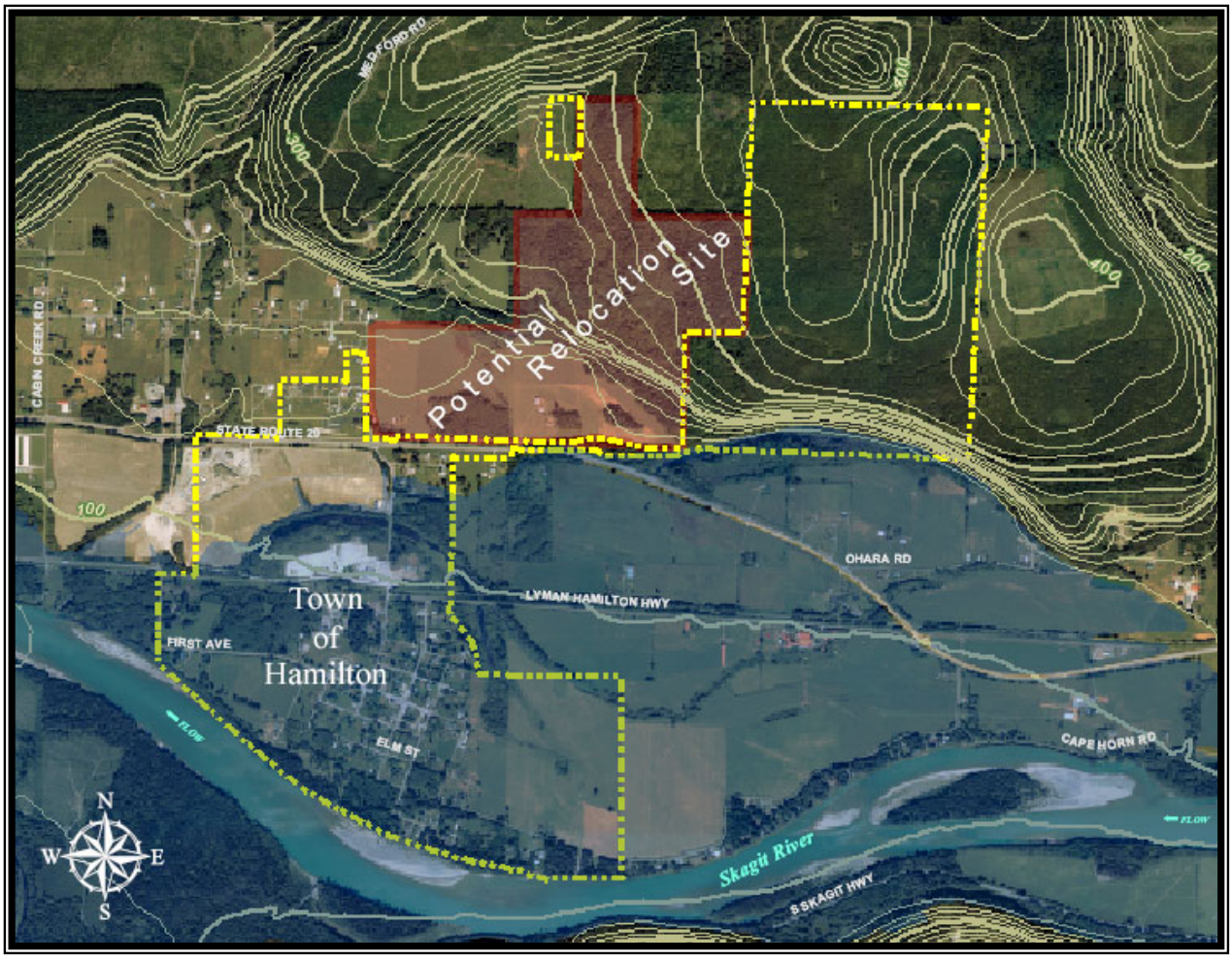
Appendix G

Overview of Benefit Cost Analysis for Hamilton-Skagit Flood Mitigation & Town Relocation Program

Benefit Cost Analysis

for the

Hamilton-Skagit Flood Mitigation & Town Relocation Project



Preliminary Report for Comment
December 2005

Hamilton Public Development Authority

Summary & Recommendation

Benefit-Cost Analysis (BCA) has demonstrated that the overall Hamilton-Skagit Flood Mitigation and Town Relocation Project is cost effective. Over the lifetime of the project, the benefits from avoided flood damage costs and the increased flood water storage associated with the removal of 400 floodway residences outweigh the cost for purchase of a 200-acre town relocation site, engineering and development of infrastructure including a wastewater treatment plant and lines, water distribution lines, storm water drainage, roads, and sidewalks, the acquisition and removal of floodway homes, and ten years of program management and enforcement of reclaimed open space[1].

BENEFITS	>	**COSTS**
Avoided Costs of Flood Damage		New Town Site Land Purchase
Increased Flood Water Storage		Infrastructure Development
		Floodway Home Acquisition
		Program Management &
		Open Space Enforcement

Based on these favorable findings, it is recommended that the State of Washington consider a FY-2006 request for $200,000 to match Federal funds procured by Congressman Rick Larsen in 2005. Federal funds are to be used toward the purchase of option agreements on the town relocation site. Obtaining option agreements is critical for two reasons: first, this enables Hamilton to add this area to their Urban Growth Area as a step toward annexation into the town, and second, options secure the relocation site while funds for purchase and infrastructure development are identified.

A total of twelve BCA scenarios were prepared in order to consider four different benefit scenarios and three different cost scenarios. Table #1 summarizes the Benefit-Cost Ratio (BCR) for each of these combinations. A BCR ≥ 1 is considered to be cost effective. All but the most conservative scenario prove highly cost effective.

Table #1: Benefit Cost Ratios

SCENARIO	1. Low Cost	2. Medium Cost	3. High Cost
A. Avoided Costs (AC)	1.21	1.08	0.63
B. AC and Indirect Economic Benefit	2.31	2.05	1.20
C. AC and Indirect Recreation Benefit	2.34	2.08	1.22
D. Avoided Costs and Indirect Benefits	2.50	2.23	1.31

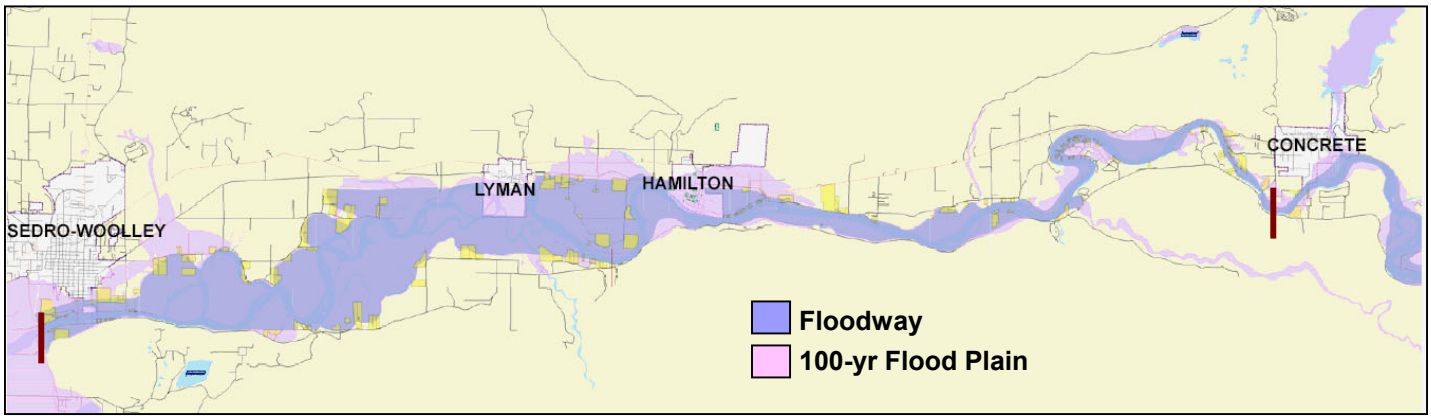
To give these figures some perspective, there are a few mitigation projects where BCRs approach or exceed 10, and such a high figure would raise concerns of illogical or faulty data or analysis. To impact the BCR by a mere 0.02 requires a cost fluctuation of one half million dollars. In other words, the project costs for most of the scenarios would need to increase by many millions of dollars in order to yield results that were not cost effective.

Background

The study area includes properties located in the Skagit River floodway between Sedro-Woolley and Concrete (Figure #1). Within the unincorporated area there are 305 residences with a floodway designation. In the Town of Hamilton, there are another 105 floodway residential units. The number of at-risk residential properties for the unincorporated area increases to 575 when the study area is expanded to the 100-year flood plain[2].

This study area creates a pool of 680 prospective developed residential properties for participation in the relocation program. It is recognized that not all qualifying property owners will choose to participate. The town relocation program, however, creates a realistic means by which owners may reestablish themselves out of harm's way in an equitable manner. This provides both an incentive for voluntary participation, and a mechanism for local government to strictly enforce state flood plain management laws that restrict the repair of flood damaged homes.

Figure #1: Study Area



Traditional FEMA buyout programs have presented significant challenges both in qualifying flood-affected properties for purchase, and in meeting the financial needs of property owners who seek to relocate. The experience of a 2004 Hamilton buyout project illustrates this challenge.

Of the 105 permanent residences in Hamilton with a floodway designation, only five met the eligibility criteria for acquisition under the FEMA Flood Mitigation Assistance program. Of these five, only one property was successfully purchased and restored to open space. It was found that the cost effective purchase price that FEMA could offer was inadequate to entice voluntary sale.

Upon closer investigation, it was found that floodway properties are being mortgaged beyond what is cost effective for federal buyout programs to purchase them. At present, lenders extending high-risk loans on Special Flood Hazard Area properties are not required to assume any of the financial loss associated with the buyout of flood damaged homes.

Federal buyout programs are required to offer "fair market value", based on the pre-flood condition of the residence. This is typically determined by an independent appraisal. Unless lenders short-sale mortgages, this conventional fair market value approach proves not to be cost effective for buyout funding programs, and owners are unable to participate, even if they are anxious to relocate.

The one successful buyout, from the 2004 project, came as a direct result of the lender having accepted a short sale on the mortgage for the amount that the National Flood Insurance claim paid. While this is considered highly inappropriate (if not illegal), in hindsight this was the best use for the insurance funds. This action prevented the inappropriate repair of a repetitive flood loss home, allowed FEMA to offer less than the pre-flood appraised value, and enabled the property owners to accept what FEMA was able to offer and reestablish themselves elsewhere.

BCA Methodology

BCA is the method by which the future benefits of a mitigation project are determined and compared to its cost. The end result is a Benefit-Cost Ratio (BCR), which is derived from a project's total net benefits divided by its total cost. The BCR is a numerical expression of the cost-effectiveness of a project. A project with a BCR of 1.0 or greater has more benefits than costs, and is therefore considered to be cost-effective[3].

FEMA BCA software was used to generate the Benefit-Cost Ratio for each scenario[4]. Attachment #1 provides a complete BCA report for each scenario. Attachment #2 is an excerpt from the FEMA software that provides details on the economic assumptions, equations, and a chart illustrating the impact of different discount rates on present value coefficients. There are two basic types of BCA software modules available for use, Full Data and Limited Data modules.

1. The Full Data (Engineering Method) modules use engineering data on the probability and severity of hazards to estimate damages and losses (before and after mitigation) vs. a quantitative measure of the hazard severity (e.g., flood depth, wind speed, or level of earthquake ground shaking). First floor elevation data is required with this approach. When the necessary hazard data are available, these modules provide the most accurate BCA and thus their use is encouraged. There are five Full Data modules: Riverine Flood, Coastal A-Zone Flood, Coastal V-Zone Flood, Hurricane Wind, and Earthquake.
2. The Limited Data (Frequency Damage Method) modules use historical data and engineering judgment to develop frequency damage relationships for both before- and after-mitigation site conditions. Although labeled as "riverine," the Riverine Limited Data module can actually be used for many types of hazards where a frequency-damage relationship has been established[3].

The FEMA Riverine Limited Data Module was used for this benefit cost analysis because of the non-site specific nature of the project and the lack of first floor elevation data.

It is relevant to note that a separate flood mitigation feasibility study is underway for Cockreham Island. This area of unincorporated Skagit County is located just west of Hamilton, within the study area. Residential floodway properties on Cockreham Island are included in the Hamilton project benefit-cost analysis. The study specific to Cockreham Island is applying the Full Data module. Analysts for both studies have conferred, are sharing information, and recognize the need for applying different FEMA BCA approaches to each study.

The BCR figures generated for each study will not be comparable, however, there is significant value in comparing the findings of each, and collaborating where appropriate. Rural property owners frequently have many acres of undeveloped floodway land adjoining their floodway residence. The Hamilton project must focus on the purchase of residentially developed floodway properties. For other interests, such as conservation groups and the county, it is more cost effective to focus on the acquisition of undeveloped property. By pursuing a collaborative mitigation approach, financial resources may be pooled to purchase larger contiguous land holdings. In this manner, the cost effectiveness of individual acquisition prospects increases, as well as the net benefits of restoration of floodway property to open space.

Assumptions

Using the FEMA BCA module ensures that the BCA mathematics is correct, however, a BCA is only as accurate and valid as the data that has been input. Data inputs for the twelve BCA scenarios are based on data and assumptions derived from highly credible sources including: the U.S. Army Corps of Engineers, Skagit County Assessor, Economic Development Association of Skagit County, 2000 Census, WA Department of Ecology, WA State Parks, King County, the Asia Pacific Environmental Exchange, and conservative estimates generated by reliable local industry professionals.

Indirect benefits considered were conservatively estimated using indicators of economic and recreational value that are based on accepted economic analysis methods such as per capita income differentials and annual park attendance. For all scenarios, it was assumed that 400 residences would be removed from the floodway and 400 residences would be built at the new town site. Attachment #3 summarizes project cost and benefit sources and assumptions. Reference information for data sources used, and literature reviewed are also cited at the end of this report.

Cost Inputs

Cost scenarios applied include Low, Medium, and High Cost. The primary cost variables that differentiate these three scenarios are the cost for purchase of the new town site, the cost of acquiring 400 residential properties and their restoration to open space, and the revenue generated by the sale of lots at the new town site (which will help to subsidize the cost of floodway buyouts). The assumptions used for these are summarized in Table #2.

Table #2: Variables in Cost and Cost Offset Assumptions

SCENARIO	COSTS		COST OFFSETS
	Relocation Site Purchase	Floodway Residential Buyout Cost	Revenue From Lot Sales
1. Low Cost	$3.00M	Average assessed value = $43.90M	$60k each
2. Medium Cost	$4.35M	USACOE formula = $44.37M	$55k each
3. High Cost	$5.70M	Weighted average of local market data = $67.52M	$50k each

Relocation Site Purchase – The range in the cost for relocation site purchase was provided by a local real estate developer. The figures are based on commercial and residential zoning and access to basic infrastructure. The property value is higher than what would be expected for their current zoning designation (Rural Resources – Natural Resource Land). Universal Field Services has been contracted to undertake the formal appraisal process to determine the fair market value for the site. The appraisal is scheduled for completion in mid-April 2006. In an opinion from the attorney for the town and the attorney for the PDA, purchase of the relocation site must be voluntary. Acquisition of this new town site using legal condemnation is not a viable alternative because the land acquired will not be strictly for public purposes, but will be re-sold to private parties for residential development. Universal Field Services will negotiate with the property owners, option agreements for the property purchase.

Floodway Residential Buyouts – For each Low Cost scenario, the cost for buying and removing 400 floodway residences was estimated by multiplying the average assessed value for floodway properties in the study area by the 400 residences slated for removal. An average assessed value of $109,759 was determined from 2005 Skagit County Assessor's data for floodway homes in Hamilton and the unincorporated areas of study, providing the $43.90 million cost used. This cost estimate is considered representative of buyout cost were lenders required to short sale floodway mortgages for the assessed value rather than the value as determined with an independent appraisal.

The Medium Cost scenario applied the formula that was used by the U.S. Army Corps of Engineers analysis conducted for this area[6]. With the 2005 Corps study, residential structures were surveyed through a random sample of the flood plain. Data collected included structure use, construction type, size, condition, use, and first-floor elevation. Structure values are based on estimates of depreciated replacement cost. This was estimated by considering structure condition, use, type, and size in conjunction with the Marshall & Swift Valuation Service. The Corps report identifies the average residential structure size as 1,600 sq. ft. with a depreciated square foot cost of approximately $69.34 per sq. ft. These replacement cost estimates are multiplied by 400 homes removed to generate the medium cost estimate of $44.37 million.

The High Cost scenario estimate of $67.52 million was generated using a weighted average of single-family residences and condominiums sold in 2004 for areas in Concrete and east, Lyman and Hamilton, and Sedro-Woolley. This data, obtained from the Economic Development Association of Skagit County, represents residential values based on what the market will bear.

Revenue From Lot Sales – The sale of lots at the new town site is anticipated to generate significant revenue that will be invested back into the mitigation program. Revenue, for example, may be used to subsidize FEMA buyout funds so that property owners can afford to relocate. The range in revenue is based on 2005 comparable sales of undeveloped one-quarter acre town lots in neighboring Lyman.

Other Costs & Cost Offsets – Water and wastewater infrastructure costs for the town relocation are detailed in Attachment #4, and remain consistent throughout the BCA. The cost for program management is calculated for 10 years, after which time the bulk of relocation site development is anticipated to be near complete. Enforcement of floodway open space restrictions is also calculated for 10 years. This cost is considered to be conservative, as partnerships with conservation interests will likely generate staff and volunteer support for enforcement activities.

The cost for floodway home removal is assumed to be covered from National Flood Insurance Increased Cost of Compliance (ICC) benefit. ICC extends up to $30,000 toward the demolition of qualifying homes. Marketing to floodway property owners the need for obtaining and maintaining flood insurance coverage is already underway, and may prove a requirement for relocation program participation.

Benefit Inputs

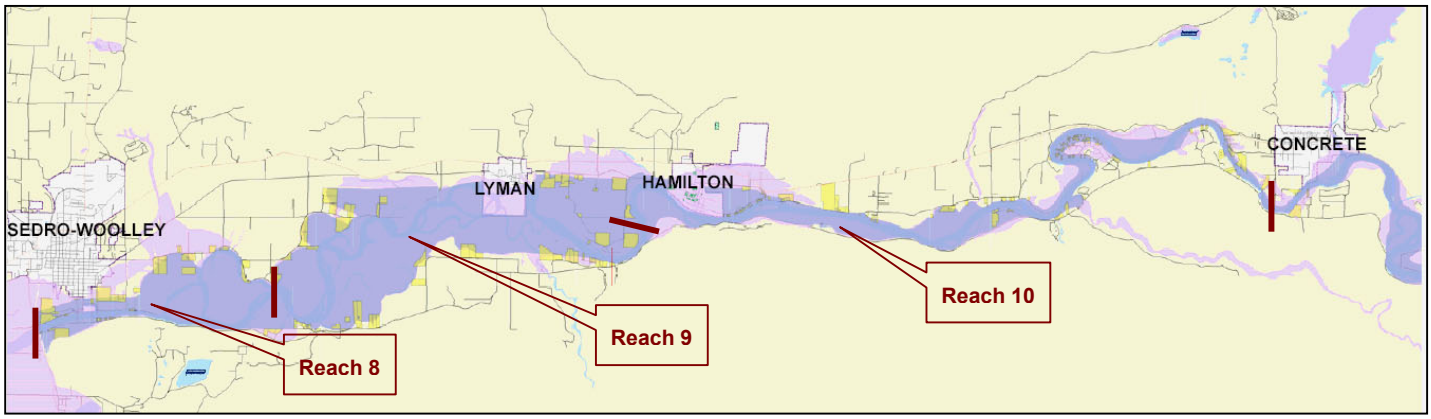
When there are no specific markers for assessing benefits, other means must be employed. This is the case with quantifying the value of the Hamilton PDA project. Valuation techniques seek to establish the "willingness to pay" or the "willingness to accept compensation" for the availability or loss of a service. The valuation methods used here include Avoided Cost, Replacement Cost, and Travel Cost[5].

Avoided Cost is the most frequently used method for flood control analysis. This measures the damage and dislocation costs that society may avoid through mitigation measures. Replacement Cost is useful when assessing the cost for relocating floodway residents to equitable living situations out of harms way. Typically, comparable appraisal values or new construction costs are applied. When considering natural systems, say the value of natural wastewater treatment by marshes, the cost for an artificial treatment plant may be used for comparison. Travel costs are a reflection of the implied value of an ecosystem. For example, the value of a recreation area is at least equal to the cost that visitors are willing to pay to gain access.

Avoided Costs – The Army Corps of Engineers conducted an economic flood damage assessment for much of the Skagit River basin as part of a flood damage reduction feasibility study for Skagit County[6]. Their June 2005 draft report included flood inundation damage cost estimates between river mile 22.4 in Sedro-Woolley and river mile 54.35 near Concrete. Figure #2 illustrates the three Corps study areas within the Hamilton benefit cost study area; Reach 8, Reach 9, and Reach 10. Reach 8 includes part of Sedro-Woolley, runs from river mile 22.4 upstream to river mile 27.04. Reach 9 runs from river mile 27.04 upstream to river mile 38.15, and includes some structures from the town of Lyman. Reach 10 starts at river mile 38.15, runs through the town of Hamilton, and ends at river mile 54.35 near Concrete. This constitutes the same area of interest for our analysis, and so Corps data for these three reaches was applied to the Hamilton BCA. Damage costs were assessed by reach location for the following flood

events: 10-yr, 25-yr, 50-yr, 75-yr, 100-yr, 250-yr, and 500-yr. Separate cost estimates were prepared for Residential Structure and Contents, Residential Clean-up, Temporary Relocation and Public Assistance, and Nonresidential Structure and Contents.

Figure #2: U.S. Army Corps of Engineers Study Areas



The Corps study used Replacement Cost to calculate the nominal depreciated structural value of residences. Their formula was used to calculate the benefit of avoided flood damage costs for residential structures, and for the medium cost scenario for floodway residential buyouts.

Corps data was also adjusted for the 400 residential acquisitions and entered into the FEMA Riverine Limited Data Module with the standard FEMA useful project life to yield average annual avoided damage figures. Corps cost estimates that were not used for the Hamilton BCA include road damage, transportation delays, and agricultural losses. The Corps report is available in its entirely as Attachment #5.

FEMA acquisition programs limit the consideration of project benefits to Avoided Costs. "Multiplier" effects cannot be counted. A multiplier effect is an indirect or secondary benefit. For example, if the open space area created following property acquisition attracts visitors, the economic benefits to the community from the visits cannot be counted, as they are not a direct effect of the project[7].

Beyond the traditionally accepted Avoided Costs estimates, policy makers are increasingly considering indirect and secondary impacts of land use decisions. The University of Maryland's Gund Institute is the leading ecological economics institution in the country. The Gund Institute has researched, published and peer-reviewed countless valuation studies of ecosystem goods and services, such as flood prevention, waste treatment, biodiversity maintenance, nursery functions, food production, and recreation, to name a few[8]. It is accepted that such studies underestimate the true value generated by the ecological services that provide an indispensable part of the human-created economy, however, intelligent land use decisions cannot be made without taking even these imperfect values into account[9].

Unlike FEMA, US Army Corps of Engineers' benefit cost analysis is not restricted to considering only direct benefits[10]. Corps studies may include long-term changes in economic development, growth, employment, and regional economic output[4].

With the Hamilton BCA, Avoided Costs figures include a conservative valuation for the benefit of increased flood storage, reflected by avoided damages to property beyond the area directly mitigated. Separate BCRs conducted also consider indicators of the indirect economic benefit from town revitalization, and the recreational value of floodway open space. These benefits would not be allowed with standard FEMA program BCA.

The vision of the Hamilton PDA is to develop and implement a permanent flood mitigation solution that restores the Town of Hamilton as a viable and desirable municipality in and around which to live and work, and reduce repetitive losses from flood-prone areas of Skagit County. Examining the value of these less tangible benefits strengthens the business case for activities peripheral to the removal of floodway residences and underscores the importance of applying a comprehensive approach to flood mitigation and town revitalization.

Economists are developing sophisticated ways to measure the value produced by ecosystems, however, few projects have the luxury of conducting such site-specific analyses at this level of detail. For this reason, economists are now establishing generalized values for different ecosystem functions and their associated goods and services that can be applied universally.

In order to conservatively estimate the flood storage benefit for the Hamilton BCA, we consulted specialists from the Gund Institute and their northwestern Washington associates[11]. We were referred to studies done in King County from which to draw value estimate assumptions[12]. The value of wetlands for flood protection in King County ranged between $7,800 per acre and $51,000 per acre[11]. The conservative figure of $7,800 was applied with a calculated average of 3.31 acres for residential parcels in the study area to derive the total benefit. Entered into the FEMA Riverine Limited Data Module, a net present value of $14.7 million over the next 100 years was derived. Again, this flood storage value is only maximized with restoration of contiguous areas to open space, as with the entire Cockreham Island floodway area.

Indirect Benefits – Separate BCRs were conducted to consider the indirect economic benefit of town revitalization, the recreational value of floodway open space restoration, and the collective benefit of these.

Per capita income (PCI) is an accepted indicator of a community's economic wellbeing. The indirect economic benefit for this BCA was calculated by annualizing the difference between the PCI for the Town of Hamilton and that for neighboring Lyman (Census 2000). A conservative population of 400 persons was used, deriving a $1.39 million annual opportunity cost of maintaining the status quo. Entered into the FEMA Riverine Limited Data Module, this generates a net present value of $19.8 million as the indirect economic benefit of town revitalization efforts over the 100-yr project lifetime.

Recreation opportunities are a major economic force in Washington. The paper *Untold Value: Nature's Services in Washington State* (APEX 2004) cites approximately one billion dollars as being spent annually on recreational fishing alone, with an additional $1.3 billion spent annually on wildlife viewing, and $408 million on hunting (WDFW 2002). Authors further cite that wildlife watching alone generates significantly more

revenue for Washington's economy than the apple industry and supports over 21,000 jobs in the state, more than any Washington employer other than Boeing (WDFW 1997).

Different methods and indicators can be used to assess the non-market environmental services that recreation affords. For example, the total public/non-profit funds invested for habitat restoration is an indicator of the cost associated human impact on the environment. The higher cost of waterfront real estate is a reflection of the value we place on this ecologic service. This also helps to explain the market forces driving floodway property higher, despite the risk of their locale. Travel Cost is another indicator of an area's recreation value, and the method applied here.

Rasar State Park is located within the Hamilton BCA study area. This park encompasses 169 forested acres and 4,000 feet of freshwater shoreline. This site represents an ideal recreation use for floodway property. Annual attendance records were obtained from the State Parks and Recreation Commission (Attachment #6). These totals were adjusted to account for a three person per car occupancy, based on State occupancy estimates. A cost of $54 per trip was applied from the King County study[12].

Benefit Scenarios – Each benefit scenario (A,B,C, and D) was separately calculated for the Low, Medium, and High Cost scenarios.

Scenario A applies only Avoided Cost figures to provide the most conservative outcomes.

Scenario B includes with the Avoided Cost figures an indicator of the Economic Benefit that is anticipated to coincide with town revitalization activities, such as relocating business and public services to the new town site, and providing for additional commercial development.

Scenario C includes with the Avoided Cost figures an indicator of the Recreation Benefit of open space restoration. This is only reflected as the minimum value that current visitors attribute to this area through their willingness to travel to one park location in the vicinity. This benefit calculation does not include the many environmental benefits associated with floodway restoration, such as salmon hatchery and eagle migration functions, and the reduced incidence of septic tank and well contamination.

Scenario D includes the Avoided Cost along with the Indirect Economic and Recreation Benefit. The three benefit cost ratios calculated for Scenario D are considered to most closely reflect the true value of this project.

Conclusion

The realized cost for permanently mitigating 400 floodway residences, and establishing the means to revitalize this historic, rural community and timber-impacted economy is projected to be between $33.9 million and $64.9 million. The benefits are conservatively estimated to range between $40.9 million and $84.8 million.

This analysis underscores the direct and indirect value of investing in a permanent solution to the chronic flooding that has eroded the financial viability of the Hamilton

community. Without intervention from the public sector, the Town of Hamilton will face bankruptcy and disincorporation in short order. This remains an option, however, this does not resolve the underlying issues of repetitive flooding, and poverty that likewise afflict area residents. Investing in the preservation of Hamilton through relocation enables both the Town and the County to utilize the town's urban density potential, under the Growth Management Act, to resolve preexisting floodway development problems.

The Hamilton Public Development Authority respectfully invites local, state, and federal support to realize the vision to restores the Town of Hamilton as a viable and desirable municipality in and around which to live and work, and reduce repetitive losses from flood-prone areas of Skagit County. Long-term benefits of this effort are projected to extend far beyond the boundaries of the town. Benefits from collaborative address of multi-jurisdictional concerns strengthen working relationships within and across participating agencies, and this increased capacity strengthens our community at large.

References

[1] FEMA Yellow Book, Appendix A: Technical Overview: The Benefit-Cost Model p. A-5, 100 years is commonly applied as the project useful lifetime for acquisition and relocation projects because benefits received beyond 100 years have negligible present value.

[2] Skagit County Assessor's Office

[3] FEMA *Guidelines for Benefit-Cost Analysis*, Mitigation BCA Toolkit CD, Version 2.0 January 2005, p. 1, 3

[4] Mitigation BCA Toolkit CD, Version 2.0 January 2005

[5] Ecological Economics, *A Typology for the Classification, Description and Valuation of Ecosystem Functions, goods and services*, Issue 41 (2002) p. 403

[6] US Army Corps of Engineers, *Economic Flood Damage Assessment of Without Project Conditions, Skagit County, WA*, June 2005

[7] FEMA Procedures for Developing Scopes of Work for the Acquisition of Floodprone Properties, January 2005, p. 32

[8] Ecological Economics, *The Dynamics and Value of Ecosystem Services: Integrating Economic and Ecological Perspectives,* Issue 41 (2002) p. 393

[9] *Untold Value: Nature's Services in Washington State* (APEX 2004)

[10] OMB Circular A-94 (governs BCAs conducted by nearly all Federal agencies)

[11] Northern Economics, Inc., headquartered in Anchorage, Alaska
Earth Economics, based in Seattle and formerly known as the Asia Pacific Environmental Exchange (APEX)

[12] *Ecosystem Services Enhanced by Salmon Habitat Conservation in the Green/Duwamish and Central Puget Sound Watershed*, APEX, February 2005

The Economic Value of Wetlands: Wetlands' Role in Flood Protection in Western Washington, Ecology Publication No. 97-100, October 1997