1.5 Stream Setback

Description

A stream setback is area adjacent to a stream channel that is left in or restored to a natural vegetated state. It provides space for natural stream processes that support water quality to freely occur. Stream meanders can migrate within a setback both naturally and to adjust to hydrologic changes brought about by a developing watershed. This unimpeded stream meandering minimizes the sediment load degrading streambanks would otherwise generate while fully distancing infrastructure and property from predictable erosion. A setback also helps develop connectivity to floodplain. Sediment and other pollutants can be assimilated from excess stormwater flow while it is safely stored and conveyed in the setback, without flooding development or erosively enlarging the channel. By promoting stability of the stream channel and its corridor, a stream setback provides significant water quality benefit. Further, setback vegetation fosters stream ecology by contributing energy as organic carbon and providing shade that moderates water temperature and algal growth. In fact, streams with undeveloped, intact setbacks and floodplains have been found to have good aquatic biologic scores despite their urbanized watershed (Milter, 2004) suggesting a setback is a fundamental component of water quality management.

This chapter applies a stream setback at the development (individual parcel) scale, however the methodology discussed is also recommended when implementing stream setbacks throughout a watershed or community through local ordinance. Consult other resources for legal and procedural recommendations when establishing a setback ordinance.

Setback Methodology

To maximize the water quality benefit, a stream setback should be based on the land area needed to sustain stream processes that are most critical to its overall stability. These are the geomorphic processes responsible for the common lateral meandering pattern that a stream exhibits. A stream meanders in a sinuous, moving pattern of bends to manage and balance the energy of flowing water by increasing resistance and reducing the channel gradient. Stream meanders migrate over time within a predictable corridor or streamway as illustrated in Figure 1.5.1. Although sediment is eroded from one bank, it is deposited along another. This balanced, predictable channel movement and adjustment is referred to as dynamic stability. This is also the process by which a stream adjusts to hydrologic changes within its watershed without significant water quality degradation or loss of conveyance services.

Development near a stream can lock the channel's lateral position in place which works against this dynamic stability. Rather than meandering, a channel is forced to adjust by downcutting and widening to gain stability and additional capacity. As the unstable stream entrenches itself, severely eroding banks produce a substantial sediment load and may jeopardize development infrastructure.

To maintain dynamic stability (or allow degraded streams to regain dynamic stability), this practice establishes a setback based on the predicted streamway width for streams in Ohio. As with a channel's size and form, the setback width is directly correlated to its drainage area. It may be established at any point along the channel length using the drainage area, the lowest ground elevation in the valley, and the channel location.

Note that this methodology differs from a static distance approach that many stream buffer references recommend to treat agricultural runoff or to conserve the unique ecological characteristics of riparian area, nor does it replicate flood hazard mapping which is based on large event flow predictions.

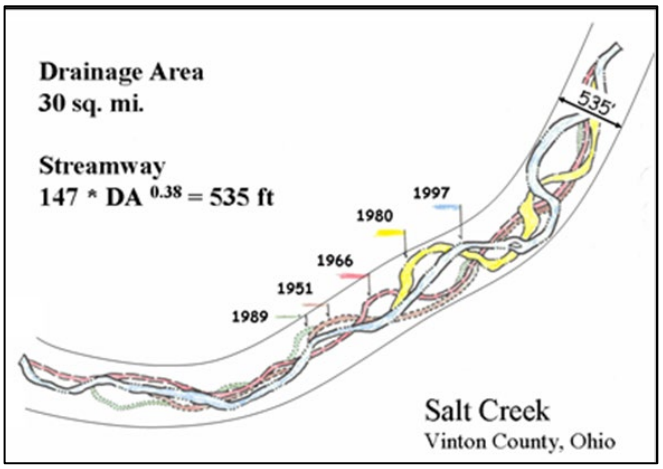

Figure 1.5.1 An illustration of stream meander migration within a streamway over time (By Dan Mecklenburg, Ohio Department of Natural Resources).

Setbacks as a restoration measure

Many Ohio streams have been intentionally straightened or channelized while others are naturally entrenched in response to a developing watershed. Rankin (1989) found these streams with little to no sinuosity were associated with low biologic scores and cites Karr and Schlosser (1977) in suggesting they often have higher levels of suspended sediments during low and moderate flow periods that stream with higher sinuosity. A stream setback is an important part of the restorative process for such modified streams. It gives room for natural adjustments to re-establish a dynamically stable channel form with a wider meander pattern and shallower flow.

Furthermore, establishment of a setback should not deter channel rehabilitation. Efforts to manually advance restoration by providing greater access to an active floodplain within the setback will ensure more natural stability and a higher functioning practice. Development construction may provide an opportune time to conduct channel restoration work at its lowest cost and degree of disruption.

Planning and Feasibility

Setbacks are appropriate for all sizes of channels from ephemeral or intermittent streams up to large rivers, however streams with drainage areas less than 10 square miles are most in need of stream corridor protection and may provide the most benefit. These small channels can be easily modified by development and are less likely to have detailed floodplain mapping and protections.

Design Criteria

Setback Width

The setback width spans both sides of the channel. As illustrated in Figure 1.5.2, it is a combination of two overlapping areas: the streamway width sized appropriate to accommodate the meander belt (approximately 10 channel widths) and a minimum distance from the channel bank (approximately one channel width). Both are calculated according to the drainage area to a given point along the stream through the following equations:

$$\text{Streamway Width (feet)} = 147(\text{DA})^{0.38} \qquad \text{Equation 1.5.1}$$

and

$$\text{Minimum Distance From Channel at Bankfull Flow (feet)} = 14.7(\text{DA})^{0.38} \qquad \text{Equation 1.5.2}$$

where DA = drainage area in square miles.

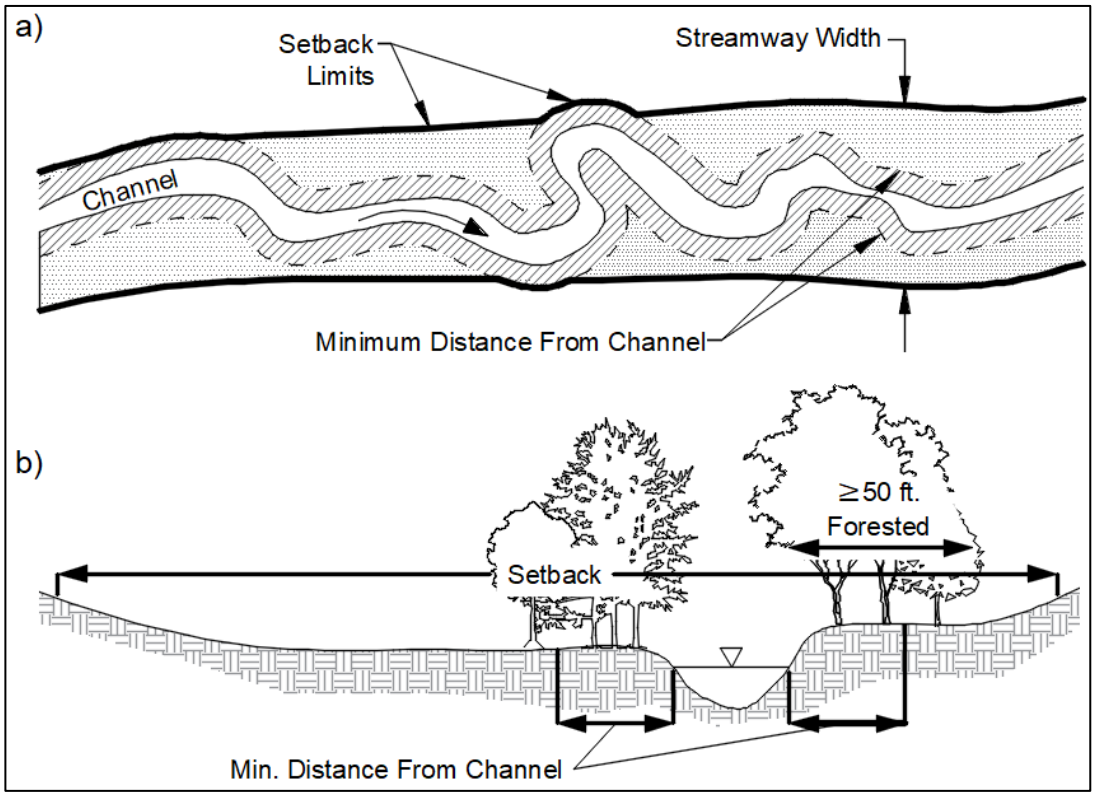

Figure 1.5.2 Illustration of a stream setback in a) plan view and b) section view (not to scale).

Lateral Positioning

The streamway is more a feature of the entire valley than any individual bend or the present location of a channel. It is more aptly visualized as a flood path or corridor in which the stream winds. Fit the streamway to the valley as illustrated in Figure 1.5.2b so the corresponding left and right boundary elevations match and the setback area incorporates the lowest elevations in the valley. The setback area will not always be exactly centered over the stream. It may also extend beyond the streamway where the minimum distance from the channel extends beyond the streamway.

Setback Width Adjustments

Certain conditions justify altering the calculated width of the setback area. Physical constraints such as a narrow, confined valley smaller than the setback width, floodplain that extends beyond the setback, wetlands contiguous to the area, or adjacent hillsides prone to slippage or being undercut because of stream flows may necessitate altering the setback area.

Reasonable adjustments may be necessary to ensure an existing parcel remains buildable and to maintain lot yields in new subdivisions to the extent possible.

Limit a parcel's setback to the line of the existing foundation/structure within the setback. This ensures expansion or redevelopment within the setback gets no closer to the stream.

Vegetation and Land Use

A healthy forest community in a setback provides the greatest benefit. Maintain forest, preferably of native species, over at least 50 feet of the setback immediately adjacent to the channel on each bank. The remaining setback area may include vegetation compatible with the surrounding land uses (such as grass or meadow) provided that the setback characteristics are not impaired. For large rivers with extensive setback distances, further refinement of acceptable land uses beyond the forested riparian area may be necessary.

Setback Identification

Clearly identify stream setback boundaries on the plat map, construction plans, stormwater pollution prevention plan (SWP3), and on the site. Prior to any site clearing or grading, install both temporary fencing to prevent encroachment and practices to minimize sediment from entering the setback. Following construction, provide a visual marker identifying any no-mow zones or permanently forested areas within the setback. Sections of split rail or similar unobtrusive fencing provide a visual marker distinguishing the setback from other land uses. In some cases, signage may suffice.

Avoid Concentrating Flow into the Setback Area

To maximize treatment, surface runoff should enter the setback area as diffuse sheet flow. Convert concentrated flows from storm drains and swales to diffuse surface flow before it enters the stream setback area through grading, constructing level spreaders, or other measures. Ensure tributary ditches and streams through the setback are not entrenched with limited access to active floodplain within the setback.

Construction Considerations

Establish a stream setback prior to any soil disturbing activities. The setback area should not be disturbed except for planting or to remove invasive species. Use proper sediment and erosion controls to prevent construction sediment from fouling the setback area.

When planting, use a diverse selection of native species conducive to a transitional and upland landscape and appropriate to the regional climate.

Maintenance Considerations

A stream setback should be inspected regularly to ensure it is maintained in accordance with its planned land use, any no-mow zones are upheld, and that forested riparian areas remain in a natural state.

Do not treat setback area with herbicides or pesticides except to control invasive species.

A stream setback should be placed in a conservation easement to protect these resources in perpetuity. Easements should be regularly monitored with any easement agreement violations addressed immediately.

Passive uses such as foot trails and picnic areas may be maintained through the setback. Timber harvesting on privately held areas should not be done within 25 feet of either bank. Removal of invasive species is allowable and highly recommended for maintenance of the setback.

Local Implementation Tools

Zoning, conservation easements, and public ownership are options to ensure long-term protection of a stream setback. Local government may utilize zoning to set appropriate land uses within the setback area. Many local governments will accept ownership of such properties if deeded in fee simple to the community and may apply credit toward local open space or parkland set aside requirements. A conservation easement offers one of the best ways to protect stream setback area in perpetuity. It maintains private ownership while limiting detrimental uses and actions. Easements can be held by a legally qualified conservation organization (for example a land trust) or a government agency.

References

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