

Restoring Stream Connectivity in the University Context:

*A PROJECT MANAGER'S
GUIDEBOOK AND
ONLINE RESOURCE
LIBRARY FOR SMALL
DAM REMOVALS AND
CULVERT
REPLACEMENTS*

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Concrete Bridge



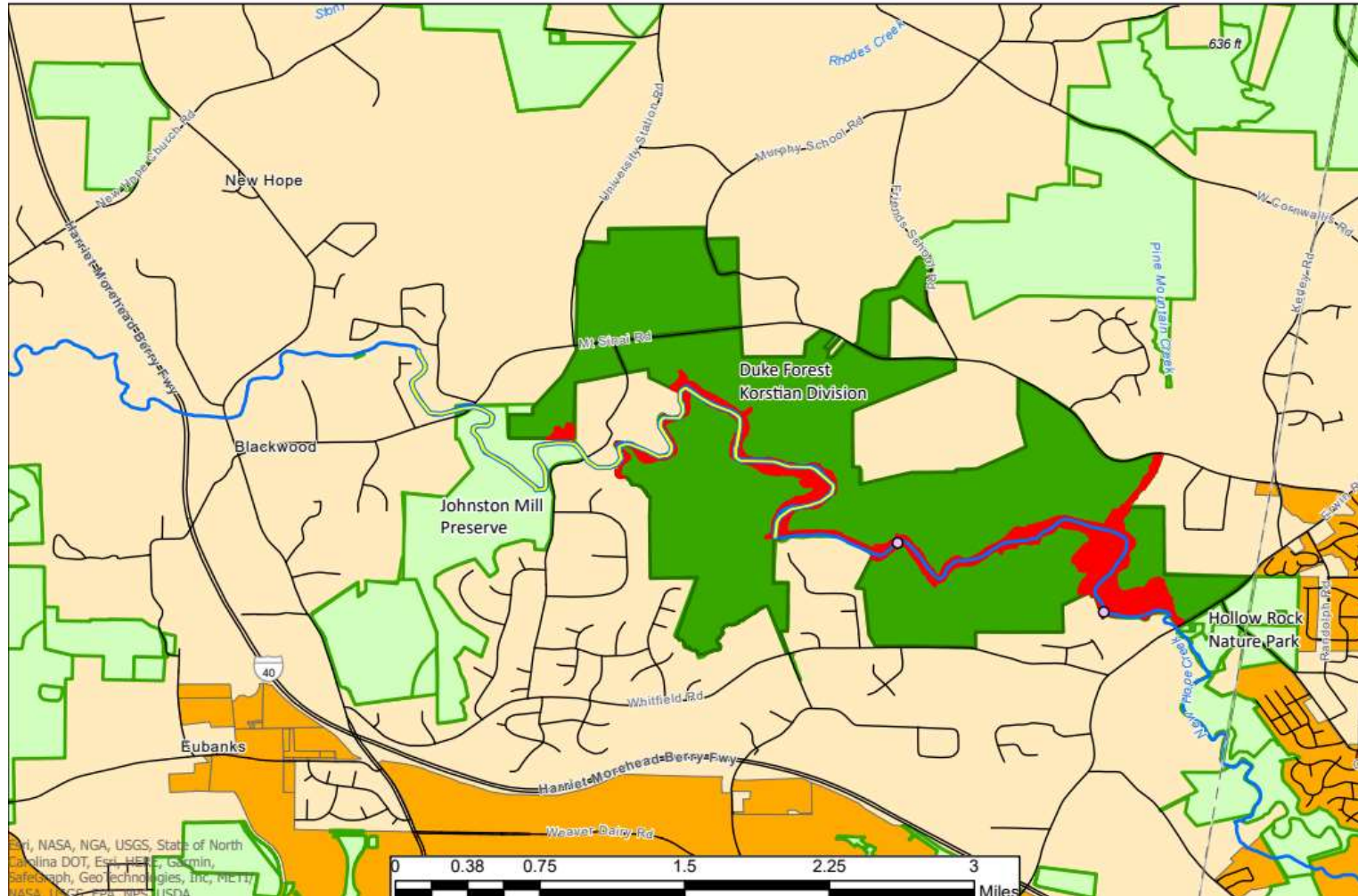
Billy Erwin Dam

Project Impetus: New Hope Creek Barrier Removal Projects in the Duke Forest

2023 Duke Forest New Hope Creek Restoration Project - Location Map with Critical Habitat



- Project Sites
- Proposed Easement
- Atlantic Pigtoe Mussel Critical Habitat
- Duke Forest Korstian Division
- Conservation Areas
- New Hope Creek
- Major Roads
- City Boundaries

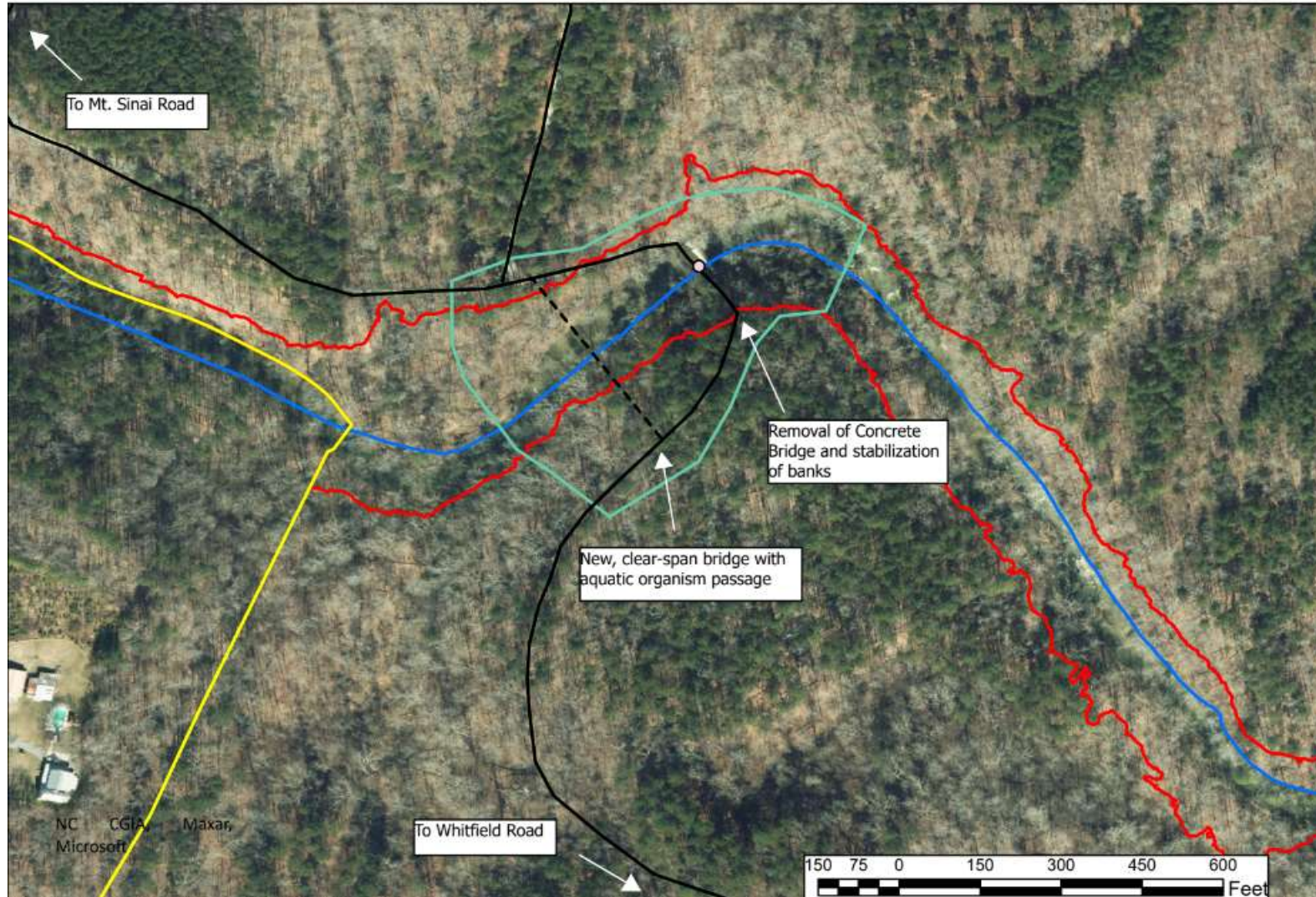


ESRI, NASA, NGA, USGS, State of North Carolina DOT, Esri, HERE, Garmin, Swiremap, GeoTechnologies, Inc., Microsoft, NASA, NOAA, EPA, NPS, USDA

2023 Duke Forest New Hope Creek Restoration Project - Concrete Bridge



- Concrete Bridge
- Concrete Bridge Project Area
- Duke Forest Korstian Division
- Duke Forest Access Roads
- Proposed Easement - 100 year Floodplain
- New Hope Creek

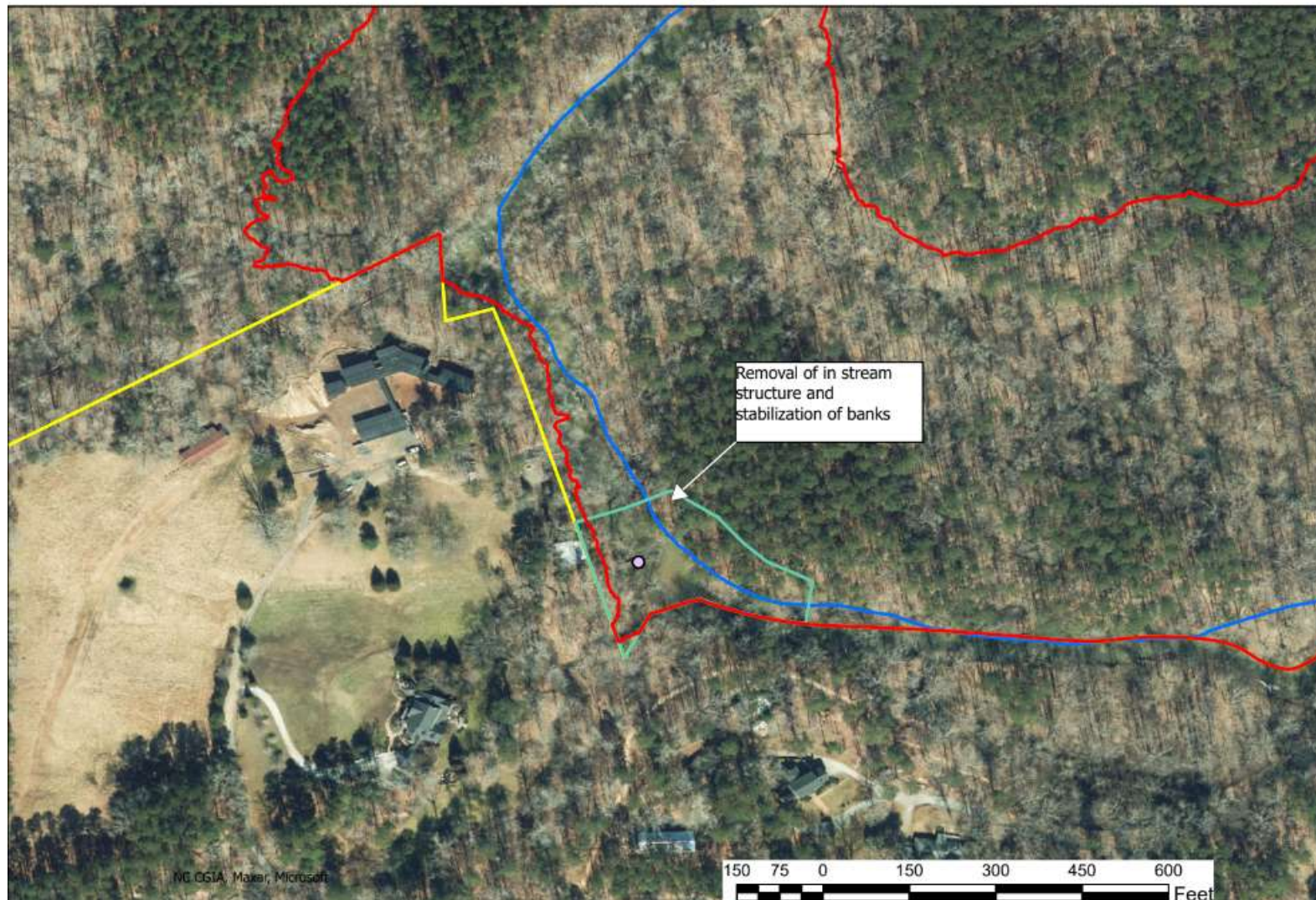


2023 Duke Forest New Hope Creek Restoration Project - Billy Erwin Dam



- Billy Erwin Dam
- Billy Erwin Project Area
- Duke Forest Korstian Division

- Proposed Easement - 100 year Floodplain
- New Hope Creek





Background on Stream Barriers

Stream barriers: Dams and undersized culverts

- Barriers block sediment, change hydraulics, and limit organism movement
- Estimated 2.5 million dams in the US
 - Countless road stream crossings
- Approximately 5,000 universities in the United States.
- Universities own or manage about 1,167 square miles of campus land in the United States,
 - not counting additional land in the form of forests and land grant holdings (HIFLD, 2022).

Guidebook Scope and Audience



Scope

- Focusing on small barrier removal projects
- Guidebook is supplemental to existing literature on these projects
- Online resource library for additional guidance

Audience

- Students and faculty
- Campus facilities or forest managers
- University administrators
- Consultants and engineers



New Hope Creek Barrier Removal Project Case Study

DUKE FOREST
Teaching & Research Laboratory
ESTABLISHED 1931

In this guidebook, we draw on a case study of two barrier removals on New Hope Creek in Duke University's Duke Forest Teaching and Research Laboratory in Orange County, North Carolina. This case study is used to illustrate the application of topics covered within a chapter.

Established in 1931, the Duke Forest Teaching and Research Laboratory is Duke University's 7,100-acre teaching and research forest. The goals of Duke Forest's New Hope Creek Restoration Projects are to improve aquatic habitat, restore aquatic habitat connectivity, stabilize stream banks, and potentially expand the stream area occupied by the federally threatened Atlantic Pigtoe mussel. This will be achieved through the removal of two in-stream, human-made structures.

The first structure is a low water bridge installed in the 1930s and known as the Concrete Bridge. Its removal and replacement with an updated bridge will help restore stream flow, improve habitat and passage for native aquatic organisms (including fish and mussels), prevent further degradation of the adjacent stream banks, and provide for safe and reliable vehicle and pedestrian passage.

The second structure located downstream of the bridge is a partially breached dam built to explore the potential for hydroelectric power generation in the early twentieth century. It is known as the Billy Erwin Dam, and its complete removal will help restore stream flow and reduce bank erosion that introduces sediment to the stream and threatens recreational trails in the area.



Figure 2 (left): the Concrete Bridge site. Figure 3 (right) the Billy Erwin Dam.

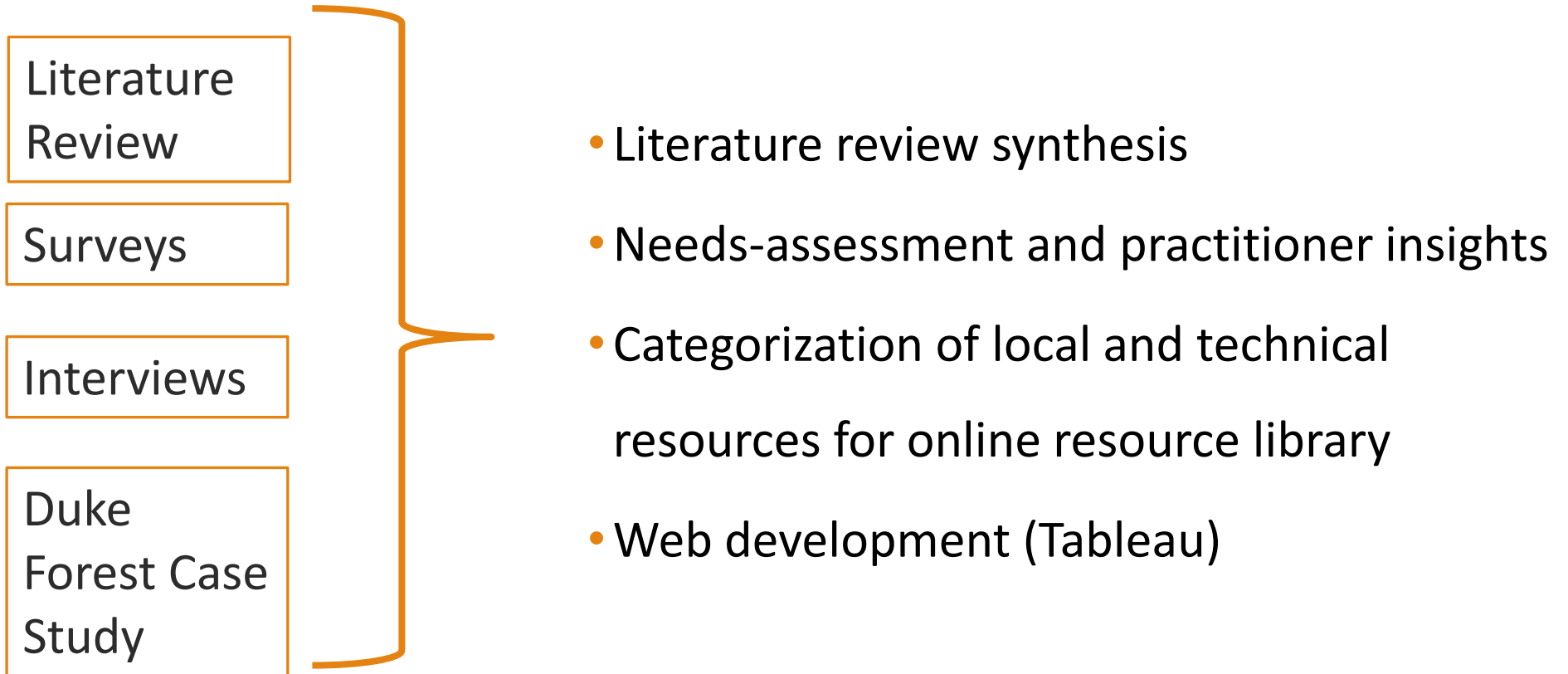
Duke Forest Project Objectives:

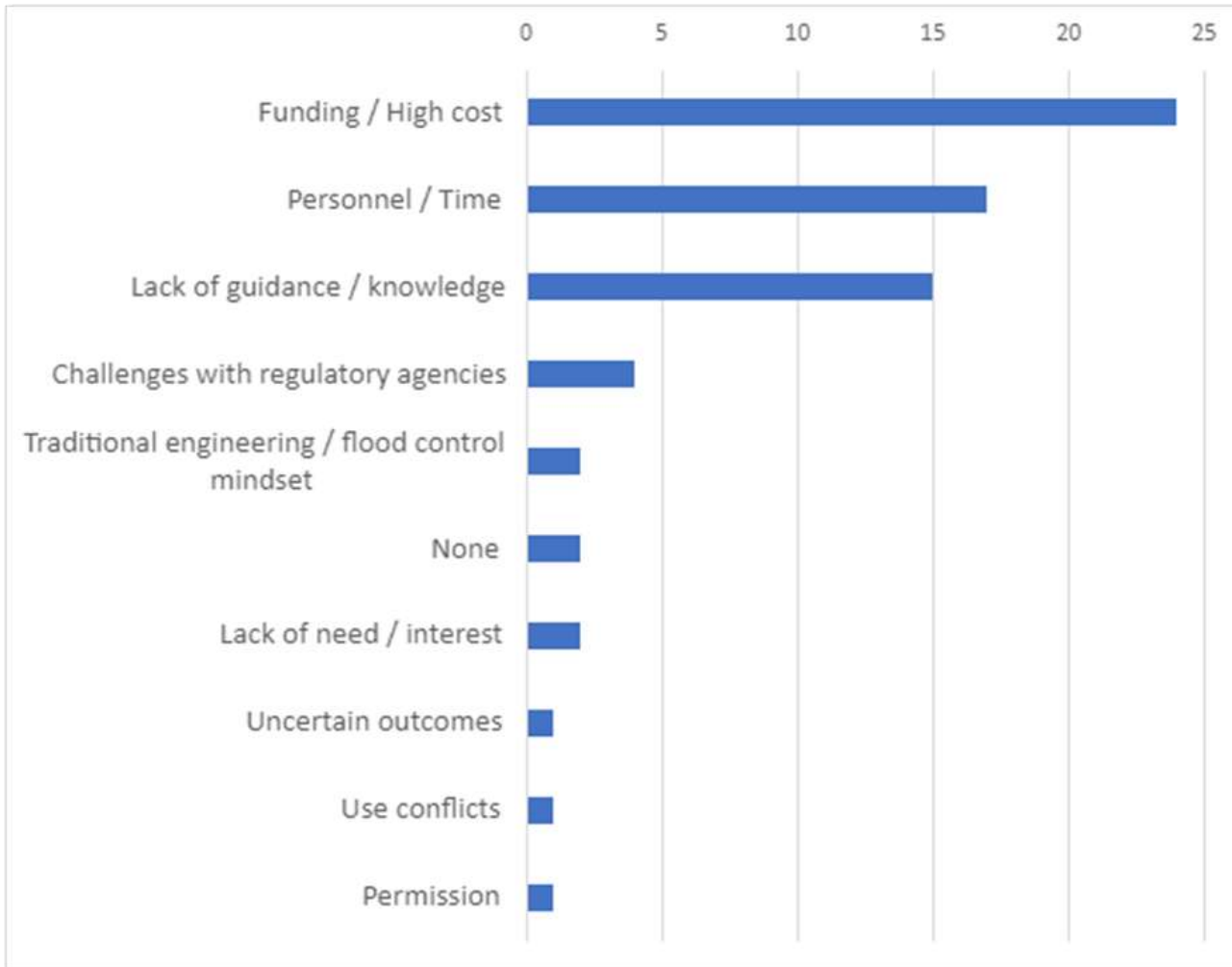
- Replace the concrete bridge to meet the ecological, vehicle, and pedestrian crossing goals
- Remove the Billy Erwin Dam
- Restore aquatic habitat currently impacted by the structures
- Restore aquatic habitat connectivity and passage for fish, mussels, and other aquatic species

Focus on Universities

- Untapped potential for Universities to be leaders and model projects that restore habitat connectivity
- Unique challenges
- Universities well poised to study effects of restoration in detail
- Large capacity for capital projects
- Project seeks to fill this Gap in guidance around the unique elements to managing these projects in university context

Methods



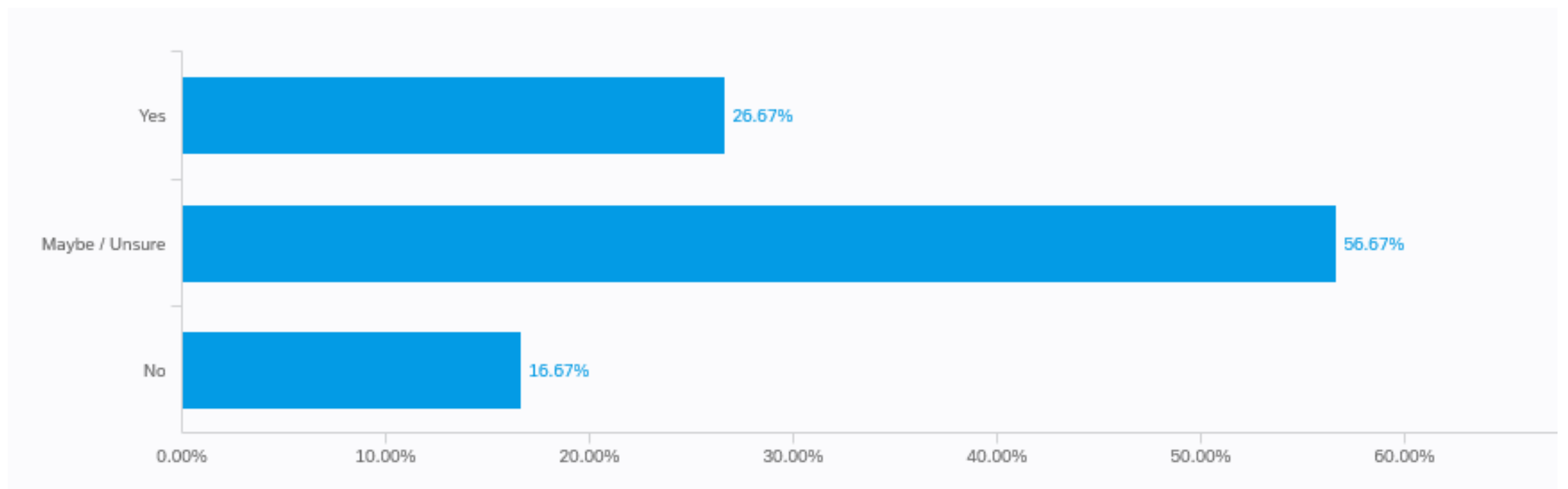


Key Survey Results

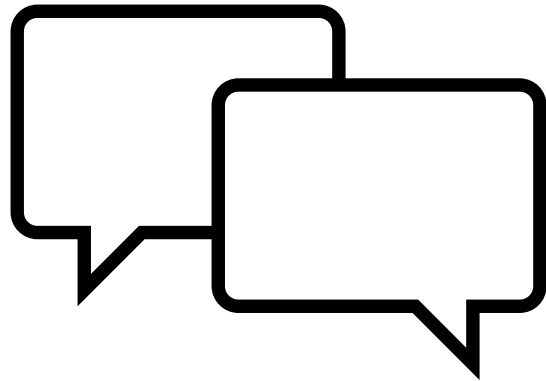
Funding is the greatest roadblock for project implementation

Mitigation Credits

Would you be more interested in pursuing stream restoration and habitat connectivity projects on your campus if they would be eligible for mitigation credits?



Key Findings from Interviews



Interview Takeaways:

- ❑ University-based projects face less complexity with land ownership issues, allowing for some streamlining
- ❑ University based expertise and data can be leveraged through a project life span
- ❑ University and community relationships are key for project success

The cover image shows a stream flowing over a dam. The water is turbulent and white with foam as it passes over the dam. The surrounding area is lush with green trees and foliage. The text is overlaid on the top left of the image.

Restoring Stream Connectivity in the University Context

**A Project Manager's Guidebook and Online
Resource Library for Small Dam Removals
and Culvert Replacements**

Masters project submitted in
partial fulfillment of the re-
quirements for the Master of
Environmental Management
degree in the Nicholas School
of the Environment of Duke
University

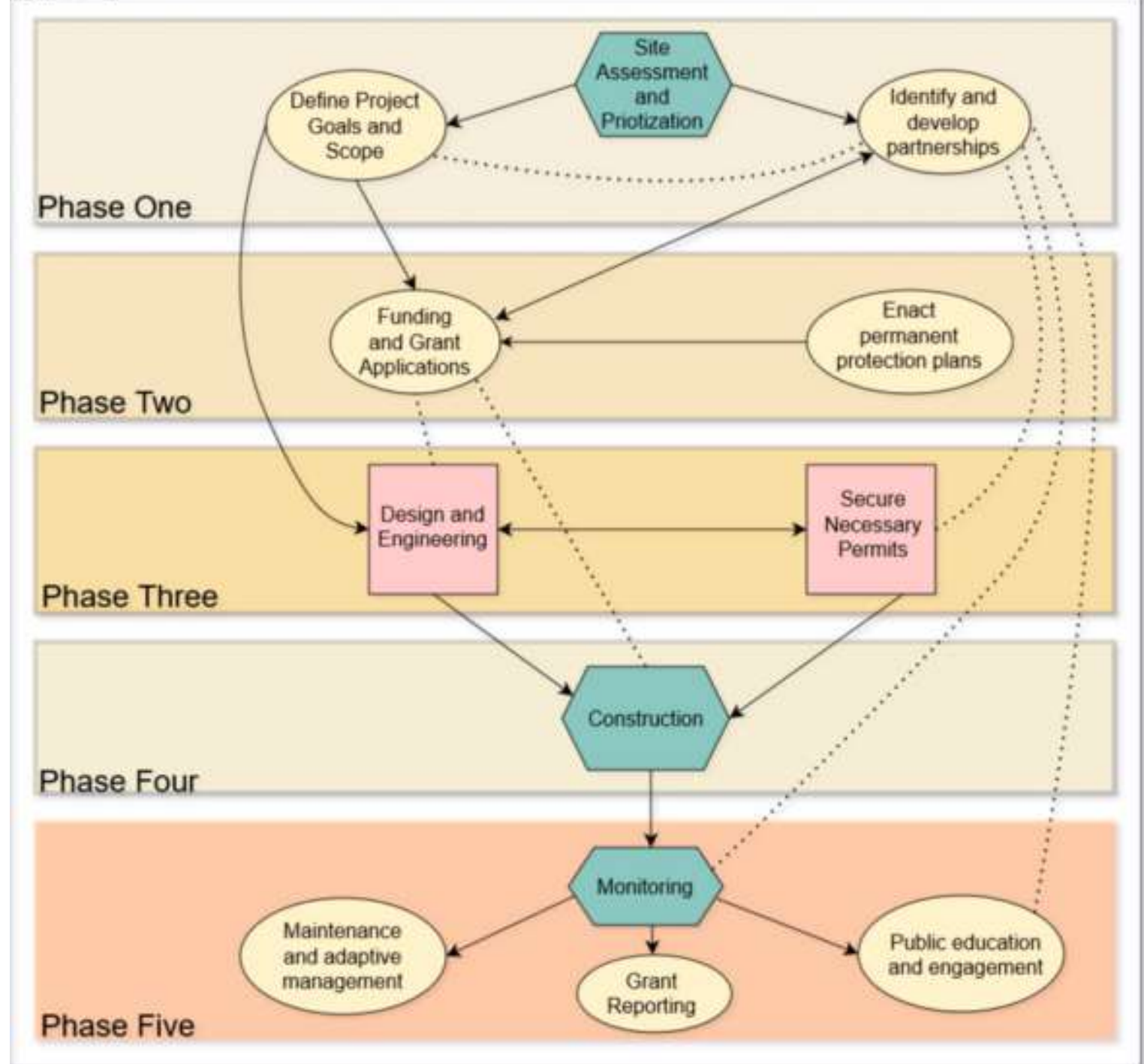
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Advised by Dr. Martin Doyle
and Sara Childs

Produced for the Duke
Forest Teaching and
Research Laboratory
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Project Manager's Guidebook Takeaways

Project Planning

- Overview of phases
- Learning from similar projects
- Keeping a record
- Common management concerns



Developing Partnerships and Engaging Stakeholders

- Most important step
- Strength of Universities
- Create Stakeholder checklist
 - Informational vs Consultation

| University Stakeholder / Partner | Project Role |
|--|--|
| Administration | <ul style="list-style-type: none">• Landowner – agreement to project is key• Financial planning and support |
| Facilities / Forest Staff | <ul style="list-style-type: none">• Project management• Project feasibility• Project and site safety• Project maintenance |
| University Extension Office (if available) | <ul style="list-style-type: none">• Technical expertise• Grant application assistance• Connections to practitioners• Connections to government agencies |
| Faculty and Researchers | <ul style="list-style-type: none">• Support student involvement• Data sharing from existing research• Pre and post restoration monitoring• Technical expertise• Research opportunities• Connections to local NGOs, researchers, practitioners |
| Students | <ul style="list-style-type: none">• Internship positions• Field courses• Research / thesis projects• Education and outreach through student groups |

Project Funding



- ❑ Break project into phases
- ❑ Utilize multiple funding sources
- ❑ Being conscious of University Requirements and timelines
- ❑ Leverage conservation easements as asset matching in grants
- ❑ Mitigation Funds can lengthen timeline significantly
- ❑ Partnerships important, can help access funds

Monitoring

- Opportunities for volunteers/partnerships with students and organizations
 - Data collection
 - Analysis/research
 - Adaptive management responsibilities
- Tailoring to project objectives
- Important consideration pre-construction for endangered species

| Objectives | Examples | Monitoring Actions |
|------------|----------|--------------------|
|------------|----------|--------------------|

| | | |
|--|--|---|
| Protect water quality for trout species | | Monitor water quality parameters relevant to trout (i.e., stream water temperature, velocity, sediment composition) |
|--|--|---|

| | | |
|--|--|--|
| Improve habitat and forage for salmonid species | | Survey quantity or quality of rearing, spawning, habitat cover, and macroinvertebrates net surveys |
|--|--|--|

| | | |
|---|--|-------------------------|
| Improve stream channel dimension and profile | | Survey channel profiles |
|---|--|-------------------------|

| | | |
|------------------------------|--|---|
| Stabilize streambanks | | Compare channel planforms to preflood conditions; riparian vegetation surveys |
|------------------------------|--|---|



Big-Picture Suggestions



Consider mitigation banking as a project funding approach for university projects



Standardize university road-stream crossing replacement guidelines to Stream Stimulation methods across university campus / forests or state university systems



Partner with USFS or other technical experts to train facilities, campus engineers, and forest managers on Stream Simulation / Stream Smart methods



Partner early on with campus researchers to share “before” data, collaborate on monitoring, and explore research opportunities



Online Resource Library

-Hosted by SARP

Online Resource Database

Regional Stream Barrier Removal Resources

| Organization/Author | Title | Link |
|--|---|---|
| American Association of State Highway... | A Summary of Existing Research on Dam Rem... | https://onlinepubs.trb.org/onlinepubs/arc... |
| American Rivers | Dam Removal and Historic Preservation: Rec... | https://www.americanrivers.org/conserva... |
| | Reyighting Streams: Breathing Life into Urb... | https://www.americanrivers.org/conserva... |
| | Funding Restoration Projects | https://www.americanrivers.org/river-rest... |
| | Innovative Finance Approach for California W... | https://www.americanrivers.org/conserva... |
| | Obtaining Permits to Remove a Dam | https://sccog.org/wp-content/uploads/ha... |
| | PAYING FOR DAM REMOVAL: A guide to Select... | https://mda.maryland.gov/programs/Wate... |
| | Permitting Restoration Projects | https://www.americanrivers.org/conserva... |
| | Removing Small Dams _ a basic guide for Proj... | https://openrivers.eu/wp-content/uploade... |
| American Rivers and Trout Unlimited | Exploring Dam Removal: A Decision-Making G... | Exploring Dam Removal: A Decision-Making... |
| American Rivers and Vermont Agency o... | User's Guide to Vermont Dam Removals: A Ba... | viseservices.duke.edu/travel/oviting-frian... |
| Aspen Institute | Dam Removal: A New Option for a New Centu... | https://www.aspeninstitute.org/wp-conta... |
| Association of State Dam Safety Officers | Dam Removal | https://damsafety.org/dam-owners/dam-r... |
| ASU Thesis by Rachael Ann Hoch | Beaver and Mill Dams Alter Freshwater Muss... | https://libres.uncg.edu/ir/asu/f/Hoch_9620... |
| Bernhardt et al | Synthesizing US river restoration efforts | https://www.sciences.org/doi/full/10.1126/... |
| Brewitt and Colwyn | Little dams, big problems: The legal and polic... | https://wires.onlinelibrary.wiley.com/doi/f... |
| CAL.FED.. | Developing a Strategic Plan for Ecosystem... | https://digitalcommons.law.ggu.edu/cgi/vi... |
| Christina Tonitto & Susan J. Riha | Planning and implementing small dam remov... | https://link.springer.com/article/10.1007/... |
| Dam Safety Program Texas Commission... | Dam Removal Guidelines | https://www.tcd.texas.gov/downloads/co... |
| Denise Hoffer-Hay | Small Dam Removal in Oregon _ a guide for p... | http://3-sa-west-2.amazonaws.com/urddi... |
| Department of Conservation and Recre... | The Virginia Stream Restoration & Stabilizati... | https://www.dec.virginia.gov/home/show... |
| Department of Environmental Conserv... | Aquatic Connectivity and Barrier Removal... | https://www.dec.ny.gov/lands/99489.html |
| Department of Natural Resources, Corn... | Annual Report on the Ecological Monitoring o... | https://eri.cals.cornell.edu/sites/eri.cals... |
| Division of Ecological Restoration | Deciding to Remove Your Dam | https://www.mass.gov/guides/deciding-to... |
| Doyle et al | Toward policies and decision-making for dam... | https://link.springer.com/proxy.lib.duke.e... |
| Environmental Policy Innovation Center | Common Pay for success contracting pitfalls a... | https://www.policyinnovation.org/blog/co... |
| | Recent efforts to streamline restoration per... | https://www.policyinnovation.org/blog/ri... |
| | Streamlining Restoration Projects with Natio... | https://www.policyinnovation.org/blog/stri... |
| Farshid Vahedifard et al | Are we ready for more dam removals in the U... | https://www.researchgate.net/publication... |
| Fleurat (VHB) | Road-Stream Crossing Design Manual | https://www.dot.ri.gov/business/document... |
| General Assembly of NC | NC Dam Removal Law | https://www.ncleg.gov/EnactedLegislatio... |
| Georgia Aquatic Connectivity Team | Stream Crossings Georgia _ a handbook for C... | https://ga-act.org/georgia-stream-crossi... |
| Graff and Evans (Geological Society of ... | The Challenges of Dam Removal and River Re... | https://pubs.geoscienceworld.org/gsa/boo... |
| Gulf of Maine Council on the Marine Env... | Stream Barrier Removal Monitoring Guide | http://www.gulfmaine.org/streambarrier... |
| Hoenke, Kumar, Batt (MEM alumni) | A GIS based approach for prioritizing dams fo... | https://www.sciencedirect.com/science/ar... |

Project Topics

- (All)
- Null
- Climate Resilience
- Decision Making, Design and Engineering
- Design
- Design and Construction
- Funding
- Monitoring
- Permitting
- Planning
- Project Design

States Filter

<https://people.duke.edu/~kbh40/Tableau.html>

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Thank You!

Questions?