APRIL 2010

FINAL REPORT

LONE TREE OVERPASS STUDY

PROJECT NO.: 03-09007

Prepared for

CITY OF FLAGSTAFF · ARIZONA · ESTABLISHED 1882 ·

Prepared by

PB PARSONS BRINCKERHOFF 125 YEARS

LONE TREE OVERPASS STUDY

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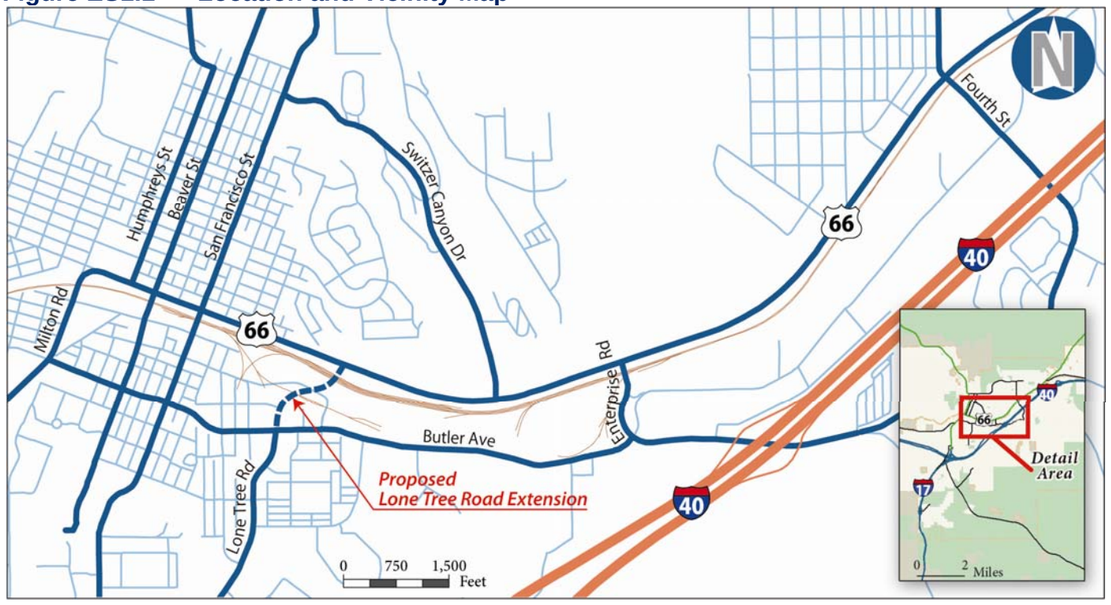
Project Background

The Flagstaff City Council has authorized the *Lone Tree Overpass Study*, a preliminary study of the extension of Lone Tree Road from Butler Avenue to Route 66 as identified in the *Lone Tree Corridor Study* (LTCS) and the Regional Land Use and Transportation Plan. The purpose of this study is to expand and enhance the level of detail generated by the LTCS, including an updated cost estimate and implementation schedule. The vicinity and location of the study area are shown on Figure ES1.1.

Figure ES1.1 Location and Vicinity Map



Goals and Objectives

Study Goals

- Secure approval of the design concept for railroad track relocation from the BNSF Railway Company (BNSF).
- Secure approval of the design concept for connection to Route 66 from the Arizona Department of Transportation (ADOT).
- Define the impacts to business and residential properties.
- Inform the public and secure approval of project.
- Prepare an updated comprehensive cost estimate for project design, acquisition of right-of-way, relocation of utilities, resident/business relocation, construction and contract administration.

Study objectives were established to achieve the goals noted above. See Section 1 for more details.

Study Area Characteristics

The study area is bounded by Route 66 on the north, Enterprise Road on the east, Butler Avenue on the south and San Francisco Street on the west. The BNSF railroad tracks run east-west through the center of the study area.

Land uses within the study area are generally mixed commercial and industrial with some residential. The residential areas are generally on the west side of the study area, south of the railroad tracks, although there are a few residences next to commercial or industrial developments further to the east. Much of the land is owned by BNSF and used for railroad operations or is leased to various commercial enterprises.

Alternatives

Development of roadway and railroad alternatives is controlled by:

- The recently-constructed south leg of the intersection of Butler Avenue and Lone Tree Road as part of the "Aspen Place" development;
- Minimum horizontal and vertical clearance requirements for railroad tracks;
- The at-grade intersections with the railroad tracks at San Francisco Street and Enterprise Road; Route 66; the historic Rio de Flag and the proposed Rio de Flag drainage channel;
- Operational requirements of BNSF for storage and siding tracks;
- Relocation of the spur track to Paramount Petroleum (Paramount).

Roadway Alternatives

Roadway alternatives were limited to improvement alternatives on Route 66 and location of local streets for circulation. The profile of Route 66 was not raised in order to avoid disruption to business access and existing drainage patterns on the north side of the roadway. Widening options for additional traffic lanes on Route 66 were investigated as part of the railroad relocation alternatives. Local street location was determined by clearance requirements for a spur track to Paramount. The local connector street shown in the LTCS was relocated next to the new Paramount spur to keep the grade of Lone Tree Road under six percent (6%).

Railroad Alternatives

Three railroad relocation alternatives were studied:

***Alternative 1—North Alignment*:** Alternative 1 relocates the railroad tracks on the north side of the existing tracks. The maintenance road is located on the south side of the relocated tracks. The alignment is composed of four horizontal curves and three vertical curves including a sag curve under the bridge. The low point in the sag curve is drained by a 36-inch diameter RCP culvert to the Rio de Flag. There is not enough space between the new tracks and Route 66 to drain the low point by ditch to Switzer Canyon Wash.

Because of the close proximity to Route 66, Alternative 1 requires construction of approximately 2,700 lineal feet of retaining wall and approximately 1,700 lineal feet of temporary shoring for railroad construction. This alternative also requires widening Route 66 symmetrically about the roadway centerline.

Alternative 2—South Alignment: Alternative 2 relocates the railroad tracks on the south side of the existing tracks. The maintenance road is located on the north side of the relocated tracks. The horizontal alignment consists of three horizontal curves and three vertical curves including a sag curve under the bridge. The low point in the sag curve can be drained eastward in a ditch to Switzer Canyon Wash. Alternative 2 does not require construction of retaining walls along Route 66 but will require approximately 400 lineal feet of low retaining wall along the north side of the proposed Rio de Flag drainage channel. It also requires approximately 2,700 lineal feet of temporary shoring for railroad construction. Route 66 is widened at the south side of the existing roadway.

Alternative 3—South Alignment with Shoofly: Alternative 3 relocates Main 1 and Main 2 to shoofly tracks using the horizontal alignment of Alternative 1 while constructing the new mainline tracks on the horizontal and vertical alignment of Alternative 2. This alternative was developed in order to reduce the length of shoring between new construction and existing tracks and to facilitate construction of the overpass structure. At the level of this study, no temporary shoring is anticipated. Route 66 is widened at the south side of the existing roadway.

Recommended Alternative

All three alternatives are constructible options for accommodating the extension of Lone Tree Road from Butler Avenue to Route 66. However, *Alternative 3 - South Alignment with Shoofly*, is judged to provide the most benefit to BNSF and the City at the least cost and is therefore the recommended alternative. BNSF has given preliminary concurrence with the Recommended Alternative.

1.0 Introduction

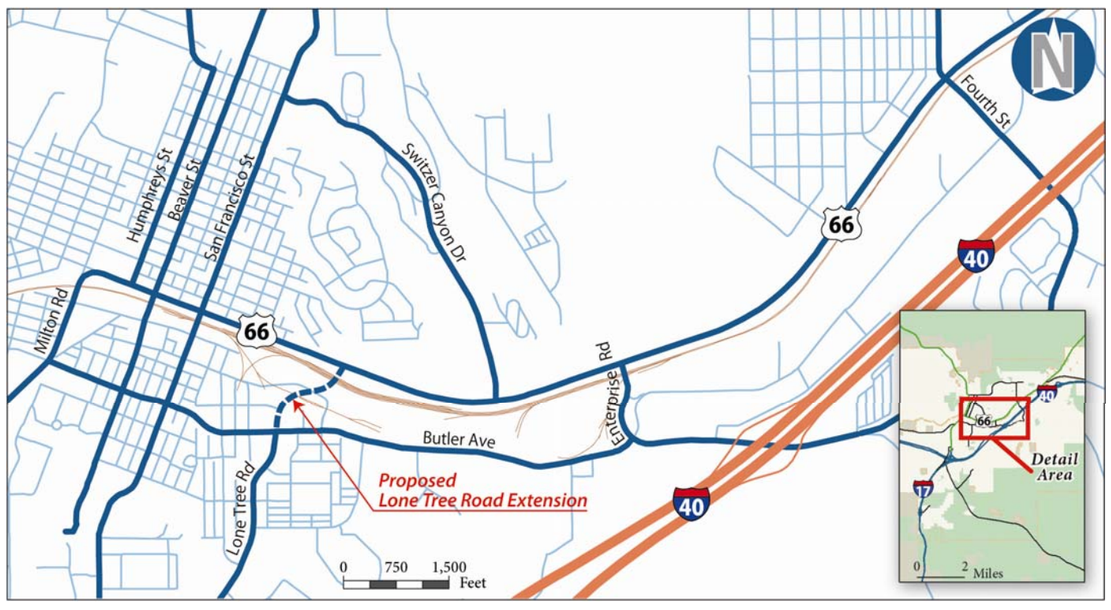
1.1 Study Overview

The City of Flagstaff completed the *Lone Tree Corridor Study* (LTCS) in 2006, with final City Council approval in 2008. The purpose of the LTCS was to identify a corridor that can be preserved by the City of Flagstaff for future development of existing Lone Tree Road into a north-south transportation route between J.W. Powell Boulevard and Route 66 that would relieve congestion on Milton Road.

The LTCS divided the corridor study into several segments, one of them between Route 66 and Butler Avenue. The Preferred Alternative for this segment called for extending Lone Tree Road from Butler Avenue to Route 66 with a grade-separation structure, the Lone Tree Overpass, over the railroad tracks owned and operated by the Burlington Northern Santa Fe Railway Company, now known as BNSF Railway Company. The Preferred Alternative required the railroad tracks to be relocated horizontally and vertically and for Route 66 to be raised several feet.

The Flagstaff City Council has authorized the *Lone Tree Overpass Study*, a preliminary study of the Lone Tree Overpass as identified in the LTCS and the Regional Land Use and Transportation Plan. The purpose of this study is to expand and enhance the level of detail generated by the LTCS, including an updated cost estimate and implementation schedule. The vicinity and location of the study area are shown on Figure 1.1.

Figure 1.1 Location and Vicinity Map



1.2 Goals and Objectives

The goals and objectives of this study as they relate to project stakeholders, the general public and the implementation of the process to fund and construct the Lone Tree Overpass are the following:

1.2.1 Study Goal 1

Secure approval of the design concept for railroad track relocation from the BNSF Railway Company (BNSF).

Objectives

- Establish communication with BNSF to establish design criteria, operating requirements and company policies.
- Prepare track relocation horizontal and vertical alignments meeting BNSF design criteria.
- Prepare a track relocation construction sequence meeting BNSF operating requirements.

1.2.2 Study Goal 2

Secure approval of the design concept for connection to Route 66 from the Arizona Department of Transportation (ADOT).

Objectives

- Establish communication with ADOT to establish design criteria, maintenance of traffic requirements and access management concepts.
- Prepare preliminary design of the Route 66-Lone Tree Road intersection showing lane configuration and intersection geometry.
- Prepare a conceptual construction sequence and maintenance of traffic plan.

1.2.3 Study Goal 3

Define the impacts to business and residential properties.

Objectives

- Determine right-of-way requirements.
- Determine relocation requirements.
- Identify potential constraints on access to existing properties.

1.2.4 Study Goal 4

Inform public and secure approval of project.

Objectives

- Conduct community information meetings.
- Establish and maintain open lines of communication with the community.
- Provide study information to local associations at their regular meetings, as requested.

1.2.5 Study Goal 5

Identify a comprehensive total project cost estimate.

Objectives

- Prepare preliminary design plans for the Lone Tree Road segment between Route 66 and Butler Avenue and the relocation of BNSF facilities with sufficient detail to identify major construction cost items.
- Prepare preliminary estimate of right-of-way acquisition costs.
- Prepare preliminary estimate of residential/business relocation costs.
- Develop implementation schedule including final design, bid and construction activities.

1.2.6 Public and Stakeholder Involvement

Gaining consensus among affected agencies and the public is critical to the success of the study and implementation of its recommendations to provide a process for funding and implementation. Two public information meetings were held during the course of the study process. The first meeting, held on September 2, 2009, provided the community with an opportunity to inform the study team about the study area and local transportation needs as well as comment on preliminary alternative concepts. A summary report from the meeting is provided in Appendix F. The second public meeting was held on February 24, 2010 to share the findings of this study and present the recommended improvements.

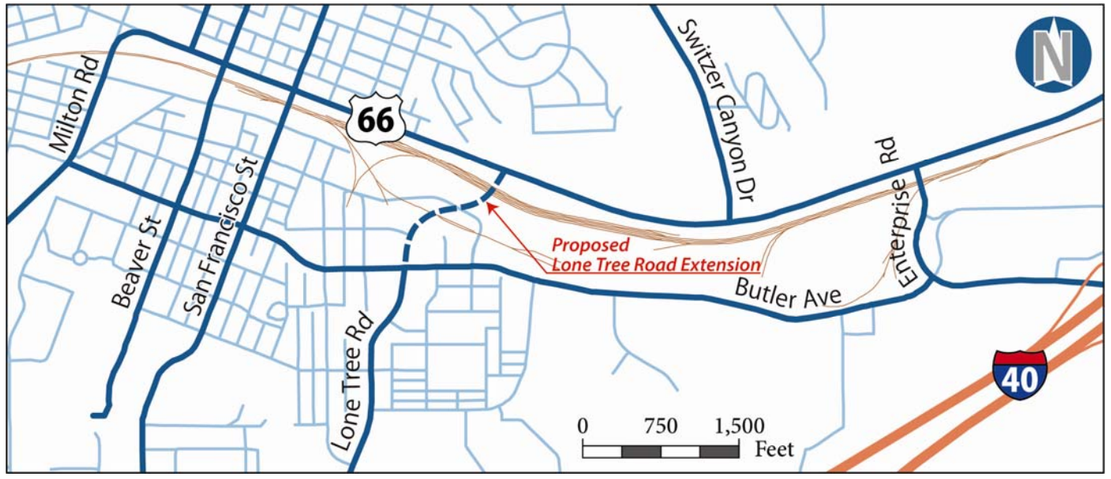
A meeting with representatives of BNSF, the City of Flagstaff and Parsons Brinckerhoff was also held on February 24, 2010 to discuss the Recommended Alternative. The attendees representing the railroad were Melvin Thomas, Manager Public Projects; Richard Barnitz, Field Engineer and Carlos Perez, Operations Manager. Representing the City of Flagstaff were Rick Barrett, City Engineer; Stu Seubert, Capital Improvements Engineer and Bret Petersen, Senior Project Manager. After review of the plans and discussion of the issues, BNSF gave preliminary approval of the Recommended Alternative subject to further review.

2.0 Characteristics Of The Study Area

2.1 Overview

The study area is bounded Route 66 on the north, Enterprise Road on the east, Butler Avenue on the south and San Francisco Street on the west, as shown in Figure 2.1, Study Area. The BNSF railroad tracks run east-west through the center of the study area.

Figure 2.1 Study Area



2.2 Roadways

Route 66 consists of two through and two multi-use shoulders in each direction, separated by a two-way left turn lane. The distance between curb faces is 64 ft. Between San Francisco Street and Enterprise Road, a distance of approximately 1.2 miles, there are no intersecting streets on the south side of Route 66. Intersecting streets on the north side include Agassiz Street, Verde Street, Elden Street and Switzer Canyon Drive. Between the study area limits there are only five driveways on the south side of Route 66: one to the BNSF offices east of San Francisco street, two to a BNSF property, and two others to a former oil company. In contrast, there are numerous driveways along the north side of Route 66 servicing local businesses and shopping centers.

There is also a FUTS (Flagstaff Urban Trail System) trail along the south side of Route 66. The trail is 10 ft wide and is separated from the roadway by a variable-width parkway. The trail is landscaped with trees, boulders and cinders.

Plate 1-Route 66 and FUTS trail

Butler Avenue has two through lanes and two bicycle lanes in each direction, separated by a median. East of Lone Tree Road, the median is raised with left turn access to southbound Lone Tree Road. West of the intersection, the median is painted.

Prior to 2009, Lone Tree Road was a two-lane roadway intersecting Butler Avenue from the south, continuing north of the intersection as Elden Street. The intersection was signalized. In 2009, Lone Tree Road was realigned to intersect Butler Avenue at Colorado Street approximately 360 ft to the east of its former intersection at as part of the construction of “Aspen Place at the Sawmill,” a mixed-use residential-commercial development south of Butler Avenue. The traffic signals were moved from the former intersection to the new one. The realignment was done in coordination with the LTCS, and marks the southern end of the study area. This intersection and the alignment of Lone Tree Road on the south leg of the intersection control the location and direction of Lone Tree Road to the north.

Currently the Lone Tree Road side of the new intersection consists of two southbound travel lanes, a north-to-west left turn lane and a combined northbound-right turn lane, with a bicycle lane in each direction. The two southbound lanes taper to one lane approximately 150 ft south of the intersection. At its ultimate configuration, Lone Tree Road will have two southbound lanes, two northbound lanes, two left turn lanes and a right turn lane, in addition to a bicycle lane in each direction. The Colorado Street side of the intersection consists of one through lane in each direction and a left turn lane.

Other roadways in the study area include Colorado Street, Brannen Avenue, Gabel Street, Cottage Avenue and Lumber Street. With the exception of Lumber Street, these roadways are two-lane residential or

commercial city streets measuring approximately 36 ft between curb faces. Lumber Street is unimproved and apparently exists as an access agreement between abutting landowners. Colorado Street was improved in 2009 to the lane configuration described in the preceding paragraph. Drainage improvements were also made.

2.3 Railroads

There are six railroad tracks at the proposed location of the Lone Tree Overpass. From north to south they are: the north storage track, the north siding track, Main 1, Main 2, the south siding track and the south storage track. The north siding track begins at a switch on Main 1 west of Enterprise Road and ends approximately 750 feet east of San Francisco Street. The south siding track begins east of Enterprise Road and ends approximately 500 feet west of San Francisco Street. The siding tracks are "single ended"; i.e., they only have one switch on the main lines. The storage tracks are approximately 2,100 feet long between switches at the siding tracks. They begin approximately 2,600 feet west of Enterprise Road and end approximately 1,500 feet east of San Francisco Street.

The main line tracks are continuously welded steel rail with concrete ties, and appear to be in very good condition. The siding and storage tracks are bolted steel rail with wood ties. The south siding and storage tracks are judged to be in fair to good condition and are in use today, but it is our understanding that the north siding and storage tracks have not been used in a number of years due to concerns about the ties and rails.

Plate 2 - Existing tracks, looking east. From left to right, spur remnant (orange stop in background), north siding (orange stop in foreground), Main 1, Main 2, south siding, south storage (with rail cars). West leg of wye track is at right.

2.3.1 Spur Tracks

Between Enterprise Road and San Francisco Street, there are four industrial spur tracks on the south siding track and two industrial spur tracks on the north siding track. One south spur track, beginning east of Enterprise Road, serves the SCA Tissue factory, Golden Eagle Sales, and a property owned by the City of Flagstaff, although it is assumed that rail service to this property is terminated. Another south spur track further to the west also serves SCA Tissue and Central Arizona Supply. The next spur track to the west serves ProBuild, a lumber and materials supply yard. The fourth south spur track begins west of San Francisco Street and serves Paramount Petroleum (Paramount). The Paramount spur also has a branch that used to serve the former sawmill on the south side Butler Avenue but which has been largely removed. On the north side, a spur track served Polmex Oil, an oil sales and distribution company. That company is no longer in business and the oil tanks have been removed, although the lease from BNSF has not been retired. Another spur track on the north side is located near the BNSF office parking lot on Route 66 east of San Francisco Street, although this is probably a remnant of a spur track that used to cross the highway.

The Paramount spur is bolted steel rail and wood ties. The Paramount spur appears to be in fair to poor condition, as there are places where weeds have grown up on the tracks and dirt has accumulated nearly to the top of the rails.

Plate 3 - Spur track to Paramount Petroleum, looking west

2.3.2 Wye Track

At the west end of the project area there is a wye track connected to the south siding track. The wye track was used to turn around locomotives when a supplementary locomotive was needed to push trains over a high point in the railroad grade at Mars Hill. There was an identical turnaround on the west side of Mars Hill near the present A-1 Mountain Traffic Interchange on Interstate 40 which has since been removed. According to BNSF, the existing wye track is only occasionally used for storage and for turning around locomotives. The wye track is judged to be in fair to poor condition.

All railroad tracks described above are shown on Figure 2.2.

Plate 4 - Wye track, looking north

2.3.3 Geometry

According to BNSF track maps, between Enterprise Road and San Francisco Street the horizontal geometry of the mainline tracks consists of three horizontal curves separated by tangent track. Horizontal railroad curves always have a clothoid spiral at each end of the curve as a transition from level to superelevated track, but neither the spiral lengths nor the superelevation are shown on the track maps. The spiral length and superelevation are back-calculated from the posted speed of the curves and current BNSF curve design criteria. The order of the curves shown in Table 1 is from east to west.

Table 2.1 Horizontal Geometry of Existing Mainline Curves between Enterprise Road and San Francisco Street

Parameter	Curve No. 276	Curve No. 277	Curve No. 278
Degree of Curve	3° 00’	4° 00’	1° 42’
Radius, ft	1,910.08	1,432.69	3,370.46
Speed, mph P/F[1]	55/50	45/40	45/40
Spiral length, ft	230	150	50
Superelevation, in.	3-3/8	2-3/4	0-3/4

[1]P/F = Passenger trains/Freight trains

Vertical geometry, as determined from 1-ft contour interval aerial mapping, consists of a long upgrade of approximately 1.24% beginning west of Enterprise Road, a crest vertical curve approximately 1,000 ft long, a short downgrade of approximately 0.90% followed by a sag vertical curve approximately 1,200 ft long with an upgrade of approximately 0.50% where the tracks cross San Francisco Street. The high point on the crest curve is at approximately Elevation 6906 and the low point of the sag curve is at approximately Elevation 6897.

2.4 Drainage

The project watershed is bounded by Route 66 to the north, Butler Avenue to the south, South San Francisco Street and South Elden Street to the west and Switzer Canyon Drive to the east. Major drainage systems in the vicinity of the proposed Lone Tree Overpass, shown on Figure 2.3, are the historic Rio de Flag channel and associated storm drains and channels, the Route 66 storm drain system, the Butler Avenue storm drain system, and the railroad drainage system.

The Rio de Flag channel is the remnant of the historic Rio de Flag that used to flow east to west along what are now Route 66 and the BNSF railroad tracks. The remnant channel begins east of the wye track and flows east approximately one half mile where it turns south to pass under Butler Avenue. The channel receives runoff from storm drains in Route 66, BNSF railroad on-site and off-site properties, storm drains in Butler Avenue and from mixed developments between the Paramount spur and Butler Avenue. Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Panel No. 040020 007 D, revised August 2, 1996, indicates that the historic Rio de Flag channel is outside the 100-year floodplain, but the area from San Francisco Street to Gabel Street between Route 66 and Butler Avenue is designated as Zone B. Zone B is an area between the limits of the 100-year flood and the 500-year flood. Figure 2.4 shows the FEMA FIRM for the area in the vicinity of the proposed Lone Tree Overpass.

Figure 2.2 Existing Railroad Tracks

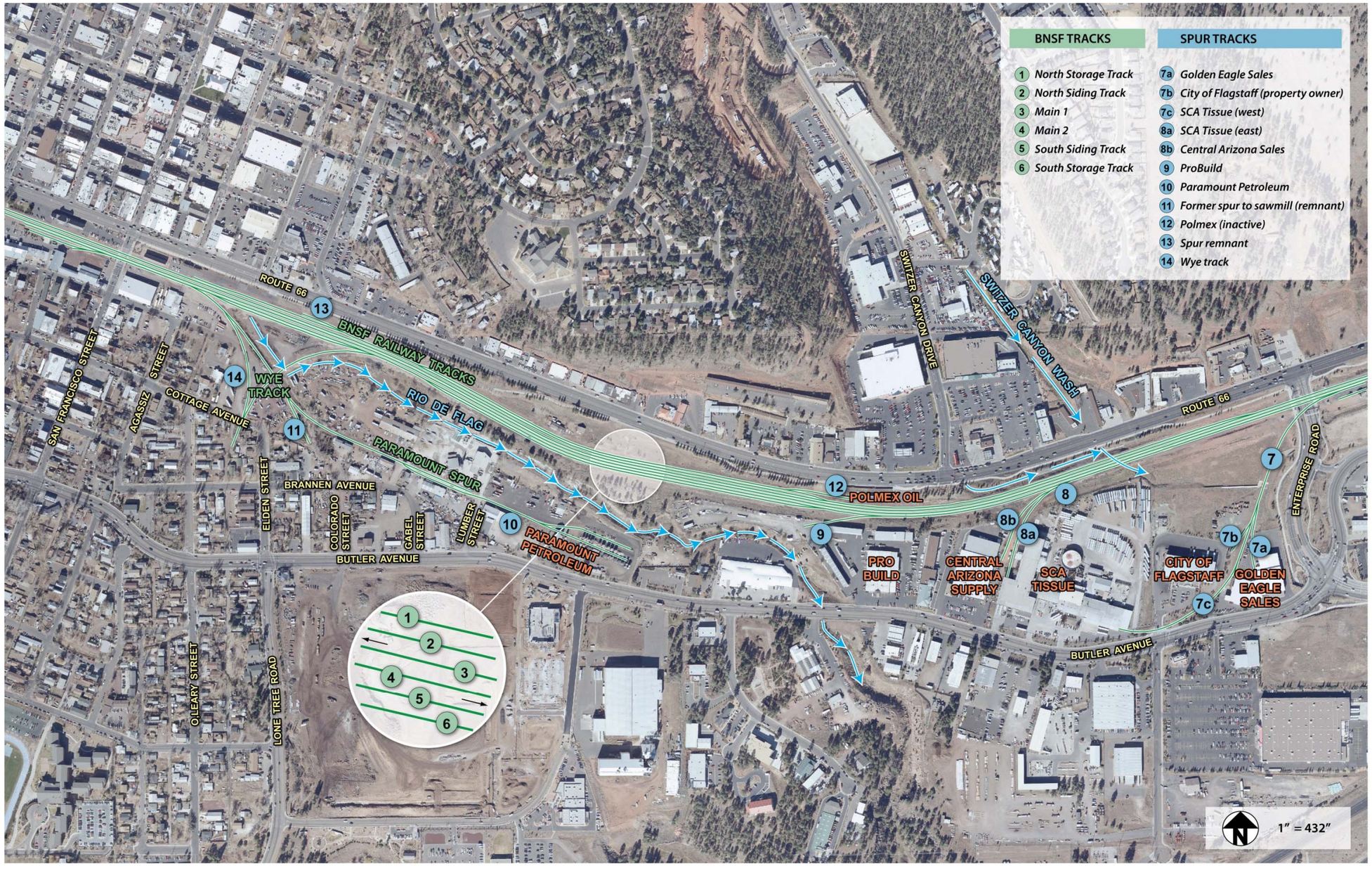


Figure 2.3 Existing Drainage Systems

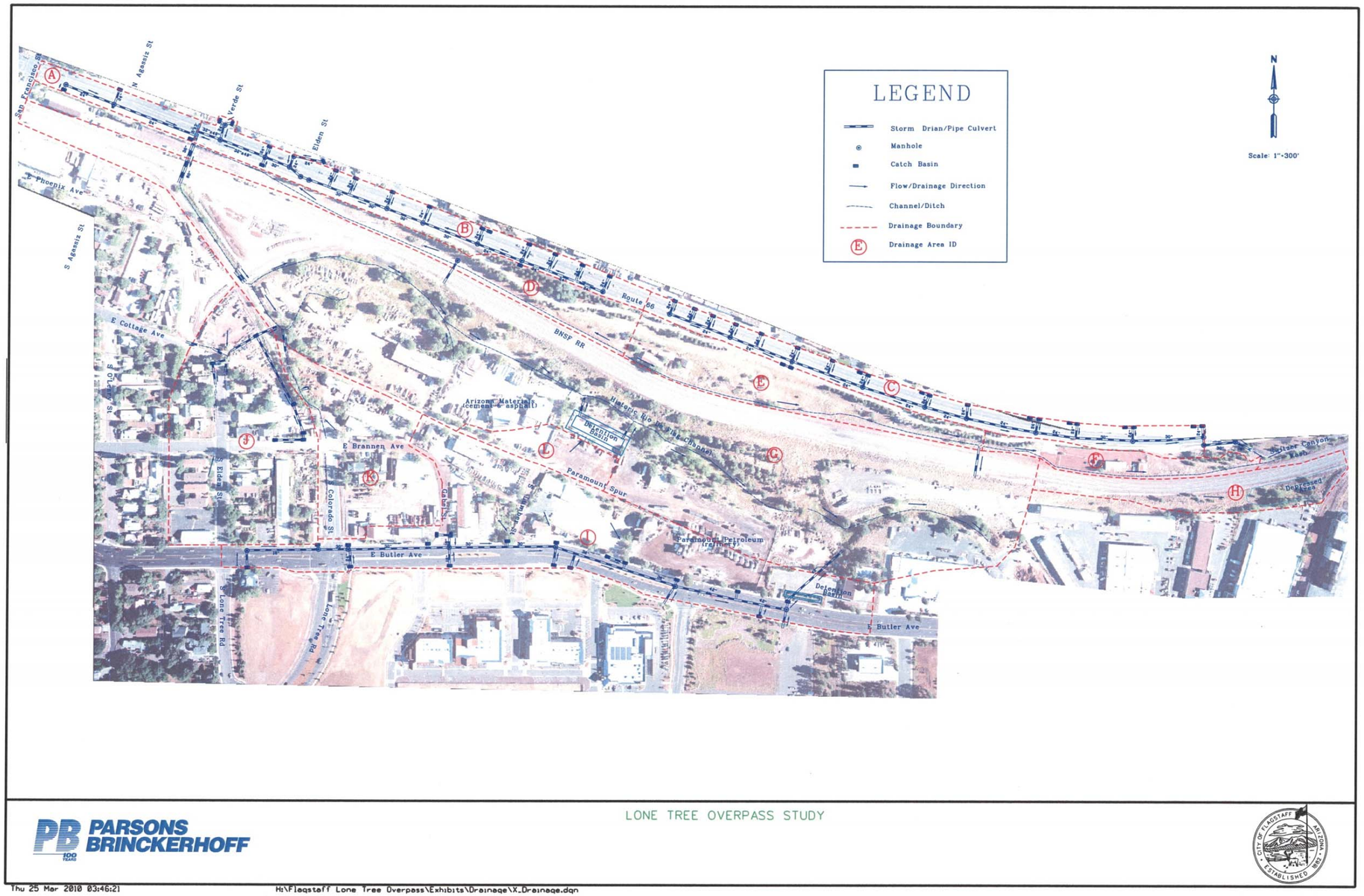


Figure 2.4 FEMA FIRM in the Vicinity of Proposed Lone Tree Overpass

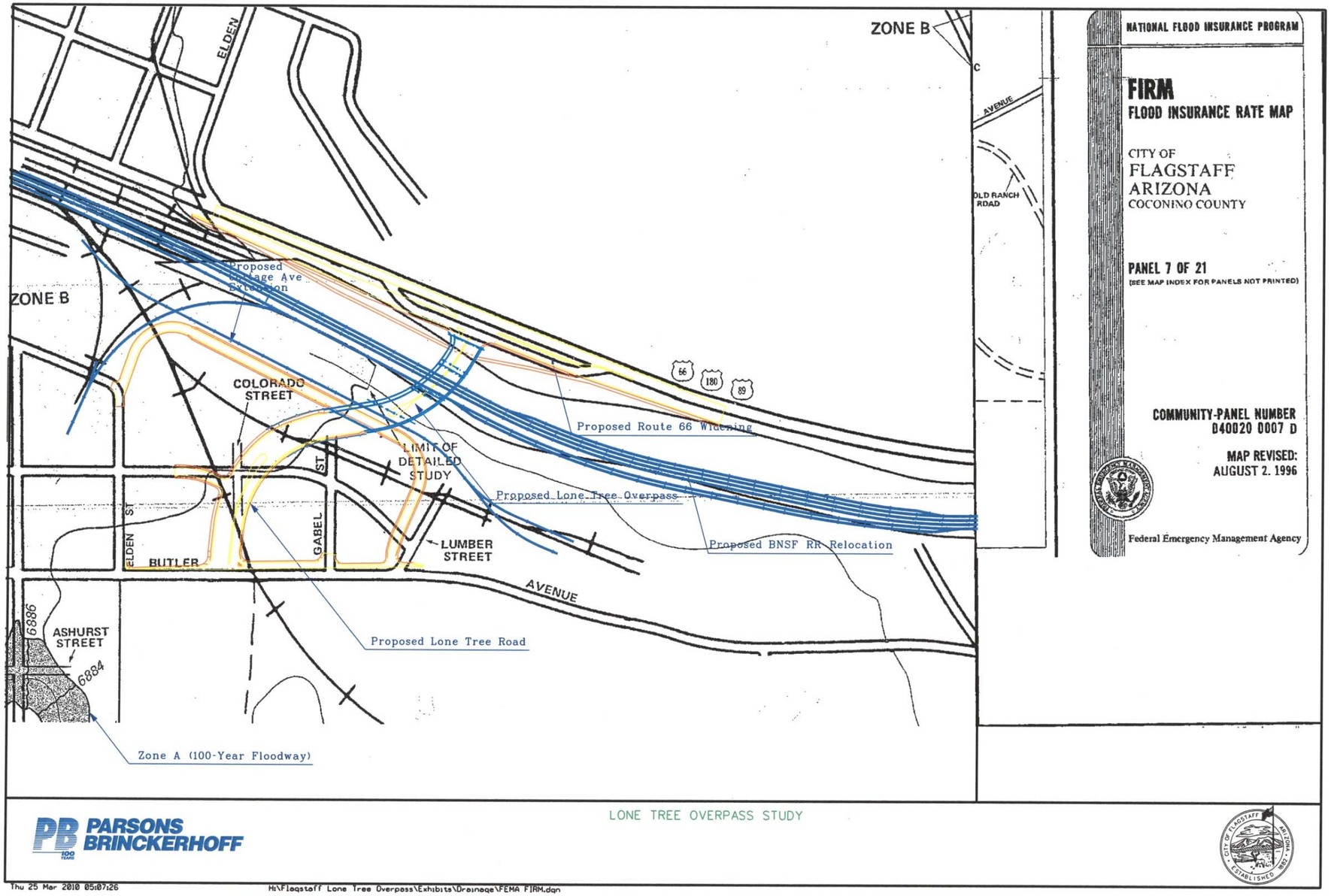


Plate 5 - Existing Rio de Flag channel, looking east

The US Army Corps of Engineers (USACE) is currently producing final plans for the Rio de Flag Flood Control Project, a system of detention basins, closed conduits and open channels to reduce flooding in several areas of Flagstaff, primarily in the Southside neighborhood south of the railroad tracks. One of the project features is the channelization of the remnant Rio de Flag between the wye track and Butler Avenue. The proposed open channel has 2:1 side slopes and is lined with grouted riprap. A 16-ft diameter conduit, now under construction, conveys runoff in the channel under Butler Avenue. Several existing drainage systems in the Lone Tree Overpass study area will be connected to the Rio de Flag drainage system. Figure 2.5 shows the proposed Rio de Flag drainage system in the vicinity of the Lone Tree Overpass.

2.4.1 Route 66 Drainage System

A storm drain system in Route 66 collects on-site and off-site runoff from Route 66 and adjacent properties between San Francisco Street and Switzer Canyon Drive. A high point on Route 66 forms a drainage divide between east and west. On the east side of the Route 66 drainage divide, the storm drains in Route 66 discharge to a concrete- and riprap-lined channel that flows east along the north side of the railroad tracks to Switzer Canyon Wash.

Storm drains in Route 66 on the west side of the divide are connected to a 5 ft x 3 ft reinforced concrete box culvert crossing under Route 66 at Verde Street. The flow in this box culvert is then conveyed to a channel along the north side of the Paramount spur via a 36-inch reinforced concrete pipe (RCP) and a 60-inch RCP. The flow in this channel passes under the east leg of the wye track through two 48-inch diameter RCPs to a shallow ditch next to the wye and then into the historic Rio de Flag. The 36-inch and 60-inch pipes are to be connected to the Rio de Flag drainage system.

2.4.2 Railroad Drainage System

The existing railroad drainage system includes ditches on the north side of the railroad tracks and pipe culverts under the tracks. A high point on the railroad tracks at Elevation 6906 forms a drainage divide, with runoff on the east side draining to Switzer Canyon Wash and runoff on the west side draining to the historic Rio de Flag.

The area east of the divide drains east in a shallow ditch on the north side of the railroad tracks to a concrete-lined channel that serves as an outfall for storm drains in Route 66. This ditch drains east to meet Switzer Canyon Wash where it passes under the railroad tracks at BNSF Structure No. BR-343.

Plate 6 - Shallow drainage ditch along north siding, looking west, upgrade.

Runoff on the west side of the divide is collected in a shallow ditch on the north side of the railroad tracks and flows west toward BNSF headquarters. Based on topographic mapping and field inspection, it appears that runoff flows across the paved area east of the BNSF offices and into Route 66 where it enters the Route 66 storm drain system, with eventual discharge to the historic Rio de Flag as previously described.

BNSF track maps show a 24-inch diameter RCP that crosses under the railroad tracks approximately 600 ft east of Elden Street. Field inspection showed that there is a headwall at the downstream end of this pipe and a manhole at the upstream end.

Figure 2.5 Proposed Rio de Flag Flood Control Project

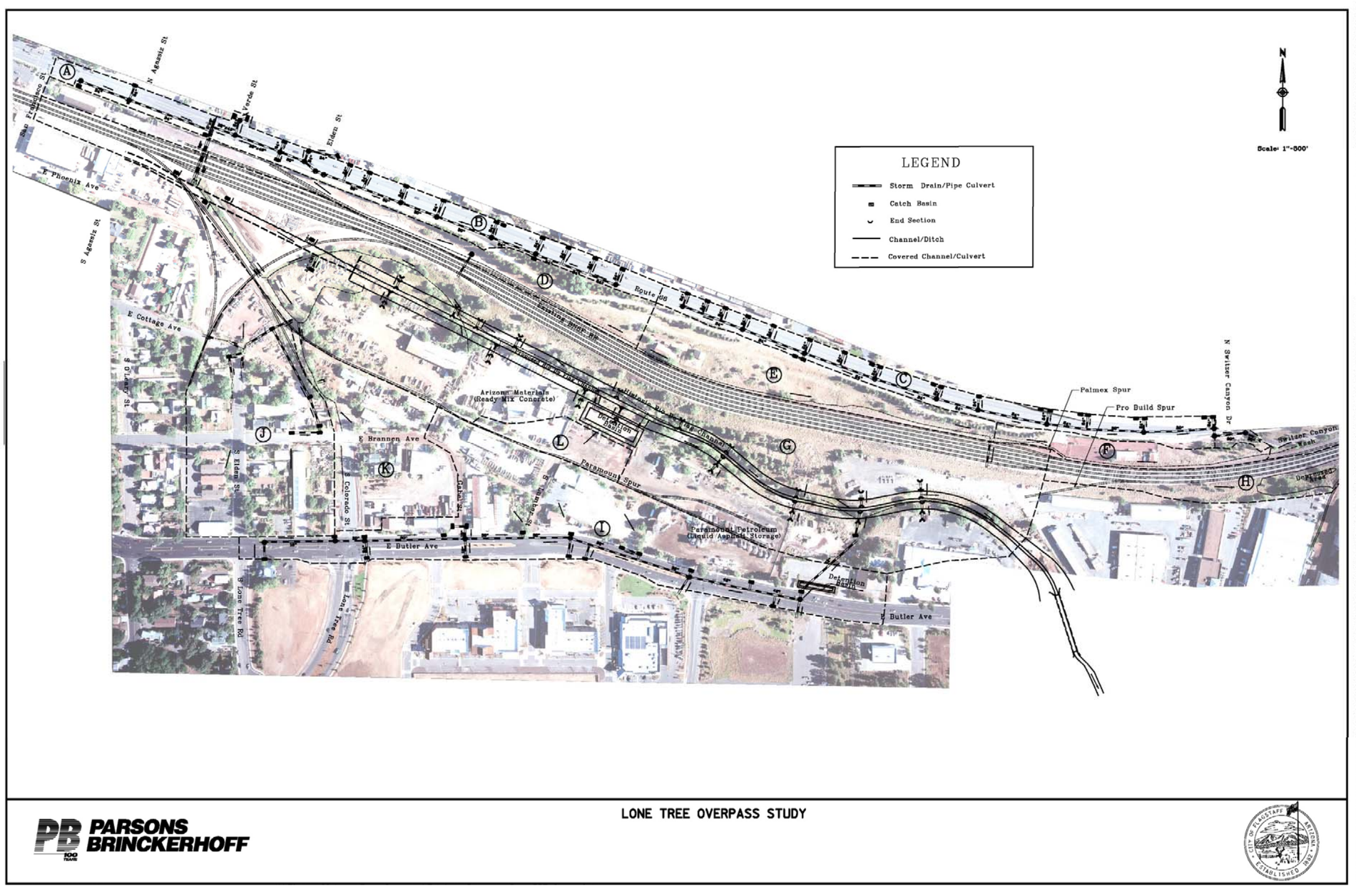


Plate 7 – 24-inch diameter culvert under tracks

City of Flagstaff GIS maps show a storm drain from a catch basin on Route 66 to the manhole; however, the latest ADOT storm drain construction plans for Route 66 do not show this connection, and it is unlikely that runoff in the Route 66 storm drain would be diverted off-site. In fact, the ADOT plans show removal of catch basins and plugging of storm drain pipes that drained off-roadway to the south. There are no catch basins or headwalls on the north side of the tracks so it assumed that the 24-inch diameter culvert is abandoned or inoperative.

BNSF track maps also show a culvert under the railroad that drains a former borrow pit north of the tracks, with discharge to the Rio de Flag. This culvert was not located in the field; the inlet may have been plugged as part of construction of a retaining wall for the FUTS trail on the south side of Route 66.

The area south of the railroad tracks drains directly to the historic Rio De Flag or to Switzer Canyon Wash.

2.4.3 Butler Avenue Drainage System

The storm drain system in Butler Avenue collects on-site runoff from Butler Avenue between (former) Lone Tree Road and a point approximately 400 ft east of Sawmill Road and some of the off-site drainage from some commercial establishments north of Butler Avenue. Discharge is to the historic Rio de Flag channel.

2.4.4 Minor Drainage from Residential-Industrial Developments

Minor storm drain systems exist at the intersection of Cottage Avenue and Elden Street and on the north side of Brannen Avenue between Elden Street and Colorado Street. These two minor systems discharge to a drainage channel on the north side of the Paramount spur and then to the historic Rio de Flag. Recent paving and drainage improvements on Colorado Avenue incorporated low intensity development (LID) drainage principals discharge to one of these minor systems.

Plate 8- Recent paving and drainage improvements on Colorado Street

2.5 Traffic

The existing Lone Tree Road is a north-south running minor arterial (generally one lane each way) between Butler Avenue and Powell Boulevard located south of I-40. At the north terminus, north of Butler Avenue, Lone Tree Road turns into Elden Street, which serves as an access road to an industrial park and finally ends at Cottage Avenue.

The existing 24 hour traffic volumes and evening peak hour turning movement counts collected in Summer 2008 and Fall 2009 were obtained from City of Flagstaff. Figure 2.6 shows the existing average daily traffic (ADT) volumes, one hour PM peak turning movement volumes and current intersection lane geometry for the Lone Tree Road intersections at the north terminus and in the vicinity of the study area.

To better understand the traffic circulation patterns in the Lone Tree Road study area, average daily traffic and intersection turning movement counts were included for the north–south corridors of Milton Road and the one-way couplet roads –Beaver Street and San Francisco Street. The traffic analysis also included two east-west corridors of Route 66 and Butler Avenue on each side of the BNSF railroad track, as well as the associated key intersections.

As shown in Figure 2.6, Milton Road is the only continuous north-south arterial which serves Downtown Flagstaff and carries 34,600 vehicles per day (vpd) south of Butler Avenue. Beaver Street and San Francisco Street are one-way couplet collector streets which carry low volumes of traffic ranging from 2000 - 7000 vpd and 4000 - 8000 vpd respectively from south to north. Lone Tree Road currently carries nearly 10,000 vpd south of Butler Avenue.

Route 66, as one of the key east-west corridors, carries 23,800 vpd west of Switzer Canyon Drive. Butler Avenue carries 26,900 vpd east of Lone Tree Road. West of Lone Tree Road, the ADT on Butler Avenue reduces to 17,400 vpd.

The ADT distribution across the three north-south corridors indicates that Milton Road is the primary corridor which serves the traffic between Downtown Flagstaff and I-40 and I-17. Beaver Street and San Francisco Street together generally accommodate the trips between Downtown Flagstaff and the industrial parks located between Route 66 and Butler Avenue, as well as trips between residential and retail areas south of Route 66 and to and from Northern Arizona University.

Route 66 is the major east-west corridor to serve Downtown Flagstaff and East Flagstaff. Butler Avenue together with Lone Tree Road is the primary route to serve Eastern Flagstaff and Lone Tree Road south neighborhoods.

A *Synchro 7.0* software analysis was performed to evaluate the current traffic operations at key study intersections during the evening peak hour. The overall Level of Service (LOS) for each intersection is displayed in Figure 2.6. The detailed delay and queue length results for each approach are provided in Appendix C. The results show that all the intersections are currently operating at LOS D or better.

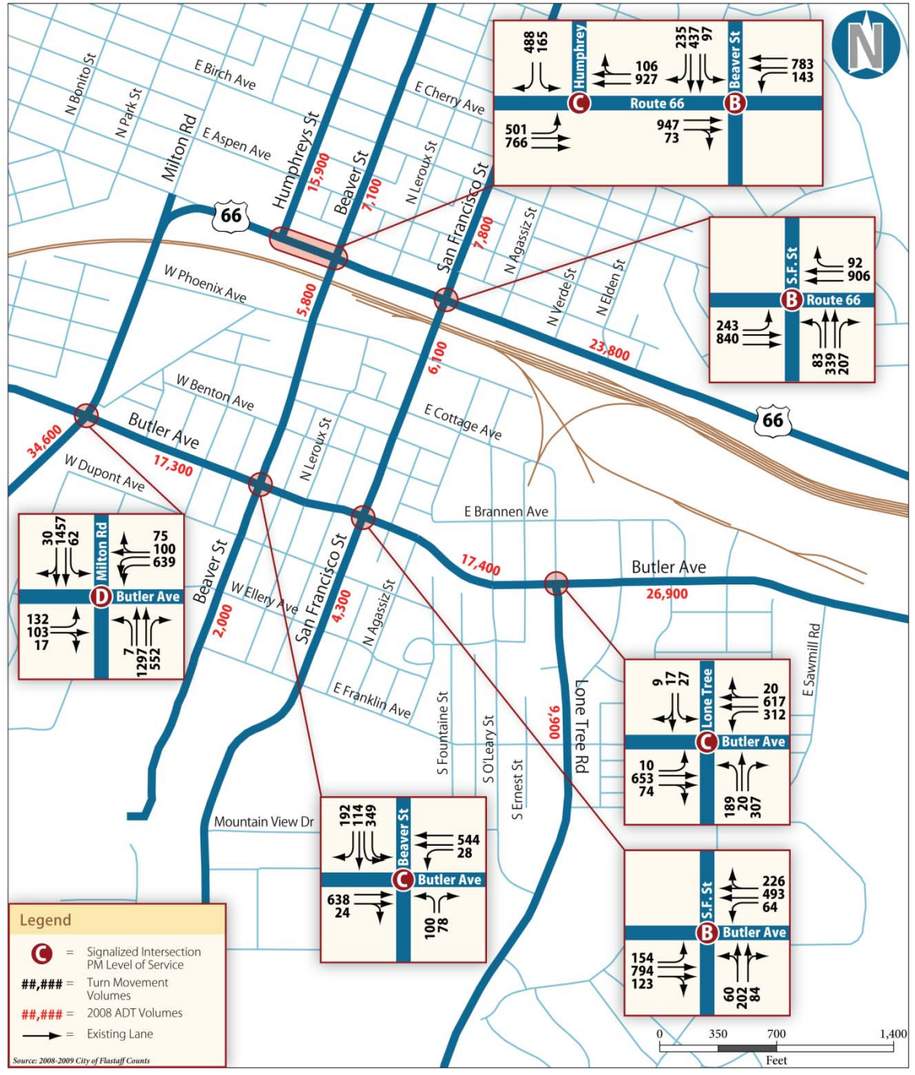


Figure 2.6 Existing Traffic Volumes and Intersection LOS for the Lone Tree Road Study Area

2.6 Socioeconomic Environment

The socioeconomic environment of the study area includes data on the resident population, land jurisdiction and ownership, and existing and future land use.

2.6.1 Population

U.S. Census data for 2000 were compiled for the study area. Information for the relevant census blocks was used to describe the demographic composition of the study area. Residential areas are concentrated in the western portion of the area. A total of 337 persons resided there in 2000. A preliminary compilation of the Census data is shown on Table 2.2 and Table 2.3. These tables show the racial and ethnic composition for the study area compared to that of the City of Flagstaff and Coconino County.

Table 2.2 Racial and Ethnic Demographics

Area	Total Population	White		African American		Native American		Asian		Pacific Islander		Other Races		Two or More Races		*Hispanic*[1]	
		#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Study Area	337	270	80.1	21	6.2	18	5.3	0	0	0	0	25	7.4	3	1.0	112	33.2
City of Flagstaff	52,894	41,214	77.9	927	1.8	5,284	10.0	660	1.2	65	0.1	3,201	6.1	1,543	2.9	8,500	16.1
Coconino County	116,320	73,381	63.1	1,215	1.0	33,161	28.5	910	0.8	108	0.1	4.801	4.1	2,744	2.4	12,727	10.9

Source: US Department of Commerce, Bureau of the Census. *Census 2000, Summary File 1*

[1] "Hispanic" refers to ethnicity and is derived from the total population, not as a separate race; i.e., it is calculated differently from the other columns in this table.

Table 2.3 Total Minority and Age 60 Years and Over

Area	Total Population	Total Minority[1]		Age 60 years and over	
		#	%	#	%
Study Area	337	179	53.1	31	9.2
City of Flagstaff	52,894	20,180	38.2	4,153	7.9
Coconino County	116,320	55,666	47.9	11,804	10.1

Source: US Department of Commerce, Bureau of the Census. *Census 2000, Summary File 1*.

[1] "Total Minority" is composed of all people who consider themselves Non-White racially plus those who consider themselves White Hispanic. Shaded areas denote percentages notably higher than comparison areas' percentages

2.6.2 Land Jurisdiction and Ownership

The study area is located within Sections 15, 16, 22 and 23 of Township 21 North, Range 7 East. According to City of Flagstaff Zoning Map 17, all land within the study area is within the corporate limits of the City of Flagstaff, with the exception of the BNSF right-of-way between the midsection line of Section 22 and the west section line of Section 23, and a small county island comprised of three parcels with a total area of 2.26 acres. The parcels are located between the railroad right-of-way and Butler Avenue approximately one-quarter mile east of Lone Tree Road/Elden Street. One of the parcels belongs to BNSF although it is not in the railroad right-of-way itself. The other two parcels belong to different owners. It is not anticipated at this time that any of the three parcels in the county island will be required for this project.

The largest landowner in the study area is the BNSF Railway Company, which aside from the right-of-way for the railroad tracks, owns several parcels between the tracks and Butler Avenue, some of which are leased to private businesses. Another major landowner is the City of Flagstaff which owns a parcel south of the tracks and east of San Francisco Street, several parcels along the south side of Route 66 and another parcel on Butler Avenue west of Enterprise Road. Other parcels are in private ownership. There no public lands such as parks in the study area.

2.6.3 Existing Land Use

The land within the project area is mixed residential, commercial and industrial. Along Route 66, the properties on the north side of the roadway are zoned C-3-E, Highway Commercial. Uses include a restaurant, a western attire store, a car dealership, a floor covering store, an antique dealership, furniture stores, and a funeral parlor. Two properties are currently vacant.

Plate 9 - Park Auto Sales on Route 66

A major land use feature is the BNSF Railroad, which runs south of and generally parallel to Route 66. Train traffic through the area varies between 60 and 85 trains per day, depending on the season. Freight traffic is expected to increase in the future. The corridor is also an important AMTRAK route, with approximately 200 passengers per day boarding in downtown Flagstaff.

Land use south of the BNSF tracks is mixed residential and industrial, zoned RM-M-E, Multiple Family Residential District and I-1-E, Restricted Industrial District. Within the immediate vicinity of proposed Lone Tree Road north of Butler Avenue, there are three residential properties, two of which are rental properties. Industrial uses include a ready-mix concrete plant, a recycling facility, a garage, a tool manufacturing plant, and an RV repair shop. Commercial uses include a bail bond office, a chain saw supply shop, a firearms shop and a real estate office. Several properties are unimproved, either vacant or used for temporary storage of goods.

Plate 10 - Northland Recycling on Brannen Avenue

2.6.4 Planned Future Land Use

The City of Flagstaff has an approved General Plan that identifies the planned land uses within the study area. The planned land uses ("Mixed Use" and "Industrial Light/Medium") do not differ significantly from the existing land uses within the study limits. However, construction of the Lone Tree Overpass project provides the possibility to redevelop the adjacent land for uses more compatible with the adjacent residential areas to the west and the Aspen Place mixed-use development to the south.

2.7 Utilities

Both public and private utilities are in the project area. A combination of utility maps and field reconnaissance has located the utilities summarized in Table 2-4 on the following page and shown in Appendix D.

Many of the existing water and sewer lines in the project area are at least fifty years old; the water line in Brannen Avenue extending east beyond Lumber Street was reportedly built in 1906.

Table 2.4 Existing Utilities

Utility Owner	Utility Type	Location	Comments
City of Flagstaff	Water	Elden St.	There are three different water lines in Elden St. 1. 10 inch line built in 1952. 2. 2 inch line that comes off the 10 inch line. Built in 1906. 3. 1 inch line that comes off an 8 inch line that runs down Brannen Ave. Built in 1964.
		Colorado St.	6 inch line that extends approximately 100 feet to the south of Brannen Ave. Built in 1906. Remainder of 6 inch line north of Butler was abandoned in 2009.
		Brannen Ave.	8 inch line that runs down the middle of the road to Gabel St. This line was built in 1906 west of Colorado St., and in 1962 east of Colorado Street.
		Route 66	12 inch line that runs along the south side of the road. Built in 1990.
		Butler Ave.	Two different water lines running down Butler Ave. 1. 10 inch line, built in 1976 2. 30 inch line, built in 1991
City of Flagstaff	Sewer	Elden St.	8 inch line built in 1919 from Butler Ave. to Brannen Ave. transitioning into a 10 inch line built in 1978. The line flows from the south to the north. This line turns back into an 8 inch line, built in 1919, that crosses under the rail road spur.
		Brannen Ave.	8 inch line that was built in 1949. The line turns south and runs down an alley way in between Colorado St. and Gabel St. The sewer flows from east to west until it gets to Elden St. There is an 8 inch line built in 1949 that runs into the main line in an alley way between Elden and Colorado St.
		Alley way between Colorado St and Gable St.	6 inch line built in 1949. The line comes from Butler Ave. and runs into Brannen Ave. from an alley way that is between Colorado St. and Gabel St.
		Rio De Flag	8 inch line built in 1919. The line comes from Elden St. and connects into a 12 inch line that was built in 1950. The Rio De Flag flood control project will realign this part of the utility. Design is 60% at this point. This line flows from Elden St. (south) to the Rio De Flag (north) then down the Rio De Flag (east).
		Route 66	6 inch line that runs along the north side of the road. The line then crosses over to the south side of the road close to where the proposed intersection comes into Route 66.
Unisource Energy Services	Gas	Elden St.	2 inch low pressure line running along the west side of the street.
		Brannen Ave.	2 inch low pressure line running down the middle of the road. The line goes to Lumber St. via an alley way between Gabel St. and Lumber St. There are two 2 inch lines that branch off the Brannen Ave. line. The first is on Colorado St. that dead ends approximately 250 feet north of the Colorado intersection. The second is a 2 inch line that runs north after the alley way between Colorado St. and Gable St. This line dead ends approximately 150 feet north of Brannen Ave.
		Alley way between Colorado St and Gable St.	2 inch low pressure line that is a branch off of the Brannen line.
		Butler Ave.	6 inch high pressure line.
		Route 66	4 inch medium pressure line on the north side of the road.

Table 2.4 Existing Utilities (Cont.)

Utility Owner	Utility Type	Location	Comments
Arizona Public Service	Electric Power	Elden St.	Overhead secondary line on joint use poles with 10 overhead services on joint use poles. The line runs along the east side of the road and turns to the southeast and ends at Colorado St. The line also has a small section of underground secondary on the east corner of the Butler Ave. intersection. There is one street light at the south east corner of the Brannen Ave. intersection.
		Alley way between Colorado St and Gable St.	Overhead secondary line on joint use poles with 6 overhead services on joint use poles. The line runs along the east side of the alley. It also has two small sections of underground secondary just north of Butler Ave. that runs into adjacent properties. The alley also has an overhead primary line on poles that runs down the middle of the alley. On the primary overhead line there are two overhead transformers. The primary line turns to the east at Brannen Ave. and goes down another alley way to Gabel St.
		Brannen Ave.	Overhead secondary line on joint use poles. The line runs down the south side of the road. The line has a branch that runs south down an alley way between Elden St. and Colorado St. There are two light poles and one overhead transformer on this line. The very east side of Brannen there is an overhead primary line on APS poles. The line comes from the alley way at Gabel St. This line turns into an overhead secondary line that dead ends into a property with an overhead transformer.
		Rio De Flag area just north of Gabel St.	Overhead primary line on joint poles with an overhead transformer. The line runs north of Gabel St. and turns into an overhead secondary line on joint poles that runs in two different directions. The first is to the east approximately 200 feet and ends in a private property with overhead service. The second direction is south and ends in a private property with overhead service.
Qwest Communications	Telephone	Whole Area	Curtis "Skip" Bardsley stated that all their utilities are on joint poles with APS.
BNSF Railway Co.	Fiber Optic Communications	Runs along tracks to the south	The BNSF Railway CO. has a fiber optic line that runs along the south side of the tracks.
AT&T	Fiber Optic Communications	Route 66	There is a fiber optic line that runs down the south side of Route 66 that belongs to AT&T.
NPG Cable, Inc.	Cable Television	Did not respond	NPG Cable, Inc. did not provide any information. Cable Utilities in the area are assumed to be overhead with electric and telephone utilities.

3.0 Traffic Analysis

The traffic analysis tasks completed include the development of future traffic volume projections for 2030, intersection level of service calculation and preliminary recommendations for intersection lane geometry improvement.

To develop reasonable traffic volume projections, the traffic circulation pattern changes were first investigated with and without Lone Tree Overpass in place. The forecasted average daily traffic volumes for 2030 between the Lone Tree Overpass Build and No-Build scenarios were then compared. A screenline analysis was performed to estimate traffic diversion and travel patterns due to the construction of the Lone Tree Overpass. Based on the traffic diversion and travel pattern analysis, PM peak hour turning movement volumes were estimated for the Build and No-Build scenarios. The *Synchro 7.0* intersection level of service analysis was then conducted to evaluate the study intersections with design year 2030 traffic volumes. The preliminary lane geometry improvements at the study intersections were then identified.

3.1 Future Traffic Volumes

3.1.1 Average Daily Traffic Volumes

The Flagstaff Metropolitan Planning Organization's (FMPO) 2030 base travel demand model includes the associated socio-economic and planned development data for 2030. For the "No-Build" condition, there is no Lone Tree Overpass between Butler Avenue and Route 66. For the "Build' condition, the traffic forecasting model was updated with the proposed connection between Butler Avenue and Route 66. The design year 2030 daily traffic volumes were the output from the travel demand models. Figure 3.1 shows the 2030 average daily traffic volumes for the Lone Tree Road study area for both No-Build and Build conditions.

Utilizing the ADT projections, a screenline analysis was conducted to identify the traffic circulation pattern changes between the two scenarios. The BNSF railroad was used as the screen line. The underlying assumption was that with or without an overpass, the total north-south traffic demand crossing the railroad should be similar within the study area. The ADTs on the five parallel corridors of Milton Road, Beaver Street, San Francisco Street, Enterprise Road and Fourth Street crossing the railroad tracks were included in the screenline analysis..

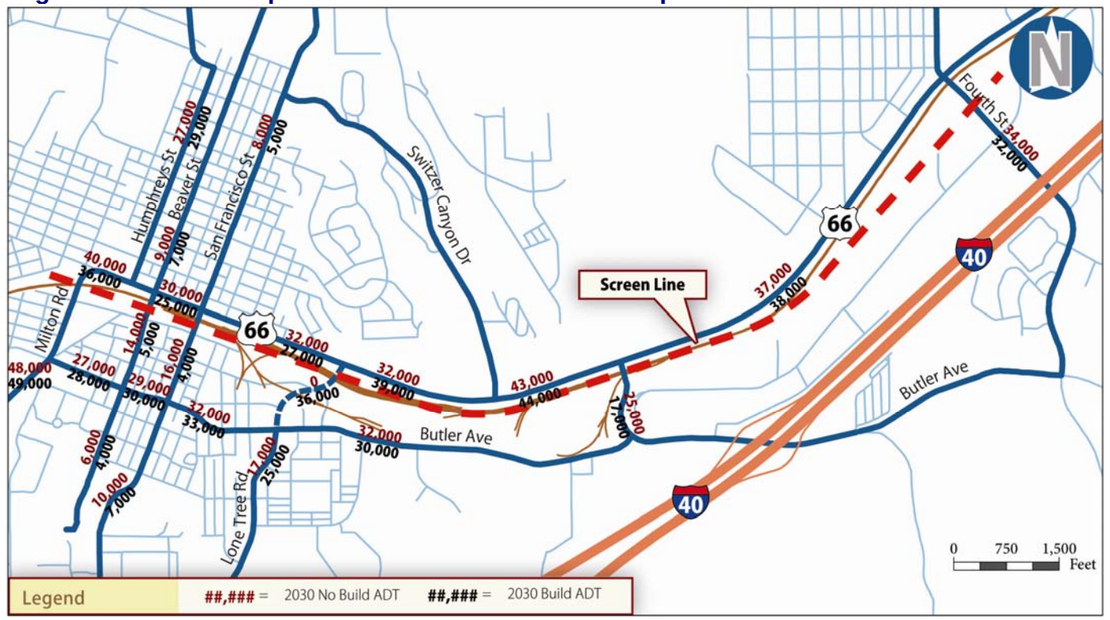
As shown in Figure 3.1, the 2030 ADT on the Lone Tree Overpass is projected to be 36,000 vpd, which equates to the total ADT reduction on the other five parallel roads. The traffic generated to use the Lone Tree Overpass was further investigated to determine its origin. It was found that approximately 60% of the traffic is from Beaver Street and San Francisco Street combined. Twenty percent (20%) of the Lone Tree Overpass traffic is from Enterprise Road. Fourth Street and Milton Road each contribute 10%. All the ADT reductions on the five parallel north-south corridors indicate that the Lone Tree Overpass provides supplemental capacity and benefits to these corridors and the study area.

In addition to benefitting the surrounding north-south corridors, the Lone Tree Overpass will alleviate traffic pressure on Route 66 west of Lone Tree Road traveling through the downtown area. The ADT reduction on this section of Route 66 ranged from 4000-6000 vpd. Also, Butler Avenue east of Lone Tree Rd is expected to carry 2,000 vehicles fewer per day.

However, the Lone Tree Overpass may have some negative impacts to Route 66 east of Lone Tree Road. The trips between East Flagstaff and the south Lone Tree Road area diverge to Lone Tree Overpass from Enterprise Road and Fourth Street. As a result, 7,000 more vehicles per day are expected to use Route 66 east of the Lone Tree Overpass. The capacity of Route 66, however, will not be exceeded due to the additional traffic.

The trips between East Flagstaff and the south Milton Road area are diverted to the Lone Tree Overpass instead of taking Route 66 through the downtown area. This may also increase the traffic pressure on Butler Avenue west of Lone Tree Road. The ADTs on this segment increased slightly compared to the No-Build condition.

Figure 3.1 ADT Comparison between Lone Tree Overpass Build and No-Build Conditions



3.1.2 PM Peak Turning Movement Volumes

The 24 hour counts collected in 2008 by the City of Flagstaff provided the data for design hour factor (K-Factor) and the directional factor (D-factor). These factors are summarized in Appendix C. The existing PM peak turning movement counts at each study intersection provided by City of Flagstaff also established the turning movement distribution patterns which were used to develop turning movement volumes at study intersections for the future year 2030 conditions.

The 2030 PM design hour approach volumes at each study intersection were derived by multiplying the existing K factor (percentage of peak hour traffic to the daily traffic) and D-factor (directional factor with the high amount of traffic in the peak direction) to the 2030 ADT. The design hour approach volumes were then adjusted and balanced out between the intersections.

Utilizing the balanced approach design hour volumes, 2030 turning movement volumes for the No-Build condition were developed by applying the existing turning movement distribution to replicate the existing traffic patterns.

For the Build condition, the turning movement distributions at the two intersections of Lone Tree Overpass and the intersection of Milton Road and Butler Avenue were adjusted based on the previously described traffic pattern analysis between the Build and No-Build conditions. The existing turning movement distributions and assumptions to derive the Build turning movement volumes are presented in Appendix C.

The PM peak turning movement volumes for 2030 No-Build and Build conditions are presented in Figures 3.2 and 3.3, respectively.

3.2 Intersection Level of Service and Improvement

The LOS analysis for signalized intersections was performed utilizing the methodology presented in the 2000 Highway Capacity Manual. This method uses the critical volumes passing through the intersection in one hour and compares those volumes to the capacity of the intersection and an associated delay. The analysis incorporates the effects of traffic volumes, geometry, traffic signal operation, truck and local bus volumes, pedestrian activity, and peaking characteristics. The result is a LOS determination for each approach and for the intersection as a whole. The capacity criteria are presented in terms of average vehicle delay in Table 3.1.

Table 3.1 Capacity Criteria for Signalized Intersections

Level of Service (LOS)	Control Delay per Vehicle (sec)
A	less than 10
B	10.1-20
C	20.1-35
D	35.1-55
E	55.1-80
F	over 80

*Source: Highway Capacity Manual

Synchro 7 software program was used for the LOS analysis. Most of the input parameters are either from assumptions or the default values from the software. The actuated-coordinated signals setup was utilized for all the intersections with the east-west direction being coordinated. The input parameters can be found in the *Synchro* HCM report provided in Appendix C.

3.2.1 PM Peak No-Build Condition

The No-Build PM Peak LOS and the needed intersection improvements to obtain the required LOS D are presented in Figure 3.2. The detailed approach LOS, delay and queue length are summarized in *Synchro* HCM report provided in Appendix C. With the existing intersection configurations and 2030 volumes, the intersection of Route 66 at Beaver Street and San Francisco Street as well as Butler Avenue intersections at Beaver Street and San Francisco Street are expected to experience LOS C or better.

To accommodate the future No-Build volumes, the intersections of Lone Tree Road at Butler Avenue, Humphreys Street at Route 66 and Milton Road at Butler Avenue need capacity improvements. At Lone Tree Road and Butler Avenue, an additional left turn lane is needed for both northbound and westbound approaches. At Humphreys Street and Route 66, an additional turn bay is needed for the southbound left turn and right turn movements. An additional left turn bay is needed for the eastbound left turn movement. At Milton Road and Butler Avenue, one additional through lane is needed for both northbound and southbound approaches to accommodate the heavy through movement volumes. One additional left turn bay and one additional through lane are needed for the eastbound approaches. With these improvements constructed, the necessary LOS D can be obtained at these three intersections. The recommended intersection lane geometry for the 2030 No-Build condition are summarized in Table 3.2.

Table 3.2 Recommended Intersection Lane Geometry for 2030 No-Build Condition

Intersection	Approach Movement	SB Left	SB Thru	SB Right	NB Left	NB Thru	NB Right	EB Left	EB Thru	EB Right	WB Left	WB Thru	WB Right
Lone Tree & Butler	Add. Num. of Lanes	--	--	--	1	--	--	--	--	--	1	--	--
	Length (ft)	--	--	--	200	--	--	--	--	--	350	--	--
Humphreys & Route 66	Add. Num. of Lanes	1	--	1	--	--	--	1	--	--	--	--	--
	Length (ft)	150	--	250	--	--	--	400	--	--	--	--	--
Milton & Butler	Add. Num. of Lanes	--	1	--	--	1	--	1	1	--	--	--	--
	Length (ft)	--	--	--	--	--	--	250	--	--	--	--	--

3.2.2 PM Peak Build Condition

The intersection LOS analysis for the 2030 Lone Tree Overpass Build condition was completed with the new Lone Tree Overpass alignment and the projected 2030 PM peak turning movement volumes. The required intersection lane geometry improvements to obtain LOS D are identified in Table 3.3 and in Figure 3.3. Figure 3.3 shows the intersection LOS and the recommended intersection lane geometry configuration. The *Synchro* HCM report provided in Appendix C shows the detailed metrics for approach LOS, delay and queue length.

With the recommended intersection improvements, all the intersections are expected to provide LOS D or better during the 2030 PM peak hour. Especially, the LOS for the Route 66 study intersections at Humphreys Street, Beaver Street and San Francisco Street may improve to LOS C or better, which is one level better than No-Build condition.

The Brannen Avenue intersection at Lone Tree Road is planned to function as a one-way stop-controlled

intersection. Lone Tree Road will set up as the free flow condition. One left turn bay 50 feet long is recommended for the Lone Tree Road northbound approach.

Table 3.3 presents the lane geometry needed to obtain LOS D for the 2030 Build condition.

Table 3.3 Intersection Improvements for Build Condition

Intersection	Approach	SB			NB			EB			WB		
	Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lone Tree & Route 66	Add. Num. of Lanes	--	--	--	2	--	2	--	--	1	2	--	--
	Length (ft)	--	--	--	150	--	50	--	--	100	250	--	--
Lone Tree & Butler	Add. Num. of Lanes	--	--	--	1	1	--	1	--	1	1	--	--
	Length (ft)	--	--	--	150	--	--	200	--	--	150	--	--
Lone Tree & Brannen	Add. Num. of Lanes	--	2	Shared	1	2	--	1	--	1	--	--	--
	Length (ft)	--	--	--	50	--	--	50	--	-	--	--	--
Humphreys & Route 66	Add. Num. of Lanes	1	--	1	--	--	--	1	--	--	--	--	--
	Length (ft)	150	--	150	--	--	--	250	--	--	--	--	--
Milton & Butler	Add. Num. of Lanes	--	1	1-	--	1	--	1	1	--	--	--	--
	Length (ft)	--	--	50	--	--	--	200	--	--	--	--	--

Figure 3.2 2030 No-Build Condition Traffic Volumes, LOS and Recommended Lane Geometry

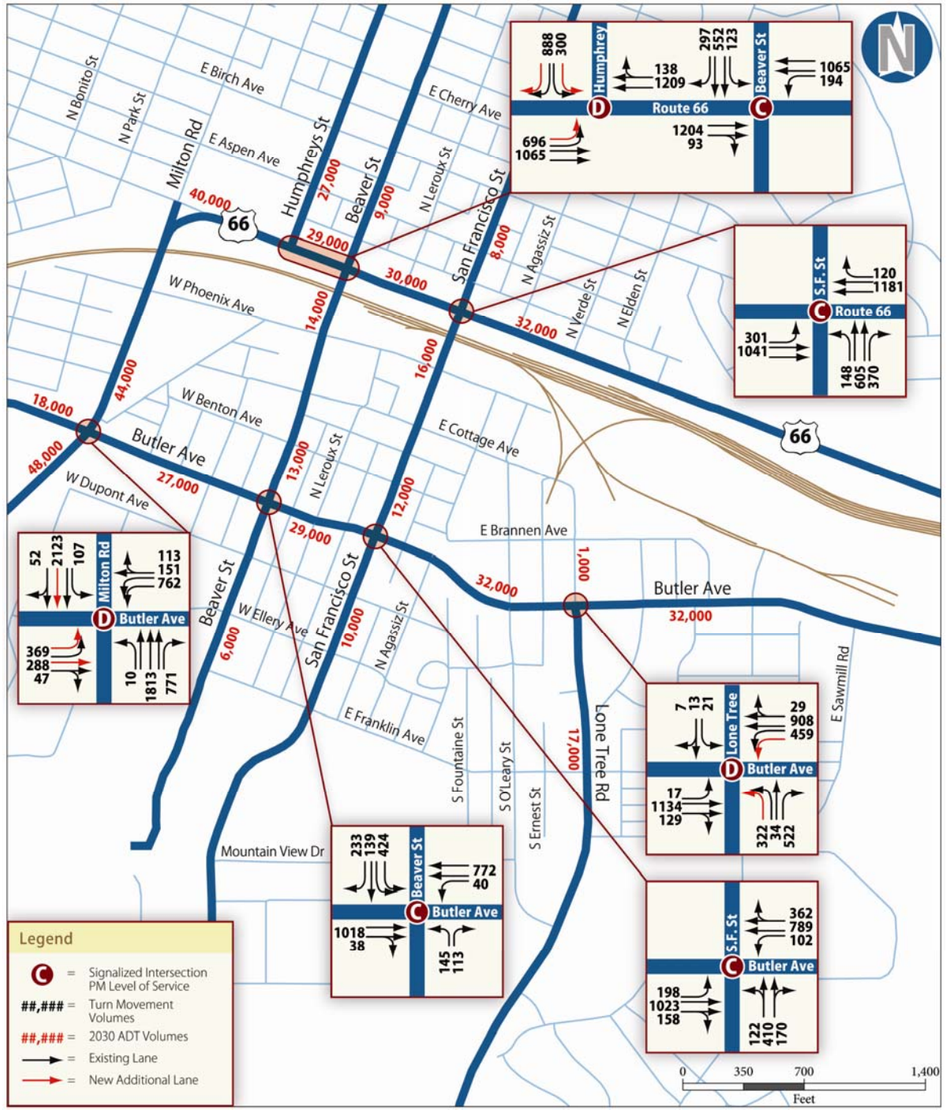
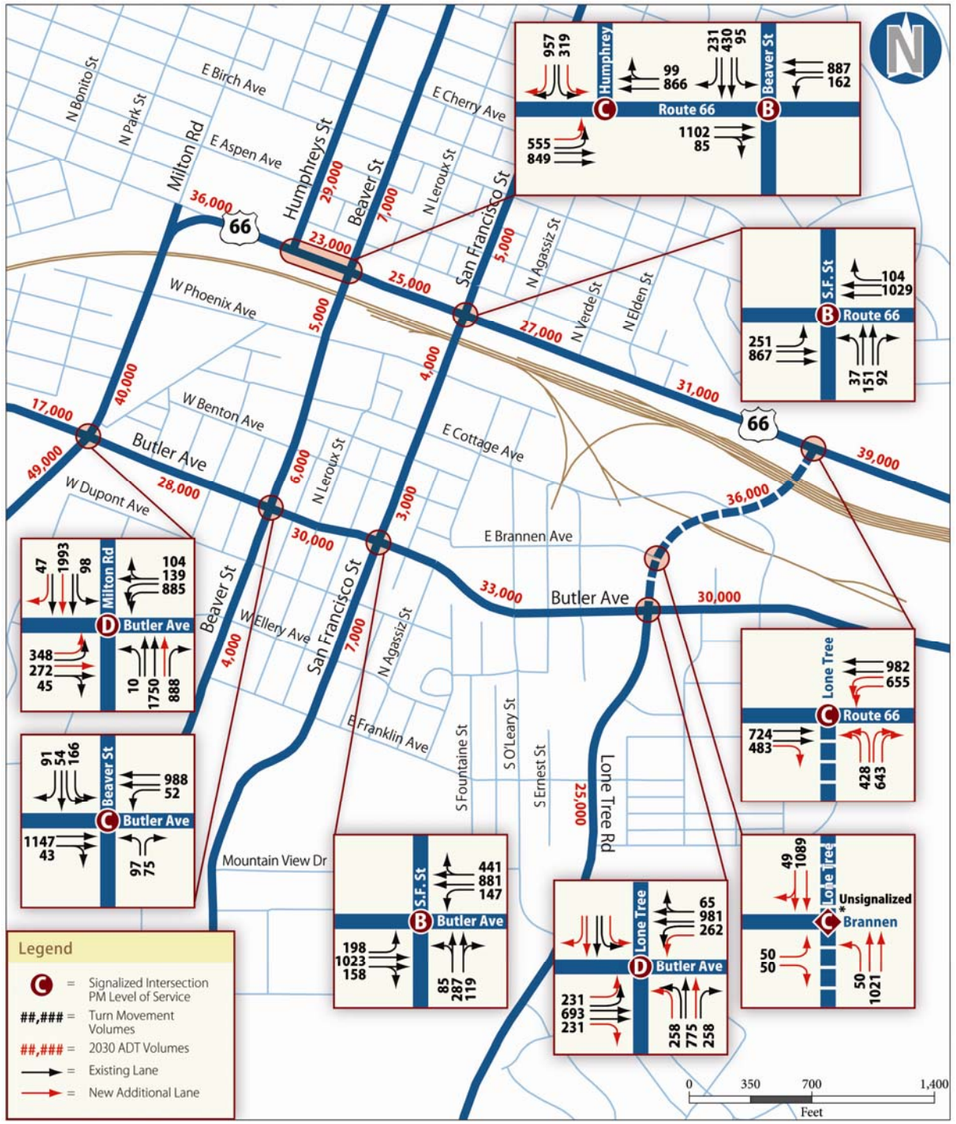


Figure 3.3 2030 Build Condition Traffic Volumes, LOS and Recommended Lane Geometry



4.0 Design Alternatives

4.1 Project Controls

4.1.1 Roadway Controls

As previously described, the south leg of the Lone Tree Road-Butler Avenue intersection was reconstructed approximately 360 ft to the east of its former alignment. This new intersection fixes the elevation and northward alignment of Lone Tree Road. The northern end of Lone Tree Road is relatively fixed by the need to intersect Route 66 near its highest point on a crest vertical curve to take advantage of the elevation difference between Route 66 and the railroad tracks.

Other roadway controls include the following:

1. The minimum vertical clearance over the BNSF tracks is 23 feet 6 inches from top of rail to soffit of structure.
2. The minimum vertical clearance over the proposed Paramount industry spur is 22 feet 6 inches from top of rail to soffit of structure.
3. The minimum vertical clearance over the proposed east-west collector street beginning at the intersection of Cottage Avenue and Elden Street and ending at the intersection of Lumber Street and Butler Avenue, hereafter called the Elden Street Extension, is 14 ft from the edge of the traveled way.
4. The Brannen Avenue profile must meet an existing driveway approximately 200 ft west of Lone Tree Road to maintain access.

4.1.2 Railroad Controls

The proposed railroad relocation is physically constrained by Route 66 on the north, San Francisco Street on the west, Enterprise Road on the east and by the Rio de Flag. As previously discussed, the US Army Corps of Engineers is currently finishing design plans to construct a large open channel along the alignment of the historic Rio de Flag, as well as a closed-conduit drainage system upstream through Flagstaff. Other controls include active spur tracks to BNSF clients and the wye track. BNSF operational controls include requirements to minimize interruptions to mainline service during line over and to maintain siding tracks and storage tracks in service during the railroad relocation or replace them in kind before their removal.

Route 66 and the Rio de Flag define a narrow band of land ranging from 200 ft to 300 ft wide for relocation of the railroad tracks. Because the existing tracks are approximately in the center of this band, their maximum horizontal displacement is limited to approximately 70 ft on either side. In comparison, the Fourth Street Railroad Crossing relocated the two mainline tracks a maximum of approximately 400 ft away from the existing tracks.

Complicating the relocation is the difference in grade between existing and relocated tracks. Because the tracks will be lowered, requirements for lateral drainage ditches and 2:1 cut slopes recommended in the geotechnical report increase the space required between existing and relocated tracks in order to avoid shoring.

The existing railroad tracks are a major constraint to relocation because of their number (four to six tracks) and the need to keep them in operation during construction or replace them in kind before being taken out of service. This requirement will require separate (in time) line over operations for siding and storage tracks and for mainline tracks. Again, by way of comparison, the Fourth Street Railroad Crossing relocated only two tracks that required only one line over operation per track.

4.2 Roadway Alternatives

In order to provide the required vertical clearance between the railroad tracks and the grade separation structure, construction of Lone Tree Road between Butler Avenue and Route 66 requires 1) raising only Route 66; 2) lowering only the railroad tracks; or 3) a combination of both. Raising only Route 66 was considered during development of the LTCS but was rejected early in the study process. The Preferred Alternative described in the LTCS adopted the third alternative, raising Route 66 by several feet and lowering the railroad tracks by approximately 14 ft.

In developing the grade separation alternatives for this study, it was decided to try to hold the existing grade on Route 66 and lower the railroad tracks. The maximum depth of vertical relocation shown in the LTCS would be maintained (or reduced) by using a 6-ft deep cast-in-place post-tensioned box girder bridge. It was decided not to raise Route 66 for the following reasons: 1) possible disruption of drainage patterns on adjacent properties; 2) difficulty of maintaining traffic on Route 66 during construction; and 3) adverse impacts to business access during construction.

The Lone Tree Road Preferred Alternative horizontal alignment was essentially unchanged for this study since it met the controls imposed upon the site. Development of the profile, however, showed the following alternative alignments:

1. The location of the Elden Street Extension where shown in the Preferred Alternative, with a 6-ft deep structure and 14-ft vertical clearance, resulted in a grade of over 7% approaching Butler Avenue.
2. Eliminating the Paramount spur but keeping the Elden Street Extension as above did not reduce the grade approaching Butler Avenue.
3. Eliminating the Paramount spur and the Elden Street Extension resulted in a grade of approximately 5% approaching Butler Avenue.
4. Relocating the Elden Street Extension next the relocated Paramount spur resulted in a grade of approximately 5.5% approaching Butler Avenue.

The first two alternatives were rejected because of the steep 7% grade. The third alternative would require elimination of the new Paramount spur by either relocating Paramount Petroleum or constructing a pumping station west of the Lone Tree Overpass for delivery of liquid asphalt by pipeline. Relocation was not considered a realistic option at this time because of the possible cost, although it may be by the City at a later time. The pump station alternative was discussed with Paramount Petroleum on two separate occasions; however Paramount Petroleum ultimately rejected the proposal because of the constraints it would place on the company's operations.

As of now the Paramount spur will be reconstructed. Therefore locating the Elden Street Extension next to

it takes advantage of the vertical clearance requirement of the spur and reduces the length of the overpass structure.

4.3 Railroad Alternatives

Three alternative railroad alignments were developed for evaluation: 1) Alternative 1-North Alignment; 2) Alternative 2-South Alignment; and 3) Alternative 3-South Alignment with Shoofly. All three alternatives were developed according to BNSF design criteria, standard track cross-sections and the following assumptions:

1. The north siding and north storage track may be removed during construction and replaced after other track work is completed.
2. The south siding and south storage track must be replaced in kind before taken out of service.
3. Per BNSF, the minimum track requirements at the overpass structure include:
   a. Main 1
   b. Main 2
   c. Space for future Main 3
   d. South siding track
   e. A maintenance road on either the north side or the south side of the tracks
4. Alternatives 1 and 2 can be constructed without a shoofly for the mainline tracks.
5. Design speeds range from 55 mph/50 mph passenger trains/freight trains at the east end to 45 mph/40 mph passenger trains/freight trains at the west end.
6. Cut and fill slopes are assumed to be 2:1 per the geotechnical report.
7. The minimum vertical clearance is 23 feet 6 inches between the top of rail and the soffit of the structure.
8. The minimum horizontal clearance is 25 ft between the centerline of a track and the face of a pier or abutment unless a crash wall is constructed on the face of the pier or abutment.

All railroad relocation begins approximately 1,350 ft west of Enterprise Road at railroad Station 17626+00± and end approximately 400 ft east of San Francisco Street at Station 17672+00±, a distance of approximately 4,600 ft. (Stationing shown on the plans is local stationing used for this study. The alignments begin at Station 10+00 = BNSF Station 17622+83, approximately.) Main line horizontal geometric parameters are shown in Table 4.1. The curve number increases from east to west. Track spacing and cross sections are shown in Figure 4-1.

Table 4.1 Horizontal Geometric Parameters for Main Line Alignments

Parameter	Curve No. 1		Curve No. 2		Curve No. 3		Curve No. 4	
Alignment[1]	North	South	North	South	North	South	North	South
Speed, mph P/F[2]	55/50	55/50	55/50	55/50	45/40	45/40	45/40	N/A
Degree of Curve	2° 20'	2° 45'	1° 40’	2° 00'	1° 20'	0° 30'	0° 45'	N/A
Radius, ft	2455.70	2083.68	3437.87	2864.93	4297.28	11459.19	7639.49	N/A
Spiral, ft	140.00	200.00	60.00	90.00	50.00	50.00	50.00	N/A
Superelevation, inches	2-1/4	3-0	1-0	1-1/2	0-3/4	0-3/4	0-3/4	N/A

[1] North = Alternative 1; South = Alternatives 2 and 3; Shoofly track uses north alignment
[2] P/F = Passenger/Freight

4.3.1 Alternative 1- North Alignment

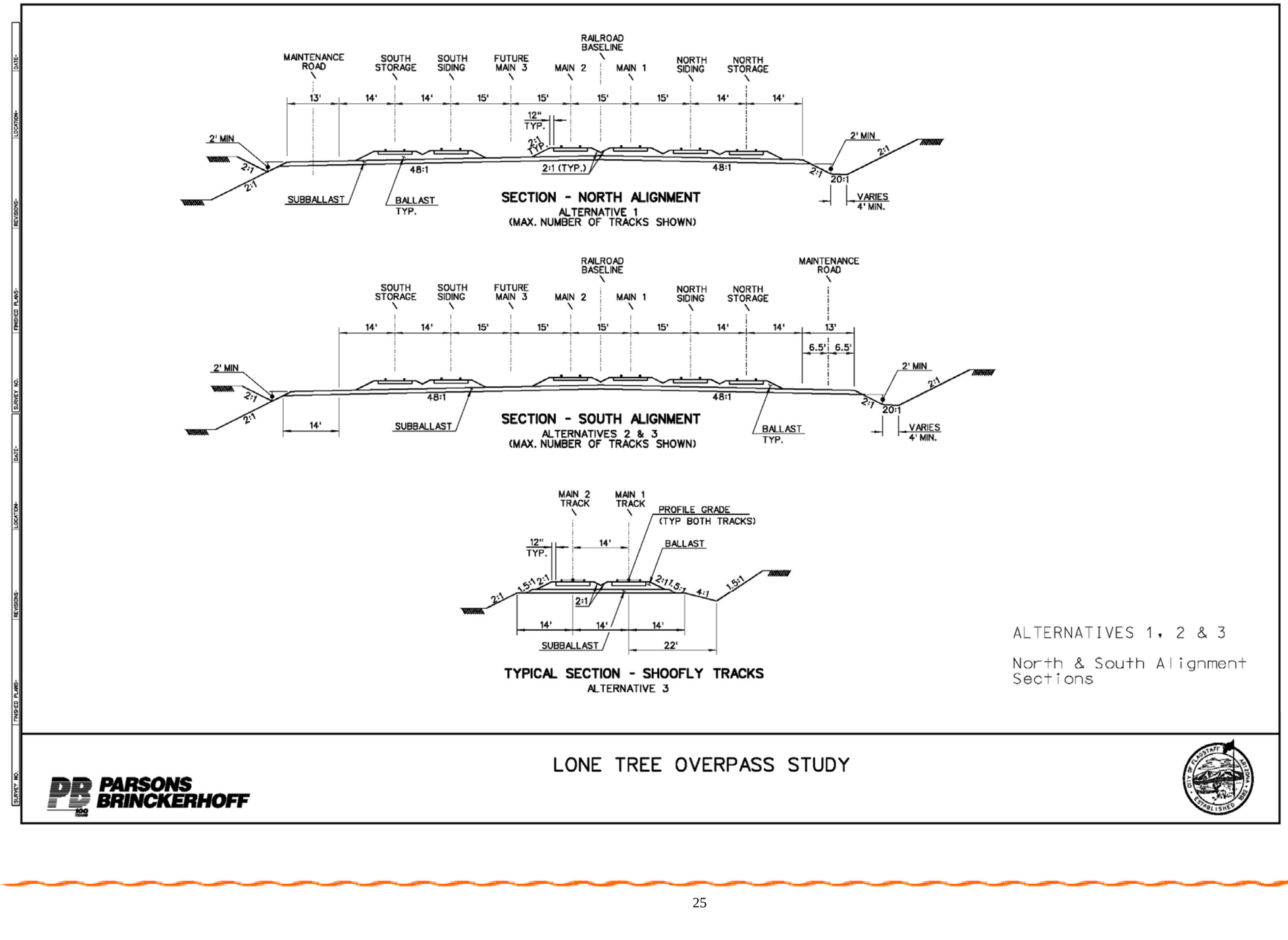
Description

Alternative 1 relocates the railroad tracks on the north side of the existing tracks. The maintenance road is located on the south side of the relocated tracks. See the plan sheets in Appendix A at the back of this report for plan and profile of Alternative 1.

The horizontal alignment consists of four horizontal curves (with spirals) ranging from 2° 20’ at the east end of the alignment to 0° 45’ at the west end. There are three vertical curves (two crest curves and one sag curve) ranging in length from 1,700 ft to 500 ft. The low point in the sag curve is drained by a 36-inch diameter RCP culvert to the Rio de Flag. There is not enough space between the new tracks and Route 66 to drain the low point by ditch to Switzer Canyon Wash.

Because of the close proximity to Route 66, Alternative 1 requires construction of approximately 2,700 lineal feet of retaining wall, ranging from 4 ft in height at the east and west ends to approximately 31 ft in height at the overpass. The total wall area is estimated to be approximately 50,000 square feet. It is assumed that the retaining walls would be built by using soil nails to stabilize the cut slope as it is excavated and then constructing the vertical reinforced concrete wall. An alternative construction method uses closely-spaced drilled shafts followed by excavation and construction of the reinforced concrete walls. This method was used in constructing the Arizona Canal Diversion Channel in urban areas of Metropolitan Phoenix.

Figure 4.1 Track Spacing



Construction Sequence

1. Construct retaining walls north of existing tracks
2. Remove north storage and north siding tracks
3. Construct new Main 1, Main 2 and new north siding track (shoring required)
4. Line over mainline traffic to new main tracks; line over north siding track
5. Remove old Main 1 and Main 2
6. Construct new south siding and south storage tracks (shoring required)
7. Line over new south siding and south storage tracks to existing tracks
8. Remove old south siding and south storage tracks

Construction of Alternative 1 requires placing approximately 800 ft of temporary shoring between Station 26+00 and Station 34+00 to construct the new mainline tracks. It also requires approximately 900 ft of temporary shoring between Station 43+00 and Station 52+00 to construct the new south siding and south storage tracks. Per BNSF requirements, shoring will have to be designed for railroad load surcharge, signed and sealed by a registered engineer and reviewed and approved by BNSF. Figure 4.2 shows an example of retaining walls and shoring required for Alternative 1.

Advantages

Alternative 1 has the following advantages:

1. Does not require mainline shoofly tracks.
2. Maintains the wye track in operation.
3. Minor reconnection of existing industrial spur tracks to new siding track.
4. Relatively short lengths of shoring.
5. Minimal impact to adjacent non-BNSF properties.
6. Improves mainline horizontal geometry by reducing a 3° 00’ curve to 2° 20’ and a 4° 00’ curve to a 1° 40’ curve.
7. Shortens the length of the existing 1.24% grade at the east end of the alignment by over 1,000 ft; other new grades are less than 1.00%.
8. Space for future Main 3 is approximately 3,450 ft long.

Disadvantages

Alternative 1 has the following disadvantages:

1. Requires long, high and expensive retaining walls.
   a. Walls require periodic inspection and repair, including anti-graffiti coatings or paint.
   b. Maintenance of retaining walls may be the City’s responsibility under a Construction and Maintenance Agreement with BNSF.
   c. Soil nails may not be appropriate next to Route 66.
2. Proximity to Route 66 limits length of new north storage track.
3. Overpass structure is longest of three alternatives.
4. North abutment requires special design.
5. North abutment of the overpass structure is very close to Route 66.
6. Route 66 must be widened symmetrically about centerline because of the proximity of the north abutment to Route 66.
   a. Requires removing and replacing existing sidewalk, curb and gutter, driveways and catch basins on north side of roadway, and extension of storm drains to connect to inlets.
   b. Will cause some loss of parking to adjacent buildings.
   c. Requires more extensive traffic control measures during construction than other alternatives.
7. Restricted space for FUTS trail under overpass structure; essentially at same elevation as railroad tracks and next to bridge abutment.
8. Drainage of low point on profile is to Rio de Flag via culvert under tracks.
9. Requires reconstruction of part of drainage channel along north side of tracks opposite Switzer Canyon Drive (outfall of Route 66 storm drain).
10. Introduces an additional horizontal curve to the alignment.

4.3.2 Alternative 2 - South Alignment

Description

Alternative 2 relocates the railroad tracks on the south side of the existing tracks. The maintenance road is located on the north side of the relocated tracks. The plan and profile of Alternative 2 are provided in Appendix A.

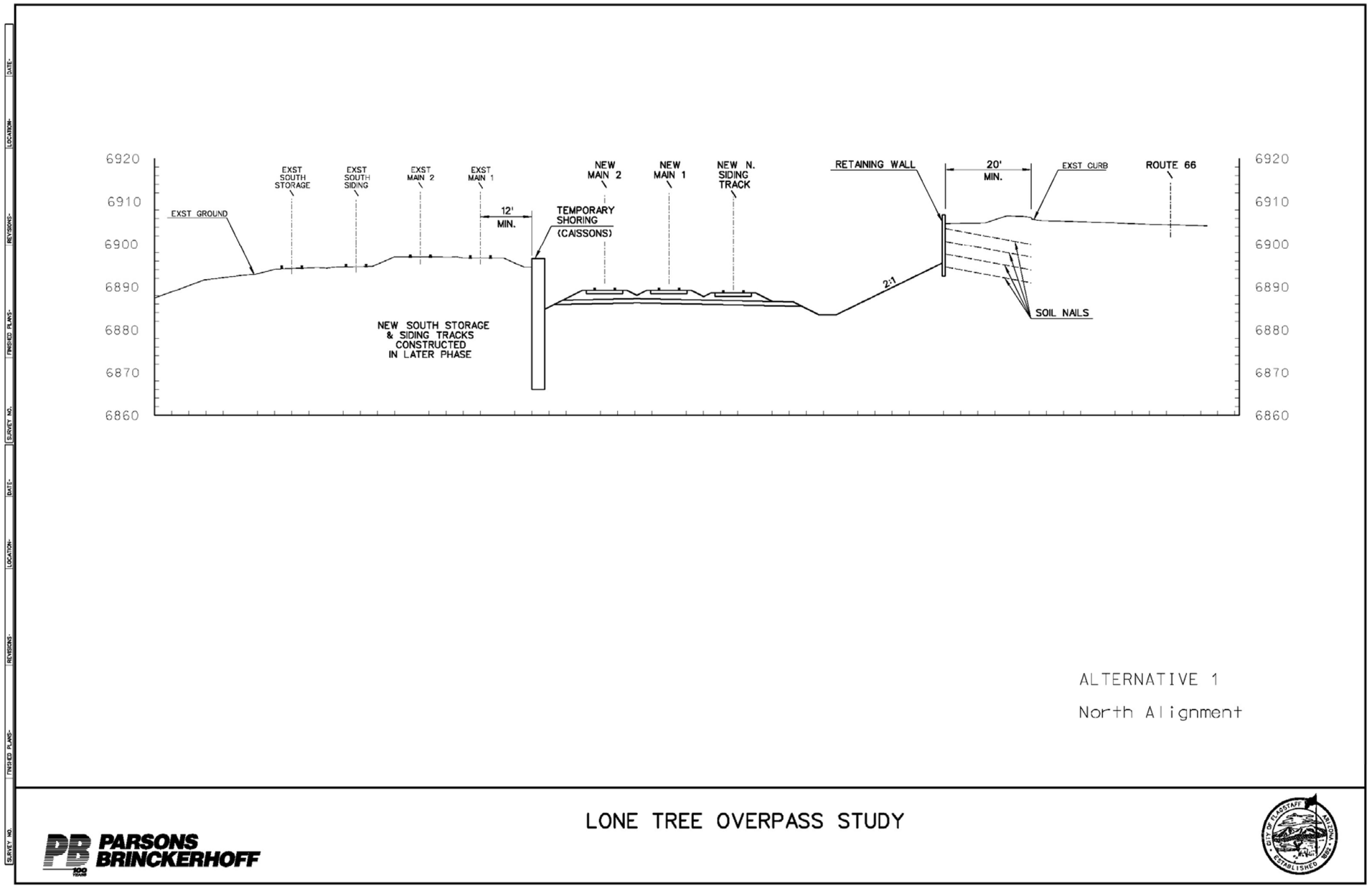
The horizontal alignment consists of three horizontal curves (with spirals) ranging from 2° 45’ at the east end of the alignment to 0° 30’ at the west end. There are three vertical curves (two crest curves and one sag curve) ranging in length from 1500 ft to 500 ft. The low point in the sag curve can be drained eastward in a ditch to Switzer Canyon Wash.

Alternative 2 does not require construction of retaining walls along Route 66 but will require approximately 400 lineal feet of low wall approximately 4 to 5 feet high along the north side of the proposed Rio de Flag drainage channel between Station 36+50 and Station 40+50. The wall is required to retain the fill slope from the new south storage track; it will be a regular cast-in-place concrete cantilever retaining wall.

Construction Sequence

1. Construct retaining walls along Rio de Flag drainage channel
2. Construct new south siding and south storage track
3. Line over new south siding and south storage tracks to existing tracks
4. Remove old south siding and storage tracks
5. Construct new Main 1 and Main 2
6. Line over new Main 1 and Main 2 to existing mainline tracks
7. Remove old Main 1 and Main 2
8. Construct new north siding and north storage tracks

Figure 4.2 Shoring and Retaining Wall



Construction of Alternative 2 requires approximately 700 lineal feet of temporary shoring between Station 37+00 and Station 44+00 to construct the new south siding and south storage tracks. It also requires approximately 1,800 lineal feet of temporary shoring between Station 32+00 and Station 50+00 to construct the new mainline tracks. Alternative 2 will require the same design, review and approval requirements for temporary shoring as Alternative 1.

Advantages

Alternative 2 has the following advantages:

1. Does not require mainline shoofly tracks.
2. Retaining wall height and area are much less than Alternative 1.
3. Retaining wall construction is conventional cantilever wall.
4. Improves mainline horizontal geometry by reducing a 3° 00’ curve to 2° 45’ and a 4° 00’ curve to a 2° 00’ curve.
5. Shortens the length of the existing 1.24% grade at the east end of the alignment by over 1,000 ft; other new grades are less than 1.00%.
6. Length of new south storage track is same as existing.
7. Length of north storage track is greater than Alternative 1.
8. Space for north siding track to pass under the bridge.
9. The wye track can be reconstructed to maintain locomotive turnaround capability.
10. No impact to existing off-site drainage facilities.
11. North side of new tracks including low point on profile can be drained by open channel to Switzer Canyon Wash.
12. Overpass structure is shorter than that of Alternative 1.
13. North abutment does not require special design.
14. Route 66 can be widened entirely to the south:
    a. No disruption to existing sidewalk, driveways or catch basins along the north side of the roadway.
    b. Storm drain system on the north side of the road stays intact.
    c. Widening about one side only improves traffic control during construction.
    d. No loss of parking to adjacent businesses.
10. FUTS trail can be located between north abutment and Pier 1, above and away from the railroad tracks.

Disadvantages

Alternative 2 has the following disadvantages:

1. More temporary shoring required than Alternative 1.
2. Length of future Main 3 is approximately 2,100 ft, less than provided by Alternative 1.
3. Connection of new siding tracks to existing industrial spur tracks and BNSF sidings require more track work than Alternative 1.
4. More impacts to adjacent non-BNSF property than Alternative 1.

4.3.3 Alternative 3 - South Alignment with Shoofly

Description

Alternative 3 relocates Main 1 and Main 2 to shoofly tracks using the horizontal alignment of Alternative 1 while constructing the new mainline tracks on the horizontal and vertical alignment of Alternative 2. See Appendix A for the shoofly plan and profile. This alternative was developed in order to reduce the length of shoring between new construction and existing tracks and to facilitate construction of the overpass structure.

Construction Sequence

1. Construct retaining walls along Rio de Flag drainage channel
2. Construct mainline shoofly and line over Main 1 and Main 2
3. Construct trackwork to use existing Main 2 as temporary south siding and existing south siding as temporary south storage
4. Construct new south siding and south storage track
5. Line over new south siding and south storage tracks to existing tracks
6. Remove old south siding and storage tracks.
7. Construct new Main 1 and Main 2
8. Line over new Main 1 and Main 2 to existing mainline tracks
9. Remove shoofly old Main 1 and Main 2

Existing Main 2 and the existing south siding are used as temporary siding and storage tracks, respectively, to avoid constructing approximately 700 lineal feet of temporary shoring between Station 37+00 and Station 44+00.

Advantages

Alternative 3 has the following advantages:

1. Shoring next to railroad tracks not required (at this level of detail).
2. Retaining wall height and area are much less than Alternative 1.
3. Retaining wall construction is conventional cantilever wall.
4. Improves mainline horizontal geometry by reducing a 3° 00’ curve to 2° 45’ and a 4° 00’ curve to a 2° 00’ curve.
5. Has one less horizontal curve than Alternative 1.
6. Shortens the length of the existing 1.24% grade at the east end of the alignment; other new grades are less than 1.00%.
7. Length of new south storage track is same as existing.
8. Length of new north storage track is same as existing.
9. Space for north siding track to pass under the bridge.
10. The wye track can be reconstructed to maintain locomotive turnaround capability.
11. No impact to existing off-site drainage facilities.
12. North side of tracks including low point on profile can be drained by open channel to Switzer Canyon Wash.

13. Overpass structure is shorter than that of Alternative 1.
14. North abutment does not require special design.
15. Route 66 can be widened entirely to the south:
    a. No disruption to existing sidewalk, driveways or catch basins along the north side of the roadway.
    b. Storm drain system on the north side of the road stays intact.
    c. Widening about one side only improves traffic control during construction.
    d. No loss of parking to adjacent businesses.
13. FUTS trail can be located between north abutment and Pier 1, above and away from the railroad tracks.

Disadvantages

Alternative 3 has the following disadvantages:

1. Requires constructing two mainline shoofly tracks designed for existing passenger and freight train speeds. The shooflys will require more lineovers.
2. Length of future Main 3 is approximately 2,100 ft, less than Alternative 1.
3. Connection of new siding tracks to existing industrial spur tracks to ProBuild and Paramount require more track work than Alternative 1.
4. More impacts to adjacent non-BNSF property than Alternative 1.

As noted above, the spur tracks to ProBuild and Paramount have to be reconstructed to connect them to the new south siding track. If they can be taken out of service during construction of the new south siding and south storage tracks, then the third step of the construction sequence previously described can be eliminated. In the case of ProBuild, deliveries can be made by truck and the owner compensated for any extra cost.

According to Paramount, asphalt deliveries are rarely made during the three months of December, January and February, but if necessary, they can be made by tanker truck. Based on experience with the Fourth Street Railroad Crossing project, BNSF does not do track work during the fourth quarter of the calendar year. However, this may only apply to mainline tracks, not auxiliary tracks that are not connected to the mainlines. Table 4.2 shows a comparison of the three track relocation alternatives.

Table 4.2 Comparison of Railroad Relocation Alternatives

Point of Comparison	Alt. 1	Alt. 2	Alt. 3
Reduces sharpness of existing horizontal curves	Yes	Yes	Yes
Increases number of horizontal curves	Yes	No	No
Reduces length of 1.24% grade	Yes	Yes	Yes
Increases number of vertical curves	Yes	Yes	Yes
Drainage of low point in sag curve	Culvert	Channel	Channel
Wye track stays in service	Yes	Yes	Yes
Feasible to construct north siding through bridge	No	Yes	Yes
Impacts to adjacent (non-BNSF) property	No	Yes	Yes
Length of retaining wall (Railroad)	2,700 ft	None[1]	None[1]

Table 4.2 (Cont.)

Point of Comparison	Alt. 1	Alt. 2	Alt. 3
Length of retaining wall (Rio de Flag channel)	None	400 ft	400 ft
Length of shoring for railroad construction	1,700 ft	2,500 ft	None[1]
Number of main track lineovers required	4	4	8
Number of auxiliary track lineovers required	5	5	9
Length of new north storage track	800 ft	2,100 ft	2,100 ft
Length of new south storage track	1,450 ft	2,100 ft	2,100 ft
Length available for future Main 3	3,450 ft	2,100 ft	2,100 ft
Estimated railroad construction cost	Highest	Middle	Lowest

[1] To level of detail of this study

The estimated difference in construction cost between the three alternatives is primarily due to three items: 1) retaining walls; 2) shoring; and 3) shoofly track. Other differences are minor when compared to these three items. Table 4.3 shows the estimated cost differentials.

Table 4.3 Estimated Cost Differential Comparison of Railroad Alternatives

Item	Alternative 1	Alternative 2	Alternative 3
Retaining Walls	$ 3,800,000	$ 200,000	$ 200,000
Shoring	$ 4,000,000	$ 6,000,000	$ 0
Shoofly Track[1]	$ 0	$ 0	$ 1,700,000
Estimated Total	**$ 7,800,000**	**$ 6,200,000**	**$ 1,900,000**

[1] Includes difference in number of lineovers

4.4 Recommended Alternatives

All three alternatives are constructible options for accommodating the extension of Lone Tree Road from Butler Avenue to Route 66. However, Alternative 3 - South Alignment with Shoofly, is judged to provide the most benefit to BNSF and the City at the least cost and is therefore the recommended alternative. Some of the direct benefits to be provided to BNSF include:

1. Over 8,000 ft of new mainline track constructed to the most current BNSF standards
2. Over 8000 ft of new siding tracks and 4,000 ft of new storage tracks
3. New spur track to Paramount Petroleum
4. Reconstruction of the wye track, including the tail track
5. Flatter horizontal curves than existing curves, including the shoofly
6. Shorter length of steep grade at east end of alignment
7. Improved drainage of the north side of the tracks by open channel to Switzer Canyon Wash

Connecting Lone Tree Road to Route 66 will provide Flagstaff with another grade-separated crossing of the railroad tracks. Traffic models calculate that this connection will reduce traffic on at-grade crossings at Beaver Street, San Francisco Street and Enterprise Road by several thousand vehicles per day by 2030, benefiting BNSF by reducing the chance for car-train collisions and benefiting the City by reducing congestion on Milton Road and other city streets.

5.0 Major Design Features of the Recommended Alternative

This section describes the major features associated with the proposed design of Lone Tree Road, Route 66, the Elden Street Extension and Brannen Avenue and recommended railroad relocation alternative, Alternative 3 – South Alignment with Shoofly. A General Plan of the Recommended Alternative is shown in Figure 5.1.

5.1 Roadways

5.1.1 Lone Tree Road

5.1.1.1 Design Criteria

The design criteria for Lone Tree Road were established using the City of Flagstaff *Engineering Design and Construction Standards and Specifications* (EDCS) (2004) and the *AASHTO Policy on Geometric Design of Highways and Streets* (2009). Selected design criteria for Lone Tree Road are summarized in Table 5.1

Table 5.1 Lone Tree Road Design Criteria

Design Feature	Criterion
Roadway	Lone Tree Road
Standard Typical Section	Urban Minor Arterial
Design Speed	35 mph
Posted Speed	30 mph
Design Vehicle	WB-50
Lanes Widths	Travel Lanes: 12 ft Turn Lanes: 11 ft Bicycle Lanes: 4.5 ft
Median	26 ft
Raised Median	4 ft minimum, 26 ft maximum
Sidewalks	SB: 10 ft (FUTS) NB: 6 ft
Parkway	5 ft
Roadway Cross Slope	1.5 %
Minimum Curve Radius	424 ft
Max. Superelevation	1.5%
Maximum Grade	< 6%
Right-of-way	Varies 116 ft to 128 ft
Curb Return Radii (Back of Curb)	45 ft (Route 66) 35 ft (Butler Avenue) 30 ft (Local Streets)
Cut/Fill Slopes	2:1 Maximum

5.1.1.2 Design Speed and Posted Speed

According to the LTCS, the design speed for Lone Tree Road is 40 mph, with a maximum superelevation of 4%. The two horizontal curves shown on the Preferred Alternative have radii of 458.37 ft and 424.41 ft. According to AASHTO guidelines (Exhibit 3-16, 2004 edition) for a design speed of 40 mph and superelevation of 4%, the minimum curve radius is 533 ft, which is greater than either of the two horizontal curves shown on the Preferred Alternative. In order to make these curves comply with a 40 mph design speed, the superelevation through the curves would have to be raised to 7.4% and 9.2%, respectively. These superelevation rates are not desirable because of the snow and ice conditions common in Flagstaff, and because the length of superelevation runoff requires much more tangent between the curves than is provided in the Preferred Alternative.

It is not possible to realign Lone Tree Road to use larger curves given the constraints on the horizontal alignment that have been previously described in this report. Therefore, after consultation with the City of Flagstaff, the design speed was reduced by 5 mph from the recommended 40 mph as shown in the LTCS. The 35 mph design speed will, per AASHTO guidelines, allow a maximum superelevation rate of 1.5% on Lone Tree Road and the bridge. This superelevation rate will raise the soffit of the structure approximately one ft, reducing the depth the railroad tracks will have to be lowered by that same amount. It will also reduce the elevation of the intersection of Lone Tree Road with Brannen Avenue by approximately the same amount.

5.1.1.3 Typical Section

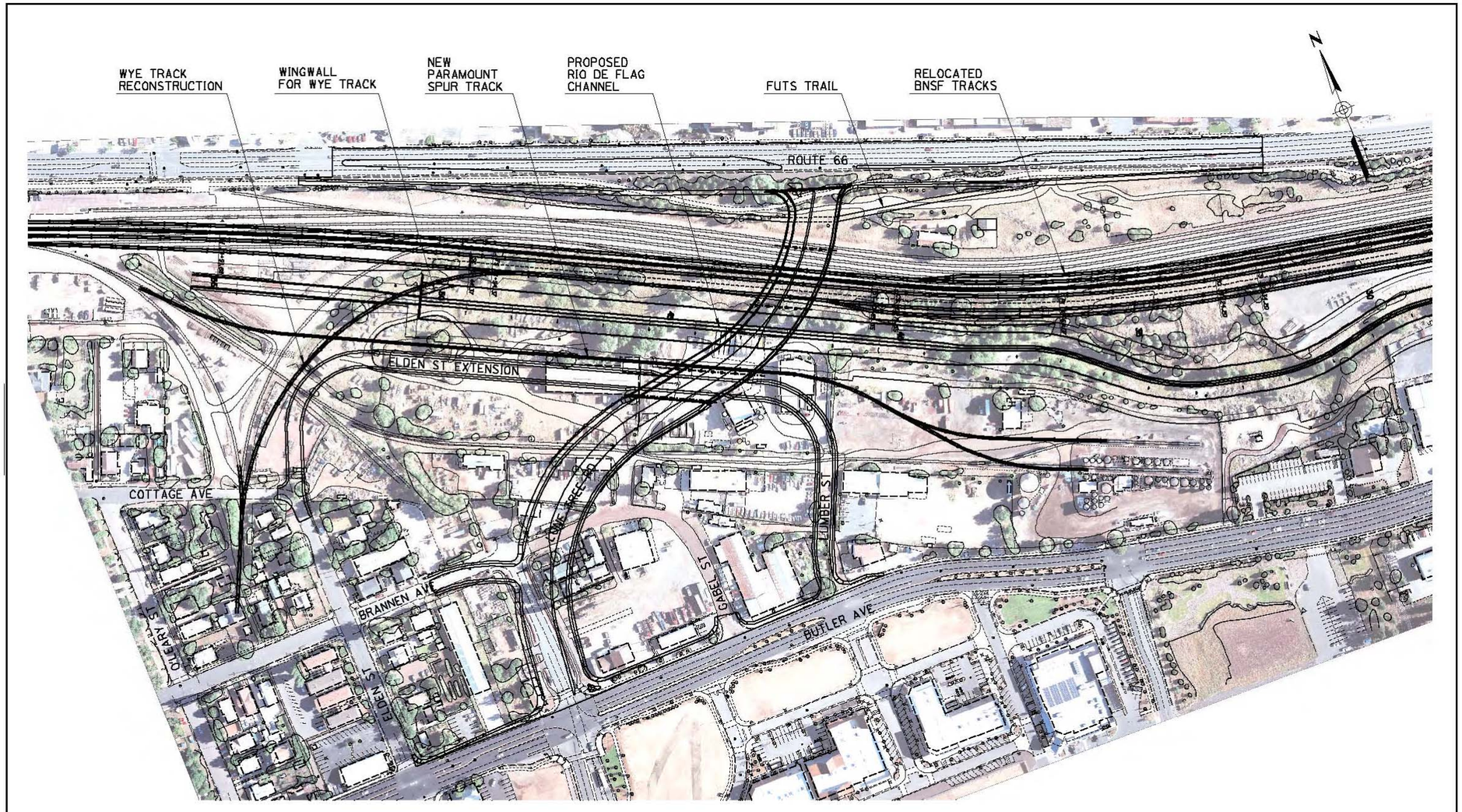
Preliminary typical sections for Lone Tree Road are shown in Appendix B. The basic width of Lone Tree Road, not considering right turn lanes, was kept constant between Route 66 and Butler Avenue because the short distance between those two intersections was not sufficient to reduce the roadway width for any significant distance. Tapers on the overpass structure also make the design of the overpass much more difficult and do not significantly reduce its cost.

5.1.1.4 Horizontal and Vertical Alignment

Preliminary roadway design plans are provided in Appendix B. The horizontal alignment begins at a new tee intersection on at Route 66 and is skewed approximately 10 degrees right from the Route 66 centerline. After a short tangent section, the alignment curves right on a new bridge over the BNSF railroad tracks, the Rio de Flag, the Paramount spur track and the Elden Street Extension. After the curve there a tangent section, followed by a curve to the left and then a tangent section meeting the existing Lone Tree intersection at Butler Avenue. The skew between the Lone Tree Road centerline and the Butler Avenue centerline is approximately 6.5 degrees right. The total length of Lone Tree Road between the centerlines of Route 66 and Butler Avenue is approximately 0.28 miles.

The vertical alignment matches the cross slope on Route 66, then curves up to provide the required clearance over the railroad tracks and the Paramount spur. The maximum grade on the roadway is approximately 5.5% and the approach grade at the Butler Avenue is approximately 0.7%. The length of approach grade to the stop bar on SB Lone Tree Road at the intersection is approximately 316 ft.

Figure 5.1 Recommended Alternative General Plan



5.1.1.5 Intersections

Lone Tree Road has a tee intersection at Route 66, a tee intersection at Brannen Avenue and a four-way intersection at Butler Avenue. The Route 66 and Butler Avenue intersections are signalized. At Route 66, Lone Tree Road has two SB travel lanes, two NB-to-WB left turn lanes, and two NB-to-EB right turn lanes.

There is a right turn lane at Brannen Avenue for SB-to-WB turns. At Butler Avenue, Lone Tree Road has two NB travel lanes, two SB-to-EB left turn lanes, two SB travel lanes and a SB-to-WB right turn lane.

5.1.1.6 Right-Of-Way

The right-of-way on Lone Tree Road is located 2 ft behind the sidewalk, FUTS or retaining wall and varies from a minimum of 116 ft to a maximum of 128 ft.

5.1.1.7 Access Control/Driveways

No driveway or access point is provided between the intersection of Butler Avenue and Route 66 with the exception of right-in, right-out access to and from Brannen Avenue.

5.1.1.8 Raised Median

Raised medians will be designed in accordance with the City of Flagstaff design standard 10-06-014 and will have brick pavers on median noses and medians on the overpass structure as shown in City of Flagstaff engineering detail 16-01-240. Other raised medians will have irrigated landscaping.

5.1.2 Route 66

Route 66 will be widened to provide dual left turn lanes in the WB-to-SB direction and a right turn lane in the EB-to-SB direction. Route 66 will continue to have two travel lanes and a bicycle lane in each direction. A raised median will also be constructed on the east and west legs of the intersection.

5.1.2.1 Design Criteria

The design criteria for Route 66 were established using the ADOT *Roadway Design Guidelines* (RDG, 2007 as amended) and the City of Flagstaff *Engineering Design and Construction Standards and Specifications* (EDCS, 2009 edition). Table 5.2 summarizes design criteria used for design of improvements to Route 66. City of Flagstaff engineering standards were used when ADOT standard were not available.

Table 5.2 Route 66 Design Criteria

Design Feature	Criterion
Roadway	Route 66
Standard Typical Section	Urban Principal
Design Speed	45 mph
Posted Speed	40 mph
Design Vehicle	WB-62
Lanes Widths	Travel Lanes: 12 ft Turn Lanes: 11 ft Multi-purpose Lanes: 4.5 ft
Median	10 ft Minimum, 28 ft Maximum
Raised Median	6 ft Minimum, 28 ft maximum
Sidewalks	EB: 10 ft (FUTS) EB: 6 ft (Existing)
Parkway	5 ft
Roadway Cross Slope	1.5%
Minimum Curve Radius	N/A
Max. Superelevation	N/A
Maximum Grade	2.7% (Existing)
Right-of-way	80 ft-100 ft (Existing) 50 ft (New)
Curb Return Radii (Back of Curb)	45 ft (Route 66)
Cut/Fill Slopes	2:1 Maximum

5.1.2.2 Design Speed and Posted Speed

The design speed is 45 mph and the posted speed is 40 mph in the EB direction and 35 mph in the WB direction.

5.1.2.3 Typical Section

The typical section for Route 66 is shown in the plans in Appendix B. Route 66 will have two travel lanes and a bicycle line in each direction. Two left turn lanes are provided from westbound to southbound direction and one right turn lane is provided from the eastbound to southbound direction at the signalized intersection.

5.1.2.4 Horizontal and Vertical Alignment

The existing horizontal and vertical alignments of Route 66 are not changed. The horizontal alignment is on tangent; the vertical alignment in the vicinity of the Lone Tree Road intersection consists of a crest vertical curve that is 1000 ft long and has grades of +2.7% and -2.5%.

All widening on Route 66 will occur on the south side of the existing roadway in order to avoid removal of sidewalk, driveways and drainage facilities on the north side and to minimize disruptions to adjacent businesses.

5.1.2.5 Intersections

A new signalized tee intersection will be constructed at Lone Tree Road as described previously. No other new intersections will be constructed on Route 66.

5.1.2.6 Right-Of-Way

The existing right-of-way on Route 66 is 80 ft from the intersection with Elden Street to a point approximately 600 ft east and then 100 ft to the end of the project. The right-of-way is distributed about the centerline 42 ft north-38 ft south and 62 ft north-38 ft south between the 80 ft and 100 ft right-of-way widths, respectively. Widening Route 66 on the south side will require a maximum of 50 ft of new right-of-way at the intersection, tapering to the existing right-of-way at the beginning and end of the pavement tapers. The City of Flagstaff owns the land next to Route 66 between Elden Street and the new intersection; BNSF owns the land south of the City-owned land.

5.1.2.7 Access Control/Driveways

Existing driveways that now have full access to Route 66 will be restricted to right-in-right-out within the limits of the raised median, except that no access will be permitted within 100 ft of the Route 66-Lone Tree road intersection. Driveways on properties acquired by the City will be closed. It is possible to provide a left turn break in the median to some properties located more than 100 ft away from the intersection; however, these breaks should be evaluated during final design in consultation with ADOT.

5.1.2.8 Raised Median

The raised median will be designed in accordance with ADOT design standards. Median noses will be paved with stamped concrete per ADOT preference; the rest of the median will be landscaped in accordance with City standards. Since Route 66 is under ADOT jurisdiction, landscaping will have to meet ADOT requirements. ADOT will request that the City be responsible for maintenance of the raised medians. Raised medians will be provided with refuge areas at crosswalks.

5.1.3 Local Streets

5.1.3.1 Design Criteria

Table 5.3 shown below summarizes design criteria recommended for the Elden Street Extension and the realignment of Brannen Avenue.

Table 5.3 Minor Streets Design Criteria

Design Feature	Criterion	Criterion
Roadway	Elden Street Extension	Brannen Avenue
Standard Typical Section	Urban Commercial Local Std. Det. 10-09-036	Urban Residential Local “Wide” Std. Det. 10-09-037
Design Speed	25 mph	20 mph
Posted Speed	20 mph	20 mph
Design Vehicle	WB-40	WB-40
Sidewalks	5 ft	5 ft
Lanes Widths	Travel Lanes: 12 ft Parking Space: None Bicycle Lane: None	Travel Lanes: 10.5 ft Parking Space: 6 ft Bicycle Lane: None
Median	None	None
Sidewalks	5 ft	5 ft
Parkway	5 ft	5 ft
Roadway Cross Slope:	1% to 2%	1% to 2%
Minimum Curve Radius	150 ft	100 ft
Right-of-way:	52 ft	61 ft
Curb Return Radius	30 ft (at Butler Avenue) 20 ft (at Cottage Avenue)	30 ft (at Lone Tree Road)
Cut/Fill Slopes	2:1 Maximum	2:1 Maximum

5.1.3.2 Typical Sections

Typical sections of the Elden Street Extension and Brannen Avenue are shown in Figure 5.2 and Figure 5.3, respectively.

Figure 5.2 Elden Street Extension Typical Section

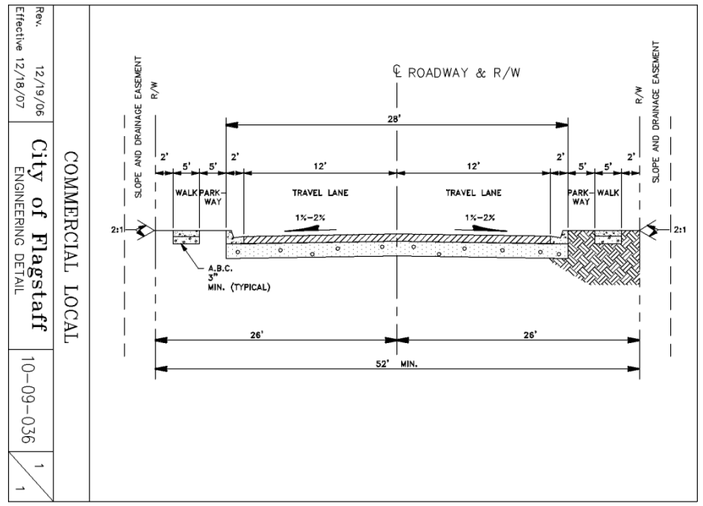
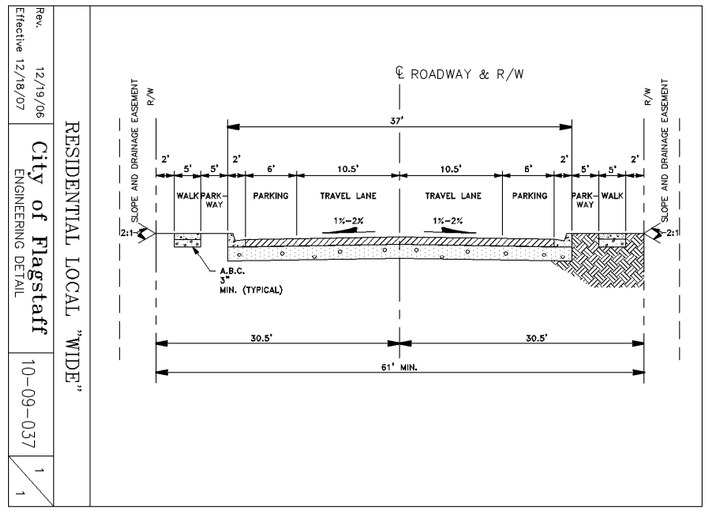


Figure 5.3 Brannen Avenue Typical Section



5.1.3.3 Horizontal and Vertical Alignment

Elden Street Extension: The Elden Street Extension begins just south of the intersection with Cottage Avenue. It continues north to a curve to the right that brings the alignment parallel to the relocated Paramount spur. After crossing under the overpass structure, the Elden Street Extension makes a 90 degree turn to the unplatted street known as Lumber Street where it intersects Butler Avenue.

The Elden Street Extension is approximately 1,800 ft long. The 5-ft parkway is eliminated under the Lone Tree Road overpass to minimize the length of the bridge span.

Grades on the Elden Street Extension range from 0.5% to approximately 0.7% except at the tie-ins to existing Elden Street and at Butler Avenue.

Brannen Avenue: Brannen Avenue begins just west of a driveway on the south side of the street and intersects Lone Tree Road at a right angle. The reconstructed length of Brannen Avenue is 200 ft.

Brannen Avenue is approximately 2 ft above existing grade at the Lone Tree Road intersection. The maximum grade is approximately 5.3%, but vertical curves at both ends reduce the actual length of this grade to 40 ft.

5.1.3.4 Access Control/Driveways

The Elden Street Extension will provide access to a property that presently is accessed via Brannen Avenue but which will lose that access when Brannen Avenue is realigned. The other existing driveway just west of the Brannen Avenue improvement limits is not impacted. Access to properties on existing Lumber Street will be maintained on the new Elden Street Extension.

5.2 Transit

Transit lines currently operating within the project area are Route 3 (Green Route) on Butler Avenue, Route 66 (Red Route) and Route 7 (Purple Route) on Route 66 and Route 4 (Gold Route) on Lone Tree Road. All routes are bi-directional except Route 4 which is northbound only on Lone Tree Road. Current bus stops on these routes are located as follows: 1) San Francisco Street and Switzer Canyon Road on Route 66; 2) San Francisco Street, Lone Tree Road and Sawmill Road on Butler Avenue; and 3) Butler Avenue at Route 66. The only stop that has a bus bay out of the traffic lane is the Switzer Canyon Road stop on eastbound Route 66; all other stops are at the outside curb line.

Construction of the Lone Tree Overpass would allow Route 4 to be extended to Route 66, although at present there are no plans for this extension. Opportunities to construct new bus bays on existing routes include the far sides of Route 66 at the proposed Lone Tree Road intersection and the far sides of Lone Tree Road at its intersection with Butler Avenue. These and other locations should be evaluated for bus stops during final design.

5.3 FUTS (Flagstaff Urban Trails System)

A 10 ft wide FUTS trail is provided in the current project on the west side of the Lone Tree Road alignment and on the Lone Tree Road bridge over the railroad tracks, connecting the existing FUTS trail on Route 66 with the recently-constructed FUTS trail on Lone Tree Road south of Butler Avenue.

Part of the existing FUTS trail on the south side of Route 66 will be removed for widening of Route 66. The FUTS trail will be reconstructed to pass under the first span of the overpass structure.

5.4 BNSF Railroad Tracks

5.4.1 Facilities

BNSF facilities to be constructed include the following:

- Temporary Main 1 and Main 2 tracks (shoofly tracks
- Temporary track work and switches to provide switching and storage
- New Main 1 and Main 2, with space for a future Main 3
- New north siding and storage tracks
- New south siding and storage track
- New spurs track to Paramount Petroleum
- Reconstruction of the east leg of the wye track, including the tail track.

BNSF officials have provisionally offered to delete the north storage and siding tracks in lieu of payment in kind. However, pending final approval, these tracks are included in the plans and estimate

5.4.2 Design Criteria

BNSF facilities will be designed in accordance with the latest BNSF standards, including, but not limited to, the following:

- *Design Guidelines for Grade Separation Projects* (January 24, 2007)
- *BNSF Railway Engineering Instructions* (latest revisions)
- *BNSF Railway Standard Plans* (latest revisions)
- *Design Guidelines for Industrial Track Projects* (October 2007)
- *Shoofly Procedures* (June 12, 2006)

5.5 Overpass Structure

The roadway section of Lone Tree Road at the overpass structure is symmetrical about the Lone Tree Road construction centerline and profile grade line. The roadway consists of two 12 ft through lanes and one 6ft bike lane in each direction. The northbound and southbound roadways are separated by a 26 ft median. At the north end of the bridge the median is replaced by two 11 ft left turn lanes and a 4 ft raised median at the intersection with Route 66. A 12 ft FUTS trail is located outside of the southbound through lanes while a 6 ft sidewalk is located outside of the northbound through lanes. The FUTS trail is separated from the southbound roadway by a 42 inch F-shaped concrete bridge barrier with safety rail. Behind the sidewalk and the FUTS trail is 1 ft-2inch wide combination pedestrian-traffic bridge railings with fences. The resulting out-to-out width of the bridge deck is a total of 107 ft-11 inches.

The outside edges of the bridge flare out to align with the curb returns at the intersection of Route 66 resulting in a variable bridge width at the north end. The Lone Tree horizontal alignment is on a tangent at the beginning and end of the bridge joined by a curved section with a normal crown and cross slope of 1.5% from the construction centerline. The major features that the bridge crosses are the FUTS trail at Span 1, the BNSF railroad tracks at Span 2, the Rio de Flag drainage channel at Span 3 and the Paramount spur and the Elden Street Extension at Span 4.

For the purpose of this study, consideration is given to a four-span hybrid bridge that utilizes a combination of cast-in-place post-tensioned concrete box girders for Spans 1, 3 and 4 and precast prestressed AASHTO Type V Modified girders for Span 2. Since the existing south siding will remain operational at the bridge location during construction, precast prestressed AASHTO girders are used at Span 2 in order to eliminate the use of falsework over the railroad tracks and minimize disruption to the railroad operation. The cast-in-place post-tensioned concrete box girders section of the bridge will have a 6 ft structure depth, while the precast section will have an approximate maximum structure depth of 6 ft-1 inch" at the hinge locations. The total bridge length will be approximately 545 ft. A composite steel plate girder bridge was initially considered but was eliminated from further evaluation due to the high initial and maintenance costs associated with that type of structure and based on discussions with the City of Flagstaff. The proposed bridge sections are shown in Figure 5.4.

5.6 Drainage

The proposed drainage systems for the Lone Tree Overpass project are shown in Figure 5.5.

5.6.1 Relocated BNSF Tracks

On-site drainage from the south side of the new railroad cross section will drain into the historic Rio de Flag or into an interceptor ditch along the north side of the proposed Rio De Flag drainage channel. The north side of the railroad cross section and off-site drainage areas between Route 66 and the tracks will drain to a lateral drainage ditch for discharge to Switzer Canyon Wash.

Temporary culverts under the railroad tracks may be required to drain low spots during construction such as parts of the shoofly track west of the high point in the profile. Runoff from that part of the shoofly track east of the high point will drain to Switzer Canyon Wash. Temporary culverts will be filled with sand or a slurry backfill and plugged at each end.

5.6.2 Lone Tree Overpass and Lone Tree Road

On-site runoff from the part of the proposed Lone Tree Overpass that slopes toward Route 66 will drain to a new storm drain along the south side of Route 66 and then to the Rio de Flag channel. The rest of the on-site runoff from the overpass structure and Lone Tree Road will be intercepted by curb inlets and coveyed by storm drain to a proposed detention basin located at northeast corner of Lone Tree Road and Butler Avenue. The detention basin will have a metered outlet to the Butler Avenue storm drain system.

5.6.3 Route 66

New curb inlets will be constructed in the widened section of Route 66 and connected to new storm drains on the south side of the roadway. The new storm drains are required to avoid relocation of a fiber optic duct bank running along the south side of Route 66. The new inlets discharge to the same watersheds as the existing inlets: those west of the intersection will drain to the Rio de Flag (historic or drainage channel) and those east of the intersection will drain to the new lateral drainage ditch along the new railroad tracks for ultimate discharge to Switzer Canyon Wash.

5.6.4 Local Streets

The on-site drainage from proposed Elden Street Extension and new Brannen Avenue will drain to either to a newly proposed detention basin located on the north side of the Elden Street Extension west of Lone Tree Road or a new storm drain between Brannen Avenue and the Rio de Flag. The detention basin will have a metered outlet to the historic Rio de Flag or to the Rio de Flag drainage channel.

According to the City of Flagstaff, the existing storm drain on the north side of Brannen Avenue does not drain properly, causing flooding of Mayorga's Welding 120 S. Elden Street, Assessor's Parcel No. 104-01-071B. This condition may be due to flat or adverse grades in the pipe or clogging. Regardless of the cause, it is assumed that the existing storm drain will be replaced with a new storm drain connected to the historic Rio de Flag or to the Rio de Flag drainage channel. A new culvert will also be constructed under the existing Paramount spur on the east side of the former spur track to the old saw mill. The present culvert, a 24"-diameter steel pipe, is clogged at both ends.

5.6.5 Detention and Low Impact Development

The City of Flagstaff's Low Impact Development (LID) Ordinance requires that the first one inch (1") of rainfall be retained on-site for new developments. The detention basins previously described will have sufficient capacity for the first inch of rainfall from their contributing areas. The volume of on-site drainage for the proposed reconstruction of Brannen Avenue is very small; therefore, no detention basin for this drainage is proposed. On-site drainage from Brannen Avenue will drain directly to a proposed catch basin.

LID opportunities within the Elden Street Extension include providing bio-retention areas off the street and adding curb extensions on the inside of curves. LID opportunities on Lone Tree Road are more limited due to the length of roadway that is on the overpass structure. Nevertheless, it may be possible to use the landscaped median off the structure for retention and absorption of street runoff from the high side of the super-elevated section of the roadway and use the parkway on the low side. On Brannen Avenue parking near the Lone Tree Road intersection could be eliminated on one or both sides and the parkway widened as a retention area. These and other LID initiatives will be addressed during final design.

Figure 5.4 Bridge Sections

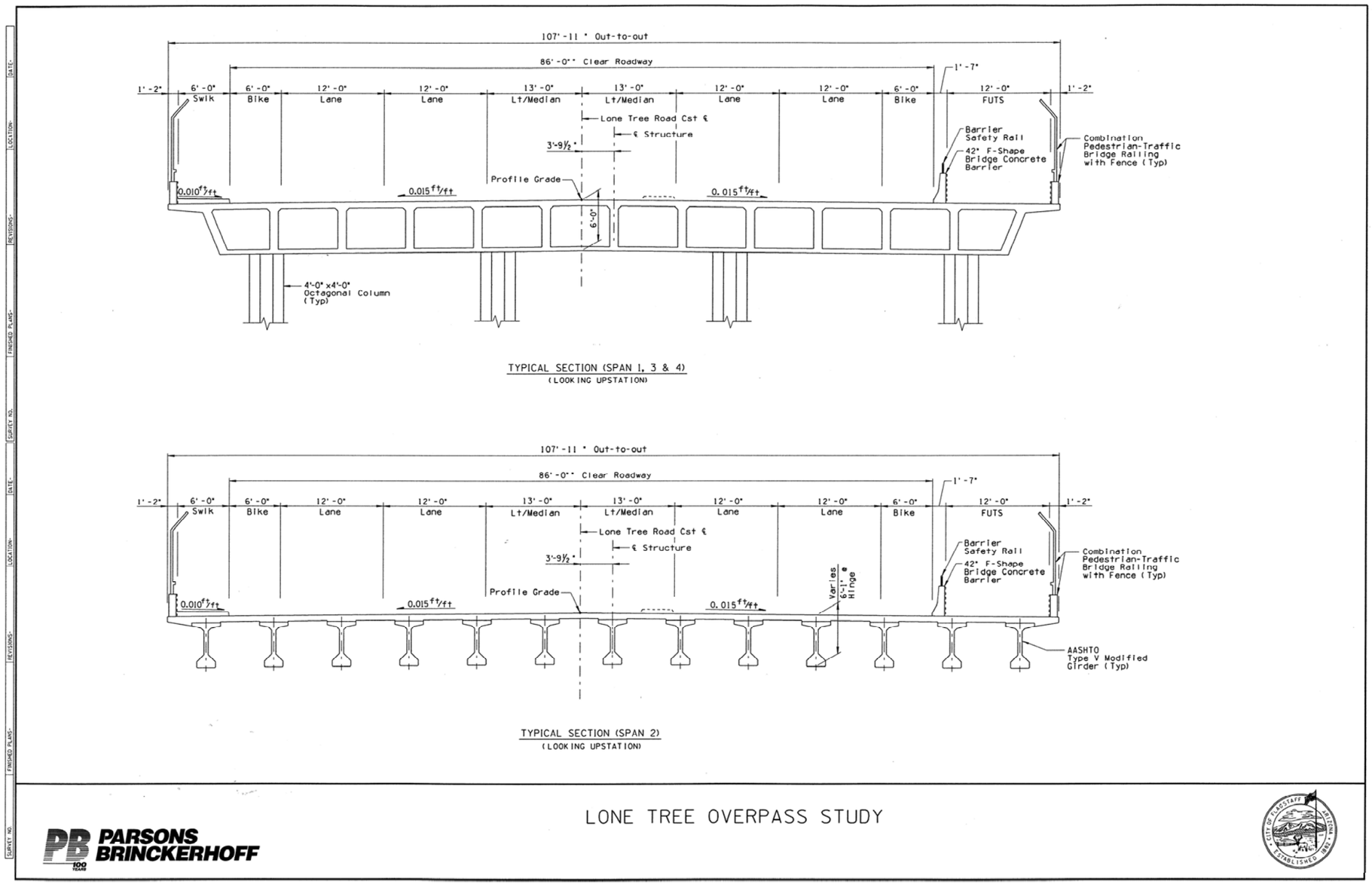
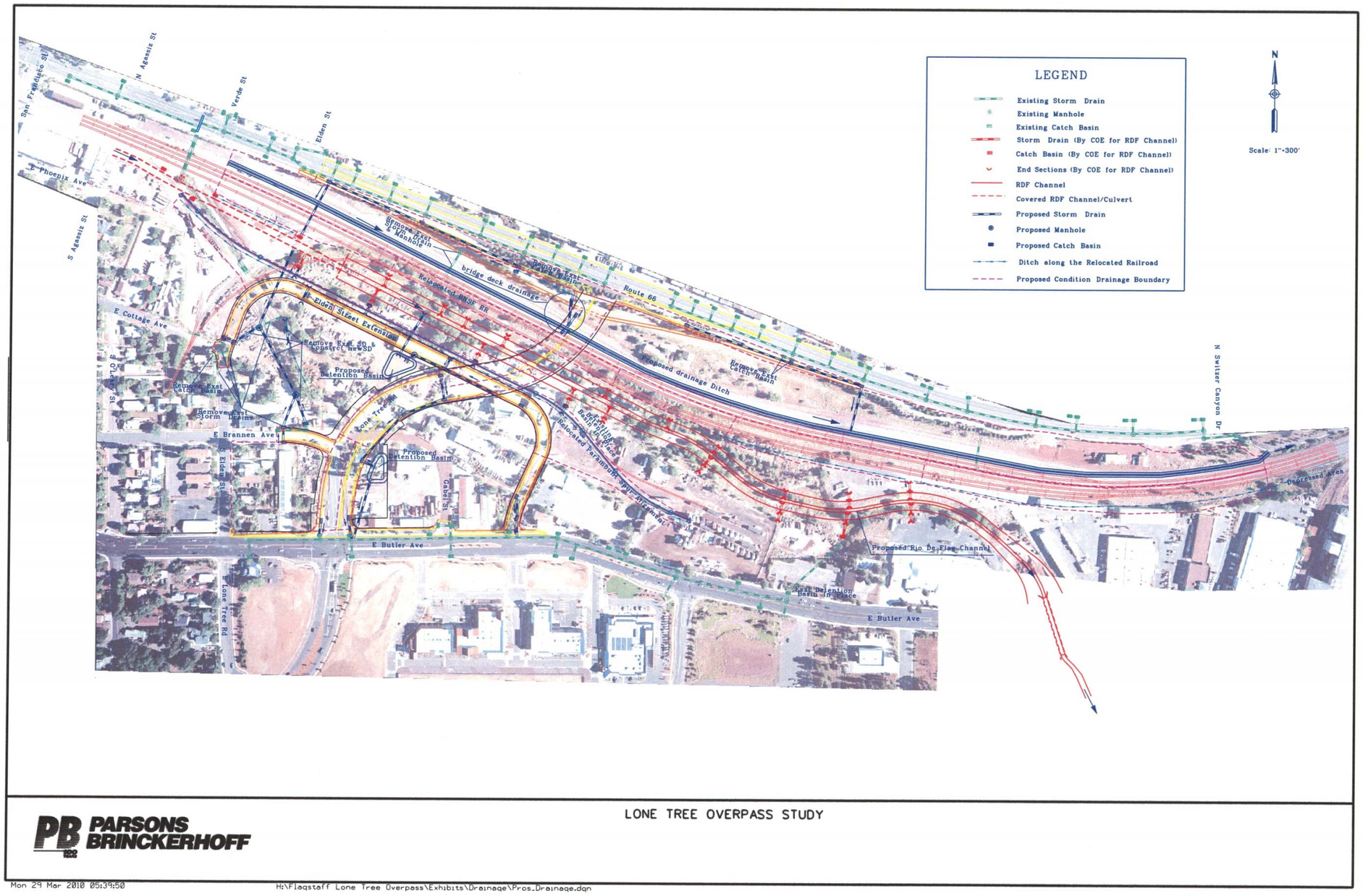


Figure 5.5 Proposed Drainage Systems for the Recommended Alternative



5.7 Construction Sequence

The construction sequence presented in this report focuses on construction of the Lone Tree Overpass and the relocation of the BNSF tracks. It has been prepared with the objective of eliminating any major shoring next to the existing railroad tracks. The construction sequence consists of six phases, described as follows and shown graphically in Figures 5.6 through 5.11. The construction sequence applies whether or not the proposed Rio de Flag drainage channel has been constructed.

Phase 1

1. Construct the new retaining wall adjacent to the Rio de Flag.
2. Relocate BNSF fiber optic lines to temporary aerial alignment.
3. Construct and line over shoofly tracks for Main 1 and Main 2.
4. Construct track work at the ends of the project to convert the existing south siding track to a temporary south storage track and existing Main 2 to a temporary south siding track, including relocation of both manual and electric switches.
5. Remove the existing south storage, Main 1, north siding and north storage tracks.

Phase 2

1. Construct Abutment 2, Span 4 over the Paramount spur Elden Street, Span 3 over the Rio de Flag/Rio de Flag Channel and the cantilevered section of Span 2 at Pier 2.

Phase 3

1. Remove falsework from Spans 4, 3 and the cantilever section of Span 2.
2. Construct and line over the new Paramount spur.
3. Construct and line over the new south siding and the new south storage tracks.
4. Remove the temporary tracks (old south siding and old Main 2).
5. Construct permanent BNSF fiber optic lines.
6. Construct the new east leg of the wye track and connect to the new south siding track.

Phase 4

1. Construct new Main 1, Main 2 and the subballast for future Main 3.
2. Construct the new north siding and north storage tracks.
3. Construct an interim drainage ditch along the north side of the tracks.

Phase 5

1. Line over new Main 1 and new Main 2.
2. Remove shoofly tracks and grade for falsework at Span 1 and Span 2.
3. Construct Abutment 1.
4. Construct Span 1 and cantilevered section of Span 2.

Phase 6

1. Remove falsework and construct drop-in AASHTO girder section and deck at Span 2.
2. Construct maintenance road.
3. Construct permanent drainage ditch on the north side of the tracks.
4. Construct new side slopes and FUTS trail under Span 1.

This construction sequence assumes that the ProBuild spur can be taken out of service and delivery of supplies performed by truck rather than railcars during construction of the new south storage and siding tracks. Delivery to Paramount by rail tank car is assumed to remain uninterrupted except during line over operations. If, however, arrangements can be made to supply Paramount by tanker truck and other BNSF deliveries are not adversely impacted, Step 2 of Phase 1 may be eliminated.

Figure 5.6 Recommended Alternative Construction Sequence Phase 1

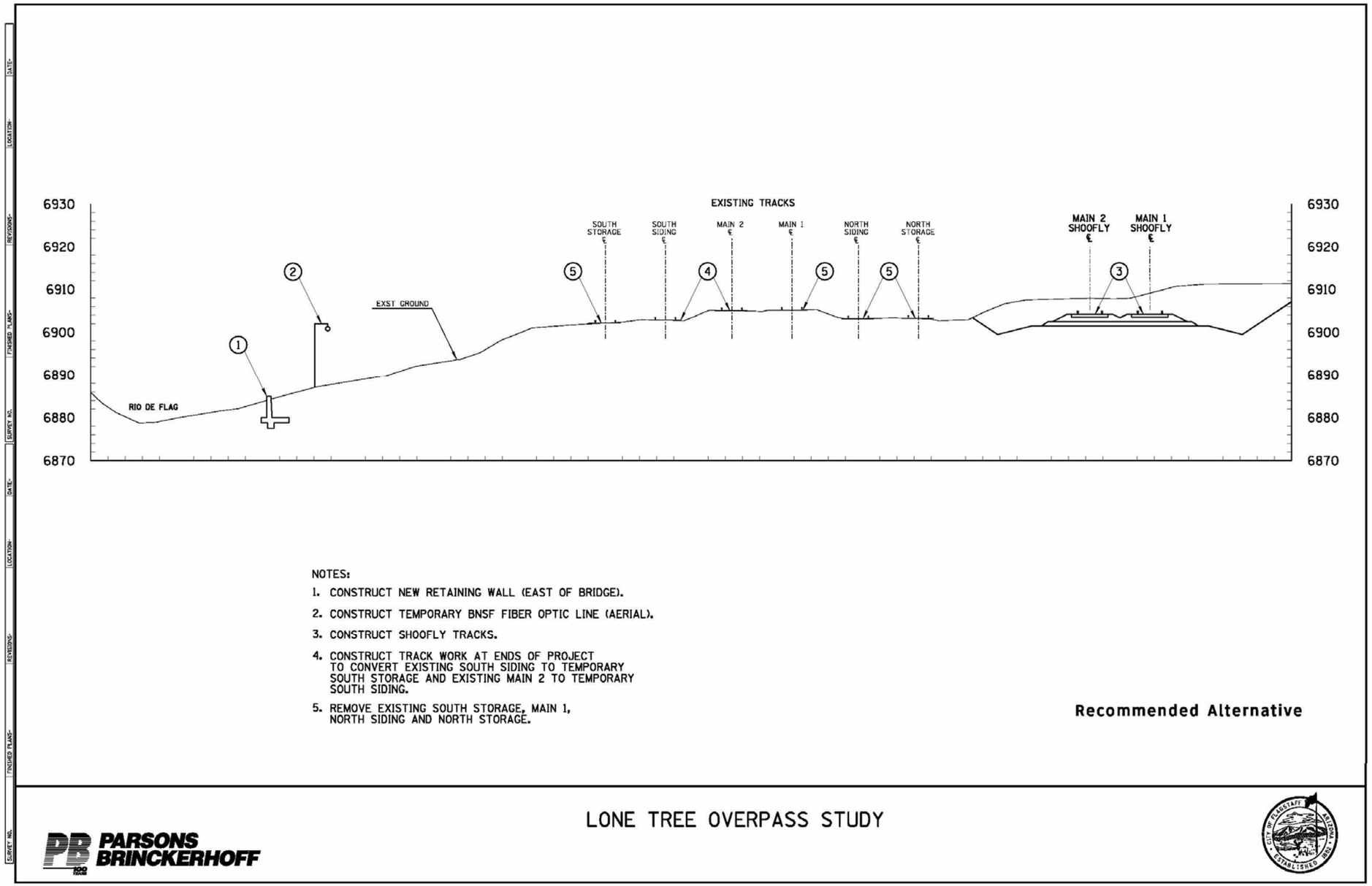


Figure 5.7 Recommended Alternative Construction Sequence Phase 2

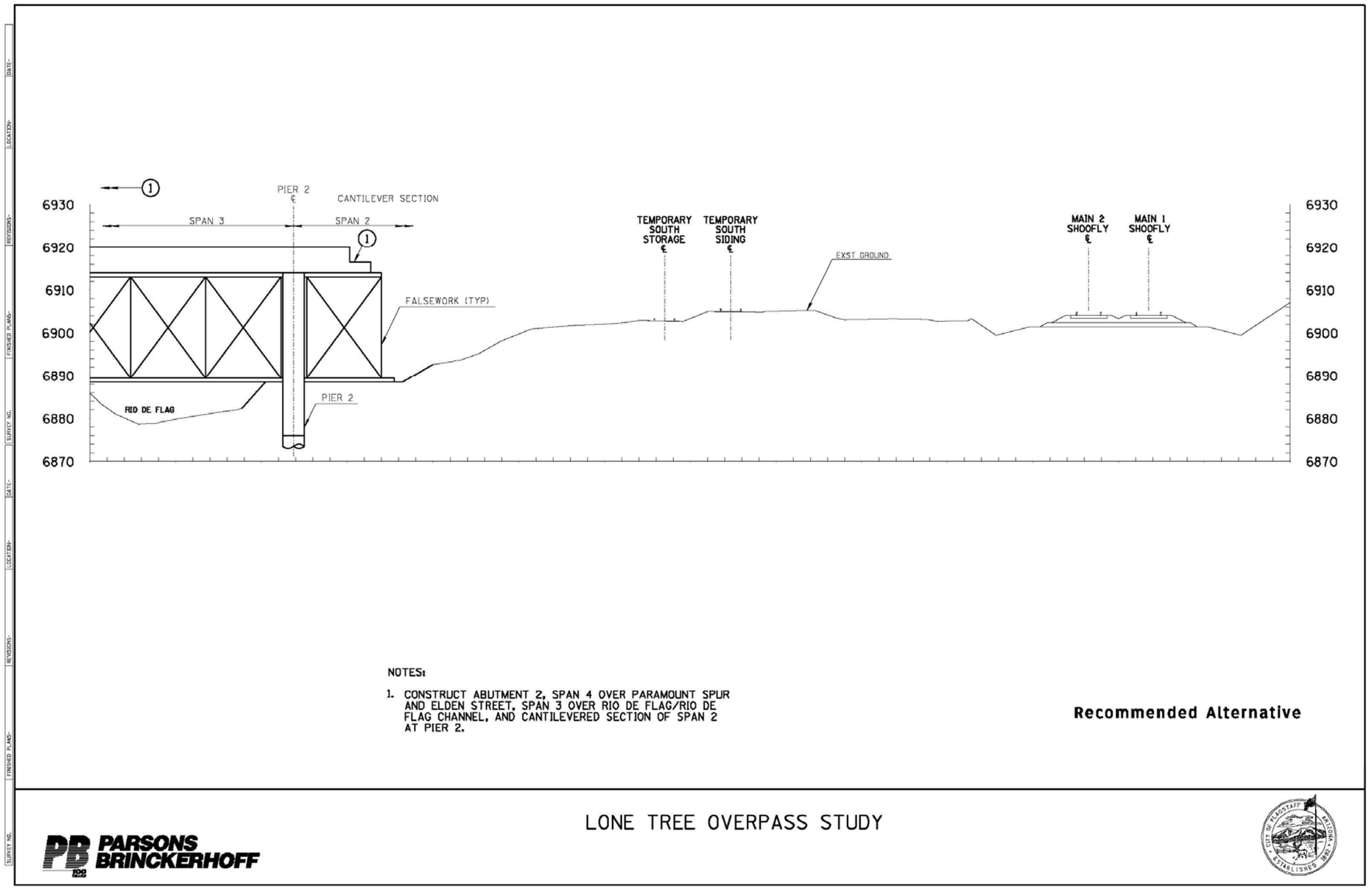


Figure 5.8 Recommended Alternative Construction Sequence Phase 3

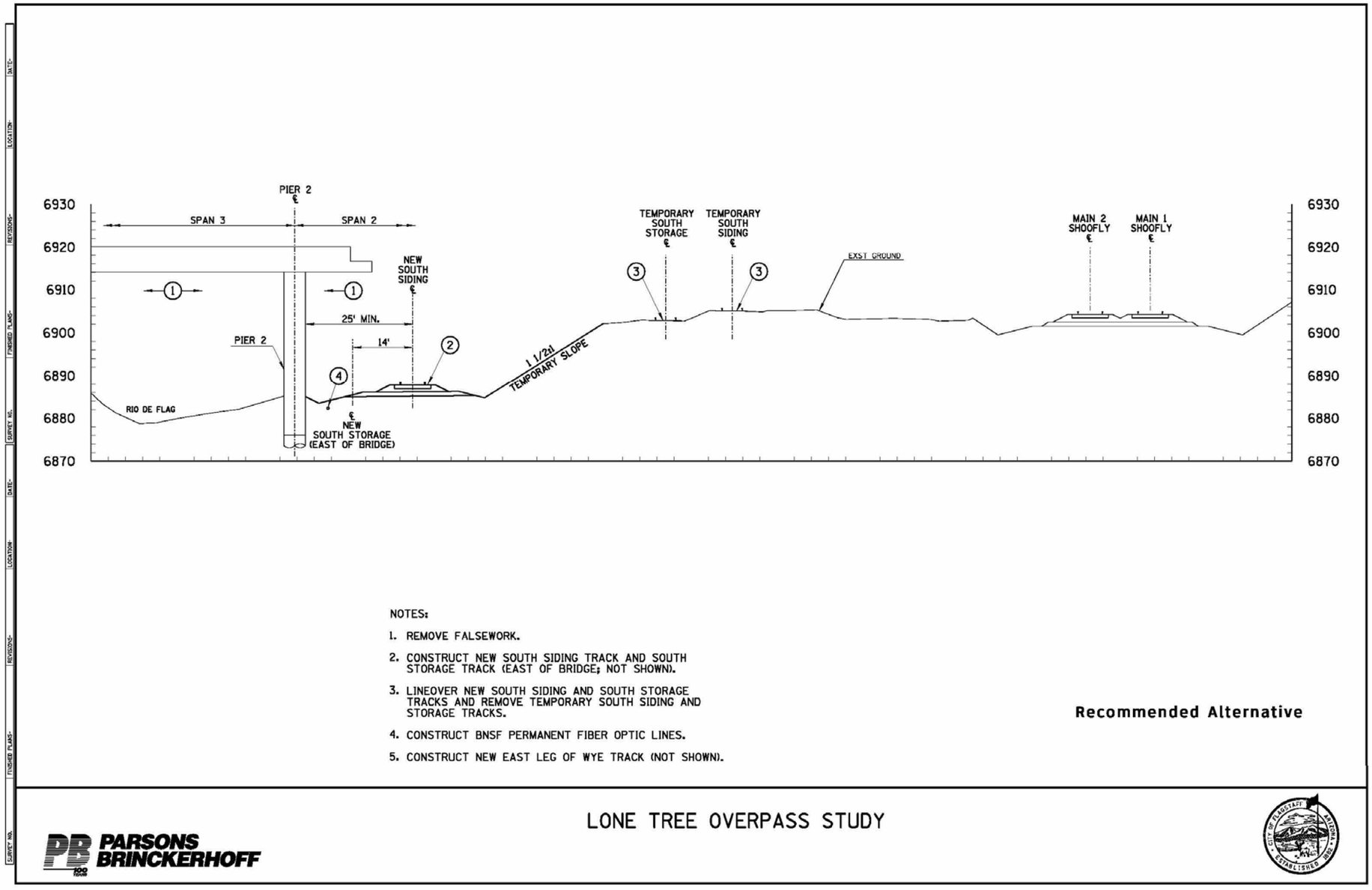


Figure 5.9 Recommended Alternative Construction Sequence Phase 4

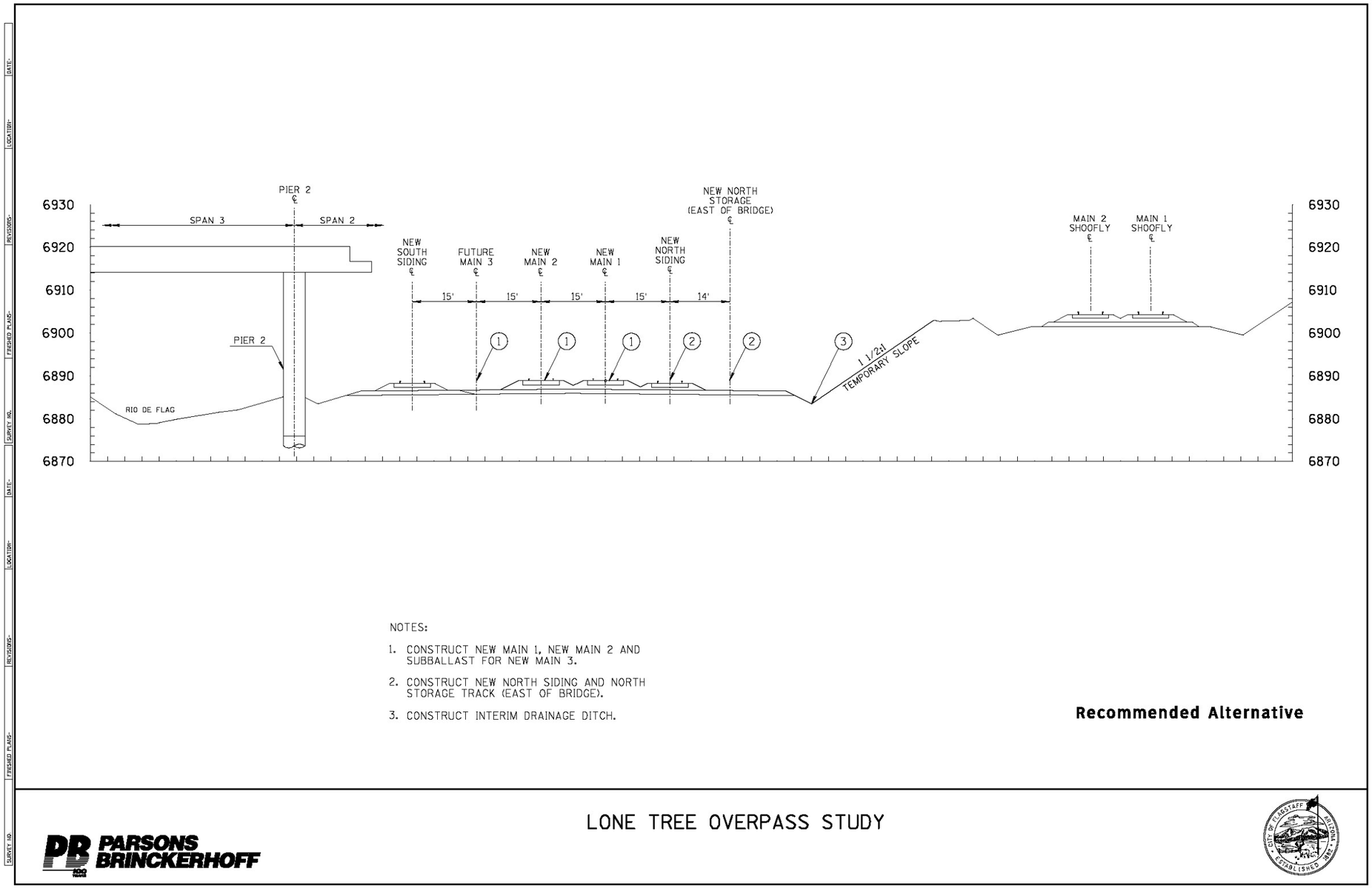


Figure 5.10 Recommended Alternative Construction Sequence Phase 5

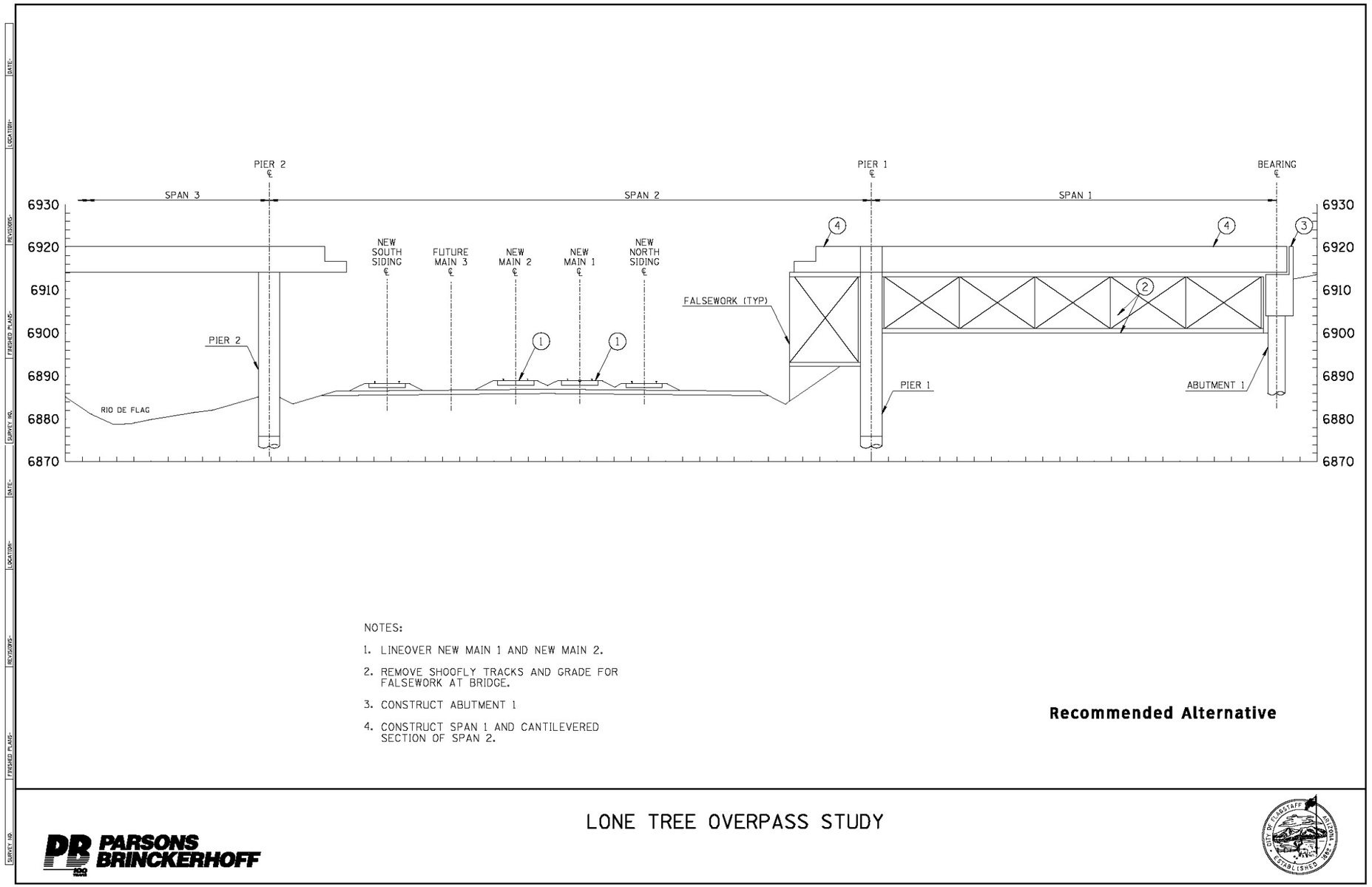
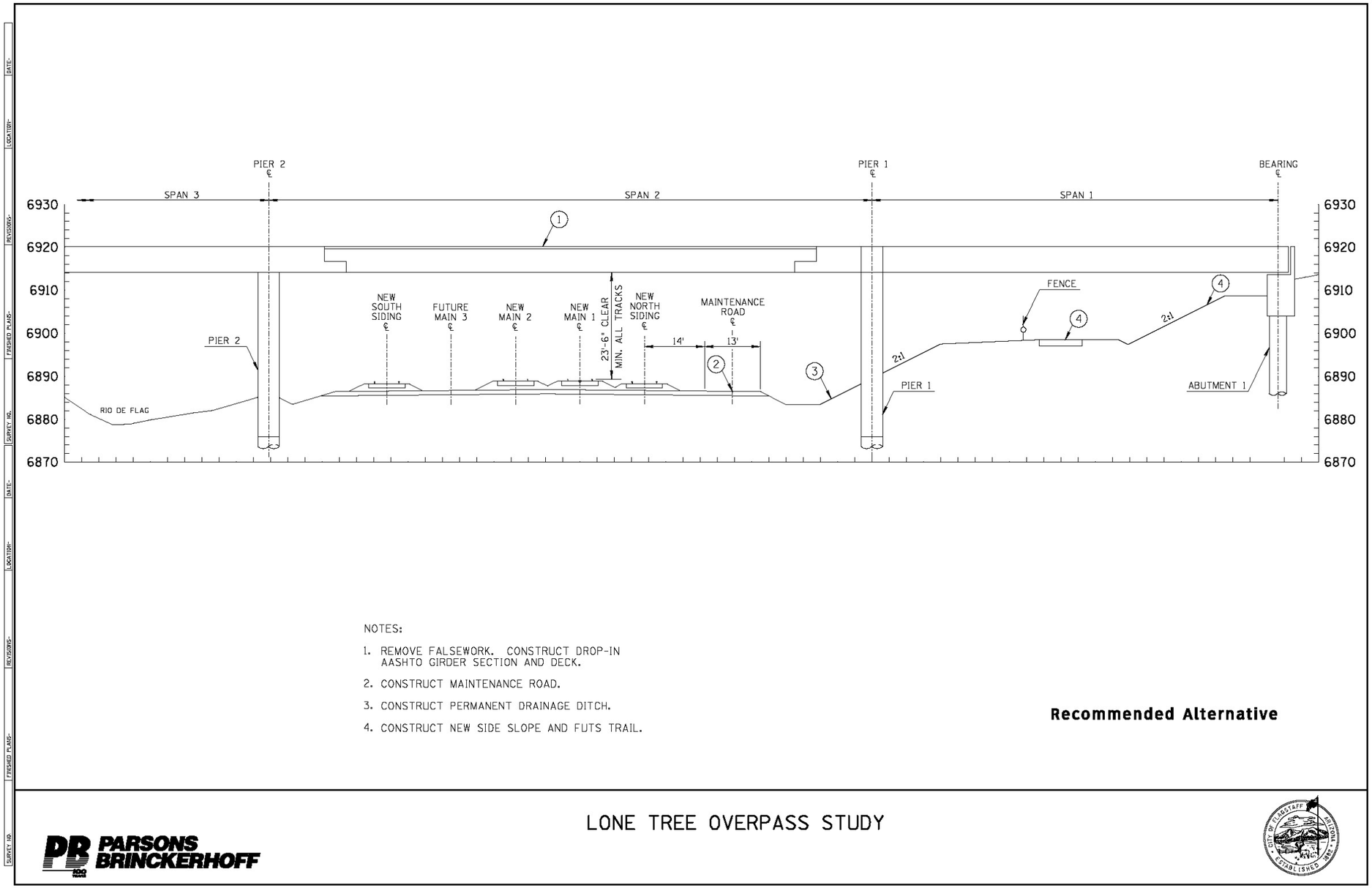


Figure 5.11 Recommended Alternative Construction Sequence Phase 6



5.8 Geotechnical Overview

AMEC Earth and Environmental, Inc. (AMEC) performed seismic refraction surveys along the BNSF railroad tracks to assess the existing surface and subsurface conditions and to provide preliminary recommendations for design and construction.

5.8.1 Review of Existing Data

Geological and geotechnical data for the project area were obtained and reviewed. These data included published geologic maps and reports, topographic mapping, aerial photographs and geotechnical reports for nearby projects, including the Rio de Flag Mainstem Flood Control Project designed by the U.S. Army Corps of Engineers.

5.8.2 Site Reconnaissance and Geologic Mapping

A reconnaissance was performed to observe general conditions within the project site, ease of access for the seismic refraction surveys, and the potential level of ambient noise that might affect the surveys. Geologic mapping of the project site was performed by AMEC. The mapping included delineation of soil and rock units on an aerial photograph of the project site.

5.8.3 Seismic Refraction Surveys

Four 120-foot-long seismic refraction surveys were completed by AMEC at selected locations, as shown in Figure 5.12. Seismic lines 1 through 3 were completed along the proposed alignment of the overpass, and seismic line 4 was completed in a planned cut area along the BNSF railroad tracks. The surveys were completed using a Geometrics Smartseis 24-channel signal enhancement seismograph with a 12-geophone array. A sledgehammer was used as the energy source of compression wave (p-wave) data for seismic refraction analysis. A person jumping at the end of the 12-geophone array generated surface wave energy for refraction microtremor (ReMi) analysis for a one-dimensional vertical shear wave (s-wave) profile at each survey line.

5.8.4 Results of Seismic Refraction Surveys

Seismic refraction survey results can be used to characterize the engineering properties of subsurface materials, but do not provide definitive information on which geologic units underlie the survey sites.

At Line 1, there appears to be an upper 5-foot-thick layer of fill with p-wave velocities ranging from approximately 750 to 1,200 feet per second (fps). The survey line was located on the south side of the railroad tracks and centered over a ridge that has an outcrop of basalt exposed in the slope between the railroad tracks and the Rio de Flag. In the central portion of the survey line, the upper layer of fill appears to be underlain by fractured basalt with p-wave velocities of approximately 3,500 to 3,600 fps. The ends of the lines appear to be underlain by fill or colluviums with p-wave velocities ranging from approximately 2,500 to 2,900 fps. These materials extend to a depth of approximately 17 feet below ground surface (bgs) and are underlain by a higher-velocity layer with p-wave velocities averaging approximately 7,900 fps. This higher-velocity layer may be a less fractured and more compact basalt or unweathered sedimentary rock (either Moenkopi Formation or Kaibab limestone). A softer zone of material with an s-wave velocity of 2,500 fps (p-wave of 5,000 fps) is present at approximately 32 feet bgs. This layer may represent softer, more weathered sedimentary rock.

The subsurface profiles at Lines 2 and 3 appear to be similar, even though the lines are completed at different elevations. Line 2 was performed at the base on the cut slope on the northern side of the railroad tracks, whereas Line 3 was performed partway up the slope and closer to Route 66. Both lines appear to have an upper layer of fill with p-wave velocities ranging from 1,000 to 1,100 fps. This layer extends to depths of approximately 3 to 7 feet bgs and is underlain by a layer of materials with p-wave velocities ranging from 2,100 to 4,500 fps. At both lines, materials in the eastern portion of the lines have higher velocities (3,500 to 4,500 fps) than the western portion of the lines (2,400 to 2,800 fps). This may indicate that the lines are cut by the fault shown on Figure 5.12, with softer materials on the downthrown side. The higher values may represent basalt and/or decomposed sedimentary rocks, and the lower values may represent colluviums. A zone of material with lower s-wave velocities is present at a depth of approximately 8 feet bgs in both lines. This zone, which may represent decomposed sedimentary rock, extends to a depth of approximately 40 feet bgs in Line 2 and 18 feet bgs in Line 3. This zone of softer material is underlain by harder rock with s-wave velocities ranging from 2,600 to 3,800 fps (estimated p-wave velocities of 5,200 to 7,600 fps). These velocities may represent less weathered sedimentary rock.

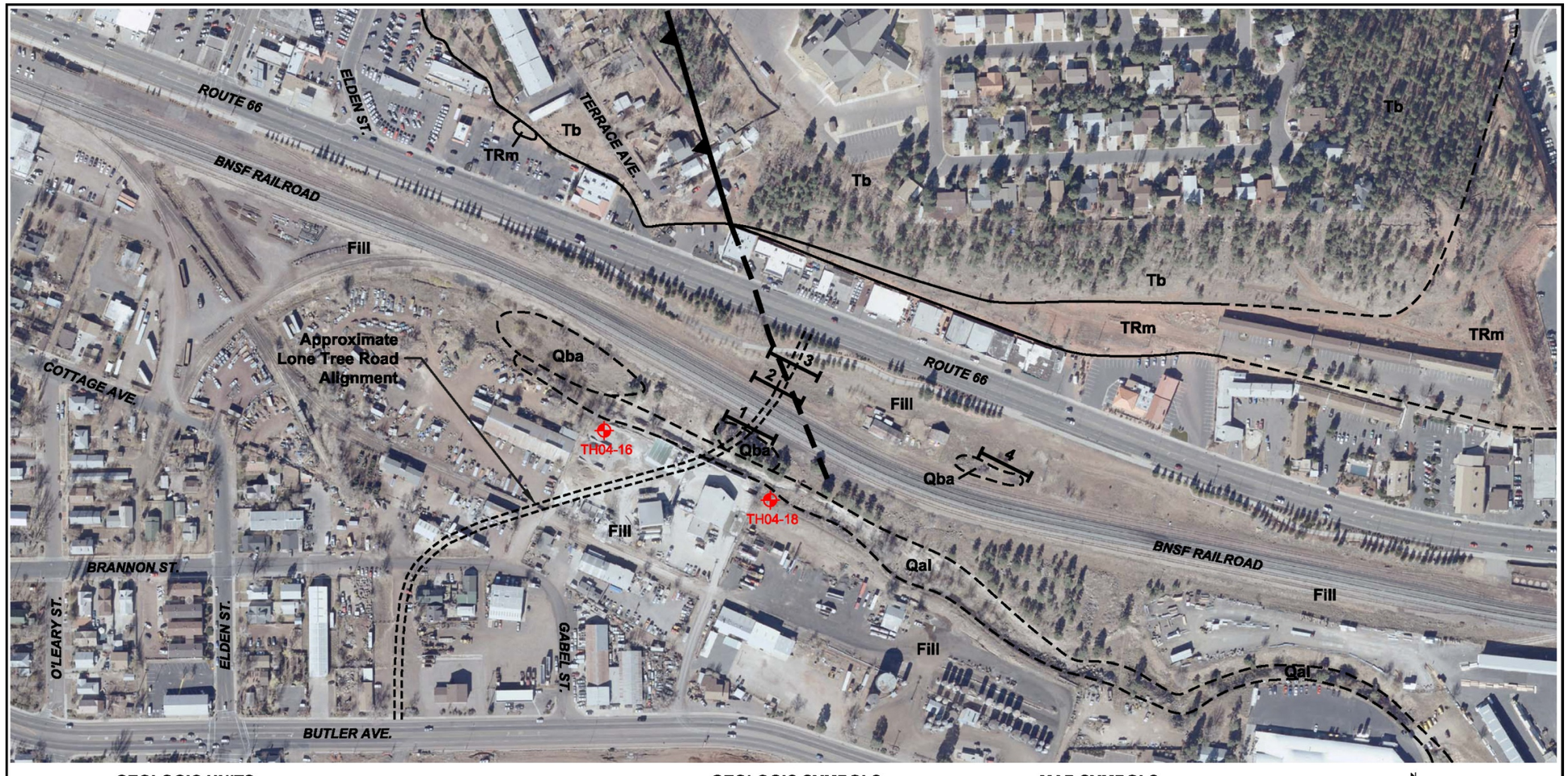
At Line 4, there appears to be an upper 5- to 10-foot-thick layer of fill with p-wave velocities ranging from approximately 950 to 1,400 fps. This layer of fill is underlain by materials with p-wave velocities ranging from approximately 1,800 to 2,900 fps, possibly representing fractured basalt. A local area in the eastern portion of the line at a depth of about 10 to 15 feet bgs has a p-wave velocity of 4,300 fps, possibly representing a zone of less fractured basalt. Materials in the profile have an s-wave velocity of approximately 900 fps (estimated p-wave velocity of 1,800 fps) at a depth of approximately 15 feet bgs. This velocity may represent decomposed Moenkopi Formation. The s-wave velocity increases to 2,600 fps (estimated p-wave of 5,200 fps) at a depth of approximately 27 feet bgs. This velocity is representative of unweathered Moenkopi Formation or weathered, fractured Kaibab limestone.

5.8.5 Excavatability of Subsurface Materials

Based on interpretations of the refraction seismic results, mass excavation of materials in significant portions of the project site can be effectively accomplished using appropriate equipment for the material encountered. Low velocity materials (3,000-6000 fps) might be successfully ripped with a D7 Caterpillar (or equivalent) whereas ripping high velocity material (7,000 fps and above) might require the equivalent of a D9, D10 or D11 Caterpillar.

Mass excavation and trench excavation using backhoe-sized equipment should be able to proceed without significant difficulty in materials with p-wave velocities less than about 3,000 fps. Subsurface materials with p-wave velocities greater than about 3,000 fps are anticipated to behave as rock. As indicated by seismic refraction results for Lines 1 through 4, seismic p-wave velocities within proposed zones of excavation may range from less than 1,500 fps to over 8,000 fps. Sufficiently powerful heavy-excavation equipment may be needed to excavate isolated zones of rock within portions of planned cut areas. Rock that may be excavatable using heavy equipment in mass excavation may not be excavatable in deep trenches or along sliver cuts without the use of specialized equipment and/or methods. Mechanical methods such as hoe ramming may be effective, or at least practical. Excavation, earthmoving and hauling techniques and equipment used on the project may have to contend with boulders ranging up to several feet in dimension. Effective excavation of individual boulders or isolated zones of very strong rock may require mechanical

Figure 5.12 Location of Seismic Lines



GEOLOGIC UNITS

- **Fill** Fill - Clayey sand and gravel with some cobbles and boulders
- **Qal** Quaternary Alluvium - Sand and gravel with some cobbles and boulders
- **Qba** Quaternary Basaltic Andesite Flow - Slightly to moderately weathered, hard to very hard, dark gray
- **Tb** Tertiary Basalt Flow - Slightly weathered, hard to very hard, dark gray
- **TRm** Triassic Moenkopi Formation - Sandstone interbedded with shale and siltstone, thinly bedded, slightly to moderately weathered, soft, brownish-red

GEOLOGIC SYMBOLS

- Geologic Contact, dashed where less certain
- Fault, inferred. Teeth on downthrown side. Dashed where less certain

MAP SYMBOLS

- 1 — Seismic Refraction Survey Location and Identifier
- TH04-16 — USACE Boring Location (approx.) and Indentifier

JOB NO.	09-117-01043
DESIGN:	RB
DRAWN:	GWH
DATE:	10/2009
SCALE:	1" = 200' (approx.)

SITE PLAN SHOWING GEOLOGY

Preliminary Geotechnical Investigation Report
Lone Tree Overpass Study
Flagstaff, Arizona

amec

means of reducing the material, or perhaps specialized expansive agents or blasting. BNSF does permit blasting near main line tracks contingent upon review and approval of a blasting plan prepared by the Contractor. A better idea of the extent of blasting that might be required will be available during the design phase after performance of a boring program to better characterize the material under the project area.

5.8.6 Preliminary Design Parameters

***Cut Slopes*:** Low seismic velocities indicate the subsurface materials have soil-like properties and will need to be laid back for slope stability purposes. The preliminary slope ratio recommendation is 2H:1V for excavations required to lower the grade of the railroad tracks. It may be possible to provide a steeper slope ratio recommendation once subsurface investigations have been completed. Steeper slopes are anticipated to suffice for portions of the cut in areas underlain by basalt flows and by unweathered to slightly weathered sedimentary rocks. These areas would probably support slopes completed at 1H:1V.

Structure Support Systems: Although bedrock appears to be present at relatively shallow depths at the project site, the upper profile of the bedrock appears to be decomposed to highly weathered and relatively soft. Due to the presence of relatively soft materials in the subsurface profile, the variable nature of the contact between basalt flows and underlying sedimentary rock units, the potential presence of a fault, and the potential presence of solution cavities within the Kaibab limestone, it is recommended that the overpass structure be supported on deep foundations (drilled shafts) that penetrate lower-velocity (softer) materials and are founded on harder materials. (The aforementioned fault is inactive. If the material along the fault is weathered or broken, the drilled shafts will have to be extended below the level of any soft or weak material. The type and quality of material along the fault will be determined during final design.)

5.9 Utilities

5.9.1 City Water and Sewer Services

Recommended City water and sewer improvements in the project area include the following:

***Water*:**
The water line in Brannen Avenue between Elden Street and a point west of Lumber Street was built in 1906 and should be replaced with a new 8 inch diameter water line. It is recommended that the new water line be placed in a steel sleeve under new Lone Tree Road.

1. Construct a new looped water line (8 inch diameter) along Elden Street and the proposed Elden Street Extension to an existing 30 inch diameter water line in Butler Avenue.

***Sewer*:**

1. The sewer line in Brannen Avenue and the alley between Gabel Street and Lumber Street dates from 1909 to 1949 and should be replaced with a new sewer. The new sewer line should be placed in a steel sleeve under new Lone Tree Road.
2. Beginning at an existing manhole at the intersection of Elden Street and Cottage Avenue, construct a new sewer line along the Elden Street Extension to a point north of the intersection with Butler Avenue.

It should be noted that existing sewer lines north of the proposed Elden Street Extension will be removed and replaced as part of the Rio de Flag drainage channel project being designed by the USACE.

5.9.2 Private Utilities

Private utilities include natural gas, cable television, telephone and electric power. These utilities will have to be relocated prior to construction. It is recommended that lines that are currently overhead be relocated underground. New electric power lines will be required in new Lone Tree Road for street lighting. It is also anticipated that new underground electric power, cable television and telephone lines will be constructed in the Elden Street Extension. It appears that private utilities are located in public rights-of-way and will therefore be relocated at owners expense, pending a complete accounting of prior rights during final design. A $50,000 allowance for unanticipated prior rights is included in the cost estimate.

Utilities in Route 66 will be protected in place. Existing manhole covers and valve covers will be adjusted to match new pavement elevations. Proposed new utilities are shown in Appendix E.

5.10 Right-of-Way and Relocation Requirements

5.10.1 Right-of-Way Requirements

The recommended alternative will impact 23 separate parcels, not counting City of Flagstaff and BNSF properties adjacent to Route 66. A detailed description of the impacted parcels is given in the report *Right-of-Way Cost Estimate* (January 13, 2010) prepared by Dennis Lopez and Associates. Estimated requirements for permanent right-of-way and temporary construction easements (TCE) are shown in Table 5.4. A map showing preliminary right-of-way requirements is shown in Figure 5.13

Table 5.4 Estimated Right-of-Way Requirements

	Right-of-Way Requirements, acres			
Type	**BNSF**	**Residential**	**Commercial**	**Vacant**
Permanent	1.51	0.50	4.26	0.01
TCE	0.03	0.00	0.19	0.02

Of those parcels that are subject to complete acquisition, the remnants are small and are not likely to be redeveloped due to size or lack of access. However, if combined with parcels that are subject to acquisitions ranging in size from minor to none, there is considerable area that could be redeveloped. The area bounded by Lone Tree Road, the Elden Street Extension (including Lumber Street) and Butler Avenue measures approximately 4.9 acres excluding the area required for a detention basin. All of this land is commercial. Similarly, the area bounded by Lone Tree Road, Brannen Avenue, Elden Street and the Elden Street Extension measures approximately 4.5 acres exclusive of detention basin area. Of this area, 1.2 acres are commercial, 0.5 acres are residential, 0.5 acres are vacant (unimproved storage yard), and 2.3 acres are BNSF property. A third area lies between Elden Street, Brannen Avenue, Lone Tree Road, and Butler Avenue. The total area is approximately 2.0 acres, which 1.2 acres are commercial, 0.7 acres are residential and 0.1 acre is nominally vacant, although there appear to be some improvements on the property.

5.10.2 Relocation Requirements

The recommended alternative will require payment of relocation expenses to 27 separate individuals or enterprises. An estimate of relocation expenses was prepared by O.R. Colan Associates and is shown in Table 5.5.

Figure 5.13 Preliminary Right-of-Way Requirements

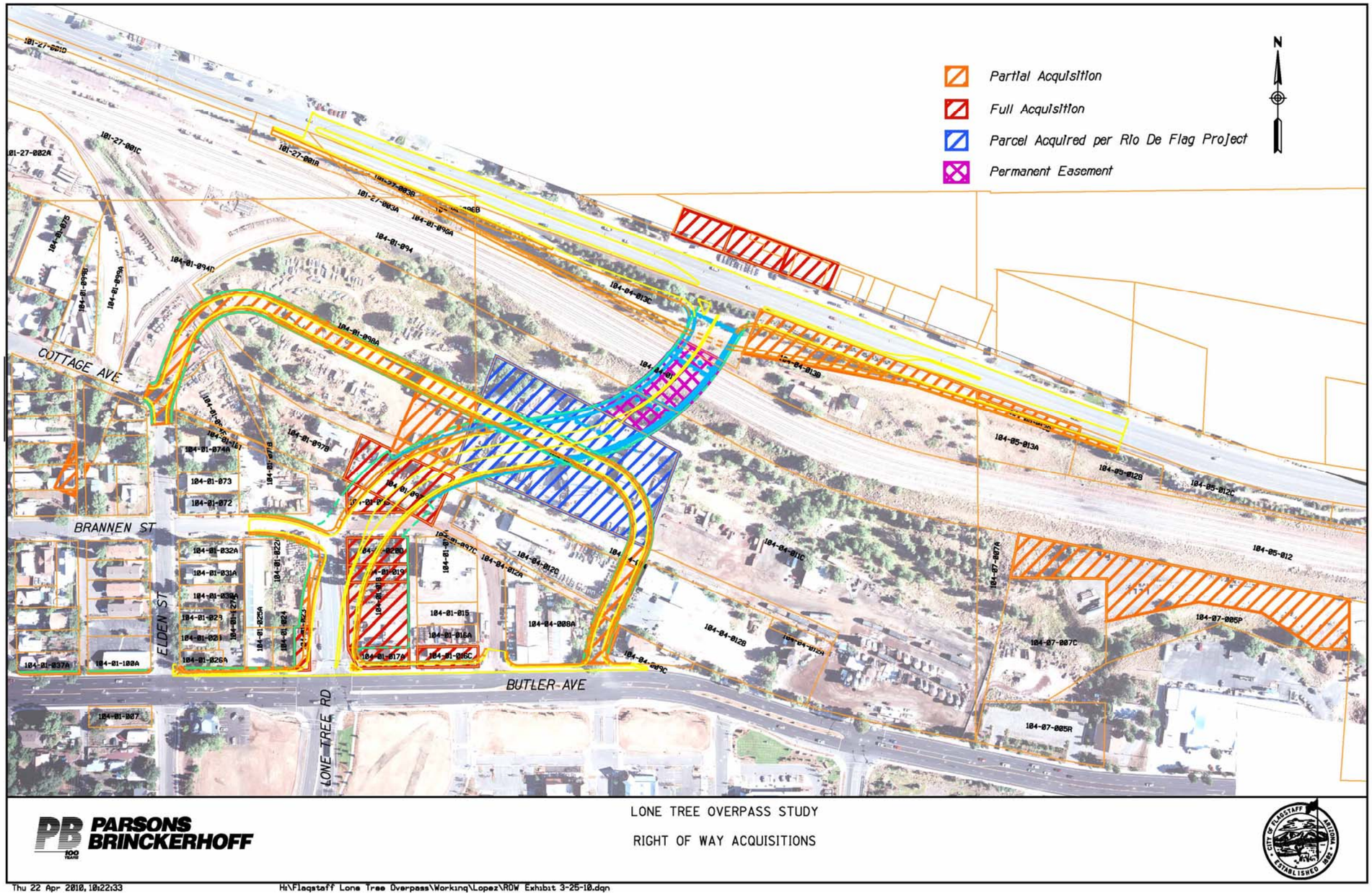


Table 5.5 Estimated Relocation Expenses

Parcel No.	Situs (86001)	Use	Legal Class	Primary Owner	Area, ac	Take, ac	Remain, ac	TCE, sf	Relocation Type*	Relocation Benefit
104-01-020D	507 E Brannen Av	Rental property with 2, possibly 3 dwellings	Rental Residential	Watkins, L. Michael & Eileen	0.198	0.198	0	0	3 Res. Tenants & NRO	$42,500
104-01-019	3 S Colorado St	Single-family residence w/detached garage or 2nd residence	Residential	Lomeli, Vera	0.132	0.132	0	0	Res. O/O Res. Tenant	$35,000
104-01-018	504 E Butler Av	No improvements; heavy equipment parking lot	Commercial	High Desert Investment Co.	0.494	0.494	0	0	Personal Property	$5,000
104-01-017A	504 E Butler Av	Office building	Commercial	High Desert Investment Co.	0.157	0	0	0	Per Dennis Lopez remainder is unmarketable	
104-01-023	424 E Butler Av	Rental property	Rental Residential	Ginsberg, Allen T.	0.082	0.082	0	0	Res. Tenant & NRO	$22,500
104-01-024	422 E Butler Av	Rental property	Vacant	Personnet, Rusty	0.118	0.007	0.111	250	Vacant lot	
104-01-022A	495 E Brannen Av	Long metal building; warehouse storage	Commercial	Moore, Guiford & Georgia M.	0.710	0.050	0.660	750	Personal Property	$5,000
104-01-025A	410 E Butler Av	Concrete driveway	Commercial	Moore, Guiford & Georgia M.	0.144	0.010	0.134	325	Personal Property	
104-01-027A	400 E Butler Av	Driveway; parking lot; plant nursery	Commercial	Sparks, Nigel & Ryan, Nancy	0.170	0.009	0.161	250	Assume all cost to cure in appraisal process	
104-01-026A	400 E Butler Av	Plant nursery; wall on Butler to be removed	Commercial	Sparks, Nigel & Ryan, Nancy	0.117	0.010	0.106	520	Assume all cost to cure in appraisal process	
104-01-093	502 E Brannen Av	Jack's RV Maintenance Service	Commercial	Martyn, Jack & Mildred T.	0.112	0.112	0	0	1 Business O/O	$35,000
104-01-097D	512 E Brannen Av	Metal building - 510 E Brannen	Commercial	Jansen, D. & Janice S.	0.600	0.600	0	0	2 Businesses & NOO	$52,500
104-04-011D	633 E Brannen Av	Cement and rock products	Commercial	Arizona Materials Properties	N/A	N/A	N/A	N/A	Relocation by Rio de Flag Project**	**
104-04-012C	524 E Brannen Av	Auto Body Techniques - car repair	Commercial	Sensibar, Jesse	0.910	0.003	0.907	470	None	
104-01-098A	520 E Brannen Av	Northland Recycling; Martinez Metal Works	Commercial	AT&SF Railway Co.	5.130	0.910	4.220	1,000	5 Businesses	$130,000
104-01-094D	NA	Wye track; spur track; BNSF storage yard	Commercial	AT&SF Railway Co.	3.240	0.410	2.830	450	Personal Property	$7,500
104-01-016C	522 E Butler Av	Horizon Shooters	Commercial	Tantiyatvanon, Preeda & Madeline	0.157	0.047	0.110		1 Business & NOO	$62,500
104-04-008A	602 E Butler Av	Offices	Commercial	Purcell, Michael & Margaret	0.950	0.160	0.790	1,650	Personal Property	$10,000

Table 5.5 Estimated Relocation Expenses (Cont.)

Parcel No.	Situs (86001)	Use	Legal Class	Primary Owner	Area, ac	Take, ac	Remain, ac	TCE, sf	Relocation Type*	Relocation Benefit
104-04-002	620 E Route 66	Image	Commercial	Stilley, Peter & Molly	0.200	0.200	0	0	2 Businesses & NOO	$62,500
104-15-003	624 E Route 66	United Flooring Brokers	Commercial	Stilley, Peter & Molly	0.110	0.110	0	0	1 Business	$45,000
104-15-002	622 E Route 66	Park Auto Sales	Commercial	Nicholson, Barbara	0.041	0.041	0	0	1 Business & NOO	$42,500
104-04-009C	620 E Butler Av	Lawn & chain saw supplies	Commercial	Arizona Power and Lawn LLC	0.271	0.005	0.266	950	None	
104-01-100A	221 S Elden St	Church; sidewalk ramp on Butler to be removed	Vacant	First Colored Baptist Church of Flagstaff	0.280	0.005	0.275	700	None	
104-01-037A	224 S O'Leary St	Sidewalk to be removed	Residential	Garcia, Rose	0.170	0.003	0.167	700	None	
104-07-005P	1200 E Butler Av	Lumber and materials yard	Commercial	LN Real Estate LLC	7.760	1.730	6.030	1,000	Personal Property	$20,000
104-01-063A	316 E. Brannen Av	Single-family residence w/detached garage	Rental Residential	Mayorga, Frank and Tamara	0.201	0.006	0.195		None	
104-01-065	124 S. O'Leary St	Single-family residence w/detached garage	Residential	Mary Gonzalez Family Trust	0.194	0.007	0.187		None	
104-01-066	118 S. O'Leary St	Residential property w/possibly two dwellings	Residential	Ramon and Elsie Jorajuria, Trustees	0.193	0.051	0.142		Res. Tenant	$10,000
104-01-067	116 S. O'Leary St	Rental property w/one, possibly two dwellings	Rental Residential	Bourne and Giodano, Trustees	0.159	0.014	0.145		Personal Property	$500
										$588,500

* NRO = Non-Resident Owner of Residential Property
O/O = Owner Occupant of Residential Property
NOO = Non-Owner Occupant of Residential Property

** Acquisition and relocation expenses are at present part of the Rio de Flag Project (RdF). However, changes to the RdF currently under evaluation by the City and the USACE could cause part or all of the acquisition and relocation costs to be assigned to the Lone Tree Overpass project. These costs are estimated to be $600,000 for acquisition and $35,000 for relocation.

5.11 Preliminary Cost Estimate

A cost estimate was prepared for the Recommended Alternative for the Lone Tree Overpass as shown in Table 5.6. The cost estimate was derived using estimated quantities and a combination of historic and recent bid tabulations from various sources. The construction cost estimate includes a 20% contingency and a mobilization cost estimated at 8% of the construction cost. It should be noted, however, that the mobilization cost could be negatively impacted by BNSF's scheduling of track construction and lineovers. The cost of traffic control was estimated at 5% of the construction cost due to fact that widening on Route 66 will be on one side only. It does, however, assume that a flagger will be needed at times during construction of the overpass. More detailed cost information is shown in Appendix E. Estimated earthwork quantities are also shown in Appendix E.

The estimated right-of-way and relocation costs have a 15% contingency. The costs of design and construction management are estimated to be 10% and 15% of the estimated construction cost, respectively. The costs were not inflated to account for construction in future years.

Table 5.6 Cost Estimate Summary

Item	Total Cost
Mobilization and Traffic Control	$ 3,600,000
Removals and Remediation	$ 688,000
Earthwork	$ 1,648,000
Railroad	$ 8,014,000
Structures	$ 11,136,000
Roadway	$ 1,577,000
Utilities	$ 931,000
Drainage	$ 709,000
Traffic	$ 375,000
Landscaping	$ 674,000
Lighting	$ 75,000
Subtotal	$ 29,427,000
Contingency (20%)	$ 5,885,000
Total Estimated Construction Cost	**$ 35,312,000**
Construction Management (15%)	$ 5,297,000
Engineering Design (10%)	$ 3,532,000
Right-of-Way (with 15% contingency)	$ 5,156,000
Relocation (with 15% contingency)	$ 677,000
Grand Total	**$ 49,974,000**
Grand Total (Rounded)	**$ 50,000,000**

6.0 Environmental Overview

The Lone Tree Overpass project does not include a federal funding component. Therefore, the formal process required by the National Environmental Policy Act (NEPA) is not required. However, the City of Flagstaff has determined that a general environmental assessment that follows the basic content and guidelines of NEPA will be conducted during final design. The eventual result will be a document that describes the existing environmental conditions and potential impacts but will not be processed through the normal NEPA review and approval steps.

At this stage of the project, a preliminary assessment of the potential environmental impacts and a summary of required future tasks have been completed. The thorough environmental evaluation and documentation will be completed at a later stage of the project definition and design process.

It is assumed that the eventual environmental documents will take the form of an Environmental Assessment that follows the NEPA guidelines. The major components of the NEPA process are described below. In each case, the results of the preliminary study are included. The remainder of each task will be completed at a later date.

6.1 Coordination and Scoping

An important part of the environmental process is the coordination of the project with other public agencies and the general public. While a number of these activities have been conducted as part of the preliminary planning for the project, the environmental process and documentation should include the items listed below. The results of the scoping process will determine the level of analysis that will be required for each of the environmental subjects. The steps in the process are:

- Identification of related federal, state, and local governmental agencies. These agencies would likely include the Arizona Department of Transportation, Federal Highway Administration, Federal Railroad Administration, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, Arizona Game and Fish Department, Arizona Department of Environmental Quality, U.S. Bureau of Reclamation, the Arizona State Historic Preservation Office (SHPO) and the Arizona Corporation Commission. Also contacted would be the Flagstaff Metropolitan Planning Organization and relevant departments of the City of Flagstaff and Coconino County. Various Indian communities may be contacted as part of the historic preservation function of the SHPO. Railroads to be contacted include BNSF and Amtrak.
- Preparation of an agency coordination plan to be followed during the study
- Holding of an agency scoping meeting to identify concerns and issues to be addressed
- Continued agency communications
- Identification of public interest groups and citizen organizations with a relationship to the project
- Preparation of a public involvement plan that describes the procedures to be used for citizen input into the study
- Holding of a public scoping meeting to identify concerns and interests to be addressed
- Scheduling of additional public meetings and hearings as needed

6.2 Determination of Purpose and Need

The future environmental document should include a clear analysis and description of the need for the project and the purpose that it will fulfill. This analysis would include a traffic analysis that documents the present and future traffic volumes and conditions. This analysis would be based on the traffic analysis conducted as a part of the current effort. It would describe the manner in which the proposed project meets the identified need.

Other considerations would include related governmental policies, social and economic development factors, safety implications, and the relationship of the proposed project to other transportation facilities

6.3 Identification of Alternatives

Alternative means of meeting the project objectives have been identified by the current and previous studies. The future environmental document should describe these alternatives and explain the rationale for choosing the preferred alternative. The consequences of the no-action alternative should also be explained.

6.4 Environmental Justice

Title VI of the Civil Rights Act of 1964 applies to any program or activity receiving federal financial assistance. It assures that individuals are not denied the benefit of the activity or subjected to discrimination on the basis of race, color, national origin, age, sex, or disability. Further, Executive Order 12898 on Environmental Justice directs that programs, policies and activities not have a disproportionately high and adverse environmental effect on minority and low-income populations.

The proposed project is not expected to use federal funds and thus does not technically fall under the requirements of Title VI/Environmental Justice. However, the City of Flagstaff has determined to evaluate the impacts to minority and low-income populations.

As shown previously in Tables 2.3 and 2.4 of Section 2 of this report, in 2000 there was a higher concentration of minority populations in the study area when compared to the larger surrounding jurisdictions. The future preparation of the environmental effects document should further evaluate this issue with regard to the impacts of the project on these populations. This effort should also seek more up-to-date information on which to base the analysis.

6.5 Right-of-Way and Relocation

Right-of-way acquisitions and potential relocations are described in Section 5 of this report. Potential relocations include several residences near Butler Avenue and Lone Tree Road. Impacts to commercial properties and industrial properties will occur on the north side of Route 66 where access will be affected by the project and in the area south of the railroad tracks. These impacts will be described in detail in the future environmental document.

Any acquisition of property by the City will require a Phase I investigation before the property is acquired. New city right-of-ways or easements require an internal environmental site assessment by City Environmental Management staff with no costs. Any properties with structures acquired by the City require surveys for asbestos and lead-based paint. Any renovation or demolition of an acquired building requires

use of an asbestos and/or lead-based paint contactor to properly remove and dispose of any regulated asbestos or lead-based paint materials that may be present.

6.6 Air Quality

This project is in an area that complies with national ambient air quality standards. Therefore, conformity procedures do not apply. The project will have no negative effects on the air quality in the area.

During construction, some deterioration of air quality may be expected due to the operation of construction equipment. However, this will be a localized condition that will be discontinued when the project is completed. Fugitive dust generated from construction activities would be controlled by the applicable state and local ordinances and rules.

6.7 Noise Impacts

The project is located in an industrial area, which may not create major noise issues. However, a noise analysis should be conducted to determine the presence of any sensitive noise receptors, analyze noise impacts, and define mitigation measures.

6.8 Cultural Resources

A Class I Cultural Resource Literature Review for the project area was conducted by a qualified archaeologist for the project site. The detailed results of the review are described in *A Class I Cultural Resource Literature Review for the Proposed Lone Tree Overpass Between Butler Avenue and Route 66 in Flagstaff, Coconino County, Arizona,* Archaeological Consulting Services, Ltd., September 9, 2009.

The purpose of the literature review was (1) to identify known cultural resources and previous resources projects; (2) to determine if any cultural resources eligible for or listed on the National Register of Historic Places would be affected by the project, and (3) to recommend any further cultural resources work that is needed.

The project area, encompassing approximately 61 acres, is located within the Flagstaff city limits in Sections15 and 22 of Township 21 North, Range 7 East, Gila and Salt River Base and Meridian. The area lies a short distance east of the original Flagstaff town site along the south side of Route 66 between San Francisco Street and Switzer Canyon Drive. The BNSF Railroad generally parallels Route 66 through the project area a short distance to the south of Route 66. The width of the project area varies to accommodate proposed construction alignments and crossings, as well as areas that may be impacted by construction activities. Butler Avenue defines most of the southern boundary of the project area. For purposes of the Class I overview, the review area consists of a one-mile buffer around the project area.

The literature review revealed that three previous projects have examined portions of the project area. These studies and associated recommendations concerning them are:

- A Class III survey for a CEMEX plant was conducted in 2001. Since this study occurred less than 10 years ago, a re-survey of the 2.84-acre parcel is not recommended.
- A 1994 survey along Route 66 occurred more than 10 years ago, so re-survey of the corridor, as well as the remainder of the project area, is recommended.
- The entire project area was examined for historic buildings by a survey in 1985. Buildings may have achieved historic status in the ensuing 24 years. Therefore, it is recommended that the project area, and a 50-foot surrounding buffer, receive a formal historic building inventory survey during the next phase of the work.

Eleven cultural resources have been recorded within or immediately adjacent to the project area. These resources are summarized below.

- Historic U.S. Route 66 and AT&SF Railroad. These facilities cross the northern portion of the project area. Although the AT&SF Railroad has been determined eligible for the National Register and portions of Route 66 are listed on the National Register, the segments within the project area have not been assessed for their contribution to the overall eligibility of each site. Because significant alterations to the road and the railroad occur as a result of the proposed project, it is recommended that the segments be documented by a Class III survey and evaluated for their contribution to each site's eligibility. If segments are found to be contributing, additional research and documentation may be needed.
- Railroad Addition Historic District. This historic district overlaps the northwestern portion of the project area and is listed on the National Register. Although no properties are depicted in the overlap area, additional archival research associated with the recommended historic building inventory survey is recommended to determine if listed or eligible buildings occur there.
- Southside Historic District. This district is located along the western boundary of the project area, with a slight overlap with the project area. Its National Register listing is pending. Six buildings within the district and one that is individually listed on the National Register occur immediately adjacent to the project area. Direct physical impacts to these properties are not anticipated. However, the proposed overpass and associated improvements may cause visual impacts to their historic character. Therefore, a visual impact assessment of these properties is recommended. Also, additional archival research is recommended to determine if additional historic buildings occur in the district.

6.9 Biological Resources

A biological review of the project site will be required to assess the potential for encountering threatened and/or endangered species and critical habitat in the project area. This assessment, which must be conducted by a qualified biologist, will include the following activities:

- Communication with appropriate state and federal agencies, which will include the Arizona Game and Fish Department and the U.S. Fish and Wildlife Service. In addition to the identification of threatened and/or endangered species and critical habitat, this activity will identify the presence of any native plants as defined by the Arizona Native Plant Law.
- A review of the potential existence of any listed species or habitat.

- A field visit to examine the overall habitat suitability for the various species and to identify any state sensitive species and protected native plants.
- Preparation of a Biological Report that identifies the existence of protected species, describes potential impacts on the biological resources that may be caused by the project, and the definition of the appropriate measures to mitigate these impacts.

Gunnison's prairie dogs, while not having an official protection status, are a sensitive species to the local community. Prairie dogs have been observed and are known to exist in most open sites in the project area. The future biological review should include an evaluation of the presence of this species and the potential for adverse impacts that may be caused by the project.

It should be noted that the historic Rio de Flag within the Lone Tree Road project area will be completely channelized by the Rio de Flag Flood Control Project. Separate environmental documents for that project have been prepared and approved. A future environmental document for Lone Tree Road should take this into consideration.

6.10 Hazardous Materials

The City of Flagstaff Brownfield Land Recycling Program has conducted voluntary Phase I and Phase II assessments in the central part of the city with grant funds. The grant area is shown in Figure 6.1. Within the boundaries of the Lone Tree Overpass study area, six properties have agreed to be assessed; the results of those assessments are shown in Table 6.1. Other properties within the study may also be expected to have some concentrations of solvents, petroleum products, pesticides, herbicides, asbestos, lead-based paint or other hazardous materials, given their past or present industrial and commercial uses or in the case of private residences, their age. It is also assumed that other properties in this area have had their own Phase I and/or II assessments, although that information is not available at this time. This includes properties along Route 66 that will be impacted by the project.

Table 6.1 City of Flagstaff Phase I and Phase II Studies in Lone Tree Overpass Study Area

Parcel	Report(s)	Conclusion	Suggestion	Other
104-01-066	PH I	PH II not suggested	Watch for potential septic and heating oil tanks	Residence
104-01-097B	PH I and II	No further testing necessary.	None	OK based on zoning
104-01-064A	PH I	PH II not suggested	Asbestos and Lead Paint; surveys necessary for addition or demolition	Residential next to Industrial zoning
104-01-032A	PH I	PH II not suggested	Asbestos and Lead Paint; surveys necessary for addition or demolition	Residence, zoned Industrial

Table 6.1 (Cont.)

Parcel	Report(s)	Conclusion	Suggestion	Other
104-01-020D	PH I	PH II not suggested	Asbestos and Lead Paint; surveys necessary for addition or demolition	
104-01-097D	PH I and II	No further testing necessary. HC, VOCs, and BTEX found.	Prudent to dig and haul contaminated soil	OK based on zoning

A report prepared by SCS Engineers for the City of Flagstaff (*Site Characterization Report, Selected Locations within Rio de Flag Channel*, January 7, 2009) described the results of investigations and tests conducted within the Rio de Flag channel. The report concluded that petroleum hydrocarbons including tar, oil and perhaps diesel fuel have impacted soil within the Rio de Flag channel. Concrete washout was also present in many areas. The report also recommended cleanup of the most heavily impacted areas since it is the City's responsibility to remove contamination that has the potential to impact water quality within the historic Rio de Flag, in accordance with agreements with USACE.

If the Rio de Flag drainage project is constructed before the Lone Tree Overpass, these contaminants will have been removed. If not, their removal and/or mitigation may be charged to the Lone Tree Overpass project if any work is done in the historic channel.

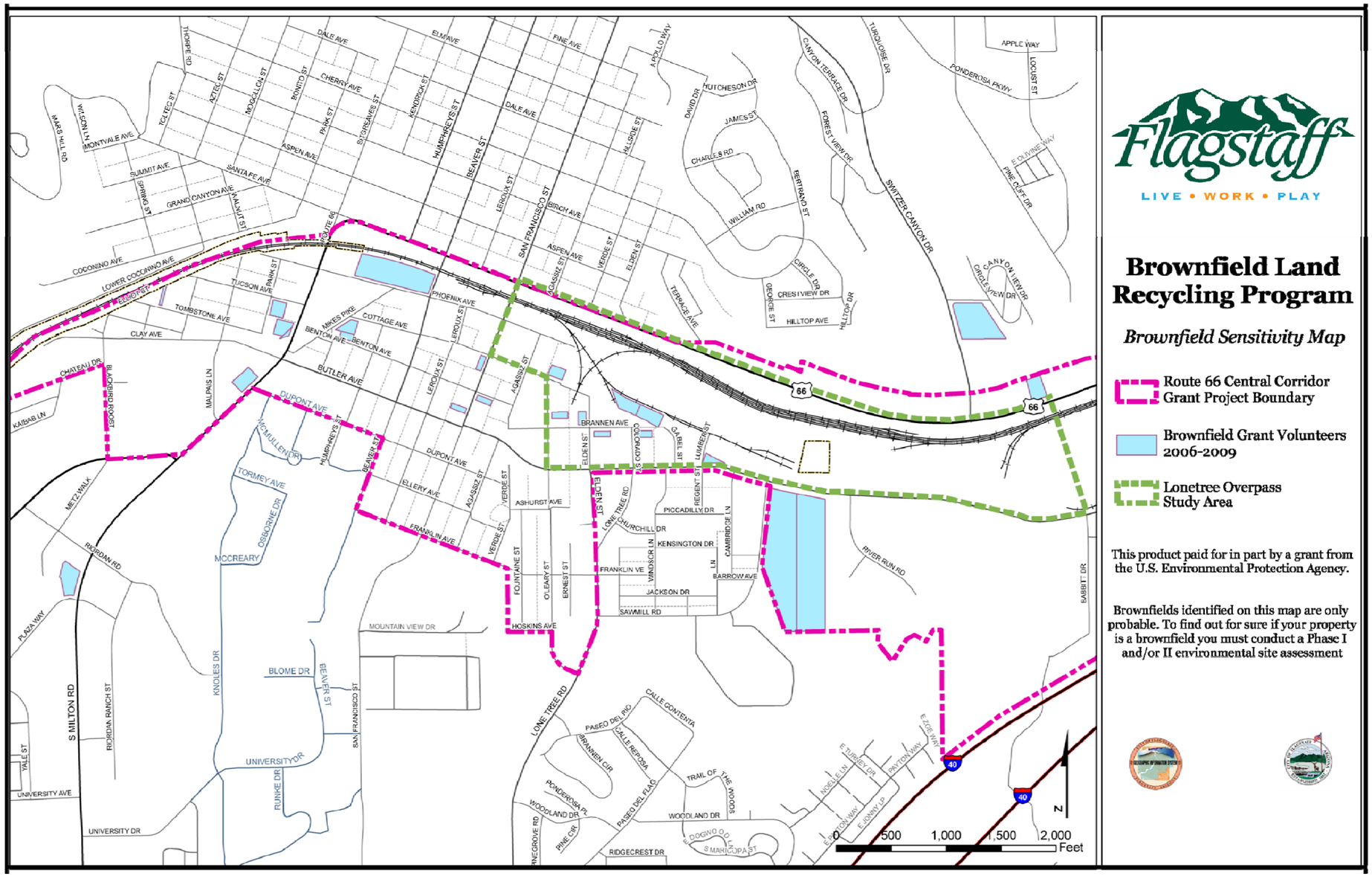
During final design, a hazardous materials report will be prepared using the results of the City's study and the SCS report as starting points. The results of the analysis, along with the identification of any mitigation measures, will then be incorporated into the overall environmental document. The project special provisions will require that any utility work that encounters transite (asbestos cement) pipe be stopped. Transite pipe often contains regulated asbestos and removal and disposal of the pipe must be performed by personnel trained in handling asbestos materials unless the pipe is tested to prove it does not contain regulated levels of asbestos. Proposed new utilities are shown in Appendix E.

6.11 Water Quality

6.11.1 Jurisdictional Delineation

Both the historic Rio de Flag and Switzer Canyon Wash are eligible for jurisdictional delineation as Waters of the U.S. by USACE and therefore fall under the permit requirements of Section 404 of the Clean Water Act. It is not known if the Rio de Flag drainage channel, once constructed, will also be eligible for jurisdictional delineation, with subsequent 404 permit requirements.

Figure 6.1 Probable Brownfield Sites



The only area observed in field reviews that could be construed as a wetland was standing water at the outlet of the 30 inch and 60 inc diameter drainage pipes described in Section 5. The area is populated by alder and other species of plants normally found around wet areas. This area, however, will be permanently altered by construction of the Rio de Flag drainage channel, as the two culverts will be directly connected to a large underground concrete arch and the site graded over. Even if the Lone Tree Overpass is constructed before the Rio de Flag project, this area will not be impacted by Lone Tree construction.

6.11.2 404 Permit Needs

The current requirements for 404 Permit coordination enables linear projects such as roadways, utilities and similar longitudinal projects to be conducted under the provisions of Section 13 for General Permits. The Section 13 requirements limit impacts to Waters of the U.S. to 0.50 acres per crossing. If impacts of a single crossing are less than 0.10 acres, work may be able to be performed under the "non-reporting" conditions of Section 13. Under "non-reporting" conditions, the formal permit process is waived unless USACE determines that unique habitat or environmental conditions warrant a formal permit process.

Based on current knowledge of the project limits and probable jurisdictional delineation, work in the historic Rio de Flag will require a 404 permit. If impacts to the delineated areas can be minimized to a "non-reporting" limit, no subsequent permit application will be required. Non-reported work will still need to be internally reviewed and documented and performed to meet the intent of the 404 Permit process.

At this time, work in Switzer Canyon Wash is not anticipated.

6.11.3 401 Certification Needs

The Arizona Department of Environmental Quality (ADEQ) oversees the 401 Certification requirements for qualifying projects. Typically, ADEQ only responds to Certification requests made by government entities providing a primary clearinghouse role in the project. The USACE policy is to request a 401 Certification review if an Individual Permit is required for a project or if special aquatic or riparian habitat conditions are present. Impacts to drainage ways are not expected to exceed the 0.5 acre threshold for Individual Permits and no special habitat conditions within the anticipated project area were identified during the review. A 401 Certification request for this project is not anticipated.

6.12 Visual Resources

The construction of the Lone Tree Overpass over the railroad tracks and the Paramount spur will create a structure that will be approximately 30 ft above existing ground. There will be a visual impact as seen from both directions of Route 66, along Butler Avenue and from surrounding areas.

Aesthetic treatments will be incorporated into the design of the overpass and retaining walls at the ends of the structure to lessen the visual impact and enhance the visual quality of the structure. The Fourth Street Bridge over the BNSF railroad tracks is an example of methods that can be used to enhance the appearance of a large structure.

7.0 Public Involvement Overview

During the Lone Tree Overpass Study, two public information meetings were conducted during the course of the study process. The public meetings were held in an "open house" format, which provided a free, open and accurate exchange of information between area residents with specific issues and questions and the study team. A report was prepared by KDA Creative documenting the public meetings and is included in Appendix F. A brief overview of the public involvement process and meetings is provided in this section.

7.1 Outreach Methods

The following outreach methods were used to inform and notify the general public and impacted residents about the study, public input meeting dates and locations and additional opportunities or means for input:

- Media release
- Newspaper advertisement
- City of Flagstaff website
- Postcards to adjacent property owners

7.2 Public Comment

Seventeen (17) people attended the first public input meeting on September 2, 2009. Graphics, aerials and display exhibits presented corridor alternatives and study information. Study Fact Sheets and Comment Sheets were distributed to all those in attendance. Public comments received at the meeting are provided in Appendix F of the summary report.

The second public meeting on February 24, 2010 was attended by 14 people. The Recommended Alternative, including an aerial plan view and a construction schedule, was presented, and a brief presentation with a question and answer session was conducted. Study Fact Sheets and Comment Sheets were distributed to all those in attendance. Public comments received at the meeting are provided in Appendix F of the summary report.

7.3 Public Information Meetings

7.3.1 Scoping and Alternatives Analysis Phase Public Meeting

Meeting Purpose: Gather public comment regarding the study area, existing conditions, current corridor deficiencies, future transportation needs and public review of overall Study Goals and Objectives.

- 5:30 – 7:30 p.m., September 2, 2009
- Lura Kinsey Community School, 1601 S. Lone Tree Road, Flagstaff, Arizona
- Attendance: 17

7.3.2 Findings and Recommendations Phase Public Meeting

Meeting Purpose: Gather public comment regarding study findings and "Preferred Alternative", recommended access management strategies and improvement phasing timeline.

- 5:30 – 7:30 p.m., February 24, 2010
- Lura Kinsey Community School, 1601 S. Lone Tree Road, Flagstaff, Arizona
- Attendance: 14

7.4 City Council Presentation

A presentation of the Final Study Report will be made to the City Council.

8.0 Implementation

8.1 Construction Contracts

The City may choose to construct the entire Lone Tree Overpass project under one contract or let out several contracts in phases, as was done on the Fourth Street Railroad Crossing project. Possible construction phases or contracts are the following:

Contract 1:

1. Shoofly tracks
2. Main line, siding and storage tracks, wye track and Paramount spur
3. Overpass structure

Contract 2:

1. Retaining walls at the south abutment
2. Lone Tree Road between end of the overpass structure to Butler Avenue
3. Local streets
4. City utilities

Contract 3:

1. Retaining walls at the north abutment.
2. Route 66 improvements
3. FUTS trail reconstruction under Lone Tree Overpass
4. Signing, marking and street lights

The fact that BNSF does not allow falsework over its tracks will require track relocation and overpass construction to be done under one contract. Because of BNSF restrictions on construction in the fourth quarter of the year and programmed winter shutdowns, relocating the tracks and building the overpass structure will probably take at least two years, although mild winters may reduce this time.

Structural requirements of the post-tensioned spans of the bridge spans dictate building the bridge under the same contract as the track relocation. It may be possible to have the Paramount spur built by a non-BNSF contractor, enabling construction during the fourth quarter. This possibility should be weighed against responsibility of the City for inspection during construction. If BNSF constructs the spur, then construction inspection is the Railroad's responsibility.

Construction along Route 66 and reconstruction of the FUTS trail cannot be in Contract 1 because of conflicts with the shoofly tracks. However, Contracts 2 and 3 could be combined and the work along Route 66 be scheduled appropriately.

8.2 Contracting Methods

Assuming that the Lone Tree Overpass is approved in the November 2, 2010 bond election, implementation of the project from design to completion will take several years. The important components of the implementation plan include:

1. Advertise for and select a design consultant
2. Prepare environmental documents, right-of-way plans, contract plans, specifications and cost estimate
3. Negotiate a Construction and Maintenance agreement with BNSF
4. Acquire all necessary permits
5. Negotiate and acquire right-of-way
6. Relocate private utilities
7. Advertise and award construction contract

With the exception of negotiations with the railroad, these steps are typical of "Design-Bid-Build" contracts prevalent in state and municipal public works contracting. However, for Phase 2 of the Fourth Street Railroad Crossing, the City chose to use "Construction Manager at Risk" (CMAR). This contracting method is popular for "vertical construction" (buildings) but has been used successfully for "horizontal construction" (roads and other civil works). The details of CMAR contracting is beyond the scope of this report, but in general involves the qualifications-based selection of a contractor (the CMAR) to work with the design consultant in preparation of final construction documents. The consultant-CMAR usually begins after preparation of the 30% plans. The end product is a "Guaranteed Maximum Price" (GMP), the maximum price the Owner will have to pay for the completed project.

In the case of the Lone Tree Overpass Project, CMAR might be useful above all in Contract 1 when development of a construction sequence for relocating the railroad tracks is very important for a successful project. Even though BNSF crews will be doing railroad construction, a CMAR or CMAR subconsultant with railroad experience would be able to work with the railroad engineering and operations personnel to devise a construction sequence that will be satisfactory to all.

8.3 Construction Schedule

The Fourth Street Railroad Crossing, a project of comparable budget and scope to the Lone Tree Overpass, took approximately 36 months from groundbreaking on November 2, 2003 to official opening on August 28, 2006. Considering that consultant selection began in August 2001, if not sooner, the total length of the project was five years.

The Lone Tree Overpass Project is considered to be much more complicated than the Fourth Street project, largely because of the construction sequence required to maintain BNSF operations. There is also the potential of the Rio de Flag drainage channel being under construction at the same time as the Lone Tree Overpass, complicating construction of the overpass structure, the Paramount spur, and adjacent roadway improvements. For those reasons, six years is considered to be a reasonable duration for the project, beginning with a "yes" vote in November 2010. A preliminary project schedule is shown in Figure 8.1

Figure 8.1 Preliminary Schedule