

Recommendations to Accelerate Estuary Restoration in Puget Sound

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Summary:

Development of Puget Sound estuaries has resulted in a loss of over 64,400 acres representing 74% of estuary wetlands and associated services. Progress towards recovering estuary acres is incremental and challenging. The people who develop and implement the projects understand best what stops us from completing this work. To evaluate barriers to project implementation, we completed 20 hours of interviews with 65 people directly involved with estuary restoration project development. We identified six ingredients necessary to complete future planned work. The ability to be nimble in acquiring land is the most challenging ingredient in most landscapes. Sociopolitical conflicts over changing land use, and the inefficient process for securing full project funding puts a severe strain on very limited capacity available for the project development phase of work. Sixteen recommendations are proposed that may accelerate restoration of estuaries in Puget Sound.

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1

Introduction

Simenstad and others (2011) document a loss of approximately 74% of vegetated tidal wetland across Puget Sound over the last five generations. These losses have occurred both in the 16 largest river deltas (with a 77% loss of vegetated tidal wetlands), and among smaller estuaries and barrier embayments (with a 67% loss). This vast deficit of approximately 64,400 acres of estuarine habitats represents one of the most significant historical injuries to Puget Sound's shoreline ecosystems (Fresh and others 2011). In addition to the loss of area, the impoundment of river sediment behind dams, confinement of river floods by levees, and the pollution of waters and sediments has reduced the function and resilience of surviving estuaries.

These estuaries only occur where rivers and streams meet the sea. They are dynamic, uniquely productive, rich in uncommon species, and irreplaceable. They provide fertile refuge for salmon during the stressful transition from fresh to salt water (Fresh 2007). Restoration of estuaries is needed to recovery of some of our most significant remaining wild salmon populations (Greene & Beamer 2005). These productive shallow waters are used as nurseries by many species (Hughes and others 2014). After itemizing the recreational, cultural, economic, and regulating services of salt marsh, Molnar and others (2012) estimate a service value to our economy of between \$405 and \$54,765 dollars per hectare per year. This places the lost value of Puget Sound tidal wetlands at somewhere between \$10.7 million and \$1.4 billion per year over decades¹.

Increasing wetland area is not the only work needed to protect and restore estuaries. Recovering the historical distribution and composition of estuaries may be vital for some species. We must also manage the functions and resilience of remaining estuaries from the threats of climate change and reckless development. Given the massive area of estuary lost, incremental gains in existing estuary function will not lead to significant ecological recovery. An emphasis on restoring historically estuarine areas to the tides focuses our attention on important and politically difficult questions about the current condition of estuarine lands, and their best and highest use.

In 2011, following a generation of estuary advocacy, the Puget Sound Partnership Leadership Council adopted "restoration of estuary acres" as an indicator for tracking Puget Sound recovery, and set a year 2020 target to restore 7,380 acres of quality tidal wetlands. With five years remaining, only 2,260 acres have been restored to the tides, and a quick review of project status says we are not going to reach our target. It is important that we know why.

To better understand the challenge of estuary restoration we need to talk to the people who do the work. A mixture of state, county, tribal, district, and non-governmental field staff spend their days talking with land owners and local leaders, developing project concepts, acquiring land, and gathering the resources to restore tidal flows. These individuals have the most intimate knowledge of how to restore an estuary, but they are often distant from the policy debates of agencies, and rarely have the time and opportunity to influence the systems of authority and funding that control their work. If our agency systems and policies become disconnected from the practical work of protecting and restoring ecosystems we increase the risk of waste and failure.

¹ Molner and others (2012) calculate ecosystem service values in 2010 Canadian dollars per hectare. These values were converted to US dollars using the approximate 2010 exchange rate of 1 CAD = 0.95 USD. All historical vegetated wetlands were assumed to have the values equivalent to those for salt marsh. Figures are rounded off for conversational purposes.

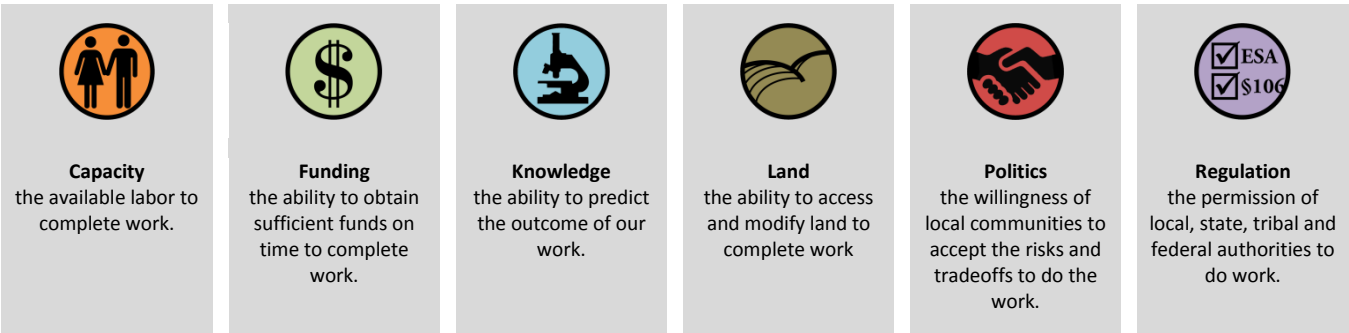
While other authors have provided insight into how we can enhance the watershed recovery system (for example, Blackmore (2009) and Sahandy & Daily (2014)), this analysis narrows focus to a specific landform, to explore specific mechanisms for solving problems in specific places. This report attempts to summarize barriers to large estuary restoration in Puget Sound from the perspective of people doing the work, and offers a set of recommendations from those conversations to accelerate estuary restoration.

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Methods

In fall and winter of 2014 and 2015 the River Delta Consortium sponsored a series of interviews with Puget Sound river delta restoration practitioners. We assembled focus groups in collaboration with Watershed Leads and Lead Entity Coordinators. To prepare for interviews, we summarized factors affecting our ability to complete capital projects in estuaries as described in draft Chinook Monitoring and Adaptive Management analyses. At each interview we proposed that six ingredients are necessary for estuary restoration (Figure 1).

Figure 1 – Six ingredients necessary to restore a Puget Sound estuary. Concepts were taken from watershed Chinook adaptive management planning and were verified with informants.



We conducted ten, two-hour meetings with sixty-five informants working in all sixteen large river estuaries as identified by Simenstad and others (2011) and many smaller stream estuaries (see Figure 3). Our informants were technical staff and managers working for tribes (18), counties (17), non-governmental organizations (12), state agencies (4), conservation districts (4), ports (4), federal agencies (3), and contractors (3). We did not consult in West Sound, Island or San Juan watersheds because of limited capacity and the absence of large river deltas.

After reviewing past and planned estuary restoration actions (to be described in a future report), we asked each group to consider their plans, and tell whether they were confident they could muster the conditions necessary to achieve their goals. We used a qualitative four point scale to describe each group’s confidence in each ingredient described above: “confident”, “possible”, “uncertain”, or “trouble”. Where our interview group faced distinct situations in different systems, we allowed the group to divide their work into more than one scenario. Perhaps more importantly than the rating, we asked questions to better understand the specific circumstances that informed each rating. After interviews, informants were individually provided the notes from our conversations, and asked to correct or clarify any inaccuracies. Informants also had an opportunity to review the draft text, including nineteen recommendations, which were reduced to the sixteen

recommendations provided herein. Of the sixty-five interviewees, eighteen chose to provide substantive comments. While I reserve responsibility for the final text, ultimately, all those comments were incorporated to the best of my ability to improve this report.

While we focused on the 16 largest river deltas, informants identified additional sites that are part of their estuary restoration ambitions. These estuary sites described by our informants were grouped into four scenarios, based on the character and extent of planned work, and similarities in the social and technical challenges faced in each system: agricultural systems, urban systems, rehabilitation work, and smaller systems. The synthesis of findings is organized around these four scenarios. A few additional interviews were completed to better describe sociopolitical issues in agricultural estuary landscapes, which influenced the narrative and recommendations surrounding agricultural estuaries.

While we had standard methods and structured our information management, this is not a social science project. My methods were focused on developing a collegial understanding of the restoration system that we have collectively created. My goal was to identify shared concerns and ideas, rather than to ascribe a particular opinion to a particular informant in a particular system. While I have tried to present these ideas with a neutral point of view, I have not rigorously checked all facts, or fully analyzed all ideas developed through interviews. Finally, this analysis primarily reflects the opinions of estuary restoration *advocates*, and not other stakeholder groups that live and work in estuaries. This analysis is intended as a starting point for improving the estuary restoration system, and developing more refined efforts that solve problems in specific situations.

3

Synthesis of Findings

Our informants confirmed that our six ingredients generally describe the conditions necessary for estuary restoration. Our description of local political support was expanded to include the need for a willing partner to accept liability for altering flood and drainage infrastructure. In many cases the six restoration ingredients interact. For example, capacity informed by knowledge, combined with flexible funding may help resolve politics in some systems. Funding can be used to increase some kinds of capacity in some situations. Problems in permitting may, in fact, be political problems that emerge during public review of permits. Current legislative debates over funding for land acquisition may be driven by political concerns about loss of land base.

The differences among how local teams described delta restoration suggest that we face distinct restoration scenarios across Puget Sound. The Deschutes Estuary stands out as a unique situation—an urbanized estuary largely under government control, where a single restoration action would completely restore historical tidal flow. Other estuary restoration scenarios described by informants were sorted into one of four groups:

- A. Agricultural Estuary Reconstruction** – Where levee setbacks could restore hundreds or thousands of acres to tidal flow, but would result in a loss of farmlands. (NOOKSACK, SAMISH, SKAGIT, STILLAGUAMISH, SNOHOMISH)
- B. Urban Estuary Enhancement** – Where fill removal is required to recover intertidal lands in industrial landscapes at a high relative cost. (DUWAMISH, PUYALLUP)
- C. Tidal Estuary Rehabilitation** – Where a variety of efforts aim to increase functions or resilience in systems where tidal flow is relatively intact (sometimes because of recent restoration). (NISQUALLY, SKOKOMISH, HAMMA HAMMA, DOSEWALLIPS, DUCKABUSH, QUILCENE, DUNGENESS, ELWHA)

D. Smaller Estuary Restoration – In addition to the 16 large deltas, informants identified additional sites where restoration may recover tens of acres and improve functions among a network of large stream estuaries. While we noted these systems, we did not extend our analysis to consider each of these systems in detail (PYSHT, HOKO, CLALLAM, SALT, SALMON-SNOW, JIMMYCOMELATELY, BIG BEEF, UNION, TAHUYA, GOLDSBOROUGH, SKOOKUM, CHAMBERS, CHICO).

Generalizing about delta restoration can create confusion—each scenario contains a different set of problems and solutions. While our interviews reinforced the uniqueness of each estuary situation, a few strong, repeated patterns were observed in most of our interviews.

- Nimble and incremental acquisition of historically estuarine parcels of land is the crux of large estuary restoration in almost every situation.
- The ability to acquire land is commonly compromised by funding policies, or by local sociopolitical conflicts.
- The capacity of many delta workgroups is stretched thin by the processes of securing incremental funding and trying to manage sociopolitical conflicts.
- No workgroup identified insufficient knowledge or project regulation as among their most significant barriers to completing the work, although a few informants involved in estuary research suggest that we know less than we think we do.

Figure 2 describes how groups rated their level of concern about the ingredients required for restoration. Restoration in agricultural estuaries was dominated by sociopolitical conflicts over the potential loss of agricultural land base and absence of a vision for the future acceptable to both restoration advocates and agricultural stakeholders. In the Samish, these conflicts combined with an absence of salmon recovery funding have forestalled discussion of tidal wetland restoration. Urban estuary restoration lacks these political tensions and is limited primarily by the availability of funding and the slow opportunistic purchase of expensive industrial lands. In tidal rehabilitation situations, where restoration doesn’t strongly impact agricultural systems, political concerns still dominate, but vary depending on the interests of rural land and business owners, or the presence of public infrastructure. Uncertainty is greater in these situations where restoration involves more subtle modification of system dynamics rather than restoring tidal flow.

Figure 2 – Typical level of concern about the ingredients necessary for restoration. Different concerns were expressed by urban practitioners compared to others. Red is equivalent to “trouble” and green is equivalent to “confident”. We did not specifically evaluate limiting factors in each smaller system.

	Trouble	Uncertain	Possible	Confident
	All Groups	(A) Agricultural	(B) Urban	(C) Tidal Rehabilitation
Politics				
Land				
Funding				
Capacity				
Knowledge				
Regulatory				

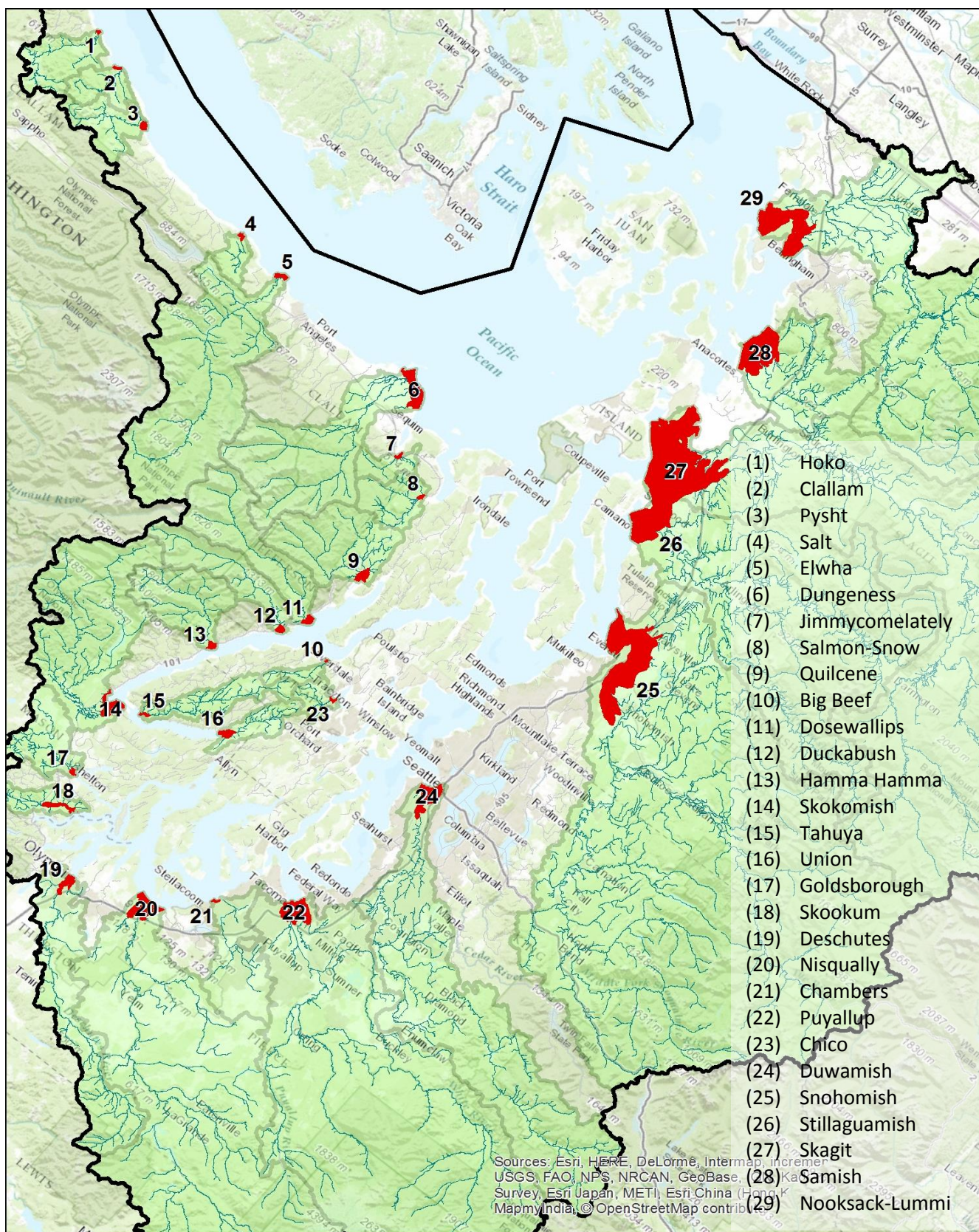


Figure 3 –River delta systems (Simenstad et al 2011), and thirteen additional estuaries identified by informants as target systems for large scale restoration or rehabilitation of estuarine acres in the Puget Sound basin.

General Issues

A number of ideas were repeatedly raised by different focus groups. They are discussed here first as general themes that might be regionally important for large estuary restoration. After a synthesis of ideas captured from interviews, I describe recommendations, developed further in Table 1.



Politics –While the precise flavor of sociopolitical conflict varied from system to system, informants typically believed that increasing the quality and quantity of communications between leaders of interest groups was critical to finding pathways to restoration that resolve social conflicts. Many informants referenced the thin line between local political concerns, and interpersonal conflicts or even resentments, and pointed to the importance of developing personal as well as institutional relationships.

Recommendation #1 addresses how agencies collectively enter into local restoration dynamics.

Recommendation #2 proposes stronger coordination and facilitation within local teams that represent diverse stakeholders.



Land – Future estuary restoration will only occur thorough acquiring and flooding a specific set of parcels. Restoration opportunities on public lands are nearly exhausted. While we can enhance existing estuarine lands to some degree, recovery of lost estuary area will require acquisition of private land and returning it to the tides. **Recommendation #3** suggests improving how acquisition programs respond to the specific needs of large estuary restoration efforts which incrementally acquire and hold parcels to build large projects. **Recommendation #4** examines how we set estuarine parcel value to incentivize sale.



Funding – Generally, capital programs are willing to fund large projects that are ready for construction. Existing funding sources, however, may not support all the necessary tasks over a project lifecycle. Project development activities prior to engineering design, and the community engagement necessary to resolve sociopolitical conflicts are poorly supported by capital programs. The state Puget Sound Acquisition and Restoration Large Capital, Floodplains by Design and Estuary and Salmon Restoration programs are suited to large estuary restoration. There are no comparable regional federal funding sources to match the scale of these large state investments. Restoration costs will likely range from \$20,000 to \$160,000 per acre depending on the need for infrastructure realignment (Estuary and Salmon Restoration Program unpublished data). Proposed targets would require somewhere in the vicinity of \$100M to \$800M requiring several to many generations of effort at current funding rates.

To implement complex projects, project managers complete a series of applications, contracts and reports to multiple public funding sources. The varied schedules, formats and requirements of these awards results in waste at the most damaging point in the supply chain by diminishing the capacity of the local teams responsible for developing and implementing projects to placate the needs of large institutions.

Recommendation #5 encourages development of multiple benefit projects that enhance other open space values to attract additional investment. **Recommendation #6** suggests that eliminating redundancy in funding selection and contracting procedures can protect limited project management capacity. **Recommendation #7** identifies reform of matching requirements as an easy mechanism for reducing wasted effort.

Recommendation #8 proposes a role for ecosystem service markets to increase resources applied to restoration. **Recommendation #9** suggests revolving funds as a tool for making acquisition funding more nimble.



Capacity – Local staffing, particularly in county governments, was commonly identified as a challenge to restoration. Lack of county engagement can create barriers, as counties are responsible for negotiating the conflicting interests of citizens, may own the land being restored, and may have jurisdiction over flood management or regulatory review that includes requirements to consider the needs of other stakeholders. The episodic nature of estuary project work makes it difficult to sustain staffing levels over time. Sociopolitical conflicts over restoration increases the need for local project capacity, while simultaneously decreasing local public interest in paying for that capacity. While increased funding can be used to contract temporary capacity, there is a need for consistent individuals that are able to build institutional memory and social networks necessary to implement projects. Some of these functions cannot be acquired through contract labor. **Recommendation #10** specifically identifies funding for project development staffing as a limiting factor. **Recommendation #11** suggests that better development of standard estuary restoration practices may support more efficient use of existing capacity and may decrease political conflicts emerging from lack of transparency. **Recommendation #12** suggests the more intentional use of regional assets to support local projects.



Knowledge – Lack of knowledge was not identified as a significant barrier to project completion, particularly compared to more pressing barriers. Several informants suggest that restoration advocates may be overconfident in the benefits of project work, and may be unaware of risks.

Competition for funding and political conflicts may create situations where revealing uncertainty may threaten an award or may delay a project. This discourages project managers from discussing uncertainty publicly, even as they privately work to obtain scientific evidence. These dynamics may lead to a reliance on generalizations for selecting projects and designing treatments, potentially threatening public confidence in estuary restoration investments.

Project managers appear comfortable with qualitative predictions, and typically do not make quantitative predictions about project outcomes. Very few estuary restoration efforts are built on a clear prediction of how sea level rise will affect estuary function over time. Few projects complete a robust quantitative evaluation after treatment. Development of robust quantitative evaluation tools is expensive and generally not supported by the capital programs. Scientists face year-to-year challenges in maintaining high quality investigations. Myriad less expensive monitoring protocols are available, but are also poorly funded, may operate at an inappropriate scale to detect project effects, and if they do manage to detect something other than the obvious, they are unlikely to provide the knowledge needed to improve future project work.

Uncertainty about project effects can both cause sociopolitical conflict, and can be used as a tool for expressing political discontent. Communities that do not support restoration conceptually may elevate uncertainties not shared by restoration practitioners, and demand new knowledge development, increasing project costs and drawing out timelines. These conflicts may reflect a lack of shared vision rather than a lack of knowledge. Alternately, stakeholder concerns about groundwater effects, changes in drainage rates, impacts to shellfish cultivation, or salt intrusion could identify project risks not anticipated or discounted by restoration advocates.

While individual workgroups are struggling to investigate estuary restoration, they are not well supported by or integrated into the capital project systems. **Recommendation #13** suggests a significant need for coordination and funding of scientific investigations that systematically reduce estuary project risks, and are integrated with capital program pre-design and feasibility work.



Regulation – Gaining government agency permission was not identified as a significant barrier to restoration by most informants. However, the different mandates of different agencies can create narrow interpretations of public benefit and liability, putting agencies in conflict with each other and putting project proponents in the position of having to resolve conflicts among different branches of government. For example, project proponents may have to balance the preservation of cultural resources, maintain future development opportunities, resolve liability for unpredictable project impacts, and insure ecosystem recovery objectives, by negotiating among various public agency representatives.

In some cases, these conflicts are the result of the personal judgments of influential individuals or the inconsistent application of rules or *ad hoc* policies due to frequent turnover of agency staff. These events can create delays and increase projects costs, but are ultimately surmountable. These permitting issues have become less as project sponsors and regulators become more experienced in estuary restoration. Regulatory barriers may also be the result of unresolved sociopolitical conflicts that spill over into the permit arena.

Specific issues mentioned by more than one informant include USACE Clean Water Act §404 evaluation of wetland loss during restoration, the modification of federal levees regulated under §408 of the Rivers Harbors Act, the application of ‘no rise’ rules based on FEMA flood management policy, DNR liability concerns around modification of State Owned Aquatic Lands, and when conflicts over land use vision emerge in SEPA review.

Recommendation #11 suggests development of shared standards that could inform communications between project sponsors, scientists, and regulators to support efficient agency review.

Agricultural Estuary Reconstruction Issues

The significant recovery of lost river delta acreage will likely succeed or fail in the Whidbey Basin. The Skagit, Stillaguamish and Snohomish systems contained 60% of historical delta tidal wetlands. Restoration in these systems strongly supports local salmon recovery plans. By contrast, while the Samish Delta has sociopolitical barriers similar to the Skagit, where estuary restoration conflicts with agricultural land preservation, however work in the Samish is not impelled by Chinook salmon recovery. While there are restoration opportunities in the Nooksack/Lummi Delta, salmon recovery managers focus existing funding toward floodplain restoration over work in the delta, based on analyses of factors limiting population recovery.

Agricultural preservation interests have strong public support in agricultural deltas. Lack of local political support for a restoration agenda that converts farmland to swamp can engender other barriers. Sociopolitical conflicts consume limited staff capacity, may reduce land availability, increase costs, and spill over into regulatory consultations.



Politics – Local communities do not broadly support conversion of agricultural land back to tidal wetlands. Reasons are economic, cultural, and personal. Contestation of restoration projects is common throughout project development, most acutely during county review processes. Local

agricultural communities are decentralized with many independent actors, making negotiation or discussion laborious. Agricultural operators, unlike their restoration counterparts don’t get paid to participate in restoration planning. Individual state and federal agencies each approach these negotiations with different authorities, objectives, and assumptions with the potential for undermining past agreements and eroding any already limited local trust in state or federal governments.

Agricultural communities feel threatened by economic, demographic, regional, and global pressures. Restoration is easily perceived as yet another assault on community integrity. In particular, delta agriculture depends on drainage. Changes to regulation of drainage networks and their maintenance have the potential to disrupt agricultural operations. Both the area of the land base, and the flexibility to adapt to future market conditions are valued by agricultural communities. The objectives of restoration are variably understood in agricultural communities, and the constancy and effectiveness of those objectives is suspect. Restoration projects change the landscape from a known condition to an unknown condition. In communities that face river flooding, proposals for intentionally flooding land may provoke a visceral reaction. A general local preference for continuation of status quo land use forces the burden of proof on restoration advocates. Restoration advocates may be unprepared or lack the capacity to discuss how restoration actions will affect local infrastructure and operations.

There are limited forums for agricultural and restoration advocates to develop trust or interpersonal relationships. Often communications flow from agencies to citizens with an advocacy format. A few local individuals may have a strong influence on agricultural community opinion, and those individuals may not be involved in project development or have cultural assumptions different than restoration advocates. Challenges to restoration from agricultural advocates may be discounted by restoration advocates as not founded in accurate information. There are few individuals who are available to consistently and respectfully represent the goals and purposes of estuary restoration in a range of local political and social settings. Local team members may not have the ability to access regional agency and political leadership to resolve problems.

In addition to general recommendations, **Recommendation #14** suggests increased opportunities for information sharing between delta teams and their publics. **Recommendation #15** suggests more robust analysis of the vulnerabilities and needs of drainage infrastructure so that agricultural productivity enhancements can be integrated into multiple-benefit projects. **Recommendation #16** suggests that linking ecological restoration and agricultural conservation funding in estuarine environments may create a motive for engagement between factions.



Land – In agricultural landscapes, development, agriculture, recreation and restoration all compete for a common land base, with development irreversibly eroding that base over time. There are no simple mechanisms for balancing these forces. The economic decisions of individuals largely determine the ultimate pattern of land ownership, within constraints defined by county zoning. There is no zoning for “ecosystem service lands”. Local communities generally favor the restoration of public land over the acquisition and conversion of private land. But public holdings are limited and conversion of public freshwater wetland to tidal wetland is often contested by hunting advocates.

Existing land acquisition mechanisms require restoration groups to use public grant applications to acquire lands at fair market value. The process is slow and unreliable. By definition, fair market value provides no incentive for a land owner to sell at any particular moment in time. Market value is based on the assumption that the desired land values can be obtained from among interchangeable and equivalent properties. Estuary restoration however, can only occur on specific parcels—there are often no parcels of comparable “restoration value”.

A single acquisition is unlikely to result in restoration, and a sequence of land rights acquisitions from multiple land owners is often needed to develop a levee or dike setback project. Public farmland preservation programs

may be used by restoration opponents to prevent restoration by legally requiring that critical parcels be available for farming in perpetuity. Because of these complexities, public funding programs may not prioritize speculative acquisition in estuary landscapes. In some settings peer pressure over the loss of agricultural land may affect the willingness of sellers. County policies may require mitigation for lost farm land area, without providing clear mechanisms or standards for that mitigation. In addition to several general recommendations, **Recommendation #16** proposes exploring mechanisms for mixing farmland conservation and restoration acquisition which allows for more flexible changes to land use over time.



Funding – Funding programs typically favor single purpose projects—costs that don’t serve program purposes are excluded or suggest inefficiency. For example, salmon recovery programs may not pay for drainage infrastructure or flood mitigation features. Local community concerns may result in restoration projects that incorporate features to improve flood or drainage performance, increasing project costs. Farm Bill funding that could support agricultural enhancements are typically extended through contracts between the federal government and individual agricultural operators—increasing the complexity of project management. **Recommendation #15** suggests increased coordination between funding programs that support restoration and agricultural conservation and enhancement.

Urban Estuary Enhancement Issues

The Duwamish and Puyallup estuaries have been filled and dredged to support industrial activities and port operations, providing regional economic benefits. Fill removal is the primary estuary restoration method. The sociopolitical conflicts common in agricultural landscapes are not present in these urbanized systems. There are both legal and regulatory incentives and general acceptance of the benefits of restoration. However, industrial land is limited and has high tax value, so municipal concern over loss of industrial land may increase over time.

Communities surrounding industrial estuaries are often disadvantaged, disproportionately exposed to toxins, and have less access to open space. Estuary restoration in these settings has the potential to redress some of these environmental injustices. Estuary restoration is strengthened when it is integrated with open space planning to provide social benefits, however this integration can undermine ecological functions when recreational use degrades vegetation or disturbs wildlife. Ongoing dredging to maintain ports creates an additional source of ongoing estuary degradation. Ongoing water quality degradation likely reduces estuary functions. While enhancement of water quality is commonly cited as a goal in urban estuaries, water quality treatment is not commonly identified as an action that provides mitigation credit.

The primary factor limiting restoration in urban environments is access to land, which largely depends on sufficient and nimble funding.



Funding – Given the high costs and smaller extent of restoration projects in urban estuaries, urban projects don’t compete well with projects in agricultural landscapes in regional or national competitions. In addition, regional restoration planners may discount the value of restoration in severely impacted urban systems, suggesting that return on investment is low and unreliable. Nimble availability of acquisition funding is the primary barrier to acquisition, and acquisition is the barrier to restoration. Restoration agents are often unable to react quickly when land enters the marketplace.

Foreclosure provides an opportunity for acquisition that is typically unavailable to public agents that struggle to amass acquisition funds through multiple grant competitions.

Natural Resource Damage Assessment and other involuntary or negotiated restoration mechanisms provide valuable resources to support restoration work. Ongoing mitigation programs, primarily developed by port authorities, may yield a net increase in ecosystem functions due to the conservative assumptions used by agencies to insure no-net-loss of ecosystem services. The scope of mitigation projects is determined by the ability of the mitigating entity to obtain credit for their action. Mitigation actors commonly attempt to obtain as much mitigation credit as possible out of a given site, given the high cost of land. However, most of the impacts to urban estuaries have already occurred, and mitigation for small future actions is unlikely to achieve recovery goals.



Land – Competition to acquire industrial land can be fierce. Restoration proponents are often poorly positioned to compete for land that comes on the market. Voluntary restoration and mitigation compete for the same land base. Land value is very high, in the vicinity of \$1,000,000 per acre, or 100 times the price of a parcel of farmland of equal area. Effective land acquisition requires a massive mobilization of resources on short notice. Recommendations that improve the funding availability like development of **Mitigation and Ecosystem Service Markets (#8)** and **Revolving Funds for Acquisition (#9)** are anticipated to most strongly reduce land access barriers.



Knowledge – Fill removal results in a very small recovery of lost estuary area. However, each project results in a proportionally large gain in ecosystem services in these decimated sites. The net effect of this work on salmonid populations is unknown. A tacit assumption of salmon recovery in urban estuaries is that floodplain or nearshore rearing can help compensate for limited estuarine rearing, and thereby support population recovery. While there are often project specific datasets, there has been no effort to synthesize evidence to support or refute a population effect hypothesis, largely because there has likely not been enough work completed to generate measureable effects in the populations. Given the severe losses in estuary rearing capacity, practitioners are generally very confident that projects have benefits.



Regulation – Industrial sites may be contaminated with spilled fuels, industrial toxins, and heavy metal. Restoration by fill removal creates the risk of a toxic release. Managing exposure risks increases project costs and increases the complexity of permitting. These contaminants are also a liability for property owners and those entities that caused their release. The question of who is responsible for contamination, or how state or federal governments may attempt to assign that liability may create so much legal uncertainty that all restoration activity is suspended until the responsibilities of various parties are determined.

Tidal Estuary Rehabilitation Issues

There are a number of deltas that were either not extensively diked or where recent work has largely restored historical tidal flows. However, the confinement of river distributaries, modification of watersheds, or changes to biota or water quality may impact function or resilience. The factors limiting function or resilience are varied, site specific, and poorly studied. “Tidal Estuary Rehabilitation” is a catch-all scenario for a variety of restoration situations where tidal flow is relatively intact.

Restoration of tidal flow is now largely complete in the Nisqually, Dosewallips, Skokomish and Quilcene deltas. Specific projects to modify river distributary flows are being developed at the Nisqually, Duckabush, Quilcene, and Dungeness river estuaries. In addition, wetland resilience and river routing issues are being discussed in the large agricultural estuaries including the Snohomish, Stillaguamish, and Skagit.

Changing river flood patterns might increase flood conveyance and reduce upstream flooding. Alternately, a change in tidal flow distribution might change the extent of the surge plain, increasing flood risk or requiring property purchase. Even in the absence of specific risks, there may be strong cultural resistance to restoring flood waters nearer to homes, or changing a land use to which communities are accustomed. Where the inflow of sediment has been constrained by levees, delta flats are often used for shellfish cultivation. Restoration of delta processes like distributary switching and sediment distribution may come at the expense of shellfish production or threaten drainage infrastructure.

In these cases, being able to accurately predict the effects of project work is important both to manage risk and describe benefits. The effects of changing how a river flows across an estuary are more subtle than restoring tidal flow. Local teams need to be able to sustain consistent and respectful communications with affected stakeholders, to iterate designs, and allow communities to engage in project development.

Both the general recommendations and recommendations for agricultural estuaries may also apply to tidal estuary rehabilitation projects.

Small Estuary Restoration

Beyond the large river deltas identified by Simenstad and others (2011), there are a variety of smaller estuaries that provide rearing for forage fish and migrating salmon, and may have a natal runs of chum, steelhead, coho, or sea-run cutthroat, with economic, cultural, and recreational value. Many workgroups identified the importance of estuary restoration sites in their salmon recovery and ecosystem recovery priorities (Figure 3). Each of these efforts is likely to fit one of the three scenarios described above, depending on the character of ecological degradation and the sociopolitical context. Restoration may involve breaching dikes or removing fill, and may result in loss of agricultural land or conflict with current uses.

Redmond and others (2005) presented a general analysis of nearshore restoration as part of Puget Sound salmon recovery planning. Cereghino and others (2012) provide an expanded analysis and classification of coastal inlet and barrier embayment systems using a regional analysis of nearshore landform attributes. A stronger inventory and classification of smaller estuaries is possible and may be desirable (Cereghino 2014). Over the short term, however, we can identify estuaries restoration targets by simply discussing salmon recovery efforts with local technical workgroups that are aware of which systems provide important estuary restoration opportunities.

Figure 3 provides a map showing the large river deltas, as well as smaller estuaries that should be considered as part of a regional estuary restoration portfolio and where significant restoration opportunities are being considered by local workgroups.

4

Discussion

The goal of this analysis is to alter practices, policies, or institutional structures to accelerate restoration of estuarine acreage. Restoring estuaries requires analysis of historically estuarine sites, property acquisition, and earthwork to restore tidal flow. This work is done by local project managers, primarily individuals working for tribes, counties or non-

profit corporations. They depend on public funding, public staff assistance and public regulatory review to complete their work. They are informed by a body of estuary science. They must operate in a socially complex local network to gain access to land and community support for restoration. A typical project may take five to fifteen years from conception to the end of construction.

This “estuary restoration system” produces estuary acres for public benefit. As a production system it is both intimately social and local, but also spans multiple levels and sectors of local, state, tribal and federal government. With system functions divided among so many organizations, there are few mechanisms for evaluating and improving the performance of the “estuary restoration system” as a whole. More typically, each organization may be motivated for political or financial reasons to defend its role regardless of how that role actually affects the performance of the whole system. The interest of individual workgroups can easily replace the purpose of the system. This disconnection between purpose of the system (to produce estuarine acres for maximum public benefit) and the purpose of the workgroup (to complete their tasks with maximum effect) is a recipe for system inefficiency which has been discussed in the industrial manufacturing sector for generations (for example, Deming 1993).

We do continue to evaluate and improve the ecosystem recovery system (for example see Sahandy & Daily 2014). Blackmore (2009) used surveys to explore barriers to salmon recovery capital projects and identified two key obstacles: the lack of a local “authorizing environment” for project work, and the local unreliability of funding, particularly for project development. Our interviews not only reinforce these findings six years later, but our narrower look at estuarine restoration suggests that we may lack some tools necessary to do the work. We have the opportunity to improve the productivity of our existing restoration system. Any such improvement can only support public confidence in our work. Improvement requires that we correctly define the system we are trying to improve and that we understand how it delivers value to the public trust.

Local project management is where the work happens— a vision, a plan, and a package of resources are used by local teams to change a piece of the ecosystem. Without a place, a vision, and project management, there is no restoration. However, a significant portion of a project team’s time is spent managing the internal demands of the “estuary restoration system” to assemble the necessary package of public resources—applying for and negotiating grants, accounting for and reporting on complex funding packages, communicating with government stakeholders and regulators, and promoting the project within the ecosystem management community. Each of these procedures can be individually justified in the name of accountability or inclusive decision making. Each of these efforts draws away limited project management from developing social and technical solutions that more directly increase public benefits.

*The most dangerous kind of waste
is the waste we do not recognize*

*It is only the last turn of a bolt that tightens it –
the rest is just movement.*

-Shigeo Shingo

Environmental agency policy leaders depend on public support for the estuary restoration system. If local work doesn't go well or is poorly communicated, these experiences feed back through local networks, weakening public confidence in the restoration system. Conversely, careful management of our "production system" creates the opportunity to improve our productivity.

While our conversations produced sixteen (16) recommendations to accelerate estuary restoration, they reflect recurring principles. Making these principles more explicit helps us focus as we consider improvements to our production system:

1. **Protect project manager capacity**—project management is the place where we can resolve the fundamentally local sociopolitical and technical challenges of estuary restoration. We can protect project manager capacity by minimizing the creation and transfer of obligations from agencies to the project manager. Currently, project managers are put in the position of having to develop communication and consensus among agencies on a project by project basis. Organizations with more authority tend to push obligations and work down to organizations with less authority. These obligations of funders and regulators accumulate at the project manager level. At best they are redundant, and at worst they create work with no value. These demands may exist purely for the purpose of allowing organizations with authority manage their risks or avoid absorbing costs. While there are specific needs for accountability and technical rigor—our existing system tends to overfund redundant oversight, while underfunding robust evaluation. This depletes project management capacity, while reducing the actual accountability that comes from evaluation of restoration effectiveness. Considering whether a system protects project management capacity can correct this imbalance.
2. **Reduce delays** – prolonging project work increases costs and depletes local capacity. Stopping project work to seek funding is a common cause of delay. Funding flow should be flexible and even throughout the project lifecycle. Lack of resources during early project development and property acquisition phases can delay or disable a project. Delay may be necessary when there are insufficient resources in the whole system to implement all projects simultaneously. With estuary acreage restoration, we are working with a finite list of known opportunities. Acquisition is a critical component of the work that must be prepared for so that critical parcels are not lost because of delay. Predictability and evenness of work allows for better allocation of assets, and reduced waste.
3. **Expand stakeholder engagement** – To increase the total resource base and work through political barriers will involve more citizens engaged and supportive of restoration. Some individuals within a social network have strong influence over the project environment. Most individuals outside the restoration system aren't compensated for their participation. Our existing system maintains high personnel costs at the administrative level, lower costs at the project level, and provides very limited resources for public participation. Projects that have broad community support are able to rapidly resolve questions and concerns and come to completion. Project with local opponents may be delayed, while consuming project manager capacity such that ecological function may even be compromised to secure stakeholder willingness.

With these general principles in mind, our recommendations take on increased coherence as part of an overall strategy for improving restoration work in estuaries.

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Recommendations

Table 1 summarizes sixteen recommendations developed through conversations with individuals working directly on estuary restoration. Some recommendations were proposed by informants, others were suggested by the author and positively received during conversations. Recommendations heard in one interview were tested by suggestion in following conversations.

The icons indicate the restoration ingredient that the recommendation aims to address. Following interviews and two opportunities for critique, we asked our informants to identify any recommendations that they thought would best accelerate their estuary restoration work. Those preferences of that sub-set of individuals are marked with an asterisk (one per “vote”). This should not be taken as a prioritization based on a cost/benefit analysis, and efforts for improvement should consider the particulars of a situation.

There may be a logical sequence to implementing these recommendations:

1. Starting work on **Agency Policy Coordination (#1)** and defining **Local Estuary Teams (#2)** are likely to improve the communications needed to support subsequent work.
2. Increasing **Funding Targeted on Acquisition to Restore (#3)** and some aspects of **Mobile Regional Capacity (#12)** can be done immediately through existing funding authorities.
3. Agency policy coordination could lead to quick efforts to reduce waste through **Match Reform (#7)** perhaps through project budget match verification at the scale of a whole project, not just phases.
4. Agency policy coordination is needed to develop **Fair Market Value for Ecosystem Service Sites (#4)**, **Mitigation and Ecosystem Service Markets (#8)**, or **Revolving Funds for Acquisition (#9)**.
5. Developed local estuary teams are positioned to describe the value of **Project Development Capacity Funding (#10)** or **Mobile Regional Capacity (#12)**, which could lead to **Multiple Benefit Projects (#5)**, **Project Standards and Mentorship (#11)**, and more defined objectives for **Scientific Risk Management (#13)** which in turn provides guidance for agency policy coordination.
6. Agricultural Estuary Teams could consider how **Mobile Regional Capacity (#12)** could support **Information Sharing Events (#14)**, or **Agricultural Infrastructure Evaluation and Development (#15)**.
7. Programmatic work by local estuary teams working on multiple benefit projects informs specific objectives for **Regional Funding Coordination (#6)**, including development of **Linked Agricultural-Ecological Funding and Regulation (#16)** in agricultural estuaries.

Table 1 – Recommendations for accelerating estuary restoration. Icons describe which ingredient a recommendation addresses. Recommendations work to achieve three general goals: 1) protect project management capacity, 2) reduce delay, and 3) expand stakeholders. “✳” indicates actions that so not have obvious dependencies, and could be implemented first. “!” Indicates recommendations that are likely to require significant effort over time. Asterisks following the title indicate interest expressed by informants in the recommendation.

General Recommendations	
  	1. Agency Policy Coordination***** – To develop agreements that resolve sociopolitical conflict, those agreements need to be supported by all governmental stakeholders. By contrast, if different local, state, tribal, and federal agencies are all pursuing independent objectives, these contradictory opinions and policies can undermine the trust in government by local communities and confound local negotiations. While agency policy coordination means different things to different informants, strong coordination likely requires transparent identification of agency actors responsible for specific situations that allow for the development of personal relationships between political leaders and among technical staff. This protects project manager capacity and reduces delays by relieving local project managers of the responsibility for coordinating agency communications and negotiations, and makes conflict resolution faster and more definitive. This recommendation has no dependencies and could be implemented immediately.
  	2. Local Estuary Teams***** – Creating a vision for ecosystem restoration requires a prolonged and respectful dialog between local restoration advocates, and local political and social leaders. The ability to sustain this dialog depends on the capacity of local teams to consistently engage in a range of local settings. It will be critical to have the right kind of staff engaged, including individuals who can provide mentorship and coaching to stakeholders, access decision makers, and bridge differences of opinion. Estuary teams need to be able to access, synthesize and communicate cutting edge scientific understanding of estuary restoration, and represent the challenges of fishery co-management. In these ways, estuary teams have both technical and sociopolitical functions, and reflect a set of relationships that extend beyond fiscal or policy procedures. Estuary teams create a way to achieve rapid consensus between regional and local authorities, and allows for some fluidity of project management effort among projects within a system that may reduce delays. The ability to rapidly assess and share project management effort within a system serves to protect project manager capacity by increasing awareness of workloads and project needs. Some aspects of this recommendation may be dependent on project development capacity (#10).
 	3. Funding Targeted on Acquisition to Restore***** – Estuary restoration increasingly requires that project managers acquire and hold multiple parcels over time until sufficient land is accumulated to complete a tidal restoration project. Acquisition funding must be nimble and prioritize an “acquisition for future estuary restoration” approach. Alternately, this could take the form of funding allocated to estuary restoration in general, with acquisition for restoration viewed as a critical element of that effort. This recommendation attempts to reduce delays during the property acquisition phase of a project. This recommendation has no dependencies and could be implemented immediately and is related to regional funding coordination (#6), and revolving funds for acquisition (#9)
 	4. Fair Market Value for Ecosystem Service Sites** – Estuarine parcels may have a high ecosystem service value if restored. These values may not be reflected in the “fair market value” appraisal procedures used to evaluate an acceptable purchase price using public funding. Considering ecosystem service values may allow for compensation levels that incentivize sale for restoration, however public entities in Washington State are not allowed to purchase property for more than assessed value plus 10%. Private interests may be positioned to provide additional incentives to encourage sale. This recommendation aims to reduce delays during the property acquisition phase. This recommendation may involve a significant shift in policy and is related to regional funding coordination (#6)

 	5. Multiple Benefit Projects*** – Projects that integrate water quality, fishery recovery, agricultural conservation, recreational benefits, tribal harvest, flood mitigation, climate change resilience, or correct environmental injustice may be able to draw from a broader national and state funding pool than single objective projects. Floodplains by Design is a new state funding source explicitly designed to support projects that both mitigate flood impacts, and recover fisheries. Project design requires development of the best and highest public land values, to attract diverse investors. This design for multiple functions is about maximizing public value, rather than buying political acquiescence or compromising ecological function. This recommendation aims to expand stakeholders in a project both to increase resource availability and to reduce delays. Some aspects of this recommendation may be dependent on regional funding coordination to support complex projects (#6) and project development capacity (#10).
  	6. Regional Funding Coordination***** – Multiple programs and agencies provide the resources necessary to complete large estuary restoration projects. Coordination of grant application, review and contracting procedures among agencies and programs can reduce administrative waste that consumes local capacity and can delay project implementation. When funding is provided in a coordinated and prompt manner, project implementation can be quicker and more cost effective. Streamlined grant administration could include standardizing grant applications, timing, budget format, and reporting requirements. This aims to protect project manager capacity expended on redundant grant management and reduce delays caused by uneven funding flow. This recommendation may involve a significant shift in policy but otherwise has no dependencies. Cereghino (2015) provides an initial analysis.
  	7. Match Reform*** – Grant matching requirements have developed ad hoc often through authorizing language. How match is implemented generates burdens for project managers and can delay projects without adding significant public value. By combining funds within a single contract, developing mechanisms for waiving match requirements, or reviewing match status at the whole project level we can reduce administrative costs and project delays caused by grant policy. This aims to protect project manager capacity by relieving project managers of the responsibility for building funding consensus through grant applications. This recommendation has no dependencies and could be implemented immediately.
 	8. Mitigation and Ecosystem Service Markets** – By assessing the full cost of ecological impacts common in developing areas and assigning a cost payable in restoration effort, governments might generate a demand for restoration actions and increase the pace of estuary restoration. This recommendation attempts to increase overall resources available for restoration by creating a new stakeholder—a consumer of restoration credits. This recommendation may involve a significant shift in policy.
  	9. Revolving Funds for Acquisition** – Rapid access to acquisition funding would improve the ability of restoration agents to act quickly when lands enter the market place. Some mechanism for producing a reserve of acquisition funding, combined with a clear prioritization system, could increase acquisition speed, making project proponents more competitive in private markets and reduces delays. This recommendation may involve a significant shift in policy.
 	10. Project Development Capacity Funding***** – Funding for consistent staffing through the early phases of project development is necessary to implement large projects or resolve complex political issues. Base funding for groups similar to Conservation Districts (local district fees), Regional Fishery Enhancement Groups (fishing license sales) or Lead Entities (benefiting from a mix of state and local funds) are vital for prospective project development. This recommendation may appear to require more resources, but could also reflect a creative reallocation of effort within the overall restoration system. So while it may have no dependencies, it could involve a significant shift in policy in capital programs.

   	11. Project Standards and Mentorship* – Clearer standards and procedures for estuary restoration practice would reduce the uncertainty and false starts that increase the need for capacity, or that aggravate sociopolitical conflicts. There are no known efforts outside of ad hoc efforts during project review and implementation to establish regional restoration standards. Estuary restoration reflects a dramatic increase in project management complexity and risk, which may be outside the experience of some salmon recovery project sponsors or permit reviewers. Development of science-based quantitative models around key processes such as hydrodynamics, channel formation, vegetative recruitment, fish use, or sediment accretion can reduce ambiguity in project selection and design. This recommendation aims to protect project manager capacity and reduce delays by increasing efficiency and clarity of planning, communications, and regulatory review. This recommendation may be dependent on development of agency coordination (#1) and delta teams (#2), and would be accelerated by the availability of project development capacity funding (#10) and scientific risk management (#13).
 	12. Mobile Regional Capacity** – Existing regional expertise developed through early projects could be cultivated and mobilized to staff or mentor successive restoration efforts. An expert design review team may have value, as course correction is easiest during the feasibility phases of work. Coordinating and developing scientific investigations to reduce uncertainty may be a vital function for regional capacity. This regional capacity could augment local capacity. Groups like Conservation Districts, The Nature Conservancy, and Washington Department of Fish and Wildlife have staff experienced at estuary restoration project management. Certain project development and implementation functions, such as protracted project development, which can be dependent on personal relationships, may not be reliably out-sourced. This recommendation has no dependencies and could be implemented immediately through existing funding negotiations, but would be enhanced through policy coordination (#1) and definition of estuary teams (#2)
    	13. Scientific Risk Management** – Coordination and funding for scientific investigations is needed to evaluate and learn from early actions so we can improve future public investments. Existing scientific capacity is largely ad hoc and self-organizing. The priorities and findings of scientific institutions need to become accessible to restoration project managers, and restoration groups can in turn advocate for estuary restoration science within science agencies. The ESRP Learning Program developed by WDFW and NOAA is one of very few programs that prioritize work with project sponsors and scientific partners to strongly support project focused learning as a method for capital project pre-design and feasibility. This recommendation aims to expand stakeholders and protect project manager capacity by insuring and demonstrating the effectiveness of public investments, and by providing project managers with robust quantitative tools to guide project selection and design. Some aspects of this recommendation have no dependencies and could be implemented immediately. It would strongly inform project standards (#11).
Agricultural Estuary Reconstruction (in addition to general recommendations)	
  	14. Information Sharing Events* – There are limited efforts to provide members and leaders of local communities with complete information about the evolving risks and opportunities of estuary restoration and salmon recovery. These communications could be two-way, increasing agency understanding of local concerns. Direct communications with organizations like The Rotary Club, Chamber of Commerce, and other civic associations may support improved understanding before a moment of crisis. The purpose of this recommendation is to expand stakeholders in project work. This would be supported by agency policy coordination (#1), to improve local understanding of agency concerns and identification of local estuary teams (#2) and would be strongly supported by scientific risk management (#13) but ultimately this recommendation has no dependencies and could be implemented immediately. NOTE: one informant was dubious of the value of increasing information sharing.

 	15. Agricultural Infrastructure Evaluation and Development* – Estuary restoration is inextricably entwined with the fate of agricultural communities. Agricultural viability is not entirely dependent on land area, and can be enhanced with drainage and flood control infrastructure. Drainage networks are typically ad hoc, and have evolved over time. Lands are subsiding and sea level and river flood events are becoming more intense in some locations. Restoration could have a stronger role as part of a larger landscape strategy for delta management. This recommendation sets the stage for multiple benefit projects (#5) and aims to expand project stakeholders in agricultural settings. This kind of collaboration may be dependent on project development capacity (#10) or mobile regional capacity (#11).
    	16. Linked Agricultural-Ecological Funding and Regulation* – Increased interaction between agricultural and ecosystem recovery advocates is most likely to occur when the means to satisfy their mutual needs are linked through funding or regulatory mechanisms that require planning and agreement. Existing mechanisms like Drainage Management Plans (DMPs) under Hydraulic Project Approval authority (WDFW) could serve as a vehicle for improved access to Farm Bill funding. Public programs that preserve farmland may intentionally or unintentionally prevent restoration, and restoration advocates should be consulted as part of proposal review. Reciprocity would require restoration programs to consult with agricultural preservation partners as part of project development. Increasing the flexibility of farmland and ecosystem recovery acquisition programs so that land can move between uses, while maintaining appropriate safeguards, allows local communities to shift land use patterns over time. A model proposed by the Skagit Delta Farmland Preservation Strategy, developed under the Farm, Fish and Flood Initiative allows for combined acquisition of parcels for farm conservation while creating an option for future restoration on a portion of land to meet future diking district mitigation needs without subdividing large parcels. Agricultural communities do not have members that are paid to participate in restoration planning, making integration of agricultural interests within the relatively well funded salmon recovery institutions difficult. This recommendation may involve a significant shift in policy.

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