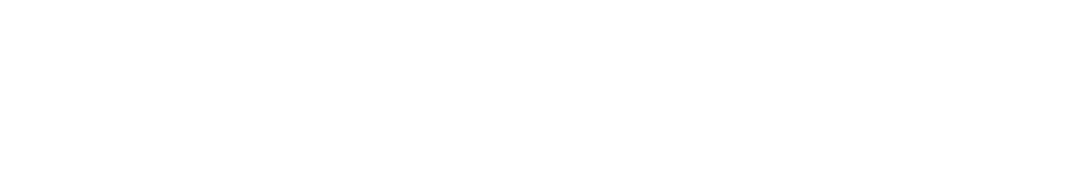
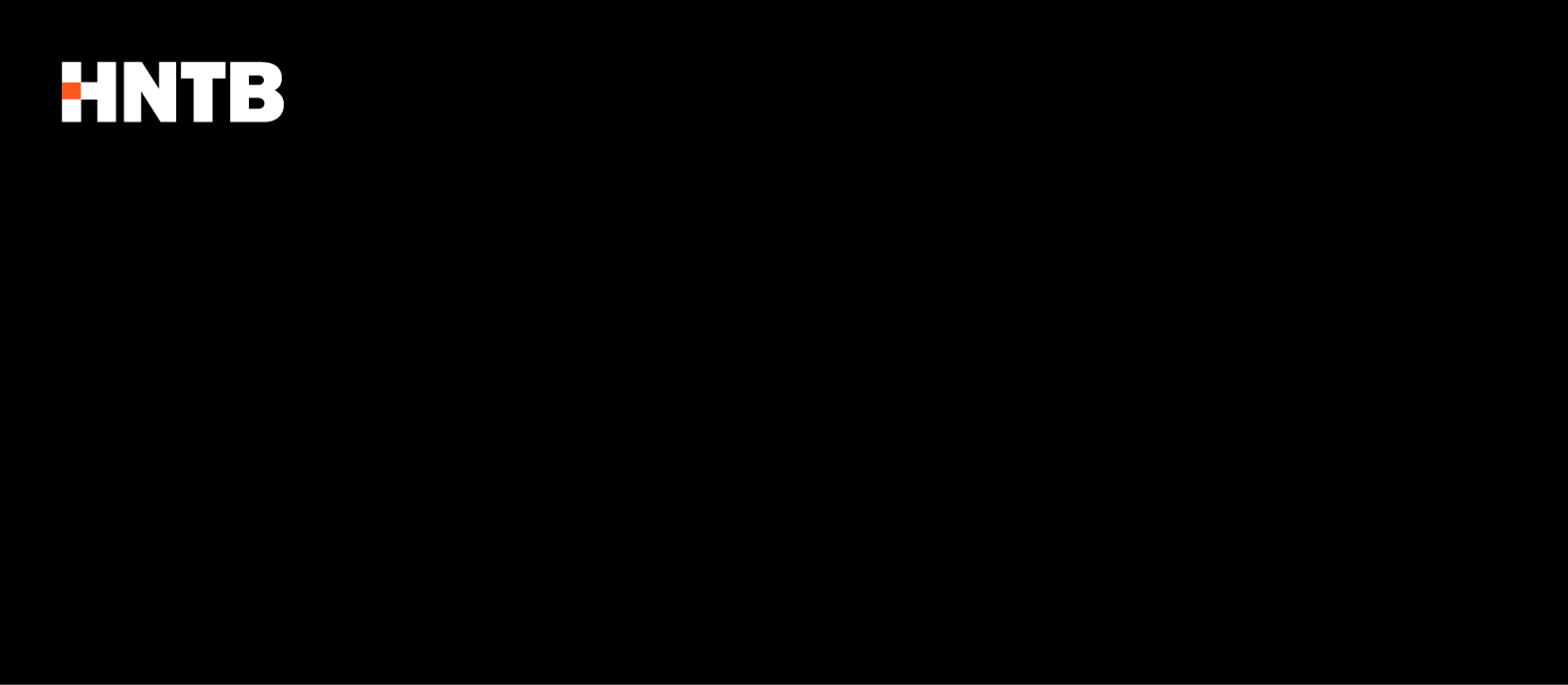
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### **Executive Summary**



The HNTB Companies Infrastructure Solutions

**BCA TECHNICAL MEMORANDUM**

Grady County US Highway 81 Realignment

Highway Realignment Project

Oklahoma Department of Transportation



The Project will transform an existing 8.5-mile undivided four-lane section of US‑81 through downtown Chickasha, Oklahoma into a seamless four-lane divided facility; matching the character of the existing four-lane divided US-81 south of Chickasha. The project includes the construction of an access controlled four-lane divided facility with six grade separated interchanges and two grade separated rail crossings. The Project provides a benefit-cost ratio **(BCR) of 1.64** and an **internal rate of return of 1.83 percent.**

At this rate, the proposed **total capital project cost of $308.6 million** will produce a **positive net user benefit of about $369.3 million (NPV)** over 30 years.

The project significantly improves travel time savings due to the realignment, removal of the at grade rail crossing and removal of delay from super loads resulting in the largest positive cash flow for this project.

The Benefit Cost Analysis (BCA) was prepared in accordance with the [2021 FHWA BCA Guidance for Discretionary Grant Programs](https://www.transportation.gov/sites/dot.gov/files/2021-02/Benefit%20Cost%20Analysis%20Guidance%202021.pdf) using total quantifiable project costs and benefits that are adjusted for inflation and then discounted to reflect the time value of money.

### Methodology

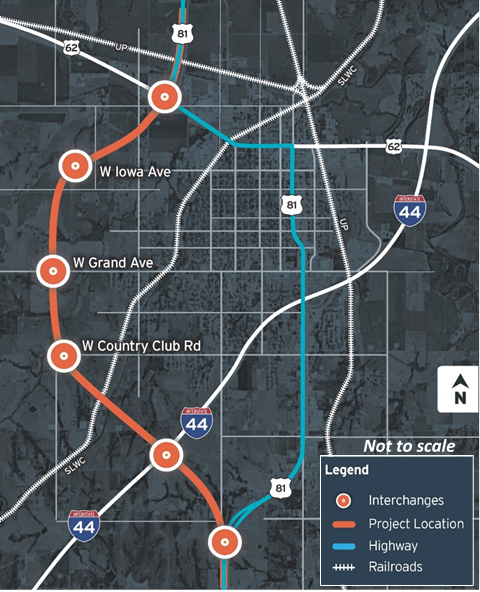
In summary, the BCA was created by:

1. Identifying the Project’s benefits and costs in terms of proposed improvements versus a no-build scenario;
2. Deriving current and forecasted use levels for the baseline and the “build case”;
3. Denominating all benefits and costs in constant 2019 dollars;
4. Discounting dollar amounts by 7 percent to reflect the time value of money; and
5. Setting an appropriate analysis period of 30 years for the Project’s development, construction and subsequent operational service.

### Project Overview

The project segment of US Highway 81 (US-81) routes along a portion of the old Chisholm Trail, one of the nation’s early freight transportation corridors. The existing route through downtown Chickasha includes more than a dozen signalized intersections and two 90-degree right-angle turns that are difficult for freight to maneuver. Current average speeds on this segment of US-81 through Chickasha are 35 mph, compared to the posted and average speeds of 70 mph and 55 mph north and south of Chickasha. The proposed project includes construction of a four-lane divided facility with six grade separated interchanges and two grade separated rail crossings. This investment will transform this segment of the corridor and match the existing four-lane divided character of US-81 south of Chickasha. The Project Area is shown in ***Figure 1*** on the following page.

**Figure 1: Project Area**

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As mentioned previously, the project will have significant savings in travel time and reduction of collisions. These are just a few of the overall benefits identified from the BCA. ***Table 1*** outlines all of the proposed improvements that were evaluated by the BCA in a detailed spreadsheet to show the total of all benefits discounted at 7 percent.

***Table 1: Proposed Improvements***



### Project Beneficiaries

The economic competitiveness category quantifies multiple benefits with its analysis. The benefits quantified represent the difference of the reduced traffic on existing US-81 through Chickasha. Benefits quantified are associated with the build realignment and also account for traffic which will remain on the existing portion of US-81. Today there are approximately two super loads per day that navigate US-81. These loads will be rerouted to the realignment and eliminate traffic delay. In addition, the at-grade rail crossing north of US-62 will receive an overpass allowing for traffic to be unimpeded by trains. Currently four trains per day utilize this crossing with the number of trains per day anticipated to grow to ten by the year 2056. These two delay contributors along with the reduction of traffic through the city center of Chickasha represent substantial benefits of the realignment project.

### Project Benefits

The Project will provide substantial benefit by removing super loads from downtown Chickasha and grade separating all rail crossings along this segment of US-81. The benefits of the change in travel characteristics were quantified including reduced travel time, vehicle operating costs, reduced crash costs, and emissions costs.

The Benefit Cost Analysis was prepared for this project application in accordance with the BCA Guidance for Discretionary Grant Programs dated January 2021. Calculations for all figures as well as the cited sources can be found within the BCA spreadsheets that are included with the INFRA grant submittal.

### Travel Time and Vehicle Operating Cost Benefit



**$374.6M**

TRAVEL TIME

SAVINGS (NPV)

The benefit from reduced travel time was calculated by determining the change in travel time for the realigned route and eliminated delays due to super loads and trains compared to the current route. The additional time (30.2 million hours from automobiles and 6.9 million hours from trucks) was then multiplied by the value of time provided in the BCA guidance ($17.90 per hour for passenger vehicles and $30.80 per hour for truck drivers).

It is important to note, that ODOT has incorporated USDOT feedback from the previous BCA submittal, which suggested that 100 percent of traffic likely would not be waiting in the queue. For this BCA submittal, 40 percent of passenger vehicle traffic was allowed to divert and experienced very low delay. The decision that only passenger vehicles would divert was based upon the nature of the alternate paths being narrow and residential in nature. The green time for the US-81 movements is based upon the T-intersection and timing and was increased to prevent the volume from exceeding capacity in the future which would create an unrealistic continuous queue. Based upon the high-level traffic analysis at this intersection the future traffic volumes become quite high for the main US-81 turning movement in town and the superloads blocking the intersection cause significant problems. This model is sensitive to the capacity of the intersection and any factor adjusting that main movement capacity can have a significant impact on the BCA calculations.

The Project will produce **travel time savings with a discounted benefit value of $374.6 million (NPV).**

***Tables******2 & 3*** below show the improvement in travel time savings from the Project on an annual basis as a summary of the calculations and the cumulative benefit for the No-Build and Build Scenarios.

***Table 2: Travel Time Savings No-Build Scenario***



***Table 3: Travel Time Savings Build Scenario with VHT Benefit Total***



Vehicle operating costs were calculated by determining the number of miles changed by moving traffic to the realigned US-81. The change in vehicle miles travelled (VMT) were found separately for automobile (-82.4 million) and truck traffic (-29.2 million). The VMTs were multiplied by the operating costs per mile provided in the BCA guidance ($0.43 per mile for automobiles and $0.93 per mile for trucks) to determine the additional costs to the user and the year in which they would occur. The Project will produce **vehicle operating costs with a discounted benefit value of $-14.8 million (NPV).**



**$-14.8M**

Operational

SAVINGS (NPV)

***Table 4*** below shows the vehicle operating costs from the Project on an annual basis as a summary of the calculations and the cumulative benefit.

***Table 4: Operational Cost Savings***

### Safety Benefit

The Project produces **safety savings of $8.98 million (NPV)**. The reduction in costs associated with crashes along existing US-81 using the existing crash rate will experience less crashes due to lower traffic volumes. The realigned US-81 crashes were then estimated utilizing the Grady County, Oklahoma crash rate to determine the number of crashes on the new facility. These two crash predictions were combined and subtracted from the projected no-build number of crashes to determine crash savings each year. The safety benefits by year are reflected below in ***Table 5.***



**$8.98M**

CRASH SAVINGS (NPV)

***Table 5: Safety Crash Savings***



Environmental Cost Savings

The Project produces an emissions increase from induced demand, resulting in **emissions damage savings of $-5.9 million NPV over 30 years.** The reduction in emission damage from traffic diverted to the realigned US-81 were computed for Volatile Organic Compounds (VOCs), Nitrogen Oxides (NOx), Particulate Matter (PM2.5), and Carbon Dioxide (CO2). In order to calculate the emission reduction, emission rates were obtained from Federal Transit Administration (FTA), New and Small Starts Evaluation and Rating Process Final Policy Guidance, in addition to Environmental Protection Agency (EPA) source. These rates were used to calculate pollution volumes by mode of travel (Automobile, Trucks, Bus). The reduction in VMT was then converted to the amount of emission (in grams) of each type of pollutant by its emission production factor (grams/VMT). This reduction was then monetized based upon the BCA guidance. ***Table 6*** on the following page shows the value of the emission improvement.



**$-5.9M**

REDUCED DAMAGE OF POLLUTANT EMISSIONS SAVINGS (NPV)

***Table 6: Emission Reduction Savings***

Project Costs

***Table 7: Summary of***

***Estimated Capital Costs***



The project has a **total capital cost of $369,288,247** in 2019 dollars over a four-year construction period from 2022 to December 2026. Numbers shown are in 2019 dollars to provide a uniform base year. All costs by year are shown in ***Table 7***. The operations and maintenance (O&M) costs shown are the incremental increase over the no-build scenario.

Benefits Summary

The Grady County US-81 Realignment has a **Benefit-Cost Ratio of 1.64**. This ratio was derived by dividing total discounted benefits by total discounted costs over a 30-year period. It and other figures shown below in ***Table 8*** and throughout this methodology memo were derived based on [FHWA 2021 BCA Guidance](https://www.transportation.gov/sites/dot.gov/files/2021-02/Benefit%20Cost%20Analysis%20Guidance%202021.pdf).

***Table 8: Summary***

