Appendix H

INCREMENTAL COST ANALYSIS

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Incremental Cost Analysis Appendix H

1. Purpose

Corps of Engineers guidance requires a cost effectiveness analysis and an incremental cost analysis for recommended environmental restoration and mitigation plans. A cost effectiveness analysis is conducted to ensure that the least cost solution is identified for each possible level of environmental output. An incremental cost analysis of the solutions is conducted to reveal changes in costs of increasing levels of environmental outputs. In the absence of a common measurement unit for comparing the nonmonetary benefits with the monetary costs of environmental plans, cost effectiveness and incremental cost analysis are valuable tools to assist in decision making. This appendix presents the results of the cost effectiveness and incremental cost analysis of the Crains Island Habitat Rehabilitation and Enhancement Project, Randolph County, Illinois.

2. Method

The project was evaluated using guidance documents and software prepared by the Corps of Engineers' Institute for Water Resources (IWR). IWR – Planning Suite Software (Version 2.0) was used to automate steps in the cost effectiveness and incremental cost analysis. Much of the text of this appendix was borrowed from the IWR Report (IWR 94-PS-2), Cost Effectiveness Analysis for Environmental Planning: Nine Easy Steps (Orth, 1994). The cost effectiveness and incremental cost analysis procedures are presented in nine steps, which are grouped into four tasks listed below.

A. Formulation of Combinations

    Step 1. Display outputs and costs
    Step 2. Identify combinable management features
    Step 3. Calculate outputs and costs of combinations

B. Cost Effectiveness Analysis

    Step 4. Eliminate economically inefficient solutions
    Step 5. Eliminate economically ineffective solutions

C. Development of Incremental Cost Curve

    Step 6. Calculate average costs
    Step 7. Recalculate average costs for additional outputs

D. Incremental Cost Analysis

    Step 8. Calculate incremental costs
    Step 9. Compare successive outputs and incremental costs

The results of these analyses are displayed as graphs and tables at the end of this appendix. They allow decision makers to progressively compare alternative levels of environmental outputs and ask if the next level is "worth it": that is, is the additional environmental output in the next level worth the additional monetary costs? It is important to note that these analyses will not usually lead, and are not intended to lead, to a single best solution as in economic cost-benefit analyses. They will improve the quality of decision making by ensuring that a rational, supportable, focused, and traceable approach is used for considering and selecting alternative methods to produce environmental outputs.

A. Formulation of Combinations

Step 1. Display outputs and costs. Outputs were determined using Habitat Evaluation Procedures and are presented as a net Average Annual Habitat Units (for additional information see Appendix G

– Habitat Evaluation & Quantification). Costs were annualized over a 50-year period of analysis at the FY 2016 federal interest rate of 2.875%. Costs include a contingency cost (30%), P&S, S&A Cost (25%), LEERDs, and mobilization and demobilization (5%).

Step 2. Identify combinable management features. The management features were reviewed to determine which were dependent on other features and logically combinable. Management features were considered as functional groups. The functional groups include: sediment deflection berm, reforestation, side channel, and depressional wetland. The following (Table 1) documents the final measures evaluated in each feature group. Additional information related to the development and screening of restoration features can be found in Section 4 of the main report.

Sediment Deflection Berm

This feature would increase fine bed load deposition throughout the Project Area. Material for the berm would come from excavation of the side channel. There were three iterations of this feature, which are described below. Several elevations for each iteration were considered for the height of the sediment deflection berm including 20% chance of annual exceedance elevation, 10% chance of annual exceedance elevation, and 8% chance of annual exceedance elevation. However, based on hydrologic modeling, only 20% chance of annual exceedance would be under the acceptable threshold for the State of Illinois 100-year flood height impacts.

A1 – The berm would start from the existing Bois Brule Levee and tie into the existing bank of the side channel. This measure would meet the project objective of deflecting coarse sediment from the upper end, but the high bank side channel is not sufficient to provide coarse sediment deflection. This iteration of the sediment deflection berm would also not protect the side channel from wandering inland towards the in-holding. This feature was screened from further evaluation.

A2 - The berm would start from the existing Bois Brule levee and curve towards the side channel, running parallel to the side channel. The proposed measure would have a 4:1 slope on the exterior with an 8:1 slope on the interior to minimize scouring when overtopped by flood events. The top of the berm would be constructed to a 20% chance of annual exceedance elevation of 374.48 NAVD 88 at a length of 13,500 feet long. The cross-sectional width of the sediment deflection berm would be approximately 150 feet wide at the base. This measure is preferred over A1 because it increases the area with protection from coarse sediment material deposition and increases fine sediment deposition. This feature was retained for further evaluation.

A2* - This berm would be the same alignment as A2 with an additional kicker berm on the inside. This measure is a larger increment of A2 and would increase the amount of acreage for reforestation when compared to A2. This feature was retained for further evaluation.

Reforestation

This measure would improve the habitat quality and reduce the fragmentation of forest throughout the Project Area. The sediment deflection berm would also be reforested. There were two iterations of reforestation considered and described below.

F1 – This measure would involve reforestation throughout the area. This feature was retained for further evaluation.

F2 – This measure would involve reforestation throughout the study but is exclusive to the A2* measure, and it would include more acres of reforestation than F1. This feature was retained for further evaluation.

Side Channel

This feature involves excavation of the side channel. Several iterations of the side channel were considered and described below. The side channel would restore depth and connectivity and increase aquatic habitat diversity and quality. Refer to Appendix C, Hydrology and Hydraulics for more information on designs and drawings.

S1 – This feature involves excavation of the side channel at the lower entrance approximately 20 ft. deeper with an elevation of 337ft NAVD88. The water depth of the proposed side channel would be approximately 5 ft. deep 85% of the time and have water approximately 98% of the time. The bottom width would be approximately 80 ft. with a trapezoidal cross section with side slopes of 1 ft. vertical on 3 ft. horizontal, extending approximately 120 ft. on each side. Removal of remnant wood pile river training structures within the excavation area would be completed. This feature was screened from further evaluation for several reasons: 1) the trapezoidal cross section did not provide enough depth diversity for fisheries resources, 2) only excavating the lower portion of the side channel does not effectively restore year-round connectivity and flow to the side channel, and 3) sediment in the lower potion would fill back into the river if existing river training structures were not altered to change the flow

S2 – This feature involves excavation of the neck of the side channel approximately 20 ft. deeper with an elevation of 337ft NAVD88. The water depth of the proposed side channel would be approximately 5 ft. deep 85% of the time and have water approximately 98% of the time. The bottom width would be approximately 80 ft. with a trapezoidal cross section with side slopes of 1 ft. vertical on 3 ft. horizontal, extending approximately 120 ft. on each side. Removal of remnant wood pile river training structures within the excavation area would be completed. The wider side channel has a higher probability of maintaining flow through along with reducing the opportunity for side channel lose connection due to debris. With a wider footprint, a “crain’s neck” design would be difficult to construct. The trapezoidal cross section did not provide enough depth diversity for fisheries resources. In addition, the “crain’s neck” design would likely not support higher velocities needed to sustain depth and reduce sedimentation over time. The design would also be difficult to construct. This feature was screened from further evaluation.

S3 – This project feature would have an excavated depth of the bottom of the side channel approximately 20 ft. deeper with an elevation of 337ft NAVD88. The water depth of the proposed side channel would be approximately 5 ft. deep 85% of the time and have water approximately 98% of the time. The bottom width would be approximately 80 ft. with a trapezoidal cross section with side slopes of 1 ft. vertical on 3 ft. horizontal, extending approximately 120 ft. on each side. Removal of remnant wood pile river training structures within the excavation area would be completed. Excavated material would be used for construction of the sediment deflection berm and dredge material would be placed adjacent to Crains Island. This feature was retained for further evaluation.

S4 – This project feature would have an excavated depth of the bottom of the side channel approximately 20 ft. deeper with an elevation of 337ft NAVD88. The water depth of the proposed side channel would be approximately 5 ft. deep 85% of the time and have water approximately 98% of the time. The bottom width would be approximately 80 ft. with a trapezoidal cross section with side slopes of 1 ft. vertical on 3 ft. horizontal, extending approximately 120 ft. on each side. Removal of remnant wood pile river training structures within the excavation area would be completed. This measure involves excavation of the side channel with benching on the river side the entire length. Benching involves one or more terraces of approximately 20 feet in width placed roughly midway through the bank. The benches allow for more vegetation growth on a less steep slope. This allows the vegetation to become inundated at different times and allows fish and wildlife to utilize this habitat. Excavated material would be used for construction of the sediment deflection berm and dredge material would be placed adjacent to Crains Island. This feature was screened from further evaluation because benching the length of the side channel only on the river side does not effectively maximize the fisheries benefits for the entire side channel.

S5 – This project feature would have an excavated depth of the bottom of the side channel approximately 20 ft. deeper with an elevation of 337ft NAVD88. The water depth of the proposed side channel would be approximately 5 ft. deep 85% of the time and have water approximately 98% of the time. The bottom width would be approximately 80 ft. with side slopes of 1 ft. vertical on 3 ft. horizontal, extending approximately 120 ft. on each side. Removal of remnant wood pile river training structures within the excavation area would be completed. This feature involves excavation of the side channel with benching on the land side the entire length. Benching involves one or more terraces of approximately 20 feet in width placed roughly midway through the bank. Excavated material would be used for construction of the sediment deflection berm and dredge material would be placed adjacent to Crains Island. This feature was screened from further evaluation because benching the entire length of the land side would likely not be sustainable on the outside bends of the two entrances where velocities are the highest. Benches constructed in these areas would likely revert to 1 ft. vertical on 3 ft. horizontal, in which case, adding the benches would not add habitat value for the entire 50 year evaluation period. In addition, benching only on one side does not effectively maximize the fisheries benefits for the entire side channel.

S6 – This project feature would have an excavated depth of the bottom of the side channel approximately 20 ft. deeper with an elevation of 337ft NAVD88. The water depth of the proposed side channel would be approximately 5 ft. deep 85% of the time and have water approximately 98% of the time. The bottom width would be approximately 80 ft. with side slopes of 1 ft. vertical on 3 ft. horizontal, extending approximately 120 ft. on each side. Removal of remnant wood pile river training structures within the excavation area would be completed. This feature involves excavation of the side channel with benching on the river and land side the entire length. Benching involves one or more terraces of approximately 20 feet in width placed roughly midway through the bank. Excavated material would be used for construction of the sediment deflection berm and dredge material would be placed adjacent to Crains Island. This feature was screened from further evaluation because benching the entire length of the land side would likely not be sustainable on the outside bends of the two entrances where velocities are the highest. Benches constructed in these areas would likely revert to 1 ft. vertical on 3 ft. horizontal, in which case, adding the benches would not add habitat value for the entire 50 year evaluation period.

S7 – This project feature would have an excavated depth of the bottom of the side channel approximately 20 ft. deeper with an elevation of 337ft NAVD88. The water depth of the proposed side channel would be approximately 5 ft. deep 85% of the time and have water approximately 98% of the time. The bottom width would be approximately 80 ft. with side slopes of 1 ft. vertical on 3 ft. horizontal, extending approximately 120 ft. on each side. Removal of remnant wood pile river training structures within the excavation area would be completed. This feature involves excavation of the side channel with benching where opportunistic. Benching involves one or more terraces of approximately 20 feet in width placed roughly midway through the bank. Benches would be placed where they are sustainable for the 50 year evaluation period and not on the outside bends where flows are higher. This feature is most effective by maximizing the fisheries habitat benefits throughout the entire side channel. Excavated material would be used for construction of the sediment deflection berm, and dredge material would be placed adjacent to Crains Island. This feature was retained for further evaluation.

Table 1. Final Array of Restoration Measures.

Code	Description	Benefit	Carried Forward?
Sediment Deflection Berm			
A0	No Action	Increase fine bed load deposition	Yes – All measures compared against no action.
A2	Starting from Bois Brule levee that curves back toward side channel and runs downstream along bank of side channel		Yes – Meets project objective
A2*	Starting from Bois Brule levee that curves back toward side channel and runs downstream along bank of side channel, with an additional kicker berm		Yes – Meets project objective
Reforestation			
F0	No Action	Improve habitat quality and reduces fragmentation	Yes – All measures compared against no action.
F1	Reforestation throughout study area		Yes – Meets project objective.
F2	Reforestation throughout the study area – dependent on A2* feature		Yes – Meets project objective.
Side Channel			
S0	No Action	Restore connectivity; increase aquatic habitat diversity and quality	Yes – All measures compared against no action.
S3	Increase side channel depth and width, no benching		Yes – Meets project objective.
S7	Increase side channel depth and width, benching were opportunistic		Yes – Meets project objective.
Wetland			
W0	No Action	Improve and increase acreage of wetland habitat	Yes – All measures compared against no action.
W1	Depressional wetlands		Yes – Meets project objective.

Due to the limited number of restoration measures, the team analyzed all possible combinations rather than identify individual alternative formulation strategies.

The final array of restoration features were combined into distinctly different alternatives based on feature dependencies and exclusivities. The following documents that rationale for the formulation of alternatives.

The side channel excavation and sediment deflection berm are dependent on each other. The material excavated from the side channel would be used for the sediment deflection berm. Obtaining material for the berm off site would be cost prohibitive and was not considered.

Reforestation is dependent on the sediment deflection berm, is a cost effective feature, and would meet the planning objective of restore floodplain forest communities. Further, reforestation is easily completed and provides benefits to areas where land disturbances occurred, such as the construction of the sediment deflection berm. This not only reduces O&M costs to control invasives, but also captures benefits earlier in the life of the project. The soil composition is critical to the success of the reforestation effort throughout the Project Area interior of the berm. The sediment deflection berm is a critical feature to ensuring forest community success is attainable by improving backing of water throughout the project area to improve soil composition. From an ecological stand point, the team determined that the high probability and negative consequences of invasive species warranted the interdependency of the SD berm and reforestation measures. Without reforestation and the sediment deflection berm, forest community diversity and restoration would not be attainable.

The wetland is an independent measure and could be part of any alternative or as a standalone alternative. As a standalone feature, it would only meet one of the planning objectives.

The final array of alternatives includes 9 action alternatives and the No Action Alterative. The following (Table 2) documents the final array of alternatives, including the No Action Alternative.

Table 2. Final Alternative Plans.

	Restoration Feature						
Alternative	A2	A2*	F1	F2	S3	S7	W1
No Action							
1A	X		X		X		X
1B		X		X	X		X
2A	X		X			X	X
2B		X		X		X	X
3A	X		X		X		
3B		X		X	X		
4A	X		X			X	
4B		X		X		X	
9							X

Each alternative was evaluated through an environmental benefits analysis to determine the magnitude of ecosystem benefits to be expected if the alternative was implemented. The benefits were then combined with cost estimates for each alternative, and then incremental cost analysis (ICA) was conducted to determine cost effectiveness. The Corps team worked through this step outside of IWR-Planning Suite software to determine the final list of alternatives that would be analyzed using IWR-Planning Suite software. A total of ten alternatives, including the No Action Alternative, were generated.

Step 3. Calculate outputs and costs of combinations. Tables 3-6 display the ten alternatives including the total output, average cost of the alternative, and average annual cost per habitat unit for each alternative.

B. Cost Effectiveness Analysis

Steps 4 and 5. Eliminate economically inefficient solutions and eliminate economically ineffective solutions. Steps 4 and 5 were carried out using the IWR-Planning Suite software. Step 4 eliminates economically inefficient solutions and identifies the least cost solution for each level of output. Inefficient in Production is defined as any alternative where the same output level can be generated at a lesser cost by another alternative. The alternatives are evaluated, and wherever there are two or more alternatives providing the same output level, aside from any other considerations (i.e., uncertainty about the reliability of cost or output estimates), the more costly alternative(s) generating the same output level is eliminated.

Step 5 eliminates the economically ineffective solutions by identifying those solutions that will produce less output at equal or greater cost than subsequently ranked solutions. Ineffective in Production is defined as any alternative where a greater output level can be generated at a lesser or equal cost by another alternative. The cost effectiveness analysis was run a second time, without Alternative 9, as it was a significantly less cost than the other eight alternatives.

Of the 10 generated plans, 4 were considered Best Buys, 2 were considered Cost Effective, and 4 were considered not cost effective. Figure 1 at the end of this appendix displays the 10 alternatives differentiated by cost effectiveness. Figure 3 at the end of this appendix displays the 9 alternatives differentiated by cost effectiveness. Alternative 9 did not affect the cost effectiveness curve and identified the same cost efficient and best buy alternatives.

C. Development of Incremental Cost Curve

Step 6. Calculate average costs. Average costs for each least-cost, cost-effective plan are determined by dividing the cost of the plan by the output (AAHUs). Average costs are expressed in cost per AAHU ($/AAHU). The plan with the lowest average cost is identified. Plans with less output at a higher average cost are eliminated.

Step 7. Recalculate average costs for additional outputs. This step asks the questions: "of the remaining levels of output, which has the lowest additional cost for additional output?" Using levels of output from Step 6, the average annual costs for additional output are calculated. The previous step's lowest average cost level of output is used as the "zero level." Levels of output less than the lowest average cost level are dropped from further analysis, while levels of output greater than the lowest average cost level advance to the next recalculation. Recalculations are then made using the new lowest average cost level as the "zero level" until the highest level of output is reached. Steps 6 and 7 were carried out using the IWR-Planning Suite Software.

D. Incremental Cost Analysis

Step 8. Calculate incremental costs. Step 8 was carried out using IWR-Planning Suite software. Incremental cost is the additional cost incurred by selecting one alternative over another, and is computed by subtracting the cost of one alternative from another. The 4 plans highlighted in Table 6 are the "Best Buy" plans, meaning the plans that provide the greatest increase in output for the least increases in cost. The incremental costs per AAHU shown in Table 6 are calculated by dividing the incremental increase in average annual costs by the incremental gain in AAHUs. Figure 1 is a graph of the incremental costs of alternatives as listed in Table 6.

Step 9. Compare successive outputs and incremental costs. Table 6 and Figure 2 were used as decision making tools by progressively proceeding through available levels of output and determining if the next level is worth the additional monetary costs. This step examined the additional habitat value, as featured by increased AAHU output, for an increase in monetary costs. Federal planning for water resources development is conducted in accordance with the requirements of the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G). The P&G provides a decision rule for selecting a tentatively selected plan where both outputs and costs are featured in dollars. This rule states: "The alternative plan with the greatest net economic benefit consistent with protecting the Nation's environment (National Economic Development Plan, NED Plan) is to be selected… (Paragraph 1.10.2)". There is no similar rule for plan selection where the outputs are not featured in dollars, as is the case in planning for ecosystem restoration. In the absences of such a decision-making rule, cost-effectiveness and incremental cost analysis helps to better understand the consequences of the preferred plan in relation to other choices.

3. ICA Conclusions and Selection of Tentatively Selected Plan

The Best Buy alternatives presented provide the information necessary to make well-informed decisions regarding desired project scale. Progressing through the increasing levels of output for the alternatives in Table 6 helps determine whether the increase in Net AAHUs is worth the additional cost. As long as decision makers consider a level of output to be “worth it”, subsequent levels of output are considered. When a level of output is determined to be “not worth it”, subsequent levels of will likely be “not worth it”, and the final decision regarding desired project scale for environmental restoration planning will have been reached.

Typically in the evaluation of Best Buy Alternatives, ‘break points’ are identified in either the last column in Table 6, or in the stir-step progression from left to right in Figure 2. Break points are defined as significant increases or jumps in incremental cost per output, such that subsequent levels of output may not be considered “worth it”. Identification of such break points can be subjective. For the Crains Island HREP, the break points were identified as occurring between alternative 9A and alternative 2A.

No Action Alterative: The No Action Alternative does not meet any of the project objectives and does not improve the habitat at Crains Island. There is no cost associated with this alternative.

Alternative 9A: This alternative includes a wetland of 21.2 acres, resulting in 17 AAHUs at an average annual cost per habitat unit of $2,583. This alternative provides an additional 17 average annual habitat units at an incremental cost of $2,583. The cost for this alternative is approximately $1,113,000. This alternative only meets one of the planning objectives (to restore wetland ecosystem). This alternative doesn’t sufficiently meet the project objectives and therefore was not selected.

Alternative 2A: This alternative includes wetlands of 21.2 acres, reforestation of approximately 61 acres, a sediment deflection berm that improves the forest resources for approximately 109 acres, and excavation of the side channel, resulting in a net gain of 151 AAHUs at an average annual cost of $8,798 per habitat unit. This alternative provides an additional 134 average annual habitat units at an incremental cost of $9,587. This alternative has direct reforestation but has less direct reforestation than Alternative 2B. Conversely, this alternative has more acres protected from the sediment deflection berm than Alternative 2B, which would indirectly restore the forest community. Indirect restoration is less expensive than direct reforestation. The habitat provided by indirect restoration would over time provide similar habitat to direct reforestation. The cost of this alternative is approximately $33,630,000. This alternatives meets all of the project objectives and reasonably maximizes habitat outputs compared to cost.

Alternative 2B: This alternative is similar to Alternative 2A with the addition of approximately 40 additional acres of reforestation on the sediment deflection berm. This alternative has a net gain of 166 AAHUs at a cost of $8,892 per habitat unit. This alternative provides an additional 15 average annual habitat units at an incremental cost of $9,840. The project first cost of this alternative is approximately $37,380,000. This alternative is very similar to Alternative 2A in terms of efficiency and ecosystem restoration outputs, but Alternative 2A adequately meets all project objectives and is less cost. This alternative is a more expensive method of accomplishing reforestation when compared to Alternative 2A. The team found Alternative 2A more reasonably maximizes benefits and that Alternative 2B was not worth the additional cost of $3.8M for 15 habitat units.

4. Summary

The results of the incremental cost analysis and habitat evaluation in this chapter were considered with other factors, including management objectives of the resources agencies, critical needs of the region, and ecosystem needs of the middle Mississippi River. The Crains Island HREP team concluded that the Alternative plan that best meets the goals and objectives of each agency and the UMRR Program is Alternative 2A. This alternative is cost-effective and is justified as a "Best Buy" plan.

Alternative 2A has an overall output of 151 AAHUs, and it was identified as the Tentatively Selected Plan. Implementation of Alternative 2A would increase the quality and quantity of ecosystem resources and meet the needs for a large variety of native aquatic species. Restoring flow and connectivity of the side channel and the main channel of Mississippi River would contribute to overwintering fish habitat as well as feeding areas for migratory wildlife; providing bathymetric diversity and flow within the side channel would provide important side channel habitat within the MMR; and restoring floodplain forest and wetland habitat would allow the Project to realize the highest benefit to fish and wildlife.

Implementation of the proposed project features would improve the overall quality of the ecosystem at Crains Island by improving the ecosystem structure and function, which are expected to provide benefits for the 50-year period of analysis. For these reasons, Alternative 2A is identified as both the National Ecosystem Restoration (NER) Plan as well as the project sponsor's preferred plan.

In cooperation with the USFWS, the Corps has planned and designed a cost effective project that serves the need of the refuge manager. Alternative 2A has an overall output of 151 AAHHs for an estimated total construction cost of approximately $33,630,000 FY16, and it includes the following restoration features:

- Sediment deflection berm
- Increase in side channel depth and width, benching on either side where opportunistic
- Reforestation throughout the study area
- Depressional wetlands

Table 3. Features Included in Alternatives.

Alternative	Features Included	Net AAHUs	Total Cost
No Action	-	0	$0
Alternative 1A	A2, S3, F1, W1	150	$39,500,000
Alternative 1B	A2*, S3, F2, W1	166	$43,500,000
Alternative 2A	A2, S7, F1, W1	151	$33,630,000
Alternative 2B	A2*, S7, F2, W1	166	$37,380,000
Alternative 3A	A2, S3, F1	139	$38,500,000
Alternative 3B	A2*, S3, F2	154	$42,500,000
Alternative 4A	A2, S7, F1	139	$32,380,000
Alternative 4B	A2*, S7, F2	155	$36,250,000
Alternative 9	W1	17	$1,113,000

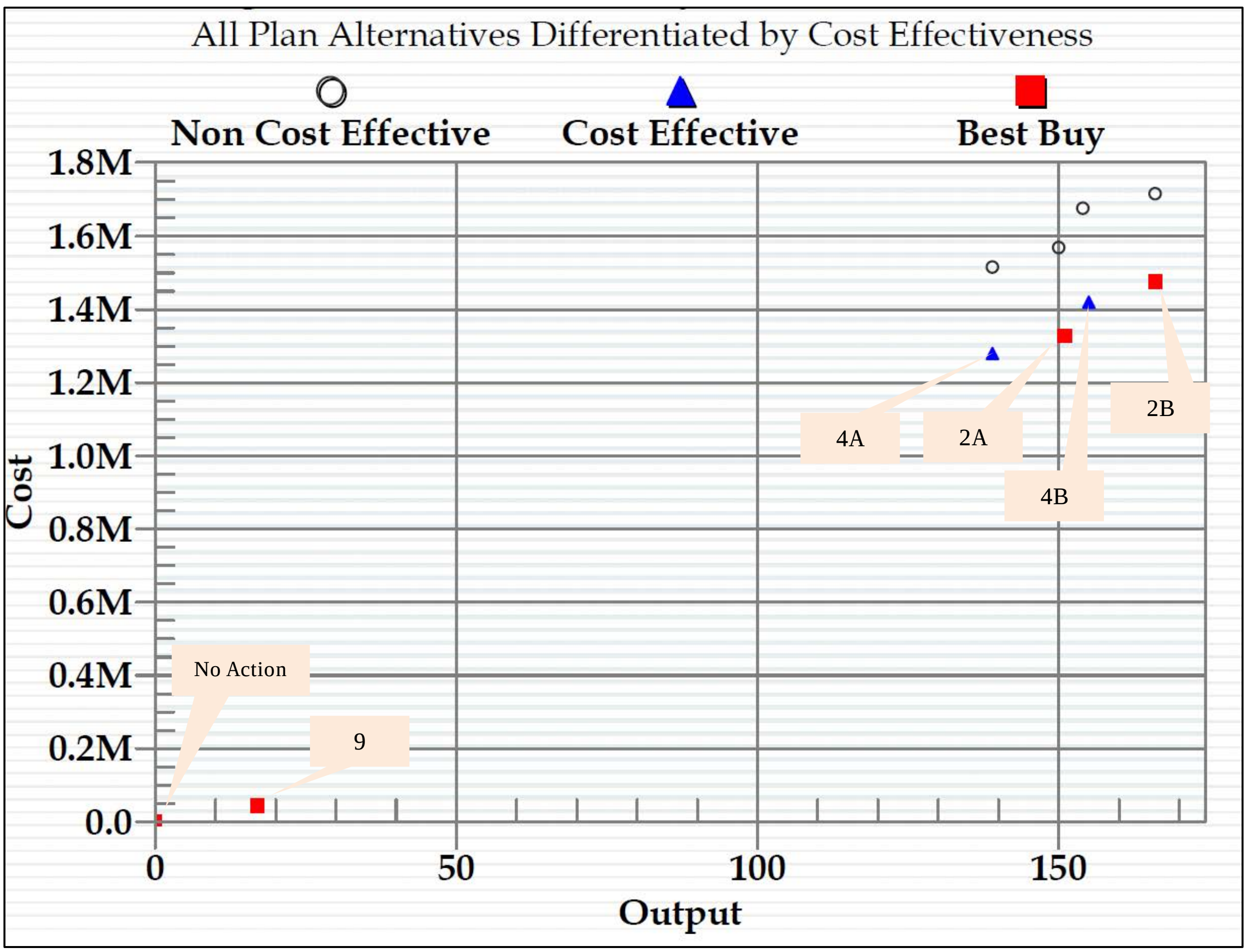

Figure 1. Cost Effective Analysis of All Alternatives.

Table 4. Cost calculations per alternative. (FY2016 Price Level – 50 year period of analysis using 2.875% discount rate and 4 phase construction)

Alt.	Construction	Contingency	Management	AM&M	LERRDs	Project First Cost	Interest During Construction	Annualized OMRR&R	Annualized Economic Cost
1A	$24,304,800	$6,926,868	$7,807,917	$397,000	$14,250	$39,450,835	$1,156,086	$11,050	$1,552,005
1B	$26,803,500	$7,638,998	$8,610,624	$397,000	$14,250	$43,464,372	$1,477,953	$11,050	$1,716,525
2A	$20,672,000	$5,891,520	$6,640,880	$397,000	$14,250	$33,615,650	$1,100,958	$11,050	$1,328,479
2B	$23,029,800	$6,563,493	$7,398,323	$397,000	$14,250	$37,402,866	$1,203,084	$11,050	$1,476,072
3A	$23,722,700	$6,760,970	$7,620,917	$339,000	$14,250	$38,457,837	$1,113,671	$11,050	$1,512,713
3B	$26,119,100	$7,574,539	$8,423,410	$339,000	$14,250	$42,470,299	$1,428,505	$11,050	$1,676,926
4A	$19,942,400	$5,683,584	$6,406,496	$339,000	$14,250	$32,385,730	$1,049,508	$11,050	$1,279,853
4B	$22,345,400	$6,368,439	$7,178,460	$339,000	$14,250	$36,245,549	$1,153,636	$11,050	$1,430,277
9A	$684,400	$164,256	$212,164	$58,000	$14,250	$1,133,070	$9,838	$550	$43,921

Table 5. Environmental Output of Focused Array of Alternatives. (FY2016 Price Level – 50 year period of analysis using 2.875% discount rate)

Alternative	Features Included	Floodplain Forest (Net AAHUs)	Side Channel (Net AAHUs)	Depressional Wetland (Net AAHUs)	Net AAHUs	$/AAHU	Project First Cost
No Action	-	-	-	-	0		$0
Alternative 1A	A2, S3, F1, W1	76	57	17	150	$10,347	$39,500,000
Alternative 1B	A2*, S3, F2, W1	92	57	17	166	$10,341	$43,500,000
Alternative 2A	A2, S7, F1, W1	76	58	17	151	$8,798	$33,630,000
Alternative 2B	A2*, S7, F2, W1	92	58	17	166	$8,892	$37,380,000
Alternative 3A	A2, S3, F1	81	57	-	139	$10,883	$38,500,000
Alternative 3B	A2*, S3, F2	97	57	-	154	$10,889	$42,500,000
Alternative 4A	A2, S7, F1	81	58	-	139	$9,208	$32,380,000
Alternative 4B	A2*, S7, F2	97	58	-	155	$9,227	$36,250,000
Alternative 9A	W1	-	-	17	17	$2,583	$1,113,000

Table 6. Results of CE/ICA for Alterative Plans sorted in order of decreasing output. Rows in gray are Cost Effective.

Alternative	NET AAHU	$/AAHU	Project First Cost	Annualized Cost	Cost Effective	Incremental Output	Incremental Cost Per Unit of Output
No Action	0	$ -			Best Buy	0	$ -
Alternative 2A	150.7	$8,521	$33,630,000	$1,328,479	Best Buy	134	$9,587
Alternative 9A	16.9	$2,515	$1,113,000	$43,921	Best Buy	17	$2,579
Alternative 2B	166.2	$8,601	$37,380,000	$1,476,072	Best Buy	16	$9,840
Alternative 4B	154.4	$8,902	$36,250,000	$1,430,277	Yes		
Alternative 4A	138.7	$8,932	$32,380,000	$1,279,853	Yes		
Alternative 1B	165.7	$10,030	$43,500,000	$1,716,525	No		
Alternative 1A	150.1	$10,067	$39,500,000	$1,552,005	No		
Alternative 3B	154.3	$10,495	$42,500,000	$1,676,926	No		
Alternative 3A	138.6	$10,632	$38,500,000	$1,512,713	No		

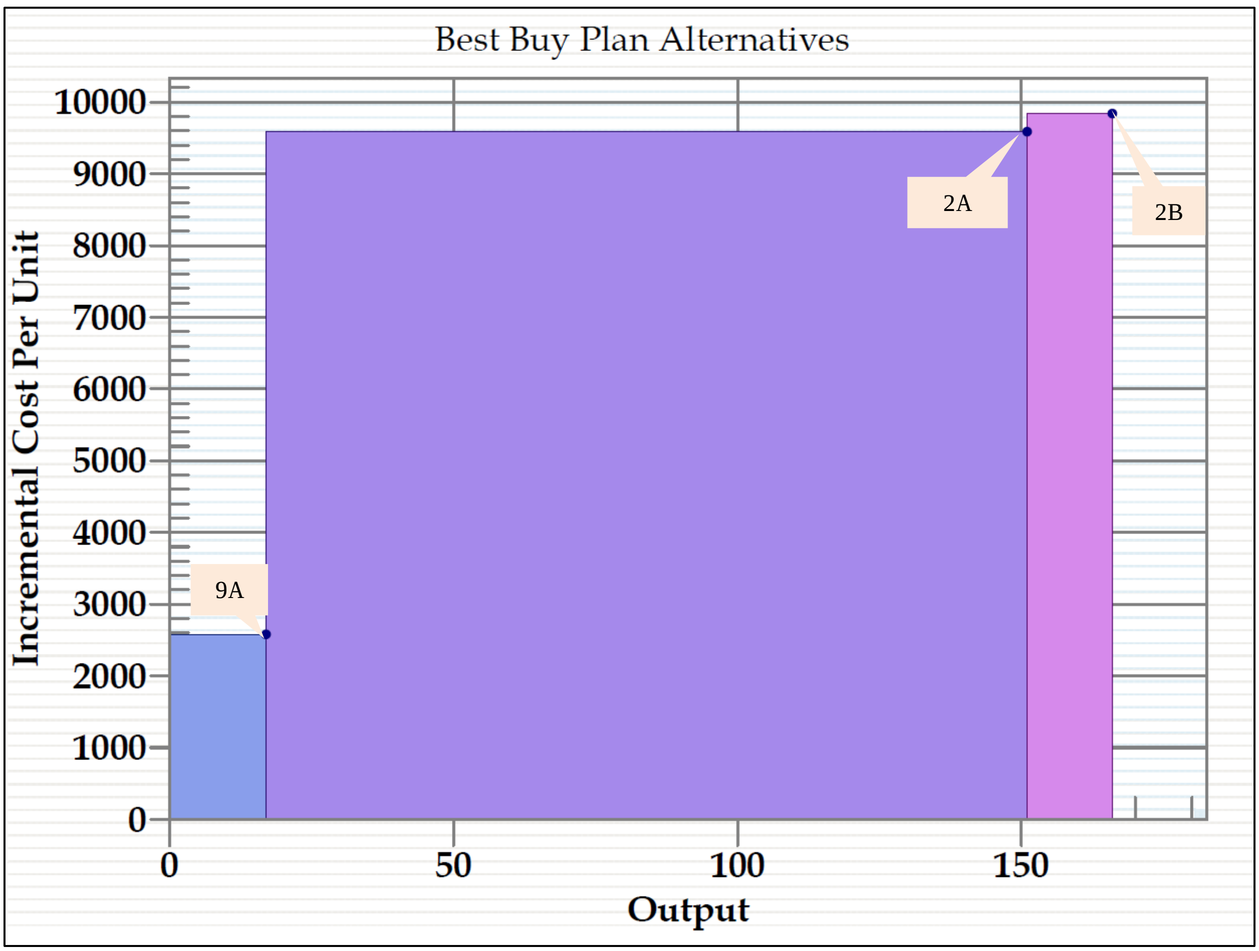

Figure 2. Incremental Cost Per Output (net AAHUs) for the Crains Island HREP Best Buy Plans