

**BENEFIT COST ANALYSIS OF BRIFEN WIRE
ROPE SAFETY FENCE ON LAKE HEFNER
PARKWAY IN OKLAHOMA CITY, OKLAHOMA**

By

JAMES N. WILKERSON

Bachelor of Science in Civil Engineering

Oklahoma State University

Stillwater, Oklahoma

Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
MASTER OF SCIENCE
May, 2010

**BENEFIT COST ANALYSIS OF BRIFEN WIRE
ROPE SAFETY FENCE ON LAKE HEFNER
PARKWAY IN OKLAHOMA CITY, OKLAHOMA**

Thesis Approved:

Dr. Stephen A. Cross

Thesis Adviser

Dr. Rifat Bulut

Dr. Tyler Ley

Dr. A. Gordon Emslie

Dean of the Graduate College

ACKNOWLEDGMENTS

I would like to thank Randy Lee of the Oklahoma Department of Transportation for his help in collecting and interpreting the accident data from the Lake Hefner Parkway. I also appreciate the help from Chris Green of Midstate Traffic Control, Inc. for providing the maintenance work orders issued during the study period. A special thank you to Jerry Emerson and Lyndal Wiseman of Brifen USA, Inc. for their in-depth knowledge and background of the Brifen WRSF product and details of the Lake Hefner Parkway project installation.

TABLE OF CONTENTS

I.	INTRODUCTION	1
II.	REVIEW OF LITERATURE	4
A.	Lake Hefner Parkway	4
B.	Median Barrier Options for the Lake Hefner Parkway	6
C.	Brifen Wire Rope Safety Fence Details	7
D.	Brifen WRSF Installation on Lake Hefner Parkway	10
E.	Brifen WRSF Maintenance on Lake Hefner Parkway	11
F.	Benefit Cost Analysis of Roadside Hardware	12
G.	Determination of Crash Costs	13
III.	METHODOLOGY	15
A.	Benefit/Cost Formulation	15
B.	Pre-Brifen WRSF (Alternative 1) Costs	16
C.	Post-Brifen WRSF (Alternative 2) Costs	18
D.	Yearly B/C Ratio's	20
E.	Crash Costs Yearly Adjustment	21
IV.	FINDINGS	22
A.	Pre-Brifen WRSF Crash Costs (CC_1)	22
B.	Pre-Brifen WRSF Direct Costs (DC_1)	23

C.	Brifen WRSF Crash Costs (CC_2)	23
D.	Brifen WRSF Direct Costs (DC_2)	25
E.	Benefit Cost Analysis.....	27
V.	CONCLUSION.....	29
	REFERENCES	31
	APPENDICES	32
	APPENDIX A -- LIST OF BRIFEN WRSF WORK ORDERS ON LAKE HEFNER PARKWAY BY DATE.....	33

LIST OF TABLES

Table 1: Initial Cost Comparisons of Median Barrier Types.....	7
Table 2: Brifen WRSF Maintenance Unit Costs.....	11
Table 3: AASHTO & FHWA Crash Costs.....	14
Table 4: Year 1993 to 2001 Crash Costs	22
Table 5: Annualized Crash Costs (1993 - 2001) (CC_1)	23
Table 6: Year 2001 - 2009 Crash Costs	24
Table 7: Year 2001 - 2009 Crash Costs w/o Semi-Trucks	24
Table 8: Annualized Crash Costs (2001 - 2009) (CC_2)	25
Table 9: Quantities of Maintenance Items for Brifen WRSF	26
Table 10: Yearly Costs of Maintenance Items.....	26
Table 11: Direct Costs of the Brifen WRSF (DC_2).....	27
Table 12: Benefit Cost Ratio (Includes All Crashes).....	28
Table 13: Benefit Cost Ratio (Excludes Semi Truck Crashes).....	28
Table 14: Yearly Benefit Cost Ratio's	28

LIST OF FIGURES

Figure 1: Guidelines for median barriers (AASHTO Roadside Design Guide, 2006)	5
Figure 2: AADT data for the Lake Hefner Parkway.....	6
Figure 3: Brifen WRSF on Lake Hefner Parkway (Courtesy of Brifen USA, Inc.).....	8
Figure 4: Brifen WRSF Standard Line Post Schematic (Courtesy of Brifen USA, Inc.)...	9

I. INTRODUCTION

Vehicle crashes involving vehicles crossing the highway median are violent collisions that frequently result in fatal or life threatening injuries to the vehicle occupants. These collisions typically involve two vehicles striking head-on or by sideswipe. On Lake Hefner Parkway in Oklahoma City, Oklahoma, these types of crashes began occurring on a frequent basis, prompting the Oklahoma Department of Transportation (ODOT) to review alternatives for preventing such accidents.

ODOT, with the aid of the Federal Highway Administration (FHWA), began looking for ways to prevent crossover accidents, including the use of median barriers. Median barriers considered included concrete barrier wall, double-faced guardrail, low-tension cable barrier, and high-tension cable barrier. Based on several factors ODOT and FHWA decided to install high-tension cable barrier, which became the first installation in the United States.

The Brifen Wire Rope Safety Fence (Brifen WRSF), a proprietary high-tension cable barrier product, was installed as an experimental project in 2000. A one-thousand foot section was installed for the trial and based on its successful performance seven more miles were installed along the median of Lake Hefner Parkway in 2001.

The Brifen WRSF system consists of four tensioned cables, three of which are weaved around weak s-shaped steel posts. When a vehicle contacts the barrier the posts fold down and the cables engage the vehicle. As the vehicle continues into the barrier the vehicle "deflects" the barrier creating temporary increased tensile forces acting on the cables. Maximum deflection occurs when the tensile forces equal the force applied by the errant vehicle and the vehicle redirects out of the system. Forces acting on the vehicle occupants are normally low enough that injuries do not occur due to the deflection of the system. After an impact, the system is restored to pre-impact conditions by replacing the damaged posts and placing the cables back to their original vertical positions.

To determine if the Brifen WRSF has been an effective median barrier from a performance and economical standpoint, an incremental benefit cost analysis can be used. The incremental benefit cost analysis takes the crash cost savings divided by the difference in direct costs, developing a ratio of the crash cost saving compared to the direct costs. The analysis bases each variable on a monetary value. Therefore, costs are assigned to each type of crash as well as costs for the installation and maintenance of the system. The American Association of State Highway Transportation Officials (AASHTO) Roadside Design Guide and the FHWA Comprehensive Crash Costs allocate costs to the severity of vehicle crashes. Installation costs were based on the contract amount to install the Brifen WRSF on Lake Hefner Parkway. The maintenance costs are based on actual maintenance costs incurred.

After nine years of service, the Brifen WRSF has significantly reduced the number of fatal and serious injury crashes. However, an increase in slight injury and

property damage incidents has occurred. In addition, the system requires maintenance after each impact, which increases direct costs to ODOT.

Costs gathered from crash data before and after the Brifen WRSF installation, along with installation and maintenance of the Brifen WRSF have been used to derive the benefit/cost ratio of the Brifen WRSF. For the Brifen WRSF to be economically successful the benefit/cost ratio should exceed 1.0. If the benefit/cost ratio is less than 1.0 then the Brifen WRSF has not been a good financial choice for ODOT.

II. REVIEW OF LITERATURE

Lake Hefner Parkway is a six-lane freeway located in northwest Oklahoma City, Oklahoma. It is a section of State Highway 74, from Interstate 44 on the south end to the John Kilpatrick Turnpike on the north end. In 2000, after several serious median crossover accidents the ODOT decided to install the Brifen Wire Rope Safety Fence to prevent future crossover crashes.

A. LAKE HEFNER PARKWAY

Lake Hefner Parkway was constructed in 1991 as a six-lane freeway with a grass center median varying in width from thirty-six (36) feet to forty-two (42) feet and a posted speed limit of sixty-five miles per hour. The roadway is located in an environmentally sensitive area due to the proximity of Lake Hefner and associated recreational facilities. Due to this sensitivity, and at the request of local residents, overhead lighting and signing were not installed (Emamian, 2003).

After being opened to traffic the combination of high traffic volumes, geometric design and median width led to a number of serious median crossover crashes. This increasing number of crossover collisions along with the high rate of crash severity

prompted ODOT to research possible design alternatives to prevent or reduce the severity of these crashes (Emamian, 2003).

The AASHTO Roadside Design Guide states that where locations have a median width between thirty (30) feet and fifty (50) feet with an ADT above 20,000 vehicles per day, median barriers should be considered as shown in Figure 1. Lake Hefner Parkway falls into this category with the combination of the ADT and median width.

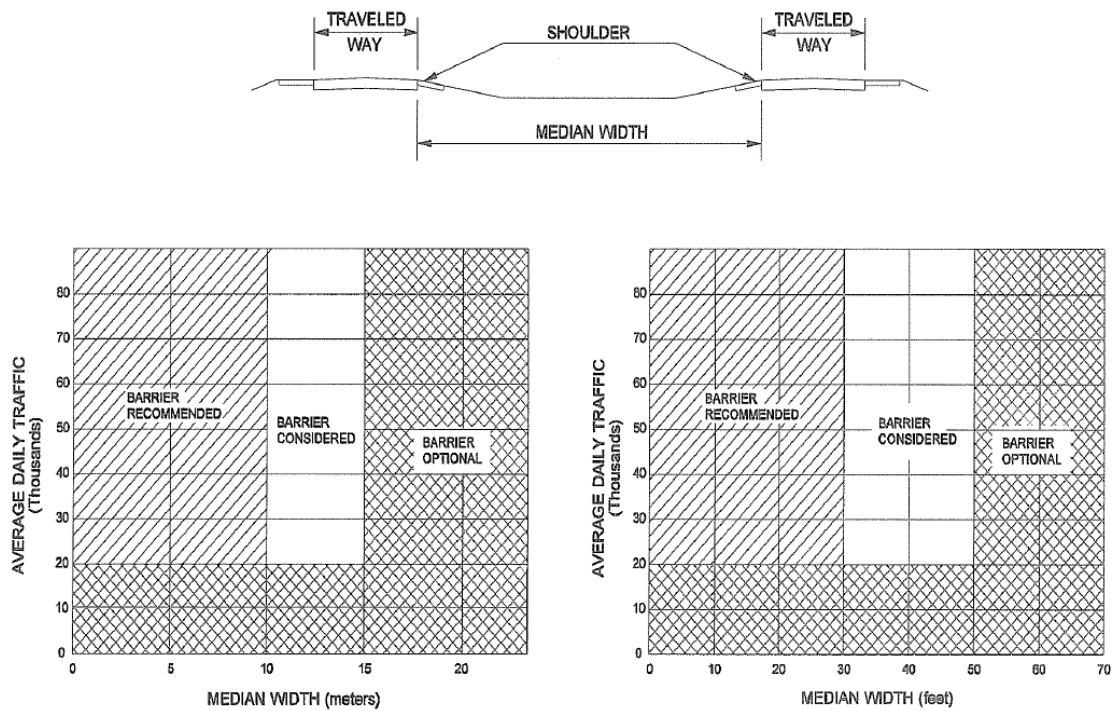


Figure 1: Guidelines for median barriers (AASHTO Roadside Design Guide, 2006)

The annual average daily traffic (AADT) shown in Figure 2 was obtained from the Oklahoma Traffic County Information System at four locations along Lake Hefner Parkway. Location 21 is located on the south end at approximately NW 56th Street.

Location AVC 65 is a permanent counting station just north of NW Grand Boulevard.

Location 23 is located just north of West Wilshire Boulevard. Location 14 is located near the north end of the parkway between NW 122nd Street and the John Kilpatrick Turnpike.

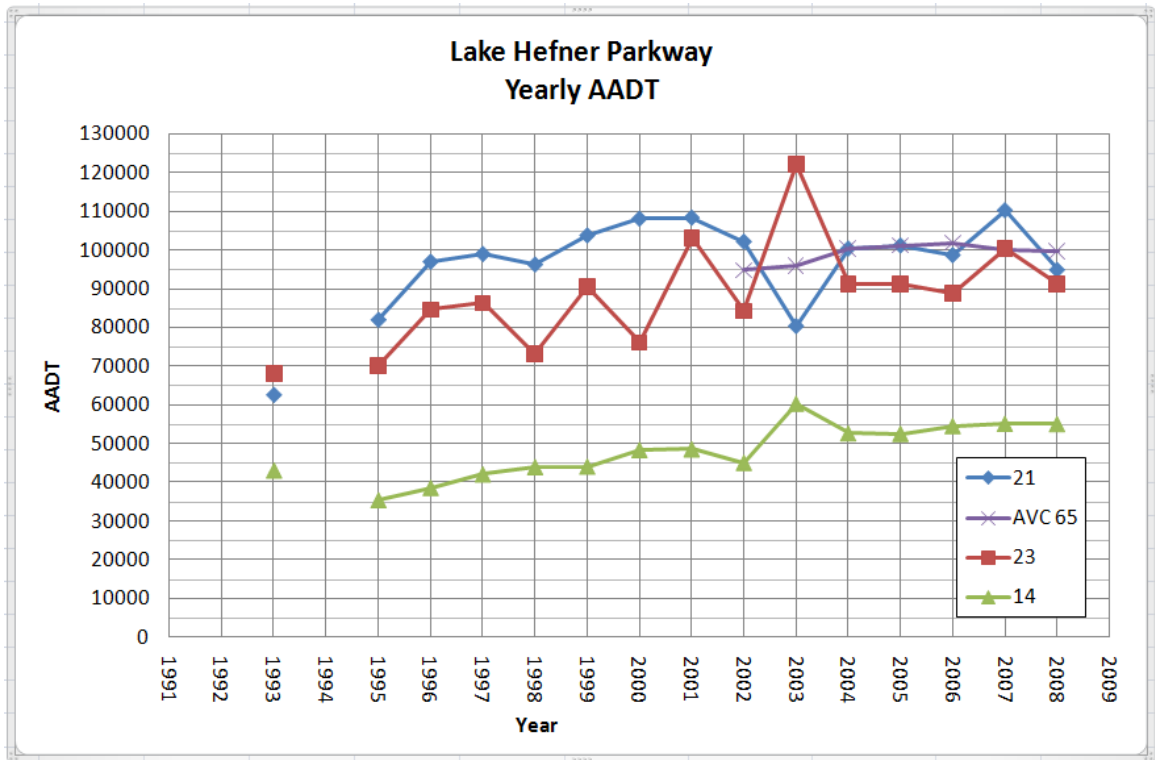


Figure 2: AADT data for the Lake Hefner Parkway

B. MEDIAN BARRIER OPTIONS FOR THE LAKE HEFNER PARKWAY

ODOT considered installing concrete median barriers, double-faced W-beam guardrail and cable barriers. The options were evaluated based upon installation costs, serviceability, performance, appearance and maintenance costs. Concrete median barriers had the highest installation cost and undesirable appearance, prohibiting the use of this option. Double-faced W-beam guardrail was also prohibitive due to installation costs,

serviceability, and undesirable appearance. Cable barrier options consisted of the Brifen WRSF and the 3-cable, low tension generic system. The Brifen WRSF was selected since its serviceability, performance and maintenance costs were all considered to be better than the generic system 3-cable low tension system. Cost comparisons for each of the median barriers considered for use are listed in Table 1; costs are in based on year 2000-dollar value.

Table 1: Initial Cost Comparisons of Median Barrier Types

Median Barrier Type	Cost per Mile
Concrete Median Barrier	\$500,000
Double-Face W-beam Guardrail	\$105,000
Three-Cable Low Tension Cable Barrier	\$50,000
Brifen WRSF	\$68,000

C. BRIFEN WIRE ROPE SAFETY FENCE DETAILS

The Brifen WRSF is a high-tension cable barrier system that uses tensioned cables that are weaved around steel posts to form a barrier. As a vehicle leaves the roadway it engages the cables, which provide resistance to the impact and redirect the vehicle. Briton, Ltd. of the United Kingdom originally developed the system in 1989 and the system has been installed in over 30 countries around the world (Brifen WRSF Product Manual, 2009).

The Brifen WRSF consists of four 3/4-inch pre-stretched galvanized cables, three of which are weaved between weak steel posts as shown in Figure 3. The S-shaped steel posts provide support to the cables and are designed to fold down allowing the cables to redirect the vehicle. The wire ropes rest on nylon pegs attached to the posts keeping the cables at the design height of the system. Figure 4 is a schematic drawing of the line posts showing dimensions, rope heights and socket embedment in the circular concrete footing.



Figure 3: Brifen WRSF on Lake Hefner Parkway (Courtesy of Brifen USA, Inc.)

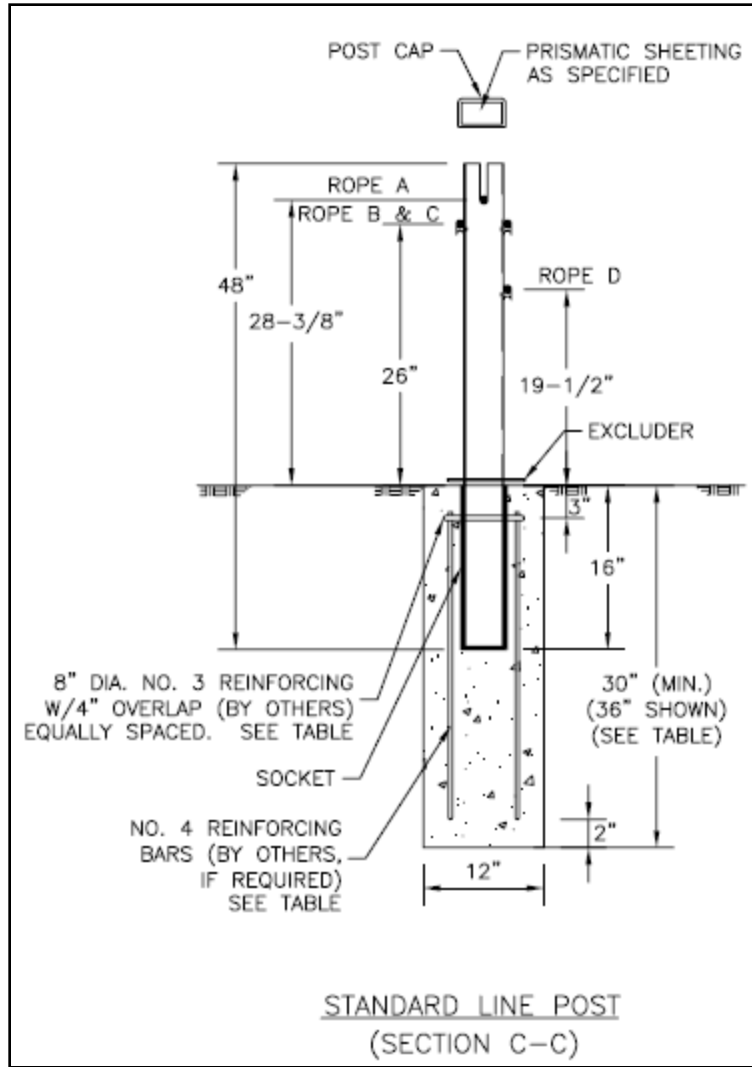


Figure 4: Brifen WRSF Standard Line Post Schematic (Courtesy of Brifen USA, Inc.)

The Brifen WRSF utilizes a 10.5-foot post spacing and the wire ropes are terminated in concrete anchors. The individual cables used on the Lake Hefner Parkway are 500 feet in length and have fittings swaged onto the ends. These threaded ends are connected by closed-bodied turnbuckles, which are used to tension the system to

approximately 2700 pounds at 100 degrees Fahrenheit. The tension in the system is temperature dependent and varies as the temperature varies throughout the day and year.

On April 10, 2001, FHWA accepted the Brifen WRSF as meeting the requirements of National Cooperative Highway Research Program Report 350 (NCHRP 350) Test Level 3 (TL-3) conditions. This acceptance is required for highway safety hardware that is used on federally funded highway projects. TL-3 conditions are the minimum test level for highway safety hardware that can be used on the National Highway System and typically specified by state highway agencies.

NCHRP 350 TL-3 acceptance involves crash testing two types of vehicles. For each test the occupant risk, ridedown acceleration and barrier deflection are measured. One of the vehicles is a small car weighing approximately 1800 pounds that is propelled into the system at 62 miles per hour at an angle of 20 degrees. The second vehicle is a pickup with a weight of 4500 pounds that is propelled into the system at 62 miles per hour at an angle of 25 degrees. The dynamic deflection measured was 3.4 feet for the small car and 7.9 feet for the pickup. The deflection of the barrier absorbs the energy from the impacting vehicle reducing the occupant risk and ridedown acceleration.

D. BRIFEN WRSF INSTALLATION ON LAKE HEFNER PARKWAY

A two-phase experimental project was initiated by ODOT and approved by FHWA in August 2000. This first phase, a 1000 foot section, was installed in August of 2000 on the north end of the Lake Hefner Parkway. The second phase, approximately 7

miles, extended the system southbound to I-44 and was constructed in the summer of 2001. Midstate Traffic Control of Oklahoma City, Oklahoma constructed both phases. The first phase was built at no cost to ODOT. The second phase was installed at a cost of \$1,106,867.83.

E. BRIFEN WRSF MAINTENANCE ON LAKE HEFNER PARKWAY

Maintenance of the Brifen WRSF was amended into the Oklahoma Department of Central Services statewide guardrail contract held by Midstate Traffic Control in 2001. Under the contract, ODOT issues work orders to Midstate Traffic Control to provide materials and labor for the repairs. Several pay items exist to maintain the Brifen WRSF, however the only pay items used to date are replacement line posts, replacement post caps, system re-tensioning and emergency callouts. Unit prices for the pay items that have been used are shown in Table 2 .

Table 2: Brifen WRSF Maintenance Unit Costs

Year	Line Post	Post Cap	Re-Tensioning	Emergency Callout
Aug-01	\$62.00	\$14.00	\$325.00	\$775.00
Aug-02	\$62.00	\$14.00	\$325.00	\$775.00
Aug-03	\$52.00	\$4.25	\$325.00	\$775.00
Aug-04	\$52.00	\$4.25	\$325.00	\$775.00
Aug-05	\$60.00	\$4.25	\$325.00	\$775.00
Aug-06	\$75.00	\$5.00	\$325.00	\$950.00
Aug-07	\$75.00	\$5.00	\$325.00	\$950.00
Aug-08	\$87.40	\$5.00	\$325.00	\$950.00
Aug-09	\$87.40	\$5.00	\$325.00	\$950.00

Upon reviewing the work orders, the re-tensioning pay item has been used three times as a routine check. Emergency callouts have been used on crashes occurring on weekends and between the times of 5:00 pm and 7:00 am when ODOT determined the system could not handle another impact in the same location.

F. BENEFIT COST ANALYSIS OF ROADSIDE HARDWARE

The benefit/cost analysis is the same used by Roadside Safety Analysis Program (RSAP) and the AASHTO Roadside Design Guide (Mak, 2003, Roadside Design Guide, 2006). Benefits are measured in terms of reduction in crash or societal costs due to decreases in the number and/or severity of crashes. Direct highway agency costs are comprised of initial installation, maintenance, and repair costs. An incremental benefit/cost ratio between incremental benefits and costs associated with an improvement option, compared to the existing condition or another improvement option is normally used as the primary measure of whether or not a safety improvement investment is appropriate (Roadside Design Guide, 2006). The incremental benefit/cost ratio is expressed as:

$$B/C \text{ Ratio}_{2-1} = \frac{CC_1 - CC_2}{DC_2 - DC_1}$$

where:

$B/C \text{ Ratio}_{2-1}$ = Incremental B/C ratio of Alternative 2 to Alternative 1

CC_1, CC_2 = Annualized crash cost for Alternatives 1 and 2

$DC_1, DC_2 =$ Annualized direct cost for Alternatives 1 and 2

When the incremental benefit/cost ratio comparing safety improvement Alternative 2 to Alternative 1 is greater than one, the analysis indicates that the increased benefits of Alternative 2 over Alternative 1, i.e., reduction in the crash and societal costs, are greater than the increased costs associated with Alternative 2 over Alternative 1 (Mak, 2002).

For the benefit/cost analysis, ODOT Traffic Division provided the crash data before and after the installation of the Brifen WRSF. Costs were determined from this data. Midstate Traffic Control provided installation costs of the Brifen WRSF as part of the direct costs. Maintenance costs were developed by reviewing ODOT work orders issued to Midstate Traffic Control. Midstate Traffic Control provided the work orders for review.

G. DETERMINATION OF CRASH COSTS

Crash costs normally used in benefit/cost analysis have been developed by AASHTO and FHWA. These costs are associated to the severity of the injuries to the occupants in the vehicle. AASHTO crash costs are included in the 2006 Roadside Design Guide. The FHWA crash costs are based on the "Comprehensive Costs in Police-Reported Crashed by K-A-B-C Scale Severity." Table 3 gives the dollar costs based on the type of injury.

Table 3: AASHTO & FHWA Crash Costs

Type of Injury	2006 Roadside Design Guide Costs	FHWA Comprehensive Costs
Fatal	\$ 1,000,000	\$ 2,600,000
Serious	\$ 200,000	\$ 180,000
Moderate	\$ 12,500	\$ 36,000
Slight/Probably Injury	\$ 3,750	\$ 19,000
Property Damage Only	\$ 3,125	\$ 2,000

III. METHODOLOGY

An incremental benefit/cost analysis shows if the Brifen WRSF has been an effective median barrier for Lake Hefner Parkway. The benefit of the Brifen WRSF was determined by using the user and agency costs of Lake Hefner Parkway before and after the installation of the Brifen WRSF. In order for the Brifen WRSF to be beneficial, the reduction in crash costs attributable to the barrier must be greater than the direct costs of the barrier.

A. BENEFIT/COST FORMULATION

The benefit/cost (*B/C*) formula used is the same formula used in the Roadside Design Guide and RSAP (Roadside Design Guide, 2006, Mak, 2003). The general formulation of the incremental *B/C* ratio is as follows:

$$B/C \text{ Ratio}_{2-1} = \frac{CC_1 - CC_2}{DC_2 - DC_1}$$

where:

*B/C Ratio*₂₋₁ = Incremental *B/C* ratio of Alternative 2 to Alternative 1

$CC_1, CC_2 =$ Annualized crash cost for Alternatives 1 and 2

$DC_1, DC_2 =$ Annualized direct cost for Alternatives 1 and 2

Benefits are measured in terms of the reduction in crash costs as a result of decreases in the number or severity of crashes after barrier installation. Direct costs of each alternative include costs of initial installation, maintenance and repair costs for each alternative. For this study, Alternative 1 is Lake Hefner Parkway before the installation of the Brifen WRSF and Alternative 2 is Lake Hefner Parkway after the installation of the Brifen WRSF.

B. PRE-BRIFEN WRSF (ALTERNATIVE 1) COSTS

Costs associated with Lake Hefner Parkway before installation of the Brifen WRSF were crash costs associated with vehicles crossing the median and impacting other vehicles or structures. The AASHTO Roadside Design Guide crash cost and FHWA crash cost values for each severity category were used to determine crash costs. Crash data provided by the Oklahoma Department of Transportation from the years 1991 to 2001 formed the database for Alternative 1.

Crash data were categorized into severity categories based on the AASHTO Roadside Design Guide and FHWA Comprehensive Costs. Categories included fatality (K), severe injury (A), moderate injury (B), slight/possible injury (C), and property damage (PDO). The number of incidents in each category was then multiplied by the corresponding crash cost. Normalized costs were determined by averaging the costs from

1991 to the installation date of the Brifen WRSF in 2001. The equation used for normalizing the Alternative 1 crash costs is:

$$CC_1 = \frac{\sum_{i=1}^n [(KC \times KE_i) + (AC \times AE_i) + (BC \times BE_i) + (CC \times CE_i) + (DC \times DE_i)]}{n}$$

where:

KC = Cost of fatal event

KE_i = Number of fatal events in year i

AC = Cost of serious injury event

AE_i = Number of serious injury events in year i

BC = Cost of moderate injury event

BE_i = Number of moderate injury events in year i

CC = Cost of slight/possible injury event

CE_i = Number of slight/possible injury events in year i

DC = Cost of property damage event

DE_i = Number of property damage events in year i

n = Number of years in Alternative 1

Before the installation of the Brifen WRSF, there were no barriers in place to prevent median crossover accidents. Therefore, no direct costs (DC_1) are associated with Alternative 1.

C. POST-BRIFEN WRSF (ALTERNATIVE 2) COSTS

Crash costs after installation of the Brifen WRSF follow the same methodology as described above. The Oklahoma Department of Transportation provided the crash data for Lake Hefner Parkway from the years 2000 to 2009. The same crash cost formula as Alternative 1 is used, substituting the new variables and is shown as:

$$CC_2 = \frac{\sum_{i=1}^j [(KC \times KE_i) + (AC \times AE_i) + (BC \times BE_i) + (CC \times CE_i) + (DC \times DE_i)]}{j}$$

where:

KC = Cost of fatal event

KE_i = Number of fatal events in year i

AC = Cost of serious injury event

AE_i = Number of serious injury events in year i

BC = Cost of moderate injury event

BE_i = Number of moderate injury events in year i

CC = Cost of slight/possible injury event

CE_i = Number of slight/possible injury events in year i

DC = Cost of property damage event

DE_i = Number of property damage events in year i

j = Number of years in Alternative 2

Direct costs after installation of the Brifen WRSF are comprised of installation cost and maintenance costs of repairing the Brifen WRSF after the barrier has been hit. Midstate Traffic Control, the contractor for both the installation and maintenance, provided the installation costs and work orders for the repairs. Annualizing the installation costs spreads this cost across the life of the barrier.

Maintenance costs were gathered by reviewing the work orders that the ODOT issued to Midstate Traffic Control as part of the Statewide Guardrail Contract, administered through the Oklahoma Department of Central Services. Under the contract pay items for line posts, post caps, cable re-tensioning, and emergency callouts were used during the period after installation of the Brifen WRSF. Costs of maintenance were annualized by taking the total cost and dividing by the total time period. The formula for calculating maintenance costs is shown as:

$$DC_2 = \frac{BIC + \sum_{i=1}^j [(LPC_i \times LPQ_i) + (PCC_i \times PCQ_i) + (CTC_i + CTQ_i) + (ECC_i + ECQ_i)]}{j}$$

where:

BIC = Installation costs of the Brifen WRSF

LPC_i = Line post cost for work order i

LPQ_i = Quantity of line posts used in work order i

PCC_i = Post cap cost for work order i

PCQ_i = Quantity of post caps used in work order i

CTC_i = Cable re-tensioning cost for work order i

CTQ_i = Quantity of re-tensioning used in work order i (Normally = 1)

ECC_i = Emergency callout cost for work order i

ECQ_i = Quantity of emergency callouts used in work order i (Normally = 1)

j = Number of years in Alternative 2

D. YEARLY B/C RATIO'S

Yearly B/C ratios were also calculated for the years after the Brifen WRSF was installed. In the analysis, the variables CC_1 and DC_1 are the same for the normalized analysis. Variables CC_2 and DC_2 were calculated for each year. The crash costs included costs for the individual year, installation costs were annualized for each year after installation and the maintenance costs were for the current year.

E. CRASH COSTS YEARLY ADJUSTMENT

Crash costs were not adjusted for the different years in the study. Two factors were used to determine not to make the adjustments. The first factor was that the data would skew heavily in favor of the later years of the study period. This would dramatically increase the B/C ratio and not compare true costs of before and after the Brifen WRSF installation.

The second factor was that the AASHTO Roadside Design Guide did not change crash cost values in the 2006 revision and FHWA has not provided adjustments for most of the years in the analysis period. According to FHWA, the costs in the FHWA Comprehensive Costs should be adjusted every year using the GDP implicit price deflator (Judycki, 1994). The GDP value to be used would be issued through a memorandum each year from the Office of the Secretary of Transportation. However, in the literature review the memorandums could not be located for most of the years in the analysis period.

IV. FINDINGS

A. PRE-BRIFEN WRSF CRASH COSTS (CC_1)

From 1991 to 2001, crashes on Lake Hefner Parkway involving vehicles that crossed the median and struck another vehicle head on or by sideswipe contained seven fatal injuries, thirty-one serious injuries, and two property damage only crashes. Table 4 provides the yearly data along with the associated crash costs using the Roadside Design Guide and FHWA values. The annualized crash costs are listed in Table 5.

Table 4: Year 1993 to 2001 Crash Costs

Year	Fatal	Serious	Moderate	Slight/ Possible	PDO	RDG Costs	FHWA Costs
1991	0	0	0	0	0	\$0	\$0
1992	0	0	0	0	0	\$0	\$0
1993	0	0	0	0	0	\$0	\$0
1994	0	0	0	0	0	\$0	\$0
1995	0	2	0	0	0	\$400,000	\$360,000
1996	0	2	0	0	1	\$403,125	\$362,000
1997	2	4	0	0	1	\$2,803,125	\$5,922,000
1998	1	4	0	0	0	\$1,800,000	\$3,320,000
1999	2	14	0	0	0	\$4,800,000	\$7,720,000
2000	0	1	0	0	0	\$200,000	\$180,000
2001	2	4	0	0	0	\$2,800,000	\$5,920,000

Table 5: Annualized Crash Costs (1993 - 2001) (CC_1)

	Roadside Design Guide	FHWA Comprehensive Costs
Annualized Crash Costs	\$1,200,568.18	\$2,162,181.82

B. PRE-BRIFEN WRSF DIRECT COSTS (DC_1)

The direct costs associated with Lake Hefner Parkway before the Brifen WRSF installation is considered to have a value of \$0. Since no median barrier existed, there was no direct cost associated with cross median crashes.

C. BRIFEN WRSF CRASH COSTS (CC_2)

Crash costs associated with the Brifen WRSF have mainly been slight to possible injury and property damage only crashes. An average of less than eight slight to possible injury crashes occurs per year. Slightly over twenty-eight personal damage only crashes occur on average per year

In 2006, one crash resulted in one fatality and one serious injury. This crash was a result of an agricultural semi-truck overriding the Brifen WRSF and impacting an SUV fatally wounding the SUV driver who was not wearing a seatbelt. The Brifen WRSF installed on the Lake Hefner Parkway is accepted to TL-3 conditions, meaning that it has not been tested to contain semi trucks, which is the typical test level for most highway safety products. In addition, the front bumper of the semi-truck had been removed prior to the crash, preventing the cables from engaging the semi truck.

Table 6 shows crash costs for the years after the Brifen WRSF installation including the 2006 fatal crash. Table 7 removes semi-truck crashes, including the 2006 fatal crash. Table 8 displays the annualized crash costs (CC_2) for total crash costs and crash costs without semi-trucks.

Table 6: Year 2001 - 2009 Crash Costs

Year	Fatal	Serious	Moderate	Slight/ Possible	PDO	RDG Costs	FHWA Costs
2001	0	0	0	6	9	\$50,625	\$132,000
2002	0	0	0	5	25	\$96,875	\$145,000
2003	0	0	0	4	21	\$80,625	\$118,000
2004	0	0	0	11	32	\$141,250	\$273,000
2005	0	0	0	11	33	\$144,375	\$275,000
2006	1	1	0	3	25	\$1,289,375	\$2,887,000
2007	0	0	0	8	40	\$155,000	\$232,000
2008	0	0	0	11	25	\$119,375	\$259,000
2009	0	0	0	10	44	\$175,000	\$278,000

Table 7: Year 2001 - 2009 Crash Costs w/o Semi-Trucks

Year	Fatal	Serious	Moderate	Slight/ Possible	PDO	RDG Costs	FHWA Costs
2001	0	0	0	6	9	\$50,625	\$132,000
2002	0	0	0	5	25	\$96,875	\$145,000
2003	0	0	0	4	21	\$80,625	\$118,000
2004	0	0	0	11	32	\$141,250	\$273,000
2005	0	0	0	11	33	\$144,375	\$275,000
2006	0	0	0	3	25	\$89,375	\$107,000
2007	0	0	0	8	40	\$155,000	\$232,000
2008	0	0	0	11	25	\$119,375	\$259,000
2009	0	0	0	10	44	\$175,000	\$278,000

Table 8: Annualized Crash Costs (2001 - 2009) (CC_2)

	Roadside Design Guide	FHWA Costs
Total Crash Costs	\$250,277.78	\$511,000.00
Crash Costs w/o Semi-Trucks	\$116,944.00	\$202,111.11

D. BRIFEN WRSF DIRECT COSTS (DC_2)

The direct costs associated with Lake Hefner Parkway after installation of the Brifen WRSF include installation costs and maintenance costs. Installation costs are annualized for each year and for the total life of the Brifen WRSF. Maintenance costs include the costs for replacement posts, post caps, re-tensioning, and emergency callouts.

Table 9 provides quantities of the repair items that have been utilized under the maintenance contract for each year and the total quantities for all years. It also lists how many work orders have been issued on a yearly and total basis. Table 10 shows the yearly costs for each of the maintenance items and total maintenance costs. Table 11 displays the total maintenance costs, annualized installation costs and total direct costs for each year and cumulative total for the Brifen WRSF.

Table 9: Quantities of Maintenance Items for Brifen WRSF

Year	Work Orders Issued	Quantities			
		Posts	Post Caps	Cable Re-Tensioning	Emergency Callouts
2001	51	244	103	0	0
2002	93	478	342	0	6
2003	45	395	115	0	17
2004	72	634	68	0	20
2005	75	626	236	2	13
2006	61	455	185	1	5
2007	73	573	351	0	13
2008	64	526	365	0	11
2009	81	853	677	0	14
TOTAL	621	4804	2442	3	100

Table 10: Yearly Costs of Maintenance Items

Year	Quantity Costs				Total Maintenance Costs
	Posts	Post Caps	Cable Tensioning	Emergency Callouts	
2001	\$15,128.00	\$1,442.00	\$0.00	\$0	\$16,570.00
2002	\$29,636.00	\$4,788.00	\$0.00	\$4,650.00	\$39,074.00
2003	\$22,420.00	\$1,112.75	\$0.00	\$13,175.00	\$36,707.75
2004	\$32,968.00	\$289.00	\$0.00	\$15,500.00	\$48,757.00
2005	\$35,320.00	\$1,003.00	\$0.00	\$10,075.00	\$47,048.00
2006	\$31,320.00	\$829.75	\$650.00	\$4,825.00	\$37,299.75
2007	\$42,975.00	\$1,755.00	\$325.00	\$12,350.00	\$57,080.00
2008	\$42,711.20	\$1,825.00	\$0.00	\$10,450.00	\$54,958.20
2009	\$70,466.20	\$3,385.00	\$0.00	\$13,300.00	\$87,181.20
TOTAL	\$322,944.40	\$16,429.50	\$975.00	\$84,325.00	\$424,673.90

Table 11: Direct Costs of the Brifen WRSF (DC_2)

Year	Total Maintenance Costs	Annualized Installation Costs	Direct Costs
2001	\$16,570.00	\$1,106,867.83	\$1,123,437.83
2002	\$39,074.00	\$553,433.92	\$592,507.92
2003	\$36,707.75	\$368,955.94	\$405,663.69
2004	\$48,757.00	\$276,719.96	\$325,473.96
2005	\$47,048.00	\$221,373.57	\$268,421.57
2006	\$37,299.75	\$184,477.97	\$221,777.72
2007	\$57,080.00	\$158,123.98	\$215,203.98
2008	\$54,958.20	\$138,358.48	\$193,344.68
2009	\$87,181.20	\$122,985.31	\$210,136.51
ANNUALIZED COSTS	\$47,185.99	\$122,985.31	\$170,171.30

E. BENEFIT COST ANALYSIS

Benefit cost ratios are derived from crash costs before and after installation of the Brifen WRSF, installation costs, and maintenance costs before and after the installation of the Brifen WRSF. In Table 12 and Table 13 the pre-Brifen WRSF crash costs are listed as CC_1 , post-Brifen WRSF crash costs are listed as CC_2 , direct costs of pre-Brifen WRSF are listed as DC_1 , and direct costs, including the installation and maintenance of the Brifen WRSF are listed as DC_2 .

Two benefit cost ratios have been calculated based on the AASHTO Roadside Design Guide and FHWA Comprehensive Costs as shown in Table 12. Table 13 shows the benefit cost ratios where crashes involving semi-trucks have been removed.

Table 12: Benefit Cost Ratio (Includes All Crashes)

Analysis	CC_1	CC_2	DC_1	DC_2	B/C
AASHTO	\$1,200,568.18	\$250,277.78	\$0.00	\$170,171.30	5.58
FHWA	\$2,162,181.82	\$511,000.00	\$0.00	\$170,171.30	9.70

Table 13: Benefit Cost Ratio (Excludes Semi Truck Crashes)

Analysis	CC_1	CC_2	DC_1	DC_2	B/C
AASHTO	\$1,200,568.18	\$116,944.44	\$0.00	\$170,171.30	6.37
FHWA	\$2,162,181.82	\$202,111.11	\$0.00	\$170,171.30	11.52

Yearly benefit cost ratios were calculated using crash costs and maintenance costs for each year individually. The pre-Brifren WRSF crash costs and direct costs were annualized along with the installation costs. Table 14 shows the yearly benefit cost ratio's for the AASHTO Roadside Design Guide and FHWA Comprehensive costs with and without semi-trucks included in the analysis.

Table 14: Yearly Benefit Cost Ratio's

Year	B/C Ratio w/ Semi-Trucks		B/C Ratio w/o Semi-Trucks	
	AASHTO	FHWA	AASHTO	FHWA
2001	1.02	1.81	1.02	1.81
2002	1.86	3.40	1.86	3.40
2003	2.76	5.04	2.76	5.04
2004	3.25	5.80	3.25	5.80
2005	3.93	7.03	3.93	7.03
2006	-0.40	-3.27	5.01	9.27
2007	4.86	8.97	4.86	8.97
2008	5.59	9.84	5.59	9.84
2009	4.88	8.97	4.88	8.97

V. CONCLUSION

The Brifen Wire Rope Safety Fence on Lake Hefner Parkway has been an effective and economical median barrier. The benefit cost analysis using both the AASHTO Roadside Design Guide and FHWA Comprehensive Costs figures are very high compared to most highway safety treatments. The high B/C ratio is attributed to the overall reduction in fatal and serious injury incidents, and the costs to install and maintain the Brifen WRSF.

The reduction in fatal and serious injury accidents is the primary reason for the high B/C ratio. Taking into account all accidents over the life of Lake Hefner Parkway the Brifen WRSF reduced the number of fatal and serious injury incidents from seven fatal and thirty-one serious injuries to one fatal and one serious injury. One incident exceeded the design limits of the Brifen WRSF resulting in the one fatal and one serious injury. This drop in the number of incidents provided an annualized savings of \$950,290 to society.

Installation costs for the Brifen WRSF are also low compared to other median barriers. The total installation costs on Lake Hefner Parkway averaged \$160,415 per mile. This \$160,415 per mile savings is attributed to the barrier and the placement of the

barrier. The Brifen WRSF itself does not contain very much material in relation to concrete median barrier or double-faced guardrail, therefore, the costs are reduced compared to the other treatments. The Brifen WRSF on Lake Hefner Parkway is placed near the top of the median slope in an asphalt mow strip, providing an additional savings since the median did not have to be reconfigured for the median barrier installation.

Maintenance costs of the Brifen WRSF averaged \$674 per work order. This takes into account material, labor and emergency callouts if necessary. Maintenance costs for the Brifen WRSF are higher than concrete barrier wall since concrete barrier wall normally does not have to be repaired each time it is impacted. The estimated maintenance cost for double-faced guardrail averages to \$2250 per work order, therefore, maintenance on the Brifen WRSF is considerably cheaper than double-faced guardrail.

Overall, the Brifen WRSF on the Lake Hefner Parkway has performed exceptionally well. The B/C ratio using the Roadside Design Guide and FHWA Comprehensive costs are 5.58 and 9.70, respectfully. These values include all incidents. When the incidents with semi-trucks are removed, the B/C ratio is 6.37 for the Roadside Design Guide and 11.52 using the FHWA Comprehensive costs. Given the calculated B/C ratios, the Brifen WRSF has been economically successful for the Oklahoma Department of Transportation.

REFERENCES

1. *Roadside Design Guide*, 3rd Edition, American Association of State Highway and Transportation Officials, Washington D.C., 2006.
2. Mak, K. K., and Sicking, D.L., *NCHRP Report 492: Roadside Safety Analysis Program (RSAP) - Engineer's Manual*, Transportation Research Board of the National Academies, Washington D.C., 2003.
3. Mak, K.K., and Sicking, D.L., "*Roadside Safety Analysis Program (RSAP) User's Manual*" Final Report, NCHRP Project 22-9, National Cooperative Highway Research Program, Washington D.C., 2002.
4. Emamian, Faria, "*Brifen Wire Rope Safety Fence, Final Report*" Oklahoma Department of Transportation, Oklahoma City, OK, 2003.
5. *Brifen Wire Rope Safety Fence Product Manual*, Revision 6.6.09, Brifen USA, Inc., Oklahoma City, OK, 2009.
6. Judycki, D.C., "*Motor Vehicle Accident Costs*" FHWA T 7570.2, United States Department of Transportation Federal Highway Administration, Washington D.C., 1994.
7. Ross, H.E. Jr., Sicking, D.L., Zimmer R.A., *NCHRP Report 350: Recommended Procedures for the Safety Performance Evaluation of Highway Features*, Transportation Research Board of the National Academies, Washington D.C., 1993

APPENDICES

**APPENDIX A -- LIST OF BRIFEN WRSF WORK ORDERS ON LAKE HEFNER
PARKWAY BY DATE**

Month	Date	Year	Brifen Post		Brifen Post Cap		Retension Cable		Emergency Callout		Post Cost	Cap Cost	EC Cost	Retension Cost	Total Cost
			Quantity	Price	Quantity	Price	Quantity	Price	Quantity	Price					
4	2	2002	9	\$62.00	9	\$14.00	0	\$325.00	0	\$775.00	\$558.00	\$126.00	\$0.00	\$0.00	\$684.00
4	3	2002	2	\$62.00	2	\$14.00	0	\$325.00	0	\$775.00	\$124.00	\$28.00	\$0.00	\$0.00	\$152.00
4	5	2002	8	\$62.00	8	\$14.00	0	\$325.00	0	\$775.00	\$496.00	\$112.00	\$0.00	\$0.00	\$608.00
4	8	2002	6	\$62.00	6	\$14.00	0	\$325.00	0	\$775.00	\$372.00	\$84.00	\$0.00	\$0.00	\$456.00
4	8	2002	1	\$62.00	1	\$14.00	0	\$325.00	0	\$775.00	\$62.00	\$14.00	\$0.00	\$0.00	\$76.00
4	17	2002	11	\$62.00	2	\$14.00	0	\$325.00	0	\$775.00	\$682.00	\$28.00	\$0.00	\$0.00	\$710.00
4	22	2002	4	\$62.00	4	\$14.00	0	\$325.00	0	\$775.00	\$248.00	\$56.00	\$0.00	\$0.00	\$304.00
4	22	2002	7	\$62.00	7	\$14.00	0	\$325.00	0	\$775.00	\$434.00	\$98.00	\$0.00	\$0.00	\$532.00
5	9	2002	13	\$62.00	0	\$14.00	0	\$325.00	1	\$775.00	\$806.00	\$0.00	\$775.00	\$0.00	\$1,581.00
5	10	2002	1	\$62.00	1	\$14.00	0	\$325.00	0	\$775.00	\$62.00	\$14.00	\$0.00	\$0.00	\$76.00
5	11	2002	7	\$62.00	7	\$14.00	0	\$325.00	0	\$775.00	\$434.00	\$98.00	\$0.00	\$0.00	\$532.00
5	12	2002	3	\$62.00	3	\$14.00	0	\$325.00	0	\$775.00	\$186.00	\$42.00	\$0.00	\$0.00	\$228.00
5	14	2002	7	\$62.00	7	\$14.00	0	\$325.00	0	\$775.00	\$434.00	\$98.00	\$0.00	\$0.00	\$532.00
5	17	2002	4	\$62.00	4	\$14.00	0	\$325.00	0	\$775.00	\$248.00	\$56.00	\$0.00	\$0.00	\$304.00
5	21	2002	10	\$62.00	5	\$14.00	0	\$325.00	1	\$775.00	\$620.00	\$70.00	\$775.00	\$0.00	\$1,465.00
5	24	2002	4	\$62.00	0	\$14.00	0	\$325.00	0	\$775.00	\$248.00	\$0.00	\$0.00	\$0.00	\$248.00
5	24	2002	7	\$62.00	7	\$14.00	0	\$325.00	0	\$775.00	\$434.00	\$98.00	\$0.00	\$0.00	\$532.00
6	4	2002	6	\$62.00	6	\$14.00	0	\$325.00	0	\$775.00	\$372.00	\$84.00	\$0.00	\$0.00	\$456.00
6	20	2002	4	\$62.00	0	\$14.00	0	\$325.00	0	\$775.00	\$248.00	\$0.00	\$0.00	\$0.00	\$248.00
6	20	2002	4	\$62.00	4	\$14.00	0	\$325.00	0	\$775.00	\$248.00	\$56.00	\$0.00	\$0.00	\$304.00
6	20	2002	4	\$62.00	4	\$14.00	0	\$325.00	0	\$775.00	\$248.00	\$56.00	\$0.00	\$0.00	\$304.00
6	20	2002	6	\$62.00	5	\$14.00	0	\$325.00	0	\$775.00	\$372.00	\$70.00	\$0.00	\$0.00	\$442.00
6	21	2002	4	\$62.00	4	\$14.00	0	\$325.00	0	\$775.00	\$248.00	\$56.00	\$0.00	\$0.00	\$304.00
6	22	2002	4	\$62.00	4	\$14.00	0	\$325.00	0	\$775.00	\$248.00	\$56.00	\$0.00	\$0.00	\$304.00
7	2	2002	11	\$62.00	11	\$14.00	0	\$325.00	0	\$775.00	\$682.00	\$154.00	\$0.00	\$0.00	\$836.00
7	2	2002	2	\$62.00	2	\$14.00	0	\$325.00	0	\$775.00	\$124.00	\$28.00	\$0.00	\$0.00	\$152.00
7	15	2002	3	\$62.00	3	\$14.00	0	\$325.00	0	\$775.00	\$186.00	\$42.00	\$0.00	\$0.00	\$228.00
7	17	2002	4	\$62.00	4	\$14.00	0	\$325.00	0	\$775.00	\$248.00	\$56.00	\$0.00	\$0.00	\$304.00
7	17	2002	1	\$62.00	1	\$14.00	0	\$325.00	0	\$775.00	\$62.00	\$14.00	\$0.00	\$0.00	\$76.00
7	24	2002	23	\$62.00	23	\$14.00	0	\$325.00	0	\$775.00	\$1,426.00	\$322.00	\$0.00	\$0.00	\$1,748.00
7	31	2002	18	\$62.00	18	\$14.00	0	\$325.00	0	\$775.00	\$1,116.00	\$252.00	\$0.00	\$0.00	\$1,368.00
7	31	2002	18	\$62.00	9	\$14.00	0	\$325.00	1	\$775.00	\$1,116.00	\$126.00	\$775.00	\$0.00	\$2,017.00
8	6	2002	8	\$62.00	0	\$14.00	0	\$325.00	0	\$775.00	\$496.00	\$0.00	\$0.00	\$0.00	\$496.00
8	14	2002	27	\$62.00	13	\$14.00	0	\$325.00	1	\$775.00	\$1,674.00	\$182.00	\$775.00	\$0.00	\$2,631.00
9	3	2002	9	\$62.00	4	\$14.00	0	\$325.00	0	\$775.00	\$558.00	\$56.00	\$0.00	\$0.00	\$614.00
9	12	2002	9	\$62.00	0	\$14.00	0	\$325.00	1	\$775.00	\$558.00	\$0.00	\$775.00	\$0.00	\$1,333.00
9	14	2002	6	\$62.00	0	\$14.00	0	\$325.00	0	\$775.00	\$372.00	\$0.00	\$0.00	\$0.00	\$372.00
9	16	2002	11	\$62.00	0	\$14.00	0	\$325.00	0	\$775.00	\$682.00	\$0.00	\$0.00	\$0.00	\$682.00
9	30	2002	7	\$62.00	7	\$14.00	0	\$325.00	0	\$775.00	\$434.00	\$98.00	\$0.00	\$0.00	\$532.00
10	2	2002	4	\$62.00	0	\$14.00	0	\$325.00	0	\$775.00	\$248.00	\$0.00	\$0.00	\$0.00	\$248.00
10	5	2002	4	\$62.00	2	\$14.00	0	\$325.00	0	\$775.00	\$248.00	\$28.00	\$0.00	\$0.00	\$276.00
10	6	2002	3	\$62.00	1	\$14.00	0	\$325.00	0	\$775.00	\$186.00	\$14.00	\$0.00	\$0.00	\$200.00
10	19	2002	2	\$62.00	0	\$14.00	0	\$325.00	0	\$775.00	\$124.00	\$0.00	\$0.00	\$0.00	\$124.00
11	2	2002	5	\$62.00	3	\$14.00	0	\$325.00	0	\$775.00	\$310.00	\$42.00	\$0.00	\$0.00	\$352.00
11	4	2002	4	\$62.00	2	\$14.00	0	\$325.00	0	\$775.00	\$248.00	\$28.00	\$0.00	\$0.00	\$276.00
11	14	2002	14	\$62.00	1	\$14.00	0	\$325.00	1	\$775.00	\$868.00	\$14.00	\$775.00	\$0.00	\$1,657.00
12	6	2002	8	\$62.00	3	\$14.00	0	\$325.00	0	\$775.00	\$496.00	\$42.00	\$0.00	\$0.00	\$538.00
12	27	2002	12	\$62.00	6	\$14.00	0	\$325.00	0	\$775.00	\$744.00	\$84.00	\$0.00	\$0.00	\$828.00
1	27	2003	7	\$62.00	0	\$14.00	0	\$325.00	0	\$775.00	\$434.00	\$0.00	\$0.00	\$0.00	\$434.00
1	30	2003	24	\$62.00	4	\$14.00	0	\$325.00	1	\$775.00	\$1,488.00	\$56.00	\$775.00	\$0.00	\$2,319.00
2	11	2003	11	\$62.00	4	\$14.00	0	\$325.00	0	\$775.00	\$682.00	\$56.00	\$0.00	\$0.00	\$738.00
2	18	2003	23	\$62.00	4	\$14.00	0	\$325.00	1	\$775.00	\$1,426.00	\$56.00	\$775.00	\$0.00	\$2,257.00
2	19	2003	5	\$62.00	2	\$14.00	0	\$325.00	0	\$775.00	\$310.00	\$28.00	\$0.00	\$0.00	\$338.00
2	24	2003	7	\$62.00	4	\$14.00	0	\$325.00	0	\$775.00	\$434.00	\$56.00	\$0.00	\$0.00	\$490.00
3	12	2003	8	\$62.00	8	\$14.00	0	\$325.00	1	\$775.00	\$496.00	\$112.00	\$775.00	\$0.00	\$1,383.00
3	13	2003	8	\$62.00	8	\$14.00	0	\$325.00	1	\$775.00	\$496.00	\$112.00	\$775.00	\$0.00	\$1,383.00
3	15	2003	6	\$62.00	6	\$14.00	0	\$325.00	0	\$775.00	\$372.00	\$84.00	\$0.00	\$0.00	\$456.00
3	17	2003	5	\$62.00	5	\$14.00	0	\$325.00	0	\$775.00	\$310.00	\$70.00	\$0.00	\$0.00	\$380.00
3	18	2003	8	\$62.00	1	\$14.00	0	\$325.00	1	\$775.00	\$496.00	\$14.00	\$775.00	\$0.00	\$1,285.00
3	31	2003	8	\$62.00	8	\$14.00	0	\$325.00	0	\$775.00	\$496.00	\$112.00	\$0.00	\$0.00	\$608.00
4	14	2003	16	\$62.00	8	\$14.00	0	\$325.00	0	\$775.00	\$992.00	\$112.00	\$0.00	\$0.00	\$1,104.00
4	19	2003	18	\$62.00	0	\$14.00	0	\$325.00	1	\$775.00	\$1,116.00	\$0.00	\$775.00	\$0.00	\$1,891.00
4	22	2003	9	\$62.00	0	\$14.00	0	\$325.00	0	\$775.00	\$558.00	\$0.00	\$0.00	\$0.00	\$558.00
5	6	2003	3	\$62.00	1	\$14.00	0	\$325.00	0	\$775.00	\$186.00	\$14.00	\$0.00	\$0.00	\$200.00
5	6	2003	13	\$62.00	1	\$14.00	0	\$325.00	1	\$775.00	\$806.00	\$14.00	\$775.00	\$0.00	\$1,595.00
5	20	2003	9	\$62.00	0	\$14.00	0	\$325.00	0	\$775.00	\$558.00	\$0.00	\$0.00	\$0.00	\$558.00
6	30	2003	6	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$312.00	\$0.00	\$0.00	\$0.00	\$312.00
7	3	2003	4	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$208.00	\$0.00	\$0.00	\$0.00	\$208.00
7	4	2003	4	\$52.00	0	\$4.25	0	\$325.00	1	\$775.00	\$208.00	\$0.00	\$775.00	\$0.00	\$983.00
7	4	2003	3	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$156.00	\$0.00	\$0.00	\$0.00	\$156.00
7	28	2003	5	\$52.00	0	\$4.25	0	\$325.00	1	\$775.00	\$260.00	\$0.00	\$775.00	\$0.00	\$1,035.00
8	7	2003	4	\$52.00	2	\$4.25	0	\$325.00	0	\$775.00	\$208.00	\$8.50	\$0.00	\$0.00	\$216.50
8	20	2003	18	\$52.00	0	\$4.25	0	\$325.00	1	\$775.00	\$936.00	\$0.00	\$775.00	\$0.00	\$1,711.00
8	23	2003	21	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$1,092.00	\$0.00	\$0.00	\$0.00	\$1,092.00
8	31	2003	7	\$52.00	0	\$4.25	0	\$325.00	1	\$775.00	\$364.00	\$0.00	\$775.00	\$0.00	\$1,139.00
9	5	2003	4	\$52.00	2	\$4.25	0	\$325.00	0	\$775.00	\$208.00	\$8.50	\$0.00	\$0.00	\$216.50
9	8	2003	6	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$312.00	\$0.00	\$0.00	\$0.00	\$312.00
9	10	2003	9	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$468.00	\$0.00	\$0.00	\$0.00	\$468.00
9	15	2003	5	\$52.00	5	\$4.25	0	\$325.00	1	\$775.00	\$260.00	\$21.25	\$775.00	\$0.00	\$1,056.25
9	15	2003	7	\$52.00	2	\$4.25	0	\$325.00	1	\$775.00	\$364.00	\$8.50	\$775.00	\$0.00	\$1,147.50
9	28	2003	11	\$52.00	0	\$4.25	0	\$325.00	1	\$775.00	\$572.00	\$0.00	\$775.00	\$0.00	\$1,347.00
9	30	2003	7	\$52.00	3	\$4.25	0	\$325.00	0	\$775.00	\$364.00	\$12.75	\$0.00	\$0.00	\$376.75
10	10	2003	3	\$52.00	3	\$4.25	0	\$325.00	0	\$775.00	\$156.00	\$12.75	\$0.00	\$0.00	\$168.75
10	31	2003	5	\$52.00	2	\$4.25	0	\$325.00	0	\$775.00	\$260.00	\$8.50	\$0.00	\$0.00	\$268.50
11	20	2003	9	\$52.00	0	\$4									

Month	Date	Year	Brifen Post		Brifen Post Cap		Retension Cable		Emergency Callout		Post Cost	Cap Cost	EC Cost	Retension Cost	Total Cost
			Quantity	Price	Quantity	Price	Quantity	Price	Quantity	Price					
3	4	2004	5	\$52.00	0	\$4.25	0	\$325.00	1	\$775.00	\$260.00	\$0.00	\$775.00	\$0.00	\$1,035.00
3	4	2004	14	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$728.00	\$0.00	\$0.00	\$0.00	\$728.00
3	4	2004	7	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$364.00	\$0.00	\$0.00	\$0.00	\$364.00
3	15	2004	5	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$260.00	\$0.00	\$0.00	\$0.00	\$260.00
3	29	2004	4	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$208.00	\$0.00	\$0.00	\$0.00	\$208.00
3	31	2004	11	\$52.00	0	\$4.25	0	\$325.00	1	\$775.00	\$572.00	\$0.00	\$775.00	\$0.00	\$1,347.00
3	31	2004	3	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$156.00	\$0.00	\$0.00	\$0.00	\$156.00
4	2	2004	6	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$312.00	\$0.00	\$0.00	\$0.00	\$312.00
4	5	2004	19	\$52.00	6	\$4.25	0	\$325.00	0	\$775.00	\$988.00	\$25.50	\$0.00	\$0.00	\$1,013.50
4	5	2004	6	\$52.00	2	\$4.25	0	\$325.00	0	\$775.00	\$312.00	\$8.50	\$0.00	\$0.00	\$320.50
4	9	2004	6	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$312.00	\$0.00	\$0.00	\$0.00	\$312.00
5	3	2004	3	\$52.00	1	\$4.25	0	\$325.00	0	\$775.00	\$156.00	\$4.25	\$0.00	\$0.00	\$160.25
5	3	2004	7	\$52.00	3	\$4.25	0	\$325.00	0	\$775.00	\$364.00	\$12.75	\$0.00	\$0.00	\$376.75
5	10	2004	14	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$728.00	\$0.00	\$0.00	\$0.00	\$728.00
5	10	2004	12	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$624.00	\$0.00	\$0.00	\$0.00	\$624.00
5	11	2004	3	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$156.00	\$0.00	\$0.00	\$0.00	\$156.00
5	15	2004	6	\$52.00	0	\$4.25	0	\$325.00	1	\$775.00	\$312.00	\$0.00	\$775.00	\$0.00	\$1,087.00
5	19	2004	7	\$52.00	0	\$4.25	0	\$325.00	1	\$775.00	\$364.00	\$0.00	\$775.00	\$0.00	\$1,139.00
6	3	2004	2	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$104.00	\$0.00	\$0.00	\$0.00	\$104.00
6	9	2004	7	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$364.00	\$0.00	\$0.00	\$0.00	\$364.00
6	9	2004	8	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$416.00	\$0.00	\$0.00	\$0.00	\$416.00
6	13	2004	6	\$52.00	0	\$4.25	0	\$325.00	1	\$775.00	\$312.00	\$0.00	\$775.00	\$0.00	\$1,087.00
6	16	2004	11	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$572.00	\$0.00	\$0.00	\$0.00	\$572.00
6	27	2004	15	\$52.00	6	\$4.25	0	\$325.00	1	\$775.00	\$780.00	\$25.50	\$775.00	\$0.00	\$1,580.50
6	27	2004	7	\$52.00	3	\$4.25	0	\$325.00	0	\$775.00	\$364.00	\$12.75	\$0.00	\$0.00	\$376.75
6	29	2004	38	\$52.00	0	\$4.25	0	\$325.00	1	\$775.00	\$1,976.00	\$0.00	\$775.00	\$0.00	\$2,751.00
6	29	2004	4	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$208.00	\$0.00	\$0.00	\$0.00	\$208.00
7	28	2004	10	\$52.00	0	\$4.25	0	\$325.00	1	\$775.00	\$520.00	\$0.00	\$775.00	\$0.00	\$1,295.00
8	6	2004	6	\$52.00	0	\$4.25	0	\$325.00	1	\$775.00	\$312.00	\$0.00	\$775.00	\$0.00	\$1,087.00
8	8	2004	13	\$52.00	0	\$4.25	0	\$325.00	1	\$775.00	\$676.00	\$0.00	\$775.00	\$0.00	\$1,451.00
8	10	2004	3	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$156.00	\$0.00	\$0.00	\$0.00	\$156.00
8	10	2004	2	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$104.00	\$0.00	\$0.00	\$0.00	\$104.00
8	10	2004	1	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$52.00	\$0.00	\$0.00	\$0.00	\$52.00
8	12	2004	27	\$52.00	12	\$4.25	0	\$325.00	1	\$775.00	\$1,404.00	\$51.00	\$775.00	\$0.00	\$2,230.00
8	12	2004	12	\$52.00	0	\$4.25	0	\$325.00	1	\$775.00	\$624.00	\$0.00	\$775.00	\$0.00	\$1,399.00
8	17	2004	13	\$52.00	0	\$4.25	0	\$325.00	1	\$775.00	\$676.00	\$0.00	\$775.00	\$0.00	\$1,451.00
8	17	2004	4	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$208.00	\$0.00	\$0.00	\$0.00	\$208.00
8	17	2004	4	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$208.00	\$0.00	\$0.00	\$0.00	\$208.00
8	17	2004	0	\$52.00	0	\$4.25	0	\$325.00	1	\$775.00	\$0.00	\$0.00	\$775.00	\$0.00	\$775.00
8	17	2004	12	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$624.00	\$0.00	\$0.00	\$0.00	\$624.00
8	23	2004	8	\$52.00	3	\$4.25	0	\$325.00	0	\$775.00	\$416.00	\$12.75	\$0.00	\$0.00	\$428.75
8	27	2004	8	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$416.00	\$0.00	\$0.00	\$0.00	\$416.00
9	14	2004	3	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$156.00	\$0.00	\$0.00	\$0.00	\$156.00
9	17	2004	4	\$52.00	2	\$4.25	0	\$325.00	0	\$775.00	\$208.00	\$8.50	\$0.00	\$0.00	\$216.50
9	20	2004	26	\$52.00	12	\$4.25	0	\$325.00	1	\$775.00	\$1,352.00	\$51.00	\$775.00	\$0.00	\$2,178.00
9	20	2004	3	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$156.00	\$0.00	\$0.00	\$0.00	\$156.00
9	20	2004	3	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$156.00	\$0.00	\$0.00	\$0.00	\$156.00
9	29	2004	28	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$1,456.00	\$0.00	\$0.00	\$0.00	\$1,456.00
9	29	2004	3	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$156.00	\$0.00	\$0.00	\$0.00	\$156.00
10	11	2004	7	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$364.00	\$0.00	\$0.00	\$0.00	\$364.00
10	18	2004	5	\$52.00	2	\$4.25	0	\$325.00	0	\$775.00	\$260.00	\$8.50	\$0.00	\$0.00	\$268.50
10	27	2004	6	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$312.00	\$0.00	\$0.00	\$0.00	\$312.00
10	27	2004	9	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$468.00	\$0.00	\$0.00	\$0.00	\$468.00
11	1	2004	9	\$52.00	4	\$4.25	0	\$325.00	0	\$775.00	\$468.00	\$17.00	\$0.00	\$0.00	\$485.00
11	10	2004	9	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$468.00	\$0.00	\$0.00	\$0.00	\$468.00
11	10	2004	20	\$52.00	12	\$4.25	0	\$325.00	0	\$775.00	\$1,040.00	\$51.00	\$0.00	\$0.00	\$1,091.00
11	10	2004	14	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$728.00	\$0.00	\$0.00	\$0.00	\$728.00
11	10	2004	6	\$52.00	0	\$4.25	0	\$325.00	1	\$775.00	\$312.00	\$0.00	\$775.00	\$0.00	\$1,087.00
11	10	2004	9	\$52.00	0	\$4.25	0	\$325.00	1	\$775.00	\$468.00	\$0.00	\$775.00	\$0.00	\$1,243.00
11	15	2004	5	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$260.00	\$0.00	\$0.00	\$0.00	\$260.00
11	15	2004	4	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$208.00	\$0.00	\$0.00	\$0.00	\$208.00
12	1	2004	2	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$104.00	\$0.00	\$0.00	\$0.00	\$104.00
12	1	2004	5	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$260.00	\$0.00	\$0.00	\$0.00	\$260.00
12	1	2004	7	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$364.00	\$0.00	\$0.00	\$0.00	\$364.00
12	13	2004	29	\$52.00	0	\$4.25	0	\$325.00	1	\$775.00	\$1,508.00	\$0.00	\$775.00	\$0.00	\$2,283.00
12	14	2004	15	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$780.00	\$0.00	\$0.00	\$0.00	\$780.00
12	23	2004	7	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$364.00	\$0.00	\$0.00	\$0.00	\$364.00
12	27	2004	3	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$156.00	\$0.00	\$0.00	\$0.00	\$156.00
1	4	2005	5	\$52.00	0	\$4.25	0	\$325.00	1	\$775.00	\$260.00	\$0.00	\$775.00	\$0.00	\$1,035.00
1	10	2005	7	\$52.00	3	\$4.25	0	\$325.00	0	\$775.00	\$364.00	\$12.75	\$0.00	\$0.00	\$376.75
1	10	2005	10	\$52.00	4	\$4.25	0	\$325.00	0	\$775.00	\$520.00	\$17.00	\$0.00	\$0.00	\$537.00
1	12	2005	4	\$52.00	0	\$4.25	0	\$325.00	1	\$775.00	\$208.00	\$0.00	\$775.00	\$0.00	\$983.00
1	18	2005	7	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$364.00	\$0.00	\$0.00	\$0.00	\$364.00
1	18	2005	5	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$260.00	\$0.00	\$0.00	\$0.00	\$260.00
1	18	2005	5	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$260.00	\$0.00	\$0.00	\$0.00	\$260.00
1	18	2005	7	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$364.00	\$0.00	\$0.00	\$0.00	\$364.00
1	24	2005	5	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$260.00	\$0.00	\$0.00	\$0.00	\$260.00
1	26	2005	16	\$52.00	8	\$4.25	0	\$325.00	1	\$775.00	\$832.00	\$34.00	\$775.00	\$0.00	\$1,641.00
2	7	2005	10	\$52.00	5	\$4.25	0	\$325.00	0	\$775.00	\$520.00	\$21.25	\$0.00	\$0.00	\$541.25
2	9	2005	5	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$260.00	\$0.00	\$0.00	\$0.00	\$260.00
2	12	2005	3	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$156.00	\$0.00	\$0.00	\$0.00	\$156.00
2	13	2005	9	\$52.00	0	\$4.25	0	\$325.00	1	\$775.00	\$468.00	\$0.00	\$775.00	\$0.00	\$1,243.00
2	24	2005	2	\$52.00	2	\$4.25	0	\$325.00	0	\$775.00	\$104.00	\$8.50	\$0.00	\$0.00	\$112.50
2	25	2005	30	\$52.00	10	\$4.25	0	\$325.00	0	\$775.00	\$1,560.00	\$42.50	\$0.00	\$0.00	\$1,602.50
3	8	2005	4	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$208.00	\$0.00	\$0.00	\$0.00	\$208.00
3															

Month	Date	Year	Brifen Post		Brifen Post Cap		Retension Cable		Emergency Callout		Post Cost	Cap Cost	EC Cost	Retension Cost	Total Cost
			Quantity	Price	Quantity	Price	Quantity	Price	Quantity	Price					
6	15	2005	3	\$52.00	3	\$4.25	0	\$325.00	0	\$775.00	\$156.00	\$12.75	\$0.00	\$0.00	\$168.75
6	15	2005	6	\$52.00	4	\$4.25	0	\$325.00	0	\$775.00	\$312.00	\$17.00	\$0.00	\$0.00	\$329.00
6	17	2005	5	\$52.00	5	\$4.25	0	\$325.00	0	\$775.00	\$260.00	\$21.25	\$0.00	\$0.00	\$281.25
6	27	2005	5	\$52.00	0	\$4.25	0	\$325.00	0	\$775.00	\$260.00	\$0.00	\$0.00	\$0.00	\$260.00
7	12	2005	6	\$60.00	6	\$4.25	0	\$325.00	0	\$775.00	\$360.00	\$25.50	\$0.00	\$0.00	\$385.50
7	20	2005	4	\$60.00	0	\$4.25	0	\$325.00	0	\$775.00	\$240.00	\$0.00	\$0.00	\$0.00	\$240.00
7	21	2005	8	\$60.00	0	\$4.25	0	\$325.00	1	\$775.00	\$480.00	\$0.00	\$775.00	\$0.00	\$1,255.00
7	29	2005	5	\$60.00	3	\$4.25	0	\$325.00	0	\$775.00	\$300.00	\$12.75	\$0.00	\$0.00	\$312.75
8	3	2005	7	\$60.00	3	\$4.25	0	\$325.00	0	\$775.00	\$420.00	\$12.75	\$0.00	\$0.00	\$432.75
8	3	2005	19	\$60.00	9	\$4.25	0	\$325.00	0	\$775.00	\$1,140.00	\$38.25	\$0.00	\$0.00	\$1,178.25
8	3	2005	15	\$60.00	8	\$4.25	0	\$325.00	1	\$775.00	\$900.00	\$34.00	\$775.00	\$0.00	\$1,709.00
8	5	2005	7	\$60.00	4	\$4.25	0	\$325.00	0	\$775.00	\$420.00	\$17.00	\$0.00	\$0.00	\$437.00
8	8	2005	5	\$60.00	2	\$4.25	0	\$325.00	0	\$775.00	\$300.00	\$8.50	\$0.00	\$0.00	\$308.50
8	8	2005	7	\$60.00	1	\$4.25	0	\$325.00	0	\$775.00	\$420.00	\$4.25	\$0.00	\$0.00	\$424.25
8	8	2005	4	\$60.00	3	\$4.25	0	\$325.00	0	\$775.00	\$240.00	\$12.75	\$0.00	\$0.00	\$252.75
8	15	2005	4	\$60.00	4	\$4.25	0	\$325.00	0	\$775.00	\$240.00	\$17.00	\$0.00	\$0.00	\$257.00
8	15	2005	3	\$60.00	3	\$4.25	0	\$325.00	0	\$775.00	\$180.00	\$12.75	\$0.00	\$0.00	\$192.75
8	16	2005	7	\$60.00	0	\$4.25	0	\$325.00	0	\$775.00	\$420.00	\$0.00	\$0.00	\$0.00	\$420.00
8	22	2005	6	\$60.00	3	\$4.25	0	\$325.00	0	\$775.00	\$360.00	\$12.75	\$0.00	\$0.00	\$372.75
8	22	2005	3	\$60.00	2	\$4.25	0	\$325.00	0	\$775.00	\$180.00	\$8.50	\$0.00	\$0.00	\$188.50
8	29	2005	3	\$60.00	0	\$4.25	0	\$325.00	0	\$775.00	\$180.00	\$0.00	\$0.00	\$0.00	\$180.00
9	2	2005	14	\$60.00	23	\$4.25	2	\$325.00	0	\$775.00	\$840.00	\$97.75	\$0.00	\$650.00	\$1,587.75
9	6	2005	2	\$60.00	2	\$4.25	0	\$325.00	0	\$775.00	\$120.00	\$8.50	\$0.00	\$0.00	\$128.50
9	12	2005	7	\$60.00	0	\$4.25	0	\$325.00	0	\$775.00	\$420.00	\$0.00	\$0.00	\$0.00	\$420.00
9	12	2005	3	\$60.00	3	\$4.25	0	\$325.00	0	\$775.00	\$180.00	\$12.75	\$0.00	\$0.00	\$192.75
9	12	2005	8	\$60.00	8	\$4.25	0	\$325.00	0	\$775.00	\$480.00	\$34.00	\$0.00	\$0.00	\$514.00
9	21	2005	7	\$60.00	0	\$4.25	0	\$325.00	0	\$775.00	\$420.00	\$0.00	\$0.00	\$0.00	\$420.00
9	23	2005	7	\$60.00	0	\$4.25	0	\$325.00	0	\$775.00	\$420.00	\$0.00	\$0.00	\$0.00	\$420.00
9	25	2005	21	\$60.00	0	\$4.25	0	\$325.00	1	\$775.00	\$1,260.00	\$0.00	\$775.00	\$0.00	\$2,035.00
10	3	2005	4	\$60.00	4	\$4.25	0	\$325.00	0	\$775.00	\$240.00	\$17.00	\$0.00	\$0.00	\$257.00
10	10	2005	8	\$60.00	0	\$4.25	0	\$325.00	0	\$775.00	\$480.00	\$0.00	\$0.00	\$0.00	\$480.00
10	10	2005	2	\$60.00	0	\$4.25	0	\$325.00	0	\$775.00	\$120.00	\$0.00	\$0.00	\$0.00	\$120.00
10	13	2005	5	\$60.00	0	\$4.25	0	\$325.00	0	\$775.00	\$300.00	\$0.00	\$0.00	\$0.00	\$300.00
10	25	2005	8	\$60.00	0	\$4.25	0	\$325.00	0	\$775.00	\$480.00	\$0.00	\$0.00	\$0.00	\$480.00
11	7	2005	9	\$60.00	9	\$4.25	0	\$325.00	1	\$775.00	\$540.00	\$38.25	\$775.00	\$0.00	\$1,353.25
11	7	2005	12	\$60.00	0	\$4.25	0	\$325.00	0	\$775.00	\$720.00	\$0.00	\$0.00	\$0.00	\$720.00
11	8	2005	11	\$60.00	6	\$4.25	0	\$325.00	0	\$775.00	\$660.00	\$25.50	\$0.00	\$0.00	\$685.50
11	17	2005	6	\$60.00	0	\$4.25	0	\$325.00	0	\$775.00	\$360.00	\$0.00	\$0.00	\$0.00	\$360.00
11	18	2005	17	\$60.00	8	\$4.25	0	\$325.00	1	\$775.00	\$1,020.00	\$34.00	\$775.00	\$0.00	\$1,829.00
11	29	2005	10	\$60.00	10	\$4.25	0	\$325.00	1	\$775.00	\$600.00	\$42.50	\$775.00	\$0.00	\$1,417.50
11	29	2005	15	\$60.00	7	\$4.25	0	\$325.00	0	\$775.00	\$900.00	\$29.75	\$0.00	\$0.00	\$929.75
12	9	2005	41	\$60.00	25	\$4.25	0	\$325.00	1	\$775.00	\$2,460.00	\$106.25	\$775.00	\$0.00	\$3,341.25
12	19	2005	2	\$60.00	0	\$4.25	0	\$325.00	0	\$775.00	\$120.00	\$0.00	\$0.00	\$0.00	\$120.00
12	19	2005	2	\$60.00	0	\$4.25	0	\$325.00	0	\$775.00	\$120.00	\$0.00	\$0.00	\$0.00	\$120.00
12	19	2005	4	\$60.00	0	\$4.25	0	\$325.00	0	\$775.00	\$240.00	\$0.00	\$0.00	\$0.00	\$240.00
12	19	2005	8	\$60.00	9	\$4.25	0	\$325.00	0	\$775.00	\$480.00	\$38.25	\$0.00	\$0.00	\$518.25
1	3	2006	9	\$60.00	9	\$4.25	0	\$325.00	1	\$775.00	\$540.00	\$38.25	\$775.00	\$0.00	\$1,353.25
1	9	2006	5	\$60.00	5	\$4.25	0	\$325.00	0	\$775.00	\$300.00	\$21.25	\$0.00	\$0.00	\$321.25
1	9	2006	4	\$60.00	4	\$4.25	0	\$325.00	0	\$775.00	\$240.00	\$17.00	\$0.00	\$0.00	\$257.00
1	20	2006	6	\$60.00	6	\$4.25	0	\$325.00	0	\$775.00	\$360.00	\$25.50	\$0.00	\$0.00	\$385.50
2	10	2006	5	\$60.00	5	\$4.25	0	\$325.00	0	\$775.00	\$300.00	\$21.25	\$0.00	\$0.00	\$321.25
2	18	2006	8	\$60.00	0	\$4.25	0	\$325.00	0	\$775.00	\$480.00	\$0.00	\$0.00	\$0.00	\$480.00
2	21	2006	2	\$60.00	2	\$4.25	0	\$325.00	0	\$775.00	\$120.00	\$8.50	\$0.00	\$0.00	\$128.50
2	21	2006	2	\$60.00	2	\$4.25	0	\$325.00	0	\$775.00	\$120.00	\$8.50	\$0.00	\$0.00	\$128.50
2	21	2006	1	\$60.00	1	\$4.25	0	\$325.00	0	\$775.00	\$60.00	\$4.25	\$0.00	\$0.00	\$64.25
2	21	2006	10	\$60.00	10	\$4.25	0	\$325.00	0	\$775.00	\$600.00	\$42.50	\$0.00	\$0.00	\$642.50
2	21	2006	4	\$60.00	4	\$4.25	0	\$325.00	0	\$775.00	\$240.00	\$17.00	\$0.00	\$0.00	\$257.00
2	21	2006	1	\$60.00	1	\$4.25	0	\$325.00	0	\$775.00	\$60.00	\$4.25	\$0.00	\$0.00	\$64.25
2	21	2006	2	\$60.00	1	\$4.25	0	\$325.00	0	\$775.00	\$120.00	\$4.25	\$0.00	\$0.00	\$124.25
2	21	2006	1	\$60.00	1	\$4.25	0	\$325.00	0	\$775.00	\$60.00	\$4.25	\$0.00	\$0.00	\$64.25
2	21	2006	1	\$60.00	1	\$4.25	0	\$325.00	0	\$775.00	\$60.00	\$4.25	\$0.00	\$0.00	\$64.25
2	21	2006	3	\$60.00	3	\$4.25	0	\$325.00	0	\$775.00	\$180.00	\$12.75	\$0.00	\$0.00	\$192.75
2	21	2006	5	\$60.00	0	\$4.25	0	\$325.00	0	\$775.00	\$300.00	\$0.00	\$0.00	\$0.00	\$300.00
2	27	2006	7	\$60.00	0	\$4.25	0	\$325.00	0	\$775.00	\$420.00	\$0.00	\$0.00	\$0.00	\$420.00
3	6	2006	5	\$60.00	0	\$4.25	0	\$325.00	0	\$775.00	\$300.00	\$0.00	\$0.00	\$0.00	\$300.00
3	16	2006	6	\$60.00	2	\$4.25	0	\$325.00	0	\$775.00	\$360.00	\$8.50	\$0.00	\$0.00	\$368.50
3	20	2006	17	\$60.00	8	\$4.25	0	\$325.00	1	\$775.00	\$1,020.00	\$34.00	\$775.00	\$0.00	\$1,829.00
3	21	2006	5	\$60.00	3	\$4.25	0	\$325.00	0	\$775.00	\$300.00	\$12.75	\$0.00	\$0.00	\$312.75
3	21	2006	3	\$60.00	3	\$4.25	0	\$325.00	0	\$775.00	\$180.00	\$12.75	\$0.00	\$0.00	\$192.75
3	27	2006	2	\$60.00	3	\$4.25	0	\$325.00	0	\$775.00	\$120.00	\$12.75	\$0.00	\$0.00	\$132.75
3	28	2006	2	\$60.00	0	\$4.25	0	\$325.00	0	\$775.00	\$120.00	\$0.00	\$0.00	\$0.00	\$120.00
4	17	2006	8	\$60.00	4	\$4.25	0	\$325.00	0	\$775.00	\$480.00	\$17.00	\$0.00	\$0.00	\$497.00
5	2	2006	6	\$60.00	2	\$4.25	0	\$325.00	0	\$775.00	\$360.00	\$8.50	\$0.00	\$0.00	\$368.50
5	5	2006	8	\$60.00	6	\$4.25	0	\$325.00	0	\$775.00	\$480.00	\$25.50	\$0.00	\$0.00	\$505.50
5	24	2006	21	\$60.00	20	\$4.25	1	\$325.00	0	\$775.00	\$1,260.00	\$85.00	\$0.00	\$325.00	\$1,670.00
5	30	2006	5	\$60.00	0	\$4.25	0	\$325.00	0	\$775.00	\$300.00	\$0.00	\$0.00	\$0.00	\$300.00
6	5	2006	7	\$60.00	4	\$4.25	0	\$325.00	1	\$775.00	\$420.00	\$17.00	\$775.00	\$0.00	\$1,212.00
6	7	2006	6	\$60.00	0	\$4.25	0	\$325.00	0	\$775.00	\$360.00	\$0.00	\$0.00	\$0.00	\$360.00
6	7	2006	11	\$60.00	5	\$4.25	0	\$325.00	0	\$775.00	\$660.00	\$21.25	\$0.00	\$0.00	\$681.25
6	12	2006	5	\$60.00	0	\$4.25	0	\$325.00	0	\$775.00	\$300.00	\$0.00	\$0.00	\$0.00	\$300.00
6	12	2006	28	\$60.00	12	\$4.25	0	\$325.00	1	\$775.00	\$1,680.00	\$51.00	\$775.00	\$0.00	\$2,506.00
6	12	2006	5	\$60.00	0	\$4.25	0	\$325.00	0	\$775.00	\$300.00	\$0.00	\$0.00	\$0.00	\$300.00
6	26	2006	11	\$60.00	0	\$4.25	0	\$325.00	1	\$775.00	\$660.00	\$0.00	\$775.00	\$0.00	\$1,435.00
7	17	2006	8	\$75.00	5	\$5.00	0	\$325.00	0	\$950.00	\$600.00	\$25.00	\$0.00	\$0.00	\$625.00
7	24	2006	7	\$75.00	0	\$5.00	0	\$325.00	0	\$950.00	\$525.00	\$0.00	\$0.00	\$0.00	\$525.00
7	27	2006													

Month	Date	Year	Brifen Post		Brifen Post Cap		Retension Cable		Emergency Callout		Post Cost	Cap Cost	EC Cost	Retension Cost	Total Cost
			Quantity	Price	Quantity	Price	Quantity	Price	Quantity	Price					
2	20	2008	9	\$75.00	3	\$5.00	0	\$325.00	0	\$950.00	\$675.00	\$15.00	\$0.00	\$0.00	\$690.00
2	20	2008	13	\$75.00	5	\$5.00	0	\$325.00	0	\$950.00	\$975.00	\$25.00	\$0.00	\$0.00	\$1,000.00
2	21	2008	6	\$75.00	7	\$5.00	0	\$325.00	0	\$950.00	\$450.00	\$35.00	\$0.00	\$0.00	\$485.00
3	24	2008	9	\$75.00	9	\$5.00	0	\$325.00	1	\$950.00	\$675.00	\$45.00	\$950.00	\$0.00	\$1,670.00
4	1	2008	0	\$75.00	5	\$5.00	0	\$325.00	1	\$950.00	\$0.00	\$25.00	\$950.00	\$0.00	\$975.00
4	10	2008	7	\$75.00	7	\$5.00	0	\$325.00	0	\$950.00	\$525.00	\$35.00	\$0.00	\$0.00	\$560.00
4	14	2008	3	\$75.00	3	\$5.00	0	\$325.00	0	\$950.00	\$225.00	\$15.00	\$0.00	\$0.00	\$240.00
4	18	2008	4	\$75.00	4	\$5.00	0	\$325.00	0	\$950.00	\$300.00	\$20.00	\$0.00	\$0.00	\$320.00
4	21	2008	5	\$75.00	1	\$5.00	0	\$325.00	0	\$950.00	\$375.00	\$5.00	\$0.00	\$0.00	\$380.00
5	8	2008	7	\$75.00	7	\$5.00	0	\$325.00	1	\$950.00	\$525.00	\$35.00	\$950.00	\$0.00	\$1,510.00
5	8	2008	3	\$75.00	3	\$5.00	0	\$325.00	0	\$950.00	\$225.00	\$15.00	\$0.00	\$0.00	\$240.00
5	8	2008	6	\$75.00	6	\$5.00	0	\$325.00	0	\$950.00	\$450.00	\$30.00	\$0.00	\$0.00	\$480.00
5	12	2008	3	\$75.00	3	\$5.00	0	\$325.00	0	\$950.00	\$225.00	\$15.00	\$0.00	\$0.00	\$240.00
5	27	2008	7	\$75.00	2	\$5.00	0	\$325.00	0	\$950.00	\$525.00	\$10.00	\$0.00	\$0.00	\$535.00
5	28	2008	11	\$75.00	12	\$5.00	0	\$325.00	0	\$950.00	\$825.00	\$60.00	\$0.00	\$0.00	\$885.00
5	29	2008	9	\$75.00	7	\$5.00	0	\$325.00	1	\$950.00	\$675.00	\$35.00	\$950.00	\$0.00	\$1,660.00
6	3	2008	6	\$75.00	6	\$5.00	0	\$325.00	0	\$950.00	\$450.00	\$30.00	\$0.00	\$0.00	\$480.00
6	3	2008	7	\$75.00	7	\$5.00	0	\$325.00	0	\$950.00	\$525.00	\$35.00	\$0.00	\$0.00	\$560.00
6	3	2008	6	\$75.00	6	\$5.00	0	\$325.00	0	\$950.00	\$450.00	\$30.00	\$0.00	\$0.00	\$480.00
6	11	2008	8	\$75.00	1	\$5.00	0	\$325.00	0	\$950.00	\$600.00	\$5.00	\$0.00	\$0.00	\$605.00
7	17	2008	9	\$75.00	0	\$5.00	0	\$325.00	0	\$950.00	\$675.00	\$0.00	\$0.00	\$0.00	\$675.00
7	25	2008	21	\$75.00	14	\$5.00	0	\$325.00	1	\$950.00	\$1,575.00	\$70.00	\$950.00	\$0.00	\$2,595.00
7	30	2008	6	\$87.40	6	\$5.00	0	\$325.00	0	\$950.00	\$524.40	\$30.00	\$0.00	\$0.00	\$554.40
8	4	2008	14	\$87.40	11	\$5.00	0	\$325.00	1	\$950.00	\$1,223.60	\$55.00	\$950.00	\$0.00	\$2,228.60
8	19	2008	13	\$87.40	6	\$5.00	0	\$325.00	1	\$950.00	\$1,136.20	\$30.00	\$950.00	\$0.00	\$2,116.20
8	19	2008	28	\$87.40	28	\$5.00	0	\$325.00	0	\$950.00	\$2,447.20	\$140.00	\$0.00	\$0.00	\$2,587.20
8	19	2008	3	\$87.40	3	\$5.00	0	\$325.00	0	\$950.00	\$262.20	\$15.00	\$0.00	\$0.00	\$277.20
8	19	2008	7	\$87.40	7	\$5.00	0	\$325.00	0	\$950.00	\$611.80	\$35.00	\$0.00	\$0.00	\$646.80
8	21	2008	10	\$87.40	5	\$5.00	0	\$325.00	0	\$950.00	\$874.00	\$25.00	\$0.00	\$0.00	\$899.00
8	25	2008	5	\$87.40	5	\$5.00	0	\$325.00	0	\$950.00	\$437.00	\$25.00	\$0.00	\$0.00	\$462.00
8	27	2008	7	\$87.40	7	\$5.00	0	\$325.00	1	\$950.00	\$611.80	\$35.00	\$950.00	\$0.00	\$1,596.80
9	5	2008	9	\$87.40	3	\$5.00	0	\$325.00	0	\$950.00	\$786.60	\$15.00	\$0.00	\$0.00	\$801.60
9	15	2008	9	\$87.40	6	\$5.00	0	\$325.00	0	\$950.00	\$786.60	\$30.00	\$0.00	\$0.00	\$816.60
9	22	2008	4	\$87.40	0	\$5.00	0	\$325.00	0	\$950.00	\$349.60	\$0.00	\$0.00	\$0.00	\$349.60
9	22	2008	3	\$87.40	3	\$5.00	0	\$325.00	0	\$950.00	\$262.20	\$15.00	\$0.00	\$0.00	\$277.20
9	22	2008	4	\$87.40	4	\$5.00	0	\$325.00	0	\$950.00	\$349.60	\$20.00	\$0.00	\$0.00	\$369.60
9	22	2008	1	\$87.40	1	\$5.00	0	\$325.00	0	\$950.00	\$87.40	\$5.00	\$0.00	\$0.00	\$92.40
9	22	2008	4	\$87.40	4	\$5.00	0	\$325.00	0	\$950.00	\$349.60	\$20.00	\$0.00	\$0.00	\$369.60
9	26	2008	6	\$87.40	0	\$5.00	0	\$325.00	0	\$950.00	\$524.40	\$0.00	\$0.00	\$0.00	\$524.40
9	30	2008	10	\$87.40	9	\$5.00	0	\$325.00	0	\$950.00	\$874.00	\$45.00	\$0.00	\$0.00	\$919.00
10	6	2008	5	\$87.40	4	\$5.00	0	\$325.00	0	\$950.00	\$437.00	\$20.00	\$0.00	\$0.00	\$457.00
10	6	2008	6	\$87.40	4	\$5.00	0	\$325.00	0	\$950.00	\$524.40	\$20.00	\$0.00	\$0.00	\$544.40
10	26	2008	7	\$87.40	7	\$5.00	0	\$325.00	0	\$950.00	\$611.80	\$35.00	\$0.00	\$0.00	\$646.80
10	30	2008	4	\$87.40	0	\$5.00	0	\$325.00	0	\$950.00	\$349.60	\$0.00	\$0.00	\$0.00	\$349.60
11	3	2008	8	\$87.40	6	\$5.00	0	\$325.00	0	\$950.00	\$699.20	\$30.00	\$0.00	\$0.00	\$729.20
11	6	2008	7	\$87.40	8	\$5.00	0	\$325.00	0	\$950.00	\$611.80	\$40.00	\$0.00	\$0.00	\$651.80
11	17	2008	4	\$87.40	4	\$5.00	0	\$325.00	0	\$950.00	\$349.60	\$20.00	\$0.00	\$0.00	\$369.60
11	18	2008	18	\$87.40	6	\$5.00	0	\$325.00	0	\$950.00	\$1,573.20	\$30.00	\$0.00	\$0.00	\$1,603.20
12	1	2008	4	\$87.40	4	\$5.00	0	\$325.00	0	\$950.00	\$349.60	\$20.00	\$0.00	\$0.00	\$369.60
12	1	2008	6	\$87.40	3	\$5.00	0	\$325.00	0	\$950.00	\$524.40	\$15.00	\$0.00	\$0.00	\$539.40
12	8	2008	26	\$87.40	5	\$5.00	0	\$325.00	0	\$950.00	\$2,272.40	\$25.00	\$0.00	\$0.00	\$2,297.40
12	10	2008	5	\$87.40	2	\$5.00	0	\$325.00	0	\$950.00	\$437.00	\$10.00	\$0.00	\$0.00	\$447.00
12	16	2008	5	\$87.40	5	\$5.00	0	\$325.00	0	\$950.00	\$437.00	\$25.00	\$0.00	\$0.00	\$462.00
12	29	2008	15	\$87.40	7	\$5.00	0	\$325.00	1	\$950.00	\$1,311.00	\$35.00	\$950.00	\$0.00	\$2,296.00
1	13	2009	17	\$87.40	17	\$5.00	0	\$325.00	0	\$950.00	\$1,485.80	\$85.00	\$0.00	\$0.00	\$1,570.80
1	20	2009	10	\$87.40	10	\$5.00	0	\$325.00	0	\$950.00	\$874.00	\$50.00	\$0.00	\$0.00	\$924.00
1	26	2009	10	\$87.40	10	\$5.00	0	\$325.00	0	\$950.00	\$874.00	\$50.00	\$0.00	\$0.00	\$924.00
1	29	2009	26	\$87.40	24	\$5.00	0	\$325.00	0	\$950.00	\$2,272.40	\$120.00	\$0.00	\$0.00	\$2,392.40
2	2	2009	9	\$87.40	9	\$5.00	0	\$325.00	0	\$950.00	\$786.60	\$45.00	\$0.00	\$0.00	\$831.60
2	9	2009	2	\$87.40	1	\$5.00	0	\$325.00	0	\$950.00	\$174.80	\$5.00	\$0.00	\$0.00	\$179.80
2	11	2009	32	\$87.40	32	\$5.00	0	\$325.00	1	\$950.00	\$2,796.80	\$160.00	\$950.00	\$0.00	\$3,906.80
2	17	2009	12	\$87.40	5	\$5.00	0	\$325.00	0	\$950.00	\$1,048.80	\$25.00	\$0.00	\$0.00	\$1,073.80
2	17	2009	3	\$87.40	3	\$5.00	0	\$325.00	0	\$950.00	\$262.20	\$15.00	\$0.00	\$0.00	\$277.20
2	17	2009	5	\$87.40	5	\$5.00	0	\$325.00	0	\$950.00	\$437.00	\$25.00	\$0.00	\$0.00	\$462.00
2	23	2009	0	\$87.40	11	\$5.00	0	\$325.00	0	\$950.00	\$0.00	\$55.00	\$0.00	\$0.00	\$55.00
2	23	2009	7	\$87.40	1	\$5.00	0	\$325.00	0	\$950.00	\$611.80	\$5.00	\$0.00	\$0.00	\$616.80
2	23	2009	9	\$87.40	9	\$5.00	0	\$325.00	0	\$950.00	\$786.60	\$45.00	\$0.00	\$0.00	\$831.60
2	24	2009	9	\$87.40	9	\$5.00	0	\$325.00	0	\$950.00	\$786.60	\$45.00	\$0.00	\$0.00	\$831.60
2	24	2009	7	\$87.40	7	\$5.00	0	\$325.00	0	\$950.00	\$611.80	\$35.00	\$0.00	\$0.00	\$646.80
2	25	2009	7	\$87.40	7	\$5.00	0	\$325.00	0	\$950.00	\$611.80	\$35.00	\$0.00	\$0.00	\$646.80
3	2	2009	13	\$87.40	13	\$5.00	0	\$325.00	1	\$950.00	\$1,136.20	\$65.00	\$950.00	\$0.00	\$2,151.20
3	9	2009	8	\$87.40	8	\$5.00	0	\$325.00	0	\$950.00	\$699.20	\$40.00	\$0.00	\$0.00	\$739.20
3	12	2009	8	\$87.40	8	\$5.00	0	\$325.00	0	\$950.00	\$699.20	\$40.00	\$0.00	\$0.00	\$739.20
3	13	2009	8	\$87.40	6	\$5.00	0	\$325.00	0	\$950.00	\$699.20	\$30.00	\$0.00	\$0.00	\$729.20
3	16	2009	7	\$87.40	7	\$5.00	0	\$325.00	0	\$950.00	\$611.80	\$35.00	\$0.00	\$0.00	\$646.80
3	16	2009	10	\$87.40	10	\$5.00	0	\$325.00	1	\$950.00	\$874.00	\$50.00	\$950.00	\$0.00	\$1,874.00
3	19	2009	6	\$87.40	4	\$5.00	0	\$325.00	0	\$950.00	\$524.40	\$20.00	\$0.00	\$0.00	\$544.40
4	14	2009	8	\$87.40	3	\$5.00	0	\$325.00	0	\$950.00	\$699.20	\$15.00	\$0.00	\$0.00	\$714.20
4	17	2009	77	\$87.40	23	\$5.00	0	\$325.00	1	\$950.00	\$6,729.80	\$115.00	\$950.00	\$0.00	\$7,794.80
4	27	2009	12	\$87.40	11	\$5.00	0	\$325.00	1	\$950.00	\$1,048.80	\$55.00	\$950.00	\$0.00	\$2,053.80
4	27	2009	6	\$87.40	6	\$5.00	0	\$325.00	0	\$950.00	\$524.40	\$30.00	\$0.00	\$0.00	\$554.40
4	48	2009	8	\$87.40	8	\$5.00	0	\$325.00	1	\$950.00	\$699.20	\$40.00	\$950.00	\$0.00	\$1,689.20
5	20	2009	16	\$87.40	12	\$5.00	0	\$325.00	1	\$950.00	\$1,398.40	\$60.00	\$950.00	\$0.00	\$2,408.40
5	20	2009	3	\$87.40	3	\$5.00	0	\$325.00	0	\$950.00	\$262.20	\$15.00	\$0.00	\$0.00	\$277.20
5	20	2009	6	\$87.40	6	\$5.00	0	\$325.00	0	\$					

Month	Date	Year	Brifen Post		Brifen Post Cap		Retension Cable		Emergency Callout		Post Cost	Cap Cost	EC Cost	Retension Cost	Total Cost
			Quantity	Price	Quantity	Price	Quantity	Price	Quantity	Price					
7	30	2009	3	\$75.00	3	\$5.00	0	\$325.00	0	\$950.00	\$225.00	\$15.00	\$0.00	\$0.00	\$240.00
7	31	2009	5	\$75.00	4	\$5.00	0	\$325.00	0	\$950.00	\$375.00	\$20.00	\$0.00	\$0.00	\$395.00
8	7	2009	12	\$75.00	7	\$5.00	0	\$325.00	1	\$950.00	\$900.00	\$35.00	\$950.00	\$0.00	\$1,885.00
8	10	2009	17	\$75.00	17	\$5.00	0	\$325.00	0	\$950.00	\$1,275.00	\$85.00	\$0.00	\$0.00	\$1,360.00
8	10	2009	9	\$75.00	9	\$5.00	0	\$325.00	0	\$950.00	\$675.00	\$45.00	\$0.00	\$0.00	\$720.00
8	10	2009	6	\$75.00	6	\$5.00	0	\$325.00	0	\$950.00	\$450.00	\$30.00	\$0.00	\$0.00	\$480.00
8	10	2009	4	\$75.00	4	\$5.00	0	\$325.00	0	\$950.00	\$300.00	\$20.00	\$0.00	\$0.00	\$320.00
8	10	2009	5	\$75.00	3	\$5.00	0	\$325.00	0	\$950.00	\$375.00	\$15.00	\$0.00	\$0.00	\$390.00
8	17	2009	5	\$75.00	5	\$5.00	0	\$325.00	0	\$950.00	\$375.00	\$25.00	\$0.00	\$0.00	\$400.00
8	19	2009	5	\$75.00	5	\$5.00	0	\$325.00	0	\$950.00	\$375.00	\$25.00	\$0.00	\$0.00	\$400.00
8	20	2009	4	\$75.00	4	\$5.00	0	\$325.00	0	\$950.00	\$300.00	\$20.00	\$0.00	\$0.00	\$320.00
8	20	2009	7	\$75.00	3	\$5.00	0	\$325.00	0	\$950.00	\$525.00	\$15.00	\$0.00	\$0.00	\$540.00
8	28	2009	4	\$75.00	2	\$5.00	0	\$325.00	0	\$950.00	\$300.00	\$10.00	\$0.00	\$0.00	\$310.00
9	2	2009	14	\$75.00	14	\$5.00	0	\$325.00	0	\$950.00	\$1,050.00	\$70.00	\$0.00	\$0.00	\$1,120.00
9	14	2009	5	\$75.00	3	\$5.00	0	\$325.00	0	\$950.00	\$375.00	\$15.00	\$0.00	\$0.00	\$390.00
9	21	2009	8	\$75.00	1	\$5.00	0	\$325.00	0	\$950.00	\$600.00	\$5.00	\$0.00	\$0.00	\$605.00
9	21	2009	12	\$75.00	9	\$5.00	0	\$325.00	1	\$950.00	\$900.00	\$45.00	\$950.00	\$0.00	\$1,895.00
9	21	2009	5	\$75.00	5	\$5.00	0	\$325.00	0	\$950.00	\$375.00	\$25.00	\$0.00	\$0.00	\$400.00
9	23	2009	20	\$75.00	20	\$5.00	0	\$325.00	0	\$950.00	\$1,500.00	\$100.00	\$0.00	\$0.00	\$1,600.00
9	29	2009	7	\$75.00	2	\$5.00	0	\$325.00	0	\$950.00	\$525.00	\$10.00	\$0.00	\$0.00	\$535.00
9	29	2009	29	\$75.00	12	\$5.00	0	\$325.00	0	\$950.00	\$2,175.00	\$60.00	\$0.00	\$0.00	\$2,235.00
9	29	2009	10	\$75.00	10	\$5.00	0	\$325.00	0	\$950.00	\$750.00	\$50.00	\$0.00	\$0.00	\$800.00
10	2	2009	19	\$75.00	12	\$5.00	0	\$325.00	1	\$950.00	\$1,425.00	\$60.00	\$950.00	\$0.00	\$2,435.00
10	8	2009	5	\$75.00	5	\$5.00	0	\$325.00	0	\$950.00	\$375.00	\$25.00	\$0.00	\$0.00	\$400.00
10	20	2009	12	\$75.00	12	\$5.00	0	\$325.00	0	\$950.00	\$900.00	\$60.00	\$0.00	\$0.00	\$960.00
10	26	2009	5	\$75.00	3	\$5.00	0	\$325.00	0	\$950.00	\$375.00	\$15.00	\$0.00	\$0.00	\$390.00
10	26	2009	9	\$75.00	9	\$5.00	0	\$325.00	0	\$950.00	\$675.00	\$45.00	\$0.00	\$0.00	\$720.00
11	9	2009	7	\$75.00	8	\$5.00	0	\$325.00	1	\$950.00	\$525.00	\$40.00	\$950.00	\$0.00	\$1,515.00
11	9	2009	12	\$75.00	12	\$5.00	0	\$325.00	1	\$950.00	\$900.00	\$60.00	\$950.00	\$0.00	\$1,910.00
11	25	2009	6	\$75.00	6	\$5.00	0	\$325.00	0	\$950.00	\$450.00	\$30.00	\$0.00	\$0.00	\$480.00
12	2	2009	7	\$75.00	7	\$5.00	0	\$325.00	0	\$950.00	\$525.00	\$35.00	\$0.00	\$0.00	\$560.00
12	2	2009	10	\$75.00	10	\$5.00	0	\$325.00	0	\$950.00	\$750.00	\$50.00	\$0.00	\$0.00	\$800.00
12	7	2009	5	\$75.00	3	\$5.00	0	\$325.00	0	\$950.00	\$375.00	\$15.00	\$0.00	\$0.00	\$390.00
12	16	2009	13	\$75.00	13	\$5.00	0	\$325.00	0	\$950.00	\$975.00	\$65.00	\$0.00	\$0.00	\$1,040.00
12	16	2009	6	\$75.00	6	\$5.00	0	\$325.00	0	\$950.00	\$450.00	\$30.00	\$0.00	\$0.00	\$480.00
12	22	2009	7	\$75.00	7	\$5.00	0	\$325.00	0	\$950.00	\$525.00	\$35.00	\$0.00	\$0.00	\$560.00
12	25	2009	37	\$75.00	37	\$5.00	0	\$325.00	0	\$950.00	\$2,775.00	\$185.00	\$0.00	\$0.00	\$2,960.00

VITA
James Neil Wilkerson
Candidate for the Degree of
Master of Science

Thesis: BENEFIT COST ANALYSIS OF BRIFEN WIRE ROPE SAFETY FENCE
ON LAKE HEFNER PARKWAY IN OKLAHOMA CITY, OKLAHOMA

Major Field: Civil Engineering

Biographical:

Education: Graduated from Shattuck High School, Shattuck, Oklahoma in May 2001; received Bachelor of Science degree in Civil Engineering from Oklahoma State University, Stillwater, Oklahoma in December 2007. Completed the requirements for the Master of Science degree in Civil Engineering at Oklahoma State University, Stillwater, Oklahoma in May 2010.

Experience: Employed by Brifen USA, Inc. as a Civil Engineer, 2009 to present.

Professional Memberships: AASHTO-AGC-ARTBA Task Force 13, Oklahoma Traffic Engineering Association.

Name: James Neil Wilkerson

Date of Degree: May, 2010

Institution: Oklahoma State University

Location: Stillwater, Oklahoma

Title of Study: BENEFIT COST ANALYSIS OF BRIFEN WIRE ROPE SAFETY
FENCE ON LAKE HEFNER PARKWAY IN OKLAHOMA CITY,
OKLAHOMA

Pages in Study: 38

Candidate for the Degree of Master of Science

Major Field: Civil Engineering

Scope and Method of Study: The purpose of this study is to determine if the Brifen Wire Rope Safety Fence (Brifen WRSF) on Lake Hefner Parkway in Oklahoma City, Oklahoma has been an effective and economical safety treatment to reduce the number of cross median crashes. To determine the effectiveness of the Brifen WRSF an incremental benefit cost analysis was completed using the FHWA Comprehensive Crash Costs and AASHTO Roadside Design Guide crash costs separately. Two analyses were conducted; one involving all cross median crashes and one with semi-trucks, which exceeded the design limits of the safety device, removed from the analysis. If the Brifen Wire Rope Safety Fence has been a good economical choice, the incremental benefit cost ratio will be 1.0 or higher.

Findings and Conclusions: The Brifen WRSF has been an effective and economical safety treatment for Lake Hefner Parkway. The number of severe injury and fatal crashes was greatly reduced after the Brifen WRSF installation. Using FHWA crash costs and including all types of crashes, the B/C ratio was 9.70 and increased to 11.52 when semi-trucks were removed from the analysis. Using AASHTO Roadside Design Guide crash costs, the B/C ratio was 5.58 and 6.37 respectively. Both methods show that the Brifen WRSF has been a highly effective and economical safety investment, since costs for installation and maintenance has been substantially less than the benefits from reduced crash severity.

ADVISER'S APPROVAL: Dr. Stephen A. Cross
