FLOODPLAIN RESTORATION AS A MEANS TO MEET WATER QUALITY GOALS

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As a landscape feature, the floodplain is often regarded in a negative context, as a constraint to competing land use. In trying to contend with this constraint by modifying it (e.g., levees) people often degrade the critical function of a floodplain. On the other hand, outright ignorance of floodplain constraints has resulted in the loss of life and economic resources (e.g., flood damages to improperly sited improvements). Though we acknowledge that many land uses are not suitable in floodplains, we often fail to recognize and act upon our opportunities to optimize our management of floodplain resources.

Though long documented, the natural functions and benefits provided by floodplains (http://www.floods.org/PDF/WhitePaper/ASFPM_NBF%20White_Paper_%200908.pdf) are not often cited as reasons to provide better floodplain protection and/or restoration. Flood attenuation, water quality benefits, and wildlife habitat are just a few of the important benefits floodplains provide to society. Forest product production, agricultural production (e.g., small grains, forage, pasture), and other uses deemed acceptable by society may not be consistent with maintaining the most fundamental floodplain benefits, which are not only universally acceptable, but necessary for all forms of life.

These natural floodplain functions are predicated on the integrated nature of floodplains, streams, and associated riparian habitat. If the floodplain is separated from its associated stream, as in the case of separation by levee, the floodplain no longer retains its function or delivers the same ecosystem services. Another force at play in the floodplain-stream separation is increased runoff volumes associated with watershed changes. In many watersheds, an increase in runoff volume and peak discharge combine with a reduction in time of concentration, to result in stream channel incision and enlargement. Larger stream channels become separated from their floodplains for the high frequency low volume precipitation events. In extreme cases, even the runoff from 100-year storms may be fully contained in the stream channel, with adjacent floodplain unable to perform its 'normal' functions.

Often such channel enlargement results in impacts to infrastructure placed near the streams (e.g., sanitary sewers, roads), and requires stabilization of the eroding stream banks closest to the 'at-risk' infrastructure. These stream bank patches often fail, as the increased stream energy associated with the modified 'urban hydrology' lets the stream move around the patch or move the patch itself, and continue its 'at-risk' behavior. More recently, the practice of stream restoration has improved to include more extensive patches and incorporation of rock and log structures to provide a 'fixed' plan-form geometry to protect stream-side infrastructure from the ravages of channel enlargement and migration. Such techniques do reduce channel erosion and thus result in some improvements to water quality, but they provide little wildlife habitat or flood attenuation. Furthermore, these efforts do little to attenuate in-stream energies, so channel enlargement continues at the downstream end of the extended patch or restoration project.

In many instances, a broad floodplain is adjacent to the degrading stream channel. Such 'disconnected' floodplains are not providing floodplain benefits. It may be mapped as floodplain, but the stream channel has enlarged to the point where it can rarely access it. In many instances, one can see a remarkable difference in the floodplain plant community. The older, larger trees are species that are known to be adapted to flooding and periods of extended soil saturation (e.g., red maple, sycamore, swamp white oak), while the younger, smaller trees are not (e.g., tulip poplar, black cherry, mulberry). Similarly, the hydric soils in the floodplain may no longer exhibit the same degree of wetness, and they may no longer support vernal pools, amphibian habitat, and other characteristic floodplain elements. Many floodplains are overtaken by invasive, nonnative species, and become a burden to adjacent property owners and local governments.

In light of the obvious need and demand for clean water and better drainage networks, integrated floodplain restoration should be a very high priority for all levels of government.

An alternative to this failed condition exists and is being advocated for and implemented in many areas around the country. The idea is to restore the connection between the floodplain, its incised stream channel, and riparian wetlands. This may be done by installing 'plugs' in the channel to trap bed load and force water out into the floodplain (http://www.wetlandsandstreamrestoreation.org/Publications/Pond%20%26%20Plug%20Treatment%20for%20Stream%20%26%20Meadow%20Restoration.pdf), by raising the entire channel to create a smaller stream channel that floods into the floodplain with even the smallest precipitation events (http://www.bae.ncsu.edu/programs/extension/wqg/srp/2010conference/pdfs/richardson_gensession.pdf), and by excavating some or all of the floodplain to recreate a flood prone feature (http://files.dep.state.pa.us/water/Chesapeake%20Bay%20Program/ChesapeakePortalFiles/Legacy%20Sediment%20Workgroup/Natural%20Floodplain%20Stream%20and%20Riparian%20Wetland%20Restoration%20BMP.pdf). Each of these techniques effectively reduce in-stream energy and improve flood attenuation, water quality, and wildlife habitat. Restoring floodplain connection dramatically increases the surface area available for stream flow to 'contact' during high flow periods. This results in an increase in material processing surface area, reduces peak discharge, increases time of concentration, reduces instream energy, re-wets the floodplain, and provides a range of benefits for water quality and quantity. It also rejuvenates and improves aquatic, terrestrial, and wetland resources.

Stream channel restoration has been identified as a billion dollar industry (http://www.palmerlab.umd.edu/docs/Bernhardtetal2005w_SOM.pdf) and a powerful tool for meeting community MS4 and TMDL compliance requirements. In the Chesapeake Bay watershed, stream restoration has been identified as useful for helping the region meet the long-term water quality goals necessary in order to restore the Chesapeake Bay to a resource capable of supporting a healthy and diverse community of aquatic and wetland flora and fauna that society is dependent upon for food, recreation, and health. In a white paper recently approved by the USEPA Region III Chesapeake Bay Partnership (http://www.cwp.org/online-watershed-library/cat_view/146-special-topics-chesapeake-bay-program-bmp-expert-panel-reports), stream restoration water quality credits were divided by the type of stream restoration being employed, with floodplain reconnection receiving a greater pollutant reduction credit than other types. In a similar effort, Pennsylvania has approved floodplain restoration (i.e., excavation as part of stream restoration) as a stormwater best management practice (BMP) for its multiple benefits. (http://www.elibrary.dep.state.pa.us/dsweb/Get/Document-68011/6.7.4%20BMP%20Floodplain%20Restoration.pdf) While the community is in general agreement that stream restoration should not be used to meet stormwater management requirements, there is good reason to restore degraded streams and their floodplains in such a way as to optimize ecosystem services. In addition to the water quality and flood attenuation benefits, these integrated floodplain reconnection projects also deliver wetland, wildlife habitat, aesthetic, as well as a variety of other public benefits.

It is not surprising that that these types of integrated restoration projects tend to be very cost effective compared to common BMPs (e.g., retrofitted detention facilities) in terms of cost per pound of pollutant removed. While the implementation costs of integrated floodplain restoration may be comparable to detention basin retrofits, such floodplain projects tend to serve larger drainage areas and remove larger quantities of pollutants. (http://www.jamesriverassociation.org/what-we-do/JRA-Cost-effective-Full-Report-June-update.pdf).

The superior improvements to water quality, wildlife habitat, and attenuation of urban hydrology that result from a floodplain that is restored through reconnection to its stream and enhancement of its riparian wetland should lead to greater adoption of this type of activity. In light of the obvious need and demand for clean water and better drainage networks, integrated floodplain restoration should be a very high priority for all levels of government. As integrated floodplain restoration is arguably the highest performing type of stream restoration and delivers very cost-effective benefits, it may become one of the more common methods of meeting water quality permit requirements and addressing failing infrastructure. This approach to ecological re-engineering of our drainage infrastructure is a form of green infrastructure that is sure to deliver a broad range of ecosystem services – to people as well as the broader ecological community on which they depend.

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Joe Berg is the Ecological Restoration Practice Lead for Biohabitats, Inc., a small private consulting firm headquartered in Baltimore, Maryland. He is an ecosystems ecologist with more than 30 years experience in the assessment and analysis of natural resources; the development, preparation, and implementation of restoration plans; and the range of studies, documentation and permitting experience required. His professional focus has included the restoration of integrated stream, wetland and floodplain functions as a means to deliver ecosystem services to society; increase natural capital; and integrate local community needs with an appreciation of natural resource values. Joe is focused on improving restoration through challenging the restoration community to recognize and understand at a deeper level that we are all working in novel ecosystems where 'normal' and 'reference' paradigms need to be considered in the context of the resources anthropogenic history. Mr. Berg graduated with an M.S. in Marine, Estuarine, and Environmental Science from the University of Maryland in 1984 after two years working on Chesapeake Bay issues as a research fellow. He received a BS in Interdisciplinary Environmental Science from the California University of Pennsylvania in 1981.