

Choctawhatchee-Pea Basin Unpaved Road-Stream Crossings Assessment and Treatment System (CATS) Demonstration Project

Caveat: The contents of this proposal may not be incorporated into a non-SAIC contract or agreement.

SAIC previously assessed county-maintained unpaved road-stream crossings within the CPB, under a Florida Department of Environmental Protection (FDEP) Section 319(h) grant. The *Northwest Florida Choctawhatchee-Pea Basin Road-Stream Crossings Assessment* project was conducted from 2008 to 2009 in collaboration with the FDEP, Three Rivers, and West Florida Resource Conservation and Development Councils, Inc., Northwest Florida Soil and Water Conservation Districts, Natural Resources Conservation Service, U.S. Fish and Wildlife Service, and participating Florida counties. The purpose was to identify the site-specific impacts of crossings on aquatic environments, prioritize crossing sites for treatment, and inventory CPB county roads and crossings maintenance. CPB crossing-induced soil erosion and waterway sedimentation was identified as a major source of water quality impairment and habitat degradation. SAIC collected field data and developed treatment priorities for 759 crossings. Public



access to the information gathered by the project can be accessed through the CPB website at <https://www.gcsaic.com/streamx2>.

PROJECT DESCRIPTION

Problem — Of all human activities that disturb lands, few cause more impacts on social, economic, and ecological environments than roads. Unpaved road crossings are particularly pervasive in terms of road-induced soil erosion and waterway turbidity and sedimentation. Crossing-induced sediment impacts are prevalent and, in some cases, catastrophic to aquatic ecosystems. Sedimentation caused by unpaved road crossings not only represents poor stewardship of the natural landscape, but also potentially exposes counties to environmental liabilities from the violation of federal and state regulations that govern water quality, listed species, and their habitats. Furthermore, chronic sedimentation indicates a loss of road surface materials, which in turn increases maintenance costs.

While erosion impacts are often obvious, cost-effective and environmentally sustainable, crossing site treatment solutions are not. Because of the diversity and complexity of interactions between the constructed crossing features (road approaches and crossing structures) and surrounding natural environments, site treatment solutions cannot be viewed as “one size fits all.” Site-specific data and technical issues must be analyzed to consider environmental and economic concerns as well as maintenance capabilities. Frequently, engineers and project planners default to a single solution, such as paving the crossing road approaches. Although paving is an effective crossing treatment option, other less-expensive alternatives often yield similar results.

The choosing of an optimal alternative requires information on site-specific problems and preliminary planning to match available resources with complementary treatment techniques. Dozens of publications describe treatment practices but there is limited instruction for assembling these practices into suitable alternatives that target site-specific problems. Improperly vetted crossing treatment applications often result in more significant catastrophic impacts in both environmental and economic terms. Figure 1 shows examples of CPB road paving crossing treatments where considerable resources were spent that made erosion and waterway sedimentation problems significantly worse.

Crossing treatments to stabilize roads and manage runoff must be explicitly examined for both environmental impacts and resource expenditures. Long-term sustainable solutions must minimize current and future environmental liabilities and produce viable treatment alternatives that maximize the utility, safety, and environmental sustainability of roads. Northwest Florida counties are faced with intense budgetary pressures to sustainably maintain road network assets into the future without compromise or decline in supporting natural, financial, and built assets.

Proposed Solution — We propose that the Crossing Assessment and Treatment System (CATS) be implemented to demonstrate the uses and benefits of an innovative approach to developing treatment alternatives for maintaining unpaved road crossings. This technology utilizes resource data and on-site investigations to formalize customized solutions that offer combinations of best practices to target and cost-effectively resolve site-specific problems. The process is employed after road crossings have been inventoried and prioritized for treatment and before project selection and engineering. Rainfall simulation would be used to estimate road crossing-induced watercourse sedimentation rates.



Figure 1. Catastrophic Crossing Failures Following Road Paving in CPB Portions of Holmes and Washington Counties

Project Objective — The project objective is to demonstrate a crossing treatment evaluation technology and process tools used to transition unpaved road crossings *from* documented sources of sedimentation, habitat degradation, impaired fish passage, and water quality impairment *to* crossings with documented discountable, insignificant, or completely beneficial environmental and socioeconomic impacts. The project would also demonstrate a process to consistently define, analyze, and monitor road crossing-induced soil erosion and water resource sediment impacts and enhance the value and utility of prioritized crossing assets by meeting the desired level of service at the lowest life cycle cost, for the present and future.

Technical Approach — The proposed technical approach is to exploit existing crossing assessment and natural resource datasets, prescribed field techniques and guidance documents, and integrate select field technologies to demonstrate the performance and cost benefits of the CATS process. The demonstration would follow axioms of road crossing treatment: 1) stabilize the road surface, 2) discharge stormwater frequently and in a nonerosive manner, and 3) reestablish native vegetation to stabilize disturbed roadside areas. Creating a road surface resistant to materials detachment and transport is a key component to an effective road drainage system. Identifying and characterizing the stormwater runoff contribution of adjacent land areas along both crossing road approaches is also important. Protocols would be developed and standardized to quantify sediment delivery to receiving waterways at each demonstration site.

Primary performance measures would include ease of use and sediment reduction estimates and projected cost benefits of each alternative. The four proposed work phases of the CATS demonstration are as follows.

Phase 1: Planning. This phase would include administrative tasks; reviewing the project scope, needs, expectations, and issues; producing the Project Demonstration Plan, selecting demonstration sites, reviewing recent literature, and gathering CPB natural resource and stream assessment data. CATS technology would be demonstrated at five high-priority crossings, including three water crossings (culvert and/or bridge) and a crossover site and proximity site crossing (Figure 2). Sites selected would be representative of the range of issues that challenge site maintenance. The candidate selection pool would be limited to road crossings that were ranked *high priority* for treatment during the CPB road-stream crossings assessment. Natural resource information would be retrieved from public databases.

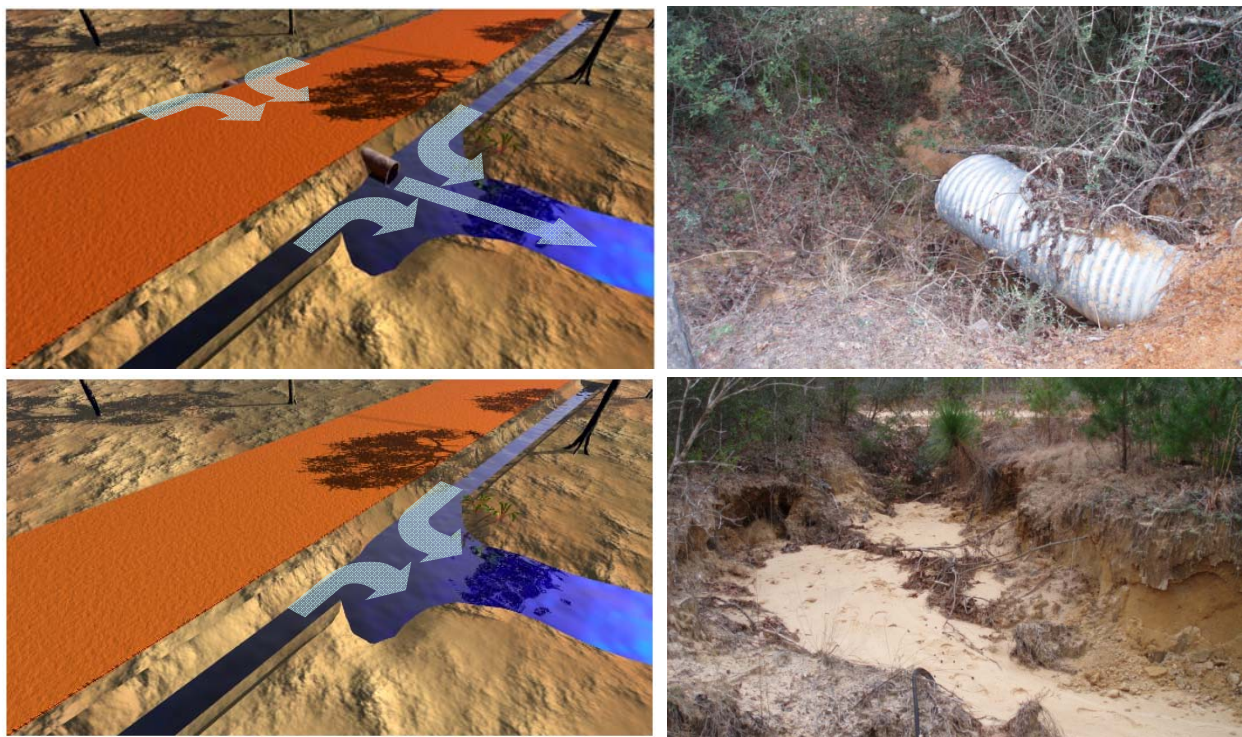


Figure 2. Crossover Site (top) and Proximity Site (bottom) Crossings

Phase 2: Crossing Surveys. Field data would be collected from each demonstration site, including road approach, crossing structure, stream channel, and roadside features. Off-site runoff issues (i.e., channelized and sheet flow inputs and road approach connectivity to other drainage features) would be located and characterized using mobile GIS tools. On-site runoff discharge points would also be located and characterized. Crossing photopoints would be taken based on a reacquisition of the 2008 crossings assessment points for comparative review. Photographs would provide a visual point-in-time illustration of site features and conditions that can be replicated to document changes. Other than standard measuring devices, no additional electronic field instruments would be required. Field data would provide the basis for pinpointing sources of crossing road approach problems, evaluating crossing discharge features,

assessing in-stream culvert position and flow capacity, and assessing resource impacts and treatment options.

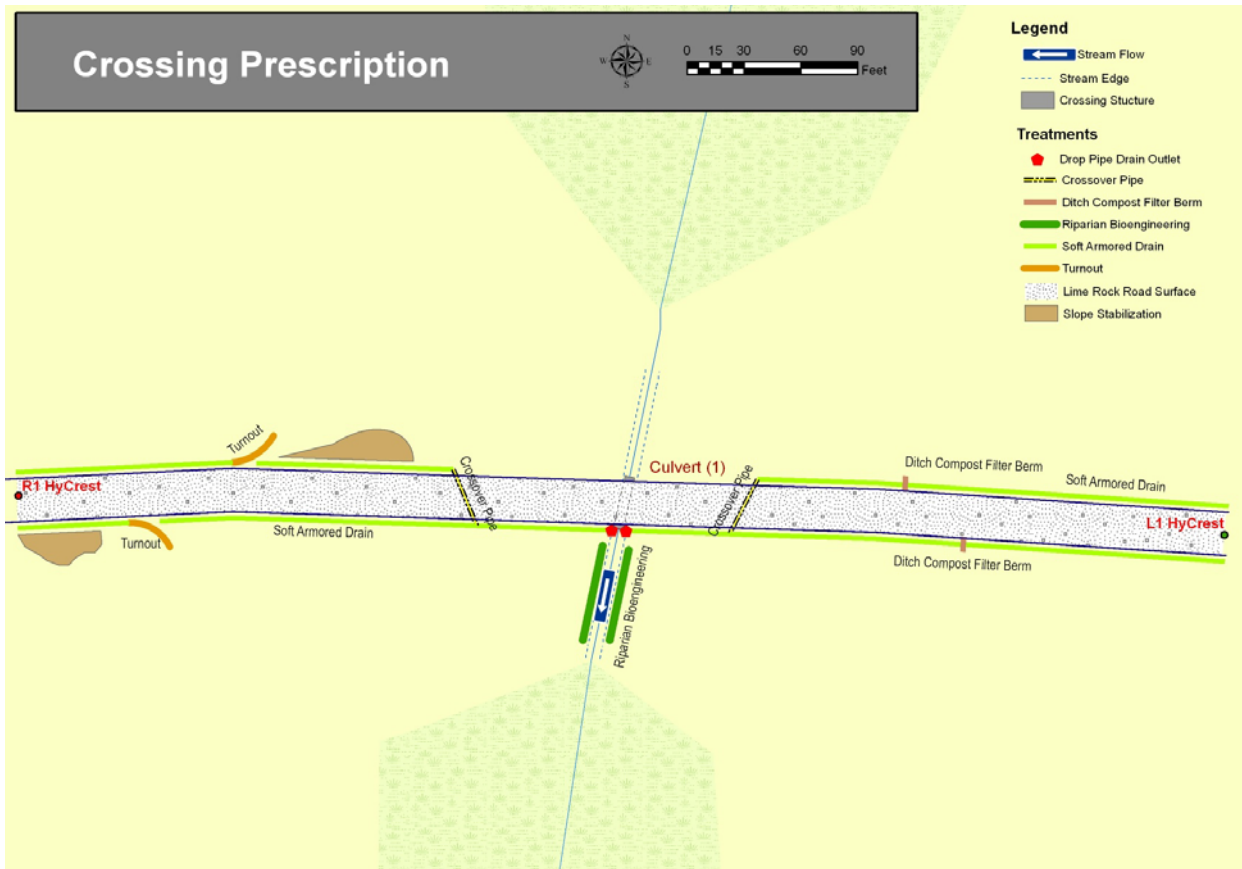
Rainfall event simulation equipment would be used to calculate average crossing site runoff flow rates and sediment loading. The system design would be patterned after the rainmaker system developed by the Center for Dirt and Gravel Road Studies; materials and construction costs are included in the project budget. Contribution locations and deposition characteristics would be recorded, and sediment samples would be analyzed by a local commercial laboratory. An important benefit of this system is the capability to control and consistently simulate repeatable rainfall events at different locations, which cannot be achieved under natural rainfall conditions. The system would be tested and calibrated before deployment.

Phase 3: Crossing Site Treatment Alternatives. Field investigation results, resource data, internal technical guidelines and professional judgment would be used to develop crossing maintenance treatment alternatives. Alternatives would be based on combining best practices and techniques provided in a road maintenance handbook and crossings manual developed for the U.S. Air Force in 2001 and 2007 to address crossing road approach stabilization, drainage, roadside stabilization, crossing structure, affected waterway issues. Considering the extent of potential issues for a given crossing and that there are over 50 available best practices, there are many potential solutions for any given situation. For each site there would be at least two maintenance alternatives (paved and unpaved roads).

Cost-benefit analysis (CBA) would be conducted to realistically evaluate and compare the current crossing maintenance scenario and proposed treatment alternatives in relation to defensible environmental and socioeconomic cost and benefit parameters. CBA establishes the framework for expressing project values and expenditures in comparable monetary units of measure that ensures cost and benefit parameters are equally analyzed, compared, and weighted. Enumerating alternative costs and benefits ensures that anticipated benefits are fully recognized, the costs are distributed in an equitable manner, and limited resources are used efficiently. Time is factored into the CBA process using a return-on-investment period. Cost-benefit ratios would be used to evaluate the relationship between costs and benefits and to investigate the allocation of limited funds among competing alternatives.

CATS treatment alternative dossiers would be developed to document problem sources, best practices selection rationales, proposed treatment processes, estimated costs, maintenance and monitoring requirements, and contingencies. Exposures to environmental regulatory liabilities associated with water quality impairment and aquatic habitat degradation would also be assessed. Opportunities for utilizing recyclable debris as a source of aggregate for stabilizing road approach surfaces would be examined. Since detailed engineering is not a component of this project, each practice would be generally depicted on the alternative plan map (Figure 3) without providing exact construction specifications.

Phase 4: Reporting. At predetermined stages of the project management reports and technical report would be provided.



HyCrest – Crossing left (L1) and right (R1) road approach hydrologic crest points marking the road drainage divide toward and away from the crossing.

Figure 3. Example Crossing Maintenance Treatment Prescription Plan

ESTIMATED PROJECT COSTS

The total estimated cost for the proposed 10-month project is \$110,300 (Table 1). There are no matching funds, in-kind contributions, or state/federal dollars associated with the project.

Table 1. Proposed Project Rough Order of Magnitude Costs Summary

Project Cost Item	Cost Estimate
Administration and Management	\$5,300
Phase 1: Planning	8,500
Phase 2: Field Surveys	39,700
Phase 3: Crossing Site Treatment Alternatives	31,800
Phase 4: Reporting	25,000
Total Costs	\$110,300

OTHER FUNDING

This project has not been submitted for additional grant funding nor is it being used to leverage other funding sources.

TECHNICAL FEASIBILITY

Technology Description — CATS is a pre-engineering process of site investigation and evaluation used to formulate and analyze viable crossing site solutions. The process utilizes crossing site inventory and prioritization data as a baseline to focus resources on screening treatment opportunities. Additional field reconnaissance is conducted to pinpoint specific issues (water crossing culverts, sources of erosion, runoff discharge points, maintenance practices, etc.) to be evaluated during the design of alternatives. To establish a quantitative baseline for measuring and monitoring aquatic resource impacts and improvements, specialized equipment is used to simulate highly repeatable rainfall events and measure crossing site sediment discharge into waterways. Following an analysis of site features and conditions, treatment alternatives are developed, each specifying the general location, state and local guidelines, maintenance and monitoring requirements, estimated costs, life cycles, and contingencies for the treatment practices. Cost-benefit analysis is conducted to establish the cumulative return on investment and quantify, to the degree possible, alternative environmental and economic benefits.

The CATS approach is innovative in that it combines select, relatively simple techniques into a framework of site evaluation that clearly highlights site considerations, priorities, and pivotal issues that are critical to the development of successful long-term projects. In addition to providing technical data important to engineering designs, the process gives project planners access to data they can use to screen and select crossing treatments that align with available resources and maintenance capabilities.

Technology Maturity — Over the past few years, the CATS process has been used to assist county and state agencies in evaluating unpaved road crossing conditions, prioritizing site treatments, and scrutinizing applicable alternatives. Specialized survey, photopoint collection, developed mobile GIS applications, custom databases, and on-site rainfall simulation tools are available and have been proven effective. Data collection and management protocols, GIS mapping, and information recording procedures are well established. Cost-benefit analysis would follow readily available technical standards. The rainfall simulator for measuring crossing sediment generation and delivery would be constructed, tested, and calibrated during Phase 1 of the project.

Technical Risks — There are minimal technical risks associated with the proposed demonstration. Internal tools and techniques have been validated and resource data is available from existing sources. The equipment and techniques for sampling runoff flow rates and sediment loading have been vetted in the field. Adjustments to the Rainmaker system would likely be needed to simulate a customized rainfall rate (inches/hour) to account for regional weather and/or crossing conditions. Since the system is limited to a 100-foot area of simulated runoff within the road corridor (off-site contributions are not considered) assumptions would be developed to extrapolate minimal estimates of sediment generation and delivery.

Technology Transition — CATS technology would be transitioned to county end users through documentation, data structure definition, on-site training and consultation, or directed project contracting. At the county scale, previous crossing inventory, assessment, and prioritization data is needed input for the CATS process. A CATS protocol document would be provided to outline data requirements, considerations, materials, implementation procedures, and resource needs.

The CATS treatment strategies can be adapted to a diversity of county situations. As presented, the road crossing treatment axioms and technical processes are applicable to any location. Process modifications

would primarily be limited to identifying applicable practices best suited to local crossing conditions and sediment generation testing considerations.

Relevant Project Experience — Past work conducted by SAIC relating to the proposed project include:

- ✚ Chattahoochee-Oconee National Forests Roads Analysis for the U.S. Forest Service, Georgia (2003)
- ✚ U.S. Fish and Wildlife Service's Northwest Florida Road-Stream Crossings Manual (2005)
- ✚ Eglin Air Force Base Range Road-Stream Crossings Management Strategic Management Plan (2007)
- ✚ Northwest Florida Lower Choctawhatchee Subbasin Road-Stream Crossings Assessment for the Florida Department of Environmental Protection (2007)
- ✚ Northwest Florida Choctawhatchee-Pea Basin Road-Stream Crossings Assessment for the Florida Department of Environmental Protection (2008–2009)
- ✚ On-Site Unpaved Road and Crossing Treatment Consultations for Holmes and Walton County, Florida and the Northwest Florida Water Management District (2008–2009)
- ✚ Range Road Network Asset Management Projects for Eglin Air Force Base, Florida (2001–2009)
 - Range Roads Maintenance Handbook* (2001)
 - Range Road Segments Decommission and Rehabilitation Plans* (2001–2003)
 - Range Roads Programmatic Environmental Assessment* (2002)
 - Range Roads Maintenance Biological Assessment* (2003)
 - Range Road-Stream Crossing Process Specific Opportunity Assessment* (2005)
 - Range Road-Stream Crossings Management Strategic Management Plan* (2007)
 - Range Road-Stream Crossings Manual* (2007)
 - Range Road-Stream Crossings Assessment* (2009)

BENEFITS

Environmental — The proposed CATS demonstration would have distinct benefits to affected CPB environments. CATS data and deliverables would provide suitable alternatives to current crossing sites to reduce sediment-induced impacts to aquatic ecosystems. Post-treatment crossing project environmental benefits would include:

- ✚ Improvements in water quality.
- ✚ Identifying opportunities to use recyclable materials to stabilize roads and crossings.
- ✚ Enhancements to the quality and range of aquatic habitats for imperiled fisheries and mussels.
- ✚ Reductions in wetlands loss and degradation, including coastal marshes, waterways, estuaries, and forested wetlands.

The process would foster collaboration among diverse stakeholders in developing optimal road crossing management strategies to achieve ecological recovery objectives and minimize potential environmental liabilities associated with road crossing-induced environmental impacts. The process would establish a baseline for realistically estimating crossing-induced soil erosion and sediment delivery that can be used to measure progress in reducing ecosystem impacts and evaluating project benefits.

Economic and Social — The proposed project would provide a diversity of socioeconomic benefits including:

- ✚ Enhanced local employment and commerce associated with the purchase of goods and services to support future crossing site project construction and maintenance.
- ✚ Improved commercial and recreational fisheries and other recreational water uses.
- ✚ Optimized allocation and benefits of ecosystem recovery financial and technical resources.
- ✚ Increased county transportation support capabilities and efficiencies.

Attention to the site-specific issues presented by problematic crossings is critical to formatting corrective approaches that effectively guide project development. This information would be used to prevent the misalignment of resources and focus expenditures on viable project implementation. Deliverables would provide information that counties and other agencies could use to assess their technical strengths and gaps in addressing crossing treatment issues. Improvements in the stability of crossings would also increase transportation asset life cycles, performance, and safety.

An efficient and manageable road network is essential to sustaining and enhancing county transportation networks. To that end, the CATS treatment strategies used to minimize environmental impacts also address the economic impacts of ineffective and costly maintenance, substandard road conditions, and the safety risks that plague many problematic crossings. CATS cost-benefit analysis also provides a defensible economic basis for acquiring and allocating limited resources.

Community Resilience — The recovery of aquatic ecosystems impacted by crossing would lead to improvements in ecosystem form and functions. As conditions improve, aquatic environments are more resistant to and recover more efficiently from the affects of significant storms and hurricane events. The implementation of CATS crossing treatments would create conditions that:

- ✚ Reduce the depletion of natural resources.
- ✚ Provide community education opportunities.
- ✚ Encourage community support for ecosystem recovery strategies, programs, and projects.
- ✚ Create opportunities for local citizens to become involved in the monitoring and preservation of their ecosystems.

CONFLICTS OR COMPLEMENTS TO EXISTING EFFORTS

The U.S. Fish and Wildlife Service, Panama City, Florida, along with regional and Washington offices, in coordination with state agencies, are developing programmatic strategies to address impacts to federally listed fisheries and mussels in the CPB. Workshops are planned for 2013 to gather and distribute

information regarding the hydrologic and water quality conditions and trends within the Escambia, Yellow, and Choctawhatchee River Basins and construct species status assessments for recently listed mussels. The proposed project would provide site-specific data regarding current crossing-induced sediment contributions and estimated reductions in sediment loading following crossing treatment projects. The CATS process would provide the tools to strategically apply resources to treat high-priority sites, targeting improvements in imperiled species habitats. Designing crossing treatments and monitoring for crossing sites known to affect imperiled species habitats would assist in optimizing habitat benefits and the viability of species populations.

COMPLIES WITH FEDERAL, STATE, LOCAL, AND TRIBAL LAWS/REGULATIONS

The proposed project would be in compliance with all federal, state, and tribal laws and regulations. No permits would be required to implement the project and no legal conflicts are anticipated.

READINESS FOR IMPLEMENTATION

The project is poised for immediate deployment and implementation. All water crossing sites (culverts and bridges) are within county right-of-ways with not access issues. Crossover and proximity site crossing discharge areas may occur on private or public lands. Access issues would generally be limited to private lands. If access to private holdings is required, permission would be acquired prior to any entry. However, no potential access issues have been identified that would compromise project implementation.

PUBLIC ACCEPTANCE

There are no known public opposition issues identified for the proposed project. On the contrary, numerous contacts with local citizens during CPB crossing field data collection during 2008 through 2009 revealed that local residents were concerned with the declines in the quality of their waterways and wetlands and were welcoming of any efforts to facilitate improvements.

ADDITIONAL INFORMATION

Examples of CPB Crossing-Induced Sedimentation

