also be triggered by upstream disturbances, at the reach or watershed scale, that may increase or decrease sediment supply. Reach level imbalances of channel geometry (width, depth, longitudinal slope and plan form) in relation to sediment supply, stream power, and bank and bed shear stress can have significant influence on the sediment regime and the adjustment processes and sensitivity.
6. **Modified Reference Condition:** There will occasionally be cases encountered in which it may be appropriate to substitute a **modified** reference condition for the reference condition in the determination of channel width, channel type departure, or adjustment process; as applied in Option 1 or Option 2 above. A modified reference stream type assignment recognizes channel, valley, and/or flood plain modifications that may prohibit the adjustment of a reach back to its reference condition and therefore reduce the lateral extent of fluvial erosion hazards. Typically, the consideration of a modified reference stream type will be limited to situations where modifications of watershed hydrology and/or the physical constraints associated with river corridor development are so pervasive as to effectively preclude any expectation of re-establishment of the reference condition. See the *SGAP Introduction*, page 7 for additional discussion of modified reference condition.

For assistance in the application of this Floodway Determination Technical Guidance, contact the Water Quality Division River Management Program at 802-241-1262 or send e.mail to kari.dolan@state.vt.us.