

**FEASIBILITY REPORT  
FOR  
PORTER MOUNTAIN ROAD OVER BILLY CREEK**

**November 2008**

**Prepared For:  
NAVAJO COUNTY**



**Project Assisted By:  
ARIZONA DEPARTMENT OF COMMERCE &  
GREATER ARIZONA DEVELOPMENT AUTHORITY**



**Prepared By:**

**TYLIN INTERNATIONAL**

**60 East Rio Salado Parkway, Suite 501 Tempe, Arizona 85281  
Phone 480.968.8814 • Fax 480.921.0002**

## Table of Contents

|             |  |           |
|-------------|--|-----------|
| <b>1.0</b>  | <b>INTRODUCTION.....</b>                       | <b>1</b>  |
| <b>2.0.</b> | <b>EXISTING CONDITIONS .....</b>               | <b>1</b>  |
|             | <b>2.1 Bridge Evaluation .....</b>             | <b>2</b>  |
| <b>3.0.</b> | <b>FUTURE IMPROVEMENTS.....</b>                | <b>2</b>  |
|             | <b>3.1 Roadway Alternative 1 .....</b>         | <b>3</b>  |
|             | <b>3.2 Roadway Alternative 2 .....</b>         | <b>5</b>  |
|             | <b>3.3 Roadway Alternative 3 .....</b>         | <b>7</b>  |
|             | <b>3.4 Roadway Alternative 4 .....</b>         | <b>8</b>  |
|             | <b>3.5 Roadway Alternative 5 .....</b>         | <b>9</b>  |
| <b>4.0.</b> | <b>401/404 PERMITTING REQUIREMENTS .....</b>   | <b>10</b> |
| <b>5.0.</b> | <b>DRAINAGE CONSIDERATIONS .....</b>           | <b>10</b> |
| <b>6.0.</b> | <b>RIGHT-OF-WAY ACQUISITION.....</b>           | <b>11</b> |
| <b>7.0.</b> | <b>COST ESTIMATES .....</b>                    | <b>11</b> |
| <b>8.0.</b> | <b>CONCLUSIONS &amp; RECOMMENDATIONS .....</b> | <b>11</b> |

### List of Figures

|  |           |
|--|-----------|
| <i>Figure 1 - Minor Arterial Typical Section .....</i>     | <b>3</b>  |
| <i>Figure 2 - Alternative 1 Typical Section .....</i>      | <b>3</b>  |
| <i>Figure 3 - Alternative 1 Bridge Section .....</i>       | <b>4</b>  |
| <i>Figure 4 - Alternative 2 Bridge Section .....</i>       | <b>7</b>  |
| <i>Figure 5 - Alternative 4 Bridge Section .....</i>       | <b>9</b>  |
| <i>Figure 6 - Principal Arterial Typical Section .....</i> | <b>9</b>  |
| <i>Figure 7 - Alternative 5 Bridge Section .....</i>       | <b>10</b> |

### List of Tables

|   |           |
|---|-----------|
| <i>Table 1 - Right-of-Way Summary .....</i> | <b>11</b> |
| <i>Table 2 - Cost Summary.....</i>          | <b>11</b> |

### List of Appendices

|   |
|---|
| <i>Appendix A – Alternative Exhibits</i>                    |
| <i>Appendix B – Preliminary Cost Estimates</i>              |
| <i>Appendix C – Photo Log</i>                               |
| <i>Appendix D – Existing Bridge Plans</i>                   |
| <i>Appendix E – Structure Inventory &amp; Appraisal</i>     |
| <i>Appendix F – Navajo County Assessor’s Maps</i>           |
| <i>Appendix G – ADOT Highway Bridge Replacement Program</i> |

## 1.0 INTRODUCTION

The *Southern Navajo/Apache County Sub Regional Transportation Plan Final Report* prepared by Wilson & Company, dated September 2007 indicates that the segment of Porter Mountain Road (PMR) between White Mountain Road (SR 260) and Penrod Road should be upgraded to accommodate future traffic volumes. Billy Creek Bridge, a two-lane crossing of Billy Creek, is located within this roadway segment. This Feasibility Study has been prepared to evaluate several alternatives to provide a minimum of two lanes in each direction at Billy Creek Bridge. Roadway alignments, roadway typical sections, and bridge structural sections were evaluated.

## 2.0. EXISTING CONDITIONS

PMR is a two-lane rural roadway in the project area. The existing asphaltic concrete pavement is approximately 30 feet wide with dirt shoulders. The roadway surface is in relatively good condition with minimal cracking. Vertical curb and gutter is used for the returns at PMR's intersection with State Route 260 (SR 260). There is an existing 5-foot sidewalk adjacent to the curb returns. The existing roadway is contained in a 100-foot wide right-of-way.

PMR is currently posted at 40 miles-per-hour (mph). There are two existing horizontal curves within the study segment of PMR. The 425-foot radius horizontal curve east of Billy Creek Bridge does not meet American Association of State Highway and Transportation Official (AASHTO) guidelines. Based on the AASHTO *A Policy on Geometric Design of Highways and Streets*, 2004 edition, (Green Book) the design speed for this curve is approximately 35 mph, less than the posted speed for the roadway. Ideally, the design speed should be a minimum of 5 mph above the posted speed. However, the posted speed of the southbound approach to this curve is signed down to 25 mph.

Several utilities are located in this area. These include overhead electric, underground electric, natural gas, water, and sewer. An existing waterline is mounted on the north side of the bridge. On the west side of PMR at the intersection of Peterson Road, there is a natural gas metering station owned by Unisource Energy. This metering station is used by the gas company to transfer gas from a high-pressure (950+ psi) gas line to lower pressure distribution lines. The high pressure gas line runs within the PMR right-of-way on the west side of the road. There are also several drainage facilities in the project area including storm drain (at the intersection with SR 260), roadside swales, and culvert crossings.

There is an existing drainage ditch along the east side of PMR. This ditch carries runoff generated in the subdivision east of the roadway north along PMR. Flow continues north along the roadway until reaching a low point approximately 150 feet north of Amanda Drive. At this point, the swale is drained by a culvert crossing beneath PMR. The runoff then flows westerly overland to Billy Creek.

## 2.1 Bridge Evaluation

The existing bridge structure is a three span reinforced concrete variable depth cast-in-place (CIP) slab bridge. Spans are 20'-6", 25'-0", 20'-6". The bridge has a clear roadway width of 30 feet and 2 ADOT Std concrete barriers for a total width of 33'-2-3/4". The existing plans are shown in *Appendix D*. The bridge was last inspected by ADOT for the City of Pinetop on July 10, 2006. *Appendix E* contains a copy of this inspection report.

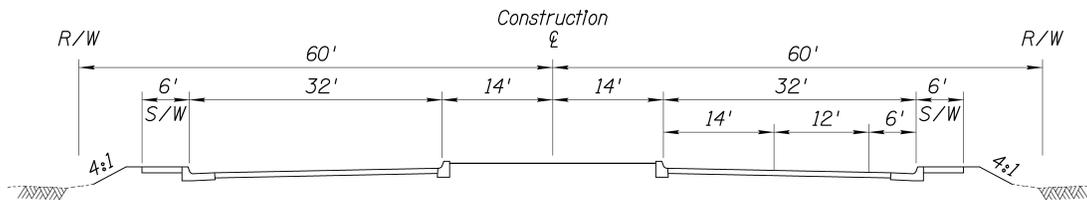
T.Y. Lin International (TYLI) reviewed the existing plans, the 2006 Inspection Report and performed a visual inspection on July 9, 2008. The following is a summary of these reviews:

1. The bridge has a sufficiency rating of 73.97. Bridges scoring below 80.0 are eligible for federal rehabilitation funds, under the Highway Bridge Replacement and Rehabilitation Program. The maximum rating is 100.
2. AC pavement is spalling at both ends of the bridge.
3. Deck undersurface has minor random hairline cracks.
4. Abutment 1 has minor vertical cracks.
5. Waterline is attached to the west side of the bridge.
6. Debris is collected on the west side of the bridge.
7. The abutments and piers are supported on concrete spread footings which are supported on basalt.
8. Slope protection at the abutments consists of grouted rocks.
9. Calculated scour is above top of footing.
10. One missing hazard marker.

It can be concluded that the existing bridge can be widened.

## 3.0. FUTURE IMPROVEMENTS

Several alternatives were evaluated to improve the capacity of PMR. The roadway cross sections used in *Roadway Alternatives 1-4* are based on the *Minor Arterial Section*, shown in *Figure 1* below, as recommended in the *Southern Navajo/Apache County Sub Regional Transportation Plan Final Report* by Wilson & Company, dated September 2007. This section is comprised of two travel lanes in each direction, 5-foot sidewalks, and a 28 foot open median. The 28-foot median will allow two additional travel lanes in the future. The recommended section was modified as discussed in each roadway alternative. *Alternative 5* is based on the *Principal Arterial Section* found in the Wilson & Company transportation plan. Although the Wilson & Company report does not recommend the *Principal Arterial Section* for PMR it was included as an alternative at the request of Navajo County.

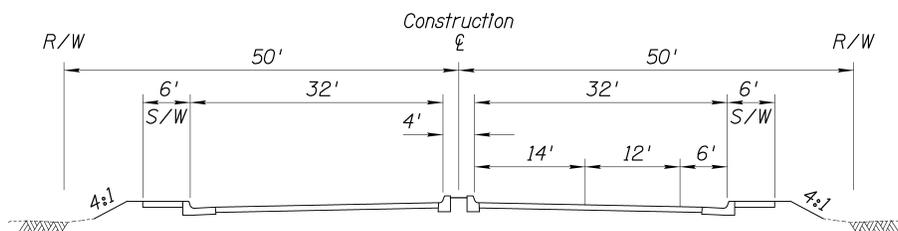


**Figure 1 - Minor Arterial Typical Section**

The roadway alternatives will be evaluated based on a design speed of 40 mph. Typically the design speed of roadways is a minimum of 5-10 mph above the posted speed. Currently, PMR is posted 40 mph in the study area. This 40 mph posting is not suitable for a roadway with a proposed 40 mph design speed. It is recommended that the posting of PMR be changed to 35 mph which is similar to other areas of PMR. Features that will be based on the design speed include horizontal geometry, vertical geometry, horizontal clearances to obstructions, and sight distance. Layouts of the alternatives can be found in *Appendix A – Alternative Exhibits*.

### 3.1 Roadway Alternative 1

*Roadway Alternative 1* was developed to avoid the existing natural gas metering station and homes along the east side of PMR. In order to minimize the new roadway footprint, the Wilson & Company *Minor Arterial Section* was modified to eliminate the 28-foot median. The proposed section is shown below in *Figure 2 – Alternative 1 Typical Section*. If additional travel lanes are warranted in the future, widening will have to occur to the outside. The Wilson & Company section was developed to allow widening to occur within the median. See *Exhibit 1 – Roadway Alternative #1* in *Appendix A* for a layout of this alternative.



**Figure 2 - Alternative 1 Typical Section**

The proposed horizontal alignment of PMR consists of two horizontal curves. The first of these curves is located at the PMR intersection with SR 260. This short curve (Radius = 734', Length = 164') allows a perpendicular intersection with SR 260. If desired, the curve can be eliminated causing a skew of approximately 15°. However, this will result in the need to relocate the existing traffic signal and control boxes at the intersection.

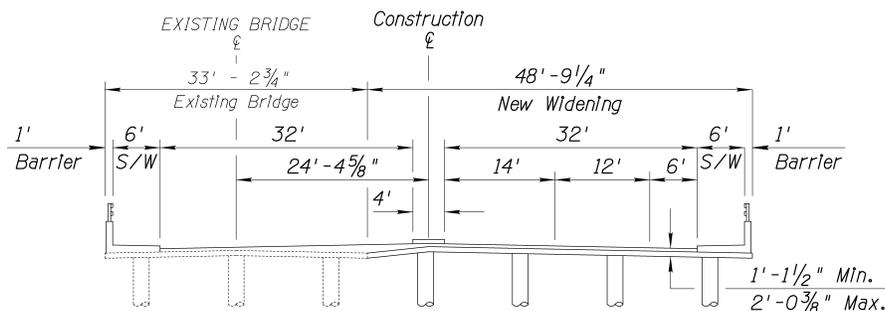
The second horizontal curve is located immediately east of Billy Creek Bridge. This 341-foot radius curve does not meet a design speed of 40 mph. However,

the tangent approaches to the bridge can be signed to warn drivers of the decreased design speed. A 25 mph warning sign is recommended.

At Andelyn Lane, the northbound right lane and bike lane are dropped in a right-turn only configuration. The remainder of the pavement is transitioned back to the existing two-lane road in a 25:1 edge-of-pavement taper. North of Andelyn Lane, the new southbound pavement is added using a 15:1 edge-of-pavement taper. The southbound roadway reaches its full width 50 feet before the Andelyn Lane intersection with PMR.

The road alignment for this alternative requires the widening of the existing Billy Creek Bridge to occur to the south. Widening the bridge to the south only is advantageous in that it does not disturb the existing waterline that is hung on the north side of the bridge. Please see *Figure 3 – Alternative 1 Bridge Section* for the proposed configuration of the bridge for this alternative.

This bridge widening consists of removing both bridge barrier rails and widening in kind to the south for a completed total structure width of 82 feet. The completed structure provides for two 1-foot barrier rails, two 6-foot sidewalks, 32-foot clear roadway in each direction and a 4-foot raised median. The abutments will have slope protection.



**Figure 3 - Alternative 1 Bridge Section**  
**Total Bridge Length = 71.7'**

Although roadway improvements physically avoid the Natural Gas Metering Station, the design of the widened roadway will need to consider the station and the high-pressure gas line on the west side of PMR. Based on a 40 mph design speed and projected traffic volumes, the AASHTO *Roadside Design Guide* recommends a clear recovery distance of 14-18 feet. There is an existing steel rail barrier protecting the metering station. In the proposed condition, these barriers will be located approximately 15 feet from the southbound travel lanes. This barrier should be evaluated based on its proximity to the travel-way during final design. A steel rail barrier also protects two valves along the roadway. Consideration should be given to replacing these barriers as well. After the PMR is widened the high-pressure gas line will fall within the roadway limits. Care

should be taken in designing the vertical profile of the roadway to avoid negatively impacting this line.

The roadway improvements also impact the overhead electric lines along the west side of the roadway. The power poles are located approximately 16 feet from the southbound travel lanes. Like the steel barrier protecting the natural gas metering station, the power poles are at the margins of the recovery zone. The County and City should determine if these should be relocated.

Two new culvert crossings and a new drainage easement will be required to maintain the existing drainage pattern. The roadway improvements will eliminate the existing drainage swale east of PMR between Peterson Road and Andelyn Lane. A culvert will be required to convey runoff carried in the Peterson Road drainage swale to the west side of PMR. From the culvert discharge a drainage easement will be required to allow the runoff to continue overland to Billy Creek. A second culvert crossing will be required at Andelyn Lane. Although a drainage analysis may show that the PMR drainage swale has the capacity to convey runoff from the Andelyn Lane drainage swale, it is recommended that a second culvert be installed crossing PMR at Andelyn Lane. This will allow the proper function of the drainage facilities when PMR is improved north of Andelyn Lane. A drainage easement will also be required at this location. Culvert extensions are required for the existing culvert crossing north of Andelyn Lane.

Approximately 0.75 acres of new right-of-way will be required along the south side of PMR between SR 260 and Peterson Road. According to the GIS maps on the Navajo County Assessor's website, the land on both sides of PMR in this area has the same property owner. The cost to obtain this new right-of-way may be partially offset by abandoning a portion of the existing right-of-way north of the road.

### **3.2 Roadway Alternative 2**

*Roadway Alternative 2* was developed to provide the cross-section as recommended in the Wilson & Company regional transportation plan. The roadway section shown in *Figure 1 – Minor Arterial Typical Section* was used to develop the proposed improvements. See *Exhibit 2 – Roadway Alternative #2* in *Appendix A* for a layout of this alternative.

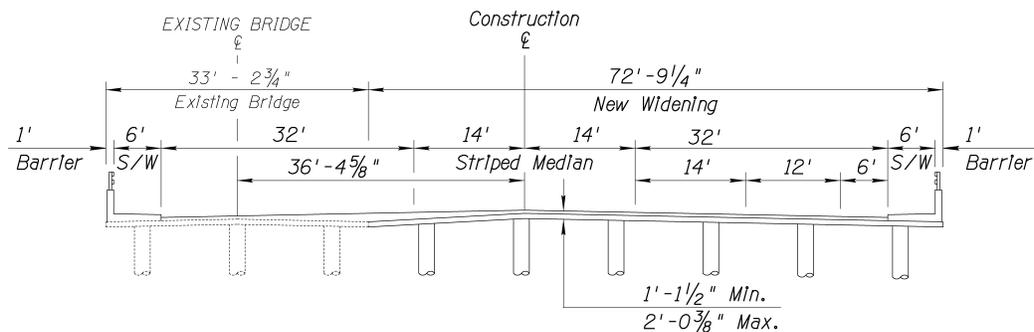
The proposed horizontal alignment is similar to the alignment for *Roadway Alternative 1*. A short horizontal curve (Radius = 722', Length = 161') is used to allow a perpendicular intersection with SR 260. Beyond this curve, the tangent was established to allow the existing bridge to be widened on one side. As in *Alternative 1* the second horizontal curve does not meet a 40 mph design speed. The curve radius is 328 feet. A 25 mph warning sign is recommended. Also, the roadway improvements transition back to the existing roadway in a similar way to *Roadway Alternative 1*.

The tangent northeast of Billy Creek Bridge is centered in the existing 100 foot right-of-way. The proposed typical section has a 120 foot right-of-way. This additional right-of-way will need to be obtained from the land owners adjacent to PMR. However, there are several existing homes located along the east side of PMR. If additional right-of-way is obtained from these owners the existing structures may not meet setback requirements. If setbacks are not met a variance will be required or the entire property will need to be acquired.

Obtaining additional right-of-way on the west side of PMR should not be an issue for most of the segment as the land is undeveloped. However, the widening and the right-of-way requirements will require the relocation of the natural gas metering station and two sets of valves. Unisource Energy was contacted regarding the feasibility and expense of relocating their facility. Unisource Energy indicated that the station can be relocated but will be difficult. Since the station serves as a main distribution hub for the area, the relocation will need to occur during a low demand period. Unisource estimated that relocation of the metering station will cost between \$750,000 and \$1,500,000 depending on the work required. Care should be taken in designing the vertical profile of the roadway to avoid negatively impacting the existing high-pressure gas line located within the PMR existing right-of-way.

The existing power poles on the west side of PMR will need to be relocated for this alternative. A public utility easement can be established to allow the undergrounding of the power lines within the roadway right-of-way. If it is desired that the power lines remain overhead, the poles can be located in between the back of sidewalk and the new right-of-way. The center of the poles will be 16 feet from the western most travel lanes which is at the margins of the clear recovery zone.

The bridge widening for this alternative is similar to the widening in *Roadway Alternative #1*. However, the total width of the completed structure is 106 feet. Rather than the 4-foot raised median in the first alternative this bridge will have a 28-foot striped median. This 28-foot median was provided to allow for the addition of two additional lanes in the future. If the 28-foot open median was provided like in the roadway typical section the additional lanes would not be able to be obtained. Please see *Figure 4 – Alternative 2 Bridge Section* for the proposed configuration of the bridge for this alternative.



**Figure 4 - Alternative 2 Bridge Section**  
**Total Bridge Length = 71.7'**

### 3.3 Roadway Alternative 3

*Roadway Alternative 3* was developed to provide the Wilson & Company regional transportation plan recommended typical section north of Peterson Road. South of the Peterson Road intersection, the roadway transitions to the typical section used in *Roadway Alternative 1*. This transition occurs through the horizontal curve located northeast of Billy Creek Bridge. The revised typical section is used between this horizontal curve and the intersection with SR 260. The typical section was changed to minimize the widening of Billy Creek Bridge. In the future if additional lanes become warranted, the bridge can be widened to accommodate the new lanes. See *Exhibit 3 – Roadway Alternative #3* in *Appendix A* for a layout of this alternative.

Unlike in *Roadway Alternative 2*, the tangent northeast of Billy Creek Bridge was not centered in the middle of the existing right-of-way for this alternative. The tangent was shifted to the west 20 feet to avoid requiring additional right-of-way from the residential parcels east of PMR.

The horizontal curve between Billy Creek Bridge and Peterson Road does not meet a 40 mph design speed. It is recommended that this curve be signed to warn drivers of the decreased design speed. A 25 mph warning sign is recommended. The roadway improvements transition back to the existing roadway in a similar way to *Roadway Alternative 1*.

Like *Roadway Alternative 2*, this alternative will require the relocation of the natural gas metering station and the existing overhead electrical lines west of the existing roadway. 20 feet of new right-of-way is required along the west side of PMR north of Peterson Road. Additional right-of-way is also required on the east side of PMR between SR 260 and Peterson Road. Approximately 1.0 acres of new right-of-way is required.

The bridge widening for this alternative is identical to *Roadway Alternative 1*.

### 3.4 Roadway Alternative 4

*Roadway Alternative 4* was developed to have the roadway geometrics meet the design speed established for the project. The typical section selected for this alternative is the section that was used for *Roadway Alternative 1*. This section was selected to avoid negatively impacting the residences east of PMR and the natural gas metering station. See *Exhibit 4 – Roadway Alternative #4* in *Appendix A* for a layout of this alternative.

PMR's intersection with SR 260 was shifted approximately 175 feet to the south. A long horizontal curve (Radius = 1000', Length = 946') connects the intersection tangent with a tangent centered in the existing right-of-way north of Peterson Road. The roadway improvements transition back to the existing roadway in a similar way to *Roadway Alternative 1*.

This alternative impacts the natural gas metering station, overhead electric lines, and PMR drainage swale in the same way as in *Roadway Alternative #1*. The realignment of the roadway does create additional impacts. These include demolishing the existing bridge and restoring the original bank of the creek, relocating the existing traffic signal at the intersection with SR 260, and relocating the waterline hung on the north side of the existing Billy Creek Bridge. Approximately 1.4 acres of new right-of-way is required to realign the roadway.

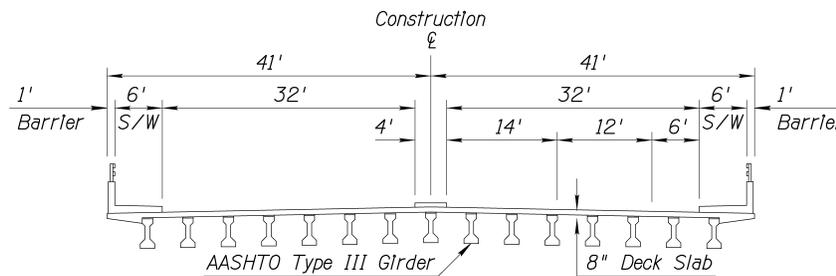
This alternative requires removing the existing bridge and building a new bridge on a new alignment to the south. The bridge width is identical to *Alternative 1* (82 feet). The length of the bridge is 318.4 feet. Two different superstructure types were studied as follows:

1. Precast concrete box bridge. The maximum depth of the superstructure would be 3'-0". The span arrangement is 61', 3 @ 76', 61'. This span arrangement and superstructure type was chosen to minimize the superstructure depth. Without a Hydraulic Report, it is assumed the bottom of the superstructure will have sufficient freeboard above the calculated highwater elevation.
2. Precast Prestressed Concrete AASHTO Type III girder bridge. The maximum depth of the superstructure would be 4'-9". The span arrangement is 61', 3 @ 76', 61'. This superstructure type was chosen for its ease of construction and its historical economical construction cost.

The cost of the precast concrete box bridge including the removal of the existing bridge is approximately \$5,790,000. This cost does not include roadway nor right-of-way costs.

The cost of the AASHTO Type III girder bridge including the removal of the existing bridge is approximately \$5,065,000. This cost does not include roadway nor right-of-way costs.

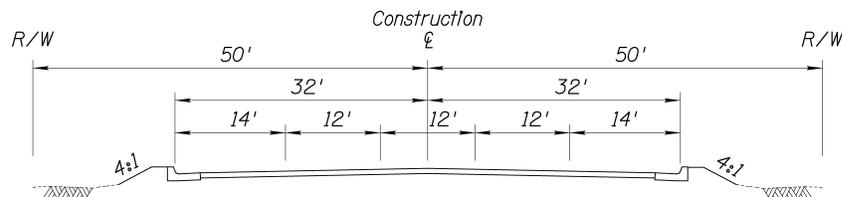
The preferred structure type for this alignment alternative based on construction cost only is the AASHTO Type III girder bridge (\$5,065,000). Please see *Figure 5 – Alternative 4 Bridge Section*.



**Figure 5 - Alternative 4 Bridge Section**  
Total Bridge Length = 318.4'

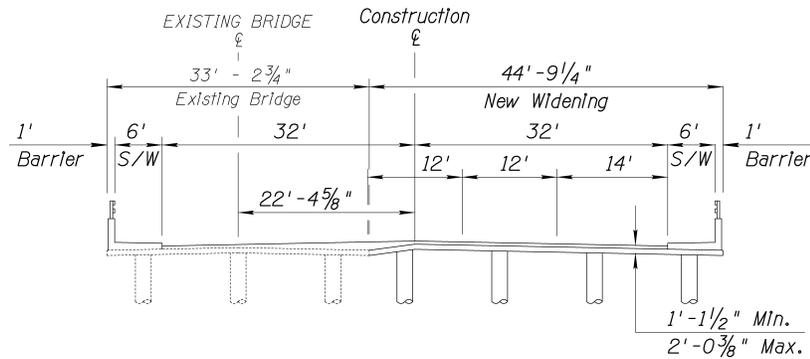
### 3.5 Roadway Alternative 5

Roadway Alternative 5 was included after the first four alternatives were presented in a meeting with the County. This section has two lanes in each direction and a two-way left turn lane. The proposed section is shown in *Figure 6 – Principal Arterial Section* below. The alignment and impacts to the existing area are essentially the same for this alternative as they are for *Roadway Alternative 1*. See *Exhibit 5 – Roadway Alternative #5* in *Appendix A* for a layout of this alternative.



**Figure 6 - Principal Arterial Typical Section**

The bridge widening for this alternative is also similar to *Roadway Alternative 1*. However, the median has been eliminated resulting in a completed structure width of 78 feet. The cost to widen this structure as described is approximately \$438,000. *Figure 7 – Alternative 5 Bridge Section* shows the proposed bridge for this alternative.



**Figure 7 - Alternative 5 Bridge Section**  
**Total Bridge Length = 71.7'**

#### 4.0. 401/404 PERMITTING REQUIREMENTS

For the purposes of 401 and 404 permitting, Billy Creek will likely be considered a Jurisdictional Water of the United States and a wetland. It is recommended that the permitting process begin very early in the design of the proposed improvements. It has been assumed in *Roadway Alternatives 1-3 and 5* that permits will be able to be obtained to place fills in portions of Billy Creek. These fills are required to widen the existing abutments and also direct the flow of the creek under the skewed alignment of the bridge. If the US Army Corps of Engineers determines that these fills are not allowable, the alternative selection will have to be revisited.

*Roadway Alternative 4* assumed a worse case scenario. It assumes that the Corps of Engineers would allow only minimal impacts to Billy Creek. The bridge length assumed for the alternative was selected to allow the abutments to be placed at the existing creek banks. This assumption results in a substantially longer bridge than may need to be provided based on the hydraulics of the creek. A shorter bridge can be provided if the Corps allows the additional fills and hydraulic modeling indicates the suitability of a shorter bridge.

#### 5.0. DRAINAGE CONSIDERATIONS

A drainage study was not within the scope of this report. However, a detailed drainage analysis should be performed in conjunction with the final design of the bridge and roadway. The drainage report should identify if the bridge can be widened without having negative effects upstream of the widened bridge.

Proposed drainage improvements have been shown on the alternative layouts found in *Appendix A*. These drainage facilities have not been sized and are shown for cost estimate purposes only.

## 6.0. RIGHT-OF-WAY ACQUISITION

Each of the proposed alternatives requires the County or City to obtain additional rights-of-way. The cost of this required acquisition may be decreased by abandonment of some of the existing right-of-way. New right-of-way lines are shown on the layouts found in *Appendix A*. A summary of the required new right-of-way and abandoned right-of-way is shown in the table below.

| <i>Roadway Alternative</i> | <i>New Right-of-Way</i> | <i>Abandoned Right-of-Way</i> |
|----------------------------|-------------------------|-------------------------------|
| Alternative 1              | 0.75 Acres              | 0.25 Acres                    |
| Alternative 2              | 1.6 Acres               | 0.4 Acres                     |
| Alternative 3              | 1.0 Acres               | 0.2 Acres                     |
| Alternative 4              | 1.4 Acres               | 1.2 Acres                     |
| Alternative 5              | 0.5 Acres               | 0.4 Acres                     |

*Table 1 - Right-of-Way Summary*

## 7.0. COST ESTIMATES

Detailed preliminary cost estimates have been prepared for each of the proposed alternatives. These estimates can be found in *Appendix B – Preliminary Cost Estimates*. A summary of the costs for each alternative is shown below.

| <i>Roadway Alternative</i> | <i>Roadway</i> | <i>Bridge</i> | <i>Design &amp; Contingencies</i> | <i>Total</i> |
|----------------------------|----------------|---------------|-----------------------------------|--------------|
| Alternative 1              | \$1,025,000    | \$476,000     | \$653,000                         | \$2,154,000  |
| Alternative 2              | \$2,207,000    | \$709,000     | \$1,532,000                       | \$4,448,000  |
| Alternative 3              | \$2,157,000    | \$476,000     | \$1,130,000                       | \$3,763,000  |
| Alternative 4              | \$779,000      | \$5,065,000   | \$2,466,000                       | \$8,310,000  |
| Alternative 5              | \$893,000      | \$437,000     | \$571,000                         | \$1,901,000  |

*Table 2 - Cost Summary*

## 8.0. CONCLUSIONS & RECOMMENDATIONS

As discussed above, TYLI has evaluated five alternatives to improve Porter Mountain Road at Billy Creek. A summary of the advantages and disadvantages of each alternative is listed below.

*Roadway Alternative 1*

## Advantages

- Avoids the relocation of the natural gas metering station.
- Avoids requiring additional right-of-way on developed residential land.
- Relatively low cost.

## Disadvantages

- Does not provide desired 28-foot median per the regional transportation plan.
- The addition of a third lane in each direction will require the reconstruction of the outside curb and gutter, sidewalk, and any storm drain system.
- Does not meet the proposed 40 mph design speed.

*Roadway Alternative 2*

## Advantages

- Utilizes the recommended typical section per the regional transportation plan.
- Provides a bridge suitable for three travel lanes in each direction.

## Disadvantages

- Requires the relocation of the natural gas metering station.
- Requires additional right-of-way from developed residential land.
- Relatively high cost.
- Requires the relocation of overhead power lines.
- Does not meet the proposed 40 mph design speed.

*Roadway Alternative 3*

## Advantages

- Utilizes the recommended typical section per the regional transportation plan northwest of the bridge.
- Avoids requiring additional right-of-way from developed residential land.

## Disadvantages

- Requires the relocation of the natural gas metering station.
- Relatively high cost.
- Requires the relocation of overhead power lines.
- Does not meet the proposed 40 mph design speed.

*Roadway Alternative 4*

## Advantages

- Avoids the relocation of the natural gas metering station.
- Avoids requiring additional right-of-way on developed residential land.
- Provides an entirely new bridge.
- Meets the proposed 40 mph design speed.
- Provides the ability to restore a portion of the creek to its natural condition.

## Disadvantages

- Highest cost alternative.
- Requires the demolition of the existing bridge
- Moves the intersection with SR 260 to the south.
- Does not provide the 28-foot median per the regional transportation plan.
- The additional of a third lane in each direction will require the reconstruction of the outside curb and gutter, sidewalk, and any storm drain system.

*Roadway Alternative 5*

## Advantages

- Avoids the relocation of the natural gas metering station.
- Avoids requiring additional right-of-way on developed residential land.
- Lowest cost alternative

## Disadvantages

- Does not provide sidewalk and curb and gutter.
- Does not utilize the typical section per the regional transportation plan.
- The additional of a third lane in each direction will require the reconstruction of the outside curb and gutter, sidewalk, and any storm drain system.

Based on engineering factors alone, TYLI would recommend that *Roadway Alternative 4* be selected as the preferred alternative. It most closely meets all of the goals of the project including providing two lanes in each direction and having all of the geometric components meet the design speed of the roadway. However, it is also the highest cost alternative. Due to its high cost and the limited added value it provides, this alternative is not a reasonable fit for the community.

TYLI recommends the selection of *Roadway Alternative 5* as the preferred alternative. *Alternative 5* provides two lanes in each direction, a striped 12-foot median, avoids negatively impacting the natural gas metering station and the existing homes on the east side of the roadway. It is also the lowest cost alternative.

# **APPENDIX A**

## **Alternative Exhibits**

## **Appendix B**

# **Preliminary Cost Estimates**

**PRELIMINARY COST ESTIMATE**

Draft Feasibility Report for Porter Mountain Road Over Billy Creek  
ROADWAY ALTERNATIVE 1

| <i>Item Description</i>                     | <i>Unit</i> | <i>Unit Price</i> | <i>Quantity</i> | <i>Amount</i>      |
|---|-------------|-------------------|-----------------|--------------------|
| Clearing and Grubbing                       | L.SUM       | \$15,000          | 1               | \$15,000           |
| Removal of Asphaltic Concrete               | SQ.YD.      | \$5               | 4,900           | \$24,500           |
| Roadway Excavation                          | CU.YD.      | \$15              | 3425            | \$51,400           |
| Borrow (Haul In)                            | CU.YD.      | \$20              | 4965            | \$99,300           |
| Aggregate Base                              | CU.YD.      | \$40              | 3,315           | \$132,600          |
| Asphaltic Concrete                          | TON         | \$120             | 2,700           | \$324,000          |
| Guard Rail, W-Beam Single Face              | L.FT.       | \$20              | 60              | \$1,200            |
| Guard Rail Terminal                         | EACH        | \$1,750           | 2               | \$3,500            |
| Guard Rail, Anchor Assembly                 | EACH        | \$1,000           | 2               | \$2,000            |
| Thrie-Beam Guard Rail Transition System     | EACH        | \$1,500           | 4               | \$6,000            |
| 6" Concrete Curb & Gutter                   | L.FT.       | \$25              | 2,550           | \$63,800           |
| 6" Concrete Single Curb                     | L.FT.       | \$20              | 2,100           | \$42,000           |
| Concrete Sidewalk                           | SQ.FT.      | \$5               | 15,165          | \$75,800           |
| Concrete Sidewalk Ramp                      | EACH        | \$2,500           | 5               | \$12,500           |
| 36" Culverts                                | L.FT.       | \$110             | 440             | \$48,400           |
| 36" Flared End Sections                     | EACH        | \$1,000           | 10              | \$10,000           |
| Bank Protection                             | SQ.FT.      | \$25              | 2,900           | \$72,500           |
| Signing & Striping                          | L.SUM       | \$15,000          | 1               | \$15,000           |
| Erosion Control                             | L.SUM       | \$25,000          | 1               | \$25,000           |
| Bridge Widening                             | SQ.FT.      | \$136             | 3,500           | \$476,000          |
| <b>SUBTOTAL</b>                             |             |                   |                 | <b>\$1,501,000</b> |
| ENGINEERING DESIGN                          | 10%         |                   |                 | \$150,000          |
| RIGHT-OF-WAY ACQUISITION (UNDEVELOPED LAND) | ACRE        | \$50,000.00       | 0.75            | \$38,000           |
| CONSTRUCTION SURVEYING                      | 3%          |                   |                 | \$45,000           |
| TRAFFIC CONTROL                             | 3%          |                   |                 | \$45,000           |
| CONSTRUCTION ADMINISTRATION                 | 5%          |                   |                 | \$75,000           |
| CONTINGENCIES                               | 20%         |                   |                 | \$300,000          |
| <b>TOTAL PROJECT COST</b>                   |             |                   |                 | <b>\$2,154,000</b> |

**PRELIMINARY COST ESTIMATE**

Draft Feasibility Report for Porter Mountain Road Over Billy Creek  
ROADWAY ALTERNATIVE 2

| <i>Item Description</i>                       | <i>Unit</i> | <i>Unit Price</i> | <i>Quantity</i> | <i>Amount</i>      |
|---|-------------|-------------------|-----------------|--------------------|
| Clearing and Grubbing                         | L.SUM       | \$15,000          | 1               | \$15,000           |
| Removal of Asphaltic Concrete                 | SQ.YD.      | \$5               | 4900            | \$24,500           |
| Roadway Excavation                            | CU.YD.      | \$15              | 4020            | \$60,300           |
| Borrow (Haul In)                              | CU.YD.      | \$20              | 6365            | \$127,300          |
| Aggregate Base                                | CU.YD.      | \$35              | 3950            | \$138,300          |
| Asphaltic Concrete                            | TON         | \$120             | 3220            | \$386,400          |
| Guard Rail, W-Beam Single Face                | L.FT.       | \$20              | 60              | \$1,200            |
| Guard Rail, Anchor Assembly                   | EACH        | \$1,000           | 2               | \$2,000            |
| Guard Rail Terminal                           | EACH        | \$1,750           | 2               | \$3,500            |
| Thrie-Beam Guard Rail Transition System       | EACH        | \$1,500           | 4               | \$6,000            |
| 6" Concrete Curb & Gutter                     | L.FT.       | \$25              | 2565            | \$64,100           |
| 6" Concrete Single Curb                       | L.FT.       | \$20              | 2200            | \$44,000           |
| Concrete Sidewalk                             | SQ.FT.      | \$5               | 15245           | \$76,200           |
| Concrete Sidewalk Ramp                        | EACH        | \$2,500           | 5               | \$12,500           |
| 36" Culverts                                  | L.FT.       | \$110             | 550             | \$60,500           |
| 36" Flared End Sections                       | EACH        | \$1,000           | 10              | \$10,000           |
| Bank Protection                               | SQ.FT.      | \$25              | 3025            | \$75,600           |
| Signing & Striping                            | L.SUM       | \$15,000          | 1               | \$15,000           |
| Overhead Electric Relocation (Undergrounding) | L.FT.       | \$60              | 1000            | \$60,000           |
| Natural Gas Metering Station Relocation       | L.SUM       | \$1,000,000       | 1               | \$1,000,000        |
| Erosion Control                               | L.SUM       | \$25,000          | 1               | \$25,000           |
| Bridge Widening                               | SQ.FT.      | \$136             | 5,215           | \$709,000          |
| <b>SUBTOTAL</b>                               |             |                   |                 | <b>\$2,916,000</b> |
| ENGINEERING DESIGN                            | 10%         |                   |                 | \$292,000          |
| RIGHT-OF-WAY ACQUISITION (UNDEVELOPED LAND)   | ACRE        | \$50,000.00       | 1               | \$50,000           |
| RIGHT-OF-WAY ACQUISITION (DEVELOPED LAND)     | ACRE        | \$475,000.00      | 0.6             | \$285,000          |
| CONSTRUCTION SURVEYING                        | 3%          |                   |                 | \$88,000           |
| TRAFFIC CONTROL                               | 3%          |                   |                 | \$88,000           |
| CONSTRUCTION ADMINISTRATION                   | 5%          |                   |                 | \$146,000          |
| CONTINGENCIES                                 | 20%         |                   |                 | \$583,000          |
| <b>TOTAL PROJECT COST</b>                     |             |                   |                 | <b>\$4,448,000</b> |

**PRELIMINARY COST ESTIMATE**

Draft Feasibility Report for Porter Mountain Road Over Billy Creek  
ROADWAY ALTERNATIVE 3

| <i>Item Description</i>                       | <i>Unit</i> | <i>Unit Price</i> | <i>Quantity</i> | <i>Amount</i>      |
|---|-------------|-------------------|-----------------|--------------------|
| Clearing and Grubbing                         | L.SUM       | \$15,000          | 1               | \$15,000           |
| Removal of Asphaltic Concrete                 | SQ.YD.      | \$5               | 4900            | \$24,500           |
| Roadway Excavation                            | CU.YD.      | \$15              | 3060            | \$45,900           |
| Borrow (Haul In)                              | CU.YD.      | \$20              | 5230            | \$104,600          |
| Aggregate Base                                | CU.YD.      | \$35              | 3895            | \$136,300          |
| Asphaltic Concrete                            | TON         | \$120             | 3175            | \$381,000          |
| Guard Rail, W-Beam Single Face                | L.FT.       | \$20              | 60              | \$1,200            |
| Guard Rail, Anchor Assembly                   | EACH        | \$1,000           | 2               | \$2,000            |
| Guard Rail Terminal                           | EACH        | \$1,750           | 2               | \$3,500            |
| Thrie-Beam Guard Rail Transition System       | EACH        | \$1,500           | 4               | \$6,000            |
| 6" Concrete Curb & Gutter                     | L.FT.       | \$25              | 2545            | \$63,600           |
| 6" Concrete Single Curb                       | L.FT.       | \$20              | 2110            | \$42,200           |
| Concrete Sidewalk                             | SQ.FT.      | \$5               | 15130           | \$75,700           |
| Concrete Sidewalk Ramp                        | EACH        | \$2,500           | 5               | \$12,500           |
| 36" Culverts                                  | L.FT.       | \$110             | 550             | \$60,500           |
| 36" Flared End Sections                       | EACH        | \$1,000           | 10              | \$10,000           |
| Bank Protection                               | SQ.FT.      | \$25              | 2900            | \$72,500           |
| Signing & Striping                            | L.SUM       | \$15,000          | 1               | \$15,000           |
| Overhead Electric Relocation (Undergrounding) | L.FT.       | \$60              | 1000            | \$60,000           |
| Natural Gas Metering Station Relocation       | L.SUM       | \$1,000,000       | 1               | \$1,000,000        |
| Erosion Control                               | L.SUM       | \$25,000          | 1               | \$25,000           |
| Bridge Widening                               | SQ.FT.      | \$136             | 3,500           | \$476,000          |
| <b>SUBTOTAL</b>                               |             |                   |                 | <b>\$2,633,000</b> |
| ENGINEERING DESIGN                            | 10%         |                   |                 | \$263,000          |
| RIGHT-OF-WAY ACQUISITION (UNDEVELOPED LAND)   | ACRE        | \$50,000.00       | 1               | \$50,000           |
| CONSTRUCTION SURVEYING                        | 3%          |                   |                 | \$79,000           |
| TRAFFIC CONTROL                               | 3%          |                   |                 | \$79,000           |
| CONSTRUCTION ADMINISTRATION                   | 5%          |                   |                 | \$132,000          |
| CONTINGENCIES                                 | 20%         |                   |                 | \$527,000          |
| <b>TOTAL PROJECT COST</b>                     |             |                   |                 | <b>\$3,763,000</b> |

**PRELIMINARY COST ESTIMATE**

Draft Feasibility Report for Porter Mountain Road Over Billy Creek  
ROADWAY ALTERNATIVE 4

| <i>Item Description</i>                     | <i>Unit</i> | <i>Unit Price</i> | <i>Quantity</i> | <i>Amount</i>      |
|---|-------------|-------------------|-----------------|--------------------|
| Clearing and Grubbing                       | L.SUM       | \$15,000          | 1               | \$15,000           |
| Removal of Asphaltic Concrete               | SQ.YD.      | \$5               | 4900            | \$24,500           |
| Roadway Excavation                          | CU.YD.      | \$15              | 2750            | \$41,300           |
| Aggregate Base                              | CU.YD.      | \$35              | 2775            | \$97,100           |
| Asphaltic Concrete                          | TON         | \$120             | 2265            | \$271,800          |
| Guard Rail, W-Beam Single Face              | L.FT.       | \$20              | 60              | \$1,200            |
| Guard Rail, Anchor Assembly                 | EACH        | \$1,000           | 2               | \$2,000            |
| Guard Rail Terminal                         | EACH        | \$1,750           | 2               | \$3,500            |
| Thrie-Beam Guard Rail Transition System     | EACH        | \$1,500           | 4               | \$6,000            |
| 6" Concrete Curb & Gutter                   | L.FT.       | \$25              | 2110            | \$52,800           |
| 6" Concrete Single Curb                     | L.FT.       | \$20              | 1680            | \$33,600           |
| Concrete Sidewalk                           | SQ.FT.      | \$5               | 12510           | \$62,600           |
| Concrete Sidewalk Ramp                      | EACH        | \$2,500           | 5               | \$12,500           |
| 36" Culverts                                | L.FT.       | \$110             | 470             | \$51,700           |
| 36" Flared End Sections                     | EACH        | \$1,000           | 10              | \$10,000           |
| Bank Protection                             | SQ.FT.      | \$25              | 2125            | \$53,100           |
| Signing & Striping                          | L.SUM       | \$15,000          | 1               | \$15,000           |
| Erosion Control                             | L.SUM       | \$25,000          | 1               | \$25,000           |
| New Bridge Construction                     | SQ.FT       | \$194             | 26,110          | \$5,065,000        |
| <b>SUBTOTAL</b>                             |             |                   |                 | <b>\$5,844,000</b> |
| ENGINEERING DESIGN                          | 10%         |                   |                 | \$585,000          |
| RIGHT-OF-WAY ACQUISITION (UNDEVELOPED LAND) | ACRE        | \$50,000.00       | 1.4             | \$70,000           |
| CONSTRUCTION SURVEYING                      | 3%          |                   |                 | \$175,000          |
| TRAFFIC CONTROL                             | 3%          |                   |                 | \$175,000          |
| CONSTRUCTION ADMINISTRATION                 | 5%          |                   |                 | \$292,000          |
| CONTINGENCIES                               | 20%         |                   |                 | \$1,169,000        |
| <b>TOTAL PROJECT COST</b>                   |             |                   |                 | <b>\$8,310,000</b> |

**PRELIMINARY COST ESTIMATE**

Draft Feasibility Report for Porter Mountain Road Over Billy Creek  
ROADWAY ALTERNATIVE 5

| <i>Item Description</i>                     | <i>Unit</i> | <i>Unit Price</i> | <i>Quantity</i> | <i>Amount</i>      |
|---|-------------|-------------------|-----------------|--------------------|
| Clearing and Grubbing                       | L.SUM       | \$15,000          | 1               | \$15,000           |
| Removal of Asphaltic Concrete               | SQ.YD.      | \$5               | 4900            | \$24,500           |
| Roadway Excavation                          | CU.YD.      | \$15              | 3425            | \$51,400           |
| Borrow (Haul In)                            | CU.YD.      | \$20              | 4965            | \$99,300           |
| Aggregate Base                              | CU.YD.      | \$35              | 3315            | \$116,000          |
| Asphaltic Concrete                          | TON         | \$120             | 2700            | \$324,000          |
| Guard Rail, W-Beam Single Face              | L.FT.       | \$20              | 60              | \$1,200            |
| Guard Rail, Anchor Assembly                 | EACH        | \$1,000           | 2               | \$2,000            |
| Guard Rail Terminal                         | EACH        | \$1,750           | 2               | \$3,500            |
| Thrie-Beam Guard Rail Transition System     | EACH        | \$1,500           | 4               | \$6,000            |
| 6" Concrete Curb & Gutter                   | L.FT.       | \$25              | 2550            | \$63,800           |
| Concrete Sidewalk                           | SQ.FT.      | \$5               | 1255            | \$6,300            |
| Concrete Sidewalk Ramp                      | EACH        | \$2,500           | 2               | \$5,000            |
| 36" Culverts                                | L.FT.       | \$110             | 480             | \$52,800           |
| 36" Flared End Sections                     | EACH        | \$1,000           | 10              | \$10,000           |
| Bank Protection                             | SQ.FT.      | \$25              | 2900            | \$72,500           |
| Signing & Striping                          | L.SUM       | \$15,000          | 1               | \$15,000           |
| Erosion Control                             | L.SUM       | \$25,000          | 1               | \$25,000           |
| Bridge Widening                             | L.SUM       | \$136             | 3,210           | \$437,000          |
| <b>SUBTOTAL</b>                             |             |                   |                 | <b>\$1,330,000</b> |
| ENGINEERING DESIGN                          | 10%         |                   |                 | \$133,000          |
| RIGHT-OF-WAY ACQUISITION (UNDEVELOPED LAND) | ACRE        | \$50,000.00       | 0.5             | \$25,000           |
| CONSTRUCTION SURVEYING                      | 3%          |                   |                 | \$40,000           |
| TRAFFIC CONTROL                             | 3%          |                   |                 | \$40,000           |
| CONSTRUCTION ADMINISTRATION                 | 5%          |                   |                 | \$67,000           |
| CONTINGENCIES                               | 20%         |                   |                 | \$266,000          |
| <b>TOTAL PROJECT COST</b>                   |             |                   |                 | <b>\$1,901,000</b> |

# Appendix C

## Photo Log



**Photo 1 - SR 260 & PMR Looking Northwest**



**Photo 2 - SR 260 & PMR Looking Southeast**



**Photo 3 - Northbound Billy Creek Bridge Approach**



**Photo 4 - Southbound Billy Creek Bridge Approach at Peterson Road**



**Photo 5 - PMR West of Billy Creek Bridge**



**Photo 6 - PMR East of Billy Creek Bridge**



**Photo 7 - Billy Creek Bridge Abutment**



**Photo 8 - North Side of Billy Creek Bridge**



**Photo 9 - West Approach Slab Joint**



**Photo 10 - East Approach Slab Joint**



**Photo 11 - South Side of the Bridge with Creek Flow**



**Photo 12 - North Side of the Bridge with Creek Flow**



**Photo 13 - Billy Creek North of the Bridge**



**Photo 14 - Billy Creek North of the Bridge**



**Photo 15 - Billy Creek South of the Bridge**



**Photo 16 - Natural Gas Metering Station Looking West**



**Photo 17 - Natural Gas Metering Station Looking East**



**Photo 18 - High-Pressure Gas Valves North of the Metering Station**



**Photo 19 - PMR Drainage Swale North of Peterson Road**



**Photo 20 - Peterson Road Drainage Swale East of PMR**



**Photo 21 - Peterson Road Cross Culvert**



**Photo 22 - Weir Structure at the PMR Drainage Swale**

## **Appendix D**

# **Existing Bridge Plans**

# **Appendix E**

## **Structure Inventory & Appraisal**

# **Appendix F**

## **Navajo County Assessor's Maps**

**Appendix G**  
**Arizona Department of Transportation**  
**Highway Bridge Replacement and Rehabilitation**  
**Program**