

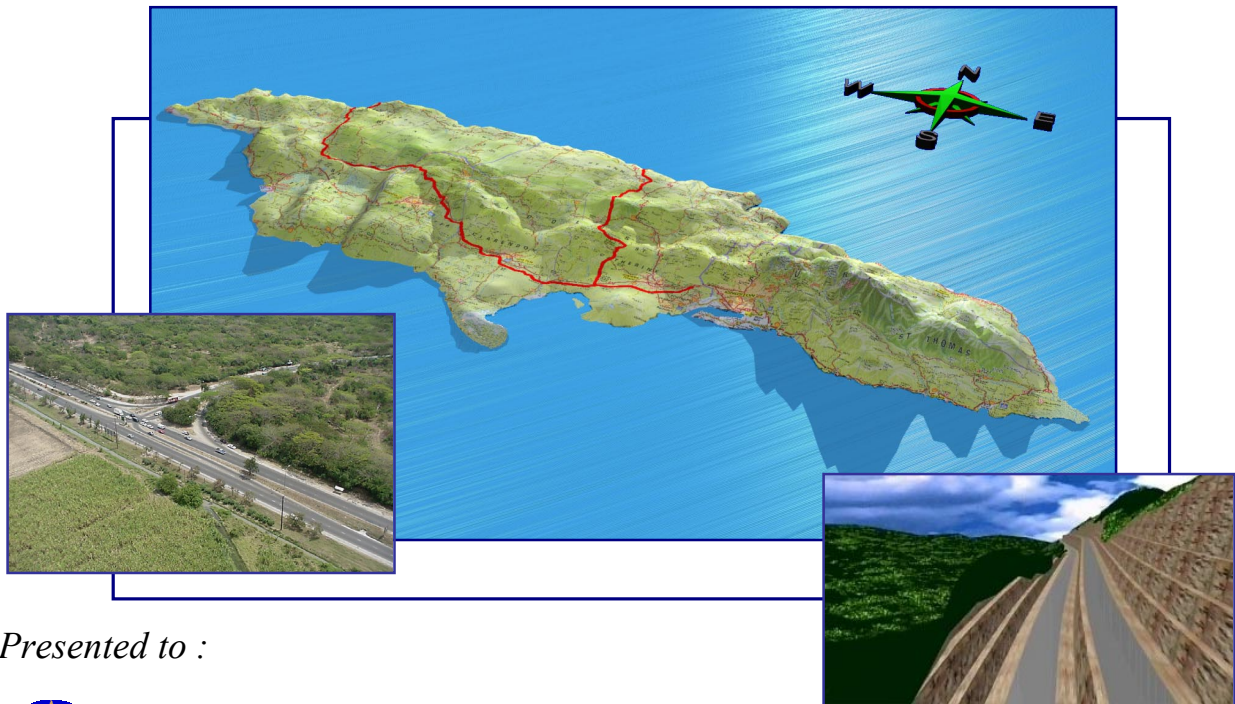


J A M A I C A

HIGHWAY 2000 PROJECT

Preliminary Design Phase

ECONOMIC COST-BENEFIT ANALYSIS



Presented to :



**DEVELOPMENT BANK
OF JAMAICA LIMITED**

By :



**DESSAU
SOPRIN**
INTERNATIONAL INC., Canada

Development Bank of Jamaica Limited

HIGHWAY 2000 PROJECT PRELIMINARY DESIGN PHASE

ECONOMIC COST-BENEFIT ANALYSIS

Prepared by : Jeff Plant, P. Eng.

Gilles Joubert
ADEC Consultants Inc.

Approved by : 

Imants Hausmanis, P. Eng.
Project Director



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EXECUTIVE SUMMARY

A conventional economic cost-benefit analysis (ECBA) has been undertaken to determine the economic profitability to Jamaica of proceeding with the development of Highway 2000.

Highway 2000 is planned as a 4-lane high speed limited access motorway that will connect Kingston to Montego Bay and Ocho Rios. The project is to be constructed in two phases: Phase 1 includes upgrading of the Portmore Causeway and completion of the Highway between Kingston and Mandeville (85 km in total); Phase 2 includes completion of the Highway between Mandeville and Montego Bay¹ and completion of the Highway between Old Harbour and Ocho Rios (148 km in total).

Costs used for the ECBA are based upon a Class “C” estimate² prepared by Dessau Soprin International using the alignment and technical requirements described in the Functional Planning Report³. Capital Costs are summarised below in Year 2000 Constant Dollars:

Construction – Phase 1	US\$235,000,000
Construction – Phase 2	US\$523,000,000
Grantor Development Costs ⁴	US\$20,000,000
Concessionaire Development Costs ⁵	<u>US\$45,000,000</u>
Total Capital Costs	US\$823,000,000

Annual operating, maintenance and rehabilitation costs are assumed to be 1.17% of the Construction Costs in Year 2000 Constant Dollars.

1. Although a decision has been made to include construction of the Montego Bay By-pass in Phase 2 of the concession project, the economic costs and benefits are not included in the calculations. The estimated capital cost of the Montego Bay By-pass works is US\$35,000,000.

2. A Class “C” cost estimate is based upon conceptual plans and a limited amount of field information. Class “C” cost estimates are generally considered to be accurate to plus or minus 25%, 19 times out of 20.

3. Highway 2000 Functional Planning Report, prepared by Dessau Soprin International for the Development Bank of Jamaica, May 2000

4. Grantor costs include preliminary design studies and land transfer costs.

5. Concessionaire Development Costs including planning, design, approvals, QA/QC and engineering during construction.

It is estimated that 36% of the total construction cost will be spent on Jamaican goods and services and 64% on foreign goods and services.

For analysis purposes, it has been assumed that construction of Phase 1 will start in 2002 and Phase 2 in 2003. A 2 year construction period has been assumed for Phase 1 and 3 years for Phase 2. The costs and benefits are compared to the status quo condition (no Highway 2000) over a 50 year period.

The Present Value (PV) of the costs of Highway 2000 have been calculated using a 10% discount rate as follows:

Phase 1 Cost (PV) =	US\$227,837,114
Phase 2 Cost (PV) =	US\$278,681,155
Total Cost (PV) =	US\$501,415,018

Construction of Highway 2000 will provide significant benefits to the Jamaican travelling public. The benefits have been assessed in terms of travel time savings, vehicle operating cost savings, public safety savings (reduced accident costs), rehabilitation and maintenance cost savings on the existing highway network and savings related to other externalities (primarily air pollution related).

The Present Value (PV) of the benefits of Highway 2000 have been calculated using a 10% discount rate in a range⁶ as follows:

	<u>Low Range</u>	<u>High Range</u>
Phase 1 Benefits (PV) =	US\$472,201,797	US\$666,373,720
Phase 2 Benefits (PV) =	US\$194,068,865	US\$237,611,329
Total Benefits (PV) =	US\$608,791,006	US\$855,911,690

A comparison of the benefits to costs at a 10% discount rate produces the following Benefit/Cost (BCR) ratios:

6. The difference is solely related to differences in the estimated value of time from J\$79.45 to J\$125.00 per hour for work-related travel, J\$57.22 to J\$107.50 per hour for work-related commuting and J\$15.93 to J\$75.00 for leisure-related travel. (J\$40 = US\$1)

	Phase 1	Phase 2	Total
BCR Low Range	2.07	0.70	1.21
BCR High Range	2.92	0.85	1.71

Another method of assessing the attractiveness of public sector projects is to estimate their Internal Rate of Return (IRR). The IRR is equivalent to the discount rate at which the NPV of the stream of benefits is exactly equal to the NPV of the stream of costs. The following is a summary of the IRR calculations for Highway 2000:

	Phase 1	Phase 2	Total
IRR Low Range	16.05%	7.76%	11.41%
IRR High Range	19.92%	9.00%	14.15%

A project is clearly worthwhile when the BCR is greater than 1.0 and becomes increasingly beneficial as the value of BCR grows. On the other hand, a project for which the BCR is less than 1.0 would only proceed if it was considered that there would be substantial secondary benefits not fully captured by the analysis or if that project was a component of a larger scheme that had an overall BCR greater than 1.0.

In the case of Highway 2000, there are many indirect benefits that are not captured in a traditional ECBA. These include the development of collateral opportunities that could not proceed unless the Highway is constructed. In addition, the stimulative effect of a major infrastructure project such as Highway 2000 can not be overlooked within the context of the Jamaican economy. The Planning Institute of Jamaica has undertaken parallel analyses which support the positive impact which Highway 2000 will have on the overall economy.

It is concluded that both the direct and indirect benefits of Highway 2000 are greater than the associated costs of proceeding with the project. In economic terms, Highway 2000 will certainly benefit the Jamaican economy when it is constructed.

1 ECONOMIC ANALYSIS

1.1 CONTEXT

The Government of Jamaica is planning a major new highway to link the Cities of Kingston, Spanish Town, Mandeville, Montego Bay and Ocho Rios.

A Pre-Feasibility Study⁷ undertaken in 1996 by Dessau International of Canada concluded that the project was technically feasible and should be considered further, perhaps on the basis of a public-private toll-based concession. In September of 1999, the Government of Jamaica announced its intentions to proceed with Highway 2000 as a concession project.

Dessau Soprin International was retained to complete a Functional Planning Study; to recommend a preferred alignment within the broad corridor that had been previously identified; to undertake supplementary technical, environmental and socio-economic investigations; and to prepare an Illustrative Solution and technical specifications for Concessionaire bidding purposes.

This report summarises aspects of the socio-economic investigations and provides an update to the economic cost-benefit analysis that was undertaken in 1996.

1.2 METHODOLOGY

Cost-benefit analysis techniques have been used to structure and analyse available information to estimate the efficiency and socio-economic profitability of Highway 2000 and thus determine the extent to which society in general will benefit from it.

A five-step work program was undertaken :

1. review of existing information and preparation of a detailed methodology;
2. identification of economic parameters;
3. data collection;

7 "Highway 2000 Project, Final Report of a Pre-feasibility Study" for National Investment Bank of Jamaica, Dessau International Ltd. January 1997

4. calculation of costs and benefits;
5. conclusions and final economic report.

The project is divided into four sections (**Table 1.1**) for analysis.

Table 1.1 Sections of Highway 2000

Section	Km
Kingston - Bushy Park	34
Bushy Park - Mandeville	51
Mandeville - Montego Bay	85
Bushy Park - Ocho Rios	63
Total	233

It is expected that construction of Highway 2000 will also improve travel conditions on the existing road network as traffic is drawn to the new highway. The basis for the economic cost-benefit analysis is a comparison of two scenarios describing the impact on the road network: the first assuming that the highway is built; the second assuming nothing is done (the status quo).

A key objective is to compare the investment required to build the highway and maintain it to a level that will generate the expected benefits on a net present value (NPV) basis and to provide an opinion on its economic viability.

The analysis relies on :

- traffic modelling and forecasts prepared by Steer Davies Gleave [SDG]⁸;
- Class “C” cost estimates prepared by Dessau-Soprin.

An economic cost-benefit analysis for Highway 2000 requires : i) an understanding of the dynamics of travelling in Jamaica and the role that the new highway could play in the

8 Highway 2000 Traffic and Revenue Forecasts, May, 31 2000

future, ii) the identification and evaluation of the discounted⁹ costs and benefits resulting from the situation in which the highway is built, and finally, iii) a comparison of potential benefits against potential costs in order to determine if the project is socially viable.

The challenge is to evaluate the full range of benefits and costs of this project and determine if there is a social case to justify the highway; and to examine, determine and report on the potential impact that the project would have.

9 Discounted refers to costs (or benefits) whose future values have been discounted, using an annual discount rate over the project's economic life, to reflect their present values (PV) in constant J\$.

2 ECONOMIC COST-BENEFIT ANALYSIS

The Economic Cost-Benefit Analysis (ECBA) approach is a well-known and recognised procedure used to structure and analyse available information in the evaluation of public infrastructure projects to address the efficiency issue and the economic growth such projects may generate. Facilitating choice among projects and allocation of public resources are the two main objectives of the ECBA. This requires setting-up a base case and comparing other scenarios against it.

The technique is recommended for the appraisal of partially or fully publicly financed investment projects in order to allocate resources in a way most profitable to society.

The objective is to set a monetary value for the benefits and economic costs of the project when compared to the base case. All elements of cost and benefit must be detailed and the appropriate monetary value attributed to them. **Table 2.1** summarises the costs and benefits that are generally considered, while **Table 2.2** lists the quantifiable factors that are generally considered.

In an ECBA, it is also recognised that the market prices of goods and factors of production do not necessarily reflect their social value and costs respectively. Corrections to market prices are therefore made.

Table 2.1: General Diagram of a ECBA

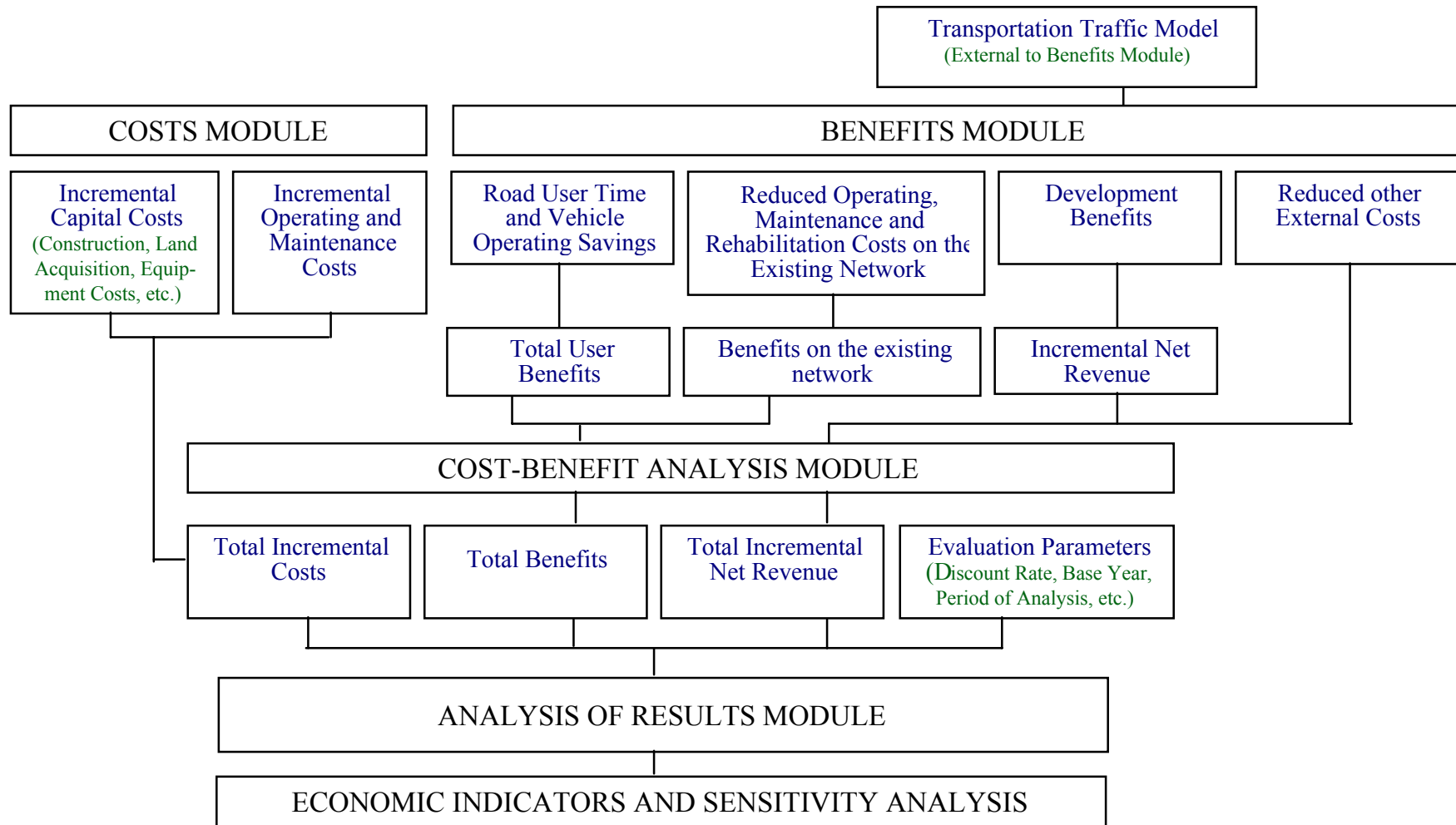


Table 2.2 : Benefits and Costs Items

Affecting Users

- Travel time savings;
- Vehicle operation cost savings;
- Security related savings (life and injuries, damage to property).

Affecting Owners and Operators of the Road Network

- Highway construction costs;
- Land acquisition;
- Maintenance costs;
- Network operating costs;
- Savings related to postponement of maintenance costs on other roads (ex. existing road).

Affecting Non-users

- Travel time savings or costs from changes in traffic on other roads or modes;
 - Costs and benefits related to air quality;
 - Costs and benefits related to energy consumption of different transportation modes;
 - Other externalities.
-

Traditional cost-benefit analysis of highway projects concentrates on savings in vehicle operating cost, maintenance cost and time savings. It is true that road projects create benefits that come in the form of savings of costs. They do not create revenues per se. In road projects, externalities are the major source of benefits and the challenge is to internalise these externalities and thus give a measure and a value of the effects on vehicle operating costs, people's time, people's lives, environment, etc. As well, it is recognised that investment in transportation infrastructure can generate substantial secondary benefits by reducing costs for existing productive activities, providing access to new areas with economic development potential and triggering investment activities. These secondary

benefits are usually translated in generated traffic, and are generally captured in the forecast activity.

The economic evaluation of public projects does not ask a different sort of question to those posed by private enterprise in pondering the wisdom of a proposed capital investment. While a financial analyst may ask whether its company owners will be made better-off by the proposed investment, the public sector analyst asks whether society as a whole will be made better-off by undertaking the project rather than not undertaking it, or by undertaking an alternative project instead.

Simply stated, public and private sector (in this case the concessionaire) analyses differ in the nature and the range of benefits and costs taken into consideration. The financial analyst must examine the earning power of a prospective investment for its shareholders. In so doing, only those costs and benefits that are internal to company operations are considered. A concessionaire for instance will be interested only in users costs savings like time, vehicle operating and security. The concessionaire will set tolls in order to capture the savings made or perceived by these users.

In the public sector, on the other hand, the project analyst must consider the earning power of an investment not just from the owners' point of view but from the national viewpoint. In the case of highway investment, improved labour productivity that stems from passenger time savings and energy conservation from the reduction in truck, mini-bus and private vehicle fuel consumption, all of which can result from new road capacity, are just as significant as the efficiency gains that an owner might achieve as a result of investment.

3 PROJECT DEFINITION AND DATA

3.1 THE PROJECT

Highway 2000 consists of building 233 km of toll highway linking the main towns and some of the major tourist areas in Jamaica. It will improve ground transportation and be a catalyst for economic activity along its corridor. Split in four sections of different lengths, their individual lengths and construction and maintenance costs are given in Table 3.1.

Table 3.1: Construction and Maintenance Costs by Road Sections

Section	Length	Lane s	Construction	Annual Maintenance
Kingston–Bushy Park	34 km	4	US\$235,000,000	US\$2,750,000
Bushy Park–Mandeville	51 km	4		
Mandeville–Montego Bay	85 km	4	US\$523,000,000	US\$6,120,000
Old Harbour–Ocho Rios	63 km	4		
Total	233 km		US\$758,000,000	US\$8,870,0000

Source : Dessau-Soprin May 2000

For the purpose of this cost-benefit analysis, two road sections will be evaluated. Phase 1 includes Kingston to Mandeville and Phase 2, Mandeville to Montego Bay and Old Harbour to Ocho Rios.

3.2 TRAVELLING PRICES AND THE VEHICLE FLEET

In the 1996 pre-feasibility study, the out-of-pocket savings were estimated at 0.049 US\$/veh-km from running on the future highway between Kingston to Montego Bay as compared to the existing road, representing a 27.8% savings on present costs. For trucks the savings were estimated to be 20.00 US\$ for a 10 ton load, a saving of 32.2% on actual costs. In 1996, the costs of travelling between Kingston and Montego Bay were estimated at US\$31.96. With the new road this price would decline to a level of US\$22.78 for a total saving of 9.18 US\$.

In 1998, 163,575 motor cars passed the fitness registration (the best proxy available of the vehicle fleet). Since about 70% of the vehicle fleet is captured in one year according to the Island Traffic Authority, the total 2000 fleet is estimated to be around 230,000 cars. In Table 3.2, the average rate of growth over the last 37 years is shown as 5% for cars and 6% for trucks. Compared with the population in Jamaica estimated at 2.55 million at this time, there is a ratio of 0.09 cars per person. Compared with the USA ratio of 0.48 or Canada at 0.46 this is fairly low. Trucks account for an additional 85,000 vehicles or roughly 37% of the fleet. The following observations are made about the vehicle fleet :

- The quantity and the quality of vehicles have changed substantially since the 70s and, in particular, since 1993. Jamaica placed or restrictions on imports of cars between the mid-1980s and 1993. In 1993, restrictions on the importation of used cars were relaxed, resulting in a flood of cars from Japan. Since then, rules have been tightened by only allowing the importation of cars less than five years old and by imposing an increased import levy.
- The figures on licensing statistics are appreciably higher than those obtained from inspection statistics. This is due to the fact that licenses may be taken for a minimum of three months at a time and many owners renew their licenses more than once a year, resulting in appreciable double counting. The fact that people can renew their license on a new car without their actual license or an old car explains the overstated number.
- In Jamaica, it is mandatory to obtain an inspection certificate to operate a vehicle on public road. New vehicles have to be inspected after 18 months, and defective vehicles may be inspected more than once a year.
- While the statistics on vehicles inspection are not a true measure of the vehicle fleet, they are the best available estimates. **Table 3.2** shows the number of inspections carried out island-wide since 1961. The same statistics are also available by Parish. According to officials of the Island Traffic Authority, they capture between 60 and 70 % of all vehicles in one year (from April to March of the following year). Thus the numbers in **Table 3.2** are adjusted to take this factor into account.

Table 3.2 : Number of Fitness Registration per Year - per Vehicle Type

Fleet Indicators Vehicle Types	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Fitness Registrations	41 677	48 633	51 024	54 830	57 194	57 571	63 204	67 354	64 910	64 982
Motors Cars	28 999	34 452	35 851	38 434	40 477	40 110	44 325	47 924	46 615	45 864
Trucks and Tractors	8 485	9 180	9 690	10 297	10 400	10 554	12 080	12 279	11 636	12 026
Motorcycles	2 414	3 265	3 683	4 275	4 478	5 175	5 277	5 521	5 126	5 716
Trailers	1 779	1 736	1 800	1 824	1 839	1 732	1 522	1 630	1 533	1 376
Annual Growth		17%	5%	7%	4%	1%	10%	7%	-4%	0%
As % of Total Fleet										
Motors Cars	70%	71%	70%	70%	71%	70%	70%	71%	72%	71%
Trucks and Tractors	20%	19%	19%	19%	18%	18%	19%	18%	18%	19%
Motorcycles	6%	7%	7%	8%	8%	9%	8%	8%	8%	9%
Trailers	4%	4%	4%	3%	3%	3%	2%	2%	2%	2%

Fleet Indicators Vehicle Types	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Fitness Registrations	72 521	72 778	71 092	77 080	88 801	84 646	72 072	60 242	60 505	53 327
Motors Cars	51 544	50 759	48 890	51 147	58 671	55 969	48 001	39 446	40 174	34 036
Trucks and Tractors	13 015	13 464	13 040	14 971	17 340	17 093	13 946	12 336	13 282	13 805
Motorcycles	6 631	7 294	8 082	10 225	11 958	10 510	9 263	7 578	6 355	4 876
Trailers	1 331	1 261	1 080	737	832	1 074	862	882	694	610
Annual Growth	12%	0%	-2%	8%	15%	-5%	-15%	-16%	0%	-12%
As % of Total Fleet										
Motors Cars	71%	70%	69%	66%	66%	66%	67%	65%	66%	64%
Trucks and Tractors	18%	19%	18%	19%	20%	20%	19%	20%	22%	26%
Motorcycles	9%	10%	11%	13%	13%	12%	13%	13%	11%	9%
Trailers	2%	2%	2%	1%	1%	1%	1%	1%	1%	1%

Fleet Indicators Vehicle Types	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Fitness Registrations	63 812	65 534	56 752	70 406	74 982	71 742	82 881	98 856	111 858	115 995
Motors Cars	41 163	40 271	35 024	42 037	42 888	44 457	52 886	63 125	72 881	69 616
Trucks and Tractors	17 394	20 167	17 392	23 154	26 060	20 737	23 032	26 885	29 793	37 481
Motorcycles	4 828	4 554	3 859	4 770	5 608	6 032	6 347	8 181	8 397	7 732
Trailers	427	542	477	445	426	516	616	665	787	1 166
Annual Growth	20%	3%	-13%	24%	6%	-4%	16%	19%	13%	4%
As % of Total Fleet										
Motors Cars	65%	61%	62%	60%	57%	62%	64%	64%	65%	60%
Trucks and Tractors	27%	31%	31%	33%	35%	29%	28%	27%	27%	32%
Motorcycles	8%	7%	7%	7%	7%	8%	8%	8%	8%	7%
Trailers	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%

Fleet Indicators Vehicle Types	1991	1992	1993	1994	1995	1996	1997	1998	Average annual growth
Fitness Registrations	117 398	109 828	125 121	135 059	160 096	180 290	223 610	227 779	5 030
Motors Cars	77 840	73 865	81 116	86 791	103 996	120 743	156 751	163 575	3 637
Trucks and Tractors	29 771	27 048	36 157	41 312	49 095	52 833	61 482	59 373	1 375
Motorcycles	8 675	8 239	7 150	6 155	6 363	5 783	4 345	3 782	37
Trailers	1 112	676	698	801	642	931	1 032	1 049	-20
Annual Growth	1%	-6%	14%	8%	19%	13%	24%	2%	5%
As % of Total Fleet									
Motors Cars	66%	67%	65%	64%	65%	67%	70%	72%	67%
Trucks and Tractors	25%	25%	29%	31%	31%	29%	27%	26%	24%
Motorcycles	7%	8%	6%	5%	4%	3%	2%	2%	8%
Trailers	1%	1%	1%	1%	0%	1%	0%	0%	1%

source: ISLAND TRAFFIC AUTHORITY
Determination of Traffic Growth, No. Fitness Registration Issues, by Year and Category of Vehicle, 1960-1998.

None of these fleet owners pay directly for the road network they now use; they contribute indirectly through income taxes, license fees and consumption taxes. But, some of their passengers do pay if they use travel services. From a small survey conducted at the end of January 2000, a number of transport services companies were asked what they charge for transporting people from Kingston to Montego Bay, for example. The survey results indicate that the average fare for taxis is J\$1,300 (US\$30.95) and for buses J\$500 (US\$11.90) (See Table 3.3).

Table 3.3 : Taxi and Buses Service Charges from Kingston to Montego Bay

Taxi Service

from: Kingston to Montego Bay.

Company	Fare (J\$)	Passengers	Trip type	Address	Telephone
Apollo Tours & Taxi Serv	5 000	4	1-way trip	30E C Spring Rd (10)	901-9512
Safe Travel Taxi	4 500	4	1-way trip	Shop 16 27A Seaward Dr (20)	901-5510
Candy Cab Ltd	5 000	4	1-way trip	189 Mountain View Ave	978-8090
Central Taxi Services Ltd	5 500	4	1-way trip	Shop 1 30 Red Hills Rd (10)	926-8470
Checkers Cabs	6 000	4	1-way trip	19 Connolley Av (4)	922-1777
AVERAGE FARE:	5 200			AVERAGE FARE PER PASSENGER:	1300 J\$
				AVERAGE FARE PER KILOMETRE:	6,95 J\$
					0.17 US\$

Source: Telephone Survey, Wed Jan 26 2000, Kingston, Jamaica.

Buses - Charter & Rental Service

from: Kingston to Montego Bay.

Company	Fare (J\$)	Max. load	Trip type	Address	Telephone
Bloomfield Ja Ltd	14 000	30	round trip	53 Hope Rd (6)	927-3484
Clough Cars & Buses	18 000	32	round trip	20 Bentley Cres (20)	933-5436
Neville's Transport	15 000	30	round trip	14 Maxfield Av (13)	923-4399
Danobal Transport Servs Ltd	18 000	40	round trip	5 Melwood (8)	924-0644
GB Transport	15 000	30	round trip	Shop 12 176 Spanish Town (11)	937-4476
AVERAGE FARE:	16 000			AVERAGE FARE PER PASSENGER:	500 J\$
				AVERAGE FARE PER KILOMETRE:	2,67 J\$
					0,07 US\$

Source: Telephone Survey, Wed Jan 27-28 2000, Kingston, Jamaica.

Charging for use of Highway 2000 as part of a resource-based tax shift would offset, or internalise, some of the costs that driving imposes on society. These costs include both common perceptions of costs, time, energy, material, health, as well as other subsidies which artificially reduce the price of driving. If drivers do not bear the full costs, they are

receiving a subsidy even if government is not paying them anything. In the USA, for example, a recent study evaluated this subsidy at US\$184 billion a year (private costs US\$59 billion and social costs US\$125 billion)¹⁰.

3.3 THE BASE CASE: THE PRESENT SITUATION

The existing road network is recognised to be unable to provide an adequate contribution to mobility and thus can not adequately support economic activities and development. Measures to optimise the existing road network are not considered to form the base case against which major investment options are subsequently evaluated. The base case for this evaluation is the existing condition of the road network.

The base case will certainly bring some benefits to society but will also use available resources that could otherwise be used for other purpose. Therefore all further savings and costs will be additional ones when compared to the base case situation.

In a recent paper by Todd Litman¹¹, all travel costs were detailed and weighted against each other.

Figure 3.1 and **Figure 3.2** contain excerpts from Litman's paper where the magnitude and distribution of costs for an average north-American automobile-owner are presented. Normalisation to the Jamaican case should be made, however, the unadjusted figures give a good understanding of the total automobile costs that society in general has to deal with. Thus there are potential savings on these costs.

A number of other recent studies examine the full costs of motor vehicle travel¹². Some transport costs are already commonly measured, such as vehicle operating expenses, transportation facility costs, and the value that people place on travel time, safety and

10 *The roads aren't free: estimating the full social costs of driving and the effects of accurate pricing*, by Clifford W.Cobb.

11 Todd Litman, *Socially Optimal Transport Prices and Markets: Principles, Strategies and Impacts*, VTPI (www.vtpi.org), November 1999, p.11-14.

12 More than two dozen such studies have been performed during the last decade. Bibliographies are available in Mark Delucchi, *Review of Some of The Literature on the Social Cost of Motor-Vehicle Use, Report # 3 in the Series: Annualized Social Cost of Motor-Vehicle Use in the U.S., 1990-1991*, Institute of Transportation Studies (Davis), UCD-ITS-RR-96-3, April 1996; Todd Litman, *Transportation Cost Analysis; Techniques, Estimates and Implications*, VTPI (www.vtpi.org), 1998; Chapter 2; K.T. Analytics, *Review of Cost of Driving Studies*, Metropolitan Washington Council of Governments (Washington DC), 1997; David Bray and Peter Tisato, "Broadening the Debate on Road Pricing," *Road & Transport Research*, Vol. 7, No. 4, Dec. 1998, pp. 34-45.

comfort under various conditions. Other costs, such as environmental impacts and social costs from road crash injuries and deaths, are more difficult to quantify, but recent studies have estimated them using various analysis techniques. **Table 3.4** defines these costs.

Table 3.4 : Costs that Can Result from Motor Vehicles¹¹

Cost	Definition	Categories
User Travel Time	Time spent travelling.	Internal-Variable
Internal Accident	Vehicle accident costs borne by users.	Internal-Variable
Vehicle Operation	User expenses that are proportional to travel.	Internal-Variable
Internal Parking	Parking costs borne by users.	Internal-Fixed
Vehicle Ownership	Fixed vehicle expenses.	Internal-Fixed
External Accident	Vehicle accident costs not borne by users.	External
Operating Subsidies	Vehicle expenses not paid by the user.	External
External Parking	Parking costs not borne by users.	External
Congestion	Delay each vehicle imposes on other road users.	External
Road Facilities	Road expenses not paid by user fees.	External
Roadway Land Value	Opportunity cost of land used for roads.	External
Municipal Services	Public services devoted to vehicle traffic.	External
Equity & Option Value	Reduced travel choices, especially for disadvantaged people.	External
Air Pollution	Costs of motor vehicle emissions.	External
Noise	Costs of motor vehicle noise.	External
Resource Consumption	External costs from consumption of natural resources.	External
Barrier Effect	The dis-amenity motor traffic imposes on pedestrians and bicyclists. Also called "severance."	External
Land Use Impacts	Economic, social and environmental costs resulting from increased pavement and low density, auto oriented land use.	External
Water Pollution	Water pollution and hydrologic impacts of vehicles & roads.	External
Waste Disposal	External costs from motor vehicle waste disposal.	External

These costs can be categorised according to how they impact consumers transport decisions:

- *Internal variable* costs are users' short-term costs that vary with the amount of travel. This includes out-of-pocket expenses, travel time and accident risk borne by the traveller. These directly affect trip decisions and are those that a concessionaire will consider in a toll-pricing policy.
- *Internal fixed* costs are not perceived as being significantly affected by vehicle use. These include vehicle depreciation, insurance, registration, and residential or leased parking. These tend to affect consumers' vehicle purchase decisions, but once a vehicle is purchased and put on the road, have little impact on its use¹³.
- *External costs* are not directly borne by individual users (although everybody, including vehicle users, bears them in aggregate). These include costs of roadway and parking facilities not charged directly to users, congestion impacts on other road users, accident risk borne by others, and environmental damages. These costs do not directly affect individual consumers' travel decisions, although they may affect a community's long-term transport policies.

13 Vehicle depreciation and insurance costs are actually partly variable, so true marginal costs average about twice what most drivers perceive when evaluating their marginal cost for a particular trip.

Figure 3.1 illustrates the estimated magnitude of these costs. The largest costs are internal and the most frequently used in transportation evaluation: time, vehicle operating costs and accidents. External costs are smaller, but more numerous.

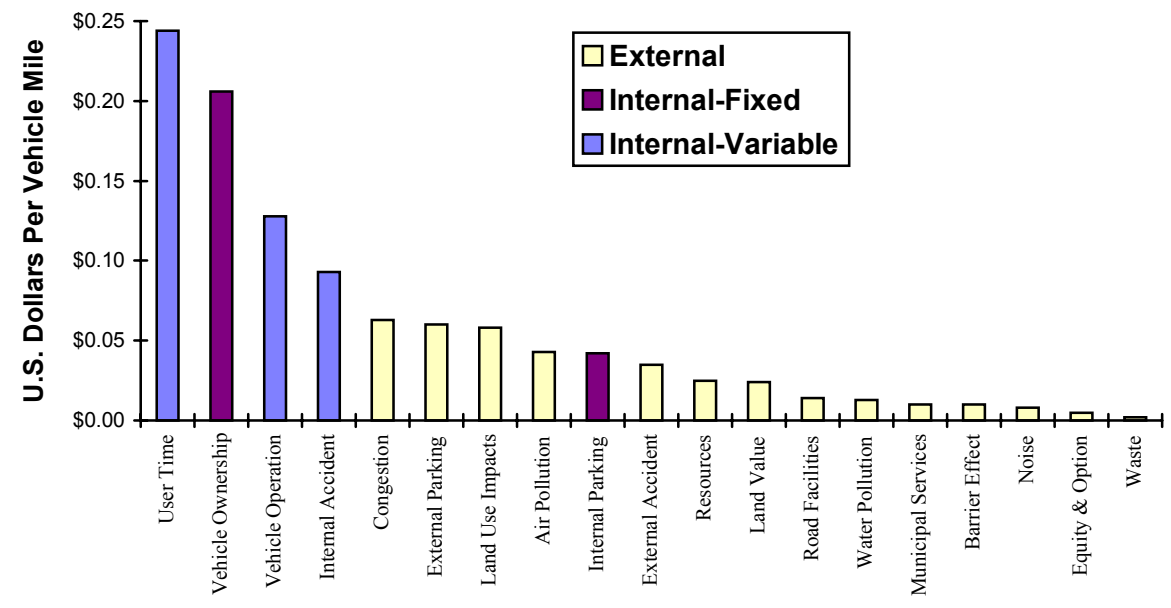


Figure 3.1: Magnitude and distribution of costs for an average automobile in North-America¹¹

Figure 3.2 illustrates the distribution of automobile costs. It shows that internal-variable costs, the “price” that affects individual trip decisions in the short run, constitute 45 % of all costs. Almost a third (32 %) of costs are external according to this figure. These figures also show that user charges would have to increase significantly to internalise all costs. In addition, almost a quarter of total costs are perceived as internal but are fixed generally speaking. Once users pay these costs they do not affect vehicle use but they are certainly affected by road improvement.

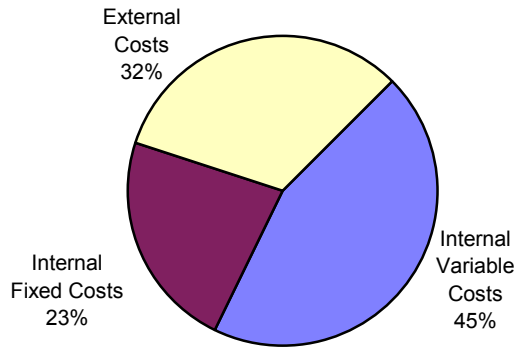


Figure 3.2 : Distribution of automobile costs¹¹.

Figure 3.3 compares the estimated magnitude and distribution of costs per passenger kilometre for eleven different modes. Most motorised forms of transport impose significant external costs. The exception is a rideshare passenger (an additional vehicle passenger using an otherwise empty seat), which has the lowest cost of all modes. Fuel efficient and electric cars reduce some external costs, such as air pollution, but not others, such as congestion, parking and accidents. Transit has relatively high external costs per passenger kilometre, due to operating subsidies where they exist, but because transit riders tend to travel less than automobile users, their annual external costs are typically lower than that of drivers.

All of these modes are not necessarily present in Jamaica but most of them are so that categories or mode categories should be used to properly reflect the Jamaican context.

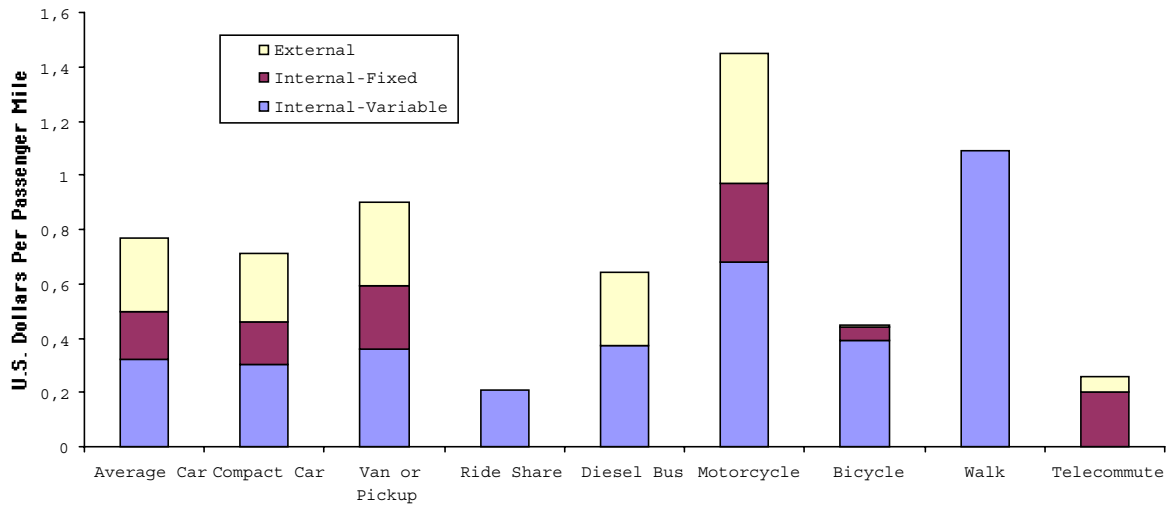


Figure 3.3 : Cost distribution for nine modes¹¹.

3.4 HIGHWAY STRATEGY

The Highway 2000 strategy is evaluated in an incremental fashion in relation to the base case. For each cost item the base case figure is compared to the highway case on a net basis (incremental).

Five major groups of benefits have been identified and each one of them is desegregated and detailed as much as possible. The categories are the following:

- travel time savings;
- vehicle operating cost savings;
- security related savings;
- maintenance and rehabilitation costs savings;
- savings related to other externalities.

3.4.1 Travel Time Savings

When roadway capacity is expanded, the following is generally observed : i) improved productivity as a result of reductions in travel time for business travellers and ii) social benefits as a result of savings in leisure time for non-business travellers.

These savings have economic value by virtue of users' willingness to pay to reduce the amount of time spent travelling.

The building of a new highway increases the capacity of the network. More vehicles travelling from one point to another more rapidly means that less time is spent on transportation and more time becomes available for other activities. These savings have economic value by virtue of user's willingness to pay to reduce the amount of time spent in travel. These benefits fall into specific categories in the *ECBA* tables as the value of time differs between modes and between motives.

SDG have estimated time saving between major cities and towns and for the road sections under study. Table 2 from the SDG report is reproduced here to illustrate this point (see Table 3.5). For more details, see Appendix A where estimated total time savings in hours per year are given.

Table 3.5 : Time Savings in Minutes by Light Vehicle

From	To	Existing Time	New Time	Saving
Kingston	Spanish Town	63	15	48
	Old Harbour	81	17	64
	May Pen	106	29	77
	Mandeville	151	42	109
	Montego Bay	242	104	138
	Ocho Rios	139	58	81
Mandeville	Ocho Rios	176	73	103

Road users travel for either business purposes or leisure activities. Daily commuting to and from the workplace, transporting people or freight, collecting or making payments and meeting clients or colleagues are all considered travel for business purposes. Travel for

leisure purposes include all other motives for road use. The next step is to attribute monetary values for the time spent or saved on the road *i.e.* value of time, for these categories of road users.

Since a person travelling for business purposes is prevented from simultaneously working at the usual workplace, society forgoes (or loses) the equivalent of the person's salary in production. Therefore, the monetary value of one hour spent on the road network is equivalent to that person's gross hourly wage.

3.4.1.1 Truckers and Motorists -- for Business Purposes (Work Motive)

The data in **Table 3.6** and **Table 3.7** enables to calculate the values of time for truck drivers and motorists. These numbers along with the procedure described in the next section allows two estimates to be calculated based on different sources of information.

By taking the weekly average salary of a driver (heavy duty) in the manufacturing sector in 1999, which from **Table 3.6** is J\$5,507 /week, and dividing it by the hours worked per week in the land transportation sector in 1998, which from **Table 3.7** is 40.10 hrs/week, the average hourly wage of a truck driver is obtained. In 2000, this represents J\$140.85/hr.

An alternative is to take the basic hourly rate in land transportation from **Table 3.7**, which was J\$57.70/hr in 1998, and assume that all workers in that sector are truck drivers. The estimate of the average hourly wage of a truck driver becomes then J\$63.95 /hr in 2000.

Table 3.6 : Weekly Salary Ranges (1997) for Drivers (J\$)

Weekly Salary Ranges Type	Maximum	Minimum	Average	Median	Number ¹	Standard Deviation	Upper Quartile	Lower Quartile
Driver ² (MB or MV)	6 831	1 711	3 672	3 339	31	1 198	2 705	4 389
Driver (Heavy Duty)	6 951	2 500	4 147	3 778	9	1 574	3 221	4 059
Driver (MB or MV)	1 085	2 846	5 022	4 805	21	1 941	5 569	3 738
Driver (Heavy Duty)	4 180	1 709	3 321	3 313	8	739	3 651	3 017
Manufacturing Sector								
Driver (Heavy Duty)	11 610	2 019	5 507	5 124	9	2 836	3 529	6 514

source: BRYAN, G. (1999), Wage, Salary and Benefits: Supervisory, Clerical and Hourly-Rated Employees, Jamaica Employers' Federation, 1999.

Table Service Summary: Salary Ranges - Clerical Staff - Driver (MV or MB), 1997, p. 17.

Table Service Summary: Salary Ranges - Hourly Rated/Weekly Paid Staff - Driver (Heavy Duty), 1997, p. 19.

Table Manufacturing Summary: Salary Ranges - Clerical Staff - Driver (MV or MB), 1997, p. 25.

Table Manufacturing Summary: Salary Ranges - Hourly Rated/Weekly Paid Staff - Driver (Heavy Duty), 1997, p. 27.

note: ¹ Number is the Number of Companies that Supplied Data for that Particular Position.

² Drives Motor Vehicle (Car, Van, etc.) for the Transport of Passenger or Freight by Road or for Collection of moneys for the Establishments.

In 1997, 63 companies were surveyed and in 1999, 61 companies were surveyed.

MB = Mini-Bus;

MV = Mini-Van.

In the case of motorists, the average hourly wage is obtained from the all-sector basic hourly rate for 1998 in **Table 3.7**. The value used for 2000 is J\$79.53 /hr which is considered a high estimate.

Table 3.7 : Hours Worked per Week and Basic Hourly Rates in Selected Sectors

All Sectors Indicators Industry	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Hours Worked Per Week	38.50	39.74	39.46	39.48	39.42	39.74	39.86	40.51	40.54	40.52	41.87
Construction	40.49	39.96	39.45	39.65	37.98	40.34	39.85	41.35	41.18	45.40	46.19
Land Transport	38.77	41.39	40.62	40.25	40.93	39.93	39.98	39.72	37.74	38.93	40.10
Services Incidental to Transport	38.55	40.25	39.47	39.50	39.22	41.49	42.68	42.07	43.55	40.46	39.68
Basic Hourly Rate	6.59	7.56	9.15	11.57	16.51	26.91	38.12	47.27	56.86	68.69	72.93
Construction	6.68	8.00	8.61	10.73	16.08	25.64	39.42	42.23	57.63	63.27	57.63
Land Transport	4.71	4.88	5.80	8.21	10.70	15.30	24.40	25.92	31.29	47.42	57.70
Services Incidental to Transport	6.65	9.10	10.44	12.56	23.75	24.48	30.09	50.84	59.49	77.56	74.71
Average Earnings Per Week	253.72	300.43	361.06	456.78	650.82	1069.40	1519.46	1914.91	2305.10	2783.32	3050.66
Construction	270.47	319.68	339.66	425.41	610.72	1034.32	1570.89	1746.21	2373.20	2872.46	2662.02
Land Transport	182.61	201.98	235.60	330.45	437.95	610.93	975.51	1029.54	1180.88	1846.06	2318.90
Services Incidental to Transport	256.36	366.28	412.07	496.12	931.48	1015.68	1284.24	2138.84	2590.79	3138.08	2964.22

source: THE STATISTICAL INSTITUTE OF JAMAICA, Employment, Earnings and Hours Worked in Large Establishments, Kingston, Jamaica, 1988-1997.
 Table A8: Quarterly Estimates of Average Standard Time Hours Worked Per Week by Hourly Rated Wage Earners in Large Establishments, by Major Industry Groups, 1992-1995 (Excluding Agriculture, Government and Free Zones), p. 47-49.
 Table A9: Quarterly Estimates of Basic Hourly Rate of Hourly Rated Wage Earners in Large Establishments, by Major Industry Groups, 1992-1995 (Excluding Agriculture, Government and Free Zones), p. 50-52.

3.4.1.2 Motorists - for Leisure Activities (Non-Work Motive)

Another calculation method can be used to derive a value for work, commute and leisure time for motorists¹⁴ as described in **Table 3.8**. It gives an average hourly value of time of J\$15.93/hr in 2000 for motorists travelling by road for leisure purposes. Work time value would be J\$79.45 and the all motives time value would be J\$57.22.

We believe that this method underestimates the value of leisure time in Jamaica for the following reasons. As indicated earlier, car ownership is relatively low in Jamaica. The weekly average salary of car owners and of car users is probably much higher than the one used in the calculations.

14 F. Juneau and J.M. Salvador (1995), Guide pour analyse avantages-coûts à l'intention des organismes publics de transport, MTQ, Montreal, December 1995, p. 37-38. (Appendix 2: Value of Time Travel, p.37.)

Table 3.8 : Value of Time Calculation Method for Traveller's

1) Work time

A) Weekly average salary in Jamaica in 1998 ¹	3 326.78J\$
B) Average hours per week Number of hours worked ¹	41.87 hrs
C) Value of time during a trip for "work motive" (A / B)	79.45J\$

2) Non-work time

D) Disposable income per capita ²	100 355.90J\$
E) Hours not-worked per year	
Hours in a year (24 hours X 7 days X 52 weeks)	8 736.00 hrs
Hours worked per year (D X 52 weeks)	2 437.41 hrs
Difference	6 298.59 hrs
F) Value of time during a trip for "non-work motive" (F / G)	15.93J\$

3) All-motive time³

G) Proportion of trips for work motive	65%
H) Proportion of trips for non-work motive	35%
I) Value of time during a trip for "all-motive" (G X C + H X F)	57.22J\$

¹ THE STATISTICAL INSTITUTE OF JAMAICA, Employment, Earnings and Hours Worked in Large Establishments, Kingston, Jamaica, 1988-1998.

² THE STATISTICAL INSTITUTE OF JAMAICA, National Income and Product 1998 (Preliminary Report), Kingston, Jamaica, 1999, 43 p.

³ Assumption.

Note also that this method generates another estimate of the motorists' value of time for work-related trips. A value of J\$79.45 /hr is estimated to be the low-wage for the average hourly wage of motorists but is very close to the estimate with the first method.

As another reference, in a recent study¹⁵, passenger time value were given in the following way :

	Car	Pickup	M bus	L bus	Truck
Passenger time value J\$ financial/hr	175	100	70	70	60
Passenger time value J\$ economic/hr	122.5	70	49	49	42

In the SDG report, the values of time were estimated from a stated preference survey. Values are quite different from those that have been estimated using analytical techniques. In Table 3.9 a comparison between SDG's empirical data and the analytical data is presented.

Table 3.9 : Value of Time J\$

	Method 1 Average hourly salary	Method 2	Method 3 Technical Enterprises Limited	SDG willingness to pay
Truck driver Manufacturing	J\$ 140.85			J\$ 156.00
Truck driver Land transportation	J\$ 63.95		J\$ 42.00	
Motorists Business	J\$ 79.53	J\$ 79.45	J\$ 122.50	J\$ 156.00
Leisure		J\$ 15.93		J\$ 103.00
Commute		J\$ 57.22		J\$ 107.00

15 TECHNICAL ENTERPRISES LIMITED. July 1999. *Clarendon Park to Williamsfield Highway : Feasibility Study*. Kingston (Jamaica):Government of Jamaica, Ministry of Transport and Works.

The empirical values may overstate the economic value of travel time of average Jamaicans, as the sample was biased towards determining the value of time of those who would be likely to pay a toll to use the highway. Those values refer to what people believe are their values while analytical values refer to what the market gives them in reality.

For economic analysis purposes, two assumptions will be used : high range values of time of J\$125/hr and J\$75/hr are assumed for work and leisure time respectively, while commuting would be J\$107.5; and low range : J\$79.45, J\$57.22 and J\$15.93.

3.4.2 Vehicle Operating Cost Savings

A smoother surface and a smoother ride contribute to lower fuel consumption and the wear and tear by road vehicles. H2K will provide both through a smoother surface, limited access and full highway configuration as opposed to the stop-and-go semi-urban configuration of most of the existing network.

These savings are compiled per category of vehicle and on a per unit of distance basis. These savings represent lower costs resulting from the implementation of the new infrastructure versus the existing one.

Actual costs of moving vehicles on the existing origin-destinations pairs were taken from the prefeasibility study and updated to year 2000 by taking the general inflation rate.

	%
1997	9.7
1998	8.6
1999	8.0 estimate
2000	8.0 estimate

Costs of moving vehicles in year 2000 on the new highway are calculated on the basis of the physical characteristics of the new road (pavement roughness, the rise and fall, the speed, the horizontal alignment, the traffic, etc.). In 1996, references to HDM-III model were used for these calculations and correction factors for two types of vehicle and various road classes and topographies were calculated.

Price adjustment to vehicle operating costs were made as follows :

1996 Basic VOC (economic)

Cars	J\$ 5.95/veh-km	(including the value of person times and excluding taxes and duties)
Trucks	J\$ 22.69/veh-km	(including the value of person times and excluding taxes and duties)

1996 Savings

Cars	J\$ 1.71/veh-km	(including the value of person times and excluding taxes and duties)
Trucks	J\$ 9.73/veh-km	(including the value of person times and excluding taxes and duties)

2000 Savings (updated according to inflation)

Cars	J\$ 2.38/veh-km	(including the value of person times and excluding taxes and duties)
Trucks	J\$ 9.73/veh-km	(including the value of person times and excluding taxes and duties)

Since the time saving and the vehicle operating cost savings can be distinguished, the proportion of time savings in total VOC can be calculated as follows:

For cars

Average kilometer/year :	30,000
Average speed :	40 km/hour
Hours spent travelling :	750 hours

Time spent travelling by purpose and value of time by purpose

		Hours	Unit Value	Total Value
Business	15 %	112.5	J\$ 125.00	14,062.50
Commuting	52 %	390	J\$ 107.50	41,925.00
Leisure	33 %	247.5	J\$ 75.00	18,562.50
				74,550.00

Average value of time in cars :	J\$ 74,550 / 30,000 km =	J\$ 2.49
Total 1996 VOC (economic) for cars :		J\$ 5.95
Inflated to 2000 :		J\$ 8.27

Proportion :

$$\frac{\text{Value of time}}{\text{VOC}} = \frac{\text{J\$ 2.49}}{\text{J\$ 8.27}} = 30 \%$$

For trucks

Average kilometer/year :	60,000
Average speed :	30 km/hour
Time spent travelling :	2,000 hours

Cost per hour for a driver :	J\$ 63.95	
Total cost :	J\$ 127,900	
Cost per kilometer :	$\frac{J\$ 127,900}{60,000 \text{ km}}$	= J\$ 2.13/km

Total 1996 VOC economic value :	J\$ 22.69
Inflated to 2000 :	J\$ 31.53

Proportion :

Value of time	=	$\frac{J\$ 2.13}{J\$ 31.53}$	= 7 %
VOC			

Vehicle operation cost savings:

Cars \$J :	2.38 X .7	=	J\$ 1.67
Trucks \$J :	9.73 X .93	=	J\$ 9.05

These costs can be compared with North American cost structures. Litman (1999) presents private vehicle operating costs in US\$ per mile so that these numbers will have to be converted into corrected J\$ per kilometre. This exercise yields the following results:

Table 3.10 : Vehicle Operating Costs in North-America

Vehicle Operating Costs per pass-km category

<i>(units)</i>	<i>(US\$/pas.-mile)</i>	<i>(J\$/pass-km)</i>	<i>(J\$/veh-km)</i>
Total Automobile	1.08	70.89	107.05
Internal-Variable	0.46	30.19	45.59
User Time	0.24	15.75	23.79
Vehicle Operation	0.13	<u>8.53</u>	12.89
Internal Accident	0.09	5.91	8.92
Internal-Fixed	0.25	16.41	24.78
External	0.37	24.29	36.67

source: Todd Litman, Socially Optimal Transport Prices and Markets: Principles, Strategies and Impacts, VTPI (www.vtpi.org), November 1999, p. 11-14.

Savings from reduction in VOC arise from the following improvement of traffic conditions:

- Reduction of travel distances;
- Improvement of the road geometry and/or surface conditions;
- Reduction of traffic congestion.

3.4.3 Security Related Savings

Safety is a major issue in road transport. Building the highway will likely reduce the frequency of accidents as it will reduce the amount of traffic sharing road space with pedestrians and separate the lanes in which traffic flows in opposite directions. From accident statistics, most fatal or serious accidents involve pedestrians being hit by cars or careless overtaking, often as a result of driver inexperience or misjudgement.

By improving travelling conditions and designing a safer highway, it is expected that accident costs will be reduced.

Table 3.11 presents the statistics on accidents for Jamaica.

Table 3.11 : Motor Vehicle Accidents

Motor Vehicle Accidents Indicator	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	Average
Accidents	6320	6608	7276	7861	8045	8247	8574	7379	6868	8660	8086	7629
Fatal	308	363	367	389	394	380	342	318	303	336	312	347
Injuries	1987	1987	2083	2227	2301	2106	2013	1992	1885	2336	2215	2103
Property Damage	4025	4258	4826	5245	5350	5761	6219	5069	4680	5988	5559	5180
Casualties	3525	3437	3589	3935	4101	3687	3440	3411	3373	4009	3737	3659
Persons Killed	343	400	393	444	428	434	385	367	342	372	356	388
Persons Injured	3182	3037	3196	3491	3673	3253	3055	3044	3031	3637	3381	3271
Major Causes	6320	6608	7276	7861	8045	8247	8574	7379	6868	8660	8086	%
Error of Judgement/Negligence	758	574	765	1381	926	985	1124	1394	915	2187	1822	15%
Improper Overtaking	944	1054	693	494	700	748	593	605	459	679	415	9%
Following Too Closely	394	500	677	687	673	563	653	518	722	1101	647	9%
Turning without Due Care	530	849	587	389	591	468	541	643	840	971	587	8%
Crossing Headlessly	557	368	583	788	713	604	703	324	839	315	560	8%
Fail to Keep to Near Side	398	561	628	479	676	621	557	621	471	627	479	7%
Losing Control	126	268	586	726	619	655	735	700	418	715	544	7%
Excessive Speed	1031	556	624	487	634	583	693	382	212	324	478	7%
Misjudging Clearance/Distance	450	363	609	671	662	538	598	485	411	621	564	7%
Improper Change of Lane	301	290	568	721	603	673	697	549	363	290	379	6%
Disobeying Stop Sign	370	229	402	368	587	503	523	314	245	125	346	5%
Disobeying Traffic Light	189	178	293	324	367	382	408	193	325	94	269	4%
Defective Vehicle	96	119	79	184	97	353	408	171	144	220	248	3%
Skidding	90	251	88	63	80	256	158	222	115	128	270	2%
Road Bad/Not Maintained	61	104	58	34	67	157	102	75	43	38	126	1%
Under the Influence of Liquor	8	29	14	27	18	41	22	23	280	180	192	1%
Other Factors	14	211	14	26	18	58	33	131	40	23	116	1%
Disobeying Pedestrian Crossing	3	104	8	12	14	59	26	29	26	22	44	0%

source : POLICE DEPARTMENT - TRAFFIC HEADQUARTERS, Accidents and Major Causes.

Precarious road conditions are the cause of many accidents. Improvements to the geometry itself can significantly reduce the frequency and severity of accidents (refer to Table 3.12).

Table 3.12 : Statistics on Accident Reduction

Type of intervention	Reduction in accidents	Source
Slope smoothing, profile correction	40% - 50%	Ogden (1996)
Increasing the visibility of traffic signals	20% - 60% of all accidents	Malo (1967), Craven (1985), Bhesania (1991), Lalani (1991), Hamilton (1998)
Profile and curve correction	10% - 60%	Persaud (1994), Ogden (1996)
Road delimitation and access management	6% of all accidents (based on 1959 data)	FHWA, Vol.1, p4-2
Speed limit reduction to 50km/h	10% - 25%	Ogden (1996)
Widening to 4 lanes (rural setting)	30% - 50% of all accidents	Ogden (1996)
Widening to 4 lanes (urban setting)	20% - 35% on all accidents 22% fatal accidents and with injuries	Fisher (1977), Hauer (1996)
Shoulder paving	20% - 65%	Heimback (1974), Armour (1984)

Source: Dessau pre-feasibility study.

3.4.3.1 Cost of Death, Injuries and Material Losses

Accidents can be grouped in three major categories: fatal accidents, accidents involving injuries and accidents that result in property damage only. Two methods of computing these costs are commonly used and are presented here: the human capital method, and the willingness to pay method. Accident claims and settlements may represent the true costs of accidents. However, the payments received for a person killed is more a question of equity than a question of lost of production. Unfortunately, when someone dies, that person's net contribution to society fails. That is why the approach using the human capital method is so controversial. The willingness to pay approach is the one used more frequently.

Examples of average cost per accident in Canada shown are the following:

Table 3.13 : Average Accident Cost in Canada (Can\$)

Accident Type	Fatal	With Serious Injuries	With Light Injuries	Property Damage
Using the human capital method				
- Cost per accident	461,404	115,762	12,424	6,995
- Multiple factor	66	17	2	1
Using the willingness to pay method				
- Cost per accident	3,529,563	121,709	121,709	7,303
- Multiple factor	483	17	1.1	1

Source: Quebec's Ministry of Transport, 1999

Unfortunately, such data is not yet available in Jamaica although efforts to obtain it date back to 1984¹⁶. Nonetheless, other available sources of information and some assumptions will allow the costs of motor vehicle accidents to be estimated. Since prices are not comparable between Canada and Jamaica and in the absence of purchasing power parity, proportioning is required. It is assumed that elements comprising accidents costs such as: health care costs, lost production, etc. are comparably weighted in Jamaica and in Canada.

Accidents with property damage are used to provide the base unit. Hence, each accident-type cost can be represented as a multiple of the cost of property damage. In both suggested methods, property damage and serious injuries (where a serious injury is 17-times more costly than a property damage) are comparable but major divergences arise when comparing fatal accidents. Roughly speaking, the willingness to pay method sets fatal accidents 10-times higher than does the human capital method.

Some statistics have been found in Jamaican sources but calculations and numeric transformations are required to present the data in the fatal accident, serious injury, light injury, and property damage form. Here are some examples :

16 WORLD HEALTH ORGANIZATION (1984), *Joint HQ/PAHO on the Prevention and Care of Motor Vehicle Injuries in the Caribbean*, Bridgetown, Barbados, June 1984,

- From Dr Ward's¹⁷ numbers, motor vehicle accidents account for 34.35% of all accidents and injuries that were estimated at J\$419 million in 1996¹⁷. This represents J\$144 million. The property damage is therefore J\$3,875 for 1996 and the other values are presented below in **Table 3.14** :

Table 3.14 : Ward's Cost of Accidents (J\$)

Accident Type	Fatal	With Serious Injuries	With Light Injuries	Property Damage
Using the human capital method	255,635	64,136	6,883	3,875
Using the willingness to pay method	411,766	14,199	14,199	852

- Gordon *et al.* (1999)¹⁸ cite the National Road Safety Board's estimation of motor vehicle accidents at US\$39 million in 1999. The average cost of a property damage type accident is therefore J\$8,546 for 1999 and the other values are presented below in **Table 3.15** :

Table 3.15 : Gordon's Cost of an Accident (J\$)

Accident Type	Fatal	With Serious Injuries	With Light Injuries	Property Damage
Using the human capital method	2,564,283	643,355	69,047	38,875
Using the willingness to pay method	4,130,444	156,468	142,429	8,546

17 WARD, E. (1996), *A Review of Hospital Care: Outlining Morbidity & Mortality Patterns, Costs of Care and Resource Inputs*, Jamaica 1996, Epidemiology Unit, Ministry of Health, Jamaica, 1996.

18 GORDON, G., DURANT, T., WARD, E., LEWIS-BELL, K. AND D. ASHLEY (1999), *Understanding the state of Accidental and Violence-Related Injuries in Jamaica*, August 19, 1999, 51 p.

- In SweRoad's report to the Ministry of Construction¹⁹ in 1993, the total cost of motor vehicle accidents is J\$1 billion for 1992. In 2000 prices this number increases to J\$1.6 billion (**Table 3.16**). This comes out to J\$5,934 /property damage in 2000 by using the highway capacity method.

Table 3.16 : SweRoad's Cost of an Accident (J\$)

Accident Type	Fatal	With Serious Injuries	With Light Injuries	Property Damage
Using the human capital method	1,803,641	452,517	48,566	27,344
Using the willingness to pay method	2,867,819	98,890	98,890	5,934

- Finally, following a brief telephone survey to insurance companies, the following information was collected as shown in **Table 3.17** :

Table 3.17 : Insurance Claims by Accident (J\$)

Average insurance claim		Number of claims	1998	1999
type				
Company 1		---	83 470	79 878
Company 2		---	---	90 000
Company 3			---	91 313
private	3 rd party	7 993	---	106 373
	PD			80 078
commercial	3 rd party	4 116	---	107 615
	PD			67 582
Survey average insurance claim (J\$)			83 470	87 064
Survey average property damage (J\$)			---	75 830

19 GOVERNMENT OF JAMAICA – MINISTRY OF CONSTRUCTION (WORKS), *Road Safety Report, Final report, Phase I*, Kingston, Jamaica, December 1993.

By using the property damage obtained this way, J\$75,830 for 2000, the highest estimates of accident costs are clearly generated as can be seen in the following **Table 3.18** :

Table 3.18 : Jamaican Estimate of the Costs of Accidents (J\$)

Accident Type	Fatal	With Serious Injuries	With Light Injuries	Property Damage
Using the human capital method	5,001,926	1,254,937	134,684	75,830
Using the willingness to pay method	36,649,098	1,263,761	1,263,761	75,830

The following **Table 3.19** summarises the different accident costs sources and assumptions.

Table 3.19 : Summary Table of the Cost of Accidents

Accident type	Fatal	with Serious Injuries	with Light Injuries	Property Damage
using the human capital method in J\$/acc.				
Ward (1996)	255635	64136	6883	3875
Gordon <i>et al.</i> (1999)	2564283	643355	69047	38875
World Health Organization (1984)	71059	17828	1913	1077
Average insurance claim (2000)	5001926	1254937	134684	75830
GOJ - Ministry of Construction (1993)	1803641	452517	48566	27344
using the willingness to pay method in J\$/acc.				
Ward (1996)	411766	14199	14199	852
Gordon <i>et al.</i> (1999)	4130444	142429	142429	8546
World Health Organization (1984)	114459	3947	3947	237
Average insurance claim (2000)	36649098	1263761	1263761	75830
GOJ - Ministry of Construction (1993)	2867819	98890	98890	5934

3.4.3.2 Reduction in the Number of Accidents

Savings from increased safety are assessed with reliability with supporting data on accidents and the economic costs of accidents.

Presently, the best estimate of avoided accidents is based on the numbers in section 3.4.3. Highway 2000 is considered to be synonymous with “widening to 4 lanes”. The corresponding rural setting/urban setting ratio is therefore 1. Traffic data obtained from the traffic consultant on trips for all origin-destination pairs versus trips for highway origin-destination pairs can be used to obtain the percentage of reported accidents that most likely occurred in the Highway 2000 corridor. Finally, the appropriate reduction percentages are applied to obtain “reduction in accidents” estimates.

In Table 3.20 an evaluation of accident savings is provided using two approaches. With these assumptions, the savings will come close to US\$1.2 million in 1998. If fatal cost estimates are subtracted, the reduction would be US\$673,500.

Table 3.20 : Jamaica : Benefits Related to Reduction in the Costs of Accidents

	Numbers in 1998	Average kms/year	Total veh-km/year	
Motor Cars: cars taxis	163 575	25 000	4 089 375 000	53%
Buses, trucks, tractors, trailers	59 373	60 000	3 562 380 000	46%
Motercycles	3 782	25 000	94 550 000	1%
			7 746 305 000	100%

Accident costs	Numbers in 1998	Costs/accident :	Gordon's		
			human capital	Costs/accidents :	willingness
Killed	356	\$2 564 283	\$912 884 748	\$4 130 444	\$1 470 438 064
Serious injuries	1 328	\$643 355	\$854 375 440	\$142 429	\$189 145 712
Minor injuries	2 053	\$69 047	\$141 753 491	\$142 429	\$292 406 737
Damage	5 559	\$3 875	\$21 541 125	\$8 546	\$47 507 214
Total			\$1 930 554 804		\$1 999 497 727
US\$			\$48 263 870		\$49 987 443

Accident costs	Numbers in 1998	Costs/accident :	Swe Road's		
			human capital	Costs/accidents :	willingness
Killed	356	\$1 803 641	\$642 096 196	\$2 867 819	\$1 020 943 564
Serious injuries	1 328	\$452 517	\$600 942 576	\$98 890	\$131 325 920
Minor injuries	2 053	\$48 566	\$99 705 998	\$98 890	\$203 021 170
Damage	5 559	\$27 344	\$152 005 296	\$5 934	\$32 987 106
Total			\$1 494 750 066		\$1 388 277 760
US\$			\$37 368 752		\$34 706 944

Reduction in accident costs		Reduction of accident in %		
Total veh-km travelled on the highway/year	246 119 500	50%	50%	25%
Total veh-km travelled on the existing road/year	246 119 500	50%	20%	10%
Total	492 239 000			
Proportion of national travelled kilometers	6.35%			
Proportion of the costs of accidents	\$3 376 019	35%		
US\$	\$1 181 607			
Less killed (US\$)	\$673 516			

As a rule of thumb, it is recognised that road accidents represent about 1 % of GNP. If this number is applied to Jamaica, the cost of accidents would be US\$68 million which is higher than the analytical data (GNP J\$272 billions in 1999). A US\$1.2 million reduction in accident costs related to Highway 2000 would represent a 1.76% overall reduction in accident costs for the country.

3.5 REHABILITATION AND MAINTENANCE COSTS SAVINGS

Maintenance requirements on roads is proportional to the design characteristics and the traffic that the pavement has to support. Since a fraction of the traffic is assumed to shift from existing roads to the new highway, less traffic on the existing network means both the need for less maintenance and of the opportunity to defer scheduled rehabilitation works.

Table 3.21 summarises investments made on the existing road network for the past ten years. Since traffic is the heaviest along the roads from which H2K is to draw traffic, it is assumed that this is also where most of the rehabilitative road work is being done and most of the resources are being spent. Therefore, 70% of the total budget intended for capital expenditure on roads is assumed to be expended on roads that will be affected by Highway 2000. The budget grew almost nine-fold during the last 10 years, from J\$225 million to almost J\$2,035 billion as can be seen in **Table 3.21**.

Table 3.21 : Recurrent and Capital expenditures on roads, in current Millions J\$

	88-89	89-90	90-91	91-92	92-93	93-94	94-95	95-96	96-97	97-98	98-99	99-00
Recurrent	16.3	13	14.3	9.6	52	39.1	82.8	146.1	146.5	149.3	123.8	133.7
Capital	225.6	168.5	248.5	329.2	547.3	1062.2	1 360.9	2 401.5	2 408.0	2 454.2	2 035.7	2 198.6
Total	241.9	181.5	262.8	338.8	599.3	1101.3	1 443.7	2 547.6	2 554.5	2 603.5	2 159.5	2 332.3
Proportion	6.7%	7.2%	5.4%	2.8%	8.7%	3.6%						
Average						5.7%						
Exchange rate				20.91	22.2	32.7	33.28	39.8	37.02	35.58	36.68	

The following assumptions are proposed to calculate the reduction of rehabilitation and maintenance costs as a consequence of the implementation of Highway 2000.

- H2K corridor proportion : 70 % X 2332 = \$1632.6 million
- US equivalent : J\$ 1632 / US\$40 = US\$40.81 million
- Proportion of :
 - capital 95 % = US\$ 38.5 million
 - maintenance 5 % = US\$ 2.3 million
- Costs reduction :
 - capital 10 % = US\$ 3.8 million
 - maintenance 20 % = US\$ 0.5 million
 - Total US\$ 4.3 million

3.6 SAVINGS RELATED TO OTHER EXTERNALITIES

Highway trips pollute less and generate less noise (on a per vehicle basis) than do trips in density populated areas. Access to high quality transportation will cause changes in real estate patterns over time and result in escalation of property values in certain areas.

It should be noted that user-based, owner/operator-based and non-user-based benefits represent the total value of productivity and output gains that occur throughout the economy as a result of a public investment -- users thus "transmit" such benefits to the economy at-large and are not necessarily the final beneficiaries (hence the expression user-based benefits).

For example, improved time for business travellers and a reduction in existing network operating and maintenance costs, to the extent that they are passed on to a given industry, permit greater output for a given call on labour and transportation resources. Depending upon the strength of market forces in the industry in question, consumers would gain from lower prices. Since this study does not examine these distributional implications of

productivity and output gains as a result of alternative highway investment strategies, the value of user benefits may be regarded as the aggregate value of such gains.

Externalities such as pollution, land use, etc., are often calculated on a per vehicle-km basis. The relationship between the two is an increasing one in the sense that when total vehicle-km increases, so do the externalities in terms of volumes and costs.

3.6.1 Unit Price of Externalities

Evaluating the environmental impacts of transportation projects and policies is relatively new science. Accounting for these impacts in transportation decisions, involves integrating what are called externalities in the economic calculation.

The main form of pollution caused by vehicles is air pollution.

The main pollutants released into the atmosphere by the majority of vehicles circulating in our cities and towns are: carbon dioxide (CO₂), carbon monoxide (CO), hydrocarbons (HC), and nitrous oxide (NO), sulphur oxide (SO) and particulates (PM).

Since the early 1980s, many evaluation methods have been suggested to evaluate the monetary costs of these externalities generated by motorised vehicles. Many operational studies in European countries now serve as benchmarks when recommendations on unit cost measurement of atmospheric and noise disturbances are needed. In this study, the prices for different pollutants are obtained from those studies.^{20 21 22 23}

Table 3.22 shows a preliminary comparison of atmospheric emissions of pollutants by vehicles circulating on Jamaica's road network along with the costs brought up by each type. The data provided so far finds three categories of road users: personal vehicles, minibuses and trucks. Pollution costs are attributed to these categories by associating them with the categories in **Table 3.22** in the following way:

20 Todd Litman, *Transportation Cost Analysis: Techniques, Estimates and Implications*, VTPI (www.vtpi.org), 1998, p. 3.10-5.

21 Massachusetts Department of Public Utilities, *Hearing on environmental externality values*, 1992.

22 Miller, P. and J. Moffet, *The price of mobility*, Natural Resources Defense Council, Washington, DC, 1993.

23 Convergence Research, *Valuing emissions from Hermiston generating project*, Seattle, Wa., 1994.

Table 3.22 : Atmospheric Pollutants

Atmospheric pollutants released	CO2	CO	HC	NO	SO	PM	Occupants per
Released quantities (g/km)							
Gasoline automobile	204	14.73	1.97	1.19	0.04	0.06	1.1
car pool		6.14	0.82	0.50	0.02	0.03	2.6
van pool		3.39	0.45	0.28	0.01	0.01	5.4
Diesel bus	1346	0.94	0.07	0.42	0.06	0.11	22.8
Articulated diesel bus	1724	1.03	0.08	0.46	0.06	0.12	26.5
methanol bus		0.01	0.01	0.31	0.00	0.00	22.8
Median cost of pollutant (J\$/ton)	40	1814	6600	8418	3586	4992	---
<hr/>							
Cost of pollutant (J\$/km)							Total
Gasoline automobile	0.008	0.027	0.013	0.010	0.000	0.000	0.058
car pool		0.011	0.005	0.004	0.000	0.000	0.021
van pool		0.006	0.003	0.002	0.000	0.000	0.012
Diesel bus	0.054	0.002	0.000	0.004	0.000	0.001	0.060
Articulated diesel bus	0.069	0.002	0.000	0.004	0.000	0.001	0.076
methanol bus		0.000	0.000	0.003	0.000	0.000	0.003
<hr/>							
(J\$/pass-km)							
Gasoline automobile	0.006	0.025	0.012	0.010	0.000	0.000	0.054
car pool		0.004	0.002	0.002	0.000	0.000	0.008
van pool		0.001	0.001	0.000	0.000	0.000	0.002
Diesel bus	0.003	0.000	0.000	0.000	0.000	0.000	0.003
Articulated diesel bus	0.003	0.000	0.000	0.000	0.000	0.000	0.003
methanol bus		0.000	0.000	0.000	0.000	0.000	0.000

source : Todd Litman, Transportation Cost Analysis: Techniques, Estimates and Implications, VTPI (www.vtpi.org),

3.7 CONSTRUCTION

Costs are incurred in the construction and acquisition of new infrastructure, land and equipment. Capital costs are treated as lump-sum outlays in the years they occur. Depreciation is thus not taken into account as it would mean double-counting capital expenses.

The construction of the highway requires heavy investment in the first 4 years of the project's life. After that, periodic investments are scheduled to maintain the infrastructure. The life-span of each element is crucial in setting its residual value in year end of evaluation.

Table 3.23 shows the estimated construction costs by Phase.

Table 3.23 : Construction and Maintenance Costs by Road Sections

**1) Construction Costs
Breakdown**

Phase 1	\$235 000 000
Phase 2	\$523 000 000
Total	\$758 000 000
Grantor development costs	\$20 000 000
Concessionnaire development costs	\$45 000 000

**2) Construction Costs
Per Year**

Year	Kingston- Williamsfield	Williamsfield- MoBay-OchoRios	TOTAL	Salvage value
2002	\$112 800 000		\$112 800 000	\$90 240 000
2003	\$122 200 000	\$120 300 000	\$242 500 000	\$194 000 000
2004		\$230 100 000	\$230 100 000	\$184 080 000
2005		\$172 600 000	\$172 600 000	\$138 080 000
Total	\$235 000 000	\$523 000 000	\$758 000 000	\$606 400 000

**3) Construction
Costs: Local and
Foreign Content**

Kingston-Williamsfield	Local	Foreign	Total	Local	Foreign
labour	\$36 100 000	\$37 200 000	\$73 300 000	49%	51%
material	\$26 400 000	\$66 900 000	\$93 300 000	28%	72%
equipment	\$6 600 000	\$61 800 000	\$68 400 000	10%	90%
total	\$69 100 000	\$165 900 000	\$235 000 000	29%	71%
Williamsfield-MoBay-Orios					
labour	\$124 400 000	\$55 800 000	\$180 200 000	69%	31%
material	\$35 200 000	\$96 600 000	\$131 800 000	27%	73%
equipment	\$40 800 000	\$170 200 000	\$211 000 000	19%	81%
total	\$200 400 000	\$322 600 000	\$523 000 000	38%	62%
Total					
labour	\$160 500 000	\$93 000 000	\$253 500 000	63%	37%
material	\$61 600 000	\$163 500 000	\$225 100 000	27%	73%
equipment	\$47 400 000	\$232 000 000	\$279 400 000	17%	83%
total	\$269 500 000	\$488 500 000	\$758 000 000	36%	64%

3.7.1 Land Acquisition, Relocation of Services (Utilities) and Costs of Externalities

These costs are considered construction costs but the distinction is that they do not have a residual value at the end of the period of analysis. They are sunk costs but are inevitable in order to make space, in an environmentally-appropriate way, for the highway.

Opportunity costs of land are not considered since the Government of Jamaica intends to swap existing land holdings for land required along the corridor. Only the transaction costs are recognised. These are estimated as follows:

Legal Survey (5,000 parcels plus corridor)	US\$5,000,000
Conveyancing	US\$5,000,000
Resettlement Assistance	US\$10,000,000
Sub-total	US\$20,000,000

These costs are included in the grantor development costs.

3.7.2 Maintenance and Operating Costs

Once the installations are in place and the highway is opened for traffic, operation and maintenance of this new facility will involve recurrent expenditures.

These costs are estimated to be 1.17% annually of the total construction costs. The costs do not include any costs related to operation or maintenance of the tolling facilities.

3.7.3 Cost Evaluations

In the economic CBA, the monetary values of the costs elements must reflect real costs *i.e.* the actual amounts of resources that have to be sacrificed in order to purchase them. As such, taxes and duties and market inefficiencies must be identified and corrected for. Market prices of goods, services and factors of production may not reflect their economic value to society.

The following sub-sections identify the elements that can misrepresent the actual prices of goods and correction factors are proposed for them.

Since taxes and duties are a simple redistribution of wealth, they must be eliminated from economic calculations in order to accurately evaluate the costs or benefits of a project.

The shadow price is a real price to society paid for goods or services. Market inefficiencies result from monopolies, government-subsidised industries, price controls, currency devaluation, etc. Labour and imports are the most frequent sectors of the economy where shadow prices exist, and therefore have to be corrected in order to accurately calculate the costs of a project.

For labour for instance, through union contracts, unsteady rates of unemployment and level of non-salary income, wages might be artificially high (or low) so that they do not reflect the real cost of labour. When market clear, economic theory dictates the following relationship between a worker's wage (W) and his/her marginal productivity (MP): $W=MP$. In cases where this relationship does not hold, wages must be multiplied by a correction factor >1 (if $W<MP$) or <1 (if $W>MP$). More generally, we can say that labour of different types may be regarded as having a value greater (or less) than the actual price paid.

Imported goods require foreign currencies in order to be purchased and inefficiencies in the foreign exchange market can maintain their prices at an artificial level. Since the highway project involves capital and other resources imported from foreign sources, prices paid for these might be corrected in order to reflect their true values.

An analysis of studies conducted for Jamaica has revealed the following data. The conversion factors for several sectors of the Jamaican economy were derived from the runs of the input-output model²⁴. The conversion factors give the ratio between the price to be used in evaluating the project, the shadow prices, and the price used to evaluate their costs, the market prices.

For non-traded sectors of the economy, the conversion factors applied will be :

- Construction \Rightarrow 0.57
- land transportation \Rightarrow 0.72
- aggregated \Rightarrow 0.70

24 National Economic Parameters and Economic Analysis for the Public Sector Investment Program in Jamaica. Prepared for the Planning Institute of Jamaica by John Weiss, University of Bradford U.K. July 1999.

These conversion factors will be applied respectively to :

- construction costs
- operation and maintenance costs

Since we know from the project cost estimate the proportions of labour, foreign exchange and capital involved we can estimate the specific conversion factor in the following way.

Conversion factor for construction

$$0.81 = 0.21 \times 0.27 + 0.65 \times 1 + 0.14 \times 0.7 + 0.0 \times 1.0$$

Labour Foreign Exchange Material & Equipment Transfers

Conversion factor for maintenance & operation

$$0.47 = 0.6 \times 0.27 + 0.10 \times 1 + 0.3 \times 0.7 + 0.0 \times 1.0$$

Labour Foreign Exchange Material & Equipment Transfers

4 EVALUATION PARAMETERS

The following parameters must be established to compare different streams of benefits and costs over time :

- discount rate;
- period of analysis;
- base year of comparison;
- salvage values of the investments made.

4.1 DISCOUNT RATE (DR)

The economic analysis assumes a 10% discount rate.

4.2 PERIOD OF ANALYSIS

The period of analysis is set at 50 years. Considering that construction is to begin in 2002, the streams of net benefits will be analysed until 2052. All infrastructure investments are expected to be functional through out the period and the sequence of investments (incl. minor maintenance investments) covers this period.

4.3 BASE YEAR

The base year is set to be 2002. All costs and benefits presently observed are evaluated in constant 2000 prices.

4.4 SALVAGE VALUES OF THE INVESTMENTS

The operation and maintenance expenditures over the life of the project are designed to ensure that the project is sustainable and has a substantial salvage value. For modelling purposes, the salvage value is assumed to be 80% of the initial capital cost.

This percentage of salvage value should be based on normal service life of the various components of the construction (50 years for design and structures, 30 years for earthworks, 15 years for pavement and drainage, etc.). It has been assumed that the level of operations, maintenance and rehabilitation expenditures will ensure that the investment has a substantial salvage value.

5 COMPUTATION

It is important to note that in a project such as Highway 2000, the costs and benefits are not contained in a static framework but rather in a dynamic framework corresponding to the life of the project. For example, operation and maintenance costs along with environmental consequences are spaced out over several years. Therefore, in order to establish a common basis for comparison of the project's costs and benefits, it is necessary that all monetary amounts be converted into their present value. In fact, all annually evaluated sums (costs and benefits) must be brought back to reflect their present value via the discount rate so that the different alternatives of the project can be compared *ex aequo* with the present situation. This discounting process will in turn allow the decision-makers to choose the alternative that maximises economic welfare.

The core of an *ECBA* lies in the discounting process where evaluating the present value of a future stream of cash-flows is obtained by calculating its present value (*PV*). The present for each category of cost or benefit, *pv*, is calculated as follows:

$$pv = \sum_{i=1}^n \frac{\text{cashflow}_i}{(1 + DR)^i}$$

where, n = period of analysis in years;
 $i = 1 \dots n$;
 DR = discount rate.

5.1 NET PRESENT VALUE (*NPV*)

This indicator is simply the value of the whole project (over the entire period of analysis) today. The *NPV* is calculated as follows:

$$NPV = \text{discounted benefits} + \text{discounted salvage value} - \text{discounted costs}$$

A project is profitable when $NPV > 0$ and becomes more so as the value of *NPV* grows positively. On the other hand, a project for which $NPV = 0$ would not normally proceed.

5.2 INTERNAL RATE OF RETURN (IRR)

The Internal Rate of Return is the discount rate at which the Present Value of the Costs is equal to the Benefits. A project with a positive IRR is expected to generate positive benefits to society.

In **Figure 5.1**, an actual net benefits curve is drawn and superimposed with the estimated curve using the IRR iterations-procedure briefly described above. The graph reflects that heavy investment takes place in the first two years (net benefits are negative) and the rest of the period of analysis is marked by positive and increasing net benefits.

Intuitively, a positive slope means a positive *IRR* and in this case, it is around 7%. Another way to see it is that the net benefits curve yields the same interest payments as an investment with a 7% annual yield. Detailed calculations and an economic model are included in **Appendix “A”**.

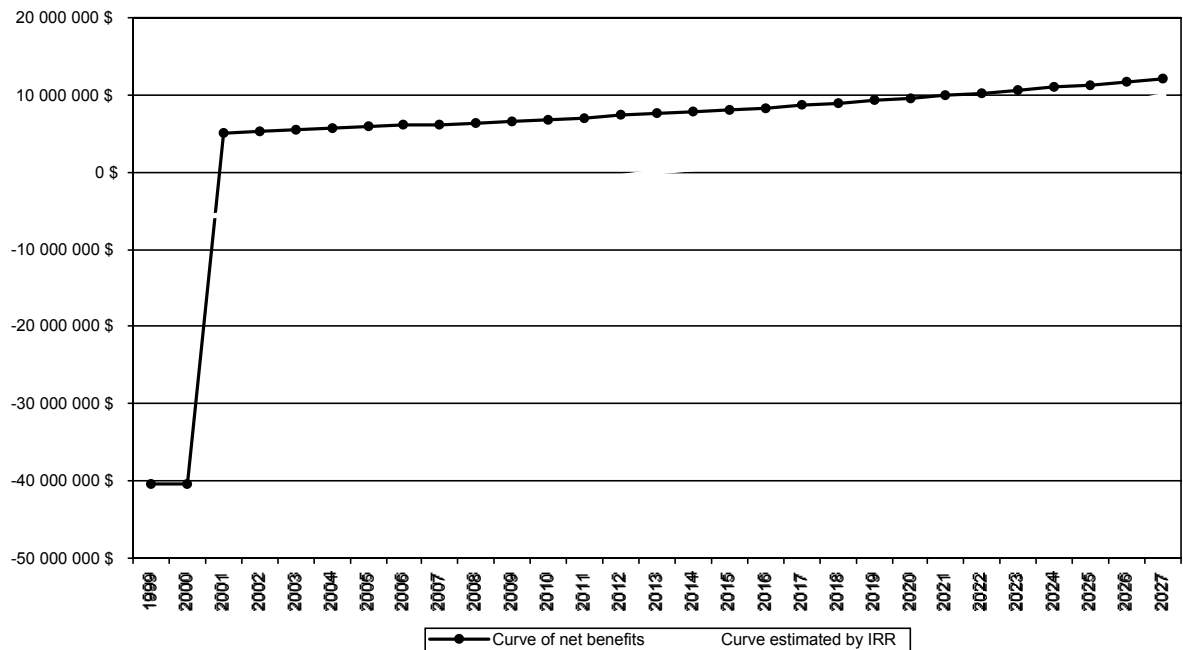


Figure 5.1: Iterations-estimation of the internal rate of return (IRR).

The relationship between the *IRR* and the *PV* is the following :

$$PV = \sum_{i=1}^n \frac{\text{cashflow}_i}{(1 + IRR)_i} = 0$$

where, n = period of analysis in years;
 $i = 1 \dots n$.

5.3 BENEFIT-COST RATIO (BCR)

This indicator is simply the ratio of benefits over costs (incl. salvage value) of the whole project over its entire life-span. The *BCR* is calculated as follows:

$$BCR = \frac{\text{(discounted benefits + discounted salvage value)}}{\text{discounted costs}}$$

A project is clearly worthwhile when $BCR > 1$ and becomes more and more beneficial as the value of *BCR* grows positively. On the other hand, a project for which $BCR < 1$ would only proceed if it was considered that there would be substantial secondary benefits not fully captured by the analysis or if that project was a component of a larger scheme that had an overall *BCR* greater than 1.

6 RESULTS, CONCLUSIONS AND RECOMMENDATION

Two scenarios have been evaluated; the only differences between scenario 1 and 2 are the values of time. See **Table 6.1**.

Table 6.1 : Evaluation Scenarios

	Scenario 1	Scenario 2
Vehicle operating costs savings		
1. Cars	J\$ 1.67/km	J\$1.67/km
2. Trucks	J\$ 9.05/km	J\$ 9.05/km
Time values		
• Work	J\$ 125/h	J\$ 79.45/h
• Commute	J\$ 107.5/h	J\$ 57.22/h
• Leisure	J\$ 75/h	J\$ 15.93/h
Pollutant savings	J\$ 0.05/veh-km	J\$ 0.05/veh-km
Maintenance savings	J\$ 172 M/pa	J\$ 172 M/pa
Accident savings	J\$ 47 M/pa	J\$ 47 M/pa

It is considered that time savings are proportionate to vehicle kilometres travelled on the highway.

With these assumptions the results are as follows:

Scenario 1

	Phase 1	Phase 2	Total
Internal rate of return at a 10% discount rate	19.92 %	9 %	14.15 %
Benefits to costs ratio	2.92	0.85	1.71
Net present value	US\$ 440,668,186	US\$ (36,325,926)	US\$ 361,372,152

Scenario 2

	Total
Internal rate of return at a 10% discount rate	11.41 %
Benefits to costs ratio	1.21
Net present value	US\$ 114,251,467

Based on the best estimates of benefits and costs, Phase 1 of the Highway 2000 project is economically justified with a benefit to cost ratio greater than 2.0. Although Phase 2 would not be economically justified as a stand-alone project (BCR < 1.0), the entire project (Phases 1 and 2) is economically justified (BCR >1.0) as currently planned.

Travel time savings and vehicle operation costs savings represent nearly 90% of total projected benefits.

A project that is economically justified is not necessarily financially feasible. The decision of a government to commit financial resources to a project should be made in the context of the economic aspects of other competing projects and on the broader development policies of the country.

The economics of the Highway 2000 project could most directly be improved by reducing the costs. The most likely opportunities for cost savings that do not generate a coincident reduction in benefits will be found in Phase 2. It is recommended that some consideration be given to the optimisation of Phase 2 if financial resources are scarce.

BIBLIOGRAPHY

Extract from *Offering Circular Memorandum*. June 1999.

DEPARTMENT OF STATISTICS. 1972. *The Labour Force*.

GOVERNMENT OF JAMAICA, MINISTRY OF CONSTRUCTION (WORKS).
November 1993. *Road Planning Unit*. Kingston(Jamaica).

GOVERNMENT OF JAMAICA. April 1996. *National Industrial Policy : A Strategic Plan for Growth and Development*.

JAMAICA PROMOTIONS CORPORATION (JAMPRO). September 1999. *Jamaica : The Premier Location for Business*.

JEFFERSON, Owen. 1972. *The Post-War Economic Development of Jamaica*. West Indies (Jamaica): Institute of Social and Economic Research, University of the West Indies.

LAMARRE VALOIS INTERNATIONAL LIMITED. December 1968. *Jamaica Transportation Survey Works: Work Outline – 6 December 1968 – Revised 13 January 1969*. Kingston (Jamaica).

LAMARRE VALOIS INTERNATIONAL LIMITED. June 1970. *Jamaica Transportation Survey : Final Report*. Kingston (Jamaica) : Government of Jamaica, Ministry of Communications and Works.

LAMARRE VALOIS INTERNATIONAL LIMITED. February 1972. *Jamaica Transportation Survey : Stage II – Inception Report*. Kingston (Jamaica) : Government of Jamaica, Ministry of Communications and Works.

LAMARRE VALOIS INTERNATIONAL LIMITED. June 1972a. *Jamaica Transportation Survey: Stage II – Interim Report*. Vol.1. Kingston (Jamaica): Government of Jamaica, Ministry of Works.

LAMARRE VALOIS INTERNATIONAL LIMITED. June 1972b. *Jamaica Transportation Survey: Stage II – Interim Report*. Vol. 2. Kingston (Jamaica) : Government of Jamaica, Ministry of Works.

MILLETTE, G. March 1969. *Jamaica Transportation Survey : Draft Report – Agriculture*. Kingston (Jamaica) : Government of Jamaica, Ministry of Communications and Works.

NATIONAL INVESTMENT BANK OF JAMAICA LIMITED. 1995. *Information Memorandum on the Jamaica Railway Corporation*. Kingston (Jamaica).

OFFICE OF THE PRIME MINISTER. September 10, 1999. *Jamaica 2000 : Millennium Projects – Private and Confidential - Draft and Preliminary.*

O’SULLIVAN & GRAHAM. March 1995. *Northern Coastal Highway Improvement Sub-Project : Economic Feasibility Study - Draft Report.* Kingston (Jamaica) : Government of Jamaica, Ministry of Local Government and Works.

PHYSICAL PLANNING UNIT, TOWN PLANNING DEPARTMENT. October 1971. *A National Physical Plan for Jamaica.* Kingston (Jamaica) : Ministry of Finance and Planning.

PLANNING INSTITUTE OF JAMAICA. 1996. *Economic and Social Survey Jamaica 1995.* Kingston (Jamaica).

TECHNICAL ENTERPRISES LIMITED. July 1999. *Clarendon Park to Williamsfield Highway : Feasibility Study.* Kingston (Jamaica):Government of Jamaica, Ministry of Transport and Works.

THE STATISTICAL INSTITUTE OF JAMAICA. 1994-1995. *Employment, Earnings and Hours Worked in Large Establishments.* Kingston (Jamaica).

THE STATISTICAL INSTITUTE OF JAMAICA. 1995a. *Statistical Yearbook of Jamaica 1995.* Kingston (Jamaica).

THE STATISTICAL INSTITUTE OF JAMAICA. 1995b. *The Labour Force 1995.* Kingston (Jamaica).

THE STATISTICAL INSTITUTE OF JAMAICA. 1996a. *Consumer Price Indices: Annual Review 1995.* Kingston (Jamaica).

THE STATISTICAL INSTITUTE OF JAMAICA. 1996b. *Jamaica Survey of Living Conditions: Report 1994.* Kingston (Jamaica).

THE STATISTICAL INSTITUTE OF JAMAICA. 1998. *National Income and Product : Preliminary Report.* Kingston (Jamaica).

THE STATISTICAL INSTITUTE OF JAMAICA. 1999. *Demographic Statistics 1998.* Kingston (Jamaica).

WEISS, JOHN. July 1999. *National Economic Parameters and Economic Analysis for the Public Sector Investment Programme in Jamaica.* Bradford (United Kingdom):Planning Institute of Jamaica.

WILBUR SMITH ASSOCIATES. 1993a. *Jamaica Transport Sector Study - Strategic Transport Plan for Jamaica : Summary Report and Action Plans*. Columbia SC (USA): Government of Jamaica, Ministry of Water and Transport.

WILBUR SMITH ASSOCIATES. 1993b. *Strategic Transport Plan for Jamaica : Draft Final Report of the Jamaica Transport Sector Study*. Kingston (Jamaica) : Government of Jamaica, Ministry of Water and Transport.

WILBUR SMITH ASSOCIATES. June 1993. *Task 4 Report – The Jamaica Railway: Proposed Actions. Strategies and Investments*.

VOURANIS. Antonis CTA. *Executive Summary of the Modernisation Action Program (MAP) for the Jamaican Apparel and Fashion Industry (JAFI)*. The 2000 and beyond series.

APPENDIX A

Evaluation of the net present value(NPV) and of the internal rate of return(IRR)

ADEC Inc.

Scenario 1

Project:	9908 - JAMAICA HYW 2000	Base year:	2000	Net present value (NPV) :	361372152	Ratio Benefits/Costs :	1.71	Rate of exchange	40J\$/US\$
Length	total 233kms	Discount rate:	10.00%	Internal rate of return :	14.15%	Salvage value :	606400000		

YEAR	BENEFITS									COSTS			DIFFERENCES		
	Benefits related to cars			Benefits related to trucks			Reduction in operation & Maintenance Costs	Reduction of Accident costs	Total Benefits	Construction Costs Economic costs	Operation & Maintenance Costs Economic costs	Total Costs Economic costs	Savings - Costs	Salvage Value	Savings - Costs +Salvage value
	Savings in VOC Total	Time savings Total	Savings in Pollutants Total	Savings in VOC Total	Pollutants Savings										
	Cars / Trucks	Cars	Cars / Trucks	Trucks											
2000							0	0	0	\$47,500,000	\$0	\$47,500,000	-\$47,500,000	\$0	-\$47,500,000
2001							0	0	0	\$47,500,000	\$0	\$47,500,000	-\$47,500,000	\$0	-\$47,500,000
2002							0	0	0	\$91,368,000	\$0	\$91,368,000	-\$91,368,000	\$0	-\$91,368,000
2003							0	0	0	\$196,668,000	\$615,888	\$197,283,888	-\$197,283,888	\$0	-\$197,283,888
2004							0	0	0	\$186,381,000	\$1,953,795	\$188,334,795	-\$188,334,795	\$0	-\$188,334,795
2005							0	0	0	\$139,806,000	\$3,216,915	\$143,022,915	-\$143,022,915	\$0	-\$143,022,915
2006	\$29,590,640	\$41,799,713	\$815,285	\$2,056,643			\$4,300,000	\$1,181,607	\$79,743,888	\$3,216,915	\$3,216,915	\$76,526,973	\$0	\$76,526,973	
2007	\$33,984,487	\$47,815,006	\$896,814	\$2,204,065			\$4,300,000	\$1,228,871	\$90,429,243	\$3,216,915	\$3,216,915	\$87,212,328	\$0	\$87,212,328	
2008	\$38,875,111	\$54,505,242	\$986,495	\$2,363,900			\$4,300,000	\$1,278,026	\$102,308,773	\$3,216,915	\$3,216,915	\$99,091,858	\$0	\$99,091,858	
2009	\$41,077,510	\$57,561,351	\$1,035,820	\$2,471,596			\$4,300,000	\$1,329,147	\$107,775,423	\$3,216,915	\$3,216,915	\$104,558,508	\$0	\$104,558,508	
2010	\$43,400,375	\$60,783,500	\$1,087,611	\$2,584,256			\$4,300,000	\$1,382,313	\$113,538,055	\$3,216,915	\$3,216,915	\$110,321,140	\$0	\$110,321,140	
2011	\$45,850,142	\$64,180,519	\$1,141,991	\$2,702,113			\$4,300,000	\$1,437,606	\$119,612,372	\$3,216,915	\$3,216,915	\$116,395,457	\$0	\$116,395,457	
2012	\$48,433,588	\$67,761,704	\$1,199,091	\$2,825,409			\$4,300,000	\$1,495,110	\$126,014,902	\$3,216,915	\$3,216,915	\$122,797,987	\$0	\$122,797,987	
2013	\$51,157,844	\$71,536,834	\$1,259,045	\$2,954,397			\$4,300,000	\$1,554,914	\$132,763,034	\$3,216,915	\$3,216,915	\$129,546,119	\$0	\$129,546,119	
2014	\$54,030,416	\$75,516,202	\$1,321,998	\$3,089,343			\$4,300,000	\$1,617,111	\$139,875,069	\$3,216,915	\$3,216,915	\$136,658,154	\$0	\$136,658,154	
2015	\$57,059,203	\$79,710,639	\$1,388,097	\$3,230,525			\$4,300,000	\$1,681,795	\$147,370,261	\$3,216,915	\$3,216,915	\$144,153,346	\$0	\$144,153,346	
2016	\$59,341,572	\$82,899,065	\$1,443,621	\$3,359,746			\$4,300,000	\$1,749,067	\$153,093,071	\$3,216,915	\$3,216,915	\$149,876,156	\$0	\$149,876,156	
2017	\$61,715,234	\$86,215,027	\$1,501,366	\$3,494,136			\$4,300,000	\$1,819,030	\$159,044,794	\$3,216,915	\$3,216,915	\$155,827,879	\$0	\$155,827,879	
2018	\$64,183,844	\$89,663,629	\$1,561,421	\$3,633,901			\$4,300,000	\$1,891,791	\$165,234,586	\$3,216,915	\$3,216,915	\$162,017,671	\$0	\$162,017,671	
2019	\$66,751,198	\$93,250,174	\$1,623,878	\$3,779,258			\$4,300,000	\$1,967,463	\$171,671,969	\$3,216,915	\$3,216,915	\$168,455,054	\$0	\$168,455,054	
2020	\$69,421,245	\$96,980,181	\$1,688,833	\$3,930,428			\$4,300,000	\$2,046,161	\$178,366,848	\$3,216,915	\$3,216,915	\$175,149,933	\$0	\$175,149,933	
2021	\$72,198,095	\$100,859,388	\$1,756,386	\$4,087,645			\$4,300,000	\$2,128,007	\$185,329,522	\$3,216,915	\$3,216,915	\$182,112,607	\$0	\$182,112,607	
2022	\$75,086,019	\$104,893,763	\$1,826,642	\$4,251,151			\$4,300,000	\$2,213,128	\$192,570,703	\$3,216,915	\$3,216,915	\$189,353,788	\$0	\$189,353,788	
2023	\$78,089,460	\$109,089,514	\$1,899,707	\$4,421,197			\$4,300,000	\$2,301,653	\$200,101,531	\$3,216,915	\$3,216,915	\$196,884,616	\$0	\$196,884,616	
2024	\$81,213,038	\$113,453,094	\$1,975,695	\$4,598,045			\$4,300,000	\$2,393,719	\$207,933,592	\$3,216,915	\$3,216,915	\$204,716,677	\$0	\$204,716,677	
2025	\$84,461,560	\$117,991,218	\$2,054,723	\$4,781,966			\$4,300,000	\$2,489,468	\$216,078,936	\$3,216,915	\$3,216,915	\$212,862,021	\$0	\$212,862,021	
2026	\$87,840,022	\$122,710,867	\$2,136,912	\$4,973,245			\$4,300,000	\$2,589,046	\$224,550,093	\$3,216,915	\$3,216,915	\$221,333,178	\$0	\$221,333,178	
2027	\$91,353,623	\$127,619,302	\$2,222,389	\$5,172,175			\$4,300,000	\$2,692,608	\$233,360,097	\$3,216,915	\$3,216,915	\$230,143,182	\$0	\$230,143,182	
2028	\$95,007,768	\$132,724,074	\$2,311,284	\$5,379,062			\$4,300,000	\$2,800,313	\$242,522,501	\$3,216,915	\$3,216,915	\$239,305,586	\$0	\$239,305,586	
2029	\$98,808,079	\$138,033,037	\$2,403,736	\$5,594,224			\$4,300,000	\$2,912,325	\$252,051,401	\$3,216,915	\$3,216,915	\$248,834,486	\$0	\$248,834,486	
2030	\$102,760,402	\$143,554,358	\$2,499,885	\$5,817,993			\$4,300,000	\$3,028,818	\$261,961,457	\$3,216,915	\$3,216,915	\$258,744,542	\$0	\$258,744,542	
2031	\$106,870,818	\$149,296,532	\$2,599,880	\$6,050,713			\$4,300,000	\$3,149,971	\$272,267,915	\$3,216,915	\$3,216,915	\$269,051,000	\$0	\$269,051,000	
2032	\$111,145,651	\$155,268,394	\$2,703,876	\$6,292,742			\$4,300,000	\$3,275,970	\$282,986,631	\$3,216,915	\$3,216,915	\$279,769,716	\$0	\$279,769,716	
2033	\$115,591,477	\$161,479,130	\$2,812,031	\$6,544,451			\$4,300,000	\$3,407,008	\$294,134,097	\$3,216,915	\$3,216,915	\$290,917,182	\$0	\$290,917,182	
2034	\$120,215,136	\$167,938,295	\$2,924,512	\$6,806,229			\$4,300,000	\$3,543,289	\$305,727,461	\$3,216,915	\$3,216,915	\$302,510,546	\$0	\$302,510,546	
2035	\$125,023,741	\$174,655,826	\$3,041,492	\$7,078,478			\$4,300,000	\$3,685,020	\$317,784,559	\$3,216,915	\$3,216,915	\$314,567,644	\$0	\$314,567,644	
2036	\$130,024,691	\$181,642,060	\$3,163,152	\$7,361,618			\$4,300,000	\$3,832,421	\$330,323,941	\$3,216,915	\$3,216,915	\$327,107,026	\$0	\$327,107,026	
2037	\$135,225,678	\$188,907,742	\$3,289,678	\$7,656,082			\$4,300,000	\$3,985,718	\$343,364,899	\$3,216,915	\$3,216,915	\$340,147,984	\$0	\$340,147,984	
2038	\$140,634,706	\$196,464,052	\$3,421,265	\$7,962,326			\$4,300,000	\$4,145,147	\$356,927,495	\$3,216,915	\$3,216,915	\$353,710,580	\$0	\$353,710,580	
2039	\$146,260,094	\$204,322,614	\$3,558,116	\$8,280,819			\$4,300,000	\$4,310,953	\$371,032,595	\$3,216,915	\$3,216,915	\$367,815,680	\$0	\$367,815,680	
2040	\$152,110,498	\$212,495,518	\$3,700,441	\$8,612,051			\$4,300,000	\$4,483,391	\$385,701,899	\$3,216,915	\$3,216,915	\$382,484,984	\$0	\$382,484,984	
2041	\$158,194,918	\$220,995,339	\$3,848,458	\$8,956,533			\$4,300,000	\$4,662,726	\$400,957,974	\$3,216,915	\$3,216,915	\$397,741,059	\$0	\$397,741,059	
2042	\$164,522,714	\$229,835,152	\$4,002,397	\$9,314,795			\$4,300,000	\$4,849,235	\$416,824,293	\$3,216,915	\$3,216,915	\$413,607,378	\$0	\$413,607,378	
2043	\$171,103,623	\$239,028,559	\$4,162,492	\$9,687,387			\$4,300,000	\$5,043,205	\$433,325,265	\$3,216,915	\$3,216,915	\$430,108,350	\$0	\$430,108,350	
2044	\$177,947,768	\$248,589,701	\$4,328,992	\$10,074,882			\$4,300,000	\$5,244,933	\$450,486,276	\$3,216,915	\$3,216,915	\$447,269,361	\$0	\$447,269,361	
2045	\$185,065,678	\$258,533,289	\$4,502,152	\$10,477,877			\$4,300,000	\$5,454,730	\$468,333,727	\$3,216,915	\$3,216,915	\$465,116,812	\$0	\$465,116,812	
2046	\$192,468,306	\$268,874,621	\$4,682,238	\$10,896,992			\$4,300,000	\$5,672,920	\$486,895,076	\$3,216,915	\$3,216,915	\$483,678,161	\$0	\$483,678,161	
2047	\$200,167,038	\$279,629,605	\$4,869,527	\$11,332,872			\$4,300,000	\$5,899,836	\$506,198,879	\$3,216,915	\$3,216,915	\$502,981,964	\$0	\$502,981,964	
2048	\$208,173,719	\$290,814,790	\$5,064,308	\$11,786,187			\$4,300,000	\$6,135,830	\$526,274,834	\$3,216,915	\$3,216,915	\$523,057,919	\$0	\$523,057,919	
2049	\$216,500,668	\$302,447,381	\$5,266,881	\$12,257,634			\$4,300,000	\$6,381,263	\$547,153,827	\$3,216,915	\$3,216,915	\$543,936,912	\$0	\$543,936,912	
2050	\$225,160,695	\$314,545,276	\$5,477,556	\$12,747,940			\$4,300,000	\$6,636,514	\$568,867,981	\$3,216,915	\$3,216,915	\$565,651,066	\$606,400,000	\$1,172,051,066	

Present value of salvage \$6,875,479.48

Present values of savings: \$ 855,911,690

Present values of costs: \$501,415,018

Total in present values: \$359,192,717

Evaluation of the net present value(NPV) and of the internal rate of return(IRR)

ADEC Inc.

Scenario 1.1

Project:	9908 - JAMAICA HYW 2000	Base year:	2000	Net present value (NPV) :	440668186	Ratio Benefits/Costs :	2.92	Rate of exchange	40J\$/US\$
Length	total 85kms	Discount rate:	10.00%	Internal rate of return :	19.92%	Salvage value :	188000000		

YEAR	BENEFITS									COSTS			DIFFERENCES		
	Benefits related to cars			Benefits related to trucks			Reduction in operation & Maintenance Costs	Reduction of Accident costs	Total Benefits	Construction Costs Economic costs	Operation & Maintenance Costs Economic costs	Total Costs Economic costs	Savings - Costs	Salvage Value	Savings - Costs +Salvage value
	Savings in VOC Section 1	Time savings Section 1	Savings in Pollutants Section 1	Savings in VOC Section 1	Time savings Section 1	Pollutants Savings									

	Cars / Trucks	Cars	Cars / Trucks	Trucks											
2000						\$0	\$0	\$0	\$47,500,000	\$0	\$47,500,000	-\$47,500,000	\$0	-\$47,500,000	
2001						\$0	\$0	\$0	\$47,500,000	\$0	\$47,500,000	-\$47,500,000	\$0	-\$47,500,000	
2002						\$0	\$0	\$0	\$91,368,000	\$0	\$91,368,000	-\$91,368,000	\$0	-\$91,368,000	
2003						\$0	\$0	\$0	\$98,982,000	\$615,888	\$99,597,888	-\$99,597,888	\$0	-\$99,597,888	
2004	\$13,595,749	\$25,321,868	\$131,814	\$1,521,226	\$1,548,000	\$756,228	\$42,118,657	\$1,292,265	\$1,292,265	\$40,826,392	\$40,826,392	\$0	\$40,826,392		
2005	\$15,771,004	\$29,216,196	\$474,348	\$1,628,991	\$1,548,000	\$786,478	\$48,638,540	\$1,292,265	\$1,292,265	\$47,346,275	\$47,346,275	\$0	\$47,346,275		
2006	\$18,196,483	\$33,554,443	\$521,782	\$1,745,759	\$1,548,000	\$817,937	\$56,384,405	\$1,292,265	\$1,292,265	\$55,092,140	\$55,092,140	\$0	\$55,092,140		
2007	\$20,898,445	\$38,383,180	\$573,961	\$1,872,358	\$1,548,000	\$850,654	\$64,126,599	\$1,292,265	\$1,292,265	\$62,834,334	\$62,834,334	\$0	\$62,834,334		
2008	\$23,905,896	\$43,753,723	\$631,357	\$2,009,698	\$1,548,000	\$884,680	\$72,733,354	\$1,292,265	\$1,292,265	\$71,441,089	\$71,441,089	\$0	\$71,441,089		
2009	\$25,260,243	\$46,206,994	\$662,925	\$2,101,534	\$1,548,000	\$920,068	\$76,699,764	\$1,292,265	\$1,292,265	\$75,407,499	\$75,407,499	\$0	\$75,407,499		
2010	\$26,686,669	\$48,793,553	\$696,071	\$2,197,617	\$1,548,000	\$956,870	\$80,880,779	\$1,292,265	\$1,292,265	\$79,588,514	\$79,588,514	\$0	\$79,588,514		
2011	\$28,195,132	\$51,520,488	\$730,874	\$2,298,143	\$1,548,000	\$995,145	\$85,287,783	\$1,292,265	\$1,292,265	\$83,995,518	\$83,995,518	\$0	\$83,995,518		
2012	\$29,783,801	\$54,395,260	\$767,418	\$2,403,322	\$1,548,000	\$1,034,951	\$89,932,751	\$1,292,265	\$1,292,265	\$88,640,486	\$88,640,486	\$0	\$88,640,486		
2013	\$31,459,059	\$57,425,721	\$805,789	\$2,513,370	\$1,548,000	\$1,076,349	\$94,828,287	\$1,292,265	\$1,292,265	\$93,536,022	\$93,536,022	\$0	\$93,536,022		
2014	\$33,225,522	\$60,620,132	\$846,078	\$2,628,516	\$1,548,000	\$1,119,403	\$99,987,652	\$1,292,265	\$1,292,265	\$98,695,387	\$98,695,387	\$0	\$98,695,387		
2015	\$35,088,050	\$63,987,189	\$888,382	\$2,748,999	\$1,548,000	\$1,164,179	\$105,424,799	\$1,292,265	\$1,292,265	\$104,132,534	\$104,132,534	\$0	\$104,132,534		
2016	\$36,491,572	\$66,546,677	\$923,918	\$2,858,959	\$1,548,000	\$1,210,746	\$109,579,871	\$1,292,265	\$1,292,265	\$108,287,606	\$108,287,606	\$0	\$108,287,606		
2017	\$37,951,235	\$69,208,544	\$960,874	\$2,973,317	\$1,548,000	\$1,259,176	\$113,901,146	\$1,292,265	\$1,292,265	\$112,608,881	\$112,608,881	\$0	\$112,608,881		
2018	\$39,469,284	\$71,976,886	\$999,309	\$3,092,250	\$1,548,000	\$1,309,543	\$118,395,272	\$1,292,265	\$1,292,265	\$117,103,007	\$117,103,007	\$0	\$117,103,007		
2019	\$41,048,055	\$74,855,961	\$1,039,282	\$3,215,940	\$1,548,000	\$1,361,925	\$123,069,163	\$1,292,265	\$1,292,265	\$121,776,898	\$121,776,898	\$0	\$121,776,898		
2020	\$42,689,978	\$77,850,200	\$1,080,853	\$3,344,577	\$1,548,000	\$1,416,402	\$127,930,009	\$1,292,265	\$1,292,265	\$126,637,744	\$126,637,744	\$0	\$126,637,744		
2021	\$44,397,577	\$80,964,207	\$1,124,087	\$3,478,361	\$1,548,000	\$1,473,058	\$132,985,290	\$1,292,265	\$1,292,265	\$131,693,025	\$131,693,025	\$0	\$131,693,025		
2022	\$46,173,480	\$84,202,776	\$1,169,051	\$3,617,495	\$1,548,000	\$1,531,980	\$138,242,781	\$1,292,265	\$1,292,265	\$136,950,516	\$136,950,516	\$0	\$136,950,516		
2023	\$48,020,419	\$87,570,887	\$1,215,813	\$3,762,195	\$1,548,000	\$1,593,259	\$143,710,572	\$1,292,265	\$1,292,265	\$142,418,307	\$142,418,307	\$0	\$142,418,307		
2024	\$49,941,236	\$91,073,722	\$1,264,445	\$3,912,683	\$1,548,000	\$1,656,990	\$149,397,075	\$1,292,265	\$1,292,265	\$148,104,810	\$148,104,810	\$0	\$148,104,810		
2025	\$51,938,885	\$94,716,671	\$1,315,023	\$4,069,190	\$1,548,000	\$1,723,269	\$155,311,038	\$1,292,265	\$1,292,265	\$154,018,773	\$154,018,773	\$0	\$154,018,773		
2026	\$54,016,441	\$98,505,338	\$1,367,624	\$4,231,957	\$1,548,000	\$1,792,200	\$161,461,560	\$1,292,265	\$1,292,265	\$160,169,295	\$160,169,295	\$0	\$160,169,295		
2027	\$56,177,098	\$102,445,552	\$1,422,329	\$4,401,236	\$1,548,000	\$1,863,888	\$167,858,102	\$1,292,265	\$1,292,265	\$166,565,837	\$166,565,837	\$0	\$166,565,837		
2028	\$58,424,182	\$106,543,374	\$1,479,222	\$4,577,285	\$1,548,000	\$1,938,444	\$174,510,506	\$1,292,265	\$1,292,265	\$173,218,241	\$173,218,241	\$0	\$173,218,241		
2029	\$60,761,149	\$110,805,109	\$1,538,391	\$4,760,377	\$1,548,000	\$2,015,981	\$181,429,007	\$1,292,265	\$1,292,265	\$180,136,742	\$180,136,742	\$0	\$180,136,742		
2030	\$63,191,595	\$115,237,313	\$1,599,926	\$4,950,792	\$1,548,000	\$2,096,621	\$188,624,247	\$1,292,265	\$1,292,265	\$187,331,982	\$187,331,982	\$0	\$187,331,982		
2031	\$65,719,259	\$119,846,805	\$1,663,923	\$5,148,823	\$1,548,000	\$2,180,485	\$196,107,297	\$1,292,265	\$1,292,265	\$194,815,032	\$194,815,032	\$0	\$194,815,032		
2032	\$68,348,030	\$124,640,678	\$1,730,480	\$5,354,776	\$1,548,000	\$2,267,705	\$203,889,669	\$1,292,265	\$1,292,265	\$202,597,404	\$202,597,404	\$0	\$202,597,404		
2033	\$71,081,951	\$129,626,305	\$1,799,700	\$5,568,967	\$1,548,000	\$2,358,413	\$211,983,335	\$1,292,265	\$1,292,265	\$210,691,070	\$210,691,070	\$0	\$210,691,070		
2034	\$73,925,229	\$134,811,357	\$1,871,688	\$5,791,726	\$1,548,000	\$2,452,750	\$220,400,749	\$1,292,265	\$1,292,265	\$219,108,484	\$219,108,484	\$0	\$219,108,484		
2035	\$76,882,238	\$140,203,811	\$1,946,555	\$6,023,395	\$1,548,000	\$2,550,860	\$229,154,859	\$1,292,265	\$1,292,265	\$227,862,594	\$227,862,594	\$0	\$227,862,594		
2036	\$79,957,527	\$145,811,964	\$2,024,417	\$6,264,331	\$1,548,000	\$2,652,894	\$238,259,133	\$1,292,265	\$1,292,265	\$236,966,868	\$236,966,868	\$0	\$236,966,868		
2037	\$83,155,829	\$151,644,442	\$2,105,394	\$6,514,904	\$1,548,000	\$2,759,010	\$247,727,578	\$1,292,265	\$1,292,265	\$246,435,313	\$246,435,313	\$0	\$246,435,313		
2038	\$86,482,062	\$157,710,220	\$2,189,610	\$6,775,500	\$1,548,000	\$2,869,370	\$257,574,762	\$1,292,265	\$1,292,265	\$256,282,497	\$256,282,497	\$0	\$256,282,497		
2039	\$89,941,344	\$164,018,629	\$2,277,194	\$7,046,520	\$1,548,000	\$2,984,145	\$267,815,832	\$1,292,265	\$1,292,265	\$266,523,567	\$266,523,567	\$0	\$266,523,567		
2040	\$93,538,998	\$170,579,374	\$2,368,282	\$7,328,381	\$1,548,000	\$3,103,511	\$278,466,545	\$1,292,265	\$1,292,265	\$277,174,280	\$277,174,280	\$0	\$277,174,280		
2041	\$97,280,558	\$177,402,549	\$2,463,013	\$7,621,516	\$1,548,000	\$3,227,651	\$289,543,287	\$1,292,265	\$1,292,265	\$288,251,022	\$288,251,022	\$0	\$288,251,022		
2042	\$101,171,780	\$184,498,651	\$2,561,534	\$7,926,377	\$1,548,000	\$3,356,757	\$301,063,099	\$1,292,265	\$1,292,265	\$299,770,834	\$299,770,834	\$0	\$299,770,834		
2043	\$105,218,651	\$191,878,597	\$2,663,995	\$8,243,432	\$1,548,000	\$3,491,027	\$313,043,703	\$1,292,265	\$1,292,265	\$311,751,438	\$311,751,438	\$0	\$311,751,438		
2044	\$109,427,397	\$199,553,741	\$2,770,555	\$8,573,169	\$1,548,000	\$3,630,669	\$325,503,531	\$1,292,265	\$1,292,265	\$324,211,266	\$324,211,266	\$0	\$324,211,266		
2045	\$113,804,493	\$207,535,890	\$2,881,377	\$8,916,096	\$1,548,000	\$3,775,895	\$338,461,752	\$1,292,265	\$1,292,265	\$337,169,487	\$337,169,487	\$0	\$337,169,487		
2046	\$118,356,673	\$215,837,326	\$2,996,632	\$9,272,740	\$1,548,000	\$3,926,931	\$351,938,302	\$1,292,265	\$1,292,265	\$350,646,037	\$350,646,037	\$0	\$350,646,037		
2047	\$123,090,940	\$224,470,819	\$3,116,497	\$9,643,649	\$1,548,000	\$4,084,008	\$365,953,914	\$1,292,265	\$1,292,265	\$364,661,649	\$364,661,649	\$0	\$364,661,649		
2048	\$128,014,578	\$233,449,652	\$3,241,157	\$10,029,395	\$1,548,000	\$4,247,369	\$380,530,151	\$1,292,265	\$1,292,265	\$379,237,886	\$379,237,886	\$0	\$379,237,886		
2049	\$133,135,161	\$242,787,638	\$3,370,804	\$10,430,571	\$1,548,000	\$4,417,263	\$395,689,437	\$1,292,265	\$1,292,265	\$394,397,172	\$394,397,172	\$0	\$394,397,172		
2050	\$138,460,567	\$252,499,143	\$3,505,636	\$10,847,794	\$1,548,000	\$4,593,954	\$411,455,094	\$1,292,265	\$1,292,265	\$410,162,829	\$188,000,000	\$598,162,829	\$188,000,000	\$598,162,829	

Present value of salvage \$2,131,580.05

Present values of savings: \$666,373,720

Present values of costs: \$227,837,114

Total in present values: \$439,992,504

Evaluation of the net present value(NPV) and of the internal rate of return(IRR)

ADEC Inc.

Scenario 1.2

Project:	9908 - JAMAICA HYW 2000	Base year:	2000	Net present value (NPV) :	-36325926	Ratio Benefits/Costs :	0.85	Rate of exchange	40J\$/US\$
Length	total 148kms	Discount rate:	10.00%	Internal rate of return :	9.00%	Salvage value :	418400000		

YEAR	BENEFITS							COSTS			DIFFERENCES				
	Benefits related to cars			Benefits related to trucks			Reduction in operation & Maintenance Costs	Reduction of Accident costs	Total Benefits	Construction Costs Economic costs	Operation & Maintenance Costs Economic costs	Total Costs Economic costs	Savings - Costs	Salvage Value	Savings - Costs +Salvage value
	Savings in VOC Section 2	Time savings Section 2	Savings in Pollutants Section 2	Savings in VOC	Time savings Section 2	Pollutants Savings									
	Cars / Trucks	Cars	Cars / Trucks		Trucks										
2000							\$ -	\$ -	\$ -		\$ -	\$ -	\$ -	\$ -	\$ -
2001							\$ -	\$ -	\$ -		\$ -	\$ -	\$ -	\$ -	\$ -
2002							\$ -	\$ -	\$ -		\$ -	\$ -	\$ -	\$ -	\$ -
2003							\$ -	\$ -	\$ -		\$ -	\$ -	\$ -	\$ -	\$ -
2004							\$ -	\$ -	\$ -	\$ 97,443,000	\$ 97,443,000	\$ 97,443,000	\$ (97,443,000)	\$ -	\$ (97,443,000)
2005							\$ -	\$ -	\$ -	\$ 186,381,000	\$ 186,381,000	\$ 186,996,888	\$ (186,996,888)	\$ -	\$ (186,996,888)
2006	\$ 11,368,987	\$ 7,602,804	\$ 293,503		\$ 362,492		\$ 2,752,000	\$ 425,379	\$ 22,805,164	\$ 139,806,000	\$ 1,926,850	\$ 141,732,850	\$ (141,732,850)	\$ -	\$ (141,732,850)
2007	\$ 13,057,143	\$ 8,731,727	\$ 322,853		\$ 388,476		\$ 2,752,000	\$ 442,394	\$ 25,694,592		\$ 2,875,977	\$ 2,875,977	\$ 19,929,187	\$ -	\$ 19,929,187
2008	\$ 14,936,164	\$ 9,988,288	\$ 355,138		\$ 416,647		\$ 2,752,000	\$ 460,089	\$ 28,908,327		\$ 2,875,977	\$ 2,875,977	\$ 22,818,615	\$ -	\$ 22,818,615
2009	\$ 15,782,345	\$ 10,554,157	\$ 372,895		\$ 435,629		\$ 2,752,000	\$ 478,493	\$ 30,375,519		\$ 2,875,977	\$ 2,875,977	\$ 26,032,350	\$ -	\$ 26,032,350
2010	\$ 16,674,810	\$ 11,150,977	\$ 391,540		\$ 455,486		\$ 2,752,000	\$ 497,633	\$ 31,922,446		\$ 2,875,977	\$ 2,875,977	\$ 27,499,542	\$ -	\$ 27,499,542
2011	\$ 17,616,033	\$ 11,780,402	\$ 411,117		\$ 476,259		\$ 2,752,000	\$ 517,538	\$ 33,553,349		\$ 2,875,977	\$ 2,875,977	\$ 29,046,469	\$ -	\$ 29,046,469
2012	\$ 18,608,616	\$ 12,444,174	\$ 431,673		\$ 497,990		\$ 2,752,000	\$ 538,240	\$ 35,272,692		\$ 2,875,977	\$ 2,875,977	\$ 30,677,372	\$ -	\$ 30,677,372
2013	\$ 19,655,299	\$ 13,144,125	\$ 453,256		\$ 520,725		\$ 2,752,000	\$ 559,769	\$ 37,085,174		\$ 2,875,977	\$ 2,875,977	\$ 32,396,715	\$ -	\$ 32,396,715
2014	\$ 20,758,967	\$ 13,882,182	\$ 475,919		\$ 544,510		\$ 2,752,000	\$ 582,160	\$ 38,995,738		\$ 2,875,977	\$ 2,875,977	\$ 34,209,197	\$ -	\$ 34,209,197
2015	\$ 21,922,654	\$ 14,660,377	\$ 499,715		\$ 569,394		\$ 2,752,000	\$ 605,446	\$ 41,009,586		\$ 2,875,977	\$ 2,875,977	\$ 36,119,761	\$ -	\$ 36,119,761
2016	\$ 22,799,560	\$ 15,246,792	\$ 519,704		\$ 592,169		\$ 2,752,000	\$ 629,664	\$ 42,539,889		\$ 2,875,977	\$ 2,875,977	\$ 38,133,609	\$ -	\$ 38,133,609
2017	\$ 23,711,543	\$ 15,856,664	\$ 540,492		\$ 615,856		\$ 2,752,000	\$ 654,851	\$ 44,131,405		\$ 2,875,977	\$ 2,875,977	\$ 39,663,912	\$ -	\$ 39,663,912
2018	\$ 24,660,004	\$ 16,490,930	\$ 562,111		\$ 640,490		\$ 2,752,000	\$ 681,045	\$ 45,786,581		\$ 2,875,977	\$ 2,875,977	\$ 41,255,428	\$ -	\$ 41,255,428
2019	\$ 25,646,404	\$ 17,150,567	\$ 584,596		\$ 666,110		\$ 2,752,000	\$ 708,287	\$ 47,507,964		\$ 2,875,977	\$ 2,875,977	\$ 42,910,604	\$ -	\$ 42,910,604
2020	\$ 26,672,281	\$ 17,836,590	\$ 607,980		\$ 692,754		\$ 2,752,000	\$ 736,618	\$ 49,298,203		\$ 2,875,977	\$ 2,875,977	\$ 44,631,987	\$ -	\$ 44,631,987
2021	\$ 27,739,151	\$ 18,550,054	\$ 632,299		\$ 720,465		\$ 2,752,000	\$ 766,083	\$ 51,160,051		\$ 2,875,977	\$ 2,875,977	\$ 46,422,226	\$ -	\$ 46,422,226
2022	\$ 28,848,717	\$ 19,292,056	\$ 657,591		\$ 749,283		\$ 2,752,000	\$ 796,726	\$ 53,096,373		\$ 2,875,977	\$ 2,875,977	\$ 48,284,074	\$ -	\$ 48,284,074
2023	\$ 30,002,666	\$ 20,063,738	\$ 683,895		\$ 779,254		\$ 2,752,000	\$ 828,595	\$ 55,110,148		\$ 2,875,977	\$ 2,875,977	\$ 50,220,396	\$ -	\$ 50,220,396
2024	\$ 31,202,772	\$ 20,866,288	\$ 711,250		\$ 810,425		\$ 2,752,000	\$ 861,739	\$ 57,204,474		\$ 2,875,977	\$ 2,875,977	\$ 52,234,171	\$ -	\$ 52,234,171
2025	\$ 32,450,883	\$ 21,700,939	\$ 739,700		\$ 842,842		\$ 2,752,000	\$ 896,208	\$ 59,382,573		\$ 2,875,977	\$ 2,875,977	\$ 54,328,497	\$ -	\$ 54,328,497
2026	\$ 33,748,919	\$ 22,568,977	\$ 769,288		\$ 876,555		\$ 2,752,000	\$ 932,057	\$ 61,647,796		\$ 2,875,977	\$ 2,875,977	\$ 56,506,596	\$ -	\$ 56,506,596
2027	\$ 35,098,875	\$ 23,471,736	\$ 800,060		\$ 911,617		\$ 2,752,000	\$ 969,339	\$ 64,003,628		\$ 2,875,977	\$ 2,875,977	\$ 58,771,819	\$ -	\$ 58,771,819
2028	\$ 36,502,830	\$ 24,410,605	\$ 832,062		\$ 948,082		\$ 2,752,000	\$ 1,008,113	\$ 66,453,693		\$ 2,875,977	\$ 2,875,977	\$ 61,127,651	\$ -	\$ 61,127,651
2029	\$ 37,962,944	\$ 25,387,030	\$ 865,345		\$ 986,005		\$ 2,752,000	\$ 1,048,437	\$ 69,001,760		\$ 2,875,977	\$ 2,875,977	\$ 63,577,716	\$ -	\$ 63,577,716
2030	\$ 39,481,461	\$ 26,402,511	\$ 899,959		\$ 1,025,446		\$ 2,752,000	\$ 1,090,375	\$ 71,651,751		\$ 2,875,977	\$ 2,875,977	\$ 66,125,783	\$ -	\$ 66,125,783
2031	\$ 41,060,720	\$ 27,458,611	\$ 935,957		\$ 1,066,464		\$ 2,752,000	\$ 1,133,990	\$ 74,407,741		\$ 2,875,977	\$ 2,875,977	\$ 68,775,774	\$ -	\$ 68,775,774
2032	\$ 42,703,149	\$ 28,556,956	\$ 973,395		\$ 1,109,122		\$ 2,752,000	\$ 1,179,349	\$ 77,273,970		\$ 2,875,977	\$ 2,875,977	\$ 71,531,764	\$ -	\$ 71,531,764
2033	\$ 44,411,274	\$ 29,699,234	\$ 1,012,331		\$ 1,153,487		\$ 2,752,000	\$ 1,226,523	\$ 80,254,849		\$ 2,875,977	\$ 2,875,977	\$ 74,397,993	\$ -	\$ 74,397,993
2034	\$ 46,187,725	\$ 30,887,203	\$ 1,052,824		\$ 1,199,626		\$ 2,752,000	\$ 1,275,584	\$ 83,354,963		\$ 2,875,977	\$ 2,875,977	\$ 77,378,872	\$ -	\$ 77,378,872
2035	\$ 48,035,234	\$ 32,122,691	\$ 1,094,937		\$ 1,247,611		\$ 2,752,000	\$ 1,326,607	\$ 86,579,082		\$ 2,875,977	\$ 2,875,977	\$ 80,478,986	\$ -	\$ 80,478,986
2036	\$ 49,956,644	\$ 33,407,599	\$ 1,138,735		\$ 1,297,516		\$ 2,752,000	\$ 1,379,672	\$ 89,932,165		\$ 2,875,977	\$ 2,875,977	\$ 83,703,105	\$ -	\$ 83,703,105
2037	\$ 51,954,910	\$ 34,743,903	\$ 1,184,284		\$ 1,349,417		\$ 2,752,000	\$ 1,434,858	\$ 93,419,372		\$ 2,875,977	\$ 2,875,977	\$ 87,056,188	\$ -	\$ 87,056,188
2038	\$ 54,033,106	\$ 36,133,659	\$ 1,231,656		\$ 1,403,393		\$ 2,752,000	\$ 1,492,253	\$ 97,046,067		\$ 2,875,977	\$ 2,875,977	\$ 90,543,395	\$ -	\$ 90,543,395
2039	\$ 56,194,430	\$ 37,579,005	\$ 1,280,922		\$ 1,459,529		\$ 2,752,000	\$ 1,551,943	\$ 100,817,829		\$ 2,875,977	\$ 2,875,977	\$ 94,170,090	\$ -	\$ 94,170,090
2040	\$ 58,442,207	\$ 39,082,166	\$ 1,332,159		\$ 1,517,910		\$ 2,752,000	\$ 1,614,021	\$ 104,740,462		\$ 2,875,977	\$ 2,875,977	\$ 97,941,852	\$ -	\$ 97,941,852
2041	\$ 60,779,896	\$ 40,645,452	\$ 1,385,445		\$ 1,578,627		\$ 2,752,000	\$ 1,678,581	\$ 108,820,001		\$ 2,875,977	\$ 2,875,977	\$ 101,864,485	\$ -	\$ 101,864,485
2042	\$ 63,211,092	\$ 42,271,270	\$ 1,440,863		\$ 1,641,772		\$ 2,752,000	\$ 1,745,725	\$ 113,062,721		\$ 2,875,977	\$ 2,875,977	\$ 105,944,024	\$ -	\$ 105,944,024
2043	\$ 65,739,535	\$ 43,962,121	\$ 1,498,497		\$ 1,707,442		\$ 2,752,000	\$ 1,815,554	\$ 117,475,150		\$ 2,875,977	\$ 2,875,977	\$ 110,186,744	\$ -	\$ 110,186,744
2044	\$ 68,369,117	\$ 45,720,606	\$ 1,558,437		\$ 1,775,740		\$ 2,752,000	\$ 1,888,176	\$ 122,064,076		\$ 2,875,977	\$ 2,875,977	\$ 114,599,173	\$ -	\$ 114,599,173
2045	\$ 71,103,881	\$ 47,549,430	\$ 1,620,775		\$ 1,846,770		\$ 2,752,000	\$ 1,963,703	\$ 126,836,559		\$ 2,875,977	\$ 2,875,977	\$ 119,188,099	\$ -	\$ 119,188,099
2046	\$ 73,948,036	\$ 49,451,407	\$ 1,685,606		\$ 1,920,641		\$ 2,752,000	\$ 2,042,251	\$ 131,799,941		\$ 2,875,977	\$ 2,875,977	\$ 123,960,582	\$ -	\$ 123,960,582
2047	\$ 76,905,958	\$ 51,429,464	\$ 1,753,030		\$ 1,997,466		\$ 2,752,000	\$ 2,123,941	\$ 136,961,859		\$ 2,875,977	\$ 2,875,977	\$ 128,923,964	\$ -	\$ 128,923,964
2048	\$ 79,982,196	\$ 53,486,642	\$ 1,823,151		\$ 2,077,365		\$ 2,752,000	\$ 2,208,899	\$ 142,330,253		\$ 2,875,977	\$ 2,875,977	\$ 134,085,882	\$ -	\$ 134,085,882
2049	\$ 83,181,484	\$ 55,626,108	\$ 1,896,077		\$ 2,160,459		\$ 2,752,000	\$ 2,297,255	\$ 147,913,383		\$ 2,875,977	\$ 2,875,977	\$ 139,454,276	\$ -	\$ 139,454,276
2050	\$ 86,508,743	\$ 57,851,152	\$ 1,971,920		\$ 2,246,878		\$ 2,752,000	\$ 2,389,145	\$ 153,719,839		\$ 2,875,977	\$ 2,875,977	\$ 145,037,406	\$ -	\$ 145,037,406

Present value of salvage \$ 4,743,899

Present values of savings: \$237,611,329

Present values of costs: \$278,681,155

Total in present values: \$ (37,829,678)

Evaluation of the net present value(NPV) and of the internal rate of return(IRR)

ADEC Inc.

Scenario 2

Projet:	9908 - JAMAICA HWY 2000
Length	total 233kms

Base year:	2000
Discount rate:	10.00%

Net present value (NPV) :	114251467
Internal rate of return :	11.41%

Ratio Benefits/Costs :	1.21
Salvage value :	606400000

Rate of exchange	40J\$/US\$
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YEAR	BENEFITS							COSTS			DIFFERENCES				
	Benefits related to cars			Benefits related to trucks			Reduction in operation & Maintenance Costs	Reduction of Accident costs	Total Benefits	Construction Costs Economic costs	Operation & Maintenance Costs Economic costs	Total Costs Economic costs	Savings - Costs	Salvage Value	Savings - Costs +Salvage value
	Savings in VOC Total	Time savings (Value 2) Total	Savings in Pollutants Total	Savings in VOC Total	Time savings (Value 2) Total	Pollutants Savings									
	Cars / Trucks	Cars	Cars / Trucks		Trucks										
2000							\$ -	\$ -	\$ -	\$ 47,500,000	\$ -	\$ 47,500,000	\$ (47,500,000)	\$ -	\$ (47,500,000)
2001							\$ -	\$ -	\$ -	\$ 47,500,000	\$ -	\$ 47,500,000	\$ (47,500,000)	\$ -	\$ (47,500,000)
2002							\$ -	\$ -	\$ -	\$ 91,368,000	\$ -	\$ 91,368,000	\$ (91,368,000)	\$ -	\$ (91,368,000)
2003							\$ -	\$ -	\$ -	\$ 196,668,000	\$ 615,888	\$ 197,283,888	\$ (197,283,888)	\$ -	\$ (197,283,888)
2004							\$ -	\$ -	\$ -	\$ 186,381,000	\$ 1,953,795	\$ 188,334,795	\$ (188,334,795)	\$ -	\$ (188,334,795)
2005							\$ -	\$ -	\$ -	\$ 139,806,000	\$ 3,216,915	\$ 143,022,915	\$ (143,022,915)	\$ -	\$ (143,022,915)
2006	\$ 29,590,640	\$ 19,441,193	\$ 815,285		\$ 2,119,293		\$ 4,300,000	\$ 1,181,607	\$ 57,448,018		\$ 3,216,915	\$ 3,216,915	\$ 54,231,103	\$ -	\$ 54,231,103
2007	\$ 33,984,487	\$ 22,238,927	\$ 896,814		\$ 2,272,981		\$ 4,300,000	\$ 1,228,871	\$ 64,922,079		\$ 3,216,915	\$ 3,216,915	\$ 61,705,164	\$ -	\$ 61,705,164
2008	\$ 38,875,111	\$ 25,350,579	\$ 986,495		\$ 2,439,707		\$ 4,300,000	\$ 1,278,026	\$ 73,229,917		\$ 3,216,915	\$ 3,216,915	\$ 70,013,002	\$ -	\$ 70,013,002
2009	\$ 41,077,510	\$ 26,771,986	\$ 1,035,820		\$ 2,551,193		\$ 4,300,000	\$ 1,329,147	\$ 77,065,655		\$ 3,216,915	\$ 3,216,915	\$ 73,848,740	\$ -	\$ 73,848,740
2010	\$ 43,400,375	\$ 28,270,618	\$ 1,087,611		\$ 2,667,833		\$ 4,300,000	\$ 1,382,313	\$ 81,108,750		\$ 3,216,915	\$ 3,216,915	\$ 77,891,835	\$ -	\$ 77,891,835
2011	\$ 45,850,142	\$ 29,850,584	\$ 1,141,991		\$ 2,789,869		\$ 4,300,000	\$ 1,437,606	\$ 85,370,192		\$ 3,216,915	\$ 3,216,915	\$ 82,153,277	\$ -	\$ 82,153,277
2012	\$ 48,433,588	\$ 31,516,205	\$ 1,199,091		\$ 2,917,553		\$ 4,300,000	\$ 1,495,110	\$ 89,861,547		\$ 3,216,915	\$ 3,216,915	\$ 86,644,632	\$ -	\$ 86,644,632
2013	\$ 51,157,844	\$ 33,272,032	\$ 1,259,045		\$ 3,051,148		\$ 4,300,000	\$ 1,554,914	\$ 94,594,983		\$ 3,216,915	\$ 3,216,915	\$ 91,378,068	\$ -	\$ 91,378,068
2014	\$ 54,030,416	\$ 35,122,850	\$ 1,321,998		\$ 3,190,931		\$ 4,300,000	\$ 1,617,111	\$ 99,583,305		\$ 3,216,915	\$ 3,216,915	\$ 96,366,390	\$ -	\$ 96,366,390
2015	\$ 57,059,203	\$ 37,073,697	\$ 1,388,097		\$ 3,337,193		\$ 4,300,000	\$ 1,681,795	\$ 104,839,986		\$ 3,216,915	\$ 3,216,915	\$ 101,623,071	\$ -	\$ 101,623,071
2016	\$ 59,341,572	\$ 38,556,645	\$ 1,443,621		\$ 3,470,681		\$ 4,300,000	\$ 1,749,067	\$ 108,861,586		\$ 3,216,915	\$ 3,216,915	\$ 105,644,671	\$ -	\$ 105,644,671
2017	\$ 61,715,234	\$ 40,098,911	\$ 1,501,366		\$ 3,609,508		\$ 4,300,000	\$ 1,819,030	\$ 113,044,049		\$ 3,216,915	\$ 3,216,915	\$ 109,827,134	\$ -	\$ 109,827,134
2018	\$ 64,183,844	\$ 41,702,867	\$ 1,561,421		\$ 3,753,888		\$ 4,300,000	\$ 1,891,791	\$ 117,393,811		\$ 3,216,915	\$ 3,216,915	\$ 114,176,896	\$ -	\$ 114,176,896
2019	\$ 66,751,198	\$ 43,370,982	\$ 1,623,878		\$ 3,904,044		\$ 4,300,000	\$ 1,967,463	\$ 121,917,564		\$ 3,216,915	\$ 3,216,915	\$ 118,700,649	\$ -	\$ 118,700,649
2020	\$ 69,421,245	\$ 45,105,821	\$ 1,688,833		\$ 4,060,206		\$ 4,300,000	\$ 2,046,161	\$ 126,622,266		\$ 3,216,915	\$ 3,216,915	\$ 123,405,351	\$ -	\$ 123,405,351
2021	\$ 72,198,095	\$ 46,910,054	\$ 1,756,386		\$ 4,222,614		\$ 4,300,000	\$ 2,128,007	\$ 131,515,157		\$ 3,216,915	\$ 3,216,915	\$ 128,298,242	\$ -	\$ 128,298,242
2022	\$ 75,086,019	\$ 48,786,456	\$ 1,826,642		\$ 4,391,518		\$ 4,300,000	\$ 2,213,128	\$ 136,603,763		\$ 3,216,915	\$ 3,216,915	\$ 133,386,848	\$ -	\$ 133,386,848
2023	\$ 78,089,460	\$ 50,737,915	\$ 1,899,707		\$ 4,567,179		\$ 4,300,000	\$ 2,301,653	\$ 141,895,914		\$ 3,216,915	\$ 3,216,915	\$ 138,678,999	\$ -	\$ 138,678,999
2024	\$ 81,213,038	\$ 52,767,431	\$ 1,975,695		\$ 4,749,866		\$ 4,300,000	\$ 2,393,719	\$ 147,399,750		\$ 3,216,915	\$ 3,216,915	\$ 144,182,835	\$ -	\$ 144,182,835
2025	\$ 84,461,560	\$ 54,878,128	\$ 2,054,723		\$ 4,939,861		\$ 4,300,000	\$ 2,489,468	\$ 153,123,740		\$ 3,216,915	\$ 3,216,915	\$ 149,906,825	\$ -	\$ 149,906,825
2026	\$ 87,840,022	\$ 57,073,254	\$ 2,136,912		\$ 5,137,455		\$ 4,300,000	\$ 2,589,046	\$ 159,076,690		\$ 3,216,915	\$ 3,216,915	\$ 155,859,775	\$ -	\$ 155,859,775
2027	\$ 91,353,623	\$ 59,356,184	\$ 2,222,389		\$ 5,342,954		\$ 4,300,000	\$ 2,692,608	\$ 165,267,757		\$ 3,216,915	\$ 3,216,915	\$ 162,050,842	\$ -	\$ 162,050,842
2028	\$ 95,007,768	\$ 61,730,431	\$ 2,311,284		\$ 5,556,672		\$ 4,300,000	\$ 2,800,313	\$ 171,706,468		\$ 3,216,915	\$ 3,216,915	\$ 168,489,553	\$ -	\$ 168,489,553
2029	\$ 98,808,079	\$ 64,199,648	\$ 2,403,736		\$ 5,778,939		\$ 4,300,000	\$ 2,912,325	\$ 178,402,726		\$ 3,216,915	\$ 3,216,915	\$ 175,185,811	\$ -	\$ 175,185,811
2030	\$ 102,760,402	\$ 66,767,634	\$ 2,499,885		\$ 6,010,096		\$ 4,300,000	\$ 3,028,818	\$ 185,366,836		\$ 3,216,915	\$ 3,216,915	\$ 182,149,921	\$ -	\$ 182,149,921
2031	\$ 106,870,818	\$ 69,438,340	\$ 2,599,880		\$ 6,250,500		\$ 4,300,000	\$ 3,149,971	\$ 192,609,509		\$ 3,216,915	\$ 3,216,915	\$ 189,392,594	\$ -	\$ 189,392,594
2032	\$ 111,145,651	\$ 72,215,873	\$ 2,703,876		\$ 6,500,520		\$ 4,300,000	\$ 3,275,970	\$ 200,141,889		\$ 3,216,915	\$ 3,216,915	\$ 196,924,974	\$ -	\$ 196,924,974
2033	\$ 115,591,477	\$ 75,104,508	\$ 2,812,031		\$ 6,760,541		\$ 4,300,000	\$ 3,407,008	\$ 207,975,565		\$ 3,216,915	\$ 3,216,915	\$ 204,758,650	\$ -	\$ 204,758,650
2034	\$ 120,215,136	\$ 78,108,688	\$ 2,924,512		\$ 7,030,963		\$ 4,300,000	\$ 3,543,289	\$ 216,122,587		\$ 3,216,915	\$ 3,216,915	\$ 212,905,672	\$ -	\$ 212,905,672
2035	\$ 125,023,741	\$ 81,233,036	\$ 3,041,492		\$ 7,312,201		\$ 4,300,000	\$ 3,685,020	\$ 224,595,491		\$ 3,216,915	\$ 3,216,915	\$ 221,378,576	\$ -	\$ 221,378,576
2036	\$ 130,024,691	\$ 84,482,357	\$ 3,163,152		\$ 7,604,689		\$ 4,300,000	\$ 3,832,421	\$ 233,407,311		\$ 3,216,915	\$ 3,216,915	\$ 230,190,396	\$ -	\$ 230,190,396
2037	\$ 135,225,678	\$ 87,861,652	\$ 3,289,678		\$ 7,908,877		\$ 4,300,000	\$ 3,985,718	\$ 242,571,603		\$ 3,216,915	\$ 3,216,915	\$ 239,354,688	\$ -	\$ 239,354,688
2038	\$ 140,634,706	\$ 91,376,118	\$ 3,421,265		\$ 8,225,232		\$ 4,300,000	\$ 4,145,147	\$ 252,102,467		\$ 3,216,915	\$ 3,216,915	\$ 248,885,552	\$ -	\$ 248,885,552
2039	\$ 146,260,094	\$ 95,031,162	\$ 3,558,116		\$ 8,554,241		\$ 4,300,000	\$ 4,310,953	\$ 262,014,566		\$ 3,216,915	\$ 3,216,915	\$ 258,797,651	\$ -	\$ 258,797,651
2040	\$ 152,110,498	\$ 98,832,409	\$ 3,700,441		\$ 8,896,411		\$ 4,300,000	\$ 4,483,391	\$ 272,323,148		\$ 3,216,915	\$ 3,216,915	\$ 269,106,233	\$ -	\$ 269,106,233
2041	\$ 158,194,918	\$ 102,785,705	\$ 3,848,458		\$ 9,252,267		\$ 4,300,000	\$ 4,662,726	\$ 283,044,074		\$ 3,216,915	\$ 3,216,915	\$ 279,827,159	\$ -	\$ 279,827,159
2042	\$ 164,522,714	\$ 106,897,133	\$ 4,002,397		\$ 9,622,358		\$ 4,300,000	\$ 4,849,235	\$ 294,193,837		\$ 3,216,915	\$ 3,216,915	\$ 290,976,922	\$ -	\$ 290,976,922
2043	\$ 171,103,623	\$ 111,173,019	\$ 4,162,492		\$ 10,007,252		\$ 4,300,000	\$ 5,043,205	\$ 305,789,591		\$ 3,216,915	\$ 3,216,915	\$ 302,572,676	\$ -	\$ 302,572,676
2044	\$ 177,947,768	\$ 115,619,940	\$ 4,328,992		\$ 10,407,542		\$ 4,300,000	\$ 5,244,933	\$ 317,849,175		\$ 3,216,915	\$ 3,216,915	\$ 314,632,260	\$ -	\$ 314,632,260
2045	\$ 185,065,678	\$ 120,244,737	\$ 4,502,152		\$ 10,823,844		\$ 4,300,000	\$ 5,454,730	\$ 330,391,142		\$ 3,216,915	\$ 3,216,915	\$ 327,174,227	\$ -	\$ 327,174,227
2046	\$ 192,468,306	\$ 125,054,527	\$ 4,682,238		\$ 11,256,798		\$ 4,300,000	\$ 5,672,920	\$ 343,434,787		\$ 3,216,915	\$ 3,216,915	\$ 340,217,872	\$ -	\$ 340,217,872
2047	\$ 200,167,038	\$ 130,056,708	\$ 4,869,527		\$ 11,707,069		\$ 4,300,000	\$ 5,899,836	\$ 357,000,179		\$ 3,216,915	\$ 3,216,915	\$ 353,783,264	\$ -	\$ 353,783,264
2048	\$ 208,173,719	\$ 135,258,976	\$ 5,064,308		\$ 12,175,352		\$ 4,300,000	\$ 6,135,830	\$ 371,108,186		\$ 3,216,915	\$ 3,216,915	\$ 367,891,271	\$ -	\$ 367,891,271
2049	\$ 216,500,668	\$ 140,669,335	\$ 5,266,881		\$ 12,662,366		\$ 4,300,000	\$ 6,381,263	\$ 385,780,513		\$ 3,216,915	\$ 3,216,915	\$ 382,563,598	\$ -	\$ 382,563,598
2050	\$ 225,160,695	\$ 146,296,108	\$ 5,477,556		\$ 13,168,861		\$ 4,300,000	\$ 6,636,514	\$ 401,039,734		\$ 3,216,915	\$ 3,216,915	\$ 397,822,819	\$ 606,400,000	\$ 1,004,222,819

Present value of salvage \$ 6,875,479

Present values of savings: \$608,791,006

Present values of costs: \$501,415,018

Total in present values: \$ 112,072,032

Evaluation of the net present value(NPV) and of the internal rate of return(IRR)

ADEC Inc.

Scenario 2.1

Projet:	9908 - JAMAICA HYW 2000	Base year:	2000	Net present value (NPV) :	246496263	Ratio Benefits/Costs :	2.07	Rate of exchange	40J\$/US\$
Length	total 85kms	Discount rate:	10.00%	Internal rate of return :	16.05%	Salvage value :	188000000		

YEAR	BENEFITS									COSTS			DIFFERENCES		
	Benefits related to cars			Benefits related to trucks			Reduction in operation & Maintenance Costs	Reduction of Accident costs	Total Benefits	Construction Costs Economic costs	Operation & Maintenance Costs Economic costs	Total Costs Economic costs	Savings - Costs	Salvage Value	Savings - Costs +Salvage value
	Savings in VOC Section 1	Time savings Section 1	Savings in Pollutants Section 1	Savings in VOC Section 1	Time savings Section 1	Pollutants Savings									
	Cars / Trucks	Cars	Cars / Trucks		Trucks										
2000						\$0	\$0	\$0	\$47,500,000	\$0	\$47,500,000	-\$47,500,000	\$0	-\$47,500,000	
2001						\$0	\$0	\$0	\$47,500,000	\$0	\$47,500,000	-\$47,500,000	\$0	-\$47,500,000	
2002						\$0	\$0	\$0	\$91,368,000	\$0	\$91,368,000	-\$91,368,000	\$0	-\$91,368,000	
2003						\$0	\$0	\$0	\$98,982,000	\$615,888	\$99,597,888	-\$99,597,888	\$0	-\$99,597,888	
2004	\$13,595,749	\$13,526,778	\$131,814	\$1,521,226	\$1,548,000	\$756,228	\$30,323,567	\$1,292,265	\$1,292,265	\$1,292,265	\$29,031,302	\$0	\$29,031,302		
2005	\$15,771,004	\$15,480,914	\$474,348	\$1,628,991	\$1,548,000	\$786,478	\$34,903,258	\$1,292,265	\$1,292,265	\$1,292,265	\$33,610,993	\$0	\$33,610,993		
2006	\$18,196,483	\$17,654,523	\$521,782	\$1,745,759	\$1,548,000	\$817,937	\$40,484,484	\$1,292,265	\$1,292,265	\$1,292,265	\$39,192,219	\$0	\$39,192,219		
2007	\$20,898,445	\$20,070,513	\$573,961	\$1,872,358	\$1,548,000	\$850,654	\$45,813,931	\$1,292,265	\$1,292,265	\$1,292,265	\$44,521,666	\$0	\$44,521,666		
2008	\$23,905,896	\$22,754,123	\$631,357	\$2,009,698	\$1,548,000	\$884,680	\$51,733,754	\$1,292,265	\$1,292,265	\$1,292,265	\$50,441,489	\$0	\$50,441,489		
2009	\$25,260,243	\$24,009,099	\$662,925	\$2,101,534	\$1,548,000	\$920,068	\$54,501,869	\$1,292,265	\$1,292,265	\$1,292,265	\$53,209,604	\$0	\$53,209,604		
2010	\$26,686,669	\$25,331,515	\$696,071	\$2,197,617	\$1,548,000	\$956,870	\$57,418,742	\$1,292,265	\$1,292,265	\$1,292,265	\$56,126,477	\$0	\$56,126,477		
2011	\$28,195,132	\$26,724,931	\$730,874	\$2,298,143	\$1,548,000	\$995,145	\$60,492,226	\$1,292,265	\$1,292,265	\$1,292,265	\$59,199,961	\$0	\$59,199,961		
2012	\$29,783,801	\$28,193,090	\$767,418	\$2,403,322	\$1,548,000	\$1,034,951	\$63,730,582	\$1,292,265	\$1,292,265	\$1,292,265	\$62,438,317	\$0	\$62,438,317		
2013	\$31,459,059	\$29,739,935	\$805,789	\$2,513,370	\$1,548,000	\$1,076,349	\$67,142,501	\$1,292,265	\$1,292,265	\$1,292,265	\$65,850,236	\$0	\$65,850,236		
2014	\$33,225,522	\$31,369,608	\$846,078	\$2,628,516	\$1,548,000	\$1,119,403	\$70,737,128	\$1,292,265	\$1,292,265	\$1,292,265	\$69,444,863	\$0	\$69,444,863		
2015	\$35,088,050	\$33,086,473	\$888,382	\$2,748,999	\$1,548,000	\$1,164,179	\$74,524,083	\$1,292,265	\$1,292,265	\$1,292,265	\$73,231,818	\$0	\$73,231,818		
2016	\$36,491,572	\$34,409,932	\$923,918	\$2,858,959	\$1,548,000	\$1,210,746	\$77,443,126	\$1,292,265	\$1,292,265	\$1,292,265	\$76,150,861	\$0	\$76,150,861		
2017	\$37,951,235	\$35,786,329	\$960,874	\$2,973,317	\$1,548,000	\$1,259,176	\$80,478,932	\$1,292,265	\$1,292,265	\$1,292,265	\$79,186,667	\$0	\$79,186,667		
2018	\$39,469,284	\$37,217,783	\$999,309	\$3,092,250	\$1,548,000	\$1,309,543	\$83,636,169	\$1,292,265	\$1,292,265	\$1,292,265	\$82,343,904	\$0	\$82,343,904		
2019	\$41,048,055	\$38,706,494	\$1,039,282	\$3,215,940	\$1,548,000	\$1,361,925	\$86,919,696	\$1,292,265	\$1,292,265	\$1,292,265	\$85,627,431	\$0	\$85,627,431		
2020	\$42,689,978	\$40,254,754	\$1,080,853	\$3,344,577	\$1,548,000	\$1,416,402	\$90,334,563	\$1,292,265	\$1,292,265	\$1,292,265	\$89,042,298	\$0	\$89,042,298		
2021	\$44,397,577	\$41,864,944	\$1,124,087	\$3,478,361	\$1,548,000	\$1,473,058	\$93,886,026	\$1,292,265	\$1,292,265	\$1,292,265	\$92,593,761	\$0	\$92,593,761		
2022	\$46,173,480	\$43,539,541	\$1,169,051	\$3,617,495	\$1,548,000	\$1,531,980	\$97,579,547	\$1,292,265	\$1,292,265	\$1,292,265	\$96,287,282	\$0	\$96,287,282		
2023	\$48,020,419	\$45,281,123	\$1,215,813	\$3,762,195	\$1,548,000	\$1,593,259	\$101,420,809	\$1,292,265	\$1,292,265	\$1,292,265	\$100,128,544	\$0	\$100,128,544		
2024	\$49,941,236	\$47,092,368	\$1,264,445	\$3,912,683	\$1,548,000	\$1,656,990	\$105,415,721	\$1,292,265	\$1,292,265	\$1,292,265	\$104,123,456	\$0	\$104,123,456		
2025	\$51,938,885	\$48,976,063	\$1,315,023	\$4,069,190	\$1,548,000	\$1,723,269	\$109,570,430	\$1,292,265	\$1,292,265	\$1,292,265	\$108,278,165	\$0	\$108,278,165		
2026	\$54,016,441	\$50,935,105	\$1,367,624	\$4,231,957	\$1,548,000	\$1,792,200	\$113,891,327	\$1,292,265	\$1,292,265	\$1,292,265	\$112,599,062	\$0	\$112,599,062		
2027	\$56,177,098	\$52,972,510	\$1,422,329	\$4,401,236	\$1,548,000	\$1,863,888	\$118,385,060	\$1,292,265	\$1,292,265	\$1,292,265	\$117,092,795	\$0	\$117,092,795		
2028	\$58,424,182	\$55,091,410	\$1,479,222	\$4,577,285	\$1,548,000	\$1,938,444	\$123,058,543	\$1,292,265	\$1,292,265	\$1,292,265	\$121,766,278	\$0	\$121,766,278		
2029	\$60,761,149	\$57,295,066	\$1,538,391	\$4,760,377	\$1,548,000	\$2,015,981	\$127,918,964	\$1,292,265	\$1,292,265	\$1,292,265	\$126,626,699	\$0	\$126,626,699		
2030	\$63,191,595	\$59,586,869	\$1,599,926	\$4,950,792	\$1,548,000	\$2,096,621	\$132,973,803	\$1,292,265	\$1,292,265	\$1,292,265	\$131,681,538	\$0	\$131,681,538		
2031	\$65,719,259	\$61,970,344	\$1,663,923	\$5,148,823	\$1,548,000	\$2,180,485	\$138,230,835	\$1,292,265	\$1,292,265	\$1,292,265	\$136,938,570	\$0	\$136,938,570		
2032	\$68,348,030	\$64,449,157	\$1,730,480	\$5,354,776	\$1,548,000	\$2,267,705	\$143,698,148	\$1,292,265	\$1,292,265	\$1,292,265	\$142,405,883	\$0	\$142,405,883		
2033	\$71,081,951	\$67,027,124	\$1,799,700	\$5,568,967	\$1,548,000	\$2,358,413	\$149,384,154	\$1,292,265	\$1,292,265	\$1,292,265	\$148,091,889	\$0	\$148,091,889		
2034	\$73,925,229	\$69,708,209	\$1,871,688	\$5,791,726	\$1,548,000	\$2,452,750	\$155,297,601	\$1,292,265	\$1,292,265	\$1,292,265	\$154,005,336	\$0	\$154,005,336		
2035	\$76,882,238	\$72,496,537	\$1,946,555	\$6,023,395	\$1,548,000	\$2,550,860	\$161,447,585	\$1,292,265	\$1,292,265	\$1,292,265	\$160,155,320	\$0	\$160,155,320		
2036	\$79,957,527	\$75,396,399	\$2,024,417	\$6,264,331	\$1,548,000	\$2,652,894	\$167,843,568	\$1,292,265	\$1,292,265	\$1,292,265	\$166,551,303	\$0	\$166,551,303		
2037	\$83,155,829	\$78,412,254	\$2,105,394	\$6,514,904	\$1,548,000	\$2,759,010	\$174,495,391	\$1,292,265	\$1,292,265	\$1,292,265	\$173,203,126	\$0	\$173,203,126		
2038	\$86,482,062	\$81,548,745	\$2,189,610	\$6,775,500	\$1,548,000	\$2,869,370	\$181,413,286	\$1,292,265	\$1,292,265	\$1,292,265	\$180,121,021	\$0	\$180,121,021		
2039	\$89,941,344	\$84,810,694	\$2,277,194	\$7,046,520	\$1,548,000	\$2,984,145	\$188,607,898	\$1,292,265	\$1,292,265	\$1,292,265	\$187,315,633	\$0	\$187,315,633		
2040	\$93,538,998	\$88,203,122	\$2,368,282	\$7,328,381	\$1,548,000	\$3,103,511	\$196,090,294	\$1,292,265	\$1,292,265	\$1,292,265	\$194,798,029	\$0	\$194,798,029		
2041	\$97,280,558	\$91,731,247	\$2,463,013	\$7,621,516	\$1,548,000	\$3,227,651	\$203,871,985	\$1,292,265	\$1,292,265	\$1,292,265	\$202,579,720	\$0	\$202,579,720		
2042	\$101,171,780	\$95,400,497	\$2,561,534	\$7,926,377	\$1,548,000	\$3,356,757	\$211,984,945	\$1,292,265	\$1,292,265	\$1,292,265	\$210,672,680	\$0	\$210,672,680		
2043	\$105,218,651	\$99,216,517	\$2,663,995	\$8,243,432	\$1,548,000	\$3,491,027	\$220,381,623	\$1,292,265	\$1,292,265	\$1,292,265	\$219,089,358	\$0	\$219,089,358		
2044	\$109,427,397	\$103,185,178	\$2,770,555	\$8,573,169	\$1,548,000	\$3,630,669	\$229,134,968	\$1,292,265	\$1,292,265	\$1,292,265	\$227,842,703	\$0	\$227,842,703		
2045	\$113,804,493	\$107,312,585	\$2,881,377	\$8,916,096	\$1,548,000	\$3,775,895	\$238,238,446	\$1,292,265	\$1,292,265	\$1,292,265	\$236,946,181	\$0	\$236,946,181		
2046	\$118,356,673	\$111,605,088	\$2,996,632	\$9,272,740	\$1,548,000	\$3,926,931	\$247,706,064	\$1,292,265	\$1,292,265	\$1,292,265	\$246,413,799	\$0	\$246,413,799		
2047	\$123,090,940	\$116,069,292	\$3,116,497	\$9,643,649	\$1,548,000	\$4,084,008	\$257,552,387	\$1,292,265	\$1,292,265	\$1,292,265	\$256,260,122	\$0	\$256,260,122		
2048	\$128,014,578	\$120,712,063	\$3,241,157	\$10,029,395	\$1,548,000	\$4,247,369	\$267,792,562	\$1,292,265	\$1,292,265	\$1,292,265	\$266,500,297	\$0	\$266,500,297		
2049	\$133,135,161	\$125,540,546	\$3,370,804	\$10,430,571	\$1,548,000	\$4,417,263	\$278,442,345	\$1,292,265	\$1,292,265	\$1,292,265	\$277,150,080	\$0	\$277,150,080		
2050	\$138,460,567	\$130,562,168	\$3,505,636	\$10,847,794	\$1,548,000	\$4,593,954	\$289,518,118	\$1,292,265	\$1,292,265	\$1,292,265	\$288,225,853	\$188,000,000	\$476,225,853		

Present value of salvage \$ 2,131,580

Present values of savings: \$472,201,797

Present values of costs: \$227,837,114

Total in present values: \$245,820,581

Evaluation of the net present value(NPV) and of the internal rate of return(IRR)

ADEC Inc.

Scenario 2.2

Project:	9908 - JAMAICA HYW 2000	Base year:	2000	Net present value (NPV) :	-79868390	Ratio Benefits/Costs :	0.70	Rate of exchange	40\$/US\$
Length	total 148kms	Discount rate:	10.00%	Internal rate of return :	7.76%	Salvage value :	418400000		

YEAR	BENEFITS							COSTS			DIFFERENCES				
	Benefits related to cars			Benefits related to trucks			Reduction in operation & Maintenance Costs	Reduction of Accident costs	Total Benefits	Construction Costs Economic costs	Operation & Maintenance Costs Economic costs	Total Costs Economic costs	Savings - Costs	Salvage Value	Savings - Costs +Salvage value
	Savings in VOC Section 2	Time savings Section 2	Savings in Pollutants Section 2	Savings in VOC	Time savings Section 2	Pollutants Savings									

	Cars / Trucks	Cars	Cars / Trucks	Trucks											
2000					\$ -	\$ -	\$ -			\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2001					\$ -	\$ -	\$ -			\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2002					\$ -	\$ -	\$ -			\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2003					\$ -	\$ -	\$ -			\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2004					\$ -	\$ -	\$ -			\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2005					\$ -	\$ -	\$ -			\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2006	\$ 11,368,987	\$ 3,478,325	\$ 293,503	\$ 362,492	\$ 2,752,000	\$ 425,379	\$ 18,680,685			\$ 186,381,000	\$ 615,888	\$ 186,996,888	\$ (97,443,000)	\$ -	\$ (97,443,000)
2007	\$ 13,057,143	\$ 3,985,187	\$ 322,853	\$ 388,476	\$ 2,752,000	\$ 442,394	\$ 20,948,052			\$ 139,806,000	\$ 1,926,850	\$ 141,732,850	\$ 15,804,708	\$ -	\$ 15,804,708
2008	\$ 14,936,164	\$ 4,549,097	\$ 355,138	\$ 416,647	\$ 2,752,000	\$ 460,089	\$ 23,469,135				\$ 2,875,977	\$ 2,875,977	\$ 18,072,075	\$ -	\$ 18,072,075
2009	\$ 15,782,345	\$ 5,176,013	\$ 372,895	\$ 435,629	\$ 2,752,000	\$ 478,493	\$ 24,997,375				\$ 2,875,977	\$ 2,875,977	\$ 20,593,158	\$ -	\$ 20,593,158
2010	\$ 16,674,810	\$ 5,464,628	\$ 391,540	\$ 455,486	\$ 2,752,000	\$ 497,633	\$ 26,236,097				\$ 2,875,977	\$ 2,875,977	\$ 22,121,398	\$ -	\$ 22,121,398
2011	\$ 17,616,033	\$ 5,768,866	\$ 411,117	\$ 476,259	\$ 2,752,000	\$ 517,538	\$ 27,541,813				\$ 2,875,977	\$ 2,875,977	\$ 23,360,120	\$ -	\$ 23,360,120
2012	\$ 18,608,616	\$ 6,089,557	\$ 431,673	\$ 497,990	\$ 2,752,000	\$ 538,240	\$ 28,918,075				\$ 2,875,977	\$ 2,875,977	\$ 24,665,836	\$ -	\$ 24,665,836
2013	\$ 19,655,299	\$ 6,427,572	\$ 453,256	\$ 520,725	\$ 2,752,000	\$ 559,769	\$ 30,368,622				\$ 2,875,977	\$ 2,875,977	\$ 26,042,098	\$ -	\$ 26,042,098
2014	\$ 20,758,967	\$ 6,783,830	\$ 475,919	\$ 544,510	\$ 2,752,000	\$ 582,160	\$ 31,897,385				\$ 2,875,977	\$ 2,875,977	\$ 27,492,645	\$ -	\$ 27,492,645
2015	\$ 21,922,654	\$ 7,159,295	\$ 499,715	\$ 569,394	\$ 2,752,000	\$ 605,446	\$ 33,508,504				\$ 2,875,977	\$ 2,875,977	\$ 29,021,408	\$ -	\$ 29,021,408
2016	\$ 22,799,560	\$ 7,554,984	\$ 519,704	\$ 592,169	\$ 2,752,000	\$ 629,664	\$ 34,848,082				\$ 2,875,977	\$ 2,875,977	\$ 30,632,527	\$ -	\$ 30,632,527
2017	\$ 23,711,543	\$ 7,857,184	\$ 540,492	\$ 615,856	\$ 2,752,000	\$ 654,851	\$ 36,131,925				\$ 2,875,977	\$ 2,875,977	\$ 31,972,105	\$ -	\$ 31,972,105
2018	\$ 24,660,004	\$ 8,171,471	\$ 562,111	\$ 640,490	\$ 2,752,000	\$ 681,045	\$ 37,467,122				\$ 2,875,977	\$ 2,875,977	\$ 33,255,948	\$ -	\$ 33,255,948
2019	\$ 25,646,404	\$ 8,498,330	\$ 584,596	\$ 666,110	\$ 2,752,000	\$ 708,287	\$ 38,855,727				\$ 2,875,977	\$ 2,875,977	\$ 34,591,145	\$ -	\$ 34,591,145
2020	\$ 26,672,281	\$ 8,838,263	\$ 607,980	\$ 692,754	\$ 2,752,000	\$ 736,618	\$ 40,299,876				\$ 2,875,977	\$ 2,875,977	\$ 35,979,750	\$ -	\$ 35,979,750
2021	\$ 27,739,151	\$ 9,191,794	\$ 632,299	\$ 720,465	\$ 2,752,000	\$ 766,083	\$ 41,801,791				\$ 2,875,977	\$ 2,875,977	\$ 37,423,899	\$ -	\$ 37,423,899
2022	\$ 28,848,717	\$ 9,559,465	\$ 657,591	\$ 749,283	\$ 2,752,000	\$ 796,726	\$ 43,363,783				\$ 2,875,977	\$ 2,875,977	\$ 38,925,814	\$ -	\$ 38,925,814
2023	\$ 30,002,666	\$ 9,941,844	\$ 683,895	\$ 779,254	\$ 2,752,000	\$ 828,595	\$ 44,988,254				\$ 2,875,977	\$ 2,875,977	\$ 40,487,806	\$ -	\$ 40,487,806
2024	\$ 31,202,772	\$ 10,339,518	\$ 711,250	\$ 810,425	\$ 2,752,000	\$ 861,739	\$ 46,677,704				\$ 2,875,977	\$ 2,875,977	\$ 42,112,277	\$ -	\$ 42,112,277
2025	\$ 32,450,883	\$ 10,753,099	\$ 739,700	\$ 842,842	\$ 2,752,000	\$ 896,208	\$ 48,434,732				\$ 2,875,977	\$ 2,875,977	\$ 43,801,727	\$ -	\$ 43,801,727
2026	\$ 33,748,919	\$ 11,183,222	\$ 769,288	\$ 876,555	\$ 2,752,000	\$ 932,057	\$ 50,262,041				\$ 2,875,977	\$ 2,875,977	\$ 45,558,755	\$ -	\$ 45,558,755
2027	\$ 35,098,875	\$ 11,630,551	\$ 800,060	\$ 911,617	\$ 2,752,000	\$ 969,339	\$ 52,162,443				\$ 2,875,977	\$ 2,875,977	\$ 47,386,064	\$ -	\$ 47,386,064
2028	\$ 36,502,830	\$ 12,095,773	\$ 832,062	\$ 948,082	\$ 2,752,000	\$ 1,008,113	\$ 54,138,861				\$ 2,875,977	\$ 2,875,977	\$ 49,286,466	\$ -	\$ 49,286,466
2029	\$ 37,962,944	\$ 12,579,604	\$ 865,345	\$ 986,005	\$ 2,752,000	\$ 1,048,437	\$ 56,194,335				\$ 2,875,977	\$ 2,875,977	\$ 51,262,884	\$ -	\$ 51,262,884
2030	\$ 39,481,461	\$ 13,082,789	\$ 899,959	\$ 1,025,446	\$ 2,752,000	\$ 1,090,375	\$ 58,332,029				\$ 2,875,977	\$ 2,875,977	\$ 53,318,358	\$ -	\$ 53,318,358
2031	\$ 41,060,720	\$ 13,606,100	\$ 935,957	\$ 1,066,464	\$ 2,752,000	\$ 1,133,990	\$ 60,555,230				\$ 2,875,977	\$ 2,875,977	\$ 55,456,052	\$ -	\$ 55,456,052
2032	\$ 42,703,149	\$ 14,150,344	\$ 973,395	\$ 1,109,122	\$ 2,752,000	\$ 1,179,349	\$ 62,867,359				\$ 2,875,977	\$ 2,875,977	\$ 57,679,253	\$ -	\$ 57,679,253
2033	\$ 44,411,274	\$ 14,716,358	\$ 1,012,331	\$ 1,153,487	\$ 2,752,000	\$ 1,226,523	\$ 65,271,973				\$ 2,875,977	\$ 2,875,977	\$ 59,991,382	\$ -	\$ 59,991,382
2034	\$ 46,187,725	\$ 15,305,012	\$ 1,052,824	\$ 1,199,626	\$ 2,752,000	\$ 1,275,584	\$ 67,772,772				\$ 2,875,977	\$ 2,875,977	\$ 62,395,996	\$ -	\$ 62,395,996
2035	\$ 48,035,234	\$ 15,917,213	\$ 1,094,937	\$ 1,247,611	\$ 2,752,000	\$ 1,326,607	\$ 70,373,603				\$ 2,875,977	\$ 2,875,977	\$ 64,896,795	\$ -	\$ 64,896,795
2036	\$ 49,956,644	\$ 16,553,901	\$ 1,138,735	\$ 1,297,516	\$ 2,752,000	\$ 1,379,672	\$ 73,078,467				\$ 2,875,977	\$ 2,875,977	\$ 67,497,626	\$ -	\$ 67,497,626
2037	\$ 51,954,910	\$ 17,216,057	\$ 1,184,284	\$ 1,349,417	\$ 2,752,000	\$ 1,434,858	\$ 75,891,526				\$ 2,875,977	\$ 2,875,977	\$ 70,202,490	\$ -	\$ 70,202,490
2038	\$ 54,033,106	\$ 17,904,700	\$ 1,231,656	\$ 1,403,393	\$ 2,752,000	\$ 1,492,253	\$ 78,817,107				\$ 2,875,977	\$ 2,875,977	\$ 73,015,549	\$ -	\$ 73,015,549
2039	\$ 56,194,430	\$ 18,620,887	\$ 1,280,922	\$ 1,459,529	\$ 2,752,000	\$ 1,551,943	\$ 81,859,711				\$ 2,875,977	\$ 2,875,977	\$ 75,941,130	\$ -	\$ 75,941,130
2040	\$ 58,442,207	\$ 19,365,723	\$ 1,332,159	\$ 1,517,910	\$ 2,752,000	\$ 1,614,021	\$ 85,024,020				\$ 2,875,977	\$ 2,875,977	\$ 78,983,734	\$ -	\$ 78,983,734
2041	\$ 60,779,896	\$ 20,140,352	\$ 1,385,445	\$ 1,578,627	\$ 2,752,000	\$ 1,678,581	\$ 88,314,901				\$ 2,875,977	\$ 2,875,977	\$ 82,148,043	\$ -	\$ 82,148,043
2042	\$ 63,211,092	\$ 20,945,966	\$ 1,440,863	\$ 1,641,772	\$ 2,752,000	\$ 1,745,725	\$ 91,737,417				\$ 2,875,977	\$ 2,875,977	\$ 85,438,924	\$ -	\$ 85,438,924
2043	\$ 65,739,535	\$ 21,783,805	\$ 1,498,497	\$ 1,707,442	\$ 2,752,000	\$ 1,815,554	\$ 95,296,833				\$ 2,875,977	\$ 2,875,977	\$ 88,861,440	\$ -	\$ 88,861,440
2044	\$ 68,369,117	\$ 22,655,157	\$ 1,558,437	\$ 1,775,740	\$ 2,752,000	\$ 1,888,176	\$ 98,998,627				\$ 2,875,977	\$ 2,875,977	\$ 92,420,856	\$ -	\$ 92,420,856
2045	\$ 71,103,881	\$ 23,561,363	\$ 1,620,775	\$ 1,846,770	\$ 2,752,000	\$ 1,963,703	\$ 102,848,492				\$ 2,875,977	\$ 2,875,977	\$ 96,122,650	\$ -	\$ 96,122,650
2046	\$ 73,948,036	\$ 24,503,818	\$ 1,685,606	\$ 1,920,641	\$ 2,752,000	\$ 2,042,251	\$ 106,852,351				\$ 2,875,977	\$ 2,875,977	\$ 99,972,515	\$ -	\$ 99,972,515
2047	\$ 76,905,958	\$ 25,483,970	\$ 1,753,030	\$ 1,997,466	\$ 2,752,000	\$ 2,123,941	\$ 111,016,365				\$ 2,875,977	\$ 2,875,977	\$ 103,976,374	\$ -	\$ 103,976,374
2048	\$ 79,982,196	\$ 26,503,329	\$ 1,823,151	\$ 2,077,365	\$ 2,752,000	\$ 2,208,899	\$ 115,346,940				\$ 2,875,977	\$ 2,875,977	\$ 108,140,388	\$ -	\$ 108,140,388
2049	\$ 83,181,484	\$ 27,563,462	\$ 1,896,077	\$ 2,160,459	\$ 2,752,000	\$ 2,297,255	\$ 119,850,738				\$ 2,875,977	\$ 2,875,977	\$ 112,470,963	\$ -	\$ 112,470,963
2050	\$ 86,508,743	\$ 28,666,001	\$ 1,971,920	\$ 2,246,878	\$ 2,752,000	\$ 2,389,145	\$ 124,534,687				\$ 2,875,977	\$ 2,875,977	\$ 116,974,761	\$ -	\$ 116,974,761

Present value of salvage \$ 4,743,899

Present values of savings: \$ 194,068,865

Present values of costs: \$ 278,681,155

Total in present values: \$ (81,372,143)