COLORADO DISASTER RECOVERY

RECOVERY CHECKLIST

A GUIDE TO PLAN, REACT, ADAPT, EVOLVE, AND ACHIEVE THE BEST POSSIBLE OUTCOMES FOR OUR COMMUNITIES AND STREAM CORRIDORS

DISASTER RECOVERY CHECKLIST

Based on:

COLORADO DISASTER RECOVERY LESSONS LEARNED

A GUIDE TO PLAN, REACT, ADAPT, EVOLVE, AND ACHIEVE THE BEST POSSIBLE OUTCOMES FOR OUR COMMUNITIES AND STREAM CORRIDORS

This document provides an abridged version of the Colorado Disaster Recovery Lessons Learned Book. It provides checklist recommendations at two levels:

- ☐ **Recommendations for Disaster Recovery Actions for Local Recovery Groups**
- ☐ **Recommendations for Changes to State and Federal Disaster Response.**

Not all of the recommended actions, guidelines, or recovery principles will directly apply to every community or recovery effort, however this checklist document is meant to be a starting place for recovery teams after a natural disaster. Several of these recommended actions relate directly to flood related recovery, however the principles are easily incorporated into a fire recovery program.

The recommendations in this document are made largely through the lens of the Colorado Water Conservation Board and the Colorado Department of Local Affairs, two of the many state agencies that were responsible for managing a long-term flood recovery program for the State of Colorado in the aftermath of the 2013 Colorado Floods. The lessons learned contained within are based on our role of managing the U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS) Emergency Watershed Protection (EWP) program, a multi-million dollar federal program that is frequently involved in stream and floodplain "fixes" in the aftermath of federally-declared flood and wildfire disasters. That effort also included management of the U.S. Department of Housing and Urban Development's (HUD) Community Development and Block Grant Disaster Recovery (CDBG-DR) program whom through a first-ever pilot program allowed for funding reach-scale recovery planning and project implementation in order to protect existing housing and infrastructure as well as to provide multiple economic and social benefits to the disaster-stricken communities.

For additional explanation, project examples, and detail regarding Pre-Disaster recommendations, see the full Colorado Disaster Recovery book that can be downloaded at the following link:

Colorado Disaster Recovery

Or, to request a hard copy of Colorado Disaster Recovery, send an email request to:

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COLORADO WATERSHEDS COLLECTIVE

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A WATERSHED APPROACH

STARTING WITH THE RIGHT MINDSET

In our recent past, many flood mitigation projects have been "band-aid" solutions that address the symptoms of a problem, but did not necessarily work toward resolving the underlying cause. In the wake of the very costly and tragic events of 2013, the State of Colorado chose a recovery pathway based on the latest river science and a grander vision for how rivers function in our landscape. The state-sponsored disaster recovery programs acknowledged that we must improve the way we as humans interact with our dynamic stream corridors so that future floods are not as devastating to our communities.

The Colorado Flood Recovery programs implemented projects that were complementary to each other based on master planning for the entire watershed and were guided by the principle of accommodating natural geomorphic processes and enhancing long-term river function. The design approach incorporated planned depositional zones for sediment in locations in the watershed where this would naturally occur, natural materials for bank stabilization and floodplain roughness, extensive vegetation throughout the active river corridor, and provided space for future channel migration. At the individual project level, conceptual designs were carefully created such that physical and ecological concerns were addressed at the project outset. Care was taken to ensure that proposed solutions did not transfer problems such as bank erosion or sedimentation to adjacent properties or to downstream communities. This approach is intended to replace traditional flood management strategies that emphasized constraining a channel, arresting lateral movement, and transporting sediment and debris away from areas of natural attenuation, all of which failed on a grand scale in 2013.

It is our belief that projects implemented through a "watershed approach" are more likely to protect life and property while simultaneously providing multiple benefits to human and natural communities including:

- Provide for temporary flood water storage and allow for a reduction of peak flood flows in adjacent and downstream communities.
- Protect (and improve) water quality.
- Provide diverse, dynamic, and complex habitats to provide critical refuge for many species.
- Reduce reliance on channelization, levees, and bank armoring, which are often detrimental to stream health, expensive to maintain, and have proven to be prone to failure.
- Create recreational opportunities for wildlife viewing, fishing, foraging, hunting, as well as trail and path networks for recreation and alternative transportation.
- Provide natural fire breaks potentially aiding a community's firefighting effort during a wildfire.
- Provide space for erosion and sediment deposition during a flood and/or wildfire.

MODEL FOR RECOVERY

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The Human Element
Communication
Stakeholders
Training

Pre-Disaster Planning
Multi-Hazard Risk Identification
Pre-Disaster Agreements

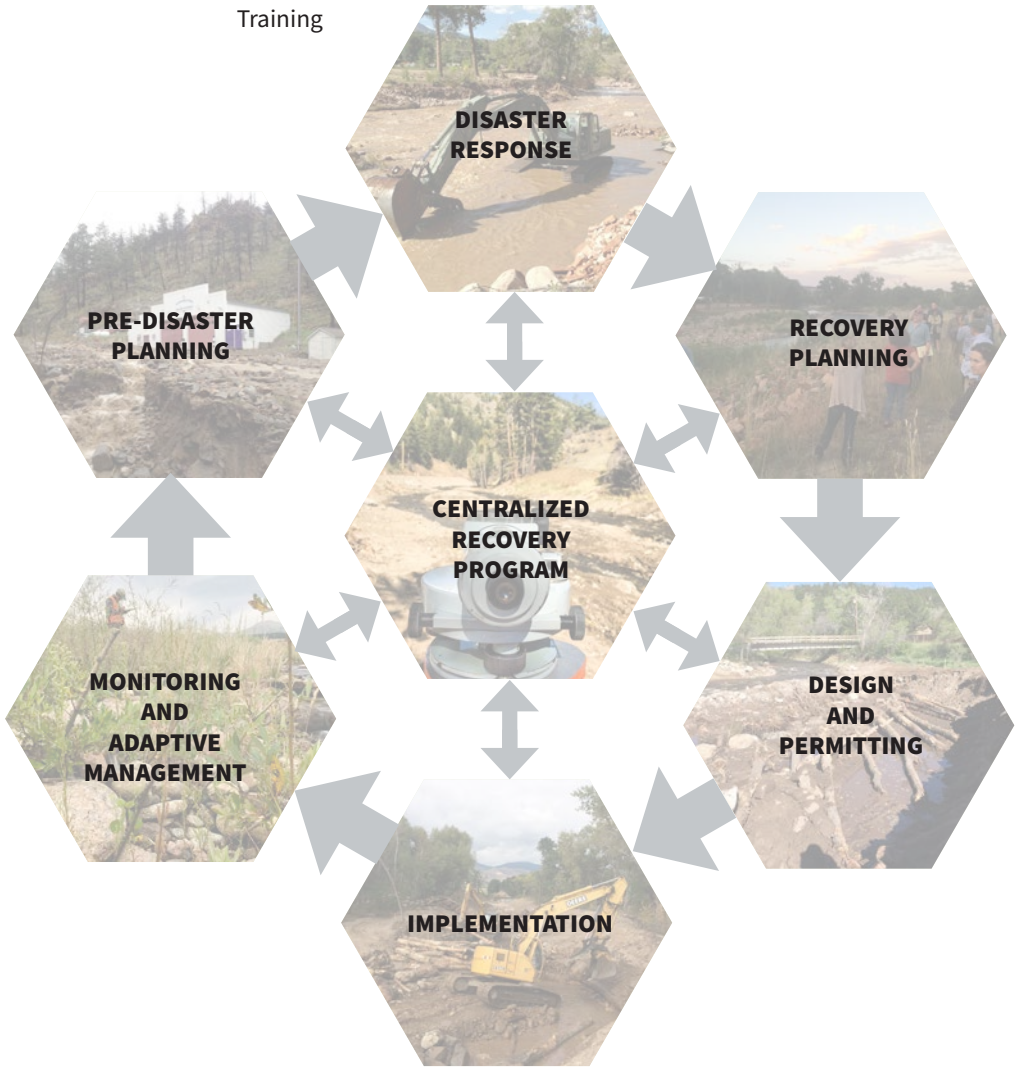
Disaster Response
Emergency Actions
Bring Together Technical Experts
Post Disaster Data Collection and Analysis

Monitoring and Adaptive Management
Monitoring
Adaptive Management

Recovery Planning
Shared Corridors
Locally Led Plan
Evaluate Buyouts
Project Scoping and Prioritization

Implementation
Construction Oversight
Standard Specifications and Invoicing
Construction Procurement
Planning for Revegetation
Plant Installation
Revegetation Maintenance

Design and Permitting
Funding for Design
Design Strategies and Standards
Quality Assurance and Quality Control
Infrastructure and Resiliency
Permitting
Floodplain Management



MODEL FOR RECOVERY

GRAPHIC: Conceptual Model for Disaster Recovery. The figure above is representative of the disaster recovery process implemented by the Colorado Water Conservation Board and Colorado Department of Local Affairs following the 2013 flood.

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ORGANIZING FOR RECOVERY

WITH ORGANIZATION COMES EMPOWERMENT

DEVELOP A CENTRALIZED RECOVERY PROGRAM THAT CAN SUPPORT A COMPREHENSIVE RECOVERY VISION

Consolidating recovery leadership with a qualified agency allows greater negotiating power over all aspects of recovery including project timelines, match funding, and provides the ability to expand and improve upon recovery goals and objectives. Centralized project sponsorship also allows for the possibility of programmatic permitting, a strategy which can reduce costs, expedite timelines, and facilitate more creative and robust project designs. A centrally-lead recovery program is critical to avoiding wasteful spending and duplication of efforts, especially as this relates to project design, sequencing, and buyouts.

Recommendations for Disaster Recovery Actions:

- ☐ Develop a comprehensive recovery program led by an agency that covers the entirety of the disaster-affected region, e.g. a state agency or regional authority that has the necessary in-house expertise for disaster recovery and an understanding of natural systems. This agency should understand rivers and flood risk. Ideally that agency should employ the floodplain administrator and be responsible for river corridor management. The expertise housed within this department is central to providing accurate assessments of problems and ongoing risk, informed and forward thinking conceptual designs, as well as responsible and defensible funding decisions. There are professional certifications (CFM, PE, PG) that require training and continuing education in the field of flood management and the agency that houses professionals with these credentials should be a strong candidate for the central leadership role--though keep in mind there is currently not a certification for professional fluvial geomorphologists, biologists or ecologists, all of whom would likely be valuable assets to a recovery program.
- ☐ Develop explicit goals and objectives for recovery and communicate these clearly and consistently throughout the duration of the programs. Use these as an anchor and a foundation to which to return when navigating difficult situations and solving complex problems.
- ☐ Agreements that recognize the phases of disaster recovery should be put in place between agencies that provide temporary fixes during the short-term recovery period (such as Office of Emergency Management and Transportation Departments) and agencies that have the expertise to provide the desired long-term interventions. These agreements would outline how the two phases will complement and build upon one another and ensure that short-term fixes are either compatible with long-term resilience and/or are expected to be removed or replaced during the long-term phase.
- ☐ Comprehensive recovery takes time and the lead agency must, with support of elected officials and local partners, work out realistic timelines that allow the program to execute successful and meaningful projects and negotiate with funding agencies to make these timelines a reality.
- ☐ There may be significant opportunities to create in-kind match for federal funding with materials sourced from road reconstruction or other infrastructure projects. Forward thinking and programmatic planning can leverage these opportunities to identify match funding for projects without the use of local cash.
- ☐ Leadership should be prepared to encounter and resolve conflicts that arise from federal, state, and local agencies whom may have different priorities in order to promote and execute the holistic recovery vision.

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DISASTER RECOVERY CHECKLIST

- ☐ The lead agency should organize and establish a single technical assistance team with expertise in flood management and river processes to guide flood recovery across agencies and funding programs.ead agency should empower local groups, coalitions and local governments to work together. Often these groups have pre-established relationships within the impacted communities; they understand local values and are already established in close proximity to the need. Empowered correctly, these local groups can effectively act as an extension of state and federal resources and may improve the ability of state and federal staff to remain focused on the overall vision and road to recovery.
- ☐ The lead agency should develop a culture of collaboration with a vision of raising the standard of performance within the local engineering, design, and construction industry. There can be significant distrust and defensiveness on the front end of large collaboration efforts. Ultimately, the objective must be to create strong partnerships, founded on the goal of achieving the best possible outcome on implemented projects--in other words, professionals need to work across disciplines and in collaboration with competitors to ensure that no opportunity is left behind.

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DISASTER RECOVERY CHECKLIST

MAXIMIZE THE BENEFIT OF FEDERAL FUNDING THROUGH CENTRALIZED LEADERSHIP AND ORGANIZATION

Historically, disaster funding from federal agencies such as FEMA, HUD, and USDA have been distributed directly to local agencies such as counties or municipalities. The disbursement of funds in this manner has supported the idea that local officials and managers know best how to implement recovery in their communities. This may work when one large city or just a handful of landowners have been impacted, but when multiple local governments and state agencies are involved, recovery efforts can quickly become disjointed and duplicative. Additionally, the way recovery is implemented will vary between local agencies, i.e. some may be focused solely on reestablishing the infrastructure that had been in place prior to the disaster without regard for future risk, while others may see the disaster as an opportunity to work with natural systems to create resilience that may reduce damages in future events while still protecting life and property. To maximize coordination and the effective use of federal funding, responsibilities are recommended to be assigned as shown on the accompanying figure:

Recommendations for State and Federal Disaster Response:

- ☐ Allow pooling of federal funding that can be awarded to one local recovery entity, i.e. the state, to be used for coordinated recovery efforts. Pre-qualify and fully vet and train partners to be ready to receive this funding in the event of a disaster. It's understood that this is a fundamental change from existing recovery funding guidelines and requirements, but to implement a well-coordinated and more resilient vision of recovery, radical changes are needed.
- ☐ Federal and/or state disaster relief programs should, upon disaster declarations, have an option for communities with limited resources to access zero interest loans from agencies administering disaster response. These loans could have an option for payback with federal disaster relief monies or options for forgiveness if certain requirements are met. This would allow small and under-resourced communities immediate access to funding to begin recovery planning and response.
- ☐ Streamline federal program rules so that different sections of the same agency's programs do not contradict. For example, FEMA's reimbursement process may prohibit the use of local variances in project designs, however, local variances to local design standards may be necessary to remain compliant with FEMA's regulations on floodplain encroachment. A recovering community should not have to negotiate these waters in the wake of a disaster.
- ☐ Build an "off-ramp" for the funding programs so that funding can be reserved for the local sponsors based on initial estimates, but transferred to other high priority projects as the design process, landowner participation, and other supporting information provide clarification on how to best spend these dollars. As an example, on Left Hand Creek, one priority project identified by NRCS and the coalition had an estimated cost of $1.5 million but was eliminated following preliminary design due to the landowner's desire to not participate in the program. Unfortunately, no second tier recovery projects had been included in the NRCS Damage Survey Reports (DSR) and clearance process, so the funding ultimately was returned to the federal government despite there being many other needs for assistance in the community.
- ☐ Increase the availability of funding for professional services and expand timelines to accommodate more robust alternatives analyses during the design process. This is especially important for programs like EWP that, by federal regulation, is required to limit project timelines to 220 days from the time a financial agreement is signed. In the case of the 2013 Colorado Floods, the CWCB coordinated with NRCS to allow that the 220 day clock be triggered only after designs were completed. This adjustment allowed for several months of design and permitting that ultimately improved the quality of the designs and outcomes of implementation.
- ☐ Increase available funding for design and oversight; too little funding limits creativity and innovation, resulting in projects that act as a band-aid and which may not achieve resiliency.

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DISASTER RECOVERY CHECKLIST

FEDERAL AGENCY RESPONSIBILITIES

- Contracts and disburses funds to lead recovery agency
- Ensures compliance with federal funding program requirements
- Provides federal funding program guidance and advice
- Addresses major environmental compliance requirements and provides a framework for permitting including USACE 404 permitting, USFWS clearance, and cultural resources

LEAD RECOVERY AGENCY RESPONSIBILITIES

- Sets the recovery program vision, establishing goals and objectives in compliance with federal guidelines
- Provides partial or complete local match funding
- Sets guidelines and standards for design and implementation of recovery projects
- Establishes and administers a program for quality assurance
- Serves as the central point of invoicing
- Develops a Technical Assistance team to support program management, design of recovery projects, construction oversight, and quality assurance

LOCAL SPONSOR RESPONSIBILITIES

- Raises/provides local match
- Addresses permitting requirements not already addressed at the programmatic level
- Conducts communication, coordination, and public outreach with citizens and stakeholders
- Oversees project implementation (bidding, contracting, and construction)
- Prepares project invoicing (and submits to lead agency)
- Commits to operations and management needs based on program requirements

Note: Local sponsors may include watershed coalitions, local governments, or other NGOs directly connected to project implementation, and which contract with the lead agency to receive funding to directly implement recovery efforts.

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DISASTER RECOVERY CHECKLIST

AUTHORIZE STATE AND LOCAL RECOVERY FUNDING

Federal money takes time to arrive and in the interim, there are immense and immediate needs that only local money can work to address. The immediate authorization of local money is critical to support recovery efforts.

Recommendations for Disaster Recovery Actions:

- ☐ Get people working! The biggest hurdle is often signing the first contract. Delays caused by administrative, legal, or contractual problems, as well as government shut-downs, will have profound impacts on the success of any disaster recovery program. A primary objective of everyone working within the first weeks of a recovery program should be getting the governing contracts signed--the time that is lost here CANNOT be made up further down the road. This applies to contracting at every level: federal-state, state-county, state-coalition, federal-county, state-contractor, county-contractor, etc.
- ☐ Keep local disaster recovery money as flexible as possible. There is no means of accurately predicting every need that will arise in the affected communities, and limiting how funds can be spent can unintentionally encourage ineffective interventions and/or leave unique but effective measures without funding.
- ☐ To the greatest extent practicable, use local funds earmarked for construction as match for or to leverage federal recovery funding. $100,000 of local money when used for construction can deliver approximately one-tenth to one-quarter of a mile of comprehensive recovery actions, however, when $100,000 of local money is used as match for federal funding, it can deliver $400,000 to $1,000,000 of construction money resulting in recovery for up to 4 miles of stream corridor.
- ☐ Keep state and local funds flowing. In addition to providing match, this funding is necessary to bridge gaps after federal funding is authorized. State and local funds with flexible uses are critical to building creative, comprehensive solutions that may not exactly fit the objectives and requirements of federal disaster recovery programs.
- ☐ Use local funding to execute assessments and recovery plans that are used to guide and support construction funding decisions. Generally, federal funding tends to lean toward supporting construction rather than planning and if non-federal money is able to be used for upfront planning, the monetary request to federal programs will be more reflective of the actual need in the community.
- ☐ Release discretionary funding to coalitions through grant funding so that they may pay for things like fees for online bidding and procurement, rental of conference rooms, etc.

> Take care of your staff, personnel, and self. Pure exhaustion, physically and emotionally, will occur and it will take a serious toll on the mental and physical health and relationships of the people involved in the disaster recovery. A good recovery plan should account for the care of the people who are taking care of the recovery.

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DISASTER RECOVERY CHECKLIST

THE HUMAN ELEMENT

WHEN A NATURAL EVENT BECOMES A HUMAN PROBLEM

SUCCESSFUL PUBLIC COMMUNICATION IS AN ONGOING PROCESS THAT REQUIRES TIME, PERSISTENCE, CONSISTENCY AND TRUST

Flood recovery managers and project design teams need to understand that public involvement is an ongoing and evolving conversation. Developing a dialogue not only builds trust within the public, but it also yields critical information that can be used to create better recovery projects and to avoid potential problems. It is important to remember that while many elements of recovery may be focused on the outcomes, such as constructed improvements, an open conversation about the process is important to maintain. During and following the 2013 Colorado Floods, strong relationships were developed through a communication strategy that focused on time, persistence, consistency, and trust.

- Time: Community values, project goals, and specific design details were developed over several months through numerous meetings with both individuals and stakeholder groups.
- Persistence: Disaster recovery is multi-faceted and requires effort and focus on multiple processes at once; this can mean that stakeholders often cannot wholly focus on something until it is critical enough to pay attention. It is likely that each plan and project design had to be revisited several times to address stakeholder concerns and comments.
- Consistency: Consistent messaging is critically important. Inconsistent messaging can derail a project, e.g. when someone feels a promise was made at one meeting, but that message is not delivered to the design or construction team, or program funding doesn't cover the promised outcome. Projects succeed when all messengers deliver the same message.
- Trust: Trust is earned through a process of successful communication that includes listening, empathy, and clear messaging regarding program goals, constraints, and realistic outcomes. Ultimately, trust is earned through a combination of time, persistence, and consistency. Be aware that staff turnover disrupts trust and communication at all levels.

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DISASTER RECOVERY CHECKLIST

Recommendations for Disaster Recovery Actions

- ☐ Focus significant time during all initial conversations about stream corridor recovery on eliciting and defining the ideals and values that the residents have for these areas. Steer initial conversations towards revealing the characteristics that these stream corridors have that benefit the community and how their recovery will be an asset by focusing on general outcomes such as “fishing access”, “safety”, and “native plants” rather than on specific physical outcomes such as “where the stream needs to be located”. Projects can then be designed to reflect values, which gives engineers a much larger canvas to paint on, rather than having to address specific physical attributes which invariably limit design options.
- ☐ Recognize that every participant has their own agenda and that this is okay. Disaster recovery does not require that people become altruistic and put aside their values for the sake of the community. It does require creative thinking by recovery managers to blend individual desires together to create a coherent project.
- ☐ Understand the fears and reasoning underlying people’s hesitancy to participate. These reasons vary widely and can be deeply personal. Sometimes more information and technical resources can be helpful and other times these types of educational campaigns cannot address the root cause of someone’s concerns.
- ☐ Actively engage and develop trust by developing multiple communication strategies and interactions.
- ☐ Avoid using fear as a driver for resident participation or action. To the greatest extent possible when discussing flood recovery including disaster response, recovery planning, design, construction, monitoring, and maintenance, do not use statements such as: “You will flood next time if no work is done.” “Your house will be damaged if you do not participate.” “Not participating puts your neighbors at risk and they will sue you.”.
- ☐ Be forthright with funding restrictions and be consistent in their application. This will help residents come to terms with the required cost-benefit analyses and understand that different funding programs have different interpretations of the “assets” that can be protected or improved. Note that these “assets” do not always align with what residents define as their own assets.
- ☐ Spend time and resources outlining the expected recovery process and project progression and give adequate warnings if something will deviate. The public cares greatly about being treated fairly and about feeling like they are part of a cohesive and predictable process. Being assured by a fair and open process is, in some instances, more important to residents than the physical outcome of project.
- ☐ Use conceptual models and illustrations to explain designs and establish realistic expectations for short-term and long-term outcomes.
- ☐ If walking away from a project or project area is necessary, do so in a way that respects the individual's decision. Threatening to walk away from a recovery project because a landowner is being difficult will create distrust, not only with that property owner, but with other participants in the community.

THE HUMAN ELEMENT

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DEVELOP A PROGRAMMATIC PUBLIC COMMUNICATION STRATEGY FOCUSED ON OPEN DIALOGUES AND GATHERING AND DISTRIBUTING CONSISTENT INFORMATION

Information collected from the community and stakeholders is valuable and needs to be fully considered and integrated into recovery actions. A focus on developing good working relationships with stakeholders and addressing their concerns through planning and design ultimately will lead to successful project outcomes including meeting budget and schedule constraints and delivering constructed improvements that meet and exceeded expectations.

Recommendations for Disaster Recovery Actions:

- ☐ Meet regularly with residents and stakeholders, and consider holding public meetings during recovery planning and project design. While public meetings are good for gathering community ideas and helping to create a common vision, they often do not directly lead to actionable items and project prioritization. Meeting with groups of residents and stakeholders, particularly those who will be directly affected by the planning decisions, will provide critical information to recovery managers and engineers.
- ☐ Have at least three people present for all discussions regarding project implementation to reduce the spread of misinformation. One-on-one meetings are costly and time consuming and can lead to confusion or suspicion within the community, especially if the messaging is unclear or inconsistent. Ad-hoc one-on-one meetings often lead to problems with communication continuity between project sponsors, designers, and residents.
- ☐ Carefully document all group meetings, one-on-one meetings, phone calls, and ad-hock meetings with stakeholders and citizens, noting discussion topics, specific issues or concerns, any required follow-up, and agreed upon action items. Share these notes with the participating stakeholders or individuals to confirm the messaging and for their records. These records can be revisited if/when citizens feel something has changed or a perceived promise isn't being addressed. This type of documentation is recommended for all phases
- ☐ Be aware that most people hear what they want to hear, occasionally hear things that no one said, and tend to only look for the pieces of information that are immediately relevant to their current situation. Write and speak concisely to reduce opportunities for this type of miscommunication happen.
- ☐ Keep messaging clear and uniform by developing and distributing fact sheets, fliers, handouts, and websites that outline the recovery process, goals, timelines, and projects. As part of the Colorado Phase 2 EWP program, program-wide fact sheets were developed as a resource to local coalitions and sponsors (descriptions and references to these resources are provided at the end of this document).
- ☐ Anyone engaging with the public on behalf of the recovery programs should distribute hard copies of the fact sheets and provide consistent contact information.
- ☐ Incorporate weekly planning and design updates with the goal of having fewer meetings and presenting information in a way that allows people to digest it on their own schedule, and improving overall communication.
- ☐ Avoid using statistics to describe the flood (e.g. 100-year flood). Statistics are difficult to understand and expounding on the historical statistical magnitude of a single event does not help to communicate what a safer future can be. Statistics also tend to work against advocating for resiliency actions if the public believes they will never see a flood of this magnitude again.
- ☐ If you MUST use statistics, use cumulative probabilities, for example, "Over the next 30-years, there is at least a 1 in 4 chance that this area will experience a flood again." This example uses the cumulative probability correlated to the area which is being defined for flood risk by a 100-year floodplain map and provides a much easier to grasp and relevant description of flood risk for a homeowner with a 30-year mortgage.

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DISASTER RECOVERY CHECKLIST

Recommendations for Changes to State and Federal Disaster Response:

- ☐ Federal programs should support and allocate funding for programmatic and project-specific outreach.
- ☐ Federal funding mechanisms should cease using the fear of "losing the money" or the money being reallocated to spur communities into construction spending and allow stakeholders time to develop and implement effective communication strategies.

EFFECTIVE PUBLIC COMMUNICATION OF FLOOD-RECOVERY CONCEPTS IS FOUNDATIONAL FOR SUCCESSFUL IMPLEMENTATION

In order for landowners to feel comfortable signing agreements for work to occur on their property, they need to see and understand the work plan and workflow. Engineering drawings are not well understood by the public and a general request for public comment will not elicit the comments, changes, and critiques needed from residents. To tease out issues that can derail a project, we recommend several different approaches to communicate project impacts and outcomes.

Recommendations for Disaster Recovery Actions:

- ☐ Flood recovery managers should develop a common language for design and construction and for communicating the details to the public:
  - ☐ Use photos of project reaches (post flood or pre project) and overlay these with proposed treatments.
  - ☐ Similarly, use a landscape artist or graphic designer to develop conceptual visualizations of the project to supplement project plans.
  - ☐ Utilize example photos of the proposed features, both in construction and completed, to explain techniques and outcomes.
  - ☐ Provide photos of each proposed treatment in various phases of maturity. The rawness of construction is often very difficult to explain and can create panic amongst landowners.

DISASTER RECOVERY CHECKLIST

- ☐ When seeking comment, provide samples of the materials that will be used (rocks, blankets, stakes, example plant materials) and stake out or paint the design features on the ground (top of bank, grade control, grading limits). This can serve as a design walk-through at the concept plan level.
- ☐ When executing work that is meant to be a stopgap between the disaster and long-term recovery, communicate clearly with the public regarding what "temporary" work means and what permanent repairs may come later. Disaster recovery funding mechanisms tend to make a distinction between "temporary" and "permanent" repairs, however, the public does not. If an intervention was justified to the public as "the solution" during emergency work, it may be difficult to propose a different approach or contrary interventions later on (e.g., a stream is moved during emergency work, and then proposed to be put back right where it was as a permanent repair).
- ☐ All parties need to understand that components of a project may be re-designed during construction in an effort to address landowner concerns and questions.
- ☐ Designers and project sponsors need to be on the same page in their understanding of what components of each project are non-negotiable (i.e. critical elements of an engineering design that must be built according to plan) and which elements can be swapped or redesigned based on community input.
- ☐ Clearly communicate on plans what areas will be protected and what level of protection is provided.
- ☐ Delineate work areas and critical features such as vegetation to be removed with flagging in the field during the design process and delineate features to be protected and areas that cannot be disturbed with fencing.
- ☐ Establish a two-step sign-off with landowners and residents: 1) landowners approve the design and 2) landowners approve the construction after staking, flagging, and fencing.
- ☐ During construction, provide weekly construction updates and make them available to stakeholders, landowners, local governments, and the lead recovery agency. These were universally found to be one of the most valuable communication tools used during the 2013 Colorado Flood Recovery. They are simple documents that provide a brief update on progress and schedule. Photographs from these updates were extremely helpful for State and Federal managers tracking these projects.
- ☐ Towards the end of construction, develop a landowner close-out sheet to communicate that projects are complete. Also note any expected monitoring and/or maintenance activities and estimated schedules or recurring intervals of each.
- ☐ Contractors should stake the construction site before grading. This helps the landowners "see" the project extent.

DISASTER RECOVERY CHECKLIST

BRING STAKEHOLDERS TOGETHER EARLY AND ENCOURAGE LOCAL COALITION BUILDING

The 2013 Colorado Flood Recovery followed strategies introduced in the State of Colorado's Water Plan which "promotes watershed health and supports the development of watershed coalitions and watershed master plans that address the needs of a diverse set of local stakeholders" (Colorado Water Plan, Section 7.1). Successful disaster recovery starts with the identification of existing organizations and stakeholders that can coordinate recovery efforts in their communities and provide support for the development of new community groups in areas that are not represented by coalitions or non-profit organizations. As part of this strategy, the process of developing flood recovery plans can be used to immediately identify and bring together stakeholder groups that include residents, non-profit organizations, agency representatives, members representing special districts, and local government. In Colorado these groups were further developed into stakeholder coalitions that included landowners and residents and were grouped by watershed. These watershed coalitions were extremely beneficial to the 2013 Colorado Flood Recovery in that they:

- Advocated for the watershed and negotiated solutions that benefited multiple landowners rather than just the loudest voice in the room.
- Worked to ensure that county or state agency goals, which often were more transportation dominated, did not steamroll the priorities of the local community and values of the landowners.
- Helped to enhance the perception that local, state, and federal agencies were stakeholders in, not owners of, the planning process and construction of projects.
- Became the primary point of communication contact for concerned residents which then enabled county, state, and federal entities to keep moving forward without getting too encumbered by individual landowner questions.
- Provided empathy and support to the landowners who were struck by the disaster and whose main point of focus, understandably so, was on the recovery and protection of their personal property.

Recommendations for Disaster Recovery Actions:

- ☐ Keep watershed planning areas and coalition sizes small enough to represent the interests of local stakeholders and citizens.
- ☐ At the onset, define the role of each local coalition to both residents and agencies. Within each coalition, determine if government agencies are considered "member entities", i.e., stakeholders in the watershed coalition and its decisions or "partner entities" i.e., entities that exist outside the coalition that make independent decisions on funding and project priorities and conduct recovery projects independent of the coalition (but that can collaborate if deemed beneficial to both groups). In some instances, the initial relationship between watershed coalitions and the city and county agencies was very tense, as some local government representatives felt the coalitions were a threat to their power, process, and funding.

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PROVIDE TRAINING AND ACCESS TO COMMON RESOURCES

Disasters stretch the capacity of available and knowledgeable resources across a community. Federal, state, and local agency staff are burdened with significant disaster recovery responsibilities and quickly reach maximum capacity on top of their everyday roles. And often, the need for expertise in project management and implementation far outweighs the capacity of available talent to begin with.

Coalitions were used in Colorado to better connect flood recovery to local citizens and stakeholders, supported by state and local agencies. Regardless of whether coalitions had been set up before or after a disaster, staff did not have the full spectrum of experience necessary to navigate the complicated and challenging process of recovery. Training coalition staff so that they could direct and manage recovery work was achieved through a process of capacity building which included topic specific trainings, on-the-job experience, and partnerships with state and local agencies and consultants. This capacity building helped coalition staff develop to a point where projects were managed and guided through the implementation process, yet the variety and complexity of the challenges and project requirements involved in recovery still exceeded the time and expertise available at the coalition level. To address this, it is strongly recommended that common resources be shared amongst the coalitions to create efficiency and consistency in administrative processes while at the same time allowing coalition staff to better focus on project delivery and outcomes for their constituents.

Recommendations for Disaster Recovery Actions:

- ☐ Provide training for coalition managers and coordinators in:
  - ☐ River dynamics, flood management, and riparian ecosystems
  - ☐ Consultant and contractor management
  - ☐ Contracting and procurement
  - ☐ Fiscal management
  - ☐ Record keeping
  - ☐ Conflict resolution
  - ☐ Working with landowners and residents
  - ☐ Permitting
- ☐ Build broad capacity throughout the coalitions by providing specific trainings for the Boards of Directors or subcommittees--many of whom may have a more vested interest and long-term commitment to the watershed than hired staff whom may be prone to turnover. Provide board member education and leadership development including:
  - ☐ Training for running non-profit organizations
  - ☐ Workshops to help board members clearly identify both the mission and a realistic plan of action for the coalition to achieve its goals
  - ☐ Addressing public relations and conflict, especially in situations where coalition staff is being pressured or criticized by stakeholders
  - ☐ Financial and fiscal management and responsibilities of the Board

COLORADO WATERSHEDS COLLECTIVE

DISASTER RECOVERY CHECKLIST

Recommendations for Changes to State and Federal Disaster Response:

- ☐ Provide ongoing financial assistance for coalition building. This includes staff training and board training in the administration and financial aspects of sustaining not-for-profit organizations.
- ☐ Fund programmatic positions to assist local coalitions and governments with:
  - ☐ Program and Davis-Bacon compliance
  - ☐ Permitting
  - ☐ Legal
  - ☐ Accounting
  - ☐ Mediation
  - ☐ Counseling
  - ☐ Education
  - ☐ Outreach

In the aftermath of a disaster, grief, uncertainty, fear, disappointment, and distrust are common and complex emotions that are best recognized and worked with rather than ignored in the recovery process. Access to support and mental health professionals for residents, landowners, community leaders, technical professionals, and recovery managers throughout the duration of the recovery process may help to alleviate tensions, resolve conflict, and provide appropriate outlets for emotional release.

COLORADO WATERSHEDS COLLECTIVE

DISASTER RECOVERY CHECKLIST

SHARED CORRIDORS

RIVERS, ROADS, AND RESIDENCES

REHABILITATION OF STREAM CORRIDORS, ADJACENT ROADWAYS, AND PRIVATE PROPERTIES REQUIRES CAREFUL AND INTENTIONAL COORDINATION, CONVERSATIONS, AND COMPROMISES

Recommendations for Disaster Recovery Actions:

- ☐ For permanent repairs, to the greatest extent practicable, roads and rivers should have concurrent design schedules but divergent construction schedules. The road should be built first, but in a way that accommodates the river to function in a way that is less dangerous to the infrastructure and adjacent communities. The river corridor and flood control system improvements should be built second, unless there are elements that are designed for both infrastructure and flood protection such as large-scale engineered log jams.
- ☐ Infrastructure design and river/floodway design should NOT be done by the same team, same firm, and/or under the same contract. There will be conflict between the teams, however, better projects are created when the conflict is exposed and worked through with the agencies rather than sequestered by project managers in internal meetings.
- ☐ Goals and objectives for the transportation corridor and river corridor should have equal weight. This will require compromise and possibly increased costs of implementation, but ultimately will result in a more robust project.
- ☐ Permit river and road recovery projects together whenever feasible. This eliminates duplicative efforts, reduces cost, and minimizes confusion on the part of regulators.
- ☐ Parallel planning and design efforts for transportation and river corridors require an understanding of how one system affects the other. For example, hardening a roadway corridor against future flood events may limit loss of roadway infrastructure, but could exacerbate damage in or adjacent to the stream and result in loss of life or private property. True resilience requires that infrastructure not always provide hardened boundaries but sometimes allows for planned failures that reduce risks to life and property. Some examples of how road infrastructure might specifically address river corridor recovery include:
  - ☐ Elevate roads on piers at known active alluvial fans or adjust their alignment so that the roadway crosses at the apex of the fan.
  - ☐ In canyon settings, relocate roads to inside of river bends where shear stresses are generally lower than on the outside of bends.
  - ☐ Locate bridges on natural meander cross-overs at angles that facilitate sediment and debris transport.
  - ☐ Plan for and design one bridge approach to fail and/or flank in the event that the bridge span clogs with debris. Design this failure to occur in a manner that minimizes damage to the most costly portions of the bridge structure and repair time.
  - ☐ Install culverts or Texas Crossings through the approaches of bridges to facilitate the movement of flow through the floodplain.

COLORADO WATERSHEDS COLLECTIVE

DISASTER RECOVERY CHECKLIST

Recommendations for Changes to State and Federal Disaster Response:

- ☐ Provide flexibility in funding schedules where recovery efforts overlap, e.g., EWP, CDBG-DR FEMA, and FHWA disaster recovery. Providing waivers for program schedules on large projects may eliminate duplication of efforts and/or scenarios where one recently implemented improvement must be removed to allow for the reconstruction of another.
- ☐ Nationally, disaster and hazard organizations should organize conferences or symposiums to bring together infrastructure and flood professionals to further develop ideas focused on coordinated recovery and resiliency.
- ☐ Fully consider whether certain contracting methodologies used in transportation or infrastructure design result in competitive costing for river projects. Some types of contract administration, such as Construction Manager/General Contractor (CMGC), resulted in higher costs for recovery projects. For 2013 EWP, CMGC projects increased project costs by up to 25 percent versus other contracting methodologies such as design-bid-build, project partners, and design-build.

SHARED CORRIDORS

COLORADO WATERSHEDS COLLECTIVE

DISASTER RECOVERY CHECKLIST

DISASTER RESPONSE

GUIDING EMERGENCY EFFORTS TOWARDS RESILIENT LONG-TERM OUTCOMES

EMERGENCY ACTIONS: STOP, COLLABORATE, AND LISTEN

Due to the fast-moving and chaotic atmosphere during disaster recovery, opportunities for partnerships, funding, and consideration of long-term resilient outcomes can be missed. Well thought out and intentional actions coupled with good communication can go miles towards obtaining positive long-term outcomes for your communities and your stream corridors. There will be extreme pressure to act swiftly and with authority, and there will be times and places where this is the right thing to do but if there is uncertainty about the right course of action, stop, slow down, collaborate with other parties (including the public), and give the situation a more weighted decision. Move with purpose, but not in haste.

Recommendations for Disaster Recovery Actions:

- ☐ Shift recovery discussions away from "how it was." Work to develop alternatives and better designs that look forward towards increased resilience, not backward. Immediately begin to frame discussions around preparing for the next flood and goals for the future. Shift discussions towards the community vision for the future of the stream corridor to given this opportunity to remake it.
- ☐ Clearly define what recovery means to the community as well as what actions will and will not be accepted as part of disaster recovery.
- ☐ Create a roles and responsibilities checklist that outlines the who, what, where, how, and proposed deliverables related to recovery actions at the outset of a recovery program. Update this document every 1-2 months as new funding enters the communities and unmet needs are identified.
- ☐ Resilient recovery must involve all stakeholders--targeted outreach with water, conservation, and agricultural districts and communities may be necessary.
- ☐ Implement the immediate post-disaster recovery effort to complete work that is needed, but manage it to ensure that the work can be leveraged against the long-term goals of the community.
- ☐ Before removing material from a river after a flood event, consider the value of natural debris to stream function and the ecosystem. There is a marked difference between “trash” and the organic material recruited by the streams during the flood. Natural “debris” such as fallen trees, branches, and other vegetative material that is recruited by a stream has value in the river and may even act as a stabilizing feature when deposited by flood waters. While woody material jams at bridges/culverts are problematic, wholesale removal of this natural material from a stream corridor without an assessment of its function and ecological value can result in the need for costly interventions in the following months/years. Hundreds of thousands of dollars were spent in Colorado following the 2013 Colorado Flood putting woody material back into river channels after emergency funding was used to remove it.

COLORADO WATERSHEDS COLLECTIVE

DISASTER RECOVERY CHECKLIST

Recommendations for Changes to State and Federal Disaster Response:

- ☐ Federal programs and federal disaster response employees need an incentive or a directive to partner with and utilize local resources, local organizations, and local experts. Significant knowledge about the community and physical characteristics are embedded at the local level and a sweeping federal response without local coordination can start the recovery process off on the wrong foot.
- ☐ Federal government agencies deploy many people with a sincere desire to provide assistance to impacted communities, however, they often do not coordinate across agencies (e.g. FEMA, FHWA, USGS, USDA). If multiple people with different governmental credentials show up to do the same work, or competing work, and give conflicting assessments of the event and the recovery path, then public trust in the entire process is eroded. Before outside personnel are permitted to work, everyone should be briefed on the communications process, the organizational structure of the whole recovery effort and all staff should be provided locally produced handouts, information cards, and contacts to provide to residents that describe the above.

DISASTER RESPONSE

COLORADO WATERSHEDS COLLECTIVE

DISASTER RECOVERY CHECKLIST

USE TECHNICAL EXPERTS IN THE DAYS AND WEEKS AFTER A DISASTER

A lack of subject matter experts involved in state and federal disaster emergency response can lead to interventions that are unnecessary, costly, and environmentally damaging. For example, interventions to return streams to their pre-flood location and configuration may do little to improve public safety and often result in significant loss of river function that later has to be repaired at great expense to landowners and taxpayers. Ask subject matter experts to navigate these decisions with you so they are done well the first time.

Recommendations for Disaster Recovery Actions:

- ☐ State and local agencies should provide subject matter experts (e.g., geomorphologists, river engineers, ecologists, and biologists) to consult on all measures taken to reduce flooding, stabilize watersheds and streams, and improve safety (both short and long term).
- ☐ These experts should also consult on and oversee the implementation of temporary and emergency repairs to infrastructure and utilities. Oftentimes significant savings in construction costs and great increases in community safety can be made by locating infrastructure in less hazardous locations that these experts can quickly identify. This includes roadway embankments, crossings, and underground and overhead utility infrastructure.
- ☐ Subject matter experts should keep the recovery process in perspective and work across disciplines and agencies and with the public to focus on positive and workable--not necessarily perfect--solutions.
- ☐ Vet and review all proposed emergency actions through the lead agency whose directive is to answer three questions:
  - ▶ Will this action be a stepping stone toward a long term solution?
  - ▶ Is this action resulting in more harm than good for the community and environment?
  - ▶ Is this action cost-effective?

DISASTER RESPONSE

COLORADO
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COLORADO WATERSHEDS COLLECTIVE

DISASTER RECOVERY CHECKLIST

DISASTER RECOVERY REQUIRES CONSISTENT AND HIGH QUALITY DATA COLLECTION AND ANALYSIS

Recommendations for Disaster Recovery Actions:

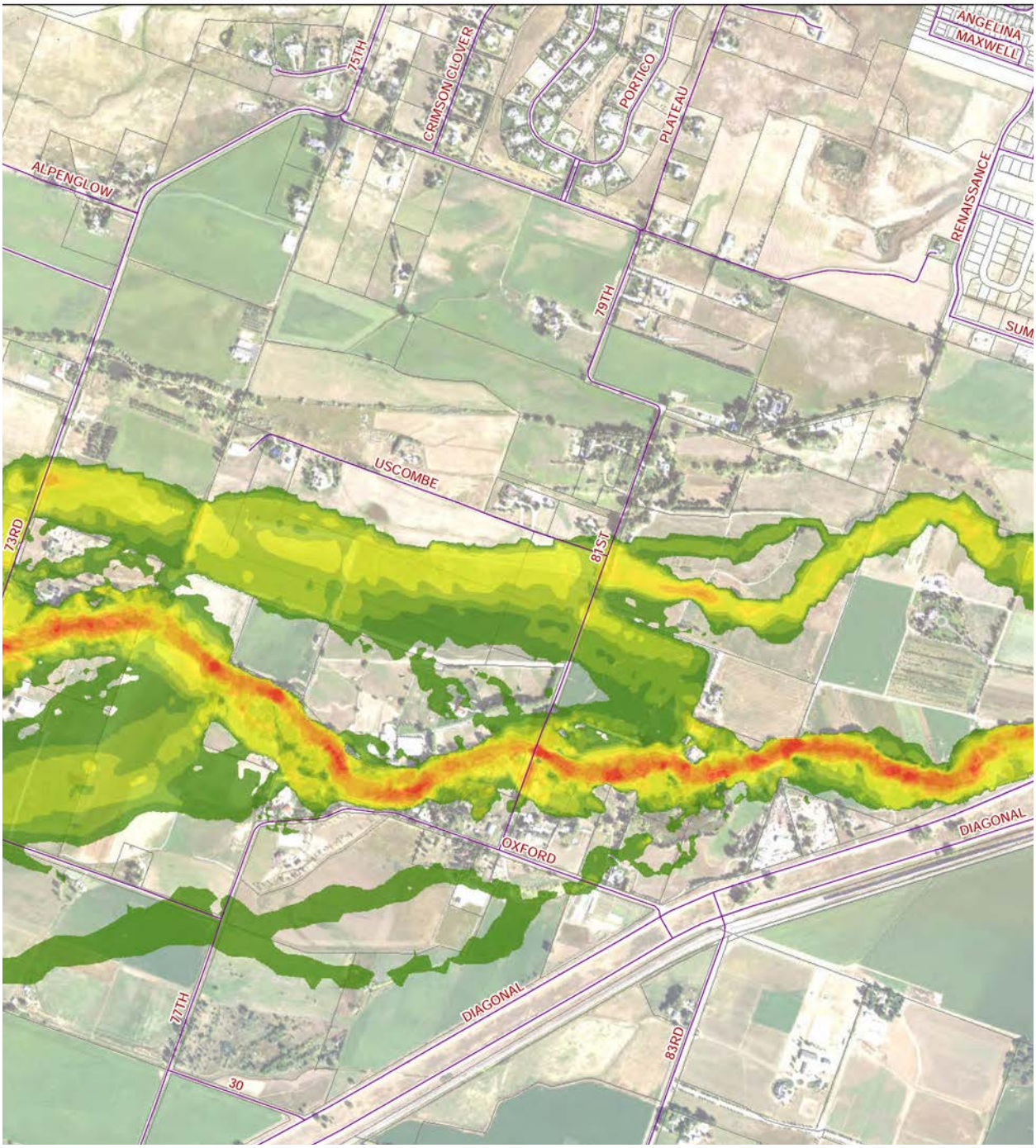
- ☐ Assess and update hydrology in all affected watersheds including results that identify new recurrence interval flows (2-, 5-, 10-, 25-, 50-, 100-year peak flows), low and moderate flows (summer low flow, winter low flow, bankfull flow, 14-day average flow during runoff, etc.,) as well as applicable hydrographs.
- ☐ Collect new and detailed topographic data immediately following the disaster event via LiDAR or another rapid regional data collection method. Include both river corridors and all hillslopes that can provide flow and sediment input to the rivers. Capture areas that experienced debris flows, if that is a local hazard. Include aerial photography with the LiDAR flights.
- ☐ Perform a rapid, 2D hydraulic analysis of the affected streams run on the newly acquired topography (LiDAR-derived digital elevation model) with the newly developed hydrologic information. This will help to identify current flooding hazards and may identify where natural flow breakouts exist. The 2D analysis does not have to be highly accurate, but instead should be used to understand how reaches interact with one another, where flood risks are most significant and where erosion and deposition have dramatically altered flood hazards. It must be pointed out that a regional hydraulic study is necessarily different and should be executed separately from floodplain remapping efforts or other attempts to determine an interim or permanent regulatory floodplain. Regional hydraulic studies should be done quickly and used to provide a baseline condition for flood recovery planning and recovery project design. Regional floodplain remapping should come years later after recovery projects have been built and inform the new flood insurance rate maps.
- ☐ Consider scenarios in which geomorphic trajectory and sediment transport analysis should also be conducted on a regional scale for use by recovery planning teams as the results would benefit multiple projects. A sediment transport analysis is an effective tool used in identifying and understanding project risks. This assessment doesn't necessarily have to be quantitative, but can be qualitative (e.g., this area is degrading and this area is aggrading and is a deposition zone). Recommendations should not focus narrowly on solutions that just move sediment efficiently through the system, but should consider and work with natural processes and functions of river corridors.
- ☐ Deploy teams to measure high water marks and calculate flood flows before emergency work erases this data. This will immediately help shape the conversation about the degree of the disaster and may prevent miscommunications in the media about how large the storm was. In the long term, this information will be helpful for planning and design teams.
- ☐ Perform a comprehensive survey of utilities that went in post flood so that their location can be considered in the design and are not a surprise during construction.
- ☐ Identify/survey all locations that contributed to compromised water quality: septic system failures, wastewater treatment failures, feedlot and processing facility inundation, agricultural waste processing facility inundation, industrial sites, and mining or other natural resource extraction sites, etc.
- ☐ Some of the biggest uncertainties during our recovery process revolved around the location and availability of subsurface water given the major topographic changes that occurred in the stream corridors. If possible, immediately after the flood, install groundwater or hyporheic zone monitoring wells to inform decisions that take into account the location and movement of subsurface water.

COLORADO WATERSHEDS COLLECTIVE

DISASTER RECOVERY CHECKLIST

Recommendations for Changes to State and Federal Disaster Response:

- ☐ To the greatest extent practicable immediately after the disaster, federal, state and/or regional agencies should combine resources to acquire and produce consistent hydrologic, hydraulic, geomorphic, topographic (particularly LiDAR) and ecological information for use by the local recovery planning teams. Comparing new data to high quality pre-flood data can be extremely useful for understanding flood processes.
- ☐ Require the use of tracer wire in utility installations.



DISASTER RESPONSE

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

COLORADO WATERSHEDS COLLECTIVE

DISASTER RECOVERY CHECKLIST

RECOVERY PLANNING

VALUES, GOALS AND OBJECTIVES

EXECUTE A LOCALLY-LED RECOVERY PLAN THAT INCLUDES ALTERNATIVES ANALYSIS AND PROJECT PRIORITIZATION

A recovery plan evaluates and communicates current risk and synthesizes data and scientific analysis to explore recovery alternatives and develop project concepts and overall recovery guidelines that reflect the values, goals, and objectives of the watershed community. Planning may initially feel out of sync with the prevailing sense of urgency after a disaster, but ultimately it is the most valuable tool in understanding residual risk, coalescing a vision for recovery, developing community support, and identifying needs for long-term recovery funding. Done well, a comprehensive flood-recovery plan expresses a community's overarching vision, goals, objectives, and policies while integrating hazard mitigation and risk reduction strategies as it sets the course for implementation of construction and reconstruction efforts across the disaster-affected watershed.

Disaster recovery plans are most useful when they identify mitigation projects, both large and small, that address inundation and fluvial hazards associated with floods, and seek to maximize the health and function of the stream corridor. To maximize usefulness for local sponsors, projects identified in the plan should: be prioritized, have approximate costs, clarify permitting requirements, and explain how improvements work together to achieve watershed-wide goals and objectives. Projects should also be classified as early action (flood recovery) or long-term (multi-benefit projects that require other sources of funding outside of flood recovery). Project cost estimates should be provided along with possible funding sources.

Encouraging planning teams to examine a full suite of alternatives, even those that exceed political will and/or budget limitations, will result in better projects and will assist in communicating the need for and the benefits of selected interventions. A robust alternatives analysis is also likely to uncover sticking points within the community before substantial money has been spent on project-specific design.

Recommendations for Disaster Recovery Actions:

Community

- ☐ Use State or other non-federal money to start a long-term planning effort immediately after the disaster. Early money allows stakeholders to develop a strategy for using federal money when it becomes available.
- ☐ Structure the planning effort in order to consider the input, responses, and needs of all groups at the table. Landowners need to understand the process and what they should expect from start to finish.
- ☐ Maximize opportunities for residents and stakeholders to be involved in the planning process. Be aware of who (which stakeholders or residents) is not in the room and why they are not present. Are meetings during working hours? Is there child care? Can materials be printed in multiple languages or can secondary language meetings be held? Are there means to reduce the burden of participation on excluded communities?

Define Goals, Objectives, and Outcomes

- ☐ Explicitly identify the guiding principles, vision, and outcomes the community supports in their recovery. Later this will provide the metrics for success when specific projects are being proposed and prioritized.
- ☐ Be careful that the goals and priorities in the plan are not overly biased by input from sponsoring or stakeholder organizations (example: transportation departments, irrigation companies, utilities, etc.).

- ☐ Provide a framework to identify the community's future interactions with their river corridors including how an area is projected to grow and develop and what areas are or will be managed for the benefits of a natural river corridor.
- ☐ Expand the outcomes of the plan to address a combination of benefits, such as public and private infrastructure, stream restoration, and floodplain management techniques.
- ☐ Develop a conceptual model that applies scientific understanding of the pathway to the desired future conditions. Identify possible future scenarios and, importantly, what intermediate steps are required to get there. Depict changes to key watershed functions and the desired future conditions.

Document and Assess Existing Conditions

- ☐ Identify the underlying problems and instabilities within each reach; be careful not to conflate the symptoms of problems (e.g., bank erosion) with the underlying physical issues resulting in that response (e.g. historic channelization).
- ☐ Include a description of the flood damage to the corridor. Immediately and continually file all photographs into a well-organized electronic filing system so that they can be readily found and retrieved for use in communication documents and activities. This documentation will become a valuable written and photographic record of the extent of the damage for decades to come.
- ☐ To the greatest extent possible, document emergency measures and projects and assess if they are addressing the underlying problems or if additional work is required in the area.
- ☐ The lead agency should provide consistent baseline data to local teams (e.g., LiDAR, hydrology, etc. - see Disaster Response section) rather than having local teams develop it themselves.

Develop Project Concepts That Bridge the Gap Between Existing & Desired Future Conditions

- ☐ Project concepts must address the underlying problems, instabilities, and constraints identified in the existing conditions assessment.
- ☐ Projects should transcend political boundaries and property lines to encapsulate the entire area necessary for mitigating the hazard and addressing the foundational problem.
- ☐ Incorporate watershed context into the project concepts. For instance, some reaches are naturally depositional and provide areas for sediment and debris to deposit away from populated areas. Converting these critical areas to transport reaches might have high unintended consequences to downstream neighbors.
- ☐ Projects should identify ALL project needs, even if they appear unfundable. This could include utility relocation, culvert upgrades/replacements, septic system removal, road realignments, driveway sharing, etc.
- ☐ Project concepts should be based on geomorphic assessment and future trajectory analysis. A study shouldn't focus on solutions to just move sediment efficiently through the system, but should work with natural processes and topography.
- ☐ The planning process should encourage a broad alternatives analysis using multiple and varying concepts (i.e. enlarging the channel vs levee construction vs constructing a bypass channel) and within those concepts, varying treatments (bioengineering vs riprap for bank stabilization). Non-structural solutions such as buyouts, easements, and floodproofing should be considered.
- ☐ Make a point to identify passive recovery projects that could be completed with minor interventions in addition to large capital projects.
- ☐ Develop cost estimates for the alternatives using guidance provided by state and local agencies.

- ☐ Provide a complete blueprint of the permitting processes required to implement identified projects including:
  - ☐ Permitting requirements and associated needs
  - ☐ Agencies and contacts
  - ☐ Timing of permits (required review process)
  - ☐ Identification of professional services needed
  - ☐ Permit costs and estimated technical support fees
  - ☐ Communication strategy (including timing of discussions with the federal, state, or local agencies)
  - ☐ Communication method(s) (i.e., How will communication be conducted? Through emails, phone calls, or face to face meetings?)

Project Prioritization

- ☐ Prioritization of projects should be completed by representatives of the community through consensus within the stakeholder group. Prioritization should include analysis of physical aspects such as the potential to reduce flood hazards and community risk and enhance the environment as well as social aspects such as degree of landowner support, cohesive vision among neighbors, and the potential for finding successful funding.
- ☐ During project prioritization, identify what goals and objectives are aligned with specific funding sources.
- ☐ Alternatives should be evaluated based on their ability to address the underlying causes of the hazards and the degree to which the options meet the community and program goals.

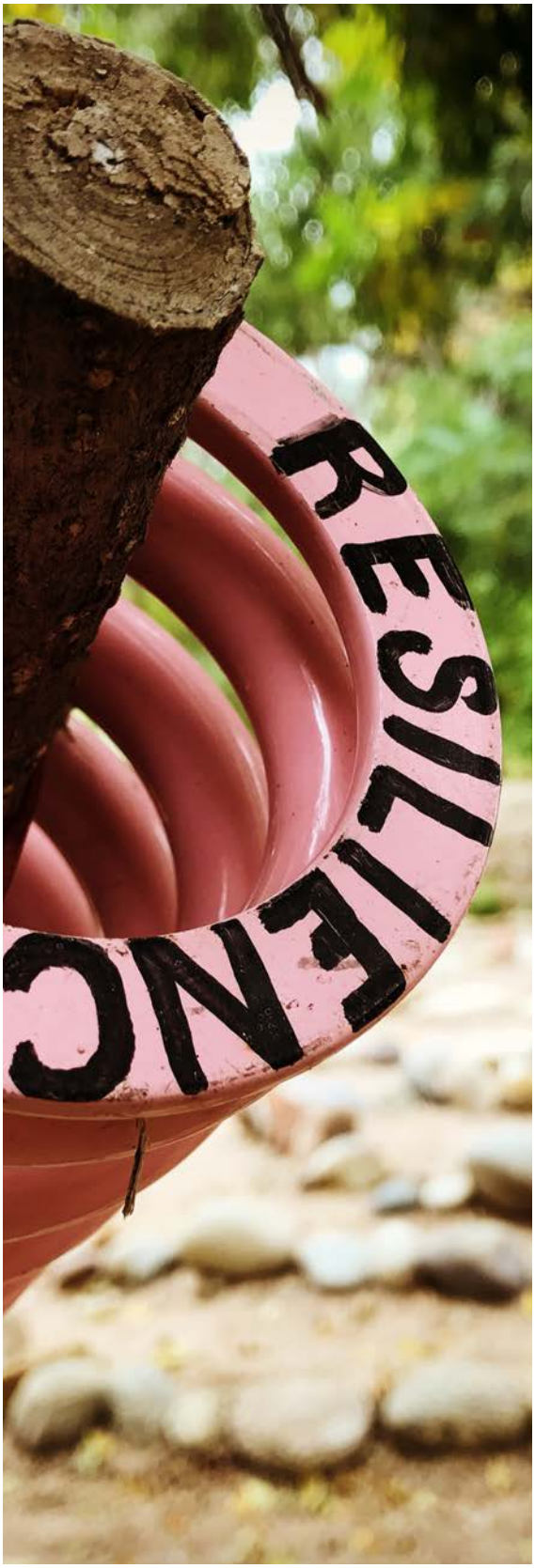
Communications

- ☐ Consider that alternative names for the planning process such as “master plan” may have a negative connotation and may relay perception of permanence and the government forcing the plan onto communities. Consider names such as resiliency plan, recovery plan, conceptual plan, or others.
- ☐ Identify projects that can be implemented early to provide demonstration of recovery techniques and to be an example of what landowners can expect. Small-scale, early-out demonstration projects were found to be beneficial in communicating with landowners and regulatory agencies the types of improvements that may be implemented. Landowners reticent to participate were often persuaded once they saw finished projects and the quality of the work. Demonstration projects were also found to bolster local capacity to manage grants and construction contracts by giving them a small “trial” project.
- ☐ Use photos, renderings, and artist conceptions to communicate the recovery process and outcomes. Generally speaking, engineering plans are not an effective means of communicating concepts.
- ☐ Keep recommendations high-level and focused on specific problems that will be addressed by the project(s). Getting too specific at this level can lead to landowners being confused/upset both during the planning process and later when actual project-level design is being completed.
- ☐ Only present alternatives that are aligned with the stakeholder and community vision and goals. A warning: unpopular or red herring alternatives may create significant stress for the homeowners and community members and may sour relations. In 2013, this was the case especially for recovery plans that suggested property buyouts.

DISASTER RECOVERY CHECKLIST

Recommendations for Changes to State and Federal Disaster Response

- ☐ Require a multi-objective watershed or stream corridor recovery plan in order for projects to be eligible for receiving federal recovery funding.
- ☐ The lead state agency should produce a model scope of work for Recovery Plans.
- ☐ The lead state agency should produce costing guidance for use by Recovery Planning Teams.
- ☐ Give funding preference to priority projects that have conceptual plans, project cost estimates, and landowner/community buy-in.
- ☐ During the recovery planning process, the lead state agency should examine the building codes and regulations and suggest changes to the frameworks that govern development and interventions in river corridors.



DISASTER RECOVERY CHECKLIST

EMBRACE AND IMPROVE THE BUYOUT - AN UNDERUTILIZED TOOL

Buyouts are an underappreciated and underused tool for avoiding future flood damages and reducing reconstruction and flood mitigation costs. They are often the cause of confusion and fear within disaster stricken communities, with rumors swirling about mandatory participation or the "government taking your land". Accurate, quick, and unbiased public communication about the programs within the first responder community, federally deployed agents, and state and local staff is necessary to get the most out of these programs.

Recommendations for Disaster Recovery Actions:

- ☐ Release unbiased, accurate, and thorough information on buyouts and buyout processes.
- ☐ Appoint staff dedicated to managing buyout programs and separate staff dedicated to managing the demolition of the structures in order to keep the office and field portions of the program moving at the same time.
- ☐ Remove local permitting requirements that are intended for the construction of projects--rather than the demolition of projects--to the greatest extent possible.
- ☐ Programmatically coordinate the decommissioning of utilities on buyout properties.
- ☐ States and local governments should consider the implementation of a zero-interest or low-interest loan program that owners can access to prevent damaged properties from falling into foreclosure.
- ☐ Provide assistance to those who are displaced by a buyout, especially those who qualify as low-to-moderate income, in finding new, suitable long term housing.
- ☐ Consider local, state, and federal programs that would allow for land or zoning swaps, perhaps allowing for more dense development on land that is outside of the river corridor in exchange for conservation of undeveloped land in hazardous zones.

DISASTER RECOVERY CHECKLIST

Recommendations for Changes to State and Federal Disaster Response:

- ☐ Buyout programs should not only remove damaged structures and outbuildings but should also fund removal of other human interventions such as previously installed riprap or levees that are no longer needed to protect the removed structures.
- ☐ Site remediation actions such as floodplain grading or channel shaping to restore or enhance conveyance, deposition, or stream function following removal of a buyout should be planned for and funded through other recovery programs.
- ☐ FEMA based buyout funds should be made available to properties mapped in the Fluvial Hazard Zone (FHZ) and/or in debris flow hazard areas, not just those identified as being within the FEMA Special Flood Hazard Area (SFHA).
- ☐ The rules that govern the use of the land acquired through a buyout often work against adjacent long term recovery projects. It is beneficial for communities to use buyout properties for staging, storage of construction materials, etc., while recovery actions are ongoing. While not a permanent use for the land, temporary uses such as construction staging and access should be permitted activities provided the land is reclaimed and restored to a condition concurrent with the vision in the recovery plans.
- ☐ Do not fund recovery projects on a property if it is on a buyout list. If the property is on a buyout list, its inclusion in other programs should be delayed until the owner makes a final decision to keep and restore the property. This will keep money intended for protection of life and property from being used on properties that are later bought out and demolished.
- ☐ Do not limit future flood recovery activities on buyout properties. Although the buyout may have removed a structure from future flood impacts, improvements on the buyout property may be done so that risk for other properties located along the river corridor becomes reduced.

DISASTER RECOVERY CHECKLIST

PLANNING IS NOT DESIGN

Following the 2013 Colorado Floods, planning grants were used as a means to provide supplemental funding for design work. It was thought funneling these planning funds to design would be an effective and creative way to support project implementation--but it wasn't. Planning and design are two distinct efforts and in the case of Colorado flood recovery, designs developed under planning efforts (CDBG-DR resilience plans) were not completed in a timely manner, often lacked the necessary foundational data (i.e. design-grade survey), and generally created concepts that were too high-level to permit or bring to construction without additional significant effort.

Planning is an important and necessary first step in bringing a project to life, however, it is different from the initial phases of a project's design. Project design must be done with an emphasis on bringing the project to, and through, construction. Planning is more about envisioning the future of the stream; considering various possibilities and alternatives to address stream function and protection of life and property; exploring cost/benefit scenarios; and facilitating and negotiating desired outcomes with the community. The planning process, however, is typically not the best time for producing design deliverables (plans, specs, and estimates).

Recommendations for Disaster Recovery Actions:

- ☐ Use Planning Grants for areas that require planning (not design) beyond what the Recovery Plans produced: complex areas with numerous landowner and infrastructure challenges benefited from planning grants and a longer track towards construction primarily because of the extra time and energy afforded to stakeholder involvement.
- ☐ Utilize Planning Grants for planning, and shift excess funds towards projects that are ready for design and implementation. This will help to alleviate the issue of having to allocate substantial additional funding when planning grants prove insufficient in producing deliverables necessary for design and construction.

COLORADO WATERSHEDS COLLECTIVE

DISASTER RECOVERY CHECKLIST

PROJECT IDENTIFICATION AND SCOPING

LAYING THE FOUNDATION FOR SUCCESSFUL RECOVERY

CAREFULLY DEFINE PROJECT LIMITS AND POTENTIAL PROJECT COMPONENTS

In the planning phase you identified projects and now you've transitioned into project scoping: defining the project area and intent for your flood recovery project(s). Project areas should be defined with sufficient forethought to allow for flexibility in design alternatives as well as connections to upstream and downstream reaches. Identification of a project area that is too small could limit the ability of designers to include features such as overflow channels, floodplain grading, sediment deposition areas, and other features that will reduce hazards in the reach and downstream communities.

Recommendations for Disaster Recovery Actions:

- ☐ Local sponsors and designers should review the final project extents before federal agencies submit projects for environmental review.
- ☐ Pay close attention to lateral extents, e.g., geomorphic floodplain width, in addition to upstream and downstream project limits. At a minimum, project areas should extend at least to the 100-year floodplain boundary and if possible to the Fluvial Hazard Zone (FHZ) boundary in locations where it has been defined.
- ☐ Consult with a fluvial geomorphologist to ensure the project boundary encompasses the entirety of the active river corridor as well as valley margins that might be susceptible to failure due to fluvial processes.
- ☐ Define the maximum project cost based on values at risk (e.g., structures, utilities, or infrastructure). Define project areas, define the values at risk, and from that, calculate the maximum investment that is possible given the required benefit-cost ratio rather than starting with a preconceived notion of what work is necessary and determining a project cost.

COLORADO WATERSHEDS COLLECTIVE

DISASTER RECOVERY CHECKLIST

Recommendations for Changes to State and Federal Disaster Response:

- ☐ Overidentify flood recovery needs during the scoping process. During the 2013 EWP program, as some projects were eliminated during the design process there were no backup projects identified as part of the Damage Survey Report (DSR) process that had also received environmental clearances. The result was that money wasn't spent, but needs still existed.
- ☐ Project extents for disaster recovery programs should be defined in such a way to provide maximum flexibility to implement reach scale solutions, i.e. larger project polygons will maximize environmental clearance area for SHPO and USFWS, ultimately allowing for more comprehensive design alternatives to be considered. Additionally, if the scope and limits of the project change, then the environmental clearances will still be valid.
- ☐ When there is a conflict between the original project scoping numbers (e.g., NRCS Damage Survey Report Numbers) and what the project design determines to be the right course of action there needs to be flexibility in the funding that allows for project costs to increase as long as required benefit/cost ratios are met.
- ☐ Ensure that the scoping mechanism (e.g., NRCS Damage Survey Report) includes all possible disturbance mechanisms including vegetation removal, ground disturbance, etc. for the submittal for environmental clearances.
- ☐ Ensure that the project scope includes adequate funds for a revegetation plan, and if possible, irrigation and vegetation adaptive management.
- ☐ If possible, create a post-project funding set-aside for adaptive management following project completion. Although this is a new concept for flood recovery funding, the idea of adaptive management is central to long-term resiliency and stream health.

COLORADO WATERSHEDS COLLECTIVE

DISASTER RECOVERY CHECKLIST

PROJECT DESIGN

EVOLVING OUR APPROACH TO STREAM REHABILITATION

PROPERLY FUND DESIGN

There is not a single rule-of-thumb for design costs as they relate to the cost of construction. A large sediment removal project may have a big construction price tag but could require less design effort than a small-scale, but difficult to design, streambank stabilization project. Flexibility for funding design is critical.

Recommendations for Disaster Recovery Actions:

- ☐ Fund design to the applicable level of completeness with a focus on the development of construction documents that are appropriate for bid.
- ☐ Understand that small project construction funding doesn't necessarily mean a small project design budget. Small projects require start-up time for the design team to perform site assessments; gather data such as site survey or geotechnical investigations; perform technical analysis; and create a design that addresses the project's goals and objectives. For small projects, design costs could approach 30 percent of construction funding or more.
- ☐ Construction oversight funding is as important as design funding and should be allocated as such. This is different from construction management funding. (Read more details in the subsequent Construction chapter).
- ☐ Be careful to not over-allocate funding: more design money does not necessarily result in a better project.
- ☐ Funding for design should be assessed per project by someone who understands the analysis and calculations required for a proper design.

Recommendations for Changes to State and Federal Disaster Response:

- ☐ Allocate funding consistent with the complexity and scale of the design process while remaining flexible in the execution of funds on a per-project basis.
- ☐ Consider whether adequate data is already available for design during the budgeting process (e.g., post-disaster topographic mapping might alleviate or reduce the need for survey in some projects).
- ☐ Ensure programs allow for technical support for permitting activities such as FEMA floodplain modifications, 404 field work and permit narratives, local permits, etc., and/or allow for funding of such activities to count as local project match. A major challenge for the 2013 Colorado EWP program was funding to address local permitting. While local agencies who were sponsors had monies to cover this cost, non-profit coalitions lacked these financial resources. EWP requires local sponsors fund permitting activities. To address this gap, CDBG-DR funding was used for some permitting activities and construction oversight where EWP technical assistance (TA) funding fell short. While this solution addressed Colorado's needs, it's recommended that this be reevaluated as part of disaster recovery reform efforts.

COLORADO WATERSHEDS COLLECTIVE

DISASTER RECOVERY CHECKLIST

DEVELOP DESIGN STRATEGIES AND STANDARDS THAT ARE APPROPRIATE FOR BUILDING IN RIVER SYSTEMS

Streambank erosion, channel avulsions, recruitment of large wood, creation of secondary channels, and other flood-related changes to a stream corridor are natural processes, many of which may have beneficial effects on the overall health of the stream. Projects should be designed to address hazards stemming from these natural processes, not to arrest the natural processes themselves.

Flood-disturbed stream systems, in particular, are complex in terms of understanding the geomorphic stability and likely trajectory of a project site. Conditions on the ground can substantially change between the onset of the design process and the first day of construction. Rendering plans that attempt to convey certainty (100% designs) can become obsolete as changing field conditions require flexibility in construction. The degree of effort that is put into the design process needs to reflect the potential uncertainty and the natural processes that are already in play as well as the variability and mobility of the materials that are used in this type of work (e.g., rocks, plants, large wood vs. concrete and steel). Additionally, many of the natural features and small details that make a stream restoration project successful are difficult to communicate on paper, as engineering drawings don't always well mimic the complexity found in the natural environment.

Recommendations for Disaster Recovery Actions:

Design Standards

- ☐ Require that all design teams produce a Basis of Design document. This document should document all assumptions related to the design work, the analysis that was done, the data that was used, and the areas of uncertainty.
- ☐ Work through the design process utilizing language that supports the goal of getting a successful project built. Unlike infrastructure projects, most stream projects do not benefit from "100% design". Stream design work should generally not go beyond what may be labeled "60%" in general civil works, as this is not money well spent. There will be significant amounts of interpretation in the project's construction due to unknown and variable conditions and this issue is particularly acute after a flood. Furthermore, going too far with a design, for example, a "95% Plan for Stream Construction" may imply a degree of immutability in the plans that results in limited flexibility with the contractor and costly change orders and construction delays.
- ☐ The terms 15% design, 30% design, 60% design, etc., were found to be confusing and mean different things to designers, regulators, and contractors. We recommend replacing this language, as it relates to work in river corridors with: "conceptual design", "preliminary design," and "construction documents."
- ☐ Agencies should scale the level of investment and analysis in the design phase with the degree of uncertainty and assets at risk in the reach.
- ☐ Make it clear to designers that initial scopes and budgets are not meant to limit possibilities, provided alternative design options are in line with the community goals and the program's requirements.
- ☐ A single design team should be responsible for the design of all projects throughout the entirety of a watershed to ensure continuity of design characteristics (e.g., channel widths) as well as continuity of watershed function understanding (e.g., erosional reaches, depositional reaches).
- ☐ Encourage designers and contractors to work together to improve construction plans in a manner that captures and conveys the designers' intent while minimizing risk for all parties.
- ☐ Understand that a project has impacts upstream, downstream, and adjacent to the work area itself. Make certain these are discussed and understood before project construction begins.

DISASTER RECOVERY CHECKLIST

- ☐ Have a third party review conceptual and preliminary designs to ensure that the project is addressing the cause of the problem and not just covering up a symptom that is likely to develop again (see following section, Develop a Standardized Programmatic Quality Assurance (QA) and Quality Control (QC) Plan). Have a third party review construction documents to provide value-added comments that will increase the overall functionality of the completed project.

Design Strategies

- ☐ Understand that in the recovery of a river corridor, there may be times where human interventions happen too early and ultimately end up being detrimental. In some instances, it is best to wait for nature to take the first step and build upon what has naturally occurred (e.g., Is the site naturally regenerating with native plants? Are flows moving and shaping sediment? Are existing features creating a diversity of habitat?).
- ☐ Assess the constraints and determine which are movable and which are not. Constraints come in many forms--social, political, physical, etc.--but most constraints can be eliminated with creative thinking and perseverance. Do not give up on ideas or visions because there is constraint; work through it.
- ☐ Recognize that stream systems are naturally regenerative and attempt to minimize the footprint of the work and maintain established areas of natural vegetation. A starting point on design may be to incorporate small features that will quickly add benefit and structure to the channel (e.g., healthy groves of vegetation, stable wood and boulders, connected side channels). Exclude areas from the design that will be problematic or difficult to protect or areas that do not need any work at all.
- ☐ That said, sometimes the system benefits greatly from the removal of mature vegetation, especially if that vegetation is invasive and posing hazards by limiting flow and debris conveyance.
- ☐ Do not overemphasize stability in a stream channel as healthy channels naturally change over time. Set hard boundaries at the foundation or boundary of infrastructure where it must be protected (e.g., use setback riprap) instead of attempting to lock the channel in place at one location. Channelization projects are highly likely to fail and have numerous detrimental effects on the health of the stream in the interim.
- ☐ Incorporate design elements (e.g., boulders, wood, microtopography) outside the constructed low-flow and bank-full channels. Understand and communicate that the stream channel will shift, and flood waters will escape the main channel - when this happens it will be important to have supporting structure outside the main channel as well as the building blocks of a new channel available to support the creation of new stable features beyond the lifespan of the flood recovery project. Communication with adjacent landowners that river-change and the abandonment of some constructed features over time is not equivalent to project failure is an important component of this task.
- ☐ Carefully document all existing conditions within the work areas before work begins. This documentation primarily will take the form of photos and photo points that can serve for comparison over time. Numerous instances will arise where this documentation may be useful.
- ☐ The decision not to construct in an area may be appropriate in some cases.
- ☐ Designers and project sponsors should be aware of complexities with regard to vegetation in recovery work; well-intended but myopic visions of saving vegetation at all cost can be contrary to overall goals of long-term recovery, corridor health and the protection of life and property.

COLORADO WATERSHEDS COLLECTIVE

DISASTER RECOVERY CHECKLIST

Recommendations for Changes to State and Federal Disaster Response:

- ☐ Allow designers and project sponsors to determine the appropriate level of design for the project. Remove requirements from funding that attaches a degree of completion to the work products (e.g., 30%, 60%, 100% design plans).
- ☐ Reconsider language in contracts and program standards that are overly restrictive. Choose instead language that allows for the flexibility needed in constructing reach-scale multi-landowner flood recovery projects.
- ☐ To the greatest extent possible, do not set programmatic design standards based on recurrence interval flooding (e.g. 10-year protection, 25-year protection). In some locations, these standards may be unfeasible and the stream reach may never have been able to handle that event in an undisturbed state. Rather than fixed design frequency standards, suggested minimums and maximums providing flexibility for the designer may be a more appropriate guideline. Designers should be directed to maximize the opportunities for protection given the physical constraints and the available funding.

PROJECT DESIGN

DISASTER RECOVERY CHECKLIST

DEVELOP A STANDARDIZED PROGRAMMATIC QUALITY ASSURANCE (QA) AND QUALITY CONTROL (QC) PLAN

Quality Assurance ensures that all elements of a program, in this case flood recovery, are consistent with the overall vision, goals, objectives, criteria, and applicable funding requirements. It is developed at the front end of a program and before project work begins. QA lists the processes, standards and policies that need to be carried out and ensures they are known to the people who need to know them. Quality Control is about ensuring that designs are supported by proper and correct analysis and calculations, that designs are constructible, and that constructed improvements meet the intent of the original design, i.e. adhere to specifications and design details. Even when you have the best plan and system in place (QA), you still need to monitor the work as it occurs to make sure the results are what you expect them to be. QC provides the opportunity to identify issues along the way while opportunity still exists to address them.

Recommendations for Disaster Recovery Actions:

- ☐ Develop a process for 3rd party technical review of designs and construction at multiple points in order to ensure compliance with the program as well as create opportunities for the best possible outcome.
- ☐ If they are not standardized, QA Plans for each project should be reviewed by the lead agency established Technical Assistance team to ensure they are appropriate and comprehensive.
- ☐ Produce QA/QC comments that provide actionable, constructive information.
- ☐ Explain to planning, design, and construction teams that QA/QC is meant to maximize outcomes and ensure opportunities to improve projects are not missed.
- ☐ Emphasize raising the bar for project outcomes and building design and construction capacity for future disasters and mitigation projects.

Recommendations for Changes to State and Federal Disaster Response:

- ☐ Develop a standardized QA Plan so that project sponsors/consultants/contractors understand program expectations and requirements.
- ☐ Before design begins for any recovery program, perform a pre-design workshop with all sponsors and potential consultants to review goals and objectives, recovery philosophy, and QA process.

COLORADO WATERSHEDS COLLECTIVE

DISASTER RECOVERY CHECKLIST

EWP PROJECT REVIEW PROCESS

STEP 1

Start your project off right!
- Schedule a meeting or site walk with your design team and an EWP TA team representative.
- Work with stakeholders and landowners to establish project goals and objectives.

STEP 2

Mid-Point Check-In
- Schedule an informal design review meeting or preliminary (15%) design review with the EWP TA Team.
- Incorporate comments on the purpose, features, and components of the project to save time and money down the road.

STEP 3

Final Review (2-3 Weeks)

Before the FA agreement can be signed, the design must be approved by the NRCS and CWCB.

NRCS Functional Review

NRCS Engineer will review the submittal for completeness and compliance with conservation practices.

CWCB Design Review

Design review team will review the basis of design report and plansets for compliance with program goals and objectives, project objectives and constraints,and adherence to standards of professional practice.
Will include review by:
- geomorphologist
- aquatic biologist
- engineer
- vegetation ecologist
- DOLA TA Team Representative*

*DOLA review team only provides review of projects where design or local match is provided by CDBG-DR funding. Projects that are locally funded for both design and local match will only be reviewed by NRCS and EWP TA Team.

Design Approved by NRCS & CWCB?

NO

Re-Submit

STEP 4

(As Necessary) Address Comments and Concerns

The State and NRCS will provide comments back in a standard document. Each comment must be addressed or responded to, before approval for construction is given.

YES

CWCB executes FA agreement with NRCS and CWCB executes contract with Project Sponsor

STEP 5

Construction Inspections
- NRCS and CWCB representative will periodically visit project in construction to inspect and observe installation of features.
- Sponsors will be required to submit weekly construction schedules.

STEP 6

Final Construction Inspection, As-Built Submittal

At the end of construction, schedule a site walk with NRCS, CWCB and/or the EWP TA Team. This will also be attended by:
- geomorphologist
- aquatic biologist (as appropriate)
- engineer
- vegetation ecologist

STEP 7

Final Construction Inspection, As-Built Submittal

Submission of monitoring and maintenance data and info as appropriate.

COLORADO EWP

Colorado Emergency Watershed Protection (EWP) Program

Sponsored by the Colorado Water Conservation Board (CWCB)
Administered by the Natural Resources Conservation Service (NRCS)

- Design
- Construction
- Post-Construction

USDA United States Department of Agriculture
Natural Resources Conservation Service

COLORADO Colorado Water Conservation Board Department of Natural Resources

COLORADO Department of Local Affairs Community Development Block Grant – Disaster Recovery

PROJECT DESIGN

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

COLORADO WATERSHEDS COLLECTIVE

DISASTER RECOVERY CHECKLIST

REACH SCALE RECOVERY CANNOT BE ACHIEVED WITHOUT INCLUDING UPGRADES TO INFRASTRUCTURE

Stream crossings (e.g., bridges and culverts) significantly affect sediment and debris transport, flood conveyance, and flood risk and can impose barriers to aquatic organism passage. The inability to upgrade infrastructure due to program funding limitations during the 2013 Colorado Flood recovery effort resulted in some flood recovery projects not convincingly achieving their stated goal of protection of life and property. Failure to include crossing structures as part of a comprehensive stream recovery project is a significant barrier to implementing a resilient and comprehensive solution. Additionally, buried and overhead utilities (e.g., power poles and lines, sewer and water lines) located within the stream corridor are not only vulnerable to future flood damage but also create significant barriers to constructing reach-scale, resilient projects. For flood recovery to achieve its full potential to improve resiliency, recovery programs must be able to address infrastructure, both public and private, that limits reach-scale improvements.

Recommendations for Disaster Recovery Actions:

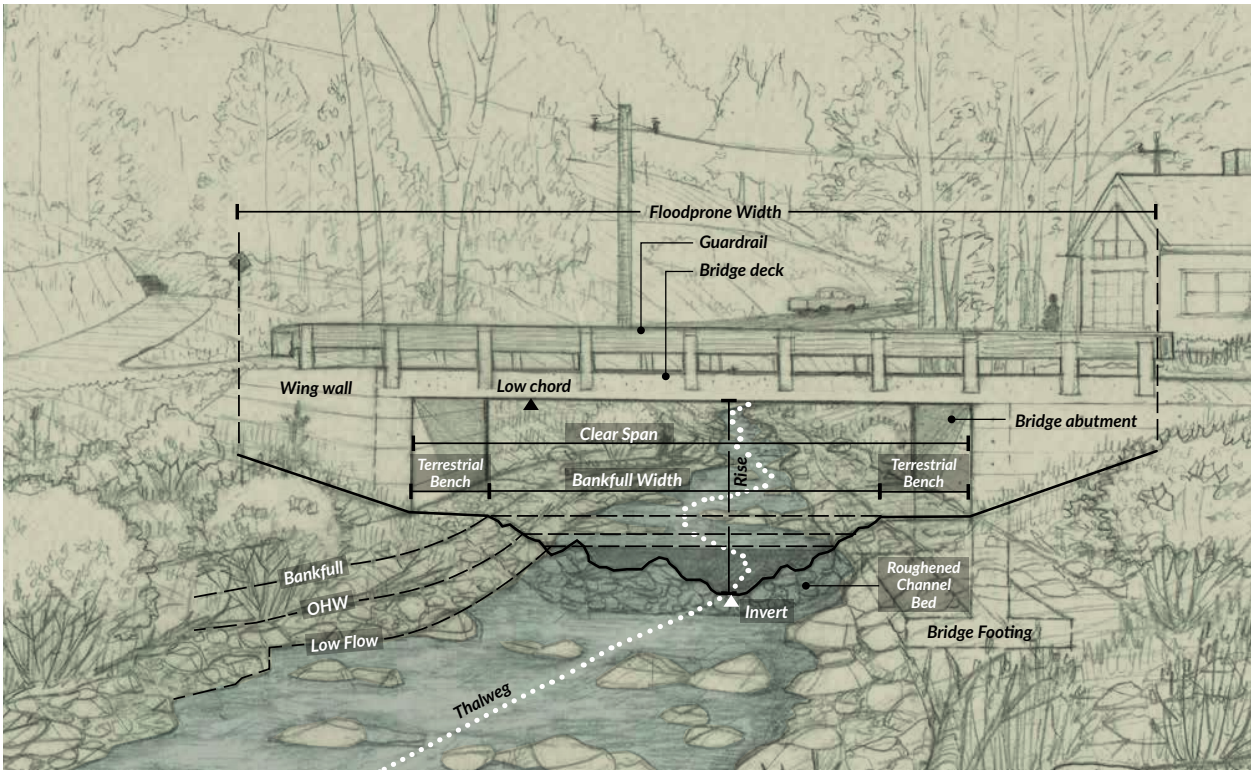
- ☐ Acknowledge areas where crossings are likely to cause problems, both during flood events and over time, and design project features that will address these hazards.
- ☐ Utilize watershed coalitions and community groups to talk to owners about culvert upgrades.
- ☐ Provide guidance on sizing and locating crossing structures for geomorphic compatibility (e.g. passing sediment and debris). Under the CDBG-DR program in Colorado, a guide for landowners entitled “Resilient Crossings Landowners Handbook” was developed to provide guidance on replacement structures that maximize stream function and resilience.
- ☐ During the design process, identify and locate public and private utilities and access and staging areas located within the project site (on plans and in the field if necessary) to minimize project risk.

PROJECT DESIGN

DISASTER RECOVERY CHECKLIST

Recommendations for Changes to State and Federal Disaster Response:

- ☐ Adjust federal funding programs to encourage better designs for infrastructure and utilities that were damaged/destroyed rather than just in-kind replacement. If infrastructure failed or was significantly damaged during a flood event, there is a strong likelihood that it's pre-flood configuration was insufficient and didn't fully consider risk associated with stream systems. Replacement infrastructure should therefore not be rebuilt in the exact same manner, but instead should fully consider the risks of flooding, debris flows, and fluvial processes.
- ☐ Allow funding to include replacement and upgrade of crossings that serve multiple properties where current crossings are shown to pose a hazard.
- ☐ If federal program dollars cannot be used for infrastructure replacement, allow funds spent on culvert or bridge replacement to count toward local match (where required) for the project reach. As an example, local communities must provide a 25% local match for EWP projects, but match is only counted for "program eligible" items. The suggestion here is that if a culvert replacement is needed for reach-scale resiliency as part of a project, the local agency could pay for that replacement and it would count as part of the 25% local match (i.e., culvert replacement would count toward the local community's required match funding but would not be funded directly by the federal dollars provided by the recovery program).
- ☐ Allow flood recovery programs to perform construction activities within public rights-of-way if the work is aligned with the project goals and design. While it's understood that this work is often considered "maintenance" for local agencies, the best time to implement improvements is during a reach-wide construction project. For example, the removal of sediment under a bridge where stream improvements are being implemented could be part of a federal recovery program.
- ☐ Develop a grant program that can be used for crossing replacement (DR Home Access Program, administered by the counties). This program should be closely coordinated with other flood recovery programs.



PROJECT DESIGN

COLORADO WATERSHEDS COLLECTIVE

DISASTER RECOVERY CHECKLIST

PERMITTING

STREAMLINING THE PROCESS FOR MAXIMUM EFFICIENCY

A PROACTIVE APPROACH CAN MITIGATE IMPACTS TO THE SCHEDULE ASSOCIATED WITH LOCAL AND NATIONAL PERMITTING REQUIREMENTS

Post-disaster project permitting in the current regulatory environment is challenging and limits project success. Satisfying permitting processes require significant time, resources, and funding. Permitting requirements can also adversely affect project outcomes, quality, and success. Until changes to regulatory requirements for post-disaster recovery can be achieved, the local sponsor must anticipate the potential impacts of floodplain regulations and associated construction permitting requirements. Developing new permit processes post-disaster is likely to create significant delays unless the new process truncates or simplifies existing requirements. It's best to get out ahead of these issues and make permitting a tool to check projects but not completely derail them. This section primarily makes recommendations for federal, state, and local agencies to consider regarding post-disaster permitting requirements, but also provides recommendations for sponsors and design teams to proactively address project permitting.

Recommendations for Disaster Recovery Actions:

- ☐ Examine permitting requirements with funders, permitting agencies, and sponsors to identify which requirements are likely cause significant project delays and/or increase project costs. Work with these key stakeholders to identify ways to eliminate these bottlenecks.
- ☐ During the conceptual planning process, the team should identify all permitting requirements that may adversely impact project implementation. Acknowledge as early as possible if a preferred solution may require a CLOMR or something equivalently burdensome and expensive. This knowledge should not derail an alternative per se, but it is more efficient to identify and consider them when assessing project alternatives, especially if they cause constraints that might derail a design from being implemented entirely.
- ☐ Ensure that funders, sponsors and permitting agencies--in particular local permitting agencies--agree upon the permitting timeline, including the turn around times for comments and revisions, prior to the start of design. Clarity here is needed for successful project implementation on tight timelines.
- ☐ Ensure design standards and regulations (e.g., permit requirements) are coordinated in order to save time and resources. This specifically became a challenge on EWP projects executed in a particular Colorado county where 100% (final) design plans stamped by an engineer were required for county permit review (building and grading permits). Only once the State lead agency intervened to convince local authorities to change their requirements were those projects able to move forward. The old permitting process often resulted in changes to the design that needed to be addressed before plans could be finalized, rendering the stamped plans obsolete and no-longer-final and thus delaying final permits.

COLORADO WATERSHEDS COLLECTIVE

DISASTER RECOVERY CHECKLIST

Recommendations for Changes to State and Federal Disaster Response:

- ☐ Federal agencies should conduct an evaluation of federal permitting requirements for disaster recovery to ensure that the requirements for one agency don't undermine or contradict those of another agency, either in terms of timelines, restrictions, or permitted actions. In particular it should be noted that EWP funding timelines, set forth in the CFR, all but eliminate the possibility that a project requiring a Conditional Letter of Map Revision (CLOMR) as required by FEMA, could be undertaken and in certain instances, this may be the only long-term and comprehensive solution available to a community.
- ☐ All agencies should consider streamlined processes for permitting disaster recovery projects to address limited funding, recovery timelines, and the immediate need for protection of life and property. Considerable effort is needed to streamline with FEMA, ACOE, and local permits. The State Floodplain Manager and State Hazard Mitigation Officer should be key persons in working with FEMA and ACOE to coordinate state and federal permitting with funding eligibility requirements.

PERMITTING

REGULATORY FLOODPLAIN MANAGEMENT AND PERMITTING: THE PROCESS MUST SUPPORT FLOOD RECOVERY PROJECTS AND THE OVERARCHING GOAL OF CREATING SAFER RIVER CORRIDORS

Floodplain permitting must be restructured to aid, not hinder, a community's ability to implement flood recovery projects.

Flood recovery goals to increase community resilience, decrease flood risk, and to rehabilitate stream corridors are not the same as the implied regulatory floodplain management objectives of reducing inundation footprints, maintaining or decreasing base flood elevations and removing structures from the mapped Special Flood Hazard Area. The goals related to increasing community resilience are forward looking and work to consider and realize how the future can be better. Floodplain regulations, however, by their very nature are backward looking and implicitly set the standard for project performance as the status quo.

For designers and regulators alike, it is imperative to understand this difference and to make decisions accordingly. Floodplain regulations do not constitute design standards, nor are they design goals for flood recovery and river rehabilitation projects. Floodplain regulations serve the purpose of providing a framework through which proposals for projects can be assessed to determine adverse impacts caused by the inundation of floodwater on nearby structures and properties. Regulators must understand that the hydraulic modeling associated with floodplain permitting is not the only metric for evaluating if a flood mitigation project will be beneficial or problematic. Making design compromises for the sole purpose of obtaining a no-rise certification is bad practice and not an outcome that designers should be embracing or regulators should be promoting.

Changes that occur to inundation extents and base flood elevations should not be the only information used to dictate if a project is "good" or "safe" as often this singular point of comparison is not reflective of the full reality of flood hazards in a river system. In Colorado, as in many other locations throughout the country, hazards associated with erosion and deposition may impose a greater threat to life and property that the inundation hazard shown on floodplain maps. Where those processes are likely to occur may extend beyond the mapped floodplain and mitigation strategies for these hazards often do not align well with floodplain regulations. In our experience, decisions that defined the maintenance of either the effective base flood elevation or the existing condition as the 'no-rise" scenario--and therefore implicitly set the status quo as project goal--did not promote resilient outcomes in areas where managing erosion and deposition was the primary objective. Furthermore, where existing maps were inaccurate or based on channel conditions that were channelized or otherwise unstable, flood recovery projects that might have been best for the stream corridor and provided the most protection to downstream assets may not have been able to be considered.

Flexibility in floodplain permitting rules, especially after devastating floods, is essential for communities hoping to build a better, safer future.

COLORADO WATERSHEDS COLLECTIVE

DISASTER RECOVERY CHECKLIST

Recommendations for Disaster Recovery Actions:

- ☐ Completing the required analyses necessary to support a floodplain permit process is costly (in the range of $20-$50k per project); sponsors must anticipate these costs when budgeting and/or requesting grant funding. These costs need to be anticipated and accounted for before beginning the design and implementation of a project (see Flood Recovery Planning section).
- ☐ Identify permitting processes, requirements, and fees as part of the planning process. If this is not possible, at least determine those requirements prior to beginning design. Develop a strategy for determining floodplain impacts, i.e. what will be the baseline hydraulic condition against which proposed project improvements will be compared? Will it be regulatory, pre-flood, or post-flood?
- ☐ Meet early and often with local floodplain officials and FEMA to discuss barriers to successful project implementation. Develop a MOU between the state or local government and FEMA outlining an acceptable process for determining adverse floodplain impacts. The purpose of the MOU is to improve project outcomes, streamline permitting timelines, and reduce project costs.
- ☐ Use 2-D models for analysis but be very careful and deliberate if trying to use 2-D models for regulatory purposes as there are no accepted standards for doing so.

Recommendations for Changes to State and Federal Disaster Response:

- ☐ For up to five years following a flood event, FEMA should suspend the minimum technical requirements associated with local floodplain regulations and NFIP compliance, in particular the language that defines what base flood elevation changes are allowable for “no-rise” permit application and what triggers a Letter of Map Revision (LOMR). In its place, allow each state or local government to define what is reasonable given their specific geography and the characteristics of their rivers.
- ☐ Allow for variances for flood recovery projects within FEMA Special Flood Hazard Areas for up to 5-years following a disaster. Enacted variances or regulatory moratoriums may mean that floodplain regulations are slightly adjusted in an effort to allow for holistic, resilient solutions to be built. In Colorado, this might have included:
  - ☐ Allowing multiple points of comparison for hydraulic analysis (see Determining the Right Baseline for Comparison example),
  - ☐ Allowing a change of 1 to 2 feet in the base flood elevation (BFE) under a local “no-rise” permit, in cases where no insurable structures are affected and for projects that address issues of erosion or deposition rather than issues of flow conveyance.
  - ☐ Not requiring a CLOMR or LOMR in areas that will require or have funding for future floodplain remapping. Note: hundreds of thousands of dollars could have been directed toward purposes that foundationally improved public safety rather than checked a regulatory box if this had been permitted in Colorado after the 2013 floods.
- ☐ For federal disaster recovery programs such as EWP and CDBG-DR, the inclusion of a programmatic agreement in the Environmental Impact Statement regarding management of floodplains following a disaster could be one pathway to allow needed flexibility in floodplain permitting for these programs.
- ☐ Wait for the completion of all federal and state flood recovery projects before updating regulatory floodplain maps. To make this a reality, the remapping funding needs to be accessible 7-8 years after the flood event, not just within the first five.

COLORADO WATERSHEDS COLLECTIVE

DISASTER RECOVERY CHECKLIST

CONSTRUCTION

MAKING THIS OPPORTUNITY COUNT

OVERSIGHT AND COMMUNICATION ARE CRITICAL TO PROJECT SUCCESS

Natural environments are complex and ever changing. These complexities make construction plans difficult to translate and implement exactly as they are shown. Because of this uncertain environment, stream work often involves a field-fit component and it is highly valuable--necessary even--for the design engineer (or a representative) to be significantly involved in the pre-construction and construction oversight process. In this context, we are not referring to construction management, i.e. someone in the field simply observing and measuring daily progress, but instead the oversight of an actual river engineer, geomorphologist, or ecologist (depending on the work being completed) that can make direct and immediate decisions about design and implementation in the field. We have found that contractors appreciate the efficiency of having a "decision-maker" on site to answer questions and ensure that the end product closely resembles a stream corridor in its most natural form. The resulting collaborations often led to our best flood recovery projects.

Recommendations for Disaster Recovery Actions:

- ☐ Design engineer(s) (or a suitable representative) involved in the development of the design should perform the construction oversight.
- ☐ Seek opportunities for the design engineer and contractor to work together to develop processes that incorporate bioengineering (plant material and soil) into structure construction. This will lead to deeper installation of live cuttings along with soil which will likely increase their survival and will allow the stake to develop a robust vertical root system faster than if stakes are installed into shallow holes with unknown or variable soil contact.
- ☐ In addition to construction oversight by the design team, a quality assurance program should be developed that allows for an independent team to provide periodic reviews of construction to note concerns and look for opportunities to improve project outcomes (see Develop a Standardized Programmatic Quality Assurance (QA) and Quality Control (QC) Plan in the Project Design section of this document) .
- ☐ Make sure contractors understand that project designs are flexible (within reason) and that designs may change during construction, and how the project budget adjusts with such changes (see Project Partners process later in this section).
- ☐ Contractors and designers should be prepared to abandon the concept of an "ideal" construction window. Both need to be willing to take on multiple mobilizations if weather (e.g., winter in the Rocky Mountains or heavy spring runoff) splits up a project's construction timeline (this may be especially true for revegetation).
- ☐ Regulators and permitting agencies need to understand and accept the use of and need for field-fit adjustments. When properly overseen by design teams, most field fits are completed in an effort to improve the overall project outcome, not as a means of cost-savings or other corner cutting.

COLORADO WATERSHEDS COLLECTIVE

DISASTER RECOVERY CHECKLIST

Recommendations for Changes to State and Federal Disaster Response:

- ☐ Ensure that adequate funding and flexibility is available for recovery programs so that design team representatives can perform construction oversight as necessary.
- ☐ Provide, hire, and/or develop personnel that are solely responsible for reviewing and approving contractor invoices. the CWCB hired a professional to work with the EWP program project sponsors to review project invoices following pay application processes that involved the contractor, engineer, and sponsor. This resulted in consistency in reimbursement processes, accelerating payments to local sponsors and contractors.
- ☐ Develop an FAQ on working with contractors and managing funds. Include information about project value, project cost, and keeping money for alternatives/contingency.
- ☐ Develop templates for construction oversight expectations, similar to the Quality Assurance Program that NRCS has developed for EWP, which specify roles and responsibilities of oversight staff and frequency and need for oversight on various construction elements.

CONSTRUCTION

COLORADO WATERSHEDS COLLECTIVE

DISASTER RECOVERY CHECKLIST

DEVELOP STANDARD SPECIFICATIONS, PAY ITEMS, AND BID TABS FOR USE ACROSS THE PROGRAM

Consistent specifications, with project-specific revisions, ensure continuity in quality and expectations for contractor delivery across projects. Consistent measurements for quantities and payment associated with these specifications will provide a means to compare costs across projects and across contractors with greater ease, allowing for the tracking of pricing trends over time. Consistency also provides contractors with a better framework to estimate costs and reduces the amount of time they spend in producing bids, which may result in sponsors receiving a greater number of competitive bids. Finally, it also reduces the time and money that designers require to write specifications, define pay items and develop bid-tabs.

Recommendations for Disaster Recovery Actions:

- ☐ Allow designers to revise specifications, as needed, provided they document the reasons for the deviations.
- ☐ Allow designers to write special specifications for features that are not included in the standard specifications.
- ☐ Require the QA/QC process to review all specification revisions and bid-tabs with special attention paid to rounding and decimal places and consistency between the specifications, pay items, measures, and bid tabs.
- ☐ Develop standard design performance expectations, contract warranty language and Operations & Maintenance plans for all aspects of the project, including vegetation.
- ☐ Use early action projects as references to be shown as installed examples of successful practices for contractors.

CONSTRUCTION

COLORADO WATERSHEDS COLLECTIVE

DISASTER RECOVERY CHECKLIST

CONSTRUCTION PROCUREMENT AND CONTRACTING METHODS SHOULD COMPLIMENT PROJECT OBJECTIVES, TIMELINES, BUDGET CONSTRAINTS, AND PERMITTING REQUIREMENTS

Project sponsors have a variety of contracting methods available to them, including time and materials, design-build, design-bid-build, and project partners. Each process has pros and cons and the selected method needs to support the needs of the project.

Recommendations for Disaster Recovery Actions:

- ☐ Because time and budget are limited resources for emergency and disaster recovery work, we recommend that sponsors strongly consider using the project partners procurement process or a T&M procurement process to eliminate lengthy selection processes and relieve the pressure of design schedules.
- ☐ When a sponsor has multiple projects, consider on-call or as-needed T&M contracts for duplicative items such as hauling or plant and nursery stock.
- ☐ Standard bid documents that can be used as a starting point for procurement by project sponsors are helpful in accelerating the solicitation process and create efficiencies program-wide for contractors bidding on multiple projects.
- ☐ Just as design needs a quality assurance review, so do procurement and contract documents. All documents should be reviewed for consistency with federal program requirements, including the actual construction contract, pay items, and project specifications.
- ☐ Provide minimum contract language to all project sponsors.

Recommendations for Changes to State and Federal Disaster Response:

- ☐ Ensure contracts are written to allow designers to provide oversight for the construction of their projects. In some cases during the 2013 Colorado Flood Recovery, agency rules prohibited the design engineer from providing construction oversight, which created significant challenges in implementing flood recovery projects. Successful stream rehabilitation projects require significant oversight by the original design team who fully understand the goals, objectives, and adjustments that can be made in the field during construction.
- ☐ Allow for and encourage the use of contracts with designers and/or contractors that span multiple projects. For example, a time and material (T&M) contract that supports hauling for multiple projects allowing materials from one site to be used at another, reducing overall project costs. For the 2013 Colorado Flood Recovery, the TA Team observed multiple scenarios where cobble, topsoil, woody materials, and the like could have been shared between project sites, significantly reducing materials costs.
- ☐ Allow for the establishment of reimbursable contracts prior to construction to support the cultivation of specific plants needed for revegetation efforts.

CONSTRUCTION

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Department of Natural Resources

COLORADO WATERSHEDS COLLECTIVE

DISASTER RECOVERY CHECKLIST

REVEGETATION

BRINGING PROJECTS TO LIFE

ADVANCED PLANNING IS REQUIRED FOR LARGE SCALE INSTALLATION OF VEGETATION

Unlike erosion control products, quarried rock, and other materials needed during a flood disaster recovery effort, live native plant materials (especially those that are adapted for specific watershed site conditions) take time to propagate and grow to a level where they can be vigorous enough to be planted at a site and have a high expectation of survival. Although there is typically a baseline supply of native plant materials available in the marketplace, recovery after a disaster can quickly exhaust the supply of available plants. Because of this, advanced planning is critical and should start ahead of many other flood-recovery tasks.

Recommendations for Disaster Recovery Actions:

- ☐ Identify existing quantities and availability of regionally-specific native plant materials from local nurseries as early as possible.
- ☐ Identify vegetation needs at the program-scale as early as possible. Most likely you will not know project-level needs at the beginning of the program, but a simple estimation can be made to get the ball rolling on the production process. Once projects have been identified and designed, the production plan (project-level species, sizes, and timing) can become more defined. Do not let perfection stand in the way of progress.
- ☐ Begin with a robust and flexible production plan and find a willing and flexible nursery manager. These are essential as project design and timing, and therefore plant quantity, will often change.
- ☐ Work with local ecologists to identify local plant material collection sites and techniques. Acquire and propagate this material early so that flood recovery projects can utilize endemic species with local genetics in their revegetation efforts.
- ☐ Proactively obtain plant material collection permits from federal, state, and local land ownership entities early in the process. Collection permits often take longer than expected. Obtaining permits and estimating a production plan should be done simultaneously.
- ☐ During plant production, use deep-rooted plant containers as they encourage improved root establishment and require less time and space then do other container shapes and sizes.
- ☐ Plants are living organisms and may not grow as intended or may die off in the production process. Remain flexible throughout the design and implementation process. Be prepared to use analogous plant species to fulfill certain niches or functions if the one in the original revegetation plan is not available.
- ☐ Depending on site conditions, temporary irrigation and/or protective barriers may be required in order to ensure survivability (e.g., cages, fences, weed barriers, etc.). Start planning and setting aside funding for irrigation and fencing costs early as infrastructure is costly and not all federal funding can be used to pay for these items.

COLORADO WATERSHEDS COLLECTIVE

DISASTER RECOVERY CHECKLIST

Recommendations for changes to State and Federal Disaster Response:

- ☐ Allow and utilize program funds to be used to contract with nurseries to grow regionally-specific native plant materials as early in the recovery process as possible. Nurseries will need funding to start harvesting and increasing seed and plant materials in anticipation of projects that may be a year to three years out from construction.
- ☐ Encourage programmatic flexibility in regards to construction schedules so that the project timing corresponds to appropriate harvest, storage, and installation for dormant materials.

REVEGETATION

COLORADO WATERSHEDS COLLECTIVE

DISASTER RECOVERY CHECKLIST

PLANT INSTALLATION REQUIRES PLANNING, ATTENTION TO DETAIL, AND COORDINATION BETWEEN ENGINEERS,ECOLOGISTS, AND CONTRACTORS

Revegetation efforts associated with flood-recovery are a critical investment in the long-term health and resilience of our waterways. Establishing collaborations between plant ecologists, engineers, and contractors to optimize revegetation activities will provide the best opportunity for these efforts to produce a return on this investment.

Recommendations for Disaster Recovery Actions:

Site Planning and Design

- ☐ To the greatest extent possible, identify in the recovery plan opportunities to either protect in place or transplant existing vegetation using proper timing and techniques during construction.
- ☐ When developing revegetation plans, consider hydrologic and climatic conditions of the site (e.g. groundwater levels and frequency of inundation) and develop plans that don't rely on supplemental irrigation wherever possible. One suggestion for sponsors is to install groundwater monitoring wells at recovery sites in anticipation of projects to determine groundwater levels over time to improve understanding of hydrologic conditions adjacent to impacted rivers and streams.
- ☐ Require revegetation plans to include the use of live woody materials (e.g., cuttings, seedlings, plugs, bare-root, and/or large potted or balled and burlapped trees). The aim is to accelerate stabilization and promote stability in the ecosystem, providing landowners with an immediate feeling of recovery and vegetative establishment in ecosystems as opposed to use of seed alone.
- ☐ Favor the use of live cuttings, seeding, and plugs over the use of container stock in areas where the goal is not channel or bank stabilization or where there is not the need for immediate visual impact provided by taller plants, i.e. where accelerating the appearance of recovery to landowners is less critical.
- ☐ Utilize the Colorado Bio-Engineering Manual (and/or similar resources) to help direct and develop confidence in stream restoration engineering designs which incorporate plant materials as part of engineered structures.
- ☐ A qualified plant ecologist should determine site-specific seed mixes that are sensitive to elevation, aspect, and hydrology. These mixes should contain diverse life forms (grasses, grass-likes, flowering plants) and diverse growth attributes (warm season, cool season, pioneer, early maturity, late succession) that have the ability to respond to a wide variety of environmental conditions and can compete with non-native species.
- ☐ Discourage standard on-center plantings and strategically lay out plants to take advantage of micro-sites, including depressions and assemblages that reinforce bioengineering and natural features as well as patterns of streamflow.
- ☐ Use the revegetation effort as an educational opportunity to share with landowners the importance of using native plants to stabilize their land, promote wildlife and pollinator habitat, and assist in long-term stream corridor health and function.
- ☐ Where practical, include landowners in the revegetation design and species selection process. Specific plants can be a point of connection with some residents--encouraging their participation in the revegetation process can ease the tension and promote long-term custodianship.
- ☐ Take the time to understand landowners' long-term plans for their property and their plant preferences prior to installing plants. Plants installed in the wrong location may be destroyed by unknowing landowners improving their property. In addition, contentious plant species may be removed by landowners if property-specific knowledge is not incorporated into the final design.

DISASTER RECOVERY CHECKLIST

Construction and Installation

- ☐ Live cuttings of native riparian plants, when used at the proper time, are cheap to acquire and provide excellent opportunity for revegetation. Install live cuttings concurrently with construction (e.g. grading and/or structure install) as this is a great opportunity to ensure proper depth and year-round access to groundwater. Installation of live cuttings into rock/boulder structures and/or native alluvium after-the-fact can be extremely time consuming and difficult on laborers and machinery.
- ☐ Plant ecologists should review seed mixes prior to installation to prevent the spread of invasive species into the project.
- ☐ Noxious weeds should be controlled prior to ground breaking; control in advance will assist in long-term weed control.
- ☐ To the greatest extent possible, stockpile and reapply native topsoil using proper live soil handling techniques.
- ☐ Include soil decompaction in revegetation plans, using techniques such as deep ripping, prior to planting in areas that have been impacted by construction activities. This is crucial to aid plant survival (not to mention make the physical act of planting possible).
- ☐ When necessary, apply soil amendments to ensure plant establishment and vigor. Ensure these amendments and their application are sensitive to water quality pollution concerns. Only use soil amendments in areas with identified need for nutrients through soil testing. This will prevent unnecessary use, controlling costs and protecting water quality.
- ☐ Work with contractors to identify favorable grading/benching to support different plant communities and groupings. Too often, uniformity in streambank construction forces uniformity in revegetation.
- ☐ Inspect nursery plant material prior to installation to verify species correctness, vigor, and proper rooting.
- ☐ Tree removal without clear communication and agreement with landowners is an easy way to lose their trust. Require marking and fencing of vegetation, with landowner review, prior to site preparation and vegetation removal.
- ☐ Depending on the site, there may be a need to aggressively install native plants in order to combat the anticipated aggressiveness of invasives species or noxious weeds. If prone to invasive species, aggressive replanting of fast colonizing natives and post-construction monitoring (for invasive removal) is critical to keeping unwanted vegetation from taking over a project site. In Colorado this isn't just an ecologic or aesthetic consideration; allowing cheatgrass (Bromus tectorum) to occupy a site that was previously vegetated with native grasses may increase the susceptibility of the area to wildfire.

Recommendations for Changes to State and Federal Disaster Response:

- ☐ Programs need to recognize that bioengineering and revegetation are a significant component of flood recovery, erosion control, and infrastructure protection. As such, revegetation must be an eligible item for reimbursement or grant funding throughout the recovery process.

REVEGETATION EFFORTS REQUIRE MAINTENANCE

Unlike some other flood-recovery investments, the revegetation component of a project not only needs time to begin to function but also often needs care and maintenance to ensure plant survival, vigor, and health, and to control invasive species. In addition, management strategies may need to adapt as the riparian corridor recovers.

Recommendations for Disaster Recovery Actions:

- ☐ Provide temporary irrigation infrastructure and labor to ensure plants have adequate water during their critical establishment phase. This is particularly important in arid areas.
- ☐ Irrigation and fencing infrastructure will require maintenance. Ensure funds have been allocated toward infrastructure maintenance.
- ☐ As part of the temporary irrigation plan, consider the installation of groundwater monitoring wells at project sites to evaluate groundwater hydrology and vegetation support in the several years following construction.
- ☐ Not all nonnative species need to be removed as some provide cover and stabilization until perennial native species become established. Work with local plant ecologists to know your weeds and understand invasion thresholds.
- ☐ Early detection and rapid response weed control can prevent the spread of unwanted nonnative and invasive species across the project site.
- ☐ Align contract requirements such as the vegetation maintenance warranty period between the sponsors, contractors, and funding agencies. If the contracts are out of alignment a sponsor or contractor may be required to pay out-of-pocket for the revegetation warranty.
- ☐ The warranty should specifically outline the revegetation success criteria for seed cover, cutting survival, container survival, and threshold for invasive species control (an example O&M document addressing plant survival and invasive species thresholds can be found in the Recovery Resources section of this document).
- ☐ Success criteria should align with the typical carrying capacity for the ecological system within the project area.
- ☐ Seed cover success criteria should be broken into three categories: native, introduced, and invasive. For example, some projects contained predominantly introduced and invasive ground cover (i.e., plants that were not the result of the applied seed), yet these projects passed warranty standards.
- ☐ Both short-term and long-term invasive species control for state-listed invasive species and other aggressive and undesired revegetation will be required in order to promote mid-and late-successional native species. Allocating funding for long-term weed control will increase the likelihood of restoration success and long-term resiliency

Recommendations for Changes to State and Federal Disaster Response:

- ☐ Programs must recognize that the success of bioengineering and revegetation requires more than site appropriate design and well implemented construction. To ensure plant survival and vigor, temporary irrigation and invasive species control may need to be included as part of a flood recovery project funding.
- ☐ The development of a healthy riparian plant community is likely to need a longer timeline than typical recovery funding programs allow. To address this concern, and improve project revegetation outcomes and the success of bioengineered improvements, costs associated with ensuring revegetation success should be funded or counted as match.

COLORADO WATERSHEDS COLLECTIVE

DISASTER RECOVERY CHECKLIST

MONITORING AND ADAPTIVE MANAGEMENT

LEARNING AND IMPROVING UPON THIS OPPORTUNITY

RECOVERY DOESN'T END AFTER IMPLEMENTATION—PROJECTS MUST BE ACTIVELY MONITORED AND ADAPTIVELY MANAGED

Financing disaster recovery as a long-term investment in a community requires facilitation of the following:

- Monitoring implemented projects so we collectively learn from our mistakes and eliminate repeated failures,
- Adaptively managing recovery projects so we maintain our investment and correct small problems before they lead to project failure, and
- Documenting the return on our investments to better understand and estimate long-term benefits of recovery efforts.

Recommendations for Disaster Recovery Actions:

- ☐ Ensure post-disaster aerial reconnaissance that includes photo-imagery and if possible LiDAR collection ahead of emergency disaster recovery work because the recovery process will reshape site conditions with earthwork.
- ☐ After all programmatic work has been completed, repeat the LiDAR and photo-imagery at a regional scale for documentation and archival purposes.
- ☐ Establish passive rehabilitation control sites. Not every reach of a river system requires active work or rehabilitation for protection of life and property. Areas that can be left alone should be identified as control sites, which will provide a baseline to which improved reaches can be referenced.
- ☐ Consider investing in pre-project monitoring for all projects enrolled in the recovery program(s) as well as the passive sites.
- ☐ Plan for project monitoring during the design phase. Determine monitoring goals and objectives, develop project specific hypothesis, identify critical cross section locations and photo points, develop a list of plant species or biological species of interest, etc.
- ☐ Design teams must directly support project monitoring as they house the institutional knowledge of a site's history and construction methods that are necessary for developing informed study questions and hypotheses. Design teams are also most likely to be able to identify critical project elements and/or observations that necessitate immediate adaptive management measures.
- ☐ Monitoring parameters must be tied to the goals and objectives of the program as well as the goals and objectives of each reach of each project.
- ☐ Programmatic and project specific monitoring must be housed within a monitoring framework that relates the measured conditions on the ground to thresholds for action. Actions could range from conducting further assessments to weed removal to the remobilization of heavy equipment.
- ☐ Monitoring and adaptive management programs must consider that many projects include, or should include, features that are designed to change with river processes over time. Just because a high flow comes along and rearranges the vegetation, a bank, or the channel bed, doesn't necessarily mean there needs to be some form of physical intervention. Determine the adaptive management thresholds for each project before monitoring is started to ensure the proper physical characteristics are being measured and that they are reflective of the design expectations and standards that determine project success and failure.

DISASTER RECOVERY CHECKLIST

- ☐ Contractor warranties are not a cost-effective means of providing ongoing adaptive management, especially as it relates to the establishment and survival of vegetation.
- ☐ Develop MOUs with permitting agencies that allow for adaptive management actions to be completed under the initial project permits for up to five years after the end of the project construction.

Recommendations for Changes to State and Federal Disaster Response:

- ☐ Funding programs should require post-project monitoring, maintenance, and adaptive management. These activities are an integral part of long-term recovery success. Requiring ongoing monitoring and adaptive management will improve project success as well as provide a means to estimate the return on investment of the activities.
- ☐ We recommend that each federal disaster recovery program consider follow-on funding specifically for monitoring and adaptive management within the first 3-5 years after project implementation on the order of 1-5 percent of the total program expenditures.
- ☐ If federal programs aren't modified to include monitoring and adaptive management funding, state and local government should consider the development of disaster recovery monitoring and adaptive management funding. This may be a part of legislative action following a disaster. In this case, state and local funding should include post recovery funding for a period of 3-5 years for monitoring and adaptive management activities.
- ☐ Provide funding incentives for post-project monitoring and adaptive management, e.g. access to additional disaster funding in future disasters.

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