Englishtown Feasibility Study

Ferry vs Bridge
March 2015

NOVA SCOTIA

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Introduction:

The Nova Scotia Department of Transportation and Infrastructure Renewal (NSTIR) was asked by the Victoria County Council to explore the option of potential replacement of the existing Englishtown ferry with a permanent structure. This Report will provide estimated costs of construction associated with replacement of the Ferry with a permanent structure. Recommendations will be made concerning the type, size, and location of a prospective replacement structure, as well as recommended steps should the decision be made to explore the permanent structure option further.

Existing Site Conditions:

The Englishtown Ferry is a Nova Scotia Provincial Government run transportation service that operates year round, moving vehicular and pedestrian traffic across the St. Ann's Bay inlet between the communities of Englishtown and Jersey Cove. The ferry has been operating at the current location for roughly 40 years. The 500ft cable ferry is located where Route 312 crosses St. Ann's Bay, 6km North of Exit 12 on Highway 105, near Englishtown on Cape Breton Island, Nova Scotia. The Englishtown side of the ferry has a small, roughly 70m approach road leading to the ferry wharf. The Jersey Cove side of the ferry utilizes a roughly 2km permanent shoal, named St. Ann's Beach, as an approach from the Northwest. The St. Ann's Beach shoal acts as a separation between St. Ann's Bay and St. Ann's Harbour. The shortest alternative route to get from one side of the existing ferry to the other is a roughly 42km stretch using Highway 105 as well as the Cabot Trail.

The 1987 Economic Study:

In 1987 NSTIR's Planning Division completed an Economic Study which compared the future cost of operating the Englishtown Ferry with the future cost of constructing a permanent bridge structure at the site. The study analyzed the economics of the then existing ferry services, which included: Operating Expenditures, Revenue, Traffic, Capital Expenditures, and Deprecation and Scrap Value of the site structures as well as the ferry itself.

The 1987 study then went on to analyze the economics of permanent crossings, including: Capital Costs of Maintenance and Major Construction, Major Maintenance, as well as other topics that are of less relevance to this report, such as revenue, operating expenditures, traffic, and scrap Value. The study focuses on just one type of replacement structure to analyze as mentioned previously. The following outlines the assumptions the study made for the construction of a new permanent structure:

- Total Structure Length: 185m
- Deck Width: 8m
- 3 Approach spans (concrete or weathering steel) leading to a steel Single Leaf Bascule Span
- 6m clearance above "Higher High Water" for approach spans

The 1987 study found that the entire estimated construction cost for this four span structure with a bascule span would be $8.5 Million in 1985 dollars. The study went on to discuss "Major Maintenance" costs, and found that there would be minimal maintenance costs on any of the spans.

The 1987 study does not discuss the method or rationale that was used to decide upon $8.5 Million as the estimated cost. It makes no mention of cost assumptions or unit values used in determining the estimated cost. It does not detail the size of any of the spans, including the bascule span, nor does discuss any alignment details or approach work. The cost of approach upgrade or new alignment likely is not included in the estimated cost provided. It does make mention of the existing Bascule Span structure located at Lennox Passage, N.S., but does not detail how or if this structure was used as part of the estimate.

Using a future value calculation and a rate of 4%, the adjusted value of $8.5 Million from 1985 to 2014 is raised to nearly $27.5 Million. As will be discussed later in this report, this value of $27.5 Million is not an accurate representation of what could be an expected replacement cost. Similarly, the suggested four span configuration does not accurately represent what would be constructed should the Department decide to build a structure complete with a movable span. A three span structure with a movable center span would be more likely, reducing the amount of piers required from three to two.

The Ferry Operational Costs of Ferry Service

Prior to estimating the cost of replacement of the existing ferry service with a structure, estimations must be made to determine what the cost would be of continuing with the existing ferry service. The following list identifies some of the key cost in operating the Englishtown Ferry and the cost that are required in the future. Any new bridge would be designed for a 75 year life span.

The Torquil MacLean is the current cable ferry on the Englishtown ferry crossing, below are some details of the crossing, the ferry's life span and replacement cost.

- Voyages- 45,000
- Sails on Demand
- Voyage Length- 185 meters
- Crossing time- 90 seconds
- Vehicle Traffic- 226,000
- Passengers- 470,000
- Annual Operating Cost- $1,254,239
- Fees Collected- $477,200
- The Torquil MacLean will need to be replace in 20 years
- Ferries have a 30 year life span (on average)
- A new cable ferry is estimated to cost $8.0 Million in 2015 dollars
- The Torquil MacLean requires dry docking every 4 years at an average cost of $400,000

Movable Span Bridge:

A moveable type bridge at the Englishtown Ferry location would provide a suitable crossing for vehicular and pedestrian traffic crossing St. Ann's Bay, as well as the opportunity for water traffic to travel between St. Ann's Bay and St. Ann's Harbour. In constructing a structure containing a movable span, the Department meets all the needs of the travelling public while keeping the grade line of approach spans closer to that of a normal replacement structure. For the purposes of this report, two moveable type spans will be considered: lift span and bascule span.

Lift Span Structure

In order to develop a cost estimate for a replacement lift span structure, it was important to find a similar recent construction project to use as a comparable – both with respect to cost as well as configuration. Through contact with Doug Power, Chief Bridge Engineer with the Newfoundland Department of Transportation (NLDOT), details were provided on the Placentia Lift Bridge replacement in Placentia, Newfoundland. The Placentia Lift Bridge project is the replacement of an existing bridge containing a lift span, currently the only operating movable bridge in Newfoundland, with a new bridge that also contains a lift span. The construction of the new structure is currently underway. A number of details were provided about the structure replacement, including cost (both of the lift span as well as the total project cost), a General Arrangement drawing with all general dimensioning, as well as the reasoning for choosing a lift span over a bascule. The General Arrangement of the Placentia Lift Bridge is provided in the attachments.

The current Placentia Lift Span Bridge has been in service for 50 years. According to NLDOT, despite a very severe marine environment the current structure has performed very well with very few mechanical issues, as well as little in the way of maintenance. NLDOT contributes this mostly to the fact that most of the moveable parts for the bridge are located high (70-80ft) above the marine environment. By contrast, a bascule span has much of the moving parts located below the grade line, thus increasing marine exposure. This was the primary reason for choosing a lift span bridge over a bascule span bridge, especially when considering the marginal difference in cost between the two types of moveable spans.

NLDOT provided a value of approximately $34 Million as the cost of constructing the 33m Placentia Lift Span, which includes the cost of the piers. The Placentia Site has two 32m approach spans and abutments, pushing the total cost of the project to roughly $40 Million.

To estimate the cost of a lift span structure at the Englishtown Ferry site, the replacement structure was approximated using a full span similar to that of the existing ferry cable length. Old Englishtown Ferry schematic drawings were scanned and used as the only documents showing conditions on site. Without accurate survey available, this was the best available approximation tool. In doing this, a 175m structure was laid out using an alignment similar to where the ferry currently is. This 175m structure would comprise of two 71m approach spans, as well as a 33m center lift span. This length of span was used to mimic the lift span dimensions of the Placentia Bridge in an attempt to keep the price estimation accurate. The laid out lift bridge dimensions can be found in the attachments.

In this scenario, the two approach spans for the structure would require 3m deep box girders, and at minimum a 3m clearance from the High Water of Ordinary Tides. Using a $\$5000/m^2$ estimating unit value, while also assuming a 11m wide structure with no sidewalks, yields an estimate of $3 Million per span, or a total cost of $6 Million for the approach spans. As mentioned, a value of $34 Million estimates the cost of the lift span, which includes the cost of the piers. The Placentia Bridge site has a depth of roughly 10m below the high water mark, resulting in 12-14m tall piers. Similarly placed piers at the Englishtown Ferry site would likely need to be 10-15m taller since the depth to the bottom of the harbour is roughly double the depth of that at the Placentia Bridge site. Due to this large height increase requirement, an additional $1.5 Million pier will be added to the original $34 Million dollar

center span estimate. In total the estimate to construct a lift span structure with two approach spans as detailed is $43 Million in 2014 dollars. Note that this estimate does not include potential alignment construction costs associated with re-alignment issues or related constraints. This is simply is an estimate of a structure spanning a similar length to the existing ferry.

Bascule Span Structure

The other moveable bridge considered for this replacement is was a single-leaf bascule span structure. Similar to the lift bridge scenario, there would be two approach spans of 71m and a 33m movable center span. Since there are no vertical clearance obstacles with a bascule span, this type of moveable span is ideal for waterways that have very tall ships that require movement through the bridge span. It is not anticipated that St. Ann's Harbour would encounter any boat movement that required more height than the 70-80ft clearance that the lift span provides.

As mentioned previously, the primary reason that the NLDOT decided to move ahead with a lift span structure instead of a bascule span structure is marine exposure, and the proximity of the important mechanical features to that environment. Through inspections, it was evident that those parts of the structure located closest to the water level were the parts that were found to be in the poorest condition, while the parts that were high above the water remained in fair condition, even after approximately 50 years of service.

An estimate for the cost of a bascule span when compared to that of a lift span would yield similar project costs. The bascule span option may have a slightly lower cost since there may be less materials used as it would not have the towers that the lift span requires.

Non-Moveable Span Bridge:

The final option looked at for a potential replacement structure was a structure that had no moveable spans, yet still provided the 60-70ft vertical clearance required for water traffic to pass underneath. Since the topography in the vicinity of the crossing is very much low lying and near ocean level, the vertical clearance requirement of the structure significantly hinders validity of this option. A simple calculation using a maximum 8% grade increase, while assuming a required 60ft (18m) clearance under the girders at mid-span, the structure would need to be, at minimum, roughly 500m long to meet the required grade. When considering the length requirement alone this option is hardly feasible, let alone the extremely high associated cost of construction. Depending on the type of structure, a bridge this length would require multiple piers, with many exceeding 35-40m in total length. A sketch of the potential location of a structure this size can be found in the attachments.

Costing Analysis:

Both the Bridge and Ferry with have Capital Costs along with yearly operational cost.

As with the Ferry service, a moveable span structure would have annual expenses that must be accounted for. NSTIR currently operates the moveable span structure located at Barra Strait for $115,000 annually. This value accounts for operator salaries and typical maintenance.

The operating cost of $115,000 annually will be used in the comparison and will be adjusted yearly using and average CPI of 1.88%.

Movable spans will also have significant maintenance cost over its life span, they include;

- 5 million (2014 dollars) on repairs every 25 years
- 1 million (2014 dollars) on maintenance every 5 years from year 25

The ferry will require dry docking every 4 years at an average cost of $400,000.

Table 1: Costing Information

	Bridge	Ferry
Capital Cost on the Books	$0	$2,500,000
Capital Cost (new)	$45,000,000	$8,000,000
Amortization Rate	5%	15%
Loan\Bond\Borrowing Interest	4%	4%
CPI	1.88%	1.88%

Conclusion:

Any replacement structure in the Englishtown Ferry location will be an expensive solution. When considering possible alignment upgrades or changes that may be required as part of the construction of a structure, as well as the high cost of the structure itself, the most cost effective solution may be upwards of $45 Million in initial capital investment. A structure containing a bascule span may turn out to be the cheapest option up front, but it may also require the most maintenance costs since the moveable parts are located close to the water level. The lift bridge option seems to avoid the maintenance costs when compared to a bascule span, but it may also turn out to be a more costly option up front. A structure with no moveable span looks to be the least viable solution when considering length needed to meet the required clearance. A structure of this required length would likely need either a structure with many very tall piers, or unique solution such as a cable-stay bridge. In any case, a structure of this magnitude would be a significantly higher cost than a structure utilizing a moveable span.

When comparing the estimated costs of the two leading options, that is, construction of a lift bridge or the continued use of the ferry, we find the estimated costs lean in favour of the bridge over 75 years, but a positive cost savings does not occur until year 44-45, and for the first 22-23 years the cost of the bridge is more. It should also be noted that in year 75, a new bridge would need to be constructed.

Recommendation:

If the Victoria County Council wishes to determine a more refined and accurate cost estimate of a new structure in the area, they should make a formal request to the Department. This would allow the Department to engage staff in the Highway Planning & Design group to explore the best alignment options available. Once an alignment option is available, it would provide the opportunity to explore a more detailed planned structure layout, as well as a more accurate estimated cost. From there more pre-engineering could be conducted as required.

If the Victoria County Council would like to further consider the replacement of the Englishtown Ferry with a permanent structure, the clear recommendation would be to explore the option of constructing a bridge with a moveable span. If taking the experiences provided by the NLDOT as a viable resource, the most logical solution would be to investigate the construction of a bridge with a lift span. This option would require the shortest overall length of structure, and the moveable parts are mostly located far from the water below. The decision on what type of moveable structure should be built would likely be decided upon through the structure design process. If more accurate costs are requested, the Department should consider hiring a consultant to prepare a feasibility study to look at options for replacement and associated costs.

Appendix

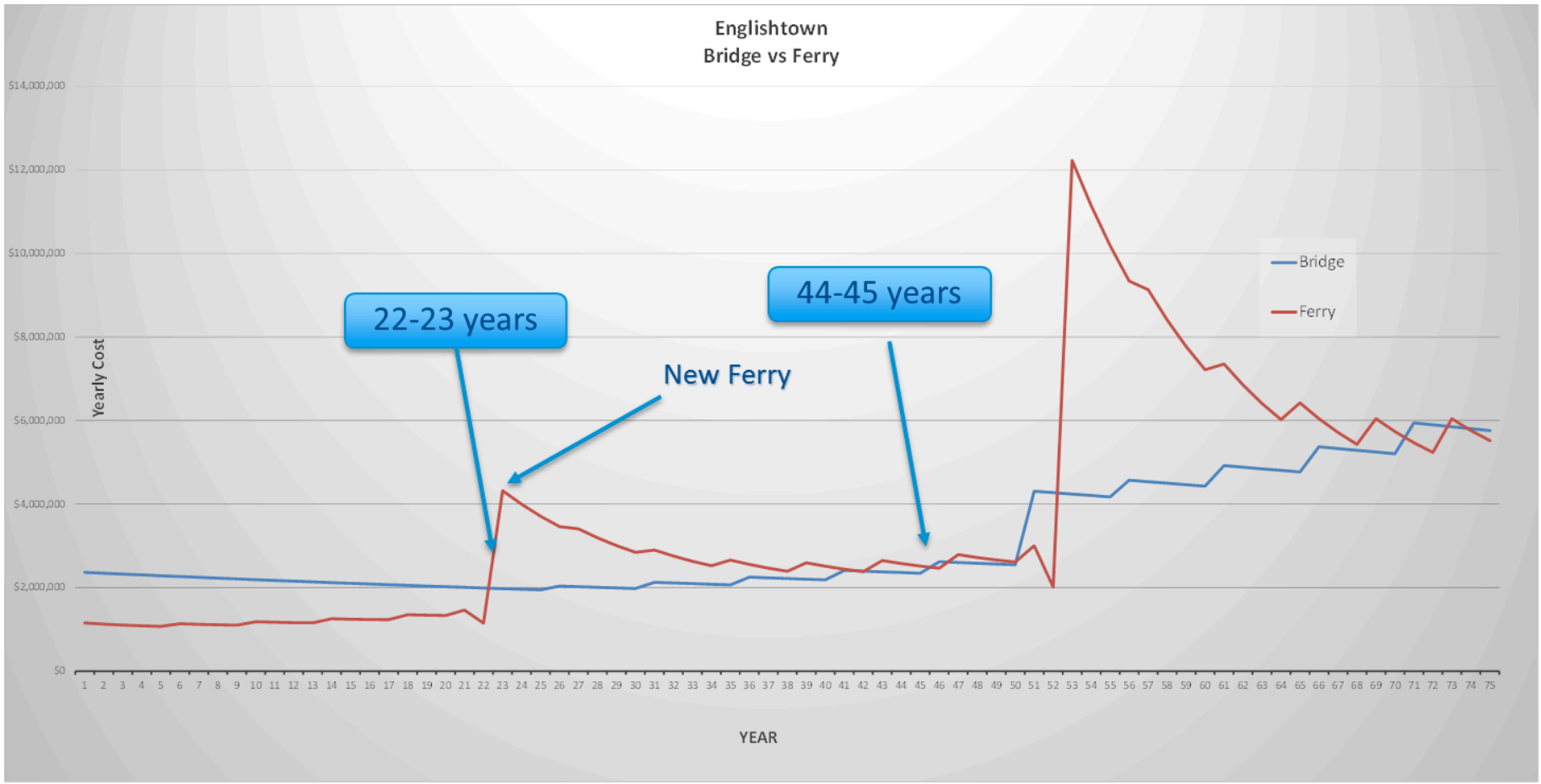
Englishtown
Bridge vs Ferry
$14,000,000
$12,000,000
$10,000,000
$8,000,000
$6,000,000
$4,000,000
$2,000,000
$0
Yearly Cost
22-23 years
New Ferry
44-45 years
Bridge
Ferry
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75
YEAR

Table 1: BRIDGE - Costing Calculation

CPI:	1.88%
Interest on 30 yr TCA bonds:	4%

(75 year design life)

Capital Cost	Year	Amortization Expense	Loan Interest 4%	Book Value	Operational Cost incease at CPI	Total Cost per year
$45,000,000	1	$2,250,000	$1,800,000	$42,750,000	$115,000	$4,165,000
	2	$2,137,500	$1,710,000	$40,612,500	$117,162	$3,964,662
Amortization %	3	$2,030,625	$1,624,500	$38,581,875	$119,365	$3,774,490
5.00%	4	$1,929,094	$1,543,275	$36,652,781	$121,609	$3,593,977
	5	$1,832,639	$1,466,111	$34,820,142	$123,895	$3,422,645
	6	$1,741,007	$1,392,806	$33,079,135	$126,224	$3,260,037
	7	$1,653,957	$1,323,165	$31,425,178	$128,597	$3,105,719
	8	$1,571,259	$1,257,007	$29,853,919	$131,015	$2,959,281
	9	$1,492,696	$1,194,157	$28,361,223	$133,478	$2,820,331
	10	$1,418,061	$1,134,449	$26,943,162	$135,987	$2,688,497
	11	$1,347,158	$1,077,726	$25,596,004	$138,544	$2,563,428
	12	$1,279,800	$1,023,840	$24,316,204	$141,148	$2,444,789
	13	$1,215,810	$972,648	$23,100,394	$143,802	$2,332,260
	14	$1,155,020	$924,016	$21,945,374	$146,506	$2,225,541
	15	$1,097,269	$877,815	$20,848,105	$149,260	$2,124,343
	16	$1,042,405	$833,924	$19,805,700	$152,066	$2,028,395
	17	$990,285	$792,228	$18,815,415	$154,925	$1,937,438
	18	$940,771	$752,617	$17,874,644	$157,837	$1,851,225
	19	$893,732	$714,986	$16,980,912	$160,805	$1,769,523
	20	$849,046	$679,236	$16,131,867	$163,828	$1,692,110
	21	$806,593	$645,275	$15,325,273	$166,908	$1,618,776
	22	$766,264	$613,011	$14,559,010	$170,046	$1,549,320
	23	$727,950	$582,360	$13,831,059	$173,242	$1,483,553
	24	$691,553	$553,242	$13,139,506	$176,499	$1,421,295
TCA Mtn	25	$656,975	$525,580	$25,811,712	$179,818	$1,362,373
	26	$1,290,586		$24,521,127	$183,198	$1,473,784
	27	$1,226,056		$23,295,070	$186,642	$1,412,699
	28	$1,164,754		$22,130,317	$190,151	$1,354,905
	29	$1,106,516		$21,023,801	$193,726	$1,300,242
TCA Mtn	30	$1,051,190		$23,216,009	$197,368	$1,248,558
	31	$1,160,800		$22,055,208	$201,079	$1,361,879
	32	$1,102,760		$20,952,448	$204,859	$1,307,619
	33	$1,047,622		$19,904,825	$208,710	$1,256,333
	34	$995,241		$18,909,584	$212,634	$1,207,875
TCA Mtn	35	$945,479		$21,910,194	$216,632	$1,162,111
	36	$1,095,510		$20,814,684	$220,704	$1,316,214
	37	$1,040,734		$19,773,950	$224,853	$1,265,588
	38	$988,697		$18,785,252	$229,081	$1,217,778
	39	$939,263		$17,845,990	$233,387	$1,172,650
TCA Mtn	40	$892,299		$21,754,711	$237,775	$1,130,075
	41	$1,087,736		$20,666,975	$242,245	$1,329,981
	42	$1,033,349		$19,633,627	$246,799	$1,280,148
	43	$981,681		$18,651,945	$251,439	$1,233,121
	44	$932,597		$17,719,348	$256,166	$1,188,764
TCA Mtn	45	$885,967		$22,674,556	$260,982	$1,146,950
	46	$1,133,728		$21,540,829	$265,889	$1,399,617
	47	$1,077,041		$20,463,787	$270,887	$1,347,929
	48	$1,023,189		$19,440,598	$275,980	$1,299,170
	49	$972,030		$18,468,568	$281,169	$1,253,198
TCA Mtn	50	$923,428		$53,078,556	$286,455	$1,209,883
	51	$2,653,928		$50,424,628	$291,840	$2,945,768
	52	$2,521,231		$47,903,397	$297,326	$2,818,558
	53	$2,395,170		$45,508,227	$302,916	$2,698,086
	54	$2,275,411		$43,232,816	$308,611	$2,584,022
TCA Mtn	55	$2,161,641		$49,717,542	$314,413	$2,476,054
	56	$2,485,877		$47,231,665	$320,324	$2,806,201
	57	$2,361,583		$44,870,082	$326,346	$2,687,929
	58	$2,243,504		$42,626,577	$332,481	$2,575,985
	59	$2,131,329		$40,495,249	$338,732	$2,470,061
TCA Mtn	60	$2,024,762		$48,990,114	$345,100	$2,369,863
	61	$2,449,506		$46,540,608	$351,588	$2,801,094
	62	$2,327,030		$44,213,578	$358,198	$2,685,228
	63	$2,210,679		$42,002,899	$364,932	$2,575,611
	64	$2,100,145		$39,902,754	$371,793	$2,471,938
TCA Mtn	65	$1,995,138		$50,706,351	$378,782	$2,373,920
	66	$2,535,318		$48,171,034	$385,903	$2,921,221
	67	$2,408,552		$45,762,482	$393,158	$2,801,710
	68	$2,288,124		$43,474,358	$400,550	$2,688,674
	69	$2,173,718		$41,300,640	$408,080	$2,581,798
TCA Mtn	70	$2,065,032		$54,807,226	$415,752	$2,480,784
	71	$2,740,361		$52,066,865	$423,568	$3,163,930
	72	$2,603,343		$49,463,522	$431,531	$3,034,875
	73	$2,473,176		$46,990,346	$439,644	$2,912,820
	74	$2,349,517		$44,640,828	$447,909	$2,797,427
	75	$2,232,041		$42,408,787	$456,330	$2,688,372
						$161,448,005

Table 2: FERRY - Costing Calculation

Dry Dock Cost (2014)	$400,000	This is a TCA expenditure

Capital Cost	Year	Amortization Expense	Loan Interest 4%	Cost Dry Dock or New Ferry (CPI added)	Book Value	Yearly Net Cost	Total Cost per year	
$2,500,000	1	$375,000	$100,000.00		$2,125,000	$777,723	$1,252,723	
	2	$318,750	$85,000.00		$1,806,250	$792,344	$1,196,094	
Amortization %	3	$270,938	$72,250.00		$1,535,313	$807,240	$1,150,428	
15.00%	4	$230,297	$61,412.50		$1,305,016	$822,416	$1,114,126	
Dry Dock	5	$195,752	$52,200.63	$486,661.16	$1,595,924	$837,878	$1,085,831	
	6	$239,389	$63,836.98		$1,356,536	$853,630	$1,156,856	
	7	$203,480	$54,261.43		$1,153,055	$869,678	$1,127,420	
	8	$172,958	$46,122.22		$980,097	$886,028	$1,105,109	
Dry Dock	9	$147,015	$39,203.88	$569,324.72	$1,402,407	$902,685	$1,088,904	
	10	$210,361	$56,096.29		$1,192,046	$919,656	$1,186,113	
	11	$178,807	$47,681.85		$1,013,239	$936,945	$1,163,434	
	12	$151,986	$40,529.57		$861,253	$954,560	$1,147,075	
Dry Dock	13	$129,188	$34,450.13	$666,029.40	$1,398,095	$972,506	$1,136,144	
	14	$209,714	$55,923.79		$1,188,381	$990,789	$1,256,427	
	15	$178,257	$47,535.22		$1,010,123	$1,009,416	$1,235,208	
	16	$151,519	$40,404.94		$858,605	$1,028,393	$1,220,316	
Dry Dock	17	$128,791	$34,344.20	$779,160.20	$1,508,974	$1,047,726	$1,210,861	
	18	$226,346	$60,358.98		$1,282,628	$1,067,424	$1,354,129	
	19	$192,394	$51,305.13		$1,090,234	$1,087,491	$1,331,191	
Dry Dock	20	$163,535	$43,609.36	$876,449.26	$1,803,148	$1,107,936	$1,315,081	
	21	$270,472	$72,125.93		$1,532,676	$1,128,765	$1,471,363	
New Ferry	22	$0	$61,307.04	$18,959,350	$20,492,026	$1,149,986	$1,211,293	Note: salvage 1.96M
	23	$3,073,804	$819,681.05		$17,418,222	$1,171,606	$5,065,091	
	24	$2,612,733	$696,728.89		$14,805,489	$1,193,632	$4,503,094	
	25	$2,220,823	$592,219.56		$12,584,666	$1,216,072	$4,029,115	
Dry Dock	26	$1,887,700		$1,108,987.91	$11,805,954	$1,238,935	$3,126,634	
	27	$1,770,893			$10,035,061	$1,262,226	$3,033,120	
	28	$1,505,259			$8,529,802	$1,285,956	$2,791,215	
	29	$1,279,470			$7,250,331	$1,310,132	$2,589,603	
Dry Dock	30	$1,087,550		$1,297,359.00	$7,460,141	$1,334,763	$2,422,313	
	31	$1,119,021			$6,341,120	$1,359,856	$2,478,877	
	32	$951,168			$5,389,952	$1,385,422	$2,336,590	
	33	$808,493			$4,581,459	$1,411,468	$2,219,960	
Dry Dock	34	$687,219		$1,517,726.54	$5,411,967	$1,438,003	$2,125,222	
	35	$811,795			$4,600,172	$1,465,038	$2,276,833	
	36	$690,026			$3,910,146	$1,492,580	$2,182,606	
	37	$586,522			$3,323,624	$1,520,641	$2,107,163	
Dry Dock	38	$498,544		$1,775,525.38	$4,600,606	$1,549,229	$2,047,772	
	39	$690,091			$3,910,515	$1,578,354	$2,268,445	
	40	$586,577			$3,323,938	$1,608,027	$2,194,605	
	41	$498,591			$2,825,347	$1,638,258	$2,136,849	
Dry Dock	42	$423,802		$2,077,113.56	$4,478,659	$1,669,058	$2,092,860	
	43	$671,799			$3,806,860	$1,700,436	$2,372,235	
	44	$571,029			$3,235,831	$1,732,404	$2,303,433	
	45	$485,375			$2,750,456	$1,764,973	$2,250,348	
Dry Dock	46	$412,568		$2,429,929.08	$4,767,817	$1,798,155	$2,210,723	
	47	$715,173			$4,052,644	$1,831,960	$2,547,133	
	48	$607,897			$3,444,748	$1,866,401	$2,474,298	
	49	$516,712			$2,928,036	$1,901,489	$2,418,201	
Dry Dock	50	$439,205		$2,842,673.34	$5,331,504	$1,937,237	$2,376,443	
	51	$799,726			$4,531,778	$1,973,657	$2,773,383	
New Ferry	52	$0		$61,492,710	$66,024,488	$2,010,762	$2,010,762	Note: salvage $6.1M
	53	$9,903,673			$56,120,815	$2,048,564	$11,952,238	
	54	$8,418,122			$47,702,692	$2,087,077	$10,505,200	
	55	$7,155,404			$40,547,288	$2,126,315	$9,281,718	
Dry Dock	56	$6,082,093		$3,596,888.64	$38,062,084	$2,166,289	$8,248,382	
	57	$5,709,313			$32,352,771	$2,207,015	$7,916,328	
	58	$4,852,916			$27,499,856	$2,248,507	$7,101,423	
	59	$4,124,978			$23,374,877	$2,290,779	$6,415,758	
Dry Dock	60	$3,506,232		$4,207,850.96	$24,076,497	$2,333,846	$5,840,078	
	61	$3,611,474			$20,465,022	$2,377,722	$5,989,197	
	62	$3,069,753			$17,395,269	$2,422,423	$5,492,177	
	63	$2,609,290			$14,785,978	$2,467,965	$5,077,255	
Dry Dock	64	$2,217,897		$4,922,590.47	$17,490,672	$2,514,363	$4,732,259	
	65	$2,623,601			$14,867,071	$2,561,633	$5,185,234	
	66	$2,230,061			$12,637,011	$2,609,791	$4,839,852	
	67	$1,895,552			$10,741,459	$2,658,856	$4,554,407	
Dry Dock	68	$1,611,219		$5,758,734.60	$14,888,975	$2,708,842	$4,320,061	
	69	$2,233,346			$12,655,629	$2,759,768	$4,993,114	
	70	$1,898,344			$10,757,284	$2,811,652	$4,709,996	
	71	$1,613,593			$9,143,692	$2,864,511	$4,478,104	
Dry Dock	72	$1,371,554		$6,736,904.96	$14,509,043	$2,918,364	$4,289,917	
	73	$2,176,356			$12,332,686	$2,973,229	$5,149,585	
	74	$1,849,903			$10,482,783	$3,029,126	$4,879,029	
	75	$1,572,418			$8,910,366	$3,086,073	$4,658,491	
							$244,890,853	

Assumptions for this report:

CPI: 1.88% average for the past 10 years

Interest on 30 yr TCA bonds: 4%

Bridge Work

Assume 5 million (2014 dollars) on repairs every 25 years

Assume 1 million (2014 dollars) on maintance every 5 years from year 25

Year	$PV	$FV
25	5000000	$13,329,181.66
30	1000000	$3,243,397.51
35	1000000	$3,946,088.99
40	1000000	$4,801,020.63
45	1000000	$5,841,175.68
50	5000000	$35,533,416.73
55	1000000	$8,646,366.92
60	1000000	$10,519,627.41
65	1000000	$12,798,735.22
70	1000000	$15,571,618.35

30	8500000	$27,568,878.84	Calculation for a New bridge from 1985 dollars to 2014 dollars, 30 years

Ferry Repairs and Rehab

Assume Dry Dock every 4 years $400,000

Assume New Ferry in Year 22 and 52, current price 8 million

Year	$PV	$FV
22	8000000	$18,959,350.33
52	8000000	$61,492,709.66