# Appendix F:  Draft Life Cycle Cost Analysis

# Sterling Highway MP 45 - 60
## *Life Cycle Cost Analysis*
## *DRAFT*

STERLING
HIGHWAY MILE POST 45 TO 60

**Agreement No:**
**DOT&PF Project No: 53014**
**Federal Project No:**

**Prepared for:**

**State of Alaska Department of Transportation and Public Facilities**

**Prepared by:**

**HDR Alaska, Inc.**
**2525 C Street Suite 305**
**Anchorage, AK 99503**

**April 2003**

# Executive Summary

The Sterling Highway is the only road that links western Kenai Peninsula communities (Kenai, Soldotna, and Homer) to the rest of the State. Since 1978, the Alaska Department of Transportation and Public Facilities (DOT&PF) has recognized the need for improved safety and traffic flow along this highway to accommodate the increase in traffic generated by community growth and tourism. The DOT&PF is investigating alternatives for improving the Sterling Highway between Milepost (MP) 45 and MP 60 in a supplemental draft environmental impact statement.

This technical memorandum provides estimated costs for comparison purposes of the reasonable alternatives for the Sterling Highway Milepost 45 - 60 Project. Cost estimates include not only the construction cost, but also program development and life cycle costs, including operation and maintenance (O&M).

## Life Cycle Cost Definition

Life cycle cost is defined as the overall estimated cost of a single project alternative over the life of the project or a defined period. All of the income and expenses associated with the project that occur during its life are used to calculate the life cycle cost. Life cycle costs take into consideration program development costs as well as annual operation and maintenance costs, major rehabilitation required during the life of the project, and the value of money.

## Life Cycle Costs For Sterling Highway Milepost 45 - 60 Project

Life cycle costs for the Sterling Highway Milepost 45 - 60 Project alternatives were determined using the present value for the life cycle cost analysis. Because construction is scheduled to start in the Year 2005, the life cycle costs for all alternatives were computed in Year 2005 dollars. The table below shows life cycle costs for the seven build alternatives and the No Build Alternative.

| ALTERNATIVE | TOTAL ESTIMATED CONSTRUCTION COST ($ MILLION) | ANNUAL AVERAGE O&M COST* ($ MILLION) | TOTAL LIFE CYCLE COST ($ MILLION) |
|---|---|---|---|
| No Build | 0 | $0.630 | $0.84 |
| Kenai River Wall Alternative | 120 | $0.205 | $104 |
| Kenai River Alternative | 73 | $0.146 | $67 |
| Cooper Creek Alternative | 95 | $0.185 | $85 |
| Russian River Alternative | 124 | $0.234 | $109 |
| “G” Alternatives | 103 | $0.200 | $92 |
| Juneau Creek “F” Alternatives | 74 | $0.154 | $70 |
| Juneau Creek Alternatives | 51 | $0.121 | $52 |

*Includes annual O&M cost as well as annual contribution to fund periodic maintenance rehabilitation costs.

**Section** **Page**

# 1.0 Introduction

The Sterling Highway is the only road that links western Kenai Peninsula communities (Kenai, Soldotna, and Homer) to the rest of the State. Since 1978, the Alaska Department of Transportation and Public Facilities (DOT&PF) has recognized the need for improved safety and traffic flow along this highway to accommodate the increase in traffic generated by community growth and tourism.

The Sterling Highway from milepost (MP) 45 to MP 60 follows the Kenai River Valley through the Kenai Mountain range and is constricted by the Kenai River, tributary creeks, and steep valley walls. The scenic nature of the area and world-class fishing on the Kenai and Russian Rivers combine to create serious congestion problems for the highway from May through September. This level of congestion has created safety issues for highway travelers, especially in areas where high-speed traffic conflicts with vehicles turning on and off the highway.

This technical memorandum has developed estimated costs for comparison purposes for the reasonable alternatives under investigation in the SDEIS. Cost estimates include not only the construction cost, but also program development and life cycle costs, including operation and maintenance costs.

# 2.0 Life Cycle Cost Comparison

Life cycle costs were estimated to allow additional economic comparisons between the eight (seven build and the no action) alternatives. Life cycle cost analyses are often used to evaluate the total cost of a project over its useful life, taking into consideration program development costs as well as annual operation and maintenance costs, major rehabilitation required during the life of the project, and the value of money. Development of life cycle costs for this project adhered to guidelines provided in Federal Highway Administration – Office of Management and Budget (OMB) Circular No. A-94, October 29, 1992 and subsequent appendices. The following list summarizes the assumptions used in the analysis:

- All pavements would have to be overlaid at 20 year intervals
- The useful life of a bridge is 50 years
- Long term inflation rate is 2%
- Long term interest rate is 6.3%
- The effective real discount rate is 3.2%

## 2.1 Definition of Life Cycle Cost

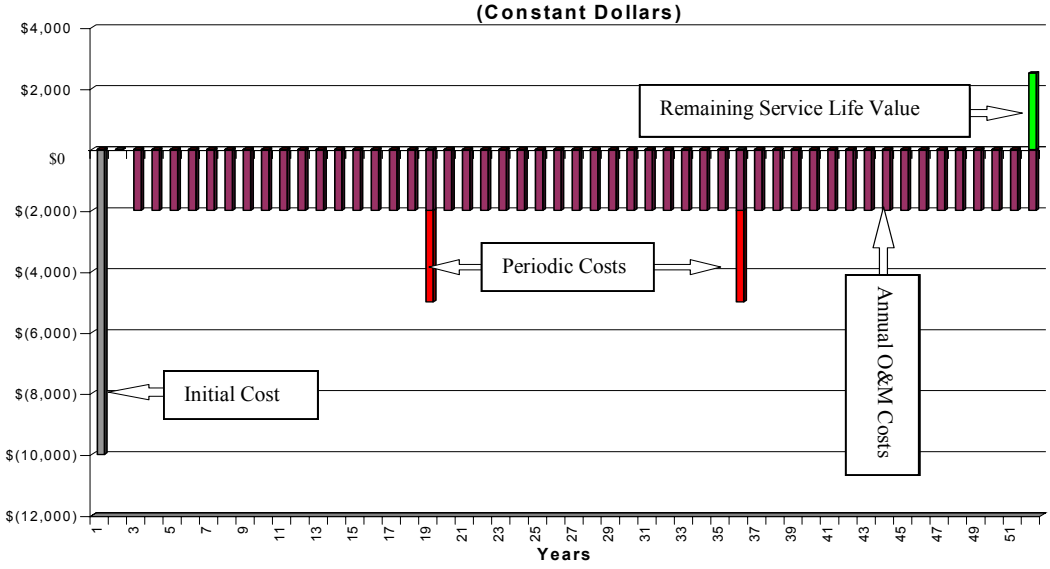
Life cycle cost is defined as the overall estimated cost of a single project alternative over the life of the project or a defined period. All of the income and expenses associated with the project that occur during its life are used to calculate the life cycle cost. Different alternatives can be evaluated by comparing their life cycle costs. For the Sterling Highway MP 45 - 60 Project, present worth is used to compare the life cycle costs of

different alternatives. Annual costs of operation and maintenance used in the analysis are based on evaluation of comparable systems.

## 2.2 Cash Flow

A cash flow diagram is often used to show how money is spent and earned. A simple cash flow diagram is shown in Figure 1. In this figure, each vertical bar represents the net expense or income for a single year. A vertical bar below the $0-line indicates that money is spent on the project and a bar above the $0-line indicates that money is earned or gained. The cash flow includes initial costs, annual operating and maintenance (O&M) costs, periodic maintenance costs, and remaining service life values. Figure 1 assumes "***constant dollars,***" which means that the income and expenses do not include the effects of inflation. Also, annual operating and maintenance costs actually occur throughout the year, but in this cash flow diagram they are shown as a lump sum at the end of the year.

**Figure 1 - Cash Flow Diagram for Life Cycle Costs**




To further explain the cash flow diagram depicted as Figure 1, consider the purchase and maintenance of an automobile, assuming the automobile was paid for in full on the day of purchase:

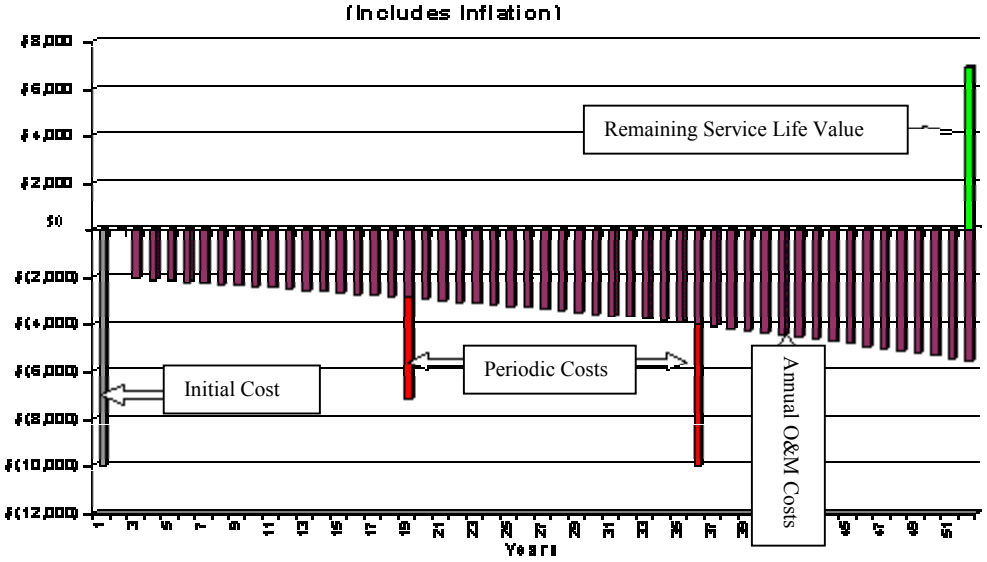
- The *initial cost* is the price that is paid for the vehicle and any taxes and fees paid at the time of purchase.
- *Annual operating and maintenance costs* include the annual cost of fuel, oil, fluids, insurance and other costs that occur every year.
- *Periodic maintenance costs* include new tires, new brakes, new batteries and other maintenance costs that occur throughout the life of the vehicle to keep the vehicle in service.
- The *remaining service life value* is the value of an item at the end of the study period.

When dealing with money or finances for a project over a long period, the time value of money must be considered. The value of money changes over time due to inflation and interest rates.

> ***Inflation*** decreases the value of money over time by increasing the cost of goods and services. When we say, "A dollar today isn't worth what it used to be," we are usually referring to the loss in a dollar's value due to inflation. If we have $100 dollars to buy an item today, the same item 50 years ago would have cost $37, assuming a 2% inflation rate. Similarly, an item that costs $100 in the Year 2000 will cost about $270 in the Year 2050 at a 2% inflation rate.
>
> Because the value of money changes over time, it is very important to specify the year that the dollars are stated in. In the previous example, the $100 price for the item is stated in Year 2000 dollars. When inflation is used to calculate the future cost, the $270 price is in Year 2050 dollars.
>
> ***Interest*** accrued over time increases the value of money. Another way to think about this is that you can "make money" with the money you have in hand today. For example, suppose you put $10 into a bank account that pays 6.3% annual interest. If you leave the account alone and let that original $10 and the interest accumulate, it will be worth $212 in 50 years.

Inflation and interest rates are combined to determine the ***present worth*** of an item. First, we assume that the price of the item purchased today is known. Second, an inflation rate is used to determine the future cost. The interest rate is used to determine how much money would have to be set aside today to pay for the item in the future. Together these factors determine the present worth of the item. Figure 2 shows the cash flow diagram from Figure 1, but with the effects of inflation.

**Figure 2 - Cash Flow Diagram for Life Cycle Costs**




The equation for calculating the future cost for an item is:

$$\text{Future Cost} = \text{Present Cost} \times \underbrace{(1 + \text{inflation rate})^{t}}_{\text{Inflation Factor}}$$

where t = number of years

The present worth of a future transaction is:

$$\text{Present Worth} = \text{Future Cost} \times \underbrace{(1 + \text{interest rate})^{-t}}_{\text{Discount Factor}}$$

where t = number of years

Using the purchase of an automobile again as an example, consider that you decide you want to purchase a new vehicle in 5 years. The 2000 model is currently selling for $20,000 (in Year 2000 dollars). With 2% inflation you can assume that when you buy the new 2005 model it is going to cost $22,082 (in Year 2005 dollars). Today, if you deposit $16,269 (Year 2000 dollars) in an account that generates 6.3% interest and the account balance is allowed to accumulate, you would have enough money for the new vehicle in 5 years. $16,269 (in Year 2000 dollars) is the present worth of the 2005 model.

$$\text{Future Cost} = \$20{,}000 \times (1 + 0.02)^{5} = \$22{,}082$$

$$\text{Present Worth} = \$22{,}082 \times (1 + 0.063)^{-5} = \$16{,}269$$

### 2.3 Remaining Service Life Value

The remaining service life value is the value of an item at the end of the of study period. The straight-line method of depreciation is the method that is used to determine the remaining service life value for this project. This method states the value of an item decreases in value at a constant rate until it reaches the end of its life span, at which point in time the value of the item is zero. Hence, when the item is halfway through the life span, the item is worth half of its original price. When the item is 75% through its life, its remaining service life value is 25% of its original price.

Remaining Service Life Value =
Cost of Item x [(Life of Item - Length of Study Period)/Life of Item]

For example, assume an item is purchased for $1,000, and it has a life span of 50 years. If the item were sold in 20 years, the remaining service life value of the item would be $600.

Remaining Service Life Value in 20 years =
$1,000 x [(50-20)/50] = $600

In the example above, a remaining service life value is calculated for an item that is purchased and sold. There is also remaining service life value associated with periodic maintenance. An item is worth more if it is maintained. The value of the maintenance performed is greater immediately after it is maintained and the value diminishes as you get closer to the next required maintenance. The straight-line method of depreciation described above is also used to determine the remaining service life value of periodic maintenance.

Using the automobile again as an example, assume you own an old car that is in desperate need of a new engine. The cost of purchasing and installing a new engine is $5,000. The engine must be replaced every 15 years. If the car is sold 5 years after the engine is replaced, the remaining service life value the new engine adds to the value of the car is $3,333.

Periodic Maintenance Cost = $5,000

Remaining Service Life Value in 5 years =
$5,000 x [(15-5)/15] = $3,333

## 3.0 Life Cycle Costs for Sterling Highway Milepost 45 - 60 Project

Life cycle costs for the Sterling Highway Milepost 45 - 60 Project alternatives were determined using the present worth value for the life cycle cost analysis. Present worth is

calculated using a real (constant dollar) discount rate of 3.2%.[1] Because construction is scheduled to start in Year 2005, the life cycle costs for all alternatives were computed in Year 2005 dollars.

The calculation of life cycle costs includes the following cash flow components (in constant Year 2005 dollars):

- **Initial Cost of Construction:** Construction is expected to begin in 2005 and to last for approximately three years. The initial cost of construction and project development was distributed over the construction period and occurs at the beginning of the year (beginning of 2005 to beginning of 2008).
- **Annual Operating and Maintenance Costs:** Annual costs are lumped at the end of the year starting at the end of 2008. The final O&M cost occurs at the end of 2027.
- **Periodic Maintenance Costs:** Periodic maintenance costs include repaving the roadway. Each of these maintenance items occurs at its respective frequency **f**. The first cost occurs **f** years after the beginning of 2008.
- **Remaining Service Life Value: Remaining Service Life (RSL)** value of the alternatives after the 20th year is determined using the straight-line method of depreciation. The proposed bridges and tieback walls have an expected life of 50 years (RSL=Cost*Percent of Useful Life left).

The table below shows life cycle costs for the seven build alternatives and the No Build Alternative.

| ALTERNATIVE | TOTAL ESTIMATED CONSTRUCTION COST ($ MILLION) | ANNUAL AVERAGE O&M COST* ($ MILLION) | TOTAL LIFE CYCLE COST ($ MILLION) |
|---|---|---|---|
| No Build | 0 | $0.630 | $0.84 |
| Kenai River Wall Alternative | 120 | $0.205 | $104 |
| Kenai River Alternative | 73 | $0.146 | $67 |
| Cooper Creek Alternative | 95 | $0.185 | $85 |
| Russian River Alternative | 124 | $0.234 | $109 |
| “G” Alternatives | 103 | $0.200 | $92 |
| Juneau Creek “F” Alternatives | 74 | $0.154 | $70 |
| Juneau Creek Alternatives | 51 | $0.121 | $52 |

*Includes annual O&M cost as well as annual contribution to fund periodic maintenance rehabilitation costs

[1] Federal Highway Administration – Office of management and Budget (OMB) Circular No. A-94, Appendix C. Revised January 2003.

# ATTACHMENT
## Cost Estimates

# STERLING HIGHWAY

| OPTION : 05/05/2003 8:58 | No Build | Kenai River Wall | Kenai River | Cooper Creek | Russian River | G | Juneau Creek "F" | Juneau Creek Alternative |
|---|---|---|---|---|---|---|---|---|
| **Begin Construction - Y =** 2005 | | | | | | | | |
| **Analysis Period (years) - n =** 20 | | | | | | | | |
| **Years to Construct - yc =** 3 | | | | | | | | |
| **Initial Cost, Distributed over the # of Years to Construct (Y/N)** n | | | | | | | | |
| **Eff. Real Discount Rate/Yr - i =** 3.2% | | | | | | | | |
| **Roadway Repaving* ($/mi) = $280,000** | | | | | | | | |
| **CASH FLOW (Constant 2005 Dollars):** | | | | | | | | |
| **LIABILITIES:** | | | | | | | | |
| **Initial Cost of Construction (incl. 25% Contingency)** | **$0.00** | **$120,000,000.00** | **$73,000,000.00** | **$95,000,000.00** | **$124,000,000.00** | **$103,000,000.00** | **$74,000,000.00** | **$51,000,000.00** |
| Year 2005 to Year 2008 (Beginning of Year) | | | | | | | | |
| **Annual Operating & Maintenance Costs:** | **$63,000** | **$205,000** | **$146,000** | **$185,000** | **$234,000** | **$200,000** | **$154,000** | **$121,000** |
| Year 2008 to 2027 (End of Year) | | | | | | | | |
| **Periodic Maintenance Costs:** | | | | | | | | |
| **Repaving:** | **$0** | **$3,724,000** | **$3,724,000** | **$3,696,000** | **$3,836,000** | **$3,808,000** | **$3,752,000** | **$4,004,000** |
| Frequency (Years): | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| Length Project (mi): | 0 | 13.3 | 13.3 | 13.2 | 13.7 | 13.6 | 13.4 | 14.3 |
| **EQUITY:** | | | | | | | | |
| **Remaining Service Life Value**:** | | | | | | | | |
| **Bridge(s) and/or Tieback Wall(s):** | **$0** | **$37,966,320** | **$15,756,000** | **$25,782,000** | **$36,426,000** | **$28,182,000** | **$12,612,000** | **$450,000** |
| **RSL value = (const. cost) * [(RSL time)/(expected life)] Construction Cost: | $0 | $63,277,200 | $26,260,000 | $42,970,000 | $60,710,000 | $46,970,000 | $21,020,000 | $750,000 |
| Life of Bridge(s) and/or Tieback Wall(s): | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| **Paving/Repaving:** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** |
| **LIFE CYCLE COST (2005 Dollars):** | | | | | | | | |
| **LIABILITIES:** | | | | | | | | |
| **Initial Cost of Construction (incl. 25% Contingency)** | **$0** | **$120,000,000** | **$73,000,000** | **$95,000,000** | **$124,000,000** | **$103,000,000** | **$74,000,000** | **$51,000,000** |
| **Annual Operating & Maintenance Costs:** | **$837,210** | **$2,724,256** | **$1,940,202** | **$2,458,475** | **$3,109,639** | **$2,657,811** | **$2,046,514** | **$1,607,976** |
| **Periodic Maintenance Costs: Repaving:** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** |
| **TOTAL LIFE CYCLE COST OF LIABILITIES :** | **$837,210** | **$122,724,256** | **$74,940,202** | **$97,458,475** | **$127,109,639** | **$105,657,811** | **$76,046,514** | **$52,607,976** |
| **EQUITY:** | | | | | | | | |
| **Remaining Service Life Value**:** | | | | | | | | |
| **Bridge(s) and/or Tieback Wall(s):** | **$0** | **$18,397,782** | **$7,635,068** | **$12,493,484** | **$17,651,371** | **$13,656,480** | **$6,111,544** | **$218,062** |
| **Paving/Repaving:** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** |
| **TOTAL LIFE CYCLE COST OF EQUITY :** | **$0** | **$18,397,782** | **$7,635,068** | **$12,493,484** | **$17,651,371** | **$13,656,480** | **$6,111,544** | **$218,062** |
| **TOTAL LIFE CYCLE COST :** | **($837,210)** | **($104,326,474)** | **($67,305,133)** | **($84,964,991)** | **($109,458,268)** | **($92,001,331)** | **($69,934,971)** | **($52,389,914)** |

**Grand Totals**

| Alternative | Roadway Cost | Bridge Cost | Wall Cost | Subtotal | Contingencies (25%) | Total |
|---|---|---|---|---|---|---|
| | ($ Million) | ($ Million) | ($ Million) | ($ Million) | ($ Million) | ($ Million) |
| Kenai River | 32.4 | 26 | 0 | 58.4 | 15 | 73 |
| Kenai River wall Variant | 33 | 9.2 | 54 | 96.2 | 24 | 120 |
| Juneau Creek 'F' | 38 | 21 | 0 | 59 | 15 | 74 |
| Juneau Creek | 40 | 1 | 0 | 41 | 10 | 51 |
| Cooper Creek | 33 | 43 | 0 | 76 | 19 | 95 |
| G' | 36 | 47 | 0 | 83 | 21 | 104 |
| Russian River | 39 | 61 | 0 | 100 | 25 | 125 |
| No Build | N/A | N/A | N/A | N/A | N/A | N/A |

| **Alternative** | **Total Estimated Construction Cost** | **Annual Average O&M Cost*** | **Total Life Cycle Cost** |
|---|---|---|---|
| | **($ million)** | **($ million)** | **($ million)** |
| No Build | 0 | $0.063 | $0.84 |
| Kenai River Wall Alternative | 120 | $0.205 | $104 |
| Kenai River Alternative | 73 | $0.146 | $67 |
| Cooper Creek Alternative | 95 | $0.185 | $85 |
| Russian River Alternative | 124 | $0.234 | $109 |
| “G” Alternatives | 103 | $0.200 | $92 |
| Juneau Creek “F” Alternatives | 74 | $0.154 | $70 |
| Juneau Creek Alternatives | 51 | $0.121 | $52 |

# No Build

| **Annual Operating & Maintenance Costs:** | |
|---|---|
| Annual System Maintenance (reflects distrcit-wide maintenance budget of $2,350 per lane mile) | $63,000.00 |
| **Total** | $63,000.00 |

# Kenai River Wall Alternative

| **Roadway** | Length (mi) | cost/mi ($) | cost/section ($) | Contingency | Total Cost ($) |
|---|---|---|---|---|---|
| (KRA) 1254+14 to 1605+00 | 6.6 | $1,900,000.00 | $12,540,000.00 | 10% | $13,794,000.00 |
| (KRA) 1605+00 to 1627+00 | 0.4 | $2,400,000.00 | $960,000.00 | 10% | $1,056,000.00 |
| 1627+00 to 1740+00 | 2.1 | $2,800,000.00 | $5,880,000.00 | 15% | $6,762,000.00 |
| 1740+00=(KRA) 1736+86 | | | | | |
| (KRA) 1736+86 to 1795+00 | 1.1 | $1,900,000.00 | $2,090,000.00 | 10% | $2,299,000.00 |
| (KRA) 1795+00 to 1860+00 | 1.2 | $1,900,000.00 | $2,280,000.00 | 10% | $2,508,000.00 |
| (KRA) 1860+00 to 1959+00 | 1.9 | $2,800,000.00 | $5,320,000.00 | 15% | $6,118,000.00 |
| | | **Roadway Subtotal** | | | $32,537,000.00 |

| **Structure** | sf | cost/sf ($) | cost/bridge ($) | Contingency | Total Cost ($) |
|---|---|---|---|---|---|
| Schooner Bend, Sta 1532+00 (280') | 13440 | $224.00 | $3,010,560.00 | 15% | $3,462,144.00 |
| Cooper Creek, Sta. 1661+50 (100') | 4800 | $151.00 | $724,800.00 | 15% | $833,520.00 |
| Walls Sta. 1671+00 to 1729+00 | 290400 | $140.00 | $40,656,000.00 | 20% | $48,787,200.00 |
| Unclassfied Excavation (Walls) | | | | | $5,250,000.00 |
| Kenai Lake, Sta. 1796+00 (400') | 19200 | $224.00 | $4,300,800.00 | 15% | $4,945,920.00 |
| | | **Bridge Structures Subtotal** | | | $9,240,000.00 |
| | | **Wall Structures Subtotal** | | | $54,037,200.00 |
| | | **Combined Subtotal** | | | $95,814,200.00 |
| | | **Contingencies (25%)** | | | $23,953,550.00 |
| | | **Total** | | | $120,000,000.00 |

| **Annual Operating & Maintenance Costs:** | |
|---|---|
| Tie Back Wall Annual Maintenance Costs (10% of construction costs over 50 year life) | $97,574.40 |
| Annnual Bridge Maintenance Costs (10% of construction costs over 50 year life) | $18,480.00 |
| MSE Wall Annual Maintenance Costs (25% of construction costs over 50 year life) | $5,340.00 |
| Annual System Maintenance (reflects district-wide maintenance budget of $2,350 per lane mile) | $83,700.00 |
| **Total** | $205,000.00 |

# Kenai River Alternative

| **Roadway** | Length (mi) | cost/mi ($) | cost/section ($) | Contingency | Total Cost ($) |
|---|---|---|---|---|---|
| 1254+14 to 1605+00 | 6.6 | $1,900,000.00 | $12,540,000.00 | 10% | $13,794,000.00 |
| 1605+00 to 1720+00 | 2.2 | $2,800,000.00 | $6,160,000.00 | 15% | $7,084,000.00 |
| 1720+00 to 1795+00 | 1.4 | $1,900,000.00 | $2,660,000.00 | 10% | $2,926,000.00 |
| 1795+00 to 1860+00 | 1.2 | $1,900,000.00 | $2,280,000.00 | 10% | $2,508,000.00 |
| 1860+00 to 1959+00 | 1.9 | $2,800,000.00 | $5,320,000.00 | 15% | $6,118,000.00 |
| | | **Roadway Subtotal** | | | $32,430,000.00 |

| **Structure** | sf | cost/sf ($) | cost/bridge ($) | Contingency | Total Cost ($) |
|---|---|---|---|---|---|
| Schooner Bend, Sta 1532+00 (280') | 13440 | $224.00 | $3,010,560.00 | 15% | $3,462,144.00 |
| W. of Juneau Ck. Sta. 1620+00 (375') | 18000 | $182.00 | $3,276,000.00 | 15% | $3,767,400.00 |
| Juneau Creek, Sta. 1665+00 (90') | 4320 | $151.00 | $652,320.00 | 15% | $750,168.00 |
| E. of Juneau Ck. Sta. 1673+00 (330') | 15840 | $182.00 | $2,882,880.00 | 15% | $3,315,312.00 |
| Princess Lodge W. Sta. 1709+00 (420') | 20160 | $224.00 | $4,515,840.00 | 15% | $5,193,216.00 |
| Princess Lodge E. Sta. 1715+00 (480') | 23040 | $182.00 | $4,193,280.00 | 15% | $4,822,272.00 |
| Kenai Lake, Sta. 1796+00 (400') | 19200 | $224.00 | $4,300,800.00 | 15% | $4,945,920.00 |
| | | **Structures Subtotal** | | | $26,260,000.00 |
| | | **Combined Subtotal** | | | $58,690,000.00 |
| | | **Contingencies (25%)** | | | $14,672,500.00 |
| | | **Total** | | | $73,000,000.00 |

| **Annual Operating & Maintenance Costs:** | |
|---|---|
| Annnual Bridge Maintenance Costs (10% of construction costs over 50 year life) | $52,520.00 |
| MSE Wall Annual Maintenance Costs (25% of construction costs over 50 year life) | $5,340.00 |
| Annual System Maintenance (reflects district-wide maintenance budget of $2,350 per lane mile) | $87,700.00 |
| **Total** | $146,000.00 |

# Cooper Creek Alternative

| **Roadway** | Length (mi) | cost/mi ($) | cost/section ($) | Contingency | Total Cost ($) |
|---|---|---|---|---|---|
| (KRA) 1254+14 to 1605+00 | 6.6 | $1,900,000.00 | $12,540,000.00 | 10% | $13,794,000.00 |
| 1605+00 to 1627+00 | 0.4 | $2,400,000.00 | $960,000.00 | 10% | $1,056,000.00 |
| 1627+00 to 1700+00 | 1.3 | $2,800,000.00 | $3,640,000.00 | 15% | $4,186,000.00 |
| 1700+00 to 1765+00 | 1.2 | $2,400,000.00 | $2,880,000.00 | 10% | $3,168,000.00 |
| 1765+00 to 1795+00 | 0.6 | $2,800,000.00 | $1,680,000.00 | 15% | $1,932,000.00 |
| (KRA) 1795+00 to 1860+00 | 1.2 | $1,900,000.00 | $2,280,000.00 | 10% | $2,508,000.00 |
| (KRA) 1860+00 to 1959+00 | 1.9 | $2,800,000.00 | $5,320,000.00 | 15% | $6,118,000.00 |
| | | **Roadway Subtotal** | | | $32,762,000.00 |

| **Structure** | sf | cost/sf ($) | cost/bridge ($) | Contingency | Total Cost ($) |
|---|---|---|---|---|---|
| Schooner Bend, Sta. 1532+00 (280') | 13440 | $224.00 | $3,010,560.00 | 15% | $3,462,144.00 |
| Cooper Creek, Sta. 1670+00 (1200') | 57600 | $500.00 | $28,800,000.00 | 20% | $34,560,000.00 |
| Cooper Creek, w/shorter Bridge (600') | 28800 | $350.00 | $10,080,000.00 | 15% | $11,592,000.00 |
| Kenai Lake, Sta. 1796+00 (400') | 19200 | $224.00 | $4,300,800.00 | 15% | $4,945,920.00 |

| | |
|---|---|
| **Structures-High- Subtotal** | $42,970,000.00 |
| **Structure-Low-Subtotal** | $20,000,000.00 |
| **Combined Subtotal High** | $75,732,000.00 |
| **Contingencies (25%)** | $18,933,000.00 |
| **Total High** | $95,000,000.00 |
| **Combined Subtotal Low** | $52,762,000.00 |
| **Contingencies (25%)** | $13,190,500.00 |
| **Total Low** | $66,000,000.00 |

| **Annual Operating & Maintenance Costs:** | |
|---|---|
| Annnual Bridge Maintenance Costs (10% of construction costs over 50 year life) | $85,940.00 |
| MSE Wall Annual Maintenance Costs (25% of construction costs over 50 year life) | $5,340.00 |
| Annual System Maintenance (reflects district-wide maintenance budget of $2,350 per lane mile) | $94,200.00 |
| **Total** | $185,000.00 |

# Russian River Alternative

| **Roadway** | Length (mi) | cost/mi ($) | cost/section ($) | Contingency | Total Cost ($) |
|---|---|---|---|---|---|
| (KRA) 1254+14 to 1376+00 | 2.3 | $1,900,000.00 | $4,370,000.00 | 10% | $4,807,000.00 |
| 1376+00 to 1476+00 | 1.9 | $2,400,000.00 | $4,560,000.00 | 10% | $5,016,000.00 |
| 1476+00 to 1696+00 | 4.2 | $2,800,000.00 | $11,760,000.00 | 15% | $13,524,000.00 |
| 1696+00 to 1765+00 | 1.3 | $2,400,000.00 | $3,120,000.00 | 10% | $3,432,000.00 |
| 1765+00 to 1839+00 | 1.4 | $2,800,000.00 | $3,920,000.00 | 15% | $4,508,000.00 |
| RR' 1839+00=(KRA) 1825+00 | | | | | |
| (KRA) 1825+00 to 1860+00 | 0.7 | $1,900,000.00 | $1,330,000.00 | 10% | $1,463,000.00 |
| (KRA) 1860+00 1959+00 | 1.9 | $2,800,000.00 | $5,320,000.00 | 15% | $6,118,000.00 |
| | | **Roadway Subtotal** | | | $38,868,000.00 |

| **Structure** | sf | cost/sf ($) | cost/bridge ($) | Contingency | Total Cost ($) |
|---|---|---|---|---|---|
| Kenai River (270') | 35040 | $224.00 | $7,848,960.00 | 15% | $9,026,304.00 |
| Russian River (1000') | 48000 | $500.00 | $24,000,000.00 | 20% | $28,800,000.00 |
| Cooper Creek (650') | 31200 | $500.00 | $15,600,000.00 | 15% | $17,940,000.00 |
| Kenai Lake (400') | 19200 | $224.00 | $4,300,800.00 | 15% | $4,945,920.00 |
| | | **Bridge Structures Subtotal** | | | $60,710,000.00 |
| | | **Combined Subtotal** | | | $99,578,000.00 |
| | | **Contingencies (25%)** | | | $24,894,500.00 |
| | | **Total** | | | $124,000,000.00 |

| **Annual Operating & Maintenance Costs:** | |
|---|---|
| Annnual Bridge Maintenance Costs (10% of construction costs over 50 year life) | $121,420.00 |
| Annual System Maintenance (reflects district-wide maintenance budget of $2,350 per lane mile) | $112,300.00 |
| **Total** | $234,000.00 |

# G' Alternatives

| **Roadway** | Length (mi) | | cost/mi ($) | cost/section ($) | Contingency | Total Cost ($) |
|---|---|---|---|---|---|---|
| (KRA) 1254+14 to 1600 | 6.6 | | $1,900,000.00 | $12,540,000.00 | 10% | $13,794,000.00 |
| 1600+00 to 1730+00 | 2.5 | | $2,800,000.00 | $7,000,000.00 | 15% | $8,050,000.00 |
| 1730+00 to 1755+00 | 0.5 | | $2,400,000.00 | $1,200,000.00 | 10% | $1,320,000.00 |
| 1755+00 to 1780+00 | 0.5 | | $2,800,000.00 | $1,400,000.00 | 15% | $1,610,000.00 |
| G' 1780+00=(JCA)1821+60 | | | | | | |
| (JCA) 1821+60 to 1860+00 | 0.7 | | $2,400,000.00 | $1,680,000.00 | 10% | $1,848,000.00 |
| (JCA) 1860+00 to 1910+00 | 0.9 | | $2,800,000.00 | $2,520,000.00 | 15% | $2,898,000.00 |
| (JCA) 1910+00=(KRA)1860+00 | | | | | | |
| (KRA) 1860+00 to 1959+00 | 1.9 | | $2,800,000.00 | $5,320,000.00 | 15% | $6,118,000.00 |
| | | **Roadway Subtotal** | | | | $35,638,000.00 |

| **Structure** | sf | | cost/sf ($) | cost/bridge ($) | Contingency | Total Cost ($) |
|---|---|---|---|---|---|---|
| Schooner Bend, Sta. 1532+00 (280') | 13440 | | $224.00 | $3,010,560.00 | 15% | $3,462,144.00 |
| Kenai River, Sta. 1620+00 (375') | 18000 | | $182.00 | $3,276,000.00 | 15% | $3,767,400.00 |
| Juneau Creek, Sta. 1663+00 (1380') | 66240 | | $500.00 | $33,120,000.00 | 20% | $39,744,000.00 |
| | | **Bridge Structures Subtotal** | | | | $46,970,000.00 |
| | | **Combined Subtotal** | | | | $82,608,000.00 |
| | | **Contingencies (25%)** | | | | $20,652,000.00 |
| | | **Total** | | | | $103,000,000.00 |

| **Annual Operating & Maintenance Costs:** | |
|---|---|
| Annnual Bridge Maintenance Costs (10% of construction costs over 50 year life) | $93,940.00 |
| MSE Wall Annual Maintenance Costs (25% of construction costs over 50 year life) | $5,340.00 |
| Annual System Maintenance (reflects district-wide maintenance budget of $2,350 per lane mile) | $100,800.00 |
| **Total** | $200,000.00 |

# Juneau Creek 'F' Alternatives

| **Roadway** | Length (mi) | cost/mi ($) | cost/section ($) | Contingency | Total Cost ($) |
|---|---|---|---|---|---|
| (KRA) 1254+14 to 1430+00 | 3.3 | $1,900,000.00 | $6,270,000.00 | 10% | $6,897,000.00 |
| 1430+00 to 1595+00 | 3.1 | $2,800,000.00 | $8,680,000.00 | 15% | $9,982,000.00 |
| 1595+00 to 1630+00 | 0.7 | $2,400,000.00 | $1,680,000.00 | 10% | $1,848,000.00 |
| 1630+00 to 1730+00 | 1.9 | $2,800,000.00 | $5,320,000.00 | 15% | $6,118,000.00 |
| 1730+00 to 1813+00 | 1.6 | $2,400,000.00 | $3,840,000.00 | 10% | $4,224,000.00 |
| 1813+00 to 1863+00 | 0.9 | $2,800,000.00 | $2,520,000.00 | 15% | $2,898,000.00 |
| F' 1863+00=(KRA) 1860+00 | | | | | |
| (KRA) 1860+00 to 1959+00 | 1.9 | $2,800,000.00 | $5,320,000.00 | 15% | $6,118,000.00 |
| | | **Roadway Subtotal** | | | $38,085,000.00 |

| **Structure** | sf | cost/sf ($) | cost/bridge ($) | Contingency | Total Cost ($) |
|---|---|---|---|---|---|
| Juneau Creek, Sta. 1643+00 (730') | 35040 | $500.00 | $17,520,000.00 | 20% | $21,024,000.00 |
| | | **Bridge Structures Subtotal** | | | $21,020,000.00 |
| | | **Combined Subtotal** | | | $59,105,000.00 |
| | | **Contingencies (25%)** | | | $14,776,250.00 |
| | | **Total** | | | $74,000,000.00 |

| **Annual Operating & Maintenance Costs:** | |
|---|---|
| Annnual Bridge Maintenance Costs (10% of construction costs over 50 year life) | $42,040.00 |
| MSE Wall Annual Maintenance Costs (25% of construction costs over 50 year life) | $2,700.00 |
| Annual System Maintenance (reflects district-wide maintenance budget of $2,350 per lane mile) | $109,300.00 |
| **Total** | $154,000.00 |

# Juneau Creek Alternatives

| **Roadway** | Length (mi) | cost/mi ($) | cost/section ($) | Contingency | Total Cost ($) |
|---|---|---|---|---|---|
| (KRA) 1254+14 to 1430+00 | 3.3 | $1,900,000.00 | $6,270,000.00 | 10% | $6,897,000.00 |
| 1430+00 to 1595+00 | 3.1 | $2,800,000.00 | $8,680,000.00 | 15% | $9,982,000.00 |
| 1595+00 to 1693+00 | 1.9 | $2,400,000.00 | $4,560,000.00 | 10% | $5,016,000.00 |
| 1693+00 to 1750+00 | 1.1 | $2,800,000.00 | $3,080,000.00 | 15% | $3,542,000.00 |
| 1750+00 to 1860+00 | 2.1 | $2,400,000.00 | $5,040,000.00 | 10% | $5,544,000.00 |
| 1860+00 to 1910+00 | 0.9 | $2,800,000.00 | $2,520,000.00 | 15% | $2,898,000.00 |
| (JCA) 1910+00=(KRA) 1860+00 | | | | | |
| (KRA) 1860+00 to 1959+00 | 1.9 | $2,800,000.00 | $5,320,000.00 | 15% | $6,118,000.00 |
| | | **Roadway Subtotal** | | | $39,997,000.00 |

| **Structure** | sf | cost/sf ($) | cost/bridge ($) | Contingency | Total Cost ($) |
|---|---|---|---|---|---|
| Juneau Creek, Sta. 1657+25 (90') | 4320 | $151.00 | $652,320.00 | 15% | $750,168.00 |
| | | **Bridge Structures Subtotal** | | | $750,000.00 |
| | | **Combined Subtotal** | | | $40,747,000.00 |
| | | **Contingencies (25%)** | | | $10,186,750.00 |
| | | **Total** | | | $51,000,000.00 |

| **Annual Operating & Maintenance Costs:** | |
|---|---|
| Annnual Bridge Maintenance Costs (10% of construction costs over 50 year life) | $1,500.00 |
| MSE Wall Annual Maintenance Costs (25% of construction costs over 50 year life) | $2,700.00 |
| Annual System Maintenance (reflects district-wide maintenance budget of $2,350 per lane mile) | $116,300.00 |
| **Total** | $121,000.00 |

## Estimating Factors (2002 Dollars)

| | | |
|---|---|---|
| 1996 Seward Highway, MP 53-59 | Total | $22,600,000.00 |
| | Less Bridge | $8,500,000.00 |
| | Total Roadway | $14,100,000.00 |
| New Embankment, Technical or >5% grade | Cost per mile | $2,600,000.00 |
| | **2005 dollars** | $2,800,000.00 |
| | | |
| 1999 Sterling Highway, MP 37-45 | Total | $13,000,000.00 |
| | Less Bridge | $400,000.00 |
| | Total Roadway | $12,600,000.00 |
| Reconstruction, Existing Embankment | Cost per mile | $1,700,000.00 |
| | **2005 dollars** | $1,900,000.00 |
| | | |
| New Embankment , non-technical <5% grade | Cost per mile | $2,200,000.00 |
| | **2005 dollars** | $2,400,000.00 |

## Risk Factors

| | Contingency |
|---|---|
| New Embankment, Technical or >5% grade | 15% |
| Reconstruction, Existing Embankment | 10% |
| New Embankment , non-technical <5% grade | 10% |
| Bridges | 15% |
| Bridges w/ length>700' | 20% |
| Tie Back Walls | 20% |