ARIZONA DEPARTMENT OF TRANSPORTATION

REPORT NUMBER: FHWA-AZ98-470

ANALYSIS OF BONDING VS "PAY-AS-YOU-GO" FINANCING

Final Report

Prepared by:
Matt Rowell
1044 North 84th Place
Scottsdale, AZ 85257

Rick Buonincontri
4505 South Hardy Drive, #1162
Tempe, AZ 85282

John Semmens
ADOT Research Center
1130 North 22nd Avenue
Phoenix, AZ 85009

March 1999

Prepared for:
Arizona Department of Transportation
206 South 17th Avenue
Phoenix, Arizona 85007
in cooperation with
U.S. Department of Transportation
Federal Highway Administration

The contents of this report reflect the views of the authors who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Arizona Department of Transportation or the Federal Highways Administration. This report does not constitute a standard, specification, or regulation. Trade or manufacturer's names which may appear herein are cited only because they are considered essential to the objectives of the report. The U.S. Government and the State of Arizona do not endorse products or manufacturers.

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FHWA-AZ-98-470	PB99-134223	

4. Title and Subtitle	5. Report Date
Analysis of Bonding vs. "Pay-As-You-Go" Financing	March 1999
	6. Performing Organization Code

7. Authors	8. Performing Organization Report No.
Matt Rowell, Rick Buonincontri, John Semmens	

9. Performing Organization Name and Address	10. Work Unit No.
Matt Rowell, 1044 N. 84 Place, Scottsdale, AZ 85257 Rick Buonincontri, 4505 S. Hardy Dr. #1162, Tempe, AZ 85282 John Semmens, ADOT Research Center, 1130 N. 22 Ave., Phoenix 85009	11. Contract or Grant No. SPR-PL-1-(53) 470

12. Sponsoring Agency Name and Address	13. Type of Report & Period Covered
ARIZONA DEPARTMENT OF TRANSPORTATION **206 S. 17TH AVENUE** **PHOENIX, ARIZONA 85007** Project Manager: John Semmens	14. Sponsoring Agency Code

15. Supplementary Notes

Prepared in cooperation with the U.S. Department of Transportation, Federal Highway Administration

16. Abstract

The decision to bond or to pay-as-you-go must be made on a case-by-case basis where all of the relevant concerns are taken into consideration. Research has allowed us to develop the following general conclusions:

The interest cost of bonding is not outweighed by the effects of inflation. While it is true that inflation causes bonds to be paid back in dollars that are worth less than the dollars that the bonds generated when they were issued, this effect is taken into account when interest rates are determined. Investors would not purchase bonds if they felt that the interest rate did not cover the inflation rate and offer a reasonable return. We could find no evidence that the effects of inflation allow governments to issue cost free debt.

In the long run, bonding will result in there being less funds available for other uses. Interest payments impose a real cost on bond issuers.

Continual bonding may result in there being less funds available for other uses, but this effect may be outweighed by the benefits bonding affords. The principal benefit of bonding is that it allows projects to be completed sooner.

17. Key Words	18. Distribution Statement	23. Registrant's Seal
transportation finance, bonding, pay-as-you-go	Document is available to the U.S. public through the National Technical Information Service, Springfield, Virginia 22161	

19. Security Classification	20. Security Classification	21. No. of Pages	22. Price
Unclassified	Unclassified	100	

METRIC (SI*) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	2.54	centimeters	cm
ft	feet	0.3048	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	6.452	centimeters squared	cm^2
ft^2	square feet	0.0929	meters squared	m^2
yd^2	square yards	0.836	meters squared	m^2
mi^2	square miles	2.59	kilometers squared	km^2
ac	acres	0.395	hectares	ha
		MASS (weight)		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams	Mg
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.0328	meters cubed	m^3
yd^3	cubic yards	0.765	meters cubed	m^3

Note: Volumes greater than 1000 L shall be shown in m^3.

		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

These factors conform to the requirement of FHWA Order 5190.1A

*SI is the symbol for the International System of Measurements

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
yd	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	millimeters squared	0.0016	square inches	in^2
m^2	meters squared	10.764	square feet	ft^2
yd^2	kilometers squared	0.39	square miles	mi^2
ha	hectares (10,000 m^2)	2.53	acres	ac
		MASS (weight)		
g	grams	0.0353	ounces	oz
kg	kilograms	2.205	pounds	lb
Mg	megagrams (1000 kg)	1.103	short tons	T
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	meters cubed	35.315	cubic feet	ft^3
m^3	meters cubed	1.308	cubic yards	yd^3

		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F

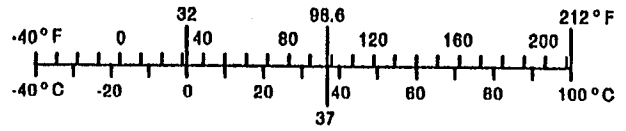

TABLE OF CONTENTS

I. Introduction

Ultimately, there is only one source of funds for highway construction. This is the revenue that flows into the hands of the highway agency from the assorted taxes and fees the law allocates to them. This revenue can be spent as it is obtained--the "pay-as-you-go" option. Or it can be borrowed against--the bonding or debt financing option.

There is no single "right way" to pay for highway construction. Arguments can be made for either the "pay-as-you-go" or the borrowing approach. Neither is there a precise formula for determining an optimal mix of financing methods. In considering the appropriate mix of pay-as-you-go and borrowing decision makers must recognize the advantages and disadvantages of each approach. The optimal mix of financing methods depends on several factors, such as the kinds and sizes of projects and infrastructure needs, the government's administrative structure and fiscal health, and legal and political constraints. For example, in Arizona there is an $800 million statutory cap on the amount of highway user revenue fund (HURF) debt the Arizona Department of Transportation (ADOT) can issue.

Our first task will be to enumerate the advantages and disadvantages of pay-as-you-go and borrowing.

The Pay-as-You-Go Approach

Most governments can not generate enough revenues from current sources to finance all of the infrastructure projects that they would need to build in order to maintain desired service levels. However, current revenues can finance a significant portion of most state government's capital needs and may include designated revenues that have been specifically collected to fund capital projects. Current revenues used to fund capital projects are often accumulated in a reserve account until amounts sufficiently large enough to fund projects are accumulated. Also, unanticipated surpluses may be earmarked for capital spending.

Governments must ensure that the commitment of current revenues to capital projects leaves enough funds to finance the operating budget and to maintain sufficient balances for emergencies. Further, it would be undesirable if an attempt to finance capital expenditures on a pay-as-you-go basis required that operating reserves be reduced below tolerable levels.

The main advantages of pay-as-you-go financing (relative to debt financing) are as follows:

- Reduced interest expense. The savings in interest costs payable on outstanding debt can be used to finance additional capital projects, reduce taxes, or expand services.
- Increased flexibility. The absence of fixed annual debt costs provided for greater flexibility during economic downturns. Future revenues are not designated for debt service and can be used for other purposes such as saving up for future projects.
- Enhanced debt capacity and credit rating. If an agency has zero outstanding current debt it may find that future ability to borrow for "greater" capital needs is enhanced. If a state

borrows now, it may not be able to borrow as much in the future. High current debt burdens may lower credit ratings and raise the cost of future borrowing.
- Increased fiscal responsibility. The likelihood of incurring excessive debt is reduced. Decision makers are *forced* to consider the impact of major capital expenditures on the operating budget.

The main disadvantages of pay-as-you-go financing (relative to debt financing) are as follows:
- Insufficient funds. Current revenues are not likely to be sufficient to pay for significant capital outlays, unless accumulated in a reserve account.
- Higher cost of construction if inflation raises costs at a rate higher than the interest cost of borrowing.
- Intergenerational inequity. Those who benefit in the future from a capital facility do not contribute to the cost of the facility.
- Lumpiness of funding requirements. Unlike debt service payments, the funds necessary for capital projects may be greatly inconsistent from year to year.
- Raiding of accumulated reserves. Reserves may be raided for other uses before they are sufficient to finance capital improvements.
- Waiting for normal cash flow to fund projects will necessarily delay the enjoyment of benefits that could be accelerated if borrowing facilitates earlier construction.

The Use of Borrowing

Strictly speaking, borrowing or debt financing are not new sources of revenue. Borrowing is a way of moving the completion of capital projects to the present and the payment for those projects into the future. These temporal movements have a cost, interest expenses necessarily accrue when debt financing is used. Ultimately, the debt plus interest expense must be repaid from the pay-as-you-go revenue sources discussed above. However, the repayment with interest can be made over time as the capital facility is used.

Under many circumstances, it would be both impractical and fiscally unwise to fund all capital needs on a pay-as-you-go basis. Debt financing is appropriate not only when other sources are not available, but when economic, fiscal, and planning considerations dictate its use. Debt financing should not be viewed as a "last resort", because it is often the best alternative available.

The main advantages of debt financing (relative to pay-as-you-go) are as follows:

- Acquisition as needed. The state can enjoy prompt use and benefit of capital improvements. Immediate or rapid construction is limited with pay-as-you-go financing.
- Intergenerational equity. The cost of capital expenditures is spread more equally over all of its users.
- Repayment in cheaper dollars. With a positive inflation rate, repayment costs will be less burdensome than would full payment at the time of acquisition.

- Enhanced Stability. Since debt service payments are known and predictable, wide fluctuations in required expenditures are avoided.
- Reduced operating cost as older, high-maintenance roadways are more quickly replaced by newer, low-maintenance roadways.

The main disadvantages of debt financing (relative to pay-as-you-go) are as follows:

- Interest costs. The cost for the use of money must be added to the total cost of the capital project.
- Encumbered future revenues. Potential revenues are dedicated to the repayment of debt and are thus not available for other uses.
- The temptation to take on too much debt. Because borrowing enables the political credit for that construction to accrue to current officeholders while passing the costs on to future administrations and legislatures there may be a temptation to take on too much debt. As the knowledge of what constitutes too much debt may not be known until after a default, some argue that it is better to not borrow at all.

II. Bonding Vs. Pay-as-You-Go: General Costs and Benefits

The Pay-as-You-Go Approach

Governments continually assert that they can not generate enough revenues from current sources to finance all of the desired infrastructure projects that they have identified. However, current revenues can finance a significant portion of most state governments' capital needs and may include designated revenues that have been specifically collected to fund capital projects. Current revenues used to fund capital projects are often accumulated in a reserve account until sufficient to fund projects. Also, unanticipated surpluses may be earmarked for capital spending.

Governments must ensure that the commitment of current revenues to capital projects leaves enough funds to finance the operating budget and to maintain sufficient balances for emergencies. Further, an attempt to finance capital expenditures on a pay-as-you-go basis should never require that operating reserves be reduced below tolerable levels.

What follows is a discussion of the arguments typically made concerning the advantages and disadvantages of the pay-as-you-go approach to transportation financing.[1]

The main advantages of pay-as-you-go financing (relative to debt financing) are as follows:

Reduced interest expense.

When financing capital projects on a pay-as-you-go basis, interest expenses are not incurred. Also, other costs of borrowing such as fees to the investment banking firms that "place" the bonds are avoided. The total cost of borrowing, including interest and transaction fees, can be substantial. Fees typically range around 1% of the total dollar amount of the bond issue. This may seem small, but for issues of a $100 million or more the fees will amount to $1 million or more. Over the life of a twenty-year bond the interest expenses alone can equal or exceed the amount of the original amount borrowed, effectively doubling the cost of the financed project.

At the time of the bond issue the cost of future interest payments is typically discounted. In theory, future payments are less costly than current payments because of the time-value of money and the effects of inflation. In practice, future interest payments almost invariably impose a higher real (inflation adjusted) burden on future budgets and taxpayers. It should also be noted that inflation is currently low relative to recent history. Low inflation makes debt relatively more expensive since the dollars paid back in the future will be worth relatively more. Thus, lower interest rates do not necessarily imply a lower real cost of borrowing when they are accompanied by lower inflation. Low interest rates are not a long-term situation, however.

---

[1] The basic outline of this discussion comes from "Financing Alternatives" Joni L. Leithe and James C. Joseph, in Financing Growth: Who Benefits?, Who Pays?, and How Much?, Susan G. Robinson, Editor 1990. The authors have inserted several of their own opinions into the discussion, however.

Under normal circumstances interest rates will exceed inflation rates. The chances that borrowers will "beat" inflation on a consistent basis are small. Investors are well aware of the risk that inflation will depreciate the value of the dollars in which they will be repaid and will, on average, obtain interest rates sufficient to cover the rate of inflation. If we compare the average interest rates on government debt to the rate of inflation for highway construction for an extended period we find that inflation exceeded the interest rate for only five years (all during the 1970's) between 1973 and 1997.

There is also an opportunity cost of incurring interest expenses. Every dollar spent on interest is a dollar that could have been spent on something else. When no debt is issued the savings in interest costs payable on outstanding debt can be used to finance additional capital projects, reduce taxes, or expand services.

Increased flexibility.

Interest expenses may not only impose a substantial financial burden on agency budgets, but they may do so in an inflexible manner. Interest payments must be made on a regular basis. This may not be a problem in years when budgets are flush and all of the agency's obligations are being met. However, in the event of an economic downturn and the subsequent reduction in tax revenues, an agency's debt payments may constitute a substantial proportion of the agency's total budget. The agency could be forced to forego critical services, such as highway maintenance, in order to meet its debt payments.

Accurately forecasting future tax revenues is difficult if not impossible. Thus, issuing debt that must be paid back on a fixed schedule is inherently risky. The absence of fixed annual debt costs provides for greater flexibility during economic downturns. Therefore, future revenues are not designated for debt servicing and will be available to be used for other purposes.

Enhanced debt capacity and credit rating.

The future ability to borrow for "greater" or emergency capital needs is enhanced. By not carrying a large amount of debt, higher debt ratings and lower interest rates may be attainable. The amount of outstanding debt an entity is carrying is often a significant indicator of the entity's credit worthiness. An agency carrying a high level of debt may have a greater risk of default than one with low levels of debt. Creditors may thus be reluctant to lend more to the agency and will require a substantially higher interest rate if they do. Therefore, if an agency currently has a substantial debt burden compared to its "coverage ratio" (i.e., cash flow available for repayment of debt), acquiring more debt may be very expensive or impossible. This may be an important limitation if it is necessary to issue debt to fund emergency capital projects.

Increased fiscal responsibility.

Issuing debt allows policy makers to spend significant amounts of money without raising taxes. The burden of the expenditures is effectively transferred to future generations. While

current policy makers can take credit for current capital improvements, the political costs of those capital improvements are passed on to future policy makers. Thus, current policy makers are faced with a significant temptation to borrow for capital improvements now and pass off the cost of those improvements onto future policy makers and taxpayers.

With pay-as-you-go financing, the decision-makers are forced to consider the impact of major capital expenditures on the operating budget. If significant capital expenditures are to take place they will require either a reduction in other spending or an increase in taxes. The political cost that the current expenditures entail will be borne by current policy makers.

This will make current policy makers much more discriminating in their choices of which capital projects to fund. Thus, it is less likely that wasteful or over-priced projects will be funded.

The main disadvantages of pay-as-you-go financing (relative to debt financing) are as follows:

Insufficient funds.

The cost of major transportation projects can be very high. Thus, current revenues may not be sufficient to pay for large capital outlays. If a particular capital project is identified as *necessary and urgently needed* the agency may have no choice but to issue debt to pay for it.

Intergenerational equity.

Intergenerational equity is a subtle but real issue. When capital expenditures are made on a pay-as-you-go basis the current generation will completely fund the expenditures. However, future generations may also enjoy the benefits of the capital improvements afforded by those expenditures. Thus, not all those who will benefit from a capital facility will contribute to the facilities' cost. This could be considered to be "unfair" or "unjust."

Since fairness and justice are essentially subjective notions, quantifying their costs and benefits is not possible. Economic science offers no way to determine whether the increased "fairness" of debt financing justifies the increased cost of debt financing. Decisions made based on the concept of intergenerational equity will require a subjective use of judgment. People may disagree over what standard to use to determine what is fair or just. The purpose of this report is to determine the relative economic costs and benefits of bonding and of paying-as-you-go, thus essentially philosophical issues such as intergenerational equity will be dealt with only in passing. This is not to imply that these issues are not important, just that they are outside the scope of this report.

Newcomer/oldtimer equity.

Intergenerational equity isn't the only temporal issue subject to debate. There is also the issue of whether new arrivals to an area pay an adequate share of the cost of facilities they use when capital expenditures are made on a pay-as-you-go basis.

Lumpiness of funding requirements.

Debt service payments are fixed and made on a regular basis. (Assuming a fixed interest rate on the debt.) Therefore, forecasting expenditures for debt payments is quite easy. Unlike debt service payments, the funds necessary for capital projects may be greatly inconsistent from year to year. The fluctuations in revenue may differ substantially from the fluctuations in capital funding needs. Consequently, there is no guarantee that funding needs and revenues available will necessarily match in any given year. As a result, a pay-as-you-go approach may force the postponement of some capital projects until such a time as sufficient revenue has been accumulated.

Quantifying the benefit of fixed payments relative to "lumpy" payments has never been accomplished. Thus, it is unclear whether the benefits of fixed payments outweigh the costs of bonding.

Raiding of accumulated reserves.

Suppose an agency has a reserve fund for capital projects. This could present policy makers with the temptation to "raid" the fund for other uses before it is sufficient to finance capital improvements. Influential policy makers may have pet projects that they want funded or powerful lobbies that they want to reward. Thus, the transportation projects that the fund was set up to finance may never be completed.

It is unclear how big a problem this is. It seems that reserve funds could be set up with sufficient safeguards to insure that raiding does not take place. If the government is so corrupt or undisciplined that this is not possible, there is little reason to expect that bonding will solve the problem. Funds raised through issuing bonds can be misappropriated as well. Thus, it is not clear that the possibility that reserves may be raided gives the bonding option a relative advantage.

The Bonding Approach

Strictly speaking, issuing debt to generate funding ("debt financing") for public expenditures is what economists call a form of "delayed taxation." This means that governments can move the completion of capital projects forward in time and the payment for those projects further out into the future rather than imposing taxes now. Ultimately, revenues will have to be generated to repay the principal and interest on the debt. Additionally, there are costs associated with a temporal adjustment of finance in terms of interest expense and the transaction costs of debt. However, the repayment with interest can be made over the expected useful life of the facility built with the borrowed funds.

Under some circumstances, it may be both impractical and fiscally unwise to fund all capital needs on a pay-as-you-go basis. Debt financing may be appropriate not only when other

sources are not available, but also when economic, fiscal, and planning considerations recommend its use. Debt financing should not necessarily be viewed only as a "last resort," because in some cases it may be the best alternative.

The main advantages of debt financing (relative to pay-as-you-go) are as follows:

Acceleration of Construction.

The use of debt can accelerate the construction process, allowing the state to enjoy more immediate use and benefit of capital improvements. Without the large sums of capital made available by debt offerings, some large projects might be difficult to complete with the revenue stream available from pay-as-you-go sources. This may lead to a considerable "down time" when no progress is made towards completion of a specific highway segment while funds from the revenue sources accumulate.

Borrowing may allow construction on a project to begin earlier and continue uninterrupted to an expeditious completion. Revenue from pay-as-you-go sources may not flow predictably or quickly enough to allow the scheduling of a project so that it will proceed without interruption. Funding generated by bonding means that funding for projects is known with certainty, allowing for the possibility that more efficient planning and utilization of the state's resources could be achieved.

Intergenerational equity.

Typically capital projects may have a useful life of ten to twenty years or more. Pay-as-you-go funding for these types of projects will place the burden of financing the cost on only a subset of all those that will derive benefits from the use of the facility. Debt financing allows the cost of capital expenditures to be spread more equally over all of the eventual users of the facility.

It is true that future generations may derive benefits from capital expenditures committed by their predecessors. However, they may be left paying the bill for choices that they would not have made were they given the opportunity. It cannot be assumed, therefore, that future generations would choose to spend their tax dollars in the same manner chosen for them by their predecessors. The intergenerational argument, threrfore, does not provide an irrefutable justification for debt financing.

Repayment in cheaper dollars.

If capital expenditures are funded by fixed interest rate borrowing, and over the life of the bond the the rate of inflation increases, then repayment of that bond will in fact be in "cheaper dollars." This would reduce some or maybe even all of the burden caused by interest rate expenses. However, capital markets and investment bankers are much more likely to be better at discounting inflation risk than are government decision makers in either the legislature or highway agency. Therefore, it would not be prudent to base borrowing decisions on a current

government decision maker's predictions regarding future inflation rates. The interest rate at the time of the bond issue will have included the capital market's expectations concerning future inflation rates. While it *may* seem possible that government decision makers could "time the market" in such a way that the highway agency could "beat" inflation via borrowing, it is extremely unlikely that this would occur on a regular basis.

The effort to "beat inflation" is complicated by the difficulties in forecasting future prices. For example, real estate prices are subject to wide fluctuations. While the general trend in the Phoenix metropolitan region has been for prices to rise, there have been "booms" and "busts." Particularly unfortunate timing of right-of-way purchases can lead to paying more for properties that could be had for less at a later date. When it comes to highway construction costs the case for accelerating expenditures has not been aided by their decline relative to the general price level over the last decade. One could make the argument that since "later" dollars may have bought relatively more than "earlier" dollars, delaying construction would have been more financially advantageous than accelerating it. Therefore, the "repayment in cheaper dollars" argument may not always apply.

Enhanced stability.

Once a project is budgeted and funded through a bond issuance, the issuing agency's future obligations are known with certainty. This may allow more efficient capital budgeting and planning of projects. Minimum revenue targets will have to be met to service the obligations. If cash flows are managed sufficiently so that the agency's obligations will be easily met even in the face of uncertain revenue streams, bonding can be a valuable tool for smoothing expenditures over time. With the bond proceeds in-hand, the highway agency could concentrate on planning and implementation of capital projects without fearing disruption of work in progress due to an unexpected shortfall in revenue.

The main disadvantages of debt financing (relative to pay-as-you-go) are as follows:

Interest costs.

The interest expense of servicing debt is perhaps the most recognized drawback to debt financing. Total expenditures for a debt financed project will often be more than twice that required under the pay-as-you-go approach. Interest expenses will consume the funds that might otherwise have been available for other projects in the future.

A Texas study[2] examined bonding as a method of financing for highway finance. The researchers' method used a net user benefit analysis to examine the impact of bonding on the highway system. This study concludes that that the use of bonds will lead to deterioration of the highway system over time if available revenues remain at current levels. The negative impact is predicted to increase dramatically at higher levels of bond use. User costs are found to decrease

[2] Evaluation of Bonds for Financing State Highway Expenditures, Research Report 1362-2F, Texas Transportation Institute, Texas Department of Transportation, November 1995.

immediately following completion of projects, resulting in short term gains in net benefits to users. After a short period, however, user costs increase substantially as the debt plus interest is repaid, resulting in a net reduction in user benefits over time. This result holds under several different bonding strategies examined by the authors.

Encumbered future revenues.

Related to the above discussion concerning interest costs, the fact is that given a fixed amount of revenues available over time for capital construction, bonding will necessarily require that a tradeoff take place: fewer total projects can be completed, but those that are will be completed sooner. There are several ways to look at this dilemma, many of which become intractable. There are many costs and benefits to consider when trying to determine the optimal method of financing expenditures.

Practical limits on the amount of debt that can be issued.

Issuing excessive amounts of debt can impair the credit standing of government agencies, place severe limits on future expenditures, sometimes leading to financial crises. Perceived default risk increases with levels of debt, damaging credit worthiness which will lead to higher future borrowing costs. The eventual result in the worst case might be that future borrowing becomes unavailable and taxpayers will be required to fund a bail out measure. These occasions have proven to be politically unpopular in the past.

III. Survey Results

A survey was sent to all of the states' DOTs. The surveys were sent to state DOT employees who hold senior positions and are involved in financing decisions. Twenty-nine of the fifty states responded to the survey. Survey respondents were asked to self select as either a state that bonds or a state that does not bond.

Highlights of the survey results are discussed below. The survey results are summarized in the tables that follow.

No Bond States
Ten of the twenty-nine respondents classified themselves as no bond states.

Legal Limits?
Of these ten states only four face legal limits on bonding.

Is Debt Desirable?
Two of these ten states indicated that bonding is a desirable policy. Some of these states such as Texas and California have bonded in the past and currently have outstanding debt. Texas plans to bond in the future.

Most Pressing Problem?
Generally, these states indicated that their most pressing problem was the need for new construction projects coupled with significant revenue shortfalls and uncertainty concerning federal funding.

Any Innovative Techniques Used?
Most of these states indicated that they are using some form of the following innovative financing techniques: SIBs, Advanced Construction Authorization, or public-private partnerships.

Any Innovative Techniques that are Desirable?
Six of the ten states either currently operate or expressed interest in State Infrastructure Banks (SIBs.)[3]

[3] SIBs are infrastructure investment funds which would be created at the state or regional level. A SIB would initially be funded by state and/or Federal aid money. The fund would be used to provide a menu of loan and credit enhancement assistance to the sponsors of transportation projects, e.g. local governments.

States That Do Not Bond

State	Legal Limits	Is Debt Desirable	Most Pressing Problem	Innovative Techniques Used	Innovative Techniques that are Desirable
Arkansas	Yes	No comment	road deterioration	No	No
California	No	No	Recovering from early 1990's recession.	Yes: Borrowing against future Federal apportionment.	No
Colorado	Yes	No	Revenue shortfalls and growth in demand.	Advance construction, private partnerships, SIB.	Privatization (construction and maintenance).
Iowa	Yes	Yes	NR	NR	NR
Pennsylvania	No	No	Limited growth tax base, lack of flexibility in Federal Funds.	Advance construction, private partnerships, SIB.	Continued Federal Funding of SIBs.
South Dakota	Yes	No	Uncertainty of future Federal funds.	Advance construction procedures.	SIB and private partnerships.
Tennessee	No	No	Major route construction.	No	State Infrastructure Banks (SIB)
Texas	No	Yes, (TX will be bonding in the future)	TxDOT can currently finance only 33% of its needs	Cash Forecasting System; SIB	
Vermont	No	No	More Federal funds needed	Advance Construction; SIB	Waiver Funding
Wyoming	No	Maybe	NR	NR	NR

States that Bond
Nineteen of the twenty-nine respondents classified themselves as states that bond.

Legal Limits?
Of these nineteen states, fifteen face legal limits on bonding.

Is Debt Desirable?
Fourteen of these nineteen states indicated that bonding is a desirable policy. Only two of these states, Maine and Mississippi, indicated that bonding is always an undesirable policy.

Most Pressing Problem?
Generally, these states indicated that their most pressing problems were securing funds from the federal government and general revenue shortfalls. Florida expressed concern about being a net donor to the federal system.

Any Innovative Techniques Used?
Most of these states indicated that they are using some form of the following innovative financing techniques: SIBs, Advanced Construction Authorization, toll based debt financing, emphasizing the sale of bonds to in-state retail investors, and public-private partnerships.

Any Innovative Techniques that are Desirable?
Development fees, increased private funding, and the leasing of interstate rest areas were listed by some of the states as innovative techniques that they would like to try. New York and Washington indicated that the notion of "innovative financing techniques" is essentially bogus. They believe that there is no "free lunch." That is, there is no avoiding the real cost of capital investment and maintenance. Also, if bonds are issued, one way or another the interest on them has to be paid.

The results of the survey are summarized in the following tables.

States That Bond

State	Legal Limit	Amount of limit	Decision process	Desirable	Most Pressing Problem	Innovative Techniques Used	Innovative Techniques that are Desirable
Arizona	Yes	$800 million for HURF debt other debt is limited by revenue coverage ratio requirements	Based on cash flow needs	Yes. Allows ADOT to accelerate projects and provide more benefits sooner	Large gap between needs and resources	state infrastructure bank, Grant anticipation notes, and advance construction	expand upon existing innovative techniques
Connecticut	Yes	two times coverage for pledged revenues against debt services required	bond issuance schedule structured to meet the cash flow requirements of bond program	Yes	working to maintain the Federal commitment of resources	phase funding and Advanced Construction Authorizations	no comment
Florida	Yes	$1.5b		Yes	Donor to Federal system	Toll based debt financing, bonding for advance purchase of rights-of-way, SIB.	
Hawaii	Yes		Legislature	Yes		Developers pay for certain projects.	
Illinois	Yes		Legislature	Yes	Funding for maintenance.	No	No

Kansas	Yes	$890m		Yes		Emphasized sale of bonds to in-state retail investors.	SIB
Kentucky	No		Existing backlog of unfunded needs	Yes	Tax revenue growth fails to keep pace with increasing use and costs	No	Tax increment financing; Development fees
Louisiana	Yes	appropriated from $200m state limit	Legislature	Yes	Inadequate funds to address backlog of immediate needs	SIB implementation pending; cash flow management of multi-year projects	Leasing of interstate rest areas for additional revenues
Maine	No		Policy is not to issue more debt then is being retired in a biennium.	No	Aging infrastructure .	Toll based debt financing.	
Michigan	Yes	50% of transportation funds.		Yes		SIB	No
Mississippi	Yes	$500m cap		No	Insufficient revenues to fund highway program	FHWA advance funding procedures	No
Montana	Yes	$150m	Advanced construction and to defer outstanding bonds	Yes	funding levels below needs	Soft match with local governments and private parties	adjusting financial strategies dependent on circumstances
New Jersey	Yes	$700m new debt annually	Financial Advisor	By virtue of NJ Laws of 1984	no comment	no comment	
New Mexico	Yes	$150m		Yes		Private sector funds.	More private funding, warrantees on projects.
New York	Yes		Referenda			No	No, there are no truly "innovative" techniques.
North Carolina	Yes	$950m		Yes	Funding for maintenance.	Federal advance construction.	
Ohio	Yes	$1.2b cap	Individual situation and circumstance s	Depends	Needs exceed resources	SIB	No

Utah	Yes	G.O. Bond limits for State	Project size	Yes	Funding for urban interstate system	SIB: Private and public partnerships	No
Virginia	No			Yes	Obtaining an equitable share of Federal Funding.	Toll revenue and toll revenue bonds.	Private partnerships.
Washington	No			Yes		SIB and private partnerships, neither is actually being used.	No, "there is no free lunch"

IV. Highway Finance Trends 1985 to 1996

Each year the US Department of Transportation publishes Highway Statistics, which includes details on each state's highway finance practices. Considered over time, this data might offer insights as to how state policy makers may or may not have altered their views towards the appropriate use of debt to finance state highway projects. This appears to be true when the data is considered on a state by state basis. The data below captures several measures of overall debt level, comparing these levels in 1985 to the same measures in 1996.

When considering individual states finance practices at two points in time spanning more than a decade, it appears that some states (Arkansas, Colorado, Missouri, North Dakota, South Dakota, and Wyoming) had no outstanding debt in either 1985 nor 1996. Other state's debt policies appear to have changed over this timeframe. This would be evidenced by the fact that in 1996, some states were carrying much higher levels of overall debt relative to revenues while other states had lowered their overall level of debt. A useful measure to compare different states' willingness to utilize debt financing is the debt/revenue ratio. That is, a state with a higher ratio could be interpreted as a "debt-friendly" state; i.e. these states would appear to be more willing to bear the burden of debt. A lower ratio might then be interpreted as indicating an aversion to debt.

The data seem to support the hypothesis that states' attitudes towards debt financing may have changed in diverse ways during the time period 1985 to 1996. Alabama, Alaska and Louisiana for example, reduced their debt/revenue ratios significantly during this time period (from 41.8% to 5.4 %, 59.9 % to 1.4 %, and 194.3% to 53.8%, respectively). Several states significantly increased the amount of debt they were willing to carry relative to the state highway revenues.

When the data below is aggregated, we find that in 1985 the average Debt/Revenue ratio was 51.7 %. This ratio increased to 61.3 % in 1996. However, during this same time period, the average portion of revenues used to service debt (Interest Expense/Revenue) actually decreased from 3.5 % to 3.3 %. This can be explained by two factors. On the one hand, interest rates were lower in 1996 than 1985. On the other hand, increases in tax receipts might persuade states that they could more easily carry higher debt amounts. It is possible that while each state has many factors to consider (both financial and political) when making financing decisions, that one of the most important factors driving the financing decision is the cost of borrowing.

One must be careful to not draw too many conclusions from this type of aggregated data. Different states follow different financing practices. For example, in California much of the urban freeway construction is funded by local government debt. In Arizona, urban freeways are funded by state debt. Without knowing this one might conclude that Arizonans are further in debt than Californians. The truth is, we don't have enough information to reach such a definitive conclusion.

State	1996 Debt Outstanding ($1,000)	96 Revenue Net of Bond Receipts ($1,000)	1985 Debt Outstanding ($1,000)	85 Revenue Net of Bond Receipts ($1,000)	Net Change In Debt 85 to 96 ($1,000)	85 Interest And Admin. ($1,000)	96 Interest and Admin. ($1,000)	85 Debt/ Revenue Ratio	96 Debt/ Revenue Ratio	85 Interest Expense/ Revenue	96 Interest Expense/ Revenue
Alabama	55,782	1,040,527	336,690	805,144	(280,908)	38,540	3,006	41.8%	5.4%	4.8%	0.3%
Alaska	6,455	453,482	205,496	343,298	(199,041)	15,567	510	59.9%	1.4%	4.5%	0.1%
Arizona	1,477,081	1,467,624	196,010	783,270	1,281,071	17,076	99,645	25.0%	100.6%	2.2%	6.8%
Arkansas	0	757,302	0	449,747	0	0	0	0.0%	0.0%	0.0%	0.0%
California	56,850	6,484,062	106,075	3,142,479	(49,225)	9,042	2,410	3.4%	0.9%	0.3%	0.0%
Colorado	0	914,400	0	570,178	0	0	0	0.0%	0.0%	0.0%	0.0%
Connecticut	3,132,031	1,048,920	655,448	619,213	2,476,583	53,914	165,008	105.9%	298.6%	8.7%	15.7%
Delaware	818,036	433,334	387,314	206,594	430,722	33,839	46,571	187.5%	188.8%	16.4%	10.7%
District of Columbia	185,666	124,218	175,058	116,107	10,608	22,714	11,403	150.8%	149.5%	19.6%	9.2%
Florida	3,226,810	3,235,884	1,003,427	1,640,119	2,223,383	79,563	206,248	61.2%	99.7%	4.9%	6.4%
Georgia	1,044,445	1,389,603	533,882	1,024,199	510,563	33,521	64,124	52.1%	75.2%	3.3%	4.6%
Hawaii	320,542	342,073	156,517	139,086	164,025	11,256	25,349	112.5%	93.7%	8.1%	7.4%
Idaho	0	391,189	0	231,344	0	0	0	0.0%	0.0%	0.0%	0.0%
Illinois	2,499,871	2,890,973	1,187,017	2,102,070	1,312,854	85,976	141,204	56.5%	86.5%	4.1%	4.9%
Indiana	597,950	1,425,531	256,970	881,378	340,980	30,825	37,493	29.2%	41.9%	3.5%	2.6%
Iowa	0	1,126,981	3,520	12,446	(3,520)	120	0	28.3%	0.0%	1.0%	0.0%
Kansas	1,081,615	953,834	259,565	516,356	822,050	20,963	56,514	50.3%	113.4%	4.1%	5.9%
Kentucky	1,527,926	1,274,849	1,108,950	822,066	418,976	98,699	78,846	134.9%	119.9%	12.0%	6.2%
Lousianna	738,369	1,371,303	1,455,887	749,375	(717,518)	97,111	143,005	194.3%	53.8%	13.0%	10.4%
Maine	249,550	416,416	93,230	241,383	156,320	7,850	13,274	38.6%	59.9%	3.3%	3.2%
Maryland	508,853	1,397,361	516,444	1,027,152	(7,591)	46,600	25,770	50.3%	36.4%	4.5%	1.8%
Massachusettes	3,050,034	1,733,473	965,585	708,702	2,084,449	62,200	142,439	136.2%	175.9%	8.8%	8.2%
Michigan	726,910	1,904,397	199,572	1,303,966	527,338	19,641	35,588	15.3%	38.2%	1.5%	1.9%
Minnesota	86,365	1,325,860	211,642	1,030,673	(125,277)	18,322	2,731	20.5%	6.5%	1.8%	0.2%
Mississippi	6,610	725,664	488,974	506,701	(482,364)	48,089	853	96.5%	0.9%	9.5%	0.1%
Missouri	0	1,413,364	0	792,303	0	0	0	0.0%	0.0%	0.0%	0.0%
Montana	86,405	383,922	107,675	259,267	(21,270)	6,930	4,706	41.5%	22.5%	2.7%	1.2%

Nebraska	0	641,274	4,000	364,375	(4,000)	289	0	1.1%	0.0%	0.1%	0.0%
Nevada	59,820	451,806	10,000	242,963	49,820	1,133	4,929	4.1%	13.2%	0.5%	1.1%
New Hampshire	359,821	319,098	114,750	228,907	245,071	11,889	20,313	50.1%	112.8%	5.2%	6.4%
New Jersey	5,305,475	2,113,655	3,515,745	1,263,625	1,789,730	122,338	300,566	278.2%	251.0%	9.7%	14.2%
New Mexico	36,835	546,466	90,529	383,829	(53,694)	8,048	1,714	23.6%	6.7%	2.1%	0.3%
New York	6,094,821	4,005,577	1,286,428	2,048,107	4,808,393	52,415	207,718	62.8%	152.2%	2.6%	5.2%
North Carolina	4,895	1,924,314	264,500	924,214	(259,605)	20,292	584	28.6%	0.3%	2.2%	0.0%
North Dakota	0	275,575	0	196,442	0	0	0	0.0%	0.0%	0.0%	0.0%
Ohio	850,450	2,809,704	294,808	1,645,948	555,642	24,350	38,978	17.9%	30.3%	1.5%	1.4%
Oklahoma	668,650	890,689	182,705	668,266	485,945	9,896	39,907	27.3%	75.1%	1.5%	4.5%
Oregon	28,635	995,430	34,850	529,058	(6,215)	2,339	1,995	6.6%	2.9%	0.4%	0.2%
Pennsylvania	2,515,181	3,005,152	1,899,367	2,416,484	615,814	113,936	136,292	78.6%	83.7%	4.7%	4.5%
Rhode Island	326,460	260,902	138,294	148,775	188,166	8,352	15,601	93.0%	125.1%	5.6%	6.0%
South Carolina	50,000	684,082	26,897	439,969	23,103	1,739	684	6.1%	7.3%	0.4%	0.1%
South Dakota	0	289,135	0	204,537	0	0	0	0.0%	0.0%	0.0%	0.0%
Tennessee	790	1,297,313	80,430	774,234	(79,640)	3,993	149	10.4%	0.1%	0.5%	0.0%
Texas	881,610	4,182,103	342,533	2,449,088	539,077	27,441	37,475	14.0%	21.1%	1.1%	0.9%
Utah	0	547,030	25,000	378,018	(25,000)	2,900	0	6.6%	0.0%	0.8%	0.0%
Vermont	24,025	183,244	55,156	136,520	(31,131)	3,612	1,385	40.4%	13.1%	2.6%	0.8%
Virginia	1,008,653	2,087,987	255,168	1,143,128	753,485	20,446	55,005	22.3%	48.3%	1.8%	2.6%
Washington	941,610	1,690,771	693,095	986,062	248,515	56,726	51,307	70.3%	55.7%	5.8%	3.0%
West Virginia	307,085	861,062	682,437	575,845	(375,352)	39,070	15,199	118.5%	35.7%	6.8%	1.8%
Wisconsin	771,271	1,311,354	142,440	703,439	628,831	9,354	37,523	20.2%	58.8%	1.3%	2.9%
Wyoming	0	285,250	0	285,076	0	0	0	0.0%	0.0%	0.0%	0.0%
Totals	41,720,243	68,085,519	20,750,080	40,161,525	20,970,163	1,398,916	2,274,021	51.7%	61.3%	3.5%	3.3%

V. Literature Review

Introduction

Financing government expenditures must ultimately come from some source of revenues. Therefore, "debt financing" is really not a true form of financing. It is simply a way of moving the completion of capital projects forward in time and the financing of those projects backward in time. Because of this, many studies on highway or transportation financing options ignore bonding all together or mention it only tangentially and focus on alternative sources of pay-as-you-go revenues. Examples of such studies include:

Eight Ways to Finance Transit: A Policymakers Guide, National Conference of State Legislatures, January 1994

An Inventory of Innovative Financing Techniques for Transportation, Gary T. Johnson and Lester A. Hoel, U S Department of Transportation, 1985

Financing Urban Transportation Improvements, Report 3: A Guide to Alternative Financing Mechanisms for Urban Highways, Federal Highway Demonstration Report Number: FHWA/PL/84/001, June 1984

Road Investment to Foster Local Economic Development, David J. Forkenbrock, Thomas F. Pogue, Norman S. J. Foster, David J. Finnegan, The University of Iowa Public Policy Center, May 1990

State and Local Highway Finance: Where Does the Money Come Form and Why Isn't There Enough? Legislative Finance paper # 78, Ronald K. Snell, National Conference of State Legislatures, September 1991

Principles of Highway Finance, Marshall F. Reed, Jr., Highway User Federation 1981

Financing Roads, Streets and Highways in Nebraska, A. L. (Roy) Fredrick, Institute of Agriculture and Natural Resources, university of Nebraska - Lincoln, August 1992

The US Department of Transportation has released several studies on highway finance[4]. While not specifically addressing the relative costs and benefits of bonding, these studies make some important points about bonding. Specifically, they point out that bonding is a useful tool for state or local governments with large-scale capital needs. Also, the fact that legal limitations on bond issuance can be avoided is discussed at length. Channeling bond sales through agencies free of debt restrictions or "lease back" arrangements that effectively disguise debt issues as

[4] See for example: Evaluation of Innovative Financing Techniques: Knoxville, Tennessee's Experience, US DOT, June 1984 and Bond Financing and Transportation Infrastructure: Exploring Concepts and roles, US DOT, Policy Discussion Series #9, February 1994

leasing arrangements are seen as the most common ways to avoid these restrictions. Under lease back arrangements such as Certificates of Participation or Equipment Trust Bonds, private investors purchase capital and lease it back to the government agency. The lease payments are structured in such a way that the return the investors receive (and the pay-out the agency makes) is identical to what they would have received by purchasing bonds from the agency, if the agency had issued bonds to finance the relevant project.

The American Association of State Highway and Transportation Officials has published studies concerning highway finance issues[5]. These studies give very detailed descriptions of the various bonding options. However, their discussion of the bonding vs. pay-as-you-go decision is limited to the obvious statement that: "The balance of bonds vs. pay-as-you-go resources must address cost, equity, and political acceptance in responding to the needs of the states."

The Texas Transportation Institute has produced a great deal of research on transportation issues. A 1993 study[6] identified two principle problems with debt: 1) If agencies incur debt in anticipation of hypothetical development, future generations may be left with a debt burden that strains the ability to repay it if the hypothetical development fails to pan-out. 2) The same result can occur if debt is used simply to avoid or postpone difficult fiscal decisions as opposed to using it in a prudent and reasoned manner.

Another Texas study[7] examined bonding as a method of financing highway finance construction. The researchers' method used a net user benefit analysis to examine the impact of bonding on the highway system. This study concluded that that the use of bonds will lead to deterioration of the highway system over time if available revenues remain at current levels. The negative impact is forecasted to increase dramatically at higher levels of bond use. User costs are found to decrease immediately following completion of projects, resulting in short term gains in net benefits to users. After a short period, however, user costs increase substantially as the debt plus interest is repaid, resulting in a net reduction in user benefits over time. This result holds under several different bonding strategies examined by the authors.

An Economic Perspective

Is government debt financing a fundamentally flawed economic policy?

Are bond-financed deficits inflationary (i.e. will they affect economic output)? The 19th century economist David Ricardo proposed that under certain simplifying assumptions, aggregate output will be unaffected by the decision to finance government expenditures by issuing bonds rather than imposing taxes. "Ricardian equivalence" refers to the result obtained by

[5] See: Debt Financing, Thomas W. Bradshaw in Understanding the Highway Finance Evolution/Revolution, American Association of State Highway and Transportation Officials, January 1987

[6] Financing Alternatives for Texas Highways, September 1993, Texas DOT, Project 1277

[7] Evaluation of Bonds for Financing State Highway Expenditures, Research Report 1362-2F, Texas Transportation Institute, Texas Department of Transportation, November 1995.

some theoretical models that people will correctly take into account of the effects on future budgets of current budgetary actions. There are two critical assumptions necessary to arrive at this result. First, people must care about the welfare of future generations. Second, people must be aware of the effects government debt will have over time on their future consumption/savings alternatives. McCallum (1984) believes both assumptions to be reasonable.[8] Other complicating aspects are ignored that could significantly alter the validity of the argument: uncertainty, distribution effects and multiple interest rates. McCallum argues that this is true of most policy-oriented theoretical analyses of macroeconomic phenomena.Thus, economic theory would suggest that bond-financed deficits could be non-inflationary.

Is the situation different in the case of a permanent deficit, financed by indefinitely continuing issuance of bonds? In this case, as the deficit continues the amount of outstanding bonds will continue to grow indefinitely. Barro (1976) argued that under these circumstances the Ricardian equivalence argument breaks down.[9] Barro suggests that the growth rate of the stock of bonds cannot exceed the economy's output growth rate. The government's ability to issue bonds will be constrained by its ability to collect future taxes, which is constrained by the value of future output. Similarly, Sargent and Wallace (1981) have argued that the real stock of bonds will grow faster than the size of the economy when the interest rate on bonds is greater than the economy's growth rate.[10] This is unsustainable, because the demand for bonds will be limited by the size of the economy, thus placing a limit on the supply of bonds.

McCallum's analysis assumes a zero growth economy and population and no depreciation. His analysis reveals that the Barro and Sargent-Wallace contentions are correct when deficit is defined to be exclusive of interest payments on current debt. However, under conventional definitions "deficit" includes current interest payments. In this case a constant, positive deficit can be financed entirely by bond sales with no resulting inflation. Furthermore, a positive growth rate of bonds outstanding can be maintained permanently if the growth rate is smaller than the rate of time preference.

Barro's (1976) suggestion that government debt cannot permanently grow at a rate above the economic growth rate is contradicted. This is based upon the presumption that tax collections cannot forever grow at a rate faster than output. The McCallum model recognizes the interest payments on the debt as disposable income. This would imply that government tax collections could actually exceed output yet be smaller than each household's disposable income.

Maintaining sustained government deficits is not an inherently flawed economic policy. This is not a claim that unbounded debt growth is feasible in actual economies. Sustained deficits may have inflationary results. In reality there will be significant complications that prevent

---

[8] McCallum, Bennett T, "Are Bond-financed Deficits Inflationary? A Ricardian Analysis", Journal of Political Economy, 1984, vol. 92, no.1, pp.123-135.

[9] Barro, Robert J., "Reply to Feldstein and Buchanon", Journal of Political Economy, April 1976, vol.84, pp. 343-49.

[10] Sargent, Thomas J., and Wallace, Neil, "Some Unpleasant Monetarist Arithmetic", Federal Reserve Bank of Minneapolis Quarterly Review, Fall 1981.

continuous debt financing from being an optimal policy choice. The choice between issuing debt or raising taxes requires an analysis of the relevant costs and benefits of each alternative.

Turnovsky[11] makes the subtle but important point that restricting analysis of societal benefits to steady states can be misleading since societal benefits along "transitional paths" may differ substantially for different policies. In other words, simply comparing the end results of different policies is not sufficient. This is because societal benefits may differ substantially during the time period from when the policies are implemented and their end results are realized. For example, when deciding whether to bond or pay-as-you-go to build a stretch of highway the end result is essentially the same: The stretch of highway gets finished. However, this does not mean that the two policy options yield the same benefit to society. Because under the bonding option the stretch of highway could be completed sooner (our assumption) society benefits more from the bonding option than the pay-as-you-go option. The objective of this study is to compare the benefits of accelerated project completion afforded by bonding with the costs of bonding.

If a specified amount of government spending must be financed, how should that finance be divided between taxing and government borrowing?

Unfortunately, economic theory does not offer a definitive answer to this question. There are several viewpoints that would favor one financing alternative over the other. Some arguments are based on relative economic efficiency of funding decisions. Other viewpoints consider the relative burdens of debt financing on future generations to taxing increases on current generations. Some of the more prominent modern day economic theories will be briefly detailed here.

Incidence of Debt Financing

There are many factors that may be considered in the bonding vs. current taxation decision. In the 19th century economists advocated balanced budgets. The reasoning for this policy was based on the 'benefit principal' of taxation: the belief that those who benefit from government spending should be forced to bear the costs of the outlays. It was also believed that balanced budgets would force governments to more closely examine the costs and benefits of government.

It is generally agreed that bonding is inappropriate for funding current consumption of goods and services. Buchanan's[12] view is that the issue of government debt centers on what individuals gain and lose from alternative financing schemes. For a proposed financing scheme to be appropriate, all affected individuals must anticipate net gains from the combination of

[11] Alternative Forms of Government Expenditure Financing: A Comparative Welfare Analysis, Stephen J. Turnovsky, Economica, 59, 235-52, May 1992

[12] Congleton, Roger D., " An Overview of the Contractarian Public Finance of James Buchanan", Public Finance Quarterly, Vol. 16 No. 2, April 1988

government services and financial obligations at issue. Since debt issues affect both present and future generations, debt will only be appropriate if benefits will accrue to both groups.

Buchanan's various analyses of the politics of debt finance uniformly imply that collective decisions tend to shift excessive amounts of the burden of financing current programs to future generations. Future generations will typically service a greater debt load than they would have been inclined to accept. Debt financing might lead politicians to an increase spending that might otherwise not receive public support. Debt in this view is a form of "hidden taxation". It was Buchanan's view that deficit financing imposes a net burden on future generations. It was his view that the bondholders (who are also taxpayers) do not gain from interest payments by the government because they could have purchased private assets and received similar returns. Therefore the future taxpayers bear a burden of paying higher taxes to finance interest payments and the repayment of the debt principal.

Buchanan's views opposed the then popular idea that the burden of debt finance takes place at the time the debt is issued. Public expenditures shift allocation of fixed resources from the private sector, reducing the output of private goods and services. In other words, present generations are foregoing current consumption of private goods and services for the sake of future generations. Therefore, there is not a net burden on society because any tax increase will fall on the future generations who also receive the benefits when the debt has to be repaid.

If taxpayers know that debt financing will induce higher taxes in the future, it is possible that they feel the burden in the present. If taxpayers are well informed about how current fiscal policy will affect them in the future, then perhaps the two views can be reconciled.

Economic Efficiency

What is the economically efficient combination of debt and current taxation? An economically efficient policy will have the effect of maximizing social benefits while causing minimal disruption to the economy. Previous analyses of this type have focused on the corresponding costs of each financing method. Both methods have "excess burdens" associated with policy implementation. One line of reasoning has that any temporary increase in government spending should be financed by a debt issuance. Taxes should only then be raised enough to finance the interest on the increased public debt. This result is based on the observation that the excess burden of taxation depends on the square the tax rate. It then follows that a large number of small increases in taxes would be preferable to a single large increase in the tax rate to finance the initial spending.[13]

Feldstein (1985) raised the issue that the above argument ignores the possibility that an increase in the public debt involves an additional excess burden.[14] Feldstein's study concludes

[13] This argument can be found in Barro, Robert J., "On the Determination of the Public Debt", Journal of Political Economy, 1979, vol.87.

[14] Feldstein, Martin, "Debt and Taxes in the Theory of Public Finance", Journal of Public Economics, 1985, vol.28.

that the debt-finance advantage of a small increase in taxes can be balanced against the disadvantage of the excess burden that arises from additional debt. His analysis shows that, with plausible parameter values, the excess burden of debt finance is likely to outweigh the advantage of avoiding a large single tax change. Therefore, financing a temporary increase in government spending by an immediate tax increase is likely to be preferable to debt financing. Additionally, the study finds that a permanent increase in government spending cannot be financed by a permanent increase in government debt.

VI. Model Methodology

Given that there is no clear-cut single answer to the question of whether pay-as-you-go or bonding should be the preferred method of funding highway construction, we have compiled a spreadsheet model that can be used to help decision makers choose a financing strategy. A hypothetical future funding scenario will be discussed in this report. Readers who would like a copy of the model with which to explore hypothetical options of their own choosing may obtain one by contacting John Semmens, Arizona Department of Transportation Research Center, 1130 N. 22 Ave., Phoenix, Arizona 85009; phone: 602-712-3137; e-mail jsemmens@dot.state.az.us.

The model included with this report is meant to compare the prospective net benefit to society of pay-as-you-go vs. borrowing highway financing approaches. The net benefit is measured in two ways. One is an estimate of the net present value of the benefits enjoyed by users and costs incurred to build the highways constructed under each approach. The other measure is simply the projected total number of miles of highway that can be built using each approach.

The model evaluates a long term financing plan. The bonds are assumed to be twenty year bonds. Thus, in order to incorporate the full effects of the bonds; the model determines the costs the bonds impose and the benefits the bonds afford over a forty year period. This time period was chosen as the minimum acceptable timeframe for comparing the pay-as-you-go and borrowing approaches. Any shorter period would yield misleading results because it would exclude at least a portion of the "payback" period necessitated under the borrowing approach. Borrowing allows the attainment of early benefits at the expense of shifting some of the costs into the future. A balanced analysis requires that these future costs be included. The specofic minimum period that must be considered depends upon the years to maturity of the borrowed money. Twenty-year bonds require an analysis timeframe in the forty-year range. Thirty-year bonds would require an analysis in the sixty-year range.

In addition to inputting the amounts to be bonded, the user inputs assumptions about interest rates, inflation, traffic volume, highway construction costs and user benefits for the next forty years. More details on these inputs, as well as the model's outputs will be discussed below.

The model comes in two versions. Version A assumes that interest is paid on the bonds at the beginning of each of the twenty years and the principal is paid off in a lump some at maturity. Version B assumes that the principal is amortized over the twenty year life of the bond. This amortized amount is included with the interest to determine the annual payment.

The model discounts all of the costs and benefits in order to estimate a net present value. This is a common practice in economic and financial analysis. The dollar value of costs and benefits that occur sooner have a greater weight than those that occur farther out in the forty year time horizon. Due to both inflation and the opportunity cost of money, dollars received or paid in the future are not worth as much as dollars received or paid in the present. Thus, the net benefit

the model produces is the present value today of the total net benefit over the entire analysis period. The discount factor the model employs is a user adjustable input.

The model implies that bonding will increase the net monetary value of the highway constructed. This is because bonding allows for the construction to be completed sooner. Thus, the public can begin benefiting from the highway at an earlier date. However the total miles of highway that the state can afford to build over the forty years declines as bonding increases. This is because the bonds must be paid back, with interest. Therefore, in future periods there will be less money available for construction if bonds are used in the earlier periods.

The results of the model are consistent with the idea that bonding affords real benefits in the short run. These benefits do not come for free however; they come at the cost of a reduction in funds available for construction in the long run. Whether the short term benefits that bonding affords outweighs bonding's long term costs is an issue that policy makers will always struggle with. The model included with this report will allow policy makers to make a more informed decision.

Model Inputs

For purposes of illustration, this write-up uses the MAG urban freeway system as its base. However, there is no inherent reason why the model could not be used for any large highway program. All the model user would need to do is adjust the inputs to reflect the different data that would be needed for a different program--different traffic, different costs of construction, and different tax revenue projections.

ADTs per mile: This gives the number of ADTs per mile for each *new* mile of highway constructed. The figure of 65,000 used in the hypothetical example shown in Appendix B was based on historical data from the urban freeways in the Phoenix region. This figure is intended to represent an average of 365 days in the year, not just weekday traffic. Users of the model may wish to input different figures. The larger the ADTs, the larger the benefits to users will be.

Interest Rate Paid: This is the interest rate that the highway agency is expected to pay on any new bonds that would be issued to fund construction. A figure of 5% was used in the hypothetical example. It is believed that 5% is close to the rate currently applicable to ADOT bonds. Users of the model may wish to input other interest rates. It is recommended that model users make a conscientious effort to choose a realistic interest rate to input. The higher the interest rate assumption, the greater will be the cost of borrowing. The interest rate paid is only relevant in the borrowing option. It does not affect the outputs in the pay-as-you-go option.

Interest Rate Received: This is the interest rate received by the state on the bond proceeds it does not spend in a given year. A figure of 4% was used in the hypothetical example. Users of the model may wish to input a different rate. The higher this rate of interest, the less burdensome

borrowing will be since the earnings from these deposits serve as a partial offset to borrowing costs. The interest rate received is only relevant in the borrowing option. It does not affect the outputs in the pay-as-you-go option.

Cost Per mile: This is the cost to build a mile of highway at year one (the model will adjust the initial number for inflation in subsequent years.) A starting figure of $25,000,000 per mile was used in the hypothetical example. This figure is believed to be a reasonable average cost per mile estimate for urban freeway construction in the Phoenix region. Model uders may wish to input other cost estimates. The higher the cost of construction, the lower the net benefit will be since costs are subtracted from benefits to get a "net" value.

Value per VMT: This is the value to highway users for each mile they travel. A figure of 30 cents per vehicle mile of travel was used in the hypothetical example. The fundamental premise for using this figure was that the value of using the roadway would be at least equal to the costs users incurred to use it. This premise is founded in consumer value theory. The idea is that the item purchased (in this case the highway-based transportation) must be worth more than its cost to the purchaser. In order to use the highways, drivers must incur the cost of owning and operating a vehicle. An estimate of these costs for the current mix of non-commercial vehicles on Arizona's roads was calculated from Motor Vehicle Division data on the age of the vehicles currently registered in the state, vehicle ownership and operating costs estimated by the American Automobile Association, and the authors' assumptions concerning depreciation and decisions made by auto owners. The calculated per vehicle mile cost for autos was 27 cents. The estimate for commercial vehicles was based upon data from the "Census of Transportation." The calculated cost per vehicle mile for commercial vehicles was 44 cents. An aggregate figure of 30 cents per vehicle mile of travel was calculated assuming a 13% share of commercial vehicles on urban freeways. Model users may wish to use other figures to estimate the value of user benefits. The higher the user benefits, the higher the net benefits will be.

Inflation Rate: This is the (projected) average annual rate of inflation over the forty years. A figure of 2% was used in the hypothetical example. This is believed to be close to current rates of inflation and compatible with financial markets' implicit estimate of future inflation as represented by the long term U.S. Treasury Bond rate. Treasury Bonds are deemed to be free of non-payment risk. Consequently, the interest rates paid on these bonds is composed of the pure opportunity cost of money (an estimated 3% to 4%) and an inflation premium. Therefore, the nominal interest rate on these bonds minus the opportunity cost of money yields an implicit inflation forecast. Model users may wish to input alternate forecasts of future inflation. While opinions on future rates of inflation may differ, model users are cautioned to avoid inconsistencies between assumed rates of inflation and the rates of interest they expect to pay on borrowed money. It would be imprudent to assume that the rate of inflation is likely to exceed the interest rate on borrowed money. A higher inflation rate will increase both the costs of construction and the future dollar value of benefits accruing to highway users.

Discount Factor: This is the factor used to discount future monetary values to their present values. This is done since a dollar today is worth more than a dollar received at some time in the future. The formula for time discounting is $PV = FV/(1+df)^i$. Where PV = present value, FV =

future value, df = the discount factor, i = the number of years before the FV will be received. In the hypothetical example the discount factor was set at 5%. This figure was chosen because it matches the interest rate that the example expects the highway agency to pay on borrowed money. This matching is recommended as a minimum estimate of the discount factor. It could be argued that since the borrowing rate faced by the highway agency is lower due to the tax-free status of the interest earned on their bonds that its borrowing rate understates the true social opportunity cost of using resources for highway construction. Consequently, there may be a case for using a discount factor that incorporates consideration of taxable uses of capital that must be sacrificed when resources are channeled toward highway construction. In any case, it is never sound to use a discount factor that is lower than the interest rate the highway agency must pay on its bonds. The higher the discount factor, the less value that will accrue to benefits in the future compared to benefits in the present.

Annual Factor 1st year: The annual factors are necessary because the state does not always spend all the money it borrows right away, although it is obligated by federal "arbitrage" law to spend any borrowed funds within 24 months. The borrowed funds that are not spent right away are placed in an interest bearing account and this interest gain must be accounted for in the model. The Annual Factor 1st year gives the average amount of borrowed funds that are bearing interest in the first year, i.e. the average amount that is not paid out in the first year for construction. The average amount is used because pay-out schedules for borrowed funds are typically compiled on a monthly basis and these monthly numbers must be converted to annual numbers for use in the model. The figure used in the hypothetical example is 63%. This is the average amount of bond proceeds that remain on deposit the during first year following the issuance of the bonded debt. Model users may wish to input a different figure. The annual factor is only relevant in the borrowing option. It does not affect the outputs in the pay-as-you-go option.

Annual Factor 2nd year: The Annual Factor 2nd year gives the average amount of borrowed funds that are bearing interest in the second year. The figure used in the hypothetical example is 14%. This is the average amount of bond proceeds that remain on deposit the during second year following the issuance of the bonded debt. Model users may wish to input a different figure. Since the annual factors are averages, the annual factors for the two years combined will not sum to 100%. The annual factors are only relevant in the borrowing option. They do not affect the outputs in the pay-as-you-go option.

Fund Availability of New Bonds: This is the ratio of bond proceeds that can be spent in the first year. Bond proceeds sit in a bank account earning interest cannot simultaneously be spent on construction. Based on figures provided by the AzDOT Financial Management Services group, it is estimated that 60% of bond proceeds are spent in the first year. The remaining 40% are spent in the second year. Model users may wish to use different assumptions regarding bond fund availability.

Maricopa County Transportation Excise Tax: This is the estimated revenue to be collected from the half-cent sales tax for freeways in Maricopa County. The estimate entered in the current model is obtained from the AzDOT Financial Management Services group. This estimate should

be updated whenever necessary. These revenues may be used to pay debt or build highways depending upon whether bonding that pledges these revenues for repayment is used. This tax expires in the year 2006.

HURF MAG Highway Funds: This is an estimate of the amount of Highway User Revenue Funds that are likely to be available for urban freeways in the Maricopa County region. The initial ten years forecast revenues are based on estimates from the AzDOT Financial Management Services group. For the sake of this illustration, figures beyond ten years were projected by the researchers to grow at an 8% per year rate. Users of the model may wish to use other rates of growth or estimates for this revenue.

Borrowed Funds: This is the amount of bonds to be issued to fund transportation projects. The amounts for each year are entered. The model is capable of handling both uniform and varied bonding amounts on an annual basis. The actual data entry should in in thousands of dollars. For example, a plan to borrow one hundred million dollars should result in a model data input number of 100,000. For a pay-as-you-go analysis, zeros would be entered in this category.

Existing Debt Service: This is the amount of revenues that must be committed to debt service for bonds outstanding at the time of the analysis. The larger this amount, the less revenue available for new construction under either the bonding or pay-as-you-go options.

Model Final Outputs

The model outputs shown in this report for illustrative purposes use the MAG urban freeway system as its base. However, there is no inherent reason why the model could not be used for any large highway program. All the model user would need to do is adjust the inputs to reflect the different data that would be needed for a different program--different traffic, different costs of construction, and different tax revenue projections.

Miles Built: This is the total number of miles of highway built over the timeframe that the model examines. The number of miles built is inversely related to the amount of bonding employed. Because bonding incurs an interest cost, the net result will be fewer miles of roadway built over the life of the bonds than if no bonds had been issued.

Net Cost of Miles Built: This is the total discounted cost of highway construction minus the costs of borrowed funds. This cost will be higher when bonding is used because more of the expenditures for highways are made earlier, before discounting significantly decreases the value of the dollars.

Total Interest Expense: In the debt paid at maturity version of the model interest and principal are recorded separately. This is the total discounted amount spent on interest payments over the years the model examines. The larger the bond program, the larger the interest expense will be.

Principal Payments: In the debt paid at maturity version of the model interest and principal are recorded separately. This is the time discounted value of the total principal payments made. The larger the bond program, the larger this figure will be.

Total Debt Service: In the debt amortization version of the model principal and interest payments are combined into one debt service figure. This is the time discounted value of the combined principal and interest payments. The larger the bond program, the larger this figure will be.

Interest Received: This is the time discounted value of the interest gain the state makes on borrowed funds that are not spent right away but that are placed in interest bearing accounts. The larger the bond program, the larger this figure will be.

Net Interest Expense: This is the difference between the total discounted interest expense paid out and the total discounted interest received in the debt paid at maturity version of the model.

Total Cost: This is the total time discounted cost of construction and interest expense over the timeframe examined in the model.

Total User Benefit: This is the time discounted monetary value of the total benefit users receive from the highways constructed over the timeframe covered by the model.

Net User Benefit: This is the "Total User Benefit" minus "Total Cost." This represents the present monetary value of the net benefit society receives from the construction completed over the timeframe covered by the model.

Model Intermediate Outputs

Total Tax Revenue: This is the sum of "Maricopa County Transportation Excise Tax" and "HURF MAG Highway Funds."

Total Revenue: This is the "Total Tax Revenue" plus any "Borrowed Funds." The higher the tax collections and the larger the borrowing, the larger these total revenues will be.

Total Revenue Available for Construction: This gives the total revenue that is available for construction in a given year. It is the sum of "Total tax Revenue," the portion of current years borrowed funds that will be used in the current year (borrowed amount x fund availability of new bonds, estimated at 60% the first year) and the portion of the previous years borrowed funds that will be used in the current year (last year's borrowed amount multiplied by the percentage of fund availability not spent in the first year, estimated at 40%) and interest earned on deposited funds minus any interest expense and principal repayment for both previously existing and new debt.

Cost/Mile Inflation Adjusted: This is the "Cost Per Mile" input adjusted for inflation rates the user enters into the model.

Possible Miles Built: This is the total miles of highway that could be built given the estimated total revenue available for construction, and the inflation adjusted cost per mile. It is "Total Revenue Available for Construction" divided by "Cost/Mile Inflation Adjusted." The higher the inflation, the fewer the number of miles that can be built under either the bonding or pay-as-you-go options.

Net Cost of Miles Built Discounted: This is the total revenue available for construction discounted for the time value of money. Expenditures made in later years have a lower present value that expenditures made in earlier years.

Total Miles: This is the total increase in size of the highway system over the timeframe of the analysis. Each year's possible miles built is added to the previous year's total to get a new running total of mileage constructed within the analysis timeframe.

Additional VMTs per Day: This gives the additional vehicle miles of travel that a given years construction makes possible. It is "Possible Miles Built" times the ADTs per mile input.

Additional VMTs per Year: This is the additional VMTs per day multiplied by 365 days per year.

Cumulative Additional VMTs per Year: This is the sum of all previous years "Additional VMTs."

Value per VMT Inflation Adjusted: This is the Value per VMT input adjusted upwards for inflation estimate the user enters into the model. It is assumed that as the general price level rises the value of driving will rise proportionately. In the absence of evidence to the contrary, we have no basis for assuming a different rate of inflation for this element than for the cost to construct highways. If such evidence were to become available it would be easy enough to create another model variable that could be used.

Total Additional Daily VMT Value: This is the "Total Additional VMTs per Year" times the "Value per VMT Inflation Adjusted."

Total Additional Daily VMT Value Time Discounted: This is "Total Additional Daily VMT Value (In whole #s)" discounted for the time value of money.

Interest Gain: This is the interest earned on borrowed funds that are not spent right away, but are deposited in interest bearing bank accounts.

Interest Gain Discounted: This is the "Interest Gain" discounted for the time value of money.

Interest Expense: In the debt paid at maturity version of the model this is the annual interest payment the state is obligated to make. It is equal to the total debt the state has times the "Interest Rate Paid."

Interest Expense Discounted: In the debt paid at maturity version of the model this is the "Interest Expense" discounted for the time value of money.

Principle Payout: In the debt paid at maturity version of the model this shows the principle that must be paid back. Assuming a 20 year standard term for bonds, it is equal to the value of the bonds issued twenty years earlier. Thus, it is zero for the first twenty years in the debt paid at maturity version of the model.

Principle Payout Discounted: This is the "Principle Payout" discounted for the time value of money.

New Debt Service Payments: In the amortization of debt version of the model this is the annual payment due on new debt issued during the year.

Cumulative Debt Service Payments: This is the sum of annual payments to be made on all debt.

Cumulative Debt Service Discounted: This is the sum of annual payments to be made on all debt discounted for the time value of money.

Debt Coverage Ratio: This is the ratio of tax revenues to cumulative debt service payments. It serves as a measure of credit worthiness. The higher this ratio, the more credit worthy and the easier it will be to sell new bonds.

VII. Using the Model to Examine Hypothetical Scenarios

The models developed with this report can be used to evaluate the effects of many variables on the costs and benefits of bonding. What follows are a few examples as to how changes in the input values can lead to different conclusions about the desirability of bonding.

First consider a scenario where inflation and interest rates are relatively low and the ADTs per day are similar to what we see on Phoenix area highways today. Specifically, the inputs are as follows:

ADTs per mile	65,000
Interest Rate Paid	5%
Interest Rate Received	4%
Cost Per mile	$25,000
Value per VMT	$0.30
Inflation Rate	2%
Discount Factor	5%
Annual Factor 1st year	63%
Annual Factor 2nd year	14%
Fund Availability of New Bonds	60%

Using these inputs, we ran both the model based on amortized payments and the model based on a final "balloon" principal payment under three different debt assumptions. First, there is the "No Debt" assumption where no debt is ever issued. There is also a "Max Debt" assumption where the maximum amount of debt that the ADOT is legally able to issue is issued. This is the amount of debt that makes the $800 million cap sustainable and that keeps the debt coverage ratio greater than two. This comes to $40 million per year starting in 2005 and continuing for the duration of the model's analysis period (until 2043) and zero per year before 2005. The models were also run under a "1/2 Max Debt" assumption where the amount bonded per year is one-half of the amount bonded per year under the "Max Debt" assumption. For each of these assumptions the projected total miles built and net-benefit realized from 1999 to 2043 are presented below:

	Amortized payments		**Pay at Maturity**	
Bonding Strategy	**Miles Built**	**Net Discounted User Benefit**	**Miles Built**	**Net Discounted User Benefit**
No Bonding	212	$9,492,389,000	212	$9,492,389,000
1/2 Max Bonding	211	$9,493,825,000	211	$9,697,310,000
Max Bonding	209	$9,495,262,000	210	$9,902,231,000

In both the amortized and pay-at-maturity scenarios increasing the amount bonded decreases the total number of miles that can be constructed and increases the net benefit to society that the highway construction affords. The total miles built decreases because the real rate of interest (i.e., the interest rate minus the inflation rate) is positive. Since funds that could have been spent on construction are spent on interest payments instead, fewer miles of highway can be built. The net benefit to users of the highways increases as more bonds are issued because the construction of highway miles is completed sooner than it would have been if less bonds had been issued. Thus, users can begin enjoying the benefits of the highways sooner which increases the total benefit they receive over the entire forty-five years that are analyzed.

An interesting implication of this analysis is that the effects of bonding may be minimal. Moving from the no bonding regime to the max bonding regime decreases the miles built by only 1.4% and increases the net benefit to society by only 4.3%.

The results of the model are sensitive to changes in the input values. If we assume that all the inputs above are the same except that the ADTs per day are only 30,000 we get much different results:

	Amortized payments		Pay at Maturity	
Bonding Strategy	**Miles Built**	**Net Discounted User Benefit**	**Miles Built**	**Net Discounted User Benefit**
No Bonding	212	$2,202,705,000	212	$2,202,705,000
1/2 Max Bonding	211	$2,058,615,000	211	$2,154,941,000
Max Bonding	209	$1,914,526,000	210	$2,107,177,000

With this low ADT assumption bonding reduces the total miles built and also reduces the net benefit to society. Since fewer people are using the highways in this scenario, the additional benefit users receive from having the highway completed early is smaller than the cost imposed by the interest payments that bonding necessitates. This implies that bonding may only be justifiable if it is used to improve highway systems that are, or will be, heavily used.

If we assume higher levels of ADTs user benefits increase dramatically. The following table uses the assumptions from above except the value used for ADTs per day is 100,000.

	Amortized payments		Pay at Maturity	
Bonding Strategy	**Miles Built**	**Net Discounted User Benefit**	**Miles Built**	**Net Discounted User Benefit**
No Bonding	212	$16,782,073,000	212	$16,782,073,000
1/2 Max Bonding	211	$16,929,035,000	211	$17,250,120,000
Max Bonding	209	$17,075,998,000	210	$17,718,167,000

The model is sensitive to macroeconomic conditions as well. If we run the model with the following inputs we get much different results:

ADTs per mile	65,000
Interest Rate Paid	11%
Interest Rate Received	10%
Cost Per mile	$25,000
Value per VMT	$0.30
Inflation Rate	8%
Discount Factor	11%
Annual Factor 1st year	63%
Annual Factor 2nd year	14%
Fund Availability of New Bonds	60%

With this "high inflation" scenario both bonding and pay-as-you-go are less attractive. Both the total miles built and the net benefit to society decline. This is because a high inflation rate will dramatically reduces the amount of work that can be accomplished with the projected non-inflation protected resources for most HURF reveune categories. The results of the model using the above inputs are summarized in the following table:

	Amortized payments		**Pay at Maturity**	
Bonding Strategy	**Miles Built**	**Net Discounted User Benefit**	**Miles Built**	**Net Discounted User Benefit**
No Bonding	70	$5,435,932,000	70	$5,435,932,000
1/2 Max Bonding	68	$5,381,568,000	68	$5,418,359,000
Max Bonding	67	$5,327,203,000	67	$5,400,785,000

Bonding would be very beneficial if the inflation rate for right-of-way and highway construction were higher than the interest rate. However, as discussed in section II of this report, such a scenario is unlikely to persist for any appreciable period of time and is extremely difficult to predict. It would be very risky for a highway agency to count on such a scenario.

This section illustrates how the model developed for this report can be used to examine a variety of scenarios. The general conclusions reached from this basic analysis are that bonding makes more sense if it is used to finance construction of highways that will be used heavily and that bonding is more attractive in a low inflation environment than in a high inflation environment. The model is versatile enough that future researchers can use it to examine a variety of other scenarios.

The model included with this report was designed to evaluate general financing decisions. For example, if a state could issue between $0 and $100 million in highway construction bonds, the model could determine what level of bonding produces the greatest potential net benefit to society. The model can make such determinations under a variety of assumptions about the level of inflation, interest rates, traffic volumes, and the value of travel.

The model is not designed to answer more specific questions about financing. For example, the model would not help a state that has already decided to borrow $30 million and must now decide which of a variety of different debt instruments is best to use. Also, the model assumes that all of the money borrowed is used for highway construction. Therefore, if the debt being issued will be used for other purposes, using this model would not be appropriate. The model is designed to evaluate a general financing and construction plan, not the costs and benefits of specific construction projects.

The model included with this report is easy to modify and can, with a little work, be used to evaluate a wide range of scenarios. Examples of potential modifications include: adding debt instruments with different characteristics, allowing forecasted interest and inflation rates to vary over time, evaluating the benefit of activities other than highway construction, and tailoring the costs and benefits of highway construction so that they represent specific projects.

VIII. Conclusions

The decision to bond or not to bond is complex and no broad statements can be made either encouraging or discouraging the use of bonding in all situations. Rather, the decision to bond or to pay-as-you-go must be made on a case-by-case basis where all of the relevant concerns are taken into consideration. However, our research has allowed us to develop the following general conclusions:

1. Bonding is only beneficial when it is used to speed (or facilitate) the construction of capital goods (highways) that will actually provide real benefits to society. The net benefit in our model resulted because real vehicle miles of travel were generated and served by the highways built with borrowed funds.

2. The interest cost of bonding is usually not outweighed by the effects of inflation. While it is true that inflation causes bonds to be paid back in dollars that are worth less than the dollars that the bonds generated when they were issued, this effect is taken into account when interest rates are determined. Investors would not purchase bonds if they felt that the interest rate did not cover the inflation rate and offer a reasonable return. We could find no evidence that the effects of inflation allow governments to issue cost free debt.

3. In the long run, bonding will result in there being less funds available for other uses. Interest payments impose a real cost on bond issuers.

4. There are innovative techniques, such as SIBs, that can be used when issuing bonds. These techniques may reduce the cost of bonding but they can not eliminate it. Thus, even with innovative techniques, the fundamental trade-off between interest cost and accelerated completion of projects that bonds represent must be considered.

5. In a high inflation environment bonding is less attractive than in a low inflation environment. This is because higher inflation implies higher uncertainty and interest rates which increases the cost of borrowing. Also, each dollar bonded for will buy less and will thus produce fewer benefits for society.

6. Continual bonding may result in there being less funds available for other uses, but this effect may be outweighed by the benefits bonding affords. The principal benefit of bonding is that it allows projects to be completed sooner

Appendix A: Survey Database

State: Arizona

Contact Person: Brad Steen

Organization: ADOT Financial Planning

Street Address: 206 S. 17 Ave.

City, State, Zip: Phoenix, AZ 85007

e-mail address: bsteen@dot.state.az.us

Phone #: 602-255-8655

Do You Use Bonding?: Yes

Are There Legal Limits on Bonding?: Yes

Amount of Limit: $800 million on HURF debt, coverage ratios on other debt

Decision Process: Based on cash flow needs

Is Debt Desirable?: Yes, accelerates projects and provides earlier user benefits

What Is the Most Pressing Transportation Problem?:
gap between needs and resources

Are Any Innovative Financing Techniques Used?:
State Infrastructure Banks
Grant Anticipation Notes
Advance Construction

State: Arkansas

Contact Person: Larry Dickerson, C.P.A.

Organization: CFO

Street Address:

City, State, Zip:

e-mail address:

Phone #: 501-224-7052

Do You Use Bonding?: No

Are There Legal Limits on Bonding?: Yes

Amount of Limit: NA

Decision Process: NA

Is Debt Desirable?: No comment

What Is the Most Pressing Transportation Problem?: road deterioration

Are Any Innovative Financing Techniques Used?: No

State: California

Contact Person: Al Halm

Organization: CDOT, Budgets

Street Address: PO Box 942874

City, State, Zip: Sacramento, CA 942874-0001

e-mail address:

Phone #: 916-653-2002

Do You Use Bonding?: No

Are There Legal Limits on Bonding?: No

Amount of Limit: NA

Decision Process: NA

Is Debt Desirable?: No

What Is the Most Pressing Transportation Problem?:
Recovering from early 1990's recession.

Are Any Innovative Financing Techniques Used?:
Yes: Borrowing against future Federal apportionment.

State: Colorado

Contact Person: Tom Talmadge

Organization: CDOT

Street Address: 4201 E. Arkansas Ave.

City, State, Zip: Denver, CO 80222

e-mail address: Tom.Talmadge@dot.state.co.us

Phone #: 303-757-9262

Do You Use Bonding?: No

Are There Legal Limits on Bonding?: Yes

Amount of Limit: NA

Decision Process: NA

Is Debt Desirable?: No

What Is the Most Pressing Transportation Problem?:
Revenue shortfalls and growth in demand.

Are Any Innovative Financing Techniques Used?:
Advance construction, private partnerships, SIB.

State: Connecticut

Contact Person: Charles E. Canane

Organization: CDOT, Bureau Chief

Street Address:

City, State, Zip:

e-mail address: charles.canane@po.state.ct.us

Phone #: 860-594-2201

Do You Use Bonding?: Yes

Are There Legal Limits on Bonding?: Yes

Amount of Limit: two times coverage for pledged revenues against debt

Decision Process: bond issuance schedule structured to meet the cash fl

Is Debt Desirable?: Yes

What Is the Most Pressing Transportation Problem?:
working to maintain the Federal commitment of resourc

Are Any Innovative Financing Techniques Used?:
phase funding and Advanced Construction Authorization

State: Florida

Contact Person: Edward McCarron

Organization: FDOT, Financial Planning Office

Street Address: 605 Suwannee St.

City, State, Zip: Tallahassee, FL 32399-0450

e-mail address:

Phone #: 850-488-5811

Do You Use Bonding?: Yes

Are There Legal Limits on Bonding?: Yes

Amount of Limit: $1.5b

Decision Process:

Is Debt Desirable?: Yes

What Is the Most Pressing Transportation Problem?: Donor to Federal system

Are Any Innovative Financing Techniques Used?:
Toll based debt financing, bonding for advance purcha

State: Hawaii

Contact Person: Roy Nagasako

Organization: HDOT, Highways Division, Administrative Service Offic

Street Address:

City, State, Zip:

e-mail address:

Phone #: 808-587-2218

Do You Use Bonding?: Yes

Are There Legal Limits on Bonding?: Yes

Amount of Limit:

Decision Process: Legislature

Is Debt Desirable?: Yes

What Is the Most Pressing Transportation Problem?:

Are Any Innovative Financing Techniques Used?:
Developers pay for certain projects.

State: Illinois

Contact Person: Barry Wright

Organization: Ill.DOT, Fiscal Analysis Section Manager

Street Address: 2300 S. Dirksen, Room 317

City, State, Zip: Springfield, IL 62674

e-mail address:

Phone #: 217-782-0105

Do You Use Bonding?: Yes

Are There Legal Limits on Bonding?: Yes

Amount of Limit:

Decision Process: Legislature

Is Debt Desirable?: Yes

What Is the Most Pressing Transportation Problem?: Funding for maintenance.

Are Any Innovative Financing Techniques Used?: No

State: Iowa

Contact Person: Nancy J. Richardson

Organization: IDOT, Operations and Finance Division

Street Address:

City, State, Zip:

e-mail address: nrichar@iadot.e-mail.com

Phone #: 515-239-1340

Do You Use Bonding?: No

Are There Legal Limits on Bonding?: Yes

Amount of Limit: NA

Decision Process: NA

Is Debt Desirable?: Yes

What Is the Most Pressing Transportation Problem?: NR

Are Any Innovative Financing Techniques Used?: NR

State: Kansas

Contact Person: Bruce Burditt

Organization: KDOT

Street Address:

City, State, Zip:

e-mail address: Bruce B@DTOSOB3.wpo.state.KS.us

Phone #: 785-296-7216

Do You Use Bonding?: Yes

Are There Legal Limits on Bonding?: Yes

Amount of Limit: $890m

Decision Process:

Is Debt Desirable?: Yes

What Is the Most Pressing Transportation Problem?:

Are Any Innovative Financing Techniques Used?:
Emphasized sale of bonds to in-state retail investors

State: Kentucky

Contact Person: Glen B. Mitchell

Organization: Kentucky Transportation Cabinet, Exec. Dir., Office of Policy & Budget

Street Address: 1025 State Office Bldg.

City, State, Zip: Frankfort, KY 40622

e-mail address: gmitchell@kytc.state.ky.us

Phone #: 502-564-4550

Do You Use Bonding?: Yes

Are There Legal Limits on Bonding?: No

Amount of Limit:

Decision Process: Existing backlog of unfunded needs

Is Debt Desirable?: Yes

What Is the Most Pressing Transportation Problem?:
Tax revenue growth fails to keep pace with increasing

Are Any Innovative Financing Techniques Used?: No

State: Louisiana

Contact Person: G.L. Ray

Organization: LaDOT

Street Address:

City, State, Zip:

e-mail address: glray@dotdmail.dotd.state.la.us

Phone #: 504-379-1234

Do You Use Bonding?: Yes

Are There Legal Limits on Bonding?: Yes

Amount of Limit: appropriated from $200m state limit

Decision Process: Legislature

Is Debt Desirable?: Yes

What Is the Most Pressing Transportation Problem?:
Inadequate funds to address backlog of immediate need

Are Any Innovative Financing Techniques Used?:
SIB implementation pending; cash flow management of m

State: Maine

Contact Person: H. Gregory Shea

Organization: MDOT, Director of Finance and Administration

Street Address: 16 State house Station

City, State, Zip: Augusta, ME 04333

e-mail address:

Phone #: 207-287-2641

Do You Use Bonding?: Yes

Are There Legal Limits on Bonding?: No

Amount of Limit:

Decision Process: Policy is not to issue more debt then is being retire

Is Debt Desirable?: No

What Is the Most Pressing Transportation Problem?: Aging infrastructure.

Are Any Innovative Financing Techniques Used?: Toll based debt financing.

State: Michigan

Contact Person: Wayne R. niles

Organization: Deputy Director Finance

Street Address: 425 W. Ottawa PO Box 30050

City, State, Zip: Lansing, MI 48909

e-mail address:

Phone #: 517-373-2117

Do You Use Bonding?: Yes

Are There Legal Limits on Bonding?: Yes

Amount of Limit: 50% of transportation funds.

Decision Process:

Is Debt Desirable?: Yes

What Is the Most Pressing Transportation Problem?:

Are Any Innovative Financing Techniques Used?: SIB

State: Mississippi

Contact Person: Brenda Redfern

Organization: MDOT, Director, Office of Administrative Services

Street Address: PO Box 1850

City, State, Zip: Jackson, Missippi 39215-1850

e-mail address: bredfern@mdot.state.ms.us

Phone #: 601-359-7025

Do You Use Bonding?: Yes

Are There Legal Limits on Bonding?: Yes

Amount of Limit: $500m cap

Decision Process:

Is Debt Desirable?: No

What Is the Most Pressing Transportation Problem?:
Insufficient revenues to fund highway program

Are Any Innovative Financing Techniques Used?:
FHWA advance funding procedures

State: Montana

Contact Person: Monte Brown

Organization: MDOT, Bureau Chief, Financial management Bureau

Street Address: 2701 Prospect Ave.

City, State, Zip: Helena, MT 59620

e-mail address:

Phone #: 406-444-6373

Do You Use Bonding?: Yes

Are There Legal Limits on Bonding?: Yes

Amount of Limit: $150m

Decision Process: Advanced construction and to defer outstanding bonds

Is Debt Desirable?: Yes

What Is the Most Pressing Transportation Problem?:
funding levels below needs

Are Any Innovative Financing Techniques Used?:
Soft match with local governments and private parties

State: New Jersey

Contact Person: Ruth Pecarsky

Organization: NJ Transportation Trust Fund Authority, Auditor

Street Address: 1035 Parkway Ave. 2nd Floor FA

City, State, Zip: Trenton, NJ 08625

e-mail address:

Phone #: 609-530-2139

Do You Use Bonding?: Yes

Are There Legal Limits on Bonding?: Yes

Amount of Limit: $700m new debt annually

Decision Process: Financial Advisor

Is Debt Desirable?: By virtue of NJ Laws of 1984

What Is the Most Pressing Transportation Problem?: no comment

Are Any Innovative Financing Techniques Used?: no comment

State: New Mexico

Contact Person: Silviya Widmer

Organization: NM State Highway and Transportation Dept., Finance bu

Street Address: PO Box 1149, Room 118

City, State, Zip: Santa Fe, NM 87504-1149

e-mail address:

Phone #: 505-827-5108

Do You Use Bonding?: Yes

Are There Legal Limits on Bonding?: Yes

Amount of Limit: $150m

Decision Process:

Is Debt Desirable?: Yes

What Is the Most Pressing Transportation Problem?:

Are Any Innovative Financing Techniques Used?: Private sector funds.

State: New York

Contact Person: Lawrence M Knapek

Organization: Assistant Commissioner for Budget and Finance

Street Address:

City, State, Zip:

e-mail address:

Phone #: 518-457-2226

Do You Use Bonding?: Yes

Are There Legal Limits on Bonding?: Yes

Amount of Limit:

Decision Process: Referenda

Is Debt Desirable?:

What Is the Most Pressing Transportation Problem?:

Are Any Innovative Financing Techniques Used?: No

State: North Carolina

Contact Person: Wayne Stallings

Organization: NCDOT, Controller

Street Address:

City, State, Zip:

e-mail address:

Phone #: 919-733-3624 x324

Do You Use Bonding?: Yes

Are There Legal Limits on Bonding?: Yes

Amount of Limit: $950m

Decision Process:

Is Debt Desirable?: Yes

What Is the Most Pressing Transportation Problem?: Funding for maintenance.

Are Any Innovative Financing Techniques Used?: Federal advance construction.

State: Ohio

Contact Person: Daryl Weininger

Organization: ODOT, Division of Finance

Street Address: 1980 W. Broad St.

City, State, Zip: Columbus, Ohio 43223

e-mail address: dweining@odot.dot.ohio.gov

Phone #: 614-466-7045

Do You Use Bonding?: Yes

Are There Legal Limits on Bonding?: Yes

Amount of Limit: $1.2b cap

Decision Process: Individual situation and circumstances

Is Debt Desirable?: Depends

What Is the Most Pressing Transportation Problem?: Needs exceed resources

Are Any Innovative Financing Techniques Used?: SIB

State: Pennsylvania

Contact Person: David L. margolis

Organization: PennDOT

Street Address:

City, State, Zip:

e-mail address:

Phone #: 717-787-5705

Do You Use Bonding?: No

Are There Legal Limits on Bonding?: No

Amount of Limit: NA

Decision Process: NA

Is Debt Desirable?: No

What Is the Most Pressing Transportation Problem?:
Limited growth tax base, lack of flexibility in Feder

Are Any Innovative Financing Techniques Used?:
Advance construction, private partnerships, SIB.

State: South Dakota

Contact Person: Chuck Fergen

Organization: SDDOT

Street Address:

City, State, Zip:

e-mail address: chuckf@dot.state.sd.us

Phone #: 605-773-3284

Do You Use Bonding?: No

Are There Legal Limits on Bonding?: Yes

Amount of Limit: NA

Decision Process: NA

Is Debt Desirable?: No

What Is the Most Pressing Transportation Problem?:
Uncertainty of future Federal funds.

Are Any Innovative Financing Techniques Used?:
Advance construction procedures.

State: Tennessee

Contact Person: Mike Shinn

Organization: Director of finance

Street Address:

City, State, Zip:

e-mail address: mshinn@mail.state.tn.us

Phone #: 615-741-2261

Do You Use Bonding?: No

Are There Legal Limits on Bonding?: No

Amount of Limit: NA

Decision Process: NA

Is Debt Desirable?: No

What Is the Most Pressing Transportation Problem?: Major route construction.

Are Any Innovative Financing Techniques Used?: No

State: Texas

Contact Person: Frank J. Smith

Organization: TxDOT, Director of Budget and Finance Division

Street Address:

City, State, Zip:

e-mail address: fsmith@mailgw.dot.state.tx.us

Phone #: 512-463-8684

Do You Use Bonding?: No

Are There Legal Limits on Bonding?: No

Amount of Limit: NA

Decision Process: NA

Is Debt Desirable?: Yes, (TX will be bonding in the future)

What Is the Most Pressing Transportation Problem?:
TxDOT can currently finance only 33% of its needs

Are Any Innovative Financing Techniques Used?: Cash Forecasting System; SIB

State: Utah

Contact Person: Max J. Ditlevsen

Organization: UDOT, Comptroller

Street Address:

City, State, Zip:

e-mail address: srdomain.srcofso2.mdihevs.cmp.co.sr

Phone #: 801-965-4358

Do You Use Bonding?: Yes

Are There Legal Limits on Bonding?: Yes

Amount of Limit: G.O. Bond limits for State

Decision Process: Project size

Is Debt Desirable?: Yes

What Is the Most Pressing Transportation Problem?:
Funding for urban interstate system

Are Any Innovative Financing Techniques Used?:
SIB: Private and public partnerships

State: Vermont

Contact Person: William H. Conway, Jr.

Organization: VT. DOT, Director of Administration

Street Address: 133 Sate St.

City, State, Zip: Montpelier, VT 05633

e-mail address: bconway@adot.state.vt.us

Phone #: 802-828-2667

Do You Use Bonding?: No

Are There Legal Limits on Bonding?: No

Amount of Limit: NA

Decision Process: NA

Is Debt Desirable?: No

What Is the Most Pressing Transportation Problem?:
More Federal funds needed

Are Any Innovative Financing Techniques Used?: Advance Construction; SIB

State: Virginia

Contact Person: Deborah E. Brown

Organization: VDOT, Debt manager

Street Address: 1401 East Broad St.

City, State, Zip: Richmond, VA 23219

e-mail address: dbrown.vdot@state.va.us

Phone #: 804-786-2789

Do You Use Bonding?: Yes

Are There Legal Limits on Bonding?: No

Amount of Limit:

Decision Process:

Is Debt Desirable?: Yes

What Is the Most Pressing Transportation Problem?:
Obtaining an equitable share of Federal Funding.

Are Any Innovative Financing Techniques Used?:
Toll revenue and toll revenue bonds.

State: Washington

Contact Person: Helga Worgenstern

Organization: WSDOT, Dep. Asst. Secretary, Finance and Administrati

Street Address: PO Box 47400

City, State, Zip: Olympia, WA 98504-7400

e-mail address: morgenh@wsdot.wa.gov

Phone #: 360-705-7410

Do You Use Bonding?: Yes

Are There Legal Limits on Bonding?: No

Amount of Limit:

Decision Process:

Is Debt Desirable?: Yes

What Is the Most Pressing Transportation Problem?:

Are Any Innovative Financing Techniques Used?:
SIB and private partnerships, neither is actually bei

State: Wyoming

Contact Person: Chuck kisicki

Organization: WDOT, Controller

Street Address:

City, State, Zip:

e-mail address: ckisic@missc.state.wy.us

Phone #: 307-777-4024

Do You Use Bonding?: No

Are There Legal Limits on Bonding?: No

Amount of Limit: NA

Decision Process: NA

Is Debt Desirable?: Maybe

What Is the Most Pressing Transportation Problem?: NR

Are Any Innovative Financing Techniques Used?: NR

Appendix B: Model Sample and Documentation

Sample: Debt Amortization

A. DEBT AMORTIZATION MODEL	B.	C. FISCAL YEAR	D. MARICOPA COUNTY TRANSPORTATION EXCISE TAX
		1999	$213,358
Dollars in thousands except where indicated		2000	$224,426
ADTs per mile	65,000	2001	$235,018
Interest Rate Paid	5%	2002	$249,364
Interest Rate Received	4%	2003	$257,971
Cost Per mile	$25,000	2004	$274,405
Value per VMT	$0.30	2005	$292,610
Inflation Rate	2%	2006	$176,123
Discount Factor	5%	2007	$0
Annual Factor 1st year	63%	2008	$0
Annual Factor 2nd year	14%	2009	$0
Fund Availability of New Bonds	60%	2010	$0
		2011	$0
Miles Built	209	2012	$0
		2013	$0
Net Cost of Miles Built(Discounted)	$2,828,422	2014	$0
Total Debt Service(Discounted)	$1,754,826	2015	$0
		2016	$0
		2017	$0
Total Cost(Discounted)	$4,583,248	2018	$0
		2019	$0
Total User Benefit(Discounted)	$14,078,510	2020	$0
Net User Benefit(Discounted)	$9,495,262	2021	$0
		2022	$0
		2023	$0
		2024	$0
		2025	$0
		2026	$0
		2027	$0
		2028	$0
		2029	$0
		2030	$0
		2031	$0
		2032	$0
		2033	$0
		2034	$0
		2035	$0
		2036	$0
		2037	$0
		2038	$0
		2039	$0
		2040	$0
		2041	$0
		2042	$0
		2043	$0

E. HURF MAG HIGHWAY FUNDS (11% of HURF State Highway Fund) after 2007 based on 5% growth rate	F. Total Tax Revenue	G. Borrowed Funds	H. Total Revenue	I. RARF Debt Service
$56,372	$269,730	$0	$269,730	$148,518
$58,937	$283,363	$0	$283,363	$148,240
$61,052	$296,070	$0	$296,070	$138,699
$63,499	$312,863	$0	$312,863	$149,238
$66,808	$324,779	$0	$324,779	$149,242
$69,723	$344,128	$0	$344,128	$149,240
$72,803	$365,413	$40,000	$405,413	$149,239
$75,262	$251,385	$40,000	$291,385	
$79,025	$79,025	$40,000	$119,025	
$82,976	$82,976	$40,000	$122,976	
$87,125	$87,125	$40,000	$127,125	
$91,481	$91,481	$40,000	$131,481	
$96,055	$96,055	$40,000	$136,055	
$100,858	$100,858	$40,000	$140,858	
$105,901	$105,901	$40,000	$145,901	
$111,196	$111,196	$40,000	$151,196	
$116,756	$116,756	$40,000	$156,756	
$122,594	$122,594	$40,000	$162,594	
$128,723	$128,723	$40,000	$168,723	
$135,160	$135,160	$40,000	$175,160	
$141,918	$141,918	$40,000	$181,918	
$149,013	$149,013	$40,000	$189,013	
$156,464	$156,464	$40,000	$196,464	
$164,287	$164,287	$40,000	$204,287	
$172,502	$172,502	$40,000	$212,502	
$181,127	$181,127	$40,000	$221,127	
$190,183	$190,183	$40,000	$230,183	
$199,692	$199,692	$40,000	$239,692	
$209,677	$209,677	$40,000	$249,677	
$220,161	$220,161	$40,000	$260,161	
$231,169	$231,169	$40,000	$271,169	
$242,727	$242,727	$40,000	$282,727	
$254,863	$254,863	$40,000	$294,863	
$267,607	$267,607	$40,000	$307,607	
$280,987	$280,987	$40,000	$320,987	
$295,036	$295,036	$40,000	$335,036	
$309,788	$309,788	$40,000	$349,788	
$325,278	$325,278	$40,000	$365,278	
$341,541	$341,541	$40,000	$381,541	
$358,619	$358,619	$40,000	$398,619	
$376,549	$376,549	$40,000	$416,549	
$395,377	$395,377	$40,000	$435,377	
$415,146	$415,146	$40,000	$455,146	
$435,903	$435,903	$40,000	$475,903	
$457,698	$457,698	$40,000	$497,698	

J. HURF Debt Service	K. Existing Debt Service	L. Total Revenue Available for Construction	M. Cost/Mile Inflation Adjusted	N. Possible Miles Built	O. Net Cost of Miles Built Discounted	P. Total Miles
$41,979	$190,497	$79,233	$25,000	3.2	$79,233	3.2
$41,038	$189,278	$94,085	$25,500	3.7	$89,604	6.9
$40,642	$179,341	$116,729	$26,010	4.5	$105,877	11.3
$31,992	$181,230	$131,633	$26,530	5.0	$113,710	16.3
$33,157	$182,399	$142,380	$27,061	5.3	$117,136	21.6
$32,346	$181,586	$162,542	$27,602	5.9	$127,356	27.5
$31,612	$180,851	$206,361	$28,154	7.3	$153,990	34.8
$31,800	$31,800	$254,397	$28,717	8.9	$180,796	43.6
$34,248	$34,248	$76,380	$29,291	2.6	$51,697	46.3
$34,247	$34,247	$77,122	$29,877	2.6	$49,714	48.8
$34,251	$34,251	$78,058	$30,475	2.6	$47,921	51.4
$35,517	$35,517	$77,938	$31,084	2.5	$45,569	53.9
$35,517	$35,517	$79,302	$31,706	2.5	$44,159	56.4
	$0	$116,413	$32,340	3.6	$61,736	60.0
	$0	$118,246	$32,987	3.6	$59,722	63.6
	$0	$120,331	$33,647	3.6	$57,881	67.2
	$0	$122,681	$34,320	3.6	$56,202	70.7
	$0	$125,309	$35,006	3.6	$54,672	74.3
	$0	$128,229	$35,706	3.6	$53,282	77.9
	$0	$131,456	$36,420	3.6	$52,021	81.5
	$0	$135,004	$37,149	3.6	$50,882	85.2
	$0	$138,890	$37,892	3.7	$49,854	88.8
	$0	$143,131	$38,649	3.7	$48,929	92.5
	$0	$147,745	$39,422	3.7	$48,101	96.3
	$0	$152,749	$40,211	3.8	$47,363	100.1
	$0	$158,165	$41,015	3.9	$46,706	103.9
	$0	$167,221	$41,835	4.0	$47,029	107.9
	$0	$176,730	$42,672	4.1	$47,337	112.1
	$0	$186,715	$43,526	4.3	$47,630	116.4
	$0	$197,199	$44,396	4.4	$47,909	120.8
	$0	$208,207	$45,284	4.6	$48,174	125.4
	$0	$219,765	$46,190	4.8	$48,427	130.2
	$0	$231,901	$47,114	4.9	$48,668	135.1
	$0	$244,645	$48,056	5.1	$48,898	140.2
	$0	$258,025	$49,017	5.3	$49,116	145.4
	$0	$272,074	$49,997	5.4	$49,324	150.9
	$0	$286,826	$50,997	5.6	$49,523	156.5
	$0	$302,315	$52,017	5.8	$49,711	162.3
	$0	$318,579	$53,057	6.0	$49,891	168.3
	$0	$335,656	$54,119	6.2	$50,062	174.5
	$0	$353,587	$55,201	6.4	$50,226	180.9
	$0	$372,415	$56,305	6.6	$50,381	187.5
	$0	$392,184	$57,431	6.8	$50,529	194.4
	$0	$412,941	$58,580	7.0	$50,670	201.4
	$0	$434,736	$59,751	7.3	$50,804	208.7

Q. Additional VMTs per day	R. Additional VMTs per year	S. Cumulative Additional VMTs per year	T. Value per VMT Inflation Adjusted	U. Total Additional Yearly VMT Value (In whole #s)
206,007	75,192,554	75,192,554	$0.30	$22,557,766
239,824	87,535,676	162,728,230	$0.31	$49,794,838
291,712	106,474,708	269,202,938	$0.31	$84,023,621
322,506	117,714,836	386,917,774	$0.32	$123,180,071
341,997	124,828,772	511,746,545	$0.32	$166,179,276
382,770	139,710,976	651,457,521	$0.33	$215,778,523
476,430	173,897,022	825,354,543	$0.34	$278,844,981
575,818	210,173,434	1,035,527,977	$0.34	$356,848,844
169,493	61,864,823	1,097,392,801	$0.35	$385,731,171
167,785	61,241,429	1,158,634,229	$0.36	$415,402,547
166,489	60,768,608	1,219,402,837	$0.37	$445,933,576
162,975	59,485,896	1,278,888,733	$0.37	$477,041,218
162,577	59,340,430	1,338,229,164	$0.38	$509,159,447
233,976	85,401,128	1,423,630,291	$0.39	$552,485,275
233,000	85,045,078	1,508,675,370	$0.40	$597,199,533
232,460	84,847,951	1,593,523,321	$0.40	$643,401,775
232,353	84,808,879	1,678,332,199	$0.41	$691,197,135
232,677	84,927,123	1,763,259,322	$0.42	$740,696,621
233,430	85,202,070	1,848,461,392	$0.43	$792,017,414
234,612	85,633,234	1,934,094,626	$0.44	$845,283,198
236,220	86,220,255	2,020,314,881	$0.45	$900,624,491
238,255	86,962,900	2,107,277,782	$0.45	$958,179,003
240,715	87,861,064	2,195,138,845	$0.46	$1,018,092,009
243,602	88,914,766	2,284,053,612	$0.47	$1,080,516,738
246,915	90,124,157	2,374,177,769	$0.48	$1,145,614,788
250,656	91,489,514	2,465,667,283	$0.49	$1,213,556,558
259,812	94,831,475	2,560,498,758	$0.50	$1,285,435,501
269,203	98,258,962	2,658,757,720	$0.51	$1,361,459,279
278,835	101,774,741	2,760,532,462	$0.52	$1,441,846,151
288,717	105,381,655	2,865,914,117	$0.53	$1,526,825,510
298,857	109,082,625	2,974,996,742	$0.54	$1,616,638,443
309,262	112,880,652	3,087,877,394	$0.55	$1,711,538,321
319,942	116,778,823	3,204,656,217	$0.57	$1,811,791,417
330,905	120,780,309	3,325,436,526	$0.58	$1,917,677,557
342,160	124,888,373	3,450,324,899	$0.59	$2,029,490,799
353,716	129,106,365	3,579,431,264	$0.60	$2,147,540,157
365,583	133,437,734	3,712,868,998	$0.61	$2,272,150,343
377,770	137,886,023	3,850,755,021	$0.62	$2,403,662,568
390,287	142,454,876	3,993,209,897	$0.64	$2,542,435,363
403,145	147,148,041	4,140,357,939	$0.65	$2,688,845,456
416,354	151,969,372	4,292,327,311	$0.66	$2,843,288,685
429,926	156,922,831	4,449,250,141	$0.68	$3,006,180,960
443,870	162,012,494	4,611,262,635	$0.69	$3,177,959,271
458,199	167,242,553	4,778,505,188	$0.70	$3,359,082,748
472,924	172,617,320	4,951,122,509	$0.72	$3,550,033,773

V. Total Additional Daily VMT Value Time Discounted	W. Interest Gain	X. New Debt Service Payments	Y. Cumulative New Debt Service Payments	Z. Cumulative Total Debt Service Payments
$22,557,766	$0	$0	$0	$190,497
$47,423,656	$0	$0	$0	$189,278
$76,211,901	$0	$0	$0	$179,341
$106,407,577	$0	$0	$0	$181,230
$136,716,101	$0	$0	$0	$182,399
$169,068,119	$0	$0	$0	$181,586
$208,078,418	$1,008	$3,210	$3,210	$184,061
$253,605,811	$1,232	$3,210	$6,419	$38,219
$261,078,040	$1,232	$3,210	$9,629	$43,877
$267,772,186	$1,232	$3,210	$12,839	$47,086
$273,764,533	$1,232	$3,210	$16,049	$50,300
$278,916,120	$1,232	$3,210	$19,258	$54,775
$283,519,032	$1,232	$3,210	$22,468	$57,985
$292,994,737	$1,232	$3,210	$25,678	$25,678
$301,626,346	$1,232	$3,210	$28,887	$28,887
$309,487,255	$1,232	$3,210	$32,097	$32,097
$316,645,372	$1,232	$3,210	$35,307	$35,307
$323,163,482	$1,232	$3,210	$38,516	$38,516
$329,099,595	$1,232	$3,210	$41,726	$41,726
$334,507,265	$1,232	$3,210	$44,936	$44,936
$339,435,899	$1,232	$3,210	$48,146	$48,146
$343,931,037	$1,232	$3,210	$51,355	$51,355
$348,034,622	$1,232	$3,210	$54,565	$54,565
$351,785,245	$1,232	$3,210	$57,775	$57,775
$355,218,383	$1,232	$3,210	$60,984	$60,984
$358,366,615	$1,232	$3,210	$64,194	$64,194
$361,516,825	$1,232	$3,210	$64,194	$64,194
$364,664,579	$1,232	$3,210	$64,194	$64,194
$367,805,779	$1,232	$3,210	$64,194	$64,194
$370,936,641	$1,232	$3,210	$64,194	$64,194
$374,053,678	$1,232	$3,210	$64,194	$64,194
$377,153,686	$1,232	$3,210	$64,194	$64,194
$380,233,719	$1,232	$3,210	$64,194	$64,194
$383,291,083	$1,232	$3,210	$64,194	$64,194
$386,323,314	$1,232	$3,210	$64,194	$64,194
$389,328,168	$1,232	$3,210	$64,194	$64,194
$392,303,604	$1,232	$3,210	$64,194	$64,194
$395,247,776	$1,232	$3,210	$64,194	$64,194
$398,159,017	$1,232	$3,210	$64,194	$64,194
$401,035,832	$1,232	$3,210	$64,194	$64,194
$403,876,881	$1,232	$3,210	$64,194	$64,194
$406,680,977	$1,232	$3,210	$64,194	$64,194
$409,447,068	$1,232	$3,210	$64,194	$64,194
$412,174,237	$1,232	$3,210	$64,194	$64,194
$414,861,684	$1,232	$3,210	$64,194	$64,194

AA. Cumulative Debt Service Discounted	AB. Debt Coverage Ratio
$190,497	1.4
$180,265	1.5
$162,668	1.7
$156,553	1.7
$150,060	1.8
$142,277	1.9
$137,349	2.0
$27,162	6.6
$29,698	1.8
$30,352	1.8
$30,880	1.7
$32,026	1.7
$32,288	1.7
$13,617	3.9
$14,590	3.7
$15,439	3.5
$16,174	3.3
$16,805	3.2
$17,338	3.1
$17,783	3.0
$18,146	2.9
$18,434	2.9
$18,653	2.9
$18,810	2.8
$18,909	2.8
$18,957	2.8
$18,054	3.0
$17,194	3.1
$16,375	3.3
$15,596	3.4
$14,853	3.6
$14,146	3.8
$13,472	4.0
$12,831	4.2
$12,220	4.4
$11,638	4.6
$11,084	4.8
$10,556	5.1
$10,053	5.3
$9,574	5.6
$9,118	5.9
$8,684	6.2
$8,271	6.5
$7,877	6.8
$7,502	7.1

Documentation: Debt Amortization

A. DEBT AMORTIZATION MODEL	B.	C. FISCAL YEAR
		1999
Dollars in thousands except where indicated		=(C5+1)
ADTs per mile	65000	=(C6+1)
Interest Rate Paid	0.05	=(C7+1)
Interest Rate Received	0.04	=(C8+1)
Cost Per mile	25000	=(C9+1)
Value per VMT	0.3	=(C10+1)
Inflation Rate	0.02	=(C11+1)
Discount Factor	0.05	=(C12+1)
Annual Factor 1st year	0.63	=(C13+1)
Annual Factor 2nd year	0.14	=(C14+1)
Fund Availability of New Bonds	0.6	=(C15+1)
		=(C16+1)
Miles Built	=SUM(N5:N49)	=(C17+1)
		=(C18+1)
Net Cost of Miles Built(Discounted)	=SUM(O5:O49)	=(C19+1)
Total Debt Service(Discounted)	=SUM(AA5:AA49)	=(C20+1)
		=(C21+1)
		=(C22+1)
Total Cost(Discounted)	=B20+B21	=(C23+1)
		=(C24+1)
Total User Benefit(Discounted)	=((SUM(V5:V49))/1000)	=(C25+1)
Net User Benefit(Discounted)	=B26-B24	=(C26+1)
		=(C27+1)
		=(C28+1)
		=(C29+1)
		=(C30+1)
		=(C31+1)
		=(C32+1)
		=(C33+1)
		=(C34+1)
		=(C35+1)
		=(C36+1)
		=(C37+1)
		=(C38+1)
		=(C39+1)
		=(C40+1)
		=(C41+1)
		=(C42+1)
		=(C43+1)
		=(C44+1)
		=(C45+1)
		=(C46+1)
		=(C47+1)
		=(C48+1)

D. MARICOPA COUNTY TRANSPORTATION EXCISE TAX	E. HURF MAG HIGHWAY FUNDS (11% of HURF State Highway Fund) after 2007 based on 5% growth rate	F. Total Tax Revenue	G. Borrowed Funds
213358.1	56372.36	=(D5+E5)	0
224425.7	58937.01	=(D6+E6)	0
235018.4	61052.09	=(D7+E7)	0
249364.4	63498.82	=(D8+E8)	0
257971	66808.06	=(D9+E9)	0
274405	69722.84	=(D10+E10)	0
292610	72803.39	=(D11+E11)	40000
176123	75261.89	=(D12+E12)	40000
0	=E12+E12*0.05	=(D13+E13)	40000
0	=E13+E13*0.05	=(D14+E14)	40000
0	=E14+E14*0.05	=(D15+E15)	40000
0	=E15+E15*0.05	=(D16+E16)	40000
0	=E16+E16*0.05	=(D17+E17)	40000
0	=E17+E17*0.05	=(D18+E18)	40000
0	=E18+E18*0.05	=(D19+E19)	40000
0	=E19+E19*0.05	=(D20+E20)	40000
0	=E20+E20*0.05	=(D21+E21)	40000
0	=E21+E21*0.05	=(D22+E22)	40000
0	=E22+E22*0.05	=(D23+E23)	40000
0	=E23+E23*0.05	=(D24+E24)	40000
0	=E24+E24*0.05	=(D25+E25)	40000
0	=E25+E25*0.05	=(D26+E26)	40000
0	=E26+E26*0.05	=(D27+E27)	40000
0	=E27+E27*0.05	=(D28+E28)	40000
0	=E28+E28*0.05	=(D29+E29)	40000
0	=E29+E29*0.05	=(D30+E30)	40000
0	=E30+E30*0.05	=(D31+E31)	40000
0	=E31+E31*0.05	=(D32+E32)	40000
0	=E32+E32*0.05	=(D33+E33)	40000
0	=E33+E33*0.05	=(D34+E34)	40000
0	=E34+E34*0.05	=(D35+E35)	40000
0	=E35+E35*0.05	=(D36+E36)	40000
0	=E36+E36*0.05	=(D37+E37)	40000
0	=E37+E37*0.05	=(D38+E38)	40000
0	=E38+E38*0.05	=(D39+E39)	40000
0	=E39+E39*0.05	=(D40+E40)	40000
0	=E40+E40*0.05	=(D41+E41)	40000
0	=E41+E41*0.05	=(D42+E42)	40000
0	=E42+E42*0.05	=(D43+E43)	40000
0	=E43+E43*0.05	=(D44+E44)	40000
0	=E44+E44*0.05	=(D45+E45)	40000
0	=E45+E45*0.05	=(D46+E46)	40000
0	=E46+E46*0.05	=(D47+E47)	40000
0	=E47+E47*0.05	=(D48+E48)	40000
0	=E48+E48*0.05	=(D49+E49)	40000

H. Total Revenue	I. RARF Debt Service	J. HURF Debt Service	K. Existing Debt Service
=F5:F49+G5:G49	148518	41979	=(I5+J5)
=F5:F49+G5:G49	148240	41038	=(I6+J6)
=F5:F49+G5:G49	138699	40642	=(I7+J7)
=F5:F49+G5:G49	149238	31992	=(I8+J8)
=F5:F49+G5:G49	149242	33157	=(I9+J9)
=F5:F49+G5:G49	149240	32346	=(I10+J10)
=F5:F49+G5:G49	149239	31612	=(I11+J11)
=F5:F49+G5:G49		31800	=(I12+J12)
=F5:F49+G5:G49		34248	=(I13+J13)
=F5:F49+G5:G49		34247	=(I14+J14)
=F5:F49+G5:G49		34251	=(I15+J15)
=F5:F49+G5:G49		35517	=(I16+J16)
=F5:F49+G5:G49		35517	=(I17+J17)
=F5:F49+G5:G49			=(I18+J18)
=F5:F49+G5:G49			=(I19+J19)
=F5:F49+G5:G49			=(I20+J20)
=F5:F49+G5:G49			=(I21+J21)
=F5:F49+G5:G49			=(I22+J22)
=F5:F49+G5:G49			=(I23+J23)
=F5:F49+G5:G49			=(I24+J24)
=F5:F49+G5:G49			=(I25+J25)
=F5:F49+G5:G49			=(I26+J26)
=F5:F49+G5:G49			=(I27+J27)
=F5:F49+G5:G49			=(I28+J28)
=F5:F49+G5:G49			=(I29+J29)
=F5:F49+G5:G49			=(I30+J30)
=F5:F49+G5:G49			=(I31+J31)
=F5:F49+G5:G49			=(I32+J32)
=F5:F49+G5:G49			=(I33+J33)
=F5:F49+G5:G49			=(I34+J34)
=F5:F49+G5:G49			=(I35+J35)
=F5:F49+G5:G49			=(I36+J36)
=F5:F49+G5:G49			=(I37+J37)
=F5:F49+G5:G49			=(I38+J38)
=F5:F49+G5:G49			=(I39+J39)
=F5:F49+G5:G49			=(I40+J40)
=F5:F49+G5:G49			=(I41+J41)
=F5:F49+G5:G49			=(I42+J42)
=F5:F49+G5:G49			=(I43+J43)
=F5:F49+G5:G49			=(I44+J44)
=F5:F49+G5:G49			=(I45+J45)
=F5:F49+G5:G49			=(I46+J46)
=F5:F49+G5:G49			=(I47+J47)
=F5:F49+G5:G49			=(I48+J48)
=F5:F49+G5:G49			=(I49+J49)

L. Total Revenue Available for Construction	M. Cost/Mile Inflation Adjusted	N. Possible Miles Built
=F5+($B$16*G5)-(Y5)+(W5)-(K5)	=B10	=L5:L49/M5:M49
=F6+($B$16*G6)-(Y6)+(W6)-(K6)	=B10+B10*B12	=L5:L49/M5:M49
=F7+$B$16*G7-Y7+W7-K7	=M6+M6*B12	=L5:L49/M5:M49
=F8+$B$16*G8-Y8+W8-K8	=M7+M7*B12	=L5:L49/M5:M49
=F9+($B$16*G9)+(1-$B$16)*(G8)-Y9+W9-K9	=M8+M8*B12	=L5:L49/M5:M49
=F10+($B$16*G10)+(1-$B$16)*(G9)-Y10+W10-K10	=M9+M9*B12	=L5:L49/M5:M49
=F11+($B$16*G11)+(1-$B$16)*(G10)-Y11+W11-K11	=M10+M10*B12	=L5:L49/M5:M49
=F12+($B$16*G12)+(1-$B$16)*(G11)-Y12+W12-K12	=M11+M11*B12	=L5:L49/M5:M49
=F13+($B$16*G13)+(1-$B$16)*(G12)-Y13+W13-K13	=M12+M12*B12	=L5:L49/M5:M49
=F14+($B$16*G14)+(1-$B$16)*(G13)-Y14+W14-K14	=M13+M13*B12	=L5:L49/M5:M49
=F15+($B$16*G15)+(1-$B$16)*(G14)-Y15+W15-K15	=M14+M14*B12	=L5:L49/M5:M49
=F16+($B$16*G16)+(1-$B$16)*(G15)-Y16+W16-K16	=M15+M15*B12	=L5:L49/M5:M49
=F17+($B$16*G17)+(1-$B$16)*(G16)-Y17+W17-K17	=M16+M16*B12	=L5:L49/M5:M49
=F18+($B$16*G18)+(1-$B$16)*(G17)-Y18+W18-K18	=M17+M17*B12	=L5:L49/M5:M49
=F19+($B$16*G19)+(1-$B$16)*(G18)-Y19+W19-K19	=M18+M18*B12	=L5:L49/M5:M49
=F20+($B$16*G20)+(1-$B$16)*(G19)-Y20+W20-K20	=M19+M19*B12	=L5:L49/M5:M49
=F21+($B$16*G21)+(1-$B$16)*(G20)-Y21+W21-K21	=M20+M20*B12	=L5:L49/M5:M49
=F22+($B$16*G22)+(1-$B$16)*(G21)-Y22+W22-K22	=M21+M21*B12	=L5:L49/M5:M49
=F23+($B$16*G23)+(1-$B$16)*(G22)-Y23+W23-K23	=M22+M22*B12	=L5:L49/M5:M49
=F24+($B$16*G24)+(1-$B$16)*(G23)-Y24+W24-K24	=M23+M23*B12	=L5:L49/M5:M49
=F25+($B$16*G25)+(1-$B$16)*(G24)-Y25+W25-K25	=M24+M24*B12	=L5:L49/M5:M49
=F26+($B$16*G26)+(1-$B$16)*(G25)-Y26+W26-K26	=M25+M25*B12	=L5:L49/M5:M49
=F27+($B$16*G27)+(1-$B$16)*(G26)-Y27+W27-K27	=M26+M26*B12	=L5:L49/M5:M49
=F28+($B$16*G28)+(1-$B$16)*(G27)-Y28+W28-K28	=M27+M27*B12	=L5:L49/M5:M49
=F29+($B$16*G29)+(1-$B$16)*(G28)-Y29+W29-K29	=M28+M28*$B$12	=L5:L49/M5:M49
=F30+($B$16*G30)+(1-$B$16)*(G29)-Y30+W30-K30	=M29+M29*$B$12	=L5:L49/M5:M49
=F31+($B$16*G31)+(1-$B$16)*(G30)-Y31+W31-K31	=M30+M30*$B$12	=L5:L49/M5:M49
=F32+($B$16*G32)+(1-$B$16)*(G31)-Y32+W32-K32	=M31+M31*$B$12	=L5:L49/M5:M49
=F33+($B$16*G33)+(1-$B$16)*(G32)-Y33+W33-K33	=M32+M32*$B$12	=L5:L49/M5:M49
=F34+($B$16*G34)+(1-$B$16)*(G33)-Y34+W34-K34	=M33+M33*$B$12	=L5:L49/M5:M49
=F35+($B$16*G35)+(1-$B$16)*(G34)-Y35+W35-K35	=M34+M34*$B$12	=L5:L49/M5:M49
=F36+($B$16*G36)+(1-$B$16)*(G35)-Y36+W36-K36	=M35+M35*$B$12	=L5:L49/M5:M49
=F37+($B$16*G37)+(1-$B$16)*(G36)-Y37+W37-K37	=M36+M36*$B$12	=L5:L49/M5:M49
=F38+($B$16*G38)+(1-$B$16)*(G37)-Y38+W38-K38	=M37+M37*$B$12	=L5:L49/M5:M49
=F39+($B$16*G39)+(1-$B$16)*(G38)-Y39+W39-K39	=M38+M38*$B$12	=L5:L49/M5:M49
=F40+($B$16*G40)+(1-$B$16)*(G39)-Y40+W40-K40	=M39+M39*$B$12	=L5:L49/M5:M49
=F41+($B$16*G41)+(1-$B$16)*(G40)-Y41+W41-K41	=M40+M40*$B$12	=L5:L49/M5:M49
=F42+($B$16*G42)+(1-$B$16)*(G41)-Y42+W42-K42	=M41+M41*$B$12	=L5:L49/M5:M49
=F43+($B$16*G43)+(1-$B$16)*(G42)-Y43+W43-K43	=M42+M42*$B$12	=L5:L49/M5:M49
=F44+($B$16*G44)+(1-$B$16)*(G43)-Y44+W44-K44	=M43+M43*$B$12	=L5:L49/M5:M49
=F45+($B$16*G45)+(1-$B$16)*(G44)-Y45+W45-K45	=M44+M44*$B$12	=L5:L49/M5:M49
=F46+($B$16*G46)+(1-$B$16)*(G45)-Y46+W46-K46	=M45+M45*$B$12	=L5:L49/M5:M49
=F47+($B$16*G47)+(1-$B$16)*(G46)-Y47+W47-K47	=M46+M46*$B$12	=L5:L49/M5:M49
=F48+($B$16*G48)+(1-$B$16)*(G47)-Y48+W48-K48	=M47+M47*$B$12	=L5:L49/M5:M49
=F49+($B$16*G49)+(1-$B$16)*(G48)-Y49+W49-K49	=M48+M48*$B$12	=L5:L49/M5:M49

O. Net Cost of Miles Built Discounted	P. Total Miles	Q. Additional VMTs per day	R. Additional VMTs per year	S. Cumulative Additional VMTs per year
=L5	=N5	=N5:N49*$B$7	=(Q5*365)	=R5
=L6/(1+$B$13)	=P5+N6	=N5:N49*$B$7	=(Q6*365)	=SUM($R$5:R6)
=L7/(1+$B$13)^2	=P6+N7	=N5:N49*$B$7	=(Q7*365)	=SUM($R$5:R7)
=L8/(1+$B$13)^3	=P7+N8	=N5:N49*$B$7	=(Q8*365)	=SUM($R$5:R8)
=L9/(1+$B$13)^4	=P8+N9	=N5:N49*$B$7	=(Q9*365)	=SUM($R$5:R9)
=L10/(1+$B$13)^5	=P9+N10	=N5:N49*$B$7	=(Q10*365)	=SUM($R$5:R10)
=L11/(1+$B$13)^6	=P10+N11	=N5:N49*$B$7	=(Q11*365)	=SUM($R$5:R11)
=L12/(1+$B$13)^7	=P11+N12	=N5:N49*$B$7	=(Q12*365)	=SUM($R$5:R12)
=L13/(1+$B$13)^8	=P12+N13	=N5:N49*$B$7	=(Q13*365)	=SUM($R$5:R13)
=L14/(1+$B$13)^9	=P13+N14	=N5:N49*$B$7	=(Q14*365)	=SUM($R$5:R14)
=L15/(1+$B$13)^10	=P14+N15	=N5:N49*$B$7	=(Q15*365)	=SUM($R$5:R15)
=L16/(1+$B$13)^11	=P15+N16	=N5:N49*$B$7	=(Q16*365)	=SUM($R$5:R16)
=L17/(1+$B$13)^12	=P16+N17	=N5:N49*$B$7	=(Q17*365)	=SUM($R$5:R17)
=L18/(1+$B$13)^13	=P17+N18	=N5:N49*$B$7	=(Q18*365)	=SUM($R$5:R18)
=L19/(1+$B$13)^14	=P18+N19	=N5:N49*$B$7	=(Q19*365)	=SUM($R$5:R19)
=L20/(1+$B$13)^15	=P19+N20	=N5:N49*$B$7	=(Q20*365)	=SUM($R$5:R20)
=L21/(1+$B$13)^16	=P20+N21	=N5:N49*$B$7	=(Q21*365)	=SUM($R$5:R21)
=L22/(1+$B$13)^17	=P21+N22	=N5:N49*$B$7	=(Q22*365)	=SUM($R$5:R22)
=L23/(1+$B$13)^18	=P22+N23	=N5:N49*$B$7	=(Q23*365)	=SUM($R$5:R23)
=L24/(1+$B$13)^19	=P23+N24	=N5:N49*$B$7	=(Q24*365)	=SUM($R$5:R24)
=L25/(1+$B$13)^20	=P24+N25	=N5:N49*$B$7	=(Q25*365)	=SUM($R$5:R25)
=L26/(1+$B$13)^21	=P25+N26	=N5:N49*$B$7	=(Q26*365)	=SUM($R$5:R26)
=L27/(1+$B$13)^22	=P26+N27	=N5:N49*$B$7	=(Q27*365)	=SUM($R$5:R27)
=L28/(1+$B$13)^23	=P27+N28	=N5:N49*$B$7	=(Q28*365)	=SUM($R$5:R28)
=L29/(1+$B$13)^24	=P28+N29	=N5:N49*$B$7	=(Q29*365)	=SUM($R$5:R29)
=L30/(1+$B$13)^25	=P29+N30	=N5:N49*$B$7	=(Q30*365)	=SUM($R$5:R30)
=L31/(1+$B$13)^26	=P30+N31	=N5:N49*$B$7	=(Q31*365)	=SUM($R$5:R31)
=L32/(1+$B$13)^27	=P31+N32	=N5:N49*$B$7	=(Q32*365)	=SUM($R$5:R32)
=L33/(1+$B$13)^28	=P32+N33	=N5:N49*$B$7	=(Q33*365)	=SUM($R$5:R33)
=L34/(1+$B$13)^29	=P33+N34	=N5:N49*$B$7	=(Q34*365)	=SUM($R$5:R34)
=L35/(1+$B$13)^30	=P34+N35	=N5:N49*$B$7	=(Q35*365)	=SUM($R$5:R35)
=L36/(1+$B$13)^31	=P35+N36	=N5:N49*$B$7	=(Q36*365)	=SUM($R$5:R36)
=L37/(1+$B$13)^32	=P36+N37	=N5:N49*$B$7	=(Q37*365)	=SUM($R$5:R37)
=L38/(1+$B$13)^33	=P37+N38	=N5:N49*$B$7	=(Q38*365)	=SUM($R$5:R38)
=L39/(1+$B$13)^34	=P38+N39	=N5:N49*$B$7	=(Q39*365)	=SUM($R$5:R39)
=L40/(1+$B$13)^35	=P39+N40	=N5:N49*$B$7	=(Q40*365)	=SUM($R$5:R40)
=L41/(1+$B$13)^36	=P40+N41	=N5:N49*$B$7	=(Q41*365)	=SUM($R$5:R41)
=L42/(1+$B$13)^37	=P41+N42	=N5:N49*$B$7	=(Q42*365)	=SUM($R$5:R42)
=L43/(1+$B$13)^38	=P42+N43	=N5:N49*$B$7	=(Q43*365)	=SUM($R$5:R43)
=L44/(1+$B$13)^39	=P43+N44	=N5:N49*$B$7	=(Q44*365)	=SUM($R$5:R44)
=L45/(1+$B$13)^40	=P44+N45	=N5:N49*$B$7	=(Q45*365)	=SUM($R$5:R45)
=L46/(1+$B$13)^41	=P45+N46	=N5:N49*$B$7	=(Q46*365)	=SUM($R$5:R46)
=L47/(1+$B$13)^42	=P46+N47	=N5:N49*$B$7	=(Q47*365)	=SUM($R$5:R47)
=L48/(1+$B$13)^43	=P47+N48	=N5:N49*$B$7	=(Q48*365)	=SUM($R$5:R48)
=L49/(1+$B$13)^44	=P48+N49	=N5:N49*$B$7	=(Q49*365)	=SUM($R$5:R49)

T. Value per	U. Total Additional	V. Total Additional
VMT	Yearly VMT Value	Daily VMT Value
Inflation	(In whole #s)	Time Discounted
Adjusted		
=B11	=(S5:S49*T5:T49)	=U5
=T5+T5*$B$12	=(S5:S49*T5:T49)	=U6/(1+$B$13)
=T6+T6*$B$12	=(S5:S49*T5:T49)	=U7/(1+$B$13)^2
=T7+T7*$B$12	=(S5:S49*T5:T49)	=U8/(1+$B$13)^3
=T8+T8*$B$12	=(S5:S49*T5:T49)	=U9/(1+$B$13)^4
=T9+T9*$B$12	=(S5:S49*T5:T49)	=U10/(1+$B$13)^5
=T10+T10*$B$12	=(S5:S49*T5:T49)	=U11/(1+$B$13)^6
=T11+T11*$B$12	=(S5:S49*T5:T49)	=U12/(1+$B$13)^7
=T12+T12*$B$12	=(S5:S49*T5:T49)	=U13/(1+$B$13)^8
=T13+T13*$B$12	=(S5:S49*T5:T49)	=U14/(1+$B$13)^9
=T14+T14*$B$12	=(S5:S49*T5:T49)	=U15/(1+$B$13)^10
=T15+T15*$B$12	=(S5:S49*T5:T49)	=U16/(1+$B$13)^11
=T16+T16*$B$12	=(S5:S49*T5:T49)	=U17/(1+$B$13)^12
=T17+T17*$B$12	=(S5:S49*T5:T49)	=U18/(1+$B$13)^13
=T18+T18*$B$12	=(S5:S49*T5:T49)	=U19/(1+$B$13)^14
=T19+T19*$B$12	=(S5:S49*T5:T49)	=U20/(1+$B$13)^15
=T20+T20*$B$12	=(S5:S49*T5:T49)	=U21/(1+$B$13)^16
=T21+T21*$B$12	=(S5:S49*T5:T49)	=U22/(1+$B$13)^17
=T22+T22*$B$12	=(S5:S49*T5:T49)	=U23/(1+$B$13)^18
=T23+T23*$B$12	=(S5:S49*T5:T49)	=U24/(1+$B$13)^19
=T24+T24*$B$12	=(S5:S49*T5:T49)	=U25/(1+$B$13)^20
=T25+T25*$B$12	=(S5:S49*T5:T49)	=U26/(1+$B$13)^21
=T26+T26*$B$12	=(S5:S49*T5:T49)	=U27/(1+$B$13)^22
=T27+T27*$B$12	=(S5:S49*T5:T49)	=U28/(1+$B$13)^23
=T28+T28*$B$12	=(S5:S49*T5:T49)	=U29/(1+$B$13)^24
=T29+T29*$B$12	=(S5:S49*T5:T49)	=U30/(1+$B$13)^25
=T30+T30*$B$12	=(S5:S49*T5:T49)	=U31/(1+$B$13)^26
=T31+T31*$B$12	=(S5:S49*T5:T49)	=U32/(1+$B$13)^27
=T32+T32*$B$12	=(S5:S49*T5:T49)	=U33/(1+$B$13)^28
=T33+T33*$B$12	=(S5:S49*T5:T49)	=U34/(1+$B$13)^29
=T34+T34*$B$12	=(S5:S49*T5:T49)	=U35/(1+$B$13)^30
=T35+T35*$B$12	=(S5:S49*T5:T49)	=U36/(1+$B$13)^31
=T36+T36*$B$12	=(S5:S49*T5:T49)	=U37/(1+$B$13)^32
=T37+T37*$B$12	=(S5:S49*T5:T49)	=U38/(1+$B$13)^33
=T38+T38*$B$12	=(S5:S49*T5:T49)	=U39/(1+$B$13)^34
=T39+T39*$B$12	=(S5:S49*T5:T49)	=U40/(1+$B$13)^35
=T40+T40*$B$12	=(S5:S49*T5:T49)	=U41/(1+$B$13)^36
=T41+T41*$B$12	=(S5:S49*T5:T49)	=U42/(1+$B$13)^37
=T42+T42*$B$12	=(S5:S49*T5:T49)	=U43/(1+$B$13)^38
=T43+T43*$B$12	=(S5:S49*T5:T49)	=U44/(1+$B$13)^39
=T44+T44*$B$12	=(S5:S49*T5:T49)	=U45/(1+$B$13)^40
=T45+T45*$B$12	=(S5:S49*T5:T49)	=U46/(1+$B$13)^41
=T46+T46*$B$12	=(S5:S49*T5:T49)	=U47/(1+$B$13)^42
=T47+T47*$B$12	=(S5:S49*T5:T49)	=U48/(1+$B$13)^43
=T48+T48*$B$12	=(S5:S49*T5:T49)	=U49/(1+$B$13)^44

W. Interest Gain	X. New Debt Service Payments	Y. Cumulative New Debt Service Payments
=G5*B14*B9	=-(PMT($B$8,20,$G5,0,0))	=X5
=(G6*B14+G5*B15)*B9	=-(PMT($B$8,20,$G6,0,0))	=Y5+X6
=(G7*B14+G6*B15)*B9	=-(PMT($B$8,20,$G7,0,0))	=Y6+X7
=(G8*B14+G7*B15)*B9	=-(PMT($B$8,20,$G8,0,0))	=Y7+X8
=(G9*B14+G8*B15)*B9	=-(PMT($B$8,20,$G9,0,0))	=Y8+X9
=(G10*$B$14+G9*$B$15)*$B$9	=-(PMT($B$8,20,$G10,0,0))	=Y9+X10
=(G11*$B$14+G10*$B$15)*$B$9	=-(PMT($B$8,20,$G11,0,0))	=Y10+X11
=(G12*$B$14+G11*$B$15)*$B$9	=-(PMT($B$8,20,$G12,0,0))	=Y11+X12
=(G13*$B$14+G12*$B$15)*$B$9	=-(PMT($B$8,20,$G13,0,0))	=Y12+X13
=(G14*$B$14+G13*$B$15)*$B$9	=-(PMT($B$8,20,$G14,0,0))	=Y13+X14
=(G15*$B$14+G14*$B$15)*$B$9	=-(PMT($B$8,20,$G15,0,0))	=Y14+X15
=(G16*$B$14+G15*$B$15)*$B$9	=-(PMT($B$8,20,$G16,0,0))	=Y15+X16
=(G17*$B$14+G16*$B$15)*$B$9	=-(PMT($B$8,20,$G17,0,0))	=Y16+X17
=(G18*$B$14+G17*$B$15)*$B$9	=-(PMT($B$8,20,$G18,0,0))	=Y17+X18
=(G19*$B$14+G18*$B$15)*$B$9	=-(PMT($B$8,20,$G19,0,0))	=Y18+X19
=(G20*$B$14+G19*$B$15)*$B$9	=-(PMT($B$8,20,$G20,0,0))	=Y19+X20
=(G21*$B$14+G20*$B$15)*$B$9	=-(PMT($B$8,20,$G21,0,0))	=Y20+X21
=(G22*$B$14+G21*$B$15)*$B$9	=-(PMT($B$8,20,$G22,0,0))	=Y21+X22
=(G23*$B$14+G22*$B$15)*$B$9	=-(PMT($B$8,20,$G23,0,0))	=Y22+X23
=(G24*$B$14+G23*$B$15)*$B$9	=-(PMT($B$8,20,$G24,0,0))	=Y23+X24
=(G25*$B$14+G24*$B$15)*$B$9	=-(PMT($B$8,20,$G25,0,0))	=Y24+X25-X5
=(G26*$B$14+G25*$B$15)*$B$9	=-(PMT($B$8,20,$G26,0,0))	=Y25+X26-X6
=(G27*$B$14+G26*$B$15)*$B$9	=-(PMT($B$8,20,$G27,0,0))	=Y26+X27-X7
=(G28*$B$14+G27*$B$15)*$B$9	=-(PMT($B$8,20,$G28,0,0))	=Y27+X28-X8
=(G29*$B$14+G28*$B$15)*$B$9	=-(PMT($B$8,20,$G29,0,0))	=Y28+X29-X9
=(G30*$B$14+G29*$B$15)*$B$9	=-(PMT($B$8,20,$G30,0,0))	=Y29+X30-X10
=(G31*$B$14+G30*$B$15)*$B$9	=-(PMT($B$8,20,$G31,0,0))	=Y30+X31-X11
=(G32*$B$14+G31*$B$15)*$B$9	=-(PMT($B$8,20,$G32,0,0))	=Y31+X32-X12
=(G33*$B$14+G32*$B$15)*$B$9	=-(PMT($B$8,20,$G33,0,0))	=Y32+X33-X13
=(G34*$B$14+G33*$B$15)*$B$9	=-(PMT($B$8,20,$G34,0,0))	=Y33+X34-X14
=(G35*$B$14+G34*$B$15)*$B$9	=-(PMT($B$8,20,$G35,0,0))	=Y34+X35-X15
=(G36*$B$14+G35*$B$15)*$B$9	=-(PMT($B$8,20,$G36,0,0))	=Y35+X36-X16
=(G37*$B$14+G36*$B$15)*$B$9	=-(PMT($B$8,20,$G37,0,0))	=Y36+X37-X17
=(G38*$B$14+G37*$B$15)*$B$9	=-(PMT($B$8,20,$G38,0,0))	=Y37+X38-X18
=(G39*$B$14+G38*$B$15)*$B$9	=-(PMT($B$8,20,$G39,0,0))	=Y38+X39-X19
=(G40*$B$14+G39*$B$15)*$B$9	=-(PMT($B$8,20,$G40,0,0))	=Y39+X40-X20
=(G41*$B$14+G40*$B$15)*$B$9	=-(PMT($B$8,20,$G41,0,0))	=Y40+X41-X21
=(G42*$B$14+G41*$B$15)*$B$9	=-(PMT($B$8,20,$G42,0,0))	=Y41+X42-X22
=(G43*$B$14+G42*$B$15)*$B$9	=-(PMT($B$8,20,$G43,0,0))	=Y42+X43-X23
=(G44*$B$14+G43*$B$15)*$B$9	=-(PMT($B$8,20,$G44,0,0))	=Y43+X44-X24
=(G45*$B$14+G44*$B$15)*$B$9	=-(PMT($B$8,20,$G45,0,0))	=Y44+X45-X25
=(G46*$B$14+G45*$B$15)*$B$9	=-(PMT($B$8,20,$G46,0,0))	=Y45+X46-X26
=(G47*$B$14+G46*$B$15)*$B$9	=-(PMT($B$8,20,$G47,0,0))	=Y46+X47-X27
=(G48*$B$14+G47*$B$15)*$B$9	=-(PMT($B$8,20,$G48,0,0))	=Y47+X48-X28
=(G49*$B$14+G48*$B$15)*$B$9	=-(PMT($B$8,20,$G49,0,0))	=Y48+X49-X29

Z. Cumulative Total Debt Service Payments	AA. Cumulative Debt Service Discounted	AB. Debt Coverage Ratio
=(Y5+K5)	=Z5	=(F5/Z5)
=(Y6+K6)	=Z6/(1+$B$13)	=(F6/Z6)
=(Y7+K7)	=Z7/(1+$B$13)^2	=(F7/Z7)
=(Y8+K8)	=Z8/(1+$B$13)^3	=(F8/Z8)
=(Y9+K9)	=Z9/(1+$B$13)^4	=(F9/Z9)
=(Y10+K10)	=Z10/(1+$B$13)^5	=(F10/Z10)
=(Y11+K11)	=Z11/(1+$B$13)^6	=(F11/Z11)
=(Y12+K12)	=Z12/(1+$B$13)^7	=(F12/Z12)
=(Y13+K13)	=Z13/(1+$B$13)^8	=(F13/Z13)
=(Y14+K14)	=Z14/(1+$B$13)^9	=(F14/Z14)
=(Y15+K15)	=Z15/(1+$B$13)^10	=(F15/Z15)
=(Y16+K16)	=Z16/(1+$B$13)^11	=(F16/Z16)
=(Y17+K17)	=Z17/(1+$B$13)^12	=(F17/Z17)
=(Y18+K18)	=Z18/(1+$B$13)^13	=(F18/Z18)
=(Y19+K19)	=Z19/(1+$B$13)^14	=(F19/Z19)
=(Y20+K20)	=Z20/(1+$B$13)^15	=(F20/Z20)
=(Y21+K21)	=Z21/(1+$B$13)^16	=(F21/Z21)
=(Y22+K22)	=Z22/(1+$B$13)^17	=(F22/Z22)
=(Y23+K23)	=Z23/(1+$B$13)^18	=(F23/Z23)
=(Y24+K24)	=Z24/(1+$B$13)^19	=(F24/Z24)
=(Y25+K25)	=Z25/(1+$B$13)^20	=(F25/Z25)
=(Y26+K26)	=Z26/(1+$B$13)^21	=(F26/Z26)
=(Y27+K27)	=Z27/(1+$B$13)^22	=(F27/Z27)
=(Y28+K28)	=Z28/(1+$B$13)^23	=(F28/Z28)
=(Y29+K29)	=Z29/(1+$B$13)^24	=(F29/Z29)
=(Y30+K30)	=Z30/(1+$B$13)^25	=(F30/Z30)
=(Y31+K31)	=Z31/(1+$B$13)^26	=(F31/Z31)
=(Y32+K32)	=Z32/(1+$B$13)^27	=(F32/Z32)
=(Y33+K33)	=Z33/(1+$B$13)^28	=(F33/Z33)
=(Y34+K34)	=Z34/(1+$B$13)^29	=(F34/Z34)
=(Y35+K35)	=Z35/(1+$B$13)^30	=(F35/Z35)
=(Y36+K36)	=Z36/(1+$B$13)^31	=(F36/Z36)
=(Y37+K37)	=Z37/(1+$B$13)^32	=(F37/Z37)
=(Y38+K38)	=Z38/(1+$B$13)^33	=(F38/Z38)
=(Y39+K39)	=Z39/(1+$B$13)^34	=(F39/Z39)
=(Y40+K40)	=Z40/(1+$B$13)^35	=(F40/Z40)
=(Y41+K41)	=Z41/(1+$B$13)^36	=(F41/Z41)
=(Y42+K42)	=Z42/(1+$B$13)^37	=(F42/Z42)
=(Y43+K43)	=Z43/(1+$B$13)^38	=(F43/Z43)
=(Y44+K44)	=Z44/(1+$B$13)^39	=(F44/Z44)
=(Y45+K45)	=Z45/(1+$B$13)^40	=(F45/Z45)
=(Y46+K46)	=Z46/(1+$B$13)^41	=(F46/Z46)
=(Y47+K47)	=Z47/(1+$B$13)^42	=(F47/Z47)
=(Y48+K48)	=Z48/(1+$B$13)^43	=(F48/Z48)
=(Y49+K49)	=Z49/(1+$B$13)^44	=(F49/Z49)

Sample: Debt Paid at Maturity

A. DEBT PAID AT MATURITY MODEL	B.	C. FISCAL YEAR	D. MARICOPA COUNTY TRANSPORTATION EXCISE TAX
		1999	$213,358
Dollars in thousands except where indicated		2000	$224,426
ADTs per mile	65,000	2001	$235,018
Interest Rate Paid	5%	2002	$249,364
Interest Rate Received	4%	2003	$257,971
Cost Per mile	$25,000	2004	$274,405
Value per VMT(actual value)	$0.30	2005	$292,610
Inflation Rate	2%	2006	$176,123
Discount Factor	5%	2007	$0
Annual Factor 1st year	63%	2008	$0
Annual Factor 2nd year	14%	2009	$0
Fund Availability of New Bonds	60%	2010	$0
		2011	$0
Miles Built	212	2012	$0
		2013	$0
Net Cost of Miles Built(Discounted)	$2,798,896	2014	$0
Total Debt Service(Discounted)	$1,246,700	2015	$0
		2016	$0
		2017	$0
Total Cost(Discounted)	$4,045,596	2018	$0
		2019	$0
Total User Benefit(Discounted)	$13,537,985	2020	$0
Net User Benefit(Discounted)	$9,492,389	2021	$0
		2022	$0
		2023	$0
		2024	$0
		2025	$0
		2026	$0
		2027	$0
		2028	$0
		2029	$0
		2030	$0
		2031	$0
		2032	$0
		2033	$0
		2034	$0
		2035	$0
		2036	$0
		2037	$0
		2038	$0
		2039	$0
		2040	$0
		2041	$0
		2042	$0
		2043	$0

E. HURF MAG HIGHWAY FUNDS (11% of HURF State Highway Fund) after 2007 based on 5% growth rate	F. Total Tax Revenue	G. Borrowed Funds	H. Total Revenue	I. RARF Debt Service
$56,372	$269,730	$0	$269,730	$148,518
$58,937	$283,363	$0	$283,363	$148,240
$61,052	$296,070	$0	$296,070	$138,699
$63,499	$312,863	$0	$312,863	$149,238
$66,808	$324,779	$0	$324,779	$149,242
$69,723	$344,128	$0	$344,128	$149,240
$72,803	$365,413	$0	$365,413	$149,239
$75,262	$251,385	$0	$251,385	
$79,025	$79,025	$0	$79,025	
$82,976	$82,976	$0	$82,976	
$87,125	$87,125	$0	$87,125	
$91,481	$91,481	$0	$91,481	
$96,055	$96,055	$0	$96,055	
$100,858	$100,858	$0	$100,858	
$105,901	$105,901	$0	$105,901	
$111,196	$111,196	$0	$111,196	
$116,756	$116,756	$0	$116,756	
$122,594	$122,594	$0	$122,594	
$128,723	$128,723	$0	$128,723	
$135,160	$135,160	$0	$135,160	
$141,918	$141,918	$0	$141,918	
$149,013	$149,013	$0	$149,013	
$156,464	$156,464	$0	$156,464	
$164,287	$164,287	$0	$164,287	
$172,502	$172,502	$0	$172,502	
$181,127	$181,127	$0	$181,127	
$190,183	$190,183	$0	$190,183	
$199,692	$199,692	$0	$199,692	
$209,677	$209,677	$0	$209,677	
$220,161	$220,161	$0	$220,161	
$231,169	$231,169	$0	$231,169	
$242,727	$242,727	$0	$242,727	
$254,863	$254,863	$0	$254,863	
$267,607	$267,607	$0	$267,607	
$280,987	$280,987	$0	$280,987	
$295,036	$295,036	$0	$295,036	
$309,788	$309,788	$0	$309,788	
$325,278	$325,278	$0	$325,278	
$341,541	$341,541	$0	$341,541	
$358,619	$358,619	$0	$358,619	
$376,549	$376,549	$0	$376,549	
$395,377	$395,377	$0	$395,377	
$415,146	$415,146	$0	$415,146	
$435,903	$435,903	$0	$435,903	
$457,698	$457,698	$0	$457,698	

J. HURF Debt Service	K. Existing Debt Service	L. Total Revenue Available for Construction	M. Cost/Mile Inflation Adjusted	N. Possible Miles Built per year	O. Net Cost of Miles Built Discounted	P. Total Miles Built
$41,979	$190,497	$79,233	$25,000	3.2	$79,233	3.2
$41,038	$189,278	$94,085	$25,500	3.7	$89,604	6.9
$40,642	$179,341	$116,729	$26,010	4.5	$105,877	11.3
$31,992	$181,230	$131,633	$26,530	5.0	$113,710	16.3
$33,157	$182,399	$142,380	$27,061	5.3	$117,136	21.6
$32,346	$181,586	$162,542	$27,602	5.9	$127,356	27.5
$31,612	$180,851	$184,562	$28,154	6.6	$137,723	34.0
$31,800	$31,800	$219,585	$28,717	7.6	$156,055	41.7
$34,248	$34,248	$44,777	$29,291	1.5	$30,307	43.2
$34,247	$34,247	$48,729	$29,877	1.6	$31,411	44.8
$34,251	$34,251	$52,874	$30,475	1.7	$32,460	46.6
$35,517	$35,517	$55,964	$31,084	1.8	$32,721	48.4
$35,517	$35,517	$60,538	$31,706	1.9	$33,710	50.3
	$0	$100,858	$32,340	3.1	$53,487	53.4
	$0	$105,901	$32,987	3.2	$53,487	56.6
	$0	$111,196	$33,647	3.3	$53,487	59.9
	$0	$116,756	$34,320	3.4	$53,487	63.3
	$0	$122,594	$35,006	3.5	$53,487	66.8
	$0	$128,723	$35,706	3.6	$53,487	70.4
	$0	$135,160	$36,420	3.7	$53,487	74.1
	$0	$141,918	$37,149	3.8	$53,487	77.9
	$0	$149,013	$37,892	3.9	$53,487	81.9
	$0	$156,464	$38,649	4.0	$53,487	85.9
	$0	$164,287	$39,422	4.2	$53,487	90.1
	$0	$172,502	$40,211	4.3	$53,487	94.4
	$0	$181,127	$41,015	4.4	$53,487	98.8
	$0	$190,183	$41,835	4.5	$53,487	103.3
	$0	$199,692	$42,672	4.7	$53,487	108.0
	$0	$209,677	$43,526	4.8	$53,487	112.8
	$0	$220,161	$44,396	5.0	$53,487	117.8
	$0	$231,169	$45,284	5.1	$53,487	122.9
	$0	$242,727	$46,190	5.3	$53,487	128.2
	$0	$254,863	$47,114	5.4	$53,487	133.6
	$0	$267,607	$48,056	5.6	$53,487	139.1
	$0	$280,987	$49,017	5.7	$53,487	144.9
	$0	$295,036	$49,997	5.9	$53,487	150.8
	$0	$309,788	$50,997	6.1	$53,487	156.8
	$0	$325,278	$52,017	6.3	$53,487	163.1
	$0	$341,541	$53,057	6.4	$53,487	169.5
	$0	$358,619	$54,119	6.6	$53,487	176.2
	$0	$376,549	$55,201	6.8	$53,487	183.0
	$0	$395,377	$56,305	7.0	$53,487	190.0
	$0	$415,146	$57,431	7.2	$53,487	197.2
	$0	$435,903	$58,580	7.4	$53,487	204.7
	$0	$457,698	$59,751	7.7	$53,487	212.3

Q. Additional VMTs per day	R. Additional VMTs per year	S. Cumulative Additional VMTs per year	T. Value per VMT Inflation Adjusted	U. Total Additional Yearly VMT Value (In whole #s)
206,007	75,192,554	75,192,554	$0.30	$22,557,766
239,824	87,535,676	162,728,230	$0.31	$49,794,838
291,712	106,474,708	269,202,938	$0.31	$84,023,621
322,506	117,714,836	386,917,774	$0.32	$123,180,071
341,997	124,828,772	511,746,545	$0.32	$166,179,276
382,770	139,710,976	651,457,521	$0.33	$215,778,523
426,104	155,527,928	806,985,449	$0.34	$272,639,006
497,021	181,412,606	988,398,056	$0.34	$340,607,604
99,363	36,267,672	1,024,665,728	$0.35	$360,167,764
106,014	38,694,946	1,063,360,674	$0.36	$381,244,332
112,775	41,163,001	1,104,523,675	$0.37	$403,922,459
117,026	42,714,505	1,147,238,181	$0.37	$427,933,944
124,109	45,299,647	1,192,537,828	$0.38	$453,727,895
202,713	73,990,318	1,266,528,146	$0.39	$491,516,762
208,675	76,166,504	1,342,694,650	$0.40	$531,497,123
214,813	78,406,695	1,421,101,345	$0.40	$573,784,592
221,131	80,712,774	1,501,814,120	$0.41	$618,500,687
227,635	83,086,680	1,584,900,799	$0.42	$665,773,123
234,330	85,530,405	1,670,431,205	$0.43	$715,736,130
241,222	88,046,006	1,758,477,210	$0.44	$768,530,774
248,317	90,635,594	1,849,112,804	$0.45	$824,305,307
255,620	93,301,347	1,942,414,151	$0.45	$883,215,526
263,138	96,045,504	2,038,459,655	$0.46	$945,425,156
270,878	98,870,372	2,137,330,027	$0.47	$1,011,106,244
278,845	101,778,324	2,239,108,351	$0.48	$1,080,439,583
287046	104,771,804	2,343,880,155	$0.49	$1,153,615,150
295489	107,853,328	2,451,733,483	$0.50	$1,230,832,566
304179	111,025,484	2,562,758,967	$0.51	$1,312,301,587
313126	114,290,940	2,677,049,907	$0.52	$1,398,242,607
322335	117,652,438	2,794,702,345	$0.53	$1,488,887,196
331816	121,112,804	2,915,815,149	$0.54	$1,584,478,664
341575	124,674,945	3,040,490,094	$0.55	$1,685,272,647
351622	128,341,855	3,168,831,949	$0.57	$1,791,537,731
361963	132,116,616	3,300,948,565	$0.58	$1,903,556,098
372609	136,002,399	3,436,950,963	$0.59	$2,021,624,213
383568	140,002,469	3,576,953,432	$0.60	$2,146,053,540
394850	144,120,189	3,721,073,621	$0.61	$2,277,171,295
406463	148,359,018	3,869,432,639	$0.62	$2,415,321,240
418418	152,722,518	4,022,155,157	$0.64	$2,560,864,510
430724	157,214,357	4,179,369,514	$0.65	$2,714,180,487
443393	161,838,309	4,341,207,823	$0.66	$2,875,667,719
456434	166,598,259	4,507,806,082	$0.68	$3,045,744,875
469858	171,498,208	4,679,304,290	$0.69	$3,224,851,766
483677	176,542,273	4,855,846,563	$0.70	$3,413,450,393
497903	181,734,693	5,037,581,256	$0.72	$3,612,026,073

V. Total Additional Yearly VMT Value Time Discounted (In whole #s)	W. Interest Gain	X. Interest Expense	Y. Principle Payout	Z. Cumulative Debt Service Payments
$22,557,766	$0	$0		$190,497
$47,423,656	$0	$0		$189,278
$76,211,901	$0	$0		$179,341
$106,407,577	$0	$0		$181,230
$136,716,101	$0	$0		$182,399
$169,068,119	$0	$0		$181,586
$203,447,424	$0	$0		$180,851
$242,063,465	$0	$0		$31,800
$243,775,719	$0	$0		$34,248
$245,753,496	$0	$0		$34,247
$247,973,351	$0	$0		$34,251
$250,204,114	$0	$0		$35,517
$252,652,669	$0	$0		$35,517
$260,661,833	$0	$0		$0
$268,442,164	$0	$0		$0
$276,000,199	$0	$0		$0
$283,342,291	$0	$0		$0
$290,474,608	$0	$0		$0
$297,403,145	$0	$0		$0
$304,133,724	$0	$0		$0
$310,672,001	$0	$0	$0	$0
$317,023,470	$0	$0	$0	$0
$323,193,468	$0	$0	$0	$0
$329,187,180	$0	$0	$0	$0
$335,009,644	$0	$0	$0	$0
$340,665,751	$0	$0	$0	$0
$346,160,256	$0	$0	$0	$0
$351,497,774	$0	$0	$0	$0
$356,682,792	$0	$0	$0	$0
$361,719,667	$0	$0	$0	$0
$366,612,631	$0	$0	$0	$0
$371,365,796	$0	$0	$0	$0
$375,983,156	$0	$0	$0	$0
$380,468,592	$0	$0	$0	$0
$384,825,872	$0	$0	$0	$0
$389,058,659	$0	$0	$0	$0
$393,170,509	$0	$0	$0	$0
$397,164,877	$0	$0	$0	$0
$401,045,121	$0	$0	$0	$0
$404,814,500	$0	$0	$0	$0
$408,476,183	$0	$0	$0	$0
$412,033,247	$0	$0	$0	$0
$415,488,680	$0	$0	$0	$0
$418,845,386	$0	$0	$0	$0
$422,106,187	$0	$0	$0	$0

AA. Cumulative Debt Service Discounted	AB. Debt Coverage Ratio
$190,497	1.4
$180,265	1.5
$162,668	1.7
$156,553	1.7
$150,060	1.8
$142,277	1.9
$134,954	2.0
$22,600	7.9
$23,180	2.3
$22,076	2.4
$21,027	2.5
$20,766	2.6
$19,777	2.7
$0	#DIV/0!
$0	#DIV/0!
$0	#DIV/0!
$0	#DIV/0!
$0	#DIV/0!
$0	#DIV/0!
$0	#DIV/0!
$0	#DIV/0!
$0	#DIV/0!
$0	#DIV/0!
$0	#DIV/0!
$0	#DIV/0!
$0	#DIV/0!
$0	#DIV/0!
$0	#DIV/0!
$0	#DIV/0!
$0	#DIV/0!
$0	#DIV/0!
$0	#DIV/0!
$0	#DIV/0!
$0	#DIV/0!
$0	#DIV/0!
$0	#DIV/0!
$0	#DIV/0!
$0	#DIV/0!
$0	#DIV/0!
$0	#DIV/0!
$0	#DIV/0!
$0	#DIV/0!
$0	#DIV/0!
$0	#DIV/0!
$0	#DIV/0!
$0	#DIV/0!
$0	#DIV/0!
$0	#DIV/0!
$0	#DIV/0!
$0	#DIV/0!

Documentation: Debt Paid at Maturity

A. DEBT PAID AT MATURITY MODEL	B.	C. FISCAL YEAR
		1999
Dollars in thousands except where indicated		=(C5+1)
ADTs per mile	65000	=(C6+1)
Interest Rate Paid	0.05	=(C7+1)
Interest Rate Received	0.04	=(C8+1)
Cost Per mile	25000	=(C9+1)
Value per VMT(actual value)	0.3	=(C10+1)
Inflation Rate	0.02	=(C11+1)
Discount Factor	0.05	=(C12+1)
Annual Factor 1st year	0.63	=(C13+1)
Annual Factor 2nd year	0.14	=(C14+1)
Fund Availability of New Bonds	0.6	=(C15+1)
		=(C16+1)
Miles Built	=SUM(N5:N49)	=(C17+1)
		=(C18+1)
Net Cost of Miles Built(Discounted)	=SUM(O5:O49)	=(C19+1)
Total Debt Service(Discounted)	=SUM(AA5:AA49)	=(C20+1)
		=(C21+1)
		=(C22+1)
Total Cost(Discounted)	=B20+B21	=(C23+1)
		=(C24+1)
Total User Benefit(Discounted)	=((SUM(V5:V49))/1000)	=(C25+1)
Net User Benefit(Discounted)	=B26-B24	=(C26+1)
		=(C27+1)
		=(C28+1)
		=(C29+1)
		=(C30+1)
		=(C31+1)
		=(C32+1)
		=(C33+1)
		=(C34+1)
		=(C35+1)
		=(C36+1)
		=(C37+1)
		=(C38+1)
		=(C39+1)
		=(C40+1)
		=(C41+1)
		=(C42+1)
		=(C43+1)
		=(C44+1)
		=(C45+1)
		=(C46+1)
		=(C47+1)
		=(C48+1)

D. MARICOPA COUNTY TRANSPORTATION EXCISE TAX	E. HURF MAG HIGHWAY FUNDS (11% of HURF State Highway Fund) after 2007 based on 5% growth rate	F. Total Tax Revenue	G. Borrowed Funds
213358.1	56372.36	=D5:D49+E5:E49	0
224425.7	58937.01	=D5:D49+E5:E49	0
235018.4	61052.09	=D5:D49+E5:E49	0
249364.4	63498.82	=D5:D49+E5:E49	0
257971	66808.06	=D5:D49+E5:E49	0
274405	69722.84	=D5:D49+E5:E49	0
292610	72803.39	=D5:D49+E5:E49	0
176123	75261.89	=D5:D49+E5:E49	0
0	=E12+E12*0.05	=D5:D49+E5:E49	0
0	=E13+E13*0.05	=D5:D49+E5:E49	0
0	=E14+E14*0.05	=D5:D49+E5:E49	0
0	=E15+E15*0.05	=D5:D49+E5:E49	0
0	=E16+E16*0.05	=D5:D49+E5:E49	0
0	=E17+E17*0.05	=D5:D49+E5:E49	0
0	=E18+E18*0.05	=D5:D49+E5:E49	0
0	=E19+E19*0.05	=D5:D49+E5:E49	0
0	=E20+E20*0.05	=D5:D49+E5:E49	0
0	=E21+E21*0.05	=D5:D49+E5:E49	0
0	=E22+E22*0.05	=D5:D49+E5:E49	0
0	=E23+E23*0.05	=D5:D49+E5:E49	0
0	=E24+E24*0.05	=D5:D49+E5:E49	0
0	=E25+E25*0.05	=D5:D49+E5:E49	0
0	=E26+E26*0.05	=D5:D49+E5:E49	0
0	=E27+E27*0.05	=D5:D49+E5:E49	0
0	=E28+E28*0.05	=D5:D49+E5:E49	0
0	=E29+E29*0.05	=D5:D49+E5:E49	0
0	=E30+E30*0.05	=D5:D49+E5:E49	0
0	=E31+E31*0.05	=D5:D49+E5:E49	0
0	=E32+E32*0.05	=D5:D49+E5:E49	0
0	=E33+E33*0.05	=D5:D49+E5:E49	0
0	=E34+E34*0.05	=D5:D49+E5:E49	0
0	=E35+E35*0.05	=D5:D49+E5:E49	0
0	=E36+E36*0.05	=D5:D49+E5:E49	0
0	=E37+E37*0.05	=D5:D49+E5:E49	0
0	=E38+E38*0.05	=D5:D49+E5:E49	0
0	=E39+E39*0.05	=D5:D49+E5:E49	0
0	=E40+E40*0.05	=D5:D49+E5:E49	0
0	=E41+E41*0.05	=D5:D49+E5:E49	0
0	=E42+E42*0.05	=D5:D49+E5:E49	0
0	=E43+E43*0.05	=D5:D49+E5:E49	0
0	=E44+E44*0.05	=D5:D49+E5:E49	0
0	=E45+E45*0.05	=D5:D49+E5:E49	0
0	=E46+E46*0.05	=D5:D49+E5:E49	0
0	=E47+E47*0.05	=D5:D49+E5:E49	0
0	=E48+E48*0.05	=D5:D49+E5:E49	0

H. Total Revenue	I. RARF Debt Service	J. HURF Debt Service	K. Existing Debt Service
=F5:F49+G5:G49	148518	41979	=(I5+J5)
=F5:F49+G5:G49	148240	41038	=(I6+J6)
=F5:F49+G5:G49	138699	40642	=(I7+J7)
=F5:F49+G5:G49	149238	31992	=(I8+J8)
=F5:F49+G5:G49	149242	33157	=(I9+J9)
=F5:F49+G5:G49	149240	32346	=(I10+J10)
=F5:F49+G5:G49	149239	31612	=(I11+J11)
=F5:F49+G5:G49		31800	=(I12+J12)
=F5:F49+G5:G49		34248	=(I13+J13)
=F5:F49+G5:G49		34247	=(I14+J14)
=F5:F49+G5:G49		34251	=(I15+J15)
=F5:F49+G5:G49		35517	=(I16+J16)
=F5:F49+G5:G49		35517	=(I17+J17)
=F5:F49+G5:G49			=(I18+J18)
=F5:F49+G5:G49			=(I19+J19)
=F5:F49+G5:G49			=(I20+J20)
=F5:F49+G5:G49			=(I21+J21)
=F5:F49+G5:G49			=(I22+J22)
=F5:F49+G5:G49			=(I23+J23)
=F5:F49+G5:G49			=(I24+J24)
=F5:F49+G5:G49			=(I25+J25)
=F5:F49+G5:G49			=(I26+J26)
=F5:F49+G5:G49			=(I27+J27)
=F5:F49+G5:G49			=(I28+J28)
=F5:F49+G5:G49			=(I29+J29)
=F5:F49+G5:G49			=(I30+J30)
=F5:F49+G5:G49			=(I31+J31)
=F5:F49+G5:G49			=(I32+J32)
=F5:F49+G5:G49			=(I33+J33)
=F5:F49+G5:G49			=(I34+J34)
=F5:F49+G5:G49			=(I35+J35)
=F5:F49+G5:G49			=(I36+J36)
=F5:F49+G5:G49			=(I37+J37)
=F5:F49+G5:G49			=(I38+J38)
=F5:F49+G5:G49			=(I39+J39)
=F5:F49+G5:G49			=(I40+J40)
=F5:F49+G5:G49			=(I41+J41)
=F5:F49+G5:G49			=(I42+J42)
=F5:F49+G5:G49			=(I43+J43)
=F5:F49+G5:G49			=(I44+J44)
=F5:F49+G5:G49			=(I45+J45)
=F5:F49+G5:G49			=(I46+J46)
=F5:F49+G5:G49			=(I47+J47)
=F5:F49+G5:G49			=(I48+J48)
=F5:F49+G5:G49			=(I49+J49)

L. Total Revenue Available for Construction	M. Cost/Mile Inflation Adjusted
=(F5)+(G5*$B$16)+(W5-X5-Y5)-(K5)	=B10
=(F6)+(G6*$B$16)+(G5)*(1-$B$16)+(W6-X6-Y6)-(K6)	=B10+B10*B12
=(F7)+(G7*$B$16)+(G6)*(1-$B$16)+(W7-X7-Y7)-(K7)	=M6+M6*B12
=(F8)+(G8*$B$16)+(G7)*(1-$B$16)+(W8-X8-Y8)-(K8)	=M7+M7*B12
=(F9)+(G9*$B$16)+(G8)*(1-$B$16)+(W9-X9-Y9)-(K9)	=M8+M8*B12
=(F10)+(G10*$B$16)+(G9)*(1-$B$16)+(W10-X10-Y10)-(K10)	=M9+M9*B12
=(F11)+(G11*$B$16)+(G10)*(1-$B$16)+(W11-X11-Y11)-(K11)	=M10+M10*B12
=(F12)+(G12*$B$16)+(G11)*(1-$B$16)+(W12-X12-Y12)-(K12)	=M11+M11*B12
=(F13)+(G13*$B$16)+(G12)*(1-$B$16)+(W13-X13-Y13)-(K13)	=M12+M12*B12
=(F14)+(G14*$B$16)+(G13)*(1-$B$16)+(W14-X14-Y14)-(K14)	=M13+M13*B12
=(F15)+(G15*$B$16)+(G14)*(1-$B$16)+(W15-X15-Y15)-(K15)	=M14+M14*B12
=(F16)+(G16*$B$16)+(G15)*(1-$B$16)+(W16-X16-Y16)-(K16)	=M15+M15*B12
=(F17)+(G17*$B$16)+(G16)*(1-$B$16)+(W17-X17-Y17)-(K17)	=M16+M16*B12
=(F18)+(G18*$B$16)+(G17)*(1-$B$16)+(W18-X18-Y18)-(K18)	=M17+M17*B12
=(F19)+(G19*$B$16)+(G18)*(1-$B$16)+(W19-X19-Y19)-(K19)	=M18+M18*B12
=(F20)+(G20*$B$16)+(G19)*(1-$B$16)+(W20-X20-Y20)-(K20)	=M19+M19*B12
=(F21)+(G21*$B$16)+(G20)*(1-$B$16)+(W21-X21-Y21)-(K21)	=M20+M20*B12
=(F22)+(G22*$B$16)+(G21)*(1-$B$16)+(W22-X22-Y22)-(K22)	=M21+M21*B12
=(F23)+(G23*$B$16)+(G22)*(1-$B$16)+(W23-X23-Y23)-(K23)	=M22+M22*B12
=(F24)+(G24*$B$16)+(G23)*(1-$B$16)+(W24-X24-Y24)-(K24)	=M23+M23*B12
=(F25)+(G25*$B$16)+(G24)*(1-$B$16)+(W25-X25-Y25)-(K25)	=M24+M24*B12
=(F26)+(G26*$B$16)+(G25)*(1-$B$16)+(W26-X26-Y26)-(K26)	=M25+M25*B12
=(F27)+(G27*$B$16)+(G26)*(1-$B$16)+(W27-X27-Y27)-(K27)	=M26+M26*B12
=(F28)+(G28*$B$16)+(G27)*(1-$B$16)+(W28-X28-Y28)-(K28)	=M27+M27*B12
=(F29)+(G29*$B$16)+(G28)*(1-$B$16)+(W29-X29-Y29)-(K29)	=M28+M28*$B$12
=(F30)+(G30*$B$16)+(G29)*(1-$B$16)+(W30-X30-Y30)-(K30)	=M29+M29*$B$12
=(F31)+(G31*$B$16)+(G30)*(1-$B$16)+(W31-X31-Y31)-(K31)	=M30+M30*$B$12
=(F32)+(G32*$B$16)+(G31)*(1-$B$16)+(W32-X32-Y32)-(K32)	=M31+M31*$B$12
=(F33)+(G33*$B$16)+(G32)*(1-$B$16)+(W33-X33-Y33)-(K33)	=M32+M32*$B$12
=(F34)+(G34*$B$16)+(G33)*(1-$B$16)+(W34-X34-Y34)-(K34)	=M33+M33*$B$12
=(F35)+(G35*$B$16)+(G34)*(1-$B$16)+(W35-X35-Y35)-(K35)	=M34+M34*$B$12
=(F36)+(G36*$B$16)+(G35)*(1-$B$16)+(W36-X36-Y36)-(K36)	=M35+M35*$B$12
=(F37)+(G37*$B$16)+(G36)*(1-$B$16)+(W37-X37-Y37)-(K37)	=M36+M36*$B$12
=(F38)+(G38*$B$16)+(G37)*(1-$B$16)+(W38-X38-Y38)-(K38)	=M37+M37*$B$12
=(F39)+(G39*$B$16)+(G38)*(1-$B$16)+(W39-X39-Y39)-(K39)	=M38+M38*$B$12
=(F40)+(G40*$B$16)+(G39)*(1-$B$16)+(W40-X40-Y40)-(K40)	=M39+M39*$B$12
=(F41)+(G41*$B$16)+(G40)*(1-$B$16)+(W41-X41-Y41)-(K41)	=M40+M40*$B$12
=(F42)+(G42*$B$16)+(G41)*(1-$B$16)+(W42-X42-Y42)-(K42)	=M41+M41*$B$12
=(F43)+(G43*$B$16)+(G42)*(1-$B$16)+(W43-X43-Y43)-(K43)	=M42+M42*$B$12
=(F44)+(G44*$B$16)+(G43)*(1-$B$16)+(W44-X44-Y44)-(K44)	=M43+M43*$B$12
=(F45)+(G45*$B$16)+(G44)*(1-$B$16)+(W45-X45-Y45)-(K45)	=M44+M44*$B$12
=(F46)+(G46*$B$16)+(G45)*(1-$B$16)+(W46-X46-Y46)-(K46)	=M45+M45*$B$12
=(F47)+(G47*$B$16)+(G46)*(1-$B$16)+(W47-X47-Y47)-(K47)	=M46+M46*$B$12
=(F48)+(G48*$B$16)+(G47)*(1-$B$16)+(W48-X48-Y48)-(K48)	=M47+M47*$B$12
=(F49)+(G49*$B$16)+(G48)*(1-$B$16)+(W49-X49-Y49)-(K49)	=M48+M48*$B$12

N. Possible Miles Built per year	O. Net Cost of Miles Built Discounted	P. Total Miles Built	Q. Additional VMTs per day	R. Additional VMTs per year
=L5:L49/M5:M49	=L5	=N5	=N5:N49*$B$7	=(Q5*365)
=L5:L49/M5:M49	=L6/(1+$B$13)	=P5+N6	=N5:N49*$B$7	=(Q6*365)
=L5:L49/M5:M49	=L7/(1+$B$13)^2	=P6+N7	=N5:N49*$B$7	=(Q7*365)
=L5:L49/M5:M49	=L8/(1+$B$13)^3	=P7+N8	=N5:N49*$B$7	=(Q8*365)
=L5:L49/M5:M49	=L9/(1+$B$13)^4	=P8+N9	=N5:N49*$B$7	=(Q9*365)
=L5:L49/M5:M49	=L10/(1+$B$13)^5	=P9+N10	=N5:N49*$B$7	=(Q10*365)
=L5:L49/M5:M49	=L11/(1+$B$13)^6	=P10+N11	=N5:N49*$B$7	=(Q11*365)
=L5:L49/M5:M49	=L12/(1+$B$13)^7	=P11+N12	=N5:N49*$B$7	=(Q12*365)
=L5:L49/M5:M49	=L13/(1+$B$13)^8	=P12+N13	=N5:N49*$B$7	=(Q13*365)
=L5:L49/M5:M49	=L14/(1+$B$13)^9	=P13+N14	=N5:N49*$B$7	=(Q14*365)
=L5:L49/M5:M49	=L15/(1+$B$13)^10	=P14+N15	=N5:N49*$B$7	=(Q15*365)
=L5:L49/M5:M49	=L16/(1+$B$13)^11	=P15+N16	=N5:N49*$B$7	=(Q16*365)
=L5:L49/M5:M49	=L17/(1+$B$13)^12	=P16+N17	=N5:N49*$B$7	=(Q17*365)
=L5:L49/M5:M49	=L18/(1+$B$13)^13	=P17+N18	=N5:N49*$B$7	=(Q18*365)
=L5:L49/M5:M49	=L19/(1+$B$13)^14	=P18+N19	=N5:N49*$B$7	=(Q19*365)
=L5:L49/M5:M49	=L20/(1+$B$13)^15	=P19+N20	=N5:N49*$B$7	=(Q20*365)
=L5:L49/M5:M49	=L21/(1+$B$13)^16	=P20+N21	=N5:N49*$B$7	=(Q21*365)
=L5:L49/M5:M49	=L22/(1+$B$13)^17	=P21+N22	=N5:N49*$B$7	=(Q22*365)
=L5:L49/M5:M49	=L23/(1+$B$13)^18	=P22+N23	=N5:N49*$B$7	=(Q23*365)
=L5:L49/M5:M49	=L24/(1+$B$13)^19	=P23+N24	=N5:N49*$B$7	=(Q24*365)
=L5:L49/M5:M49	=L25/(1+$B$13)^20	=P24+N25	=N5:N49*$B$7	=(Q25*365)
=L5:L49/M5:M49	=L26/(1+$B$13)^21	=P25+N26	=N5:N49*$B$7	=(Q26*365)
=L5:L49/M5:M49	=L27/(1+$B$13)^22	=P26+N27	=N5:N49*$B$7	=(Q27*365)
=L5:L49/M5:M49	=L28/(1+$B$13)^23	=P27+N28	=N5:N49*$B$7	=(Q28*365)
=L5:L49/M5:M49	=L29/(1+$B$13)^24	=P28+N29	=N5:N49*$B$7	=(Q29*365)
=L5:L49/M5:M49	=L30/(1+$B$13)^25	=P29+N30	=N5:N49*$B$7	=(Q30*365)
=L5:L49/M5:M49	=L31/(1+$B$13)^26	=P30+N31	=N5:N49*$B$7	=(Q31*365)
=L5:L49/M5:M49	=L32/(1+$B$13)^27	=P31+N32	=N5:N49*$B$7	=(Q32*365)
=L5:L49/M5:M49	=L33/(1+$B$13)^28	=P32+N33	=N5:N49*$B$7	=(Q33*365)
=L5:L49/M5:M49	=L34/(1+$B$13)^29	=P33+N34	=N5:N49*$B$7	=(Q34*365)
=L5:L49/M5:M49	=L35/(1+$B$13)^30	=P34+N35	=N5:N49*$B$7	=(Q35*365)
=L5:L49/M5:M49	=L36/(1+$B$13)^31	=P35+N36	=N5:N49*$B$7	=(Q36*365)
=L5:L49/M5:M49	=L37/(1+$B$13)^32	=P36+N37	=N5:N49*$B$7	=(Q37*365)
=L5:L49/M5:M49	=L38/(1+$B$13)^33	=P37+N38	=N5:N49*$B$7	=(Q38*365)
=L5:L49/M5:M49	=L39/(1+$B$13)^34	=P38+N39	=N5:N49*$B$7	=(Q39*365)
=L5:L49/M5:M49	=L40/(1+$B$13)^35	=P39+N40	=N5:N49*$B$7	=(Q40*365)
=L5:L49/M5:M49	=L41/(1+$B$13)^36	=P40+N41	=N5:N49*$B$7	=(Q41*365)
=L5:L49/M5:M49	=L42/(1+$B$13)^37	=P41+N42	=N5:N49*$B$7	=(Q42*365)
=L5:L49/M5:M49	=L43/(1+$B$13)^38	=P42+N43	=N5:N49*$B$7	=(Q43*365)
=L5:L49/M5:M49	=L44/(1+$B$13)^39	=P43+N44	=N5:N49*$B$7	=(Q44*365)
=L5:L49/M5:M49	=L45/(1+$B$13)^40	=P44+N45	=N5:N49*$B$7	=(Q45*365)
=L5:L49/M5:M49	=L46/(1+$B$13)^41	=P45+N46	=N5:N49*$B$7	=(Q46*365)
=L5:L49/M5:M49	=L47/(1+$B$13)^42	=P46+N47	=N5:N49*$B$7	=(Q47*365)
=L5:L49/M5:M49	=L48/(1+$B$13)^43	=P47+N48	=N5:N49*$B$7	=(Q48*365)
=L5:L49/M5:M49	=L49/(1+$B$13)^44	=P48+N49	=N5:N49*$B$7	=(Q49*365)

S. Cumulative Additional VMTs per year	T. Value per VMT Inflation Adjusted	U. Total Additional Yearly VMT Value (In whole #s)	V. Total Additional Yearly VMT Value Time Discounted (In whole #s)
=R5	=B11	=(S5:S49*T5:T49)	=U5
=SUM($R$5:R6)	=T5+T5*$B$12	=(S5:S49*T5:T49)	=U6/(1+$B$13)
=SUM($R$5:R7)	=T6+T6*$B$12	=(S5:S49*T5:T49)	=U7/(1+$B$13)^2
=SUM($R$5:R8)	=T7+T7*$B$12	=(S5:S49*T5:T49)	=U8/(1+$B$13)^3
=SUM($R$5:R9)	=T8+T8*$B$12	=(S5:S49*T5:T49)	=U9/(1+$B$13)^4
=SUM($R$5:R10)	=T9+T9*$B$12	=(S5:S49*T5:T49)	=U10/(1+$B$13)^5
=SUM($R$5:R11)	=T10+T10*$B$12	=(S5:S49*T5:T49)	=U11/(1+$B$13)^6
=SUM($R$5:R12)	=T11+T11*$B$12	=(S5:S49*T5:T49)	=U12/(1+$B$13)^7
=SUM($R$5:R13)	=T12+T12*$B$12	=(S5:S49*T5:T49)	=U13/(1+$B$13)^8
=SUM($R$5:R14)	=T13+T13*$B$12	=(S5:S49*T5:T49)	=U14/(1+$B$13)^9
=SUM($R$5:R15)	=T14+T14*$B$12	=(S5:S49*T5:T49)	=U15/(1+$B$13)^10
=SUM($R$5:R16)	=T15+T15*$B$12	=(S5:S49*T5:T49)	=U16/(1+$B$13)^11
=SUM($R$5:R17)	=T16+T16*$B$12	=(S5:S49*T5:T49)	=U17/(1+$B$13)^12
=SUM($R$5:R18)	=T17+T17*$B$12	=(S5:S49*T5:T49)	=U18/(1+$B$13)^13
=SUM($R$5:R19)	=T18+T18*$B$12	=(S5:S49*T5:T49)	=U19/(1+$B$13)^14
=SUM($R$5:R20)	=T19+T19*$B$12	=(S5:S49*T5:T49)	=U20/(1+$B$13)^15
=SUM($R$5:R21)	=T20+T20*$B$12	=(S5:S49*T5:T49)	=U21/(1+$B$13)^16
=SUM($R$5:R22)	=T21+T21*$B$12	=(S5:S49*T5:T49)	=U22/(1+$B$13)^17
=SUM($R$5:R23)	=T22+T22*$B$12	=(S5:S49*T5:T49)	=U23/(1+$B$13)^18
=SUM($R$5:R24)	=T23+T23*$B$12	=(S5:S49*T5:T49)	=U24/(1+$B$13)^19
=SUM($R$5:R25)	=T24+T24*$B$12	=(S5:S49*T5:T49)	=U25/(1+$B$13)^20
=SUM($R$5:R26)	=T25+T25*$B$12	=(S5:S49*T5:T49)	=U26/(1+$B$13)^21
=SUM($R$5:R27)	=T26+T26*$B$12	=(S5:S49*T5:T49)	=U27/(1+$B$13)^22
=SUM($R$5:R28)	=T27+T27*$B$12	=(S5:S49*T5:T49)	=U28/(1+$B$13)^23
=SUM($R$5:R29)	=T28+T28*$B$12	=(S5:S49*T5:T49)	=U29/(1+$B$13)^24
=SUM($R$5:R30)	=T29+T29*$B$12	=(S5:S49*T5:T49)	=U30/(1+$B$13)^25
=SUM($R$5:R31)	=T30+T30*$B$12	=(S5:S49*T5:T49)	=U31/(1+$B$13)^26
=SUM($R$5:R32)	=T31+T31*$B$12	=(S5:S49*T5:T49)	=U32/(1+$B$13)^27
=SUM($R$5:R33)	=T32+T32*$B$12	=(S5:S49*T5:T49)	=U33/(1+$B$13)^28
=SUM($R$5:R34)	=T33+T33*$B$12	=(S5:S49*T5:T49)	=U34/(1+$B$13)^29
=SUM($R$5:R35)	=T34+T34*$B$12	=(S5:S49*T5:T49)	=U35/(1+$B$13)^30
=SUM($R$5:R36)	=T35+T35*$B$12	=(S5:S49*T5:T49)	=U36/(1+$B$13)^31
=SUM($R$5:R37)	=T36+T36*$B$12	=(S5:S49*T5:T49)	=U37/(1+$B$13)^32
=SUM($R$5:R38)	=T37+T37*$B$12	=(S5:S49*T5:T49)	=U38/(1+$B$13)^33
=SUM($R$5:R39)	=T38+T38*$B$12	=(S5:S49*T5:T49)	=U39/(1+$B$13)^34
=SUM($R$5:R40)	=T39+T39*$B$12	=(S5:S49*T5:T49)	=U40/(1+$B$13)^35
=SUM($R$5:R41)	=T40+T40*$B$12	=(S5:S49*T5:T49)	=U41/(1+$B$13)^36
=SUM($R$5:R42)	=T41+T41*$B$12	=(S5:S49*T5:T49)	=U42/(1+$B$13)^37
=SUM($R$5:R43)	=T42+T42*$B$12	=(S5:S49*T5:T49)	=U43/(1+$B$13)^38
=SUM($R$5:R44)	=T43+T43*$B$12	=(S5:S49*T5:T49)	=U44/(1+$B$13)^39
=SUM($R$5:R45)	=T44+T44*$B$12	=(S5:S49*T5:T49)	=U45/(1+$B$13)^40
=SUM($R$5:R46)	=T45+T45*$B$12	=(S5:S49*T5:T49)	=U46/(1+$B$13)^41
=SUM($R$5:R47)	=T46+T46*$B$12	=(S5:S49*T5:T49)	=U47/(1+$B$13)^42
=SUM($R$5:R48)	=T47+T47*$B$12	=(S5:S49*T5:T49)	=U48/(1+$B$13)^43
=SUM($R$5:R49)	=T48+T48*$B$12	=(S5:S49*T5:T49)	=U49/(1+$B$13)^44

W. Interest Gain	X. Interest Expense	Y. Principle Payout	Z. Cumulative Debt Service Payments
=G5*B14*B9	=B8*G5		=(X5+Y5+K5)
=(G6*B14+G5*B15)*B9	=$B$8*SUM($G$5:G6)		=(X6+Y6+K6)
=(G7*B14+G6*B15)*B9	=$B$8*SUM($G$5:G7)		=(X7+Y7+K7)
=(G8*B14+G7*B15)*B9	=$B$8*SUM($G$5:G8)		=(X8+Y8+K8)
=(G9*B14+G8*B15)*B9	=$B$8*SUM($G$5:G9)		=(X9+Y9+K9)
=(G10*$B$14+G9*$B$15)*$B$9	=$B$8*SUM($G$5:G10)		=(X10+Y10+K10)
=(G11*$B$14+G10*$B$15)*$B$9	=$B$8*SUM($G$5:G11)		=(X11+Y11+K11)
=(G12*$B$14+G11*$B$15)*$B$9	=$B$8*SUM($G$5:G12)		=(X12+Y12+K12)
=(G13*$B$14+G12*$B$15)*$B$9	=$B$8*SUM($G$5:G13)		=(X13+Y13+K13)
=(G14*$B$14+G13*$B$15)*$B$9	=$B$8*SUM($G$5:G14)		=(X14+Y14+K14)
=(G15*$B$14+G14*$B$15)*$B$9	=$B$8*SUM($G$5:G15)		=(X15+Y15+K15)
=(G16*$B$14+G15*$B$15)*$B$9	=$B$8*SUM($G$5:G16)		=(X16+Y16+K16)
=(G17*$B$14+G16*$B$15)*$B$9	=$B$8*SUM($G$5:G17)		=(X17+Y17+K17)
=(G18*$B$14+G17*$B$15)*$B$9	=$B$8*SUM($G$5:G18)		=(X18+Y18+K18)
=(G19*$B$14+G18*$B$15)*$B$9	=$B$8*SUM($G$5:G19)		=(X19+Y19+K19)
=(G20*$B$14+G19*$B$15)*$B$9	=$B$8*SUM($G$5:G20)		=(X20+Y20+K20)
=(G21*$B$14+G20*$B$15)*$B$9	=$B$8*SUM($G$5:G21)		=(X21+Y21+K21)
=(G22*$B$14+G21*$B$15)*$B$9	=$B$8*SUM($G$5:G22)		=(X22+Y22+K22)
=(G23*$B$14+G22*$B$15)*$B$9	=$B$8*SUM($G$5:G23)		=(X23+Y23+K23)
=(G24*$B$14+G23*$B$15)*$B$9	=$B$8*SUM($G$5:G24)		=(X24+Y24+K24)
=(G25*$B$14+G24*$B$15)*$B$9	=$B$8*SUM(G6:G25)	=G5	=(X25+Y25+K25)
=(G26*$B$14+G25*$B$15)*$B$9	=$B$8*SUM(G7:G26)	=G6	=(X26+Y26+K26)
=(G27*$B$14+G26*$B$15)*$B$9	=$B$8*SUM(G8:G27)	=G7	=(X27+Y27+K27)
=(G28*$B$14+G27*$B$15)*$B$9	=$B$8*SUM(G9:G28)	=G8	=(X28+Y28+K28)
=(G29*$B$14+G28*$B$15)*$B$9	=$B$8*SUM(G10:G29)	=G9	=(X29+Y29+K29)
=(G30*$B$14+G29*$B$15)*$B$9	=$B$8*SUM(G11:G30)	=G10	=(X30+Y30+K30)
=(G31*$B$14+G30*$B$15)*$B$9	=$B$8*SUM(G12:G31)	=G11	=(X31+Y31+K31)
=(G32*$B$14+G31*$B$15)*$B$9	=$B$8*SUM(G13:G32)	=G12	=(X32+Y32+K32)
=(G33*$B$14+G32*$B$15)*$B$9	=$B$8*SUM(G14:G33)	=G13	=(X33+Y33+K33)
=(G34*$B$14+G33*$B$15)*$B$9	=$B$8*SUM(G15:G34)	=G14	=(X34+Y34+K34)
=(G35*$B$14+G34*$B$15)*$B$9	=$B$8*SUM(G16:G35)	=G15	=(X35+Y35+K35)
=(G36*$B$14+G35*$B$15)*$B$9	=$B$8*SUM(G17:G36)	=G16	=(X36+Y36+K36)
=(G37*$B$14+G36*$B$15)*$B$9	=$B$8*SUM(G18:G37)	=G17	=(X37+Y37+K37)
=(G38*$B$14+G37*$B$15)*$B$9	=$B$8*SUM(G19:G38)	=G18	=(X38+Y38+K38)
=(G39*$B$14+G38*$B$15)*$B$9	=$B$8*SUM(G20:G39)	=G19	=(X39+Y39+K39)
=(G40*$B$14+G39*$B$15)*$B$9	=$B$8*SUM(G21:G40)	=G20	=(X40+Y40+K40)
=(G41*$B$14+G40*$B$15)*$B$9	=$B$8*SUM(G22:G41)	=G21	=(X41+Y41+K41)
=(G42*$B$14+G41*$B$15)*$B$9	=$B$8*SUM(G23:G42)	=G22	=(X42+Y42+K42)
=(G43*$B$14+G42*$B$15)*$B$9	=$B$8*SUM(G24:G43)	=G23	=(X43+Y43+K43)
=(G44*$B$14+G43*$B$15)*$B$9	=$B$8*SUM(G25:G44)	=G24	=(X44+Y44+K44)
=(G45*$B$14+G44*$B$15)*$B$9	=$B$8*SUM(G26:G45)	=G25	=(X45+Y45+K45)
=(G46*$B$14+G45*$B$15)*$B$9	=$B$8*SUM(G27:G46)	=G26	=(X46+Y46+K46)
=(G47*$B$14+G46*$B$15)*$B$9	=$B$8*SUM(G28:G47)	=G27	=(X47+Y47+K47)
=(G48*$B$14+G47*$B$15)*$B$9	=$B$8*SUM(G29:G48)	=G28	=(X48+Y48+K48)
=(G49*$B$14+G48*$B$15)*$B$9	=$B$8*SUM(G30:G49)	=G29	=(X49+Y49+K49)

AA. Cumulative Debt Service Discounted	AB. Debt Coverage Ratio
=Z5	=(F5/Z5)
=Z6/(1+$B$13)	=(F6/Z6)
=Z7/(1+$B$13)^2	=(F7/Z7)
=Z8/(1+$B$13)^3	=(F8/Z8)
=Z9/(1+$B$13)^4	=(F9/Z9)
=Z10/(1+$B$13)^5	=(F10/Z10)
=Z11/(1+$B$13)^6	=(F11/Z11)
=Z12/(1+$B$13)^7	=(F12/Z12)
=Z13/(1+$B$13)^8	=(F13/Z13)
=Z14/(1+$B$13)^9	=(F14/Z14)
=Z15/(1+$B$13)^10	=(F15/Z15)
=Z16/(1+$B$13)^11	=(F16/Z16)
=Z17/(1+$B$13)^12	=(F17/Z17)
=Z18/(1+$B$13)^13	=(F18/Z18)
=Z19/(1+$B$13)^14	=(F19/Z19)
=Z20/(1+$B$13)^15	=(F20/Z20)
=Z21/(1+$B$13)^16	=(F21/Z21)
=Z22/(1+$B$13)^17	=(F22/Z22)
=Z23/(1+$B$13)^18	=(F23/Z23)
=Z24/(1+$B$13)^19	=(F24/Z24)
=Z25/(1+$B$13)^20	=(F25/Z25)
=Z26/(1+$B$13)^21	=(F26/Z26)
=Z27/(1+$B$13)^22	=(F27/Z27)
=Z28/(1+$B$13)^23	=(F28/Z28)
=Z29/(1+$B$13)^24	=(F29/Z29)
=Z30/(1+$B$13)^25	=(F30/Z30)
=Z31/(1+$B$13)^26	=(F31/Z31)
=Z32/(1+$B$13)^27	=(F32/Z32)
=Z33/(1+$B$13)^28	=(F33/Z33)
=Z34/(1+$B$13)^29	=(F34/Z34)
=Z35/(1+$B$13)^30	=(F35/Z35)
=Z36/(1+$B$13)^31	=(F36/Z36)
=Z37/(1+$B$13)^32	=(F37/Z37)
=Z38/(1+$B$13)^33	=(F38/Z38)
=Z39/(1+$B$13)^34	=(F39/Z39)
=Z40/(1+$B$13)^35	=(F40/Z40)
=Z41/(1+$B$13)^36	=(F41/Z41)
=Z42/(1+$B$13)^37	=(F42/Z42)
=Z43/(1+$B$13)^38	=(F43/Z43)
=Z44/(1+$B$13)^39	=(F44/Z44)
=Z45/(1+$B$13)^40	=(F45/Z45)
=Z46/(1+$B$13)^41	=(F46/Z46)
=Z47/(1+$B$13)^42	=(F47/Z47)
=Z48/(1+$B$13)^43	=(F48/Z48)
=Z49/(1+$B$13)^44	=(F49/Z49)

Appendix C: The Value of Travel

In order to estimate the value of new highways for this project we used a "consumer choice" theory for determining value. This theory assumes that the amount of money consumers voluntarily pay to undertake the consumption or use of a product or service represents a minimum value for that good or service *as perceived by the consumer.* In most commercial transactions, the sales revenue obtained from customers serves as the best estimate of this minimum value. For highways, the situation is a little more complex. We lack direct sales revenue data. The tax collection data we do have is not, strictly speaking, sales revenue. It also, in our opinion, grossly understates the value customers would place on the roads they use.

To resolve these difficulties we opted to consider the complimentary package of services represented by the combined amounts paid by consumers for both the vehicle and the roadway. We justify this on the grounds that automobiles and trucks are essentially worthless (for the most part) without the availability of roadways. Consumers wouldn't be buying cars if there were no roads on which to drive them. Likewise, trucking businesses would have no revenues if there were no roads on which to carry out their business. Consequently, we obtained data on the combined costs of owning and operating cars and commercial trucking businesses as a means of estimating a minimum per vehicle mile value of the existence of the roadways in Arizona. The weighted average value is then used in the model to represent the benefits to highway users.

The estimate of the value per truck mile was simpler to calculate. A publication entitled *Freight Transportation in Arizona: Selected Data from Federal Sources*[15] provided trucking revenue totals for the state for the year 1992. This figure was $1,466,657,000. Since this revenue must cover all costs of operating a trucking business--including taxes paid to the highway agency--it represents a reasonable estimate of the mimimum value of using roadways for trucking. Truck vehicle miles of travel in Arizona for 1992 were 3,545,610,000. Dividing the revenues by the vehicle miles of travel produced a per vehicle mile value of 41 cents. To get a 1998 equivalent value, this 41 cent figure was inflated to dollars of 1998 purchasing power using the producer price index for motor freight.[16] The resulting value per vehicle mile for trucks in 1998 is then around 44 cents.

Estimating the value automobile use of roadways was a bit more complicated. The overwhelming majority of cars are not used to generate a revenue. So it was necessary to estimate values from Motor Vehicle Division and American Automobile Association data. We started with a listing of every vehicle registered in Arizona as of 1997 by model year. The following calculations were made.

A weighted average cost for each vehicle when new was calculated for each year. Data on numbers and gross values of vehicles in several vehicle classes for each year was provided by the

---

[15] *Freight Transportation in Arizona: Selected Data from Federal Sources* (Bureau of Transportation Statistics, US DOT; www.bts.gov; phone 202-366-3282; October 1996), p. 25.

[16] *Bureau of Labor Statistics* (http://stats.bls.gov/blshome.html).

ADOT Motor Vehicle Division. The vehicles included in this analysis were cars, pick-up trucks, sport utility vehicles, vans, and motorcycles. Summing the gross values and dividing by the number of total vehicles produced the weighted average cost for each vehicle.

Finance cost was estimated from American Automobile Association data.[17] In their booklet, the AAA estimates finance cost by assuming a loan for 80% of the value of the vehicle, a 9% interest charge and a four year term. The amounts shown are for interest paid on the loan. Vehicles older than four years are assumed to be fully paid off. This data could be refined further if we could obtain information on the percentage of new cars that are purchased for cash and the percentage of older cars that are financed. For now, the data here is offered as a reasonable aggregate estimate of finance costs.

Depreciation was estimated by applying a 20% per year depreciation of the residual value schedule. That is, a new vehicle will depreciate by 20% of its original value the first year, another 20% of the remaining value the second year, etc.

The vehicle license tax was estimated by using the statutory formula of 60% of the original vehicle cost for the first year times the $3.35 per $100 tax rate and decreasing the tax liability by 15% for each year thereafter.

The flat registration fee is $8 per vehicle.

The liability insurance estimate was taken from the AAA booklet. It is the estimated cost for a liability coverage of $100,000/$300,000/$50,000.[18] Some vehicles may carry more insurance, some less. Some locations may require higher rates for this level of coverage. Some may require lower rates. This figure is our current best estimate.

Collision insurance costs are based on a combination of AAA starting data and vehicle depreciation rates. The resulting rate was 1.75% of the residual undepreciated value per year. Newer, more costly vehicles will cost more to repair or replace than older vehicles. Consequently, the cost of collision insurance should fall with vehicle age. As vehicles age, many owners will drop collision coverage. So, this cost will diminish for older cars.

Comprehensive insurance costs are based on a combination of AAA starting data and vehicle depreciation rates. The resulting rate was 0.65% of the residual undepreciated value per year.

Gasoline costs were based on the average of 11,300 miles per vehicle per year at an average miles-per-gallon fuel consumption[19] and a price of $1.10 per gallon of gasoline. Newer cars get better gas mileage, but are driven more miles. Older cars drive fewer miles, but consume

---

[17] *Your Driving Costs* (American Automobile Association, 1000 AAA Dr., Heathrow, FL 32746-5063; phonr 407-444-7000; 1997), pp. 4-5.

[18] *Ibid.*

[19] *Highway Statistics 1996* (Federal Highway Administration), p. V-94.

more gasoline per mile. The estimates used here could be further refined if data on vehicle miles of travel and miles per gallon for cars of various years of age were obtained.

Oil cost estimates were based on an assumed three oil changes per year at a cost of $25 each.

Tire cost estimates were based on an assumed new set of tires every other year at a cost of $200 per set.

Maintenance costs are taken directly from the AAA's 2.8 cents per mile[20] multiplied by an 11,300 miles per year per vehicle.

Total costs are the sum of each separate item in the table.

Cost per mile is the total cost divided by the average 11,300 miles per vehicle per year.

The percentage of fleet figure was obtained from ADOT's Motor Vehicle Division. This is just one "snapshot" of the vehicles registered in Arizona at a previous point in time. The precise combination of vehicles, of course, changes over time. Nevertheless, the changes are incremental in their impact on the total picture. While it is recommended that this data be updated periodically it seems unlikely that drastic changes in the mix will occur from one year to the next.

Weighted cost per mile is the product of the multiplication of the cost per mile times the percentage of the fleet figure for each year. The sum of this column of data is the weighted average cost per vehicle mile for non-commercial vehicles using the highways in Arizona. Using these data, we come up with an estimated weighted average cost per vehicle mile of around 27.5 cents.

One further amalgamation is required in order to obtain the value that will be entered into the model. We must estimate the relative percentages of trucks vs. cars in the traffic mix. Since this version of the model is focused on the potential use of bonding for an urban freeway system, the percentages used were 13% trucks and 87% cars.[21] The combined weighted average for all vehicles, then, is around 30 cents per vehicle mile (43.9 cents x 13% + 27.4 cents x 87%).

---

[20] *Your Driving Costs, op cit.*.

[21] Data supplied by ADOT's Travel and Facilities section.

Estimated Value Per Vehicle Mile for Autos																
Year	Wtd Avg Cost/ Vehicle	Finance	Depr.	Veh. Lic. Tax	Regis-tra-tion	Liability Insurance	Collision Ins.	Comp Ins.	Gas	Oil	Tires	Maint.	Total	Cost/Mi.	% Of Fleet	Wtd. Cost/ Mi.
1997	$19,753	$1,280	$3,951	$397	$8	$400	$346	$128	$584	$75	$100	$316	$7,585	$0.671	8.2%	$0.055
1996	$18,711	$909	$2,994	$382	$8	$400	$210	$78	$584	$75	$100	$316	$6,055	$0.536	7.1%	$0.038
1995	$17,985	$553	$2,302	$312	$8	$400	$161	$60	$584	$75	$100	$316	$4,871	$0.431	7.7%	$0.033
1994	$16,961	$191	$1,737	$250	$8	$400	$122	$45	$584	$75	$100	$316	$3,828	$0.339	6.9%	$0.023
1993	$16,176		$1,325	$203	$8	$400	$93	$34	$584	$75	$100	$316	$3,138	$0.278	6.1%	$0.017
1992	$16,020		$1,050	$171	$8	$400	$73	$27	$584	$75	$100	$316	$2,804	$0.248	5.2%	$0.013
1991	$14,742		$773	$133	$8	$400	$54	$20	$584	$75	$100	$316	$2,463	$0.218	5.3%	$0.012
1990	$14,431		$605	$111	$8	$400	$42	$16	$584	$75	$100	$316	$2,257	$0.200	5.0%	$0.010
1989	$13,544		$454	$89	$8	$400	$32	$12	$584	$75	$100	$316	$2,070	$0.183	5.5%	$0.010
1988	$12,914		$347	$72	$8	$400	$24	$9	$584	$75	$100	$316	$1,935	$0.171	5.1%	$0.009
1987	$12,151		$261	$57	$8	$400	$18	$7	$584	$75	$100	$316	$1,826	$0.162	4.8%	$0.008
1986	$10,931		$188	$44	$8	$400	$13	$5	$584	$75	$100	$316	$1,733	$0.153	5.0%	$0.008
1985	$10,878		$150	$37	$8	$400	$10	$4	$584	$75	$100	$316	$1,684	$0.149	4.4%	$0.007
1984	$10,674		$117	$31	$8	$400	$8	$3	$584	$75	$100	$316	$1,643	$0.145	3.6%	$0.005
1983	$10,340		$91	$26	$8	$400	$6	$2	$584	$75	$100	$316	$1,608	$0.142	2.2%	$0.003
1982	$9,734		$68	$20	$8	$400	$5	$2	$584	$75	$100	$316	$1,578	$0.140	1.8%	$0.002
1981	$8,647		$49	$15	$8	$400	$3	$1	$584	$75	$100	$316	$1,552	$0.137	1.6%	$0.002
1980	$7,562		$34	$11	$8	$400	$2	$1	$584	$75	$100	$316	$1,532	$0.136	1.3%	$0.002
1979	$7,261		$26	$10	$8	$400	$2	$1	$584	$75	$100	$316	$1,522	$0.135	1.9%	$0.003
1978	$4,518		$13	$10	$8	$400	$1	$0	$584	$75	$100	$316	$1,507	$0.133	11.3%	$0.015
														Weighted Average Cost Per Vehicle Mile of Travel		$0.274