5. MAJOR DESIGN FEATURES

5.1 Introduction

This section describes the major design features associated with the recommended alternative. The recommended alternative is comprised of design concept alternative segments A-1a, B-2a and C-3 as described in section 4.6 and shown on the plan sheets in Appendix D.

5.2 Design Controls

The following design controls were used in the development of the design concept for the selected alternative. All criteria is based on "Rural" standards as no portion of the roadway studied qualifies for "Urban" standards.

- Design Year: 2025

- Design Speed:
  - New mainline roadway design speed:
    - 70 mph. Minimum
    - 75 mph. Desired
  - Frontage Roads and local roads will be designed to modified ADOT RC typical section, pending an IGA with the County to maintain these facilities after construction.
  - Frontage road design speed: 50 mph.
  - Realigned local road connections design speed: 50 mph.
  - Realigned SR 71, over the US 93 Mainline: 45 mph.

- Typical Sections
  - Four-lane Divided Rural Highway (Section RA, ADOT Roadway Design Guidelines):
    Lane Width: 12-ft
    Shoulder Width: 10-foot outside shoulder
    4-ft inside shoulder
    New Bridges: Shoulder plus 2 feet to face of barrier
    Number of Lanes: Two lanes each direction
    Median Width: Varies 46 ft to 600 ft
  - Two-lane Undivided Rural Roadways (Frontage Roads & Local Roads) (Section RC, ADOT Roadway Design Guidelines, Modified):
    Lane Width: 12 ft
    Shoulder Width: 2 ft.
    New Bridges: 28 ft.
    Number of Lanes: One lane each direction

- Slope Criteria:
  US 93 Mainline roadway section, ADOT Standard C-02 series as appropriate. No embankment slopes for any roadway section are to be steeper than 2:1 (2 horizontal to 1 vertical). Frontage and Local Roads follow ADOT Standard C-02.30.

- Maximum Gradient:
  US 93 Mainline:
  - Level terrain - 3 %
  - Rolling Terrain – 4%

  Frontage and Local Roads: 7 %
  Intersection approach grade for side roads: 3%

- Maximum Rural Superelevation: 0.10 ft/ft (ADOT Roadway Design Guidelines recommend 0.10 ft/ft for elevations below 4,000 ft.

- Maximum Degree of Curve (based on superelevation rates specified above):

Design Speed (mph)	Degree of Curve
70	3° 30'

- Median crossovers associated with the divided roadway alternatives were provided at locations of obvious need (major intersections, turnouts to developed properties) and are shown on the recommended design concept alternative plans. However, the median crossovers are to be considered as interim access provisions only. See Section 7, Access Management Plan, for further details.

- Guardrail: Provide per ADOT Criteria and/or AASHTO Roadside Design Guide.

5.3 Horizontal and Vertical Alignments

The horizontal and vertical alignments of the recommended alternative were set to follow the existing route and use the existing roadway for one direction of travel through the entire length of the project:

- For maintenance of traffic during construction.
- To mitigate the impact on the environment by minimizing the construction area.
- To maintain existing access to adjoining properties.
- For overall economy of the proposed improvements.

The existing horizontal and vertical alignment provides a usable roadway throughout the length of the project. Although the existing roadway does not meet new construction criteria for shoulder width, and has minor deviations from AASHTO criteria for superelevation and grades, it will meet the needs for one direction of travel for many years. Improvement of the existing shoulder width can be constructed in phases over several years to allow reasonable funding levels to be programmed while still providing the needed capacity and safety improvements necessary to handle projected increases in traffic.

Minor adjustments of the horizontal and vertical alignments of the new roadway as presented herein will be necessary during final design to minimize impacts to existing development and to achieve an optimum earthwork balance (see Section 5.9.9 for a discussion on earthwork balancing).

5.4 Access

Full control of access is recommended along US 93 to enhance traffic operation and safety as well as to preclude uncontrolled future access and random strip development. Initially, partial access control will be implemented. Frontage roads will serve as collector roads in areas having numerous, closely spaced turnouts. Right-in right-out provisions will be provided for isolated situations. Later, as traffic increases, the median crossovers will be replaced with traffic interchanges resulting in a fully access controlled highway, See Section 7, Access Management Plan, for details.

5.5 Right-of-Way

Of the property presently fronting the highway, approximately 78 percent is State land, approximately 16 percent is private land, with the remainder being BLM land. The width of existing right-of-way along US 93 varies from 100 feet to more than 300 feet on the west side and from 100 feet to more than 250 feet on the east side. An additional width to provide a 500 foot scenic setback on both sides of the existing centerline is present throughout the Joshua Forest Scenic Road section.

The recommended alternative will require additional right-of-way from private property, State Land, and B. N. S. F. Railroad. Table 5-1 lists the County Assessor's parcel number, parcel ownership, and estimated additional right-of-way required, for the various design concept alternatives. The design concept plans in Appendix D identify new right of way needs with a Plans Reference Number (A101, A116, etc.), which is keyed to the plan's reference number column in Table 5-1.

Table 5-1: Estimated New Right-of-Way

Plans Ref.	Parcel Number			Owner	Approx Take (Acres)
	BK	Map	Par.		
S100				State of Arizona	
A100	201	06	001G	Wvdl Ui & Boyd, Alwxander Ui	2.66
A101	201	06	001F	Petroleum Inc.	0.00
A102	201	02	002N	Wvdl Ui & Boyd, Alwxander Ui	0.08
A103	201	02	002P	Petroleum Inc.	0.00
A104	201	02	002A	Demers Kerry Louise Ss & Cossey Judith Kathleen Ss	3.29
A105	201	02	151V	Mader Craig G & Deborah A Trustees / Mader Graig Family Trust	7.45
A106	201	13	035C	Cramer Randal M & Suzanne G.	0.20
A107	201	13	035B	Macias Frank & Ranea Rs	1.09
A108	201	13	030	Coughanour David V & Laura B Jt	0.77
A109	201	13	028	North Dale Kings	0.82
A110	201	13	026	Rockwood Richard W & Sandra L Rs	1.09
A111	201	13	014	Owen John W & Valerie Y Rs	0.87
A112	201	13	013D	Urias-Soto Pedro & Stormie Jt	1.73
A113	201	13	013C	Meier Joyce W Living Trust Ui & Meier J J Living Trust Ui	0.15
A114	201	13	048	Russell Paul M & Patricia A Jt	0.65
A115	201	13	065	Jensen Rodney L & Sharon K Jt	0.55
A116	201	13	064	Cobasky George Lee & Charlotte Rs	0.61
A117	201	13	017G	Putnam Donald & Geraldine	0.62
A118	201	13	017F	Douthat John M & C Denise Jt	0.62
A119	201	13	017D	Sadowski David & Donna Jt	0.62
A120	201	13	063	Brink Rober T.	0.61
A121	201	13	062	Coughanour Davis V & Laura B Jt	0.61
A122	201	13	164	Vista Royale Llc	0.52
A123	201	13	163		0.52
A124	201	13	162		0.52
A125	201	13	161		0.52
A126	201	13	017B	Richards Sharon J & Rockwell Carol H Jt	1.13
A127	201	13	019E	Pitt Sharlet	0.49
A128	201	13	019F	Dierks Norman F.	0.65
A129	201	13	019C	Canary Christopher N. & Stacey A.	0.52
A130	201	13	021B	Overley Muriel M.	0.59
A131	201	13	160	Vista Royale Llc	0.82
A132	201	13	158	Vista Royale Llc	1.67
A134	201	13	021	Stoddard Roy K. & Doris A.	0.60
A135	201	13	157	Echols Mark A & Vickie S Rs	1.96
A136	201	13	155		0.88
A137	201	02	151C		0.22
A138	201	13	015	Simms Arlyn H & Stevenson Carol S Jt	1.03
B100	201	18	009	Billings Donald Q. & Laura D.	0.01
B101	201	19	008	Cornerstone Propane Lp	0.48
B102	201	20	005	Cornerstone Propane Lp	0.63
B103	201	21	006	Scott Linda Joan	0.00
B104	201	22	007	Brown Forest W	1.76
C100	200	09	001	Goodchild Sid	2.45
C101	200	09	001C	Way Robert & Lea Rs	0.00
C102	200	13	003	Craig Terry A And Rothermel Frederic M And Susan S Jt	29.09
C103	200	14	002	Pingitore Family Trust	14.26
C104	200	15	002	Pingitore Family Trust	0.00
C105	200	16	001	Pingitore Family Trust	0.00
C106	200	16	001A	Pingitore Family Trust	6.39
C107	200	16	001A	Barnes Erik & Tina Jt / Santa Maria Ranch	0.00

5.6 Drainage

Drainage has been evaluated in a separate report for this study entitled "Initial Drainage Report; US 93, US 89-Santa Maria River, May, 2003".

5.6.1 Existing Conditions

The US 93 roadway is oriented from northwest to southeast through the northern study area, and generally forms the southern / western boundary of the watershed (**Figure 5-1**). The Date Creek watershed is bounded by US 93 on the west, the Date Creek Mountains on the south, the Weaver Mountains on the east, and a lesser mountain range approximately seven miles north of the Date Creek Mountains. The Date Creek watershed is the largest runoff area in the study and generally drains to the southwest. Big Jim Wash (formerly named Black Canyon Wash) is the second largest area and generally drains to the west. The Date Creek Mountains also form the northern watershed boundary for the various south-flowing runoff basins between Date Creek and the US 89 intersection. The runoff areas that are located north of the Date Creek bridge drain westward, with a few minor exceptions.

5.6.2 Vegetation

The rolling foothills area from MP 161 to MP 177 is dominated by Joshua trees, Cat-claw Acacia, Desert Broom, Creosote, Chain Cholla, and range grasses. The upper elevations of the watershed are sparsely vegetated with Gamble Oak, varieties of holly, and Jojoba bush. Creosote bush is the primary foliage in the flat desert areas, with range grasses, desert broom, cat-claw acacia, and several varieties of cacti. Mesquite trees are prevalent along the banks of most of the intermittent streambeds. Palo Verde trees are sporadically distributed on many of the hillsides and ridges. The upper Date Creek Mountains had stands of dense brush vegetation between the rock outcrops.

5.6.3 Existing Culverts and Bridges

Existing cross drainage structures within the study limits include two bridges (Date Creek and Big Jim Wash), 78 concrete box culverts, and 125 pipe culverts. The culvert numbering starts with 100 at the US 89 interchange and ends with 302 at MP 162.02. Culverts 98 and 99, which are located just southeast of the US 89 interchange, were added later to the study.

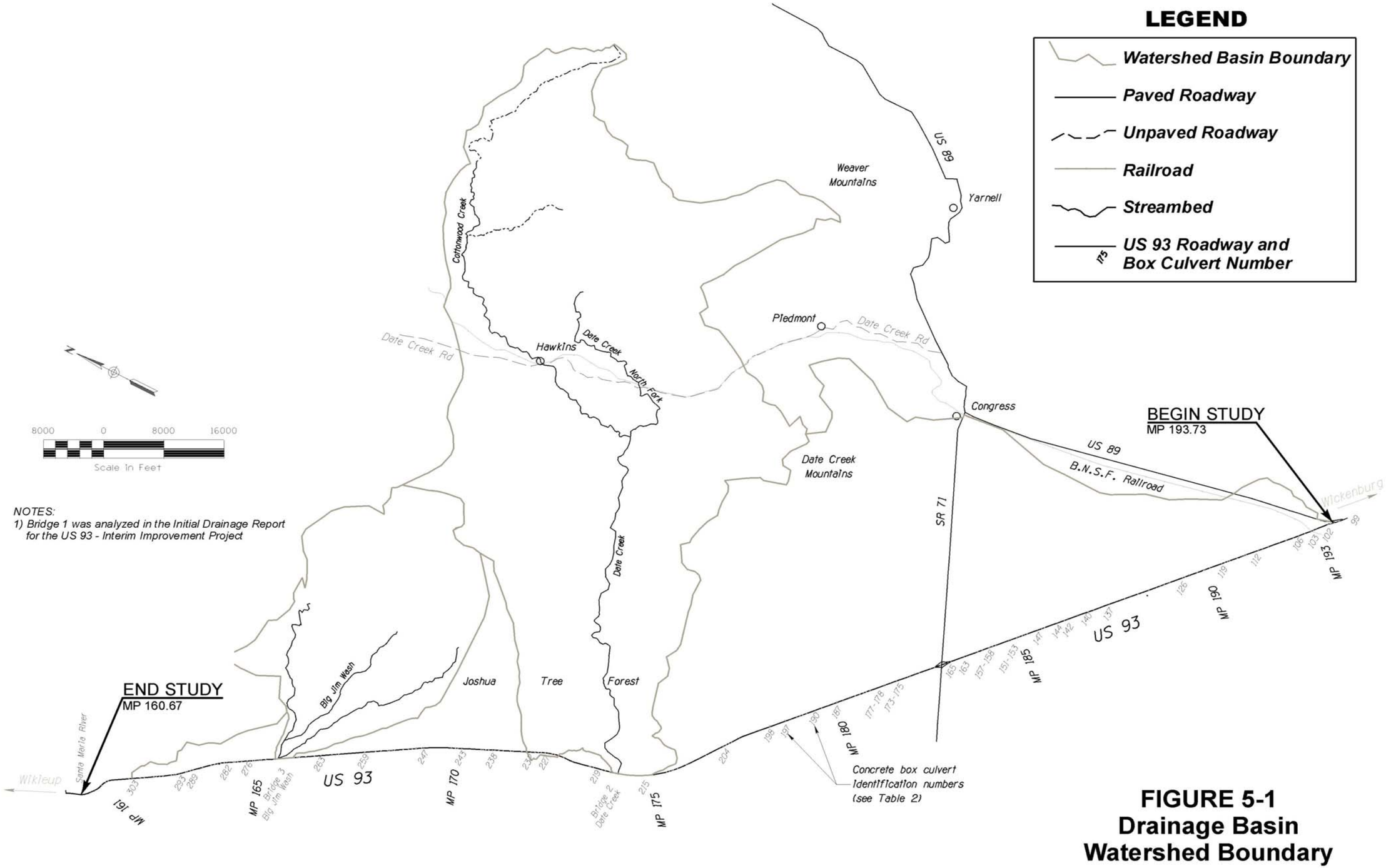

FIGURE 5-1
Drainage Basin Watershed Boundary

State Route 71 is oriented from southwest to northeast and has 9 major culvert crossings located upstream of US 93. The SR 71 roadway profile is very low and does not provide significant storm water detention upstream. The culverts are expected to pass all runoff without attenuation.

The Burlington Northern Santa Fe (BNSF) railroad and US 89 are oriented along a north to south ridge. Runoff that cannot be passed by the adjacent US 93 culverts (103 & 104), flows along the railroad fill and passes through the concrete railroad overpass at MP 192.88. An existing steel-trestle railroad bridge is located a few hundred feet due south of MP 118 on US 60.

A diversion channel on the east side of the road between MP 191.4 and MP 192.5 diverts flows to Culvert 106. Minor roadside channels on both sides of US 93 near MP 198, divert runoff into the cross culverts (252 - 257).

5.6.4 Hydrology and Hydraulics Methodology

- **Hydrology**

The basins (and sub-basins) were originally delineated using digital 1:24,000 USGS topographic maps. The range of sub-basin areas is 0.25 and 4.34 square miles. As the 2-foot contour interval aerial mapping became available, the rational basins and sub-basins adjacent the roadway were revised. The ADOT Highway Drainage Design Manual, Hydrology, was used for the drainage analysis. This analysis included using the Rational Method for drainage areas less than 160 acres and the Corps of Engineers' HEC-1 hydrologic computer modeling software for larger watersheds. Certain small sub-basins (less than 160 acres) were modeled in HEC-1 because they are part of a larger basin. The peak flows from each drainage basin have been summarized in Appendix F. This information was taken from the May 2003 Initial Hydrology Report, US 93 – SR 89 to the Santa Maria River, Project No. 093 YV 161, TRACS No. H 4871 01L.

- **Hydraulics**

The existing culverts were analyzed using CulvertMaster® computer software. The relative culvert invert elevations and roadway elevations (overtopping wier) were taken from ADOT as-built roadway plans. The inlet configuration was selected using the photographs of the inlet area. All culverts were modeled with no blockages, damage, or clogging factor applied.

5.6.5 Drainage Requirements

Appendix E summarizes the drainage structures required for each of the design concept alternatives. These structures were only designed for the offsite drainage requirements. The culvert quantities and project estimates do not include specific provisions for onsite culverts or special ditches as these features are assumed to be included with the contingency estimate. **Note: The hydraulics analysis for this report is preliminary in nature. A final hydraulic study will be required for the final design of the selected alternative**.

5.7 Section 404 of the Clean Water Act

Coordination with the U.S. Army Corps of Engineers (COE) during project design will be necessary to ascertain the need for any nationwide or individual permits required under Section 404 of the Clean Water Act. Any deposition of fill material or excavation waterward of the ordinary high water mark will require a permit. Construction activities that will require permits include, but are not limited to, bridge pier construction, culvert installations, replacements, and/or extensions requiring excavation and placement of fill material, and roadway embankment widenings.

Based on information received from the COE, 83 streams and washes are crossed by the various design concept alternatives that must be investigated for a Section 404 permit. The following table lists the streams and washes along each alternative by Station (refer to plan and profile sheets in Appendix D) that fall under COE jurisdiction.

Table 5-2
CORPS OF ENGINEERS
JURISDICTIONAL STREAMS AND WASHES

Design Concept Alternative	Location (MP)	Description
A-1a	193.31	CBC, Un-named Wash
A-1a	192.91	CBC, Un-named Wash
A-1a	192.52	CBC, Un-named Wash
A-1a	191.36	CBC, Un-named Wash
B-2a	190.45	CBC, Un-named Wash
B-2a	190.19	CBC, Un-named Wash
B-2a	189.40	CBC, Un-named Wash
B-2a	188.69	CBC, Un-named Wash

Table 5-2
CORPS OF ENGINEERS
JURISDICTIONAL STREAMS AND WASHES

Design Concept Alternative	Location (MP)	Description
B-2a	188.31	CBC, Un-named Wash
B-2a	186.85	CBC, Un-named Wash
B-2a	186.56	CBC, Un-named Wash
B-2a	186.30	CBC, Un-named Wash
B-2a	186.03	CBC, Un-named Wash
B-2a	185.49	CBC, Un-named Wash
B-2a	184.93	CBC, Un-named Wash
B-2a	184.77	CBC, Un-named Wash
B-2a	184.71	CBC, Un-named Wash
B-2a	184.17	CBC, Un-named Wash
B-2a	184.01	CBC, Un-named Wash
B-2a	183.74	CBC, Un-named Wash
B-2a	183.41	CBC, Un-named Wash
B-2a	183.16	CBC, Un-named Wash
B-2a	182.62	CBC, Un-named Wash
B-2a	182.20	CBC, Un-named Wash
B-2a	181.92	CBC, Un-named Wash
B-2a	181.70	CBC, Un-named Wash
B-2a	181.54	CBC, Un-named Wash
B-2a	181.40	CBC, Un-named Wash
B-2a	181.36	CBC, Un-named Wash
B-2a	181.13	CBC, Un-named Wash
B-2a	180.98	CMP, Un-named Wash
B-2a	180.88	CMP, Un-named Wash
B-2a	180.81	CMP, Un-named Wash
B-2a	180.71	CMP, Un-named Wash
B-2a	180.58	CMP, Un-named Wash
B-2a	180.45	CBC, Un-named Wash
B-2a	180.41	CBC, Un-named Wash
B-2a	180.09	CBC, Un-named Wash
C-3	179.86	CBC, Un-named Wash
C-3	179.51	CBC, Un-named Wash
C-3	179.24	CBC, Un-named Wash
C-3	179.02	CBC, Un-named Wash
C-3	178.85	CBC, Un-named Wash
C-3	178.71	CBC, Un-named Wash
C-3	178.29	CBC, Un-named Wash
C-3	178.01	CBC, Un-named Wash
C-3	177.46	CBC, Un-named Wash

Table 5-2
CORPS OF ENGINEERS
JURISDICTIONAL STREAMS AND WASHES

Design Concept Alternative	Location (MP)	Description
C-3	177.24	CMP, Un-named Wash
C-3	177.02	CBC, Un-named Wash
C-3	176.32	CBC, Un-named Wash
C-3	175.83	CBC, Un-named Wash
C-3	175.12	CBC, Un-named Wash
C-3	174.22	Bridge, Date Creek
C-3	173.97	CMP, Un-named Wash
C-3	173.85	CMP, Un-named Wash
C-3	173.76	CBC, Un-named Wash
C-3	173.65	CBC, Un-named Wash
C-3	173.35	CBC, Un-named Wash
C-3	172.44	CMP, Un-named Wash
C-3	172.34	CBC, Un-named Wash
C-3	172.10	CMP, Un-named Wash
C-3	171.91	CBC, Un-named Wash
C-3	171.46	CBC, Un-named Wash
C-3	170.94	CBC, Un-named Wash
C-3	170.16	CBC, Un-named Wash
C-3	169.21	CBC, Un-named Wash
C-3	169.03	CBC, Un-named Wash
C-3	168.69	RCP, Un-named Wash
C-3	168.47	RCP, Un-named Wash
C-3	168.41	RCP, Un-named Wash
C-3	168.13	RCP, Un-named Wash
C-3	167.06	CMP, Un-named Wash
C-3	166.61	CBC, Un-named Wash
C-3	166.45	CMP, Un-named Wash
C-3	166.23	RCP, Un-named Wash
C-3	165.53	Bridge, Big Jim (Black Canyon) Wash
C-3	165.05	CMP, Un-named Wash
C-3	164.75	CBC, Un-named Wash
C-3	164.61	CBC, Un-named Wash
C-3	164.51	CMP, Un-named Wash
C-3	163.37	CBC, Un-named Wash
C-3	163.06	CBC, Un-named Wash
C-3	161.85	CBC, Un-named Wash

5.8 Floodplain Considerations

The Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map panels for the project area were reviewed. US 93 intersects or is adjacent to the 100-year floodplain in 11 locations within the project limits. The preferred alternative would require the extension of existing culverts, construction of new culverts, construction of new bridges, and construction of roadway embankment within the 100-year floodplain. The preferred alternative would be designed to minimize floodplain encroachments to the extent possible and ensure that the flood-carrying capacity of the drainages crossing the project area would not be impaired, as described in the project drainage report.

5.9 Earthwork

A preliminary geotechnical assessment for US 93 was conducted for this project, and is contained in a report entitled "Preliminary Geotechnical Assessment, Design Concept Study of US 93, Santa Maria River - Wickenburg" dated July 2001. The assessment and report were based on a research review of available information and a site reconnaissance. Portions of the report data are included in the following discussion on earthwork.

5.9.1 General Geologic Setting

The US Highway 93 alignment from the Santa Maria River to Wickenburg is located within the Basin and Range Physiographic Province (Basin and Range) near its boundary with the Arizona Transition Zone, which separates the Basin and Range from the Colorado Plateau to the north. The Basin and Range is characterized by rugged isolated fault-bounded mountain ranges separated by broad alluvium-filled valleys. Mountain ranges in the Basin and Range generally trend in a northwesterly direction.

The area from the Santa Maria River to Wickenburg is characteristic of the Basin and Range with relatively subdued rolling terrain. The existing and proposed widening of the alignment traverses alluvial valleys between several mountain blocks. From the Santa Maria River, US 93 gradually climbs from the river basin along the northern foothills of the Black Mountains, which are located immediately southwest of the current roadway alignment. US 93 continues southeast in an alluvial basin area between the Black Mountains and Malpais Mesa, crosses as Big Jim Wash, then climbs the large northwesterly to westerly sloping alluvial fans of the Date Creek Mountains. As US 93 approaches Date Creek, the highway descends into the relatively shallow and broad Date Creek Drainage where shallow Precambrian granitic rocks and Tertiary sedimentary rocks may be encountered. The drainages flow predominantly to the west and/or northwest between the Santa Maria River and Date Creek. As the alignment leaves the Date Creek Drainage, it climbs onto relatively large, south to southwest sloping alluvial fans originating from the Date Creek Mountains to the east of the highway. The drainages along this segment of the alignment are predominantly tributaries of Sols Wash spaced at approximately ¼-mile intervals. The tributaries flow from the alluvial fans southwest to Sols Wash. Sols Wash flows towards the southeast; parallel to US 93 until they both reach Wickenburg and the Hassayampa River. This terrain is generally subdued and sloping towards the southeast and Wickenburg.

5.9.2 Site Geology

The main geologic units exposed along the corridor to be widened are Tertiary and Quaternary sedimentary units deposited from the erosion of the surrounding mountain ranges. These Tertiary and Quaternary sedimentary units consist, from oldest to youngest, of Quaternary/Tertiary sedimentary rocks, Quaternary alluvial fan and Quaternary active stream channel deposits. The mountain ranges typically are composed of a crystalline basement of metamorphic and plutonic rocks of Proterozoic and Cretaceous age, uncomformably overlain by a sequence of Tertiary volcanic and sedimentary rocks. These older units can be observed from the highway alignment at several locations but they are not exposed on the alignment itself, with the exception of granites observed on the north abutment of the Date Creek Bridge. The Granite from the Date Creek Mountains is exposed at the surface of the alignment at the crossing of Date Creek (approximate MP 182.9). The granite will most probably be encountered at a shallow depth from the creek to a couple miles to the north of it (to approximate MP 172).

- Date Creek Granite (gr) – The granite exposed on the northern abutment of Date Creek Bridge is a light to medium gray coarse-grained granite with crystals of up to 1-inch in diameter. It is predominantly moderately to highly weathered to locally decomposed and very closely to closely fractured near the surface. The granite was soft where decomposed and moderately hard where moderately to highly weathered.

- Quaternary/Tertiary Sedimentary Rx (QTs) – The Quaternary/Tertiary sedimentary rocks consist of a relatively undeformed sequence of interbedded sandstone and conglomerate with varying degrees of cementation.

- Quaternary alluvial fan and Quaternary active stream channel deposits – The Quaternary alluvial fan and active stream channel deposits are relatively unconsolidated deposits that can vary in particle size distribution from very fine-grained silty and/or clayey sands within floodplains and terraces to coarse-grained sand, gravel and cobbles within active stream channels. Old stream and pediment deposits have strongly developed clay and calcium carbonate-rich soils while the younger deposits typically consist of sands with minimal to some calcium carbonate development and are prone to flooding events. The eolian/alluvial deposits consist of wind deposited or a mix of wind and water deposited material that are found on both the basin floor and the bedrock pediments. Typically, these deposits consist of relatively well sorted sands that locally cover coarser grained sand and gravel deposits.

Available subsurface characterization data is limited to the existing bridge foundation as-builts obtained from ADOT's engineering records and from SCS maps. Depth of investigations for the bridge as-builts varied from approximately 6 to 80 feet, while the SCS map information is provided for a total depth of 5-feet.

5.9.3 Groundwater Conditions

Due to the length and variable nature of the geology and topography along the study corridor, depth to groundwater throughout the proposed alignment is highly variable. Shallow groundwater levels will probably be encountered within the existing valley lows and drainage pathways. The depth to groundwater noted on two of the borings for the Date Creek Bridge Foundation as-built data sheets is approximately 20 and 50 feet.

A natural spring is located immediately west of the US 93 alignment at approximate MP 166.7.

5.9.4 Seismic Design Considerations

The southern end of the project corridor is located within the Sonoran Seismic Zone. At approximate US93 MP 175, the corridor transitions into the Arizona Mountain Seismic Zone. The Sonoran Seismic Zone represents a tectonically stable area distinguished by its paucity of earthquakes, few short Quaternary faults, mature physiography, thin crust, gravity anomalies, and magnetic trends. The Arizona Mountain Zone distinguishes itself from the rest of the seismic ones in the state of Arizona due to its higher level of seismicity, abundant Quaternary faults and northwesterly trends and physiography. The Arizona Mountain Zone is an area of active block faulting being broken off and downfaulted from the Colorado Plateau, however, the seismic sources within this zone are discrete and faulting displays a slow rate. The nearest active features to the project corridor within the Arizona Mountain Zone are the Wagoner and Date Faults located at approximately 20-miles northeast and 10-miles east, respectively, of the town of Wickenburg and US 93 MP 170. The length, slip rate and age of latest movement for these faults are not known, however their maximum credible earthquake is 6.5 for both of the faults.

Based on seismic acceleration contour maps developed by Euge and others (1992) for ADOT, the expected horizontal acceleration in bedrock with a 90 percent probability of non-exceedance in 50 years is 0.03g from approximately MP 120 on US 60 to 0.04 towards the northern end of the project at approximate MP 161.

5.9.5 Excavatability of Site Soils & Bedrock

In general, the Tertiary to Quaternary sedimentary units throughout the project should be readily excavatable, although areas of varying degree of cementation may be encountered. Granitic rocks are anticipated to be very shallow near Date Creek. It is anticipated that the granitic rocks will be moderately weathered to decomposed near the surface and may be marginally rippable using heavy duty excavation equipment, however the need for blasting may arise in some areas. In areas where blasting is needed, controlled blasting techniques should be utilized in accordance with ADOT criteria.

5.9.6 Collapsible Soils

Due to the proximity of the proposed alignments to mountain flanks and their associated alluvial fans, the potential for collapsible soils exists. Further investigation and detailed mapping should be performed to determine the areal extent of the hazard as well as to better characterize these deposits for final roadway design.

5.9.7 Expansive Soils

Areas along the alignment from MP 165.0 to 165.4; 166.6 to 167.5; and 178.6 to 186.0 may have deposits of expansive clays that may require mitigation in the form of over excavation or other mitigation/stabilization techniques. The noted areas should be studied in more detail during final investigations to identify the limits and type of treatment that may be required.

5.9.8 Earthwork Factors

Based on professional experience with similar soil types, the shrink factor for the native soils throughout the project will be approximately 5% to 10%. The existing embankment materials will neither shrink nor swell where used for construction of new roadway embankment.

A swell factor for rock excavation of approximately 15% is recommended.

Ground compaction during the construction of the roadway embankments is likely to occur within the fine-grained, young sediments deposited on the basin floors and the fine-grained alluvial fans of the lower piedmonts. On average, soils within the project corridor will experience 0.2 feet of ground compaction prior to earthwork activities.

5.9.9 Preliminary Cut and Fill Slope Recommendations

For preliminary cut slope design, slopes of 1(h): 1(v) can be used, however, as most of the cuts were minor in height and material was needed, a 2:1 standard backslope was the steepest cut section applied. Stability of cut slopes in bedrock encountered at the cut areas will be dependent upon fracture orientations and weathering conditions encountered within the rock mass. A more detailed study on a cut–by-cut basis should be performed for final design.

All non-stabilized fill slopes should be constructed no steeper than 2(h):1(v). Should steeper slopes be required within drainages or near existing structures, use of mechanically stabilized embankments is recommended. In areas of potential excessive fill erosion, treatment of slopes with geosynthetics should be considered.

5.9.10 Potential Borrow Sources

A review of borrow pit information available at ADOT's Materials Section revealed a large number of borrow pits that have been historically used by ADOT along the US 93 highway corridor. No current ADOT-leased (deeded or granted) sources were identified. For an ADOT-leased pit to be considered a potential material source, the lease agreement between ADOT and the landowner has to be active and an environmental permit has to be issued.

One commercial pit was identified within the project limits and two additional commercial pits were identified within 15-miles of the southerly end of the project.

Table 5-3: Commercial Pits

Site ID	Location	Company	Materials Produced
CM 101	US 60 MP 115	Wickenburg Concrete & Materials	AB, Sand, Rip Rap
CM 237	US 60 MP 117	Wickenburg Concrete & Materials	MA, AB, Sand, Rip Rap, Borrow
CM 404	US 93 MP 174	Way's Drilling, Inc.	AB, Sand, Rip Rap, Borrow, Water

5.9.11 Preliminary Bridge Foundation Design

Existing bridges along US 93 within the project limits are the Big Jim Wash Bridge (Str. No. 00548), the Date Creek Bridge (Str. No. 02366), the SR 71 TI Overpass (Str. No. 00842) and the Matthie Railroad Overpass (Str. No. 00780). The expansion of US 93 to a four lane divided highway will use the existing bridges for one direction of travel and require that new bridges be constructed for the new 2-lane roadway in the opposite direction of travel.

At the Big Jim Wash Bridge site, it appears that drilled shafts or driven piles would likely be the best alternatives for support of the structure, based on the as-built plans and foundation data information. However, spread-type footings or a box culvert type structure may be a viable alternative if a cutoff wall or some other type of scour protection is utilized.

At the Date Creek Bridge site, it appears that drilled shafts socketed into bedrock or spread-type footings with rock bolts or keyed into bedrock would likely be the best alternatives for support of the structure, based on the as-built plans and foundation data information. However, according to the foundation data information, bedrock is at a depth of 15 to 20 feet below grade, which may make spread-type footings uneconomical due to the amount of excavation that would be required. Spread-type footings or a box culvert type structure bearing on shallow streambed and alluvial soils may be a viable alternative if a cutoff wall or some other type of scour protection is utilized.

At the SR 71 TI Overpass site and the Matthie Railroad Overpass site, it appears that drilled shafts, driven piles or spread-type footings would likely be the best alternatives for support of the structures, based on the as-built plans and foundation data information.

Test drilling at each foundation element for each structure during the final investigation should clearly indicate which foundation type is best suited to each location.

5.9.12 Earthwork Balancing

The excavation, embankment, and balance values shown in Table 5-4 are a result of applying the slope criteria listed in Section 5.2. The earthwork factors shown in Section 5.9.8 were considered, but not directly applied at this time. For the purposes of this study, the earthwork was considered "balanced" if the cut/fill balance was within 5%. Once the projects are divided into final design segments, the final balancing of earthwork can be achieved by minor adjustments to the profile grade or side slopes. An absolute balance of earthwork was not attempted at this time because of the unavailability of detailed geotechnical information.

Only the mainline roadway sections were evaluated for earthwork calculations. The material required for the frontage/access roads and median cross-overs was considered incidental to the overall volume of material excavated.

Table 5-4
EARTHWORK SUMMARY
Cubic Yards [cy]

Design Concept Alternative	Excavation cy	Embankment cy	Balance cy
A-1a	**165,000**	**135,000**	**30,000**
B-2a Mainline	345,000	365,000	(20,000)
B-2a TI / Ramps For SR 71 Undercrossing	165,000	135,000	30,000
Total: B-2a	**510,000**	**500,000**	**10,000**
C-3 Southern SB	440,000	420,000	20,000
C-3 NB Alignment	635,000	610,000	25,000
C-3 Northern SB	20,000	16,000	4,000
Total: C-3	**1,095,000**	**1,046,000**	**49,000**

An extensive geotechnical investigation will be required during final design of the recommended alternative to:

- Establish site-specific shrink and swell factors based on field investigation and testing;
- Establish cut/fill slope requirements based on a field investigation of materials; and
- Prepare detailed geologic mapping to predict areas of potential slope failure in deep cuts.

5.10 Constructability and Traffic Control

Maintenance of traffic through the work zone will be a critical element associated with implementation of the recommended alternative. Routes for rerouting traffic are limited and major detours must receive advance agreement. As a result, maintenance of traffic and traffic control during construction may determine the overall phasing and local staging of construction and relate directly to the constructability of the project.

One of the goals established at the outset of the study was to maximize the use of the existing roadway as part of the traffic control plan. This goal has been achieved throughout the project. New construction parallels the existing roadway to easily reroute traffic between roadways during the phasing and staging of the work. In areas where the new roadway crosses from one side of the existing roadway to the other, temporary connections and minor detours may be required.

The reconstruction of the mainline and ramps at the SR 71 traffic interchange will require phased construction and minor detours to maintain traffic through the interchange during construction.

5.11 Intersections

Table 5-5 lists 19 intersections identified along US 93 where interim access crossovers will be located (see also Chapter 7, Access Management Plan). The design concept plans address only left-turn lane requirements at crossover locations based upon current data. Additional traffic analyses will be needed during final design to determine the turning lane requirements at each intersection.

Table 5-5
MAJOR INTERSECTIONS/CROSSOVERS

Milepost	Intersection Description
162.35	
165.3	
167.1	
168.9	
171.3	
174.0	Date Creek Residence Area
175.9	
177.3	
178.6	Alamo Road
181.2	Stock Tank
182.9	SR 71 Traffic Interchange
184.4	
186.2	
187.5	
190.0	
191.5	
192.1	Vista Royale Subdivision Entrance
192.6	Moreton Road / Nine Irons Road
193.5	SR 89 Intersection

5.12 Utilities

Contact was made with all known utility companies between SR 89 and the Santa Maria River crossing, requesting utility information and an indication of possible conflicts with the recommended alternative. The following information was gathered:

Western Area Power Administration (WAPA): Two WAPA transmission lines cross US 93 at MP 163.3; the Mead- Liberty 345 kV line and the Mead-Perkins 500kV line. The WAPA tower located nearest to the east side of US 93 is for the 345kV line, and is designated as 162-3.

One tower for each of the two lines will be located in the median of the divided highway. Access will be permitted. No conflicts are anticipated at the crossing area.

Access to the WAPA transmission lines is via primitive roads that intersect US 93 in several locations. The existing roads will be retained during Partial Access Control, so there will be no impact on access to the WAPA lines. When full access control is implemented, most of the access to the WAPA lines will be from the interchange crossroads. However, if access is needed in addition to that provided at interchanges, permits can be given to WAPA or the land owner (usually ASLD on this project) for gated and locked access points that will not be available to the public. No conflicts are anticipated.

Contact is:

Chuck McEndree, Project Manager
Western Area Power Administration
Desert Southwest Region
615 S. 43rd Avenue
Phoenix, AZ 85009
Telephone : (602) 352-2790

Arizona Public Service Company (APS): An overhead powerline is located within ADOT R/W on the east side of US 93 from MP 193.9 to MP 192.1. There will probably be a conflict between this line and the proposed frontage road serving the residential area on the east side of US 93.

An underground powerline crosses US 93 at MP 192.4 (vicinity of Nine Irons Ranch Road). It is likely that this line may be in conflict with the new 2-lane road to be constructed on the west side of existing US 93.

An underground powerline crosses Quail Run parallel to US 93 at approximate MP 192.6. It is likely that this line will be in conflict with the proposed frontage road serving the residential area on the east side of US 93.

Contact was:

Dave D'Angio
125 E.Apache
Wickenburg, AZ 88390
Telephone: (623) 932-6675

Qwest Communications (Qwest): Qwest occupies the APS poles from SR 89 junction to MP 192.1. Qwest lines then go underground. They have a buried cable inside the R/W on the east side of US 93 through the residential area to approx. MP 191.5 There is a buried cable under US 93 at MP 192.0. The buried cable crosses US 93 to serve the subdivision on the west side (Vista Royale), and it continues northerly on the west side of US 93 through the Vista Royale subdivision to approx. MP 191.5 .

The Qwest lines on the APS poles and the buried line running along the east side of US 93 will conflict with the frontage road that is proposed to provide access to the residential area.

The buried Qwest lines under US 93 at MP 192 and the buried lines within the R/W on the west side of US 93 may be in conflict with the new 2-lane road proposed on the west side of US 93.

Contact is:

Tom Meador, Area Engineer
6350 S. Maple Ave., Room 125
Tempe, AZ 85283
Telephone: (602) 630 1425

There are no other utilities within the project limits—no cable, no gas. We checked with both Districts and with APS with respect to utilities at SR 71 TI. There are no records of any facilities within the R/W.

Contact was made with Citizens Telephone (Jeff Mathiesen). They have no facilities south of Wikieup.

Contact was made with Tabletop Communications (Linda Feidt, Network Engineering Manager). They have no facilities along US 93. They serve areas near Congress and Bagdad.

5.13 New Bridges

New bridges will be required for the new two lane roadway at two drainage crossings, the SR 71 traffic interchange, and one Railroad overcrossing as described in Table 5-6. Except for the SR 71 interchange, the existing bridges at the other locations will remain since the existing roadway will be used for traffic in one direction.

Table 5-6

Location	Station	No. Bridges	Type	Comments
Matthie Railroad Overcrossing	198+65.30	1	155', 3-span, Continuous Steel Girder	Exist. Bridge to remain. New SB bridge to be constructed.
SR 71 TI Undercrossing	724+29.02 BK = 470+16.27 AHD	1	280', 2-span, Type VI Precast Prestressed Conc. Girder	Exist. Bridge to be replaced. New bridge to be constructed over the improved US 93 highway.
Drainage Crossing Bridge (MP 178.3)	715+00	2	160 ' 3-span Continuous Slab	New bridges to replace existing multi-cell RCBC.
Date Creek Bridge	930+97.82	1	216', 3-span,Type III Precast Prestressed Conc. Girder	Exist Bridge to remain. New SB bridge to be constructed.
Big Jim Wash Bridge	1388+84.50	1	275', 7-span Continuous Slab	Exist Bridge to remain*. New NB bridge to be constructed.

* Existing bridge is structurally deficient, but replacement will be under a separate project.

5.14 Other Design Considerations

5.14.1 Final Design Details

The development of several design details must be coordinated with several entities during final design.

- Location of turn-outs, acceleration/deceleration lanes, median cross-overs and frontage roads – State Land Dept., Department of Public Safety, ADOT Kingman and Prescott Districts, Yavapai and Mohave Counties, and private property owners. (See also Section 8, Implementation Plan).
- Slope treatment, including slope rounding, slope warping, and rock roughening/rounding, - ADOT Roadside Development Section, ADOT Prescott and Kingman Districts.
- Fencing and cattle guards - State Land Dept., Mohave and Yavapai Counties, ADOT Prescott and Kingman Districts.

5.14.2 Wildlife Crossings

The need for wildlife crossings was evaluated in consultation with the Arizona Game and fish Department. Based upon the agency's record of animal "strikes" and recommendations for wildlife crossing provisions, no exclusive wildlife crossings were identified along US 93 corridor. There was agreement that no existing box culverts would be reduced in size if either replaced or extended, as many of the boxes are used for cattle passes.

5.15 Design Exceptions

Design exceptions for shoulder width and superelevation rates below the AASHTO recommended minimums for the existing roadway to remain in place will be requested prior to completion of the final Design Concept Report. The grades in excess of the AASHTO recommended maximum would be corrected by construction of the preferred alternative.