EVALUATION OF SAFETY TREATMENTS FOR ROADSIDE CULVERTS

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MwRSF Research Report No. TRP-03-201-09

April 24, 2009

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No.	2.	3. Recipient's Accession No.
TRP-03-201-09		

4. Title and Subtitle	5. Report Date
Evaluation of Safety Treatments For Roadside Culverts	April 24, 2009
	6.

7. Author(s)	8. Performing Organization Report No.
Albuquerque, F.D., Sicking, D.L., Lechtenberg, K.A	TRP-03-201-09

9. Performing Organization Name and Address	10. Project/Task/Work Unit No.
Midwest Roadside Safety Facility (MwRSF) University of Nebraska-Lincoln 527 Nebraska Hall Lincoln, Nebraska 68588-0529	11. Contract © or Grant (G) No.

12. Sponsoring Organization Name and Address	13. Type of Report and Period Covered
Iowa Department of Transportation	Final Report 2004-2009
800 Lincoln Way Ames, IA 50010	14. Sponsoring Agency Code

15. Supplementary Notes

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

16. Abstract (Limit: 200 words)

Roadside cross-drainage culverts have been found to impact vehicle accident injury levels. Designers have commonly used three safety treatments to protect errant drivers from culvert accidents. These treatments have included: culvert extension, guardrail installation and grating. In order to define which safety treatment is the most appropriate, benefit-cost analysis has used accident cost reduction to estimate societal gains earned by using any safety treatment.

The purpose of this study was to estimate accident costs for a wide range of roadway and roadside characteristics so that designers can calculate benefit/cost ratios for culvert safety treatment options under any particular scenario.

This study began with conducting a parametric study in order to find variables which have significant impact on accident cost changes. The study proceeded with highway scenario modeling which included scenarios with different values for combinations of roadway and roadside variables. These variables were chosen based upon findings from the parametric study and their values were assigned based upon highway classification. This study shows that the use of different culvert safety treatments should be flexible to roadway and roadside characteristics. It also shows that culvert extension and grating were the safety treatments found to produce the lowest accident costs for all highway scenarios modeled. Therefore, it is believed that the expanded adoption of culvert extension and culvert grates can improve overall highway safety.

17. Document Analysis/Descriptors	18. Availability Statement
Highway Safety, Culverts, Benefit-Cost Analysis, Roadside Safety Analysis Program	No restrictions. Document available from: National Technical Information Services, Springfield, Virginia 22161

19. Security Class (this report)	20. Security Class (this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	191	

DISCLAIMER STATEMENT

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 Iowa Department of Transportation. This report does not constitute a standard, specification, or regulation.

ACKNOWLEDGEMENTS

The authors wish to acknowledge several sources that made a contribution to this project: (1) the Iowa Department of Transportation for sponsoring this project; and (2) MwRSF personnel for putting valuable knowledge and insights into this report.

Acknowledgment is also given to the following individuals who made a contribution to the completion of this research project.

Midwest Roadside Safety Facility

R.K. Faller, Ph.D., P.E., Research Assistant Professor
J.D. Reid, Ph.D., Professor
Undergraduate Assistants

Iowa Department of Transportation

David Little, P.E., Assistant District Engineer
Deanna Maifield, P.E., Methods Engineer
Chris Poole, P.E., Litigation/Roadside Safety Engineer
Will Stein, P.E., Former Design Methods Engineer

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1 INTRODUCTION

1.1 Problem Statement

In the United States, approximately 40,000 lives are lost due to traffic fatalities every year (1). Over the years, the number of deaths on the United States' highways has even been higher than war, most diseases, and all natural disasters (2). Approximately one third of all highway deaths have occurred on the roadside. Utility poles, trees, sign supports, culverts, and guardrails are some of the roadside obstacles, most commonly associated with serious ran-off-road accidents. More specifically, striking a culvert or a ditch is the first harmful event for more than 10 percent of the total fatal ran-off-road crashes in the United States (3).

According to American Association of State Highway and Transportation Officials (AASHTO) Roadside Design Guide (RDG) (1), some safety measures may be adopted to reduce hazards created by roadside obstacles. The options, in order of preference, are: (1) remove the obstacle; (2) redesign it; (3) relocate it; (4) reduce the impact severity by using appropriate devices; (5) shield the obstacle; and finally (6) delineate it, if nothing else can be done. In accordance with these options, several research studies have been performed to investigate the viability of treatments for roadside culverts. The most commonly used safety alternatives have been: (1) relocating the hazard by extending the culvert outside the clear zone; (2) reducing the severity of the hazard by placing safety grates over the culvert; (3) shielding the obstacle with guardrail; and (4) delineating the culvert. More than one of these alternatives may be appropriate depending on the specific combination of roadway, roadside and traffic characteristics.

Identifying the most appropriate safety treatment for roadside culverts has not been a simple task. Sometimes, safety treatments have been found to cause more injuries and fatalities than the original culvert. For instance, guardrail installation is an effective safety improvement

on highway sections where high embankments exist. However, guardrail is also a hazard and it must be placed much closer to the travel way than a culvert. In addition, long runs of guardrail are needed to adequately shield traffic from impacting a culvert. These long runs of guardrails placed close to the travel way greatly increase the number of crashes. In fact, placing guardrail to treat small and moderate- sized roadside culverts can actually increase vehicle occupant injuries and fatalities.

Other safety treatments, such as extending the culvert out of the clear zone and placing grates over the culvert also create unanticipated difficulties. Culvert extension creates complicated slope transitions that can also prove to be hazardous to errant motorists. Further, debris can clog grating and reduce the hydraulic flow through the culvert sufficiently to cause flooding problems.

Unfortunately, relatively few studies have focused on developing guidelines for culverts treatments and all of these are now dated. Thus, there is a need to evaluate all of the appropriate culvert safety treatments to determine the most appropriate design for each combination of highway and traffic characteristics.

An evaluation of culvert treatment options should include an incremental benefit to cost analysis. In order to conduct such an analysis, both benefits and direct costs need to be determined. Benefits may be determined in terms of accident cost reduction, while direct costs include installation, repair, and/or maintenance costs. However, direct cost estimation often varies widely from site to site. For instance, costs for culvert extension change from a site to site depending on the amount, cost, and the availability of fill material. Therefore, the direct cost of treating a culvert could be very different even though all other highways and traffic

characteristics are the same. On the other hand, researchers have developed procedures for estimating accident costs to allow one to find the benefits in terms of accident cost reduction.

These techniques attempt to estimate accident costs based upon roadway, roadside, and traffic conditions of a site. Using these techniques, it is possible to relate expected accident costs to roadway and roadside conditions.

After both the benefits and costs have been estimated, one can proceed with an incremental benefit to cost analyses. Even though simple Benefit/Cost (B/C) ratios provide information on which treatment options are cost-effective, one can only find which safety treatment is the most appropriate by using an incremental approach. The general formulation for the incremental B/C ratio is provided in Equation 1.1:

$$B/C\ \text{Ratio}_{2-1} = \frac{AC_1 - AC_2}{DC_2 - DC_1} \tag{1.1}$$

where:

B/C Ratio_{2-1} = Incremental B/C ratio for Alternative 2 to Alternative 1;
AC_1, AC_2 = Annualized societal crash cost for Alternatives 1 and 2; and
DC_1, DC_2 = Annualized direct cost for Alternatives 1 and 2.

The difficulty in estimating the direct cost of a safety treatment makes developing culvert treatment selection guidelines very difficult. The wide variations in construction cost can only be addressed by designers calculating these costs on a site by site basis. However, as shown above, a designer can calculate incremental B/C ratios for any site provided direct costs and accident costs of each treatment option.

1.2 Study Objective

The primary objective of this study is to develop accident costs for a wide range of highway and traffic characteristics. These accident costs will allow highway designers to estimate the incremental B/C ratios for culvert safety treatment options at any particular site. These accident costs should be applicable to four safety treatment options: 1) Do-Nothing, 2) Culvert Extension, 3) Guardrail Protection, and 4) Grating, as well as to a wide range of highway conditions.

1.3 Study Scope

This study is presented in nine chapters as follows: Literature Review, Research Approach, Parametric Study, Accident Cost Prediction, Safety Treatments, Results, Conclusions and Recommendations, and References. This report also contains five appendices. Appendix I shows numerical results from the parametric study; which was undertaken to find roadway, roadside, and traffic characteristics relevant to accident cost changes. Figures 22 through 28 are presented in Appendix II and are intended to help the reader identify the least costly safety treatment for each situation. Appendices III, IV, and V show accident costs as a function of highway characteristics as well as of the applicable safety treatment for the highway classifications: local road, rural arterial and freeway, respectively.

2 LITERATURE REVIEW

A summary of relevant information as well as findings from previous research studies are presented below. This chapter is divided into four sections. The first section provides information about the current status of highway and roadside safety. The second section presents cost-effectiveness tools which have been used to evaluate roadside design projects over past years. The third section presents safety alternatives commonly applied to treat roadside culverts, and the fourth explains the limitations and deficiencies of current cost-effectiveness and/or benefit-cost analysis models.

2.1 Highway and Roadside Facts

Annually, the number of injuries and deaths occurring due to traffic accidents in the United Sates has remained very high over the last several decades. According to the AASHTO RDG, the number of annual traffic fatalities has been near 40,000 since the mid-1960s, (1). Vehicle accidents have killed more Americans than any war or natural disaster, and most diseases (2). In the year 2005, the number of traffic fatalities reached 43,443 according to the Fatal Accident Reporting System (FARS) (3). In truth, highway safety improvements have reduced the risk of a fatality. Even though the number of fatalities has remained roughly constant, the fatality rate, in terms of fatalities per 100 million vehicle miles traveled (MVMT), has dropped significantly (1). For example, 1.73 fatalities per 100 MVMT occurred in 1994 as compared to 1.44 fatalities per 100 MVMT in 2004. This reduction amounts to nearly a 17 percent decrease in fatalities when total vehicle miles traveled are considered. As can be seen in Figure 1, the fatality rate has had a downward trend when analyzed from the year 1925 to the year 1995.

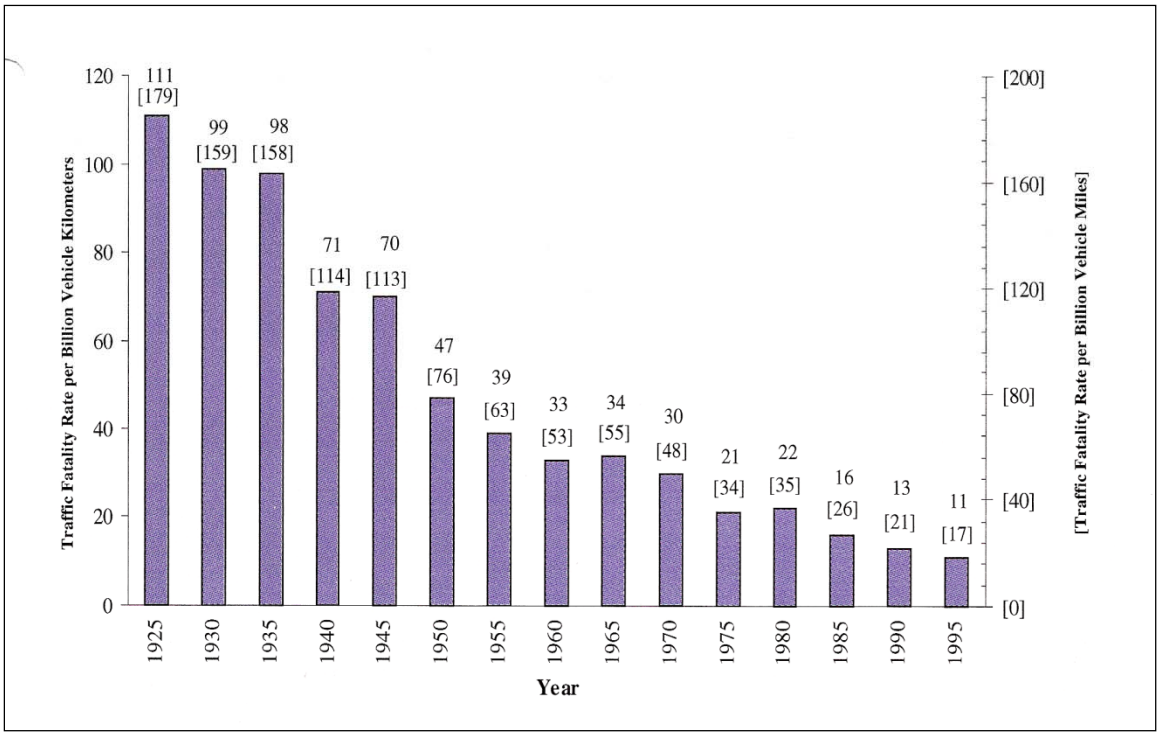

Figure 1. Annual fatality rates from 1925 to 1995 provided by RDG [1]

The fatality rate reduction may be attributed not only to improvements in highway standards, but also to other factors such as more enforcement, better driver education, as well as improvements in vehicle design. However, much still has to be done. According to FARS, much effort has to be placed on two specific areas which have been identified as the primary causes of fatal accidents, roadside and intersection (3). According to FARS, in 2005, eighty percent of all fatalities occurred either on roadside areas or on intersections. Fifty-nine percent of these fatalities were involved with roadway departure crashes.

Roadside crashes involve vehicles leaving the roadway and rolling over as well as vehicles leaving the roadway and crashing into a fixed obstacle. Just in North Carolina, these types of accidents accounted for approximately 70 percent of the cross-section related collisions

(4). Culverts and ditches alone have been responsible for approximately 12 percent of all traffic fatalities, as shown in Table 1 from the RDG (2).

Table 1. First harmful event fixed-object fatalities by object type

	YEAR						
FIXED OBJECT	1993	1994	1995	1996	1997	1998	1999
Boulder	82	96	90	93	87	90	91
Bridge/ Overpass	448	434	459	435	431	402	409
Building	100	77	77	62	96	78	81
Concrete Barrier	229	183	229	221	239	259	280
Culvert/Ditch	1,359	1,380	1,476	1,437	1,396	1,491	1,481
Curb/Wall	810	830	921	947	915	823	753
Embankment	1,060	1,143	1,269	1,239	1,186	1,206	1,268
Fence	397	441	432	478	429	473	512
Guardrail	1,128	1,125	1,191	1,137	1,159	1,248	1,185
Impact Attenuator	23	28	35	26	19	19	24
Sign or Light Support	471	453	580	634	514	504	546
Tree/Shrub	3,035	3,014	3,198	3,128	3,220	3,226	3,348
Utility Pole	1,274	1,096	1,135	1,096	1,111	1,092	1,070
Other Fixed Objects	575	587	564	569	534	508	508
Other Pole/ Support	301	350	359	404	359	312	352
Total Fatalities	11,292	11,237	12,015	11,906	11,695	11,731	11,908

Culverts are structures that are built for drainage purposes and must be placed on the roadside. Consequently, crashes involving culverts have not been uncommon nationwide. Culverts might be located very close to the travel way what makes crashes more likely to occur, as shown in Figure 2. Indeed, culverts have been found to be one of the roadside features that significantly affect the severity of run-off-roadway accidents (5). In another study, culverts were found among the roadside obstacles associated with the highest percentage of severe accidents (6). Unfortunately, developing implementation of safety treatments for roadside culverts has proven to be a difficult task.

Figure 2. Culvert opening on a local road

2.2 Cost-Effectiveness and/or Benefit-Cost Tools

Transportation funds have decreased in the past decades. Typically, transportation projects have to compete for funding with other sectors, such as health and security. Furthermore, some transportation projects even have to compete with other transportation projects for state and federal funds. Therefore, safety treatments implemented in the transportation sector shall not only be technically but also economically efficient. The technical viability of safety treatments has been generally examined by analyzing crash data, conducting vehicle crash testing, and performing computer simulations of crash tests. The economical viability of treatments has been checked by applying cost-effectiveness and/or benefit-cost analysis methodologies to the proposed alternatives. Several research studies have shown the

efficacy of economical analyses on roadside safety improvement measures (7-17). Many of these studies also reported limitations which restrict the reliability of the results.

Although it is known that limitations still exist, much progress has been achieved over the last four decades. In 1969, the first encroachment probability model was developed (18). This model was based on the encroachment probability approach, which assumes that crash frequency is proportional to encroachment frequency. In order to estimate the encroachment frequency, encroachments are assumed to follow a uniform probability distribution for any highway segment with similar characteristics. The model developed in 1969 was presented in NCHRP Report 77, and it was based upon the Hutchinson and Kennedy encroachment data. This encroachment data is one of the few encroachment data available nowadays (19). This data was developed by taking measurements of wheel tracks on medians in Illinois back in the 1960s. However, this approach has also led to much scrutiny which will be further discussed in Section 2.3.2. The encroachment model was also relatively crude in that it used too long encroachment extents, certainly caused by the use of the Hutchinson and Kennedy encroachment data. The model utilized average values for vehicle type, speed, and angle. Also, the model was limited to point objects. Nevertheless, the model represented the first effort to assess the economic viability of a safety device by relating encroachment rate to cost rates.

Later, changes in the same model were made to allow its use for any type of object (9). Still, many of the other limitations remained. In 1977, the concept of severity index was included in a subsequent model (20). This change was a major improvement over the previous models developed at that time. However, a single severity index was assigned to each hazard, regardless of the type of roadway involved. Further, the severity indices were estimated based on high-speed crashes which tended to overestimate crash severity. Moreover, the procedure was based

upon the assumption that barriers never allowed penetration. As a result, cars would never impact a shielded hazard.

Other important contributions on this topic were made by Post and McCoy, researchers at the University of Nebraska-Lincoln (14-17). These studies used computer simulation of vehicle behavior to model vehicular impacts against different roadside features. Even though the studies used sites with some different characteristics, major limitations existed. Just one vehicle type was used. These procedures still relied upon only one impact angle and one impact speed. Multiple object crashes were not considered.

In the mid-1980s, the Texas Transportation Institute (TTI) developed the TTI ABC Model. This approach presented six major advances over previous models. First, the model used Cooper's encroachment data (21) instead of Hutchinson and Kennedy encroachment data. Second, the model attempted to account for controlled encroachments (22). Third, the model considered the effect of horizontal and vertical alignment on encroachment frequency based on findings from Wright and Robertson (23). Fourth, the model corrected lateral extent and encroachment frequency distributions found by Cooper (21). Fifth, the model was able to analyze multiple hazards at the same time, thereby allowing for the possibility that a vehicle could travel behind or penetrate through a barrier. Lastly, the model included multiple vehicle types as well as multiple encroachment speed and angle distributions. Encroachment speed and angle distributions were based on findings from the study conducted by Mak (25). Even with such advances, the model presented some limitations that made its results inappropriate and its applications difficult. The impact conditions found by Mak tended to overestimate crash severity since the data used was from crashes against bridge rails and utility poles. Also, because the software did not have a user-friendly interface, its use was extremely limited.

In 1988, the TTI ABC Model was modified by the Federal Highway Administration (FHWA). The modified model was called Benefit/Cost Analysis Program (BCAP) (26). A friendlier interface was developed, but the model incorporated inputs for crash and severity prediction that were much more subjective. This greatly reduced the acceptability of the BCAP.

Subsequently, FHWA strived to provide friendlier benefit/cost analysis programs. FHWA, then, developed ROADSIDE which was basically a simplification of BCAP (27). That model, actually, could not be defined as an improvement over BCAP in terms of accuracy of technical results. ROADSIDE did not consider multiple hazard analysis, and it did consider just one combination of vehicle size, speed, and angle. Those considerations were adopted in order to reduce the time required for running BCAP and to make the program more user-friendly. However, those measures were considered to be a step backward in the technical progress of benefit-cost analysis procedures.

In 2003, a new cost-effectiveness procedure, known as the Roadside Safety Analysis Program (RSAP), was developed by Mak and Sicking (28). NCHRP Report 492 contains descriptions on this procedure which evaluates the cost-effectiveness of roadside safety features. This new procedure RSAP adopted a systematic approach composed by four modules. The encroachment module uses encroachment data in order to estimate encroachment frequency along a highway segment. Cooper's encroachment data (21) was used in RSAP because researchers believed that it provided higher quality data than the encroachment data obtained from Hutchinson and Kennedy encroachment data (33-34). The encroachment module assumes equal encroachment probability throughout segments with similar characteristics, and it also adopts adjustment factors in order to control for horizontal and vertical alignments. The encroachment module determines the encroachment rate for a specific roadway segment and,

afterwards, the crash prediction module uses that information in order to estimate crash frequency given an encroachment rate. The primary function of the severity prediction module is to estimate the severity of a crash predicted by the crash prediction module. Therefore, these three modules that were incorporated into RSAP contain analysis procedures which allow the user to determine how many crashes would occur and their respective severities. The fourth module, benefit/cost analysis module, converts all information gathered from the previous modules (i.e., number and severity of crashes) into accident costs. This process is completed by assigning accident cost to each accident severity level. In RSAP, there are three accident cost sets available for use by the analyst. Accident cost is the only parameter that is needed to calculate the benefits (i.e., accident cost reduction) of implementing a safety treatment. RSAP has presented significant improvement in how encroachments and eventual crashes were assigned by adopting a stochastic solution method instead of a deterministic approach. The Monte Carlo simulation technique used by the stochastic approach assigned encroachments randomly. Therefore, the new methodology tended to provide more realistic results than those found when encroachments were assigned deterministically. Among the improvements over the previous models, the RSAP software has been found to be more user-friendly than many of its predecessors (29).

2.3 Safety Treatment Options for Roadside Culverts

Over the years, three safety treatments have been applied to roadside culverts, including extending the culvert hazard outside the clear zone, providing guardrail protection in front of the culvert, and covering the culvert opening with grating (7). Even though any of these treatments may produce an overall accident severity reduction, accident frequency may actual increase. For instance, the placement of a guardrail installation in front of a culvert would be expected to

decrease the average accident severity, but it may increase accident frequency due to its closer proximity to the traveled way. A large increase in accident frequency would be expected to produce higher total accident costs. In fact, even though a safety treatment may reduce average impact severity, it may still increase the total number of injuries and fatal crashes.

Available literature about the three most commonly adopted measures used to treat roadside culverts (i.e., culvert extension, guardrail protection, and grating) is described below. Related research on these topics is also presented.

2.3.1 Culvert Extension

Culverts have long been recognized as potentially serious roadside obstacles, and engineers have proposed safety treatments to decrease the frequency and/or severity of culvert crashes. The most commonly used safety treatments have been to extend the culvert farther away from the traveled way, to install guardrail, and to place metal grates on the top of the culvert opening. However, in 1978, Kohutek showed that cost-effectiveness and/or benefit-cost analyses indicate that, under certain circumstances, none of those safety treatments may be economically feasible (7). For example, unless the required earth work is minimal and the fill material is abundant, culvert extension tends to be an expensive safety alternative.

Culverts are normally relocated to the edge of the clear zone along a roadway. The clear zone may be defined as a roadside area that is relatively flat and free from roadside obstacles, and a region that is intended to provide drivers with area to redirect the errant vehicle to the roadway or stop it safely. Figure 3 shows a rural freeway segment which contains smooth sideslopes and unobstructed roadside areas.

Figure 3. Clear zone area on a rural freeway

Clear zones measuring 30 feet (9.1 meters) wide and with 6:1 embankment slope have been suggested since late 1960s (9). The clear zone concept has been one of the most discussed safety topics addressed by the RDG. As shown in Table 2, clear zone values vary with design speed, average daily traffic, and slope steepness.

Glennon and the Minnesota Department of Transportation have found important clear zone related information (9,30). These studies collected accident data and conducted statistical analyses in order to verify the impact of roadside design policies on single vehicle run-off-the-road accident rates. The safety effect of sideslopes with different steepnesses was examined. Highway accident rates and severities from road sections with 6:1, 4:1, and other steeper sideslopes were compared. Steeper sideslopes usually contained unprotected fixed objects close to the edge of the traveled way. Different highway classifications were adopted as well. Single vehicle run-off-the-road accident data were collected from sites in the States of Illinois,

Minnesota, and Missouri. From this investigation, the highest accident rates were found from sites with sideslopes steeper than 3:1, while the lowest accident rates were found from sites with 6:1 sideslopes. Thus, the design of the roadside, particularly sideslopes, was found to have a direct impact on single vehicle run-off-the-road accident rate.

Table 2. Clear zone value ranges suggested by RDG (Table 3.1 from the 2002 RDG)

DESIGN SPEED	DESIGN ADT	FORESLOPES			BACKSLOPES		
		1V:6H or Flatter	1V:5H to 1V:4H	1V:3H	1V:3H	1V:5H to 1V:4H	1V:6H or Flatter
40 mph (64 km/h) or less	UNDER 750	7-10	7-10	**	7-10	7-10	7-10
	750-1500	10-12	12-14	**	10-12	10-12	10-12
	1500-6000	12-14	14-16	**	12-14	12-14	12-14
	OVER 6000	14-16	16-18	**	14-16	14-16	14-16
45-50 mph (72-80 km/h)	UNDER 750	10-12	12-14	**	8-10	8-10	10-12
	750-1500	12-14	16-20	**	10-12	12-14	14-16
	1500-6000	16-18	20-26	**	12-14	14-16	16-18
	OVER 6000	18-20	24-28	**	14-16	18-20	20-22
55 mph (88 km/h)	UNDER 750	12-14	14-18	**	8-10	10-12	10-12
	750-1500	16-18	20-24	**	10-12	14-16	16-18
	1500-6000	20-22	24-30	**	14-16	16-18	20-22
	OVER 6000	22-24	26-32	**	16-18	20-22	22-24
60 mph (96 km/h)	UNDER 750	16-18	20-24	**	10-12	12-14	14-16
	750-1500	20-24	26-32	**	12-14	16-18	20-22
	1500-6000	26-30	32-40	**	14-18	18-22	24-26
	OVER 6000	30-32	36-44	**	20-22	24-26	26-28
65-70 mph (104-112 km/h)	UNDER 750	18-20	20-26	**	10-12	14-16	14-16
	750-1500	24-26	28-36	**	12-16	18-20	20-22
	1500-6000	28-32	34-42	**	16-20	22-24	26-28
	OVER 6000	30-34	38-46	**	22-24	26-30	28-30

Accident rates have also been shown to be sensitive to clear zone widths (9). That is, single-vehicle run-off-the-road accident rates increased as clear zone width decreased from 30 to 20 feet (9.1 to 6 meters). Furthermore, a study of highways with 30-ft (9.1-m) clear zones was conducted by the Minnesota Department of Transportation. This study showed that fatal, injury,

property-damage-only (PDO), and total accident rates were all greater for highway sections with 4:1 embankment slopes within the clear zone as compared to highway sections with 6:1 embankment slopes within the clear zone (30).

In the study conducted by Glennon as well as in the study conducted by the Minnesota Department of Transportation (9, 30), benefit-cost analyses were conducted in order to provide guidelines for where and when to adopt a specific sideslope. From these benefit-to-cost analyses, it was found that the decisions on roadside design should be flexible. That is, they should change according to roadway, roadside, and traffic characteristics. Thus, roadside design policies (i.e., adoption of any clear zone width or allowable slope steepness) should be adjusted for each highway section group with similar characteristics. For instance, it was found that the use of 6:1 slopes can be more cost-effective than 4:1 slopes at traffic volumes between 2,000 and 4,000 vehicles per day (30). In another study, it was found that flattening sideslopes from 3:1 to 7:1 may be related to lower rates of single-vehicle accidents (6).

In a study conducted by Post at the University-of-Nebraska Lincoln, in 1978, the probability of injury accidents was found to significantly decrease by flattening driveway slopes from 3:1 to 8:1. This study also showed that the most cost-effective improvement was a driveway slope from 6:1 to 8:1, while flattening a driveway slope from 8:1 to 10:1 was not cost-effective (14).

2.3.2 Guardrail Protection

Shielding has been widely adopted as a safety treatment for roadside obstacles. However, protective barriers that are used to shield obstacles represent a hazard as well (32). As shown in Figure 4, a crash with a guardrail causes significant damage and instability to a pick-up truck used as the crash testing vehicle by the Midwest Roadside Safety Facility (MWRSF). Even

though, in some cases, crashes against barriers may be less severe than other fixed obstacles, accident costs may still increase since they are often installed closer to the roadway than the hazards, thus causing accident frequency to increase.

Figure 4. A pickup truck strikes a W-beam guardrail in a full-scale crash test

Cost-effectiveness and/or benefit-cost analyses attempt to identify the optimum guardrail location and length for each group of roadway, roadside, and traffic characteristics. The RDG presents guidelines for determining guardrail length-of-need. The encroachment data used by the RDG comes from research conducted by Hutchinson and Kennedy in the 1960s (19). The encroachment data provided information on the extent of lateral and longitudinal travel by the encroaching vehicles. From that encroachment data, the guardrail runout length was determined. The guardrail runout length is calculated as the distance that a vehicle would have to travel along the roadway in order to go behind the guardrail and strike the hazard. This distance is measured from the point that the vehicle would need to leave the roadway in order to miss the barrier to the

hazard. The RDG essentially uses encroachment data from the Hutchinson and Kennedy study to determine guardrail runout lengths so that guardrail installations should capture the 85th percentile longest encroachment distance.

However, research has shown that traveled distances, found by Hutchinson and Kennedy, are excessive. These encroachment distances were measured from vehicle tracks found in the median. However, there was no means for determining whether these encroachments were controlled or uncontrolled.

The data was collected from newly opened rural interstate freeways with very low traffic volumes, many with less than 5,000 vehicles per day. Further, most of the drivers on these new facilities were unaccustomed to driving on a freeway with wide-flat medians. Hence, drivers were more willing to intentionally pull off of the roadway into the median. When compared to accident data and other sources of encroachment data (e.g., Cooper's study), the data from Hutchinson and Kennedy included a much higher proportion of low angle encroachments, which would indicate a high proportion of controlled or intentional encroachments. Finally, a careful evaluation of the Hutchinson and Kennedy data revealed that the low angle encroachments (i.e., 0 to 5 degrees) were much longer than those from other data sources, while encroachment length compared relatively well for all other angle categories. Hence, it can be concluded that encroachment lengths from Hutchinson and Kennedy's study are excessive and will produce excessive guardrail runout lengths. Runout lengths suggested by Hutchinson and Kennedy are shown in Table 3.

Table 3. Suggested runout lengths for barrier design by Hutchinson and Kennedy

	Traffic Volume (ADT)			
Design Speed	Over 6000 vpd	2000-6000 vpd	800-2000 vpd	Under 800 vpd
km/h [mph]	Runout Length	Runout Length	Runout Length	Runout Length
	L_R	L_R	L_R	L_R
	m [ft]	m [ft]	m [ft]	m [ft]
110 [70]	145 [475]	135 [445]	120 [395]	110 [360]
100 [60]	130 [425]	120 [400]	105 [345]	100 [330]
90 [55]	110 [360]	105 [345]	95 [315]	85 [280]
80 [50]	100 [330]	90 [300]	80 [260]	75 [245]
70 [45]	80 [260]	75 [245]	65 [215]	60 [200]
60 [40]	70 [230]	60 [200]	55 [180]	50 [165]
50 [30]	50 [165]	50 [165]	45 [150]	40 [130]

Research performed by Sicking and Wolford as well as by Coon, at the University of Nebraska, has confirmed that Cooper's encroachment data provided more accurate and shorter guardrail runout lengths (33-34). These MWRSF researchers developed simplified charts for determining the appropriate length-of-need for guardrail by using benefit-cost analysis techniques combined with Cooper's data. They could verify that guardrail lengths of need found by using benefit-cost analysis techniques were much shorter than those recommended by the RDG and compared relatively well to procedures developed using Cooper's data. Furthermore, research was undertaken to compare the appropriateness of the two data sets, Hutchinson and

Kennedy's to Cooper's, but also to compare the data sets to real-world crash data (34). According to the findings, guardrail runout lengths recommended by Hutchinson and Kennedy were confirmed to be excessive, while the accident data compared very well to the Cooper data. Therefore, since it is believed that real-world crash data may produce more reliable guardrail length-of-need, it is expected that guardrail systems that are based on the guardrail runout lengths recommended by Wolford and Sicking should produce the most appropriate installation lengths. Runout lengths suggested by Wolford and Sicking are displayed in Table 4.

Table 4. Runout length values recommended by Wolford and Sicking (33)

Design Speed	Runout Length (L_R) Given Traffic Volume (ADT), m(ft)			
km/h (mph)	Over 10,000	5,000 to 10,000	1,000 to 5,000	Under 1,000
113 (70)	110 (360)	91 (300)	79 (260)	67 (220)
97 (60)	79 (260)	64 (210)	55 (180)	52 (170)
80 (50)	64 (210)	52 (170)	46 (150)	40 (130)
64 (40)	49 (160)	40 (130)	34 (110)	30 (100)
48 (30)	34 (110)	27 (90)	24 (80)	21 (70)

Finding optimum guardrail lengths has been crucial to minimize costs and maximize benefits. Although determination of where and when to install guardrails has been widely discussed, there has been relatively little direct research performed on this topic. Guardrails may be placed to protect errant motorists from point or discrete hazards (i.e., traffic control devices and luminary supports) or continuous obstacles (i.e., embankments, ditches, and side slopes). For long obstacles, the use of guardrail installations is more likely to be justified. On the other hand, guardrails are less likely to be used when they are installed to protect errant drivers against point

objects. This is due to the fact that, in the last case, the exposure to roadside obstacles would significantly increase since guardrails may also be analyzed as hazards. Therefore, defining the optimum scenario to erect guardrail installations has been an issue. Several studies have been conducted to provide guidelines to address the confusing problems of when and where to install guardrail systems. These studies make use of cost-effectiveness analyses. These analyses allow one to analyze the guardrail use appropriateness for each specific group of roadway, roadside and traffic characteristics (8, 10, 35-37). These studies have shown that when protecting longitudinal obstacles, the use of guardrail tends to be mostly justifiable on cases of highway sections with the existence of steep slopes and moderate to high traffic volumes (7).

2.3.3 Grating

Culvert extension may be a costly alternative where roadside embankments are high as well as where sideslopes are steep. Guardrail installation may increase accident costs when placed on highway segments with sideslopes because, in these roads, the guardrail has to be installed parallel to the travel way. For all of these reasons, grating may appear to be an attractive safety alternative.

Studies conducted by Ross, the New York State Department of Transportation, and the MWRSF have shown that safety grating may be a feasible and effective safety treatment for culvert openings since the culvert ends are made to be traversable (38- 41). It was found that the terrain, on which the grate was located, had a greater effect on vehicle trajectory than the grate itself (39). Actually, sideslopes and ditches were found to be the dominant vehicle tripping mechanism involved in rollovers (42).

However, grating may be an expensive alternative in the case of relatively flat sideslopes, because the length of the culvert opening greatly increases. Larger culvert grates lead to larger and more costly structures.

Recently, small car and pickup truck crash tests were conducted in order to evaluate the safety performance of culvert grates used to shield a large culvert opening located on a 3:1 slope. These vehicles were launched off of the shoulder edge and down the sloped embankments and onto a culvert opening protected by grates. The encroachment angle and speed were 20 degrees and 25 degrees for the small car and pickup truck, respectively, and 62.14 mph (100 km/h) for both tests. An analysis of the test results showed that both vehicles remained quite stable, experienced very low accelerations, and the safety grating system was found to be structurally adequate (41). Figure 5 shows photos taken from the grating system placed on the culvert opening.

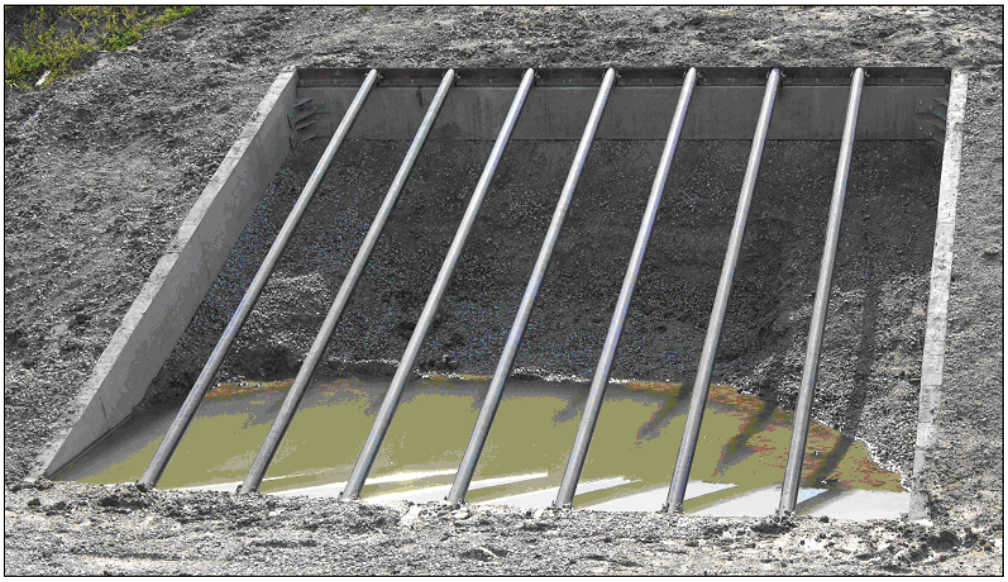

Figure 5. Safety treatment for cross-section drainage culverts

2.4 Deficiencies of Current Economical Analyses

As described in the Literature Review chapter, much progress on benefit-cost and/or cost-effectiveness analysis procedures over the past decades. However, deficiencies still exist on current procedures, and further research is needed in order to address these problems.

In this section, some issues which lead to inaccuracies on benefit-cost procedures are commented. Three major issues are described as follows.

2.4.1 Crash Frequency Accuracy

Limitations on the availability of accident data have seriously retarded roadside safety research. Benefit-to-cost and/or cost-effectiveness analyses may be based on encroachment probability or actual crash data. Both methodologies have been highly used and have their respective pros and cons.

Generally, models based on crash data rely on police accident records. A study conducted by Zegeer and Cynecki described a typical procedure for developing a crash data based model (13). Nonlinear regression models were developed to predict utility pole accident experience as a function of roadway and utility pole characteristics. However, crash data based models require a large amount of data. The large sample size is required because of the large degree of variability in highway and roadside conditions. In addition, it is impossible to consider any factor beyond those provided on police-level accident reports. These factors may directly affect road crash rates, but they can seldom be modeled. For example, 6 to 10 years of accident data were collected by Zegeer and Cynecki, resulting in a sample of more than 9,600 utility pole accidents.

On the other hand, encroachment probability based models essentially involve an attempt to predict accident frequency and severity from basic knowledge about encroachments. That is, it

is assumed that crash frequency is proportional to encroachment frequency. Encroachment probability based models use available encroachment data to estimate accident frequency (28).

Thus, both categories of accident prediction models are based on collected data. This fact has been one of the major sources of uncertainty included in most benefit-cost analyses. That is, crash data based models suffer from the inaccuracies inherent to crashes that were not reported and factors that were not included in the police report. Encroachment probability based models suffer from inaccuracies inherent to the current level of understanding about the nature and frequency of encroachments.

2.4.2 Crash Severity Accuracy

For years, it has been known that inaccuracies exist within estimates of both accident frequency and accident severity. To estimate crash severity, the use of the severity index (SI) has been common practice. The SI value serves as an indicator of how severe a single-vehicle crash may be when occurring against a specific obstacle. Based on the SI, the injury level may be classified in different categories (e.g., fatal, injury, or property damage only). Due to their direct impact on injury level determination, estimations of the SI value are crucial for accurate benefit-cost analysis models. A slight change in the SI value may have a significant impact on total estimated accident costs.

Moreover, studies conducted by Turner and Hall concluded that different methodologies used to estimate severity indexes have resulted in very divergent SI values. Different severity indexes were estimated when the same data set were used, just by using different estimation methods (44).

The RDG presents the most comprehensive listing of SI values available today. Even though the severity indexes suggested by the RDG have been widely used, they are largely based

upon one man's judgment regarding average accident severities. In addition, there are severity indexes that are not available for all roadside obstacles. It is believed that most severity indexes were estimated based on crash data and crash tests. However, many roadside obstacles have never been thoroughly tested or included in a detailed accident analysis study. Hence, a great deal of uncertainty remains in the estimation of SI values included in the RDG.

2.4.3 Accident Costs

Accident costs are also a very important input parameter within any benefit-cost and/or cost-effectiveness analysis model. In these models, dollar values are assigned to each injury level so that the cost of a collision can be estimated (27-28).

Much complexity has been found in accident cost estimation. Different highway accident costs may be found depending upon the methods used to estimate them as well as what costs are considered. Most historical research studies have recommended that accident cost values be based on comprehensive costs. That is, accident costs should also include indirect costs such as those due to suffering, pain, lost quality of life, and an estimate of the public's willingness to pay to reduce risks (45).

However, accident cost estimation has suffered from inaccuracy, because it has heavily been based on collected crash data. Many unreported low injury level accidents, as well as incorrect information on injury levels written on police reports, are some of the sources of inaccuracy included in accident cost values. For example, a person might not have external, but internal injuries only, and then the accident might be classified as a property damage only accident.

3 RESEARCH APPROACH

The study described herein utilized an encroachment probability model, the Roadside Safety Analysis Program (RSAP), to identify the benefits of various culvert safety treatment options. This effort was divided into three major tasks: Parametric Study, Accident Cost Prediction, and Safety Treatments.

The following sections describe procedures associated with each of these tasks.

3.1 Parametric Study

A parametric study was undertaken to determine the sensitivity of accident costs to changes in input parameters. This process was intended to identify the highway and roadside characteristics that have the greatest impact on the benefits from a culvert safety treatment. The roadway and roadside parameters found to be important to the estimation of accident costs would be candidates for inclusion in the final benefit estimation procedure while parameters that proved to be less important would be omitted from the study.

The parametric study began with the identification of roadway, roadside and traffic characteristics that could affect accident costs associated with crashes involving roadside culverts. The variables selected for inclusion in the parametric study are shown in Table 5.

After choosing the variables and selecting their values, the sensitivity analysis was conducted by running RSAP to analyze the impact of each variable on accident cost change. The importance of each parameter was then evaluated by changing it to its low, moderate and high values, while values for all other parameters were held constant. By holding all other scenario characteristics constant, the variation in accident costs may be attributed to changes in the variable that has been changed.

Table 5. Parametric study variables

Roadway, Roadside and Traffic Variables Used in the Parametric Study									
Average Daily Traffic (Veh./Day)	Traffic Growth Factor (%)	Horizontal Curvature (Degrees)	Culvert Size (ft)	Slope Steepness	Culvert Offset (ft)	Lane Width (ft)	Number of Lanes (Und.)	Culvert Type	Slope Depth (ft)
								Rounded pipe culvert	10
								Rounded pipe culvert with concrete rip-rap	11
950	0	0	4x6	2 on 1	14	10	2	Vertical end culvert	12
6000	2	2	8x10	4 on 1	16	11	6	Box culvert with tangent wall	14
12000	4	4	10x12	6 on 1	18	12	10	Box culvert with flared wall	20

3.2 Accident Cost Prediction

As discussed previously, roadway, roadside, and traffic characteristics were selected based upon results from the parametric study. Table 6 shows the seven variables selected for inclusion in the accident cost analysis and presents all variations in each variable included in the study. Note that as shown in the table, variations in parameters were dependent upon highway functional class.

The selected variables were used to model more than three thousand highway scenarios in RSAP. Accident costs were then predicted out of this modeling process. These predicted costs can be used to determine the benefits (i.e., accident cost reduction) of applying each culvert safety treatment on any particular highway scenario.

3.3 Safety Treatments

For all scenarios modeled, accident costs were predicted for a total of four safety treatment options. These options are: (1) leave the culvert unprotected, (2) extend the culvert outside the clear zone, (3) shield the culvert with guardrail, and (4) place safety grates over the culvert.

The do-nothing alternative has been defined as the first alternative. For this alternative, no safety treatment was applied. Therefore, there is no cost to implement this safety treatment. Under normal circumstances, the do-nothing alternative should only be chosen if all safety treatment alternatives do not provide an appropriate reduction in accident costs. The unprotected culvert shown in Figure 6 illustrates this safety option.

Table 6. Roadway, roadside and traffic characteristics used in the main study analysis

Slope Steepness	TGF (%)	Curvature (Degrees)	Culvert Size (ft)	Slope Offset (ft)	Culvert Offset (ft)	ADT (Veh./Day)
Local Highway Class						
2:1	0	0L	4x6	2	4	200
						400
		5L	8x10	6	10	800
4:1	3					1600
		10L	10x12	10	16	3000
Rural Arterial Highway Class						
2:1	0	0L	4x6	8	10	1000
						2000
		3L	8x10	14	18	4000
4:1	3					8000
		6L	10x12	20	26	12000
Freeway Highway Class						
2:1	0	0L	4x6	8	10	5000
						25000
4:1	3	2L	8x10	16	18	50000
6:1		4L	10x12	24	26	100000

Figure 6. Unprotected roadside culvert

Culvert extension has been defined as the second alternative. Culvert extension has been one of the most widely used methods for safety treatments of roadside culverts. This safety treatment involves relocating the culvert so that it may be located farther away from the traveled way to reduce the risk of vehicles striking the culvert. Even though culvert extension may provide highway users with high safety levels, it may involve high costs with fill material and earthwork as shown in Figure 7. Culvert extension implements the third option for treating roadside hazards recommended by the RDG.

Guardrail installation has been defined as the third alternative. Guardrail installation should correspond to the fifth option (i.e., shield the obstacle) for treating roadside hazards recommended by the RDG. Figure 8 illustrates the guardrail protection option.

Figure 7. Culvert extension under implementation

Figure 8. Guardrail installed to shield culvert opening

Even though guardrail erection might seem an efficient, safe and obvious alternative to protect errant drivers from hitting roadside culverts, guardrails can actually increase accident costs in some circumstances. Therefore, it is important that one be aware of where and when guardrail installation would provide attractive benefit/cost ratios.

Grating has been defined as the fourth alternative. This safety treatment consists of placing steel tube grates on the culvert top so that errant vehicles do not fall into the opening. This safety option has shown to be an efficient treatment for moderate-sized culverts (41). In addition, grating can become even more attractive when its implementation costs are taken in account. Its costs can be lower than earth work and guardrail installation costs associated with the second and third options of this study. Figure 9 shows a grating installation placed on a roadside area.

Figure 9. Grating protection

4 PARAMETRIC STUDY

A parametric study was conducted in order to find the highway and traffic characteristics that have the greatest effect on accident costs associated with culvert accidents. The primary objective of this study was to verify whether accident costs were found to be sensitive to a specific variable or not.

Eleven variables were chosen to be included in the parametric study. All these variables were traffic or highway related. Table 5 shows all chosen variables with the respective values assigned for each one of them.

As shown in Table 5, three values were assigned for each variable with the exception of culvert type for which five types were assigned. The culvert types used were: rounded pipe culvert, rounded pipe culvert with concrete rip-rap, vertical end-culvert, box culvert with tangent wall, and box culvert with flared wall. Note that these culverts represent the most widely used designs across the nation.

The results of the parametric study are presented below. The numerical results from the parametric study are presented in Appendix I.

4.1 Side Slope

Accident costs were found to decrease significantly as roadside slopes were flattened. This was true for all four safety treatments. The roadside slope is a hazard that can cause vehicles to rollover and flattened slopes are less likely to create rollover than are steeper slopes. This finding is consistent with accident analysis studies that have shown increase in accident severity as roadside slopes become steeper (9, 30). RSAP indicated a much greater effect from increasing the slope from 4:1 to 2:1 than for flattening the slope from 4:1 to 6:1.

4.2 Average Daily Traffic (ADT)

Results show that accident cost increases as ADTs increase. Accident costs almost doubled from ADT 950 to ADT 6,000. However, from ADT 6,000 to ADT 12,000, accident costs slightly increased. This effect arises from the fact that RSAP calculates crash frequency based on encroachment frequency. Furthermore, Cooper's data (21) indicates that encroachment frequency increases rapidly from 0 vehicles per day to an ADT of 5,000. Thereafter, the estimated encroachment frequency flattens out and actually declines somewhat before beginning to increase again as ADT exceed 7,500.

4.3 Traffic Growth Factor (TGF)

The parametric study indicated that as TGF increases, accident costs tend to increase. This finding is not surprising since TGF controls how rapidly traffic volume increases over time. Hence, raising TGF can be considered a surrogate for raising traffic volume.

4.4 Slope Offset

Results show that accident costs decreased as the slope offset distance got longer. Moving the roadside slope farther from the travel way would reduce the number of vehicles that reach the hazard and fewer crashes lead to lower accident costs.

4.5 Culvert Offset

RSAP results show that accident costs from culvert extension option decreased slightly as culvert offset distance got longer; but for the other three alternatives, accident cost variation was not significantly affected by the culvert offset at all. For the first alternative (i.e., leave the culvert unprotected), accident cost remained roughly the same. This result can be attributed to the fact that increasing culvert offset, without increasing the offset to the start of the roadside embankment would necessarily increase the depth of the roadside slope. Deeper roadside slopes

are more severe and this increased risk of a serious slope accident counter balanced the reduced risk of a culvert crash. Notice that as the culvert gets farther from the traveled way, the slope gets deeper for construction and safety reasons (i.e., culverts are constructed with the bottom of the pipe flush with the bottom of the ditch). For the third and fourth alternatives (i.e., guardrail protection and grating), the same thinking applies. For the second alternative (i.e., culvert extension), while there was no significant difference in accident costs between scenarios with culvert offsets of 14 feet (4.2 meters) and 16 feet (4.8 meters), costs dropped as the culvert offset distance increased from 16 feet (4.8 meters) to 18 feet (5.5 meters). Note that, for culvert extensions, some procedures were adopted. First, culverts were extended to a minimum required distance from the travel way. This distance is suggested by the RDG and shown in Table 2. Second, sideslopes had to match with the culvert top. Third, slope steepness values had to be integer values for construction reasons. That is, no slope steepness values such as 4.5:1 or 6.55:1 were used. Because of these procedures, culverts with initial offsets of 14 and 16 feet (4.2 and 4.8 meters) were extended to a final position of 26 feet (7.9 meters) from the travel way, while the culvert with initial offset of 18 feet (5.5 meters) was extended to a final position of 34 feet (10.4 meters) from the travel way.

4.6 Horizontal Alignment

Results show that accident costs are higher as horizontal curves become sharper. RSAP was found to be very sensitive to horizontal radius. RSAP uses adjustment factors, based on the Georgia study (13), to deal with encroachment frequency values. Horizontal alignment was one more parameter added to the main analysis of this study.

4.7 Culvert Size

The results show that accident costs tend to increase as culvert size increases. This finding may be attributed to the fact that larger culverts have higher severity and present a larger target to be struck. Furthermore, deeper slopes must be present when larger culverts are used.

4.8 Slope Depth

It was found that accident costs did not follow any consistent trend when varying slope depth. This finding was attributed to the fact that as slope depth changed, other variables (e.g., slope width, culvert offset distance, and guardrail length-of-need) changed as well. Therefore, slope depth was allowed to be controlled as a function of other parameters.

4.9 Lane Width

Results show that accident costs slightly increased as lanes got narrower. It seems reasonable to assume that vehicles encroach the roadside more often when traveling on narrower highway lanes. However, because accident cost variations were within a very short range, lane width was not added as one more parameter in the main analysis of this study.

4.10 Number of Lanes

Results show that adding traffic lanes increased accident costs. Considering that the traffic volume is roughly the same on all lanes, accident costs were expected to decrease as the number of lanes increase. A careful evaluation of the RSAP program revealed a bug in the code that led to this problem. The RSAP code was found to correctly evaluate roadways with four lanes or less. Hence, the code was implemented for the remaining of the study and only two or four lane highways were considered.

4.11 Culvert Type

Five different culvert types were used in the analysis, including rounded pipe culvert, rounded pipe culvert with concrete rip-rap, vertical end culvert, box culvert with tangent wall, and box culvert with flared wall. These five types represent most of the culverts in use today. Scenarios with rounded pipe culverts presented the lowest accident costs, while scenarios with culvert vertical end culverts presented the highest accident costs. This can be attributed to the fact that the rounded pipe culvert has the lowest accident severity index while the vertical end culvert has the highest accident severity index. The difference between the lowest and highest accident costs was less than 15 percent for all alternatives studied. Even though there is a difference of more than fifty percent between the lowest and highest accident severity indexes, changes on culvert type do not increase accident exposure; therefore, changes on them only are not expected to raise accident costs significantly. Due to small accident cost differences as well as to time and cost constraints, culvert type was not taken in account.

Based upon the parametric study, described above, four variables were found to have relatively limited impact on accident costs. These four variables: number of lanes, lane width, slope depth, and culvert type, were therefore eliminated from the remaining of the study.

5 ACCIDENT COST PREDICTION

As stated in Section 1.2, the main objective of this study is to determine accident costs in order to allow highway designers to estimate the incremental B/C ratios for culvert safety treatment alternatives under different roadway and traffic conditions. In order to determine B/C ratios, Benefit-Cost procedures were used. Such procedures are commonly used as an economic tool to aid decision-making. In benefit-cost analyses, the benefits and costs are estimated in terms of the public's willingness to pay for them and willingness to pay to avoid them, respectively. In transportation, benefits are generally measured as the monetary value associated with variables such as reduction in injuries, fatalities, property damage, travel-time, and vehicle operating costs. On the other hand, costs are measured as the direct monetary resource that has to be spent in order to achieve the benefits. Costs include construction, repair, and/or maintenance costs.

Even though benefits are hard to determine, estimating them is made possible by using RSAP. RSAP incorporates stochastic simulation technique to estimate the number of crashes as well as their respective severity (28). RSAP attempts to link the risk of run-off-road crashes to measured encroachment rates and encroachment/crash characteristics. RSAP incorporates the most advanced encroachment probability crash prediction technique available today. RSAP attributes accident costs to five different accident injury levels, as shown in Table 7.

FHWA Comprehensive Costs were used as the used accident costs. These costs include not only direct but also indirect costs associated with highway crashes such as the costs of pain, suffering, and reductions in quality of life. By adopting these comprehensive costs, analysis should tend to be more accurate (45).

Table 7. FHWA Comprehensive Costs

INJURY LEVEL	ACCIDENT COSTS (U$$)
Property Damage Only (PDO)	2,000
Minor Injury	19,000
Moderate Injury	36,000
Severe Injury	180,000
Fatal Injury	2,600,000

RSAP estimates the accident costs for any specific roadway and roadside conditions. In order to identify accident costs over a wide range of highway conditions; it was necessary to run RSAP for a wide range of highway conditions. As shown in Table 6, combinations of traffic, roadway, and roadside variables were used in order to predict accident costs from a wide range of roadway and roadside characteristics. Variations in each of these variables incorporated in the RSAP analysis are presented below.

5.1 Local Road

Local roads provide land access and circulation to residential, commercial, and industrial areas. They do not require much right-of-way land acquisition and, as a result, roadside obstacles and obstructions are not far from the travel way. Based on this, slope and culvert offset distances were chosen to be short. Values of 2, 6, and 10 feet (0.6, 1.8, and 3 meters) were selected for slope offset and values of 4, 10, and 16 feet (1.2, 3, and 4.8 meters) were selected for culvert offset. Slope steepness values of 2:1 and 4:1 were used which reflects the types of slopes commonly found on constructed roadways with low traffic volumes and design speeds.

Local roads primarily serve intra-country level travels with relatively short distances. Further, low traffic volumes are observed on these roads. Therefore, large degrees of horizontal curvature are also acceptable. Based on this, low traffic volumes of 200, 400, 800, 1,600, and 3,000 vehicles per day, as well as relatively sharp horizontal curvatures of 0, 5, and 10 degrees were incorporated into the analysis. These values for horizontal curve radius were assigned based on the Exhibit 3-14 (Minimum Radius for Design of Rural Highways, Urban Freeways, and High-Speed Urban Streets Using Limiting Values of e and f) from "A Policy on Geometric Design of Highways and Streets" (43). The same procedure was used to calculate horizontal curvature degrees for freeway and rural arterial highway classes.

Note that culvert sizes were equally selected for all three highway classes. Culverts with sizes of 4 by 6 feet (1.2 by 1.8 meters), 8 by 10 feet (2.4 by 3 meters) and 10 by 12 feet (3 by 3.6 meters) were selected. Even though it is known that there are much larger culverts on real-world highways, especially on local roads, the selected sizes are the most commonly seen culvert sizes across the nation. Furthermore, it would be unrealistic to adopt grating as an appropriate safety treatment for extremely large culverts since this treatment is impractical for such roadside structures. The structural capacity required for the grates to overcome too lengthy spans would make this treatment not feasible.

Traffic growth factors were also equally selected for all three highway classes. Considering that traffic volumes grow as employment and population raises, the assumption of equal traffic growth factors for all three highway classes should not be an issue because most parts of the transportation network are mostly located on rural areas where population and employment growth are comparable in most regions.

5.2 Rural Arterial

Rural arterial highways provide a higher degree of mobility compared to local roads, but they do not provide the same degree of accessibility as local roads. Rural arterial highways generally have fewer at grade intersections and move at higher operating speeds than local roadways. Clear zones and shoulders are also usually wider than those for local roads. Traffic volumes for these roadways typically range from 1,000 to 10,000 vehicles per day and speed limits typically range from 40 to 60 mph (64 to 96 km/h).

The slope and culvert offsets adopted for this highway class reflect required offsets for these particular operational and design characteristics. Values of 8, 14, and 20 feet (2.4, 4.2, and 6 meters) were selected for slope offset while values of 10, 18, and 26 feet (3, 4.8, and 7.9 meters) were selected for culvert offset. Similarly, traffic volumes and horizontal curvatures of 1,000, 2,000, 4,000, 8,000, and 12,000 vehicles per day and 0, 3, and 6 degrees, respectively, were assigned to this highway class.

5.3 Freeway

Freeways are high-speed transportation facilities with full access control. They usually carry high traffic volumes. Thus, average daily traffic of 5,000, 25,000, 50,000, and 100,000 vehicles per day were assigned for this study. Even though it is known that there are freeways that carry much higher traffic volumes, it is believed that these values correspond to traffic volumes carried by most freeways.

Safety standards require freeways to have relatively wide shoulders and clear zone distances. Therefore, relatively lengthy slope and culvert offset distances as well as flatter roadside slopes are required. Based on this situation, slope offset distances of 8, 16, and 24 feet (2.4, 4.8, and 4.8 meters) and culvert offset distances of 10, 18, and 26 feet (3, 5.4, and 7.9

meters) were selected. Further, instead of using only 2:1 and 4:1 sideslope steepnesses, as used for local and arterial highways, sideslope steepness of 6:1 was also selected for freeways.

Because drivers travel at high speeds when driving on freeways, the horizontal alignment must be much smoother than on other highway classes. Thus, the degrees of curvature used with freeways were limited to 0, 2, and 4.

6 SAFETY TREATMENTS

Four safety treatments were chosen for this study. They are: do-nothing, culvert extension, guardrail installation, and grating. Applications of RSAP to model these treatments are presented below.

6.1 Do-nothing

The do-nothing option consists of applying no safety procedure to treat the culvert. Under normal provision of transportation funds, the do-nothing option must only be adopted if there is of benefit on adopting any other safety treatment.

6.2 Culvert Extension

Although culvert extension appears to be an efficient safety treatment for roadside culverts, it might not be economically feasible when all costs are considered. In order to extend a cross-drainage culvert out of the clear zone, the roadside embankments must be flared away from the travel way. If flared at a high rate, the flared embankment itself can prevent a serious rollover risk. However, large fill volumes become necessary when low flare rates are used.

Culverts are normally extended to the edge of the clear zone. Thus, for purposes of this study, culverts were extended to the edge of the clear zone in the RDG. The following sections explain how the appropriate clear zone was selected and how extension was accomplished in RSAP.

6.2.1 Clear Zone Concept

Clear zone may be defined as the unobstructed, relatively flat area on the roadside intended to provide errant drivers with the chance for recovery. Thus, the main function of the clear zone is to provide errant vehicles chances to stop safely or to take recovery action to go back to the traveled way.

The RDG recommends that clear zone width be selected based on the design speed, average daily traffic, and sideslope steepness, as shown in Table 2. The RDG provides ranges of clear zone values for each group of these three highway characteristics. Clear zone widths can be selected from anywhere within the recommended range. Therefore, other factors such as right-of-way availability, environmental impacts, and funding constraints should be considered as well. Cost-effectiveness studies have also shown that roadside policies should be flexible in relation to adoption of clear zone areas (30).

It was impossible to consider site specific issues such as environmental impacts and availability of right-of-way in the study. Hence, average clear zone values were selected from Table 2 of the RDG. For example, for a highway section with average value for each range was used. For instance, for a highway section with average daily traffic of 8,000 vehicles per day, design speed of 70 mph (112.6 km/h) and slope steepness of 8:1, the RDG recommends a clear zone range from 30 to 34 feet (9 to 10.2 meters). The 32-feet (9.6-meters) average value was selected for use in the current study.

Another important decision in the design of a culvert extension is the selection of slope steepness. Recall that slope steepness is one of the three factors that have direct influence on determining recommended clear zone distance. For purposes of this study, slope steepness was chosen based on the clear zone associated with the pre-existing roadside and geometric characteristics of the roadside. The culvert was then extended to the edge of the clear zone. The top of the culvert then defined the location of one of the slope break points along the roadside. The new slope was then created that extended from the existing edge of the shoulder to the top of the culvert. The following paragraphs illustrate the culvert extension design process.

Culvert extension of Scenario 1 from the rural arterial highway section is described below. The characteristics of this highway section are shown in Appendix IV. The pre-extension roadside geometry for the scenario is shown below in Figure 10.

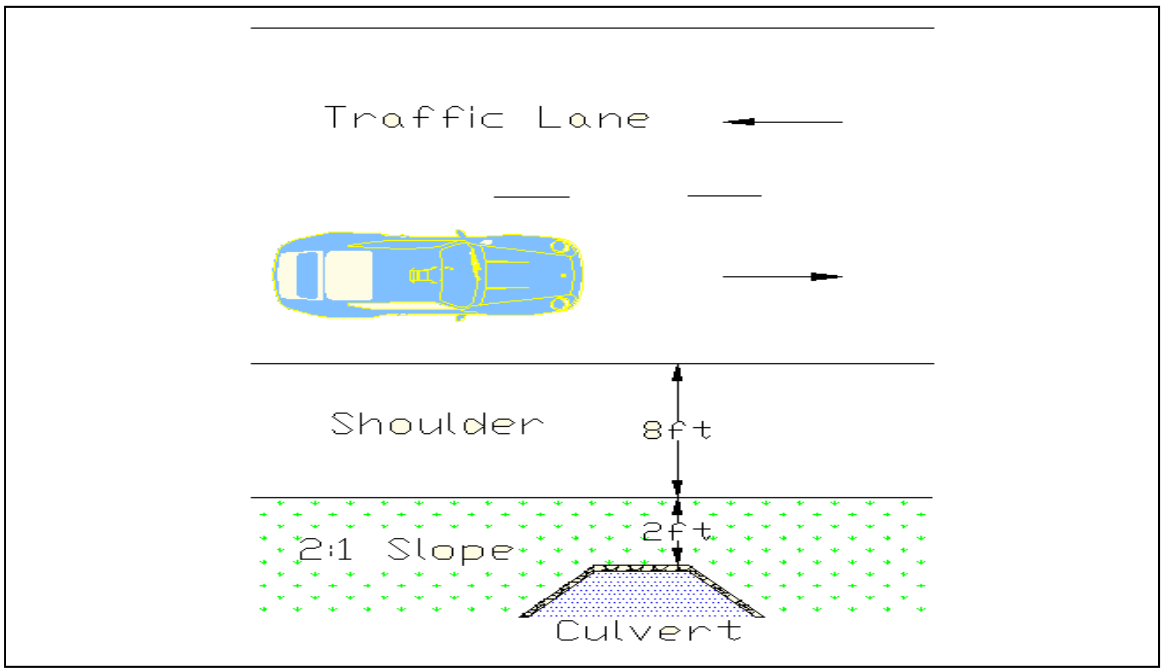

Figure 10. Plain view of scenario 1 from the rural arterial highway class

Table 2 from the RDG was used to select the appropriate clear zone distance based upon the design speed of 60 mph (96.5 km/h), average daily traffic of 1,000, and slope steepness of 6:1 or flatter. Based on these parameters, Table 2 from the RDG recommends a clear zone distance of 20 to 24 feet (6 to 7.2 meters). As noted above, the average value of 22 feet (6.6 meters) from Table 2 was used in the current study. The cross-section of the final position of the culvert is shown in Figure 11.

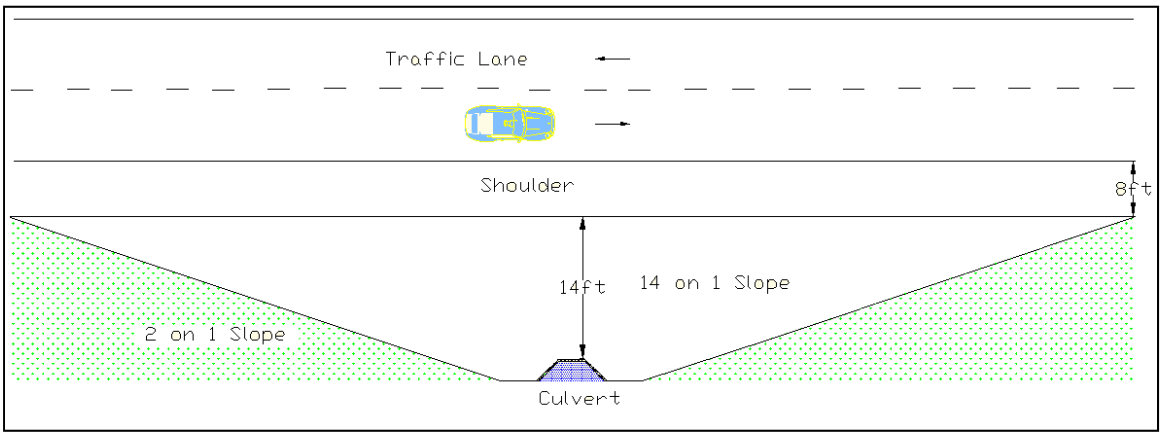

Figure 11. Scenario configuration after culvert extension

Unfortunately, RSAP is only able to model rectangular hazards while the slopes associated with the culvert extension are triangular as shown in Figure 11. In order to model triangular hazards, a series of rectangular hazards were input into RSAP. In order to define the most appropriate model configuration, a study was undertaken to determine how many rectangles would suffice to converge outputs to relatively stable results.

The entire slope was divided into small rectangular hazards to create a “mesh”. A series of slope models with various numbers of rectangular hazards was analyzed including one, two, three, four, and five rectangles. Figures 12 through 16 show the possible configurations for the same scenario according to the number of rectangles adopted.

Accident costs for the models shown in Figures 12 through 16 were calculated using RSAP so that one can see how much accident costs changed as the mesh was refined.

It was found that accident costs increased as the number of rectangles increased. This may be attributed to the fact that the more rectangles the scenario has, the smaller the flattened sideslope area is. However, the degree of accident cost increase was small. Then, it was necessary to define how many rectangles are needed to provide an accurate benefit analysis

while considering time and cost constraints. As the number of rectangles used on the highway scenario increased, the scenario modeling time enormously increased.

Further, the increase in accident costs with mesh refinement was found to be only 2 percent as each rectangle was added. Thus, highway scenarios with three rectangles were used when applying the culvert extension safety treatment.

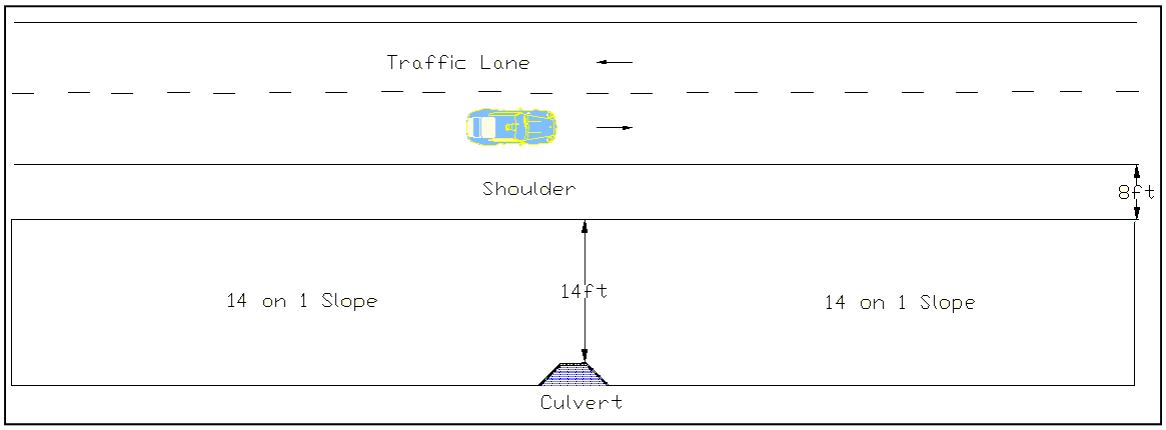

Figure 12. Scenario with one rectangle

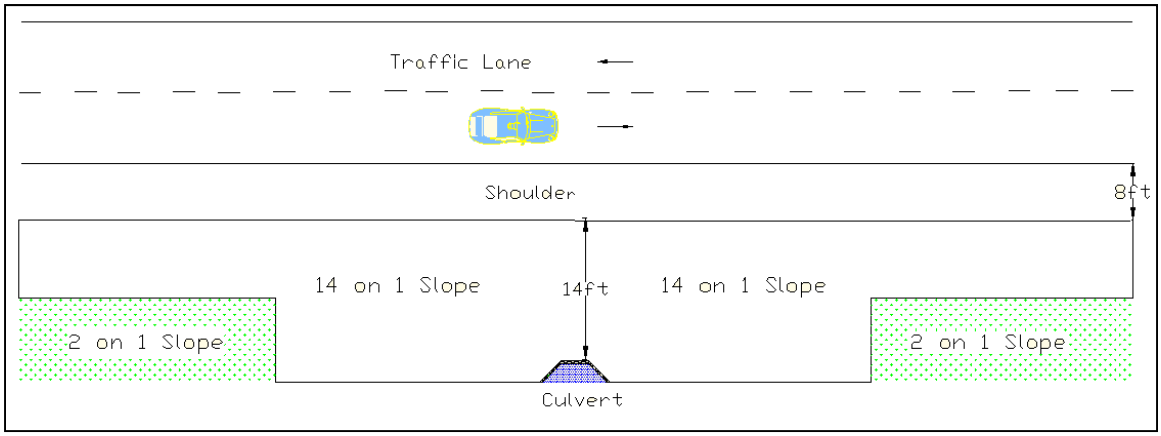

Figure 13. Scenario with two rectangles

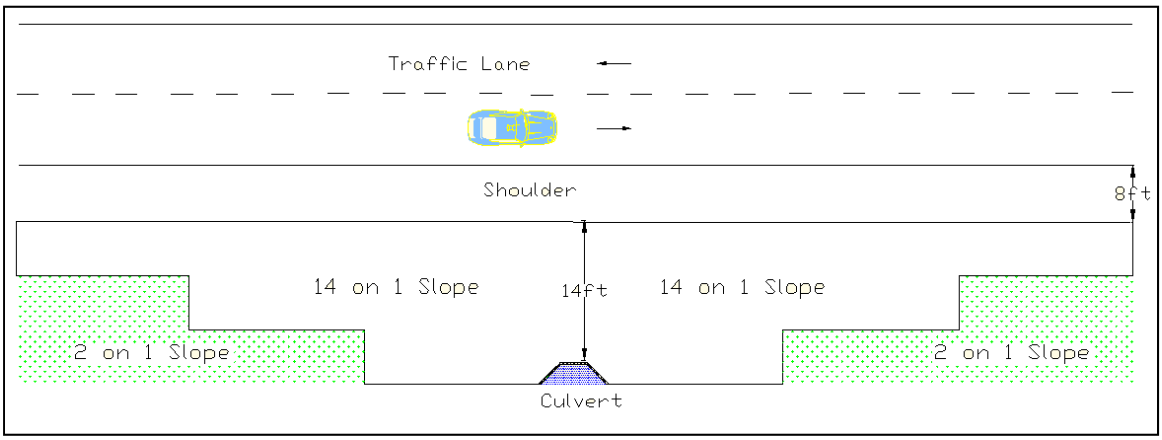

Figure 14. Scenario with three rectangles

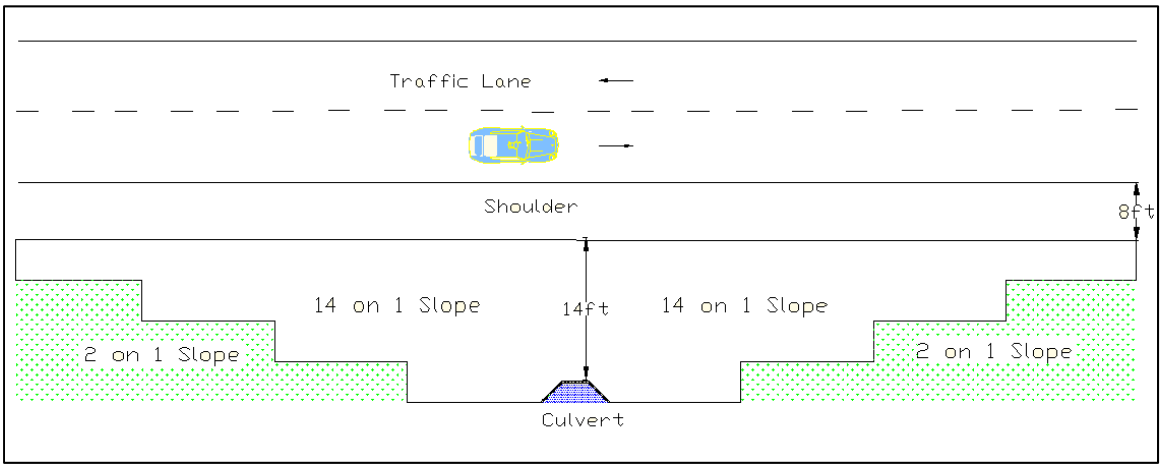

Figure 15. Scenario with four rectangles

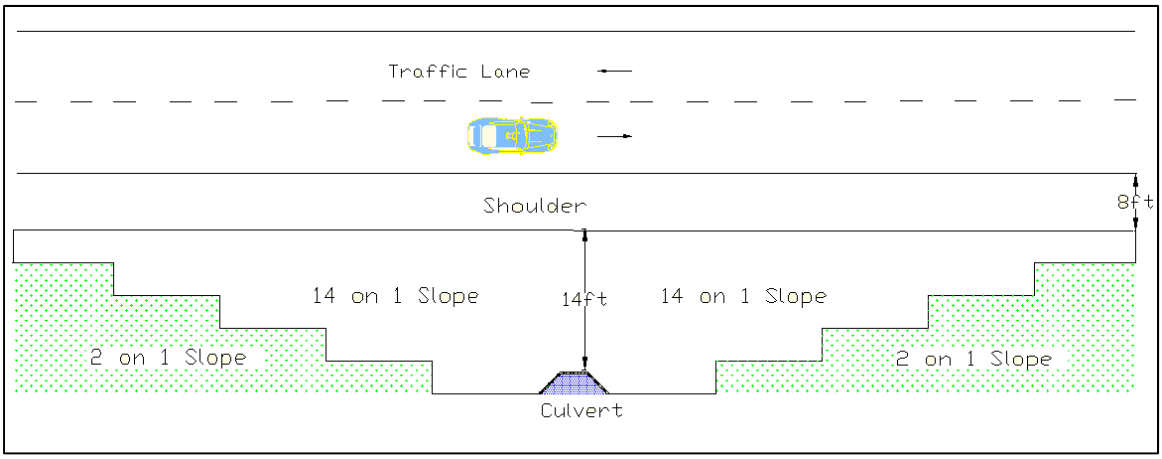

Figure 16. Scenario with five rectangles

6.3 Guardrail Installation

Guardrail installation was used as the third safety treatment. Accident frequency is expected to increase when a guardrail is used to protect errant drivers from hitting a roadside culvert because guardrails must be closer to the traveled way than the hazard intended to be shielded. Further, a guardrail must be much longer than the hazard in order to prevent vehicles from running behind the guardrail and striking the hazard. In some circumstances, guardrails can actually increase accident costs by raising accident frequency sufficiently to overcome the benefits of reduced accident severity. Proper locations to use protective barriers are sites where the costs associated with accidents, without guardrails, are higher than costs associated with accidents with guardrails. These sites may include highway scenarios with extremely large culverts and deep drop offs as shown in Figure 17.

Figure 17. Culvert opening shielded by a guardrail installation

A TL-3 W-beam guardrail was selected for use in this study because it represents the most widely used system across the nation. Guardrail length-of-need was calculated based on the methodology used by the RDG which adopts the following equation for guardrail length-of-need determination:

$$x = \frac{L_a + (b/a)(L_1) - L_2}{(b/a) + (L_a/L_r)} \qquad (0.0.2)$$

where:

b/a = Flare rate;
L_1 = Tangent length of barrier upstream from the hazard;
L_2 = Lateral distance from the edge of the traveled way;
L_a = Distance from the traveled way edge to the back of the hazard; and
L_r = Runout length.

Figure 18 shows what each variable listed above represents on a guardrail installation layout.

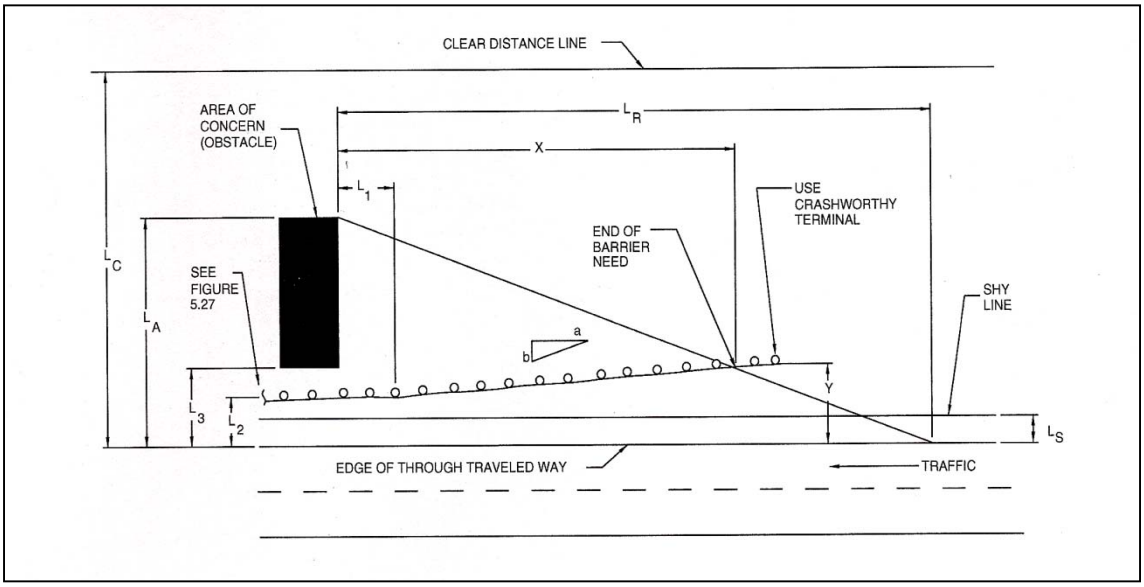

Figure 18. Figure 5.24 from the RDG 2002: "Opposing barrier layout variables"

In Equation 6.3.1, flare rates were considered. The main reasons behind using flare rates are to decrease accident frequency since the guardrail installation gets farther from the roadway

and to decrease costs by adopting shorter guardrail systems. Figure 19 shows a flared guardrail installation which requires relatively flat sideslopes beyond the shoulder.

Figure 19. Flared guardrail installation

However, culverts are roadside obstacles that are placed on roadside slopes. Guardrail use was restricted to tangent installations since guardrail cannot be safely flared onto steep slopes and slope steepnesses used in this study were not flat enough to use flared guardrail installations. Figure 20 shows a tangent guardrail installation placed right beyond the roadway shoulder.

Figure 20. Tangent guardrail installation

When flare rate is removed from Equation 6.3.1, the formula for guardrail length-of-need becomes:

$$x = \frac{L_a - L_2}{L_a / L_r} \tag{6.3.2}$$

The runout length L_r is the theoretical distance needed for most vehicles that leave the roadway to come to a stop. This variable is directly linked to values for the distance traveled by encroaching vehicles. The RDG suggests values for runout lengths that are essentially based on encroachment data collected by Hutchinson and Kennedy (19). More recently, Cooper collected encroachment data from Canadian highways (21). Wolford and Sicking used Cooper's encroachment data and a separate benefit/cost analysis approach to determine optimum guardrail length-of-need (33). The recommended values based upon a B/C analysis match well with those

developed from Cooper's data, both were significantly lower than those shown in the RDG. In order to determine the real appropriateness of each of these three sources of guardrail runout length, required guardrail lengths were compared to those determined from real-world crash data (34) Reconstructions of real-world single vehicle run-off-the-road crashes also matched vehicle runout lengths from Cooper very closely. Thus, runout lengths recommended by Wolford and Sicking were used instead of those suggested by RDG. It is believed that by doing this, more cost-effective guardrail lengths will improve the overall cost effectiveness of guardrail use.

Equation 6.3.2 was used for determination of both upstream and downstream guardrail lengths. The only difference between upstream and downstream calculation is the L_a value. Since the L_a value corresponds to the distance between the traveled way edge and the back of the roadside hazard, one more lane width (12 feet or 3.6 meters), corresponding to the opposing lane, is added to the L_a distance when calculating downstream, or opposing traffic guardrail.

Guardrail end-terminals were also used so that the entire guardrail installation may be set according to current standards. TL-3 guardrail end-terminals are used so that this performance level may match with the performance level of the rest of the guardrail system. Width of 2 feet (0.6 meters) was adopted for guardrail systems. On freeways, guardrail end-terminals are placed on the upstream side of the installation in order to make vehicle impacts safer if guardrail ends are involved in a crash, as shown in Figure 21.

Figure 21. Upstream side guardrail end-terminal

6.4 Grating

Culvert grates were suggested to treat culvert openings greater than 36 inches (0.9 meters) (39). For these culvert openings, grates were placed on the plane of the sideslope and perpendicular to the traffic flow. Also, as presented in the previous chapter, grate designs have shown to be structurally capable of sustaining passenger cars as well as pickup truck impacts. In addition, it was found that decelerations suffered by vehicle occupants were acceptable and that the roadside terrain appeared to influence the trajectory of the vehicles more than the grates themselves. Thus, grating might be a cost-effective safety measure to treat cross-drainage culverts.

In the present study, grating was defined as the fourth safety treatment. In order to implement this treatment, different procedures were adopted depending upon two circumstances. First, for scenarios with 3:1 or flatter slopes, the only change in the scenario was the placement of grates on top of the culvert opening. Second, for scenarios with slopes steeper than 3:1, the entire slope was flattened to 3:1 and a grate was added to the culvert. This approach was adopted because safety grates have been tested successfully on 3:1 slopes (41) and it is believed that they would not be effective on steeper slopes since rollover propensity on sideslopes steeper than 3:1 is too high.

Crash test has shown that grates do not greatly increase the risk of occupant injury. Thus, the grates were considered to have the same severity as the slope upon which they were installed.

7 RESULTS

RSAP was run for every combination of roadway and traffic characteristics shown in Table 6. Accident costs were tabulated for each run and are presented in Appendices III, IV, and V. This chapter is divided in two sub-sections. Section 7.1 describes the main conclusions drawn from accident costs presented in Appendices III, IV, and V. Section 7.2 shows how designers can use the found accident costs to determine the adequate safety treatment for any given project.

7.1 Findings

Whenever the direct costs of the various safety treatment options are found to be very similar, the option with the lowest accident cost will provide the most appropriate safety treatment. Further, the safety treatment that produces the lowest accident costs can be considered the safest alternative, regardless of costs. In an effort to help designers better understand the situations where each safety treatment in most likely to be optimal, the following observations were compiled from the accident cost tables in Appendices III, IV, and V.

7.1.1 Local Roads

- Grating was found to produce the lowest accident cost on roads with 2:1 sideslopes.
- Culvert extension was found to produce the lowest accident cost on roads with 4:1 sidelopes and average daily traffic volume not lower than 800.

7.1.2 Rural Arterial

- Grating was found to produce the lowest accident cost on roads with 2:1 sideslopes.
- Grating was found to produce the lowest accident cost on any straight segment road.
- Culvert extension was found to produce the lowest accident cost on roads with 4:1 sideslopes with an offset distance of 8 feet and average daily traffic volume higher than 1000.

7.1.3 Freeway

– Grating did produce the lowest accident cost for all scenarios.

7.2 Example Applications

Selection of the most appropriate safety treatment for a roadside cross-drainage culvert should be based upon an incremental benefit/cost analysis. This type of analysis can be conducted using the accident costs tabulated in Appendices III through V and direct costs estimated for each safety treatment at any given site. The following paragraphs illustrated how such an analysis can be conducted.

Assume that the costs to implement culvert extension, guardrail installation, and grating are $15,000, $5,000, and $2,000 respectively. Culvert extension costs should include costs related to materials and services such as fill material and earthwork. Guardrail installation costs are proportional to guardrail length-of-need. Finally, grating costs are expected to be lowest among the three since it involves nothing but the grates themselves.

The direct costs for construction of the safety treatments must then be converted to annualized costs in order to match the accident costs tabulated in Appendices III through V. Direct costs are annualized using the following equation:

$$A = P.\left[\frac{i.(1+i)^n}{(1+i)^n - 1}\right] \qquad (7.2.1)$$

where:

A = annual payment required over n years,
P = initial investment required,
i = interest rate, and
n = periods of repayment or project life.

Assume a 4% discount factor of interest rate and a project life of 25 years are used when applying Equation 7.2.1. After being annualized, the direct costs for culvert extension, guardrail installation and grating were estimated to be $960.18, $320.06, and $128.02, respectively.

The incremental benefit-cost ratio for each treatment option can then be calculated using the equation shown below.

$$B/C \text{ Ratio}_{2-1} = \frac{AC_1 - AC_2}{DC_2 - DC_1} \tag{7.2.2}$$

where:

AC_n = Accident cost for safety treatment n, and

DC_n = Direct cost for safety treatment n.

Note that the incremental B/C analysis is easiest to interpret when the treatment options are ordered from the lowest accident cost to highest accident cost. In this example, and most real-world situations, the lowest direct cost option is the do-nothing option. Culvert grates are the second lowest cost and guardrail protection and culvert extension are the third and fourth lowest cost options. First, using Equation 7.2.2, the B/C ratios for constructing culvert grates are calculated as shown below.

$$B/C \text{ Ratio}_{Grating-Do-nothing} = \frac{AC_{Do-nothing} - AC_{Grating}}{DC_{Grating} - DC_{Do-nothing}} = \frac{4,668.98 - 1,769.90}{128.02 - 0} = 22.64$$

Clearly, constructing a culvert grate is cost beneficial since the found B/C ratio is much greater than 1.0. Thus, grating would be recommended over the do-nothing option. Because grating was found to be cost beneficial, the remaining options will be compared to grating. If grating was not found to be cost beneficial, the do-nothing option would be the basis for comparing the remaining alternatives.

The incremental B/C ratio for installing guardrail instead of culvert grating is then calculated using Equation 7.2.2.

$$B/C \text{ Ratio}_{Guardrail-Grating} = \frac{AC_{Grating} - AC_{Guardrail}}{DC_{Guardrail} - DC_{Grating}} = \frac{1,769.90 - 4,061.31}{320.06 - 128.02} = -11.93$$

The B/C ratio is negative which means that accident costs associated with guardrail installation are higher than those associated with grating; therefore, grating is a safer treatment than guardrail installation for this example. Because the B/C ratios of guardrail compared to culvert grates is negative, guardrail installation is not recommended. Thus, culvert grating remains the basis for comparison for the culvert extension option. The incremental B/C ratio for culvert extension compared to grating is then calculated using Equation 7.2.2.

$$B/C \text{ Ratio}_{Extension-Grating} = \frac{AC_{Grating} - AC_{Extension}}{DC_{Extension} - DC_{Grating}} = \frac{1,769.90 - 4,183.04}{960.18 - 128.02} = -2.89$$

The B/C ratio for this option is also negative. Because transportation agencies seek safety treatments which provide B/C ratios higher than 1.0, neither guardrail installation nor culvert extension were found to provide any benefit over grating. On the other hand, grating was found to provide significant benefits over the option of leaving the culvert unprotected.

Most transportation agencies adopt a threshold value for funding safety projects at a B/C ratio of at least 2.0 because of inaccuracies included in the crash cost prediction algorithms. These inaccuracies include crash frequency prediction, crash severity estimation, and accident cost determination as discussed in Section 2.4. Hence, considering that the B/C ratio of 22.64 is much higher than 2.0, grating is the safety treatment that should be chosen for this example.

Using the accident cost tables shown in Appendices III, IV, and V, and the procedure above, designers should be able to quickly determine which of the four possible safety treatments is most cost beneficial.

8 SUMMARY AND CONCLUSIONS

The purpose of this study was to develop guidelines on safety treatments for roadside culverts. Guidelines were developed based on accident costs which were associated with various roadway and roadside conditions. These accident costs were estimated by using an encroachment probability model (28). Therefore, it is possible to quantify the benefits derived from the adoption of each safety treatment applied.

The study began with a parametric study which investigated roadway and roadside characteristics that have significant impact on accident cost change. Eleven variables were initially utilized and three of them were found not to impact accident costs much. Thus, these variables were eliminated from further analysis. The remaining variables were used in order to model highway scenarios from three different highway classes. Values were assigned to the variables used based upon highway functional class. Appendix I shows accident cost variations calculated in the parametric study.

Subsequently, procedures were implemented in order to model the adopted safety treatments in the encroachment probability based model. These procedures were implemented based either on information from the RDG or on findings from relevant literature, and they were discussed in chapter 6. Highway scenarios were then modeled for each combination of roadway and roadside variables as well as for each one of the four safety treatments, resulting in over three thousand scenarios.

The accident cost tables shown in Appendices III, IV, and V display accident costs resulting from each safety treatment under different roadway and roadside conditions. These costs can provide guidance on identifying the most appropriate safety treatment for roadside cross-drainage culverts. This data should greatly simplify the process for conducting benefit cost

analysis of various treatment options, thereby facilitating the design of most 3R and similar projects. Further, the simplified procedures should provide improved application of scarce safety funds, thereby improving overall highway safety.

It should be noted that guardrail installation has not been found to be the safety option with the lowest accident cost for any scenario. Even though guardrail protection has been widely used to protect errant drivers from crashing roadside culverts, it is not the safest option under most circumstances. Culvert extension has been found to be the safety option with the lowest accident costs for scenarios with 4:1 sideslopes, average daily traffic not lower than 1000 and slope offset distances not greater than 10 feet. Therefore, culvert extension seems to be the safest treatment for some scenarios with 4:1 sideslopes, This may be attributed to the fact that, for scenarios with such sideslopes, relatively lengthy clear zone distances are required making sideslopes even flatter and culverts farther from the travel way. It should also be noted that a large proportion of the roadside scenarios showed that grating produced the lowest overall cost. Furthermore, grating has been found to be the safest treatment for all freeway scenarios.

These findings indicate that the choice of culvert safety treatments must be flexible to roadway and roadside characteristics, and that the expanded use of culvert extension and grating can produce safer roadsides.

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APPENDIX I – PARAMETRIC STUDY RESULTS

	ACCIDENT COSTS ($)			
	Do-nothing	Culvert extension	Guardrail installation	Grating
SIDE SLOPE STEEPNESS (H:V)				
2H:1V	31614.56	28015.94	24311.19	11005.47
4H:1V	9764.97	6919.98	7348.78	3523.02
6H:1V	5379.83	4854.32	5320.98	870.40

	ACCIDENT COSTS ($)			
	Do-nothing	Culvert extension	Guardrail installation	Grating
AVERAGE DAILY TRAFFIC (No Vehicles / Day)				
950	15620.76	14704.56	12494.03	5437.81
6000	27576.76	24498.54	21402.82	9599.86
12000	30703.16	25640.77	22646.23	10688.20

	ACCIDENT COSTS ($)			
	Do-nothing	Culvert extension	Guardrail installation	Grating
TRAFFIC GROWTH FACTOR (%)				
0	27300.46	22799.11	20136.46	9503.67
2	30703.16	25640.77	22646.23	10688.20
4	35416.56	29577.01	26122.78	12329.00

	ACCIDENT COSTS ($)			
	Do-nothing	Culvert extension	Guardrail installation	Grating
Lane Width (ft)				
10	32252.53	26964.24	23819.72	11223.29
11	31459.14	26258.32	23187.29	10951.61
12	30703.16	25640.77	22646.23	10688.20

	ACCIDENT COSTS ($)			
	Do-nothing	Culvert extension	Guardrail installation	Grating
NUMBER OF LANES (Und)				
2	27576.76	24498.54	21402.82	9599.86
6	36853.62	34279.32	30840.08	12947.80
10	42259.83	37988.50	35898.75	14731.21

	ACCIDENT COSTS ($)			
	Do-nothing	Culvert extension	Guardrail installation	Grating
SLOPE OFFSET(ft)				
6	40388.27	35177.46	30621.60	14073.14
10	31614.56	28122.63	24536.63	11005.47
14	24159.50	22676.80	19071.88	8401.34

	ACCIDENT COSTS ($)			
	Do-nothing	Culvert extension	Guardrail installation	Grating
CULVERT OFFSET (ft)				
14	31614.56	28122.63	24536.63	11005.47
16	31766.35	28531.92	24616.06	11022.43
18	31885.65	25646.36	24704.44	11033.61

	ACCIDENT COSTS ($)			
	Do-nothing	Culvert extension	Guardrail installation	Grating
SLOPE DEPTH (ft)				
10	31614.56	28122.63	24536.63	11005.47
11	31766.35	28531.92	24616.06	11022.43
12	31885.65	25646.36	24704.44	11033.61
14	32004.74	28388.42	24741.37	11044.66
20	30931.70	28481.02	24420.54	11551.49

	ACCIDENT COSTS ($)			
	Do-nothing	Culvert extension	Guardrail installation	Grating
HORIZONTAL RADIUS (ft)				
1080	72526.52	62467.77	58188.34	26327.16
1295	63027.95	53883.22	48574.15	22734.40
1600	46127.84	40096.29	35537.83	16672.03

	ACCIDENT COSTS ($)			
	Do-nothing	Culvert extension	Guardrail installation	Grating
CULVERT TYPE				
Rounded pipe culvert	29307.74	26834.40	23632.11	11005.47
Rounded pipe culvert with concrete Rip-rap	29388.99	27124.60	23680.90	11005.47
Vertical end culvert	33348.05	29208.16	25192.95	11005.47
Single box culvert	30511.66	27526.15	24124.04	11005.47
Flared wing wall culvert	31614.56	28122.63	24536.63	11005.47

	ACCIDENT COSTS ($)			
	Do-nothing	Culvert extension	Guardrail installation	Grating
Culvert Size (ft)				
4x6	25744.10	23472.51	21247.93	9690.47
8x10	31614.56	28087.38	24536.63	11005.47
10x12	29437.11	27985.5	23527.04	11033.61

APPENDIX II – THE LOWEST ACCIDENT COST SAFETY TREATMENTS

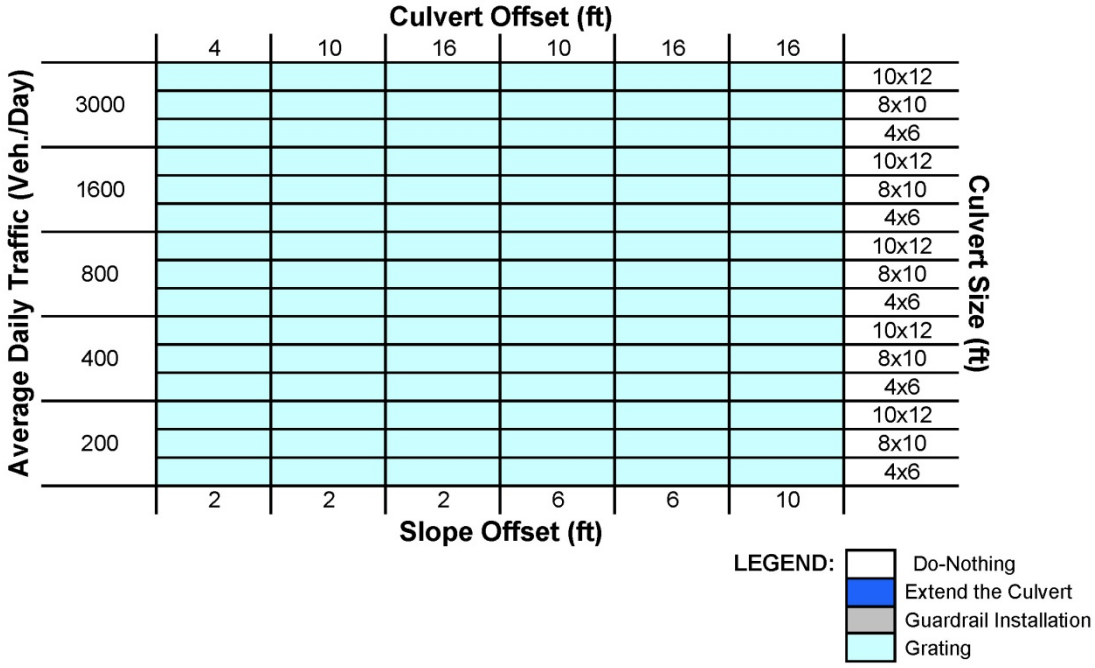

Figure 22. Results from the local road with 2 on 1 side slopes

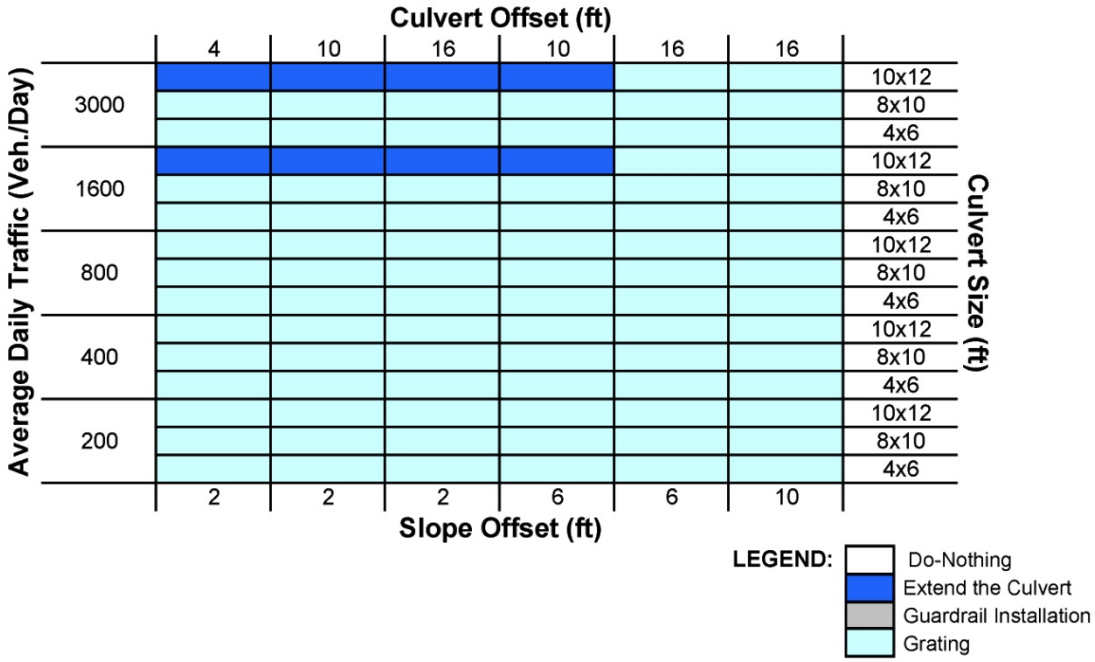

Figure 23. Results from the local road with traffic growth factor of 0% per year, straight segment, and 4 on 1 side slope

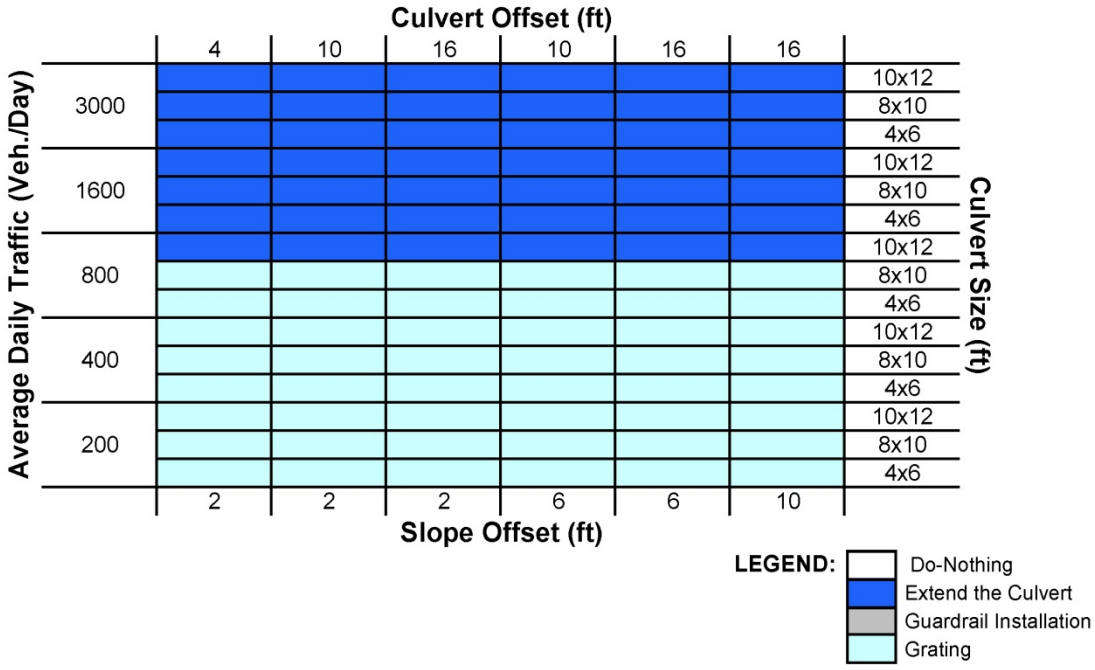

Figure 24. Results from the local road for all other cases

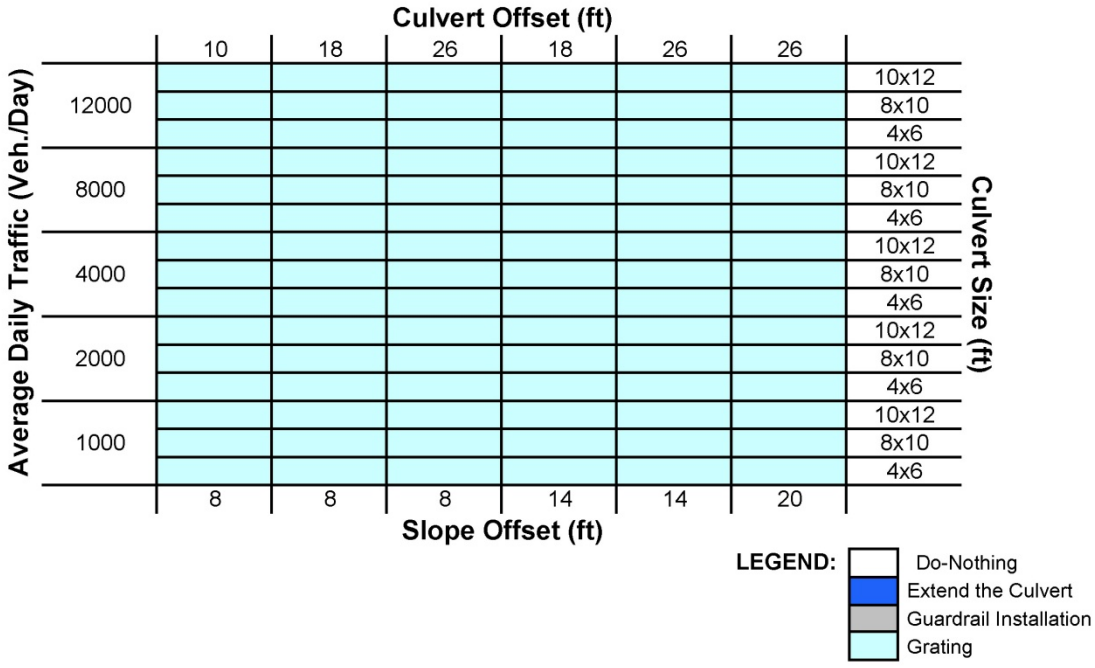

Figure 25. Results from the rural arterial highway with 2 on 1 side slopes

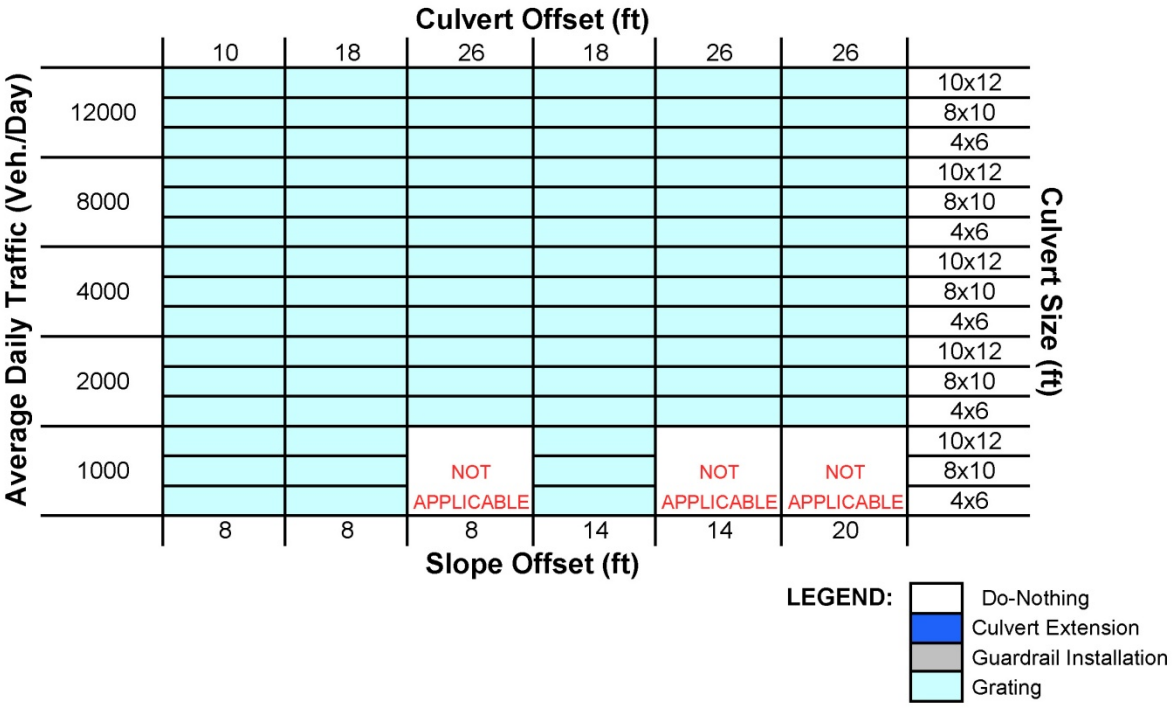

Figure 26. Results from the rural arterial highway with straight segments and 4 on 1 side slopes

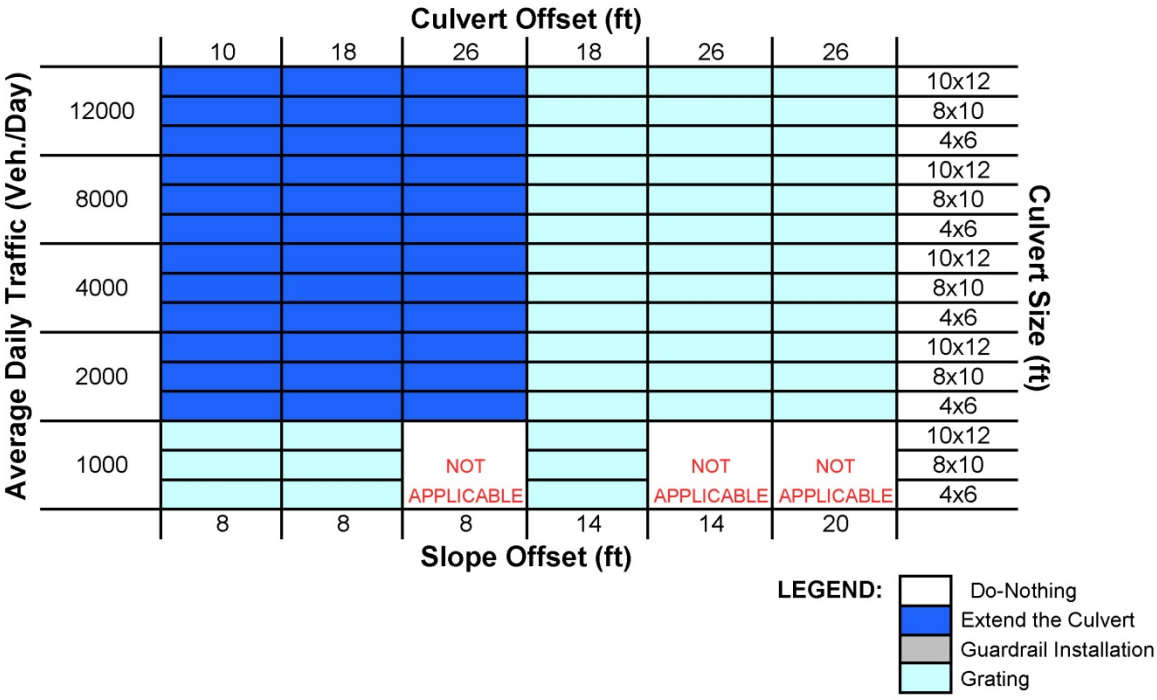

Figure 27. Results from the rural arterial highway with curved segments and 4 on 1 side slopes

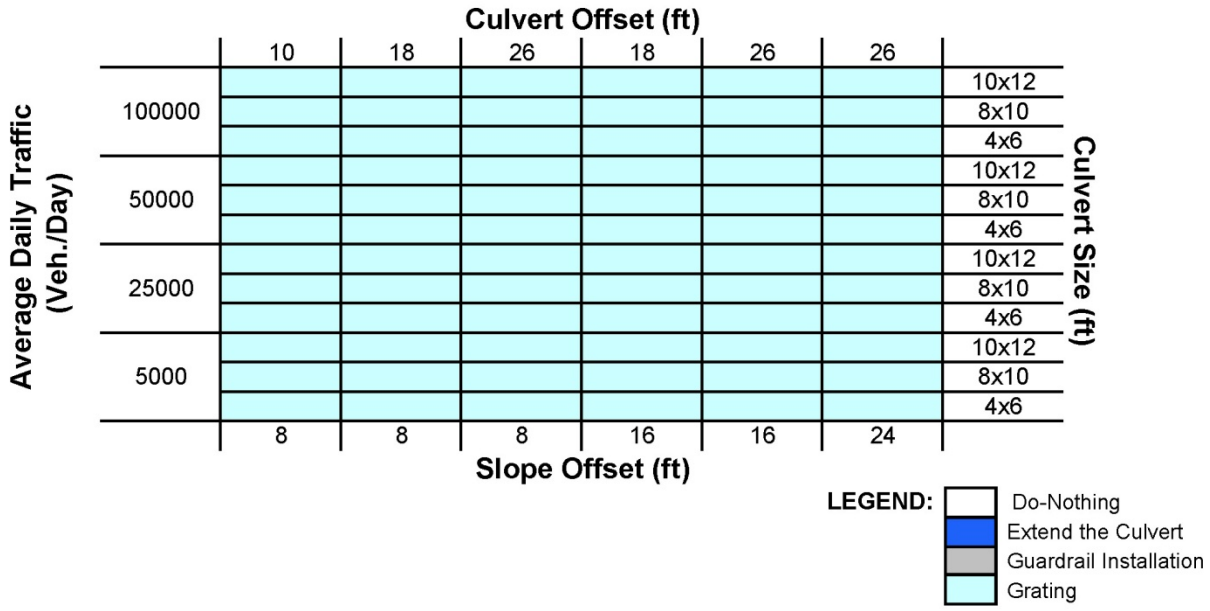

Figure 28. Results from the freeway for any highway scenario

APPENDIX III – LOCAL ROAD ACCIDENT COST COMPILATION

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	**Culvert** Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
1							**4**	5	4668.98	4183.04	4061.31	1769.9
2						2	10	8	4772.56	4251.97	4133.43	1797.76
3							16	11	5501.96	4826.91	4703.38	2031.47
4					2 on 1		10	6	3751.07	3661.16	3326.79	1417.36
5						6	16	9	3819.43	3526.91	3366.33	1413.33
6				4x6		10	16	7	2956.66	2867.41	2658.04	1111.86
7							4	4.5	1184.52	851.6	1236.84	631.5
8						2	10	6	1137.14	925.77	1018.04	637.5
9					4 on 1		16	7.5	1087.05	884.83	1055.77	640.68
10							10	5	930.63	796.78	784.44	503.96
11						6	16	6.5	892.24	715.54	820.42	507.14
12						10	16	5.5	722.05	605.15	623.52	394.65
13							4	9	5137.58	4358.89	4231.39	1803.16
14	200	0	0			2	10	12	6625.35	5903.36	5079.06	2576.78
15							16	15	5895.64	5071.64	4885.38	2038.57
16					2 on 1		10	10	4609.12	4345.22	3872.13	1609.85
17						6	16	13	4655.23	4283.97	3926.31	1615.64
18				8x10		10	16	11	3608.18	3494.59	3086.37	1258.71
19							4	8.5	1765.96	1185.2	4502.38	642.19
20						2	10	10	1616.6	1240.18	1310.21	643.66
21					4 on 1		16	11.5	1476.68	1135.72	1298.13	644.31
22							10	9	1345.16	1089.95	1025.23	510.12
23						6	16	10.5	1225.79	928.24	1029.8	510.77
24						10	16	9.5	882.16	814.02	786.75	398.28
25							4	11	5468.31	5050.69	4744.79	2031.47
26				10x12	2 on 1	2	10	14	5501.87	4087.71	4674.55	2037.79
27							16	17	5781.8	5066.7	4882.53	2133.71

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
28							10	12	4353.75	4326.99	3784.97	1614.48
29					2 on 1	6	16	15	4373.22	4234.79	3776.86	1617.21
30						10	16	13	3403.61	3450.53	2985.31	1260.6
31							4	10.5	1086.29	796.36	1305.66	643.89
32			0	10x12		2	10	12	1016.07	822.28	978.22	644.42
33					4 on 1		16	13.5	952.15	760.9	964.43	644.68
34							10	11	833.76	711.65	773.7	510.88
35						6	16	12.5	778.93	610.41	768.49	511.14
36						10	16	11.5	629.62	539.46	291.88	398.65
37							4	5	12046.98	10433.92	10818.04	4575.83
38						2	10	8	12221.29	10056.67	10875.54	4619.38
39							16	11	14124.67	11394.87	12235.17	5210.32
40					2 on 1		10	6	9481.36	9104.04	8608.96	3589.66
41						6	16	9	9568.44	8579.13	8668.17	3616.73
42	200	0		4x6		10	16	7	2621.78	1749.3	3655.29	1629.44
43							4	4.5	7333.97	6988.19	6737.55	2773.74
44						2	10	6	2386.74	1872.68	2344.44	1637.61
45			5		4 on 1		16	7.5	2212.52	1710.91	2427.18	1643.2
46							10	5	1923.66	1576.08	1783.09	1274.79
47						6	16	6.5	1765.96	1276.69	1774.2	1280.11
48						10	16	5.5	1399.22	1161.28	1342.35	983.76
49							4	9	12881.55	10798.91	10984.6	4627.43
50						2	10	12	6625.35	5903.36	2079.06	2576.78
51							16	15	14633.43	11694.37	12296.57	5221.97
52					1 on 2		10	10	11382.67	10583.02	9774.99	4062.47
53						6	16	13	11373.81	10121.97	9760.13	4072.11
54				8 x 10		10	16	11	8727.92	8260.12	7639.51	3132.57
55							4	8.5	3543.64	2124.22	11232.96	1646.35
56					4 on 1	2	10	10	3115.57	2305.66	2672.47	1648.56
57							16	11.5	2787.14	2110.21	2608.34	1649.9

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
58							10	9	2537.94	1969.37	2080.09	1285.46
59				8x10	4 on 1	6	16	10.5	2245.36	1550.45	2021.32	1286.8
60						10	16	9.5	1628.05	1438.66	1536.1	990.4
61							4	11	14081.54	12519.19	12526.34	5210.32
62						2	10	14	14135.58	9866.64	12162.31	5220.41
63					2 on 1		16	17	14860.05	12284.06	12598.6	5463.93
64							10	12	11009.21	10366.03	9724.38	4069.38
65						6	16	15	11048.36	9998	9629.63	4074.41
66			5	10 x 12		10	16	13	8498.47	8330.64	7576.86	3135.86
67							4	10.5	2382.01	1681.95	3853.27	1649.12
68						2	10	12	2209.24	1816.73	2355.8	1650.07
69					4 on 1		16	13.5	2069.36	1634.29	2323.33	1650.43
70							10	11	1770.74	1506.99	1823.85	1286.97
71						6	16	12.5	1644.59	1251.43	1795.57	1287.3
72	200	0				10	16	11.5	1297.14	1123.96	1368.54	990.89
73							4	5	10360.17	8907.44	10250.55	3906.96
74						2	10	8	10446.01	8517.48	10409.39	3938.86
75							16	11	12027.12	9754.26	11586.04	4434.22
76					2 on 1		10	6	8063.03	7655.73	7911.12	3045.49
77						6	16	9	8122.15	7181.25	7960.51	3061.01
78			10	4x6		10	16	7	6142.4	5806.82	6047.09	2318.13
79							4	4.5	2304.12	145.36	4303.51	1388.99
80						2	10	6	2091.01	1545.39	2648.89	1396.28
81					4 on 1		16	7.5	1883.92	1405.07	2712.46	1399.45
82							10	5	1682.61	1292.55	1988.53	1081.93
83						6	16	6.5	1499.51	1019.59	1933.75	1085.08
84						10	16	5.5	1176.47	937.41	1406.54	822.65
85							4	9	10999.68	9093.24	10441.15	3943.54
86				8x10	2 on 1	2	10	12	6625.35	5903.36	5079.06	2576.78
87							16	15	12458.54	9943.51	11601.14	4442.78

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
88							10	10	9651.28	8753.76	8957.33	3439.48
89					2 on 1	6	16	13	9634.14	8385.16	8948.51	3445.73
90						10	16	11	7292.94	6860.58	6813.85	2614.09
91							4	8.5	2932.89	1618.61	10457.82	1401.09
92				8x10		2	10	10	2564.65	1763.86	2899.18	1402.7
93					4 on 1		16	11.5	2252.62	1629.06	2765.86	1403.54
94							10	9	2081.5	1496.31	2197.9	1088.23
95						6	16	10.5	1357.43	1067.82	1536.75	826.4
96						10	16	9.5	12012.59	10371.36	11655.62	4434.22
97		0	10				4	11	12049.54	8189.57	11511.94	4441.62
98						2	10	14	12659.39	10293.5	11861.78	4647.97
99					2 on 1		16	17	9331.74	8709.83	8895.79	3444.57
100							10	12	9353.63	8317.46	8859.07	3447.5
101						6	16	15	7094.86	6829.92	6822.98	2615.99
102	200			10x12		10	16	13	2002.52	1349.82	4523.59	1402.97
103							4	10.5	1840.27	1458.4	2640.23	1403.68
104						2	10	12	1715.21	1336.91	2584.65	1403.87
105					4 on 1		16	13.5	1468.33	1194.37	2012.66	1089.1
106							10	11	1357.03	993.08	1974.28	1089.28
107						6	16	12.5	1056.4	871.48	1463.14	826.73
108						10	16	11.5	1806.5	1125.4	2114.35	1088.95
109							4	5	7040.76	6307.96	6124.4	2668.99
110						2	10	8	7196.96	6411.92	6233.16	2711
111							16	11	8296.89	7278.92	7092.63	3063.43
112					2 on 1		10	6	5656.57	5520.99	5016.75	2137.37
113		3	0	4x6		6	16	9	5759.66	5318.53	5076.39	2158.42
114						10	16	7	4458.61	4324.02	4008.28	1676.67
115							4	4.5	1786.24	1284.21	1865.14	952.29
116					4 on 1	2	10	6	1714.79	1396.04	1535.2	961.34
117							16	7.5	1639.26	1334.31	1592.09	966.13

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
118							10	5	1403.37	1201.54	1182.92	759.97
119				4x6	4 on 1	6	16	6.5	1345.48	1079.02	1237.18	764.77
120						10	16	5.5	1088.84	912.56	940.26	595.12
121							4	9	7747.4	6844.58	6830.88	2719.15
122						2	10	12	6625.35	5903.36	5079.06	2576.78
123							16	15	8890.54	7647.96	7367.09	3074.14
124					2 on 1		10	10	6950.49	6552.54	5839.13	2427.63
125						6	16	13	7020.02	6460.17	5920.83	2436.36
126				8x10		10	16	11	5441.09	5269.79	4654.21	1898.12
127							4	8.5	2663.04	1787.27	6789.52	968.42
128						2	10	10	2437.81	1870.18	1975.78	970.63
129					4 on 1		16	11.5	2226.82	1712.65	1957.57	971.6
130							10	9	2028.48	1643.63	1546.03	769.26
131						6	16	10.5	1330.29	1227.54	1186.4	600.59
132	200	3	0			10	16	9.5	8246.14	7616.38	7155.09	3063.43
133							4	11	8296.75	6164.21	7049.15	3072.96
134						2	10	14	8718.87	7640.51	7362.8	3217.6
135					2 on 1		16	17	6565.39	6525.04	5707.69	2434.62
136							10	12	6594.76	6386.01	5695.46	2438.73
137						6	16	15	5132.6	5203.35	4501.81	1900.97
138				10x12		10	16	13	1638.11	1200.91	1968.92	970.98
139							4	10.5	1532.22	1239.99	1475.15	971.77
140						2	10	12	1435.83	1147.42	1454.34	972.16
141					4 on 1		16	13.5	1257.3	1073.16	1166.72	770.4
142							10	11	1174.61	920.49	1158.88	770.79
143						6	16	12.5	949.45	813.45	892.55	601.15
144						10	16	11.5	1848.48	1399.78	1552.93	770.23
145							4	5	18166.69	15734.21	16313.47	6900.3
146			5	4x6	2 on 1	2	10	8	18429.54	15162.32	16400.16	6965.97
147							16	11	21299.81	17183.31	18450.48	7857.09

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
148							10	6	14297.77	13728.77	12982.2	5413.15
149					2 on 1	6	16	9	14429.07	12937.21	13071.49	5449.46
150						10	16	7	11059.52	10538.09	10160.14	4182.76
151							4	4.5	3953.61	2637.92	5512.13	2457.18
152				4x6		2	10	6	3599.17	2823.98	3535.39	2469.49
153					4 on 1		16	7.5	3336.45	2580.04	3660.15	2477.92
154							10	5	2900.85	2376.71	2688.87	1922.37
155						6	16	6.5	2663.04	1925.23	2675.47	1930.39
156						10	16	5.5	2110.01	1751.19	2024.25	1483.5
157							4	9	19425.21	16284.61	16564.63	6978.1
158						2	10	12	6625.35	5903.36	5079.06	2576.78
159							16	15	22067.01	17634.96	18543.06	7874.67
160					2 on 1		10	10	17164.91	15959.05	14740.56	6126.16
161						6	16	13	17151.55	15263.79	14718.14	6140.69
162	200	3	5	8 x 10		10	16	11	13161.59	12456.14	11520.29	4723.87
163							4	8.5	5343.76	3203.3	16939.16	2482.68
164						2	10	10	4698.25	3476.91	4030.04	2486
165					4 on 1		16	11.5	4202.97	3182.17	3933.35	2488.03
166							10	9	3827.18	2969.78	3136.74	1938.46
167						6	16	10.5	2455.07	2169.47	2316.43	1493.5
168						10	16	9.5	21263.78	18878.77	18889.55	7857.09
169							4	11	21316.26	14878.76	18340.6	7872.32
170						2	10	14	22408.76	18524.2	18998.52	8239.53
171					2 on 1		16	17	16601.74	15631.84	14664.24	6136.57
172				10 x 12			10	12	16660.78	15076.85	14521.36	6144.15
173						6	16	15	12815.59	12562.49	11425.8	4728.84
174						10	16	13	3592.03	2536.35	5810.68	2486.85
175							4	10.5	3331.5	2739.6	3552.51	2488.28
176					4 on 1	2	10	12	3120.57	2464.49	3503.56	2488.83
177							16	13.5	2670.26	2272.53	2750.35	1940.73

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
178							10	11	2480.01	1887.14	2707.7	1941.23
179			5	10x12	4 on 1	6	16	12.5	1956.07	1694.92	2063.74	1494.25
180						10	16	11.5	3385.98	2338.06	3048.13	1940.48
181							4	5	15623.01	13432.3	15457.7	5891.65
182						2	10	8	15752.45	12844.25	15697.23	5939.75
183							16	11	18136.74	14709.3	17471.6	6686.75
184					2 on 1		10	6	12158.95	11544.74	11929.86	4592.56
185						6	16	9	12248.1	10829.24	12004.35	4615.96
186				4x6		10	16	7	9262.67	8756.61	9118.93	3495.71
187							4	4.5	3474.58	2190.14	6489.63	2094.58
188						2	10	6	3153.21	2330.43	3994.49	2105.57
189					4 on 1		16	7.5	2840.92	2118.82	4090.35	2110.35
190							10	5	2537.36	1949.15	2998.68	1631.54
191						6	16	6.5	2261.24	1537.53	2916.07	1636.29
192						10	16	5.5	1774.11	1413.61	2121.04	1240.54
193							4	9	16587.37	13712.48	15743.61	5946.8
194	200	3	10			2	10	12	6625.35	5903.36	5079.06	2576.78
195							16	15	18787.31	14994.68	17494.36	6699.66
196					2 on 1		10	10	14554	13200.55	13507.54	5186.69
197						6	16	13	14528.16	12644.7	13494.24	5196.12
198				8x10		10	16	11	10997.66	10345.66	10275.2	3942.01
199							4	8.5	4422.75	2440.84	15770.25	2112.82
200						2	10	10	3867.46	2659.88	4371.92	2115.25
201					4 on 1		16	11.5	3396.92	2456.6	4170.89	2116.52
202							10	9	3138.87	2256.41	3314.4	1641.01
203						6	16	10.5	2046.98	1610.26	2317.39	1246.21
204						10	16	9.5	18114.83	15639.88	17576.53	6686.75
205							4	11	18170.55	12349.77	17359385	6697.9
206				10x12	2 on 1	2	10	14	19090.2	15522.47	17887.41	7009.08
207							16	17	14072.13	13134.31	13414.74	5194.37

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
208							10	12	14105.16	12542.62	13359.36	5198.78
209					2 on 1	6	16	15	10698.96	10299.43	10288.97	3944.88
210						10	16	13	3019.77	2035.51	6821.51	2115.66
211							4	10.5	2775.1	2199.24	3981.44	2116.73
212	200	3	10	10x12		2	10	12	2586.52	2016.04	3897.61	2117.01
213					4 on 1		16	13.5	2214.23	1801.09	3035.07	1642.34
214							10	11	2046.39	1497.56	2977.19	1642.62
215						6	16	12.5	1593.03	1314.18	2206.4	1246.7
216						10	16	11.5	2724.18	1697.08	3188.41	1642.13
217							4	5	9337.95	8366.07	8122.62	3539.8
218						2	10	8	9545.13	8503.95	8266.87	3595.52
219							16	11	11003.93	9653.82	9406.765	4062.94
220					2 on 1		10	6	7502.15	7322.33	6653.57	2834.73
221						6	16	9	7638.87	7053.82	6732.67	2862.66
222				4x6		10	16	7	5913.32	5734.83	5316.07	2223.72
223							4	4.5	2369.04	1703.21	2473.68	1263
224						2	10	6	2274.28	1851.53	2415.18	1275
225					4 on 1		16	7.5	2174.1	1769.66	2475.58	1281.36
226	400	0	0				10	5	1861.25	1593.57	1830.64	1007.92
227						6	16	6.5	1784.48	1431.07	1900.01	1014.29
228						10	16	5.5	1444.09	1210.3	1433.06	789.3
229							4	9	10275.16	9077.77	8462.78	3606.33
230						2	10	12	6625.35	5903.36	5079.06	2576.78
231							16	15	11791.28	10143.28	9770.76	4077.14
232					2 on 1		10	10	9218.23	8690.44	7744.27	3219.7
233				8x10		6	16	13	9310.46	8567.94	7852.63	3231.28
234						10	16	11	7216.36	6989.18	6172.74	2517.42
235							4	8.5	3531.91	2370.4	9004.75	1284.39
236					4 on 1	2	10	10	3233.2	2480.36	3010.49	1287.32
237							16	11.5	2953.36	2271.44	2990.41	1288.61

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
238							10	9	2690.32	2179.9	2325.9	1020.25
239				8x10	4 on 1	6	16	10.5	2451.58	1856.48	2342.06	1021.54
240						10	16	9.5	1764.32	1628.05	1773.53	796.55
241							4	11	10936.62	10101.39	9489.59	4062.94
242						2	10	14	11003.74	8175.41	9349.09	4075.58
243					2 on 1		16	17	11563.59	10133.39	9765.07	4267.42
244							10	12	8707.49	8653.98	7569.95	3228.97
245						6	16	15	8746.44	8469.58	7553.73	3234.42
246			0	10x12		10	16	13	6807.22	3901.05	5970.62	2521.2
247							4	10.5	2172.58	1592.73	2611.32	1287.78
248						2	10	12	2032.15	1644.56	2250.65	1288.83
249					4 on 1		16	13.5	1904.3	1521.79	2326.08	1289.35
250							10	11	1667.52	1423.3	1828.67	1021.76
251						6	16	12.5	1557.86	1220.82	1823.5	1022.28
252	400	0				10	16	11.5	1259.23	1078.86	1393.09	797.29
253							4	5	24093.96	20867.83	21636.09	9151.67
254						2	10	8	24442.57	20109.35	21751.07	9238.77
255							16	11	28249.33	22789.74	24470.35	10420.64
256					2 on 1		10	6	18962.72	18208.07	17217.93	7179.31
257						6	16	9	19136.87	17158.26	17336.35	7227.46
258				4x6		10	16	7	14667.93	13976.37	13475.1	5547.47
259							4	4.5	5243.56	3498.6	7310.58	3258.88
260			5			2	10	6	4773.48	3745.36	6201.51	3275.22
261					4 on 1		16	7.5	4425.03	3421.83	6226.75	3286.39
262							10	5	347.32	3152.16	4579.34	2549.58
263						6	16	6.5	3531.92	2553.37	4604.19	2560.22
264						10	16	5.5	2798.45	3233.56	3407.51	1967.52
265							4	9	25763.1	21597.81	21969.2	9254.85
266				8x10	2 on 1	2	10	12	6625.35	5903.36	5079.06	2576.78
267							16	15	29266.85	13388.74	14593.13	10443.95

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
268							10	10	22765.33	51166.04	19549.98	8124.95
269					2 on 1	6	16	13	22747.62	20243.93	19520.25	8144.23
270						10	16	11	17455.85	16520.23	15279.03	6265.13
271							4	8.5	7087.27	4248.44	22465.93	3292.71
272				8x10		2	10	10	6231.15	4611.33	6865.51	3297.11
273					4 on 1		16	11.5	5574.28	4220.42	6772.26	3299.8
274							10	9	5075.88	3938.73	5258.44	2570.92
275						6	16	10.5	4490.73	3100.9	5175.78	2573.61
276						10	16	9.5	3256.1	2877.31	3872.88	1980.79
277							4	11	28163.09	25038.38	25052.68	10420.64
278						2	10	14	28271.15	19733.27	24324.61	10440.83
279			5		2 on 1		16	17	29720.1	24568.11	25197.2	10927.86
280							10	12	22018.42	20732.06	19448.77	8138.76
281						6	16	15	22096.72	19995.99	19259.27	8148.81
282	400	0		10x12		10	16	13	16996.95	16661.28	15153.71	6271.72
283							4	10.5	4764.01	3363.89	7706.54	3298.24
284						2	10	12	4418.47	3633.45	6248.34	3300.14
285					4 on 1		16	13.5	4138.73	3268.59	6197.76	3300.86
286							10	11	3541.49	3013.99	4783.74	2573.94
287						6	16	12.5	3289.17	2502.86	4733.76	2574.6
288						10	16	11.5	2594.28	2247.93	3571.75	1981.78
289							4	5	20720.35	17814.87	20501.1	7813.93
290						2	10	8	20892.02	17034.97	20818.78	7877.73
291							16	11	24054.25	19508.52	23172.08	8868.44
292					2 on 1		10	6	16126.06	15311.46	15822.24	6090.99
293						6	16	9	16244.31	1432.51	15921.02	6122.02
294			10	4x6		10	16	7	12284.81	11613.65	12094.18	4636.26
295							4	4.5	4608.23	2904.71	8607.02	2777.98
296					4 on 1	2	10	6	4182.02	3090.79	6828.71	2792.56
297							16	7.5	3767.84	2810.14	6798.77	2798.9

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
298							10	5	3365.23	2585.1	5010.46	2163.87
299				4x6	4 on 1	6	16	6.5	2999.01	2039.18	4956.5	2170.17
300						10	16	5.5	2352.95	1874.83	3540.31	1645.3
301							4	9	21999.36	18186.47	20880.3	7887.07
302						2	10	12	6625.35	5903.36	5079.06	2576.78
303							16	15	24917.07	19887.01	23202.27	8885.57
304					2 on 1		10	10	19302.56	17507.51	17914.66	6878.96
305						6	16	13	19268.29	16770.31	17897.02	6891.46
306				8x10		10	16	11	14585.88	13721.15	13627.71	5228.18
307							4	8.5	5865.77	3237.22	20915.63	2808.18
308						2	10	10	5129.3	3527.73	7331.6	2805.4
309					4 on 1		16	11.5	4505.24	3258.12	7057.64	2807.07
310							10	9	4163	2992.61	5522.99	2176.46
311						6	16	10.5	3613.01	2250.79	5379.28	2177.91
312	400	0	10			10	16	9.5	274.85	2135.64	3888.87	1652.81
313							4	11	24025.18	20742.73	23311.24	8868.44
314						2	10	14	24099.09	16379.15	23023.88	8883.24
315					2 on 1		16	17	25378.78	20587	23723.56	9295.95
316							10	12	18663.47	17419.66	17791.59	6889.15
317						6	16	15	18707.27	16634.92	17718.14	6894.99
318				10x12		10	16	13	14189.73	13659.84	13645.97	5231.98
319							4	10.5	4005.03	2699.63	9047.18	2805.94
320						2	10	12	3680.54	2916.79	6837.16	2807.36
321					4 on 1		16	13.5	3430.43	2673.82	6738.73	2807.73
322							10	11	2936.66	2388.74	5183.62	2178.19
323						6	16	12.5	2714.07	1986.18	5125.33	2178.56
324						10	16	11.5	2112.79	1742.95	3778.08	1653.46
325							4	5	13813	12375.37	12025.24	5236.19
326		3	0	4x6	2 on 1	2	10	8	14119.46	12579.31	12228.61	531861
327							16	11	16288.36	14280.25	13914.78	6010.03

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
328							10	6	11097.42	10831.42	9842.18	4193.22
329					2 on 1	6	16	9	11299.66	10434.23	9959.18	4234.53
330				4x6		10	16	7	8747.18	8483.14	7863.7	3289.4
331							4	4.5	3504.36	2519.44	3659.15	1868.26
332						2	10	6	3364.18	2738.85	3572.6	1886.02
333					4 on 1		16	7.5	3216	2617.73	3661.95	1895.42
334							10	5	2753.22	2357.26	2707.94	1490.95
335						6	16	6.5	2639.66	2116.89	2810.56	1500.36
336						10	16	5.5	2136.15	1790.31	2119.83	167.55
337							4	9	15199.34	13428.13	12518.41	5334.6
338						2	10	12	6625.35	5903.36	5079.06	2576.78
339							16	15	17442.04	15004.26	14453.22	6031.03
340					2 on 1		10	10	13635.91	12855.18	11455.57	4762.68
341						6	16	13	13772.32	12673.97	11615.86	4779.81
342	400	3	0	8x10		10	16	11	10674.68	10338.61	9130.92	3723.84
343							4	8.5	5224.52	3506.38	13320.12	1899.91
344						2	10	10	4782.66	3669.03	4453.21	1904.24
345					4 on 1		16	11.5	4368.71	3359.99	4423.51	1906.15
346							10	9	3979.61	3224.58	3440.54	1509.18
347						6	16	10.5	3626.46	2746.17	3464.45	1511.09
348						10	16	9.5	2609.84	2408.26	2623.46	1178.29
349							4	11	16177.79	14942.3	14037.3	6010.03
350						2	10	14	16277.09	12093.33	13829.48	6028.72
351							16	17	17105.24	14989.64	14444.8	6312.5
352					2 on 1		10	12	12880.41	12801.25	11197.71	4776.39
353						6	16	15	12938.02	12528.48	11173.72	4784.46
354				10x12		10	16	13	10069.45	10208.26	8831.93	3729.44
355							4	10.5	3213.75	2356.02	3862.75	1904.93
356					4 on 1	2	10	12	3006.02	2432.68	3477.15	1906.48
357							16	13.5	2816.91	2251.08	3440.81	1907.25

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
358							10	11	2466.65	2105.39	2705.03	1511.42
359			0	10x12	4 on 1	6	16	12.5	2304.43	1805.87	2697.38	1512.19
360						10	16	11.5	1862.7	1595.88	2060.7	1179.38
361							4	5	35640.56	30868.36	32004.79	13537.45
362						2	10	8	36156.23	29746.4	32174.88	13666.28
363							16	11	41787.32	33711.32	36197.32	15414.54
364					2 on 1		10	6	28050.27	26933.97	25469.31	10619.87
365						6	16	9	28307.87	25381.04	25644.49	10691.1
366				4x6		10	16	7	21697.28	20674.29	19932.8	8206
367							4	4.5	7756.44	5175.25	10814.05	4820.65
368						2	10	6	7061.08	5540.26	9173.47	4844.81
369					4 on 1		16	7.5	6545.65	5061.68	9210.81	4861.34
370							10	5	5691.08	4662.77	6773.91	3771.42
371						6	16	6.5	5224.52	3777.03	6810.66	3787.16
372	400	3				10	16	5.5	4139.55	3435.6	5040.49	2910.42
373							4	9	38109.61	31948.18	32497.54	13690.07
374						2	10	12	6625.35	5903.36	5079.06	2576.78
375							16	15	43292.47	34597.38	36378.95	15449.03
376					2 on 1		10	10	33675.21	31309.48	28918.96	12018.69
377						6	16	13	33649	29945.48	28874.98	12047.2
378			5	8x10		10	16	11	25821.25	24437.26	22601.23	9267.58
379							4	8.5	10483.72	6284.44	33232.32	4870.68
380						2	10	10	9217.32	6821.22	10155.69	4877.19
381					4 on 1		16	11.5	8245.65	6242.99	10017.75	4881.17
382							10	9	7508.4	5826.3	778.45	3802.99
383						6	16	10.5	6642.83	4586.95	7656.18	3806.96
384						10	16	9.5	4816.52	4256.21	5728.88	2930.05
385							4	11	41659.74	37037.57	67058.73	15414.54
386				10x12	2 on 1	2	10	14	41819.6	29190.09	35981.75	15444.41
387							16	17	43962.93	36341.94	37272.51	1614.84

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
388							10	12	32570.36	30667.53	28769.24	12039.12
389					2 on 1	6	16	15	32686.18	29578.71	28488.93	12053.99
390						10	16	13	25142.43	24645.9	22415.86	9277.33
391							4	10.5	7047.08	4975.98	11399.77	4878.87
392			5	10x12		2	10	12	6535.94	5374.72	9242.74	4881.67
393					4 on 1		16	13.5	6122.14	4835	9167.93	4882.74
394							10	11	5238.68	4458.39	7076.26	3807.45
395						6	16	12.5	4865.45	3702.31	7002.33	3808.43
396						10	16	11.5	3837.54	3325.2	5283.45	2931.51
397							4	5	30650.2	26352.33	30325.89	11558.62
398						2	10	8	30904.15	25198.67	30795.81	11652.99
399							16	11	35581.81	28857.63	34276.88	13118.48
400					2 on 1		10	6	23854.19	22649.2	23404.76	9009.98
401						6	16	9	24029.1	21245.48	23550.89	9055.89
402				4x6		10	16	7	18172.08	17179.28	17890.1	6858.11
403							4	4.5	6816.64	4296.75	12731.77	4109.28
404						2	10	6	6186.17	4571.99	10101.24	4130.84
405	400	3	10		4 on 1		16	7.5	5573.51	4156.84	10056.96	4140.23
406							10	5	4977.95	3823.96	7411.63	3200.86
407						6	16	6.5	4436.24	3016.42	7331.82	3210.18
408						10	16	5.5	3480.55	2773.3	5236.94	2433.77
409							4	9	32542.16	26902.01	30886.82	11666.81
410						2	10	12	6625.35	5903.36	5079.06	2576.78
411							16	15	36858.14	29417.51	34321.55	13143.82
412					2 on 1		10	10	28552.96	25897.68	26499.95	10175.57
413						6	16	13	28502.27	24807.18	26473.85	10194.07
414				8x10		10	16	11	21575.9	20296.77	2058.54	7733.69
415							4	8.5	8676.84	4788.6	30939.07	4145.07
416					4 on 1	2	10	10	7587.42	5218.33	10845.13	4149.84
417							16	11.5	6664.29	4219.51	10439.88	4152.32

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
418							10	9	6158.04	4426.77	8169.79	3219.49
419				8x10	4 on 1	6	16	10.5	2724.18	1697.08	4055.94	1642.13
420						10	16	9.5	4015.9	3159.1	5752.54	2444.89
421							4	11	35538.82	30683.31	34482.74	13118.48
422						2	10	14	35648.14	24228.56	34059.66	13140.37
423					2 on 1		16	17	37452.36	30452.96	35092.66	13750.86
424							10	12	27607.6	25767.72	26317.89	10190.65
425						6	16	15	27672.39	24606.9	26209.24	10199.29
426	400	3	10	10x12		10	16	13	20989.9	20206.08	50785.55	7739.31
427							4	10.5	5924.38	3993.38	13382.88	4150.64
428						2	10	12	5444.37	4314.61	10113.74	4152.74
429					4 on 1		16	13.5	5074.4	3955.19	9968.14	4153.29
430							10	11	4344.01	3533.5	7667.78	3222.05
431						6	16	12.5	4014.73	2938	7581.56	3222.6
432						10	16	11.5	2112.79	1742.95	3775.08	1653.46
433							4	5	17975.56	14890.83	16134.57	6814.13
434						2	10	8	18374.38	15658.25	15913.72	6921.37
435							16	11	21182.57	18583.62	18108.01	7821.15
436					2 on 1		10	6	14441.64	13158.94	12808.13	5456.85
437						6	16	9	14707.82	13578.6	12960.39	5510.61
438	800	0	0	4x6		10	16	7	11383.15	10231.24	10233.41	4280.67
439							4	4.5	4560.4	2865.39	4761.84	2431.27
440						2	10	6	4377.98	3190.61	5042.08	2454.37
441					4 on 1		16	7.5	4185.14	3406.59	4765.48	2466.61
442							10	5	3582.91	2543.97	3759.04	1940.26
443						6	16	6.5	3435.12	2754.81	3657.52	1952.5
444						10	16	5.5	2779.88	2329.82	2758.64	1519.39
445							4	9	19779.69	16071.27	16290.85	6942.19
446				8x10	2 on 1	2	10	12	22535.65	18985.98	16566.8	18414.16
447							16	15	22692.21	19525.81	18808.72	7848.49

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
448							10	10	17745.11	15736.03	14907.72	6197.92
449					2 on 1	6	16	13	17922.63	16493.28	15116.32	6220.22
450						10	16	11	13891.5	12316.74	11882.53	4846.03
451							4	8.5	6798.94	3744.9	17105.7	2472.45
452						2	10	10	6223.92	4123.77	6067.1	2478.09
453				8x10	4 on 1		16	11.5	5685.22	4372.52	5756354	2480.58
454							10	9	5178.86	3384.45	4600.45	1963.97
455						6	16	10.5	4719.3	3650.09	4507.34	1966.47
456			0			10	16	9.5	3396.32	3133.99	3414.04	1533.36
457							4	11	21052.99	18174.54	18049.81	7821.15
458						2	10	14	21182.21	18719.92	18228.1	21329.88
459					2 on 1		16	17	22259.92	19506.79	18797.76	8214.78
460							10	12	16761.93	15853.22	21296.93	6215.76
461						6	16	15	16836.91	16303.95	14540.93	6226.27
462	800	0		10x12		10	16	13	13103.89	12239.87	11493.45	4853.31
463							4	10.5	4182.21	2653.19	5592.08	2478.98
464						2	10	12	3911.88	2841.35	5078.91	2481
465					4 on 1		16	13.5	3665.79	2929.45	4477.71	2482
466							10	11	3209.98	2307.48	3949.39	1966.89
467						6	16	12.5	2998.88	2347.39	3510.24	1967.89
468						10	16	11.5	242.02	2076.8	2681.7	1534.79
469							4	5	46380.88	36365.65	42609.46	17616.97
470						2	10	8	47051.95	37713.44	41870.82	17784.62
471							16	11	54379.96	43870.25	47105.43	20059.73
472					2 on 1		10	6	36503.25	32085.84	33144.62	13820.17
473						6	16	9	36838.48	33029.65	33372.48	13912.87
474			5	4x6		10	16	7	28235.77	24364.13	25938.79	10678.89
475							4	4.5	10093.86	5766.11	14072.88	6273.35
476					4 on 1	2	10	6	9188.95	6316.29	14162.3	6304.79
477							16	7.5	8518.19	6587.02	11986.5	6326.31

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
478							10	5	7406.09	4953.34	10193.21	4907.95
479				4x6	4 on 1	6	16	6.5	6798.94	4915.25	8863.06	4928.43
480						10	16	5.5	5387.01	4470.92	6559.45	3787.48
481							4	9	49593.98	37602.34	42290.71	17815.59
482						2	10	12	22535.65	18985.98	16566.8	18414.16
483							16	15	56338.7	45023.34	47341.79	20104.61
484					2 on 1		10	10	43823.27	37537.19	37633.72	15640.53
485						6	16	13	43789.16	38969.57	37576.49	15677.64
486				8x10		10	16	11	33602.51	28629.28	29412.13	12060.38
487							4	8.5	13643	6806.77	42998.38	6338.46
488						2	10	10	11994.96	7642.61	15145.83	6346.94
489					4 on 1		16	11.5	10730.48	8124.32	13036.61	6352.12
490							10	9	9771.07	5941.34	11482.63	4949.03
491						6	16	10.5	8644.65	6099.97	9933.43	4954.2
492	800	0	5			10	16	9.5	6267.98	5538.83	7455.29	3813.03
493							4	11	54213.95	43688.47	47012.59	20059.73
494						2	10	14	54421.98	44761.75	47987.48	54740.93
495					2 on 1		16	17	57211.2	47293.62	48505.62	21036.13
496							10	12	42385.47	38538.2	53864.71	15667.12
497						6	16	15	42536.19	38492.29	37074.1	15686.47
498				10x12		10	16	13	32719.13	29327.88	29170.9	12073.06
499							4	10.5	9170.72	5700.99	16454.47	6349.12
500						2	10	12	8505.56	6145.64	14796.85	6352.77
501							16	13.5	7967.06	6292.03	11930.69	6354.16
502							10	11	6817.37	4890.75	11252.17	4954.83
503					4 on 1	6	16	12.5	6331.65	4816.79	9112.49	4956.11
504						10	16	11.5	4993.98	4327.26	6875.62	3814.92
505							4	5	39886.68	30866.83	40219.34	15041.82
506						2	10	8	40217.15	31833.4	40076.17	15164.63
507							16	11	46304.43	37553.91	44606.26	17071.75

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
508							10	6	31042.68	27005.88	30457.83	11725.15
509					2 on 1	6	16	9	31270.3	27647.83	30647.97	11784.89
510				4x6		10	16	7	23648.26	20207.24	23281.09	8924.81
511							4	4.5	8870.85	4744.68	16568.51	5347.62
512						2	10	6	8050.38	5208.46	16589.46	5375.67
513					4 on 1		16	7.5	7253.09	5409.51	13087.63	5387.89
514							10	5	647.06	4035.3	11851.63	4165.45
515						6	16	6.5	5773.1	3952.42	9541.27	4177.57
516						10	16	5.5	4529.42	3609.04	6815.1	3167.19
517							4	9	42348.78	31656.97	40194.59	15182.62
518						2	10	12	22535.65	18985.98	16566.8	18414.16
519							16	15	47965.38	38282.51	44664.38	17104.72
520					2 on 1		10	10	37157.43	31167.21	34485.74	13242
521						6	16	13	37091.46	32282.85	34451.77	13266.07
522	800	0	10	8x10		10	16	11	28077.82	23519.08	26233.34	10064.24
523							4	8.5	11291.61	5132.84	40485.13	5394.19
524						2	10	10	9873.9	5780.56	17365.5	5400.4
525					4 on 1		16	11.5	8672.58	6271.88	13585.95	5403.63
526							10	9	8013.77	4368.34	13261.17	4189.69
527						6	16	10.5	6955.04	4464.98	10282.13	4192.47
528						10	16	9.5	5226.09	4111.1	7486.08	3181.66
529							4	11	46248.49	36362.8	44383.82	17071.75
530						2	10	14	46390.75	36650.1	44760.74	46608.89
531					2 on 1		16	17	48738.66	39629.99	45667.87	17894.7
532							10	12	35927.19	31726.4	47582.44	13261.61
533						6	16	15	36011.5	32022.22	34107.42	13272.86
534				10x12		10	16	13	27315.23	23699.54	26268.49	10071.57
535							4	10.5	7709.69	4537.8	18148.54	5401.44
536					4 on 1	2	10	12	7085.03	4910.28	17312.34	5404.17
537							16	13.5	6603.58	5147.1	12972.05	5404.89

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
538							10	11	5653.08	3824.82	12976.07	4193.02
539		0	10	10x12	4 on 1	6	16	12.5	5224.58	3725.76	9866.27	4193.74
540						10	16	11.5	4067.12	3355.19	7272.8	3182.92
541							4	5	26134.7	21649.8	23458.08	9907.07
542						2	10	8	26714.53	22765.55	23136.98	10062.99
543							16	11	30797.36	27018.74	26327.26	11371.19
544					2 on 1		10	6	20996.72	19131.79	18621.76	7933.72
545						6	16	9	21379.36	19741.95	18843.12	8011.89
546				4x6		10	16	7	16549.98	14875.21	14878.37	6223.67
547							4	4.5	6630.38	4166	6923.25	3534.82
548						2	10	6	3635.15	4638.83	7330.69	3568.42
549					4 on 1		16	7.5	6084.79	4952.85	6928.54	3586.21
550							10	5	5209.2	3698.68	5465.28	2820.94
551						6	16	6.5	4994.32	4005.23	5317.68	2838.74
552	800	3	0			10	16	5.5	4041.67	3387.33	4010.79	2209.05
553							4	9	28757.71	23366.04	23685.29	10093.25
554						2	10	12	32764.62	27603.75	24086.5	26772.37
555							16	15	33000.93	28388.6	27346.02	11410.93
556					2 on 1		10	10	25799.63	23024.02	21674.35	9011.16
557						6	16	13	26057.73	23979.61	21977.63	9043.58
558				8x10		10	16	11	20196.88	17907.33	17276.03	7045.65
559							4	8.5	9884.98	5444.71	24870	3594.69
560						2	10	10	9048.96	5995.56	8820.96	3602.89
561					4 on 1		16	11.5	8265.75	6357.21	8369.44	3606.51
562							10	9	7529.56	4920.65	6688.6	2855.43
563						6	16	10.5	6861.39	5306.87	6553.23	2859.05
564						10	16	9.5	4937.92	4556.52	4963.68	2229.36
565							4	11	30608.97	26423.98	26242.64	11371.19
566				10x12	2 on 1	2	10	14	30796.85	27216.91	26501.86	31011.54
567							16	17	32363.73	28360.94	27330.09	11943.47

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
568							10	12	24370.19	23049.01	30963.63	9037.11
569					2 on 1	6	16	15	24479.2	23704.33	21141.07	9052.38
570						10	16	13	19051.77	17795.56	16710.34	7056.23
571			0	10x12			4	10.5	6080.53	3857.48	8130.33	3604.2
572						2	10	12	5687.49	4131.04	7384.24	3607.13
573					4 on 1		16	13.5	5329.69	4259.13	6510.14	3608.59
574							10	11	4667	3354.85	5742.02	2859.66
575						6	16	12.5	4360.07	3412.88	5103.54	2861.12
576						10	16	11.5	3524.29	3019.47	3898.93	2231.43
577							4	5	67433.22	52872.07	61949.95	25613.33
578						2	10	8	68408.9	54831.62	60876.04	25857.09
579							16	11	79163.1	63783.02	68486.64	29164.86
580					2 on 1		10	6	53072.12	46649.64	18189.01	20093.17
581						6	16	9	53559.52	18021.85	48520.29	20227.94
582	800	3		4x6		10	16	7	41052.02	35423.04	37712.43	15526.05
583							4	4.5	14675.47	8383.35	20460.57	9120.84
584						2	10	6	13359.82	9183.26	20590.59	9166.55
585			5		4 on 1		16	7.5	12384.61	9576.88	17427.18	9197.82
586							10	5	10767.72	7201.67	14819.93	7135.67
587						6	16	6.5	9884.98	7146.28	12886.02	1765.45
588						10	16	5.5	7832.18	6500.28	7513.85	5506.62
589							4	9	72104.75	54670.1	61486.52	25902.11
590						2	10	12	22535.65	18985.98	16566.8	18414.16
591							16	15	81910.91	65459.49	68830.29	29230.11
592					2 on 1		10	10	63714.71	54575.37	54715.71	22739.79
593						6	16	13	63665.12	56657.92	54632.5	22793.74
594				8x10		10	16	11	48854.74	41624.14	42762.34	17534.6
595							4	8.5	19835.58	9896.37	62515.39	9215.49
596					4 on 1	2	10	10	17439.49	11111.6	22020.54	9227.82
597							16	11.5	15601.06	11811.96	18953.94	9235.36

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
598							10	9	14206.17	8638.12	16694.62	7195.4
599				8x10	4 on 1	6	16	10.5	12568.46	8868.75	14442.22	7202.91
600						10	16	9.5	9113.03	8052.91	10839.25	5543.76
601							4	11	78821.73	63518.72	68351.66	29164.86
602						2	10	14	79124.18	65079.16	69769.05	79587.91
603			5		2 on 1		16	17	83179.44	68760.26	70520.93	30584.46
604							10	12	61624.29	56030.73	78313.98	22778.45
605						6	16	15	61843.42	55963.99	53902.08	22806.57
606				10x12		10	16	13	47570.39	42639.84	42411.61	17553.04
607							4	10.5	13333.33	8288.68	23923.18	9231
608						2	10	12	12366.24	8935.16	21513.16	9236.3
609					4 on 1		16	13.5	11583.31	9148	17346.05	9238.32
610							10	11	9911.78	7110.67	16358.09	7203.84
611						6	16	12.5	9205.6	7003.14	13248.65	7205.69
612	800	3				10	16	11.5	7260.76	6291.41	996.48	5546.52
613							4	5	57991.29	4877.32	58474.95	21869.32
614						2	10	8	58471.77	46282.62	58266.8	22047.88
615							16	11	67322.08	54599.69	64853.1	24820.65
616					2 on 1		10	6	45133	39263.89	44282.69	17047.22
617						6	16	9	45463.94	40197.22	44559.13	17134.07
618				4x6		10	16	7	3482.24	29379.33	33848.41	12975.79
619							4	4.5	12897.34	6898.29	24088.98	7774.91
620						2	10	6	11704.46	7572.59	24119.44	7815.69
621			10		4 on 1		16	7.5	10545.28	7864.9	19028.13	7833.46
622							10	5	9418.46	5866.93	17231.1	6056.15
623						6	16	6.5	8393.52	5707.17	13872.06	6073.78
624						10	16	5.5	6585.33	5247.19	9908.48	4604.79
625							4	9	61570.95	45893.81	58438.98	22074.03
626				8x10	2 on 1	2	10	12	22535.65	18985.98	16566.8	18414.16
627							16	15	47965.38	38282.51	44664.38	17104.72

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
628							10	10	37157.43	31167.21	34485.74	13242
629					2 on 1	6	16	13	37091.46	32282.58	34451.77	13266.07
630						10	16	11	28077.82	23519.08	26233.34	10064.24
631							4	8.5	11291.61	5132.84	40485.13	5394.19
632						2	10	10	9873.9	5780.56	17365.5	5400.4
633				8x10	4 on 1		16	11.5	8672.58	6271.88	13585.95	5403.63
634							10	9	8013.77	4368.34	13261.17	4189.69
635						6	16	10.5	10111.95	6491.64	14949.2	6095.44
636						10	16	9.5	7598.22	5977.14	10884.02	4625.82
637							4	11	67240.74	52867.93	64529.7	24820.65
638						2	10	14	67447.58	53285.64	65077.71	67764.73
639	800	3	10		2 on 1		16	17	70861.21	57618.1	66396.58	26017.13
640							10	12	52234.59	46127.06	69180.17	19281.08
641						6	16	15	52357.17	46557.15	49588.82	19297.43
642				10x12		10	16	13	39713.65	34456.79	38191.8	14643.06
643							4	10.5	11209.13	6597.52	26386.19	7853.17
644						2	10	12	10300.94	7139.06	25170.44	7857.13
645					4 on 1		16	13.5	9600.95	7483.37	18860.09	7858.18
646							10	11	8219.02	5560.91	18865.93	6096.24
647						6	16	12.5	7596.02	5416.89	14344.58	6097.28
648						10	16	11.5	3524.29	3019.47	3898.93	2231.43
649							4	5	37076.19	26564.83	30365.4	13012.84
650						2	10	8	37726.81	32463.85	30956.17	14679.99
651							16	11	42546.86	26182.84	34960.59	14711.67
652	1600	0	0	4x6	2 on 1		10	6	33262.46	26719.79	27782.62	11617.73
653						6	16	9	33595.22	25212.63	28458.88	11659.54
654						10	16	7	26039.04	23235.8	22138.21	9083.68
655							4	4.5	12744.32	5427.45	31824.24	4634.5
656					4 on 1	2	10	6	11666.47	5388.25	11460.53	4645.07
657							16	7.5	10656.71	6697.37	11724.26	4649.74

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
658							10	5	9707.56	4927.1	8657.87	3681.39
659				4x6	4 on 1	6	16	6.5	8846.12	5982.2	8979.36	3686.06
660						10	16	5.5	7258.21	4335.26	6720.57	2874.22
661							4	9	39462.95	30414.09	33951.07	14660.43
662						2	10	12	39705.17	35151.61	33626.69	14706.04
663							16	15	41725.3	22266.5	34954.65	14722.83
664					2 on 1		10	10	31419.54	27042.28	27156.57	11651.19
665						6	16	13	31560.08	25394.93	27132.41	11670.88
666				8x10		10	16	11	24562.7	22914.99	21421.59	9097.32
667							4	8.5	7862.26	4132.73	9677.9	4646.75
668						2	10	10	7332.66	4125.32	9677.05	4650.53
669			0		4 on 1		16	11.5	10692	6935.04	15222.7	6975.22
670							10	9	6016.98	3621.64	7512.86	3686.85
671						6	16	10.5	5621.27	3863.81	7579.88	3688.73
672	1600	0				10	16	9.5	4543.73	3086.99	5753.84	2876.9
673							4	11	33694.45	25162.78	29113.61	12772.79
674						2	10	14	34442	29354.49	29636.42	12973.83
675					2 on 1		16	17	39705.84	24564.22	33665.87	14660.43
676							10	12	27070.25	17416.88	23880.26	10228.64
677						6	16	15	27563.58	21298.51	24152.36	10329.42
678				10x12		10	16	13	21337.24	19147.89	19075.59	8023.94
679							4	10.5	8548.29	4321.92	9091.89	4557.31
680						2	10	12	8206.34	4403.17	9591.95	4600.62
681					4 on 1		16	13.5	7844.88	5573.77	9990.25	4623.56
682							10	11	6716.02	3851.28	7098.1	3636.93
683						6	16	12.5	6438.99	4727.09	7555.08	3659.88
684						10	16	11.5	5210.76	3295.95	5591.26	2848.04
685							4	5	92961.85	61372.34	18935.02	33394.59
686			5	4x6	2 on 1	2	10	8	93073.35	76759.89	78223.7	37626.77
687							16	11	105604.55	54431.19	87766.71	37685.25

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
688							10	6	82144.9	62297.16	70143.41	29317.52
689					2 on 1	6	16	9	82080.97	56940.43	70689.43	29387.08
690				4x6		10	16	7	62986.51	54348.29	54932.4	22606.68
691							4	4.5	25573.25	10287.07	80089.45	11881.18
692						2	10	6	22484.06	10257.01	29142.13	11897.07
693					4 on 1		16	7.5	20113.85	11210.68	29072.33	11906.79
694							10	5	18315.46	9054.71	21952.67	9276.75
695						6	16	6.5	16204.03	11146.14	21790.43	9286.44
696						10	16	5.5	12975.78	7757.54	16325.39	7147.36
697							4	9	101621.8	72046.15	89308.11	37601.12
698						2	10	12	102011.73	8245.67	82457.67	37673.98
699							16	15	107240.02	46380.06	90293.17	37701.96
700					2 on 1		10	10	79449.8	64548.23	69474.12	29367.36
701						6	16	13	79732.32	59219.71	69415.67	29403.63
702	1600	0	5	8x10		10	16	11	61330.65	54973.89	54536.04	22630.46
703							4	8.5	17216.99	8883.55	28600.04	11901.17
704						2	10	10	15943.31	8951.86	28425.36	11908
705					4 on 1		16	11.5	26003.46	16884.67	4941.41	19304.48
706							10	9	12778.87	7760.61	21682.79	9281.63
707						6	16	10.5	11868.42	7642.14	21837.24	9290.02
708						10	16	9.5	9361.01	6491.04	16230.12	7150.91
709							4	11	86939.02	59545.49	77716.11	33022.27
710						2	10	14	88196.94	70746.83	78123.72	33336.54
711					2 on 1		16	17	101932.98	52807.04	87713.44	37601.12
712							10	12	68423.83	41275.36	61810.14	25905.34
713						6	16	15	69152.2	49164.69	62381.41	26079.1
714				10x12		10	16	13	52926.78	45866.4	48764.83	20017.13
715							4	10.5	18920.51	8974.42	27104.64	11759.14
716					4 on 1	2	10	12	17224.3	8987.62	27237.76	11818.07
717							16	13.5	15966.99	9578.4	27386.84	11858.4

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
718							10	11	13882.41	7830.92	19612.43	9199.74
719			5	10x12	4 on 1	6	16	12.5	12744.33	9239.08	20187.48	9238.14
720						10	16	11.5	10097.73	6625.55	14642.63	7099.47
721							4	5	74765.91	50497.71	74452.98	28195.26
722						2	10	8	75385.38	60023.86	75121.1	28425.46
723							16	11	101932.98	52807.04	87713.44	37601.12
724					2 on 1		10	6	68423.83	41275.36	61810.14	25905.34
725						6	16	9	58614.88	41037.05	57512.69	22090.29
726				4x6		10	16	7	44327.69	37940.11	43684.43	16729.18
727							4	4.5	16628.03	7348372	31983.34	10023.88
728						2	10	6	15090.11	7383.67	32101	10076.47
729					4 on 1		16	7.5	13595.61	7773.95	31843.25	10099.37
730							10	5	12142.85	6274.39	22915.12	7807.96
731						6	16	6.5	10821.44	7431.36	23368.28	7830.69
732			10			10	16	5.5	8490.21	5210.74	16437.9	5936.77
733							4	9	79381.02	51356.36	75412.51	28459.19
734	1600	0				2	10	12	79353.16	63660.55	75221.95	32020.22
735							16	15	89909.11	44061.73	83905.84	32062.09
736					2 on 1		10	10	69650.06	51615.28	64635.31	24821.57
737						6	16	13	68526.4	47712.03	64382.7	24866.69
738				8x10		10	16	11	52630.71	44483.36	49211.89	18865.01
739							4	8.5	21165.65	7737.4	76332.91	10111.18
740						2	10	10	18505.21	7633.37	33606.43	10122.82
741					4 on 1		16	11.5	16256.4	8240.49	33472.41	10128.88
742							10	9	15021.48	6645.4	25025.93	7853.4
743						6	16	10.5	13036.94	8358.5	24409.14	7858.61
744						10	16	9.5	10331.19	5583.97	18280.01	5963.89
745							4	11	86690.87	59154.14	83996.95	32000.29
746				10x12	2 on 1	2	10	14	86957.54	69971.53	83170.32	32053.68
747							16	17	91358.6	37971.09	85535.98	32071.96

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
748							10	12	67344.02	52651.08	64304.78	24858.35
749					2 on 1	6	16	15	67502.05	48245.52	64436.36	24879.42
750						10	16	13	51201.26	44423.79	49287.65	18878.73
751							4	10.5	14453.65	7145.42	33607.69	10124.78
752						2	10	12	13280.6	7158.73	33507.18	10129.9
753		0	10	10x12	4 on 1		16	13.5	22326.23	14340.79	59133.63	17746.31
754							10	11	10596.46	6084.39	25120.9	7859.64
755						6	16	12.5	979.25	5994.96	25273.54	7860.98
756						10	16	11.5	7623.65	5034.26	18687.4	5966.25
757							4	5	45513.22	33988.96	39325.6	17253.02
758						2	10	8	46522.99	39650.97	40031.79	17524.57
759							16	11	53633.19	33180.45	45474.62	19802.77
760					2 on 1		10	6	36565.51	23526.09	32256.25	13816.47
761						6	16	9	37231.87	28769.25	32624.12	13952.59
762				4x6		10	16	7	28821.56	25864.27	25766.61	10838.44
763							4	4.5	11546.71	5837.89	12281	6155.85
764						2	10	6	11084.83	5947.63	12956.46	6214.35
765	1600	3	0		4 on 1		16	7.5	10596.57	7221.49	13494.47	6245.34
766							10	5	9071.75	5202.17	9587.86	4912.63
767						6	16	6.5	8697.55	3685.18	10205.12	4943.63
768						10	16	5.5	7038.51	4533.7	7552.47	3847.03
769							4	9	50081.16	35882.8	41016.47	17577.26
770						2	10	12	37726.81	32463.85	30956.17	14679.99
771							16	15	54740.73	35366.82	47223.47	19871.98
772					2 on 1		10	10	44929.71	36092.09	37527.74	15692.81
773						6	16	13	45379.19	34228.28	38035.92	15749.28
774				8x10		10	16	11	35172.59	31386.06	29903.49	12269.9
775							4	8.5	17214.56	7331.19	42987.01	6260.11
776					4 on 1	2	10	10	15758.64	7278.25	15480.46	6274.39
777							16	11.5	14394.7	9046.56	15836.69	6280.69

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
778							10	9	13112.62	6655.35	11694.73	4972.68
779				8x10	4 on 1	6	16	10.5	11949.02	8080.54	12128.99	4978.99
780						10	16	9.5	9804.13	5855.91	9077.9	3882.4
781							4	11	53305.1	41082.24	45859.86	19802.77
782						2	10	14	53632.29	47481.51	45421.7	19864.37
783			0		2 on 1		16	17	56361	30076.77	47215.46	19887.06
784							10	12	42440.36	36554.88	36681.1	15738
785						6	16	15	42630.2	34302.54	36649.46	15764.6
786				10x12		10	16	13	33178.39	30990.74	28935.5	12288.33
787							4	10.5	10620.05	5582.34	13072.55	6276.66
788						2	10	12	9904.69	5572.33	13071.41	6281.76
789					4 on 1		16	13.5	14442.37	9367.6	20562.27	9421.87
790							10	11	8127.51	4891.98	10148.1	4980.07
791						6	16	12.5	7593	5219.09	10238.63	4982.6
792	1600	3				10	16	11.5	13745.45	5799.82	12455.4	3828.74
793							4	5	117434.04	80431.86	104976.07	44605.27
794						2	10	8	119133.18	95562.21	105526.65	45029.78
795							16	11	137687.33	71329.81	118480.09	50790.21
796					2 on 1		10	6	92424.39	55753.24	83490.87	34991.98
797						6	16	9	93273.17	66274.77	84262.52	35226.68
798			5	4x6		10	16	7	71491.55	61954.64	65869.74	27038.4
799							4	4.5	25557.13	12122.31	36611.96	15883.81
800						2	10	6	23265.95	12140.14	36791.77	15963.42
801					4 on 1		16	7.5	21567.62	12938.15	36993.14	16017.89
802							10	5	18751.85	10577.72	26491.75	12426.67
803						6	16	6.5	17214.57	12479.82	27268.5	12478.54
804						10	16	5.5	13639.64	8949.55	19778.73	9589.71
805							4	9	125569.45	82899.5	106622.52	45108.18
806				8x10	2 on 1	2	10	12	93073.35	76759.59	78223.7	37626.77
807							16	15	142646.75	73523.65	118552.05	50903.84

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
808							10	10	110958.31	84148.72	94747.15	39601.03
809					2 on 1	6	16	13	110871.95	76913.04	95484.69	39694.99
810				8x10		10	16	11	85079.87	73411.67	74200.66	30536.27
811							4	8.5	34543.4	13895.39	108181.88	16048.66
812						2	10	10	30370.64	13854.8	39364.12	16070.13
813					4 on 1		16	11.5	27169.04	45442.98	39269.84	16083.25
814							10	9	24739.85	12230.77	29652.86	12530.69
815						6	16	10.5	21887.81	15055.8	29433.71	12543.78
816						10	16	9.5	17527.21	10478.61	22051.73	9654.39
817							4	11	137266.98	97317.29	120634.12	50790.21
818						2	10	14	137793.7	111380.79	118662.38	50888.63
819	1600	3	5		2 on 1		16	17	144855.88	62648.48	121964.7	50926.42
820							10	12	107317.87	87189.38	93843.09	39668.36
821						6	16	15	107699.48	79991.8	93764.13	39717.34
822				10x12		10	16	13	82843.19	74256.7	73665.28	30567.38
823							4	10.5	23256.08	11999.58	38631.88	16075.66
824						2	10	12	21535.64	12091.85	38395.93	16084.89
825					4 on 1		16	13.5	35124.51	22807.19	66851.18	26075.78
826							10	11	17261.23	10482.75	29288.31	12545.39
827						6	16	12.5	16037.43	10322.72	29496.94	12548.61
828						10	16	11.5	12644.51	8768.86	21923.05	9659.18
829							4	5	100991.05	68210.45	100568.35	38085.12
830						2	10	8	101827.79	81078.03	101470.82	38396.07
831							16	11	137687.33	71329.81	118480.09	50790.21
832					2 on 1		10	6	92424.39	55753.24	83490.87	34991.98
833						6	16	9	79174.83	55431.33	77686.02	29838.74
834			10	4x6		10	16	7	59876.21	51248.11	59007.32	22597.16
835							4	4.5	22460.54	9926.38	43201.92	13539.89
836					4 on 1	2	10	6	20383.16	9973.59	43360.85	13610.93
837							16	7.5	20383.16	9973.59	43360.85	13610.93

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension Acc. Cost ($)**	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
838							10	5	16402.12	8475.22	30952.9	10546.7
839				4x6	4 on 1	6	16	6.5	14617.21	10038	31565.01	10577.41
840						10	16	5.5	11468.27	7038.48	22203.71	8019.17
841							4	9	107224.97	69370.27	101864.45	38441.62
842						2	10	12	79353.16	63660.55	75221.95	32020.22
843							16	15	121455.91	59515.62	113336.92	43308.29
844					2 on 1		10	10	94080.74	69720.02	87307	33528.07
845						6	16	13	93913.7	64447.65	86965.79	33589.01
846	1600	3	10	8x10		10	16	11	71091.62	60086.49	66473.62	25482.16
847							4	8.5	28589.79	10451.4	103107.68	13657.82
848						2	10	10	25000.22	10310.87	45394.34	13673.54
849					4 on 1		16	11.5	21958.54	11130.95	45213.3	13681.71
850							10	9	20290.46	8976.36	33804.11	10608.09
851						6	16	10.5	17609.82	11290.36	32970.97	10615.12
852						10	16	9.5	13955	7542.62	24691.97	8055.8
853							4	11	117098.84	79903.24	113459.99	43224.82
854						2	10	14	117459.05	94514.97	112343.41	43296.93
855					2 on 1		16	17	123403.84	51289.95	115538.86	43321.62
856							10	12	90965.82	71119.15	86860.53	33577.74
857						6	16	15	91179.29	65168.28	87038.27	33606.21
858				10x12		10	16	13	69160.77	60006.02	66575.95	25500.7
859							4	10.5	19523.46	9651.78	45396.03	13676.18
860						2	10	12	17938.95	9669.75	45260.27	13683.09
861					4 on 1		16	13.5	30157.46	19371.02	19875.53	23971.06
862							10	11	14313.31	8218.58	33932.39	10616.51
863						6	16	12.5	13228.37	8097.77	34138.57	10618.33
864						10	16	11.5	6137.51	4169.79	7772.07	3886.01
865							4	5	52915.06	39516.6	45721.14	20058.59
866	3000	0	0	4x6	2 on 1	2	10	8	54089.05	46099.43	46542.08	20374.6
867							16	11	62355.58	38576.59	52870.18	23023.3

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
868							10	6	42512.17	27352.15	37505.48	16063.45
869					2 on 1	6	16	9	43286.91	33448	37828.8	16221.71
870						10	16	7	33508.82	30070.59	29957.04	12601.1
871							4	4.5	13424.56	6787.31	14278.26	7156.98
872				4x6		2	10	6	12887.56	6914.9	15063.57	7224.99
873							16	7.5	12319.9	8395.93	15689.08	7261.02
874					4 on 1		10	5	10547.09	6048.2	11147.14	5711.57
875						6	16	6.5	10112.03	7423.6	11764.78	5747.62
876						10	16	5.5	8183.18	5271.02	8780.73	4472.68
877							4	9	58225.88	41718.44	47687	20435.86
878						2	10	12	37726.81	32463.85	30956.17	14679.99
879							16	15	66817.23	41118.54	54903.45	23103.78
880					2 on 1		10	10	52236.65	41961.77	43630.89	18244.94
881						6	16	13	52759.23	39794.84	44221.8	18310.59
882	3000	0	0	8x10		10	16	11	40891.72	36490.39	34766.71	14265.36
883							4	8.5	20014.18	8523.47	49978.01	7278.19
884						2	10	10	18321.48	8461.92	17998.05	7294.79
885					4 on 1		16	11.5	16735.71	10517.81	18412.22	7302.13
886							10	9	15245.13	7737.72	13596.65	5781.39
887						6	16	10.5	13892.29	9394.68	14101.53	5788.73
888						10	16	9.5	11398.58	6808.26	10554.24	4513.79
889							4	11	61974.14	47763.46	53318.08	23023.3
890						2	10	14	62354.54	55203.45	52808.66	23094.93
891					2 on 1		16	17	65527.02	34968.17	54894.13	23121.31
892							10	12	49342.46	42499.82	42647.73	18297.48
893						6	16	15	49563.17	39881.18	42609.79	18328.4
894				10x12		10	16	13	38574.21	36030.77	33641.29	14286.78
895							4	10.5	12347.19	6490.2	15198.54	7297.44
896					4 on 1	2	10	12	11515.49	6478.57	15197.22	7303.37
897							16	13.5	16791.13	10891.06	23906.32	10954.15

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
898							10	11	9449.29	5687.56	11798.49	5789.98
899			0	10x12	4 on 1	6	16	12.5	8827.85	6067.88	11903.74	5792.93
900						10	16	11.5	7135.65	4847.93	9136.05	4517.99
901							4	5	136532.39	93512.53	122048.38	51859.45
902						2	10	8	138507.86	111103.54	122688.49	52352.99
903							16	11	160079.48	82930.22	137748.56	59050.25
904					2 on 1		10	6	107455.41	64820.41	97069.03	40682.75
905						6	16	9	108442.23	77053.08	97966.17	40955.62
906				4x6		10	16	7	83118.25	72030.36	76582.16	31435.67
907							4	4.5	29713.5	14093.77	42566.18	18467.01
908						2	10	6	27049.7	14114.5	42775.23	18559.56
909					4 on 1		16	7.5	25075.18	15042.29	43009.35	18622.88
910							10	5	21801.47	12297.98	30800.11	14447.63
911						6	16	6.5	20014.18	14509.41	31703.2	14507.93
912	3000	0	5			10	16	5.5	15857.86	10405.02	22995.36	11149.28
913							4	9	145990.88	96381.48	123962.59	52444.14
914						2	10	12	146165.98	120546.7	122845.5	59090.53
915					2 on 1		16	15	165845.45	85480.84	137832.22	59182.36
916							10	10	129003.52	97833.87	110155.92	46041.37
917						6	16	13	128903.12	89421.45	111013.41	46150.61
918				8x10		10	16	11	98916.45	85350.65	86267.95	35502.39
919							4	8.5	40161.21	16155.21	125775.55	18658.66
920						2	10	10	35309.84	16108.01	45765.93	18683.62
921					4 on 1		16	11.5	31587.56	17605.69	45656.31	18698.88
922							10	9	28763.3	14219.86	34475.32	14568.56
923						6	16	10.5	25447.44	17504.33	34220.53	14583.78
924						10	16	9.5	20377.67	12182.75	25638.01	11224.49
925							4	11	159590.78	113144.05	140252.91	59050.25
926				10x12	2 on 1	2	10	14	160203.16	129494.7	137960.48	59164.68
927							16	17	168413.84	72837.04	141799.88	59208.61

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
928							10	12	124771.02	101369.03	109104.84	46119.64
929					2 on 1	6	16	15	125214.7	93000.91	109013.04	46176.59
930						10	16	13	96316.02	86333.11	85645.51	35539.74
931			5	10x12			4	10.5	27038.22	13951.07	44914.61	18690.05
932						2	10	12	25037.99	14058.35	44640.28	18700.79
933					4 on 1		16	13.5	40836.83	26516.34	77723.21	30316.49
934							10	11	20068.43	12187.57	34051.48	14585.65
935						6	16	12.5	18638.63	12001.51	34294.04	14589.4
936						10	16	11.5	14700.9	10193.78	25488.41	11230.06
937							4	5	117415.27	79303.55	116923.84	44278.93
938						2	10	8	118388.09	94263.79	117973.07	44640.45
939							16	11	160079.48	82930.22	137748.56	59050.25
940					2 on 1		10	6	107455.41	64820.41	97069.03	40682.75
941						6	16	9	92051.07	64446.16	90320.14	34691.43
942				4x6		10	16	7	69613.91	59582.62	68603.72	26272.15
943							4	4.5	26113.3	11540.71	50227.87	15741.89
944						2	10	6	23698.09	11595.6	50412.64	15824.48
945	3000	0	10		4 on 1		16	7.5	21351.07	12208.52	50007.87	15860.44
946							10	5	19069.61	9853.55	35986.78	12261.92
947						6	16	6.5	16994.41	11670.49	36698.45	12297.62
948						10	16	5.5	13333.36	8183.15	25814.71	9323.34
949							4	9	124663.02	80652	118430.71	44693.4
950						2	10	12	124619.27	99974.98	118131.45	50285.79
951					2 on 1		16	15	141196.72	69194.67	131768.97	50351.54
952							10	10	109381.14	81058.62	101505.79	38980.75
953						6	16	13	109186.94	74928.8	101109.08	39051.61
954				8x10		10	16	11	82653.29	69858.39	77284.25	29626.33
955							4	8.5	33239.36	12151.12	119876.14	15878.99
956					4 on 1	2	10	10	29066.01	11987.73	52776.84	15897.27
957							16	11.5	25529.67	12941.18	52566.36	15906.78

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
958							10	9	23590.31	10436.19	39301.69	12333.29
959				8x10	4 on 1	6	16	10.5	20473.71	13126.52	38333.05	12341.46
960						10	16	9.5	16224.5	8769.28	28707.64	9365.92
961							4	11	136142.69	92897.95	131912.05	50254.49
962						2	10	14	136561.47	109885.98	130613.88	50338.33
963					2 on 1		16	17	143473.06	59631.26	134329	50367.04
964							10	12	105759.61	82685.29	100986.7	39038.5
965						6	16	15	106007.83	75766.63	101193.35	39071.6
966		0	10	10x12		10	16	13	80408.43	69764.84	77403.23	29647.89
967							4	10.5	22698.57	11221.45	52778.81	15900.35
968						2	10	12	20856.37	11242.35	52620.96	15908.38
969					4 on 1		16	13.5	35061.98	22521.34	92865.73	27869.49
970							10	11	16641.09	9555.17	39450.83	12343.08
971						6	16	12.5	15379.7	9414.71	39690.55	12345.19
972						10	16	11.5	11972.47	7905.99	29347.41	9369.63
973	3000						4	5	60146.71	44917.15	51969.64	22800.24
974						2	10	8	61751.14	52399.62	52902.89	23159.1
975					2 on 1		16	11	70877.43	43848.68	60095.7	26169.79
976							10	6	48322.11	31090.24	42627.78	18258.77
977						6	16	9	49202.73	38019.19	43113.49	18438.66
978		3	0	4x6		10	16	7	38088.32	34180.2	34051.13	14323.23
979							4	4.5	15259.23	7714.9	16229.6	8135.09
980						2	10	6	14648.84	7859.93	17122.24	8212.39
981					4 on 1		16	7.5	14003.6	9543.36	17833.23	8253.35
982							10	5	11988.52	6874.78	12670.56	6492.15
983						6	16	6.5	11494	8438.15	13486.29	6533.12
984						10	16	5.5	9301.54	5991.38	9980.75	5083.93
985							4	9	66183.34	41419.9	54204.16	23228.73
986				8x10	2 on 1	2	10	12	50960	43850.98	41814.46	19829.19
987							16	15	75948.82	46738.02	62406.85	26261.26

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
988							10	10	59375.59	17696.48	49593.72	20738.39
989					2 on 1	6	16	13	59969.59	45233.42	50265.38	20813.01
990						10	16	11	46481.34	41477.37	39515.11	16214.94
991							4	8.5	22749.42	9688.33	56808.27	8272.87
992						2	10	10	20825.39	9678.37	20457.76	8291.74
993				8x10	4 on 1		16	11.5	19022.91	1955.23	20928.54	8300.07
994							10	9	17328.62	8795.19	15454.84	6571.51
995						6	16	10.5	15790.89	10678.61	16028.72	6579.84
996						10	16	9.5	12956.37	7738.71	11996.64	5130.67
997							4	11	70443.85	54291317	60604.81	26169.79
998			0			2	10	14	70876.23	62747.85	60025.77	26251.2
999					2 on 1		16	17	74482.3	39747.11	32396.25	26281.19
1000							10	12	56085.86	48308.07	48476.2	20798.11
1001						6	16	15	56336.74	45331.55	48433.07	20833.26
1002	3000	3		10x12		10	16	13	43845.97	40954.93	38238.89	16239.29
1003							4	10.5	14034.63	7377.19	17275.66	8294.74
1004						2	10	12	13089.26	7363.96	17274.15	8301.49
1005					4 on 1		16	13.5	19085.9	12379.49	27173.48	12451.2
1006							10	11	10740.68	6464.86	13410.93	6581.27
1007						6	16	12.5	10034.32	6897.14	13530.57	6584.62
1008						10	16	11.5	8110.85	5510.47	10270.96	5135.44
1009							4	5	155191.62	106292.45	138728.16	58946.84
1010						2	10	8	157437.08	126284.54	139455.75	59507.83
1011							16	11	181956.8	94263.9	156574	67120.38
1012					2 on 1		10	6	122140.84	73679.11	110335	46242.66
1013						6	16	9	123262.52	87583.55	111354.74	46552.83
1014			5	4x6		10	16	7	94477.63	81874.41	87048.29	35731.84
1015							4	4.5	33774.31	16019.9	48383.5	20990.81
1016					4 on 1	2	10	6	30746.45	16043.46	18621.12	21096.01
1017							16	7.5	28502.08	17098.05	48887.23	21167.98
1018						6	10	5	24780.97	13978.68	65009.42	16422.12

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
1020						10	16	5.5	18025.08	11827.02	26138.02	12673
1021							4	9	165942.75	109553.48	140903.98	59611.44
1022						2	10	12	146165.98	120546.7	122845.5	59090.53
1023					2 on 1		16	15	188510.78	97163.09	156669.11	67270.54
1024							10	10	146633.81	111204.36	125210.41	52333.62
1025						6	16	13	146519.7	101642.26	126185.09	52457.79
1026				8x10		10	16	11	112434.89	97015.12	98057.79	40354.34
1027							4	8.5	45649.85	18363.06	142964.7	21208.65
1028						2	10	10	40135.46	18309.42	52020.54	21237.02
1029					4 on 1		16	11.5	35904.48	20011.77	51895.94	21254.36
1030							10	9	32694.25	16163.23	39186.9	16559.58
1031						6	16	10.5	28925.22	19896.56	38897.29	16575.87
1032	3000	3	5			10	16	9.5	23162.59	13847.71	29141.84	12758.48
1033							4	11	181401.3	128606.91	159420.59	67120.38
1034						2	10	14	182097.36	147192.12	156814.91	67250.43
1035					2 on 1		16	17	191430.17	82791.34	161179	67311.37
1036							10	12	141822.89	115222.66	124015.68	52422.59
1037						6	16	15	142327.2	105710.91	123911.34	52487.33
1038				10x12		10	16	13	109479.07	98131.84	97350.27	40396.79
1039							4	10.5	30733.41	15857.7	51052.88	21244.33
1040						2	10	12	28459.81	15979.64	50741.05	21256.53
1041					4 on 1		16	13.5	46417.8	30140.2	88345.28	34459.71
1042							10	11	22811.09	13853.19	38705.14	16579.01
1043						6	16	12.5	21185.88	13641.7	38980.84	16583.26
1044						10	16	11.5	16710	11586.92	28971.79	12764.82
1045							4	5	133461.86	90140.6	117242.99	50330.32
1046						2	10	8	134567.64	107146.38	117209.84	50741.25
1047							16	11	181956.8	94263.9	140083.19	67120.38
1048			10	4x6	2 on 1	6	10	6	122140.84	73679.11	100855.94	46246.66
1049							16	9	104631.25	73253.71	91371.6	39432.55

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
1050						10	16	7	79127.71	67725.49	70508.52	29862.64
1051							4	4.5	29682.09	13117.93	40887.4	17893.26
1052						2	10	6	26936.79	13180.32	40756.77	17987.13
1053				4x6	4 on 1		16	7.5	24269.02	13877	40800.6	18028.02
1054							10	5	21675.76	11200.19	29736.36	13937.7
1055						6	16	6.5	19316.96	13265.44	29982.13	13978.27
1056						10	16	5.5	15155.56	9301.5	21617.01	10597.51
1057							4	9	141700.12	91674.33	118642.13	50801.44
1058						2	10	12	124619.27	99974.98	118131.45	50285.79
1059							16	15	160493.42	78651.18	13167.33	57232.85
1060					2 on 1		10	10	124329.74	92136.52	104403.2	44308.07
1061						6	16	13	124109	85168.97	103306.98	44388.61
1062				8x10		10	16	11	93949.12	79405.61	80085.1	33675.22
1063							4	8.5	37782.02	13811.75	118276.41	18049.1
1064						2	10	10	33038.33	13626.04	42436.64	18069.88
1065	3000	3	10		4 on 1		16	11.5	29018.7	14709.79	41862.11	18080.68
1066							10	9	26814.29	11862.46	31932.32	14018.82
1067						6	16	10.5	23271.76	14920.46	31096.48	14028.11
1068						10	16	9.5	18441.83	9967.74	23412.04	10645.91
1069							4	11	154748.66	105593.88	133045.38	57122.54
1070						2	10	14	155224.67	124903.58	131424.61	57217.83
1071					2 on 1		16	17	163080.86	67780.78	135318.12	57250.47
1072							10	12	120213.31	93985.5	103092.09	44373.71
1073						6	16	15	120495.41	86121.3	102872.05	44411.34
1074				10x12		10	16	13	91397.47	79299.27	79311.73	33699.72
1075							4	10.5	25800.68	12755.03	42277.96	18073.37
1076						2	10	12	23706.71	12778.79	41739.22	18082.5
1077					4 on 1		16	13.5	39853.74	25599.22	72197.88	31678.28
1078							10	11	18915.35	10861.03	31656.98	14029.95
1079						6	16	12.5	17481.57	10701.38	31620.55	14032.35
1080						10	16	11.5	13608.7	8986.46	23779.46	10650.13

APPENDIX IV – RURAL ARTERIAL ACCIDENT COST COMPILATION

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
1							10	5	11707.41	10696.41	10413.68	4455.44
2							18	9	12045.49	11258.58	10592.63	4531.69
3					2 on 1	8	26	13	13695.31	10947.23	11810.28	5110.39
4							18	6	8045.97	7440.35	7253.2	3044
5				4x6		14	26	10	9193.55	8119.04	8116.15	3452.85
6						20	26	7	5268.41	5063.52	4759.65	1990.94
7							10	4.5	3355.95	2389.38	4088.13	1605.56
8					4 on 1	8	18	6.5	3158.04	2247.45	2889.54	1620.3
9						14	18	5	2285.51	1899.32	1855.42	1092.31
10							10	9	13014.46	11762.4	10929.31	4531.69
11							18	13	14665.42	13614.3	12338.25	5110.39
12					2 on 1	8	26	17	14194.46	10724.39	12113.89	5350.11
13							18	10	9810.65	9100.4	8364.09	3452.85
14	1000	0	0	8x10		14	26	14	9937.85	8768.26	8494.22	3462.39
15						20	26	11	6402.51	6102.99	5511.36	2246.57
16							10	8.5	4905.62	3311.98	4112.55	1629.06
17					4 on 1	8	18	10.5	4281.88	2592.54	3651.87	1632
18						14	18	9	3170.38	2585.62	2365.49	1104.01
19							10	11	13504.2	12991.55	11737.96	5103.02
20							18	15	13598.84	13406.15	11711.76	5116.2
21					2 on 1	8	26	19	14207.66	11514.48	12044.8	5350.11
22							18	12	9175.16	8887.57	8058.4	3459.27
23				10x12		14	26	16	9601.3	8742.52	8279.12	3620.17
24						20	26	13	5977.38	6068.15	5273.73	2246.73
25							10	10.5	2961.1	2162.61	3370.82	1632
26					4 on 1	8	18	12.5	2670.82	1902.41	2633.49	1632.96
27						14	18	11	1933.3	1634.98	1740.51	1104.97

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
28							10	5	10461.7	9397.7	8936.42	3990.24
29							18	9	10622.83	9578.4	8733.39	4030.93
30					2 on 1	8	26	13	12128.21	8826.43	9657.31	4539.14
31							18	6	6960.38	6211.01	6067.31	2650.62
32				4x6		14	26	10	7980.31	6678.1	6671.48	2997.62
33						20	26	7	4411.45	4231.13	3840.76	1682.37
34							10	4.5	2463.72	1636.27	2909.59	1432.29
35					4 on 1	8	18	6.5	2164.01	1522.01	2065.89	1441.44
36						14	18	5	1515.03	1231.61	1348.1	950.41
37							10	9	11206.02	9676.66	8891.6	4030.93
38							18	13	12566.27	11224.65	9846.35	4539.14
39					2 on 1	8	26	17	12637.56	8301.65	10004.46	4750.37
40							18	10	8255.07	7208.07	6726.43	2997.62
41	1000	0	3	8x10		14	26	14	8277.42	7024.18	6646.95	3002.86
42						20	26	11	5210.95	4971.59	4272.09	1894.43
43							10	8.5	3183.47	2002.21	2441.62	1446.28
44					4 on 1	8	18	10.5	2691.68	1663.21	2337.06	1448.16
45						14	18	9	1910.46	1503.55	1523.07	956.94
46							10	11	12031.76	10851.45	9711.92	4534.11
47							18	15	12098.64	11324.83	9623.11	4542.38
48					2 on 1	8	26	19	12646.92	9559.47	9957.28	4750.37
49							18	12	7985.67	7282.8	6618.67	3000.58
50				10x12		14	26	16	8355.79	7311.32	6784.93	3139.69
51						20	26	13	5058.07	4940.02	4201.59	1894.88
52							10	10.5	2135.63	1530.54	2197.53	1448.14
53					4 on 1	8	18	12.5	1924.3	1396.54	1998.57	1448.86
54						14	18	11	1333.12	1139.07	1298.32	957.65
55							10	5	28644.31	25544.81	27165.45	10969.56
56			6	4x6	2on 1		18	9	29066.21	26268.63	27433.55	11083.84
57						8	26	13	33340.73	23530.35	30350.12	12466.57

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
58							18	6	18950.36	16744.16	18186.93	7248.23
59					2 on 1	14	26	10	21840.14	18167.02	20415.31	8181.11
60				4x6		20	26	7	12073.58	11552.58	11728.83	4603.07
61							10	4.5	5824.92	4049.18	10727.92	3936.52
62					4 on 1	8	18	6.5	5264.27	3850.03	5804.03	3964.22
63						14	18	5	3617.71	3026.26	3626.17	2598.46
64							10	9	30165.66	26082.52	27547.49	11083.84
65							18	13	34229.7	30537.89	30670.75	12466.57
66					2 on 1	8	26	17	34782.64	21633.74	31532.44	13041.24
67							18	10	22383.91	19341.92	20508.14	8181.11
68		0	6	8x10		14	26	14	22469.26	19242.11	20626.64	8188.91
69						20	26	11	14176.46	13430.7	13183.89	5180.8
70							10	8.5	7405.59	4787.56	9977.26	3973.77
71					4 on 1	8	18	10.5	6475.18	4238.47	6443.53	3977.9
72	1000					14	18	9	4514.37	3615.97	4104.41	2611.94
73							10	11	33152.87	29589.33	30545.35	12453.29
74							18	15	33292.8	30936.22	30323.06	12471.66
75					2 on 1	8	26	19	34805.96	25425.05	31463.99	13041.24
76							18	12	21839.59	19611.35	20403.71	8187.19
77				10x12		14	26	16	22853.78	19753.51	21104.83	8562.4
78						20	26	13	13856.35	13435.84	13132.05	5180.65
79							10	10.5	5377.58	4028.98	10142.18	3977.9
80					4 on 1	8	18	12.5	4923.16	3743.85	5979.42	3978.44
81						14	18	11	3355.27	3002.75	3837.03	2612.43
82							10	5	16800.89	15350.04	14944.31	6393.85
83							18	9	17285.48	16156.79	15201.11	6503.26
84					2 on 1	8	26	13	19653.65	15709.98	16948.52	7333.73
85		3	0				18	6	11546.48	10677.38	10408.81	4368.34
86				4x6		14	26	10	13193.34	11651.34	11647.2	4955.06
87						20	26	7	7560.51	7266.48	6830.4	2857.12

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
88	1000	3	0	4x6	4 on 1	8	10	4.5	4816.01	3428.91	5995.58	2304.08
89							18	6.5	4531.99	3225.24	4146.48	2325.24
90						14	18	5	3279.86	2725.64	2662.64	1567.54
91				8x10	2 on 1	8	10	9	18676.59	16879.8	15684.05	6503.26
92							18	13	21045.83	19537.4	17706.19	7333.73
93							26	17	20369.53	15390.19	17384.21	7677.75
94						14	18	10	14078.91	13059.66	12003.01	4955.06
95							26	14	14261.45	12583.02	12189.75	4968.76
96						20	26	11	9188.02	8758.18	7909.16	3223.97
97					4 on 1	8	10	8.5	7039.88	4752.9	5901.77	2337.81
98							18	10.5	6144.77	3720.46	5240.67	2342.02
99						14	18	9	4549.7	3710.53	3394.63	1584.32
100				10x12	2 on 1	8	10	11	19379.4	18643.72	16844.74	7323.16
101							18	15	19515.21	19238.69	16807.13	7342.08
102							26	19	20388.92	16524.03	17285.06	7677.75
103						14	18	12	13166.94	12754.24	11564.32	4964.27
104							26	16	13778.48	12546.08	11881.07	5195.17
105						20	26	13	8577.92	8708.19	7568.13	3224.19
106					4 on 1	8	10	10.5	4249.37	3103.48	4837.34	2342.02
107							18	12.5	3832.8	2730.09	3779.23	2343.4
108						14	18	11	2774.4	2346.3	2497.74	1585.7
109			3	4x6	2 on 1	8	10	5	15013.21	13486.3	12824.33	5726.25
110							18	9	15244.45	13745.62	12532.98	5784.64
111							26	13	17404.76	12666.5	13858.86	6513.95
112						14	18	6	9988.6	8913.2	8706.98	3803.81
113							26	10	11452.26	9583.51	9574	4301.78
114						20	26	7	6330.71	6071.94	5511.74	2414.34
115					4 on 1	8	10	4.5	3535.6	2348.15	4175.44	2055.43
116							18	6.5	3105.5	2184.19	2964.69	2068.56
117						14	18	5	2174.16	1767.44	1934.61	1363.91

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
118	1000	3	3	8x10	2 on 1	8	10	9	16081.36	13886.64	12760.02	5784.64
119							18	13	18033.41	16108.1	14130.14	6513.95
120							26	17	18135.72	11913.4	14357.04	6817.08
121						14	18	10	11846.56	10344.05	9652.86	4301.78
122							26	14	11878.64	10080.16	9538.8	4309.29
123						20	26	11	7478.04	7134.55	6130.72	2718.62
124					4 on 1	8	10	8.5	4568.49	2873.31	3503.88	2075.5
125							18	10.5	3862.73	2386.82	3353.84	2078.17
126						14	18	9	2741.64	2157.69	2236.68	1373.27
127				10x12	2 on 1	8	10	11	17266.35	15572.53	13937.22	6506.74
128							18	15	17362.34	16251.87	13809.79	6518.61
129							26	19	18149.15	13718.46	14289.34	6817.08
130						14	18	12	11459.95	10451.28	9498.21	4306.02
131							26	16	11991.1	10492.21	9736.82	4505.66
132						20	26	13	7258.65	7089.25	6029.55	2719.27
133					4 on 1	8	10	10.5	3064.77	2196.43	3153.59	2078.17
134							18	12.5	2761.49	2004.13	3144.07	2079.21
135						14	18	11	1913.11	1634.63	1863.17	1374.29
136			6	4x6	2 on 1	8	10	5	41711.89	37697.19	39368.92	15906.02
137							18	9	47846.11	33767.57	43554.39	17890.33
138							26	13	27194.99	24028.95	26099.41	10401.68
139						14	18	6	31342.02	26070.84	29297.29	11740.42
140							26	10	17326.37	16578.71	16831.63	6605.7
141						20	26	7	8359.14	5810.83	15395.26	5649.16
142					4 on 1	8	10	4.5	7554.56	5525.05	8329.16	5688.91
143							18	6.5	5191.65	4342.87	5203.78	3728.96
144						14	18	5	43289.67	37430.11	39532.43	15906.06
145					2 on 1	8	10	9	49121.83	43823.84	44014.5	17890.33
146							18	13	49915.34	31045.81	45251.09	18715.02
147							26	17	32122.35	27756.9	29430.51	11740.42

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
148							18	10	32244.84	27613.66	29600.56	11751.61
149				8x10	2 on 1	14	26	14	10627.5	6870.46	14318.01	5702.62
150						20	26	11	9292.3	6082.48	9246.88	5708.54
151							10	8.5	20344.13	19273.93	18919.73	7434.78
152					4 on 1	8	18	10.5	6478.41	5189.15	5890.09	3748.31
153	1000	3	6			14	18	9	47576.51	42462.6	43834.55	17871.28
154							10	11	47777.33	44395.48	43515.55	17897.63
155							18	15	49948.8	36486.59	45152.86	18715.02
156					2 on 1	8	26	19	31341.21	28143.55	29280.65	11749.15
157							18	12	32796.64	28347.56	30286.79	12287.6
158				10x12		14	26	16	19884.75	19281.3	18845.35	7434.57
159						20	26	13	7717.17	5781.84	14554.68	5708.54
160							10	10.5	7065.06	5372.67	8580.86	5709.32
161					4 on 1	8	18	12.5	4815.03	4309.14	5506.39	3749
162						14	18	11	41106.43	36658.46	38984.17	15742.03
163							10	5	21566.29	18093.88	18348.32	8207.39
164							18	9	22188.31	17434.88	18473.78	8347.84
165					2 on 1	8	26	13	25228.19	20142.63	20659.66	70.66
166							18	6	14821.52	13705.26	12778.55	5607.37
167	2000	0	0	4x6		14	26	10	16935.49	14956.12	14261.3	6360.51
168						20	26	7	9704.97	8768.93	8475.15	3667.51
169							10	4.5	6182.02	3570.83	4894.4	2957.6
170							18	6.5	7368.69	5227.6	6807.5	89.76
171					4 on 1	8	26	8.5	5190.75	3482.97	5202.57	3000.91
172							18	5	4210.16	2831.61	3974.69	2012.15
173						14	26	7	3761.44	2554.21	3530.31	2028.29
174						20	26	5.5	2640.46	1792.43	2201.82	1313.6
175							10	9	23974	19515.96	19043.68	70.29
176				8x10	2 on 1		18	13	27015.25	21466.14	21568.45	9413.87
177						8	26	17	26147.13	21308.99	21008.65	9855.47

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
178							18	10	18072.24	16633.41	14796.76	6360.51
179					2 on 1	14	26	14	18306.56	16023.36	14961.55	6378.09
180						20	26	11	11794.1	10480.91	9768.98	4138.41
181				8x10			10	8.5	9036.67	4765.82	6387.24	3000.91
182						8	18	10.5	7887.67	5281.69	6636.5	3006.31
183					4 on 1		26	12.5	6666.71	4241.95	6293.96	3008.08
184							18	9	5840.17	3855.82	4239.89	2033.7
185						14	26	11	4910.81	3352.66	4292.32	2035.47
186						20	26	9.5	3522.5	2324.78	2690.27	1320.78
187			0				10	11	24876.16	21797.04	20476.98	9400.3
188							18	15	25050.49	20915.71	20361.43	9424.58
189					2 on 1	8	26	19	26172.01	21210.89	21001.75	9855.47
190							18	12	16901.6	16380.63	14197.61	6372.33
191						14	26	16	16983.73	16024.41	14038.17	6377.25
192						20	26	13	11010.96	10487.01	9280.68	4138.69
193	2000	0		10x12			10	10.5	5454.65	3328.75	4976.1	3006.31
194						8	18	12.5	4919.93	3597.27	5048.72	3008.08
195					4 on 1		26	14.5	4391.66	3085.25	4653.46	3007.89
196							18	11	3561.33	2572.09	3288.37	47.47
197						14	26	13	3154.04	2283.5	3166.48	2035.28
198						20	26	11.5	2205.45	1601.38	2023.47	1320.58
199							10	5	19271.45	15477.19	16473	7350.4
200							18	9	19568.37	14469.12	16087.82	7425.4
201					2 on 1	8	26	13	22341.44	16271.25	17789.78	62.66
202							18	6	12821.76	11441.29	11176.62	4882.71
203						14	26	10	14700.57	12301.76	12289.56	5521.93
204			3	4x6		20	26	7	8126.35	7078.07	7075.09	3099.1
205							10	4.5	4538.43	2478.18	4128.38	2638.43
206					4 on 1		18	6.5	5048.14	3535.29	5132.1	79.76
207						8	26	8.5	3558.31	2385.22	3673.69	2664.19

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
208							18	5	2790.84	1886.32	3129.3	1750.76
209				4x6	4 on 1	14	26	7	2423.66	1539.56	2396.36	1759.59
210						20	26	5.5	1627.65	1160.31	1426.12	1109.05
211							10	9	20642.66	15844.71	16379.26	62.43
212							18	13	23148.4	16352.34	18137.99	8361.57
213					2 on 1	8	26	17	23279.72	17202.61	18429.26	8750.68
214							18	10	15206.76	13246.75	12390.79	5521.93
215						14	26	14	15247.89	12878.13	12244.37	5531.58
216						20	26	11	9599.11	8202.42	7869.64	3489.73
217			3	8x10			10	8.5	5864.29	2825.91	4497.72	2664.19
218						8	18	10.5	4958.35	3222.14	4373.01	2667.62
219					4 on 1		26	12.5	4292.59	2693.6	4084.84	2668.95
220							18	9	3519.27	2202.95	2871.09	1762.78
221						14	26	11	2957.04	1767.3	2666.13	1764.09
222	2000	0				20	26	9.5	2022.61	1341.35	1596.69	1113.21
223							10	11	22163.76	18151.68	17890.37	8352.31
224							18	15	22286.98	16706.48	17726.79	8367.54
225					4 on 1	8	26	19	23296.96	17609.55	18342.22	8750.68
226							18	12	14710.44	13410.15	12192.28	5527.38
227						14	26	16	14752.68	13062.09	12014.33	5530.85
228						20	26	13	9317.49	8350.47	7739.77	3490.57
229				10x12			10	10.5	3934.06	2355.79	4048.07	2667.62
230						8	18	12.5	3544.76	2613.93	4035.85	2668.95
231					4 on 1		26	14.5	3247.06	2301.72	3583.67	2668.73
232							18	11	2455.74	1797.43	2601.86	41.44
233						14	26	13	2203.74	1549.23	2361.37	1763.9
234						20	26	11.5	1465.3	1142.26	1440.11	1113.05
235							10	5	52765.83	41869.54	46049.05	20207.09
236			6	4x6	2 on 1		18	9	53543.02	38924.33	45436.45	20417.6
237						8	26	13	61417.14	43559.59	50809.01	173.09

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
238							18	6	34908.56	30844.4	31136.25	13352
239					2 on 1	14	26	10	40231.84	33465.55	34984.44	15070.46
240				4x6		20	26	7	22240.81	19330.8	20263.05	8479.34
241							10	4.5	10730.12	6311.65	11672.43	7251.48
242							18	6.5	12278.58	8977.5	15089.98	220.59
243					4 on 1	8	26	8.5	8869.81	6338.79	10690.41	7320.11
244							18	5	6664.21	4772.67	8508.35	4786.64
245						14	26	7	5997.91	4022.69	6713.5	4804.16
246						20	26	5.5	3953.71	3050.19	4099.15	3036.67
247							10	9	55568.31	42467.01	45634.87	172.63
248							18	13	63054.71	43490.36	51063.25	22964.73
249					2 on 1	8	26	17	64073.29	45844.43	52796.35	24023.33
250							18	10	41233.51	35355.04	34975.5	15070.46
251						14	26	14	41390.74	35029.9	34583.24	15084.83
252						20	26	11	26114.53	22158.67	22583.41	9543.57
253	2000	0	6	8x10			10	8.5	13641.87	7089.63	12867.76	7320.11
254						8	18	10.5	11927.96	8237.51	12868.82	7327.71
255					4 on 1		26	12.5	10578.64	7255.25	11633.92	7328.71
256							18	9	8315.94	5521.02	8212.05	4811.48
257						14	26	11	7236.08	4613.07	7465.36	4812.36
258						20	26	9.5	4851.29	3574	4659.98	3044.89
259							10	11	61071.07	49035.52	51054.45	22940.28
260							18	15	61328.85	44818.15	50485.08	22974.1
261					2 on 1	8	26	19	64116.23	46835.62	52049.28	24023.33
262							18	12	40230.81	36125.95	34695	15081.67
263						14	26	16	40336.5	35278.71	34167.95	15083.77
264						20	26	13	25524.85	22588.56	22376.69	9543.31
265				10x12			10	10.5	9906.07	6263.68	12762.56	7327.71
266					4 on 1	8	18	12.5	9068.98	7013.85	12773.81	7328.71
267							26	14.5	8448.77	6320.05	10977.36	7328.47

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
268							18	11	6180.77	4812.71	8114.03	113.83
269		0	6	10x12	4 on 1	14	26	13	5693.08	4180.75	7005.29	4812.13
270						20	26	11.5	3738.19	3124.84	4383.83	3044.66
271							10	5	27457.26	23036.34	23360.3	10449.3
272							18	9	28249.21	22197.33	23520.02	10628.11
273					2 on 1	8	26	13	32119.45	25644.73	26302.98	89.96
274							18	6	18870.12	17448.95	16269.1	7139.06
275						14	26	10	21561.53	19041.49	18156.87	8097.93
276				4x6		20	26	7	12355.95	11164.23	10790.2	4669.32
277							10	4.5	7870.68	4546.22	6231.34	3765.49
278							18	6.5	9381.5	6655.55	8667.02	114.27
279					4 on 1	8	26	8.5	6608.64	4434.36	6623.69	3820.62
280							18	5	5360.19	3605.08	5060.41	2561.78
281						14	26	7	4788.9	3251.91	4494.64	2582.34
282						20	26	5.5	3361.72	2282.04	2803.26	1672.41
283	2000	3	0				10	9	30522.67	24846.88	24245.6	89.48
284							18	13	34394.65	27329.76	27460.06	11985.33
285					2 on 1	8	26	17	33289.39	27129.69	26747.3	12547.55
286							18	10	23008.8	21176.95	18838.6	8097.93
287						14	26	14	23307.12	20400.25	19048.4	8120.31
288						20	26	11	15015.75	13343.84	12437.44	5268.85
289				8x10			10	8.5	11505.09	6067.64	8131.96	3820.62
290						8	18	10.5	10042.25	6724.42	8449.31	3827.51
291					4 on 1		26	12.5	8487.77	5400.66	8013.19	3829.76
292							18	9	7435.45	4909.07	5398.04	2589.22
293						14	26	11	6252.24	4268.46	5464.8	2591.47
294						20	26	9.5	4484.69	2959.81	3425.14	1681.55
295							10	11	31671.26	27751.05	26070.41	11968.05
296				10x12	2 on 1		18	15	31893.2	26628.99	25923.3	11998.96
297						8	26	19	33321.07	27004.79	26738.53	12547.55

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
298							18	12	6263.84	4579.89	6427.82	3829.76
299					2 on 1	14	26	16	21518.39	20855.11	18075.78	8112.98
300						20	26	13	21622.95	20401.59	17872.8	8119.25
301			0	10x12			10	10.5	14018.67	13351.61	11815.76	5269.21
302						8	18	12.5	6944.63	4238.03	6335.36	3827.51
303					4 on 1		26	14.5	5591.28	3928	5924.57	3829.51
304							18	11	4534.14	3274.67	4186.61	60.74
305						14	26	13	4015.59	2907.25	4031.43	2591.23
306						20	26	11.5	2807.88	2038.8	2576.2	1681.31
307							10	5	24535.58	19704.9	20972.71	9358.21
308							18	9	24913.61	18421.46	20482.32	9453.69
309					2 on 1	8	26	13	28444.15	20715.86	22649.18	79.78
310							18	6	16324.11	14566.55	14229.6	6216.46
311						14	26	10	18716.13	15662.08	15646.54	7030.29
312				4x6		20	26	7	10346.12	9011.5	9007.7	3945.64
313							10	4.5	5778.13	3155.11	3256.08	3359.13
314							18	6.5	6427.08	4500.97	6533.97	101.55
315	2000	3	3		4 on 1	8	26	8.5	4530.29	3036.76	4677.18	3391.93
316							18	5	3553.18	2401.59	3984.09	2229
317						14	26	7	3085.7	1960.1	3050.94	2240.23
318						20	26	5.5	2072.25	1477.25	1815.67	1411.99
319							10	9	26281.35	20172.8	20853.37	79.48
320							18	13	29471.54	20819.1	23092.5	10645.59
321					2 on 1	8	26	17	29638.73	21901.62	23463.34	11140.99
322							18	10	19360.52	16865.2	15775.42	7030.29
323						14	26	14	19412.95	16395.88	15589.01	7042.57
324						20	26	11	12221.17	10442.97	10019.28	4442.98
325				8x10			10	8.5	7466.16	3597.83	5726.3	3391.93
326					4 on 1	8	18	10.5	6312.76	4102.29	5567.57	3396.3
327							26	12.5	5465.14	3429.38	5200.64	3397.99

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
328							18	9	4480.59	2804.7	3655.35	2244.3
329				8x10	4 on 1	14	26	11	3764.78	2250.05	3394.4	2245.96
330						20	26	9.5	2575.11	1707.75	2032.84	1417.3
331							10	11	28217.94	23109.93	22777.24	10633.8
332							18	15	28374.82	21269.97	22568.98	10653.19
333					2 on 1	8	26	19	29660.68	22419.72	23352.52	11140.99
334							18	12	18728.69	17073.23	15522.69	7037.22
335						14	26	16	18782.48	16630.09	15296.13	7041.64
336						20	26	13	11862.63	10631.46	9853.94	4444.04
337			3	10x12			10	10.5	5008.68	2999.29	5153.83	3396.3
338						8	18	12.5	4513.04	3327.94	5138.27	3397.99
339					4 on 1		26	14.5	4134.02	2930.45	4562.58	3397.71
340							18	11	3126.54	2288.41	3312.57	52.76
341						14	26	13	2805.7	1972.42	3006.4	2245.72
342	2000	3				20	26	11.5	1865.56	1454.27	1833.49	1417.08
343							10	5	67179.17	53306.49	58627.66	25726.79
344							18	9	68168.66	49556.77	57847.72	25994.8
345					2 on 1	8	26	13	78193.65	55458.19	64687.84	220.37
346							18	6	44444.07	39269.76	39641.33	16999.19
347						14	26	10	51221.44	42606.9	44540.68	19187.05
348			6	4x6		20	26	7	28316.04	24611.14	25798.04	10795.53
349							10	4.5	13661.12	8035.73	14860.83	9232.28
350							18	6.5	15632.56	11429.77	19211.91	280.85
351					4 on 1	8	26	8.5	11292.66	8070.28	13610.56	9319.65
352							18	5	8484.58	6076.36	10832.47	6094.14
353						14	26	7	7636.28	5121.51	8547.34	6116.45
354						20	26	5.5	5033.7	3883.38	5218.86	3866.15
355							10	9	70747.17	54067.16	58100.34	219.76
356				8x10	2 on 1		18	13	80278.53	55370.05	65011.52	29237.7
357						8	26	17	81575.34	58367.15	67218.02	30585.46

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
358							18	10	52496.72	45012.51	44529.29	19187.05
359					2 on 1	14	26	14	52696.91	44598.56	44029.89	19205.35
360						20	26	11	33247.89	28211.46	28752.22	12150.46
361				8x10			10	8.5	17368.24	9026.21	16382.68	9319.65
362						8	18	10.5	15186.17	10487.65	16384.02	9329.33
363					4 on 1		26	12.5	13468.27	9237.07	14811.81	9330.6
364							18	9	10587.49	7029.12	10455.23	6125.76
365						14	26	11	9212.66	5873.16	9504.58	6126.89
366	2000	3	6			20	26	9.5	6176.45	4550.27	5932.88	3876.62
367							10	11	77753.05	62429.9	65000.32	29206.57
368							18	15	78081.24	57060.54	64275.42	29249.63
369					2 on 1	8	26	19	81630.02	59629.09	66266.89	30585.46
370							18	12	51220.13	45993.99	44172.17	19201.32
371						14	26	16	51354.69	44915.34	43501.15	19204
372						20	26	13	32497.13	28758.77	28489.04	12150.13
373				10x12			10	10.5	12611.98	7974.65	16248.74	9329.33
374						8	18	12.5	11546.24	8929.72	16263.06	9330.6
375					4 on 1		26	14.5	10756.61	8046.42	13975.9	9330.29
376							18	11	7869.08	6127.33	10330.44	144.93
377						14	26	13	7248.18	5322.75	8918.83	6126.6
378						20	26	11.5	4759.31	3978.41	5581.3	3876.33
379							10	5	31835.95	26710.01	28317.91	12115.67
380							18	9	32754.18	25737.2	28804.49	12323.01
381					2 on 1	8	26	13	37241.62	29734.36	32115.68	13896.66
382							18	6	21879.39	20231.58	19723.3	8277.54
383						14	26	10	25000.01	22078.09	22070.23	9389.33
384	4000	0	0	4x6		20	26	7	14326.39	12944.62	12942.9	5413.95
385							10	4.5	9125.84	5271.22	8712.4	4365.98
386					4 on 1		18	6.5	10877.59	7716.93	12099.18	5576.89
387						8	26	8.5	7662.54	5141.52	8662.3	4429.91

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
388							18	5	6214.99	4179.99	6724.08	2970.32
389				4x6	4 on 1	14	26	7	5552.6	3770.5	5793.44	2994.15
390						20	26	5.5	3897.82	2645.96	3572.16	1939.12
391							10	9	35390.2	28809.27	29719.65	103.76
392							18	13	39879.66	31688.11	33551.39	13896.66
393					2 on 1	8	26	17	38598.14	31456.13	32941.27	14548.55
394							18	10	26678.07	24554.09	22744.46	9389.33
395						14	26	14	27023.96	23653.53	23098.31	9415.28
396						20	26	11	17410.34	15471.82	14987.03	6109.09
397			0	8x10			10	8.5	13339.84	7035.26	11183.25	4429.91
398						8	18	10.5	11643.71	7796.78	11617.24	4437.89
399					4 on 1		26	12.5	9841.34	6261.92	10339.19	4440.5
400							18	9	8621.2	5691.93	7311.19	3002.13
401						14	26	11	7249.3	4949.17	7037.39	3004.74
402	4000	0				20	26	9.5	5199.88	3431.81	4351.05	1949.72
403							10	11	36721.95	32176.58	31919.02	13876.63
404							18	15	36979.29	30875.58	31847.77	13912.47
405					2 on 1	8	26	19	38634.88	31311.31	32753.7	14548.55
406							18	12	24949.98	24180.93	21913.18	9406.78
407						14	26	16	25071.22	23655.08	21757	9414.04
408						20	26	13	16254.27	15480.82	14340.86	6109.5
409				10x12			10	10.5	8052.11	4913.88	9166.25	4437.89
410						8	18	12.5	7262.75	5549.05	9316.52	4440.5
411					4 on 1		26	14.5	6482.93	4554.41	7948.17	4440.21
412							18	11	5257.21	3796.89	5966.33	3004.74
413						14	26	13	4655.97	3370.88	5370.93	3004.46
414						20	26	11.5	3255.66	2363.94	3381.96	1949.43
415							10	5	28448.33	22847.29	25827.56	10850.58
416			3	4x6	2 on 1		18	9	28886.65	21359.18	25637.29	10961.3
417						8	26	13	32980.22	24019.47	28579.65	12343.27

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
418	4000	0	3	4x6	2 on 1	14	18	6	18927.36	16889.52	17310.34	7207.82
419							26	10	21700.84	18159.75	19447.03	8151.43
420						20	26	7	11996.04	10448.58	10938.75	4574.87
421					4 on 1	8	10	4.5	6699.59	3658.27	7891.79	3894.82
422							18	6.5	7452.02	5218.76	10055.87	4961.26
423							26	8.5	5252.74	3521.04	6718.19	3932.85
424						14	18	5	4119.81	2784.57	5656.19	2584.46
425							26	7	3577.79	2272.69	4317.59	2597.49
426						20	26	5.5	2402.71	1712.84	2509.09	1637.17
427				8x10	2 on 1	8	10	9	30472.51	23389.81	26080.6	92.16
428							18	13	34171.45	24139.17	28962.78	12343.27
429							26	17	34365.3	25394.34	29580.4	12917.67
430						14	18	10	22448	19554.74	19470.19	8151.43
431							26	14	22508.79	19010.57	19476.87	8165.67
432						20	26	11	14170.12	12108.34	12290.64	5151.51
433					4 on 1	8	10	8.5	8656.81	4171.58	8841.58	3932.85
434							18	10.5	7319.48	4756.5	8733.41	3937.92
435							26	12.5	6336.68	3976.27	7415.23	3939.88
436						14	18	9	5195.12	3251.97	5496.54	2602.2
437							26	11	4365.16	2608.87	4833.75	2604.13
438						20	26	9.5	2985.76	1980.09	2845.5	1643.32
439				10x12	2 on 1	8	10	11	32717.93	26795.34	28478.23	12329.6
440							18	15	32899.82	24661.95	28400.33	12352.09
441							26	19	34390.75	25995.06	29522.48	12917.67
442						14	18	12	21715.41	19795.94	19162.29	8159.47
443							26	16	21777.77	19282.14	19216.15	8164.59
444						20	26	13	13754.39	12326.89	12174.81	5152.74
445					4 on 1	8	10	10.5	5807.42	3477.59	8278.01	3937.92
446							18	12.5	5232.74	3858.66	8303.42	3939.88
447							26	14.5	4793.28	3397.77	6701.57	3939.55

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
448							18	11	3625.14	2653.35	5261.01	2604.13
449			3	10x12	4 on 1	14	26	13	3253.13	2286.96	4384.95	2603.86
450						20	26	11.5	2163.07	1686.19	2651.68	1643.07
451							10	5	77892.41	61807.41	73870.95	29829.51
452							18	9	79039.7	57459.72	74600	30140.26
453					2 on 1	8	26	13	90663.39	64302.25	82531.03	33900.31
454							18	6	51531.68	45532.21	49455.64	19710.1
455						14	26	10	59389.86	49401.54	55515.32	22246.86
456				4x6		20	26	7	32831.67	28535.94	31894.15	12517.12
457							10	4.5	15839.7	9317.21	24309.02	10704.57
458							18	6.5	18125.53	13252.5	32266.37	13644.21
459					4 on 1	8	26	8.5	13093.54	9357.27	20772.04	10805.88
460							18	5	9837.64	7045.37	16637.35	7065.99
461						14	26	7	8854.06	5938.25	12788.45	7091.86
462	4000	0	6			20	26	5.5	5836.43	4502.67	7653.44	4482.7
463							10	9	82029.41	62689.39	74909.84	254.84
464							18	13	93080.76	64200.05	83402.91	33900.31
465					2 on 1	8	26	17	94584.38	67675.12	85746.11	35463.01
466							18	10	60868.52	52190.77	55767.75	22246.86
467						14	26	14	61100.62	51710.81	56089.98	22268.08
468						20	26	11	38550.02	32710.42	35850.92	14088.13
469				8x10			10	8.5	20138	10465.65	27131.13	10805.88
470						8	18	10.5	17607.95	12160.14	27591.22	10817.1
471					4 on 1		26	12.5	15616.1	10710.13	22381.65	10818.57
472							18	9	12275.91	8150.07	17247.08	7102.66
473						14	26	11	10681.83	6809.77	14199.75	7103.96
474						20	26	9.5	7161.43	5275.91	8677.19	4494.83
475							10	11	90152.54	72385.77	83061.91	33864.22
476				10x12	2 on 1		18	15	90533.06	66160.13	82457.44	33914.15
477						8	26	19	94647.77	69138.3	85559.98	35463.01

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
478							18	12	59388.34	53328.78	55483.79	22263.41
479					2 on 1	14	26	16	59544.36	52078.1	55700.54	22266.52
480						20	26	13	37679.54	33345.01	35709.97	14087.74
481		0	6	10x12			10	10.5	14623.24	9246.38	27579.61	10817.1
482						8	18	12.5	13387.55	10353.77	27918.76	10818.57
483					4 on 1		26	14.5	12472	9329.6	21460.71	10818.21
484							18	11	9123.99	7104.47	17473.69	7103.96
485						14	26	13	8404.06	6171.58	13634.67	7103.62
486						20	26	11.5	5518.28	4612.86	8526.88	4494.5
487							10	5	29835.05	25031.28	26538.12	11354.2
488							18	9	30695.57	24119.61	26994.12	11548.5
489					2 on 1	8	26	13	34900.97	27865.55	30097.2	13023.25
490							18	6	20504.26	18960.02	18483.69	7757.3
491						14	26	10	23428.75	20690.47	20683.11	8799.21
492				4x6		20	26	7	13425.97	12131.04	12129.44	5073.68
493							10	4.5	8552.28	4939.92	8164.82	4091.58
494							18	6.5	10193.93	7231.92	11338.74	5226.38
495	4000	3	0		4 on 1	8	26	8.5	7180.94	4818.38	8117.88	4151.49
496							18	5	5824.38	3917.28	6301.47	2783.63
497						14	26	7	5203.62	3533.52	5429.32	2805.97
498						20	26	5.5	3652.84	2479.67	3347.65	1817.24
499							10	9	33165.91	26998.6	27851.76	97.23
500							18	13	37373.21	29696.5	31442.67	13023.25
501					2 on 1	8	26	17	36172.24	29479.1	30870.91	13634.17
502							18	10	25001.35	23010.86	21314.96	8799.21
503						14	26	14	25325.5	22166.9	21646.58	8823.52
504						20	26	11	16316.1	14499.41	14045.09	5725.13
505				8x10			10	8.5	12501.43	6593.09	10480.38	4151.49
506					4 on 1	8	18	10.5	10911.9	7306.75	10887.1	4158.97
507							26	12.5	9222.81	5868.36	9689.37	4161.41

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
508							18	9	8079.36	5334.19	6851.68	2813.45
509				8x10	4 on 1	14	26	11	6793.68	4638.11	6595.09	2815.89
510						20	26	9.5	4873.06	3216.12	4077.58	1827.18
511							10	11	34413.97	30154.28	29912.9	13004.48
512							18	15	34655.13	28935.04	29846.13	13038.07
513					2 on 1	8	26	19	36206.66	29343.39	30695.12	13634.17
514							18	12	23381.87	22661.15	20535.93	8815.56
515						14	26	16	23495.49	22168.36	20389.56	8822.37
516						20	26	13	15232.68	14507.85	13439.53	5725.52
517			0	10x12			10	10.5	7546.03	4605.04	8590.15	4158.97
518						8	18	12.5	6806.28	4976.51	8730.98	4161.41
519					4 on 1		26	14.5	6075.48	4268.16	7448.63	4161.15
520							18	11	4926.79	3558.26	5591.34	2815.89
521						14	26	13	4363.34	3159.02	5033.36	2815.63
522	4000	3				20	26	11.5	3051.01	2215.36	3169.4	1826.91
523							10	5	26660.34	21411.33	24204.29	10168.62
524							18	9	27071.12	20016.75	24025.98	10272.38
525					2 on 1	8	26	13	30907.4	22509.84	26783.41	11567.49
526							18	6	17737.77	15828.01	16222.38	6754.8
527						14	26	10	20336.94	17018.4	18224.78	7639.11
528			3	4x6		20	26	7	11242.08	9791.89	10251.25	4287.34
529							10	4.5	6278.52	3428.34	7395.79	3650.03
530							18	6.5	6983.66	4890.76	9423.86	4649.44
531					4 on 1	8	26	8.5	4922.61	3299.74	6295.95	3685.67
532							18	5	3860.88	2609.56	5300.69	2422.03
533						14	26	7	3352.92	2129.85	4046.23	2434.23
534						20	26	5.5	2251.7	1605.18	2351.4	1534.27
535							10	9	28557.3	21919.76	24441.42	86.36
536				8x10	2 on 1		18	13	32023.76	22622.02	27142.46	11567.49
537						8	26	17	32205.43	23798.29	27721.27	12105.79

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
538							18	10	21037.13	18325.71	18246.48	7639.11
539					2 on 1	14	26	14	21094.1	17815.75	18252.74	7652.45
540						20	26	11	13279.52	11347.32	11518.17	4827.73
541				8x10			10	8.5	8112.72	3909.4	8285.88	3685.67
542						8	18	10.5	6859.45	4457.55	8184.52	3690.42
543					4 on 1		26	12.5	5938.42	3726.36	6949.18	3692.26
544							18	9	4868.61	3047.58	5151.08	2438.66
545						14	26	11	4090.81	2444.9	4529.94	2440.46
546						20	26	9.5	2798.11	1855.64	2666.66	1540.03
547							10	11	30661.6	25111.24	26688.36	11554.68
548							18	15	30832.06	23111.94	26615.36	11575.75
549			3		2 on 1	8	26	19	32229.28	24361.26	27666.98	12105.79
550							18	12	20350.59	18551.76	17957.94	7646.64
551						14	26	16	20409.03	18070.25	18008.41	7651.44
552						20	26	13	12889.92	11552.14	11409.62	4828.89
553	4000	3		10x12			10	10.5	5442.42	3259.02	7757.73	3690.42
554						8	18	12.5	4903.86	3616.14	7781.55	3692.26
555					4 on 1		26	14.5	4492.02	3184.22	6280.38	3691.95
556							18	11	3397.3	2486.58	4930.35	2440.46
557						14	26	13	3048.67	2143.23	4109.35	2440.2
558						20	26	11.5	2027.12	1580.21	2485.02	1539.8
559							10	5	72996.86	57922.8	69228.14	27954.72
560							18	9	74072.03	53848.37	69911.38	28245.94
561					2 on 1	8	26	13	84965.18	60260.84	77343.94	31769.67
562							18	6	48292.9	42670.5	46347.34	18471.31
563						14	26	10	55657.19	46296.64	52026.17	20848.64
564			6	4x6		20	26	7	30768.2	26742.45	29889.59	11730.42
565							10	4.5	14844.17	8731.62	22781.19	10031.79
566					4 on 1		18	6.5	16986.33	12419.58	30238.42	12786.66
567						8	26	8.5	12270.6	8769.16	19466.51	10126.72

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
568							18	5	9219.34	6602.57	15591.69	6621.89
569				4x6	4 on 1	14	26	7	8297.58	5565.03	11984.69	6646.13
570						20	26	5.5	5469.61	4219.67	7172.42	4200.96
571							10	9	76873.85	58749.35	70201.73	238.82
572							18	13	87230.61	60165.07	78161.02	31769.67
573					2 on 1	8	26	17	88639.73	63421.72	80356.95	33234.15
574							18	10	57042.92	48910.57	52262.73	20848.64
575						14	26	14	57260.43	48460.77	52564.71	20868.53
576						20	26	11	36127.14	30654.56	33597.68	13202.69
577			6	8x10			10	8.5	18872.33	9807.88	25425.94	10126.72
578						8	18	10.5	16501.29	11395.87	25857.11	10137.24
579					4 on 1		26	12.5	14634.62	10036.99	20974.96	10138.62
580							18	9	11504.36	7637.84	16163.1	6656.25
581						14	26	11	10010.48	6381.77	13307.29	6657.48
582	4000	3				20	26	9.5	6711.33	4944.32	8131.83	4212.33
583							10	11	84486.43	67836.3	77841.45	31735.85
584							18	15	84843.04	62001.95	77274.97	31782.64
585					2 on 1	8	26	19	88699.14	64792.94	80182.52	33234.15
586							18	12	55655.77	49977.05	51996.62	20864.15
587						14	26	16	55801.98	48804.98	52199.75	20867.06
588						20	26	13	35311.37	31249.27	33465.59	13202.33
589				10x12			10	10.5	13704.17	8665.25	25846.22	10137.24
590						8	18	12.5	12546.14	9703.04	26164.06	10138.62
591					4 on 1		26	14.5	11688.13	8743.24	20111.9	10138.28
592							18	11	8550.54	6657.96	16375.47	6657.48
593						14	26	13	7875.87	5783.7	12777.73	6657.16
594						20	26	11.5	5171.46	4322.94	7990.96	4212.02
595							10	5	22798.65	18190.17	18990.55	8676.39
596	8000	0	0	4x6	2 on 1		18	9	23456.23	17952.75	18957.63	8824.87
597						8	26	13	26669.82	21293.65	21176.02	9951.81

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
598							18	6	15668.47	14265.67	13346.73	5927.79
599					2 on 1	14	26	10	17903.24	15810.77	14800.8	6723.97
600				4x6		20	26	7	10259.55	9090.02	8785.43	3877.09
601							10	4.5	6535.28	3234.72	5157.47	3126.61
602							18	6.5	6149.86	3485.11	5688.68	3155.33
603					4 on 1	8	26	8.5	5487.37	2868.4	5501.75	3172.39
604							18	5	4450.74	2670.23	3567.59	2127.13
605						14	26	7	3976.38	3054.98	3717.15	2144.2
606						20	26	5.5	2791.35	1888.11	2292.66	1388.66
607							10	9	25341.44	19328.62	19448.22	8824.87
608							18	13	28558.99	22282.36	22076.59	9951.81
609					2 on 1	8	26	17	27641.26	22526.66	21441.05	10418.73
610							18	10	19104.95	16816.8	15255.84	6723.97
611						14	26	14	19352.65	16939.8	15260.38	6742.56
612						20	26	11	12468.06	10575.97	10024.6	4374.9
613	8000	0	0	8x10			10	8.5	9553.05	8335.62	6654.72	3172.39
614						8	18	10.5	8338.4	5314.45	6857.01	3178.1
615					4 on 1		26	12.5	7047.67	3520.88	6603.27	3179.97
616							18	9	6173.9	3570.39	4388.98	2149.91
617						14	26	11	5191.43	3810.59	4462.84	2151.78
618						20	26	9.5	3723.78	2800.35	2817.83	1396.25
619							10	11	26297.67	21796.54	21043.91	9937.46
620							18	15	26481.96	21923.37	20897.96	9963.13
621					2 on 1	8	26	19	27667.57	22422.95	21347.81	10418.64
622							18	12	17867.41	17143.56	14587.67	6736.47
623						14	26	16	18697.27	17024.91	14906.53	7049.8
624						20	26	13	11640.16	10894.59	9557.99	4375.19
625				10x12			10	10.5	5766.35	3169.18	5258.01	3178.1
626					4 on 1	8	18	12.5	5201.07	3571.43	5319.3	3179.97
627							26	14.5	4642.62	2609.3	4936.04	3179.77

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
628							18	11	3764.84	2481.69	4389.23	2151.78
629			0	10x12	4 on 1	14	26	13	3334.28	2641.93	3327.66	2151.58
630						20	26	11.5	2331.48	1897.09	2129.27	1396.04
631							10	5	20372.68	15314.1	18249.5	7770.42
632							18	9	20686.58	14951.86	18092.43	7849.71
633					2 on 1	8	26	13	23618.1	17201.05	20171.7	8839.38
634							18	6	13554.44	11906.18	12291.17	5161.73
635						14	26	10	15540.61	13004.73	13727.42	5837.48
636				4x6		20	26	7	8590.72	7509.81	7755.91	3276.2
637							10	4.5	4797.77	2205.61	5965.15	2789.19
638							18	6.5	4214.13	2000.04	6003.67	2807.02
639					4 on 1	8	26	8.5	3761.64	1848.05	3958.36	2816.43
640							18	5	2950.32	1749.42	3701.2	1850.81
641						14	26	7	2562.16	1937.85	2579.04	1860.14
642	8000	0				20	26	5.5	1720.65	1068.75	1510.15	1172.42
643							10	9	21816.29	15588.01	18364.8	7849.71
644							18	13	24471.18	17560.63	20460.88	8839.38
645					2 on 1	8	26	17	24610	18185.63	20812.05	9250.82
646							18	10	16075.67	13620.42	13843.88	5837.48
647						14	26	14	16119.2	13614.27	13564.37	5847.67
648						20	26	11	10147.63	8186.33	8703.31	3689.15
649			3	8x10			10	8.5	6199.39	5622.19	6701.32	2816.43
650						8	18	10.5	5241.69	2816.64	6625.24	2820.06
651					4 on 1		26	12.5	4537.88	1999.7	4340.49	2821.46
652							18	9	3720.38	1987.86	4111.64	1863.52
653						14	26	11	3126.02	2221.25	2836.7	1864.89
654						20	26	9.5	2138.19	1558.16	1698.99	1176.83
655							10	11	23430.27	17622.77	20134.28	8829.58
656				10x12	2 on 1		18	15	23560.53	17762.27	20011.66	8845.69
657						8	26	19	24628.23	18615.82	20715.09	9250.72

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
658							18	12	15551.04	14142.54	13473.61	5843.23
659					2 on 1	14	26	16	16271.82	14237.83	13808.91	6114.14
660						20	26	13	9849.92	8883.91	8617.08	3690.03
661			3	10x12			10	10.5	4158.87	2288.57	6339.11	2820.06
662						8	18	12.5	3747.32	2394.41	6314.79	2821.46
663					4 on 1		26	14.5	3432.61	1821.48	3841.83	2821.23
664							18	11	2596.07	1719.3	3976.53	1864.89
665						14	26	13	2329.66	1849.29	2510.79	1864.7
666						20	26	11.5	1549.04	1274.12	1538.2	1176.65
667							10	5	55781.05	42010.68	53004.54	21361.79
668							18	9	56602.64	40360.2	53358.55	21584.33
669					2 on 1	8	26	13	64926.71	46048.73	59001.47	24277.01
670							18	6	36903.35	32484.58	35380.41	14114.98
671						14	26	10	42530.82	35377.89	39637	15931.63
672				4x6		20	26	7	23511.72	20610.37	22752.31	8963.88
673							10	4.5	11343.27	5849.26	18974.45	7665.86
674							18	6.5	10251.47	5101.51	19868.52	7719.8
675	8000	0	6		4 on 1	8	26	8.5	9376.67	4859.68	11695.42	7738.4
676							18	5	7045.02	4615.33	11681.77	5060.16
677						14	26	7	6340.65	5157.32	7329.12	5078.69
678						20	26	5.5	4179.64	2823.27	4482.1	3210.19
679							10	9	58761.54	42323.29	53602.12	21584.33
680							18	13	66657.86	47207	59355.47	24277.01
681					2 on 1	8	26	17	67734.65	48464.14	60747.83	25396.22
682							18	10	43589.73	36906.61	39972.63	15931.63
683						14	26	14	43755.95	37031.8	39659.5	15946.83
684						20	26	11	27606.8	21958.18	25524.37	10088.92
685				8x10			10	8.5	14421.42	14758.41	20920.68	7738.4
686					4 on 1	8	18	10.5	12609.57	7192.87	21285.6	7746.44
687							26	12.5	11183.14	5176.8	12426.1	7747.5

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
688							18	9	8791.14	5224.39	13250.42	5086.42
689				8x10	4 on 1	14	26	11	7649.57	5899.05	8016.53	5087.36
690						20	26	9.5	5128.51	4097.64	5073.76	3218.88
691							10	11	64560.88	48070.68	58970.1	24251.16
692							18	15	64833.38	47927.52	58981.76	24286.92
693		0	6		2 on 1	8	26	19	67780.05	49511.96	60572.96	25396.1
694							18	12	42529.73	38374.61	39513.88	15943.48
695						14	26	16	44504.74	38467.38	40731.75	16674.15
696						20	26	13	26983.42	24195.02	25458.34	10088.65
697				10x12			10	10.5	10472.13	6228.08	21398.29	7746.44
698						8	18	12.5	9587.21	6397.5	21693.08	7747.5
699					4 on 1		26	14.5	8931.56	4864.04	11722.16	7747.24
700							18	11	6533.96	4717.44	13551.32	5087.36
701						14	26	13	6018.4	5116.14	7564.52	5087.11
702						20	26	11.5	3951.81	3471.26	4783.21	3218.64
703	8000						10	5	25069.54	20002.02	20882.13	9540.61
704							18	9	25792.62	19740.96	20845.93	9703.88
705					2 on 1	8	26	13	29326.3	23414.63	23285.29	10943.07
706							18	6	17229.15	15686.62	14676.16	6518.24
707						14	26	10	19686.51	17385.62	16275.05	7393.72
708		3	0	4x6		20	26	7	11281.46	9995.44	9660.51	4263.27
709							10	4.5	7186.23	3556.92	5671.18	3438.04
710							18	6.5	6762.43	3832.25	6255.31	3469.62
711					4 on 1	8	26	8.5	6033.94	3154.11	6049.76	3488.38
712							18	5	4894.06	2936.2	3922.94	2339.01
713						14	26	7	4372.45	3359.28	4087.41	2357.77
714						20	26	5.5	3069.38	2076.18	2521.02	1526.98
715							10	9	27865.61	21253.87	21385.38	9703.88
716				8x10	2 on 1		18	13	31403.65	24501.82	24275.55	10943.07
717						8	26	17	30394.51	24770.45	23576.71	11456.5

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
718	8000	3	0	8x10	2 on 1	14	18	10	21007.92	18491.86	16775.42	7393.72
719							26	14	21280.3	18627.12	16780.41	7414.16
720						20	26	11	13709.95	11629.4	11023.11	4810.66
721					4 on 1	8	10	8.5	10504.6	9165.9	7317.57	3488.38
722							18	10.5	9168.96	5843.8	7540.01	3494.66
723							26	12.5	7749.66	3871.58	7261	3496.72
724						14	18	9	6788.86	3926.03	4826.15	2364.06
725							26	11	5708.53	4190.15	4907.37	2366.12
726						20	26	9.5	4094.7	3079.29	3098.5	1535.32
727				10x12	2 on 1	8	10	11	28917.08	23967.61	23140.01	10927.29
728							18	15	29119.73	24107.07	22979.53	10955.52
729							26	19	30423.43	24656.42	23474.19	11456.4
730						14	18	12	19647.12	18851.17	16040.69	7407.47
731							26	16	20559.63	18720.7	16391.31	7752.01
732						20	26	13	12799.59	11979.76	10510.03	4810.99
733					4 on 1	8	10	10.5	6340.72	3484.85	5781.74	3494.66
734							18	12.5	5719.13	3921.82	5849.13	3496.72
735							26	14.5	5105.05	2869.2	5427.7	3496.49
736						14	18	11	4139.84	2728.88	3819.84	2366.12
737							26	13	3666.39	2905.08	3659.11	2365.89
738						20	26	11.5	2563.7	2086.05	2341.36	1535.1
739			3	4x6	2 on 1	8	10	5	22401.93	16839.48	18687.86	8544.4
740							18	9	22747.09	16441.16	18263.5	8631.59
741							26	13	25970.61	18914.38	20100.35	9719.83
742						14	18	6	14904.55	13092.11	12720.38	5675.87
743							26	10	17088.55	14300.08	14025.38	6418.92
744						20	26	7	9446.41	8257.84	8058.66	3602.53
745					4 on 1	8	10	4.5	5275.66	2425.3	4915.96	3067.01
746							18	6.5	4633.88	2199.26	4848.56	3086.62
747							26	8.5	4136.33	2032.13	4352.64	3096.97

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
748							18	5	3244.19	1923.67	3114.19	2035.16
749				4x6	4 on 1	14	26	7	2817.36	2130.88	2835.93	2045.42
750						20	26	5.5	1892.04	1175.2	1660.57	1289.21
751							10	9	23989.32	17140.68	18551.4	8631.59
752							18	13	26908.66	19309.78	20416.65	9719.83
753					2 on 1	8	26	17	27061.31	19997.03	20751.32	10172.25
754							18	10	17676.9	14977.1	14082.99	6418.92
755						14	26	14	17724.78	14970.34	13838.03	6430.14
756						20	26	11	11158.4	9001.74	8988.49	4056.61
757			3	8x10			10	8.5	6816.89	6182.2	5374.31	3096.97
758						8	18	10.5	5763.8	3097.2	5200.84	3100.96
759					4 on 1		26	12.5	4989.88	2198.88	4772.83	3102.5
760							18	9	4090.95	2185.86	3332.75	2049.13
761						14	26	11	3437.39	2442.5	3119.26	2050.65
762	8000	3				20	26	9.5	2351.17	1713.37	1868.22	1294.05
763							10	11	25764.07	19378.11	20309.41	9709.07
764							18	15	25907.3	19531.5	19982.19	9726.78
765					2 on 1	8	26	19	27081.35	20470.08	20522.78	10172.15
766							18	12	17100.02	15551.23	13770.78	6425.26
767						14	26	16	17892.59	15656.01	14022.42	6723.15
768						20	26	13	10831.04	9768.8	8797.17	4057.58
769				10x12			10	10.5	4573.11	2516.52	4814.88	3100.96
770						8	18	12.5	4120.58	2632.9	4801.15	3102.5
771					4 on 1		26	14.5	3774.52	2002.92	4224.5	3102.24
772							18	11	2854.66	1890.55	3105.46	2050.65
773						14	26	13	2561.71	2033.49	2760.88	2050.43
774						20	26	11.5	1703.33	1401.03	1691.42	1293.85
775							10	5	61337.19	46195.21	52476.55	23489.56
776			6	4x6	2 on 1		18	9	62240.62	44380.33	51915.54	23734.26
777						8	26	13	71393.83	50635.48	57672.87	26695.15

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
778	8000	3	6	4x6	2 on 1	14	18	6	40579.16	35720.25	35714.11	15520.92
779							26	10	46767.16	38901.75	39748.14	17518.52
780						20	26	7	25853.64	22663.29	23216.12	9856.74
781					4 on 1	8	10	4.5	12473.13	6431.88	14338.02	8429.43
782							18	6.5	11272.58	5609.66	14652.16	8488.74
783							26	8.5	10310.64	5343.73	12860.35	8509.2
784						14	18	5	7746.75	5075.05	9079.13	5564.19
785							26	7	6972.22	5671.02	8059.14	5584.56
786						20	26	5.5	4595.96	3104.49	4928.55	3529.95
787				8x10	2 on 1	8	10	9	64614.56	46538.96	52632.83	23734.26
788							18	13	73297.41	51909.11	58236	26695.15
789							26	17	74481.45	53291.47	59424.47	27925.84
790						14	18	10	47931.54	40582.74	39893.45	17518.52
791							26	14	48114.32	40720.4	39159.83	17535.23
792						20	26	11	30356.61	24145.35	25807.61	11093.84
793					4 on 1	8	10	8.5	15857.88	16228.44	15561.66	8509.2
794							18	10.5	13865.56	7909.33	15488.12	8518.04
795							26	12.5	12297.06	5692.44	13663.82	8519.2
796						14	18	9	9666.79	5744.78	9987.42	5593.06
797							26	11	8411.52	6486.63	8815.03	5594.09
798						20	26	9.5	5639.34	4505.79	5579.14	3539.5
799				10x12	2 on 1	8	10	11	70991.55	52858.82	57985.58	26666.73
800							18	15	71291.2	52701.41	57082.77	26706.05
801							26	19	74531.37	54443.67	59015.09	27925.71
802						14	18	12	46765.96	42196.96	39289.61	17531.55
803							26	16	48937.69	42298.97	40494.82	18335
804						20	26	13	29671.14	26605	25558.22	11093.54
805					4 on 1	8	10	10.5	11515.22	6848.43	15483.29	8518.04
806							18	12.5	10542.16	7034.74	15551.41	8519.2
807							26	14.5	9821.2	5348.53	12889.76	8518.91

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
808							18	11	7184.78	5187.33	9964.65	5594.09
809	8000	3	6	10x12	4 on 1	14	26	13	6617.87	5625.74	8318	5593.82
810						20	26	11.5	4345.43	3817.02	5259.65	3539.24
811							10	5	24852.58	19828.91	21291.74	9458.04
812							18	9	25569.39	19570.11	21346.87	9619.89
813					2 on 1	8	26	13	29072.49	23211.98	23497.68	10848.36
814							18	6	17080.04	15550.85	14759.28	6461.82
815						14	26	10	19516.13	17235.15	16272.67	7329.73
816				4x6		20	26	7	11183.82	9908.93	9708.34	4226.37
817							10	4.5	7124.04	3526.14	7029.63	3408.28
818							18	6.5	6703.9	3799.08	7702.28	3439.59
819					4 on 1	8	26	8.5	5981.72	3126.81	7073.43	3458.19
820							18	5	4851.7	2910.79	4693.95	2318.76
821						14	26	7	4334.61	3330.2	4624.33	2337.37
822	12000	0				20	26	5.5	3042.82	2058.21	2823.3	1513.76
823							10	9	27624.44	21069.93	21817.07	9619.89
824							18	13	31131.86	24289.77	24249.93	10848.36
825					2 on 1	8	26	17	30131.45	24556.07	23878.58	11357.35
826							18	10	20826.11	18331.81	16682.79	7329.73
827						14	26	14	21096.13	18465.9	16782.68	7349.99
828						20	26	11	13591.3	11528.75	11009.98	4769.03
829							10	8.5	10413.68	9086.57	8784.45	3458.19
830						8	18	10.5	9089.6	5793.22	9082.52	3464.42
831					4 on 1		26	12.5	7682.59	3838.07	8243.82	3466.46
832							18	9	6730.1	3892.05	5717.04	2343.6
833						14	26	11	5659.13	4153.88	5482.27	2345.64
834						20	26	9.5	4059.26	3052.64	3411.04	1522.04
835							10	11	28666.81	23760.18	23349.75	10832.72
836				10x12	2 on 1		18	15	28867.71	23898.43	23104.21	10860.7
837						8	26	19	30160.13	24443.03	23873.69	11357.25

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
838							18	12	19477.08	18688.02	16203.66	7343.36
839					2 on 1	14	26	16	20381.7	18558.67	16521.13	7684.91
840						20	26	13	12688.82	11876.08	10516.03	4769.35
841			0	10x12			10	10.5	6285.84	3454.69	7752.04	3464.42
842						8	18	12.5	5669.63	3887.87	7886.88	3466.46
843					4 on 1		26	14.5	5060.87	2844.37	6598	3466.23
844							18	11	4104.01	2705.26	5054.16	2345.64
845						14	26	13	3634.66	2879.94	4388.94	2445.51
846						20	26	11.5	2541.52	2068	2759.03	1521.81
847							10	5	22208.05	16693.74	19527.76	8470.46
848							18	9	22550.22	16298.87	19317.76	8556.88
849					2 on 1	8	26	13	25745.84	18750.68	21262.04	9635.71
850							18	6	14775.55	12978.81	13128.91	5626.75
851						14	26	10	16940.65	14176.32	14355.08	6363.37
852				4x6		20	26	7	9364.65	8186.37	8353.65	3571.35
853							10	4.5	5230	2404.31	7031.27	3040.47
854							18	6.5	4593.78	2180.22	7226.1	3059.91
855	12000	0	3		4 on 1	8	26	8.5	4100.53	2014.54	5932.87	3070.16
856							18	5	3216.11	1907.02	4333.77	2017.55
857						14	26	7	2792.98	2112.43	3726.33	2027.71
858						20	26	5.5	1875.67	1165.03	2147.92	1278.05
859							10	9	23781.7	16992.33	19820.57	8556.88
860							18	13	26675.77	19142.66	21539.72	9635.71
861					2 on 1	8	26	17	26827.1	19823.96	21871.53	10084.22
862							18	10	17523.92	14847.48	14623.6	6363.37
863				8x10		14	26	14	17571.37	14840.77	14340.48	6374.49
864						20	26	11	11061.83	8923.84	9310.87	4021.5
865							10	8.5	6757.89	6128.69	7982.41	3070.16
866					4 on 1	8	18	10.5	5713.91	3070.39	7889.95	3074.12
867							26	12.5	4946.7	2179.85	6380.01	3075.65

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
868							18	9	4055.55	2166.95	4795.18	2031.4
869				8x10	4 on 1	14	26	11	3407.64	2421.36	4111.14	2032.9
870						20	26	9.5	2330.82	1698.54	2388.74	1282.85
871							10	11	25541.09	19210.39	21310.4	9625.04
872							18	15	25683.09	19362.46	21082.48	9642.6
873					2 on 1	8	26	19	26846.97	20292.91	21622.22	10084.11
874							18	12	16952.03	15416.64	14284.71	6369.65
875						14	26	16	17737.73	15520.51	14677.41	6664.96
876						20	26	13	10737.3	9684.26	9168.45	4022.46
877			3	10x12			10	10.5	4533.54	2494.74	7570.33	3074.12
878						8	18	12.5	4084.92	2610.12	7582.39	3075.65
879					4 on 1		26	14.5	3741.85	1985.58	5909.49	3075.39
880							18	11	2829.95	1874.19	4707.05	2032.9
881						14	26	13	2539.54	2015.89	3784.84	2032.69
882	12000	0				20	26	11.5	1688.59	1388.9	2281.45	1282.65
883							10	5	60806.34	45795.41	57185.69	23286.27
884							18	9	61701.95	43996.23	57528.77	23528.85
885					2 on 1	8	26	13	70775.94	50197.25	63452.84	26464.12
886							18	6	40227.96	35411.11	38301.61	15386.59
887						14	26	10	46362.41	38565.07	42788.08	17366.91
888			6	4x6		20	26	7	25629.89	22467.15	24787.08	9771.43
889							10	4.5	12365.18	6376.21	22949.29	8356.47
890							18	6.5	11175.02	5561.11	24447.86	8415.27
891					4 on 1	8	26	8.5	10221.41	5297.48	19123.9	8435.55
892							18	5	7679.7	5031.12	14257.95	5516.03
893						14	26	7	6911.88	5621.94	11650.52	5536.22
894						20	26	5.5	4556.18	3077.62	6828.78	3499.4
895							10	9	64055.35	46136.18	58023.64	23528.85
896				8x10	2 on 1		18	13	72663.05	51459.86	63948.41	26464.12
897						8	26	17	73836.84	52830.25	65148.16	27684.15

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
898							18	10	47516.71	40231.52	43001.7	17366.91
899					2 on 1	14	26	14	47697.91	40367.98	42851	17383.47
900						20	26	11	30093.89	23936.38	27701.33	10997.83
901			6	8x10			10	8.5	15720.64	16087.99	26220.25	8435.55
902						8	18	10.5	13745.56	7840.87	26783.29	8444.32
903					4 on 1		26	12.5	12190.63	5643.17	20431.79	8445.46
904							18	9	9583.13	5695.06	16256.53	5544.65
905						14	26	11	8338.72	6430.49	12833.01	5545.67
906						20	26	9.5	5590.53	4466.79	7760.07	3508.87
907							10	11	70377.14	52401.35	63568.89	26435.94
908							18	15	70674.2	52245.29	63459.19	26474.92
909		0			2 on 1	8	26	19	73886.33	53972.48	64919.12	27684.03
910							18	12	46361.22	41831.76	42634.16	17379.82
911						14	26	16	48514.15	41932.89	43817.02	18176.32
912						20	26	13	29414.35	26374.74	27571.82	10997.53
913	12000			10x12			10	10.5	11415.56	6789.16	26792.89	8444.32
914						8	18	12.5	10450.92	6973.85	27080.08	8445.46
915					4 on 1		26	14.5	9736.2	5302.24	19800.84	8445.18
916							18	11	7122.6	5142.43	16620.94	5545.67
917						14	26	13	6560.59	5577.05	12558.86	5545.41
918						20	26	11.5	4307.82	3783.99	7738.99	3508.61
919							10	5	29919.3	23871.46	25632.52	11386.27
920							18	9	30782.26	23559.89	25698.88	11581.12
921					2 on 1	8	26	13	34999.54	27944.24	28288.19	13060.03
922							18	6	20562.17	18721.23	17862.01	7779.2
923						14	26	10	23494.91	20748.9	19672.17	8824.05
924		3	0	4x6		20	26	7	13463.88	11929.08	11735.47	5088.01
925							10	4.5	8576.43	4245.02	8712.99	4103.14
926					4 on 1		18	6.5	8070.63	4573.6	9508.19	4140.83
927						8	26	8.5	7201.22	3764.28	8515.5	4163.21

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
928							18	5	5840.83	3504.21	5790.88	2791.49
929				4x6	4 on 1	14	26	7	5218.31	4009.13	5567.1	2813.89
930						20	26	5.5	3663.16	2477.82	3398.89	1822.38
931							10	9	33256.27	25365.48	26393.34	11581.12
932							18	13	37478.75	29241.76	29322	13060.03
933					2 on 1	8	26	17	36274.39	29562.35	28870.65	13672.79
934							18	10	25071.95	22069.14	20163.82	8824.05
935						14	26	14	25397.02	22230.57	20279.53	8848.44
936						20	26	11	16362.17	13879.13	13298.37	5741.3
937			0	8x10			10	8.5	12536.73	10939.06	10797.16	4163.21
938						8	18	10.5	10942.71	6974.29	11167.82	4170.71
939					4 on 1		26	12.5	9248.85	4620.55	9924.5	4173.17
940	12000	3					18	9	8102.18	4685.52	7026.24	2821.39
941						14	26	11	6812.86	5000.74	6599.95	2823.85
942						20	26	9.5	4886.82	3674.98	4106.45	1832.34
943							10	11	34511.16	28604.2	28110.1	13041.2
944							18	15	34753	28770.63	27942.07	13074.89
945					2 on 1	8	26	19	36308.91	29426.26	28740.85	13672.67
946							18	12	23447.9	22497.97	19507.12	8840.46
947						14	26	16	24536.94	22342.25	19963.24	9251.65
948						20	26	13	15275.7	14297.27	12705.99	5741.69
949				10x12			10	10.5	7567.34	4159.01	9332.45	4170.71
950						8	18	12.5	6825.5	4680.5	9494.79	4173.17
951					4 on 1		26	14.5	6092.64	3424.25	7943.14	4172.9
952							18	11	4940.7	3256.79	6084.56	2823.85
953						14	26	13	4375.66	3467.07	5283.72	2823.58
954						20	26	11.5	3059.66	2489.6	3321.52	1832.07
955			3	4x6	2 on 1		10	5	26735.63	20097.11	23508.91	10197.34
956							18	9	27147.56	19261.74	23256.1	10301.39
957						8	26	13	30994.68	22573.41	25596.76	11600.15

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
958							18	6	17787.87	15624.81	15805.52	6773.88
959					2 on 1	14	26	10	20394.37	17066.46	17281.67	7660.68
960				4x6		20	26	7	11273.83	9855.33	10056.72	4299.44
961							10	4.5	6296.25	2894.48	8464.74	3660.34
962							18	6.5	5530.32	2624.71	8699.29	3683.73
963					4 on 1	8	26	8.5	4936.51	2425.25	7142.41	3696.08
964							18	5	3871.78	2295.81	5217.3	2428.87
965						14	26	7	3362.39	2543.1	4486.03	2441.11
966						20	26	5.5	2258.06	1402.55	2585.82	1538.61
967							10	9	28630.11	20456.58	23861.42	10301.39
968							18	13	32114.2	23045.3	25931.05	11600.15
969					2 on 1	8	26	17	32296.38	23865.5	26330.51	12140.1
970							18	10	21096.54	17874.45	17604.93	7660.68
971						14	26	14	21153.67	17866.38	17264.1	7674.06
972						20	26	11	13317.02	10743.15	11209.08	4841.37
973	12000	3	3	8x10			10	8.5	8135.64	7378.16	9609.79	3696.08
974						8	18	10.5	6878.82	3696.36	9498.48	3700.84
975					4 on 1		26	12.5	5955.19	2624.26	7680.71	3702.69
976							18	9	4882.35	2608.72	5772.78	2445.54
977						14	26	11	4102.36	2915	4949.29	2447.35
978						20	26	9.5	2806.01	2044.82	2875.74	1544.38
979							10	11	30748.19	23126.84	25654.98	11587.31
980							18	15	30919.13	23309.92	25380.59	11608.45
981					2 on 1	8	26	19	32320.3	24430.06	26030.37	12139.98
982							18	12	20408.06	18559.65	17196.95	7668.24
983						14	26	16	21353.95	18684.7	17669.71	8023.76
984						20	26	13	12926.33	11658.6	11037.63	4842.53
985				10x12			10	10.5	5457.79	3003.35	9113.7	3700.84
986					4 on 1	8	18	12.5	4917.71	3142.25	9128.23	3702.69
987							26	14.5	4504.71	2390.38	7114.26	3702.38

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
988							18	11	3406.9	2256.29	5666.68	2447.35
989			3	10x12	4 on 1	14	26	13	3057.28	2426.87	4556.46	2447.09
990						20	26	11.5	2032.84	1672.06	2746.58	1544.15
991							10	5	73203.01	55131.77	68844.2	28033.67
992							18	9	74281.21	52965.8	69257.23	28325.71
993					2 on 1	8	26	13	85205.12	60431.02	76389.05	31859.39
994							18	6	48429.29	42630.41	46110.21	18523.47
995						14	26	10	55814.37	46427.38	51511.34	20907.52
996				4x6		20	26	7	30855.08	27047.55	29840.45	11763.54
997							10	4.5	14886.09	7676.14	27628	10060.12
998							18	6.5	13453.29	6694.86	29432.08	10130.9
999					4 on 1	8	26	8.5	12305.26	6377.49	20322.71	10155.32
1000							18	5	9245.38	6056.82	17164.74	6640.59
1001						14	26	7	8321.01	6768.09	14025.73	6664.9
1002	12000	3	6			20	26	5.5	5485.06	3705.06	8220.97	4212.82
1003							10	9	77114.39	55542.03	69852.99	28325.71
1004							18	13	87476.95	61951.05	76985.66	31859.39
1005					2 on 1	8	26	17	88890.05	63600.82	78430	33328.16
1006							18	10	57204.01	48433.57	51768.52	20907.52
1007						14	26	14	57422.14	48597.85	51587.09	20927.46
1008						20	26	11	36229.16	28816.32	33348.83	13239.97
1009				8x10			10	8.5	18925.62	19367.87	31565.8	10155.32
1010						8	18	10.5	16547.88	9439.4	32243.63	10165.87
1011					4 on 1		26	12.5	14675.95	6793.65	24597.24	10167.25
1012							18	9	11536.85	6856.12	19570.77	6675.05
1013						14	26	11	10038.75	7741.48	15449.29	6676.28
1014						20	26	9.5	6730.28	5377.44	9342.13	4224.23
1015							10	11	84725.02	63084.48	76528.77	31825.47
1016				10x12	2 on 1		18	15	85082.64	62869.61	76396.7	31872.39
1017						8	26	19	88949.62	64975.91	78154.26	33328

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
1018	12000	3	6	10x12	2 on 1	14	18	12	55812.95	50360.06	51326.04	20923.07
1019							26	16	58404.8	50481.8	52750.05	21881.95
1020						20	26	13	35411.09	31751.8	33192.93	13239.61
1021					4 on 1	8	10	10.5	13742.87	8173.28	32255.2	10165.87
1022							18	12.5	12581.57	8395.62	32600.94	10167.25
1023							26	14.5	11721.14	6383.22	23837.66	10166.92
1024						14	18	11	8574.69	6190.83	20009.47	6676.28
1025							26	13	7898.11	6714.05	15119.25	6675.96
1026						20	26	11.5	5186.06	4555.43	9316.74	4223.92

APPENDIX V – FREEWAY ACCIDENT COST COMPILATION

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
1							10	5	38409.57	33274.62	33302.77	14772.25
2							18	9	40085.92	34328.67	34553.28	15333.12
3						8	26	13	46222.43	39458.41	39808.43	17666.65
4					2 on 1		18	5	27586.84	25931.34	24649.78	10569.35
5						16	26	9	28699.52	26207.13	25272.75	11041.78
6						24	26	5	20990.17	20453.58	18701.98	8042.73
7							10	4.5	11939.29	8245.60	8485.41	5347.72
8							18	6.5	11530.26	9193.23	9441.33	5482.02
9				4x6	4 on 1	8	26	8.5	10622.04	8424.74	9848.85	5589.11
10						16	18	4.5	8783.51	7032.03	6009.58	3831.27
11							26	6.5	8215.98	6800.73	6720.71	3938.38
12						24	26	4.5	6135.44	4931.53	4557.67	2765.32
13							10	4.33	9367.66	6021.82	6143.59	1349.87
14							18	5.66	8191.46	6253.93	6768.65	1376.14
15	5000	0	0		6 on 1	8	26	7	6990.06	4969.78	7092.15	1395.86
16							18	4.33	7005.03	5251.66	4341.89	970.37
17						16	26	5.66	7662.73	5213.12	6272.20	1251.36
18						24	26	4.33	5284.02	3787.40	3270.11	740.08
19							10	9	43193.43	37366.69	35512.63	15333.12
20							18	13	49368.23	41549.13	41154.18	17666.65
21						8	26	17	48429.31	42938.27	41763.61	18700.41
22				8x10	2 on 1		18	9	30987.57	29352.65	25924.13	11041.78
23						16	26	13	35345.93	33844.93	30210.50	12655.60
24						24	26	9	23485.29	22073.28	19833.38	8396.36
25							10	8.5	18397.10	10274.93	11691.62	5589.11
26					4 on 1		18	10.5	14155.16	11842.66	12699.35	5669.21
27						8	26	12.5	15363.45	13174.90	13254.41	5709.43
28						16	18	8.5	13334.74	11433.69	8471.50	4018.48

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
29					4 on 1	16	26	10.5	12326.49	9826.95	9372.17	4058.71
30						24	26	8.5	10091.10	8591.22	6451.19	3043.86
31				8x10	6 on 1		10	8.33	15636.67	9751.35	9743.10	1405.84
32							18	9.66	13540.26	9483.68	10233.43	1409.68
33						8	26	11	11314.00	7988.40	10224.19	1409.25
34							18	8.33	11831.55	9234.11	7072.93	1003.91
35						16	26	9.66	9949.79	6975.06	7473.56	1003.48
36						24	26	8.33	8766.54	6620.85	5146.25	753.46
37					2 on 1		10	11	45121.88	41053.64	38847.48	17450.15
38							18	15	46164.42	41623.32	44341.42	19910.90
39						8	26	19	48940.05	43063.88	42012.58	18737.91
40	5000	0	0				18	11	32410.51	32269.31	28530.08	12546.07
41						16	26	15	33282.24	33951.77	29126.64	12736.48
42						24	26	11	24791.11	24783.17	21664.23	9499.47
43					4 on 1		10	10.5	11272.41	8563.14	9210.71	5669.21
44							18	12.5	10706.07	8915.76	9633.14	5709.43
45						8	26	14.5	9981.49	8454.04	9746.92	5724.80
46				10x12			18	10.5	8304.68	7327.02	6657.77	4058.71
47						16	26	12.5	7788.73	6543.33	6926.13	4074.07
48						24	26	10.5	6279.38	5465.93	4976.08	3059.22
49					6 on 1		10	10.33	8313.58	5150.17	6685.94	1409.25
50							18	11.66	6558.62	5002.30	6818.51	1409.25
51						8	26	13	6090.32	4087.11	6727.09	1409.25
52							18	10.33	6225.07	4759.27	4807.80	1003.48
53						16	26	11.66	5249.47	3600.62	4875.41	1003.48
54						24	26	10.33	4550.39	3385.76	3361.58	753.46
55							10	5	29989.79	25610.43	25788.22	11517.42
56			2	4x6	2 on 1		18	9	30823.79	25542.03	26263.15	11846.21
57						8	26	13	35552.57	29234.99	29976.49	13564.71

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
58							18	5	21291.87	19989.48	18582.97	8175.34
59					2 on 1	16	26	9	21892.42	20158.64	18724.45	8432.97
60						24	26	5	16052.26	15743.32	14223.14	6178.19
61							10	4.5	7828.62	5508.59	5763.99	4158.60
62							18	6.5	7481.40	6059.02	6237.18	4236.35
63				4x6	4 on 1	8	26	8.5	6997.48	5783.40	6453.34	4298.20
64						16	18	4.5	5668.25	4655.49	4027.92	2954.07
65							26	6.5	5254.08	4393.62	4220.60	3015.93
66						24	26	4.5	3819.80	3285.83	3123.91	2235.37
67							10	4.33	5656.47	3362.46	3948.02	1043.30
68							18	5.66	4879.45	3379.78	3964.49	1058.47
69						8	26	7	4082.14	2902.02	4219.19	1069.87
70	5000	0	2		6 on 1		18	4.33	4121.33	3095.48	2538.08	742.84
71						16	26	5.66	4354.17	3092.39	3358.62	953.30
72						24	26	4.33	2961.28	2219.93	1853.32	561.56
73							10	9	32417.38	27764.48	26795.63	11846.21
74							18	13	37067.44	30591.56	30433.51	13564.71
75						8	26	17	37245.34	31593.46	31142.19	14325.79
76					2 on 1		18	9	23061.98	21734.95	19178.79	8432.97
77						16	26	13	26338.74	25451.05	22042.04	9641.14
78						24	26	9	17386.66	16432.36	14659.36	6374.22
79							10	8.5	11523.50	6582.27	7472.87	4298.20
80							18	10.5	8919.70	7547.84	7761.23	4344.44
81						8	26	12.5	9656.09	7986.20	7999.33	4374.10
82				8x10	4 on 1		18	8.5	8222.28	6903.29	5250.82	3062.18
83						16	26	10.5	7491.02	5922.13	5408.65	3091.83
84						24	26	8.5	6009.56	4937.70	3818.65	2309.10
85							10	8.33	9187.73	5229.97	5580.59	1077.20
86					6 on 1		18	9.66	7702.39	5099.40	29874.05	1079.92
87						8	26	11	6345.49	4189.97	33577.75	1079.59

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
88							18	8.33	6628.28	4888.91	31501.46	764.32
89				8x10	6 on 1	16	26	9.66	5431.20	3633.07	3676.77	763.99
90						24	26	8.33	4702.82	3455.78	2552.15	571.28
91							10	11	35135.57	31242.57	29874.05	13436.38
92							18	15	35653.08	30569.99	33577.75	15264.58
93						8	26	19	37659.77	31670.31	31501.43	14351.25
94					2 on 1		18	11	24945.62	24302.00	21335.36	9569.27
95						16	26	15	25405.27	25289.46	21561.09	9697.90
96						24	26	11	18873.75	18530.21	16549.53	7216.54
97							10	10.5	7493.48	5496.63	6315.86	4344.44
98							18	12.5	7113.39	5799.26	6305.81	4374.10
99						8	26	14.5	6565.49	5243.39	6320.33	4384.72
100	5000	0	2	10x12	4 on 1		18	10.5	5409.94	4661.50	4314.91	3091.83
101						16	26	12.5	4957.47	4177.21	4314.00	3102.45
102						24	26	10.5	3900.47	3418.65	3109.26	2319.72
103							10	10.33	4935.53	2859.49	4039.55	1079.59
104							18	11.66	3961.18	2787.24	3930.53	1079.59
105						8	26	13	3530.39	2300.96	3923.37	1079.59
106					6 on 1		18	10.33	3580.25	2634.99	2711.36	763.99
107						16	26	11.66	2934.92	1989.89	2657.22	763.99
108						24	26	10.33	2485.87	1854.79	1859.39	571.28
109							10	5	65774.66	55620.05	56392.71	25231.97
110							18	9	67194.69	52731.89	56876.02	25796.02
111						8	26	13	77350.58	61473.39	65588.32	29472.25
112			4	4x6	2 on 1		18	5	44828.68	41912.73	40040.64	17188.60
113						16	26	9	45652.77	42575.62	40143.17	17686.07
114						24	26	5	32950.70	32400.03	30062.90	12699.67
115							10	4.5	15432.03	10002.68	11525.86	9109.13
116					4 on 1		18	6.5	13579.70	10991.76	11552.83	9222.43
117						8	26	8.5	12899.13	10506.77	11669.46	9352.93

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
118						16	18	4.5	9854.13	8254.99	7649.55	6195.14
119					4 on 1		26	6.5	9364.60	7759.80	7856.39	6318.71
120						24	26	4.5	7153.37	6100.14	6364.33	4848.85
121				4x6			10	4.33	9800.20	4920.48	6445.76	2273.23
122							18	5.66	7349.83	4943.77	6443.36	2304.84
123						8	26	7	6383.41	4308.73	6481.06	2327.19
124					6 on 1		18	4.33	6057.49	4525.78	4171.76	1558.13
125						16	26	5.66	6632.10	4623.64	5389.27	1996.51
126						24	26	4.33	4468.20	3337.21	2941.36	1154.33
127							10	9	70055.89	58227.89	57427.18	25796.02
128							18	13	79471.07	63842.30	65506.06	29472.25
129						8	26	17	81409.73	66596.77	68201.94	31107.71
130					2 on 1		18	9	47296.81	44173.66	40363.11	17686.07
131						16	26	13	54063.40	52216.46	46150.62	20168.30
132	5000	0	4			24	26	9	34874.29	33045.54	30545.62	13096.46
133							10	8.5	20606.69	11229.29	12821.60	9352.93
134							18	10.5	15857.67	13664.38	12779.06	9440.63
135						8	26	12.5	16717.97	14370.91	13040.97	9497.98
136				8x10	4 on 1		18	8.5	13224.27	11205.96	8738.53	6403.41
137						16	26	10.5	12575.93	10479.28	9060.61	6460.72
138						24	26	8.5	9973.32	8404.87	6683.83	4738.50
139							10	8.33	16812.72	9054.26	8963.92	2584.56
140							18	9.66	13063.30	8950.66	8756.50	2591.82
141						8	26	11	11170.58	7505.94	8828.22	2591.00
142					6 on 1		18	8.33	11030.50	8315.55	6110.50	1766.67
143						16	26	9.66	9354.17	6447.05	6257.65	1765.84
144						24	26	8.33	8048.98	6070.34	4512.82	1294.91
145							10	11	84653.59	73837.66	71633.85	32210.95
146				10x12	2 on 1		18	15	85427.88	71715.84	92653.69	42268.92
147						8	26	19	90423.45	73514.15	75436.61	34417.70

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
148							18	11	57607.29	55688.69	50176.40	22100.62
149					2 on 1	16	26	15	58752.82	57902.39	50977.33	22377.71
150						24	26	11	42835.90	41317.99	38273.91	16364.88
151							10	10.5	15790.63	11531.73	13164.60	10420.66
152							18	12.5	14695.85	12373.82	13385.21	10483.97
153						8	26	14.5	14077.68	11645.22	13410.83	10513.58
154		0	4	10x12	4 on 1		18	10.5	10726.20	9472.36	9169.42	7131.41
155						16	26	12.5	10242.23	8878.98	9242.23	7161.12
156						24	26	10.5	7190.39	6340.54	6053.83	4761.78
157							10	10.33	8793.39	4973.25	7050.75	2347.32
158							18	11.66	6413.87	4910.43	6955.28	2347.32
159						8	26	13	6271.75	4113.05	6997.13	2347.32
160					6 on 1		18	10.33	5786.67	4492.81	4843.30	1599.77
161						16	26	11.66	5077.55	3467.09	4896.76	1599.77
162	5000					24	26	10.33	4240.97	3165.43	3448.92	1173.13
163							10	5	42396.87	36383.86	36759.93	16305.76
164							18	9	44247.24	37892.34	38140.25	16924.86
165						8	26	13	51020.78	43554.59	43940.95	19500.63
166					2 on 1		18	5	30450.63	28557.30	27208.68	11666.56
167						16	26	9	31678.82	28830.25	27896.32	12188.03
168						24	26	5	23169.16	22576.87	20643.43	8877.65
169							10	4.5	13178.71	9101.58	9366.28	5902.86
170							18	6.5	12727.21	10019.70	10421.43	6051.11
171		3	0	4x6	4 on 1	8	26	8.5	11724.72	9299.31	10871.26	6169.32
172						16	18	4.5	9698.33	7762.03	6633.43	4228.99
173							26	6.5	9068.89	7111.75	7418.39	4347.23
174						24	26	4.5	6772.35	5443.48	5030.81	3052.38
175							10	4.33	10340.12	6308.83	6781.36	1490.00
176					6 on 1		18	5.66	9041.81	6403.85	7471.30	1518.99
177						8	26	7	7715.70	5485.69	7828.39	1540.76

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
178							18	4.33	7732.22	5796.83	4792.62	1071.10
179				4x6	6 on 1	16	26	5.66	8458.20	5754.30	6923.32	1381.26
180						24	26	4.33	5832.55	4180.57	3609.58	816.90
181							10	9	47677.34	40779.57	39199.20	16924.86
182							18	13	54493.14	45862.35	45426.39	19500.63
183						8	26	17	53456.76	47710.96	28615.32	20641.70
184					2 on 1		18	9	34204.39	32133.92	28615.32	12188.03
185						16	26	13	39015.19	37358.37	33346.66	13969.38
186						24	26	9	25923.30	24364.71	21892.28	9267.98
187							10	8.5	20306.90	11341.57	12905.33	6169.32
188							18	10.5	15624.61	13072.04	14071.67	6257.73
189						8	26	12.5	16958.33	14542.59	14630.35	6302.13
190	5000	3	0	8x10	4 on 1		18	8.5	14719.02	12620.62	9350.92	4435.64
191						16	26	10.5	13606.10	10847.09	10345.10	4480.04
192						24	26	8.5	11138.66	9349.41	7120.88	3359.84
193							10	8.33	17259.92	10763.64	10754.53	1551.78
194							18	9.66	14945.88	10468.18	11295.76	1556.02
195						8	26	11	12488.51	8817.68	11285.57	1555.54
196					6 on 1		18	8.33	13059.78	10192.71	7807.17	1108.13
197						16	26	9.66	10982.67	7699.14	8249.39	1107.65
198						24	26	8.33	9676.60	7308.16	5680.48	831.68
199							10	11	49805.99	45315.43	42880.24	19261.65
200							18	15	50956.75	45944.24	56514.57	25377.08
201						8	26	19	54020.52	47534.34	43373.91	20683.10
202				10x12	2 on 1		18	11	35775.04	35619.19	31491.79	13848.48
203						16	26	15	36737.27	37213.99	32150.28	14058.65
204						24	26	11	27364.68	27355.91	23913.19	10485.61
205							10	10.5	12442.60	9452.08	10166.88	6257.73
206					4 on 1		18	12.5	11817.47	9841.30	10633.15	6302.13
207						8	26	14.5	11017.67	8904.96	10758.75	6319.09

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
208							18	10.5	9166.79	8087.64	7348.91	4480.04
209					4 on 1	16	26	12.5	8597.28	7229.20	7645.13	4497.00
210						24	26	10.5	6931.25	6143.79	5492.65	3376.80
211			0	10x12			10	10.33	9176.61	5684.81	7380.01	1555.54
212							18	11.66	7239.47	5521.59	7526.34	1555.54
213						8	26	13	6722.56	4511.40	7425.43	1555.54
214					6 on 1		18	10.33	6871.30	5253.33	5306.89	1107.65
215						16	26	11.66	5794.42	3974.40	5381.52	1107.65
216						24	26	10.33	5022.76	3736.60	3710.55	831.68
217							10	5	33103.04	28269.05	28465.30	12712.04
218							18	9	34023.60	28193.55	28989.53	13075.97
219						8	26	13	39243.29	32269.88	33088.35	14972.86
220					2 on 1		18	5	23502.18	22064.59	20512.07	9024.03
221	5000	3				16	26	9	24165.07	22251.31	20668.06	9308.40
222						24	26	5	17718.65	17377.64	15699.64	6819.55
223							10	4.5	8641.31	6080.43	6362.35	4590.30
224							18	6.5	8258.05	6688.01	6884.66	4676.12
225			2	4x6	4 on 1	8	26	8.5	7723.56	6383.77	7123.27	4744.40
226						16	18	4.5	6256.67	5138.78	4446.06	3260.73
227							26	6.5	5799.50	4849.73	4658.74	3329.02
228						24	26	4.5	4216.33	3626.93	3448.21	2467.42
229							10	4.33	6243.67	3711.52	4357.87	1151.60
230							18	5.66	5385.98	3730.63	4376.04	1168.35
231						8	26	7	4505.91	3203.27	4657.18	1180.94
232					6 on 1		18	4.33	4549.17	3416.82	2801.56	819.99
233						16	26	5.66	4806.18	3431.41	3707.27	1052.26
234						24	26	4.33	3268.70	2450.38	2045.71	619.86
235							10	9	35782.63	30646.72	29577.29	13075.97
236				8x10	2 on 1		18	13	40915.41	33767.28	33592.81	14972.86
237						8	26	17	41111.79	34873.18	34375.06	15812.95

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
238							**18**	9	25456.05	23991.26	21169.74	9308.40
239					**2 on 1**	**16**	**26**	13	29072.96	28093.12	24330.23	10641.99
240						**24**	**26**	9	19191.57	18138.20	16181.15	7035.93
241							**10**	8.5	12719.75	7265.57	8248.63	4744.40
242							**18**	10.5	9845.65	8331.39	8566.92	4795.44
243						**8**	**26**	12.5	10658.49	8815.24	8829.74	4828.17
244				**8x10**	**4 on 1**		**18**	8.5	9075.84	7619.92	5795.91	3380.06
245						**16**	**26**	10.5	8268.66	6536.90	5970.12	3412.79
246						**24**	**26**	8.5	6633.42	5450.28	4215.06	2548.81
247							**10**	8.33	10138.20	5772.89	6159.91	1189.03
248							**18**	9.66	8501.97	5628.77	5941.87	1192.02
249						**8**	**26**	11	7004.22	4624.94	6016.34	1191.67
250	**5000**	**3**	**2**		**6 on 1**		**18**	8.33	7316.37	5396.42	4108.84	843.66
251						**16**	**26**	9.66	5995.02	4010.22	4058.46	843.30
252						**24**	**26**	8.33	5191.02	3814.52	2817.09	630.59
253							**10**	11	38793.00	34485.86	32975.27	14831.21
254							**18**	15	39354.23	33743.46	42795.92	19455.20
255						**8**	**26**	19	41569.23	34958.01	34771.62	15841.06
256					**2 on 1**		**18**	11	27535.22	26824.79	23550.19	10562.66
257						**16**	**26**	15	28042.60	27914.76	23779.35	10704.64
258						**24**	**26**	11	20833.03	20453.83	18267.54	7965.68
259							**10**	10.5	8271.38	6067.24	6971.51	4795.44
260							**18**	12.5	7851.84	6401.28	6960.41	4828.17
261						**8**	**26**	14.5	7247.05	5787.71	6976.44	4839.89
262				**10x12**	**4 on 1**		**18**	10.5	5971.54	5145.41	4762.84	3412.79
263						**16**	**26**	12.5	5472.41	4610.85	4761.83	3424.51
264						**24**	**26**	10.5	4305.38	3773.54	3432.04	2560.53
265							**10**	10.33	5447.89	3156.34	4458.90	1191.67
266					**6 on 1**		**18**	11.66	4372.39	3076.58	4338.56	1191.67
267						**8**	**26**	13	3896.88	2539.82	4330.65	1191.67

Scen. No.	ADT	TGF	**Curvature**	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
268							18	10.33	3951.91	2908.22	2992.82	843.30
269			2	10x12	6 on 1	16	26	11.66	3239.60	2196.46	2933.07	843.30
270						24	26	10.33	2743.93	2047.33	2052.42	630.59
271							10	5	72602.72	61393.97	62246.84	27851.30
272							18	9	74170.16	58205.99	62780.32	28473.90
273						8	26	13	85380.34	67854.94	72397.05	32531.77
274					2 on 1		18	5	49482.34	46263.69	44197.26	18972.95
275						16	26	9	50391.98	46695.40	44310.43	19522.06
276						24	26	5	36391.31	35763.48	33183.73	14018.02
277							10	4.5	17034.03	11041.06	12722.35	10054.75
278							18	6.5	14989.41	12132.81	12752.13	10179.81
279				4x6	4 on 1	8	26	8.5	14238.19	11597.48	12880.87	10323.85
280						16	18	4.5	10877.09	9360.88	8443.65	6838.26
281							26	6.5	10336.74	8565.34	7025.71	6974.66
282	5000	3	4			24	26	4.5	7898.96	6733.39	7025.01	5352.21
283							10	4.33	10817.56	5431.27	7114.89	2509.21
284							18	5.66	8112.82	5456.98	7112.25	2544.10
285						8	26	7	7046.07	4756.02	7153.85	2568.77
286					6 on 1		18	4.33	6686.32	4995.60	4604.83	1719.88
287						16	26	5.66	7320.58	5103.62	5948.73	2203.77
288						24	26	4.33	4932.04	3683.64	3246.71	1274.16
289							10	9	77328.39	64272.53	63388.69	28473.90
290							18	13	87720.96	70469.77	72306.24	32531.77
291						8	26	17	89860.87	73510.18	75281.98	34337.00
292					2 on 1		18	9	52206.69	48759.33	44553.20	19522.06
293						16	26	13	59786.10	57637.05	50941.51	22261.97
294				8x10		24	26	9	38494.59	36475.99	33716.57	14456.00
295							10	8.5	22745.87	12395.00	14152.62	10323.85
296					4 on 1		18	10.5	17503.85	15082.88	14105.65	10420.66
297						8	26	12.5	18453.47	15862.76	14394.75	10483.97

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
298							18	8.5	14597.08	12369.25	9645.68	7068.14
299					4 on 1	16	26	10.5	13881.44	11567.14	10001.19	7131.41
300						24	26	8.5	11008.65	9277.38	7377.68	5230.41
301				8x10			10	8.33	16812.72	9054.26	8963.92	2584.56
302							18	9.66	13063.30	8950.66	8756.50	2591.82
303						8	26	11	11170.58	7505.94	8828.22	2591.00
304					6 on 1		18	8.33	11030.50	8315.55	6110.50	1766.67
305						16	26	9.66	9354.17	6447.05	6257.65	1765.84
306						24	26	8.33	8048.98	6070.34	4512.82	1294.91
307							10	11	84653.59	73837.66	71633.85	32210.95
308							18	15	85427.88	71715.84	92653.69	42268.92
309						8	26	19	90423.45	73514.15	75436.61	34417.70
310	5000	3	4		2 on 1		18	11	57607.29	55688.69	50176.40	22100.62
311						16	26	15	58752.82	57902.39	50977.33	22377.71
312						24	26	11	42835.90	41317.99	38273.91	16364.88
313							10	10.5	15790.63	11531.73	13164.60	10420.66
314							18	12.5	14695.85	12373.82	13385.21	10483.97
315						8	26	14.5	14077.68	11645.22	13410.83	10513.58
316				10x12	4 on 1		18	10.5	10726.20	9472.36	9169.42	7131.41
317						16	26	12.5	10242.23	8878.98	9242.23	7161.12
318						24	26	10.5	7936.82	6998.75	6682.28	5256.10
319							10	10.33	9706.22	5489.52	7782.69	2591.00
320							18	11.66	7079.69	5420.18	7677.31	2591.00
321						8	26	13	6922.82	4540.03	7723.51	2591.00
322					6 on 1		18	10.33	6387.38	4959.21	5346.08	1765.84
323						16	26	11.66	5604.65	3828.00	5405.10	1765.84
324						24	26	10.33	4681.23	3494.03	3806.95	1294.91
325							10	5	101650.28	85656.84	85811.76	39094.52
326	25000	0	0	4x6	2 on 1		18	9	106086.70	89613.97	88909.23	40578.86
327						8	26	13	122326.86	104426.02	102707.88	46754.50

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
328	25000	0	0	4x6	2 on 1	16	18	5	73008.09	66592.07	63997.52	27971.61
329							26	9	75952.81	66454.65	65390.47	32778.24
330						24	26	5	55550.12	54130.00	48471.93	21284.96
331					4 on 1	8	10	4.5	31597.13	20498.09	21956.37	14152.64
332							18	6.5	30514.64	22965.89	24263.41	14508.08
333							26	8.5	28111.05	21865.98	25604.96	14791.48
334						16	18	4.5	23245.41	17221.42	15472.74	10139.38
335							26	6.5	21743.46	15282.44	17262.44	10422.87
336						24	26	4.5	17256.07	15609.71	11544.96	7737.01
337					6 on 1	8	10	4.33	24791.36	13500.62	15939.99	3572.41
338							18	5.66	21678.55	13763.67	17379.86	3641.93
339							26	7	18499.07	14545.17	18815.11	3694.12
340						16	18	4.33	18538.69	13347.06	11148.88	2568.07
341							26	5.66	16007.27	12508.99	12805.81	2620.26
342						24	26	4.33	13984.06	12103.74	8335.50	1958.60
343				8x10	2 on 1	8	10	9	114310.68	94027.46	91182.39	40578.86
344							18	13	130652.16	111432.69	105928.01	46754.50
345							26	17	128167.34	113634.93	107561.45	49490.32
346						16	18	9	82008.08	76162.84	66826.48	29221.89
347							26	13	93542.40	84711.35	77912.60	33492.84
348						24	26	9	62153.43	61004.86	51456.52	22220.81
349					4 on 1	8	10	8.5	48687.61	31567.46	29431.60	14791.48
350							18	10.5	44615.59	33819.17	32093.66	15003.47
351							26	12.5	40659.10	19428.48	33834.39	15109.92
352						16	18	8.5	35290.16	28002.75	21571.84	10634.85
353							26	10.5	32621.85	28855.04	23504.91	10741.30
354						24	26	8.5	26705.92	24262.42	16157.90	8055.51
355					6 on 1	8	10	8.33	41382.19	23252.88	24417.20	3720.52
356							18	9.66	35834.07	22985.33	25637.08	3730.70
57							26	11	29942.32	20169.80	26511.13	3729.55

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
358							18	8.33	31311.99	22003.94	17818.95	2656.84
359				8x10	6 on 1	16	26	9.66	26331.94	21102.94	18717.57	2655.69
360						24	26	8.33	23200.50	19874.86	12700.38	1994.03
361							10	11	119414.29	105328.74	99954.47	46181.53
362							18	15	122173.36	110155.41	101996.43	47082.21
363						8	26	19	129519.04	114247.41	108124.09	49589.58
364					2 on 1		18	11	85773.86	83154.54	73890.36	33202.97
365						16	26	15	88080.88	83650.58	75344.45	33706.88
366						24	26	11	65609.26	67602.38	52198.68	25140.19
367							10	10.5	29832.25	21276.79	24033.78	15003.47
368							18	12.5	28333.43	22788.41	24913.47	15109.92
369						8	26	14.5	26415.84	19248.57	25455.63	15150.58
370	25000	0	0	10x12	4 on 1		18	10.5	21978.21	18458.50	17293.15	10741.30
371						16	26	12.5	20612.75	18513.43	17981.02	10781.96
372						24	26	10.5	16618.29	15850.55	12676.85	8096.17
373							10	10.33	22001.74	12397.31	17532.42	3429.55
374							18	11.66	17357.27	12072.44	17894.46	3729.55
375						8	26	13	16177.94	12231.32	17954.24	3729.55
376					6 on 1		18	10.33	16474.54	11259.84	12583.00	2655.69
377						16	26	11.66	13892.64	10821.79	12720.43	2655.69
378						24	26	10.33	12042.52	9803.96	8686.84	1994.03
379							10	5	79367.48	65200.25	66894.88	30480.66
380							18	9	81574.62	67171.22	66735.27	31350.80
381						8	26	13	94089.27	77369.90	76275.09	35898.73
382			2	4x6	2 on 1		18	5	56348.57	51668.46	48619.28	21635.91
383						16	26	9	57937.91	48897.42	48309.31	25032.15
384						24	26	5	42482.04	41664.44	37208.63	16350.49
385							10	4.5	20718.32	13969.08	14901.06	11005.66
386							18	6.5	19799.40	15212.94	16086.26	11211.42
387					4 on 1	8	26	8.5	18518.72	14964.77	16623.95	11375.12

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
388						16	18	4.5	15000.93	11645.05	10576.25	7817.89
389					4 on 1		26	6.5	13904.83	10530.95	11060.10	7981.62
390						24	26	4.5	10976.97	9777.73	7858.14	5910.07
391				4x6			10	4.33	14969.76	8053.12	10332.56	2761.07
392							18	5.66	12913.38	8242.89	10429.72	2801.23
393						8	26	7	10803.32	8653.19	10724.80	2831.40
394					6 on 1		18	4.33	10907.03	7426.55	6842.25	1966.00
395						16	26	5.66	9097.22	7354.35	7075.66	1996.18
396						24	26	4.33	7836.99	6545.33	4783.44	1486.16
397							10	9	85792.05	70597.09	68377.16	31350.80
398							18	13	98098.34	80960.05	77476.94	35898.76
399						8	26	17	98569.16	83610.52	79693.56	37912.95
400					2 on 1		18	9	61033.14	56069.57	49551.42	22317.72
401						16	26	13	69705.02	59881.30	56607.03	25515.11
402	25000	0	2			24	26	9	46013.49	45702.02	38236.48	16869.26
403							10	8.5	30496.75	19403.37	19301.12	11375.12
404							18	10.5	27984.85	20943.24	19744.59	11497.49
405						8	26	12.5	25554.67	16318.91	20231.81	11575.97
406				8x10	4 on 1		18	8.5	21760.13	16998.19	13643.31	8103.99
407						16	26	10.5	19824.85	16883.51	13852.93	8182.48
408						24	26	8.5	15904.21	14363.47	9785.61	6111.00
409							10	8.33	24307.24	12400.03	14403.34	2850.79
410							18	9.66	20384.24	12153.30	13923.32	2857.98
411						8	26	11	16793.24	12800.37	13744.88	2857.13
412					6 on 1		18	8.33	17541.64	11713.71	9550.30	2022.75
413						16	26	9.66	14373.59	11239.08	9436.52	2021.90
414						24	26	8.33	12445.92	10457.98	6541.04	1511.89
415							10	11	92985.69	78608.82	76060.24	35559.16
416							18	15	94355.27	80902.96	76494.48	36095.30
417				10x12	2 on 1	8	26	19	99665.95	83726.32	80125.11	37980.34

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
418							18	11	66018.15	62599.39	55349.93	25324.91
419					2 on 1	16	26	15	67234.62	59400.80	55651.45	25665.33
420						24	26	11	49949.05	51031.61	42888.58	19098.44
421							10	10.5	19831.36	13571.38	16480.80	11497.49
422							18	12.5	18825.48	14354.71	16522.03	11575.97
423						8	26	14.5	17375.45	11839.91	16437.88	11604.08
424			2	10x12	4 on 1		18	10.5	14317.31	11586.51	11482.79	8182.48
425						16	26	12.5	13109.37	11360.90	11347.36	8210.58
426						24	26	10.5	10322.53	9809.35	8223.55	6139.10
427							10	10.33	13061.81	6918.50	10739.54	2857.13
428							18	11.66	10483.20	6737.92	10552.51	2857.13
429						8	26	13	9343.12	7093.54	10419.20	2857.13
430					6 on 1		18	10.33	9475.06	6331.26	7234.44	2021.90
431						16	26	11.66	7767.22	6087.29	7168.02	2021.90
432	25000	0				24	26	10.33	6578.82	5442.64	4882.10	1511.89
433							10	5	174071.48	141036.06	146419.19	66775.97
434							18	9	177829.58	143015.53	146631.20	68268.73
435						8	26	13	204706.98	162688.27	167928.00	77997.82
436					2 on 1		18	5	118638.32	108960.20	104354.04	45489.34
437						16	26	9	120819.27	100052.02	104343.85	52499.20
438						24	26	5	87203.46	85746.13	79148.10	33609.45
439							10	4.5	40840.59	25229.98	31262.70	24107.17
440							18	6.5	35938.44	26179.48	312201.32	24407.01
441			4	4x6	4 on 1	8	26	8.5	34137.33	27253.57	31214.81	24752.36
442						16	18	4.5	26078.79	20617.46	20689.71	19395.34
443							26	6.5	24783.26	18940.94	21140.79	16722.37
444						24	26	4.5	19174.00	17096.24	15008.90	12174.65
445							10	4.33	25936.06	12246.88	18340.20	6016.06
446							18	5.66	19451.21	12213.21	17988.56	6099.71
447					6 on 1	8	26	7	16893.58	13714.85	18335.05	6158.86

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	**Do-Nothing** Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
448							18	4.33	16031.05	10953.25	11651.11	4123.55
449				4x6	6 on 1	16	26	5.66	13859.52	11165.53	12110.89	4180.60
450						24	26	4.33	11825.01	9843.70	8136.70	3054.92
451							10	9	185401.72	146445.39	148378.48	68268.73
452							18	13	210318.81	168957.55	168119.12	77997.82
453						8	26	17	215449.44	176244.89	175493.05	82326.01
454					2 on 1		18	9	125170.20	114162.66	104792.52	46805.87
455						16	26	13	143342.50	120076.89	119770.90	53375.07
456						24	26	9	92294.23	91944.22	79624.08	34659.56
457							10	8.5	54535.24	32615.61	34189.80	24752.36
458							18	10.5	46707.82	34507.89	34281.08	24984.46
459						8	26	12.5	44243.83	28467.22	34839.82	25136.24
460			4	8x10	4 on 1		18	8.5	34997.80	27994.42	23549.46	16946.50
461						16	26	10.5	33281.99	27857.27	24280.86	17098.19
462	25000	0				24	26	8.5	26394.22	23902.94	17573.53	12540.37
463							10	8.33	40309.99	19691.00	22583.02	6196.71
464							18	9.66	31320.43	19479.11	21909.38	6214.13
465						8	26	11	26782.45	21827.28	22037.89	6212.14
466					6 on 1		18	8.33	26446.59	18248.28	15191.76	4235.75
467						16	26	9.66	22427.46	18376.97	15450.45	4233.75
468						24	26	8.33	19298.14	16557.63	11087.45	3104.67
469							10	11	202964.52	165753.08	166381.16	77228.63
470							18	15	204820.94	171945.14	166862.55	78421.70
471						8	26	19	216798.27	177834.82	175780.19	82519.52
472				10x12	2 on 1		18	11	138118.59	129188.21	118079.45	52988.20
473						16	26	15	140865.12	121393.23	119765.59	53652.56
474						24	26	11	102702.88	103386.52	90321.11	39236.27
475							10	10.5	37859.43	25983.22	32519.20	24984.46
476							18	12.5	35234.61	26800.28	32796.04	25136.24
477					4 on 1	8	26	14.5	33752.49	22957.97	32846.00	25207.25

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
478							18	10.5	25717.02	21541.34	22596.82	17098.19
479					4 on 1	16	26	12.5	24556.65	21090.02	22595.46	17169.43
480						24	26	10.5	19029.23	18271.32	16297.71	12601.98
481		0	4	10x12			10	10.33	23271.52	12063.31	20001.96	6212.14
482							18	11.66	16974.20	11924.28	19779.26	6212.14
483					6 on 1	8	26	13	16598.08	13086.06	19845.73	6212.14
484							18	10.33	15314.32	10737.05	13639.33	4233.75
485						16	26	11.66	13437.64	10814.10	13631.77	4233.75
486						24	26	10.33	11223.66	9212.40	9702.98	3104.67
487							10	5	167252.73	140020.00	141192.45	64325.10
488							18	9	174552.31	147448.50	146288.94	66767.40
489						8	26	13	201273.44	171819.88	168992.88	76928.64
490					2 on 1		18	5	120125.62	109568.87	105299.85	46023.76
491						16	26	9	124970.77	109342.76	107591.78	53932.47
492						24	26	5	91400.74	89064.09	79754.45	35021.72
493							10	4.5	51989.09	33727.02	36126.45	23286.38
494							18	6.5	50207.98	37787.49	39922.39	23871.22
495	25000	3	0	4x6	4 on 1	8	26	8.5	46253.20	35977.72	42129.73	24337.53
496						16	18	4.5	38247.39	28335.69	25458.45	16683.07
497							26	6.5	35776.13	25145.33	28403.18	17149.51
498						24	26	4.5	28392.69	24281.06	18995.79	12730.28
499							10	4.33	40791.06	22213.58	26227.24	5877.95
500							18	5.66	35669.32	22646.39	28596.37	5992.33
501						8	26	7	30437.90	23932.25	30957.89	6078.21
502					6 on 1		18	4.33	30503.09	20589.94	18344.08	4225.43
503						16	26	5.66	26337.95	20581.97	21070.35	4311.31
504						24	26	4.33	23009.01	18593.37	13715.01	3222.62
505							10	9	188083.81	154710.34	150029.12	66767.40
506							18	13	214971.69	180923.81	174291.20	76928.64
507				8x10	2 on 1	8	26	17	210883.22	188214.78	176978.81	81430.09

Scen. No.	ADT	TGF	Curvature	Culvert **Size**	Slope **Steepness**	Slope **Offset**	Culvert **Offset**	Slope **Depth**	Do-Nothing **Acc. Cost ($)**	**Culvert Extension** **Acc. Cost ($)**	**Guardrail Installation** **Acc. Cost ($)**	Grating **Acc. Cost ($)**
508							18	9	134933.97	123494.64	109954.55	48080.94
509					2 on 1	16	26	13	153912.23	137920.75	128195.38	55108.25
510						24	26	9	102265.65	100375.82	84665.23	36561.55
511							10	8.5	80109.33	51033.11	48425.98	24337.53
512							18	10.5	73409.34	57397.11	52806.07	24686.31
513						8	26	12.5	66899.42	31967.12	55670.23	24861.47
514				8x10	4 on 1		18	8.5	58065.50	45528.82	35493.75	17498.31
515						16	26	10.5	53675.14	47477.33	38674.37	17673.46
516						24	26	8.5	43941.23	40069.73	26585.79	13254.33
517							10	8.33	68089.18	38259.68	40175.41	6151.65
518							18	9.66	58960.46	37819.45	42182.59	6138.39
519						8	26	11	49266.32	38569.54	43620.72	6136.51
520					6 on 1		18	8.33	51519.94	36204.71	29318.84	4371.50
521						16	26	9.66	43325.89	34722.22	30797.41	4369.61
522	25000	3	0			24	26	8.33	38173.50	32701.57	20896.88	3280.93
523							10	11	196481.19	173305.19	164462.47	75985.89
524							18	15	201020.88	181246.86	167822.28	77467.84
525						8	26	19	213107.23	187979.73	177904.56	81593.40
526					2 on 1		18	11	141130.08	136820.33	121577.29	54631.30
527						16	26	15	144925.98	136234.08	123969.80	55460.42
528						24	26	11	107951.77	111231.20	92935.11	41365.01
529							10	10.5	49085.21	35008.27	39544.56	24686.31
530							18	12.5	46619.10	37495.46	40991.97	24861.47
531						8	26	14.5	43463.93	31671.10	41884.03	24928.37
532				10x12	4 on 1		18	10.5	36162.37	30371.15	28453.70	17673.46
533						16	26	12.5	33915.69	30461.52	29585.50	17740.36
534						24	26	10.5	27343.29	26080.09	20858.16	13321.23
535							10	10.33	36201.09	20398.21	28847.38	6136.51
536							18	11.66	28559.20	19863.68	29443.08	6136.50
537					6 on 1	8	26	13	26520.04	20125.09	29541.45	6136.51

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
538							18	10.33	27106.79	18753.55	20703.74	4369.61
539			**0**	**10x12**	**6 on 1**	16	**26**	11.66	22858.59	17805.89	20929.87	4369.61
540						**24**	**26**	10.33	19814.45	16317.27	14293.10	3280.93
541							10	5	130589.19	107278.80	110067.11	50152.07
542							18	9	134220.77	110521.78	109804.48	51583.78
543						8	26	13	154812.05	127302.43	125501.06	59066.89
544					2 on 1		18	5	92714.47	85013.95	79996.89	35599.16
545						16	26	9	95329.55	80454.54	79486.90	41187.26
546						24	26	5	69898.85	68553.59	61222.12	26902.67
547							10	4.5	34089.39	22984.37	26988.75	18108.42
548							18	6.5	32577.42	25030.98	26467.92	18446.98
549				4x6	4 on 1	8	26	8.5	30470.22	24622.65	27352.62	18716.32
550						16	18	4.5	24682.14	19160.46	17401.88	12863.35
551							26	6.5	22878.64	17327.35	18198.01	13132.75
552	25000	3	2			24	26	4.5	18061.22	16088.02	12929.58	9727.28
553							10	4.33	24630.86	13250.40	17000.93	4542.99
554							18	5.66	21247.34	13562.64	17160.79	4609.07
555						8	26	7	17775.51	14237.74	17646.31	4658.72
556					6 on 1		18	4.33	17946.15	12219.46	11258.07	3234.80
557						16	26	5.66	14968.33	12100.65	11642.11	3284.46
558						24	26	4.33	12894.78	10769.52	7870.54	2445.29
559							10	9	141160.02	116158.62	112506.02	51583.78
560							18	13	161408.47	133209.58	127478.55	59066.89
561						8	26	17	162183.16	137570.59	131125.73	62380.98
562				8x10	2 on 1		18	9	100422.36	92255.41	81531.29	36721.00
563						16	26	13	114690.83	98527.14	93139.74	41981.90
564						24	26	9	75709.41	75196.93	62913.32	27756.25
565							10	8.5	50178.55	31925.80	31757.56	18716.32
566							18	10.5	46045.55	34459.46	32487.23	18917.68
567					4 on 1	8	26	12.5	42047.00	26850.72	33288.90	19046.81

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
568							18	8.5	35803.55	27968.38	22448.35	13334.10
569					4 on 1	16	26	10.5	32619.30	27779.69	22793.25	13463.24
570						24	26	8.5	26168.37	23633.28	16101.00	10054.87
571				8x10			10	8.33	39994.50	20402.69	23715.34	4690.62
572							18	9.66	33539.70	19996.73	22909.07	4702.45
573						8	26	11	27631.16	21061.40	22615.46	4701.04
574					6 on 1		18	8.33	28862.56	19273.44	15713.82	3328.18
575						16	26	9.66	23649.93	18492.50	15526.60	3326.78
576						24	26	8.33	20478.20	17207.30	10762.46	2487.60
577							10	11	152996.23	129340.92	125147.55	58508.11
578							18	15	155249.70	133115.64	125862.04	59390.28
579						8	26	19	163987.77	137761.12	131835.78	62491.87
580	25000	3	2		2 on 1		18	11	108624.55	102999.41	91071.34	41668.95
581						16	26	15	110626.11	97736.54	91567.46	42229.07
582						24	26	11	82184.88	83966.09	70567.76	31424.08
583							10	10.5	32630.00	22329.99	27117.09	18917.68
584							18	12.5	30974.95	23618.87	27184.92	19046.81
585						8	26	14.5	28589.12	19481.08	27046.47	19093.04
586				10x12	4 on 1		18	10.5	23557.33	19064.14	18893.49	13463.24
587						16	26	12.5	21569.81	18692.93	18670.65	13509.47
588						24	26	10.5	16984.42	16140.05	13530.81	10101.11
589							10	10.33	21491.56	11383.52	17670.56	4701.04
590							18	11.66	17248.79	11086.40	17362.83	4701.04
591						8	26	13	15372.93	11671.53	17143.49	4701.04
592					6 on 1		18	10.33	15590.02	10417.29	11903.37	3326.78
593						16	26	11.66	12779.98	10015.87	11794.08	3326.78
594						24	26	10.33	10824.62	8955.17	8032.88	2487.62
595							10	5	286412.72	232057.09	240914.36	109871.45
596							18	9	292596.19	235314.06	241263.20	112327.58
597			4	4x6	2 on 1	8	26	13	336819.59	267683.06	276304.41	128335.59

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
598							18	5	195204.42	179280.30	171701.44	74846.99
599					2 on 1	16	26	9	198792.91	164623.02	171684.69	86380.83
600						24	26	5	143482.33	141084.48	130228.23	55300.12
601							10	4.5	67198.05	41512.75	51438.83	39665.31
602							18	6.5	59132.18	43075.05	51337.85	40158.66
603				4x6	4 on 1	8	26	8.5	56168.68	44842.32	51360.04	40726.90
604						16	18	4.5	42909.38	33923.43	34042.32	26976.47
605							26	6.5	40777.74	31164.93	34784.51	27514.55
606						24	26	4.5	31578.41	28129.72	24695.25	20031.86
607							10	4.33	42674.53	20150.70	30176.49	9898.67
608							18	5.66	32004.52	20095.29	29597.92	10036.30
609						8	26	7	27796.26	22566.06	30168.02	10133.63
610	25000	3	4		6 on 1		18	4.33	26377.07	18022.20	19170.44	6784.79
611						16	26	5.66	22804.10	18371.47	19926.95	6878.65
612						24	26	4.33	19456.56	16196.57	13387.91	5026.48
613							10	9	305055.19	240957.45	244138.12	112327.58
614							18	13	346053.16	277998.38	276618.84	128335.59
615						8	26	17	354494.94	289988.75	288751.75	135457.08
616					2 on 1		18	9	205951.80	187840.28	172422.92	77013.17
617						16	26	13	235852.05	197571.42	197067.94	87821.96
618						24	26	9	151858.53	151282.64	131011.41	57027.95
619							10	8.5	89730.88	53664.89	56255.01	40726.90
620							18	10.5	76851.84	56778.38	56405.20	41108.79
621						8	26	12.5	72797.66	46838.90	57324.54	41358.52
622				8x10	4 on 1		18	8.5	57584.48	46061.29	38747.68	27883.34
623						16	26	10.5	54761.32	45835.63	39951.09	28132.92
624						24	26	8.5	43428.37	39329.28	28915.03	20633.59
625							10	8.33	66325.02	32399.06	37157.51	10195.91
626							18	9.66	51533.82	32050.42	36049.12	10224.57
627					6 on 1	8	26	11	44067.16	35914.04	36260.57	10221.30

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
628							18	8.33	43514.54	30025.25	24996.12	6969.38
629				8x10	6 on 1	16	26	9.66	36901.56	30236.99	25421.78	6966.11
630						24	26	8.33	31752.67	27243.50	18243.00	5108.35
631							10	11	333952.56	272725.84	273759.25	127069.99
632							18	15	337007.09	282914.09	274551.34	129033.05
633						8	26	19	356714.28	292604.78	289224.19	135775.47
634					2 on 1		18	11	227256.77	212562.95	194284.84	87185.41
635						16	26	15	231775.83	199737.30	197059.20	88278.54
636						24	26	11	168984.67	170109.52	148612.02	64558.35
637							10	10.5	62292.93	42752.12	53506.26	41108.79
638							18	12.5	57974.11	44096.49	539061.76	41358.52
639						8	26	14.5	55535.47	37774.45	54043.96	41475.36
640	25000	3	4	10x12	4 on 1		18	10.5	42314.12	35443.57	37180.22	28132.92
641						16	26	12.5	40404.88	34700.97	37177.99	28250.13
642						24	26	10.5	31310.21	30063.16	26815.84	20734.94
643							10	10.33	38290.36	19848.65	32910.71	10221.30
644							18	11.66	27928.91	19619.90	32544.29	10221.30
645						8	26	13	27310.05	21531.46	32653.65	10221.30
646					6 on 1		18	10.33	25197.78	17666.47	22441.80	6966.11
647						16	26	11.66	22109.95	17793.24	22429.36	6966.11
648						24	26	10.33	18467.12	15157.84	15965.03	5108.35
649							10	5	240203.88	201092.94	202776.80	92381.98
650							18	9	250687.33	211761.56	210096.22	95889.53
651						8	26	13	289063.50	246763.06	242703.02	110482.84
652					2 on 1		18	5	172521.19	157359.86	151228.81	66098.09
653	50000	0	0			16	26	9	179479.69	157035.13	154520.42	77456.36
654						24	26	5	131267.28	127911.45	114541.20	50297.25
655							10	4.5	74665.34	48437.85	51883.83	33443.28
656							18	6.5	72107.37	54269.37	57335.46	34283.20
657				4x6	4 on 1	8	26	8.5	66427.60	51670.23	69943.60	34952.90

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
658	**50000**	**0**	**0**	4x6	4 on 1	16	18	4.5	54929.88	40694.95	36562.74	23959.78
659							26	6.5	51380.71	36113.05	46106.29	24629.67
660						24	26	4.5	40776.81	34871.81	30251.47	18282.89
661					6 on 1	8	10	4.33	58583.02	31902.54	37666.86	8441.75
662							18	5.66	51227.32	32524.13	50515.63	8606.02
663							26	7	43714.09	34370.86	54162.59	8729.36
664						16	18	4.33	43807.71	29570.71	31660.48	6068.45
665							26	5.66	37825.85	29559.27	35425.90	6191.79
666						24	26	4.33	33044.92	26703.29	23072.04	4628.24
667				8x10	2 on 1	8	10	9	270120.94	222190.83	215467.81	95889.53
668							18	13	308736.56	259837.91	250312.33	110482.84
669							26	17	302864.78	270309.00	254172.20	116947.70
670						16	18	9	193788.53	177359.67	157913.77	69052.55
671							26	13	221044.61	198078.06	184110.75	79144.98
672						24	26	9	146871.17	144157.06	121593.92	52508.71
673					4 on 1	8	10	8.5	115050.86	73292.38	69548.09	34952.90
674							18	10.5	105428.51	82432.17	75838.66	35453.82
675							26	12.5	96079.16	45910.31	90490.00	35705.38
676						16	18	8.5	83392.12	65387.27	50975.17	25130.60
677							26	10.5	77086.79	68185.66	61517.34	25382.15
678						24	26	8.5	63107.21	57547.06	41998.76	19035.51
679					6 on 1	8	10	8.33	97787.84	54947.52	57698.86	8791.74
680							18	9.66	84677.41	54315.29	71193.39	8815.79
681							26	11	70754.95	55392.53	73291.05	8813.09
682						16	18	8.33	73991.55	51996.23	48333.79	6278.22
683							26	9.66	62223.48	49867.13	50593.68	6275.51
684						24	26	8.33	54823.77	46965.12	34298.24	4711.98
685				10x12	2 on 1	8	10	11	282180.97	248896.23	236196.59	109128.89
686							18	15	288700.78	260301.86	241021.84	111257.23
687							26	19	306058.91	269971.44	255501.75	117182.25

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
688							**18**	11	202687.23	196497.67	174606.03	78460.01
689					**2 on 1**	**16**	**26**	15	208138.80	195655.72	178042.09	79650.77
690						**24**	**26**	11	155037.42	159747.25	133470.91	59407.31
691							**10**	10.5	70494.87	50277.94	56792.83	35453.82
692							**18**	12.5	66953.09	53849.96	58871.57	35705.38
693						**8**	**26**	14.5	62421.73	45485.18	70370.97	35801.46
694			**0**	**10x12**	**4 on 1**		**18**	10.5	51935.43	43618.22	40864.44	25382.15
695						**16**	**26**	12.5	48708.80	43748.02	48922.36	25478.23
696						**24**	**26**	10.5	39269.70	37455.52	33919.30	19131.60
697							**10**	10.33	51991.04	29295.36	41429.84	8813.09
698							**18**	11.66	41015.95	28527.68	52577.15	8813.09
699						**8**	**26**	13	38087.36	28903.11	52906.33	8813.09
700					**6 on 1**		**18**	10.33	38930.04	26933.35	36381.31	6275.51
701						**16**	**26**	11.66	32828.89	25572.34	36878.42	6275.51
702	**50000**	**0**				**24**	**26**	10.33	28456.97	23434.42	25025.89	4711.98
703							**10**	5	187548.67	154070.92	158075.42	72027.07
704							**18**	9	192764.25	158728.41	157698.23	74083.25
705						**8**	**26**	13	222336.89	182828.31	180241.23	84830.28
706					**2 on 1**		**18**	5	133154.02	122094.74	114889.40	51126.55
707						**16**	**26**	9	136909.72	115546.65	114156.94	59152.03
708						**24**	**26**	5	100386.85	98454.82	87925.56	38636.88
709							**10**	4.5	48958.26	33009.52	35211.84	26006.83
710							**18**	6.5	46786.82	35948.82	38012.52	26493.05
711			**2**	**4x6**	**4 on 1**	**8**	**26**	8.5	43760.50	35362.39	48661.93	26879.88
712						**16**	**18**	4.5	35447.83	27517.73	24992.12	18473.99
713							**26**	6.5	32857.69	24885.07	31673.75	18860.90
714						**24**	**26**	4.5	25939.04	23105.18	21531.56	13965.75
715							**10**	4.33	35374.18	19029.87	24416.27	6524.52
716							**18**	5.66	30514.86	19478.30	33911.80	6619.42
717					**6 on 1**	**8**	**26**	7	25528.71	20447.86	35046.82	6690.73

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
718							18	4.33	25773.77	17549.26	21276.87	4645.74
719				4x6	6 on 1	16	26	5.66	21497.12	17378.63	22390.08	4717.05
720						24	26	4.33	18519.14	15466.90	14635.44	3511.86
721							10	9	202730.20	166823.88	161578.11	74083.25
722							18	13	231810.48	191312.00	183081.25	84830.28
723						8	26	17	232923.08	197575.17	188319.23	89589.89
724					2 on 1		18	9	144223.89	132494.73	117093.04	52737.70
725						16	26	13	164715.88	141502.03	133764.78	60293.27
726						24	26	9	108731.80	107995.80	90354.41	39862.78
727							10	8.5	72065.09	45850.98	45609.36	26879.88
728							18	10.5	66129.38	49489.75	46657.29	27169.05
729						8	26	12.5	60386.76	38562.28	57640.45	27354.51
730	50000	0	2	8x10	4 on 1		18	8.5	51420.10	40167.44	32239.71	19150.08
731						16	26	10.5	46846.96	39896.44	38665.05	19335.54
732						24	26	8.5	37528.31	33941.47	26891.29	14440.54
733							10	8.33	57439.03	29301.79	34059.33	6736.55
734							18	9.66	48168.81	28718.76	42755.93	6753.53
735						8	26	11	39683.13	30247.82	42622.91	6751.51
736					6 on 1		18	8.33	41451.63	27680.00	28675.81	4779.84
737						16	26	9.66	33965.40	26558.43	28645.35	4777.83
738						24	26	8.33	29410.23	24712.66	19579.56	3572.65
739							10	11	219729.08	185755.95	179733.55	84027.77
740							18	15	222965.44	191177.09	180759.67	85294.72
741						8	26	19	235514.81	197848.81	189338.98	89749.14
742				10x12	2 on 1		18	11	156003.66	147924.97	130794.20	59843.82
743						16	26	15	158878.23	140366.58	131506.72	60648.25
744						24	26	11	118031.71	120589.84	101347.51	45130.41
745							10	10.5	46862.33	32069.74	38944.84	27169.05
746							18	12.5	44485.39	33920.79	39042.25	27354.51
747					4 on 1	8	26	14.5	41058.93	27978.20	48736.07	27420.92

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
748							**18**	10.5	33832.40	27379.41	27134.32	19335.54
749					**4 on 1**	**16**	**26**	12.5	31002.76	26846.29	33111.82	19401.94
750			**2**	**10x12**		**24**	**26**	10.5	24392.57	23179.90	23322.88	14506.94
751							**10**	10.33	20865.59	16348.71	25377.98	6751.51
752							**18**	11.66	24772.25	15921.99	34638.57	6751.51
753						**8**	**26**	13	22078.19	16762.33	34655.07	6751.51
754					**6 on 1**		**18**	10.33	22389.96	14961.03	23480.79	4777.83
755						**16**	**26**	11.66	18354.26	14384.53	23458.86	4777.83
756						**24**	**26**	10.33	15546.03	12861.18	15855.31	3572.65
757							**10**	5	411338.22	333274.97	345994.69	157794.41
758							**18**	9	420218.75	337951.69	346495.69	161321.86
759						**8**	**26**	13	483731.19	386045.28	396820.91	183792.56
760					**2 on 1**		**18**	5	280347.31	257477.52	246592.97	107493.23
761						**16**	**26**	9	285501.00	236427.12	246568.91	124057.81
762	**50000**	**0**				**24**	**26**	5	206065.44	202621.72	187030.28	79420.55
763							**10**	4.5	96508.04	59619.50	73875.06	59966.25
764							**18**	6.5	84924.04	61863.22	73730.03	57674.78
765			**4**	**4x6**	**4 on 1**	**8**	**26**	8.5	80667.95	64401.33	102034.45	58490.87
766						**16**	**18**	4.5	61625.29	48719.92	48890.66	38742.88
767							**26**	6.5	58563.89	44758.23	65931.56	39515.66
768						**24**	**26**	4.5	45308.97	40399.14	44637.75	28769.21
769							**10**	4.33	61288.01	28939.88	43338.66	14216.21
770							**18**	5.66	45964.02	28860.32	70306.85	14413.86
771						**8**	**26**	7	39920.24	32408.76	72161.40	14553.65
772					**6 on 1**		**18**	4.33	37882.04	25883.00	43396.26	9744.13
773						**16**	**26**	5.66	32750.62	26384.61	45361.67	9878.94
774						**24**	**26**	4.33	27942.99	23261.07	28875.45	7218.89
775							**10**	9	438112.03	346056.59	350624.59	161321.86
776							**18**	13	496992.12	399253.78	397272.53	184312.12
777				**8x10**	**2 on 1**	**8**	**26**	17	509116.06	416474.06	414697.44	194539.81

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
778							**18**	9	295782.41	269771.16	247629.14	110604.24
779					**2 on 1**	**16**	**26**	13	78646.73	65827.89	75051.09	40403.74
780						**24**	**26**	9	218095.14	217268.03	188155.05	7233.30
781							**10**	8.5	128869.06	77072.06	80791.93	58490.87
782							**18**	10.5	110372.55	81543.58	81007.63	59039.34
783						**8**	**26**	12.5	104550.03	69282.37	82327.95	59397.99
784				**8x10**	**4 on 1**		**18**	8.5	82701.28	66151.28	55648.37	40045.30
785						**16**	**26**	10.5	78646.73	65827.89	75051.09	40403.74
786						**24**	**26**	8.5	62370.65	56483.65	52432.45	29633.41
787							**10**	8.33	95254.20	46530.65	53364.61	14643.08
788							**18**	9.66	74011.48	46029.95	81099.95	146684.25
789						**8**	**26**	11	63288.06	51578.77	82152.93	14679.55
790					**6 on 1**		**18**	8.33	62494.41	43121.45	53559.82	10009.24
791						**16**	**26**	9.66	52997.02	43425.55	54945.74	10004.54
792	**50000**	**0**	**4**			**24**	**26**	8.33	45602.32	39126.38	38326.12	7336.47
793							**10**	11	479613.66	391681.50	393165.62	182494.50
794							**18**	15	484000.47	406313.56	396303.22	185313.77
795						**8**	**26**	19	512303.41	420231.09	415375.97	194997.06
796					**2 on 1**		**18**	11	326380.03	305277.16	279026.69	125213.33
797						**16**	**26**	15	332870.19	286857.31	283011.69	126783.26
798						**24**	**26**	11	242691.22	244306.69	213432.56	92716.95
799							**10**	10.5	89463.43	61399.45	76844.24	59039.34
800							**18**	12.5	83260.85	63330.19	77498.42	59397.99
801						**8**	**26**	14.5	79758.55	54358.41	77616.47	59565.79
802				**10x12**	**4 on 1**		**18**	10.5	60770.39	50903.10	53397.23	40403.74
803						**16**	**26**	12.5	58028.40	49836.60	71757.96	40572.07
804						**24**	**26**	10.5	44966.88	43175.90	50500.67	29779.01
805							**10**	10.33	54991.59	28506.10	47265.48	14679.55
806							**18**	11.66	40110.74	28177.56	76781.62	14679.55
807					**6 on 1**	**8**	**26**	13	39221.96	30922.91	77415.63	14679.55

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
808							18	10.33	36188.38	25372.11	31120.85	10004.54
809		0	4	10x12	6 on 1	16	26	11.66	31753.72	25554.18	51886.74	10004.54
810						24	26	10.33	26521.98	21769.28	35780.70	7336.47
811							10	5	442797.16	370931.97	374462.19	170214.30
812							18	9	461863.72	390172.16	388002.00	176584.34
813						8	26	13	532196.38	454871.84	447382.62	203381.48
814					2 on 1		18	5	313539.78	287436.91	274662.75	120114.35
815						16	26	9	325896.62	286155.97	280738.47	140791.83
816						24	26	5	239249.30	234040.09	209545.08	91826.14
817							10	4.5	137513.84	87540.92	95626.51	61619.40
818							18	6.5	131821.06	97446.56	105098.91	63126.52
819				4x6	4 on 1	8	26	8.5	120518.84	94231.27	127930.92	64367.25
820						16	18	4.5	99578.02	73700.25	66035.16	43527.93
821							26	6.5	92583.79	65623.99	83313.81	44768.97
822						24	26	4.5	73650.48	63594.55	54823.97	33356.89
823	50000	3	0				10	4.33	107323.48	57351.90	68953.19	15548.57
824							18	5.66	93029.48	58047.17	92329.66	15852.98
825						8	26	7	78872.34	62172.66	98976.18	16068.13
826					6 on 1		18	4.33	79331.44	53181.27	57072.41	11033.34
827						16	26	5.66	68115.66	53375.21	64038.88	1124.51
828						24	26	4.33	59582.56	48151.04	41746.60	8436.66
829							10	9	497910.19	409064.47	398498.75	176584.34
830							18	13	567983.31	477824.28	461644.56	203381.48
831						8	26	17	557956.69	498029.53	468988.78	215053.33
832				8x10	2 on 1		18	9	351639.72	323134.34	286575.66	125515.83
833						16	26	13	401388.06	360499.28	334492.88	14707.59
834						24	26	9	267594.25	263897.53	221943.78	95702.66
835							10	8.5	210586.03	133110.53	127993.23	64367.25
836							18	10.5	192298.38	149188.25	139400.25	65241.52
837					4 on 1	8	26	12.5	174182.11	82934.88	165038.56	65655.98

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
838							18	8.5	1511.87.50	117994.38	91940.80	45643.27
839					4 on 1	16	26	10.5	139134.39	123213.87	111232.30	46057.73
840				8x10		24	26	8.5	114112.53	104090.22	76121.33	34645.92
841							10	8.33	178681.75	98837.92	106033.95	16170.85
842							18	9.66	153464.34	98035.34	129534.01	16209.25
843						8	26	11	127176.32	100278.64	132999.94	16204.92
844					6 on 1		18	8.33	133760.42	93185.77	87015.17	11389.61
845						16	26	9.66	111569.74	89132.30	91025.60	11385.28
846						24	26	8.33	98182.23	83858.98	61536.76	8573.45
847			0				10	11	519992.94	458785.81	435815.62	201027.69
848							18	15	531804.56	479124.16	444769.81	204742.31
849						8	26	19	563557.94	497296.25	470907.81	215427.80
850					2 on 1		18	11	368475.94	359975.34	317635.56	142538.45
851						16	26	15	378207.41	359707.22	323830.28	144504.92
852						24	26	11	282718.00	292929.34	245776.67	108176.30
853	50000	3					10	10.5	129171.41	91811.28	104391.17	65241.52
854							18	12.5	122462.83	98213.87	107965.16	65655.98
855						8	26	14.5	113542.44	83157.80	129080.69	65809.37
856				10x12	4 on 1		18	10.5	94242.92	79063.73	74161.96	46057.73
857						16	26	12.5	87930.55	78928.59	88690.27	46211.12
858						24	26	10.5	70995.17	67883.93	61605.05	34799.29
859							10	10.33	94766.31	52592.75	75800.23	16204.92
860							18	11.66	74691.63	51119.32	96260.62	16204.92
861						8	26	13	68536.83	52271.96	96717.30	16204.92
862					6 on 1		18	10.33	70333.52	48231.16	65750.47	11385.28
863						16	26	11.66	58780.93	45909.83	66591.57	11385.28
864						24	26	10.33	50841.92	41755.37	45008.07	8573.45
865							10	5	346686.69	285210.94	292192.50	133139.64
866							18	9	356037.00	293057.38	292819.75	136905.92
867			2	4x6	2 on 1	8	26	13	410737.44	337104.72	336867.28	156716.80

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
868							**18**	5	241882.77	223390.84	209874.06	92950.86
869					**2 on 1**	**16**	**26**	9	248731.09	210866.22	210270.16	107559.83
870						**24**	**26**	5	182855.69	180054.52	161371.27	70430.23
871							**10**	4.5	89105.03	60622.89	66773.65	48066.98
872							**18**	6.5	84940.13	65878.44	70494.76	48952.10
873				**4x6**	**4 on 1**	**8**	**26**	8.5	79482.11	64756.84	90293.16	49658.18
874						**16**	**18**	4.5	63625.36	50192.47	45826.46	33577.50
875							**26**	6.5	59042.37	45056.26	57137.57	34283.70
876						**24**	**26**	4.5	46689.47	42136.20	39475.44	25449.19
877							**10**	4.33	63738.48	34797.29	45179.50	12061.29
878							**18**	5.66	54669.38	35196.17	62942.97	12234.76
879						**8**	**26**	7	45611.33	37127.64	64756.62	12361.59
880	**50000**	**3**	**2**		**6 on 1**		**18**	4.33	45955.50	31667.82	38506.07	8449.26
881						**16**	**26**	5.66	38198.00	31397.90	39693.09	8576.09
882						**24**	**26**	4.33	32928.30	27824.80	26615.76	6400.34
883							**10**	9	374210.22	308856.69	300598.03	136905.92
884							**18**	13	427865.00	352994.75	343436.91	156716.80
885						**8**	**26**	17	431449.53	364111.88	349930.03	165363.42
886					**2 on 1**		**18**	9	261818.89	242295.48	215091.06	95895.48
887						**16**	**26**	13	299688.59	258138.12	245172.11	109553.59
888						**24**	**26**	9	197934.66	197525.20	165843.86	72622.09
889							**10**	8.5	130838.77	83265.45	84460.84	49658.18
890							**18**	10.5	119376.09	90353.30	85977.52	50173.44
891						**8**	**26**	12.5	108857.51	70288.89	106085.74	50483.36
892				**8x10**	**4 on 1**		**18**	8.5	92005.66	72334.81	58302.63	34798.98
893						**16**	**26**	10.5	83733.46	72085.14	70293.66	35108.91
894						**24**	**26**	8.5	67232.23	61551.07	48781.25	26274.65
895							**10**	8.33	103271.71	53019.55	62443.12	12437.92
896							**18**	9.66	86057.53	52139.45	77301.02	12465.04
897					**6 on 1**	**8**	**26**	11	70878.55	54894.33	78327.35	12461.81

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
898							18	8.33	73762.16	49910.74	51930.33	8679.53
899				8x10	6 on 1	16	26	9.66	60380.23	48026.11	51760.77	8676.31
900						24	26	8.33	52190.61	44613.07	35401.00	6500.57
901							10	11	406036.66	344302.19	334383.41	155273.41
902							18	15	412000.53	352632.78	336339.31	157523.97
903						8	26	19	435219.53	364970.56	352143.66	165617.69
904					2 on 1		18	11	283633.09	269983.41	239103.42	108783.26
905						16	26	15	288840.75	255964.31	240898.31	110118.04
906						24	26	11	215114.50	220336.09	185957.11	82146.27
907							10	10.5	85317.55	58841.11	72139.43	50173.44
908							18	12.5	80836.48	62382.32	72348.62	50483.36
909						8	26	14.5	74710.12	51341.18	90064.34	50589.38
910	50000	3	2	10x12	4 on 1		18	10.5	60760.07	49770.98	48750.66	35108.91
911						16	26	12.5	55747.86	48857.82	60381.69	35214.90
912						24	26	10.5	43896.89	42090.50	42609.37	26380.65
913							10	10.33	55598.58	29538.18	46853.00	12461.81
914							18	11.66	44393.38	29031.40	63968.23	12461.81
915						8	26	13	39600.35	30463.12	63928.23	12461.81
916					6 on 1		18	10.33	39908.57	26996.22	42733.81	8676.31
917						16	26	11.66	32630.95	25911.94	42668.36	8676.31
918						24	26	10.33	27560.14	23152.29	28802.17	6500.57
919							10	5	758374.94	616494.56	643102.25	291069.09
920							18	9	774654.62	622716.06	645132.31	297552.53
921						8	26	13	892251.88	707644.75	734905.06	339845.38
922					2 on 1		18	5	507647.84	468601.47	449177.59	194775.70
923						16	26	9	517166.56	430533.88	448434.56	224859.22
924			4	4x6		24	26	5	374963.81	369622.75	340885.94	144653.17
925							10	4.5	175020.22	109936.67	137534.94	105038.23
926							18	6.5	154226.00	114046.75	137183.19	106341.82
927					4 on 1	8	26	8.5	147424.72	118812.78	189558.86	107551.80

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
928							18	4.5	110247.20	89176.34	89203.01	70184.40
929					4 on 1	16	26	6.5	105687.71	81909.65	121637.91	71621.38
930						24	26	4.5	82035.20	73935.04	81353.43	52391.86
931				4x6			10	4.33	109744.48	53255.44	80603.04	26224.27
932							18	5.66	82583.49	53301.78	130936.17	26589.75
933						8	26	7	72255.62	59679.77	134098.06	26837.34
934					6 on 1		18	4.33	67577.89	47339.02	79467.16	17668.23
935						16	26	5.66	58909.76	48641.30	83139.41	17907.26
936						24	26	4.33	50329.02	42538.22	52833.76	13141.85
937							10	9	807210.31	643220.81	651365.31	297552.53
938							18	13	916364.31	736024.12	741468.81	339845.38
939						8	26	17	939416.00	767533.75	770683.12	358441.31
940					2 on 1		18	9	535549.50	492023.78	451357.73	200472.94
941						16	26	13	614288.44	517239.81	515895.69	228502.97
942	50000	3	4			24	26	9	397228.81	395769.78	344361.88	149084.19
943							10	8.5	234081.98	140923.17	149421.11	107851.80
944							18	10.5	200727.17	149235.61	150309.61	108827.59
945						8	26	12.5	190903.98	123856.03	206789.48	109422.65
946				8x10	4 on 1		18	8.5	148746.00	120599.23	101652.09	72564.51
947						16	26	10.5	142254.22	120371.00	137346.88	73159.55
948						24	26	8.5	113077.82	102708.77	95867.52	53882.04
949							10	8.33	171838.16	84595.79	98112.22	26985.53
950							18	9.66	133334.30	84119.57	151084.08	27051.24
951						8	26	11	114721.52	94478.80	152873.73	27043.74
952					6 on 1		18	8.33	111986.22	78387.16	98162.09	18120.73
953						16	26	9.66	95571.86	79212.29	100731.59	18113.24
954						24	26	8.33	82125.77	71001.66	70139.38	13333.85
955							10	11	884691.56	727139.81	730929.12	336687.56
956							18	15	892465.94	746783.50	732911.31	341615.09
957				10x12	2 on 1	8	26	19	945021.31	771203.88	771398.06	359171.09

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing **Acc. Cost ($)**	**Culvert Extension** **Acc. Cost ($)**	**Guardrail Installation** **Acc. Cost ($)**	Grating **Acc. Cost ($)**
958							18	11	591367.19	555963.44	508827.19	226942.05
959					2 on 1	16	26	15	603085.69	520409.88	513777.72	229541.23
960						24	26	11	441548.53	445899.44	390484.81	168614.95
961							10	10.5	163131.08	114265.91	143016.62	108827.59
962							18	12.5	152083.36	118167.46	144062.50	109422.65
963						8	26	14.5	146065.27	100006.98	201551.80	109690.54
964	50000	3	4	10x12	4 on 1		18	10.5	109521.39	92707.92	97452.74	73159.55
965						16	26	12.5	104920.14	90990.60	131220.30	73428.23
966						24	26	10.5	81525.82	78727.18	92690.60	54114.46
967							10	10.33	99198.58	51966.38	87953.66	27043.74
968							18	11.66	72385.40	51387.47	144517.70	27043.74
969						8	26	13	71110.20	56447.43	145579.47	27043.74
970					6 on 1		18	10.33	64828.21	45977.98	93766.77	18113.24
971						16	26	11.66	57010.75	45965.97	94987.34	18113.24
972						24	26	10.33	47527.66	39442.31	65445.01	13333.85
973							10	5	671209.12	562744.44	567149.12	257941.42
974							18	9	699878.81	590976.31	588781.81	267511.44
975						8	26	13	806123.12	689497.56	678140.25	308037.78
976					2 on 1		18	5	471250.25	433621.94	412654.06	180520.67
977						16	26	9	489559.38	432528.72	421870.62	212630.72
978						24	26	5	360213.97	353193.66	317594.81	138392.95
979							10	4.5	208335.84	131620.88	144938.88	93377.56
980							18	6.5	198830.33	146931.33	158779.94	95625.15
981	100000	0	0	4x6	4 on 1	8	26	8.5	180951.94	141989.70	193021.83	97511.41
982						16	18	4.5	149437.08	110399.18	98874.46	65407.46
983							26	6.5	138430.00	98661.88	124399.13	67294.16
984						24	26	4.5	110280.88	95684.82	82259.45	50253.28
985							10	4.33	162084.61	85629.02	104089.06	23557.33
986							18	5.66	139758.73	87650.05	139246.81	24020.20
987					6 on 1	8	26	7	118023.44	93385.15	149253.31	24335.39

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
988							18	4.33	118976.26	79421.74	85121.46	16587.24
989				4x6	6 on 1	16	26	5.66	101805.80	79908.45	96220.51	16902.45
990						24	26	4.33	89122.24	72025.82	62577.36	12703.31
991							10	9	754718.75	620520.94	604352.88	267511.44
992							18	13	859941.31	723260.38	699422.69	308037.78
993						8	26	17	845457.25	754695.69	711307.31	325510.34
994					2 on 1		18	9	528012.94	486396.00	430344.16	188668.33
995						16	26	13	602978.81	542296.56	502643.02	215873.83
996						24	26	9	402804.19	398372.16	335631.38	144089.66
997							10	8.5	317868.38	199793.47	193135.45	97511.41
998							18	10.5	289654.38	224035.92	210215.00	98792.60
999						8	26	12.5	261402.94	124194.08	248582.42	99376.71
1000				8x10	4 on 1		18	8.5	226899.03	177285.31	136606.41	68575.43
1001						16	26	10.5	208243.11	184548.00	166664.53	69159.55
1002	100000	0	0			24	26	8.5	170985.06	155785.09	114343.76	52119.01
1003							10	8.33	269433.69	147622.52	159723.55	24480.07
1004							18	9.66	230267.30	146498.70	194823.47	24532.95
1005						8	26	11	189860.38	150198.70	199717.80	24527.00
1006					6 on 1		18	8.33	200394.55	138507.31	130032.07	17100.00
1007						16	26	9.66	166311.38	132224.17	135971.78	17094.04
1008						24	26	8.33	146245.17	124655.84	91654.89	12894.92
1009							10	11	788058.94	695413.19	663567.44	304597.38
1010							18	15	805777.75	725627.50	674450.44	310040.88
1011						8	26	19	853691.06	753485.75	713922.19	326026.09
1012				10x12	2 on 1		18	11	553921.19	541868.25	477685.12	214185.48
1013						16	26	15	568387.62	541310.94	486950.47	216961.44
1014						24	26	11	425792.12	442077.59	370992.16	162779.48
1015							10	10.5	195103.22	138388.98	157762.39	98792.60
1016							18	12.5	184773.14	148202.86	163232.25	99376.71
1017					4 on 1	8	26	14.5	170742.64	125434.42	195089.28	99587.96

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
1018							**18**	10.5	141515.69	118643.66	111301.12	69159.55
1019					**4 on 1**	**16**	**26**	12.5	131620.58	117915.71	133100.41	69370.74
1020						**24**	**26**	10.5	106365.99	101861.27	92556.14	52330.24
1021			**0**	**10x12**			**10**	10.33	142686.53	78427.73	114337.80	24527.00
1022							**18**	11.66	112397.26	76562.01	145322.66	24527.00
1023						**8**	**26**	13	102389.62	78331.48	145880.28	24527.00
1024					**6 on 1**		**18**	10.33	105331.27	72222.34	98487.49	17094.04
1025						**16**	**26**	11.66	87545.39	68757.59	99694.99	17094.04
1026						**24**	**26**	10.33	75618.95	61999.58	67216.12	12894.92
1027							**10**	5	526377.56	433362.03	444998.62	202143.98
1028							**18**	9	540314.19	445022.53	449249.69	207831.34
1029						**8**	**26**	13	623397.50	511524.44	313341.12	237861.00
1030					**2 on 1**		**18**	5	363449.00	337117.00	316641.22	139735.67
1031						**16**	**26**	9	373762.50	318306.81	318364.97	161714.30
1032	**100000**	**0**				**24**	**26**	5	275207.44	271619.62	243973.81	106049.04
1033							**10**	4.5	134041.61	91690.48	101764.59	72974.27
1034							**18**	6.5	127583.01	99412.91	107236.64	74305.90
1035			**2**	**4x6**	**4 on 1**	**8**	**26**	8.5	119417.78	97777.75	137397.73	75369.90
1036						**16**	**18**	4.5	94903.72	75546.91	69855.65	50469.60
1037							**26**	6.5	88128.49	67565.08	86150.15	51533.82
1038						**24**	**26**	4.5	69763.13	63360.29	59644.43	38311.83
1039							**10**	4.33	95298.26	52129.80	68637.26	18313.29
1040							**18**	5.66	81451.19	52714.63	95796.24	18574.96
1041						**8**	**26**	7	67840.38	55771.77	98291.52	18763.07
1042					**6 on 1**		**18**	4.33	68265.62	47367.73	58039.32	12704.80
1043						**16**	**26**	5.66	56619.61	47021.83	59736.87	12892.91
1044						**24**	**26**	4.33	48828.85	41860.98	39831.83	9635.97
1045							**10**	9	567684.38	468726.97	458116.16	207831.34
1046							**18**	13	649058.81	535375.44	523345.97	237861.00
1047				**8x10**	**2 on 1**	**8**	**26**	17	655867.31	555130.19	532928.38	250853.80

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
1048							**18**	9	393247.03	365534.03	324153.38	144176.41
1049					**2 on 1**	**16**	**26**	13	450313.19	388865.97	369472.81	164637.83
1050						**24**	**26**	9	297791.88	297607.25	250749.44	109310.65
1051							**10**	8.5	196530.42	125011.08	128651.45	75369.90
1052							**18**	10.5	178688.06	135958.00	130299.70	76134.98
1053						**8**	**26**	12.5	162804.06	105831.35	158591.25	76576.09
1054				**8x10**	**4 on 1**		**18**	8.5	136970.17	108087.12	86704.88	52298.92
1055						**16**	**26**	10.5	124572.62	107959.70	104410.84	52740.03
1056						**24**	**26**	8.5	100077.10	91684.77	73235.54	39518.46
1057							**10**	8.33	154200.72	79476.05	94346.50	18871.49
1058							**18**	9.66	230267.30	146498.70	194823.47	24532.95
1059						**8**	**26**	11	189860.38	150198.70	199717.80	24527.00
1060					**6 on 1**		**18**	8.33	109434.86	74350.33	77883.03	13038.66
1061						**16**	**26**	9.66	89525.19	71880.38	77524.30	13034.22
1062	**100000**	**0**	**2**			**24**	**26**	8.33	77297.06	66559.28	53041.41	9777.30
1063							**10**	11	616367.62	523367.25	509542.03	235705.45
1064							**18**	15	625405.88	534934.25	512636.00	239040.64
1065						**8**	**26**	19	660678.38	554858.19	536583.19	251203.84
1066					**2 on 1**		**18**	11	426402.38	407230.47	360644.06	163522.30
1067						**16**	**26**	15	434214.75	385498.59	363796.62	165412.86
1068						**24**	**26**	11	323154.53	332235.00	281101.75	123580.76
1069							**10**	10.5	128368.72	89197.70	109746.23	76134.98
1070							**18**	12.5	121487.07	94471.48	109849.73	76576.09
1071						**8**	**26**	14.5	112370.85	77614.70	136723.09	76722.09
1072				**10x12**	**4 on 1**		**18**	10.5	90661.30	74969.29	739985.08	52740.03
1073						**16**	**26**	12.5	83246.59	73494.61	90939.46	52886.03
1074						**24**	**26**	10.5	65582.23	63228.77	64387.75	39664.43
1075							**10**	10.33	83113.11	44541.65	71084.93	18904.38
1076							**18**	11.66	66152.41	43603.38	96442.41	18904.38
1077					**6 on 1**	**8**	**26**	13	59042.32	45742.01	96944.63	18904.38

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
1078			**2**	**10x12**	**6 on 1**		**18**	10.33	59270.58	40362.42	64283.33	13034.22
1079						**16**	**26**	11.66	48384.00	38736.07	64161.72	13034.22
1080						**24**	**26**	10.33	40792.50	34418.59	43277.62	9777.30
1081			**4**	**4x6**	**2 on 1**		**10**	5	1149668.25	936415.44	979579.62	441381.72
1082							**18**	9	1174263.12	942839.00	986738.25	451192.47
1083						**8**	**26**	13	1352985.88	1071340.75	1120307.88	515222.53
1084							**18**	5	761307.19	703856.75	676041.38	292218.12
1085						**16**	**26**	9	775752.62	647866.25	675646.94	337414.62
1086						**24**	**26**	5	563989.56	556506.06	514807.91	217699.56
1087					**4 on 1**		**10**	4.5	262715.72	166732.89	205957.03	159243.64
1088							**18**	6.5	231697.12	172870.14	207740.84	161217.42
1089						**8**	**26**	8.5	222323.91	180185.03	289200.16	163511.41
1090						**16**	**18**	4.5	164109.53	134404.00	134389.64	105280.80
1091							**26**	6.5	158169.84	123624.91	183621.69	107470.18
1092	**100000**	**0**				**24**	**26**	4.5	123017.56	111903.02	122778.28	78842.02
1093					**6 on 1**		**10**	4.33	163454.22	80696.02	122819.18	39767.70
1094							**18**	5.66	123257.66	80575.24	199848.91	40322.68
1095						**8**	**26**	7	108331.52	90218.43	205193.56	40688.95
1096							**18**	4.33	100415.57	71422.66	120951.27	26518.28
1097						**16**	**26**	5.66	87985.48	73126.46	125594.32	26872.12
1098						**24**	**26**	4.33	75231.14	64520.52	80852.45	19772.41
1099				**8x10**	**2 on 1**		**10**	9	1223227.25	975985.00	994156.75	451192.47
1100							**18**	13	1389238.00	1115720.88	1129202.88	515222.53
1101						**8**	**26**	17	1424809.25	1162289.62	1174288.75	643179.25
1102							**18**	9	803107.06	741767.25	679713.25	300820.56
1103						**16**	**26**	13	922084.44	778828.50	777731.94	342784.12
1104						**24**	**26**	9	597819.62	595784.38	519766.66	22487.81
1105					**4 on 1**		**10**	8.5	351711.88	215465.91	227944.48	163511.41
1106							**18**	10.5	301816.72	227881.42	229234.52	164958.77
1107						**8**	**26**	12.5	287742.56	187612.36	315087.19	165801.62

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
1108							**18**	8.5	222150.83	181565.92	153041.30	108870.03
1109				**8x10**	**4 on 1**	**16**	**26**	10.5	213191.30	181586.56	207295.42	109713.08
1110						**24**	**26**	8.5	169706.22	154935.48	144613.39	81008.59
1111							**10**	8.33	257111.73	127609.75	149802.77	40898.64
1112							**18**	9.66	199333.61	126854.15	230437.98	40989.12
1113						**8**	**26**	11	172155.23	141642.14	233015.05	40978.81
1114					**6 on 1**		**18**	8.33	166868.25	117832.68	148285.55	27171.74
1115						**16**	**26**	9.66	142967.12	118957.98	152193.77	27161.42
1116						**24**	**26**	8.33	122751.25	106668.40	105861.09	20041.27
1117							**10**	11	1341552.00	1105019.62	1113492.12	510608.41
1118							**18**	15	1353056.62	1130008.75	1116394.38	517836.28
1119						**8**	**26**	19	1433064.12	1166497.75	1174596.38	544184.31
1120	**100000**	**0**	**4**		**2 on 1**		**18**	11	887191.56	836698.69	766335.19	340529.41
1121						**16**	**26**	15	904734.50	781335.06	773535.06	344205.06
1122						**24**	**26**	11	664085.06	671808.88	589395.31	253529.36
1123							**10**	10.5	245677.33	173452.34	218009.61	164958.77
1124							**18**	12.5	229277.02	179402.80	219372.38	165801.62
1125						**8**	**26**	14.5	220547.39	151322.62	307131.25	166170.50
1126				**10x12**	**4 on1**		**18**	10.5	163771.52	139518.78	146843.11	109713.08
1127						**16**	**26**	12.5	157203.22	137368.84	197958.45	110083.06
1128						**24**	**26**	10.5	122354.20	118562.85	140011.33	81328.63
1129							**10**	10.33	148419.64	78250.53	133496.36	40978.81
1130							**18**	11.66	108329.73	77396.94	220543.94	40978.81
1131						**8**	**26**	13	106722.48	85104.79	222037.94	40978.81
1132					**6 on 1**		**18**	10.33	96581.44	68904.30	141713.44	27161.42
1133						**16**	**26**	11.66	85051.99	68844.76	143392.03	27161.42
1134						**24**	**26**	10.33	70821.65	59171.60	98224.38	20041.27
1135							**10**	5	1407872.00	1180365.50	1189604.50	541036.31
1136							**18**	9	1468007.12	1239582.25	1234979.38	561109.50
1137		**3**	**0**	**4x6**	**2 on 1**	**8**	**26**	13	1690856.25	1446232.25	1422410.12	646114.19

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope **Steepness**	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
1138							18	5	988455.00	909529.00	865548.56	378645.03
1139					2 on 1	16	26	9	1026858.69	905117.50	884880.44	443898.84
1140						24	26	5	755554.62	740829.38	666160.19	290281.47
1141							10	4.5	436987.78	276076.91	304011.62	195860.94
1142							18	6.5	417049.81	308190.81	333043.47	200575.28
1143				4x6	4 on 1	8	26	8.5	379549.59	297825.69	404866.41	204531.77
1144						16	18	4.5	313446.69	231564.06	207390.78	137193.22
1145							26	6.5	290359.16	206944.89	260929.17	141150.59
1146						24	26	4.5	231315.92	200700.44	172540.53	105407.05
1147							10	4.33	339975.06	179608.25	218328.48	49411.88
1148							18	5.66	293146.22	183847.41	292072.44	50382.76
1149						8	26	7	247556.06	195876.84	313061.25	51043.88
1150					6 on 1		18	4.33	249554.61	166588.38	178543.64	34792.00
1151						16	26	5.66	213539.31	167609.27	201824.06	35453.16
1152	**100000**	3	0			24	26	4.33	186935.34	151075.31	131257.00	26645.40
1153							10	9	1583034.75	1301552.75	1267639.88	561109.50
1154							18	13	1803740.75	1517050.38	1467050.38	646114.19
1155						8	26	17	1773360.25	1582986.25	1491978.62	682763.19
1156					2 on 1		18	9	1107515.62	1020223.44	902653.81	395734.84
1157						16	26	13	1264757.75	1137475.75	1054301.88	452798.84
1158						24	26	9	844888.31	835592.00	703992.25	302230.38
1159							10	8.5	666734.06	419070.03	405104.72	204531.77
1160							18	10.5	607554.75	469918.97	440929.34	207219.06
1161						8	26	12.5	548296.88	260499.08	521405.66	208444.25
1162				8x10	4 on 1		18	8.5	475924.38	371858.81	286534.16	143838.06
1163						16	26	10.5	436793.28	387092.38	349581.53	145063.28
1164						24	26	8.5	358643.91	326761.72	239837.88	109320.46
1165							10	8.33	565141.50	309640.59	335022.72	51347.34
1166							18	9.66	482989.38	307283.38	408645.38	51458.27
1167					6 on 1	8	26	11	398235.22	315044.22	418911.31	51445.78

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
1168							**18**	8.33	420330.78	290521.34	272744.38	35867.53
1169				**8x10**	**6 on 1**	**16**	**26**	9.66	348840.81	277342.34	285203.00	35855.03
1170						**24**	**26**	8.33	306751.59	261467.64	192247.61	27047.30
1171							**10**	11	1652966.38	1458640.38	1391843.38	638897.88
1172							**18**	15	1690131.75	1522015.25	1414670.62	650315.75
1173						**8**	**26**	19	1790630.75	1580448.50	1497463.38	683845.00
1174					**2 on 1**		**18**	11	1161858.62	1136577.38	1001952.25	449257.50
1175						**16**	**26**	15	1192202.25	1135408.50	1021386.44	455080.12
1176						**24**	**26**	11	893105.81	927264.88	778162.06	341432.59
1177							**10**	10.5	409232.12	290273.12	330909.16	207219.06
1178							**18**	12.5	387564.62	310857.88	342382.25	208444.25
1179						**8**	**26**	14.5	358135.44	263100.72	409202.91	208887.34
1180	**100000**	**3**	**0**	**10x12**	**4 on 1**		**18**	10.5	296831.41	248857.00	233455.88	145063.28
1181						**16**	**26**	12.5	276076.28	247330.09	279180.25	145506.25
1182						**24**	**26**	10.5	223104.39	213655.64	194137.98	109763.52
1183							**10**	10.33	299287.28	164503.41	239825.38	51445.78
1184							**18**	11.66	235755.06	160590.05	304816.62	51445.78
1185						**8**	**26**	13	214763.88	164301.53	305986.25	51445.78
1186					**6 on 1**		**18**	10.33	220934.02	151487.52	206579.09	35855.03
1187						**16**	**26**	11.66	183627.88	144220.16	209111.86	35855.03
1188						**24**	**26**	10.33	158611.97	130045.12	140986.91	27047.30
1189							**10**	5	1104085.50	908983.81	933391.81	424000.28
1190							**18**	9	1133317.62	933441.94	942308.44	435929.59
1191						**8**	**26**	13	1307586.25	1072930.75	1076741.25	498917.28
1192			**2**	**4x6**	**2 on 1**		**18**	5	762340.12	707108.31	664160.06	293097.81
1193						**16**	**26**	9	783972.88	667653.69	667775.62	339198.34
1194						**24**	**26**	5	577252.00	569726.56	511739.00	222439.56
1195							**10**	4.5	281154.44	192322.27	213452.86	153064.70
1196							**18**	6.5	267607.41	208520.19	224930.58	155857.83
1197					**4 on 1**	**8**	**26**	8.5	250480.72	205090.41	288193.97	158089.58

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
1198						**16**	**18**	4.5	199062.08	158460.84	146523.34	105860.80
1199					**4 on 1**		**26**	6.5	184850.94	141718.84	180701.33	108093.01
1200						**24**	**26**	4.5	146329.30	132899.23	125105.16	80359.67
1201				**4x6**			**10**	4.33	199889.64	109343.10	143967.77	38412.43
1202							**18**	5.66	170845.17	110569.78	200934.16	38961.28
1203						**8**	**26**	7	142296.30	116982.17	206168.05	39355.85
1204					**6 on 1**		**18**	4.33	143188.23	99354.57	121738.42	26648.51
1205						**16**	**26**	5.66	118760.53	98629.05	125299.05	27043.08
1206						**24**	**26**	4.33	102419.30	87804.08	83547.91	20211.60
1207							**10**	9	1190727.12	983162.38	960906.00	435929.59
1208							**18**	13	1361411.25	1122958.62	1097726.62	498917.28
1209						**8**	**26**	17	1375692.25	1164394.50	1117825.88	526169.88
1210					**2 on 1**		**18**	9	824841.94	766713.56	679916.94	302412.31
1211						**16**	**26**	13	944539.19	815652.62	774975.19	345330.50
1212	**100000**	**3**	**2**			**24**	**26**	9	624623.25	624236.00	525951.00	229280.84
1213							**10**	8.5	412225.72	262212.75	269848.50	158089.58
1214							**18**	10.5	374801.09	285174.09	273305.72	159694.36
1215						**8**	**26**	12.5	341484.12	221982.97	332647.72	160619.59
1216				**8x10**	**4 on 1**		**18**	8.5	287297.12	226714.47	181864.89	109697.83
1217						**16**	**26**	10.5	261293.08	226447.20	219003.42	110623.05
1218						**24**	**26**	8.5	209913.34	192310.28	153612.72	82890.59
1219							**10**	8.33	323438.50	166702.28	197893.31	39583.26
1220							**18**	9.66	482989.38	307283.38	408645.38	51458.27
1221						**8**	**26**	11	398235.22	315044.22	418911.31	51445.78
1222					**6 on 1**		**18**	8.33	229541.39	155951.02	163360.91	27348.79
1223						**16**	**26**	9.66	187780.53	150770.27	162608.48	27339.49
1224						**24**	**26**	8.33	162131.83	139609.16	111255.20	20508.04
1225							**10**	11	1292841.00	1097771.25	1068772.62	494995.97
1226							**18**	15	1311798.88	1122033.25	1075262.25	501391.59
1227				**10x12**	**2 on 1**	**8**	**26**	19	1385783.62	1163824.00	1125491.88	526904.12

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
1228							**18**	11	894385.88	854172.50	756456.75	342990.62
1229					**2 on 1**	**16**	**26**	15	910772.44	808589.50	763069.31	346956.16
1230						**24**	**26**	11	677821.81	696868.25	589615.44	259212.62
1231							**10**	10.5	269255.47	187093.59	230194.47	159694.36
1232							**18**	12.5	254821.08	198155.44	230411.58	160619.59
1233						**8**	**26**	14.5	235699.67	162798.08	286778.88	160925.81
1234			**2**	**10x12**	**4 on 1**		**18**	10.5	190163.53	157249.30	155184.89	110623.05
1235						**16**	**26**	12.5	174611.05	154156.12	190746.98	110929.30
1236						**24**	**26**	10.5	137559.78	132623.36	135054.34	83196.77
1237							**10**	10.33	174331.08	93426.83	149101.78	39652.24
1238							**18**	11.66	138755.73	91458.79	202289.52	39652.24
1239						**8**	**26**	13	123842.23	95944.60	203342.92	39652.24
1240					**6 on 1**		**18**	10.33	124320.99	84660.82	134835.33	27339.49
1241						**16**	**26**	11.66	101486.22	81249.52	134580.23	27339.49
1242	**100000**	**3**				**24**	**26**	10.33	85562.93	72193.55	90775.51	20508.04
1243							**10**	5	2411448.25	1964147.00	2054684.50	925805.44
1244							**18**	9	2463036.50	1977620.38	2069699.75	946383.62
1245						**8**	**26**	13	2837909.75	2247155.00	2349864.00	1080687.88
1246					**2 on 1**		**18**	5	1596854.50	1476351.12	1418008.00	612932.31
1247						**16**	**26**	9	1627154.25	1358910.25	1417180.62	707732.81
1248						**24**	**26**	5	1182977.38	1167280.88	1079818.25	456628.41
1249							**10**	4.5	551050.62	349724.97	431998.34	334016.12
1250							**18**	6.5	485988.56	362597.94	435739.91	338156.16
1251			**4**	**4x6**	**4 on 1**	**8**	**26**	8.5	466328.03	377941.06	606602.12	342967.88
1252						**16**	**18**	4.5	344222.44	281914.59	281884.47	220828.22
1253							**26**	6.5	331763.81	259305.28	385149.56	225420.48
1254						**24**	**26**	4.5	258031.36	234718.47	257529.45	165372.42
1255							**10**	4.33	342847.91	169261.20	257615.27	83413.41
1256							**18**	5.66	258534.97	169007.89	419186.31	84577.48
1257					**6 on 1**	**8**	**26**	7	227227.12	189234.64	430396.91	85345.74

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	Culvert Extension Acc. Cost ($)	Guardrail Installation Acc. Cost ($)	Grating Acc. Cost ($)
1258							**18**	4.33	210623.31	149810.19	253697.28	55622.54
1259				**4x6**	**6 on 1**	**16**	**26**	5.66	184551.00	153383.97	263436.16	56364.71
1260						**24**	**26**	4.33	157798.56	135332.86	169589.36	41472.95
1261							**10**	9	2565739.75	2047144.62	2085260.12	946383.62
1262							**18**	13	2913949.50	2340243.00	2368521.50	1080687.88
1263						**8**	**26**	17	2988561.25	2437921.25	2463090.25	1139327.50
1264					**2 on 1**		**18**	9	1684530.25	1555869.00	1425709.75	630976.12
1265						**16**	**26**	13	1934087.25	1633605.62	1631305.50	718995.25
1266						**24**	**26**	9	1253936.50	1249667.62	1090219.12	470447.34
1267							**10**	8.5	737721.44	451943.25	478117.34	342967.88
1268							**18**	10.5	633065.56	477985.06	480823.19	346003.75
1269						**8**	**26**	12.5	603544.69	393520.06	660900.69	347771.59
1270				**8x10**	**4 on 1**		**18**	8.5	465965.00	380837.47	321006.59	228356.73
1271						**16**	**26**	10.5	447172.25	380880.75	434805.59	230124.97
1272						**24**	**26**	8.5	355961.56	324979.78	303328.94	169916.86
1273	**100000**	**3**	**4**				**10**	8.33	539296.12	267663.53	314213.75	85785.59
1274							**18**	9.66	418105.50	266078.66	483347.47	85975.38
1275						**8**	**26**	11	361098.50	297096.75	488752.91	85953.73
1276					**6 on 1**		**18**	8.33	350008.84	247156.00	311031.38	56993.18
1277						**16**	**26**	9.66	299875.91	249516.36	319228.94	56971.53
1278						**24**	**26**	8.33	257472.78	223738.69	222045.41	42036.89
1279							**10**	11	2813927.25	2317797.25	2335567.75	1071009.62
1280							**18**	15	2838058.50	2370212.25	2341655.50	1086170.25
1281						**8**	**26**	19	3005875.25	2446748.25	2463735.50	1141435.62
1282				**10x12**	**2 on 1**		**18**	11	1860898.88	1754989.38	1607400.62	714266.00
1283						**16**	**26**	15	1897695.50	1638863.00	1622502.50	721975.75
1284						**24**	**26**	11	1392929.25	1409130.25	1236266.62	531781.94
1285							**10**	10.5	515312.25	363819.19	457278.75	346003.75
1286							**18**	12.5	480912.38	376300.34	460137.12	347771.59
1287					**4 on 1**	**8**	**26**	14.5	462601.81	317401.69	644212.88	348545.38

Scen. No.	ADT	TGF	Curvature	Culvert Size	Slope Steepness	Slope Offset	Culvert Offset	Slope Depth	Do-Nothing Acc. Cost ($)	**Culvert Extension** Acc. Cost ($)	**Guardrail Installation** Acc. Cost ($)	Grating Acc. Cost ($)
1288							18	10.5	343513.44	292642.97	308005.88	230124.97
1289					4 on 1	16	26	12.5	329736.38	288133.44	415221.06	230901.03
1290						24	26	10.5	256639.92	248687.55	293676.09	170588.17
1291							10	10.33	311312.69	164131.80	280010.81	85953.73
1292	**100000**	3	4	10x12			18	11.66	227223.38	162341.38	462594.59	85953.73
1293						8	26	13	223852.16	178508.69	465728.25	85953.73
1294					6 on 1		18	10.33	202581.14	144527.89	297246.25	56971.53
1295						16	26	11.66	178397.94	144403.03	300767.16	56971.53
1296						24	26	10.33	148549.58	124113.41	206028.31	42036.89