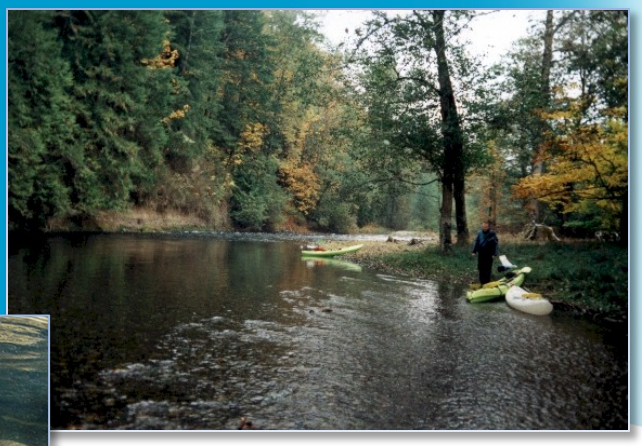
Independent Expert Panel Review of Water and Land Resources Division's Project Scoping and Implementation Practices

FINAL REPORT
January 30, 2012



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Definitions

Throughout this report, the following abbreviations are used:

CIP	Capital Improvements Plan
CPMWG	Capital Project Management Working Group (King County)
DNRP	Department of Natural Resources and Parks (King County)
DOE	Department of Ecology (Washington State)
ELJ	engineered log jams
ESA	Endangered Species Act of 1973
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FHMP	2006 King County Flood Hazard Management Plan
KCFCD	King County Flood Control District
LW	large wood
NGO	Non-Governmental Organization
PSP	Puget Sound Partnership
SRFB	Salmon Recovery Funding Board
USACE	United States Army Corps of Engineers
WLRD	Water and Land Resources Division of King County DNRP
WRIA	Water Resources Inventory Area

1 Executive Summary

In August of 2011, the King County Department of Natural Resources and Parks (DNRP) Director's Office began an independent expert review of the Water and Land Resources Division's (WLRD) capabilities and capacity to successfully deliver river and floodplain management projects and programs.

As part of its emphasis on increased efficiency and effectiveness, DNRP asked an Independent Expert Review Panel to evaluate how well project scoping and implementation address four established policy objectives:

1) Protecting public safety;
2) Preventing property damage;
3) Recovering salmon; and,
4) Providing recreation.

This report presents findings and recommendations to DNRP based on the results of this independent expert review, addressing aspects of WLRD's river projects, including project scoping, delivery processes, technical assumptions, construction methods, maintenance procedures, and post project monitoring and mitigation.

The Independent Expert Review Panel (Panel) was formed by MWH Americas Inc., based upon an identified "short list" of river and floodplain management professionals that have expertise with the various WLRD policy areas. Upon review of potential panel members' resumes and subsequent discussions with the DNRP Directors Office to eliminate any conflicts of interest, five panel members were identified as follows;

- Dr. Paul DeVries, P.E.
- Dr. Christopher Frissell
- Dr. Yung-Hsin Sun, P.E.
- Dr. Doug Whittaker
- Mr. Tracy Yount

MWH served as Panel facilitator and liaison to King County and stakeholders. This report synthesizes the Panel's verbal and written assessments, which included a review of materials provided by the County and stakeholders, discussions with WLRD staff and stakeholders, and site visits. This report represents the Panel's impression of the subject County activities based upon these data sources and the expectation is that interested parties will give consideration to the report findings within this context. It is anticipated that many of these findings and recommendations will spur further discussion and evaluations.

The report represents recommendations of the Panel as a whole, not the opinion of MWH or any particular author. Although the Panel found consensus on most issues, individual report sections were typically synthesized from contributions of a subset of the Panelists with particular topic expertise. Given the scope and range of King County services and projects, the Panel believes this review report and the subsequent recommendations will be useful for all departments and divisions within King County that perform any kind of project work within or near King County rivers.

There is increasing awareness in recent decades of the interconnection and mutual influence among different objectives and associated actions for river and floodplain management. Therefore, project formulation and implementation has shifted from the traditional single purpose project, with necessary compensatory mitigations, to a multi-objective approach to incorporate features that promote public safety, flood management, ecosystem restoration and recreation. While traditional river management involves strategies to control river through channelization or hardening embankments, the more integrated approach seeks opportunities to allow river meandering for transitory storage and potential restoration of critical floodplain functions. This multi-objective approach, especially when applied on a system wide level, allows more flexible management strategies, improved prioritization and effectiveness in using limited resources, and more sustainable outcomes.

Overall, the Panel found that the County has a well-established environmental stewardship policy that aligns with this new approach for integrating ecosystem restoration and/or rehabilitation into river management activities, while achieving their goals in public safety, flood management, and recreation. The resulting river management strategy, to the extent feasible, has a focus on floodplain management as a means to reduce economic damage due to flooding while ensuring public safety and improving local habitat. The progressive nature of this policy aligns well with the policy of the State of Washington and other federal agencies (e.g., Federal Emergency Management Agency) for potential funding support and has alleviated some potential roadblocks and hardships that might have been imposed by regulatory agencies under the Endangered Species Act or Clean Water Act. In addition, the staff has been successful in leveraging various public funds (e.g., FEMA grants, SRF grants) for project implementation when opportunities arise.

While WLRD has demonstrated a proactive approach to their river and floodplain management projects, their practices could further benefit from program level planning, coordination, and execution. Not every river segment in King County has equal potential for habitat restoration, floodplain capacity, or specific types of recreation use. Consequently, it is unlikely that every project will equally serve all of these project objectives. To address this, the Panel recommends improved information about "project drivers" and the specific needs of the site, segment, and watershed. Many projects are initiated opportunistically as funding sources become available or in response to specific state and federal regulations and directives, but existing project objectives and descriptions do not always effectively communicate why they have been chosen. This alignment and communication of project objectives must occur both internally for project team members, and externally with the public. Improved documentation, with links to broader strategic goals for a basin can better ensure public and stakeholder understanding, and improve chances of community support.

Another area of improvement arises from the fact that stakeholder engagement currently tends to occur primarily at the project level. The Panel recommends earlier discussions with the public at the basin-wide strategic level on all related issues and challenges. While stakeholder engagement should occur throughout a project's life cycle (from planning through post-project monitoring), earlier planning stages allow WLRD to communicate broader strategic goals, describe support for new paradigm approaches from the scientific community, as well as hear stakeholder and public concerns that can become the focus of individual project designs and siting. Higher level engagement can be largely achieved through improved strategic implementation planning, documentation, and effective communication. This can be seen in

Figure 1 below which demonstrates the various levels of program/project development and the recommendation that stakeholder engagement focus on the basin-wide planning phase.

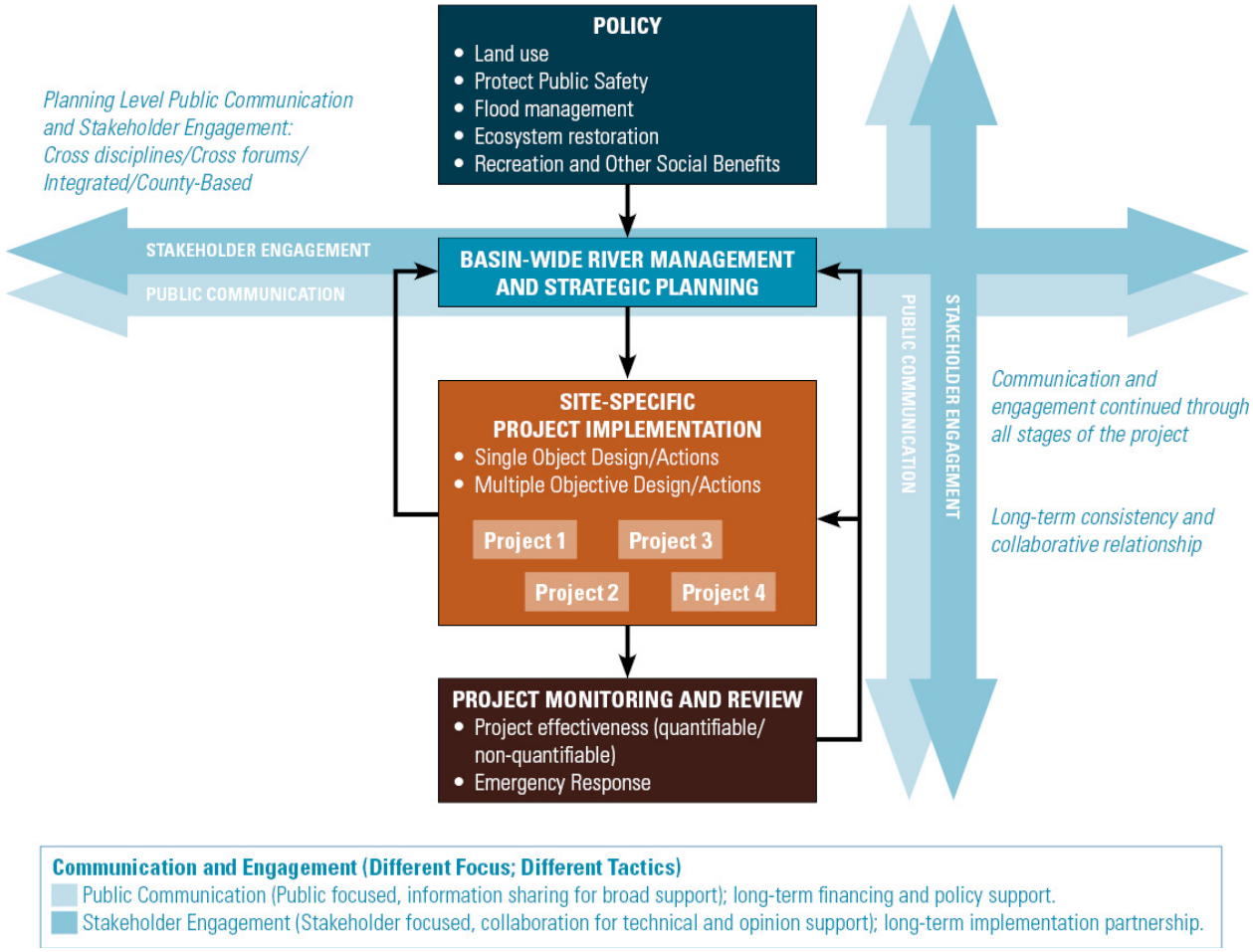

Figure 1: Recommended Stakeholder Engagement Strategy

Public safety continues to be a primary concern as floodplain projects are conceived and implemented. The Panel recognizes that balancing the policy directive for a multi-objective, progressive approach to river management is further complicated by the considerable uncertainty involved in allowing river segments to become more dynamic. Such dynamic projects will likely increase hazards in some river segments, and King County may need to assume greater responsibility to identify and possibly mitigate some hazards, while providing more systematic public outreach efforts to warn recreational users of potential river hazards. In some situations, specific project designs or sites may need to be avoided to reduce the risk of recreation hazards. In order to address these potential recreational hazards, the Panel recommends the assignment of dedicated King County staff to coordinate recreation aspects of all river and floodplain management projects. This will encourage earlier stakeholder engagement on recreational issues, better coordination of recreational impacts throughout the project life cycle, and a consistent approach to identifying and mitigating potential hazards across all WLRD river projects.

The Panel also concludes that WLRD appears to use scientifically accepted principles for managing floodplains within the context of balancing other stated policy objectives. These relatively new engineering and restoration techniques (e.g., large wood and engineered log jams) are quasi-experimental in nature and still require a significant amount of refinement and customization for site-specific considerations. Although there are well-established structural design guidelines for engineering large wood structures, siting decisions are largely based on professional judgments that interact with the inherent variability of dynamic river systems. While there has been at least one individual project failure in the past (unintended remobilization of LW at the Cedar Rapids site), no consistent or systemic design or siting failures invalidate the new approaches to floodplain management or urge a moratorium on additional projects. Instead, the Panel recommends several connected procedural reforms that will better help select, design, construct, and monitor projects (or address post-project impacts as necessary). One such recommendation is identifying and acknowledging these less certain project elements through earlier and more effective communication with stakeholders. More extensive stakeholder engagement during project selection, siting, and design will allow the County to more clearly define project expectations, failures, and success. Taken together, these systematic improvements are more likely to identify designs and siting that will restore habitat while protecting floodplain development and provide recreation in accordance with programmatic objectives.

The Panel also found the County could improve the clarity and consistency of existing monitoring and post-project mitigation by focusing on the goals and objectives set forth by the project or program. While WLRD often conducts detailed monitoring efforts related to some project elements, monitoring has been implemented unevenly for other elements, particularly simple measures of ecological and flood management effectiveness. A comprehensive post-project management plan that evaluates project objectives at the site, segment, and basin scale is needed. Consistent and systematic monitoring, coupled with clear presentation of findings, are more likely to garner stakeholder or public support for the program. Improved and transparent monitoring will be able to identify project successes and challenges, showing when project elements met design expectations and should be used in the future, as well as identifying when designs or siting did not behave as planned and should be revised in future projects. Monitoring will also allow improved planning for flooding and post-flood response, which may include mitigation for adverse impacts caused by the projects.

The Panel observed a clearly communicated policy directive to meet public safety requirements and environmental objectives / permitting conditions that are manifested at the project level. However, there is a general void of program definition and direction that exists between the policy level directive and individual project execution. It is within this void where multiple program level guidance documents and coordination agreements would provide value to both the consistent execution of projects and the management of stakeholder expectations.

Similarly, there appears to exist a general lack of system definition, objectives, and processes that could be consistently employed by WLRD staff. The degree to which stand-alone projects were able to satisfy multiple project drivers appeared to be dependent on the expertise of individuals assigned to the projects. This is becoming more of an issue for the WLRD because of the exponential increase in funding, complexity of the objectives, and the nature of regulatory requirements, that at times are in direct conflict with competing safety or environmental objectives. These conflicts have created an increased likelihood of one or more project

objectives either being unmet or misunderstood by the general public. While these conflicts may be unavoidable in some situations, an agency endorsed program level regulatory strategy, providing both staff direction and the basis for public communications, will be invaluable. The linkage of policy agreements between WLRD and permitting agencies will then flow from the policy through the program to the project. This defined relationship will become the basis for internal project direction while also creating a linkage between the permitting agency direction and stakeholder interests.

Taken together, the findings above create an enterprise-level risk for King County. Enterprise Risk Management (or ERM) uses an integrated or holistic approach to understand and manage all the risks an organization faces. Its primary purpose is to improve the quality of decision-making throughout an organization by managing four distinct types of organizational risks:

1) **Strategic risk** involves the organization's direction and determining if the organization's current course and ability to adapt to changes are correct. This includes overall objectives, assumptions, and constraints faced by the organization.
2) **Operational risk** involves the people, processes, and technology required to carry out the organization's strategic objectives.
3) **Financial risk** involves the allocation of resources, including the organization's financial investments and determination of whether or not financial resources are allocated to generate the best value to customers and stakeholders.
4) **Insurable risk** includes those "pure" risks that involve financial loss and are typically addressed by insurance.

The nature of these highly uncertain river and floodplain projects, combined with program expansions at WLRD over the past decade, has increased the overall enterprise-level risk. While much of this risk is controlled at the basin-wide level, King County frequently addresses risk at the project level on a case by case basis. This limits the ability of the County to manage risk through early stakeholder engagement and a clearly defined basin-wide strategy. By improving King County's existing procedures, development of a Strategic River Management Plan, and through completion of a comprehensive programmatic risk assessment, many current project level risks can be reduced or mitigated.

The Panel's primary findings and recommendations as discussed above are presented below in Table 1: Major Findings and Recommendations.

Table 1: Major Findings and Recommendations

	Finding	Recommendation
1	**General support for ecological/dynamic floodplain management strategies** The scientific literature supports a shift from "hard engineering" to "ecological/dynamic" floodplain management strategies when possible. King County has missed opportunities to clearly describe these strategies and show how individual projects meet strategic goals or fit with current scientific theory and practice.	Develop a Strategic River Management Plan for river and floodplain project. This document should: • Summarize the legal drivers and policy mandates that encourage use of ecological/dynamic floodplain management strategies when possible. • Broadly describe the scientific and applied practice support for implementing ecological/dynamic floodplain strategies (while also identifying when more traditional approaches may be needed).

	Finding	Recommendation
		• Clearly document WLRD's river and floodplain management strategy, including project objectives and implementation approaches at the multi-basin, watershed, and river segment scale. • Summarize programmatic processes by which individual projects are selected, funded, designed and sited, constructed, and monitored. • Connect policy and programmatic elements to existing FHMP and WRIA plans. • Suggest potential improvements in the upcoming revision of the FHMP to more clearly identify strategic planning objectives, management actions, and criteria for project selection and implementation. • Be concise and accessible to staff, agencies, stakeholders and the general public.
2	**Clarify project objectives** County ordinances and policies prescribe the overall management directives and goals, but individual projects may have more specific objectives contributing to the overall goals, with prioritized actions associated with river basin, segment, and site considerations. These specific objectives should be clarified and linked to larger basin strategies, and potential tradeoffs identified between objectives. Improved objectives will better communicate why an individual project has been developed, what it intends to accomplish, how it fits with other projects, and how it collectively contributes to the overall program goals.	Based on the overall management plan(s) that delineate the overall goals and specific objectives (anticipated outcomes) from specific projects, develop concise summaries for individual projects. This short standardized document for each project should: • Clarify site-specific project goals and objectives and explain how they fit into the larger basin-wide or multi-basin strategies. • Identify potential tradeoffs between objectives for individual projects. • Communicate key project features and illustrate potential outcomes to help the public and stakeholders understand how those will help meet larger strategic objectives.
3	**Improve public and stakeholder collaboration** County procedures for public and stakeholder input during project planning, design and review could be more uniformly implemented to encourage stronger public support and stakeholder engagement.	Encourage earlier and more collaborative stakeholder involvement: • Encourage stakeholder engagement at basin-wide river management and strategic planning scales. • Develop earlier recognition when projects will have substantial recreational safety impacts and match levels of engagement with recreation stakeholders. • Design opportunities for stakeholders and the public to address potential problems through initial design and siting decisions, developing outreach to warn of potential hazards, or post-project mitigation.

	Finding	Recommendation
4	**Inadequate formalized engagement of stakeholders regarding recreational usage** Public safety continues to be a primary concern as floodplain projects are conceived and implemented. Increased large wood recruitment, placed wood, and engineered log jams are likely to increase hazards for recreation users in some river segments. Formalized collaboration with recreation stakeholders and external recreation experts through the project lifecycle can improve project design and siting. Systematic inventories and explicit criteria can also help assess potential hazards in light of recreation use factors to help guide potential management actions to reduce, mitigate, or warn users about hazards.	Develop a dedicated "Office of River Public Use" (one to two staff) to coordinate recreational aspects of projects. This office should: • Encourage recreation stakeholder involvement in project selection, design, and siting. • Invite external recreational expertise to assist with recreation-sensitive projects. • Participate in project designs as an independent advisor. • Support or initiate recreation use monitoring to anticipate the types and amounts of recreation use that may be exposed to project related hazards, and develop management actions that can reduce risks from these hazards. • Support hazard monitoring to inform systematic public outreach programs. • Support and maintain a systematic record of wood-related safety or injury incidents. • Serve as a liaison to river recreation users • Work with stakeholders and education/ outreach specialists to raise awareness of river safety and potential hazards.
5	**Uncertainty of project consequences** Dynamic flood plain management strategies have inherently uncertain consequences even as standards can assure that projects' structural designs are sound. Project siting involves experimentation that increases the need for systematic monitoring and potential post-project mitigation to address flood management, ecological response, or recreation hazards. The extent of uncertainty should also be explicitly acknowledged to stakeholders and the public throughout the project life cycle.	Acknowledge inherent uncertainty with some project outcomes and identify responsibilities to mitigate adverse impacts (when possible) or avoid similar problems in future projects. This includes: • Improving documentation of considerations and recommendations in siting and design of structures to reflect the project-specific needs and local hydrological and hydraulic conditions. • Improving project-specific conceptual or feasibility planning document(s) that illustrate broader agreements about project objective priorities, proposed project details, anticipated and potential beneficial and adverse outcomes, performance measures and indicators of success. • Properly characterizing the reliability and longevity of structural designs and siting decisions relative to intended outcomes during the design phase. • Establish efficient and comprehensive monitoring to identify whether designs and siting are providing ecological, recreation, or flood protection successes so policy makers can review potential trade-offs for

	Finding	Recommendation
		future projects. • Revise both internal and external (public) documents to clearly identify project uncertainty, and avoid implying that project outcomes can be predicted with great certainty.
6	**Standardize project monitoring and improve post-project mitigation response** WLRD conducts monitoring and post-project mitigation, but efforts are uneven and opportunities exist for improvement. Monitoring should assess cumulative effects across multiple projects in a basin, focusing on simple measures of ecological and flood management effectiveness that can help assess whether structure design and siting are achieving stated project objectives.	Establish standardized project monitoring approaches for all WLRD projects at watershed, river segment, and project scales. Monitoring should: • Focus on simple measures of effectiveness and tests of design and siting assumptions. • Include river-scale monitoring and evaluations to determine cumulative basin-wide project effectiveness. • Examine levels of recreation hazards in higher use recreation segments, and assess the proportion associated with placed or engineered large wood projects vs. natural large wood recruitment. • Formalize regular public monitoring reports at the river basin level. • Proactively communicate through reporting and/or documentation the nature of unexpected or undesired project performance and the selected remedial actions.
7	**Lack of integrated program elements create an increased risk profile** A comprehensive program that includes objectives, system definition, regulatory strategy, stakeholder strategy, and aligned project procedures is not currently present. Independent but related program elements have converged to increase the County's enterprise-level risk profile. These include the use of experimental designs, recent program expansion, inconsistent application of procedures, varied levels of stakeholder involvement, and intermittent success in consistently balancing or communicating varied objectives.	Perform a comprehensive programmatic risk assessment that includes: • Risk Assessment - Perform a risk assessment that evaluates the impact to the DNRP of procedures, policy changes, organizational changes, new and reassigned staff, and new processes etc. that relate to department actions and objectives. • Program Assessment/Define System - Define how interrelated programs, procedures, objectives, and policies relate to each other to better prepare for intended and unintended consequences of planned actions. • Regulatory Strategy - Develop (or formalize) an enterprise level regulatory strategy in conjunction with oversight agencies that is built upon objectives and legal drivers. Focus on the paradigm evolution of King County flood/safety project balance with environmental restoration objectives. o Formalize and Integrate enterprise

	Finding	Recommendation
		level regulatory strategies and objectives within the project identification, scoping, design, and execution procedures. o Establish formal policy, program planning, project coordination, and dispute resolution frameworks with each regulatory organization that have action or funding authority over King County. • Stakeholder Strategy - Create a stakeholder engagement strategy that incorporates risk assessment findings, paradigm shifts, competing regulation prioritization, and lessons learned that influence project execution.

2 Introduction

The Department of Natural Resources and Parks (DNRP) initiated an independent review of project scoping and implementation practices conducted by the Water and Land Resources Division (WLRD). The review focuses on river and floodplain management projects and programs intended to address four primary objectives:

- Protect public safety;
- Prevent property damage;
- Recover salmon; and,
- Provide recreation.

Research studies and experience show that there are significant risks and uncertainties associated with river and floodplain management. As WLRD floodplain management practices have become more dynamic in recent years, the DNRP determined that an independent review was necessary to evaluate whether King County effectively designs and constructs projects that will meet their multiple objectives while appropriately addressing public safety. Consequently King County enlisted the help of MWH to facilitate an Independent Expert Review Panel (Panel) to evaluate their river and floodplain management procedures and practices associated with identifying, scoping, controlling, implementing, and monitoring project effectiveness.

2.1 Scope of the Independent Review

MWH facilitated the review by the Panel, which included individuals with different disciplinary backgrounds and experience in related fields. Panel members were selected by MWH and qualifications reviewed and approved by DNRP Director's Office. The Panel had two primary objectives:

- To assess how projects are identified, scoped, controlled, implemented, and monitored for effectiveness in meeting objectives.
- To consider the assumptions, soundness of concept, design standards and practices, and construction methods for river and floodplain management projects.

The panel was instructed to perform a high level review focusing on the methodology and overall approach to project scoping and implementation, rather than project-specific in-depth review. The Work Order scopes of work associated with this review are included with this report in Appendix A.

Panel review recommendations resulted from review of documentation, input from stakeholders, meetings with WLRD and stakeholders, site visits to selected illustrative project sites, and any additional information available to the Panel through expertise in their respective fields.

The Panel was not scoped to review specific projects, though site visits at selected project locations were performed, and project specific information was provided to the Panel for reference. The Panel was also not scoped to review King County Policy as it relates to WLRD's larger flood management, salmon recovery, or recreation management priorities, goals, and objectives.

2.2 Intended Use of Review Panel Findings and Recommendations

The Panel review is designed to help DNRP and WLRD identify strengths and challenges in their program and projects, and provide recommendations on how to improve scoping and implementation practices. This review was performed using information provided to the Panel during the review period and represents the findings and recommendations of the Panel as a whole, not the opinion of MWH or any one particular author. Although the Panel found consensus on most issues, individual report sections were typically synthesized from contributions of a subset of the Panelists with particular topic expertise. This Expert Panel Review Report is provided to King County for its use and distribution. Given the scope and range of King County services and projects, the Panel believes this review and recommendations will be useful for all departments and divisions within King County that perform any kind of project work within or near rivers.

2.3 Coordination and Facilitation of the Panel Review

The Panel review was facilitated by Jeff Schmidt, PE (MWH) with assistance from William Cranston, PE (MWH) and Karen Ditz (MWH). MWH also served as the overall project coordinator throughout the process and as the Point of Contact for both WLRD and stakeholders.

3 Assessment Methodology

3.1 Workshops with WLRD to Review Scoping and Implementation Practices

At the onset of the review and prior to the formation of the Panel, MWH scheduled two (2) workshops with WLRD staff to better understand WLRD's current scoping and implementation practices. The outcome of the workshops included an outline of a typical project life cycle for river management projects, including project scoping, design, construction, maintenance, and monitoring. Karen Ditz (MWH) facilitated these workshops on September 13, 2011 and October 4, 2011 which were attended by WLRD staff representing each relevant business group. Attendees included Karen Ditz and Jeff Schmidt from MWH and Don Althauser, Steve Bleifuhs, Diane Concannon, Jon Hansen, Clint Loper, Will Mansfield, and David St. John from WLRD.

3.1.1 Purpose of the WLRD Process Workshops

The purpose of these reviews was to provide a framework for the Panel associated with general WLRD processes and help the Panel understand how the river and floodplain projects are planned and implemented. The workshops also served to highlight the key decision points where there are opportunities to improve project delivery. In preparation for these workshops, the MWH team reviewed several documents related to the project delivery process, including relevant statutes, policies, and procedures to illustrate the processes used by WLRD to execute projects. The Panel reviewed the documents to provide additional insight to the project delivery process and to validate workshop data points. Copies of the Workshop Meeting notes and associated flow diagrams resulting from this review are included in Appendix B.

Following the initial workshop in September, MWH and WLRD staff went to three (3) projects on the Cedar River to provide additional context with the program information. The three (3) sites included the Cedar Rapids project and two (2) bank stabilization projects. The bank stabilization projects included different bank treatments incorporating large wood and vegetation.

3.1.2 WLRD Organizational Summary

During the workshops, three (3) groups within WLRD provided the information relating to the project delivery processes. These groups were the:

- Stormwater Services Section
- River and Floodplain Management Section
- Rural and Regional Services Section - Ecological Restoration and Engineering Services Unit

These three groups within the WLRD plan, design, and construction projects throughout King County, including the following watersheds: Cedar River, Central Puget Sound, Green River, Sammamish, Snoqualmie, and White River. These groups often coordinate and cross-matrix with other groups and/or hire outside consultants as necessary to enlist specialty expertise. Detailed descriptions for each group are included in Table 2: Description of WLRD Groups.

Table 2: Description of WLRD Groups

Name	Approx. Annual Budget*	Staff	Description
Stormwater Services Section	$5.5M	16 – 18 engineers	• Funded primarily through DOE and FEMA grants • Prioritize projects by citizen complaints or other agency directions with stormwater damages becoming the primary driver • Have capacity to provide their own Resident Inspectors on construction efforts
River and Floodplain Management Section	$45M	34 professionals, divided into basin teams, primarily made up of engineers and ecologists	• Oversees 500 different facilities, including 119 miles of levees and revetments • Designs and oversees construction of flood risk reduction CIP projects • Provides cradle to grave services from planning and policy through design, construction, and operations/maintenance • Created FHMP in 2006 currently serving as the official plan for prioritizing upcoming projects • Prepares all major mapping of King County rivers and provides information to FEMA for flood insurance purposes
Rural and Regional Services Section – Ecological Restoration and Engineering Services Unit	$5M	15 scientists, engineers, and project managers	• Designs, implements, and monitors habitat restoration projects within various basins • Provides input to Basin Stewards regarding ranking and prioritization of projects based on recommendations from salmon recovery plans • Overlaps frequently with River and Floodplain Management projects

* *Estimated budgetary figures represent annual "spending authority" including funds from Surface Water Management, external grant funding, and other revenue sources.*

* *Note that River and Floodplain Management Section budget includes "non-structural" CIPs such as floodplain buyouts, cost sharing on home elevations, etc.*

WLRD recently completed in December 2011 a separate third-party independent review of project management practices and procedures in order to create a Project Management Manual for use by WLRD staff. This document was still under development at the time of this

Independent Expert Panel Review, so for informational purposes WLRD provided the Panel with the Draft Table of Contents and a Draft Gap Analysis conducted for the Manual.

3.2 Guiding Questions for the Panel

Through initial meetings with the King County DNRP Director, MWH prepared a list of questions to be addressed by the Panel. The Panel primarily addressed questions of programmatic guidance and implementation and not a detailed review of the program's policy direction or the technical objectives of individual projects, except as appropriate for a "case study" exercise. Through development of these questions, which were reviewed by WLRD and other stakeholders, MWH and the Panel determined that the breadth and depth of issues to be addressed could not be encapsulated by a limited number of questions. As a result, this document evolved over time to represent a set of guiding questions that could be used by the Panel during meetings with stakeholders and WLRD staff to guide the review towards specific topics. A copy of the final Guiding Questions document is included in Appendix C for reference.

3.3 Selection Process for the Expert Panel

To begin the Panel selection process, MWH created a short list of experts for DNRP Director's Office to review. This short list was developed from a much longer list of potential experts identified through industry contacts and references. Panel members were selected for their technical expertise and represent respected members of the engineering, planning, and fisheries science field who had availability and willingness to participate in the Panel review process. The individuals included engineers and scientific experts (ideally with direct, recent experience working with rivers in King County or the Puget Sound basin) and subject matter experts and practitioners (ideally from or with experience representing institutions which have successfully addressed similar issues, potentially from outside of the Puget Sound area). The criterion for selection includes the following:

- Expertise and reputations in the engineering, planning, and fisheries science fields
- Availability and willingness to participate in the review within the given timeframe and scope
- No perceived conflicts of interest, including involvements in relevant WLRD projects or past reviews

In coordination with WLRD, MWH selected an independent panel comprised of five (5) technical experts representing the four (4) primary objectives to provide an unbiased review of WLRD scoping and implementation practices.

The selected Panel members for the independent review are show in Table 3: Expert Panel Members with Associated Technical Expertise.

Table 3: Expert Panel Members with Associated Technical Expertise

Name	Company	Technical Expertise
Dr. Paul DeVries, P.E	R2 Resource Consultants	Water Resource Engineering, Fluvial Geomorphology and Fisheries Science
Dr. Chris Frissell	Independent Expert	Fisheries Science and Ecology
Dr. Yung-Hsin Sun, P.E	MWH	Water Resource Engineering, Planning, and Management
Dr. Doug Whittaker	Confluence Research and Consulting	Environmental and Outdoor Recreational Research and Planning
Mr. Tracy Yount	Sapere Consulting	Stakeholder, External Agency, and Policy Issues

A full resume of each Expert Panel member is contained within Appendix D.

3.4 Expert Panel Meetings and Review of Available Documents

Following selection of the Panel, the independent review process was initiated on October 7, 2011 with a conference call among the Panel members to define the project goals, expectations, and limitations of the review.

To assist with its review, the Panel was initially provided the following documents:

- Memo dated October 18, 2011 (Appendix C) with guiding questions developed by MWH with input from King County and stakeholders.
- Materials presented in oral and written forms. Specific materials provided to the Panel by both King County and stakeholders are included in the bibliography in Appendix E.
- Results of WLRD Staff Workshops facilitated by MWH to clarify WLRD organization, project planning, and project implementation processes. Meeting minutes and process flow diagrams from these workshops are included in Appendix B.

WLRD staff, MWH representatives and the Panel held a workshop on October 20, 2011 to allow the Panel an opportunity to learn more about WLRD projects and practices and provide an opportunity for the Panel to ask specific questions of WLRD staff. A site visit to the Lower Tolt River Floodplain Reconnection Project site followed this meeting. WLRD selected this site as an illustrative multi-objective project where WLRD implemented many of the river and floodplain improvement practices, including the use of LW. Meeting notes from these discussions are included in Appendix F.

Following the workshop and site visit with WLRD, the Panel met with external stakeholders on October 21, 2011 to allow the Panel to introduce themselves to interested parties, ask questions of stakeholders, and listen to stakeholder concerns. Meeting notes from these stakeholder discussions are included in Appendix G.

Subsequent conference calls were held by the Panel on November 2, 2011 and November 22, 2011 to further discuss review findings and development of the Independent Expert Panel Review Report.

On December 5, 2011 the Panel returned for a follow up site visit of additional project sites in order to gain better understanding of LW and ELJ usage by WLRD. The additional sites reviewed by the Panel were as follows:

1) Belmondo Site Revetment Repair (Cedar River)
2) Briscoe School Levee Repair (Green River)
3) Cedar Rapids Levee Setback Repair (Cedar River)
4) Herzman Levee Repair (Cedar River)
5) Kent Shops-Narita Levee Rehabilitation (Green River)

Following this second round of site visits, the panel again met to discuss findings and recommendations in light of the additional project site examples.

Throughout the review process, WLRD and community stakeholders provided documents for Panel review. Given the volume of information provided, every Panel member was not expected to read every document; they were advised to review the full range of materials and selectively focus on the documents most beneficial to their specific area of expertise. An evolving bibliography was maintained throughout the review so that Expert Panel members could quickly find and focus on relevant sources of information. This list of provided documents in included in Appendix E. A listing of additional specific references used by the Panel for this report is included in Appendix H.

MWH instructed Panel members to provide specific, substantive comments and recommendations for incorporation into the Independent Expert Panel Review Report. Following compilation of this synthesized set of findings and recommendations, the Panel participated in a final conference call on December 22, 2011 to review and discuss the Final Independent Expert Panel Review Report. The purpose of this discussion was to confirm final findings and recommendations to ensure that these were are agreed upon by the entire Panel or documented appropriately where conflicting opinions among the Panel exist.

The following sections provide the Panel's findings and recommendations.

4 Expert Panel Review Findings

The following section provides a detailed summary of the Panel's discussions and findings. The findings and associated major recommendations were generally agreed upon by the Panel members.

These findings and recommendations in Sections 4 and 5, are generally organized to follow the steps within a project life cycle, following an initial section devoted to outlining the context of the discussions and a subsequent section outlining the program level discussions and findings. A final section is included to address stakeholder and public engagement activities. The organization of the findings in this section is as follows:

- 4.1 Context and Background Information
- 4.2 Program Level and Overall Process Findings
- 4.3 Project Scoping
- 4.4 Project Planning
- 4.5 Design
- 4.6 Construction
- 4.7 Monitoring Effectiveness and Adaptive Management
- 4.8 Stakeholder and Public Engagement

4.1 Context and Background Information

The following text sections provide general Panel comments associated with river and floodplain management.

4.1.1 Watershed Management Strategy Shift

For over 100 years, deforestation and riparian vegetation loss, woody debris removal, rural and urban development, flow regime changes, and increasing channelization of floodplains designed to swiftly convey flood waters downstream accompanied increasing development along rivers . Over the past two decades, scientists and land managing practitioners recognized the need for a different approach that reconnects rivers to their floodplains, protects riparian forests and vegetation, and enhances the amount of wood in rivers to encourage more natural geomorphic and hydraulic processes to define channels and better handle floods.

When successfully implemented, this new strategy paradigm is expected to increase ecological health for endangered aquatic species (e.g., salmonids) as well as protect infrastructure and public safety during floods at lower cost than the old "channelize and armor" systems of the past (PSP, 2010). The general concept is to limit human activities and development within 100 year floodplains and allow rivers to find their own equilibrium within those boundaries, reducing the need for more levees and other protective structures. However, this strategy is also likely to produce substantial changes in river environments, which could have a range of positive and adverse consequences on human activities. Newly dynamic rivers will have greater latitude to move within their floodplain, creating localized areas with more substantial erosion or deposition, as well as increased amount and mobilization of large wood. In turn, these physical changes will affect recreation activities that have historically developed in less complex and dynamic channels, requiring users to adjust to a likely increase in hazards.

Changing Floodplain River Science and Management Concepts: *The emerging view of floodplain rivers as complex and dynamic ecosystems has globally replaced the traditional archetype of rivers as stable, single-thread systems (Ward et al. 2001). In parallel is emerging a synthesis that floodplain river ecosystems across all biomes are among the most productive and biodiverse of all land-based ecosystems, yet they are also among the most extensively altered and endangered by human use and conversion (Naiman et al. 1995, Tockner and Stanford 2002). This is as true in the Pacific Northwest as elsewhere in the world, and the transformation of floodplain rivers for human commercial and other appropriated use is identified by many sources as a major causal element in the declines of Pacific salmon (e.g., NRC 1996, Williams et al. 1999 and 2006, Montgomery et al. 2003, Waples et al. 2009). New science has revealed a common conclusion that continuation of the previous two centuries' policies for river management will lead inexorably to impoverishment of societies dependent on riverine and freshwater resources (Tockner and Stanford 2002).*

The shift from traditional "hard engineering" solutions to a more ecologically and geomorphically dynamic approach to river management mandates different metrics for river integrity and for success in management and restoration (Kondolf 1995, Trush et al. 2000, Buijse et al. 2002, Palmer et al. 2005, Newson and Large 2006). The kinds of restoration actions for floodplain rivers receiving increasing emphasis under this emerging paradigm include; removal of dams to restore fish passage and the continuity of water and sediment flows, reconnecting flow through artificially cut-off side channels, and setting back or breaching levees and other earthworks to assist in restoring hydrologic connectivity in longitudinal, lateral, and vertical dimensions (NRC 1996, Stanford et al. 1996, Trush et al. 2000, Kondolf et al. 2006). Not only is the scope and scale of restoration programs and projects increasing to match the scale of effectiveness necessary to attain true restoration in large river ecosystems, the science of dynamic river restoration is evolving as rapidly with recognition that most larger-scale restoration projects have a scope for a variety of outcomes and a large experimental component (sensu Trush et al. 2000). This necessitates involvement of a variety of scientific and engineering disciplines in both monitoring, evaluation, and preparedness for real-time response to adaptively steer ecosystem responses toward desired outcomes (Kondolf 1995, Stanford et al. 1996, Kondolf and Micheli 1999, Poff et al. 2003). Strategic and large-scale reshaping of riverine ecosystems necessitates, or in many cases is predicated upon, ongoing and dynamic changes in human societies. New ecosystem configurations and conditions challenge some entrenched values and social or economic interests, and consequently direct and close attention to social values and social response is necessary (Stanford et al. 1996, Pahl-Wostl 2006, Palmer et al. 2008).

Large river restoration concepts and practices in western North America have moved forward over the past two decades predicated on the ideal of partial or "normative" restoration, that is, not all elements in all places of the river system are returned within natural historical limits, but key attributes and locations regain natural historical functions across a broad enough range of circumstances that production of high-quality waters, biotic, diversity and other essential natural resource values are regained (Stanford et al. 1996, Trush et al. 2000, Tockner and Stanford 2002). Although restored patches must be of substantial enough spatial area to support dynamic river channels and sustain a resulting patchwork of habitats and hydrologic features (e.g., a patch scale spanning a linear dimension of at least two meander wavelengths), scientific consensus is that substantial natural value and function of rivers can be maintained or regained on such an incremental basis, short of completely excluding appropriated human uses from all river floodplains (Stanford et al. 1996, Trush et al. 2000).

Large downed wood and floodplain forest mosaics that include late successional patches comprise an integral and massive biophysical element of Puget Sound rivers that is well known to be dramatically diminished in abundance, spatial extent, and functional role compared to predevelopment conditions (Collins and Montgomery 2002, Collins et al. 2002, Montgomery et al. 2003). Restoring both greater abundance of large wood and a more natural distribution and function of wood accumulations is critical for restoring river dynamics, habitat diversity, floodplain mosaics, and the productivity of salmon and other species. Even without direct human introduction of wood into rivers, natural wood recruitment will inexorably increase as a result of widespread protection of forests on riverine floodplains, which were heavily logged under prevailing policies until the last couple decades of the previous century. Whether through active or passive actions, large wood will increasingly re-emerge as an important structural and functional element of Puget Sound rivers. Many contemporary restoration efforts attempt to hasten wood debris jam formation, but also control their location, stability, and area of influence and effects (Abbe and Montgomery 1996, Abbe et al. 1997). Hence, deliberate design and placement of wood (in appropriate configurations) can presumably reduce uncertainty about river response and outcomes compared to responses that might be seen under un-manipulated natural re-accumulation of large wood.

The physical changes in these channels and floodplains will generally start to occur within several years, but will occur stochastically (with a mix of predictable and random elements) over time, with larger changes during episodic flood events. When these larger changes come, they are likely to become noticeable to and criticized by landowners and river users. In many cases, there will be more abundant hazards that will require river users to be more vigilant, modify their activities, or even abandon some activities in some river segments. In contrast, many ecological benefits are expected to be longer term and potentially less certain given many other variables that can affect "ecological health." In addition, some of the positive outcomes are only probabilistic for a specific project, with cumulative effects of many projects in combination with other watershed improvements needed to produce measurable fish productivity benefits.

Complicating this situation further, a "floodplain connectivity" strategy may not be able to be implemented on every segment of every river in a watershed where 150 years of development may not be easily removed from the floodplain. Bridges, roads, industry, agriculture, and residences are often in close proximity to rivers and protected by the "old strategy" levees and riprap in constrained channels.

Based upon review of the submitted materials and interactions with WLRD staff, the Panel agrees that the County has a progressive staff committed to learning and implementing a scientifically-based program for restoration of rivers and floodplains. WLRD direction is focused on integrating the most important public safety and river ecological considerations into its watershed and floodplain management practices. Programmatically, WLRD has effectively anticipated, and therefore avoided, more substantial federal or state mandates associated with flood risk and endangered species management, when compared to other jurisdictions with less foresight. The degree to which WLRD's programmatic goals and objectives are responsive to the evolving scientific literature on the hydrology, ecology, management and restoration of floodplain rivers is to be commended.

4.1.2 Impacts from Outside Agencies

WLRD scoping and implementation practices are often influenced by outside agencies such as the Salmon Recovery Fund Board, Puget Sound Partnership, and Federal Emergency Management Agency. The integration of these outside agency policies into specific projects needs to link policies to objectives, design, implementation, and monitoring at the project and "cumulative project" levels.

During the interaction with WLRD staff and some stakeholders, policy mandates released by these agencies were often referenced as the driving factors for certain decisions. Although policy directives were not within the scope of the Panel review, the Panel members performed a cursory review of the State and countywide policy framework in order to comment on WLRD's river management practice.

King County's flood management strategy includes partnership and coordination with both FEMA and the United States Army Corps of Engineers (USACE). The Panel's observation, however, was that King County has a preference for floodplain management, in partnership with FEMA, rather than flood management facility development, in partnership with the United States Army Corps of Engineers (USACE). The challenging requirements for federal PL 84-99 funding eligibility and incompatible management policy (e.g., levee vegetation policy) further reduces the

potential role of USACE in the overall flood management landscape in King County, although continued engagement with USACE is necessary for some specific applications, particularly in urban areas. The WLRD's preference is appropriated based on the land use policy of outside agencies, resulting in a significant focus in various tactics for moving people out of the floodplain (e.g., buyout and elevation). King County's zero-rise policy in floodplain encroachment management (prohibiting any flood fringe development that results in a perceptible rise in the floodway) is also very stringent, not only for development, but also for any structural installation (including those for environmental restoration purposes).

Land use in the context of flood management could be the most controversial element due to the potential development pressure on rural lands. However, the 1994 State Growth Management Act made a strong policy in managing growth to direct development to designed urban areas and away from the Rural Area and Resources Lands. The corresponding WLRD Countywide Planning Policies, the multi-county planning policies, and resulting comprehensive plans reflect this growth management policy. In comparison with other states (such as California), this policy allows opportunities for a more integrated flood management approach in rural areas that incorporates floodplain process and environmental restoration elements.

Salmon recovery is also a clear policy directive in all levels of government in the State of Washington with State funding from the SRFB and WRIA-based salmon recovery planning and implementation efforts. The WLRD staff reported that their project implementation has not been hindered by environmental permitting and compensatory mitigation requirements; the significant efforts of the State, regional and local levels in salmon recovery may be a major contributing factor to that positive outcome.

4.1.3 Societal Expectations

Based on the Panel's review of legal and policy documents, there is broad societal agreement to improve ecological function and habitat in western Washington rivers. This consensus is evidenced in the history of ESA-driven WRIA and FEMA planning and additional public agreement is evident in a 2003 survey of King County residents' attitudes toward restoration issues on the Cedar River (Montgomery, 2003). "On the ground" implementation of many WLRD projects has become more noticeable in the past decade, and the acceleration of projects is likely to increase substantially. As the immediate and direct consequences of those WLRD projects (or related management actions) become more obvious, longer-term ecological benefits may not be as evident or possibly confounded by other limiting factors, which will only increase stakeholder and public awareness of the issue.

The growing population in King County, combined with the proximity and desirable features of rivers in the County, has had the inevitable effect of increasing recreation use, which may include walking along river banks and levees (using improved trails where available), picnicking and camping on the river banks, sport fishing, swimming, floating, and canoeing/kayaking/rafting (including white water boating where available). When improvements are made to facilitate fish recovery efforts or restore more natural river processes, the risks to the safety of river users change, often for the worse. Placement of LW to improve salmon habitat may increase the hazards for rafters, boaters, swimmers and anglers, and set back of levees to restore more natural river processes may reduce river velocities and facilitate the creation of log jams during flood events, adding potentially hazardous barriers where none existed before. These modified risks have become a growing concern among recreational groups, riverside land owners, and

public safety professionals. Recognition and mitigation of these potential hazards has become an important element of any efforts to manage the rivers.

With increased awareness of WLRD's river management efforts and increased use of the rivers for recreational uses, it becomes more likely that sub-groups of the public or stakeholders will advocate revisiting larger policy objectives or specific implementation procedures to mitigate real or perceived adverse effects. This phenomenon has occurred on at least two occasions in the past (1997 appeal decision and 2009 ordinance 16581), with both cases leading to policy shifts toward greater attention toward recreation safety issues.

Taken together, integrating a wide variety of flood, habitat improvement, and stormwater projects will be complex and challenging, requiring careful understanding of the big picture and how to implement at the project level. Experimentation followed by systematic monitoring and periodic comprehensive reviews are needed to successfully implement the larger goals of flood management and salmonid restoration programs (Kondolf, 1998).

4.2 Program Level and Overall Process Findings

This section provides details on the overall program-level findings and recommendations from the review. These topics focus on WLRD's structural organization and general process for defining and implementing projects. These findings do not address the adequacy of larger habitat or flood management planning or funding processes, such as WRIA plans, SRFB, FEMA programs, etc., although the recommendations address how these efforts interact with King County capital improvements planning decisions.

At the programmatic level there doesn't appear to exist a comprehensive strategy that aligns objectives, regulatory strategies, risk management, and stakeholder outreach with project delivery. The WRLD would benefit greatly from a comprehensive program approach that allows for a clear flow of overarching objectives through discrete project deliverables. The programmatic strategy would include the following elements:

- program definition and system description
- multi layered objectives from policy to program
- risk assessment starting at the enterprise level through project delivery
- regulatory strategy that encompasses the breadth of requirements
- project procedures aligned with change management, value management, and project controls

4.2.1 System Definition

The WLRD is in and of itself a complex "system", with varying objectives between individual groups within WLRD and King County as a whole. While the organizational structure may be clearly defined, the impacts of any one group's decisions will likely have a direct impact on other groups and their ability to balance competing objectives. Specifically, WLRD appears to be in an evolutionary state and the River and Floodplain Management Section has seen a recent three-fold increase in staffing, including both new and reassigned King County staff. In addition, the WLRD operates in a diverse and complicated external system with unique stakeholders, regulatory drivers, and an evolving paradigm for safety and environmental projects. All of these various factors further complicate the system within which WLRD implements projects. Before WLRD can effectively proceed with programmatic changes, there will first need to be a clear

definition of this system and the interrelation of these various independent, yet interconnected, elements.

The value of a system definition is three fold. First, the extensive nature and complexity of the system is generally retained within the collective knowledge base of the King County staff. Each staff member has their individual perspective of priorities, influences, and objectives that govern their actions within a broad context of acceptable constraints. The process of defining the system will confirm some perceptions, and lay bare other views that are inconsistent with the actual system. Second, the defined system will allow for a robust analysis of influences and risks that require management attention. This includes both internal and external influences. Finally, a system definition will provide the starting point for defining the policy direction of the WLRD, and how best King County can achieve these goals. This will likely require a gap analysis and specific strategies on how to use WLRD strengths to close the identified gaps.

4.2.2 Risk Management

Based on Panel discussion with the program management team, it appears that a formal project level risk policy, procedure, structure, and management plan exist; however, it was not clear if proactive risk management is utilized for all project planning and execution, or consistently employed at the programmatic level.

The recent increase in funding levels and staffing within the River and Floodplain Management Section, evolution of organizational objectives, and lack of established procedures, coupled with inherently uncertain designs, public safety concerns, and emerging environmental restoration approaches, all combine to create a new enterprise level risk profile for WLRD. To address these risks, a formal risk management program is essential to mitigate risks that are introduced when system wide changes are made. A comprehensive risk management program would implement control elements responding to each of these change conditions that lead to control measures and monitoring programs.

It is essential that risk identification be cross-functional. If the majority of formal risk identification participants are engineers, then the majority of risks will be technical. Contract managers, quality managers, stakeholder representatives, and construction specialists should all be included in the risk identification sessions. Risk elements may include scope, schedule, cost, quality, staff, regulatory, environmental, and external stakeholders.

For example, the risk analysis for the Lower Tolt River project identified risks associated with the installation of new types of stream channel structures. The handling action was to over build the structures to mitigate potential design/installation problems. During the site visit, staff indicated that they over built the structures but when questioned why this was done, they were unable to correlate their action with the Project Risk Register contained in the management plan. While the resulting action did satisfy the mitigative action for the identified risk, there appears to be a lack of procedural measurement opportunity for post project analysis to determine if the risk program itself appropriately addressed this or other project risks.

4.2.3 Regulatory Strategy

The development of an enterprise level regulatory strategy, built upon objectives and legal drivers, is necessary to reduce schedule delays and unexpected project specific cost impacts. At the same time this strategy will also strive to provide opportunity for the integration of

program objectives prior to project definition and execution. By focusing on the paradigm evolution of WLRD flood/safety project objectives with environmental restoration objectives, a comprehensive regulatory strategy will provide guidance to staff for more efficient execution of projects. Development of this strategy would include the following:

- Formalize and integrate enterprise level regulatory strategies and objectives within the project identification, scoping, design, and execution procedures.

- Establish formal policy, program planning, project coordination, and dispute resolution frameworks with each regulatory organization that have action or funding authority over King County.

4.2.4 Project Management Procedures

Based upon the information received for review and the meeting with WLRD staff, the Panel confirmed the need to improve standardization and consistency of project management across the groups. By implementing standard project delivery procedures, the Division will save time and cost, as well as improve the quality of deliverables.

The Panel recognizes that a Project Management Manual is in development for WLRD and will be available in 2012. A centralized format and issuance of the new PM manual will facilitate this consistent project management processes. Currently, project management procedures reside in multiple locations and are largely based on King County's 1996 Capital Services Manual. It is not clear whether all groups effectively use this document or that all elements of PM practice are included.

The enforcement of governance to monitor compliance with updated processes is equally important. An electronic program manual will provide standard operating procedures in one location, serving as the official source for all the teams to follow. The manual should reduce the issue of ad-hoc project management and individual project manager's decisions regarding standard procedures. An electronic manual will also improve team communication and coordination.

Documenting issues and decisions is another essential component of effective scope management. The Panel recommended that both issue logs and decision logs be developed and maintained. The benefits of these logs are meant to assist the program in:

- Promoting visibility of identified issues;
- Reaching decisions/achieving resolution;
- Tracking/monitoring the status of issues and associated decisions;
- Highlighting the parties responsible for taking action;
- Providing visibility on the status of issues and decisions; and,
- Alerting parties to where immediate action is needed/warranted.

4.2.5 Consistent Processes across WLRD

Based on the Panel's review, WLRD is implementing various processes across the groups. Improved "chartering" using consistent templates, guidelines, and examples (as planned in the new Project Management Manual) will begin the process of allowing decision-makers,

stakeholders, and the public to understand explicit project objectives and how they fit in with larger planning or funding programs (e.g., FHMP, WRIA Plans, PSP funding priorities).

Consistency will also help address the overuse of acronyms and redundant labels for different steps and tasks in their respective processes. It is challenging for reviewers, the public and stakeholders to distinguish projects with different objectives or funding sources. If there is renewed skepticism for specific kinds of projects, greater consistency should help narrow the debate to critical elements.

4.2.6 Change Management Procedures

Scope management is an essential component to ensure project success. The later in the project life cycle that scope changes occur, the more expensive and disruptive the changes are, as projects move from conceptualization through design, construction, and commissioning. Effective program management requires tight change management control. It is a natural tendency to want to change or improve the design during construction, but this situation needs to be closely managed.

All potential changes should be evaluated based on need and impact on overall project cost and schedule. Construction and operations/maintenance staff should be given an opportunity to provide their input during planning and design but then they have to abide by the decisions agreed to during the design process.

4.2.7 Value Management Procedures

During workshops with WLRD staff, the Panel identified that WLRD used value engineering or value management on a case by case basis, with project cost being the primary determining factor as to whether a value engineering study is undertaken. During the facility planning stage or during the development of the five-year CIP budgets, WLRD determines the budgets for projects. During the workshops, the Panel learned that the current project budgeting process does not include independent design/cost check at critical milestones within the project. Instead, WLRD uses the estimates prepared by the designer at each phase during the development of the design.

Value management is a rigorous, systematic effort to improve the value and optimize the life cycle cost of each project within the program. It is an organized process with a known and accepted history of improving value and quality of capital improvements projects. The value engineering process identifies opportunities to remove unnecessary costs while assuring that quality, reliability, performance, and other critical factors will meet or exceed the expectations of WLRD. The improvements are the result of recommendations made by stakeholder teams representing all parties involved. Value engineering typically generates these cost improvements without sacrificing performance in the process.

In addition to the above, one of the key elements for successful use of decision-making methodologies is consistency, which adds transparency and helps to build confidence between management and staff. It is essential that project teams are able to use their expert knowledge to determine the best-value technical solution to deliver the objectives and essential that the approval committees have the confidence in the teams. The use of standard templates, tools, and methodologies helps to build this confidence and establish consistency, allowing approval committees to clearly see how and why decisions have been made by the project teams.

4.2.8 Project Controls Procedures

During the workshops, the Panel discussed how project teams address scope, schedule, and budget management. In addition, the team reviewed current processes being implemented to develop project baseline schedules and construction schedules for cash flow and reporting purposes.

The Panel identified the methods currently used by the groups within WLRD and then compared to industry standards. Currently, the project management and dedicated program controls groups use Excel for scheduling simple projects and MS Project for scheduling more complex projects. It was noted that at present, WLRD cannot track costs on a real time basis as it can take up to three (3) months for expenditures to show within the countywide accounting system. To address this lag, individual project managers have frequently implemented other methodologies to track these costs on a more real-time basis, including tracking labor and costs using spreadsheets. A new financial accounting system will be implemented countywide in 2012 that is anticipated to reduce this lag time.

Project controls and project scheduling are an essential component of program and project management. A proactive project controls approach is recommended in order to:

- Govern standard work practices, create a project controls standard operating procedure that clearly defines data input and integrity requirements and enforce compliance with these requirements thereafter to ensure standardization across WLRD.

- Conduct internal planning with senior staff to develop typical project schedule templates containing activities and milestones for the performance of internal project requirements.

- Establish monthly internal design and construction management project review meetings; specify contractor cost and schedule performance metrics to be reviewed and reported, and formally document each review should be formally documented.

4.3 Project Scoping

This section provides details on project scoping findings and recommendations based on the Panel's review.

4.3.1 Linking Projects with Funding Sources and Other Drivers

WLRD's major sources of funding include the King County FCD, King County Surface Water Management (SWM) funds, Conservation Futures (for property acquisitions) and King County Conservation District funds. Discussions with WLRD staff and review of the Panel documents suggest that additional funding sources include federal (e.g., USACE and FEMA) and State (e.g., SRFB) agencies. WLRD should continue to leverage limited local funds to maximize the federal and state shares of funding in all project phases, including planning, design, implementation, and post-implementation monitoring and management. However, the criteria established for these external funding sources could influence the project focus and resulting overall social, economic, and environmental conditions.

To further help identify their "place in the puzzle," individual project descriptions should identify funding source requirements and key mandates addressed. Current descriptions recite the same four broad objectives without explaining how those specifically fit in the larger picture. For example, the Lower Tolt project had several compelling elements, but the links between those elements, specific habitat or flood protection goals, and design decisions were somewhat inconclusive.

Multiple use land units cannot provide for every resource on every acre and land use plans are attempts to fairly allocate resources. Similarly, not every river segment in King County has equal potential for habitat restoration, floodplain capacity, or specific types of recreation use. Consequently, it is unlikely that every project will equally serve all of these objectives. Implementation systems need to improve links between the characteristics of the project and the needs of the site, segment, and watershed.

For example, the below text is a quote from the "Procedures for Considering Public Safety When Placing Large Wood in King County Rivers" (2010) and a paraphrase of the requirements established by King County Ordinance 16581:

> *"In designing the specific placement of large wood, the design team will seek to maximize achievement of stated project goals and objectives while minimizing potential public safety risks, including risks to recreational users, and will seek to ensure that the procedures and design options affording the greatest safety for river users are of primary consideration in design concerns involving a balancing of important public purposes as it addresses safety issues."*

The above goal is important; however, it may not be possible to maximize other project goals while minimizing all safety risks. If the safety of river users is the primary consideration, it may not be possible to balance this criterion with other important public purposes. As an alternative, WLRD should acknowledge trade-offs and the need to review alternatives that are weighted in different ways for decision-makers to consider.

4.3.2 Impacts from Private Projects

Based on the review, the Panel did not clearly identify how WLRD projects consider cumulative effects of private projects in their assessments of safety and/or other impacts from large wood. Stakeholders provided an example of a privately-funded bank erosion project that was placed on a river and then later failed. This project featured a series of stacked horizontal logs that formed small "fences" that could create straining/pinning hazards to boaters, tubers, or swimmers using that reach of river. Private project development, both upstream and downstream of WLRD project, may directly impact the behavior of river and floodplain management projects completed by King County. Accordingly, monitoring efforts that measure potential hazards should account for natural large wood hazards, county-project and related large wood hazards, and private project large wood hazards.

4.4 Project Planning

WLRD undergoes an extensive process in the project planning stage and has increasingly worked to involve potentially affected stakeholders early in the design process for river and floodplain projects. While planning efforts include WRIA or basin plans, the 2006 FHMP serves as the central planning document for defining the goals and means for reducing hazards to

public safety, property, and infrastructure. The primary means for accomplishing these goals are through:

- Levee and other flood protection projects
- Acquisition of flood prone properties
- Increase flood warning system and public outreach
- Update FEMA flood insurance maps
- Increase stakeholder involvement
- Apply adaptive management through reliance on monitoring and dislodging accumulated wood at locations where an imminent threat is perceived

These are sensible goals and approaches, reflect standard practices in flood management, and are supported by years of study and discussion regarding highest priority needs in King County.

In the context of levee setback projects, the key planning parameter is the extent of real estate available for the setback, along with a determination as to whether the setback is sufficient to make a meaningful difference to both flood control and salmon habitat. Following that, project descriptions should clarify that expansion of flood flows over the floodplain will produce greater channel migration that will probably form multiple channels, mid-channel "islands" and log jams, and possibly some channel-spanning logs. All of these situations are unequivocally beneficial for fish habitat based on the weight of research evidence and case studies. However, the specific shape, location, and timing of these new features cannot be precisely predicted or "designed for." The point of these setbacks is to allow natural processes to occur in a larger area, which includes erosion and deposition. It is distinct from projects designed to eliminate the opportunity for erosion (typically rock-based riprap) or reduce sediment and large wood pieces that migrate into the area from upstream. In a levee setback situation, wood recruited from upstream or natural processes are not removed mechanically from the river during floods, which is economically and technically infeasible.

Consequently there is an overarching question for site selection and establishing basic design elements in setback projects: "Is the floodplain area available to execute a project suited to accommodate the dynamic changes in channel locations and configurations that are likely to result"? Similarly, are there adjacent ownerships or floodplain infrastructure that could be adversely affected by channel changes immediately adjacent? Setback projects should be designed to accommodate constraints on downstream and upstream tracts. This will require a project area that is larger than the actual extent of setback treatments (e.g., a project area spanning down-valley reach distance of two or three median meander wavelengths, with only the central half of the reach allocated to natural channel dynamic behavior). Setback projects that actively restore natural channel function on larger rivers may require fairly large, contiguous acreages (e.g., tracts in excess of 60-100 acres) to accommodate these constraints.

4.4.1 Flood Hazard Management Plan Formulation and Utilization

While many states struggle to form a set long-term sustainable river management policy, the policy framework established for Washington State and WLRD provides clear preferences. While this in itself is positive, the challenge for WLRD is to translate this strong policy into an effective implementation plan that provides the logic and reasoning for trade-offs in the decision making process.

The FHMP is the primary flood management tool that guides the long-term investment and near-term (10-year) actions. The Executive Summary of the FHMP states:

> *"The 2006 King County Flood Hazard Management Plan advocates for efficient and environmentally beneficial flood risk reduction projects and solutions that strive to accommodate, rather than oppose, natural riverine processes. Specific project and program recommendations are presented in a 10-year Action Plan that defines the projects needed to help protect public safety and reduce flood risks, in conjunction with maximizing other public benefits. King County's current multi-objective approach to river and floodplain management balances the high financial and ecological costs associated with traditional flood control measures with innovative and cost effective river and floodplain management strategies." (Flood Hazard Management Plan: Executive Summary; King County, 2006).*

Based upon this statement, the Panel observed the following as shown in Table 4: Panel Observations - FHMP Formulation and Utilization.

Table 4: Panel Observations - FHMP Formulation and Utilization

Observation	Comments
Plan reflects significant effort and implementation results, as evidenced by the high Community Rating System (CRS) score and reduced premiums for the National Flood Insurance Program (NFIP), especially in rural areas with affordability issues.	Accomplishment is worth noting and demonstrating the benefits of long-term sustainable floodplain management, even under the conditions of pending NFIP reform by Congress and last revision of USACE policy in levee certification to alleviate potential liability of federal governments in the event of levee failures.
Customized for CRS rating and formulated based on the 10-step process outlined by FEMA	It is more process-driven so that specific elements can be checked for "compliance" purposes and resulting score. It is sufficient for CRS rating purposes, but it does not clarify the overall flood management problems and resources management opportunities that the plan should address. The plan lacks a vision of the future in flood management and, most importantly, the rationales for trade-offs among actions and project prioritization. Rather, it seems that the FHMP relies on established policies in filling this gap, which is much less convincing, especially as it does not appear that WLRD has an effective long-term public outreach and stakeholder engagement strategy.
Definition of "objectives" needs to be revised. The plan states, ***"Objectives" are the set of flood hazard management actions that will lead to achieving the identified goals.***	This definition is more applicable to a solution set or alternatives. While the goals establish the direction where the long-term planning is heading, objectives establish the specific outcomes or outputs to be accomplished. According to the established objectives, the measurements of success can be established for project implementation. Use of SMART objectives (**S**pecific, **M**easurable, **A**chievable, **R**ealistic and **T**imely) may help.
Similar to salmon restoration planning, flood management planning should be conducted on a watershed level.	New approaches to floodplain management could help reconnect the river to the floodplain to improve habitat; however, other factors may also affect habitat, including "maintenance flows", which are outside the scope of flood management. This is particularly true for rivers with upstream storage facilities or localized groundwater conjunctive

	projects. Additional benefits of a river basin approach would allow more integrated planning, potentially identifying more efficient ways to integrate multiple benefits, and prioritize actions at different river locations. It is also possible to concentrate on localized restoration actions after overall opportunity assessment is completed. With the climate change perspective, some additional upstream actions could benefit groundwater recharge in critical areas, alleviate downstream flood threats due to hydrologic changes, or provide potential fishery benefits.
Prioritization criteria are not clear in the document.	The prioritization criteria may be more critical because it is important to explain why many deferred feasibility studies and other improvements would be within the acceptable risk, which is also not defined in the document.
Trade-offs in different flood management strategies are not clear, especially for long-term operation and maintenance.	If large wood or engineered log jams are subject to fail or their anticipated functions could diminish after sediment accumulation (e.g., the Cedar Rapid project design), it is important to fully disclose these expectations and associated O&M or replacement costs compared to other options. Similar approaches could address the potential concerns over the long-term effects without dredging.

Stakeholders have questioned whether the FHMP includes sufficient information for flood management strategy development and implementation. This is a valid concern if the FHMP is used as the primary flood management tool that guides the long-term investment and near-term implementation through its plan formulation approach. However, this weakness is not due to an overall lack of information and data.

The Panel identified that the FHMP does not explicitly describe approaches to the planning and implementing salmon habitat projects that are compatible with flood planning goals. More clear and coherent description of approaches in the FHMP could improve communication and planning, and engender increased public confidence in King County's program goals and objectives. The FHMP does identify several recommendations germane to this review, including the recommendations TECH-6, ERA-6, and WD-1 through WD-4 in the FHMP. The following observations may help in implementing these recommendations:

- Imminent Threat Definition - Define and achieve a common understanding of the threshold for what constitutes an imminent threat more explicitly in the plan through discussions with stakeholders. For example, it is unclear whether such threats apply equally to "flood-related safety" issues (safety of people and infrastructure outside the bank-full channel but within the 100 year floodplain) and recreation safety issues (safety of people who may recreate in the river when it is inside the bank-full channel).
- Longevity of Habitat Structures - Expand discussion of in-stream structures on page 73 of the FHMP to address the issue of longevity of planned habitat structures.
- Life Span of Large Wood Structures - Expand discussion of bioengineering on page 76 of the FHMP related to moving away from rock to using large wood. This action is responsive to the weight of scientific evidence that large wood provides greater quantity and quality of fish habitat than rock, which is further mandated by agency and tribal policies and agendas. The plan would benefit from a more in-depth discussion of wood structure longevity, which may be relatively short (e.g., 10 to 15 years), and should identify specific needs for monitoring, maintenance, or adjustment of wood structures, depending on site-specific river response. In some more dynamic settings, rock may be the only application that prevents channel migration from eroding properties or

infrastructure over the long term. If wood is favored in these situations, the county should acknowledge that it is consciously choosing a shorter acceptable life span for the project, and the need for additional projects at the same site in the future. The discussions needed to arrive at this life span decision do not appear to have been completed. This need is also implied in the Green River External Advisory Review Panel Report (e.g., see response to question 4C in the executive summary of that report).

4.4.2 Stakeholder Perceptions

The Panel identified opportunities for WLRD to better manage stakeholder perceptions about river management strategies. Some of the problems that WLRD faces with stakeholders stems from misunderstanding related to the basic policy, legal, and scientific drivers of current WLRD floodplain management. Complaints that begin about practices in the field can elevate to debates about the ideology and goals of river management and how tradeoffs between public safety and environmental benefit are balanced.

Since these practices and projects are experimental to a large degree, it is difficult to gain public acceptance on the basis of providing assurances about specific outcomes and project performance when those assurances are difficult to substantiate. Nature and chance will largely determine the outcomes of specific projects at specific sites and project "success" must be evaluated and justified on whether the general direction of ecosystem chance is toward new states that better sustain fish and wildlife, river dynamics, and human infrastructural, recreational, and other values. Public confidence can be gained by transparent accounting of project goals and objectives, watchful monitoring and objective evaluation of outcomes, and a visible, effective organizational response when emergency or remedial measures are required. A strategic plan will clarify and identify how the county will pursue both the evaluation and dynamic management of complex outcomes from large projects.

4.4.3 Strategic River and Floodplain Management Plan

An explicit written strategic plan will help build a relationship between WLRD and its stakeholders. The Panel reviewed multiple documents that began to address strategic implementation, but needed clarification related to:

- Policy direction
- Project selection
- Design procedures and priorities
- Linkage among activities like acquisition, setback projects, and habitat restoration projects

A strategic implementation plan for floodplain and river management should be concise and accessible to both public and professional readers. The plan will develop the road map by which WLRD starts with current policy, legal drivers, and current environmental conditions, and then plans to implement actions that will produce desirable future conditions. It should encompass the following:

- Explicit policy base for current direction, including FEMA and NFIP policy, ESA instruments in place or anticipated for various listed species, public safety policy and state how these policies interact, overlap, and complement each other as well as how differences will be resolved when they may seem to conflict in specific circumstances.

- Explicit processes by which projects are prioritized, sited, and funded; designed, implemented, evaluated, and managed post-implementation.
- Clear criteria used to factor ecological, economic, and social considerations (including public infrastructure, commercial and residential property, and recreational use of waterways) into the decision to prioritize and move forward with a project.
- Provide, for each river basin management unit, a capsulated strategic plan and set of priorities that outline basic steps needed to attain a desired future condition. This is conceived as a basin-specific rationale for categories of action, not simply or even necessarily a list of specific projects, and should be largely drawn from existing sources (WDFW, NOAA, PSP, others), but distilled in accessible form.
- Identify a specific, staged process for project design that includes both internal and public review steps and makes risks to property and public safety, and their mitigation, specific.
- Identify a staged process for project implementation that includes mandatory cross-departmental internal review or, when deemed necessary, an external professional review well before project completion.
- Identify an explicit process and permanent structure by which performance of all implemented ("completed") projects be monitored on an ongoing basis, as well as an emergency basis during stressing events, and by which real-time active response will be brought to bear as needed to manage, mitigate, and adjust projects during and immediately after large floods.
- Identify an administrative unit and process for biennial evaluation and reporting, which in a public review document reports the cumulative effects of actions taken by WLRD on each river, placing them in context with other factors to ascertain that projects are contributing in a satisfactory way to progress toward improving the ecological, economic, and social conditions of the river as a whole.

Through strategic assessment and biennial review, WLRD should identify factors outside of King County's direct jurisdiction that help or hinder the ability of King County projects to attain desired river conditions and biological and social goals. Particularly in the endangered species recovery context, this evaluation and action must be comprehensive to be effective. For example, if Washington Dept. of Fish and Wildlife (WDFW) or tribal salmon hatchery practices potentially inhibit the behavioral and genetic capacity of wild fish to respond to and benefit from newly created floodplain habitats, WLRD should identify these barriers and a find a means to work with other agencies and authority to address these impacts. Such issues can be most effectively tracked and addressed over time at the river basin management level, but direction to tackle it would need to be nested in the overall strategic plan.

4.4.4 Team Augmentation Considerations

4.4.4.1 Need for In-House Staff with Recreation Expertise

The new rule and procedures for including recreation input on teams is appropriate, but it is unclear whether there is specific staff expertise with boating and recreation management experience in WLRD. A critical recommendation is to develop an "Office of River Public Use" with at least one dedicated staff position to coordinate all aspects of compliance with the recreation ordinance and associated procedures. These staff could be the initial recreation member(s) of project teams, but may play a role in design and implementation depending upon the size of the project and recreation and safety implications. If recreation safety issues and

design challenges are substantial, additional input through contractors and interaction with stakeholder groups may also be necessary.

Alternatively, because recreation management or public administration education and expertise is the foundation for effectively handling recreation issues with these projects, staff expertise with boating and other river activities could help gain stakeholder trust. Additional skills or familiarity with meeting facilitation, social science and survey research, and hydrology, geomorphology, or fisheries sciences could also be helpful.

Specific responsibilities of recreation staff should include:

- Encourage recreation stakeholder involvement in project selection, design, and siting.
- Serve as liaison and point of contact for river recreational users.
- Conduct studies that measure types and amounts of recreation use on County rivers for consideration during project selection and design.
- Participate as an independent advisor to project design teams during site selection, conceptual design, detail design, and 90-percent implementation reviews.
- Invite external recreational expertise to assist with recreation-sensitive projects.
- Support hazard monitoring and work with education and outreach specialists to develop and implement public education programs, including effective signage and other communications.

4.4.4.2 Need for Outside Recreation Expertise

For projects with substantial recreation safety issues and design challenges, there may be a need to include specific outside recreation expertise, which may include:

- Recreation users
- Emergency (SAR) responders
- King County Sheriff's Office marine officers
- Recreation advocates, or
- Members of the River Safety Council (an organization formed in the past at least partly to specifically become engaged in King County river management planning).

WLRD has recognized this need in the past and has used it on specific projects, but recent adoption of procedures to satisfy Ordinance 16581 argues for more formal engagement with this expertise.

4.5 Design

4.5.1 Consistent Application of Standards

There is increasing awareness of the interconnection and mutual influence among different objectives and associated actions for river and floodplain management. Therefore, the project formulation and implementation has shifted from the traditional single purpose project with necessary compensatory mitigations to a multi-objective approach to incorporate features that promote public safety, flood management, ecosystem restoration and recreation in concert. While the traditional river management involves strategies to control river through channelization or hardening embankments, the more integrated approach seeks opportunities to allow more rooms for the river for transitory storage and potential restoration of critical floodplain

functions, where feasible. The multi-objective approach, especially when applied on a system wide level, would allow more flexible management strategies, improved prioritization and effectiveness in using limited resources, and more sustainable outcomes.

Traditional engineering disciplines benefit from established standards and a long history of lessons learned. By comparison, more recent environmental objectives call for projects intended to alter the environment to improve habitat. An attempt to recreate or replace natural geomorphologic processes with biologically derived solutions is as much an art as it is an exact science. The extreme episodic conditions in which these projects are intended to perform leads to shorter lifecycles and higher incidents of "failure" (e.g. the structure deforms or erosion occurs in unexpected areas). While some failures are certain to occur, some stakeholders perceive them to be unexpected rather than a probabilistic progression in the project life cycle.

An example of this is the traditional approach to protecting communities adjacent to waterways. The channeling of a stream via levees coupled with the removal of aggrading sediment and natural debris has been standard practice for decades. The policies that drove these practices arose from episodic events that resulted in loss of life, property, and economic damage. The practices that emerged to support new policies evolved over time as a result of technological advancements, lessons learned, and standardization of design and construction methodologies. Projects adhered to these practices and were generally successful in satisfying the policy of protecting both property and the public.

While these objectives are still in place today, additional objectives have emerged that require an evolution of the traditional historic approach. Public safety standards continue to exist; however, the practices that once satisfied this objective can now be at odds with emerging objectives for environmental protection and restoration.

The consequence of these new objectives and the emerging solutions that have been developed is that there are no established, accepted standards for many of the solutions that are being used. That is not to say that no standards are available, since there are numerous standards available in the areas of structural, hydraulic, and civil engineering, and the Panel assumes that these are being used where appropriate. For the areas not covered by traditional engineering standards, it is essential that the WLRD maintain a system of lessons learned so that information gained on projects is not lost and that internal standards are developed and applied, as appropriate. It is important to recognize the purpose of such a "system" is not to replace staff professional judgment, which will always play a crucial role in projects of this nature. Rather, the primary functions are threefold: 1) to ensure institutional learning accrues from individual project experience; 2) to provide an efficient, documented context to monitor, evaluate, and adjust post-implementation project performance; and, most important, 3) to improve external communications and public support for projects by making design and evaluation rationales more explicit and accessible.

4.5.2 Design Development

4.5.2.1 Recreation and Public Safety Design Procedures

Ordinance 16581 (2009) related to public safety and required WLRD to follow certain procedures when installing large wood (LW) in rivers that may affect recreation safety. The procedures outlined to satisfy Ordinance 16581 (adopted in March 2010) provide a useful checklist for recreation safety considerations in design development. It appropriately recognizes

the importance of assessing a full range of recreation uses (and their characteristics), brainstorming alternative designs, assessing potential safety or other consequences, and including outside expertise in the process. Based on discussions with staff and stakeholders, the central concern is whether these procedures are adequately applied.

While specific procedures for installing large wood included several provisions related to specific project processes, a missing concept was the notion of a "progressive sliding scale of analysis." This idea recognizes that there are limited resources for analysis and agencies should spend them more efficiently on the most important and challenging issues.

This concept has been used in a variety of recreational decision-making settings, particularly FERC relicensing. It broadly formalizes three levels of effort that inform whether additional levels are required if existing information has not satisfactorily resolved the major questions needed to successfully design the project. These levels are shown in Table 5: Levels of Effort.

Table 5: Levels of Effort

Level	Description
1	Required for all projects and focuses on a review of project objectives and existing recreation-relevant information (e.g., aerial photos or other site materials, river hydrology, recreation use reports, recreation surveys). It may include a single site visit and contacts with key recreation stakeholders. If that review suggests that recreation issues are relevant, analysis moves on to level 2 or 3.
2	Involves increased interaction with stakeholders and experts through focus groups and site visits, as well as limited onsite or interview work to ascertain additional information about recreation use and trip characteristics.
3	Involves more extensive interaction with stakeholders as part of a design team, additional site visits (possibly including similar projects on other rivers), or more intensive studies of recreation use, characteristics, or attitudes/knowledge/behaviors related to safety issues.

Although recreation stakeholders have had opportunities to comment on basin-wide salmon recovery and flood hazard management plans, these do not feature extensive discussion of recreation impacts. When specific projects that may have recreation consequences are being developed, current stakeholder entry into project-level processes does not tend to consistently occur until the 30% design phase is complete, usually concurrent with a public meeting where the initial design is presented. For projects with obvious recreation implications (e.g., Cedar River projects in medium to high use segments), earlier engagement with stakeholders who will be most directly impacted by a project is likely to pay important dividends. Formal procedures should be developed to allow for involvement from 0 to 30% in the design process.

4.5.2.2 Need for Recreation Use and User Characteristic Information

Ordinance 16581 and associated procedures require recreation information collection as part of the design process. In general, it appears WLRD understands and has taken this step in the past, although there is room for more detailed information in many cases.

The first county-wide assessment of recreation river uses (MacIlroy, 2009) provides a suitable "Level 1" example of such an effort, offering an efficiently collected interview-based summary of types of uses and relative use levels for WLRD's major boating streams. However, it lacked

information about local (neighborhood) tubing opportunities, which are probably the ones at greatest risk with large wood projects. The study also was not intended to provide more detailed information about user characteristics or safety related attitudes, knowledge, and behaviors.

The recent draft Cedar River recreation study (Biedenweg & Akyuz, 2011) was more detailed, and provides a good example of a Level 3 effort. It provides the base information necessary for assessing likely hazards and potential mitigation options, with a balanced focus on use levels, trip characteristics, types of users, and safety-related attitudes, knowledge, and behaviors. Similarly precise information for other moderate to high use river reaches are a priority for other basins, particularly moderate to higher use reaches or those with substantial levels of lower skilled boating, swimming, and angling use. For reaches that are known to have considerable use, the actual amount of use may not be as important as information about trip characteristics and safety-related attitudes and knowledge, which can help with design or mitigation decisions.

4.5.2.3 Design Expectations

Some ELJ and bank stability projects in King County include progressive or "state of the art" designs. A review of other agencies' LW and recreation policies (Blackmore Consulting, 2009) suggests that few have specific written policies or standards to address public safety concerns in their designs. Transparent recognition that some designs are quasi-experimental is critical to public acceptance over the long term. Even if some projects "fail" according to certain criteria, WLRD can use this information to develop "lessons learned" and avoid those problems in the future. By comparison, bold claims of success or effectiveness – when followed by evident contrary results – can cause a loss of faith among stakeholders. WLRD should adopt a scientific attitude toward these less than desirable outcomes; with the focus remaining on "testing design hypotheses" and comparing outcomes to project objectives. Engineering heuristics such as "Failure mode and effects analysis" and "Forensics analysis" can help identify causes and correct them in future designs.

Projects should be as explicit as possible about design elements and expectations. If deformation after a certain period of time is expected or is a "feature" in a setback levee situation, it should be specified, along with ultimate design life and the design flow. Similarly, if logs are intended to be mobile, or channels are expected to migrate and structures are hence designed with redundant or contingent functions to influence complex channel response, predictions about probable or stochastic outcomes are needed. Without predictions and post-project assessments to compare them, the science cannot improve as quickly. Current project summaries tend to focus on the structures built rather than processes engaged by their presence and outcomes those processes produce.

Other project specifications should clarify floodplain capacities for levee setback projects. Some of these only move levees back 60 to 90 feet, by a few hundred feet in length. An examination is needed to identify the sufficiency of such setbacks to meaningfully increase floodplain capacity or recruit sediment, thus engaging more natural processes. These questions inform more overarching strategic matters of resource allocation and program sequencing. For example, rather than building semi-constrained or small-scale setback projects on existing small county parcels of a river today, those resources might be far better invested during the next decade acquiring more parcels to increase the contiguous area of King County floodplain ownership. Then projects of more effective scale can be developed in the future, after sufficient contiguous area and key locations are acquired. The Panel recognizes that many small-scale projects are opportunistic and cannot be delayed, such as when emergency levee maintenance is required.

In some cases, however, costs of maintenance could be reduced by deferring small-scale setbacks, and some of those dollars more strategically allocated to land or easement acquisitions.

4.5.2.4 Importance of Riparian Vegetation

Initial review of project photos on the King County website show many projects lack a visible bank and over-story vegetation at many sites; however, it is possible this is a "methods effect" due to project photos being taken as the initial construction was completed and vegetation was young. It may also reflect an over-focus on geomorphic and large wood elements of the projects. If so, project descriptions and designs may consider greater attention on riparian elements, which can also serve several ecological objectives by providing future large wood recruitment, shade, and organic materials to rivers.

The lack of vegetation is also an issue along levees certified by the USACE mandate to remove vegetation for structure integrity and inspection. Although WLRD has received variances for smaller scale riparian vegetation on these levees, there are indications that future variances may be difficult or impossible to obtain (PSP, 2010).

4.5.3 Design Considerations

4.5.3.1 Cross-Departmental Internal Review at Pre-design or Early Design Stage

Examination of the 2011 organization chart provided for the WLRD reveals a wealth of expertise on river restoration, floodplain management, and aquatic ecology across several programs, including River & Floodplain Management, Rural & Regional Services, Stormwater Services, WLRD Support, and Science and Technical Support. Through review of materials and conversations with WLRD staff, it did not appear this wealth of expertise was formally involved in design review or implementation review of most projects; however, informal consultations do occur. The integrity and robustness of project design could be improved by developing a formal process for review of project selections and early design by a broader internal team of experts. The result of such internal reviews would likely place additional burden on the design team to demonstrate due diligence in responding to these concerns.

An external review process could achieve similar ends, but is likely to be more expensive and require more lead time to execute. WLRD should take advantage of its rare depth of staffing to pursue an internal review process

4.5.3.2 Public Review at Pre-design or Early Design Stage

A project-level scoping step for public review is important at the pre-design or early design stage. Besides identifying concerns, public review serves a key role in public education about both the need for and kind of considerations that go into project planning.

Public review for projects would be best conducted after an internal review is held and identified issues are addressed. For a given year, projects across a single river basin could be bundled into one public meeting and review process, if their timing and staging allow. However, aggregating a review over multiple river basins and communities almost certainly greatly dilutes the effectiveness of public review and outreach. WLRD should consider dedicated staffing to work with project managers to plan and conduct public project reviews, if such does not currently exist.

4.5.3.3 Large Wood Design

At its heart, restoration design focuses on reducing risk. Schwar and Bernard (1998) wrote the following summary statements:

> *"Restoration projects entail two different types of risk: the risk of structural failure and the risk of restoration failure. Structural failure is a conventional concern in civil engineering projects, and given the state of the practice this risk can be adequately addressed. Under known conditions, a competent practitioner can design restoration projects to an appropriate level of structural design, although site constraints and safety conditions may require what is perceived as "over-engineered" solutions. However, reducing the risk of failure as a restoration requires considerations not often associated with other engineering projects....*
>
> *"Although the existing body of knowledge varies depending on the type of project, restoration is not yet a mature science. Accepted standards have yet to be developed for many restoration designs, so study of successful and unsuccessful projects is still necessary."*

As they relate to projects involving large wood, the two types of risk can be rephrased as two key, sequential design questions that require careful thought and analysis:

1. Exactly where and how should a large wood structure be sited and laid out? (involves less intangible design criteria)
2. How can the structure be designed to be stable in the chosen location? (involves more tangible criteria)

4.5.3.4 Large Wood Structure Siting and Layout

There are two scales of importance when it comes to design and project structure siting. At the large scale (or reach scale), design decisions regarding which reach site(s) to focus on are based on perceived need, site characteristics, and funding. These decisions should involve stakeholders and can be relatively well defined and supported. During this stage, however, it must be decided what applications and/or types of structures should be implemented to meet the project objectives. There are limited design guidelines and analytic procedures available for specific project siting of a LW structure (such as Rosgen's classification-based approach, and the NRCS National Engineering Handbook Part 654), in large part because it is difficult to predict quantitative river response at a given site when channel migration and erosion are not completely controlled. Use of existing siting guidelines, however, do not guarantee a selected project will work as intended (Simon et al. 2007). Choice of technique and structure presently depends on broad recommendations and professional preference of the planners and designers. Consequently there remains uncertainty as to what types of actions and structures are most suitable to apply in a site. At the smaller scale (or site scale), there is little to no quantitative, single-solution basis for placing a structure at one location instead of another. Precisely where to put a large wood structure is presently the most uncertain aspect of restoration design, and likely will continue to be for some time.

The uncertainty in structure siting must be acknowledged directly and frequently as it is a fundamental aspect of the "ecological / dynamic channel" strategy shift described earlier. Claiming certainty about how and when a river will respond to a specific project works against stakeholder trust if such expectations are not met. The term 'restoring natural process' is often used loosely where it is assumed that anything that resembles nature must be beneficial,

without ever explicitly linking an action to the desired outcome. Placement of LW structures is frequently justified this way, with mixed project results. 'Restoring natural processes has become a default explanation that is trusted to be inherently mechanistic, when in reality these processes are quite variable. Only stating the desired outcome, but not the decision on where to place a LW structure, is not justification in itself. The Panel noted cases where only the goal is stated, but where the mechanism and specific objectives are not clearly defined. Examples include: "*further reduce the likelihood of the channel migrating into the setback levees", "reduce the likelihood of a mainstem avulsion and meander cut-off through the side channel",* "*discourage large-scale channel migration*", "*slow erosion and migration*", and "*add hydraulic roughness for flood attenuation*". What appears to be missing is an answer to the critical question; "how do you know?" which should be asked of any uncertain design assumptions. This would lead to more effective 'what-if' discussions during the planning and design process, which in turn could lead to simpler siting and design modifications with fewer associated side effects and safety problems.

Taken together, acknowledging uncertainty related to structure placement encourages designers to consider and identify the ways that project elements could go wrong, which can then also guide monitoring practices. Similarly, project descriptions should avoid broad technical terminology that predicts specific channel changes without providing specific explanations that would hold up to peer review. Acknowledging uncertainty is akin to many geotechnical engineering reports, that while written and stamped by a licensed professional engineer, are also typically accompanied by language and disclaimers that describe the considerable level of uncertainty and potential unknowns. This same explicit level of qualification is recommended when it comes to river management project siting.

An additional level of dynamic response is related to migrating wood that racks up on structures. Pictures of the Tolt River provided to the Panel show how natural wood can rack along extensive lengths of riverbank. There is no guarantee that extensive collections of racked-up wood that appears to be solid and immovable will not deform and migrate completely during a flood. One panelist has described this on the Skykomish River, where a flood blew out a large, 1,000+ ft. long array of large wood piled up tightly along the outside bend bank and the river then eroded 150-250 feet into the floodplain. Prior to the flood, the large wood array had the appearance of indestructibility. These possibilities must be factored into project siting when designing large wood structures. A 'what-if' discussion held during the planning and design process could lead to simpler siting and design modifications with fewer attendant side effects and safety problems.

The Panel noted that such "what if" discussions did clearly underlie the designs for protection of the park shoreline on the Tolt project, where multiple possible river response scenarios led to a set of designs intended to work in redundant or contingent ways to produce a desired future range of river response and channel configurations. While it can sometimes be expensive, this kind of robust design rationale is necessary for success in large-scale restorations of floodplain rivers.

Educating and building consensus using input from stakeholders and independent practitioners regarding structure siting during project planning and design could be one way to address the inherent uncertainty. This could be accomplished through one or more design charettes with the County and its consultant, involving independent technical input not directly affiliated with the project. This independent perspective should be enlisted throughout the design process to

continue asking the question "How do you know?". The more reviewers identifying potential failure modes, the greater the chance that a design will function as planned. This suggestion is generally consistent with the fourth bullet of Recommendation 2 of the Large Wood Stakeholder Committee Final Report and Recommendations (October 2009), which could be modified to include input from independent technical reviewers regarding structure placement (and possibly size). This recommendation can be extended to include specific descriptions of the intended function of the wood, how it affects the existing site conditions, and how the wood is expected to meet project goals and objectives. The Panel did not see this explicitly and clearly identified in the provided Basis of Design Reports or related documents for the Cedar and Tolt River Projects. This input from stakeholders and other practitioners would also be appropriate for discussion of the 'what-ifs' associated with wood racking up on structures.

Although it may be tempting for restoration project opponents to infer that because of the uncertainty, no projects should be built, in a multi-objective stakeholder environment, that choice is clearly not an option. There are well documented ecological benefits to placing large wood, and the consensus is that they deserve a chance to be realized. Under the new paradigm of adaptive management, the emphasis is to accept uncertainty and learn from doing, while also incorporating other concerns such as public safety and protection of property and infrastructure to the extent possible.

With that premise, the problem of siting structures can be phrased as follows: "Of all the possible locations where a structure could be sited, which locations have highest risk of impact to concerns other than fish, and can we identify specific locations where a large wood structure should not be built because of those concerns?"

Given the concerns raised by the stakeholders and after reviewing the provided relevant documentation, there is a circumstance that the County could discuss with all stakeholders. It concerns not constructing structures composed of logs protruding at or above the low flow water surface, within the bank-full channel along the outside of bends. This is possibly the most difficult hydraulic condition for inexperienced boaters and floaters to avoid. The primary rationale for placing large wood on the outside of bends appears to have been that it provides an ecological benefit. Peters et al. (1998) performed a rigorous comparative study and found that while such structures may be associated with higher numbers of fish than a purely rip-rapped bank, more fish were found associated with large jams containing more complex rootwads.

If large wood is identified at an outside bend for erosion protection, logs could be placed well below the summer low flow water line, avoiding higher stage locations. If suitable toe protection can be provided as well (i.e., when the designer cannot avoid the use of large rock on a project), the upper part of the bank can in many cases be protected with a vegetated geogrid or other bioengineering method of re-vegetation. Where discrete log structures are desired along the outside of the bend, either in channel or on the floodplain, the potential for a river "end-run" and avulsion must be discounted more convincingly during the planning and design stages than was seen in the provided Basis of Design reports. Any time a hard structure is placed on a bend, the river may attack the softer edges upstream and downstream and eventually flank it and cut through on the landward side. Alternatively, if the structure is placed near a floodplain channel, it may concentrate flow into the channel and increase avulsion risk.

4.5.3.5 Structure Design

There are four aspects of the structural designs prepared for WLRD and provided for review that warrant thoughtful discussion and possible reconsideration.

The first aspect concerns the balance between project cost and function/stability. It appears to be a recent trend over the past 5-10 years to construct large impact and expensive projects involving many LW structures. Not all of these projects will function or have functioned as intended and there appears to be a broader public and legislative backlash against funding these types of expensive projects if their success cannot be demonstrated in simple terms. WLRD may benefit from directing designs towards answering the question, "What is the simplest and least expensive approach that could be taken to address the problem identified and/or meet the restoration goal?" There may be fewer negative outcomes that can be linked directly to the project.

The second aspect concerns actually designing for failure. Projects that are designed to be 'bomb-proof' can lead to the river responding by attacking weaker locations, and even abandoning structures. More importantly, such designs imply the structure will last in perpetuity. Instead, bioengineered projects could, and probably should, be designed and expected to last for a fixed period of time, say 5-15 years. Use of chain and cable can assure stability until the wood rots or the structure fails. In the latter case, logs with chain or cable wrapped around them that become exposed or end up downstream lead at best to negative aesthetic perceptions and at worst to safety hazards. There are other known techniques such as anchoring wood structures using large diameter hemp rope, which rots over time. Designing for failure in this context may not be applicable in every project, but it should be given fuller consideration during both the planning and design stages of any project. Failure to explicitly state the life span of a structure during the planning and design stages of a project carries the risk of over-selling the lifespan.

The third aspect concerns fundamental structural design assumptions related to public safety that warrant further discussion and possible reconsideration:

- Any LW project has the potential for wood protrusions to create recreation hazards for boaters, swimmers, or wading anglers. Even at relatively low current velocities, a boat or person can be held by the force of the water against a rough solid surface. There are no "safe" protrusion lengths, especially as many LW projects are intended to rack additional wood. King County should avoid describing such design criteria as relevant to structure design, when they are more pertinent to project siting.

- Similarly, a 'deflector log' (as referenced in Ms. Parker's letter and in the basis of design report and construction drawings for the Cedar River Belmondo site) is not necessarily a suitable protective design for preventing recreation hazards. In these types of designs, "deflection" typically refers to flow deflection as opposed to "deflecting" boaters and swimmers. While a smooth surface on the current facing edge is generally less likely to be hazardous than a rough or sieve-like structure, other variables such as current direction and water level are often even more decisive. Preventing hazards by structure design alone is exceedingly difficult, and formally labeling such designs as a 'deflector log' in construction drawings could lead to a false sense of security among planners and recreation users.

The fourth aspect concerns design criteria. If the intent is for the structures to not move before the wood decays, then worst case assumptions must be made, including using conservative buoyancy, drag, and scour parameters. For example, one parameter that a panel member has seen calculated in a non-conservative manner in the past is the value of the coefficient of drag when evaluating log structure stability, where a value of CD=0.3 (which is representative of a cylinder) is used in a design without accounting for debris building up on the structure. The more conservative assumption is that the structure will act as a larger mass when debris builds up and the effective drag coefficient becomes closer to CD≈1.2, corresponding to a four-fold increase in computed drag force (cf. Alonso 2004). The Panel has no information as to whether this was the case in recent King County designs, but the example illustrates the importance of applying conservative assumptions in the case of stable structure design.

Another design parameter of particular concern is the variable buoyancy of logs when they are dry (during low flow periods) vs. waterlogged (which may take weeks or months of submersion). Similarly, if LW is intended to be anchored without chains or cables, there may be a greater need to ensure designs provide adequate means of stabilization to keep the logs in place (Ripp & Prager, 2004).

4.5.3.6 Adequacy of Design Documentation

In the Panel review of the provided Basis of Design Report and memo for two Cedar River projects (Cedar Rapids Levee Setback Project and the Cedar River Trail 2B Project) it was unclear to some of the panelists whether the documents could be used to track and review the adequacy of structure design calculations and decisions. Instead of production of a formal report, it may be more useful from a Quality Assurance/Quality Control (QA/QC) perspective for the design team to provide WLRD with copies of calculation packages that detail and show the sequence of assumptions, calculations, and decisions that led to the design. A spot check of the calculated quantities (e.g., scour and piling depths) to assess whether order of magnitude errors existed or overly conservative design assumptions were used showed no untoward results, but any such review would be more certain if it were based on the calculations, and not a summary report, unless considerable effort is funded to ensure all calculation details and decisions are thoroughly documented.

4.5.3.7 Cross-Divisional 90 Percent Design Review

A second-look external review by a subset of the initial external review group could assure that all issues identified in the initial internal and public reviews were adequately resolved by the project design team. This review of near-complete project designs should be coupled with a defined elevation and resolution process in the event reviewers are in disagreement with the project design team or project manager about the adequacy of designs.

4.6 Construction

This section provides details on construction findings and recommendations based on the Panel's review.

4.6.1 Construction Management Procedures

During the WLRD workshops, the team documented the construction management processes currently used by WLRD and identified potential improvement opportunities. Discussions with WLRD indicate that some of the fundamental construction management processes take place on larger projects. For example, on larger projects that are led by external construction

contractors, field observation reports, progress meeting minutes, and daily inspector's reports are required.

It was recognized that there are varying levels of construction management policies and procedures between the groups within WLRD, but no comprehensive construction management procedure. Project managers manage independently with their own processes based on the size and complexity of the project and, consequently, there is no apparent consistency regarding the management of internal construction resources and resident engineers. To improve construction coordination, WLRD should ensure that the Project Management Manual that is currently under development includes standardization of construction management practices.

In general it was determined that WLRD needs improved alignment, coordination, and communication between engineering and construction management groups. This includes ensuring that construction managers are given the opportunity to review and comment on design submittals and construction management staff should involve the design team in proposed changes. Coordination between these groups throughout the project life cycle will offer key opportunities to control cost, verify schedule, and ensure the quality of construction.

Some projects have issues with undocumented changes, quality of the design documents, and change order negotiation. It appears that, in some cases, there are not appropriate quality reviews taking place between the construction management staff and construction contractors.

In an effort to improve quality, the field engineers and inspectors should ensure that the construction contractors implement their respective quality control programs and that the permanent work is constructed in accordance with the contract requirements. Establishing an effective and professional working relationship with the construction contractor at all levels facilitates this quality effort.

Throughout the construction of each project the resident engineer and inspectors should maintain ongoing logs of minor work items to be completed or corrected. These items should be reviewed with the construction contractors' staff on a regular basis. By developing these deficiency lists, most corrective work can be completed prior to the final acceptance inspections. This process keeps the projects moving forward and the closeout/final payment process less burdensome to the program staff.

4.6.2 Construction and Implementation

An issue raised through stakeholder correspondence suggests that use of appropriate construction techniques may have been a problem at the Cedar Rapids site as described in the document Cedar Rapids Levee Setback and Floodplain Reconnection Project – Response to November 7, 2008 Flood Damages. In this specific case (Phase 1 of the Cedar Rapids project) it should be noted that construction was performed by County staff and not through a formal construction contract. The problems regarding rock size at Cedar Rapids are typically avoided by requiring formal contractor and supplier submittals that the engineer must approve in writing. Materials and techniques that are sub-standard, do not meet specifications, and do not provide equivalent level of function or purpose should be rejected. The formal submittal process provides a mechanism for completing these reviews. If this part of the process broke down, WLRD could consider requiring an independent engineer or other designated representative to sign off as a QA/QC measure. The Panel understands that these more rigorous and formal

construction management procedures do typically occur on County projects using outside construction contractors.

4.7 Monitoring Effectiveness and Adaptive Management

The Panel review recognized that program level monitoring and reporting procedures were not standardized or consistently enforced. Projects being implemented by WLRD could have an impact on neighboring jurisdictions, altering the rivers function and impacting the ultimate program goals. It is apparent that there is a need to account for both the effects of County-sponsored projects and events in the same ecosystem. This section provides details on monitoring effectiveness and adaptive management findings and recommendations based on the Panel's review.

4.7.1 Monitoring Effectiveness

WLRD participates in various types of monitoring on a project site basis. There is growing recognition that river restoration projects are inherently experimental in nature, and therefore monitoring is an important way to evaluate project behavior, success, and failures. It should be pointed out, however, that even the term 'experimental' may be euphemistic, because it implies control over other sources of variation. For river restoration projects, there is not sufficient level of control to qualify the monitoring as testing an experimental outcome, and consequently monitoring can only test the general hypotheses used in the design. The Panel recommends giving highest priority to effectiveness monitoring, whereby all design assumptions and uncertainties are checked. As part of this, WLRD can identify the highest priority "need to know" metrics, how to measure them, and what the results mean with respect to project performance. Specific targets of monitoring can include:

- Validating design specifications determined at scale of specific structure/action using standard engineering/scientific calculations and engineering/geomorphic judgments reflecting uncertainty.
- Demonstrating intended or unintended physical change is occurring at the site scale, involving:
  - Simple, quantitative metrics evaluating if the structure/action is generally changing habitat conditions in the direction of project goal(s); it may not be possible to detect statistical differences because of temporal sample size limitations and non-stationary natural stochastic processes
  - Qualitative metrics providing indirect evidence that project is performing as intended

This information is valuable for assessing the appropriateness of assumptions made in the context of both siting and structure design.

The floodplain connectivity restoration paradigm encourages natural processes to do more of the work of handling flows and creating habitat. By definition, this creates more dynamic channels that change more frequently during flood events. Because there are both positive and adverse impacts possible with this increased dynamism, there is a greater need for monitoring to assess what is happening and how engineered solutions have affected those consequences. Schwartz et al. (2004) provide general principles for monitoring that apply in urban settings. There is uncertainty involved in allowing natural processes to operate and that it is unlikely that all designs will work exactly as anticipated (Kondolf and Downs, 2004). In order to advance from "art to science" with these LW projects, a robust monitoring and adaptive management program

will be necessary. In addition, floodplain projects in one reach of a river may have direct impact on both the upstream and downstream reaches, directly impacting the behavior of the river in those locations. Additional project monitoring, including evaluation of impacts on other neighboring reaches, will allow King County to better define project success and gauge the impact that these dynamic river changes may have on the entire watershed.

The major categories of monitoring follow from the major objectives addressed by these projects:

- Habitat improvements and, if possible, longer term effects on ecological health;
- Public safety related to flood injuries/deaths and property damage;
- Flood management variables (ability to contain floods of specific sizes);
- Recreation safety; and,
- Aesthetics.

4.7.2 Recreational Safety Monitoring

4.7.2.1 Database of In-Channel Search and Rescue (SAR) Incidents

A major recommendation of the Large Wood Stakeholder Committee (2009) which the Panel also endorses is the development of a comprehensive database of in-channel SAR incidents, organized systematically to allow comparisons of types, factors, and locations. This database could be developed by WLRD and City public safety departments with variables chosen in coordination with the Boater Safety Council or additional stakeholders. This also will help quantify risk for future risk management estimates and can be a powerful educational tool. Potential variables in the database include date, time, location, type of craft, skill of boater/swimmer/tuber, size of group, flow, water temperature, air temperature, involvement of LW, and narrative details if they can be ascertained. A photo or sketch of the location is also helpful.

The 2009 Large Wood Stakeholder Committee asked for and received preliminary information about in-river deaths or other search and rescue incidents related to LW. It suggested that although wood has been a hazard in King County's rivers in recent years, no King County LW projects have been implicated in specific incidents. However, several recreation stakeholders have suggested that future incidents are possible or even likely, and at least one incident may have occurred in another Washington location. Parker reports that the logs associated with the fatality were from a LW project to reduce bridge piling scour and increase fish habitat at a bridge, and that design characteristics or construction implementation may have been contributing factors in the death.

Another addition to such a database might include an online or phone-based "incident report" system. This would allow users to report potential hazards (natural or project-based) for county staff to investigate or simply provide better information to other users.

4.7.2.2 LW Hazard Monitoring

For each of the six watersheds (Cedar River, Central Puget Sound, Green River, Sammamish, Snoqualmie, and White River), it would be helpful to gauge the number and distribution of all LW (both natural and human-placed) and compare it with estimates of those presenting hazards, as urged by Ordinance 16581. WLRD procedures in response to the ordinance suggest there will be periodic post-installation monitoring (contingent on funding) to assess

hazards, but this monitoring appears to focus on specific structures. The procedures also require a third party independent assessment of specific project structures for hazards every three years.

There are opportunities to reduce recreation safety concerns and liability exposure by developing a more systematic monitoring program that assesses both natural and project-related LW hazards and compares it to all LW present. This requires development of a hazard categorization system that involves some "professional judgments." Such a system provides more systematic information about natural and project-related hazards for use in outreach efforts, helps hone judgments about when to remove vs. leave natural LW hazards. This is essential for quantifying future risks. Developing such a system in consultation with the Boater Safety Council or other recreation stakeholders offers additional opportunities to develop rapport with those groups. A repeatable, efficient method for making these judgments is possible and would be well-received, offering useful indices of LW hazards for different reaches. While assessments may not be needed in all segments of the watersheds, they would prove valuable for higher recreation use segments, helping SAR officers, the public, and stakeholders calibrate their personal observations of LW conditions with more quantifiable counts. A similar inventory of LW on the upper Chattooga River through North Carolina, South Carolina, and Georgia (Roghair et al. 2008) provided ecological and recreation management benefits in a recent Environmental Assessment on recreation management for the upper river.

4.7.2.3 Outreach and Education Related to Recreation Hazards

Ordinance 16581 includes direction to offer outreach, which can include off-site programs, web-based information, onsite information at access points, and signs at specific hazards. These are proactive and adequate program ideas with their effectiveness depending largely on execution. Additional notes on these elements are provided in Table 6: Elements of Outreach and Education.

Table 6: Elements of Outreach and Education

Elements	Description
Off-site Programs	• Focus on encouraging users to take responsibility for their equipment and safety-related decisions • Focus on PFD use, trip plans, use of appropriate craft and gear for the conditions, need for appropriate skills, and informed decision-making • Proactive education programs in schools, scouts and other similar youth programs, at festivals, and through local media • Messages should be coordinated with groups such as the River Safety Council and local public safety departments
Web Pages	• Well-developed and easy-to-use series of web pages. • Improve existing WLRD web pages addressing safety and LW projects, including: o Grouping LW projects and hazards by geographic proximity; o Including natural LW hazards in the same database; o Linking projects and hazards to an interactive map that corresponds to segments that river users know (defined by access points and prominent geographic features); o River user descriptions of location (side of river, river mile); o Providing river-perspective photos of every project and hazard at

	typical boatable flows; o Providing examples of river-perspective photos of projects and hazards at higher flows; o Recommending scouting or portaging options; o Linking to boater or user "forums" where users can report incidents or opinions about how to handle the hazard ; o Linking to aerial photos of the river locations, if available; o Including a disclaimer about comprehensive and accurate information ; o Photos indicating flow levels and downstream direction; and, o Providing descriptions of projects of consistent length and providing characteristics with bullet phrases rather than extended narration.
On-Site Information at Access Sites	• Signs at access points. • Summary information about hazards downstream matching the format of web page information to show consistency and indicate a coordinated program, which may reduce liability exposure. • Accuracy and ease of use are important.
On-Site Information at Hazards	• Visible, clear signs at hazards located early enough so that users have time to take action. • Two or more signs to ensure there is a margin for error.

4.7.3 Monitoring Recreational Use

WLRD is beginning to collect and document recreation use levels and trends on some of its rivers (notably the Cedar River) to provide baseline information for future monitoring of this variable. In general, it is helpful to have good use information, and opportunities to employ mechanical counters at access points or even on the river as indices of use should be explored. More targeted observations focused on craft types, PFD use, presence of alcohol, and responses to hazards may provide more useful information.

4.7.4 Need for Cumulative Effects Monitoring

Little work has attempted to assess the cumulative effects of multiple LW projects on recreation or aesthetics (Daily, 2002). Studies that assessed stakeholder and public evaluations of these issues, which could include attitudes toward recreation / restoration trade-offs, would provide additional information to decision-makers addressing larger policy balances. Existing reports on LW in King County tend to focus on project-by-project effects, whereas basin-wide assessments of the existing level of LW, target levels of LW, and evaluations of the ecological, flood management, or recreation safety consequences of existing or future levels of LW projects would provide more useful data as to the overall success of WLRD's river projects.

4.7.5 Evaluating Attitudes toward LW Projects

There has been some work evaluating public attitudes toward salmon restoration and related LW projects (Montgomery, 2003), and an upcoming study also addresses this issue. This study shows awareness of issues among landowners and strong support for general ecosystem health over "maintain in-river recreation." It also shows strong support for land purchases and protection, and active and passive restoration. However, the study also notes that the general

public thinks pollution is a bigger concern than channel width and complexity and they may not understand the implications of specific in-river projects that have infrastructure and safety consequences.

General attitudes do not always match specific attitudes, nor predict support for specific management actions. Considerable work in "human dimensions of natural resources" has documented support for general ecological values (e.g., modern wildfire management concepts, predator wildlife protection, restoration) while showing more variable support for specific attitudes related to those values (e.g., "let burn" actions in their area, prescribed burning, predator protection in urban or suburban areas etc.). Future studies that examine this issue for LW structures or responses to natural LW hazards are interesting areas for research that are likely to help inform WLRD's policy and implementation choices.

4.7.6 Post-Implementation Tracking

Many of these projects are quasi-experimental in nature and two of their prime virtues are that they are meant to be both dynamic and long-lasting in their effect. WLRD has demonstrated a commitment to real-time response to flood hazards, including those associated with restoration and remediation projects. By identifying the staging and preparedness for response as a real-time mitigation factor, this capacity can provide the public with greater assurance that the risks of floodplain restoration projects are manageable and acceptable. When emergency responses are instead perceived by the public as desperation measures, whether successful or not, this erodes public confidence and willingness to accept risk.

The second function of post-project tracking is to centralize and focus project performance monitoring and reporting. The focus of this tracking and reporting function would be threefold:

1. Identify post-project remediation needs to manage risks or improve performance;
2. Evaluate the contribution of each project to overall restoration and floodplain management goals in the river basin;
3. Provide some quantitative or semi-quantitative information to drive a biennial review and report on river basin status and trends relative to program goals.

Focusing this responsibility for reporting in a central office would increase the incentive for consistency, follow-through, and sustaining best practices in the monitoring and evaluation program.

4.8 Stakeholder and Public Engagement

The section provides details on stakeholder and public engagement findings and recommendations based on the Panel's review. For the purpose of this report, it is important to note that there are two distinct approaches towards dealing with the public. The first (and simplest) is public communication, which involves a broad public focus, sharing of information in a concise and simple manner, and working to achieve broad support of long-term financing and policy. The second (and more complicated) is stakeholder engagement, which is focused on land owners, river users, and downstream communities who have a specific interest in a specific river due to frequent interactions with the river and ecosystem. Stakeholder engagement must be collaboratively focused, technical in nature, and working to achieve a long term implementation partnership. If stakeholders can be engaged in the process through education and collaborative discussions to be advocates for King County planning and design processes,

this will reduce the County time and energy spent during project implementation explaining the purpose and impacts of specific river and floodplain management projects.

4.8.1 Effective Stakeholder Processes

Current stakeholder processes appear undefined and inconsistently applied at the project level. While stakeholder participation was evident during the Lower Tolt River Floodplain Reconnection Project, WLRD staff indicated during the workshops that agreements made with stakeholders early and throughout the project translated into costly actions during project execution. Specifically this included construction of additional ballast and substantial scour toes designed around the ELJs. Due to the duration of the project, WLRD staff that initiated discussions with stakeholder groups were not in the same project role during final negotiations or project execution. This is may be a common occurrence for long-term projects and requires coordinated stakeholder engagement strategies to ensure cost effective implementation of negotiated agreements.

In addition, when general questions posed to WLRD staff as to how, who, when, and for what purpose stakeholder involvement is requested, there was no consistent representation of a formalized process. A similar line of questioning posed to a small stakeholder group also resulted in little clarity as to how they viewed their ability to participate in public safety and habitat restoration processes.

An effective stakeholder process requires structured involvement opportunities at the basin-wide river management and strategic planning level that recognize the interaction of regulatory processes, policy, and the evolution of river and floodplain management designs in meeting multiple objectives. If these high level strategy drivers are not fully understood by stakeholders, the ability to engage, capture, and balance interests at appropriate times in the project level design process is compromised. The later in the process in which stakeholders engage, typically the higher the cost of modifications to satisfy their interests and the higher overall enterprise-level risk to King County. This can be seen in the Figure 2 below which demonstrates the various levels of program/project development and the recommendation that stakeholder engagement focus on the basin-wide planning phase instead of the project implementation phase where King County currently focuses most of its effort. In addition, both stakeholder engagement and public communication should extend throughout the project life cycle to ensure appropriate access points into the overall process and better understanding of the project life cycle.

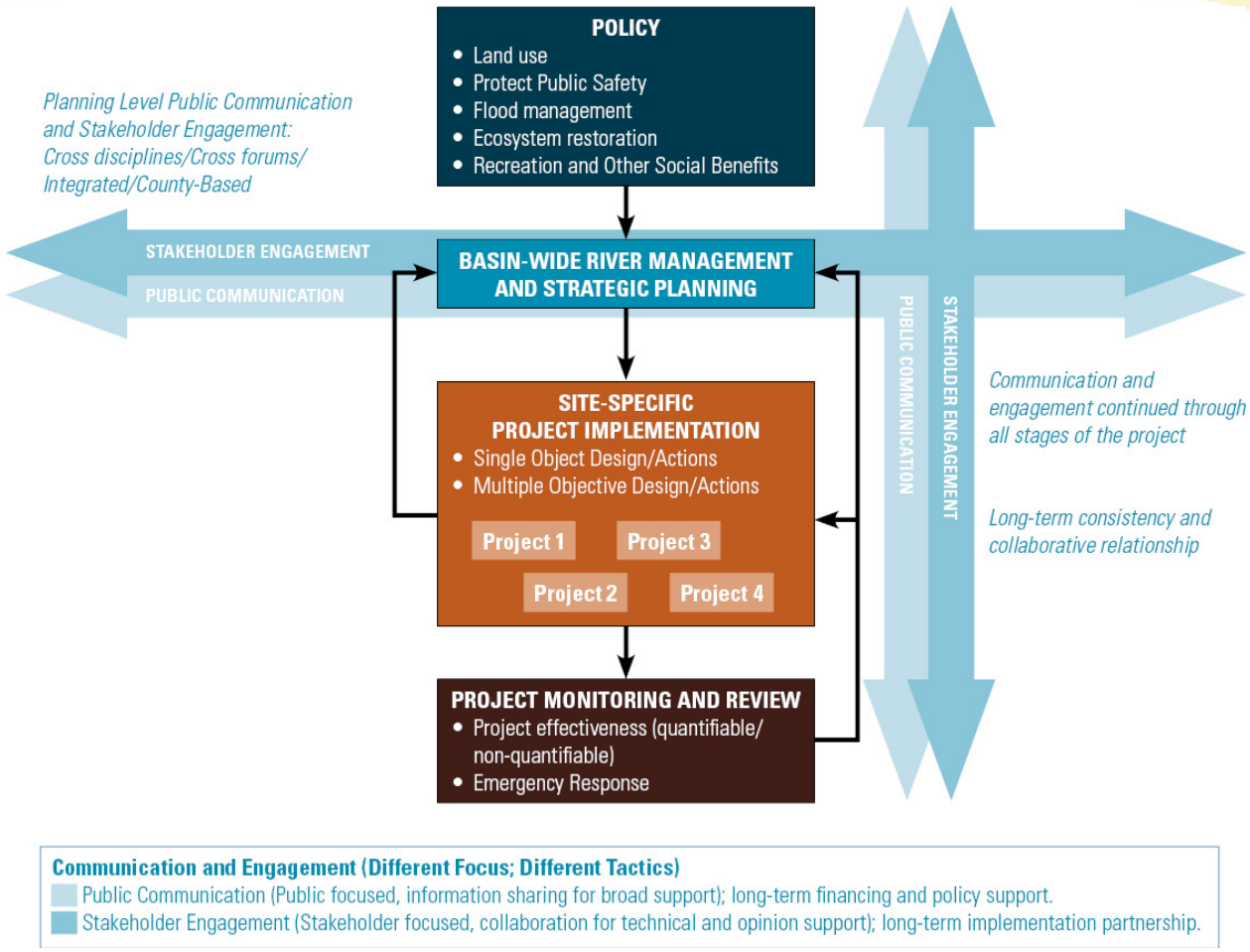

Figure 2: Recommended Stakeholder Engagement Strategy

Stakeholder participation processes benefit from technical facilitation and the application of collaborative analytical tools. Successful collaborative processes must be adapted to specific situations and based on standardized approaches, written guidance, and proven collaborative decision-making concepts.

Technical facilitation ensures that project specific processes be followed:

- Identification of all stakeholder objectives
- Prioritization of project objectives
- Identification of conflicts
- Identification of alternatives
- Establishment of measurements

Examples of collaborative analytical tools are as follows:

- Regulatory Process Mapping of:
  - Environmental Objectives
  - Site Selection Criteria
  - Public Safety Requirements
- Project Influence Diagrams
- Defined process participation for stakeholders

4.8.2 Defining Stakeholders

Ordinance 16581 and associated procedures appropriately identified possible stakeholders to engage. The extent of involvement with these stakeholders hinges in part on the "sliding scale" concept described earlier in section 4.5.2.1. Potential for more recreation impacts should result from additional outreach. If necessary, the Panel endorses engaging outside expertise that may include:

- King County Sheriff's Office (marine team);
- Cooperating local governments (e.g., cities, towns, homeowner associations);
- Interest groups (e.g., environmental NGOs, recreation user group NGOs, formal or informal recreation user groups, neighborhood groups); and,
- Local swiftwater rescue experts.

4.8.3 Use of the River Safety Council

Many of these stakeholders have participated in, or worked with, the River Safety Council, which offers one institutional mechanism for engaging these individuals as outside "experts" or more typical stakeholders. Initially developed in 1995 as the Boater Safety Advisory Committee, this group has worked to skeptically address specific problems associated with specific WLRD projects. The group took on a broader scope after the 1997 appeal decision by Titus, which included strong direction about considering recreation safety in project designs (similar to the Council's stated mission).

WLRD successfully worked with this group (or individuals that are members of the group) when more projects were being implemented in the late 1990s and over the last 4 or 5 years. In most cases, contacts appear to have been informal and the Council has been invited to comment on project objectives or designs as with any other stakeholder group. Although there are still some Council members strongly opposed to most LW projects or the floodplain connectivity paradigm, others appear to hold less ardent views. Based on this review, it appears that members of the Council have generally worked well with WLRD staff on several projects; in most cases designs were able to improve safety without eliminating habitat or bank protection benefits.

While the relationship with the Council (or some of its members) has been generally successful to date, it might be strengthened with a formal agreement about roles and responsibilities, independence of advice, and possible compensation for time spent for substantial effort. This would allow timely review of projects, with the WLRD recreation staff having a direct mechanism for engaging outside expertise as needed. The Council is also likely to benefit, becoming the "go to" institution for user groups and other stakeholders to gain access to the design process.

4.8.4 Greater Attention to Summary Information across Multiple Projects

Existing materials about WLRD flood management, habitat improvements, and stormwater projects are voluminous and detailed, but may be challenging to navigate for both stakeholders and the public. Although several excellent materials about WLRD's in-river programs and guiding mandates are available on the King County website, a concise but informative summary is needed. A summary narrative (<4 pages), chronology of milestones (< 2 pages), and table of program statistics (numbers of projects by era and type) would provide useful context. It is challenging to track the range of projects and guidance across the three WLRD business groups (habitat, flood control, and stormwater) without such summary materials and current documentation encourages a more myopic focus on individual projects rather than considering the cumulative thrust of multiple projects. Project prioritization occurs at multiple scales within planning agencies (Timm et al., 2004), but current processes in WLRD appear to encourage a project-by-project perspective. Greater attention to larger scale perspectives, and a strategic-level plan that summarizes the full scale of cumulative projects and likely consequences, could be very useful in communicating programmatic results to the public.

4.8.5 Assessing Public Safety Consequences

4.8.5.1 Distinguishing Types of Public Safety

"Public safety" broadly refers to the prevention of and protection from events that can harm an individual or damage property. In most flood management contexts it refers to injuries/deaths or damage from water that has left its ordinary high water channel (floods), while in recreation management contexts it refers to injuries/deaths (Search and Rescue or SAR incidents) or property damage associated with any interaction of people, water, and biophysical features in or near a river. For clarity's sake, the Panel refers to these as "flood-related safety" and "recreation safety."

These distinctions are important when interpreting the public safety "priority" of WLRD's LW projects. Projects address the two types of safety differently and designs and monitoring need to account for both separately (current project descriptions sometimes conflate them in objectives and general descriptions).

Although WLRD does not have a specific river recreation management program, it has clear recreation responsibilities for public lands in its inventories and has assumed several recreation management responsibilities related to in-river restoration and flood control projects. This includes providing information on LW projects and potential recreation consequences, placing warning signs at some project sites, and developing and implementing a natural LW hazard removal policy in conjunction with the Sheriff's Office. Although it is likely that other agencies (e.g., the State of Washington Department of Natural Resources for all rivers; US Forest Service for rivers adjacent to National Forest Lands) have similar or possibly greater responsibilities to assess and manage recreation on King County's rivers, the County has clearly been a cooperator and has led several recreation-relevant management activities. Moreover, Ordinance 16581 (and associated policies) appear to direct the County to increase its attention toward those activities as restoration or flood control projects are designed and implemented. Given that the county is implicitly assuming this increased role, the Panel believes they should more explicitly recognize the totality of these actions as a kind of recreation management program, even as it may not be responsible for all aspects of recreation on likely navigable rivers.

4.8.5.2 Individual Decisions and User Responsibilities

As with many outdoor activities, elements of risk and challenge are part of the attraction and agencies attempt to balance safety concerns with providing opportunities for users to test their skills. There are inherent risks to boating, swimming, wading, or fishing rivers, and many suggest that users should be responsible for assuming those risks when they enter a river corridor. Many land managing agencies, however, also have assumed responsibilities for reducing or providing information about hazards in their recreation management areas, especially those hazards that human actions have introduced. By adopting deliberative processes that consider actions to reduce or warn users about those hazards, WLRD can proactively help users make informed decisions about their activities and behaviors.

4.8.5.3 Recognition of the "Recent Historical Condition"

Boating, tubing and swimming in King County generally occur in rivers that have been modified (often confined in narrower channels), have altered flow regimes, and less LW. New river management policies allow more recruitment of natural wood, add LW or engineered structures that include wood and rock, and may encourage more natural flow regimes and riparian vegetation growth. All of these changes may feel "new" to recreation users, some of whom may resist such change.

4.8.5.4 Need for a County-Wide Safety Program

Ordinance 16581 specifies the need for a county-wide safety education and outreach program, a central idea developed by the 2009 Large Wood Stakeholder Committee and endorsed by the River Safety Council. The Ordinance implies that King County has responsibility for the increased hazards from LW projects at King County project sites, which may be offset by more robust education programs that warn users how to avoid those hazards. Input from the same stakeholders and the Council is likely to be important. A review of potential elements in this program is provided in Section 4.7 on monitoring and post-installation management, which are responsibilities that could be assumed by recommended recreation staff.

4.8.5.5 Variables that Affect Safety

The creation of a hazard in moving water involves consideration of a complex mix of factors. Boating safety literature generally notes that many variables are under the control of the user (equipment, skill, experience, etc.) while others are part of the environmental setting that tests a user's capabilities. Unless these variables are adequately accounted for, it is challenging to assess the relative risk of any given situation, let alone predict a specific outcome of certain types of users in that setting. The difference between a major and minor hazard can be a matter of inches or a slight angle of the wood's position; readers are cautioned from assuming that individual designs in a dynamic river setting can account for all of these variables.

User variables:
Level of skill in criterion craft
Experience on rivers in general
Craft capability and durability
Propulsion capability (number of paddles)
Attire / equipment
Information about trip conditions
Attention to conditions and route-finding
(Lack of) alcohol or drug use
Leadership capability within group
PFD use
Swimming ability and experience
Rescue knowledge and experience
Group size and cohesion
Challenge/risk orientation of user
Age and gender

Environmental variables:
Availability of "clear channel"
Visibility of potential obstacles
Flow (depths, velocities and "power")
Gradient of river and reach
Juxtaposition of rocks or wood
Hydraulics created by rocks or wood
Pinning/wrapping potential of rocks or wood
Substrate size, shape, and surface
Riparian vegetation
Water temperature
Water clarity
Air temperature

While the number of variables is high, the "equation" can be simplified by specifying "criterion" variables. For some river reaches, the focus will be on the most vulnerable user in typical environmental conditions, but in other cases, the focus might shift to higher skilled users in higher performance equipment and more demanding conditions to reflect the common uses of a reach.

In general, highly skilled boaters (or swimmers and anglers) are able to assess LW hazards and portage or otherwise avoid these obstructions. For less skilled recreation users, analysis of risk is much more challenging. To help develop a consensus opinion about criteria for which risk assessments are needed, the analysis choices could be made in consultation with stakeholders after a review of use, hydrology, or other information developed from studies.

4.8.5.6 Considerations for Minimizing Hazards of LW Structures

To understand a specific hazard presented by a piece of wood (or juxtaposition of several logs), WLRD has to consider the range of variables above, as well as the configuration of wood relative to current direction and power in the specific situation. Ultimately, the risk of the hazard comes down to a combination of the probability of a problem and the severity of consequences if that problem occurs. The Panel has compiled some commonly discussed issues for consideration as shown in Table 7 below (developed from Colburn, 2001; Colburn, in review; River Safety Council, 2009). Some items are labeled 'less hazardous'; however, this does not imply such design considerations provide safe conditions as they still contain some elements of risk.

Table 7: Commonly Discussed Issues

Considerations for Structure Design	
More Hazardous	**Less Hazardous**
• **Logs that span the channel.** • **Small openings that can entrap hands/feet, particularly those on current-facing edge.** • **Sieve characteristics, particularly those on the current facing edge.** • **Rough and sharp protrusions on the current-facing edge.** • **Structures with undercuts on the current-facing edge.** • **Branches protruding on the current-facing edge.** • **Use of chains or cables.** • **Logs level with the water surface elevations.** • **Logs that substantially constrict the channel or significantly increase rise of upstream pool.** • **Logs just barely submerged at boatable flows (difficult to see).** • **Erodible toe material (scour may create undercuts).**	• Align logs with current (parallel or near-parallel). • Removed branches (especially on current facing edges). • No space or loose connections if chains or cables are used. • Provide large rock or smooth wood to deflect current (create a "pillow" hydraulic"). • Rootwads closer to the bank. • Downward angled logs toward the river (higher on the bank, lower toward the river).
Considerations for Structure Siting	
More Hazardous	**Less Hazardous**
• **On the outside of bends.** • **In areas with short sight distances.** • **In direct path of the thalweg or fastest and deepest part of the current.** • **In the "boatable channel" at typical boatable flows.** • **In canyons, rapids, or constricted channels.** • **On smaller rivers with narrower channels.**	• On insides of bends. • In sloughs and backwaters. • Near lower gradient reaches or eddies for scouting and recovery. • At tops of islands when clear channels on either side are available. • At bottom of islands. • On larger rivers with wider channels. • Adjacent to beaches or bars that afford easier portage options.

4.8.5.7 Channel Spanning Logs or Log Jams

In smaller streams, it may be common for natural log jams or channel-spanning logs to require boater to portage obstacles. If human-built structures are designed for such river segments, and "racked" wood are likely to span the channel, this expectation should be clear to boaters/stakeholders. It may well be acceptable to change a currently boatable reach into one with many portages (which may develop a reputation as "unboatable") but this change should be considered explicitly. There may also be some reaches where the decision is made to avoid multiple portages by judicious hazard mitigation.

4.8.5.8 Wood Designed to Migrate

Some designs may expect log structures to deform or migrate over time, similar to natural LW. On some rivers, especially below dams with decreased LW recruitment, agencies may add LW designed to migrate downstream. To better mimic natural processes, these might be initially placed at elevations more likely to move at higher flows. Logs that become mobile at low to medium flows are likely to become grounded in low flow channels that tend to be used by less skilled recreation users.

4.8.5.9 Interaction with Natural LW (and Natural Wood Hazard Policies)

Human-built LW occurs in settings where there may be considerable natural LW and can be affected by policies to remove or mitigate hazards from natural wood. On most large rivers, hazards from natural wood are avoidable and it is rare for logs to completely block a channel. On smaller streams, especially in the heavily forested Northwest, channel spanning logs or log jams may be more frequent.

On many rivers with consistent boating use, agencies, outfitters, or even private users may cut out and occasionally blast these obstacles in the interests of access. Increasing recognition of the ecological benefits of LW has reduced the practice and boating advocacy groups are encouraging users to portage around rather than cut every potential hazard (Colburn, 2001). However, many river managing agencies do not have stated or well-developed standards for making these decisions and there is some debate of when it is acceptable to cut LW in the interests of safety or convenience (Colburn, 2001). WLRD "protocols for responding to naturally occurring large wood" are well thought-out and provide an appropriate developed framework for making defensible decisions

4.8.5.10 Restricting or Prohibiting Use Due to Hazards

In some situations, LW structures (natural, human-built, or a combination) create hazards severe enough for agencies to consider use warnings or restrictions. It is useful to distinguish between warnings or advisories that recommend certain uses or practices; use restrictions (e.g. requiring certain skills, minimum craft capability, PFDs, or behavior such as minimum group sizes); and use prohibitions (where users are required to portage or not use an area).

Some of the variables worth considering include:

- Legal or administrative designation of the river segment;
- Remoteness and character of the setting;
- How the hazard fits with other features in the segment;
- Likelihood of search and rescue incidents;
- Characteristics and attitudes of users;
- Availability of information about the hazard;
- Potential for resource impacts from users avoiding or portaging the hazard;
- Public and stakeholder acceptability of warnings, restrictions, or prohibitions; and,
- Liability implications of warnings, restrictions, or prohibitions.

In general, agencies are more likely to warn about such hazards than enforce restrictions or prohibitions, but WLRD has closed segments of the Cedar River due to log jams and many agencies and users have signed log jams or other impassable reaches. In addition, many agencies have PFD or minimum boat requirements to address safety concerns. In any case,

agencies that conduct formal deliberative processes that consider the full range of variables and offer explicit rationales for safety related decisions are likely to make better and more defensible decisions. Processes that include a substantial public involvement element are also likely to be better accepted and followed.

4.8.5.11 Warning or Restriction Signs

Education efforts may have "off-site" elements (e.g., information on websites, public notices through local media) as well as on-site signing at access points or the hazard itself. WLRD has utilized signs at access points warning of specific LW dangers or closures, and has employed signs at specific hazard structures, Figure 3: Mason Thorson Project, Middle Fork Snoqualmie River, 1999 . To be effective, signs need to be highly visible, grab the target users' attention, provide enough information so users understand the meaning and know what action to take, and be located appropriately so there is enough time to take the action (e.g., upstream of the eddy where users should stop to portage around the hazard).

Figure 3: Mason Thorson Project, Middle Fork Snoqualmie River, 1999

These are case-by-case decisions, but also can be improved by deliberative processes and written rationales for the decision made. There are several examples of signs and restrictions in use by various agencies across the country and WLRD could benefit from a review and the development of "best practices" that could then be employed consistently.

5 Recommendations

Based on the information presented in the report, the following section outlines program and specific recommendations to WLRD to improve the delivery of river management projects. These recommendations represent areas of improvement based upon the scope of this Panel review. In many cases, further analysis by WLRD, or outside expertise as necessary, would be recommended in order to fully improve upon existing project practices. Note that these recommendations are embedded in the discussion within Section 4, but have been compiled here separately in an abridged form for ease of reference and use by the County.

5.1 Summary of Critical Findings

The Panel's primary findings and associated recommendations are repeated below in Table 8, Major Findings and Recommendations.

Table 8: Major Findings and Recommendations

	Finding	Recommendation
1	**General support for ecological/dynamic floodplain management strategies** The scientific literature supports a shift from "hard engineering" to "ecological/dynamic" floodplain management strategies when possible. King County has missed opportunities to clearly describe these strategies and show how individual projects meet strategic goals or fit with current scientific theory and practice.	Develop a Strategic River Management Plan for river and floodplain project. This document should: • Summarize the legal drivers and policy mandates that encourage use of ecological/dynamic floodplain management strategies when possible. • Broadly describe the scientific and applied practice support for implementing ecological/dynamic floodplain strategies (while also identifying when more traditional approaches may be needed). • Clearly document WLRD's river and floodplain management strategy, including project objectives and implementation approaches at the multi-basin, watershed, and river segment scale. • Summarize programmatic processes by which individual projects are selected, funded, designed and sited, constructed, and monitored. • Connect policy and programmatic elements to existing FHMP and WRIA plans. • Suggest potential improvements in the upcoming revision of the FHMP to more clearly identify strategic planning objectives, management actions, and criteria for project selection and implementation. • Be concise and accessible to staff, agencies, stakeholders and the general public.

	Finding	Recommendation
2	**Clarify project objectives** County ordinances and policies prescribe the overall management directives and goals, but individual projects may have more specific objectives contributing to the overall goals, with prioritized actions associated with river basin, segment, and site considerations. These specific objectives should be clarified and linked to larger basin strategies, and potential tradeoffs identified between objectives. Improved objectives will better communicate why an individual project has been developed, what it intends to accomplish, how it fits with other projects, and how it collectively contributes to the overall program goals.	Based on the overall management plan(s) that delineate the overall goals and specific objectives (anticipated outcomes) from specific projects, develop concise summaries for individual projects. This short standardized document for each project should: • Clarify site-specific project goals and objectives and explain how they fit into the larger basin-wide or multi-basin strategies. • Identify potential tradeoffs between objectives for individual projects. • Communicate key project features and illustrate potential outcomes to help the public and stakeholders understand how those will help meet larger strategic objectives.
3	**Improve public and stakeholder collaboration** County procedures for public and stakeholder input during project planning, design and review could be more uniformly implemented to encourage stronger public support and stakeholder engagement.	Encourage earlier and more collaborative stakeholder involvement: • Encourage stakeholder engagement at basin-wide river management and strategic planning scales. • Develop earlier recognition when projects will have substantial recreational safety impacts and match levels of engagement with recreation stakeholders. • Design opportunities for stakeholders and the public to address potential problems through initial design and siting decisions, developing outreach to warn of potential hazards, or post-project mitigation.
4	**Inadequate formalized engagement of stakeholders regarding recreational usage** Public safety continues to be a primary concern as floodplain projects are conceived and implemented. Increased large wood recruitment, placed wood, and engineered log jams are likely to increase hazards for recreation users in some river segments. Formalized collaboration with recreation stakeholders and external recreation experts through the project lifecycle can improve project design and siting. Systematic inventories and explicit criteria can also help assess potential hazards in light of recreation use factors to help guide potential management actions to reduce, mitigate, or warn users about hazards.	Develop a dedicated "Office of River Public Use" (one to two staff) to coordinate recreational aspects of projects. This office should: • Encourage recreation stakeholder involvement in project selection, design, and siting. • Invite external recreational expertise to assist with recreation-sensitive projects. • Participate in project designs as an independent advisor. • Support or initiate recreation use monitoring to anticipate the types and amounts of recreation use that may be exposed to project related hazards, and develop management actions that can reduce risks from these hazards. • Support hazard monitoring to inform systematic public outreach programs. • Support and maintain a systematic record of wood-related safety or injury incidents. • Serve as a liaison to river recreation users • Work with stakeholders and education/

	Finding	Recommendation
		outreach specialists to raise awareness of river safety and potential hazards.
5	**Uncertainty of project consequences** Dynamic flood plain management strategies have inherently uncertain consequences even as standards can assure that projects' structural designs are sound. Project siting involves experimentation that increases the need for systematic monitoring and potential post-project mitigation to address flood management, ecological response, or recreation hazards. The extent of uncertainty should also be explicitly acknowledged to stakeholders and the public throughout the project life cycle.	Acknowledge inherent uncertainty with some project outcomes and identify responsibilities to mitigate adverse impacts (when possible) or avoid similar problems in future projects. This includes: • Improving documentation of considerations and recommendations in siting and design of structures to reflect the project-specific needs and local hydrological and hydraulic conditions. • Improving project-specific conceptual or feasibility planning document(s) that illustrate broader agreements about project objective priorities, proposed project details, anticipated and potential beneficial and adverse outcomes, performance measures and indicators of success. • Properly characterizing the reliability and longevity of structural designs and siting decisions relative to intended outcomes during the design phase. • Establish efficient and comprehensive monitoring to identify whether designs and siting are providing ecological, recreation, or flood protection successes so policy makers can review potential trade-offs for future projects. • Revise both internal and external (public) documents to clearly identify project uncertainty, and avoid implying that project outcomes can be predicted with great certainty.
6	**Standardize project monitoring and improve post-project mitigation response** WLRD conducts monitoring and post-project mitigation, but efforts are uneven and opportunities exist for improvement. Monitoring should assess cumulative effects across multiple projects in a basin, focusing on simple measures of ecological and flood management effectiveness that can help assess whether structure design and siting are achieving stated project objectives.	Establish standardized project monitoring approaches for all WLRD projects at watershed, river segment, and project scales. Monitoring should: • Focus on simple measures of effectiveness and tests of design and siting assumptions. • Include river-scale monitoring and evaluations to determine cumulative basin-wide project effectiveness. • Examine levels of recreation hazards in higher use recreation segments, and assess the proportion associated with placed or engineered large wood projects vs. natural large wood recruitment. • Formalize regular public monitoring reports at the river basin level. • Proactively communicate through reporting and/or documentation the nature

	Finding	Recommendation
		of unexpected or undesired project performance and the selected remedial actions.
7	**Lack of integrated program elements create an increased risk profile** A comprehensive program that includes objectives, system definition, regulatory strategy, stakeholder strategy, and aligned project procedures is not currently present. Independent but related program elements have converged to increase the County's enterprise-level risk profile. These include the use of experimental designs, recent program expansion, inconsistent application of procedures, varied levels of stakeholder involvement, and intermittent success in consistently balancing or communicating varied objectives.	Perform a comprehensive programmatic risk assessment that includes: • Risk Assessment - Perform a risk assessment that evaluates the impact to the DNRP of procedures, policy changes, organizational changes, new and reassigned staff, and new processes etc. that relate to department actions and objectives. • Program Assessment/Define System - Define how interrelated programs, procedures, objectives, and policies relate to each other to better prepare for intended and unintended consequences of planned actions. • Regulatory Strategy - Develop (or formalize) an enterprise level regulatory strategy in conjunction with oversight agencies that is built upon objectives and legal drivers. Focus on the paradigm evolution of King County flood/safety project balance with environmental restoration objectives. o Formalize and Integrate enterprise level regulatory strategies and objectives within the project identification, scoping, design, and execution procedures. o Establish formal policy, program planning, project coordination, and dispute resolution frameworks with each regulatory organization that have action or funding authority over King County. • Stakeholder Strategy - Create a stakeholder engagement strategy that incorporates risk assessment findings, paradigm shifts, competing regulation prioritization, and lessons learned that influence project execution.

5.2 Additional Recommendations

In addition to the primary set of issues identified above, additional recommendations to improve WLRD practices and procedures are as follows.

5.2.1 Program Level Recommendations

Project Management

The Panel recognizes that a Project Management Manual is currently being developed for use by the WLRD. Finalization of this document and adherence to best management practices will provide a strong framework for project implementation improvements.

Specific recommendations associated with improving project management practices include:

- Improving alignment, coordination, and communication between engineering and construction management and ensuring operations and construction management staff are given the opportunity to review and comment on design submittals during the planning and design process.
- Standardizing the use of issue logs and decision logs throughout the project implementation process to promote issue visibility and tracking issue resolution.
- Maintaining a system of lessons learned to better utilize information gained on projects and to develop and apply internal standards, as appropriate, to future projects.
- Improve continuity and compliance with standard QA/QC procedures and protocols to ensure standards are met.

Risk Management

Risk management is a fundamental component of program and project management. Risk management is defined as the activity of identifying and controlling undesired outcomes proactively. The Panel recommends a proactive risk management approach be established as summarized below:

- Develop a comprehensive programmatic risk assessment to determine additional areas of focus that have not been identified as part of this high level review effort.
- Develop a more formalized and standardized project level risk assessment on WLRD projects.
- Develop a procedure for post project analysis to measure how the implemented risk program appropriately addresses project risks.
- Understand how cost and schedule risk profiles change due to varying regulatory requirements associated with the project alternatives.

Regulatory Strategy

Develop an enterprise level regulatory strategy built upon objectives and legal drivers which will include the following:

- Formalize and integrate enterprise level regulatory strategies and objectives within the project identification, scoping, design, and execution procedures.
- Establish formal policy, program planning, project coordination, and dispute resolution frameworks with each regulatory organization that have action or funding authority over King County.

Project Controls

Project controls and project scheduling are an essential component of program and project management. The Panel recommends a proactive project controls approach be implemented as summarized below:

- Create a WLRD project controls standard operating procedure that clearly defines data input and integrity requirements. Input should be obtained from senior staff to develop a project schedule template with typical activities and milestones.

- Establish monthly internal design and construction management project review meetings. Specify contractor cost and schedule performance metrics to be reviewed and reported. Each review should be formally documented.

5.2.2 Project Scoping and Planning Recommendations

WLRD Strategies, Objectives and Project Definition

Project planning is a great opportunity to outline the management decision-making process in balancing among multiple river management objectives. Accompanied with the strategic stakeholder engagement process, this would establish a solid basis for public support and understanding.

Project objectives should be aligned with established King County policy objectives for:

- Public safety
- Environmental objectives
- Cost targets
- Public involvement
- Inter program coordination

Specific recommendations associated with incorporating strategies, objectives, and project definition include:

- Create and provide improved project summaries, specifically including information relating to larger planning drivers at the early stages of project planning.
- Clarify individual project descriptions and make these more transparent with regards to identifying project funding sources, key mandates, and outside regulatory drivers. The project descriptions should explain how competing project objectives are met.
- Develop consistent templates, guidelines, and examples to improve "chartering" and begin the process of allowing decision-makers, stakeholders, and the public to understand explicit project objectives and how they fit in with larger planning or funding programs.
- Develop key performance indicators for monitoring achievement of project goals and objectives, including evaluation of project outcomes

Flood Management Strategic Planning

Specific recommendations associated with flood management procedures include:

- Implement a more robust flood management plan approach to address the long-term system needs for flood management, in the context of other resources management needs. One commonly used approach is outlined in U.S. Water Resources Council's 1983 *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (P&G).[1]
- Revise the 2006 FHMP in order to develop a truly explicit and effective written strategic plan for floodplain management throughout King County.
    - Work with stakeholders to develop a definition of "Imminent Threat" to achieve a common understanding of the threshold for what constitutes an imminent threat per the FHMP.

[1] The recommendation of the planning approach in the P&G does not mean King County would have to take the same analytical process to define economic interests or select the national economic plan. Rather, it demonstrates a robust planning process. The P&G is current under revision to allow more flexibility in plan selection and additional integrated resources management benefits.

- Develop additional text to include within planning documents to identify longevity and life span of habitat structures, including when and where to apply various types of structures, such as large wood or rock.
- Revise the definition of 'objectives' to include establishment of specific outcomes through implementation.
- Develop a system of criteria prioritization and clearly document in the FHMP

Strategic Implementation Plan

An explicit written strategic implementation plan will help build a relationship between WLRD and its stakeholders by clearly defining policy direction, project selection, design procedures, and implementation practices. The plan needs to be concise and accessible to both public and professional readers and should incorporate the following:

- Explicit policy base for current direction, including external agency policy, public safety policy and how these policies interact, overlap, and complement each other.
- Explicit processes by which projects are prioritized, sited, and funded; designed, implemented, evaluated, and managed post-implementation.
- Clear criteria used to factor ecological, economic, and social considerations into the project prioritization.
- Provide individual capsulated strategic plan for each river basin and a set of priorities that outline basic steps needed to attain a desired future condition.
- Identify a specific, staged process for project design that includes both internal and external review steps and identification of specific risks to property and public safety.
- Identify an explicit monitoring process and emergency response process to manage, mitigate, and adjust projects during and immediately after large floods.
- Identify a process for biennial evaluation and public reporting, which reports the cumulative effects of actions taken by WLRD on each river, placing them in context with other factors to ascertain that projects are contributing in a satisfactory manner toward improving the ecological, economic, and social conditions of the river as a whole.

Team Augmentation Considerations

The Panel identified a need to additional recreational staffing to ensure that recreational impacts are properly addressed.

- Develop a dedicated "Office of River Public Use" with at least one staff position to coordinate all aspects of compliance with the recreation ordinance and associated procedures. Staff would serve as the initial recreation member(s) of project teams and would support projects through the following specific responsibilities:

    - Encourage recreation stakeholder involvement in project selection, design, and siting.
    - Serve as liaison and point of contact for river recreational users.
    - Conduct studies that measure types and amounts of recreation use on County rivers for consideration during project selection and design.
    - Participate as an independent advisor to project design teams during site selection, conceptual design, detail design, and 90-percent implementation reviews.
    - Invite external recreational expertise to assist with recreation-sensitive projects.
    - Support hazard monitoring and work with education and outreach specialists to develop and implement public education programs, including effective signage and other communications

- Include specific outside recreation expertise as necessary, which may include recreation users, SAR responders, the King County Sheriff's Office marine officers, recreation advocates, or members of the River Safety Council.

5.2.3 Design Recommendations

Design management is an essential component of program and project management. Specific recommendations associated with design management procedures include:

Stakeholder Engagement

- Develop formal procedures to allow for stakeholder engagement at the onset of the design process.
- Assess the full range of recreation users with potential safety or other consequences. Information collected could include:
    - Summary of types of uses and relative use levels;
    - Trip characteristics;
    - Local tubing opportunities;
    - Detailed information about user characteristics; and,
    - Detailed information about safety related attitudes, knowledge, and behaviors.
- Establish a standard compliance gateway to ensure that each project adequately addresses these recreational safety considerations.
- Communicate the potential consequences of WLRD introduced and naturally occurring hazards to help river users make informed decisions about their recreational activities and behaviors.
- Develop a framework for making decisions about specific conditions under which warnings, restrictions, or prohibitions would be enacted.

Design Specifications

- Document the design elements and expectations for each project.
- Clarify design expectations with stakeholders, including design life of ELJ and LW structures.
- Recognize the uncertainty that is related to natural, environmental processes that are unmanageable.
- Clarify floodplain capacities for levee setback project and identify sufficiency of such setbacks on specific projects to ensure meaningful natural processes.
- Increase focus on riparian elements along river banks to serve ecological objectives.

Technical Reviews for Design

- Develop a formal process for reviewing project selections and design approaches. This review process could include external technical experts.
- Ensure correct diversity of project team members by incorporating all disciplines early in the project scoping and design process.
- Implement a monitoring program, whereby all design assumptions and uncertainties are checked. As part of this, WLRD can identify the highest priority "need to know" metrics, how to measure them, and what the results mean with respect to project performance.

5.2.4 Construction Recommendations

The following construction management enhancements are recommended:

- Standardize constructability reviews at all stages of the project, including preliminary design.
- Standardize construction management processes in the field for all projects, regardless of size and complexity. This should include at a minimum maintenance of all construction logs (submittals, RFIs, Change Requests), progress meeting minutes, construction photo logs, and daily inspector's reports.
- Ensure that the construction contractors implement their respective quality control programs.
- Maintain on-going logs of minor work items to be completed or corrected and review these with the contractors' staff on a regular basis throughout construction. By developing these deficiency lists, most corrective work can be completed prior to the final acceptance inspection which keeps the project moving forward and streamlines the closeout/final payment process.
- Construction management staff should consistently involve the design team in proposed project changes to ensure that project objectives are still achieved.
- To improve construction coordination, WLRD should ensure that the Project Management Manual that is currently under development includes standardization of construction management practices.

<u>Recreational and Safety Considerations during Construction</u>

- Develop best practices for consistent implementation of warning signs and specific site restrictions.
- Utilize off-site programs that focus on encouraging river users to take responsibility for their equipment and safety-related decisions.
- Update existing King County web pages to communicate status of existing projects, including interactive maps, river use descriptions, photographs, and links to safety information on specific river reaches. Updates should happen prior to seasonal recreational use.

5.2.5 Monitoring Recommendations

The Panel review recognized that program level monitoring and reporting procedures were not standardized or consistently enforced. Projects being implemented by WLRD could have an impact on neighboring jurisdictions, altering the rivers function and impacting the ultimate program goals. It is apparent that there is a need to account for both the effects of County-sponsored projects and events in the same ecosystem.

Subsequently, recommendations associated with monitoring procedures could include:

<u>Pre-Project Monitoring</u>

- Collect and document recreation use levels and trends along all King County Rivers to provide baseline usage data.
- Evaluate upstream and downstream river system dynamics to better assess impacts from planned WLRD projects.
- Collect data on the cumulative effects of multiple LW projects on recreation and aesthetics, focusing on stakeholder and public perceptions and attitudes towards these projects and the associated trade-off in project objectives.

Post Project Monitoring

- Develop a systematic monitoring program that assesses both natural and project-related hazards. The monitoring program should focus on simple measures of effectiveness and performance to test design assumptions.
- Implement a comprehensive monitoring plan to determine whether the design achieves the project objectives
- Develop a comprehensive database of in-channel SAR incidents, organized systematically to allow comparisons of types, factors, and locations.
- Monitor and document the performance of WLRD's emergency response
- Monitor changes in river conditions upstream and downstream of the project reach to better understand potential impacts on expected project performance.
- Include monitoring of other upstream and downstream private projects or projects constructed by other agencies to assess impacts on King County projects.

5.2.6 Public Communication and Stakeholder Engagement Recommendations

WLRD is committed to public communication and stakeholder engagement during the life cycle of a project. In order to achieve general stakeholder consensus on project objectives, however, the following public communication and stakeholder engagement enhancements are recommended:

- Shift the current stakeholder engagement focus from the project level to the basin-wide river management and strategic planning level.
- Establish a long term stakeholder engagement process so that continuity and different perspectives can be fully communicated and provide the opportunity for mutual education and exposure throughout the project life cycle.
- Utilize technical facilitation and application of collaborative analytical tools during the stakeholder participation process.
- Prepare summary documents, which are available on line, that provide general project objectives, constraints, and design details to assist with communication of project conditions to the general public.
- Engage recreational expertise in determining project impacts on recreational opportunities.
- Formally engage (continue to engage) the River Safety Council.
- Continue engagement with the public after projects have been constructed to provide additional information, as necessary, to warn users of river project hazards.
- Assess public safety consequences:
    - Define types of public safety.
    - Develop deliberate processes that reduce hazards or warn users.
    - Establish a County-wide Safety Program.
    - Evaluate typical user variables and environmental variables to establish relative risk.
    - Work with the community on the consideration of less hazardous project designs and expectations on community recreational usage.

6 Conclusions

The County is faced with a complex regulatory framework that has been in a state of change for some time. As such, the progressively minded staff at WLRD appear committed to learning and implementing a scientifically-based program for river and floodplain restoration. WLRD direction is also focused on integrating important public safety and river ecological considerations into its floodplain management practices while seeking to fully understand the complexities of doing so. Programmatically, WLRD has effectively anticipated substantial federal or state mandates associated with flood risk and endangered species management, developing approved programs that preserve greater local management flexibility when compared to many other jurisdictions. Taken together, WLRD's programmatic goals and objectives are proactive and responsive to the evolving scientific literature on the hydrology, ecology, management and restoration of floodplains and rivers.

Despite this proactive approach to river and floodplain management, there are considerable opportunities to improve the program and develop more successful projects. There has been a paradigm shift in floodplain management where traditional strategies that focus on channelization and levees to protect property have been increasingly replaced by more progressive techniques. These new approaches encourage setback levees, broader floodplain connections, increased large wood recruitment, and greater channel dynamism to improve habitat while protecting public property and providing acceptable recreation conditions. As the County implements these evolving approaches, there are increased responsibilities to understand and improve designs, siting, construction, and monitoring/mitigation to reduce adverse consequences. While these new approaches may not be able to restore all river segments to their full natural potential (and other segments may continue to require some traditional bank stabilization or levee protection), they offer promising alternatives to meet multiple public objectives for less cost.

The Panel concludes that WLRD uses scientifically accepted principles for managing floodplains within the context of balancing other stated policy objectives. While there has been at least one identified project failure in the past (unintended remobilization of LWD at the Cedar Rapids site), no consistent or systemic design or siting failures invalidate the new approaches to floodplain management or urge a moratorium on additional projects. Instead, the Panel recommends several connected procedural reforms that will better help select, design, construct, and monitor projects (or address post-project impacts as necessary). Taken together, these systematic improvements are more likely to identify designs and siting that will restore habitat while protecting floodplain development and provide recreation in accordance with programmatic objectives.

These reforms recognize the considerable uncertainty involved in allowing river segments to become more dynamic. Such projects will probably increase hazards in some river segments, and King County may need to assume greater responsibility to identify and possibly mitigate some hazards, while providing more systematic public outreach efforts to warn recreational users. In some situations, specific project designs or sites may need to be avoided to reduce the risk of recreation hazards. Similarly, although there are well-established structural design guidelines for engineering large wood structures, siting decisions are largely based on professional judgments that interact with the inherent variability of dynamic river systems. The Panel recommends identifying and acknowledging these less certain project elements through earlier and more effective communication with stakeholders. More extensive stakeholder

engagement during project selection, siting, and design will allow the County to more clearly define project expectations, failures, and success.

Panel members express their thanks to the WLRD and its management and staff for their input and their open and frank discussions, and welcome further dialogue regarding the findings and recommendations discussed in this report.