

HDR Inc.

# The New Mexico Highway 4 Bypass Benefit-Cost Analysis

**Pueblo of Jemez, New Mexico**

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# 1. INTRODUCTION

## 1.1 Background, Purpose and Summary of Major Findings

New Mexico State Road 4 is the main access route, in conjunction with New Mexico State Road 501 and New Mexico State Road 502, connecting the remote town of Los Alamos, Los Alamos National Laboratory, and Bandelier National Monument to other more major highways in New Mexico. Its total length is approximately 64 miles. The Highway bisects the Pueblo of Jemez along a roughly five-mile stretch about four miles from the southern terminus of the route at Highway 550. This part of the Highway is the gateway to the Valle Caldera National Preserve, the country's newest National Trust Site.

Highway 4 is a nationally designated Scenic By-way, and is one of the most scenic routes in the State. The road travels through striking red rock areas, along creek beds and soda dam formations, past natural hot springs, enormous mesas and sheer rock wall cliffs into the thick conifer forests of the Jemez Mountains. Recreational opportunities for hunting, fishing, hiking, biking, camping, boating and swimming in natural springs, pools and lakes abound. The Valle Caldera is one of the most scenic spots in New Mexico. Added to these attractions is the fact that Highway 4 is the only access to the Pueblo of Jemez, one of New Mexico's most traditional Pueblo villages, where roughly 2,000 Tribal members preserve their language, customs and ceremonies. Highway 4 is one of the major tourist areas of the State. With the new Valle Caldera National Preserve tourist traffic to this area will increase substantially. National Park officials are projecting an additional 100,000 visitors annually. There is also legislation pending in Congress to create a Manhattan Project National Park in Los Alamos which would increase tourist traffic along Highway 4 even more.

The portion of Highway 4 that goes through Jemez Pueblo was constructed on Indian trust land illegally in 1938. There was no right-of-way agreement between the Tribe and the State, nor was the Tribe consulted in any way during the building of the Highway. The construction of the Highway was based on an eminent domain condemnation that was overturned by the New Mexico State Supreme Court. There is no legal basis for the portion of the road that traverses the Pueblo. The Pueblo has never recognized nor accepted the loss and destruction of the affected land. No compensation has ever been paid to the Tribe for the illegal seizure of land.

Nowhere else in the State of New Mexico would the unsafe conditions found within Jemez Pueblo along Highway 4 be allowed to exist. This major two-lane thoroughfare goes through the center of a highly populated area with residences on both sides of the road and many entrance ways into the Pueblo. There is constant pedestrian and animal traffic going back and forth along the road daily; yet there are no sidewalks, no shoulders and no crosswalks. Residents park their cars on their properties all along the road, yet there are no turning lanes, exits or egresses to accommodate the many people turning on and off the highway.

There is a high incidence of accidents within this area. According to Federal Highway Administration Road Safety Audit "NM4 Through the Jemez Pueblo":

*Substantial pedestrian traffic, including children, was observed walking along the highway shoulders and crossing the highway. A substantial volume of trucks was observed. No cyclists or motorcyclists were observed at the time of the visits, but Pueblo staff stated that these road users are present during the summer.*

*Over a period of ten years (1996 through 2005), a total of 24 collisions were reported along the audit segment (between MP4.3 and MP7.5), most of which (21 of 24) occurred in the residential area between MP4.3 and MP5.7.1. About 1/3 of reported crashes resulted in at least one injury or fatality. Animal collisions predominated, accounting for over half of reported crashes.*

*The risk of collision is increased by continuous vehicle access to and from adjacent properties and the Red Rocks recreational area, which can result in unexpected conflicts as drivers approach and leave the road in an uncontrolled and undirected manner. In addition, the presence of parked vehicles on the shoulder can limit pedestrians' and drivers' views of one another, increasing the risk of collision.*

*A re-alignment of NM4 to bypass the Pueblo to the east has been proposed in the Jemez Valley Corridor Assessment study as a long-term solution to these conflicts. The results of this RSA suggest that this suggested bypass would have significant traffic safety benefits in terms of reducing the volume of through traffic on NM4, and consequently the exposure to conflicts between through traffic on the one hand, and local vehicle, pedestrian, and livestock traffic on the other. The bypass has been identified in the 2006 Regional Transportation Improvement Program Recommendations, and may be implemented as part of the Statewide Transportation Improvement Program (STIP).*

The RSA Study was completed in 2007. Traffic has increased substantially since that time, and will continue to increase especially due to the new Valle Caldera Park. Much of the traffic during the summer months reflect large RV and camping vehicles. The Valle Caldera is mandated to be a self-sustaining operation and has some of the best grazing land in the State. During the spring and fall months there are now ranchers hauling livestock to and from the area traversing Highway 4. A few years ago, Jemez Pueblo formed a joint venture enterprise to thin the national forests within the Jemez Mountains and process wood material. Large logging trucks are currently making eight trips per day through the Pueblo. This is projected to increase to 32 trips within two years.

The Pueblo of Jemez holds from 20 to 25 traditional ceremonies annually. There are three major public ceremonies at various times during the year in addition to Christmas ceremonies that last for 12 days. During the public and Christmas ceremonies there is bumper-to bumper traffic along Highway 4 and parked cars lined up for miles along both sides of Highway 4 with no shoulder. Often through traffic, especially trucks, can barely squeeze by the parked cars. During

the less public ceremonies there are processions and large numbers of Tribal members that routinely cross Highway 4 while traffic is completely stopped.

The Jemez Mountains are very susceptible to wildfires, especially during drought conditions like we have now and into the foreseeable future. There have been recent major fires including the Las Conchas Fire that occurred in 2011 and burned 150,000 acres, making it the largest wildfire in New Mexico history. On the first day the fire was burning about one acre per second. Mandatory evacuation orders were issued for Los Alamos. The fire caused severe flooding in surrounding regions during the New Mexico rainy season. The Thompson Ridge Fire burned 23,000 acres just west of Los Alamos in 2013 near the Valle Caldera. The Cerro Grande Fire occurred in May of 2000. Over 400 families lost their homes in the town of Los Alamos. The entire town was evacuated and the Laboratory was shut down. Structures at the Lab were destroyed or damaged. Over 48,000 acres were burned. The US General Accounting Office estimated total damages at \$1 billion.

Los Alamos National Laboratory is the nation's major nuclear weapons research lab. There are many sites where radioactive waste is stored or buried. The volatile mixture of potential wildfire, nuclear material, potential flooding and even the possibility of terrorist acts, makes the community of Los Alamos uniquely susceptible to emergency situations. One can imagine an emergency event that blocks the eastern exits of the town forcing evacuation along Highway 4 during a Pueblo of Jemez ceremonial period.

As addressed in the main body of this application, flooding in the Pueblo was a major issue in 2013, causing considerable damage. However, there are routinely two to three floods at Jemez Pueblo every year causing substantial damage whenever there is a major rain. Most of the flood water drain off of the hard surface of Highway 4 and flow into the Pueblo with no barriers to impede the flow. Jemez Pueblo has earmarked funds to both maintain Highway 4 as an Indian/BIA road, as well as to install rock and vegetative systems along the roadway that will impede the flow of water and prevent future flooding. The State does not have plans to do this, so the flood mitigation systems will only be installed once the bypass is complete and Jemez Pueblo takes over the old road.

Pueblo maintenance crews and residents are continually repairing damages caused by flooding. The 2013 flood damages are estimated at \$750,000 by the Pueblo Maintenance Department. About \$350,000 resulted from damage to homes; about 200,000 resulted from damage to dirt roadways; and about \$200,000 resulted from damage to irrigation channels. Although a single event cause that damage in 2013, roughly the same amount of damages occur annually from the lesser flooding events.

The purpose of this project is to construct a bypass around the Village of Jemez Pueblo (Walatowa) in order to address and enhance the cultural preservation of the Pueblo of Jemez, to improve the quality of life, to address reparation to the Pueblo for an illegal land grab, to address egregious safety issues, to provide for emergency vehicles and evacuation routes, to

allow the Pueblo to take over management and maintenance of the old highway and install amenities to deal with flooding, and to stimulate job creation and economic development.

The bypass will allow for the use of the existing Highway 4 tract through the Pueblo as a destination route to the Pueblo of Jemez rather than as a thoroughfare. The old Highway 4 will be used by Pueblo residents and by tourists and visitors to the Pueblo. Traffic will be greatly decreased. Safety will be enhanced as people will be either driving to their homes or sight-seeing at a leisurely pace. It will be easier for tourists and visitors to pull off the road to patronize arts and craft businesses and food stands that belong to Tribal members along the roadway. In addition, the Tribe has future plans to build a resort/spa and other businesses.

With the bypass, through traffic and trucks will not be impeded by Pueblo of Jemez ceremonies. The old route will be able to accommodate cars and people during ceremonial activities. Faster and more convenient access along Highway 4 to the Valle Caldera, tourist amenities and Los Alamos from New Mexico's major population areas will draw more visitors to the area providing more business to the restaurants, lodges, hot springs and spas that are mostly located just north of Jemez Pueblo in Jemez Springs. The entire Jemez Valley is classified as an economically distressed area.

The benefit-cost analysis described in the following sections estimates specific benefits and costs associated with the proposed bypass according to approved TIGER methodology. The project is evaluated as compared to the current system, which is considered the baseline, and a future scenario without major capital improvements. While the benefits associated with the reduced congestion on NM-4 are included in the analysis, many of the benefits of this project are not easily quantifiable. As a result, the benefit-cost discussion includes both the benefits that can be monetized and the benefits that cannot.

## **1.2 Summary of Benefit-Cost Results**

Using the TIGER III guidance recommended discount rate of 7 percent, the New Mexico Highway 4 Bypass project will result in:

- Total benefits of \$19.5 million in present value terms;
- Total costs of \$23.0 million in present value terms;
- Benefit-cost ratio (BCR) of 0.85 at a 7 percent discount rate.
- Benefit-cost ratio (BCR) of 1.51 at a 3 percent discount rate.

A benefit-cost ratio (BCR) of 0.85 at a 7 percent discount rate indicates that the costs exceed the quantifiable benefits of the project. For comparison purposes, the BCR was also calculated at a 3 percent discount rate, resulting in a BCR of 1.51 for the bypass construction. Measurable benefits are estimated to outweigh costs up to a discount rate of 5.72 percent. In addition to the quantifiable benefits, there are numerous benefits to the project that are difficult to quantify, including the preservation of the cultural identity of the Jemez people. A discussion of the benefit-cost results, as well as those benefits that could not be incorporated into the analysis, is provided in subsequent sections.

### **1.3 Organization of the Report**

This report provides the framework of the benefit-cost analysis in Section 2. Information related to the traffic estimation utilized in the analysis is provided in Section 3. Benefits and costs are detailed in Section 4, and Section 5 presents the results with a conclusion evaluating the findings of the study. Figures and tables are provided throughout the report to better illustrate the analysis.

## **2. FRAMEWORK OF THE ANALYSIS**

### **2.1 Benefit-Cost Analysis**

A comparison of the benefits and costs of a project can give an indication of whether or not a project is worthwhile. To be deemed economically feasible, projects must pass one or more value benchmarks: the total benefits must exceed the total costs on a present value basis; and/or the rate of return on the funds invested should exceed the cost of raising capital, often defined as the long-term treasury rate or the social discount rate. A fundamental tenet of the benefit-cost analysis approach is that only those incremental benefits directly attributable to the construction and operation of the project are included in the estimation of benefits and costs.

For this analysis, the cost to build and operate the bypass represents the foregone value of an alternative investment. The benefits of the project refer to the improvement in the social well-being delivered by the project.

In the bypass benefit-cost analysis, benefits are estimated for current and future users on an incremental basis; that is, the change in welfare that consumers and, more generally, society derive from access to the new bypass, as compared to the current situation. As with most transportation projects, the benefits derived from the implementation of infrastructure projects are actually a reduction in the costs associated with transportation activities.

The benefits of a project are the cost reductions that may result from the project's implementation. These cost reductions may come in the form of average time saved by users, reductions in the operating expenses, reduction of pollution or, more generally, a combination of these effects.

#### **2.1.1 Principles**

The benefit-cost analysis was conducted by HDR using methods and parameters consistent with the US Department of Transportation and the Transportation Investment Generating Economic Recovery (TIGER) Discretionary Grants guidance. The following principles guide the estimation of benefits and costs in the analysis:

- Only incremental benefits and costs are measured.
  - Incremental benefits of the project include transportation cost savings for the users of the bypass. Users of the Cultural Preservation Highway Bypass include automobile drivers and truck drivers.
  - Incremental costs of implementation of the project include initial and recurring costs. Initial costs refer to capital costs incurred for design and construction of the bypass. Recurring costs include incremental operating costs and maintenance expenses. Only additions in costs to the current operations and planned investments are considered in the analysis.
- Benefits and costs are valued at their opportunity costs.
  - The benefits stemming from the implementation of the bypass are those above and beyond the benefits that could be obtained from the best transportation alternative.

### 2.1.2 Measurement Data and Assumptions

As part of the TIGER III Grant application process, which was the impetus behind this analysis, benefits and costs associated with specific long term outcomes criteria were estimated. Table 1 presents the benefits measured in this project application as they relate to the five long term outcomes identified in the TIGER VI grant guidance: State of Good Repair; Economic Competitiveness; Quality of Life; Sustainability; and, Safety.

**Table 1: Benefits and Description of Evaluation Criteria Identified in Long Term Outcomes**

Criteria	Benefit(s)	Description
<b>State of Good Repair</b>	Pavement Maintenance Savings	Pavement maintenance savings due to new bypass
<b>Economic Competitiveness</b>	Long Term Employment	Value of long-term jobs and whether created in areas of economic distress
	Increased community business	Destination access road for convenient local business patronization and destination tourism development
<b>Quality of Life</b>	Travel Time Savings	Door-to-door trip time savings to transportation users
	Vehicle Operating Cost Savings	Savings associated with reduced vehicle operations
	Benefits to New Users	Benefits accrued to users who did not previously use the corridor

<b>Sustainability</b>	Emissions Reductions	Reductions in pollutants and green house gases due to auto and truck use reductions
	Fuel Cost Savings	The savings incurred due to reduced fuel costs associated with the change in speed of travel permitted on the bypass versus NM 4
<b>Safety</b>	Accident Reduction	Reductions in property losses and injuries and deaths due to the bypass
<b>Job Creation and Economic Stimulus</b>	Short Term Employment	Value of new short-term jobs created
<b>Environmental Damage Mitigation</b>	Savings from flood damage mitigation	Damage mitigation from road systems improvements installed by Pueblo
<b>Social Benefits</b>	Emergency preparedness	Barriers to rapid emergency vehicle transit removed
	Improvement in Quality of Life	Cohesiveness of community facilitating safe ceremonial and traditional life
<b>Legal Benefits</b>	Return of illegally confiscated land	Legal status of Highway 4 will be corrected

**2.1.3 Valuation**

The valuation of benefits makes use of a number of assumptions that are required to produce monetized values for non-pecuniary benefits. For instance, the different components of time are monetized by using a “value of time” that is assumed to be equivalent to the user’s willingness to pay for time savings in transit. United States Department of Transportation (USDOT) valuation guidance on the preparation of TIGER VI applications was used in the analysis. Where USDOT has not provided valuation guidance or a reference to guidance, standard industry practice has been applied.

All benefits and costs are estimated in 2013 dollars in the analysis, and annual costs and benefits are computed over a long-run planning horizon of 30 years and summarized through a lifecycle cost analysis. All benefits are discounted to 2014 per USDOT Guidance.

#### **2.1.4 The Opportunity Cost of Capital**

The opportunity cost associated with the delayed consumption of benefits and the alternative uses of the capital for the implementation of the project is measured by the discount rate. All benefits and costs are discounted to reflect the opportunity costs of committing resources to the project. Calculated real discount rates are applied to all future costs and benefits as a representation of how the public sector evaluates investments. Per USDOT Guidance, a 7 percent real discount rate is used in the analysis, with a sensitivity test at 3 percent.

#### **2.1.5 Model Structure**

When conducting a benefit-cost analysis, a baseline scenario is compared to an alternative. For this study, the current NM 4 condition is considered the baseline condition. The construction of the bypass is the alternative. Data from numerous sources are combined using a variety of relationships and TIGER VI guidance to develop benefit and cost estimates.

## **3. TRAFFIC ESTIMATION**

### **3.1 Estimating Travel Data and Travel Time Savings**

The following section provides information about the traffic estimates that were utilized for the benefit-cost analysis. These estimates provided the basis for the estimation of benefits and costs associated with the bypass.

As part of this work effort, traffic estimates were collected to measure two specific scenarios: a “no build” and a “build” scenario. The “build” scenario assumes that the bypass construction occurs in 2015 with operations beginning in 2016. The “no-build” scenario assumes that NM 4 remains as it is today. Daily traffic data was obtained from the “NM 4 Jemez Pueblo Boundary to NM290 Phase B” report.

Traffic data for the individual roadways in the project area were analyzed for the benefit-cost analysis. It was assumed that in the “no-build” scenario there would be some increase in traffic levels on NM 4. For the “build” scenario, it is assumed that some portion of the existing NM 4 traffic will divert to the new bypass. In addition, some natural traffic growth is also assumed for the bypass. The difference in traffic between the “no-build” and “build” scenarios was converted to vehicle miles traveled (VMT) and vehicle hours traveled (VHT) estimates. Because the bypass is actually longer than the existing route, VMT increases when the project is complete. Speeds on the bypass are higher, however, so VHT decreases once the bypass is built. These effects are captured in the benefit-cost analysis.

There is significant local traffic in the study area. Using daily and hourly traffic counts, estimates were made for the number of vehicles, VMT, and VHT by segment for NM 4 including intersections with NM 290, Mission Road, and other local Pueblo roads. Average annual VMT growth was estimated to be 0.8%. Upon bypass completion, the analysis assumed VMT would grow by 1.1% due to the increased length of the bypass. VHT was estimated to increase at an

average annual rate of 0.7% per year and then decrease by 0.1% annually following the completion of the bypass. This reflects the faster rates of speed, and subsequent reduction in travel time, that the bypass would allow. The table below shows the estimates for total VMT and VHT for the entire traffic study region.

**Table 2: VMT and VHT for NM4 and Bypass in thousands**

	2013	2030 No Build	2030 Build
VMT	5,386	5,925	6,175
VHT	206	231	201

Using these VMT and VHT data, as well as other information provided by the TIGER VI Grant guidelines and other sources, estimation of benefits for the analysis was completed. A full description of these benefits measures is provided later in the report.

## 4. BENEFITS AND COSTS ASSOCIATED WITH THE CULTURAL PRESERVATION BYPASS HIGHWAY

The benefit-cost analysis was conducted using methods and parameters consistent with US Department of Transportation guidance.

### 4.1 Benefits

Seven categories of benefits were measured for this analysis: 1) travel time savings; 2) vehicle operating cost savings; 3) benefits to new users; 4) accident reduction benefits; 5) emission reduction benefits; 6) pavement maintenance benefits; and 7) fuel cost savings. Costs include capital construction costs and operating and maintenance (O&M) costs for NM-4 and the new bypass. A description of the benefits associated with the bypass is provided in the following subsections. A list of non-monetized benefits is provided in section 5, subsection 5.3.

#### 4.1.1 Travel Time Savings

Once the bypass is built, travel time will be reduced as both autos and trucks will have better mobility options than they currently have. These travel time savings, due to the bypass, are estimated using value of time parameters from the US DOT, escalated to 2013 dollars. They account for a mix of personal (90%) and business auto trips (10%), as well as truck impacts. It is also worth noting that travel time decreases for highway vehicles once the bypass is constructed because the speed of travel is higher on the new roadway than it is on the existing NM 4.

#### 4.1.2 Vehicle Operating Costs

While the distance on the bypass is longer than the existing conditions, the average travel speed will increase, offsetting the impacts of the increase in operating costs. Information from the Highway Economic Requirements System (HERS) was used to generate vehicle costs by

travel speed for existing users. For the analysis, vehicle operating costs include oil, depreciation, tire wear, and maintenance and repair.

#### **4.1.3 Benefits to New Users**

Using the “rule of one-half”, benefits can be estimated for those users who would not have previously made the trip, but will now do so due to the improved conditions. This benefit applies to the “generalized cost of travel” or the cost of travel time plus the cost of vehicle operations to existing users. This benefit applies to the incremental new users in the build case.

#### **4.1.4 Accident Savings**

Because of the reduction in congestion associated with the improvements provided by the bypass, annual accidents are expected to be reduced by 45 percent per year according to the New Mexico Department of Transportation. On average, based on the data presented previously, there are currently 0.11 fatalities, 0.61 injury accidents, and 1.41 property damage only accidents per year in this area. Once the bypass is open, this rate will fall to approximately 0.14 accidents per year. Additionally, safety is likely to be improved for residents of the Pueblo due to the bypass.

#### **4.1.5 Emissions Reduction Benefits**

To monetize emissions, the change in auto and truck VMT is combined with a factor for each emission type, VOC (HC), CO, CO<sub>2</sub>, NO<sub>x</sub>, SO<sub>2</sub>, and PM, varying by auto and truck. The change in VMT is based on estimates of traffic in the Jemez Pueblo area before, during, and after the bypass construction. When the bypass is complete, VMT will increase because the bypass is slightly longer than the existing routes for travel in the area. The speed of travel, however, will be higher on the bypass than on NM4. As a result, fuel efficiency for those vehicles using the bypass is greater than it would be on NM 4 with its slower speed and increased number of stops and starts. These factors combined produce emission reduction benefits due to the project.

#### **4.1.6 Pavement Maintenance Savings**

Pavement maintenance cost reduction is another benefit of the bypass project. In addition to the costs that individual drivers incur for auto and truck trips, there are costs in terms of damage to the road surface. Because traffic on NM 4 will be reduced, the costs to maintain that road go down. Although VMT increases due to the project, the reduction in maintenance costs for NM 4 outweigh the increase in maintenance costs associated with the increased miles. The result is a pavement maintenance savings for the overall bypass project.

#### **4.1.7 Fuel Cost Savings**

Fuel savings are generated by the project because the speed of travel increases for both auto and truck traffic on the bypass. This improves vehicle fuel efficiency, which is reflected in lower fuel costs.

## **4.2 Construction and Operating and Maintenance Costs**

The costs of the bypass project consist of initial construction costs, as well as operation and maintenance (O&M) costs. Construction of the bypass is expected to cost \$24.5 million. The incremental cost of operations and maintenance costs for the bypass are estimated to be \$6,966.

# **5. BENEFITS AND COSTS ESTIMATION**

## **5.1 Estimation of Benefits and Costs – Bypass**

The following section provides detail on the benefits and costs to existing automobile and truck travelers. For the purpose of estimating the costs and benefits, it is assumed that the construction of the bypass will begin in 2015 and be completed in one year. Operating and maintenance costs occur annually, while construction costs are only incurred in the relevant construction period. Benefits increase annually as well.

### **5.1.1 Travel Time Savings**

For the analysis, the values of time are drawn directly from the US DOT's guidance on travel time along with guidance on escalating the values of time from 2000 dollars to 2013 dollars. The auto value of time is \$25.43 in 2013 dollars for business trips and \$12.42 for personal trips (assumed to be 90% of all auto trips). This results in a weighted average value of travel time of \$13.72 per person. The value of time for truck drivers is \$25.75 per hour. Per USDOT Guidance, a 1.6% per year increase in the value of time is assumed to account for increases in real wage growth and productivity. In order to determine the actual value per vehicle mile traveled, the vehicle occupancy must also be considered. This analysis uses a value of 1.6 persons per vehicle based on USDOT guidance.

In the analysis, cumulative non-discounted travel time savings are estimated to be \$35 million.

### **5.1.2 Vehicle Operating Costs**

Vehicle operating costs (VOC) are an integral element of the generalized cost of traveling. These costs are typically the most recognized of user costs because they usually include some out-of-pocket expenses associated with owning, operating, and maintaining a vehicle. The cost components of VOC measured in this analysis include: oil consumption, maintenance and repairs, tire wear, and vehicle depreciation.

The estimation of VOC is based on consumption and depreciation rate tables from the FHWA's HERS, and the individual cost components vary by auto and truck. While vehicle miles increase because of the project, the average operating speed also increases, reducing overall consumption rates.

Cumulative non-discounted vehicle operating cost savings are estimated to be \$1.1 million for the bypass.

### **5.1.3 Benefits to New Users**

The increased travel speed, ability to avoid traveling through the Pueblo during special events, and the ability to attend special events with less constraint will all attract new users to the roadway. The benefits to these new users have been estimated applying the rule of one-half to the generalized travel cost savings attributable to existing users. The generalized travel cost savings is the sum of travel time and vehicle operating cost savings for both new autos and new trucks.

The total cumulative, non-discounted benefit to new users due to the bypass is \$1.2 million.

### **5.1.4 Accident Savings**

Due to the improvements in roadway conditions and reduction in congestion associated with the bypass project, overall accident rates are expected to decrease. The current average accidents per year – 0.11 fatalities, 0.61 injuries, and 1.41 PDO, will be reduced by approximately 45 percent due to the roadway improvements. Accident savings are calculated based on USDOT recommendations, the current value of a statistical life is \$9.2 million for a fatality, the average value for an injury accident of unknown severity is \$106,737, and the value of a PDO accident is \$3,927.

The total cumulative, non-discounted accident reduction benefit is \$16.9 million.

### **5.1.5 Emission Reduction Benefits**

Emission reduction benefits are due to the improved fuel efficiency that is gained when vehicles move off of NM 4, with its more frequent stops and starts, and on to the new bypass. Emissions reduction benefits are calculated as the change before and after the implementation of the project for autos and trucks. The Environmental Protection Agency's values of grams per mile of emission were used to estimate the change in emissions from the change in VMT and were monetized using estimates of dollars per ton of emission from FHWA's HERS and the Victoria Transport Policy Institute. Emissions measured include VOC (HC), CO, CO<sub>2</sub>, NO<sub>X</sub>, SO<sub>2</sub>, and PM, varying by auto and truck. The social cost of carbon increases annually and must be discounted at a value of 3% rather than 7% per US DOT guidance. The investment in the bypass will result in non-discounted total emissions benefits of \$715 thousand.

### **5.1.6 Pavement Maintenance Savings**

In addition to the costs that individual drivers incur for auto and truck trips, there are costs in terms of damage to the road surface. Because traffic will be moved off of NM 4 and on to the bypass, maintenance costs on NM 4 will decrease. Although VMT will increase when the bypass is complete and this will generate new pavement maintenance costs associated with the highway, the net impact of the reduction in NM 4 costs and the increase in the bypass costs will be a savings in overall pavement maintenance expenses.

A 30 percent savings on pavement maintenance is expected on NM 4 due to the shift in traffic to the bypass road. An annual pavement maintenance value of \$1,883 per lane mile, in 2013 dollars, was used to estimate the savings in pavement maintenance.

Total pavement maintenance cost savings are estimated to be \$135 thousand for the bypass.

### 5.1.7 Fuel Cost Savings

Fuel savings are generated by the project because the speed of travel increases for both auto and truck traffic on the bypass. The longest section of the bypass will have an assumed average speed of 57 miles per hour which improves vehicle fuel efficiency and is reflected in lower fuel costs. For the bypass project, cumulative fuel cost savings are estimated to be \$7.8 million.

## 5.2 Summary of Benefit-Cost Results

The Cultural Preservation Highway Bypass will result in total benefits of \$19.5 million, when discounted by 7 percent (noting that carbon emissions are discounted at 3%). The present value of total costs associated with this project is \$23.0 million, and the net present value is a negative \$3.5 million. The BCR is 0.85 at 7 percent and 1.51 at a 3 percent discount rate. The benefits and costs are equal at a discount rate of 5.72 percent.

A summary table of the benefits and costs associated with the new bypass is provided in Table 3. As shown below, the largest category of benefits is time savings, followed by fuel cost reductions.

**Table 3: Summary Table of Benefits and Costs for Cultural Preservation Highway Bypass**

<b>Benefit-Cost Results Discount Rate 7%</b>		<b>Benefit-Cost Results Discount Rate 3%</b>	
<b>Costs</b>		<b>Costs</b>	
Construction & Maintenance Costs	\$24.8	Construction & Maintenance Costs	\$24.8
Present Value of Total Costs	\$23.0	Present Value of Total Costs	\$24.0
<b>Benefits</b>		<b>Benefits</b>	
Emissions Benefits	\$0.7	Emissions Benefits	\$0.7
Time Savings	\$35.4	Time Savings	\$35.4
Accidents	\$16.9	Accidents	\$16.9
Highway Maintenance Savings	\$0.1	Highway Maintenance Savings	\$0.1
Vehicle Operating & Maint	\$1.1	Vehicle Operating & Maint	\$1.1
Fuel Costs	\$7.8	Fuel Costs	\$7.8
New User Benefits		New User Benefits	\$1.2
Total Benefits	\$63.3	Total Benefits	\$63.3
Present Value of Total Benefits	\$19.5	Present Value of Total Benefits	\$36.2
Net Present Value	(\$3.5)	Net Present Value	\$12.2
Benefit-Cost Ratio (BCR)	0.85	Benefit-Cost Ratio (BCR)	1.51

Another sensitivity test included the benefits of flood mitigation. There have been a number of forest fires in the region in the past few years, and grasses and other vegetation have been destroyed. As a result, flooding activity has increased in the area of the Pueblo. In fact, a significant flooding event occurred in 2013 that required approximately \$850,000 in repairs. In addition, smaller flooding events have been occurring with increased regularity.

The current roadway is owned by NMDOT. If the bypass is built, the ownership of this roadway will be transferred to the Pueblo who will take on the operating and maintenance costs required to maintain the roadway. Because of the significant flooding that has occurred recently, the Pueblo plans to install a flood mitigation system that would prevent significant flood damage from occurring with such regularity. It is expected that this system would generate a benefit of a \$200,000 per-year avoided cost to repair flood damage. When including the benefit of a \$200,000 per-year avoided cost, the BCR becomes 0.95 at a 7% discount rate and the NPV is reduced to -\$1.2 million.

### **5.3 Non-Monetized Benefits**

As referred to in the Introduction/ Summary section there are many significant benefits that the bypass will facilitate that are not captured in the benefit/cost analysis. These include:

- Safety benefits regarding emergency vehicles and evacuation routes that are currently compromised by slow moving traffic and frequent public/ceremonial events within the Pueblo of Jemez.
- Increased tourism and resulting economic development to an economically distressed area from faster and more convenient access to Jemez Pueblo and the attractions of the Jemez Mountains, including the new Valle Caldera Park
- More efficient transportation for current economic activity including area logging and grazing permits
- Resolution of the illegal status of Highway 4 right-of-way
- Community and village cohesion and safe passage for prevalent pedestrian, ceremonial and animal traffic without a major highway passing directly through the village and residential areas