Consequences of BMP Crediting, Resource Tradeoffs, and Need For an Ecosystem Approach

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Need for Ecosystem Approach

Jurisdictions must meet Load Allocations to reduce Sediments and Nutrients under Chesapeake Bay TMDL

Numerous BMPs are eligible for credit towards Reducing Sediments and Nutrients

Crediting for reductions only fails to consider other ecosystem services and Bay Goals, Including Habitat-and species related goals

Outcomes vary. There may be overall improvement; Some Components may benefit; Others may be lost or perform at a lower level of functioning in services and processes

This Has Led to Debates about Resource Tradeoffs

When considering ecosystems, benefits and consequences to different system components depend upon condition of project site, project design and implementation, and upstream and downstream areas

- Unintended or Adverse Consequences potentially greater for existing sensitive and functioning resources and critical infrastructure
- What are Benefits and Consequences which should be considered to meet all relevant goals and achieve Net Ecological Uplift?
- “Ecological Uplift” itself may have different interpretations depending upon perspective. A collaborative approach is essential to avoid or minimize adverse impacts.

Wetlands, being at the land/water interface, provide support for both adjacent upland and connected waters

Restoration which affect wetlands and fail to account for these connections may result in further degradation, rather then improvement, of certain ecosystem components, functions, and processes

May occur when wetland is still functioning. Level of degradation in wetland does not always match level of degradation in stream

Degradation of wetland may lead to “Chain Reaction” of other adverse effects to connected resources

Chesapeake Bay Restoration

Commitments to meet TMDL Requirements for Nutrient and Sediment Reduction

Commitments for Habitat and Living Resources, which may suffer from lack of Ecosystem Crediting, including:

- SAV
- Wetlands
- Riparian Forest
- Healthy Streams
- Fish Passage
- Anadromous Fish, Brook Trout, Other Fisheries

Example: Stream Restoration and Wetlands

- An Understanding and Acknowledgement of Both Benefits and Consequences is Necessary to Avoid and Minimize Adverse Effects
- The Consequences Described in the Presentation Do Not Occur at All Sites, But May Occur When the Design Does Not Consider All Functions and Characteristics at the Site

Example: Stream Restoration and Wetlands

"A stream corridor is an ecosystem that usually consists of three major elements:

- Stream channel
- Floodplain (often includes wetlands)
- Transitional upland fringe
- Together they function as dynamic and valued crossroads in the landscape."

(*Stream Corridor Restoration Principles, Processes, and Practices*, Federal Interagency Stream Restoration Work Group Part 653, National Engineering Handbook, NRCS, 1998 rev. 2001)

Example: Stream Restoration and Wetlands

For Successful Stream/Riparian Corridor, Both a Stable, Connected Stream Channel and Fully Functioning Riparian Areas, Including Wetlands, Are Required

Fully Functioning Stream/Wetland/Riparian Corridors Are Dominated by Appropriate Native Vegetation; Natural Patterns of Surface and Groundwater Inundation and Saturation, and Intact, Non-Compacted Soil Profiles

Stream Restoration for BMP Credit Typically Attempts to Increase Connection to Floodplain by:

Raising Streambed
Lowering Floodplain

Example: Stream Restoration and Wetlands

BMP Construction:

May Be Limited or Extensive. More adverse impacts occur with extensive grading, removal of vegetation, soil compaction. Extent of recovery likely variable.

Grading, vegetation removal, installation of berms, excavation, access roads

Potential Adverse Effects:

Vegetation

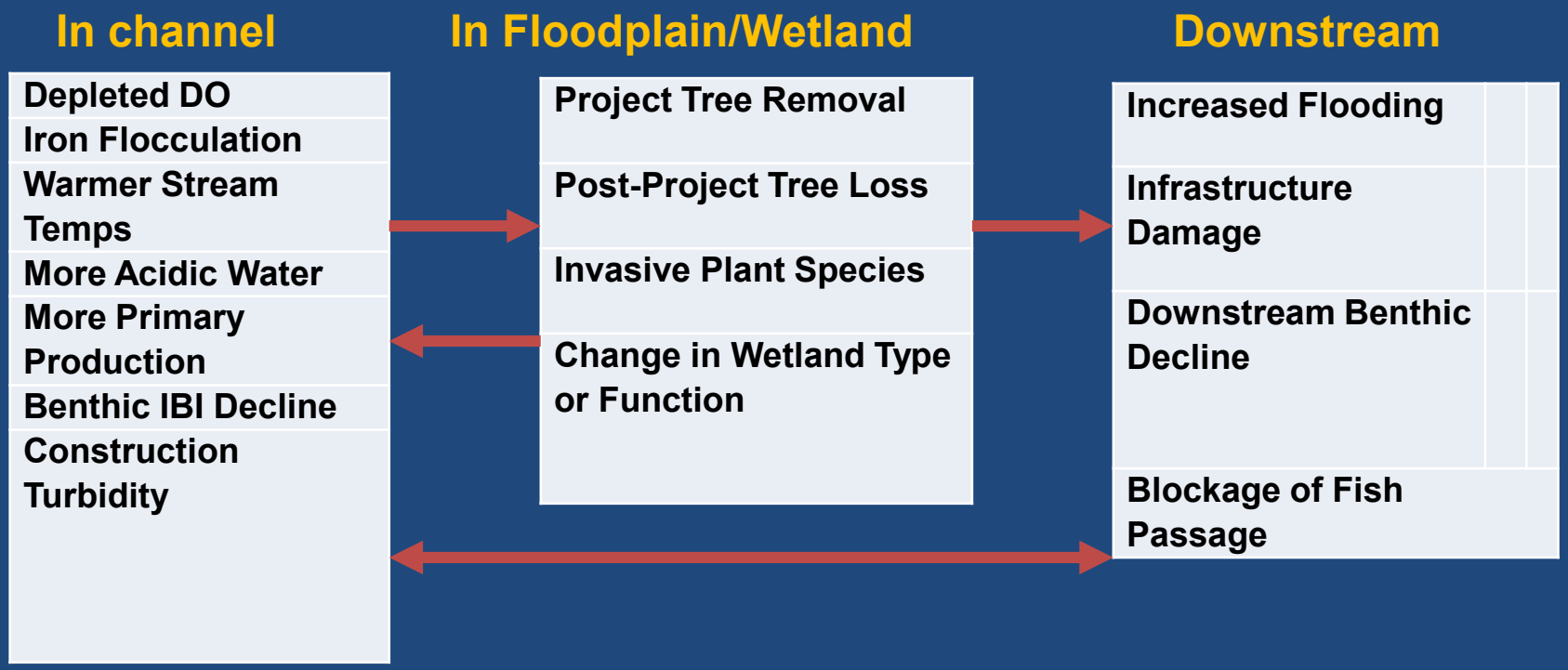
Soil compaction from equipment operation
– restricts root growth, groundwater movement through smaller pores; loss of belowground habitat and organisms; reduced infiltration

New Structures in Channel – Alteration of Flows

Potential Adverse Effects of Stream Restoration

"Consensus Recommendations to Improve Protocols 2 and 3 for Defining Stream Restoration Pollutant Removal Credits" approved October 26, 2020

lists the following potential adverse impacts from construction and post-construction:



In-Channel Changes from Structures- Blockages to Passage to Aquatic Life

Blockages May be Physical or Chemical

- If aquatic life cannot move over, through, or around structure, there is a blockage
- If "drop" is too great from top of structure to water in channels, aquatic species movement may be prevented or impaired
  - Structure with openings allowing flow may allow movement

In-Channel Changes from Structures

Structures which may slow flow or force more rapid downwelling may reduce effective instream denitrification

Increased Flooding

If Structure Fails

- Risk to Infrastructure
- Increased Erosion and Sedimentation

Water Chemistry

- Changes found: Many related to increases in water levels which result in loss of vegetation and shade over nutrient-laden water
- Increased temperature. Potential chemical blockage.
- Lower DO. Potential chemical blockage
- Also disturbance of highly acidic soils – potential pH decrease
- Iron flocculation
- Decline in Macroinvertebrate Scores

May Result in New Impairment Listings and TMDL Requirements

Designs which maintain shade or spring flow, or expose cold water springs may not have temperature increases

Direct Removal of Vegetation

- If forested-loss of shade; specific detrital inputs; woody debris (if removed)
- Loss/change in plant communities for habitat. May or May Not Be Desirable, Depending Upon what is Present and Valued
- Increase in invasive species
- Fragmentation of forest

Difficulty in successful Re-establishment by Planting of Desired Plant Communities

Soil Compaction

Reduction in Soil Pore Spaces

- **Restricts root growth – threatens remaining trees and New Plantings**
- **Groundwater movement through smaller pores**
- **Loss of belowground habitat and organisms**
- **Reduced infiltration**

Reduction in Hyporheic Exchange

Hyporheic exchange depends upon flow; groundwater levels; hydraulic conductivity (heterogeneous sediments and bed complexity and topography; and features such as wood) and permeability in streambed; DOC; residence time; microbial communities

Potential Loss/Change from Increased Water Levels

- Plants require oxygen to roots, are stressed by low oxygen and toxins in soil. Most tree species die with prolonged inundation and saturation
- Broad range of tolerance to increased water levels– species specific
- Tree seedlings more sensitive
- N, P uptake by Trees may decrease in wetter soils with lower redox potential
- Changes again affect water chemistry

Potential Loss/Change from Increased Water Levels cont.

- Changes in plant community type or aquatic resource type and habitats

More Water on Floodplain May Increase Hazards to Upstream and Downstream Infrastructure

Minimizing Unintended Consequences While Maximizing Ecological Uplift

"Maximizing Uplift" Means Considering the Range of Ecological Processes and Ecosystem Services Which Could Be Improved by a Restoration Project

- **Consider existing functions and other factors in site design**
- **Consider potential adverse effects of altering floodplain/wetland and channel**
- **Design and build for specific site conditions and retain natural system and processes where feasible**

Recognize that more modest alterations may be most beneficial overall when system has existing desired functions and condition

Reducing Unintended Consequences

Address problems at source

- **Maximize upland treatment**
- **Properly size culverts and other crossings, if undersized structures resulted in erosive flows**

Reducing Unintended Consequences

The potential problems do NOT always occur in all cases

This effort will hopefully result in incentives to:

- **Address the Unintended Consequences of projects with a design/construction which may not be appropriate for a specific site**
- **Maintain or improve habitat conditions on sites with more limited degradation**
- **Allow for adjusted credit toward TMDL**

Considerations for Ecosystem Crediting

- Assessment of Ecosystem Condition. Interpretation May Vary by Jurisdiction.
- Identification of Functioning Components Which Should Not Be Reduced
- Identification of Ecosystem Improvements and Potential Tradeoffs
- Adjustments to Databases
- Credit Adjustments
- Other Incentives

Bonus Credit for Retention or Restoration of Desired Components and Processes

OR

Credit Reduction for Degradation of Ecosystem Component

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