Pinal County's East-West Corridor Study

Project Document:

Final Design Concept Report

Submitted to:
Pinal County
Department of Public Works

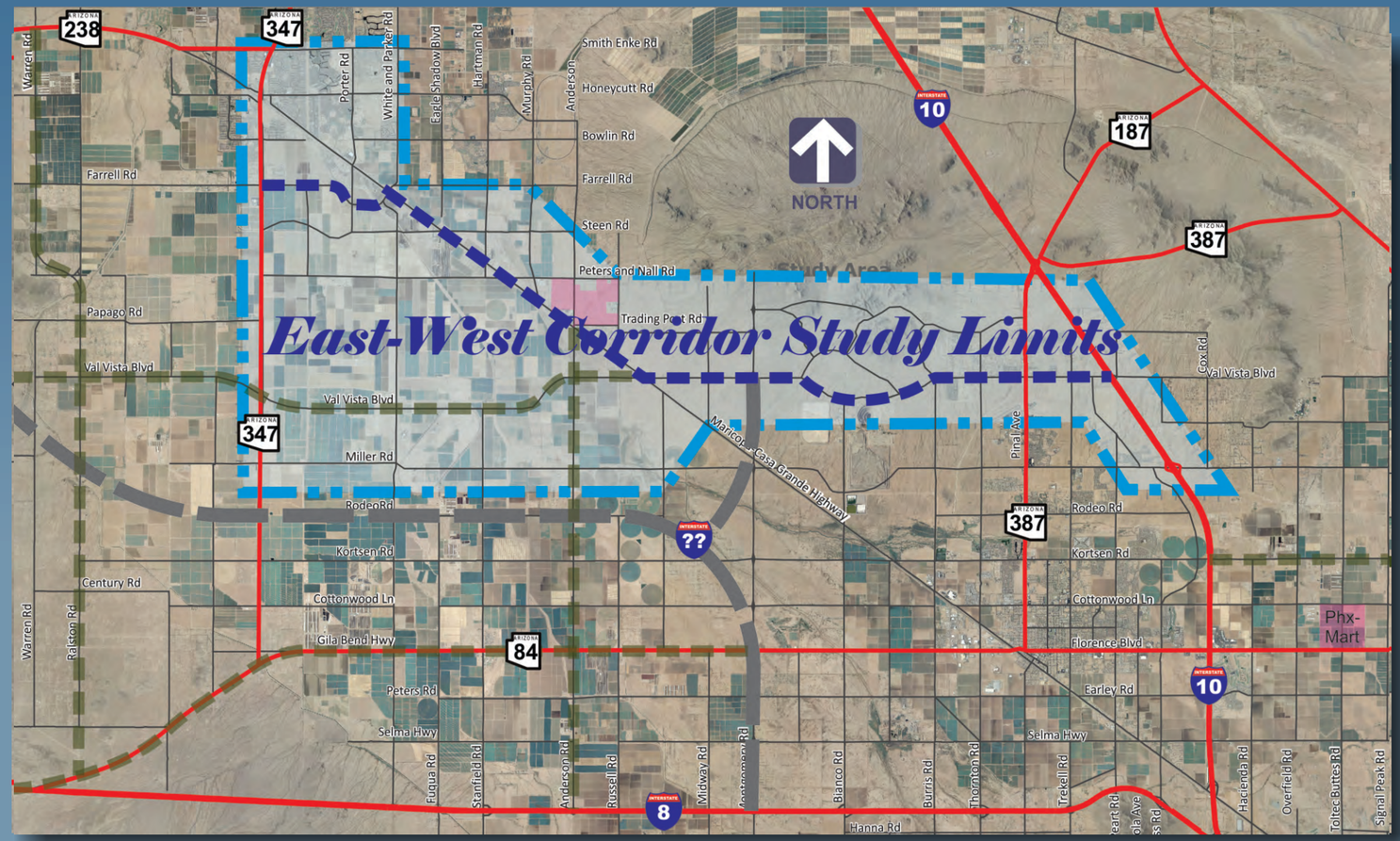
Final Submitted:
December, 2015

PINAL • COUNTY
Wide open opportunity

City of Casa Grande

CITY OF MARICOPA

JACOBS™



MARICOPA

CASA GRANDE

PINAL COUNTY

Submitted by:
Jacobs
101 N. 1ST Avenue, Suite 2600
Phoenix, AZ 85003
P: 602.253.1200
F: 602.253.1202
www.jacobs.com

TABLE OF CONTENTS

Table of Contents i

List of Tables, Figures, and Appendices ii

List of Acronyms iii

Executive Summary iv

Introduction iv
Need for the Project iv
Description for the Project v
Project Objectives v
Design Concept Evaluation Criteria v
Design Concept Alternatives vi
Corridors Considered vi
Recommended Corridor vi
Alternatives Considered vii
Recommended Alternative vii
Recommended Solution viii
Estimated Cost viii
Implementation Plan viii

1.0 Introduction 1

1.1 Foreword 1
1.2 Previous Studies 2
1.2.1 BQAZ Hidden Valley Framework Study 4
1.2.2 City of Coolidge Comprehensive Transportation Feasibility Study 5
1.2.3 Challenges with BQAZ Hassayampa Freeway Corridor 6
1.2.4 Hassayampa Freeway Corridor / I-11 7
1.2.5 Interstate 11 Corridor Study 8
1.3 Need for the Project 9
1.4 Characteristics of the Existing Corridor 9
1.4.1 Existing Roadways 9
1.4.2 Existing Horizontal and Vertical Alignments 10
1.4.3 Existing Roadway Operations 10
1.4.4 Existing Access 10
1.4.5 Existing Right-of-Way 10
1.4.6 Existing Drainage 10
1.4.7 Existing Utilities 12
1.4.8 Existing Railroad 12
1.4.9 Existing Structures 12
1.4.10 Existing Site Topography and Geology 12
1.5 Project Objectives 13
1.5.1 Extension of the RSRSM Process 13
1.5.2 Issues, Concerns, and Opportunities 13

2.0 Existing Traffic conditions 14

2.1 Introduction 14
2.1.1 Study Area and Influence Area 14
2.2 Traffic Forecast – Existing Conditions 15
2.3 Traffic Forecast – Future Conditions 17
2.3.1 No Build Roadway Network Conditions 17
2.3.2 Base Roadway Network Scenarios 17
2.3.3 2040 Roadway Network Screenline Analysis 22
2.3.4 2040 Roadway Network Mobility Improvement Analysis 22

3.0 Social, Economic, and Enviromental Overview 23

3.1 Introduction 23
3.2 Physical and Natural Environment 23
3.2.1 Native Vegetation/Plant Communities 23
3.2.2 Biology/Wildlife 23
3.2.3 Hydrology 25
3.2.4 Prime and Unique Farmlands 26
3.2.5 Noise 27
3.2.6 Air Quality 27
3.2.7 Hazardous Materials 28
3.2.8 Section 4(f) Resources 29
3.3 Socioeconomic Environment 30
3.3.1 Land Use, Ownership, and Jurisdiction 30
3.3.2 Socioeconomics 31
3.3.3 Title VI/Environmental Justice 32
3.3.4 Visual Resources 33
3.3.5 Cultural Resources 34
3.4 Environmental Overview Conclusion 35

4.0 Alternative Corridor Investigation 36

4.1 Introduction 36
4.2 Corridor Location Analysis 36
4.3 Corridor Evaluation Criteria 37
4.4 No-Build Alternative 37
4.5 Corridor Descriptions: 37
4.5.1 Corridor 1 37
4.5.2 Corridors 2-5 37
4.5.3 Corridors 6-8 38
4.5.4 Corridors 9-11 39
4.6 Corridor Evaluation 39

5.0 Design Concept Alternatives 42

5.1 Introduction 42
5.2 Zone 1 Alternatives 43
5.3 Zone 2 Alternatives 44
5.4 Zone 3 Alternatives 47
5.5 Zone 4 Alternatives 48
5.6 Zone 5 Alternatives 49

6.0 Arizona Parkway Overview 50

6.1 Introduction 50
6.2 Intersection Control 50
6.3 Requirements of the Arizona Parkway 51
6.3.1 Median Width 51
6.3.2 Design Vehicle 51
6.3.3 Right-of-Way 52
6.3.4 Median Crossover Spacing 53
6.4 Benefits of the Arizona Parkway 53
6.4.1 Traffic 53
6.4.2 Safety 53
6.5 Challenges of the Arizona Parkway 53
6.5.1 Traffic 53
6.5.2 Cost 53

7.0 Major Design Features 54

7.1 Introduction 54
7.2 Design Criteria Comparison 54
7.3 Recommended Design Criteria 55
7.4 Recommended Typical Sections 55
7.4.1 Arizona Parkway Typical Section 55
7.4.2 Ak-Chin Undivided Typical Section 56
7.4.3 Arizona Parkway Compressed Typical Section 56
7.4.4 Arizona Parkway Typical Section (Interior Drainage Channel) 57
7.5 Horizontal and Vertical Alignments 57
57
7.5.1 Horizontal Alignment 57
7.5.2 Vertical Alignment 57
7.6 Proposed Structures 58
7.6.1 WB and EB Santa Rosa Wash Bridges #1 and #2 58
7.6.2 WB and EB MCGH UPRR Bridges #3 and #4 58
7.6.3 WB and EB MCGH and Val Vista Boulevard Bridges #5 and #6 58
7.6.4 WB and EB Val Vista Boulevard UPRR Bridges #7 and #8 58
7.6.5 EB I-10 Underpass Bridge #9 58
7.7 Access Management 59
7.8 Right-of-Way 61
7.9 Drainage 63
7.9.1 Existing Conditions 63
7.9.2 Vegetation 63
7.9.3 Topography 63
7.9.4 Soil Types 63
7.9.5 Existing Drainage Structures 63
7.9.6 Proposed Drainage Structures 63
7.9.7 Hydrology and Hydraulics Methodology 64
7.9.8 Drainage Requirements 64
7.10 Earthwork 65
7.10.1 General Geologic Setting 65
7.10.2 Earthwork Factors 65
7.10.3 Earthwork Balancing 65
7.10.4 Cut and Fill Slope Recommendations 65
7.11 Pavement Structural Section 65
7.12 Intersections 66
7.13 Utilities 67
7.13.1 Arizona Department of Transportation 67
7.13.2 Arizona Public Service 67
7.13.3 CenturyLink 67
7.13.4 City of Casa Grande 67
7.13.5 El Paso Natural Gas Company (EPNG) 67
7.13.6 Electrical District No. 3 68
7.13.7 Global Water 68
7.13.8 Kinder Morgan 68
7.13.9 Southwest Gas Corporation 68

8.0 Itemized Cost Estimate 69

8.1 Estimate Items 69
8.2 Right-of-Way and Easement Estimate 70
8.3 Itemized Estimate 70

Registered Professional Engineer (Civil)
CERTIFICATE NO. 25339
BERWYN S. WILBRINK
Date Signed 12-20-15
ARIZONA, U.S.A.
Expires 12-31-2016

9.0 Implementation Plan 72

9.1 Phase 1 – Ak-Chin Compressed Segment 75
9.2 Phase 2 – MCGH Segment 76
9.3 Phase 3 – Farrell Road Segment 77
9.4 Phase 4 – Ak-Chin Casino Segment 78
9.5 Phase 5 – White and Parker Road Interchange Segment 79
9.6 Phase 6 – Val Vista Boulevard, West of Pinal Avenue Segment 80
9.7 Phase 7 – Val Vista Boulevard, East of Pinal Avenue Segment 81
9.8 Phase 8 – Val Vista Boulevard & I-10 Interchange Segment 82
9.9 Phase 9 – Val Vista Boulevard, East of Trekell Road Segment 83
9.10 Phase 10 – Copper Mountain Segment 84
9.11 Phase 11 – Val Vista Boulevard, West of Corrales Road Segment 85
9.12 Phase 12 – MCGH & Val Vista Interchange Segment 86
9.13 Implementation Plan – Cost Comparison 87

LIST OF TABLES, FIGURES, AND APPENDICES

LIST OF TABLES

Table 1-1: Utility Company Contacts 12
Table 2-1: Major Roadway Networks 15
Table 2-2: Socioeconomic Data for Project Influence Area 17
Table 2-3: Roadway Description of Base Scenarios 17
Table 2-4: Projected 2040 Congestion for Base Scenarios 17
Table 2-5: Roadway Network Screenline Analysis 22
Table 2-6: Roadway Network VMT and VHT Comparison 22
Table 3-1. USFWS listed species in Pinal County 23
Table 3-2. Other special status species in Pinal County 24
Table 3-3. Study area population and growth data 32
Table 3-4. Recommended sources for environmental justice data collection 33
Table 3-5. Potential consulting parties to the Section 106 compliance process 34
Table 3-6. Summary of resources and recommendations for further analysis 35
Table 4-1: Evaluation of Corridor Alternatives 40
Table 7-1: Design Criteria Comparison 54
Table 7-2: Summary of Turning Movements 59
Table 7-3: Estimated Right-of-Way Requirements 61
Table 7-4: Proposed Drainage Structures 64
Table 7-5: Intersection / Median Crossover Locations 66
Table 8-1: Right-of-Way and Easement Estimate 70
Table 8-2: EWC Itemized Estimate 70
Table 8-3: EWC Cost Adjustments 71
Table 9-1: EWC Phase 1 Itemized Estimate 75
Table 9-2: EWC Phase 2 Itemized Estimate 76
Table 9-3: EWC Phase 3 Itemized Estimate 77
Table 9-4: EWC Phase 4 Itemized Estimate 78
Table 9-5: EWC Phase 5 Itemized Estimate 79
Table 9-6: EWC Phase 6 Itemized Estimate 80
Table 9-7: EWC Phase 7 Itemized Estimate 81
Table 9-8: EWC Phase 8 Itemized Estimate 82
Table 9-9: EWC Phase 9 Itemized Estimate 83
Table 9-10: EWC Phase 10 Itemized Estimate 84
Table 9-11: EWC Phase 11 Itemized Estimate 85
Table 9-12: EWC Phase 12 Itemized Estimate 86
Table 9-13: EWC Cost Comparison 87

LIST OF FIGURES

Figure 1-1: Project Location Map 1
Figure 1-2: Project Vicinity Map 2
Figure 1-3: East-West Corridor Study Limits 3
Figure 1-4: I-8 / I-10 Hidden Valley Transportation Framework Study 4
Figure 1-5: Coolidge Comprehensive Transportation Feasibility Study 5
Figure 1-6: Combined Framework Recommendations 6
Figure 1-7: Proposed Hassayampa Freeway Corridor through Casa Grande 7
Figure 1-9: I-11 Study Recommended Corridors 8
Figure 1-8: I-11 and Intermountain West Corridor Study 8
Figure 1-10: East-West Corridor Study Existing Drainage Basins 11
Figure 2-1: Study Area and Project Influence Area Map 14
Figure 2-2: Level of Service Depiction 15
Figure 2-3: 2010 Roadway Network Level of Congestion 16
Figure 2-4: 2040 No Build Roadway Network – Level of Congestion 18
Figure 2-5: 2040 Base Scenario 1 Roadway Network – Level of Congestion 19
Figure 2-6: 2040 Base Scenario 2 Roadway Network – Level of Congestion 20
Figure 2-7: 2040 Base Scenario 3 Roadway Network – Level of Congestion 20
Figure 2-8: Screenline Analysis 22
Figure 4-1: Initial EW Corridor Alternatives 36
Figure 4-2: Corridor 1 Alignment 37
Figure 4-4: Corridors 2-5 Detailed Alignments 37
Figure 4-3: Corridors 2-5 Alignments 37
Figure 4-6: Corridors 6-8 Detailed Alignments 38
Figure 4-5: Corridors 6-8 Alignments 38
Figure 4-8: Corridors 9 & 10 Detailed Alignments 39
Figure 4-7: Corridors 9-11 Alignments 39
Figure 5-1: East West Corridor Detailed Study Zones 42
Figure 5-2: Study Zone 1 Alternatives 43
Figure 5-3: Study Zone 2 Alternatives 44
Figure 5-4: MIS Study Recommendations 45
Figure 5-5: Study Zone 3 Alternatives 47
Figure 5-6: Study Zone 4 Alternatives 48
Figure 5-7: Study Zone 5 Alternatives 49
Figure 6-1: Median U-Turn Intersection Treatment 50
Figure 6-2: Example of an Implemented Parkway 50
Figure 6-3: Arterial to Arterial Intersection Turning Movements 50
Figure 6-5: Arterial to Parkway Intersection Turning Movements 51
Figure 6-4: Arterial to Parkway Intersection Turning Movements 51
Figure 6-6: WB-67 Design Vehicle 51
Figure 6-7: BQAZ Recommended Parkway Typical Sections 52
Figure 6-8: MDOT Crossover Spacing Design Guide 53
Figure 7-1: Arizona Parkway Typical Section 55
Figure 7-2: Ak-Chin Undivided Typical Section 56
Figure 7-3: Arizona Parkway Compressed Typical Section 56
Figure 7-4: Arizona Parkway Typical Section (Interior Drainage Channel) 57
Figure 7-6: Arizona Parkway Proposed U-Turn after Compressed Section 60
Figure 7-5: Arizona Parkway Proposed U-Turn at Tuzigoot Drive 60
Figure 7-5: Recommended Pavement Structural Section 65
Figure 9-1: EWC Implementation Plan – MCGH Segment 73
Figure 9-2: EWC Implementation Plan – Val Vista Boulevard Segment 74

LIST OF APPENDICES

APPENDIX A: ..... INITIAL PLAN SET (400 SCALE)

APPENDIX B: ..... ENLARGED PLAN EXHIBITS (200 SCALE)

APPENDIX C: ..... DRAINAGE ALTERNATIVES (AK-CHIN)

APPENDIX D: ..... DRAINAGE SUMMARY

Expires 12-31-2016

LIST OF ACRONYMS

AADT	Average Annual Daily Traffic
AASHTO	American Association of State Highway and Transportation Officials
AB	Aggregate Base
AC	Asphaltic Concrete
ACS	American Community Survey
ADEQ	Arizona Department of Environmental Quality
ADOT	Arizona Department of Transportation
AGFD	Arizona Game and Fish Department
APE	Area of Potential Effect
APS	Arizona Public Service
ASLD	Arizona State Lands Department
ASM	Arizona State Museum
Ave	Avenue
b	Channel Bottom Width
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BQAZ	Building a Quality Arizona
CAA	Clean Air Act
CAG	Central Arizona Governments
cfs	Cubic Feet per Second
CFR	Code of Federal Regulations
CMP	Corrugated Metal Pipe
CY	Cubic Yards
d	Channel Depth
DCR	Design Concept Report
Det.	Detail
Dist.	Distance
Dr	Drive
EA	Environmental Assessment
EB	Eastbound
ED	Environmental Document
ED3	Electrical District No. 3
e.g.	For Example
Envir. Mit.	Environmental Mitigation
EO	Environmental Overview
EPNG	El Paso Natural Gas
ERNS	Emergency Response Notification System
EWC	East West Corridor
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Maps
FIS	Flood Insurance Study
FPPA	Farmland Protection Policy Act
ft	Feet
GIS	Geographic Information System
GRIC	Gila River Indian Community
H	Height
HEC	Hydrologic Engineering Center
HWY	Highway
I	Interstate
ICO's	Issues, Concerns, and Opportunities
JD	Jurisdictional Delineation
kV	Kilo-volt
L/DCR	Location / Design Concept Report
Lin. Ft.	Linear Feet
LOS	Level of Service
LUST	Leaking Underground Storage Tank
MSIDD	Maricopa-Stanfield Irrigation and Drainage District
Max.	Maximum
MBTA	Migratory Bird Treaty Act of 1918
MCGH	Maricopa Casa Grande Highway
Min.	Minimum
MIS	Major Investment Study
mph	Miles Per Hour
MSAT	Mobile Source Air Toxins
Mtn	Mountain
MUTCD	Manual on Uniform Traffic Control Devices
N/A	Not Applicable
NAAQS	National Ambient Air Quality Standards
NB	Northbound
NRCS	Natural Resources Conservation Service
NDOT	Nevada Department of Transportation
NEPA	National Environmental Policy Act
No.	Number
NOAA	National Oceanic and Atmospheric Administration
NRHP	National Register of Historic Places
PARA	Planning Assistance for Rural Areas
Pcf	Pounds per cubic foot
PCCP	Portland Cement Concrete Pavement
PEL	Planning and Environment Linkages
R/W	Right-of-Way
RCBC	Reinforced Concrete Box Culvert
RCP	Reinforced Concrete Pipe
RCRA	Resource Conservation and Recovery Act
Rd	Road
Realign	Realignment
RR	Railroad
RSRSM	Regionally Significant Routes for Safety and Mobility
SB	Southbound
SFHA	Special Flood Hazard Areas
Shldr	Shoulder
Sht	Sheet
Sq. Yd.	Square Yard
SR	State Route
SUE	Subsurface Utility Engineering
UG	Underground
UPRR	Union Pacific Railroad
U.S.	United States
USFWS	U.S. Fish and Wildlife Service
UST	Underground Storage Tank
VHT	Vehicle Hours Traveled
VMT	Vehicle Miles Traveled
VRM	Visual Resource Management
WB	Westbound
z	Channel Side Slope

EXECUTIVE SUMMARY

Introduction

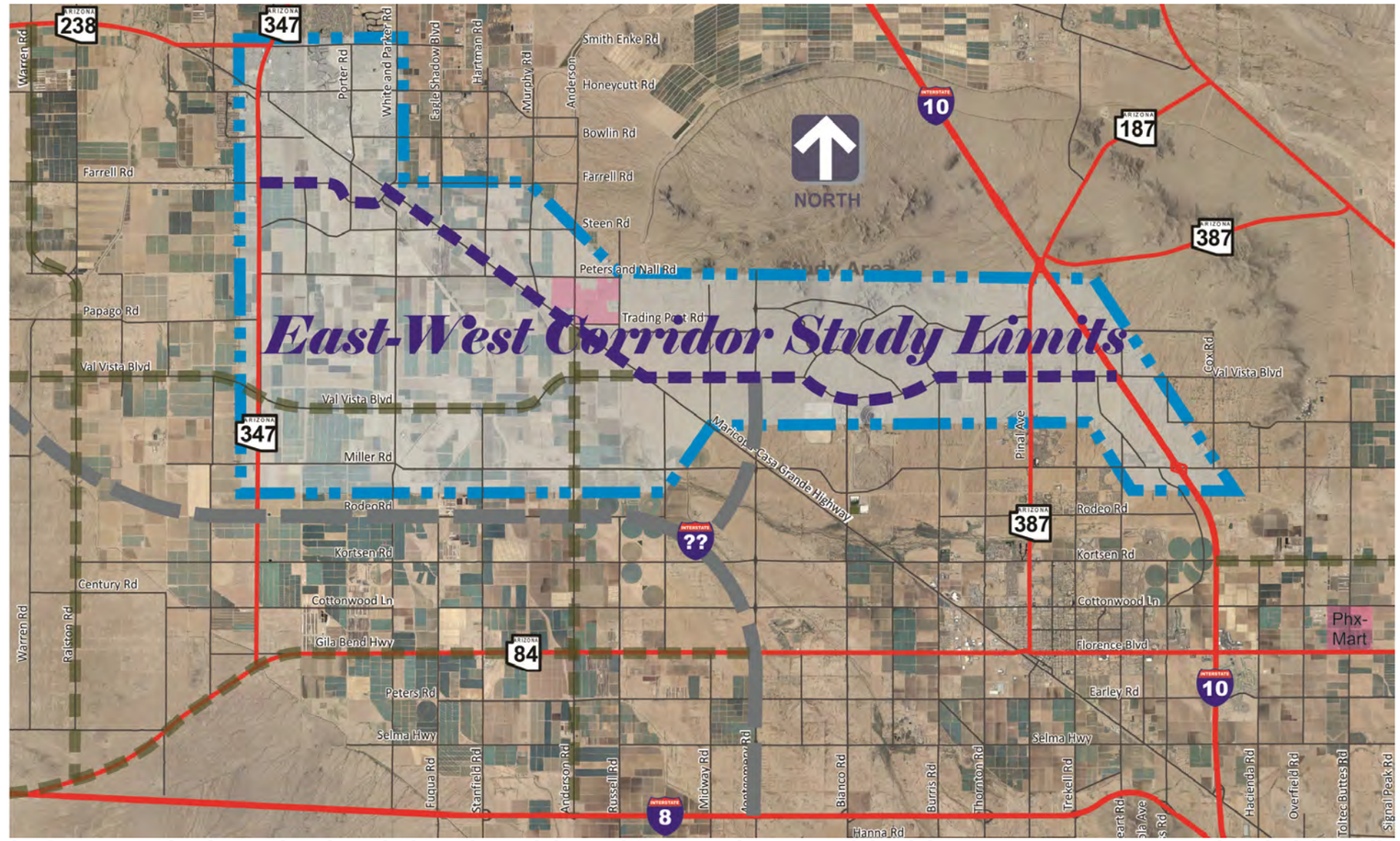
Jacobs Engineering is under contract (Contract #ED11-001) with the Pinal County, in cooperation with the City of Maricopa and the City of Casa Grande to conduct a Location / Design Concept study regarding the development of a high efficiency – high capacity transportation corridor. This corridor will connect the City of Maricopa beginning at Arizona State Route 347 (SR 347) and terminate in the City of Casa Grande at Interstate 10 (I-10). Named the East-West Corridor (EWC), this transportation corridor encompasses a study area that is approximately 107 square miles within Pinal County.

This Final Location / Design Concept Report (LDCR) present the results of an investigation of alternatives for development of the EWC. At this time, the project improvements are not funded. The design concept study process will develop corridors which will be refined to design alternatives carried forward for development along with the No-Build Alternative. This document will ultimately produce a preferred alignment along with a recommendation for how to facility will convey the high volume traffic anticipated for the corridor.

A number of governmental agencies have been involved in the development of this study including Pinal County, city of Maricopa, city of Casa Grande, City of Coolidge, Ak-Chin Indian Community, Bureau of Indian Affairs (BIA), Gila River Indian Community (GRIC), Bureau of Land Management (BLM), U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, Arizona Department of Transportation (ADOT), Federal Highway Administration (FHWA), Union-Pacific Railroad, and various public utilities.

Need for the Project

The communities of the Cities of Maricopa and Casa Grande, and the Ak-Chin Indian Community are growing quickly. The City of Maricopa is one of the fastest growing communities within the nation with a population that has increased from 1,040 residents in 2000 to 43,482 residents in 2010 which equates to a 4,000% growth. Within this same timeframe, the City of Casa Grande grew by nearly 100%. Both of these communities have major transportation facilities that connect to the north and south such as SR 347 and I-10, however, neither of these communities have an efficient / high-capacity east – west transportation facility connecting these two growing communities.



The County completed several studies which emphasized the need for a high-capacity transportation corridor that linked the Cities of Maricopa and Casa Grande. The Pinal County: Regionally Significant Routes for Safety and Mobility (RSRSM) study was completed in 2008 which ultimately defined the proposed transportation network within Pinal County. This study identified the Maricopa-Casa Grande Highway (MCGH) and Val Vista Boulevard as two corridors within the study limits for implementation of high-efficiency / high-capacity routes.

Completed in October 2009, ADOT published the Building a Quality Arizona (BQAZ): I-8 / I-10 Hidden Valley Transportation Framework Study which looked at the entire state and recommended an entire transportation network looking out towards the next 50 years. This document validated the Hassayampa Freeway corridor which basically demonstrated that the Val Vista Boulevard alignment between the Cities of Casa Grande and Maricopa as a high efficiency / high capacity transportation corridor. This very alignment as specified in the Hidden Valley Transportation Framework Study lies within the EWC study limits.

While outside of the EWC study limits, the City of Coolidge, located east of the City of Casa Grande, has also completed a feasibility study planning their roadway network for the foreseeable future. Completed in June 2012, this study took the findings of the Hidden Valley Transportation Framework Study and proposed the extension of the Hassayampa Freeway along the Val Vista Boulevard alignment through the northern boundary of the City of Coolidge.

Projected travel demand is not the only reason for the need of the EWC. The community of Maricopa relies on SR 347 as a primary link to Metropolitan Phoenix for both jobs and services. Since SR 347 is the only link between these two communities, traffic incidents have frequently closed this link which leaves no other efficient alternate routes for traffic to detour. SR 347 is also bounded by the GRIC whereas detours through the reservation are problematic and not adequately designed to carry detour traffic intended for a state route. By implementing the EWC, detour traffic would have a high efficiency corridor that would retain connectivity between the City of Maricopa and Metropolitan Phoenix when the SR 347 connection is severed.

A high-capacity transportation facility directly linking the Cities of Maricopa and Casa Grande between SR 347 and I-10 would accommodate existing and projected local and regional travel demands; provide a roadway level of service that meets both regional and State goals for a major rural arterial highway for the 2040 design year; and conform to local and regional transportation plans. The vision for the roadway improvements is to develop the most feasible alternative that allows traffic to flow without undue hindrance or delay, and to minimize impacts to local businesses and residences.

Description for the Project

The study corridor begins at SR 347 in the City of Maricopa and extends easterly to terminate at I-10 in the City of Casa Grande. While there are a series of arterials and local streets within this corridor, there is no existing continuous transportation facility that meets the capacity requirements for the anticipated growth within the study limits.

Within the study limits, the existing roadway network is comprised of regional and local routes. The existing streets are primarily stop controlled with select signalized intersections at SR 347, the MCGH, and Pinal Avenue. The eastern limit of the study is I-10. Currently, traffic interchanges with I-10 are limited to Pinal Avenue, McCartney Road, and Florence Boulevard. There are overpass structures located at Val Vista Boulevard and Cottonwood Lane.

Project Objectives

The project objectives for the EWC were compiled following scoping and progress / development meetings with both governmental stakeholders and the public. These meetings were the backbone in developing the requirements for the EWC while also isolating the needs of all involved parties ranging from the traveling public and local landowners, to the regional authorities responsible for the management and maintenance of the transportation corridor. These needs were used as evaluation factors for comparing / evaluating the various design alternatives that were developed.

During the agency and public scoping meetings, the issues, concerns, and opportunities (ICO's) were identified. These ICO's were categorized between roadway design objectives, and environmental / social / economic objectives.

Roadway ICO'S:

- The configuration of the East-West roadway was a concern. Access to adjacent properties was considered important and the configuration of the roadway could affect access. A parkway or expressway would have different access to adjacent properties than a freeway.
- Previously identified corridors should not control alternatives. Consider what the region needs for the future.
- Need to work with adjacent communities relative to long-range planning of the communities.
- Multimodal solutions should be considered. Do not preclude other modes.
- The operation of parkways is not clear. If a parkway is planned the public will have to be educated as to its operational function.
- How will the EWC affect the UPRR?
- Will crossings of the UPRR be at-grade or grade separated?
- Any new at-grade crossing of the UPRR will require that two existing at-grade crossings be eliminated.
- Access to adjacent properties must be maintained. Access is more limited with a freeway than with a parkway.
- The EWC improvement has potential to impact SR 347, SR 238, SR 387 and I-10.
- Concerns with terminating the project at I-10. Consider extending further to the east.
- Impacts of the proposed improvement on floodplains must be considered and addressed.
- If the current project will be an interim project, with a freeway planned for the future, the access control requirements should be for the ultimate facility. Severing access to developed properties later on is very costly.
- Planning and zoning of the lands adjacent to the EWC will remain the responsibility of the underlying land manager (City, County, or Tribe). Access to the EWC from these lands may be restricted to follow the operational characteristic of the Arizona Parkway.

Environmental/Social/Economic ICO'S:

- The involvement of property owners is important as the project planning develops.
- The BIA must be involved if roadway expansion involves either the Ak-Chin or Gila River Indian Communities.
- Any cultural sites should be avoided.
- While working with Tribal lands is different than say private or public lands, they should not be bypassed without the involvement and discussion of the Tribal Communities.
- Keep the communities involved as the project develops.
- Impacts to existing communities/lifestyle are important
- Identify and address open space and trail plans.
- Consider proposed and existing land uses in determining impacts of the alternative improvements.
- Involve wildlife preservation groups to ensure that wildlife crossings are addressed.

Design Concept Evaluation Criteria

Based on the project objectives isolated through the numerous agency and public scoping meetings, a series of criteria were developed to aid in the evaluation of the alternatives considered by the study team. The criteria are as follows:

1. Compatibility for widening the facility from four-lanes to six-lanes.
2. Potential for access control.
3. Compatibility of the existing roadway to be maintained for one direction of travel, therefore limiting construction costs.
4. Consistency with planned developments.
5. Alternative fits the existing topography.
6. Avoid major environmental impacts.
7. Compatibility with Tribe requirements.
8. Alternate route to detour traffic should connection between City of Maricopa and Metropolitan Phoenix be severed.

Design Concept Alternatives

Developing a high capacity limited access facility after existing roads and infrastructure are in place is a difficult task. Fortunately, the evaluation of alternatives process allows opportunities for choosing a concept that is compatible with the existing roadway network. The proposed improvements should be an efficient, access-controlled facility that will meet the 2040 design year traffic models. For the majority of the corridor, the improvements will be constructed adjacent to the existing two-lane roadway utilizing the existing pavement to the extent feasible. The major objectives of the improvements are to increase capacity, enhance traffic efficiency / preference given to the east-west movement, enhance safety, and improving operational features within the study limits.

Corridors Considered

No-Build Alternative: It needs to be stressed that the No-Build Alternative is provided for comparison purposes throughout the development of this study process. This solution provides no improvements to the capacity, safety, and operational features of the existing roadway, and involves no cost and no apparent change to the environmental features of the existing roadway corridors.

Corridor 1: This corridor is the base corridor as provided by the RSRSM beginning at the intersection of SR 347 and Farrell Road, then turning south east along the existing MCGH until intersecting with a projected Val Vista Boulevard alignment. At this point, the corridor will proceed easterly until it terminates at I-10.

Corridors 2-5: This series of corridors all retain the easterly alignment as shown with *Corridor 1*; however differentiate on how they terminate at SR 347.

Corridors 6-8: This series of corridors involve the different alternatives that were considered in the middle of the corridor including an option that bypasses the Ak-Chin Indian Community and an alternative that shows an extension of the Val Vista Boulevard south of the Ak-Chin Indian Community.

Corridors 9-11: This series of corridors involve the different alternatives that were considered for ultimately terminating the facility. These corridors include an option to terminate adjacent to the Pinal Avenue interchange as well as an option to continue adjacent to the MCGH to terminate within the heart of the City of Casa Grande.

General Map Legends:

- City of Maricopa Planning Area
- City of Casa Grande Planning Area
- Ak-Chin Community Planning Area
- Proposed Land / Facilities
- Existing State Freeway / Highway
- Proposed New Freeway (Current I-11 Concept)
- Proposed New Parkways (Hidden Valley Study)
- Proposed New Parkways (Per Updated RSRs)
- Proposed New Parkway Concepts (Public Mtgs)

Recommended Corridor

As a result of the evaluation process, it was determined that Corridor 1 with a few adjustments meets the greatest needs of the traveling public while also remaining compatible with the original RSRSM study recommendations. The results of this evaluation were shared with project stakeholders and the public which officially began the alignment alternatives phase of this study.

Alternatives Considered

Based on the recommended corridor determined during the previous phase, the study team looked at different design alternatives to determine the most feasible way for implementing the EWC. The recommended alternative for the EWC was determined by analyzing the different alignments and figuring out which alignment best fit the needs of the project while also providing a cost efficient facility.

The recommended corridor was broken into five separate alternative zones which independently evaluated different alignment options. The recommended alternative would represent a conglomerate of different design alternatives chosen based on their design merits and feasibility.

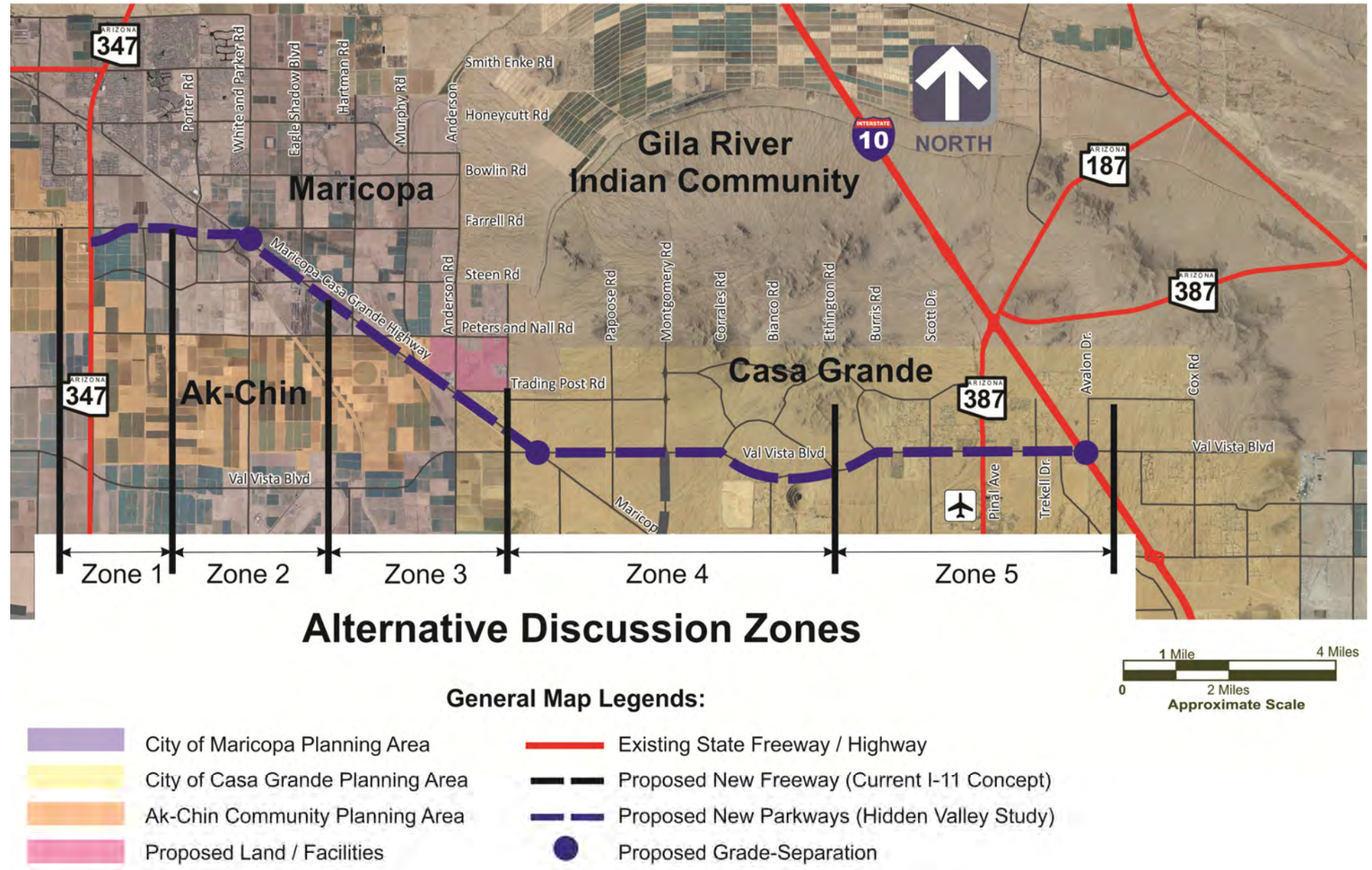
Recommended Alternative

Zone 1: Through coordination with the proposed developments and in discussions with the Ak-Chin Indian Community, an alignment was chosen to intersect the EWC with SR 347 adjacent to the Harrah's Casino. By veering south of the Farrell Road alignment towards the intersection with SR 347, the existing homes can be saved while still providing adequate room for the implementation of the parkway concept and avoid the historical properties located adjacent to Farrell Road.

Zone 2: This zone involves the different alignment alternatives considered for intersecting the EWC with the MCGH while still maintaining access to the MCGH to the north and providing adequate access to White and Parker Road. The recommended alignment involves elevating the proposed alignment to have a bridge crossing of the Santa Rosa Wash as well as the UPRR / MCGH. From this point, the alignment will come back down to existing grade as quickly as possible in order to reduce the amount of borrow material needed to create embankment. Access to the existing MCGH and White and Parker Road are maintained through a series of ramps and strategically placed U-Turn facilities.

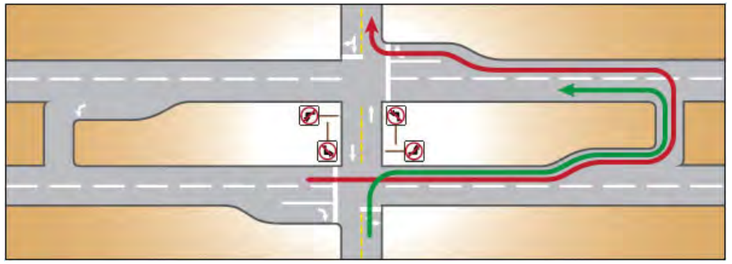
Zone 3: This zone involves the different alternatives for implementing the design corridor through the Ak-Chin Indian Community without significantly impacting Tribe property. The Santa Cruz Wash in this area represents a design hurdle as much of the drainage in this area converges to ultimately flow in to the wash. While it is preferable to maintain the proposed parkway improvements through the reservation, the drainage needs of this area require special treatment.

Zone 4: There were no separate alternatives necessary for Zone 4 as the alignment shown in the RSRSM represented the best course of action for this section. The MCGH / Val Vista Boulevard intersection would be handled through the use of an overpass structure with a series of ramps necessary to maintain access in each direction. The "dip" shown towards the end of Zone 4 follows the desires of the Copper Mountain planned development as they would prefer that the parkway would follow the southern limits of the proposed development.



Zone 5: This zone involves the different alignment alternatives spanning from the Copper Mountain planned development to the I-10 terminus of this corridor. The main factors with this zone involve whether the EWC will follow the Val Vista Boulevard corridor north or south of the Avalon Community. Other design consideration involves the compatibility with the Casa Grande Municipal Airport and its planned expansion. It was determined that the preferred alignment would pass north of the Avalon Community and then follow the Val Vista Boulevard alignment to ultimately terminate at a traffic interchange with I-10. This alignment keeps the EWC out of the expansion of the Casa Grande airport while also allowing compatibility with the planned developments east of Pinal Avenue.

Recommended Solution



The EWC will implement the Arizona Parkway Concept which has been used in many states such as Florida, Maryland, New Jersey, and Louisiana. It has been used with great success in Michigan for over 40-years. The basis of its design and recommended use is to provide a solution to the following problem: How can a roadway provide significantly greater capacity while maintaining unrestricted access to local communities and businesses without severing the connectivity of local arterial cross-streets?

A Parkway is generally characterized by a large median with the elimination of the left-turn movements at arterial intersections. For vehicles wishing to turn-left, they would have to utilize strategically placed U-Turn facilities along the Parkway which effectively reverses their direction of travel. By implementing the Parkway Concept, efficiency of intersections are greatly enhanced as there is effectively only two phases of operation.

Safety is enhanced by the implementation of the Parkway Concept. As discussed previously a Parkway reduces the signal phases at intersections by eliminating the left-turn movements. By removing the left-turn movements at intersections, the probability of head-on and angled collisions is significantly reduced. These types of incidents are commonly known to have higher risk of bodily injury.

As communities continue to grow, traffic will grow respectively impacting the existing roadway systems requiring the need for further roadway improvements. Although the Parkway Concept does not necessarily have the higher speeds commonly found in freeways or highways, Parkways are more efficient than normal arterials as they give preference for the through movement. This preference is primarily achieved by strategic signal timing in combination with the elimination of the left-turn movement signal phase. This translates to less time spent waiting at intersections and more time getting to your destination.

Estimated Cost

The estimated cost of the EWC improvements is approximately $145 million with $2.5 million going towards acquiring easements and R/W necessary to construct the improvements. *Section 8.0* covers the different costs and assumptions used with the implementation of the EWC as one complete package. As a part of the cost estimating process the following factors were applied to the construction bid item totals:

- Furnish Water – 2%
- Maintenance of Traffic – 10%
- Environmental Impact Mitigation – 4%
- Mobilization – 10%
- Contractor Quality Control – 2%
- Construction Surveying and Layout – 2%
- Construction Engineering – 10%
- Design Engineering – 10%
- Contingency – 30%

Implementation Plan

While the corridor improvements have been justified throughout this document, and construction is desired to be completed as soon as possible, Pinal County and Cities of Maricopa and Casa Grande have limited funds available each year. It is therefore unrealistic to assume that all of the EWC improvements can be constructed as a single project. It is more likely that a series of projects will be funded to complete the improvements over an extended period of time. It should be noted that the costs for implementation are strictly based on 2015 unit bid prices and do not account for the market fluctuations or inflation / deflation experienced each year.

It is suggested that all private R/W required from private parties or corporations be purchased for the entire corridor in conjunction with the first phase of improvement projects to ensure that the access management concepts proposed herein are adhered to. It should be noted that the majority of the property required for construction of the recommended alternative is owned by private properties or corporations.

The cost to construct the entire EWC proposed improvements is $145 million while the total costs to construct the improvements in phases cost nearly $175 million. While these limits will likely change as construction funds become available, these estimates provide a baseline for the smaller, constructible segments that can be used for future programming and planning purposes.

Segments 1 and 2 were selected first as they are through the Ak-Chin lands that are currently experiencing both drainage and capacity issues that require the participation of Pinal County. Outside of these projects, the others are influenced by the rate of development and regional funding that they receive. There are no stronger compelling reasons to construct in the order provided.

EWC COST ESTIMATE VS IMPLEMENTED COST		
COST ESTIMATE	**TOTAL**	**SOURCE**
EWC Estimate	$144,844,000	*Table 8-3*
EWC Phase 1 Estimate	$19,894,000	*Table 9-1*
EWC Phase 2 Estimate	$7,394,000	*Table 9-2*
EWC Phase 3 Estimate	$6,308,000	*Table 9-3*
EWC Phase 4 Estimate	$4,609,000	*Table 9-4*
EWC Phase 5 Estimate	$38,267,000	*Table 9-5*
EWC Phase 6 Estimate	$12,554,000	*Table 9-6*
EWC Phase 7 Estimate	$6,513,000	*Table 9-7*
EWC Phase 8 Estimate	$13,101,000	*Table 9-8*
EWC Phase 9 Estimate	$5,120,000	*Table 9-9*
EWC Phase 10 Estimate	$17,230,000	*Table 9-10*
EWC Phase 11 Estimate	$9,596,000	*Table 9-11*
EWC Phase 12 Estimate	$34,118,000	*Table 9-12*
PHASED COST TOTAL	**$174,704,000**	

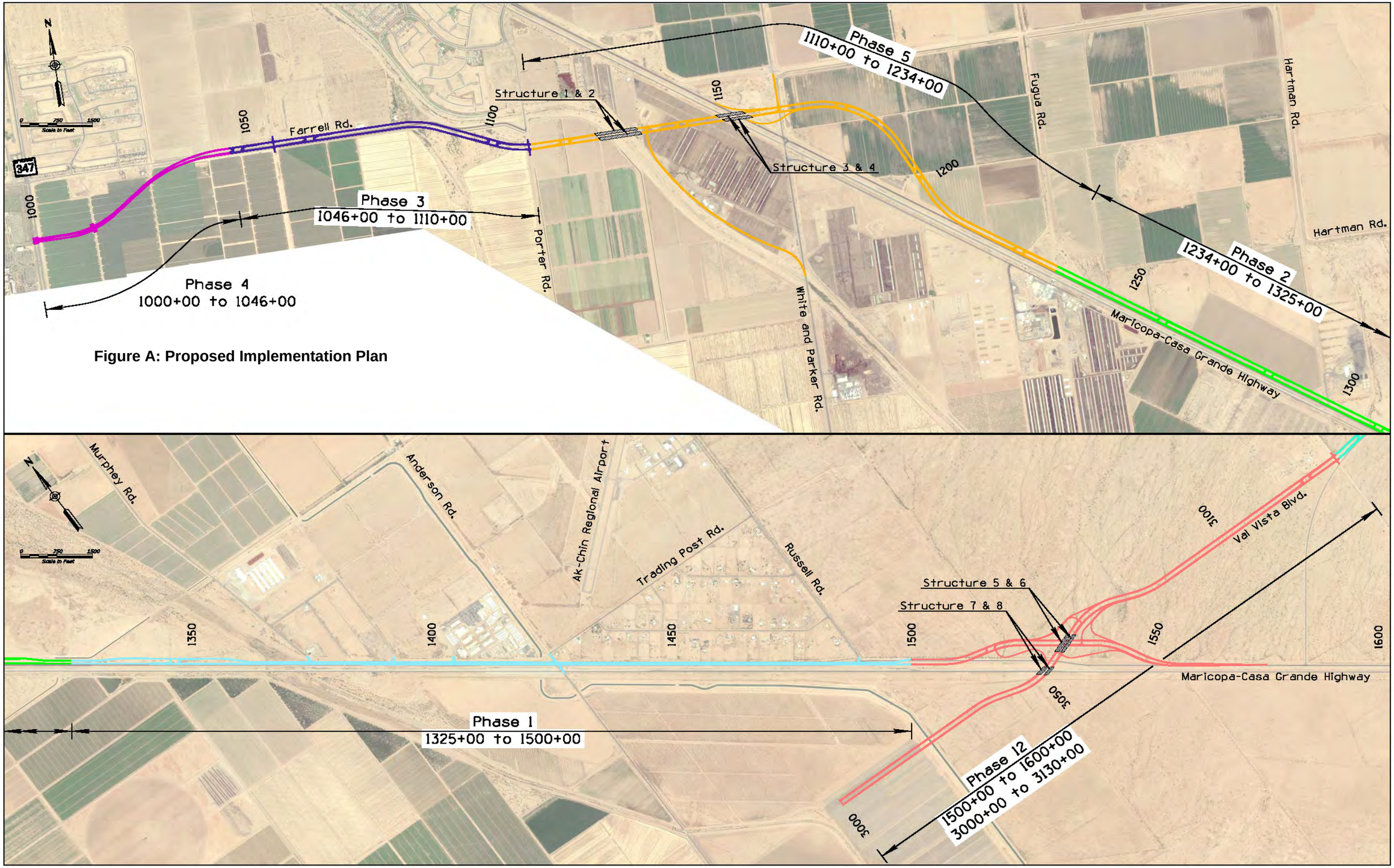
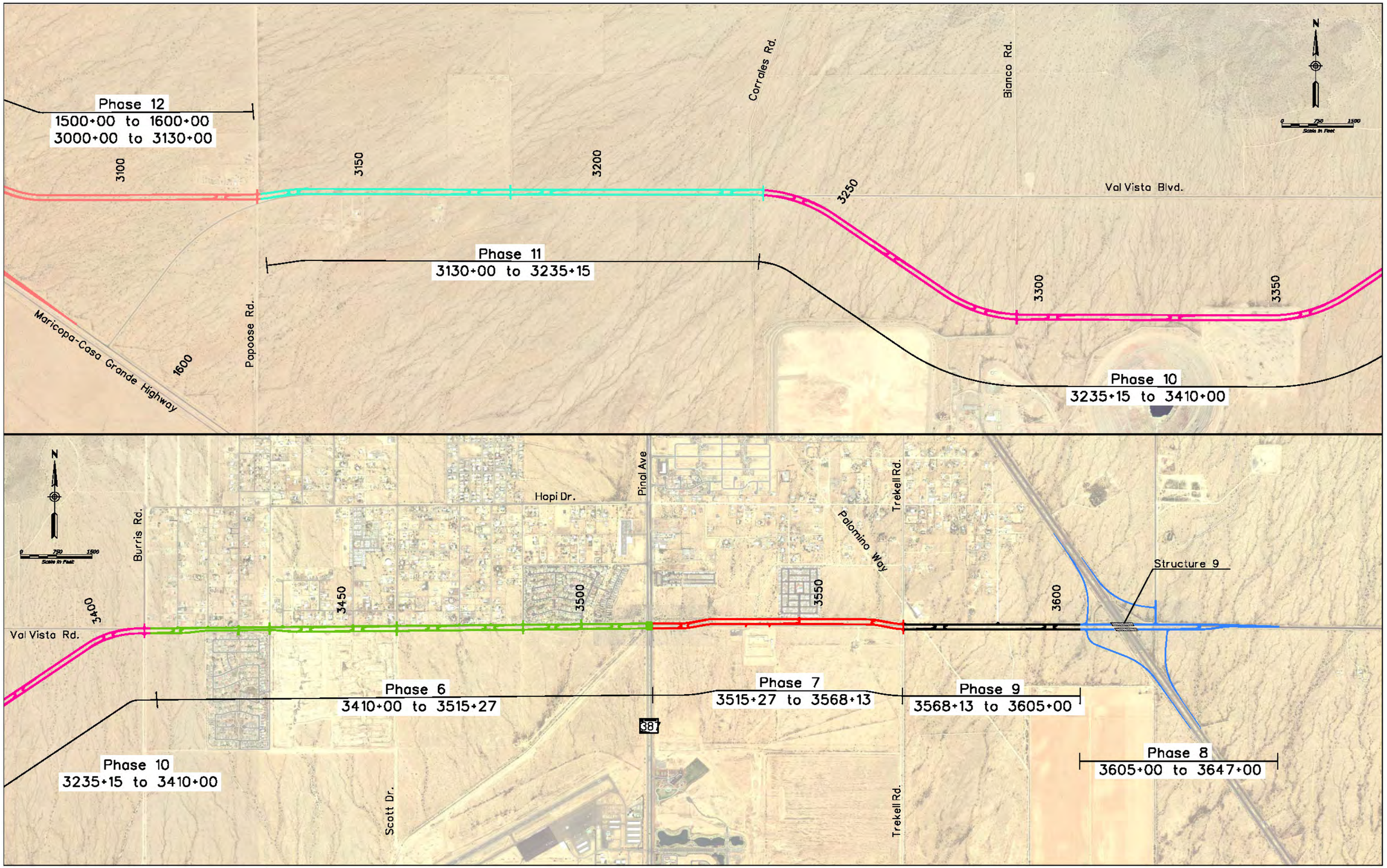


Figure A: Proposed Implementation Plan


Phase 12
1500+00 to 1600+00
3000+00 to 3130+00
3100
3150
3200
3250
Corrales Rd.
Bianco Rd.
Val Vista Blvd.
Phase 11
3130+00 to 3235+15
3300
3350
Maricopa-Casa Grande Highway
1600
Papoose Rd.
Phase 10
3235+15 to 3410+00
Burris Rd.
Hopi Dr.
Pinal Ave
Trekell Rd.
Palomino Way
Structure 9
3400
3450
3500
3550
3600
Val Vista Rd.
Phase 6
3410+00 to 3515+27
Phase 7
3515+27 to 3568+13
Phase 9
3568+13 to 3605+00
387
Phase 8
3605+00 to 3647+00
Phase 10
3235+15 to 3410+00
Scott Dr.
Trekell Rd.

1.0 INTRODUCTION

1.1 Foreword

Pinal County, in cooperation with the City of Maricopa and the City of Casa Grande, has initiated a design concept study with the related environmental studies to identify and evaluate alternatives for developing a high efficiency, high capacity East-West transportation corridor between Arizona State Route 347 (SR 347) in the City of Maricopa, and Interstate 10 (I-10) in the City of Casa Grande, all located within Pinal County (See **Figures 1-1 and 1-2**). The study is further constrained by the Gila River Indian Community to the north, and generally follows the northern and eastern boundaries of the Ak-Chin Indian Community located to the southwest. Major transportation features within the study area include State Routes 347 and 238 to the west, SR 84 to the south, SR 387 through the eastern half of the study area, and I-10 to the east.

The purpose of this project is to improve the safety, mobility and connectivity of the cities, towns, and Pinal County transportation networks within the designated study limits. This study is intended to ultimately produce an East – West Corridor Location / Design Concept Report (L/DCR) and an Environmental Document (ED) that meets the evaluation and documentation requirements of the National Environmental Policy Act (NEPA) that recommends a specific conceptual-level transportation facility to achieve this purpose. The report should provide an understanding of the potential impacts, mitigation, coordination, scheduling and costs associated with development and construction of such a transportation corridor. The intent of this study is to continue where previous planning studies left off, developing a parkway concept within the study limits.

During the course of this study, the requirement of being fiscally constrained (having a viable funding source to complete the improvements) made the goal of completing an EA under the Federal Highway Administration (FHWA) not possible, as no federal funding has yet to be identified for the needed improvements. To retain the progress made on the NEPA efforts to date including scoping and alternatives analysis, the team is following FHWA's Planning and Environmental Linkage (PEL) approach to document the planning and environmental discoveries. Following NEPA, Public involvement, agency coordination, and stakeholder coordination will be maintained throughout the project duration to build consensus among local communities, agencies and stakeholders.

The formats of these study documents and the workflows to develop these documents will be consistent with the Arizona Department of Transportation's (ADOT) procedures for L/DCR location studies and PEL planning studies.

It is the intent of the participating agencies that the conclusion of this study effort will yield initial plans of a proposed corridor improvement that will provide a high capacity facility between I-10 to the east and SR 347 to the west consistent with the transportation plans of Pinal County and the Cities of Maricopa and Casa Grande.

The design concept study process will develop first alternative corridors, and then drill down into alternative alignments for consideration within this study corridor, along with the No-Build Alternative. The conclusion of this study will produce a preferred alignment for the East-West Corridor (EWC) as a priority east-west alignment through the Cities of Maricopa, Casa Grande, and Pinal County.

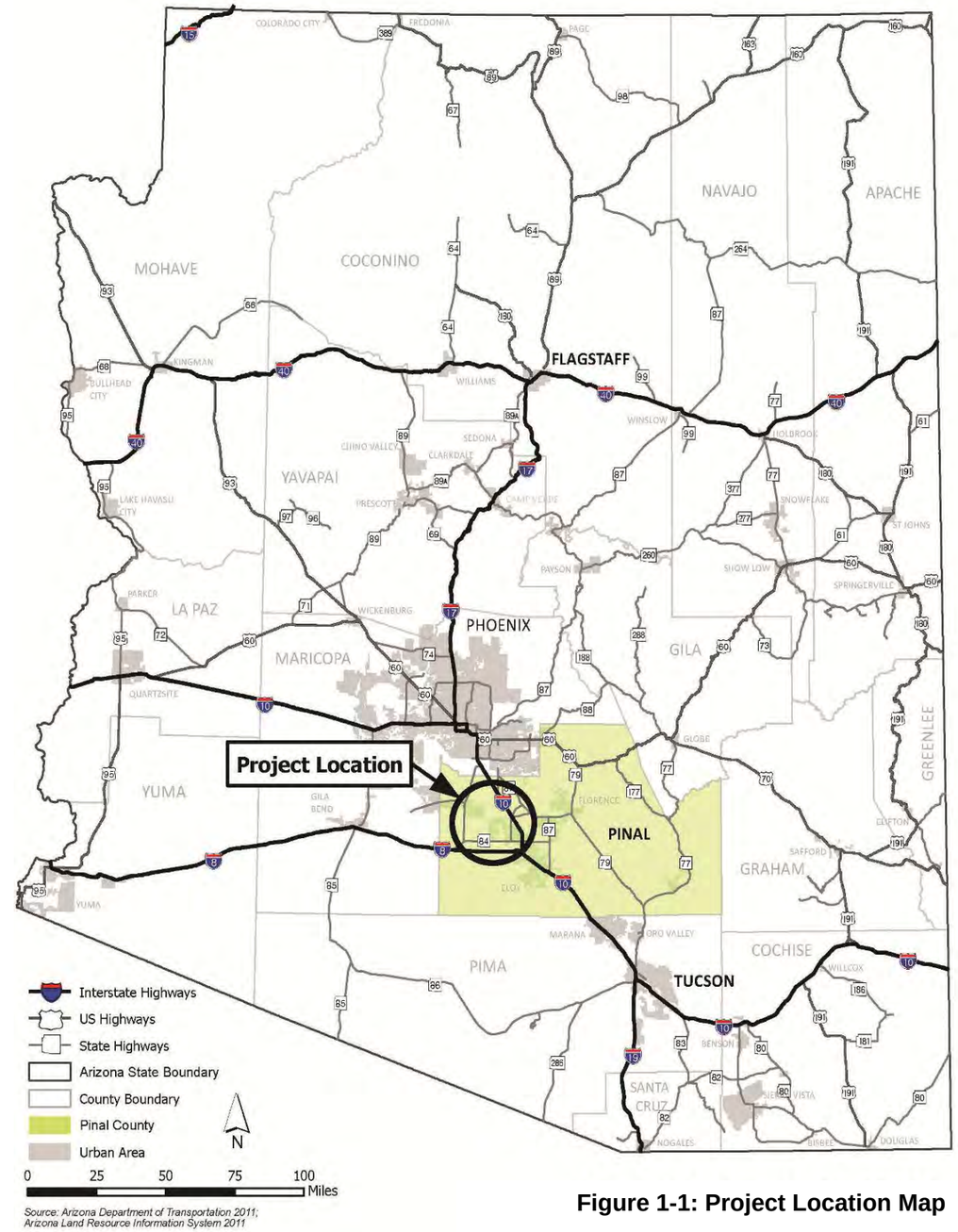


Figure 1-1: Project Location Map

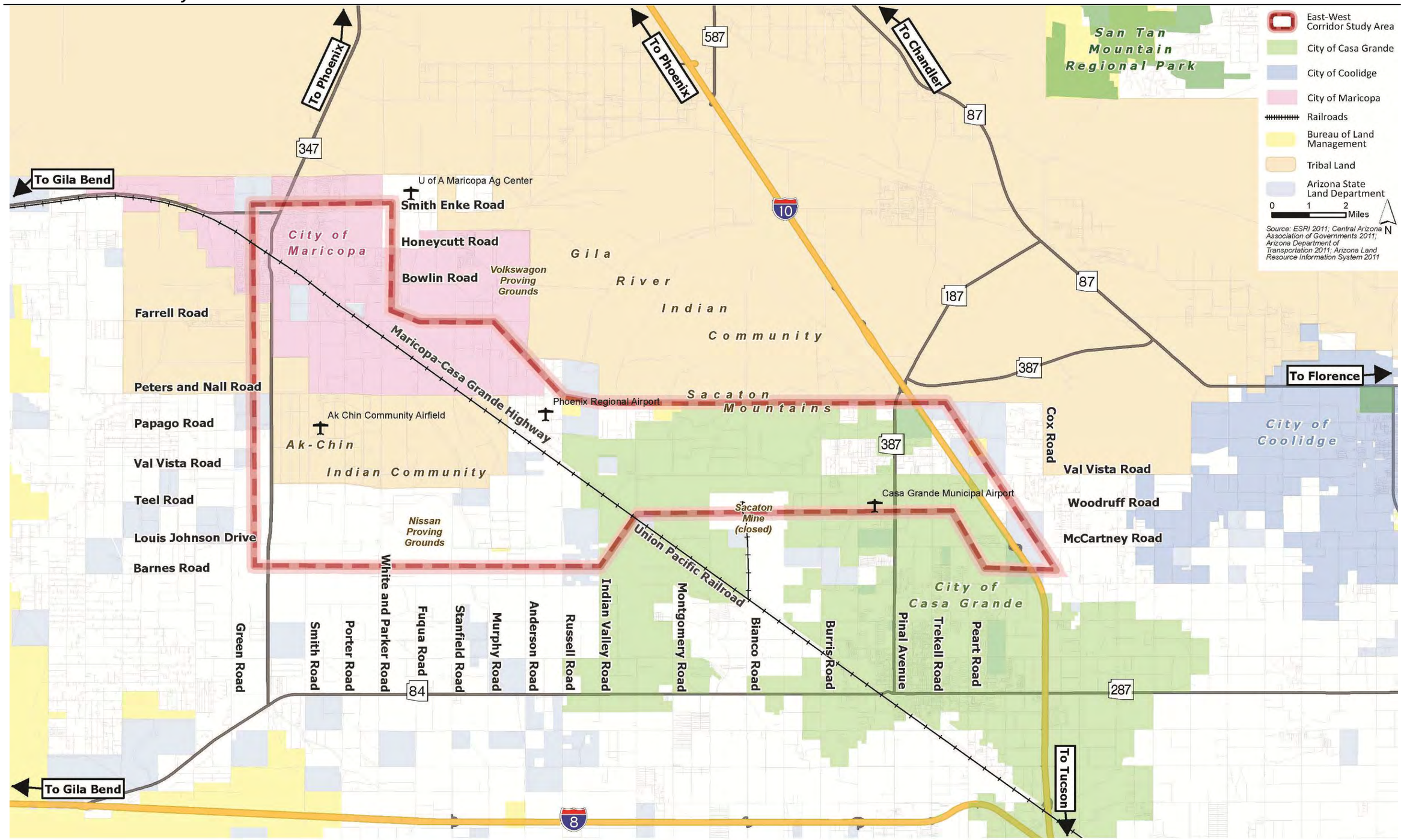


Figure 1-2: Project Vicinity Map

1.2 Previous Studies

Pinal County completed several studies that identified the need for a high-capacity transportation corridor within the East-West corridor's study limits, in cooperation and coordination with various cities and towns within and adjacent to its jurisdiction. The primary controlling document that defined where these improvements should be focused is the Regionally Significant Routes for Safety and Mobility (RSRSM) study completed in 2008. That Study defined a transportation network that will provide connectivity within, through, and around Pinal County. This long range regional transportation network identified the need for an improved transportation facility that safely handles the projected high east-west travel demand within the study area.

Several additional studies identified the need for a high-capacity transportation corridor generally following a similar alignment to the East-West Corridor. These studies include:

- Building a Quality Arizona (BQAZ); Interstate 8 and 10 Hidden Valley Transportation Framework Study
- City of Casa Grande Small Area Transportation Study
- MCGH Project Assessment
- City of Maricopa Regional Transportation Plan Update
- BQAZ Statewide Transportation Planning Framework Program and Rail Framework Study

As a result of the improvements recommended by these studies and through coordination within the County and the lead local agencies that funded this study, the limits of this East-West corridor study were defined **(See Figure 1-3).**

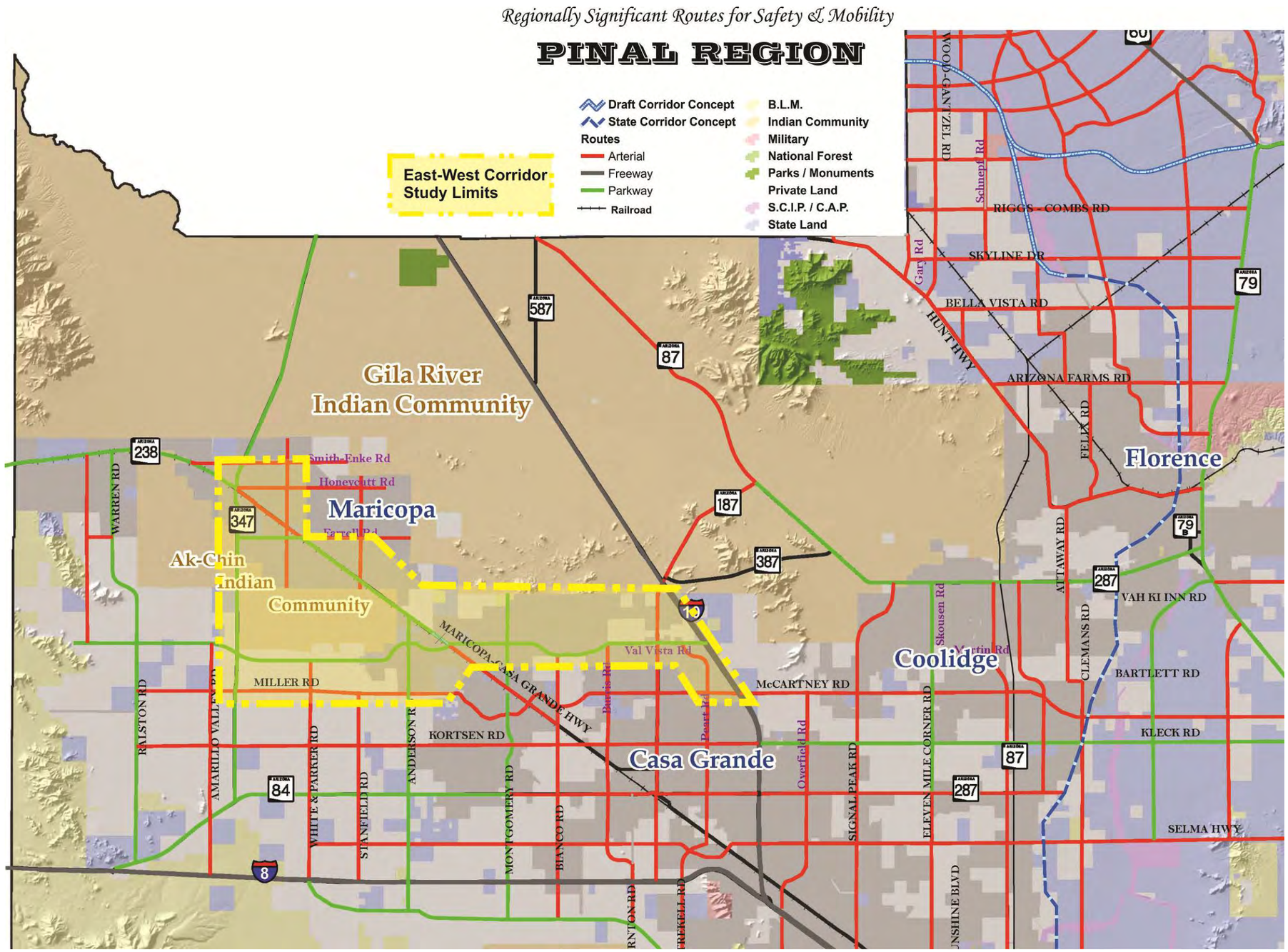


Figure 1-3: East-West Corridor Study Limits

1.2.1 BQAZ Hidden Valley Framework Study

While the RSRSM focused on the desires of the County and the adjacent cities, ADOT looked at the transportation needs of the entire state through the BQAZ framework studies. Completed in October of 2009, the BQAZ study team developed the Hidden Valley Framework Study, a study focused on addressing transportation growth and development for the next 50 years.

The recommended framework, shown in **Figure 1-4**, is a multimodal solution featuring expanded and new high-capacity roadway corridors to accommodate future travel demand, as well as transit corridors to facilitate travel to the major employment centers of metro Phoenix and Tucson, as well as the activity hubs within the Hidden Valley.

In addition to the arterial and parkway corridors identified in the RSRSM, the Hidden Valley Framework identified locations of proposed freeways and expressways within the Framework limits. Specifically, the Hassayampa Freeway corridor traverses through the center of the East-West corridor's study limits, with the intent of extending this proposed freeway facility east along a McCartney Road corridor, ultimately to tie to the future North-South freeway corridor between I-10 and US 60, somewhere between Coolidge and Eloy.

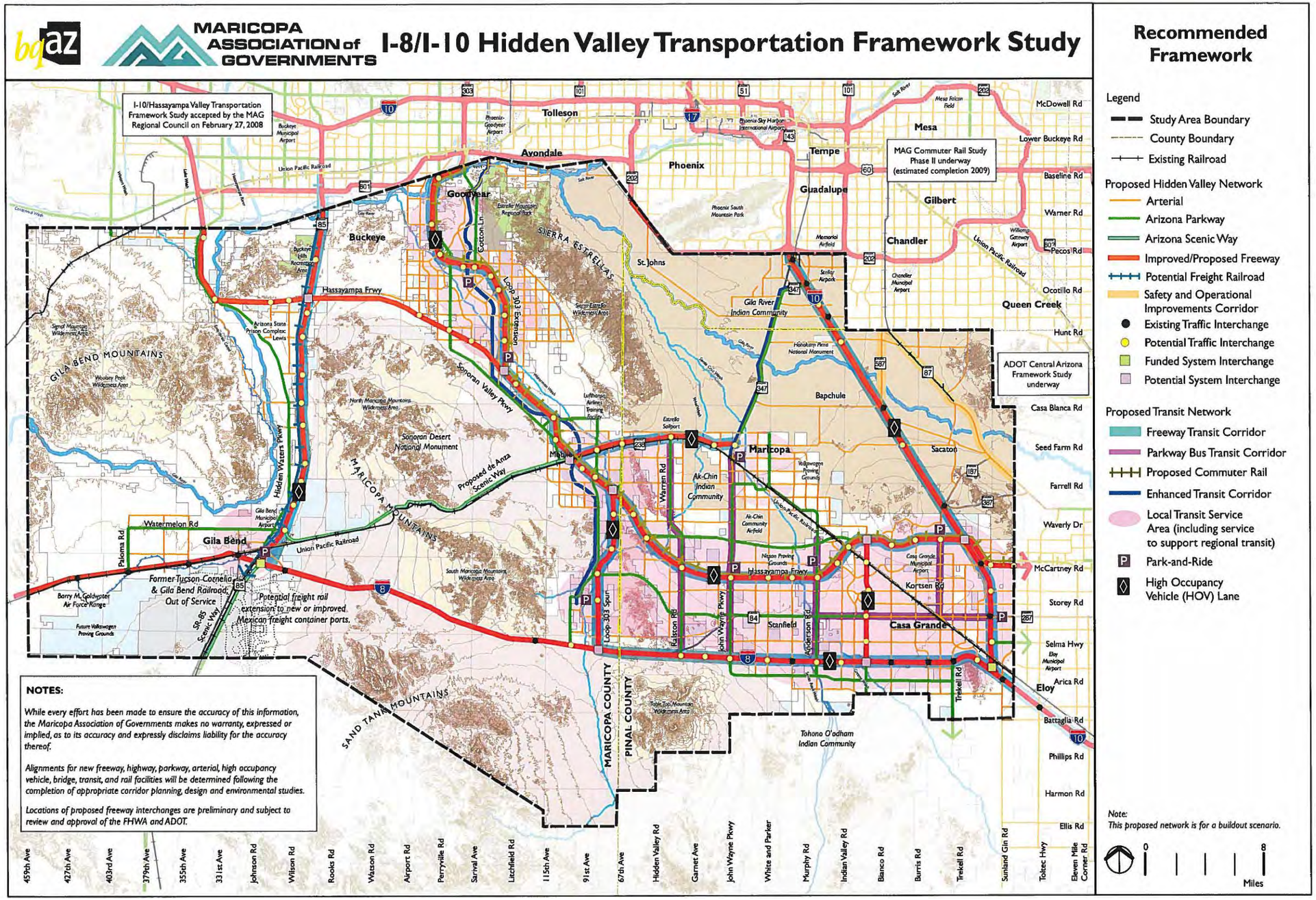
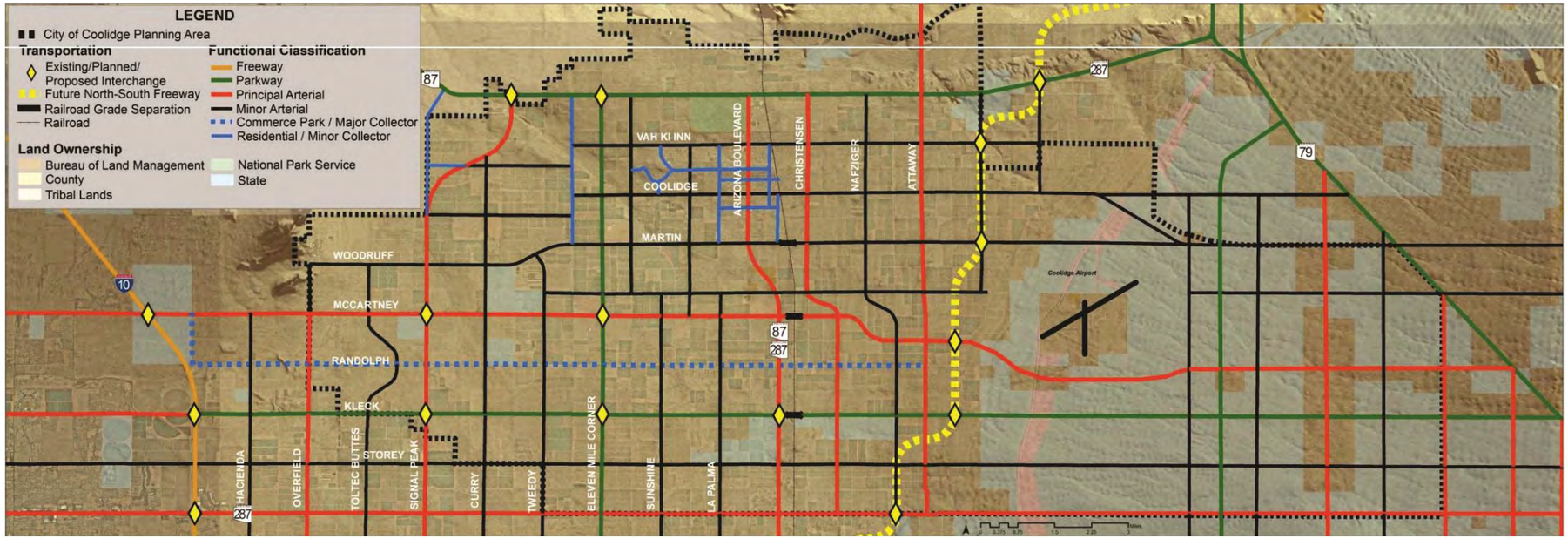


Figure 1-4: I-8 / I-10 Hidden Valley Transportation Framework Study

1.2.2 City of Coolidge Comprehensive Transportation Feasibility Study

The City of Coolidge, working through ADOT's Planning Assistance for Rural Areas (PARA) program, developed a comprehensive Transportation Feasibility Study for the Coolidge Area. Among other goals, this study evaluated the possibility of extending the Hassayampa Freeway facility proposed in the BQAZ study into the planning limits of the City of Coolidge, east of I-10. This study was not available to the BQAZ study team at the time of the development of the Hidden Valley Framework Study.

The greatest challenge of continuing a freeway between I-10 and the proposed future North-South freeway corridor planned for the east is that while most of the area is yet agricultural, many of the lands are already constrained with proposed subdivisions and commercial development. As a freeway corridor was considered that continued east as an extension of the proposed Hassayampa Freeway, it was pushed further and further south. Ultimately, consensus was not achieved on where an East-West freeway corridor could be located, so none was shown on the proposed long-range plan for this area. Instead, a parkway corridor was identified along the Kleck Road alignment that would ultimately provide high-capacity connectivity between I-10, Coolidge, and the future North-South Freeway corridor. These proposed improvements are shown on **Figure 1-5**.



Coolidge Transportation Plan: Functional Classifications

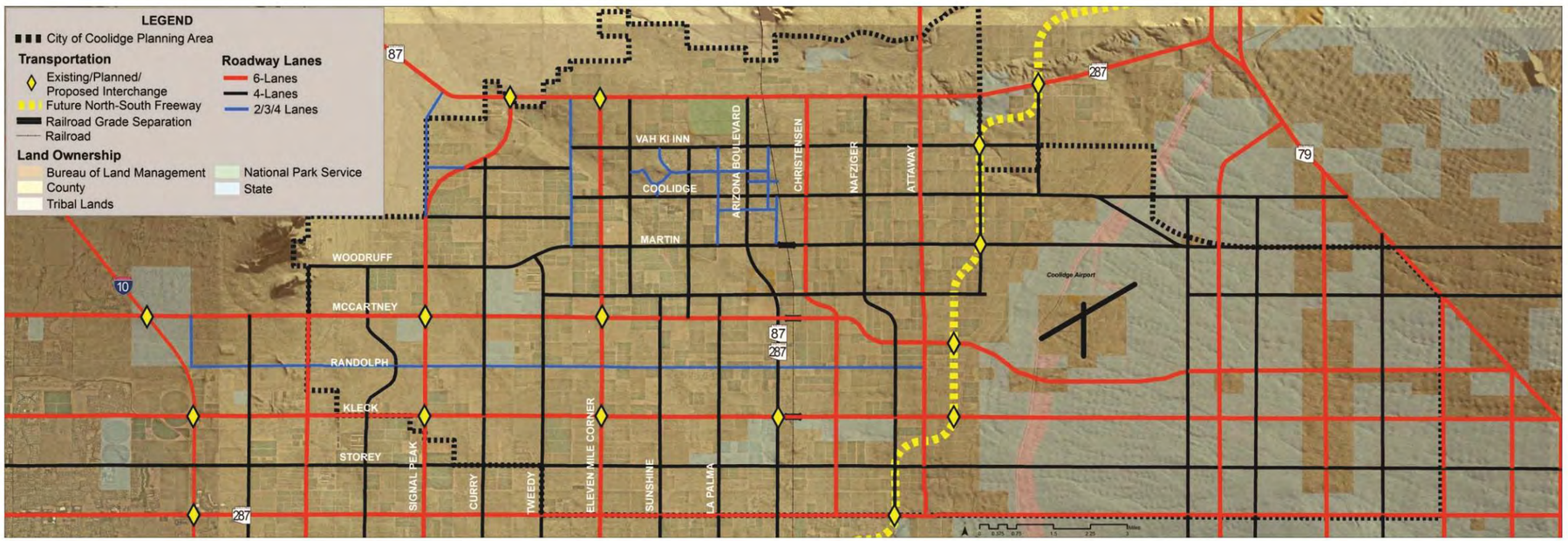


Figure 1-5: Coolidge Comprehensive Transportation Feasibility Study

Coolidge Transportation Plan: Number of Lanes

1.2.3 Challenges with BQAZ Hassayampa Freeway Corridor

Superimposing the RSRSM, Coolidge PARA, and BQAZ Hidden Valley Framework recommended improvements onto a single exhibit; we have the information shown in **Figure 1-6**. The Hassayampa Freeway is essentially constrained to terminate at I-10, as the Coolidge PARA did not identify any feasible freeway corridors continuing to the east. What becomes apparent is the challenge of locating both a high-capacity parkway that maintains local access with a regional freeway in the same corridor between the limits of Montgomery Road to the west, and I-10 to the east. This particular corridor is additionally constrained by an airport to the south, and the terrain/topography of the Sacaton Mountains to the north.

The area north of the Casa Grande Airport provides its own challenges to a regional freeway. Several major drainageways converge near Pinal Avenue and Val Vista Boulevard., flowing towards the airport and continuing southwesterly ultimately flowing into the north branch of the Santa Cruz Wash. The proposed freeway and cross-streets would need to be maintained over these drainage features. Depressing a freeway corridor will conflict with these drainage features as they would effectively become large channels. Elevating either the freeway or the cross streets to maintain separation near the airport creates conflicts with the protected air space approaching the airport.

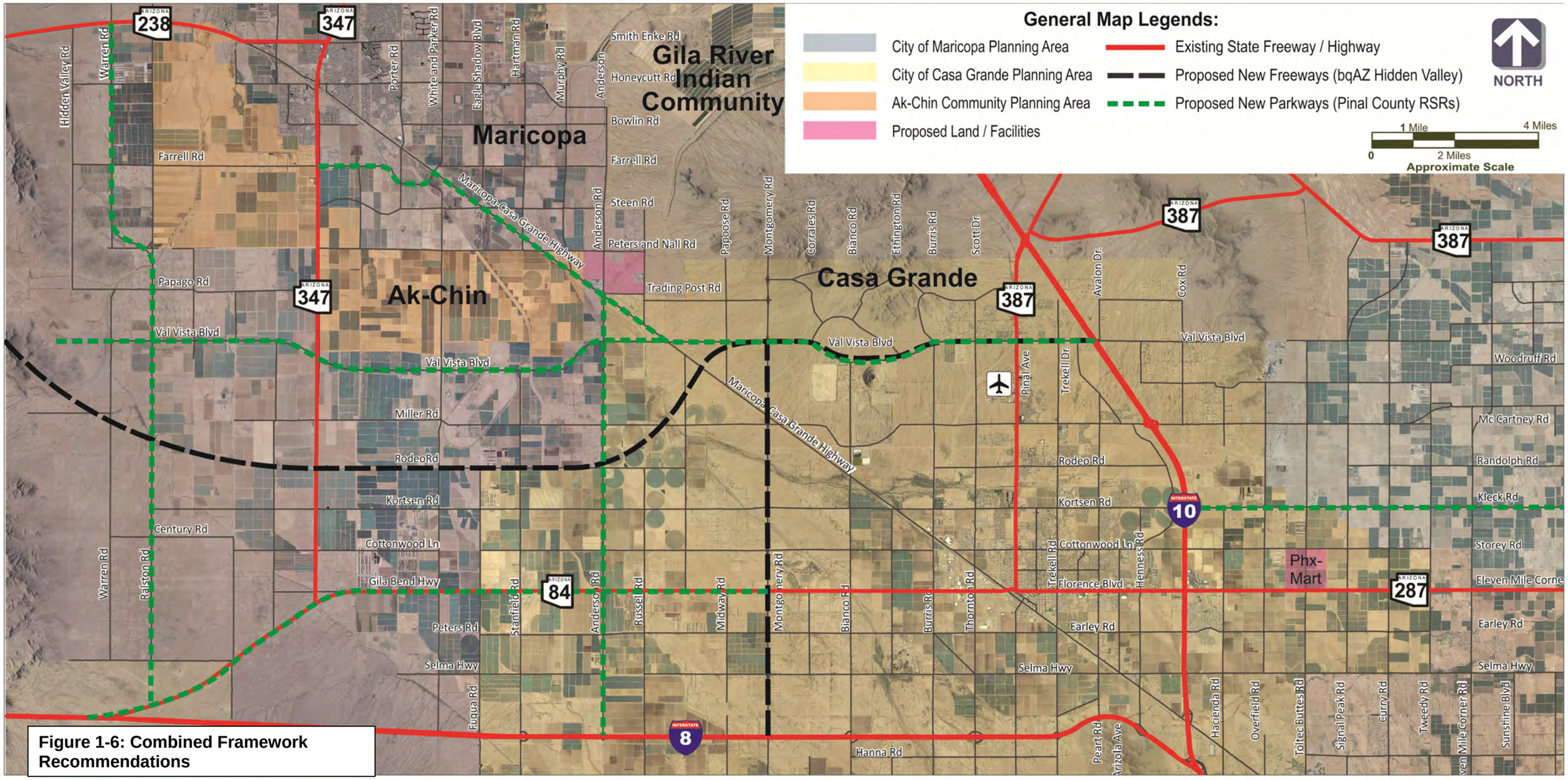


Figure 1-6: Combined Framework Recommendations

Finally, if the Hassayampa Freeway does not ultimately continue east, the greatest component is to provide North-South connectivity following the international trade route of the CANAMEX corridor. As such, providing the most direct route from the south (Tucson, Mexico) to the north (Western Metropolitan Phoenix, Las Vegas) would be desirable. Therefore, locating the eastern terminus of this facility north of Casa Grande seems to be out of the main travel path.

1.2.4 Hassayampa Freeway Corridor / I-11

The key to understanding how an east-west route can best be identified between SR 347 and I-10, the study must have a reasonable solution for all proposed transportation features within the study limits. While the BQAZ Framework study suggested the Hassayampa Freeway corridor be located north of Casa Grande, our discussions with the Cities and County impacted by this planning study all agree that an alternative route should be considered for planning purposes through this area. The alignment of the Hassayampa Freeway is now part of the I-11 freeway study. The challenges and problems associated with the Casa Grande Airport and the primary flow of traffic heading North/South on this facility has been shared with I-11 study team. While the I-11 study is still in its relative infancy, preliminary indications are that the geometry of the I-11 will shift as proposed by the dashed blue line in the exhibit below.

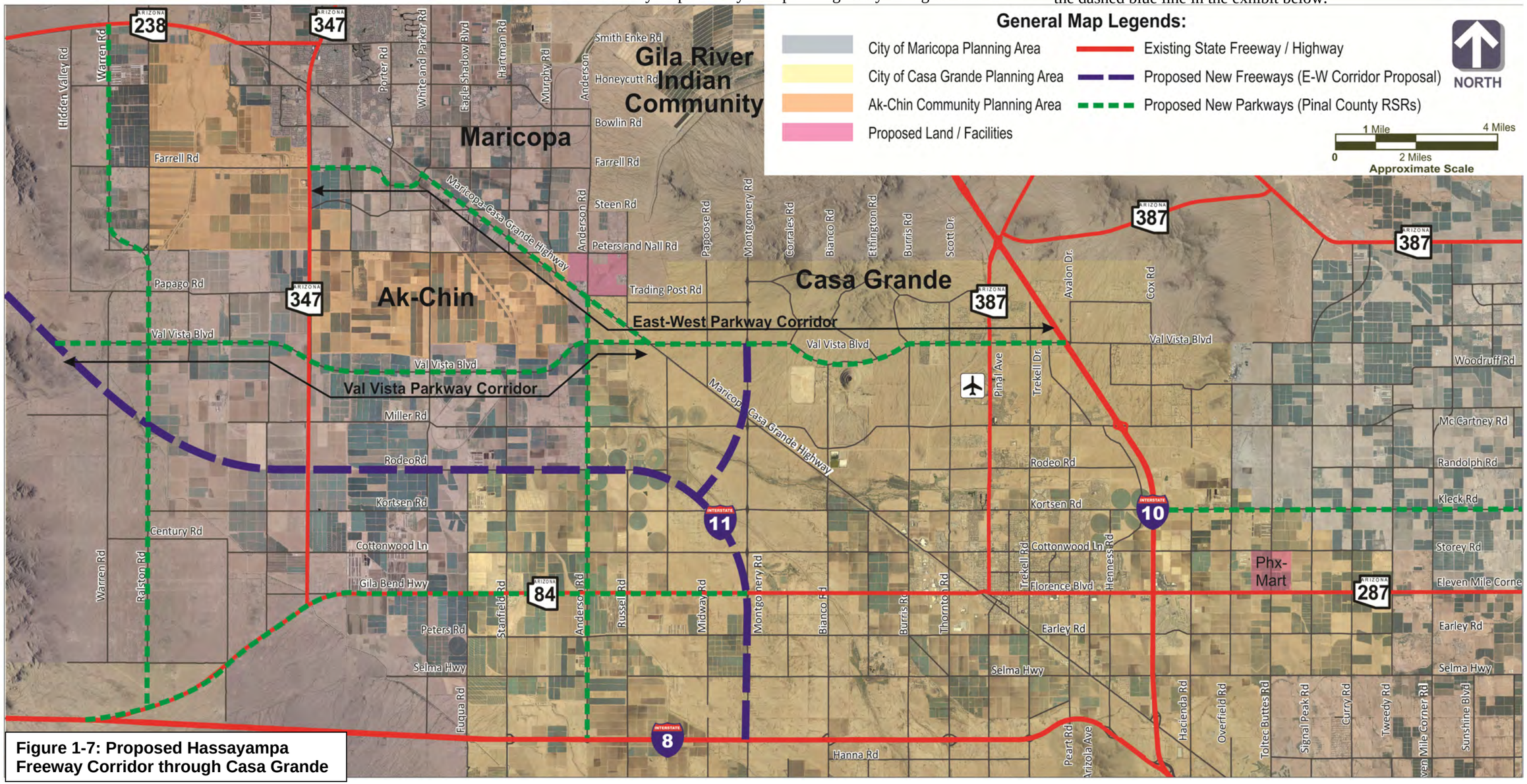


Figure 1-7: Proposed Hassayampa Freeway Corridor through Casa Grande

The revised I-11 route shown in the previous **Figure 1-7** better meets both the local and regional needs of the State through this area. This proposed alignment:

- Is better aligned with the traffic flows of CANAMEX.
- Keeps International traffic (noise/volumes) out of the Val Vista Boulevard residential corridor.
- Avoids the topography, drainage, and FAA clear-zone challenges north of the Casa Grande Airport.
- Avoids competing for the same limited right-of-way (R/W) as a local East-West parkway proposed along the Val Vista Boulevard corridor.

1.2.5 Interstate 11 Corridor Study

In the fall of 2014, the ADOT and the Nevada Department of Transportation (NDOT) completed an initial two-year feasibility study as the first step in the Interstate 11 process. In December of 2014, the Arizona State Transportation Board took action to approve $15 million for the Tier 1 Environmental Impact Statement, which will allow ADOT to begin an environmental study in the area between Nogales and Wickenburg. The Tier 1 EIS is expected to begin in late 2015 and is estimated to take three years to complete.

As shown in **Figure 1-8**, the recommended corridor exhibit below, the preliminary study evaluations have maintained and recommended the modification shown by this study for the Hassayampa / I-1l corridor to tie into I-8 along the Montgomery Road alignment.

While the focus of this EWC study is not to address where I-11 should be, removing conflicts from the potential parkway corridor is a priority. All indications are that the EWC should proceed using the parkway corridors presented in the previous planning study documents, and summarized on **Figure 1-7**.

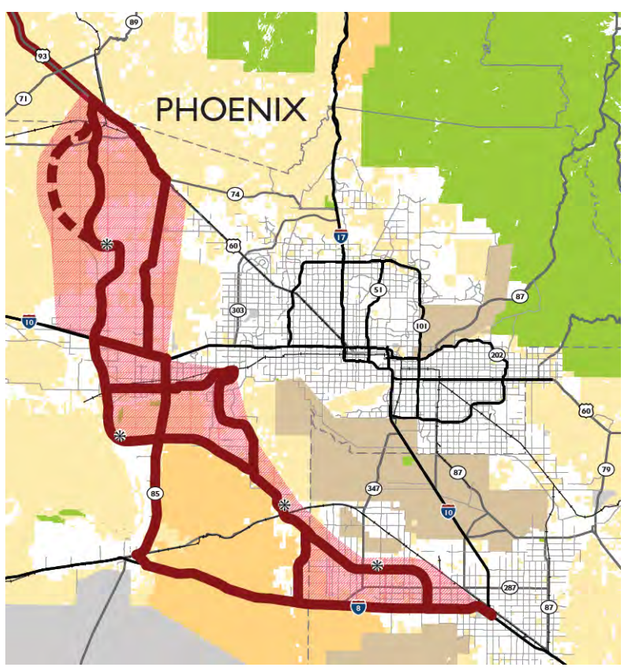


Figure 1-8: I-11 and Intermountain West Corridor Study

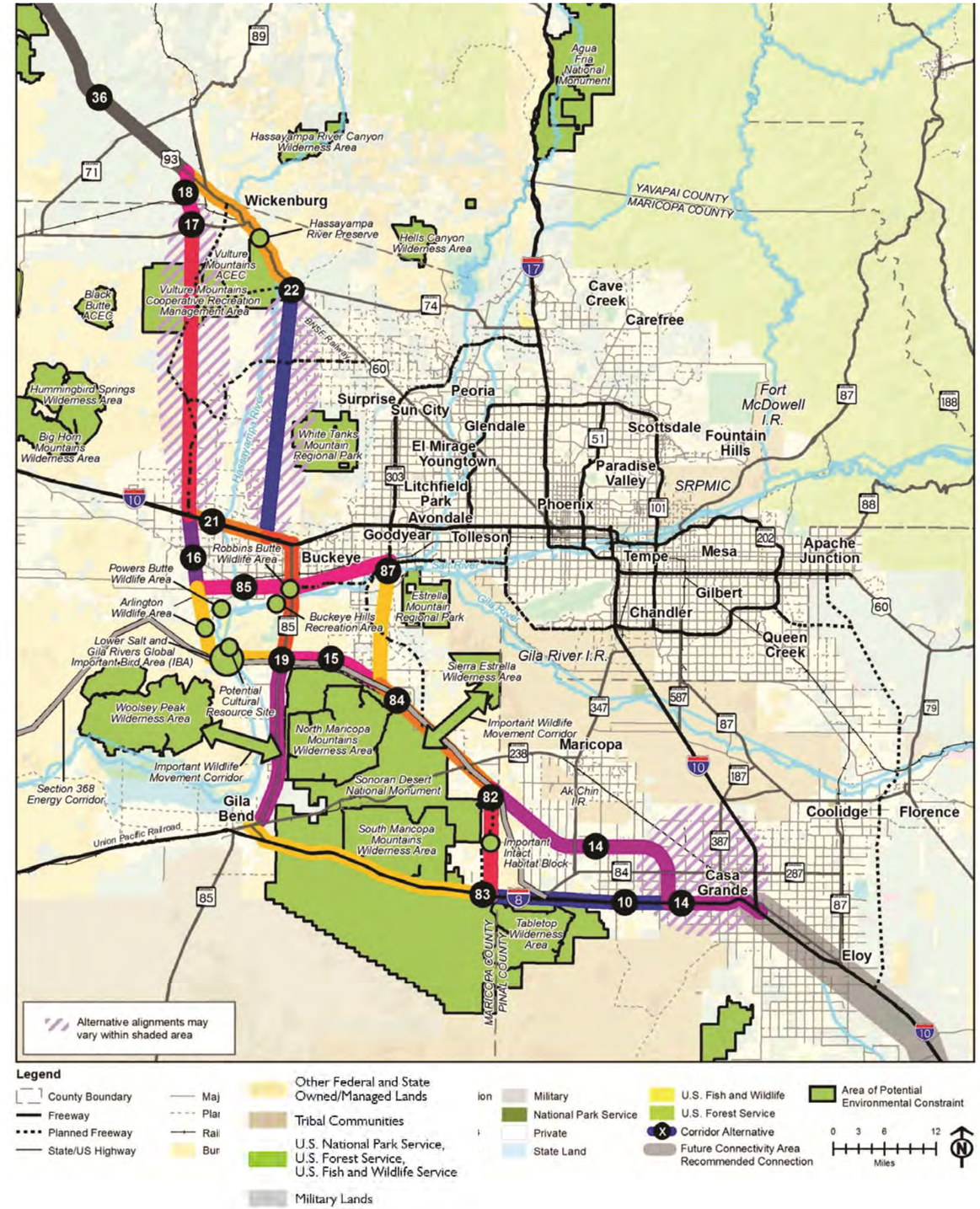


Figure 1-9: I-11 Study Recommended Corridors

1.3 Need for the Project

The communities of Maricopa, Ak-Chin, and Casa Grande are growing. The City of Maricopa is one of the fastest growing communities in the nation with a population that has increased from approximately 1,040 residents in 2000 to 43,482 residents in 2010, for an overall increase of more than 42,000 people or 4,000 percent (US Census 2012). In the same timeframe, Casa Grande grew by nearly 100 percent. Both of these communities have major transportation facilities that connect to the north and the south: SR 347 is a 4- to 6-lane state highway between I-8 and I-10 in Maricopa, and I-10 is a 4- to 6-lane interstate linking Casa Grande with Phoenix and Tucson. While these two communities are experiencing significant growth, there is no efficient, high-capacity east-west transportation facility linking these two communities.

The Pinal County Regionally Significant Routes for Safety and Mobility Study (RSRSM) identified the need for a new east-west facility to accommodate the projected high travel demand between the communities of Florence, Coolidge, Casa Grande, Maricopa, and the surrounding unincorporated Pinal County. The need is supported by the projected travel demand models shown in *Section 2.0* of this study.

Projected travel demand is not the only reason for a high-capacity link. The community of Maricopa relies on SR 347 as the primary link to Metropolitan Phoenix for jobs and services. Since SR 347 is the only major link between these two destinations, traffic incidents that restrict or close the facility (an event that occurs almost biweekly), there is no efficient alternative route that provides access between Maricopa and the Phoenix Area. These two communities are also developing their own retail shopping and entertainment businesses that increasingly draw local and regional residents to drive between the two communities.

While both high-capacity parkway routes identified by the RSRSM are viable, the northern segment provides the most direct link between the heart of Maricopa and the closest link to I-10, and was therefore established as the higher priority for study.

Based on the projected growth and planned development within these two communities:

- There is currently an estimated population within the influence area of over 119,000 persons. This population is projected to increase by 347% to over 533,000 by the year 2040. The areas northeast of the Maricopa-Casa Grande Highway in Maricopa, south of the Maricopa-Casa Grande Highway in Maricopa, and between I-10 and the Maricopa-Casa Grande Highway in Casa Grande are expected to have the highest population concentrations by 2040.
- Employment within the area of influence is projected to increase by over 600% by the year 2040, from an estimated 26,000 employees in 2010 to over 196,000. Employment centers are expected be concentrated in downtown Casa Grande and east of I-10, downtown Maricopa, along the I-10 Corridor and Maricopa-Casa Grande Highway, and southeast of the Ak-Chin Indian Community.
- At present, the existing roadway network is largely comprised of several regional corridors and some local routes. Traffic volumes are currently the highest along I-10, SR 347, SR 287/Florence Boulevard, and SR 387/Pinal Avenue. Congestion along these routes range from low to moderate, with the only severe congestion in the area occurring along SR 347 north of the study area.
- If no roadway improvements are made to the local roadway network by the year 2040, the roadway network will not be able to accommodate the significant increase in population and traffic within the influence area. Congestion levels for the No Build scenario identify that the majority of the influence area's roadways will fail; particularly the Maricopa-Casa Grande Highway, Val Vista Boulevard, White and Parker Road, Ralston Road, and SR 347.

A high-capacity transportation facility directly linking these two communities between SR 347 and I-10 would accommodate existing and projected local and regional travel demands; provide a roadway level of service that meets both regional and State goals for a major rural arterial highway to 2040; and conform to local and regional plans. The vision for the roadway improvements is to develop the most feasible alternative that allows traffic to flow without undue hindrance or delay, and to minimize impacts to local businesses and residences.

1.4 Characteristics of the Existing Corridor

1.4.1 Existing Roadways

While there are a series of local streets and arterials that provide a link between SR 347 and I-10, there is no continuous transportation facility that meets the capacity requirements for the anticipated growth within the study area.

Within the study limits, the existing roadway network is comprised of regional and local routes. Streets are characterized by their number of lanes and functional classification. Functional Classification is the grouping of streets and highways by the character of service they intend to provide. Defining a street's functional classification, serves as a basis for establishing speed limits, design standards, and access controls.

Major roadways that transverse the study area include:

- I-10: A six-lane (three-lanes each direction) east-west transcontinental Interstate that provides a link between California and Florida as well as regional access to the metropolitan Phoenix and Tucson areas. The road is six-lanes, with the exception of small portions that are four-lanes.
- I-8: A four-lane (two-lanes each direction) east-west Interstate facility that serves as a regional connection for southern Arizona communities and southern California.
- Maricopa-Casa Grande Highway: A two-lane Principal Arterial that runs parallel to the Union Pacific Railroad and connects the downtown area of Casa Grande and Maricopa.
- SR 387/Pinal Avenue: A four-lane Principal Arterial that provides connectivity from the Casa Grande downtown area to I-10 north of the city limits.
- SR 287/Florence Boulevard: A Principal Arterial that provides connectivity from the Casa Grande downtown area to SR 87 south of Coolidge. The roadway is four-lanes in the downtown Casa Grande area that transitions into two-lanes at Hacienda Road.
- SR 84/Gila Bend Highway: A two-lane Principal Arterial that connects downtown Casa Grande to I-8 west of Stanfield.
- SR 347/John Wayne Parkway: A north/south Principal Arterial that extends from SR 84 to I-10 and connects the City of Maricopa to the metro areas of Phoenix. The road is four-lanes, with the exception of a small portion in Maricopa which is six-lanes.

Local streets that transverse the study area include:

- Smith Enke Road - approximate volumes between 10,300 and 16,940 east of SR 347,
- Farrell Road - approximate volumes between 2,900 and 7,300 east of SR 347,
- Maricopa-Casa Grande Highway - volumes range from 8,900 to 14,300 between SR 347 and Hartman Road,
- SR 287/Florence Boulevard - between Maricopa-Casa Grande Highway and I-10, volumes range between 16,700 and 30,400

- SR 387/Pinal Avenue - from SR 287 and Val Vista Boulevard volumes range between 8,300 and 15,800; between Val Vista Boulevard and I-10 volumes range from 15,400 to 22,000
- Val Vista Boulevard - from Maricopa-Casa Grande Highway to I-10 estimated volumes are between 3,300 and 6,600.

See *Section 2* for more traffic information and analysis.

1.4.2 Existing Horizontal and Vertical Alignments

The existing horizontal alignments of the existing roads and streets are primarily north-south, or east-west tangent sections, crossed by the Maricopa-Casa Grande Highway (MCGH) which parallels the Union Pacific Railroad (UPRR), which is also primarily on a tangent. Vertically, the area is generally flat with essentially all profiles existing flatter than 1.0%, except at the eastern terminus over the I-10 interstate.

1.4.3 Existing Roadway Operations

The existing streets are primarily stop controlled. Select intersections on SR 347, the MCGH, and Pinal Avenue have signalized control.

The terminus of the MCGH onto SR 347 is a signalized intersection. The proximity of this intersection to the at-grade RR crossing of the UPRR makes this intersection extremely congested. This UPRR facility is a transcontinental route with 40 to 60 trains per day crossing SR 347. Each passing train stops traffic on SR 347 between four and seven minutes, resulting in delays and congestion. When trains pass through the City, traffic on SR 347 is brought to a halt on both sides of the roadway/railroad intersection.

The terminus of the eastern limits of the study is I-10. Currently, there is no service interchange on the interstate at this grade-separated overpass.

1.4.4 Existing Access

Currently, there is very little access control within the study limits. All of the local streets allow ingress/egress in both directions as there are few roadways with raised / separated medians. Access control to a degree is maintained on the MCGH adjacent to the UPRR as there are limited crossing of the RR.

1.4.5 Existing Right-of-Way

The existing right-of-way of the various streets within the study varies depending on the classification of the streets. The major arterials in both cities are proposed to have 150-ft in R/W. Where the parcels are undeveloped adjacent to the roadway, the existing R/W may be less, ranging between 66-ft and 150-ft.

1.4.6 Existing Drainage

1.4.6.1 Federal Emergency Management Agency Regulated Floodplains

An evaluation of Federal Emergency Management Agency (FEMA) regulated floodplain and floodway boundaries was developed based on the Flood Insurance Rate Map (FIRM) Panels 0745E, 0775E, 1150E, 1175E and 1200E of 2575. The following section describes the existing flood hazard zones encountered along the study area from west (SR 347) to east (I-10). See *Section 7.9* for more drainage information and analysis.

The segment of the study from SR 347 to approximately one-half mile west of Porter Road is centered with existing Farrell Road and is located within Zone X. Zone X is defined on the FIRM as "Areas determined to be outside the 0.2% annual chance flood." Within this segment, the study corridor crosses a portion of the Vekol Wash Tributary which lies immediately east of and parallel to SR 347. The floodplain for this wash is designated as Zone AE based on the "*Vekol Wash Tributary Floodplain Delineation Study"*, April 2012, by Wood/Patel. Zone AE is defined as areas subject to inundation by the 1-percent-annual-chance flood event determined by detailed methods. Base Flood Elevations (BFEs) are shown.

Between Porter Road and White & Parker Road, the study crosses the Santa Rosa Wash. In the vicinity of this crossing, the study corridor crosses several flood zone designations including Zone X Shaded, Zone A and Zone AO. Zone X Shaded is defined on the FIRM as "Areas of 0.2% chance annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood". Zones A and AO are defined on the FIRM as Special Flood Hazard Areas (SFHA) subject to inundation by the 1% annual chance flood. The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. Zone A is defined as a SFHA with "No base flood elevations determined". Zone AO is defined as a SFHA with "Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined".

The study corridor from White & Parker Road to approximately one-half mile east of Russell Road is coincident with the existing MCGH alignment. This portion of the study from White & Parker Road to east of Fuqua Road is located within the Zone A associated with the Santa Rosa Wash. Between Hartman Road and Murphy Road, the study crosses the North Santa Cruz Wash which is also designated as Zone A. The remainder of this segment is designated as Zone X including a reach approximately 1-mile long between Fuqua Road and Hartman Road that lies between the Santa Rosa Wash Zone A and Santa Cruz Wash Zone A.

The study alignment diverges from the highway and continues to the east approximately along the Val Vista Boulevard alignment to I-10. This entire segment is designated as Zone X.

1.4.6.2 Hydrology and Hydraulics

There are several distinct drainage patterns along the study corridor. Between SR 347 and the North Santa Cruz Wash, the flow direction is generally from south to north with concentrated flow conveyed within three significant wash corridors. East of the North Santa Cruz Wash the flow is generally conveyed within shallower split flow areas the direction of which is determined by the Sacaton Mountains. From the North Santa Cruz Wash to approximately Russell Road, the flow direction is almost due west. The flow direction transitions to the southwest between Russell Road and Bianco Road, to south between Bianco Road and Faldale Road and to the southeast from Faldale Road to I-10.

The study alignment crosses three significant wash corridors. The effective FEMA Flood Insurance Study (FIS), dated December 4, 2007, includes 100- year peak flow information for two of these crossings, the Santa Rosa Wash and the North Santa Cruz Wash, and is the basis of the current floodplain delineation at these locations. The off-site flow for the Vekol Wash Tributary was developed by Wood/Patel as part of the "Hydrology Update Report for Vekol Wash Tributary", August 2011. The basins for these various crossings are shown on **Figure 1-10**.

> **Vekol Wash Tributary:** The study alignment crosses the Vekol Wash Tributary immediately east of SR 347. A FEMA flood delineation study defining the Vekol Wash Tributary floodplain limits was conducted by Baker/AECOM in 2011. This study uses previous defined flows from the City of Maricopa Master Drainage Study and Plan, by HDR, dated August 2009. However, the City chose to appeal the FEMA study. Wood/Patel has re-evaluated the hydrology and hydraulics and has developed new 100-year peak flows and floodplain limits as documented in the City of Maricopa Vekol Wash Tributary Floodplain Delineation Study Technical Data Notebook (TDN), dated April 2012. It's anticipated that once the City's review is completed and all comments are addressed, the TDN will be submitted to FEMA as part of the appeal process. The 100-year peak flow from this study is 1,627 cfs at the study alignment crossing.

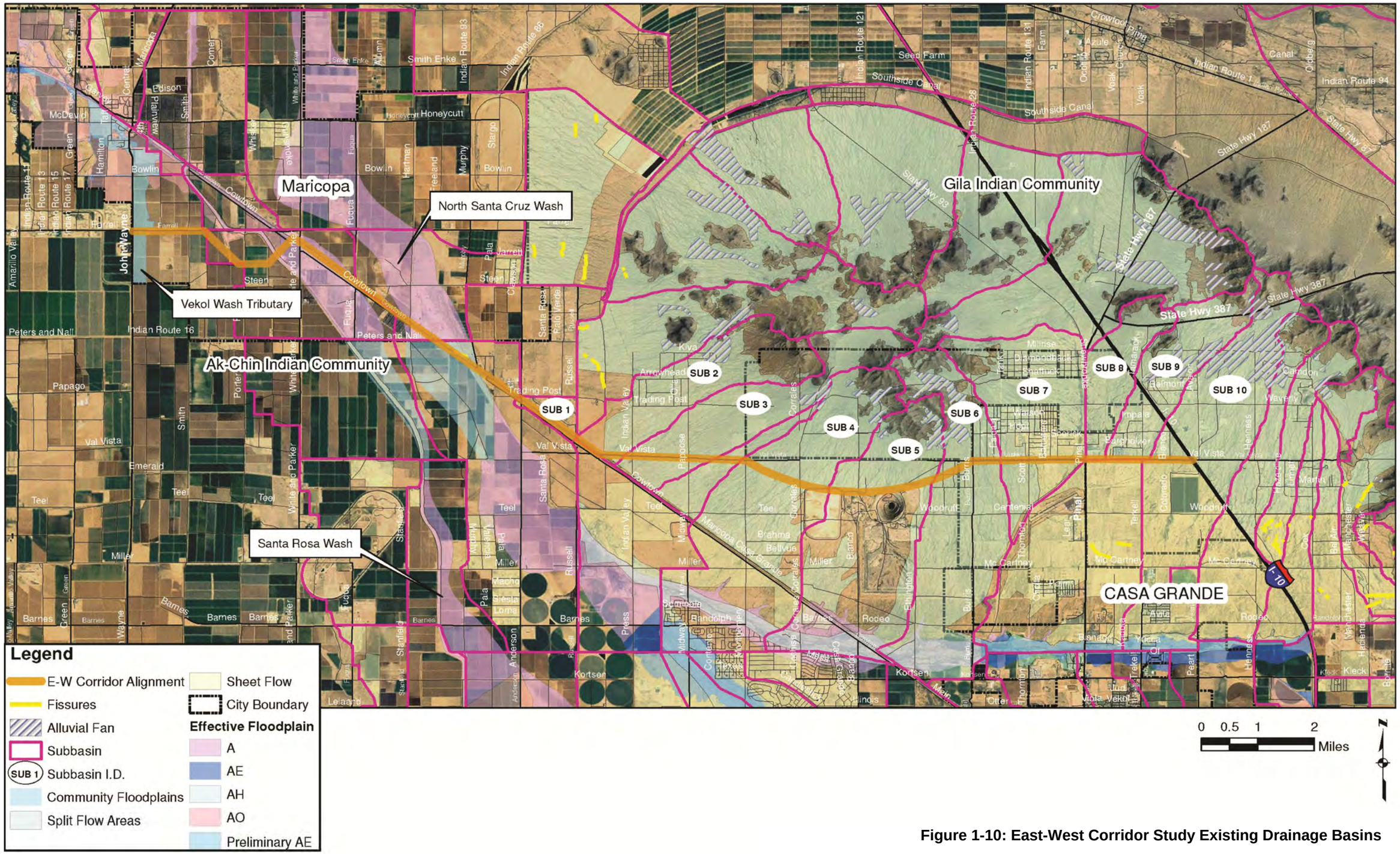


Figure 1-10: East-West Corridor Study Existing Drainage Basins

Santa Rosa Wash: The study corridor crosses the Santa Rosa Wash between Porter Road and White & Parker Road. The 100-year peak flow from the published FIS at this location is 14,800 cfs.

North Santa Cruz Wash: The study corridor crosses the North Santa Cruz Wash between Hartman Road and Murphy Road. The 100-year peak flow from the published FIS at this location is 9,800 cfs.

A detailed review of the existing and proposed drainage is included in *Appendix D* of this report.

1.4.7 Existing Utilities

At the onset of this Study, Blue Stake was contacted to identify the existing utilities within the East-West Corridor. Blue Stake conducted a Quality Level D Subsurface Utility Engineering (SUE) Investigation. Quality Level D SUE Investigation is the most basic level of information for utility locations; it comes from existing utility records and it is useful for project planning and route selection activities. This investigation provided the Study Team with the information contained in **Table 1-1**.

Table 1-1: Utility Company Contacts

Utility Name	Facility Type	Contact / Phone
Ak-Chin Indian Community	Fiber, Sewer, Water	Mr. Jerry Owen Dir. of Planning Office (520) 568-1066
Arizona Department of Transportation (ADOT)	Traffic Signals, Storm Drain	ADOT Engineering Records Section (602)712-8216
Arizona Public Service (APS)	Electric	Mr. Franco Garcia Customer Project Manager (520)705-8629
Arizona Water Co	Water	Mr. Kevin Pakka Construction Operations Manager (520)836-8785
CenturyLink, Inc.	Coaxial, Fiber	Mr. Rocky Villareal Engineer – Casa Grande (520)426-6770
City of Casa Grande	Sewer	Mr. Terrence McKeon Deputy Public Works Director/City Engineer (520)421-8625
El Paso Natural Gas (EPNG)	Gas	Mr. Russell E. Williams Damage Prevention Supervisor Off - (602)438-4249 Cell (480)270-2392
Electrical District No. 3 (ED3)*	Electric	Mr. Larry Yates ED3 Director of Engineering and Operations (520)424-0417
Global Water	Reclaimed Water, Sewer, Water	Mr. Cos Borunda Field Locator (520)483-8587
Kinder Morgan Energy	Petroleum	Mr. Jeff Ferguson (602)272-1312
Maricopa-Stanfield Irrigation and Drainage District (MSIDD)*	Irrigation	Mr. Tony Solano Operations Manager – Irrigation (520)424-9276
San Carlos Irrigation Project	Electric	Mr. Arlan Riggs Supervisor Engineer (520)723-6243
Southwest Gas	Gas	Mr. Jude Fernando (520)316-5019

* ED3 and MSIDD operate under the same board of directors, CEO, and general manager.

All of the utility organizations were contacted to have their facilities shown on the project plans. See the discussion in *Section 7* for a more detailed discussion on the approach to avoiding these existing utilities.

1.4.8 Existing Railroad

The **Union Pacific Railroad Sunset Line**, which currently consists of two tracks, is the critical rail transportation corridor between Los Angeles, CA and El Paso, TX. This UPRR facility is a transcontinental route with 40 to 60 trains per day crossing SR 347 in downtown Maricopa. Each passing train stops traffic on SR 347 between four and seven minutes, resulting in delays and congestion. When trains pass through the City, traffic on SR 347 is brought to a halt on both sides of the roadway/railroad intersection.

There are currently five crossings of the UPRR with at-grade crossings:

- SR 347
- Porter Road
- White & Parker Road
- Hartman Road
- Anderson Road

ADOT and the City of Maricopa are developing plans to create an overpass at SR 347.

Any future improvements to the existing crossings of this busy double track need to be improved to grade-separated crossings over the tracks.

The Maricopa AMTRAK passenger train station serves as a major transit facility that provides regional connectivity within the southwestern United States. The station is located on the northeast corner of the SR 347 / UPRR intersection.

1.4.9 Existing Structures

There is currently only one existing bridge structure within the existing corridor, and it is the freeway underpass at I-10, where Val Vista Boulevard goes over the freeway which remains at the existing grade level. While there is a structure over the freeway, no access ramps to the mainline are provided.

There are several box culverts that convey drainage within the study zone. These are detailed in the drainage report in *Appendix D*.

1.4.10 Existing Site Topography and Geology

The study area lies between 1,130 and 2,235 feet above mean sea level in the western portion of Pinal County, AZ. The study area's terrain is generally flat to gently sloping downward to the north and west. One topographical exception is the foothills of the Sacaton Mountains that extend into the northeastern portion of the study area and present significant variations in topography.

Soils in the study area include Denure sandy loam, Casa Grande fine sandy loam, Trix clay loam, and Vaiva-Rock outcrop complex at a 15 to 50 percent slope. These are well-drained to somewhat excessively drained, very deep, medium coarse-textured soils on nearly level to steep soils. These soils occur above buried argillic horizons, on relic basin floors, stream terraces, fan terraces, or steep slopes. These soils, which were formed in stratified stream or fan alluvium, derived from

igneous rocks. Soils in the study area are well-suited to moderately-suited for using the natural surface of the soil for road construction. The well-suited soils pose no known limitations to road construction, and the moderately-suited soils would perform fairly well for road construction.

With the exception of the Sacaton Mountain foothills, nearly the entire study area has experienced groundwater level declines greater than 100 feet, resulting in land subsidence and earth fissures (Maricopa Association of Governments2009). Fissures are longitudinal gaps in the earth's surface associated with extensive groundwater declines. They may be more than one mile in length, up to 15 feet wide, and hundreds of feet deep. During torrential rains, these fissures could erode rapidly and present substantial hazards to people and infrastructure. Within this study, the general locations of areas affected by subsidence and fissures are near the Santa Cruz Wash crossing of the MCGH, and the surrounding lands associated within the Ak-Chin community boundary.

1.5 Project Objectives

The L/DCR process for the EWC was initiated with scoping meetings conducted with government agencies and the public.

An Agency Scoping Meeting was held on November 17, 2011, from 9:00 a.m. to 11:00 a.m. in Casa Grande's Public Safety Facility. Notice of the meeting was sent to representatives of federal, state, and local agencies as well as to the Ak-Chin and Gila River Indian Communities. The meeting was attended by representatives of the FHWA, Bureau of Indian Affairs (BIA) Pima Agency, ADOT, Arizona State Land Department (ASLD), UPRR, Pinal County, Casa Grande, and Maricopa.

A separate Scoping Meeting was held with the Ak-Chin Indian Community on November 28, 2011 following a Tribal Council meeting.

Two public scoping meetings were held. The first was on December 8, 2011 at the Maricopa Unified School District Administrative Building in Maricopa from 6:00 p.m. to 8:00 p.m., and the second was December 14, 2011 at the Casa Grande Council Chambers from 6:00 p.m. to 8:00 p.m.

In addition, two public update meetings were held. One of the meetings was on February 20, 2013 at the Maricopa Unified School District Office Administrative Building – Board Room #118, from 6:00 p.m. to 8:00 p.m. The other was on February 21, 2013 at the City of Casa Grande Council Chambers from 6:00 p.m. to 8:00 p.m. The presentation was the same at both meetings. The purpose of these meetings was to provide an update on the study, present the alternative corridors, discuss the environmental and engineering processes and schedule, and provide the opportunity for public comments and suggestions.

1.5.1 Extension of the RSRSM Process

While this study process invoked scoping, it began as an extension of the County's RSRSM process. As such, the founding goals of that process are still part of this study's goals and objectives. From the public outreach that established the RSR's we have the following:

Characteristics	Not Important	Somewhat Important	Highly Important
Provide continuous routes through the County / Community	1	3	6
Provide a consistent roadway cross section on the route	0	3	7
Provide high capacity routes	1	4	5
Control access to adjacent property along the route	0	3	7

Scores reflect an average score of agreement distributing 10 points between each category.

1.5.2 Issues, Concerns, and Opportunities

During the agency and public scoping meetings, the following issues, concerns, and opportunities (ICO'S) were identified.

1. **Roadway ICO'S:**

- The configuration of the East-West roadway was a concern. Access to adjacent properties was considered important and the configuration of the roadway could affect access. A parkway or expressway would have different access to adjacent properties than a freeway.
- Previously identified corridors should not control alternatives. Consider what the region needs for the future.
- Need to work with adjacent communities relative to long-range planning of the communities.
- Multimodal solutions should be considered. Do not preclude other modes.
- The operation of parkways is not clear. If a parkway is planned the public will have to be educated as to its operational function.
- How will the EWC affect the UPRR?
- Will crossings of the UPRR be at-grade or grade separated?
- Any new at-grade crossing of the UPRR will require that two existing at-grade crossings be eliminated.
- Access to adjacent properties must be maintained. Access is more limited with a freeway than with a parkway.
- The EWC improvement has potential to impact SR 347, SR 238, SR 387 and I-10.
- Concerns with terminating the project at I-10. Consider extending further to the east.
- Impacts of the proposed improvement on floodplains must be considered and addressed.
- If the current project will be an interim project, with a freeway planned for the future, the access control requirements should be for the ultimate facility. Severing access to developed properties later on is very costly.
- Planning and zoning of the lands adjacent to the EWC will remain the responsibility of the underlying land manager (City, County, or Tribe). Access to the EWC from these lands may be restricted to follow the operational characteristic of the Arizona Parkway.

2. **Environmental/Social/Economic ICO'S:**

- The involvement of property owners is important as the project planning develops.
- The BIA must be involved if roadway expansion involves either the Ak-Chin or Gila River Indian Communities.
- Any cultural sites should be avoided.
- While working with Tribal lands is different than say private or public lands, they should not be bypassed without the involvement and discussion of the Tribal Communities.
- Keep the communities involved as the project develops.
- Impacts to existing communities/lifestyle are important
- Identify and address open space and trail plans.
- Consider proposed and existing land uses in determining impacts of the alternative improvements.
- Involve wildlife preservation groups to ensure that wildlife crossings are addressed.

2.0 EXISTING TRAFFIC CONDITIONS

2.1 Introduction

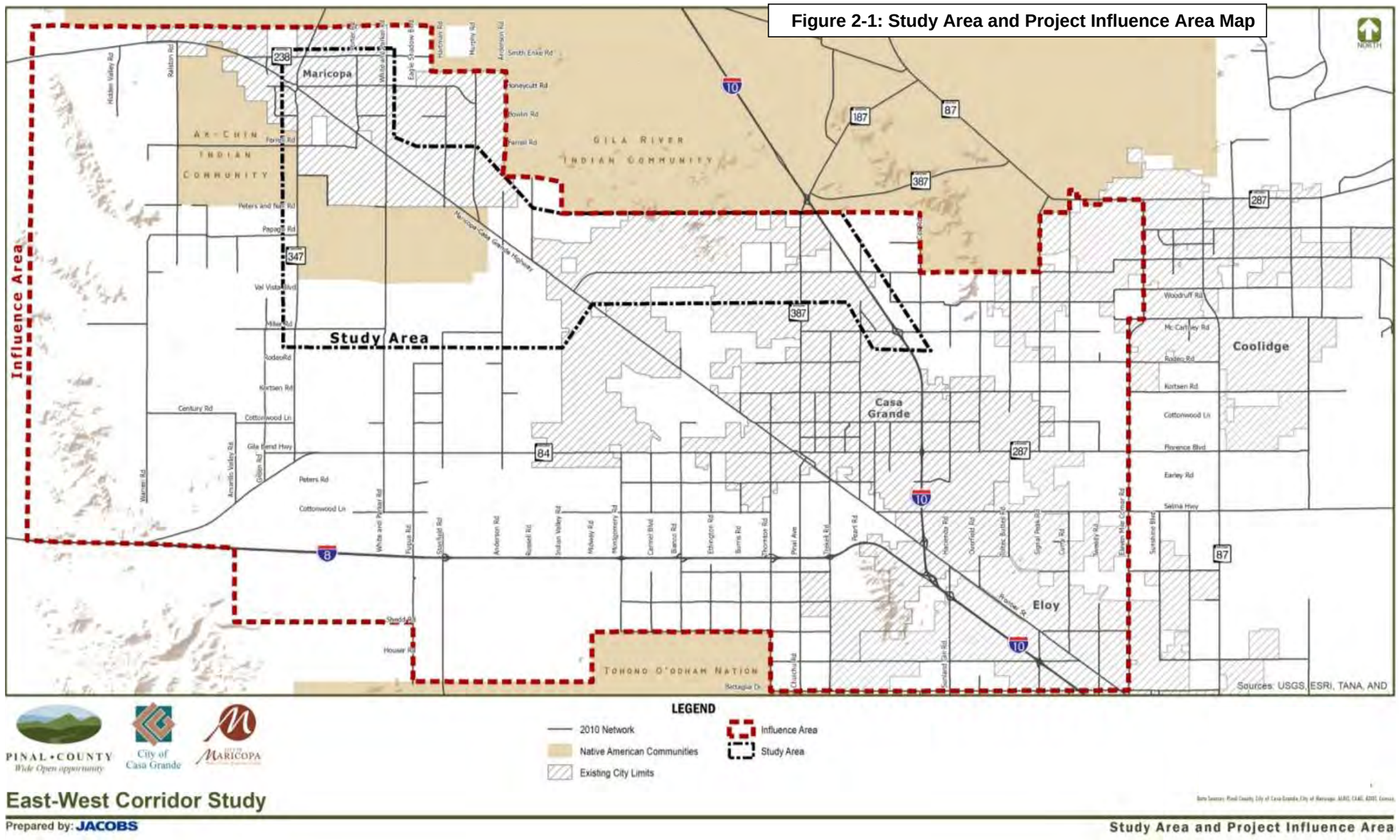
Existing and projected traffic volumes were examined within the study limits. An *Initial Traffic Report* for Pinal County's East-West Corridor Study was prepared by Jacobs and submitted to Pinal County in December 2012. The *Initial Traffic Report* provides a detailed study of the traffic forecast for existing conditions (study year 2010) and future conditions (study year 2040) utilizing Synchro traffic modeling software. Models were created for three roadway network scenarios for the 2040 design year and modeled the projected traffic impact in Pinal County.

2.1.1 Study Area and Influence Area

The current East-West Corridor study area includes 107 square miles in Pinal County. These include portions of the City of Maricopa, the Ak-Chin Indian Community, the City of Casa Grande, and unincorporated portions of Pinal County.

A project influence area was established and used in the *Initial Traffic Report* to accurately quantify the impact of area growth and the generated regional traffic. The project influence area is bounded to the north by the Gila River Indian Community (GRIC), to the south by the Tohono O'odham Indian Community, and extends from Eleven Mile Corner Road to west of Warren Road. Project study area and the project influence area are shown in **Figure 2-1.**

Figure 2-1: Study Area and Project Influence Area Map



Travel demand modeling was used to assess how future transportation systems will perform based on the land use and forecast growth. The model takes into account several variables such as population, housing units, areas of employment, and roadway characteristics. For this study, the updated Pinal County countywide travel demand was utilized. The model encompasses other areas in Pinal County not included in the East-West Corridor influence area. For a more accurate forecast of future travel demand in the region, the socioeconomic data and the roadway network for both the current and future scenarios were updated for the project influence area.

2.2 Traffic Forecast – Existing Conditions

The Initial Traffic Report identifies that population and employment for 2010 is concentrated in the core areas within the cities of Casa Grande and Maricopa. In Maricopa, the highest concentrations of both population and employment centers occur along SR 347, north and south of the MCGH. Within Casa Grande, housing unit concentrations tend to follow regional routes SR 387, SR 287 / Florence Boulevard, and Kortsen Road; while employment centers within Casa Grande are located along SR 287 / Florence Boulevard and Cotton Lane between Maricopa-Casa Grande Hwy and I-10.

The roadways that make up the major roadway network, along with the number of lanes and the functional classification of each roadway are shown in **Table 2-1.**

Table 2-1: Major Roadway Networks

NAME	FACILITY TYPE	NO. OF LANES
Interstate 10	Transcontinental Interstate Facility	Two lanes in each direction
Interstate 8	Interstate Facility	Two lanes in each direction
Maricopa-Casa Grande Hwy	Principal Arterial	Four lanes
SR 387/Pinal Avenue	Principal Arterial	Four lanes
SR 287/Florence Blvd	Principal Arterial	Four lanes in downtown Casa Grande Two lanes at Hacienda Road
SR 84/Gila Bend Hwy	Principal Arterial	Two lanes
SR 347/John Wayne Pkwy	Principal Arterial	Four lanes; Five and six lanes in short segments of City of Maricopa

Existing traffic count data was obtained from the City of Casa Grande, the City of Maricopa, and Pinal County. Data has been incorporated in the Pinal County countywide travel demand model. The existing highest estimated traffic volumes are located:

- I-10 between SR 287 / Florence Boulevard and I-18
- Within the City of Maricopa:
  - Smith Enke Road
  - Maricopa-Casa Grande Highway
  - SR 347
  - SR 238
- Within the City of Casa Grande:
  - SR 287/Florence Boulevard between Maricopa-Casa Grande Highway and I-10
  - SR 387/Pinal Avenue between SR 287 and I-10
  - Cottonwood Lane between SR 387 and Arizona Avenue
  - Trekell Road between Maricopa-Casa Grande Highway to Kortsen Road
  - Peart Street between Maricopa-Casa Grande Highway

Traffic congestion within the influence area was estimated using the existing count data. The degree of traffic congestion is expressed in terms of Level of Service (LOS); LOS is a qualitative measurement represented in six classifications from LOS A to LOS F. LOS A represents the best free flow condition, LOS F represents heavily congested flow with traffic demand exceeding roadway capacity.

For regional planning purposes, unsatisfactory capacity is defined as the forecasted annual average daily traffic (AADT) that results in LOS E-F in the urban environment and D-F in the rural environment. **Figure 2-2** is a visual representation of LOS and traffic flow. The roadway network level of congestion for 2010 is shown in **Figure 2-3**.

Figure 2-2: Level of Service Depiction

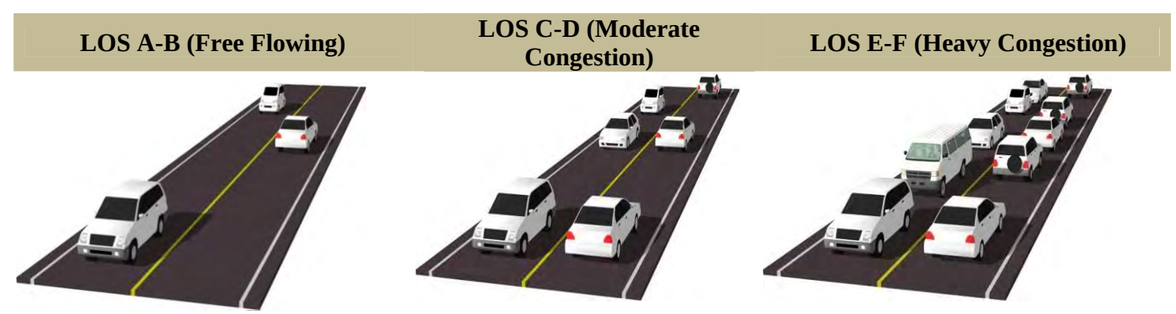
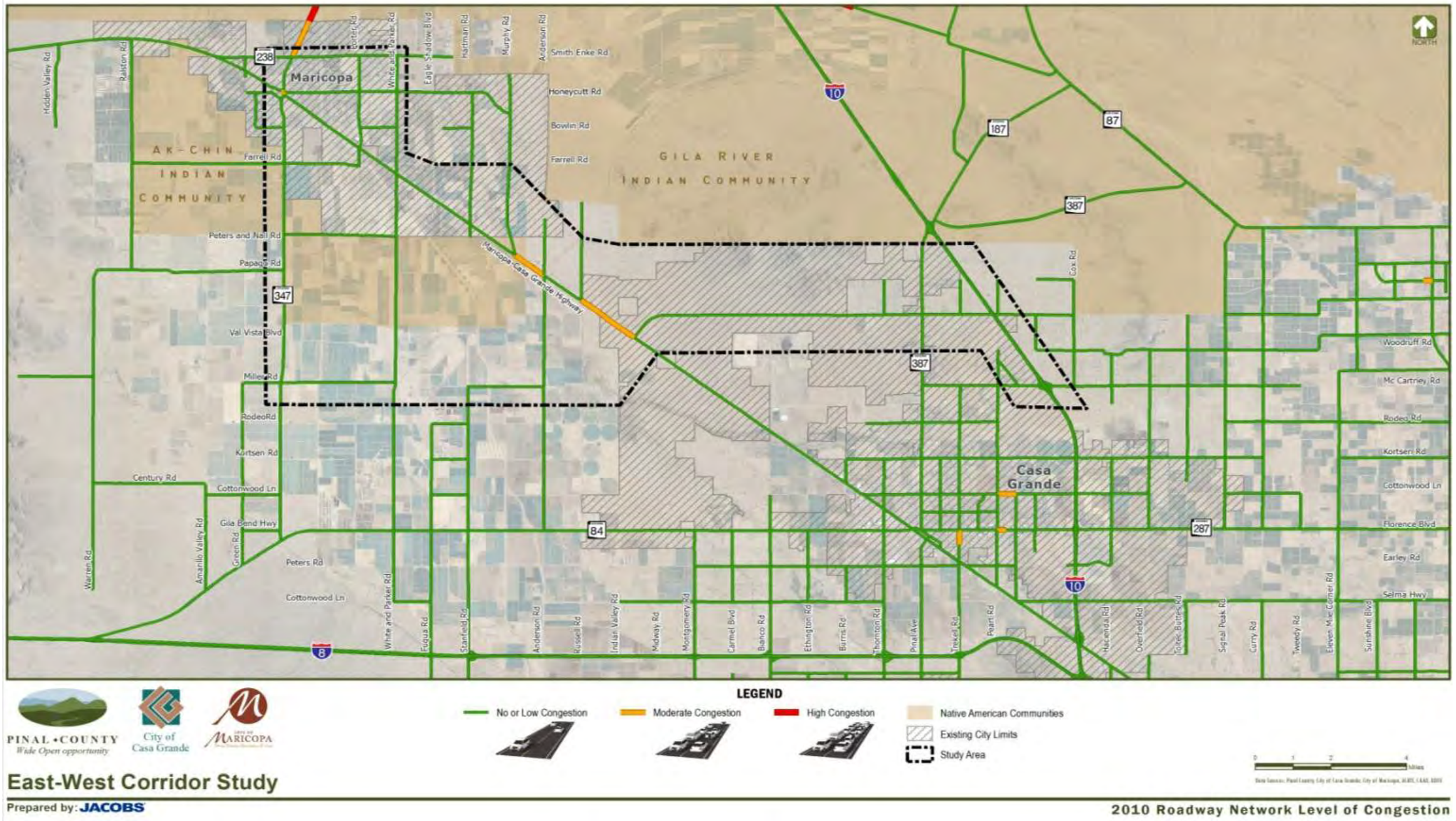


Figure 2-3: 2010 Roadway Network Level of Congestion



2.3 Traffic Forecast – Future Conditions

Arizona Department of Administration, Office of Employment and Population Statistics, 2040 population forecast, was used as the base for determining the future socioeconomic conditions of this study. The projections were made in 2006 and a very aggressive growth trend was reflective of economic conditions at that time; therefore, the original forecast was reviewed by each jurisdiction and minor adjustments were made. The employment forecast was primarily developed using the jurisdictions' long-range transportation plans growth assumptions and the approved general land use plans.

Future projections for Pinal County show a rapid growth rate in population and employment, especially within the project influence area. The projected 2040 population for the project influence area is over 533,000, a 347% increase from 2010 with an annual growth rate of 11.6%. Employment opportunities are projected to grow primarily along the I-10 corridor, along the MCGH, in downtown Casa Grande west of I-10, south of the Ak-Chin Indian Community, and in the northwest portion of the influence area. **Table 2-2** shows a summary of the population, housing and employment data for the project influence area.

Table 2-2: Socioeconomic Data for Project Influence Area

DESCRIPTION	EXISTING CONDITIONS (2010)	FUTURE CONDITIONS (2040)
Total Population	119,385	533,953
Total Housing Units	50,240	214,745
Total Employment	25,959	196,485
Employment Ratio	0.22	0.37

2.3.1 No Build Roadway Network Conditions

The No-Build roadway network scenario will be used as a benchmark for evaluating the performance of all alternatives developed in this study. The No-Build scenario will be compared to the 2040 base scenarios to verify the need for the improvements.

For the 2040 No-Build conditions, the number of lanes and function classifications for the roadway network remain consistent with the 2010 model with the exception of the improvements of I-10 to three lanes in each direction. **Figure 2-4** illustrates the level of congestion for the roadway network under the No-Build scenario. Congestion levels are highest along the arterial and state routes in Maricopa, the MCGH, Val Vista Boulevard, White and Parker Road, Ralston Road, SR 347, and on the arterial roads near Coolidge.

2.3.2 Base Roadway Network Scenarios

Base roadway network scenarios have been identified to determine how future transportation systems operate with planned improvements. City of Maricopa, City of Casa Grande and Pinal County were consulted to identify which improvements should be included in the base roadway network for this study. Types of improvements include new roadway alignment, roadway widening and roadway extensions. **Table 2-3** shows three base roadway networks that were evaluated for 2040 projected traffic.

Table 2-3: Roadway Description of Base Scenarios

BASE SCENARIO	ROADWAY DESCRIPTION
Base Scenario 1	East-West Connection: East-West Corridor from SR 347 to I-10 is a two-lane facility.
Base Scenario 2	East-West Arterial Connection: East-West Corridor from SR 347 to I-10 is a four-lane facility comprised of principal and minor arterials.
Base Scenario 3	East-West Expressway Connection: East-West Corridor from SR 347 to I-10 is a four-lane facility that is functionally classified as an expressway.

Key roadway alignments and capacity enhancements incorporated in the base scenarios include:

- Montgomery Road: Extended from SR 64 to north of Val Vista Boulevard.
- Warren Road: Four-lane principal arterial.
- Farrell Road: Extended west to Hidden Valley Road and east to Anderson Road.
- Network of arterial and collectors providing additional regional and local circulation.

Results of the traffic demand modeling for the projected 2040 daily traffic volumes and the 2040 level of congestion are shown in **Table 2-4.**

Figures 2-5, 2-6 and **2-7** illustrate the projected 2040 level of congestion of Base Scenarios 1, 2 and 3 respectively.

Table 2-4: Projected 2040 Congestion for Base Scenarios

BASE SCENARIO	PROJECTED 2040 CONGESTION
Base Scenario 1	Overall congestion is significantly improved from the No Build Scenario; however, traffic volumes continue to remain high along the main travel corridors including SR 347, Maricopa-Casa Grande Highway, White and Parker Road, Anderson Road, and Val Vista Boulevard.
Base Scenario 2	Congestion is significantly decreased along the majority of the roadways within the influence area compared to the No Build Scenario. In comparison to Base Scenario 1, fewer road segments have high congestion levels and traffic volumes are higher along the East-West Corridor.
Base Scenario 3	Compared to Base Scenarios 1 and 2, traffic volumes are reduced along the arterial and collector roadways, with the main travel corridors consisting of I-10, SR 347, Maricopa-Casa Grande Hwy, and the East-West Corridor. High congestion levels can be found in downtown Maricopa, and along portions of the East-West Corridor approaching I-10.

Figure 2-4: 2040 No Build Roadway Network – Level of Congestion

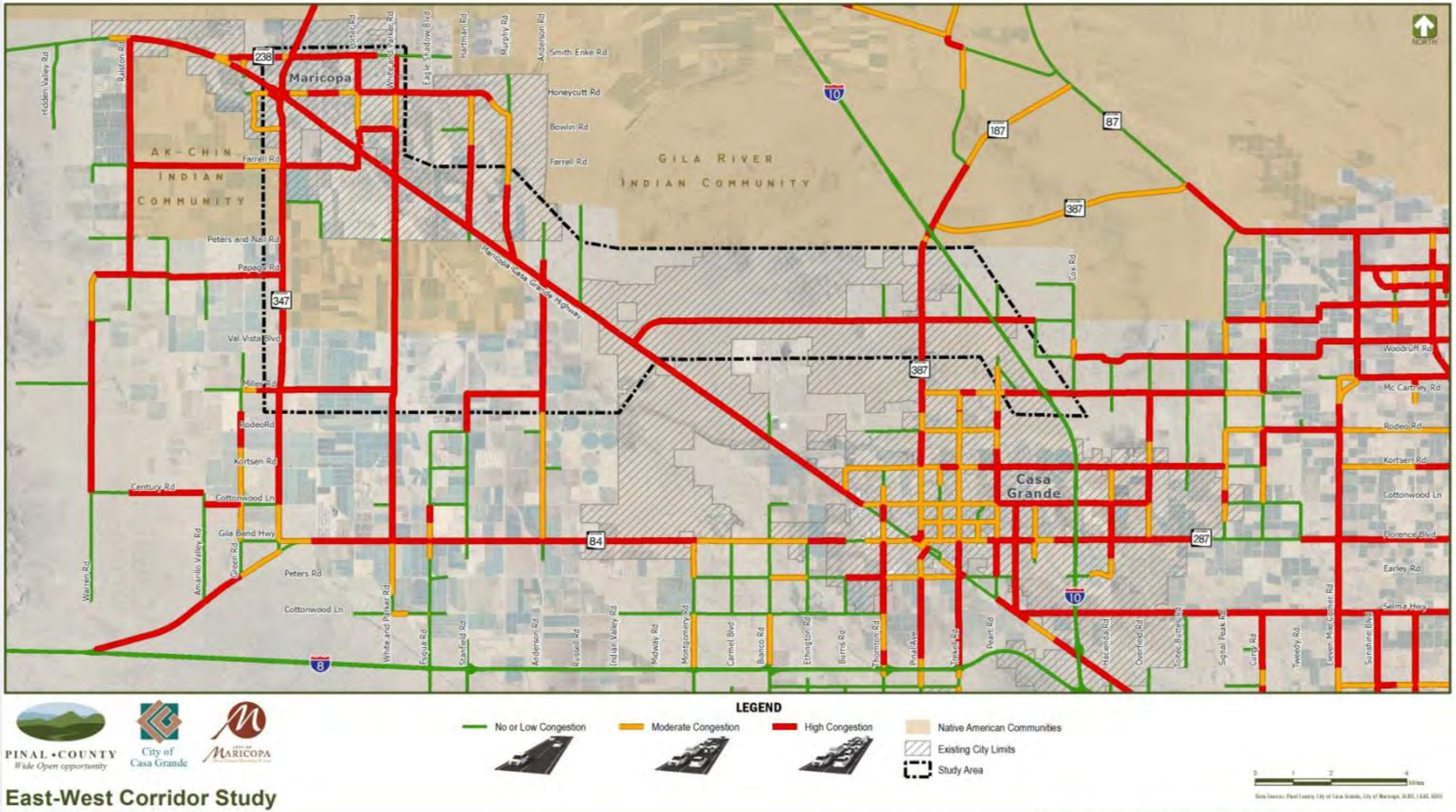


Figure 2-5: 2040 Base Scenario 1 Roadway Network – Level of Congestion

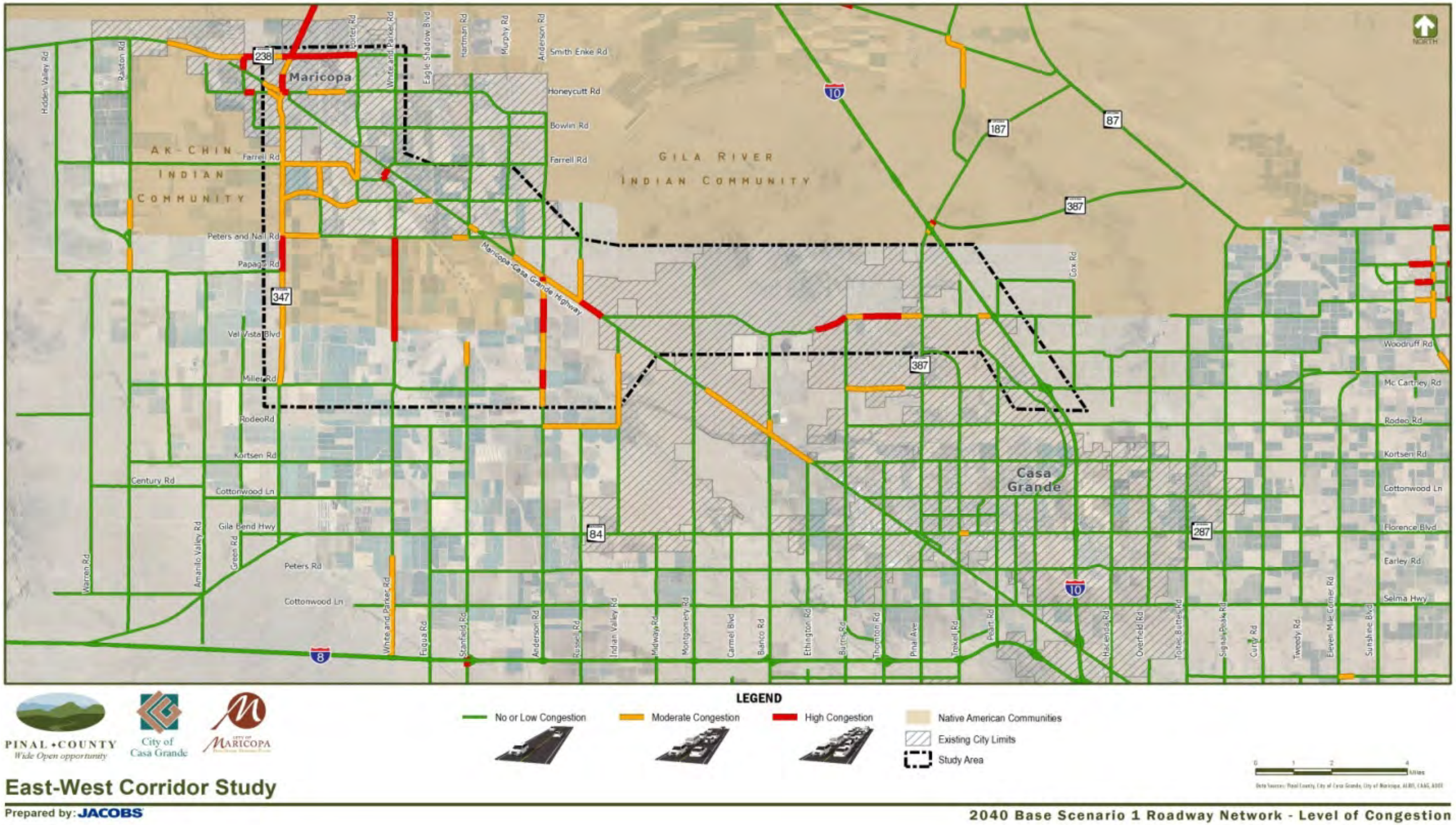


Figure 2-6: 2040 Base Scenario 2 Roadway Network – Level of Congestion

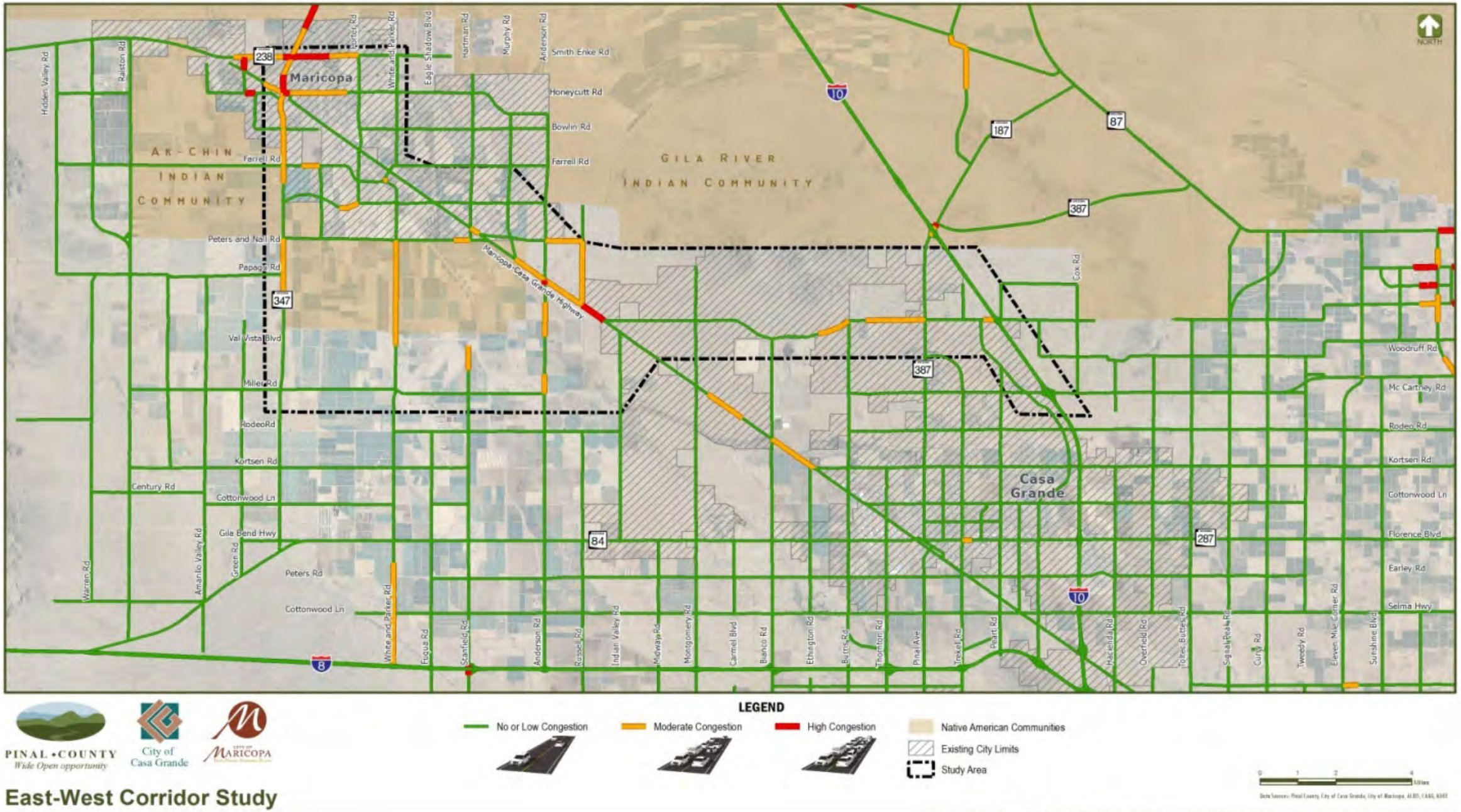
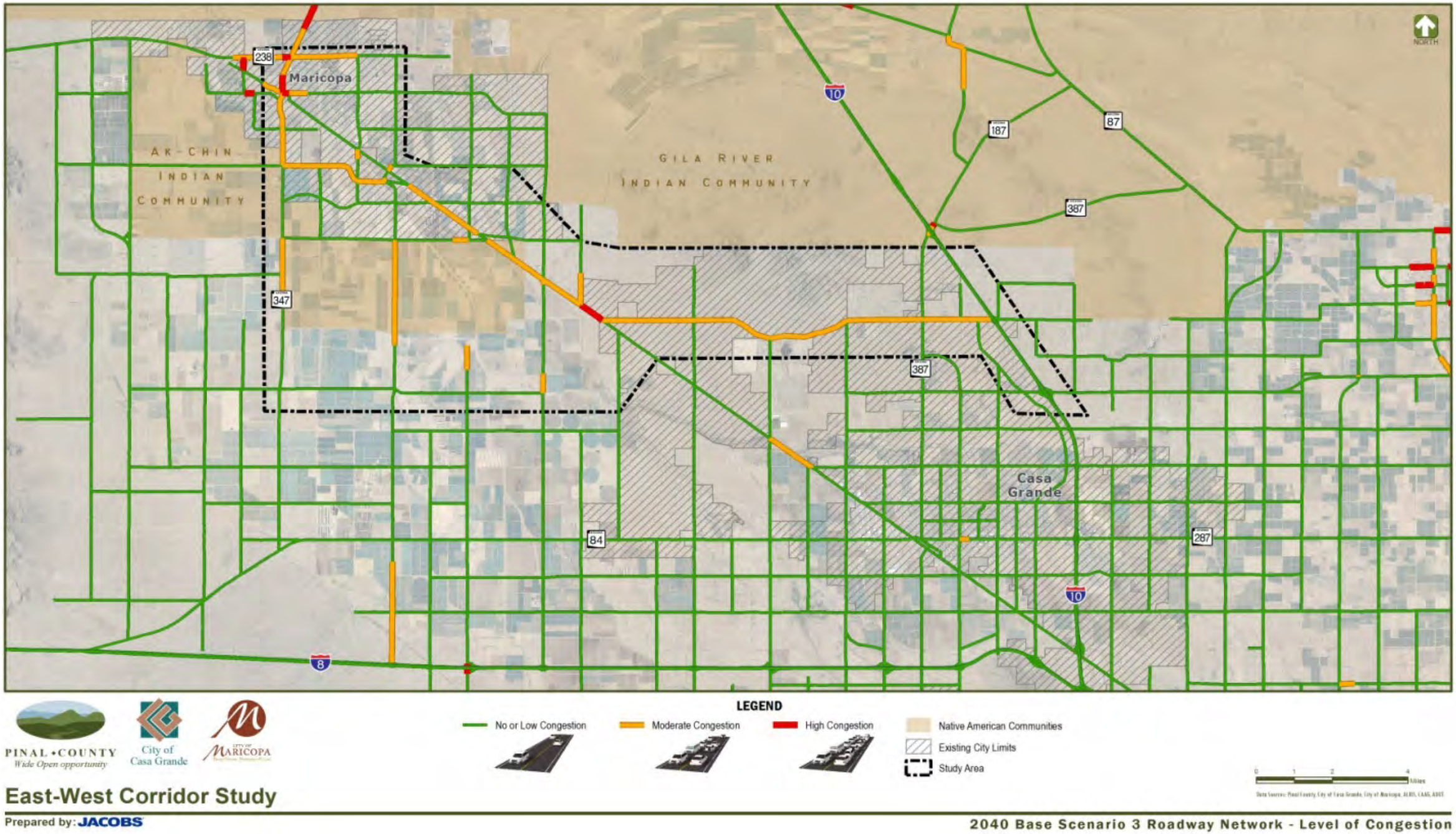


Figure 2-7: 2040 Base Scenario 3 Roadway Network – Level of Congestion



2.3.3 2040 Roadway Network Screenline Analysis

A network screenline analysis was conducted for all future traffic scenarios being studied, using the screenlines shown in **Figure 2-8.** The projected traffic volumes identified through the screening process provides an indication of traffic volumes for each scenario will increase between 2010 and 2040. Projected traffic volumes for each screenline, based on the No-Build scenario and the three improvement scenarios are shown in **Table 2-5.**

Table 2-5: Roadway Network Screenline Analysis

Screen-line	Traffic Volumes (Vehicles per Day)				
	2010	2040 No Build	2040 Base Scenario 1	2040 Base Scenario 2	2040 Base Scenario 3
1	35,351	212,664	208,773	201,369	230,163
2	28,771	115,576	104,009	103,617	118,071
3	30,231	141,611	93,935	94,824	108,051
4	46,873	223,885	158,992	157,747	169,112
5	16,655	127,026	96,652	95,948	97,187
6	19,613	280,718	237,224	223,195	218,271
7	98,619	435,777	283,498	267,943	263,151
8	98,496	491,774	332,378	319,955	312,436
9	71,946	391,749	268,598	260,916	268,940
Total	446,555	2,420,781	1,784,057	1,725,514	1,785,383

- Screenline 6 has the highest increase of traffic volumes if no roadway improvements are made. This screenline captures north-south travel patterns along the southern portion of the study area.
- Traffic volumes increase along Screenlines 1 and 2 in Base Scenario 3. This increase suggests that the changes of the East-West Corridor's to a four-lane expressway improved the travel time along the corridor resulting in an increase usage of the facility.

2.3.4 2040 Roadway Network Mobility Improvement Analysis

Table 2-6 displays the comparison of the Vehicle Miles Traveled (VMT) and Vehicle Hours Traveled (VHT) for the various scenarios within the influence area. If no improvements are made, average speeds significantly decrease and the total travel times increase. Of the three base scenarios, Scenario 3 provides the most mobility benefit and Scenario 1 provides the least amount of improvement.

Figure 2-8: Screenline Analysis

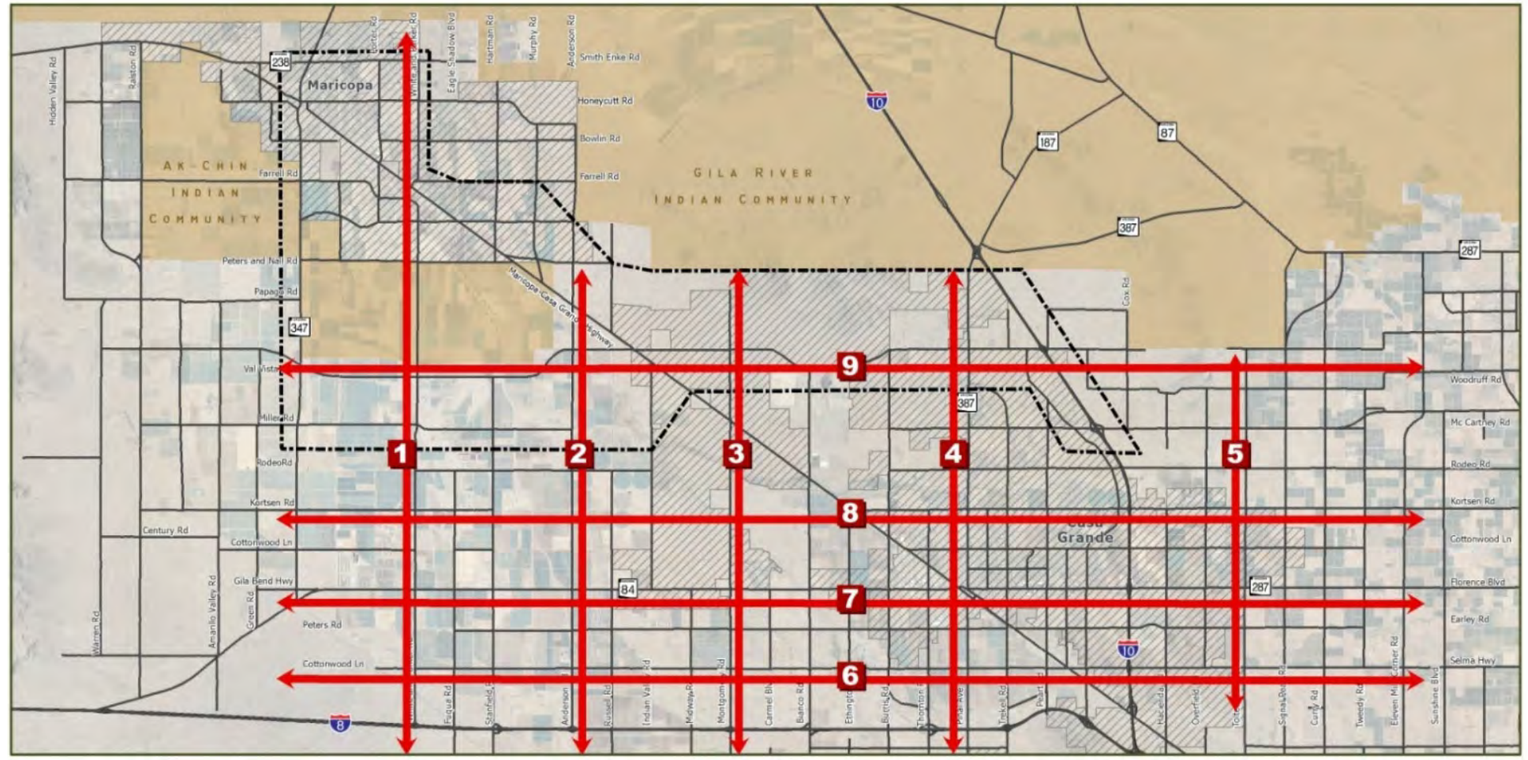


Table 2-6: Roadway Network VMT and VHT Comparison

Scenario	VMT	VHT	Average Network Speed (MPH)
2010	2,718,186	58,848	40.4
2040 No Build	13,466,953	10,210,843	18.6
2040 Base Scenario 1	10,675,628	360,450	36.0
2040 Base Scenario 2	10,269,510	319,852	36.8
2040 Base Scenario 3	10,450,450	316,108	37.2

3.0 SOCIAL, ECONOMIC, AND ENVIROMENTAL OVERVIEW

3.1 Introduction

The Environmental Overview (EO) describes the existing environment (i.e., the existing physical, natural, and socioeconomic environments). The EO also identifies potential environmental issues associated with the Pinal County East-West Corridor study area. The EO is intended to contribute to decision-making at the Alternatives Analysis stage of the National Environmental Policy Act (NEPA) process. The EO identifies, early in the planning process, the issues, constraints, and opportunities that are to be considered in the preliminary analysis of alternatives. Information presented herein is based on existing records review, local jurisdiction and regulatory agency coordination, and limited field review.

The EO describes the natural and built environment within the overall study area by resource topic. The discussion for each topic concludes with environmental concerns and recommendations for additional analysis and coordination. Some resource topics are purposefully omitted. Based on a review of available information, no wetlands, wilderness areas, sole source aquifers, or wild and scenic rivers are present in the study area. Therefore, the EO does not discuss these resources further.

3.2 Physical and Natural Environment

3.2.1 Native Vegetation/Plant Communities

The study area lies almost entirely within the Lower Colorado River Valley subdivision of Sonoran Desertscrub (Turner and Brown, 1994). The common creosote bush *(Larrea tridentata)* is the dominant native vegetation species in this plant subdivision. Most of the study area has been disturbed, either by agricultural practices or commercial and residential development. Native vegetation generally is limited to scattered patches throughout much of the study area. Native plant communities that do exist in these areas are limited in diversity with some exceptions, such as along ephemeral drainages.

The northeastern portion of the study area, where the Sacaton Mountains foothills are located, presents a different native plant community, the Arizona Upland subdivision of Sonoran Desertscrub. Within this upland area, the vegetation consists of foothill palo verde *(Parkinsonia microphylla)*, mesquite (*Prosopis* spp.), and cat-claw acacia (*Acacia greggii*). Protected native plants include cacti, such as saguaro (*Carnegiea gigantea*), barrel cactus (*Ferocactus* spp.), and several varieties of cholla (C*ylindropuntia* spp., *Opuntia* spp.).

The native plant communities in the study area:

- Do not pose any particular limitations on or unique requirements for construction of a high-capacity transportation facility.
- Do not present any unique physical attributes that may warrant special consideration not typically accounted for on this type of project. For example, coordination with the Arizona Department of Agriculture is recommended to arrange for proper treatment of disturbed native plants per state regulations.
- May contribute to establishing differences among possible alternatives that may occur in the study area. Particularly, alternatives that would pass through the more sensitive foothill plant communities may generate greater impacts than alternatives that would pass through agricultural/urbanizing areas.

It is recommended that future transportation alternatives avoid designated areas with native vegetation or plant communities per guidelines in the various comprehensive, open space, and recreation plans adopted by Pinal County, Maricopa, and Casa Grande (reference the Land Use, Ownership, and Jurisdiction section for a full list). Overall, potential differences in impacts on native vegetation and plant communities should be addressed when screening and comparing alternatives.

3.2.2 Biology/Wildlife

The following section is divided into three subsections, threatened and endangered species, other special status species, and wildlife movement corridors and linkages. These subsections establish and define the affected environment and environmental concerns related to plant biology and wildlife species.

Threatened and Endangered Species

A qualified biologist reviewed the U.S. Fish and Wildlife Service (USFWS) list of endangered, threatened, proposed, and candidate species for Pinal County to determine which listed species may occur in the vicinity of the study area. **Table 3-1** lists each species' status and the presence or absence of suitable habitat. Suitable habitat within the study area was determined by each species' habitat requirements, by understanding the biology of the species, and by conducting a windshield survey of the study area.

Table 3-1. USFWS listed species in Pinal County

Common Name	Scientific Name	Status[a]	Suitable Habitat Present?	Occupied Habitat Present?	Critical Habitat Present?	Species Affected?	Critical/ Suitable Habitat Affected?
American peregrine falcon	*Falco peregrinus anatum*	D	No	No	No	No	No
Bald eagle	*Haliaeetus leucocephalus*	D	No	No	No	No	No
Cactus ferruginous pygmy-owl	*Glaucidium brasilianum cactorum*	D	Yes	No	No	No	Yes
California bR/Wn pelican	*Pelecanus occidentalis californicus*	D	No	No	No	No	No
Mexican spotted owl	*Strix occidentalis lucida*	T	No	No	No	No	No
Southwestern willow flycatcher	*Empidonax traillii extimus*	E	No	No	No	No	No
Yuma clapper rail	*Rallus longirostris yumanensis*	E	No	No	No	No	No
Yellow-billed cuckoo	*Coccyzus americanus*	C	No	No	No	No	No

Table 3-1. USFWS listed species in Pinal County

Common Name	Scientific Name	Status[a]	Suitable Habitat Present?	Occupied Habitat Present?	Critical Habitat Present?	Species Affected?	Critical/ Suitable Habitat Affected?
Lesser long-nosed bat	*Leptonycteris curasoae yerbabuenae*	E	No	No	No	No	No
Ocelot	*Leopardus pardalis*	E	No	No	No	No	No
Desert tortoise, Sonoran population	*Gopherus morafkai*	C	Yes	No	No	No	Yes
Northern Mexican Gartersnake	*Thamnophis eques megalops*	C	No	No	No	No	No
Tucson shovel-nosed snake	*Chionactis occipitalis klauberi*	C	Yes	Yes	No	Yes	No
Desert pupfish	*Cyprinodon macularius*	E	No	No	No	No	No
Gila chub	*Gila intermedia*	E	No	No	No	No	No
Loach minnow	*Tiaroga cobitis*	T	No	No	No	No	No
Razorback sucker	*Xyrauchen texanus*	E	No	No	No	No	No
Roundtail chub	*Gila robusta*	C	No	No	No	No	No
Spikedace	*Meda fulgida*	T	No	No	No	No	No
Acuna cactus	*Echinomastus erectocentrus var. acunensis*	C	Yes	No	No	No	Yes
Arizona hedgehog cactus	*Echinocereus triglochidiatus var. arizonicus*	E	No	No	No	No	No
Nichol Turk's head cactus	*Echinocactus horizonthalonius var. nicholii*	E	No	No	No	No	No

[a]C = Candidate, D= Delisted, E = Endangered, PT = Proposed Threatened, T = Threatened (USFWS 2011)

No designated critical habitat for listed species that potentially could occur in Pinal County is located within the study area. Suitable habitat within the study area is noted for the Acuna cactus, the cactus ferruginous pygmy-owl, the Tucson shovel-nosed snake, and the Sonoran Desert tortoise.

Other Special Status Species

The Arizona Game and Fish Department (AGFD) heritage data management system was accessed to determine other special status species known to occur in or near the study area. In addition, AGFD was contacted directly to identify any other special status species not yet listed in the database. AGFD responded with a list of special status species occurrences within 3 miles of the study area. **Table 3-2** presents the presence or absence of suitable habitat for the species included in AGFD's reply.

Table 3-2. Other special status species in Pinal County

Common Name	Scientific Name	Status[a]	Suitable Habitat Present?	Occupied Habitat Present?	Species Affected?
Western burrowing owl	*Athene cunicularia hypugaea*	SC, S	Yes	Yes	Yes
Tucson shovel-nosed snake	*Chionactis occipitalis klauberi*	C	Yes	Yes	Yes
Desert tortoise, Sonoran population	*Gopherus morafkai*	C, S, WSC	Yes	No	Yes
Western yellow bat	*Lasiurus xanthinus*	S, WSC	Yes	Yes	Yes

[a]C = USFWS Candidate Species; S = U.S. Forest Service or Bureau of Land Management Sensitive Species, SC = USFWS Species of Concern, SR = Salvage Restricted, WSC = Wildlife of Special Concern in Arizona (AGFD 2010)

Migratory Bird Treaty Act of 1918

The Western burrowing owl (*Athene cunicularia hypugaea)* is federally protected under the Migratory Bird Treaty Act of 1918 (MBTA) and is listed as a USFWS Species of Concern, but is not provided protection under the Endangered Species Act. Threats to burrowing owls include habitat loss due to development, degradation, and fragmentation; predation; illegal shooting; and pesticides. The primary threat appears to be the eradication of burrowing rodents through control programs. Burrowing owls occur in arid, open habitats including grasslands, deserts, and prairies. They may also use constructed landscapes such as golf courses, airports, and agricultural fields (AGFD 2009). The MBTA states it is unlawful to take, kill, or possess migratory birds that are listed under its protection. Protection is provided for the birds, their nests, and eggs.

Wildlife Movement Corridors and Linkages

The movement of wildlife through the study area depends on the availability of preferred habitat, foraging range, migration, and dispersal patterns. Many resident birds and terrestrial wildlife species find that limited cover, altered habitat, and the presence of structures and roadways in developed areas present a barrier to movement. For these species, wildlife corridors include gaps in development where animals are funneled between patches of preferred habitat.

The potential traffic, noise, and walls in the study area could pose a barrier for many large mammals and other terrestrial species. The Arizona Wildlife Linkages Workgroup has identified known and potential wildlife corridors and has assessed wildlife linkages around the state, classifying areas as habitat blocks, potential linkage zones, or fracture zones. The study area is part of a fracture zone (i.e., an area with a higher amount of restrictions to wildlife movement between habitat areas because of development, roadways, and other man-made structures). As such, wildlife movement and connectivity is impaired in the study area, and it does not form a good link between existing habitat regions.

Wildlife may use undeveloped areas as movement corridors with relatively little disturbance because of the isolation from human disturbances. The natural drainage channels crossing the study area, such as the Santa Cruz Wash, can act as wildlife corridors. In the washes identified, habitat complexity and topographic relief provided by the drainage channels and bordering xeroriparian vegetation can serve to funnel wildlife through adjacent developed or open terrain. Potentially affected wildlife associated with this area, including javelin (*Tayassu tajacu*), coyote (*Canis latrans*), and possibly kit fox (*Vulpes macrotis*), gray fox (*Urocyon cinereoargenteus*), bobcat (*Lynx rufus*) and skunks (family Mephitidae), can traverse and forage in the undeveloped space and wash corridors in the study area.

Because of its developed nature, the study area generally does not offer prime habitat for native plant and animal wildlife.

However, construction within the study area may have the potential to affect the plants and wildlife identified in the AGFD special status species list or the USFWS threatened and endangered species list. During the environmental clearance phase, a more detailed Biological Evaluation would be conducted to determine the specific presence/absence of protected species and potential mitigation measures. Impacts to protected species could result in some level of Section 7 consultation with USFWS. Further coordination with USFWS, AGFD, and Pinal County would also be needed. A survey for protected native plants (as defined by the Arizona Department of Agriculture) would also be undertaken during future environmental analyses.

Pinal County recognizes the need to protect critical habitat for wildlife and to promote wildlife linkages as a means of preserving species integrity. If biological resources were affected by a future alternative, further studies to identify habitat and wildlife surveys for listed species would be needed to determine conservation strategies to be implemented as part of the project design. Currently, protocols have been established for the western burrowing owl, the cactus ferruginous pygmy-owl, and the Sonoran Desert tortoise as a means to minimize impacts.

With respect to wildlife, the study area:

- Does not contain any designated critical habitat for USFWS listed threatened or endangered species potentially occurring in Pinal County.
- Contains suitable habitat for the Acuna cactus, the cactus ferruginous pygmy-owl, the Tucson shovel-nosed snake, and the Sonoran Desert tortoise.
- Contains suitable habitat for the Western burrowing owl (protected by the MBTA).
- Does not contain or lie within any habitat blocks or potential linkage zones identified by the Arizona Wildlife Linkages Workgroup.

Overall, potential differences in impacts on suitable wildlife habitat and connectivity should be included in the criteria used to screen and compare alternatives.

3.2.3 Hydrology

Beyond initially defining drainages in the study area, the following section is divided into three subsections, floodplains, water quality, and wells. These subsections establish and define the affected environment and environmental concerns related to hydrology.

The drainages in the study area are ephemeral, eventually combining with Santa Rosa Wash and the Santa Cruz Wash. Three named washes are located within the study area and have the following attributes:

- The Vekol Wash Tributary, which flows northwest into the Vekol Wash northwest of the study area.
- The Santa Rosa Wash flows north, eventually joining the Santa Cruz Wash upstream from its confluence with the Gila River.
- The Santa Cruz Wash and its North Branch flow northwest to the Gila River.

Several other unnamed washes and numerous irrigation canals are also located in the study area, including:

- Casa Blanca Canal;
- Southside Canals # 1 and #2;
- Numerous unnamed irrigation canals, many of which are located in the southwest section between SR 347 and Indian Valley Road; and
- An unnamed wash west of the Casa Grande Municipal Airport.

Floodplains

Executive Order 11988 requires federal agencies to avoid long- and short-term adverse impacts to floodplains to the extent possible, as well as to avoid direct and indirect support of floodplain development wherever there is a practicable alternative.

A review of the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) panels shows FEMA-mapped floodplains present in the study area. The floodplains are associated with the Vekol Wash Tributary in the northwest portion of the study area, and the Santa Rosa and Santa Cruz washes in the central portion of the study area. In addition, two flood control structures adjacent to the Santa Rosa and Santa Cruz washes have been classified by FEMA as accredited levees.

Floodplains are not identified within the Ak-Chin Indian Community, although FEMA identifies the Community as Zone D, an “area in which flood hazards are undetermined, but possible.” It appears that the floodplains, while not mapped, physically extend through the Community, following the Santa Rosa and Santa Cruz washes. The balance of the FEMA-mapped floodplains in the study area comprise 100-year and 500-year floodplains (Zones A and X, respectively).

Currently, Pinal County and Maricopa are working with FEMA to update floodplain mapping in the County and City. Preliminary FIRMs were released in December 2011 for the portions of the study area associated with Southside Canals #1 and #2 and Vekol Wash Tributary.

The study area contains FEMA-mapped floodplains that could be affected by a future alternative through the addition of fill, excavation, and/or construction of bridges and other roadway structures. Impacts to floodplains from highway construction would need to be mitigated to reduce or eliminate induced increases to 100-year flood event water surface elevations, in keeping with applicable local, State, and/or federal regulations.

Overall, potential differences in impacts to floodplains should be considered when screening and comparing alternatives.

Water Quality

Four primary washes traverse the study area, the Vekol Wash Tributary, Santa Rosa Wash, Santa Cruz Wash, and an unnamed wash west of the Casa Grande Municipal Airport. The Santa Rosa and Santa Cruz washes flow south to north toward the Gila River. Other minor drainages occur in the study area and may be jurisdictional. The majority of the minor drainages flow generally in a southwesterly direction from the Sacaton Mountains. As noted, the National Wetlands Inventory does not indicate that any wetlands are present in the study area.

The majority of the southwestern portion of the study area is used for agriculture and, except for the Santa Rosa Wash, no longer contains ephemeral drainages because field leveling and agricultural activity have blocked, diverted, or altered natural flow patterns. Irrigation canals, which typically are considered non-jurisdictional utilities unless the water is taken directly from and returned directly to jurisdictional water,

border these fields. Many irrigation districts maintain records of the jurisdictional status, or lack thereof, of their canals.

According to the U.S. Army Corps of Engineers' (Corps') Los Angeles District Regulatory Division, six jurisdictional delineations have been completed within the study area. Readily available data includes the general location of the previous jurisdictional delineations but does not include data on all of the subject washes or their status as Waters of the U.S. (Waters).

Waters have been identified in the following locations:

- Southeast of High Desert Trail and Hartman Road in the future Cortona subdivision;
- North of Val Vista Boulevard and MCGH in the future Grande Valley North subdivision;
- The Santa Rosa Wash southwest of Farrell Road and Porter Road, near the Santa Rosa Springs subdivision;
- Southeast of McCartney Road and Peart Road (April 2006); and
- The Santa Cruz Wash southwest of Farrell Road and Hartman Road in the future Eagle Shadow subdivision.

If potential Waters were affected by a future alternative, a jurisdictional delineation would be required during final design to identify all Waters in the study area. Further analysis of jurisdictional waters could be addressed in the environmental clearance document. A pre-application meeting with the Corps is recommended to develop a mutually agreeable upon protocol for evaluating Waters throughout the study area, to obtain previously approved jurisdictional delineations, and to determine the applicability of the previous jurisdictional delineations. Jurisdictional delineations typically are valid for approximately five years. Coordination with the Maricopa-Stanfield Irrigation & Drainage District is recommended to confirm the jurisdictional status of irrigation canals in the study area. Lastly, the absence of wetlands could be confirmed during the jurisdictional delineation fieldwork.

Depending on the nature and extent of construction, the project could be permitted under a Nationwide Permit No. 14, Linear Transportation Projects. New, permanent impacts over 0.10 acres would require a pre-construction notification and Corps approval. Impacts exceeding 0.50-acre would require an Individual Permit. All permitting activities should occur during final design so that project proponents would not have to reapply for permits because of project design changes.

Overall, potential differences in impacts on Waters should be accounted for in the comparative performance consideration of alternatives.

Wells

According to Arizona Department of Water Resources, approximately 431 wells are located within the study area, ranging in depth from 46 to 2,536 feet. Figures in the EO show all of the wells registered within the study area. Thirty-four of the wells are identified as having zero-foot depth, and an additional 29 wells have no identified depth. Pumping capacity of the wells is identified as ranging from 1 to 3,600 gallons per minute, with 87 wells having a zero gallon per minute pumping capacity and an additional 43 wells having no identified pumping capacity.

Overall, potential differences in impacts on wells and groundwater resources should be considered when screening and comparing alternatives.

3.2.4 Prime and Unique Farmlands

The Farmland Protection Policy Act (FPPA) was established in 1981 in response to concerns about the declining acreages in the U.S. being actively farmed. The purpose of the FPPA is to minimize the extent to which federal programs contribute to the unnecessary and irreversible conversion of farmland to nonagricultural uses. The FPPA states that "federal programs shall be administered in a manner that, as practicable, would be compatible with state and local government and private programs and policies to protect farmland."

Prime farmland and agricultural land are not necessarily the same. The agricultural land use designation is a product of local community planning efforts, while the prime or unique farmland designation is a product of Natural Resources Conservation Service (NRCS) criteria. Definitions of prime and unique farmland are as follows and are what determines the existing conditions and environmental concerns related to farmlands in the study area.

> Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, fiber, forage, oilseed, and other agricultural crops with minimum inputs of fuel, fertilizer, pesticides, and labor, and without intolerable soil erosion. Prime farmland includes land that possesses the above characteristics, but is being used to produce livestock and timber. It does not include land already in or committed to urban development or water storage (7 Code of Federal Regulation [CFR] 658.2).
>
> Unique farmland is land other than prime farmland that is used for production of specific high-value food and fiber crops. It has the special combination of soil quality, location, growing season, and moisture supply needed to economically produce sustained high quality or high yields of specific crops when treated and managed according to acceptable farming methods. Examples of such crops include citrus, tree nuts, olives, cranberries, fruits, and vegetables (7 CFR 658.2).

According to the U.S. Department of Agriculture, Pinal County had 48,193 acres of farmland in 1997. This number has dropped to 27,674 acres by 2007. Nationally, farmland acreage has declined over the same period from 16,375,332 to 10,737,015 acres.

The presence of prime farmland soils in the study area was determined using the most current soil survey data and recent aerial photography to identify irrigated farmland with soil types that support prime and unique farmlands. The study area comprises NRCS-designated farmland of unique importance (approximately 10 percent of the study area), prime farmland if irrigated (approximately 50 percent of the study area), and prime farmland if irrigated and either protected from flooding or not frequently flooded during the growing season (approximately 30 percent of the study area). Only approximately 10 percent of the study area is not classified as prime farmland, all of which is located east of Indian Valley Road.

Of the approximately 90 percent of the study area that the NRCS has designated prime or unique farmland, approximately 50 percent is currently used for agriculture and is clustered in the western portion of the study area. As noted, approximately 10 percent of the study area is urban or developed land, with current land uses in the remaining portion considered vacant, open space, unclassified, or unknown. Future land use plans identify urban uses for the majority of the study area, except within the Ak-Chin Indian Community, which is designated for future agricultural uses.

Future development plans in the western half of the study area consist mainly of urban development (such as residential and commercial land uses or planned communities) with agriculture remaining on the Ak-Chin Indian Community. The eastern half of the study area comprises only planned urban use areas with no designated agricultural use areas remaining.

Because prime farmlands cover 90 percent of the study area, it is possible that a future alternative could affect this resource. An evaluation of the "land committed to urban development is recommended as part of the environmental clearance document to determine farmland protected by the FPPA, and if an alternative were to affect prime farmland, impacts would be evaluated via the Land Evaluation and Site Assessment form. Coordination with regulating agencies, including NRCS, the cities of Maricopa and Casa Grande, and the Ak-Chin Indian Community, is recommended to identify farmlands of local importance, which may or may not exist in the study area. Coordination between NRCS and the Ak-Chin Indian Community is also recommended to determine the applicability of the FPPA on Tribal land.

Overall, prime farmlands do not necessarily contribute to establishing differences among possible alternatives that may occur in the study area. However, potential differences in impacts on prime farmland should be considered when screening and comparing alternatives.

3.2.5 Noise

CFR Title 23, Part 772, provides procedures for preparing operational and construction noise studies, as well as evaluating noise abatement considered for federal and federal-aid highway projects. Under CFR Title 23, Part 772.7, a project is categorized as a Type I, Type II, or Type III project, with a noise analysis being required for all Type I projects. A Type I project would include one of the following attributes:

- Construction of a highway on a new location;
- Physical alteration of an existing highway;
- Addition of a new through lane, high-occupancy-vehicle lane, or auxiliary lane;
- Addition or relocation of interchange lanes or ramps added to complete an existing partial interchange;
- Restriping of existing pavement for the purpose of adding a through-traffic lane or auxiliary lane; or
- Addition of a new or substantial alteration of weigh stations, rest stops, ride share lot, or toll plaza.

Noise is generated primarily from roadways and interstates in and near the study area. However, there are two airports and two automotive testing facilities that influence ambient noise in the study area. The two airports are the Phoenix Regional Airport adjacent to the Maricopa-Casa Grande Highway and the Casa Grande Municipal Airport immediately adjacent to SR 387. The two automotive testing facilities located within the study area are the Nissan Proving Grounds and the Volkswagen Proving Grounds.

Prior to the development of these noise generators, the study area experienced relatively low noise levels similar to rural, mostly agricultural regions. The above listed noise generators were also built at a time when there were relatively few noise-sensitive receptors in the study area. Over time, land uses in the study area have intensified and are varied, with residential noise-sensitive receptors concentrated in the northwest and eastern portions of the study area.

The central portion is more rural in character with scattered residential dwellings and open, undeveloped land. Existing and planned trail systems and designated open spaces, both of which are noise-sensitive areas, are located throughout the study area.

Maintaining acceptable noise levels to preserve the character of open spaces, residential quiet zones, and recreational facilities are to be considered when selecting a potential transportation corridor location. Existing and future parks, recreational trail systems, residential development, and community uses requiring low noise levels would be identified as part of the noise analysis. If a future alternative were to potentially affect noise-sensitive receptors or qualify as a Type I project, a detailed noise analysis would be recommended during the environmental clearance efforts. If the modeled noise levels exceed Federal Highway Administration (FHWA) noise thresholds, feasible and reasonable noise abatement measures would be assessed for the affected noise-sensitive receptors.

Overall, the locations of noise-sensitive receptors may contribute to establishing differences among possible alternatives that may occur in the study area. However, potential differences in impacts on noise-sensitive receivers should be included in the criteria used to screen and compare alternatives.

3.2.6 Air Quality

Air quality for projects of regional significance is assessed at the regional and project level. The study area is under the jurisdiction of the U.S. Environmental Protection Agency (EPA), Arizona Department of Environmental Quality (ADEQ), the Pinal County Air Quality Control District, and the Central Arizona Governments (CAG).

The Clean Air Act (CAA) of 1970, which was last amended in 1990, is the federal law that governs air quality. The EPA is responsible for establishing National Ambient Air Quality Standards (NAAQS) for six criteria pollutants in order to protect the public from the health hazards associated with air pollution. These six criteria pollutants are carbon monoxide (CO), ozone (O_3), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter less than 2.5 microns in diameter and less than 10 microns in diameter ($PM_{2.5}$ and PM_{10}), and lead (Pb). The State has adopted these NAAQS for each of the six criteria pollutants, and for the purposes of this project, pollutants typically associated with vehicle traffic (CO, O_3, nitrogen oxides [NOx], $PM_{2.5}$, and PM_{10}) are of specific concern.

Furthermore, the EPA designates areas as meeting (attainment) or not meeting (non-attainment) the established standards for each criteria pollutant. In other words, attainment status indicates that air quality in an area meets the NAAQS for a criteria pollutant. An area can also be classified as non-attainment status, indicating that air quality does not meet the NAAQS standards. Areas previously designated as non-attainment status that have consistently demonstrated meeting the NAAQS are reclassified as maintenance areas, although submittal and approval of maintenance plans is required under the CAA.

As a historically rural area, Pinal County has not experienced the air quality challenges faced by the metropolitan areas of Phoenix and Tucson. However, significant growth in population and development over the last 10 years, particularly within the study area, has brought a steep reduction in overall air quality. While Western Pinal County, Arizona is designated as an attainment area for O_3, CO, NO_2, PM_{10}, SO_2, and Pb, it is a non-attainment area for the 24-hour $PM_{2.5}$standard (Pinal County 2010). In addition, on May 23, 2012, EPA re-designated a portion of Western Pinal County within the study area as a non-attainment area for the 24-hour PM_{10} standard, citing Pinal County's PM_{10} levels as some of "the worst in the country".

As noted throughout this overview, the Ak-Chin Indian Community has land within the study area designated as Tribal land, and the GRIC also has designated Tribal land located north of, but not within, the study area. While the area surrounding the Tribal lands can be designated, it should be noted that neither ADEQ nor the related counties have jurisdiction to designate attainment status within these Tribal lands. Rather, the EPA is authorized under Section 301(d) of the CAA to treat Indian tribes in the same manner as states under the CAA,

and the EPA explicitly recognizes the authority of an "eligible" tribe to make the same recommendations regarding the attainment status of lands over which it has jurisdiction. In its May 2012 PM_{10} redesignation, EPA did not include either Tribe in the Pinal County PM_{10} non-attainment area, but is deferring its decision until the Tribal air quality consultation is complete.

Currently, air quality monitoring is not in place on the Ak-Chin Indian Community, and the position of the Ak-Chin Indian Community is that the Reservation maintains a designation of "attainment" for the various NAAQS. However, the Ak-Chin Indian Community is currently investigating development of an Air Quality Program. The Gila River Indian Community has "Treatment as a State" status under CAA Section 107 designations and has implemented an air quality monitoring network that reports quality-assured data to EPA's Air Quality System.

Air Quality Monitoring

The Pinal County Air Quality Control District monitors concentrations of criteria pollutants at 15 monitoring stations in Pinal County. In October 2009, the EPA notified the Governor of Arizona and Tribes with lands located in Pinal County that the Cowtown monitoring site, located adjacent to the Maricopa-Casa Grande Highway and just north of Hartman Road was violating the 24-hour $PM_{2.5}$ standard based on the most recent air quality monitoring data. For the designated Pinal County $PM_{2.5}$ non-attainment area, the State must develop a State Implementation Plan that provides for attainment of the NAAQS within three years following the March 7, 2011 designation.

Ambient air quality monitors located in the PM_{10} non-attainment area, including those located in Maricopa, "routinely record concentrations two to three times the level of the standard and several monitors have recorded levels approaching or exceeding the significant harm level of 600 micrograms per cubic meter (ug/m3)." The State has six years to attain the PM_{10} standard.

Mobile Source Air Toxics

In addition to the NAAQS for criteria air pollutants, the EPA also regulates air toxics. Most air toxics originate from human-made sources, including on-road mobile sources, non-road mobile sources (e.g., airplanes), area sources (e.g., dry cleaners), and stationary sources (e.g., factories or refineries). The amount of mobile source air toxics (MSATs) emitted from a project would be proportional to the vehicle miles traveled. Technical shortcomings of emissions and dispersion models and uncertain science with respect to health effects currently limit meaningful and/or reliable estimates of MSAT emissions and effects. However, levels of future MSAT emissions from the project can be qualitatively assessed during the environmental clearance document (although this analysis cannot identify and measure health impacts). This analysis can provide a basis for identifying and comparing the potential differences among MSAT emission, if any, between alternatives. Additional MSAT information is presented in *Appendix A* of the EO.

Class I Areas

Under the provisions of the CAA, the EPA has designated a number of areas in the State as Mandatory Class I Federal Areas, where visibility is an important value. These include national parks and wilderness areas. These Class I areas are listed in 40 CFR 81.403. Of the Class I areas, the Superstition Wilderness Area is the closest to the study area, approximately 35-miles northeast in Maricopa County.

Conformity

The CAA requires that all regionally significant and federally-funded transportation projects in non-attainment or maintenance areas must meet the transportation conformity regulations. Pursuant to the conformity provisions of the CAA, projects in non-attainment or maintenance areas must conform to the established State Implementation Plan and ensure that transportation activities would not cause or contribute to new violations, worsen existing violations, or delay attainment of air quality standards. An air quality nonexempt project generally adds transportation capacity and must comply with the conformity requirements.

At the project level, FHWA is mostly concerned with CO because it is directly emitted from the tailpipes of motor vehicles. Conformity at the project level requires a "hot spot" analysis if an area is in "non-attainment" or "maintenance" for CO.

To comply with State and local air quality requirements, a project constructed in the study area must be included in the fiscally-constrained and air quality-conforming programs and plans. The project would also need to adhere to local air quality regulations, including the Pinal County Air Quality Control District Code of Regulations, Title 18 of the Arizona Administrative Code, and the Arizona Revised Statutes Section 49-401.

According to 40 CFR 93.116, all FHWA non-exempt projects must have a project-level conformity determination. Because a portion of the County is designated as non-attainment for the 24-hour $PM_{2.5}$ standard, a qualitative analysis of $PM_{2.5}$ will be included in the environmental clearance document. A conformity determination would be conducted based on interagency consultation, which would typically involve FHWA, Pinal County, and CAG. Hot-spot analyses of CO would not be required for the environmental clearance document because the study area is in attainment for CO. However, the redesignation of a portion of the study area as a PM_{10} non-attainment area would trigger a quantitative hot-spot analysis during the environmental clearance. A qualitative assessment of MSATs would be provided during the environmental clearance and would derive, in part, from FHWA guidance.

Overall, potential air quality impacts would not be critical to the screening and comparison of alternatives.

3.2.7 Hazardous Materials

A regulatory database review of federal and State hazardous materials databases was completed for the study area. The purpose of the regulatory database review was to evaluate and identify the presence of hazardous materials or similar environmental concerns present in the study area. This effort included a review of recent aerial photography and a study area reconnaissance.

Potential hazardous materials sites are often associated with past and current activities on or nearby the site. A majority of the study area is relatively free of potential hazardous material sites because the study area consists of primarily undeveloped and agricultural areas. Older developed sites, such as city centers for the cities of Maricopa and Casa Grande, have higher concentrations of potential sites. Older industrial areas, where mining and other activities have taken place over time, also demonstrate higher frequencies of potential hazardous materials sites.

The environmental database search and study area reconnaissance revealed the following potential hazardous material sites:

- Five Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS)/No Further Remedial Action Planned (NFRAP) sites;
- Five active and 12 inactive Resource Conservation and Recovery Act (RCRA) sites;

- Six federal Emergency Response Notification System (ERNS) incidents and two ADEQ Emergency Response Logbook incidents, with one overlap with an ERNS incident;
- Oneclosed solid waste landfill;
- Two bR/Wnfields/Voluntary Remediation Program sites;
- 16 sites with underground storage tanks (USTs);
- Six sites with leaking USTs (LUST) (only one of which is still in operation); and
- 800 registered drywells at 73 sites.

Appendix B of the EO lists the potential hazardous material risks in the study area and provides information, risk category, and recommendations for further action. The hazardous materials evaluation considered the relative risk of a hazardous materials site if it were to be located within a potential transportation corridor or acquired as a full property "take." *Appendix B* of the EO presents recommendations for avoidance based on the current knowledge of the study area and environmentally recognized conditions. More site-specific analysis of hazardous materials would be undertaken during the environmental clearance.

A tire fire occurred on April 11, 2011 at a used tire facility on the northeastern corner of the Maricopa-Casa Grande Highway and North Hartman Road. The fire was reported in AZCentral.com as being capped, and was not indicated on the database review as of June 2012. Should a chosen alternative be located in proximity to this site, additional research would be conducted during the environmental clearance.

Asbestos sampling and/or abatement was not considered in the “take” scenarios discussed in Table B-1 in the EO. In general, National Emission Standards for Hazardous Air Pollutants regulations require that a certified inspector sample any structures that will undergo demolition or renovation activities for asbestos prior to the action. National Emission Standards for Hazardous Air Pollutants notification is also to be submitted to the regulatory agency responsible for enforcement of air quality regulations (in this instance, Pinal County). This notification is required to be submitted regardless of the presence or absence of asbestos.

In the event that the amount of asbestos is 160 square feet, 260 linear feet, or 35 cubic feet or more, it is considered regulated asbestos, and a certified contractor would remove it prior to any disturbance. These regulations apply to load-bearing structures and are interpreted to include roadway structures such as bridges and culverts in addition to buildings. As a result, if any roadway structures or buildings would be demolished as part of a future alternative, each would likely require asbestos sampling and possibly asbestos abatement, depending on the results of the sampling.

In addition, certain buildings and roadway structures in the study area are likely to contain lead-based paint. Because materials containing lead can be a hazardous waste under RCRA and because the Occupational Safety and Health Administration regulates each as a safety hazard, sampling for lead-based paint is also recommended on certain buildings and roadway structures that would potentially be demolished as part of a future alternative.

Overall, all of the hazardous materials sites identified at this stage are considered low risk if located within a potential transportation corridor. However, it has been recommended to avoid direct take of 11 of the identified sites. Hazardous materials should be included in the criteria used to screen and compare alternatives.

3.2.8 Section 4(f) Resources

Section 4(f) of the U.S. Department of Transportation Act of 1966 and Section 6(f) of the Land and Water Conservation Fund Act are intended to protect the nation’s recreational resources from significant transportation-related impacts. Section 4(f) states that the Secretary of Transportation:

> …may approve a transportation program or project…requiring the use of publicly owned land of a public park, recreation area, or wildlife and waterfowl refuge of national, state, or local significance, or land of an historic site of national, state, or local significance (as determined by the federal, state, or local officials having jurisdiction over the park, area, refuge, or site) only if…there is no prudent and feasible alternative to using that land and the program or project includes all possible planning to minimize harm to the park, recreation area, wildlife and waterfowl refuge, or historic site resulting from the use (49 United States Code [U.S.C.] 303[c]).

A “use” of a Section 4(f) resource, as defined in CFR Title 23, Part 771.135(p), occurs when:

- Property is permanently incorporated into a transportation facility;
- There is a temporary occupancy of land that is adverse in terms of the statute’s preservation purpose; or
- There is a constructive use of a Section 4(f) resource.

A constructive use of a Section 4(f) resource occurs when a project does not incorporate land from a Section 4(f) resource, but the project’s proximity creates impacts that are so severe that the activities, features, or attributes that qualify a resource for protection under Section 4(f) are substantially impaired. For example, a constructive use can occur as follows:

- The projected noise level increase attributable to the project substantially interferes with the use and enjoyment of a noise-sensitive resource protected by Section 4(f).
- The proximity of the proposed action substantially impairs aesthetic features or attributes of a resource protected by Section 4(f), where such features or attributes are considered important contributing elements to the value of the resource. Examples of such an effect would be the location of a proposed transportation facility in such proximity that it obstructs or eliminates the primary views of an architecturally-significant historical building, or substantially detracts from the setting of a Section 4(f) resource that derives its value in substantial part due to its setting.
- The project results in a restriction of access that substantially diminishes the utility of a significant Section 4(f) resource, such as a publicly-owned park, recreation area, or historic site.

A historic site is considered a Section 4(f) resource if it is eligible for the National Register of Historic Places (NRHP) under Criterion A, B, or C. Notably, this would occur if the resource:

- Is associated with events that have made a significant contribution to the broad patterns of our history (Criterion A);
- Is associated with the lives of persons significant in our past (Criterion B); or
- Embodies the distinctive characteristics of a type, period, or method of construction or that represents the work of a master, or that possesses high artistic values, or that represents a significant distinguishable entity whose components may lack individual distinction (Criterion C).

Section 6(f), which refers to Section 6(f)(3) of the Land and Water Conservation Fund Act (Public Law 88-578), requires that any property acquired or developed with Land and Water Conservation Fund assistance be

maintained perpetually in public outdoor recreation use. The acquisition of a Section 6(f) resource requires that the property be replaced in-kind, and only with the approval of the National Park Service.

The study area, and a 0.25-mile buffer around the study area, was reviewed for publicly-owned parks, recreation areas, and wildlife and waterfowl refuges protected under Section 4(f). This 0.25-mile buffer is included to account for potential constructive use impacts (e.g., noise and visual impacts) that may extend outside of the study area. The scope of the cultural resources analysis for this EO (see applicable section below) did not include determination of significance; therefore, significant historic sites are not included in this Section 4(f) review.

The vast majority of properties listed are schools, parks, and recreation areas. From this list, there are a number of "potential" Section 4(f) resources in the study area or within the 0.25-mile buffer around the study area (see *Appendix C* of the EO), including:

- Two existing public parks and 14 planned parks;
- Twenty-seven planned or proposed paths/trails and trailheads; and
- Nine existing schools.

A majority of remaining listed resources are considered "pocket parks" and playgrounds within master planned communities or subdivisions. It was verified that none of these recreation facilities are publicly owned and, therefore, none would be afforded Section 4(f) protection. *Appendix C* of the EO does not list each of these parks individually but aggregates them by subdivision. No wildlife or waterfowl refuges are located in the study area, and no Section 6(f) properties are located in the study area.

With respect to Section 4(f) properties in the study area:

- Two existing public parks, Pacana Park in the City of Maricopa and Villago Park in the City of Casa Grande, are considered Section 4(f) resources and should be avoided in developing alignment alternatives.
- Effects of a future alternative on any of the remaining potential Section 4(f) resources (including 14 planned parks, 27 planned or proposed paths/trails and trailheads, and 9 existing schools) would necessitate investigation and coordination to minimize, avoid, or mitigate potential impacts.
- The widespread distribution of these potential Section 4(f) resources, particularly in the western portion of the study area, lessens the degree of differentiation that could be established among possible alternatives in the study area.

Should the project result in Section 4(f) involvement, a Section 4(f) evaluation report would be required to document:

- Coordination with local jurisdictions and, as warranted, project stakeholders;
- Attempts to avoid the resources;
- Direct or constructive use impacts;
- Measures to minimize harm; and
- Any impacts from temporary occupancy of a Section 4(f) resource.

With *Appendix C* of the EO listing the recommended status for each property, all properties recommended as "potential" Section 4(f) resources would require additional coordination with the local official having jurisdiction over each property in order to determine if the property is of local significance and if it would be affected by a future alternative. Determining the Section 4(f) eligibility of schools requires investigation into whether the publicly-owned school's recreational facilities are available for public use. This is based on coordination with the district(s) having jurisdiction over the school. If a school's recreational facility is available for public use without prior authorization outside of school hours, then the school is afforded Section 4(f) protection. Even fenced schools would be considered Section 4(f) if their gates remain open.

Because a number of the potential sites are in the planning stage of development, close coordination with the future owner/operators of these facilities (e.g., Pinal County Natural Resources Parks and Recreation, City of Maricopa Community Services Department, City of Casa Grande Community Services Department) would be prudent during environmental clearance preparation if any of the planned sites would be affected by a future alternative. This could provide for opportunities to avoid the resources, minimize impacts, or ensure compatibility.

Historic properties that are also potentially Section 4(f) resources, which will be evaluated during the environmental clearance process, would require coordination with the official with jurisdiction, the State Historic Preservation Office (SHPO), and/or local preservation agencies to determine whether the resource is locally important or if the resource would be affected by a future alternative.

With the passage of Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users in 2005, Congress amended Section 4(f) requirements to allow FHWA to approve a project that would result in a *de minimis* impact on a resource afforded protection under Section 4(f) without having to evaluate an avoidance alternative(s) typically required for a Section 4(f) evaluation. The 2008 Section 4(f) Final Rule established procedures for determining when a direct use would result in a *de minimis* impact on a Section 4(f) resource. As it relates to an affected area, the regulation (CFR Title 23, Part 774.17) defines a d*e minimis* impacts as follows: "For parks, recreation areas, and wildlife and waterfowl refuges, a *de minimis* impact is one that will not adversely affect the features, attributes, or activities qualifying the property for protection under Section 4(f)." FHWA would make a *de minimis* determination only after the public has been provided an opportunity to comment and after the official with jurisdiction has submitted written concurrence.

The first requirement when dealing with properties afforded Section 4(f) protection is to develop specific measures to minimize harm, with avoidance of the resource being the preferred approach. Each alternative carried forward for further study would be analyzed for direct use, constructive use, and, if warranted, measures to minimize harm. If avoidance is determined not to be "prudent and feasible," then measures to minimize impacts would be developed and require coordination with vested agencies, jurisdictions, and possibly major user groups on the part of the project proponents and FHWA.

While the widespread distribution of potential Section 4(f) resources, particularly in the western portion of the study area, lessens the degree of differentiation among possible alternatives, there are Section 4(f) resources that should be avoided. Overall, potential differences in impacts on Section 4(f) resources should be included in the criteria used to screen and compare alternatives.

3.3 Socioeconomic Environment

3.3.1 Land Use, Ownership, and Jurisdiction

As noted, the study area covers portions of the cities of Maricopa and Casa Grande as well as the Ak-Chin Indian Community. Most of the study area land is privately owned, with the exception of lands under the jurisdiction of the Arizona State Land Department and the Bureau of Land Management (BLM). Both agencies manage lands under their jurisdiction for multiple uses, including grazing allotments and recreation,

and surface and subsurface mineral rights. Several plans govern growth and development in the study area and the surrounding region, including:

- *City of Maricopa General Plan 2006* (City of Maricopa 2006)
- *City of Maricopa Parks, Trails, and Open Space Master Plan* (City of Maricopa 2008)
- *City of Maricopa Redevelopment District Area Plan* (City of Maricopa 2009)
- *City of Casa Grande General Plan 2020* (City of Casa Grande 2009)
- *City of Casa Grande Regional Trail System Master Plan* (City of Casa Grande 2008)
- *BLM Lower Sonoran and Sonoran Desert National Monument Draft Resource Management Plan and Environmental Impact Statement* (BLM 2011)
- *BLM Phoenix Resource Management Plan and Environmental Impact Statement* (BLM 1988)
- *BLM Approved Amendment to the Lower Gila North Management Framework Plan and the Lower Gila South Resource Management Plan and Decision Record* (BLM 2005)
- *Pinal County Comprehensive Plan* (Pinal County 2009)
- *Pinal County Open Space and Trails Master Plan* (Pinal County 2007)

Land use is a representation of the current physical use of the land, along with entitled developments (e.g., planned residential communities that municipal and/or county planning boards have approved). Environmental planning personnel obtained general information on study area land use through online aerial imagery and research as well as performed field verification in November 2011.

The study area's northwest portion, located in the City of Maricopa, has the greatest degree of residential development. Vacant developable land consists chiefly of residential communities that have been entitled (i.e., approved for development by the local land use regulation authority, such as a planning board, but not yet constructed).

Noted above, the study area's northwestern portion in the City of Maricopa consists primarily of single-family, detached residential developments, with a strip of retail and service-based commercial development running north to south along SR 347 between Smith Enke Road and the Maricopa-Casa Grande Highway. Interspersed within these developments are playground areas, a library, several schools, parks, and a public golf course.

Residential developments further south, towards the Ak-Chin Indian Community, are only partially constructed and occupied. Roughly half the developments are not built or just have streets constructed and utilities extended to the vacant lots. Agricultural land is prevalent in this portion of the City, similar to the Ak-Chin Indian Community, which is almost entirely agricultural. A Scott's Miracle GROW fertilizer plant occupies approximately 50 acres in this area, and a mix of commercial and institutional uses are located along the Maricopa-Casa Grande Highway. The remaining portion of the study area in the City south of the Ak-Chin Indian Community is agricultural, with the exception of the Nissan Proving Grounds within a four-square-mile area. Much of this agricultural land, particularly along SR 347, is entitled as residential development.

Proceeding east in the study area, just past a district known as Cowtown, which includes a 2.75-square-mile dairy cattle facility, the study area crosses into the City of Casa Grande. From this point due east for about six miles, the land within the study area is almost entirely undeveloped. Most of this land is entitled for future residential development.

Residential and commercial land uses are more active within the study area toward Pinal Avenue (SR 387), which includes a few pockets of older, low-density housing and a partially-constructed new development. As the study area intersects with I-10, the degree of construction and occupancy of residential development increases. The Villago subdivision, located at McCartney Road and Pinal Avenue (SR 387), and Casa Grande Municipal Airport dominate the southeastern end of the study area.

Land use in the study area does not present any unique physical attributes that warrant special consideration not typically accounted for on this type of project. Potential differences among possible alternatives that may occur in the study area as a result of land use designations could include the varying extent of property acquisition and access changes needed. Different alignment alternatives may require different amounts of land to be converted to transportation use within agricultural, commercial, industrial, or residential areas.

Additional analysis to determine if future alternatives would be consistent with adopted land use plans and zoning is recommended during the environmental clearance process. If a future alternative affects land under the jurisdiction of the BLM, coordination to determine consistency with BLM plans would also be recommended. If a future alternative were to cross the Ak-Chin Indian Community, additional Tribal coordination would be required, and it is likely that BIA's NEPA requirements would be addressed as part of the environmental clearance. It is recommended that alternative alignment locations and designs be compatible with existing commercial/industrial land uses and, to the extent practicable, adjacent residential land uses as well.

Overall, consistency with existing and future land use plans and zoning should be included in the criteria used to screen and compare alternatives.

3.3.2 Socioeconomics

The population for study area's socioeconomic analysis is dispersed among the City of Maricopa, the Ak-Chin Indian Community, unincorporated Pinal County land, and the City of Casa Grande. Overall, the study area has experienced substantial increases in population and development over the past ten years.

Pinal County's population growth has ranked amongst the highest in the nation since 2000. **Table 3-3** presents population and growth data for the study area. When interpreting this data, it should be noted that because the City of Maricopa was only incorporated in 2003 the boundaries used for the Maricopa Census Designated Place in 2000 differ from those used for the incorporated city in 2010. Therefore, while the resulting change in Census mapping precludes precise comparisons between 2000 and 2010 data, an order-of-magnitude comparison is sufficient for the purpose of this study.

Table 3-3. Study area population and growth data

Jurisdiction	2000	2010	Growth
City of Maricopa[a]	1,040	43,482	4,081.0%
Ak-Chin Village Census Designated Place	669	862	28.8%
Casa Grande Urban Area[b]	29,815	51,331	72.2%
Pinal County	179,727	375,770	109.1%

[a] The City of Maricopa was incorporated in 2003 from Maricopa Census Designated Place and surrounding unincorporated areas. The 2000 data represents the population of only the Maricopa Census Designated Place.

[b] The Casa Grande Urban Area includes unincorporated areas of Pinal County. In 2000, Casa Grande did not quality as a designated Urban Area; however, the 2010 Census provides comparative population statistics for both 2000 and 2010.

Source: U.S. Census Bureau 2000; U.S. Census Bureau 2010a; U.S. Census Bureau 2010b.

The population is dispersed between the northwest and eastern portions of the study area. Residential subdivisions are concentrated north and east of the intersection of the Maricopa-Casa Grande Highway and SR 347 in the City Maricopa, as well as just west of I-10 between Val Vista Boulevard and McCartney Road in the City of Casa Grande. Throughout the remainder of the study area, residential development is less dense, with most of the land either undeveloped or designated for agricultural uses.

Primary employment in the study area includes education, government, entertainment/tourism, retail, transportation, and agriculture. The City of Maricopa's largest employers are Maricopa United School District, a Wal-Mart department store, City government, Fry's supermarket, Volkswagen Proving Grounds, and Pinal Feeding Company, Inc., with each entity employing 150 persons or more. Most of the listed employers are located within the study area.

The Ak-Chin Indian Community provides employment to 1,203 persons, including Tribal government staff and the employees of numerous Tribe-owned facilities. This number includes positions filled at Harrah's Phoenix Ak-Chin casino, hotel, and associated restaurants; an industrial park; and the Southern Dunes Golf Club.

Similar to the City of Maricopa, the City of Casa Grande's elementary and high school districts and government offices are among the City's largest employers. Abbott Nutrition; Aco Polymer Products, Inc.; Cardinal IG Co. (a division of Cardinal Glass Industries, Inc.); Casa Grande Regional Medical Center; Daisy Brand; Frito-Lay, Inc.; Hexcel Composites; Walmart Distribution Center #7013; and Monsanto are also major employers in the City of Casa Grande. However, none of these employers are located in the study area.

The residential neighborhoods in the study area are primarily adjacent to SR 347 and the Maricopa-Casa Grande Highway in the City of Maricopa, and adjacent to SR 387 and I-10 in the City of Casa Grande. Neighborhood continuity is mixed, with a majority of the residential development being less than 10 years old. Many of these developments have pedestrian/bicycle paths incorporated into their design and separated from the street network. The paths connect to others in adjacent subdivisions. The main entrances to these residential developments are often located directly across the arterial road from one another, fostering a sense of connection. Currently, however, these new residential areas contain large, partially developed or unfinished tracts with no discernible current construction activity.

Some of the older, low-density residential areas close to the intersection of the Maricopa-Casa Grande Highway and SR 347 are more likely to exhibit a sense of community cohesion. However, very few older neighborhoods exist across this historically agricultural and undeveloped study area.

Construction of a high-capacity transportation facility in the study area would possibly result in property acquisitions, which could result in the displacement or relocation of residents and businesses. Based on the amount of available commercial property within the study area, the ability to relocate acquired businesses into the community could limit possible job losses. Other economic implications may occur through loss of property or sales tax revenue if businesses cannot relocate in the area, especially agriculture-based businesses that rely on physical proximity to farms.

Different alignment alternatives could have varying impacts on neighborhood continuity. It is recommended that considered alternatives not encroach considerably beyond the existing transportation network, particularly in developed areas. Impacts to community cohesion and character; access to institutions such as schools, libraries, and government offices; and impacts on emergency response times and other public services would vary from one alternative to another, all of which would require individual analysis.

As with all construction projects, access during and after construction is likely to be of primary concern to residents and business owners. An aggressive public and business community involvement program is recommended to minimize issues and assist businesses.

Overall, potential differences in impacts on socioeconomics, especially residential and commercial displacements, should be included in the criteria used to screen and compare alternatives.

3.3.3 Title VI/Environmental Justice

Title VI of the Civil Rights Act of 1964 and related statutes ensure that individuals are not excluded from participation in, denied the benefit of, or subjected to discrimination under any program or activity receiving federal financial assistance on the basis of race, color, national origin, age, sex, and disability. Executive Order 12898 directs that programs, policies, and activities identify and address, as appropriate, disproportionately high and adverse human health and environmental effects on minority and low-income populations.

For environmental justice and Title VI evaluations, consideration is given to the following population types:

- Racial and ethnic minorities,
- The elderly (persons 60 and older),
- Persons with disabilities,
- Female heads of household (with children younger than 18 and no husband present), and
- Low-income households (household income at or below the U.S. Department of Health and Human Services poverty guidelines).

Environmental justice analyses have historically relied on decennial census data for identifying these protected populations. In the past, the "long form," which was sent to a random selection of homes, provided statistical data that included detailed disability, income, dwelling, journey-to-work, household, and vehicle ownership information.

Changes in data gathering for the 2010 and future censuses, have created gaps with regard to income and disability status. In a program that began in 1995 and was fully implemented in 2010, the U.S. Census Bureau

has used the American Community Survey (ACS) to obtain the demographic, housing, social, and economic information formerly gathered through the "long form." Going forward, the ACS will capture income and disability data no longer provided by the decennial census.

The ACS annually samples a small number (approximately one percent) of households across a country, and while it does not provide official population counts, it does provide the ability to monitor social and economic trends in a local community. The ACS combines population or housing data from multiple years to produce reliable numbers for small counties, neighborhoods, and other local geographies.

ACS data is released as both single-year and multi-year estimates. For smaller geographies such as census tracts or block groups, ACS data is only available in five-year estimates, requiring that five years of data be collected before results can be released. These estimates are updated by removing the earliest year's data and replacing it with the most recent year. For instance, the 2005 to 2009 estimate was replaced with a 2006 to 2010 estimate, which was released in 2011.

To account for the differences in Census and ACS data, FHWA's Arizona Division has determined the specific sources to use for environmental justice data collection. Based on the current availability of data, **Table 3-4** presents each type of data typically accessed in an environmental justice evaluation as well as the currently recommended source.

Table 3-4. Recommended sources for environmental justice data collection

Data Set	Source
Racial and ethnic minorities	Census 2010
Elderly (persons 60 and older)	
Female heads of household (with children <18 and no husband present)	
Low-income households (persons living below the poverty level)	2006-2010 ACS[a]
Persons with disabilities[b]	Census 2000

[a] The 2006-2010 estimates were released on December 8, 2011.

[b] Because disability questions were changed substantially in 2008, disability data collected prior to 2008 cannot be compared with data collected from 2008 or later. Since five years of data have not yet been able to be collected since 2008, there is no five-year disability estimate available, which means the most recent disability information at the census tract level is from Census 2000.

The 2010 Census data indicate that minority populations are wide spread within the study area. The percentage of minority populations represents over 30 percent of the total population throughout the majority of the study area, and this is higher than the corresponding percentages for Pinal County and the cities of Maricopa and Casa Grande. Therefore, census blocks containing protected populations have been identified in the EO. Further analysis to identify elderly populations, persons with disabilities, female heads of household, and low-income households will occur to support the environmental clearance.

While it does not present any particular limitations from a construction standpoint, the high percentage of minority population throughout the study area makes it likely that any future transportation facility would affect protected populations. Environmental justice factors that could differentiate the viability of alternatives in the study area include displacements and relocations, traffic noise, and access changes to businesses that may be owned or chiefly patronized by minority populations.

It is recommended that targeted outreach be undertaken during the environmental clearance to further identify protected populations and provide opportunities for the populations to participate meaningfully in the project development process. It is also recommended that a Community of Comparison be defined as part of the environmental clearance to further refine the environmental justice and Title VI analysis. Continued coordination with the lead environmental agency would determine whether to adhere to the source and categories of environmental justice data to be analyzed.

Overall, environmental justice impacts may not necessarily contribute to establishing differences among possible alternatives that may occur in the study area. However, potential differences in impacts on environmental justice communities should be addressed when screening and comparing alternatives.

3.3.4 Visual Resources

In short, the visual character of the study area varies from a developed suburban/commercial setting in the northwest section of City of Maricopa to extensive agricultural fields in the southern portion to large, open, undeveloped areas along Val Vista Boulevard. Additionally, there are no designated scenic roads or byways located in the study area.

Land under the jurisdiction of BLM's Lower Sonoran Field Office is subject to a visual resource management (VRM) system that assesses the scenic value of an area and then establishes management objectives based on an acceptable level of visual preservation or disturbance. No other land-managing agencies with visual impact requirements (e.g., National Park Service, U.S. Forest Service) own or have jurisdiction over land in the study area.

The overall goal of BLM's VRM system is to minimize visual impacts wherever they occur on public land. The existing visual resource classifications for the BLM land in the study area are Class III near the Gila River Indian Community border and Class IV east of I-10. VRM Class III allows management activities that partially retain the existing character of the landscape. The level of change to the characteristic landscape should be low to moderate. Management activities may attract attention but should not dominate the view of the casual observer, and changes should repeat the basic elements found in the predominant natural features of the characteristic landscape. VRM Class IV allows major modifications to the existing characteristics of the landscape. The level of change can be high and management activities may dominate the view. However, every attempt should be made to minimize the visual impacts of such activities.

Generally undeveloped terrain and the western foothills of the Sacaton Mountains to the northeast dominate views east of Anderson Road. With the exception of these areas, the terrain in the study area is flat to gently sloping downward to the south.

Commercial/residential development characterizes much of the northwest and central portions of the study area. Distinctive visual features in the central portion of the City of Maricopa include the water tower adjacent to the railroad tracks and a cluster of older industrial buildings surrounding it. The agricultural portion of the study area features open land with low-growing crops extending for miles, as well as a small number of pecan groves visible from the major highways. In the City of Maricopa, residential developments give way to undeveloped areas moving northeast from the Maricopa-Casa Grande Highway. I-10 dominates the horizon heading east in the study area through the City of Casa Grande. Vegetation in the undeveloped portions of the study area is sparse and predominately consists of low shrubs and trees.

Overall, impacts to visual resources do not necessarily contribute to establishing differences among possible alternatives that may occur in the study area. However, potential differences in impacts on visual resources are not anticipated to be a critical factor when screening and comparing alternatives. The study area does include land managed by the BLM, which could trigger a visual impact analysis should a future alternative cross BLM land.

3.3.5 Cultural Resources

Cultural resources are properties that reflect the heritage of local communities, states, and nations. Properties judged to be significant and to retain sufficient integrity to convey that significance are termed "historic properties" and are afforded certain protection in accordance with state and federal legislation. The National Historic Preservation Act of 1966, as amended, defines historic properties as sites, buildings, structures, districts (including landscapes), and objects included in, or eligible for inclusion in, the NRHP, as well as the artifacts, records, and remains related to such properties. Traditional cultural properties having heritage value for contemporary communities also can be determined eligible for and listed in the NRHP because of their association with historic cultural practices or beliefs that are important in maintaining the cultural identities of these communities, e.g., Native American groups.

Section 106 of the National Historic Preservation Act requires federal agencies to consider the potential effects of their undertakings on historic properties. Effects can be direct and result in physical alteration to the property, or indirect, in that the characteristics qualifying the property for NRHP listing are altered as a result of visual, auditory, or atmospheric intrusions.

To be considered eligible for listing in the NRHP, a property must meet at least one of the following criteria:

- Is associated with events that have made a significant contribution to the broad patterns of our history (Criterion A);
- Is associated with the lives of persons significant in our past (Criterion B);
- Embodies the distinctive characteristics of a type, period, or method of construction or that represents the work of a master, or that possesses high artistic values, or that represents a significant distinguishable entity whose components may lack individual distinction (Criterion C); or
- Has yielded, or may be likely to yield, information important in prehistory or history (Criterion D).

When defining the affected environment, archival research and record searches were conducted using only the AZSITE cultural resource database. The AZSITE records search identified 93 prior archaeological projects and 43 previously recorded cultural resource sites in the study area (AZSITE 2011). As listed in Table E-2 of *Appendix E* in the EO, known cultural resources include a prehistoric habitation, prehistoric artifact scatters, prehistoric sherd scatters, historic trash/artifact scatters, a historic railroad siding, a historic transmission line, a historic well, rock piles/concentrations with prehistoric artifacts, historic runways/taxiways, and historic roads. A complete list of prior project surveys in the study area can be found in Table E-1 of *Appendix E* in the EO.

NRHP eligibility recommendations of properties identified in Table E-2 of the EO were based solely on information found on the AZSITE cultural resources database. In some cases, previous evaluations of these sites included eligibility recommendations. In other cases, sites were not evaluated for inclusion in the NRHP. Sites listed as "not considered" eligible or not eligible/eligible or tested suggest that some consultation has occurred as a result of past projects. However, no details were available on AZSITE.

Environmental Concerns and Recommendations for Further Analysis

As project planning progresses, additional cultural resources research and inventory would likely be required to determine the area of potential effect (APE) for future alternatives. Efforts to obtain specific eligibility criteria and to arrive at definitive eligibility assessments, including assessing whether the portions of eligible properties subject to potential effects are contributing or non-contributing, would also occur. It is probable that an agreement document (a memorandum of agreement or a programmatic agreement) would be developed to demonstrate Section 106 compliance. When a preferred alternative is defined (assuming it is one of the build rather than no-build alternatives), the project proponents and federal lead agency would determine what impact construction of that alternative would have on the identified historic properties. The three possible determinations are "no historic properties affected," "no adverse effect," and "adverse effect."

Just because a historic property may be on or near the preferred alternative does not necessarily mean that it will be subject to an "adverse effect" determination. Various strategies can be employed to completely avoid effects or to ensure that effects are minimized and, therefore, not adverse. If it is determined that a historic property would be adversely affected, it would be necessary to identify mitigation measures to minimize those effects to the extent possible. Such measures can include data recovery of archaeological sites and documentation of historic buildings and structures. If adverse effects to cultural resources valued for in-place preservation (typically those determined eligible under Criterion A, B, or C) cannot be avoided, a Section 4(f) alternatives evaluation would be required to explore the potential for a prudent and feasible alternative that would not result in a Section 4(f) use.

When project alternatives and an APE have been identified, impacts on historic properties would be evaluated. In addition, cultural resource surveys according to current Arizona State Museum (ASM) guidelines would be conducted for all portions of the APE that have not been previously surveyed or that were surveyed over ten years ago.

Table 3-5 presents agencies and tribes that may be involved in the Section 106 compliance process.

Table 3-5. Potential consulting parties to the Section 106 compliance process

FHWA	BLM
Ak-Chin Indian Community	Gila River Indian Community
Colorado River Indian Tribes	Fort Yuma-Quechan Indians
Hopi Tribe	Pascua Yaqui Tribe
San Carlos Apache Nation	Tohono O'odham Nation
Tonto Apache Tribe	White Mountain Apache Tribe
Yavapai-Apache Nation	ADOT
Arizona State Land Department	Pinal County
City of Casa Grande	City of Maricopa
Union Pacific Railroad	

Overall, potential differences in impacts on cultural resources should be included in the criteria used to screen and compare alternatives.

3.4 Environmental Overview Conclusion

The evaluation of social, economic, and environmental resources in the study area uncovered a number of issues that could potentially affect the selection of viable alternatives evaluated in this study. For example, a given alternative could result in impacts that would render it infeasible when compared to a different alternative with fewer impacts. Focused, detailed analysis and documentation, stakeholder participation, and development of mitigation measures would occur during preparation of the subsequent final environmental clearance documents. These clearance documents would follow NEPA guidelines (42 U.S.C. 4321–4347) (NEPA1970), as implemented by the Council on Environmental Quality (CFR Title 40, Part 1508.8), and FHWA guidelines (CFR Title 23, Part 771). **Table 3-6** summarizes the resources within the study area and recommendations for further analysis.

Table 3-6. Summary of resources and recommendations for further analysis

Resource	Existing Conditions	Further Analysis	Alternatives Selection
Topography / Physiography	Relatively flat; washes; Sacaton Mountains; subsidence and faults	None recommended; avoid large cuts/fills and fault lines	Not a critical factor
Native Vegetation / Plant Communities	Lower Colorado River Valley and Arizona Upland subdivisions of Sonoran desert scrub; protected native plants; invasive species	Minimize vegetation removal; implement invasive species mitigation measures; coordinate with Arizona Department of Agriculture for protected native plant salvage	Consider when screening/ comparing
Biology / Wildlife	Desert tortoise (Sonoran population); Acuna cactus; Western burrowing owl; Tucson shovel-nosed snake; Western yellow bat	Additional USFWS and AGFD coordination; Biological Evaluation for agency review	Consider when screening/ comparing (wildlife connectivity not a critical factor)
Hydrology	100-year floodplains; Waters; registered wells	Evaluate impacts; coordinate with affected agencies and landowners; proceed with permits as required (Letter of Map Revision, Section 401/402/404, etc.)	Consider when screening/ comparing
Prime and Unique Farmlands	Prime farmlands in 90 percent of the study area	Determine extent to which FPPA applies; coordinate with NRCS and local governments	Consider when screening/ comparing
Noise	Noise-sensitive receptors (residences, recreation areas, schools, etc.)	Noise modeling and abatement evaluation	Include in criteria used to screen/compare
Air Quality	$PM_{2.5}$ and PM_{10} non-attainment areas	Qualitative analysis of $PM_{2.5}$, interagency consultation regarding status as a project of air quality concern, and quantitative PM_{10} hotspot analysis	Not a critical factor

Table 3-6. Summary of resources and recommendations for further analysis

Resource	Existing Conditions	Further Analysis	Alternatives Selection
Hazardous Materials	Known hazardous materials sites	Avoid where possible; additional location-specific evaluation depending on alternatives and new right-of-way acquisition	Include in criteria used to screen/compare
Section 4(f)	Two Section 4(f) parks; potential for schools and planned parks/trails	Coordinate with jurisdictions to determine availability and local significance of potential resources; avoid impacts to Section 4(f) resources	Include in criteria used to screen/compare
Land Use, Ownership, Jurisdiction	Pinal County, Ak-Chin Indian Community, BLM, Arizona State Land Department, City of Casa Grande, City of Maricopa	Evaluate alternatives for conformance with land use plans and zoning	Include in criteria used to screen/compare
Socio-economics	Existing residential and commercial neighborhoods and employers	Evaluate potential for displacements, relocations, and impacts to neighborhood continuity and community cohesion	Include in criteria used to screen/compare
Title VI/ Environmental Justice	Existing protected populations	Identify community of comparison, identify impacts to protected populations, and conduct environmental justice analysis; conduct targeted outreach to identify protected populations and provide opportunities for meaningful input	Consider when screening/ comparing
Visual Resources	BLM parcels subject to VRM analysis	Coordinate with BLM and perform visual impact analysis if alternatives affect land under BLM jurisdiction	Not a critical factor
Cultural Resources	43 cultural resource sites previously recorded on AZSITE	Complete literature review to determine known site eligibility and additional survey requirements; conduct consultation based on alternatives and impacts	Include in criteria used to screen/compare

4.0 ALTERNATIVE CORRIDOR INVESTIGATION

4.1 Introduction

Developing a high capacity limited access facility after existing roads and infrastructure are in place would be a difficult task. Fortunately, the location process for the EWC is starting and identifying a route while virtually all of the existing roads are still 2-lane facilities. The goal of providing an efficient, access controlled facility that will meet the requirements of projected traffic in the 2040 design year and beyond is well within reach. In general, improvements will be constructed within existing roadway corridors (not necessarily within the existing R/W) and will utilize the existing paved roadway to the extent feasible. Design concept alternatives will be defined, developed and evaluated to present a recommended alternative for implementation.

Major objectives of the study include providing needed capacity, enhancing the efficiency / preference for the east-west movement, improving safety, and improving operational features within the study limits.

The study is defined to begin at the western limits on SR 347, and progresses from west to east. The engineering stationing and subsequent descriptions of the work for this facility therefore progresses from west to east. The alternatives have been developed and described from west to east, in accordance with the engineering stationing. As there is no state or federally defined route with mileposts for these improvements, all location references will be based on existing cross streets.

4.2 Corridor Location Analysis

During development of Pinal County's RSRSM study, a corridor for the EWC was defined in general terms; a route that started at SR 347 on Farrell Road, then heading east to the MCGH, then heading southeast to Val Vista Boulevard to I-10. The intent of this study is to develop that specific alignment, intersections, and access configurations of that corridor.

During the scoping process, the RSRSM solution described above was shown as the center for the Study Area. Participants from both the Agency and Public scoping meeting provided comments on where they thought the corridor should be located. The results of that scoping process are shown in **Figure 4-1**.

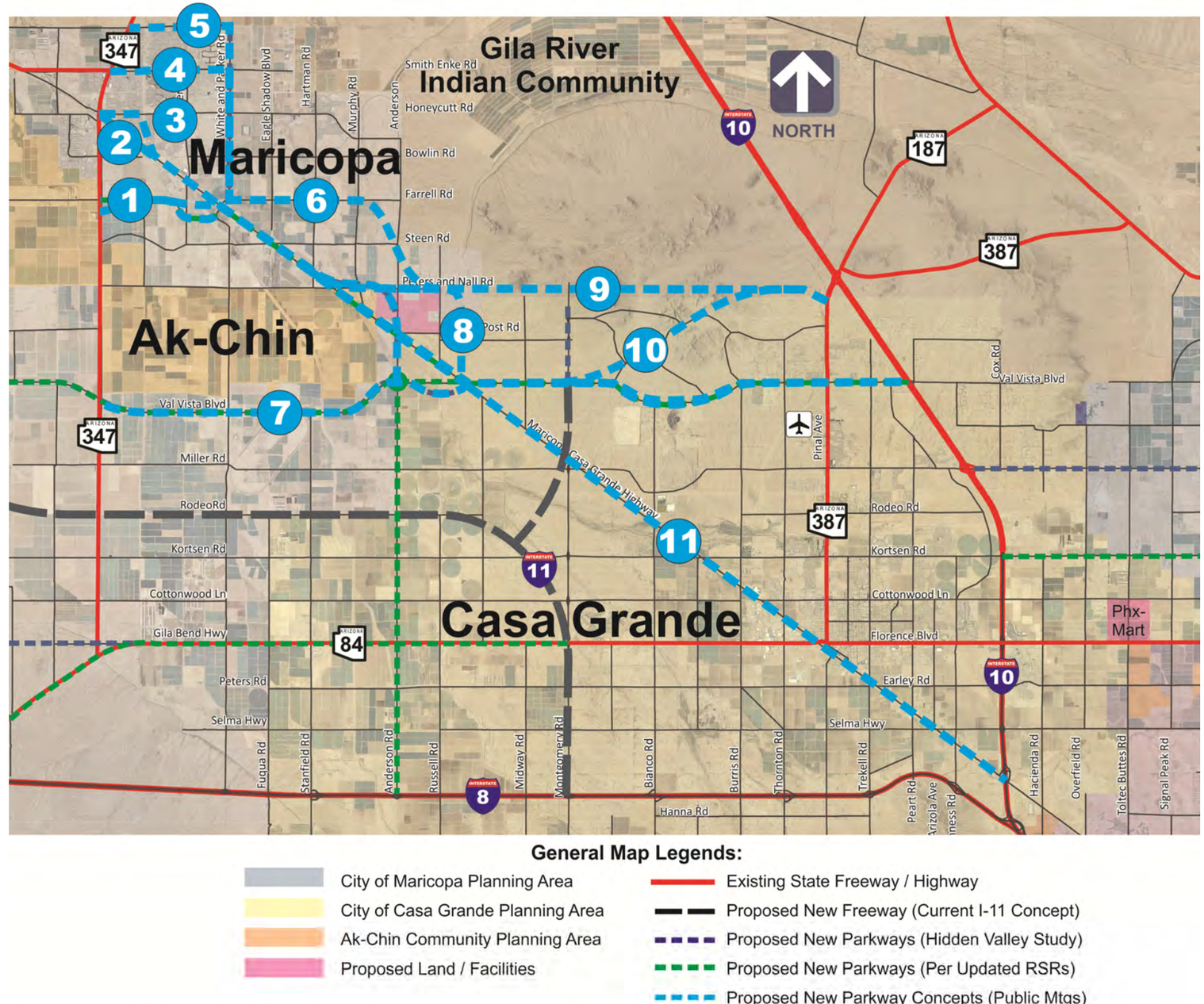


Figure 4-1: Initial EW Corridor Alternatives

4.3 Corridor Evaluation Criteria

The Study Team evaluated each one of the corridors shown in **Figure 4-1** for possible advancement. The criteria used for evaluating the initial corridors were developed from the public and agency scoping comments. Other factors that influenced the decision to use, or eliminate, a corridor as the basis for the east-west improvements include:

1. The ability to widen the existing roads to a four-lane (and ultimately a six-lane) divided parkway facility within the available R/W corridor was stressed as a primary project objective. This requirement was not such that the desired 200-ft for a parkway was already dedicated, but that requiring this R/W would not be restricted due to existing homes, structures, railroads, or environmental/cultural sites.
2. Potential for access control - The goal of a parkway is to efficiently convey traffic through the corridor at a consistent speed. Limiting the number of signalized intersection, along with limited impedance from adjacent properties and cross streets supports this type of facility.
3. Potential use of the existing roadway for one direction of travel, requiring less construction of new roadway surfaces. Maintaining the existing roadway for one direction of travel will reduce impacts on adjacent property, and retain access to existing drives and turnouts.
4. Consistency with planned developments - The EWC should be consistent with City master plans and development plans, and avoid major impacts with existing developments. With so much undeveloped land within the study area, the taking of existing homes and businesses should be avoided. While the alignment should consider proposed developments, it will not consider future planned developments as equal to existing homes and businesses.
5. Fits the existing landform - While most of the study area is relatively flat, the proposed improvements should avoid major mountains and topographic features that would make construction of the route excessive.
6. Avoid major environmental impacts - The area has many know cultural sites, as well as large waterways, existing mines, prime farmlands, and public parks. These features have many national protection measures in place that suggest transportation facilities should avoid them.
7. Respect that decisions on using or addressing improvements on Tribal lands is not under the discretion of the Cities, Counties, or State, but rather under the sovereign control of the respective Tribal Government.
8. Alternative route / reliever to SR 347 when this connection between Maricopa and metropolitan Phoenix is severed / delayed due to a major car crash or emergency.

4.4 No-Build Alternative

It needs to be stressed that the No-Build Alternative is provided for comparison purposes throughout the development of this study process. This solution provides no improvements to the capacity, safety, and operational features of the existing roadway, and involves no cost and no apparent change to the environmental features of the existing roadway corridors.

4.5 Corridor Descriptions:

4.5.1 Corridor 1

Figure 4-2: Corridor 1 Alignment

This is the base corridor provided by the RSRSM. It starts at SR 347 near the intersection of Farrell Road, then heading east towards the MCGH. A new grade-separated crossing of the UPRR is required to combine with the MCGH. It then continues southeast to extension of Val Vista Boulevard to the MCGH. This intersection is a future parkway-to-parkway intersection of the EW corridor, and the future Val Vista Boulevard parkway continuing west. At this same intersection, the alignment heads easterly along Val Vista Boulevard to I-10, the eastern terminus of this corridor.

4.5.2 Corridors 2-5

These corridors all have the same alignment as Corridor 1 as they head easterly, but how they connect to SR 347 is what differentiates them.

Figure 4-3: Corridors 2-5 Alignments

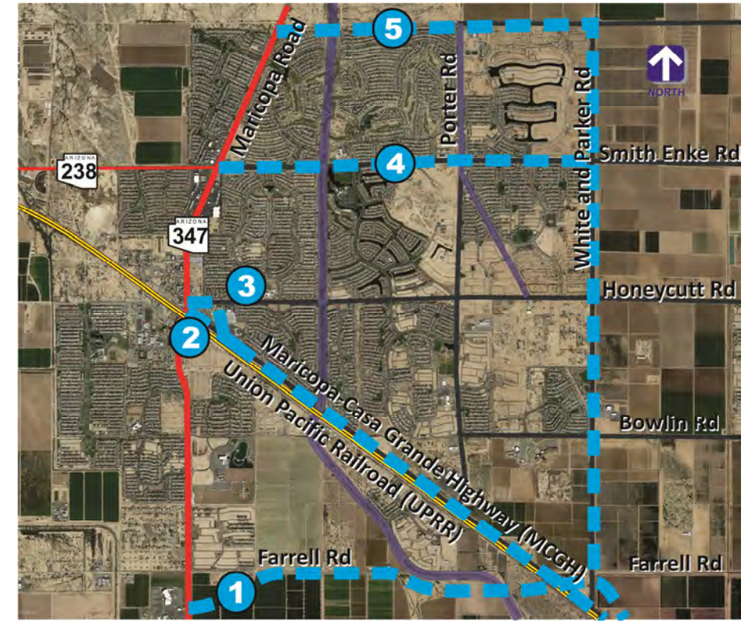


Figure 4-4: Corridors 2-5 Detailed Alignments

Corridor 2: This corridor starts on SR 347 in the same location as the MCGH does today, just north of the UPRR Tracks. From this existing intersection, the alignment heads southwest following the MCGH until it intersects with the southeast to extension of Val Vista Boulevard to the MCGH. There is no difference from Corridor 1 southeast of Farrell Road.

Corridor 3: This corridor starts on SR 347 at the intersection of West Honeycutt Road, just north of the current MCGH intersection. The alignment then continues east along Honeycutt Road to 4th Avenue, where the alignment curves to the south and realigns with the MCGH, avoiding impacts to the Maricopa Unified School District offices and bus maintenance area. Once on the alignment of the MCGH, it follows the alignment of Corridors 1 and 2.

Corridor 4: This corridor starts on SR 347 at the intersection of Smith Enke Road, which is also the intersection with SR 238 heading west to Gila Bend. The corridor continues to the east through the developments of Rancho El Dorado, Province, The Lakes at Rancho El Dorado, and Homestead North where it turns south at the intersection of White and Parker Road. It continues south along White and Parker to the intersection of the MCGH, where this corridor heads southeast following the MCGH, and following the alignment of Corridor 1 for the remainder to I-10.

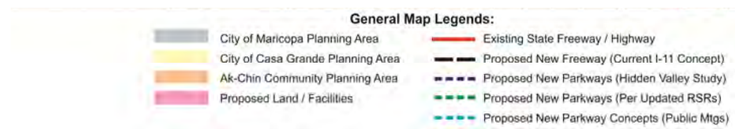
Corridor 5: This corridor starts at the boundary of the GRIC and Maricopa, building a new road immediately north of the existing developments of Rancho El Dorado and The Lakes at Rancho El Dorado. The alignment continues east where it turns south at the intersection of White and Parker Road. It continues south along White and Parker to the intersection of the MCGH, where this corridor heads southeast following the MCGH, and following the alignment of Corridor 1 for the remainder to I-10.

4.5.3 Corridors 6-8

These corridors are in the mid-section of the study, and can tie to multiple corridors both east and west.

Corridor 6: This corridor starts similar to Corridor 1 following the Farrell Road corridor from SR 347. When this corridor crosses over the UPRR, it continues on the Farrell Road alignment due east through the balance of the City of Maricopa. As it approaches the eastern limits of the City, the alignment heads southeast, with the option of tying in with Corridor 8, or Corridor 9 for the balance of the improvements.

Figure 4-5: Corridors 6-8 Alignments



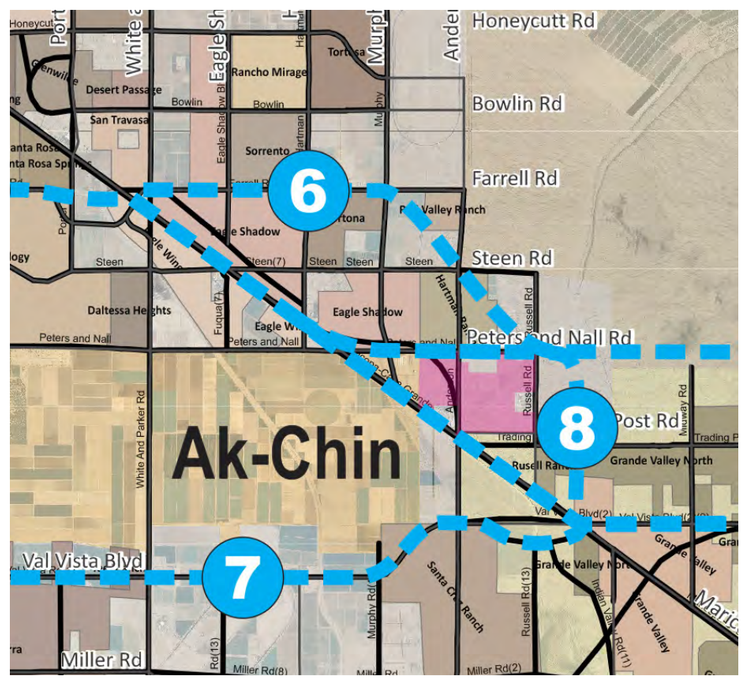


Figure 4-6: Corridors 6-8 Detailed Alignments

Corridor 7: The RSRSM identifies several future corridors for parkways. Another parkway corridor identified in the RSRSM is an alignment that follows an approximate Val Vista Boulevard route from Warren Road all the way to the MCGH. The route is generally south of the Ak-Chin Indian Community lands, and north of the Volkswagen proving grounds. This corridor is being evaluated by the Town of Maricopa in greater detail as to how it would be located, similar to this study. Selecting Corridor 7, the EWC would begin at SR 347 and go on a new alignment south of the Ak-Chin lands until it aligns with the Val Vista Boulevard crossing over the UPRR. From this point, it would continue east following the Corridor 1 alignment to the intersection with I-10.

Corridor 8: This corridor starts similar to Corridor 1 following the Farrell Road corridor through and aligning with the MCGH as it approaches the boundaries of the Ak-Chin Indian Community. Just prior to Peters and Nall Road, this corridor turns and heads east following just north of the northern boundaries of the Ak-Chin Indian Community. Once past the Ak-Chin Indian Community lands, this alignment turns and heads south, paralleling about ½ miles east of Russell Road, to combine with Corridor 1 once it reaches Val Vista Boulevard. From this intersection, it continues east following Val Vista Boulevard to I-10.

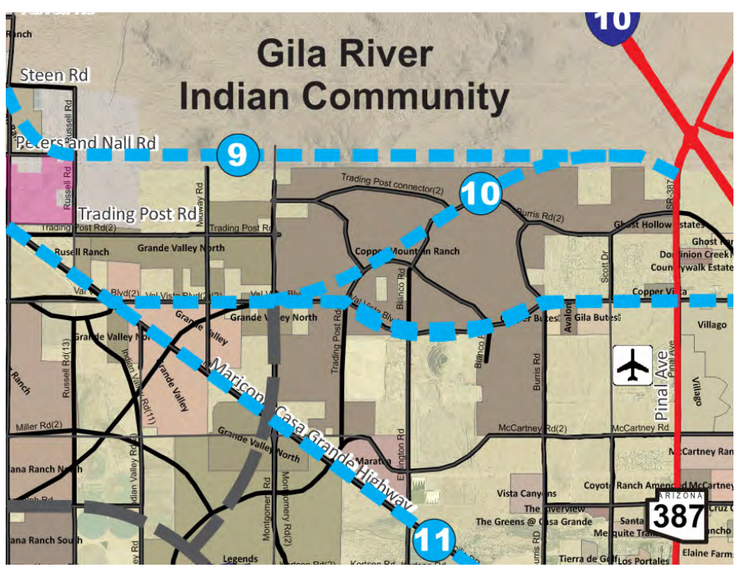
This corridor had initially a similar alignment as the Corridor 8 segment shown, but it turned south after Anderson Road rather than after Russell Road, the original limits of the Ak-Chin Indian Community. They have since expanded to include the pink-colored lands enveloping the airfield as part of the Community. The intent of both of these corridors was to avoid Ak-Chin Community lands if it should turn out that Pinal County would not be able to successfully acquire any R/W through the Ak-Chin Indian Community lands for the MCGH highway. Since the start of the study, those easements have been formally acquired, granting Pinal County an easement that is 150-ft wide and parallel to the UPRR for the MCGH to be maintained.

4.5.4 Corridors 9-11

These corridors are alternatives to the eastern terminus of the study.

Figure 4-7: Corridors 9-11 Alignments

Figure 4-8: Corridors 9 & 10 Detailed Alignments



Corridor 9: This corridor has the option of being a continuation of Corridors 1 through 6, and is the "outer loop" of these alternatives. Once the previous corridors approach the Ak-Chin Indian Community lands, the alignment heads due east and follows just north of the northern limits of the Tribe. Beyond Russell Road, the alignment continues east, but remains just south of the southern boundary of the GRIC. The alignment continues until it intercepts Pinal Avenue (SR 387), where this concept terminates. Beyond the intersection with SR 387, a left turn onto SR 387 brings you to the existing interchange with I-10.

Corridor 10: This corridor has the option of being a continuation of Corridors 1 through 5, or Corridor 7, but after heading east from the MCGH intersection with Val Vista Boulevard, this alternative traverses through the proposed Copper Mountain Ranch to eventually tie into the Pinal Avenue (SR 387) just ½-mile south of I-10, where this concept terminates. The alignment does not follow any existing or proposed subdivision alignment, but would require the some modification of the development plans of this subdivision to work. Beyond the intersection with SR 387, a left turn onto SR 387 brings you to the existing interchange with I-10.

Corridor 11: This corridor could begin as any of the previous alternatives, but it terminates with I-10 at the existing Jimmie Kerr Blvd. interchange already constructed on I-10. This concept continues along the MCGH to its terminus today at the intersection of Cottonwood Lane, then continues the parkway parallel to the UPRR through private property until it intersects with SR 84, just west of the intersection of SR 287, and SR 387. The alignment would continue following 2nd Street to eventually continue on Main Street, and continue southeast to the intersection with I-10.

4.6 Corridor Evaluation

Each of the 11 Corridor Alternatives was evaluated by the Study Team against the Corridor Evaluation Criteria described in Section 4.2. **Table 4-1** shows the results of this evaluation.

While each of the alternatives had benefits to the community, **Corridors 5, 9, 10, and 11** had a fatal flaw that eliminated them from further consideration.

Corridors 2 and 3 connect to SR 347 in the heart of the downtown area. While SR 347 is being reconstructed to provide a grade-separated crossing over the UPRR, a major intersection with a high capacity parkway in the immediate location of the overpass would significantly impact the downtown, and is therefore not being carried forward.

Corridor 4, while acceptable for a series of arterials, does not support a regional parkway with the 90-degree turns, limited R/W, and existing subdivision infrastructure. Widening to provide the eventual 6-lanes will take out R/Ws of homes on both sides of the R/W. Therefore, this concept is not being carried forward.

Corridor 6 routes the regional parkway through a corridor that did not anticipate the parkway, and through lands (Farrell Road to Val Vista Boulevard) where no major regional route was previously proposed. Using the MCGH through this area maintains traffic on an existing major regional route, provides access desired to the Ak-Chin Indian Community, and does not impact development plans. Therefore, this concept is not being carried forward.

Corridor 7 is a RSRSM approved route / corridor. However, the desire of the EW corridor is to determine the route for the northerly parkway improvement that will address traffic going into and out of the downtown Maricopa area. This alignment is too far to the south, and is intended to service the Maricopa lands south of the Ak-Chin Indian Community when this area eventually develops. Therefore, this concept is not being carried forward.

Corridor 8 was developed as an alternative to going through the Ak-Chin Indian Community lands if the Tribe was opposed to improvements through the MCGH and its lands. Contrary to this concept, the Community desires the alignment be maintained on the MCGH to provide access to its commercial lands. Therefore, this concept is not being carried forward.

Corridor 1: The greatest challenge associated with Corridor 1 was the adjustments through the initial private property with developers adjacent to SR 347. This work is described in greater detail in *Section 5.0* with the development of alternatives addressing properties around the intersection with Farrell Road and SR 347. The balance of the corridor has been planned with developers since the RSRSM was approved, through both the Maricopa and Casa Grande. Therefore, this is the route proposed for all future parkway improvements.

The results of this evaluation was shared with the Stakeholder Agencies and the Public at our February 20 and 21, 2013 meetings, held at the City of Maricopa and the City of Casa Grande, respectively.

While the main corridor from SR 347 to I-10 was defined through this process to be Corridor 1, there were several alternatives for intersection layout, interchange layout, and detailed alignment decisions that were worked out with the stakeholder agencies. The refinements of the corridor to the recommended improvements are described in Section 5.0 of this report.

Table 4-1: Evaluation of Corridor Alternatives

Criteria:	1: Available R/W	2: Access Control	3: Re-Use of Existing	4: Planned Development	5: Land Form	6: Environmental	7: Tribal Approval	8: Relieves SR 347
Alternatives:								
Corridor 1	Initial 1.5 mile segment requires developer adjustments. New road R/W required for 1-mile segment between Porter and White/Parker. Balance of the route is using existing roads with at least 150-ft of available R/W	No distinguishable difference between the alternatives, as all will invoke the Arizona Parkway to achieve the desired access control	Most of the route allows re-use of the existing roadway.	Initial first mile requires adjustments to the development plans, although the City has been working with the developer to find a common approach that is acceptable. Balance of route is consistent with development plans.	The majority of the route proposed is basically flat and has no critical challenges to overcome.	No fatal flaws were identified with the EO.	No GRIC lands are affected. Proposed improvement through Ak-Chin lands are consistent with Tribe desires.	If required, could support realignment of traffic heading between community and metropolitan Phoenix.
Corridor 2	Western terminus is limited through the older downtown. Balance of route is using existing roads with at least 150-ft of available R/W.		Greatest potential of re-use of all of the alternatives.	Majority of route is consistent with development plans.		New alignment through historic downtown Maricopa requires additional review as cultural and environmental justice concerns may be present.		
Corridor 3	Initial alignment through existing developments do not support Parkway R/W, with only 100-ft available. Balance of the route is using existing roads with at least 150-ft of available R/W		New alignment required for first mile.	Majority of route is consistent with development plans.		New alignment through historic downtown Maricopa requires additional review as cultural and environmental justice concerns may be present.		
Corridor 4	Initial alignment through existing developments do not support Parkway R/W, with only 100-ft available. Balance of the route is using existing roads with at least 150-ft of available R/W.		The completed arterial through the first 2.5 miles does not fit a parkway, especially with the future regional traffic demand diverted through this area. While built with a median, it is too narrow for the parkway requirements. Full reconstruction is required.	Not consistent with existing development for first two miles. Parkway not planned for White and Parker Road due to the heavy utilities located in corridor.		No fatal flaws were identified with the EO.		
Corridor 5	Initial alignment through GRIC lands, which is not approved by Tribe. Balance of the route is using existing roads with at least 150-ft of available R/W		The initial two miles either requires construction on GRIC lands, or complete acquisition of existing homes to provide for this roadway. These are fatal flaws that will not be carried forward.	Not consistent with existing development for first two miles. Parkway not planned for White and Parker Road due to the heavy utilities located in corridor.		Initial alignment crosses through GRIC lands, which may have significant cultural issues. Further environmental investigation is necessary.	No access across GRIC lands is approved by the Tribe. Concepts requiring access across GRIC lands is a fatal flaw that cannot be carried forward.	
Corridor 6	Middle transition area crosses several planned subdivision where this route was not planned. Balance of route is using existing roads with at least 150-ft of available R/W.		Concept requires the widening of Farrell Road, and development of a new parkway through lands not developed between Farrell Road and Val Vista Blvd Connection.	Not consistent with development plans for the arterial of Farrell, and requires redesign of development concepts between Farrell Road and Val Vista Boulevard.		No fatal flaws were identified with the EO.	Concept for realignment outside of the Ak-Chin Indian Community is not supported by the Tribe, as this excludes the Community lands from desired access to the EWC.	
Corridor 7	Western half crosses new properties where there is no established R/W at this time. Mostly farm fields.		The western half does not exist. All new construction for this effort.	Majority of route is consistent with development plans, with the understanding that a parkway is proposed along this general alignment, although no provisions for the R/W have been acquired to date.		This corridor is outside of the initial study limits of the EO. No information on fatal flaws associated with the environmental review is available.	Concept for realignment outside of the Ak-Chin Indian Community is not supported by the Tribe, as this excludes the Tribe from desired access to the proposed parkway.	Proposed route does not pass near the heart of Maricopa, and is not as desirable as other alternatives for providing relief should SR 347 to the north being closed.

Table 4-1: Evaluation of Corridor Alternatives

Criteria:	1: Available R/W	2: Access Control	3: Re-Use of Existing	4: Planned Development	5: Land Form	6: Environmental	7: Tribal Approval	8: Relieves SR 347
Alternatives:								
Corridor 8	Most of the route is using existing roads with at least 150-ft of available R/W The connection between Peters & Nall Road and Val Vista Boulevard would require new R/W.	No distinguishable difference between the alternatives, as all will invoke the Arizona Parkway to achieve the desired access control	All new construction is required for the segment around the Ak-Chin Indian Community, which is primarily the purpose of this route (an alternative if the R/W and access through the Ak-Chin Indian Community lands were not possible).	Connection between Peters and Nall Road and Val Vista Boulevard will require adjustments to development plans. Balance of route is consistent with development plans.	The majority of the route proposed is basically flat and has no critical challenges to overcome.	No fatal flaws were identified with the EO	Concept for realignment outside of the Ak-Chin Indian Community is not supported by the Tribe, as this excludes the Community lands from desired access to the EWC.	If required, could support realignment of traffic heading between community and metropolitan Phoenix.
Corridor 9	No road is planned along most of this route. Requires all new R/W and redevelopment plans.		The eastern half does not exist. All new construction for this effort.	This route was not requested nor anticipated by developers. It will require the re-design of most of the lands between Anderson Road and Pinal Avenue.	Proposed alignment goes through the peak of the Sacaton mountains. While the proposed alignment looks good on flat paper, it is not feasible for construction over this mountain range. This is a fatal flaw that will not be carried forward.	No fatal flaws were identified with the EO	No access across GRIC lands is approved by the Tribe. Concepts requiring access across GRIC lands is a fatal flaw that cannot be carried forward.	
Corridor 10	This corridor requires re-design of the Copper Mountain Subdivision, as the proposed route is not consistent with development plans.			The alignment does not take into account the desires of the development. With all of the streets already developed in the master plan, this change would have a significant impact to a very large master planned community.	The majority of the route proposed is basically flat and has no critical challenges to overcome.	No fatal flaws were identified with the EO	No GRIC lands are affected, assuming northern connection requires all new private R/W and no encroachment into GRIC community is required. Proposed improvement through Ak-Chin lands are consistent with Tribe desires.	
Corridor 11	Western 2/3 of the route is using existing roads with at least 150-ft of available R/W. Eastern third requires new or significantly widened R/W through historic downtown Casa Grande.		There is no existing roadway that links the MCGH all the way through Casa Grande. Significant disturbance to the homes/businesses is required to extend the roadway between Cottonwood Lane and Main Street.	There are no development plans in conflict, because the route follows were all development is complete.		This corridor is outside of the initial study limits of the EO. No information on fatal flaws associated with the environmental review is available; however, it traverses through the core of the historic downtown Casa Grande and will likely have cultural, historic, and environmental justice concerns.	No GRIC lands are affected. Proposed improvement through Ak-Chin lands are consistent with Tribe desires.	This does not support getting traffic from Maricopa directly back to I-10 with any improvement

5.0 DESIGN CONCEPT ALTERNATIVES

5.1 Introduction

Section 4.0 confirmed the location of the corridor. The public and agencies agreed to the selection of that corridor in February, 2013. Since that time, most of the effort by the study team was focused on gaining consensus on how the specific improvements will fit with proposed development plans, and existing infrastructure.

This Section focuses on the details of determining the specific alignment of the parkway throughout the study corridor. The project was broken into zones where various alternatives were considered. For each zone, all of the alternatives considered will be described. The recommended improvement may be a combination of alternatives, or an evolution of a single concept that changed as comments were received.

There are no specific evaluation criteria being used to refine these alternatives. The primary goal of all of the improvements is to fit a parkway typical section with lanes that will sustain traffic well after the 2040 projected travel demands, and accommodate both existing and proposed adjacent development. When there was a conflict with these primary objectives, the study team worked with the underlying City, County or Tribe to resolve what best met their desired goals for the corridor.

As in prior sections, since the study is defined to begin at the western limits on SR 347, and progresses from west to east, the concept zones progress from west to east. The alternatives have been developed and described from west to east, in accordance with the engineering stationing. As there is no state or federally defined route with mileposts for these improvements, all location references will be based on existing cross streets.

Figure 5-1: East West Corridor Detailed Study Zones

5.2 Zone 1 Alternatives

The terminus of the parkway has been a major discussion point of this study. The desire is to keep the connection to SR 347 as far north as possible to facilitate traffic heading to / from Metropolitan Phoenix has been a primary goal of many stakeholders. Efforts to find a corridor to the north of Farrell Road were attempted with the corridor alternatives. Finding a corridor that can accommodate the eventual 6-lanes needed to support local and regional traffic demands does not work to the north, where all of the existing subdivisions and infrastructure was not designed to accommodate it.

The subdivisions planned at or near the intersection of Farrell Road have also not accounted for the requirements of a major parkway. The difference here is that most of the infrastructure at this location is not yet constructed. To fulfill the needs of maintaining this regional facility, the Study Team has worked with the City, County, and developers to create and evaluate several solutions to make this improvement viable.

Alternative 1-1: This alignment brings the parkway to SR 347 along the section line of Farrell Road, which was the original intent of the RSRSM concept. West of SR 347, Farrell Road enters into the historic district of the Ak-Chin Indian Community. Representatives of the Community expressed their desires to keep this road a low speed, low volume road to preserve the historical integrity of this facility. As such, if the parkway were to terminate at this alignment, raised medians would need to be installed to divert the regional parkway traffic onto SR 347, and discourage traffic from continuing west.

This was a viable solution, but further discussions with the Ak-Chin revealed that the community was considering other improvements at this location that would impact the desired location for the parkway terminus. The Community, in developing it's long range plans for transportation and also preserving Farrell Road, proposed to build a new roadway south of Farrell Road, between the Harrah's Casino and the Ak-Chin Activity Center. With the construction of this road, the Community worked with ADOT to eventually shift the location of the traffic signals that currently control traffic from entering the Casino, to being located at this new access road intersection, approximately 1/3-mile south of Farrell Road. Once this road is constructed, not only will it relieve traffic from the historic roadway, but developed throughout the Ak-Chin Indian Community to the west, providing the region another access to the west that does not exist today. This access will eventually provide this area with improved access to I-11, if it remains on the current, proposed corridor. Therefore, terminating the parkway at Farrell Road no longer fits with the long-term east-west connectivity of the area. Other alternatives were thereby developed that shifted the improvements to align with the future *Community Road* (the name has not yet been designated for this facility).

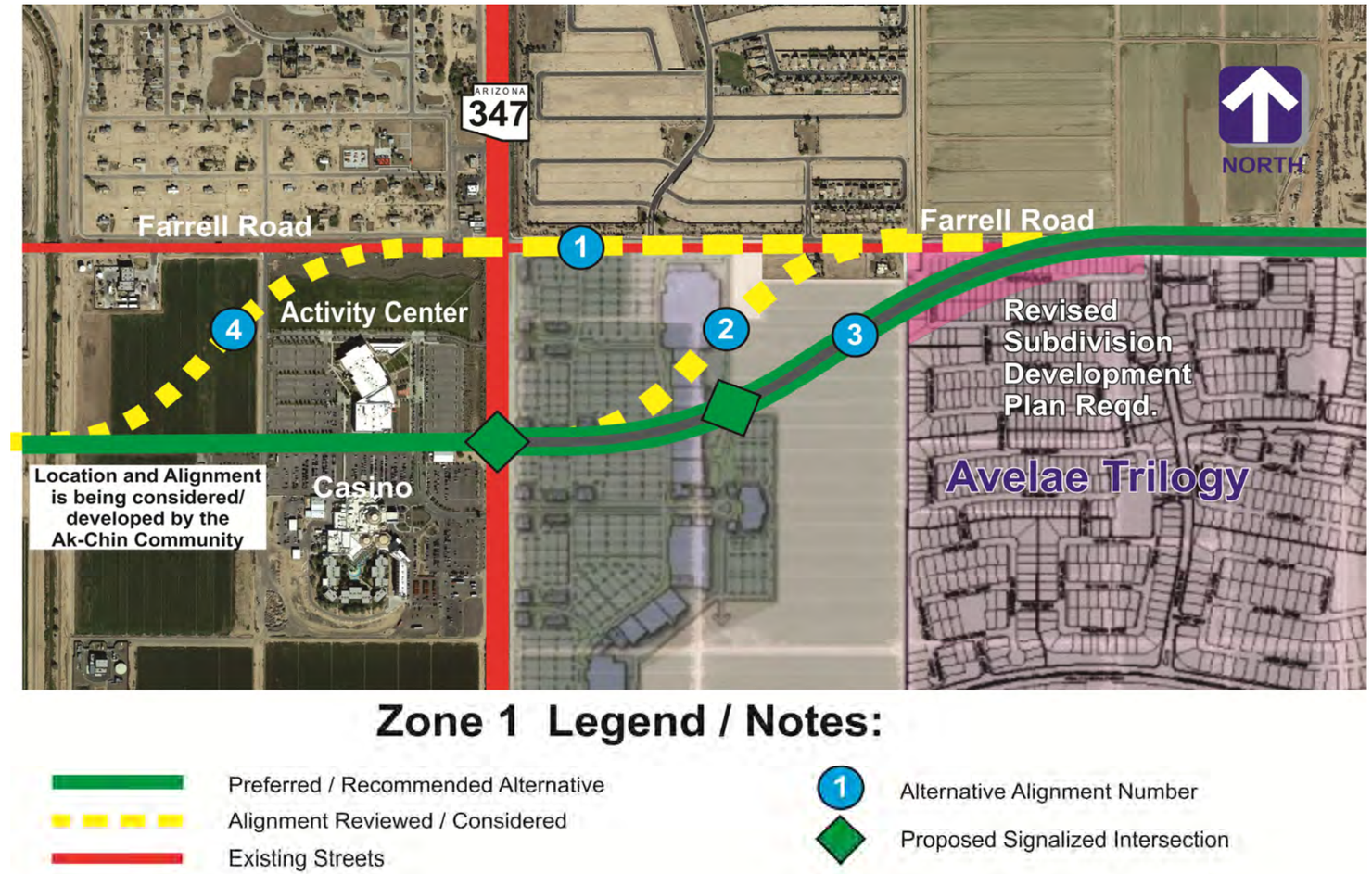


Figure 5-2: Study Zone 1 Alternatives

When presented to the staff and Council of the City of Maricopa, they were in agreement that working to align the parkway with this future east-west route was in the best interest of all of the community. Therefore, **Alternative 1-1** is not being recommended.

Alternative 1-2: Two improvement plans were submitted to the City for improvements south of Farrell Road. The master planned residential community of Avelae Trilogy starting ½-mile east of SR 347, and a new commercial center located between SR 347 and Avelae. The concept developed introduced a reversing curve between the last ½-mile of Farrell Road, aligning with the *Community Road* at SR 347 to the west, and Farrell Road to the east. **Alignment 1-2** cuts through the proposed commercial development thereby requiring a new layout of the retail center to accommodate the parkway.

The result of this alignment cuts through two existing residential properties and homes. When presented to the Transportation Advisory Committee of Maricopa, they agreed that it didn't seem appropriate to take existing homes for a new alignment when the new alignment could be adjusted to go around these structures. As **Alternative 1-3** continues to this approach, **Alternative 1-2** is not being recommended, as it impacts existing homes when other alternatives can avoid them.

Alternative 1-3: This alternative attempts to align the terminus with the *Community Road*, and avoid the existing residential homes located south of Farrell Road. Due to the close proximity of SR 347, the geometry of the parkway could not fit between the homes and SR 347. Therefore, the new alignment was developed to the south and east of these homes, returning to Farrell Road immediately to the east of these homes. This shift will encroach into the proposed Avelae Trilogy development. The Study Team was informed by the City that they had contacted the Avalae Development Community and they were amenable to making adjustments to their plan to avoid the taking of the existing homes. The reversing curves were developed to accommodate the design standards of the parkway corridor.

While this alignment impacts two developments, these developments are still in the early planning stages.

In working with developers of the commercial property, the City has requested that the terminus of the parkway incorporate the following requirements:

- The future east-west segment will be an arterial road classification when it starts the bend south of Farrell Road.
- The segment south of Farrell will have a full access, signalized intersection located at the border of the proposed commercial and transitional parcels (approximately 1/4-mile east of SR 347) and then another full access signalized intersection again at the SR 347.

This alternative provides the northern-most connection of the parkway to SR 347. It aligns with the future east-west road through the Ak-Chin community that, even though it will not be a parkway, can facilitate continuing traffic on this facility heading west, ultimately connecting with other lands of Maricopa, and the future I-11 freeway. After considering all other alternatives, this approach is recommended.

Alternative 1-4: The developer of the commercial property east of SR 347 developed and requested consideration of an alternative shifting the Farrell Road alignment between the historic road and the new Community Road after SR 347, as shown in **Figure 5-2**. This approach would avoid any major impacts to the proposed developments east of SR 347.

The concept was presented for consideration to the Ak-Chin Indian Community. The response was that the requested improvement was not consistent with the desires of the Tribe. This concept is therefore no longer being considered.

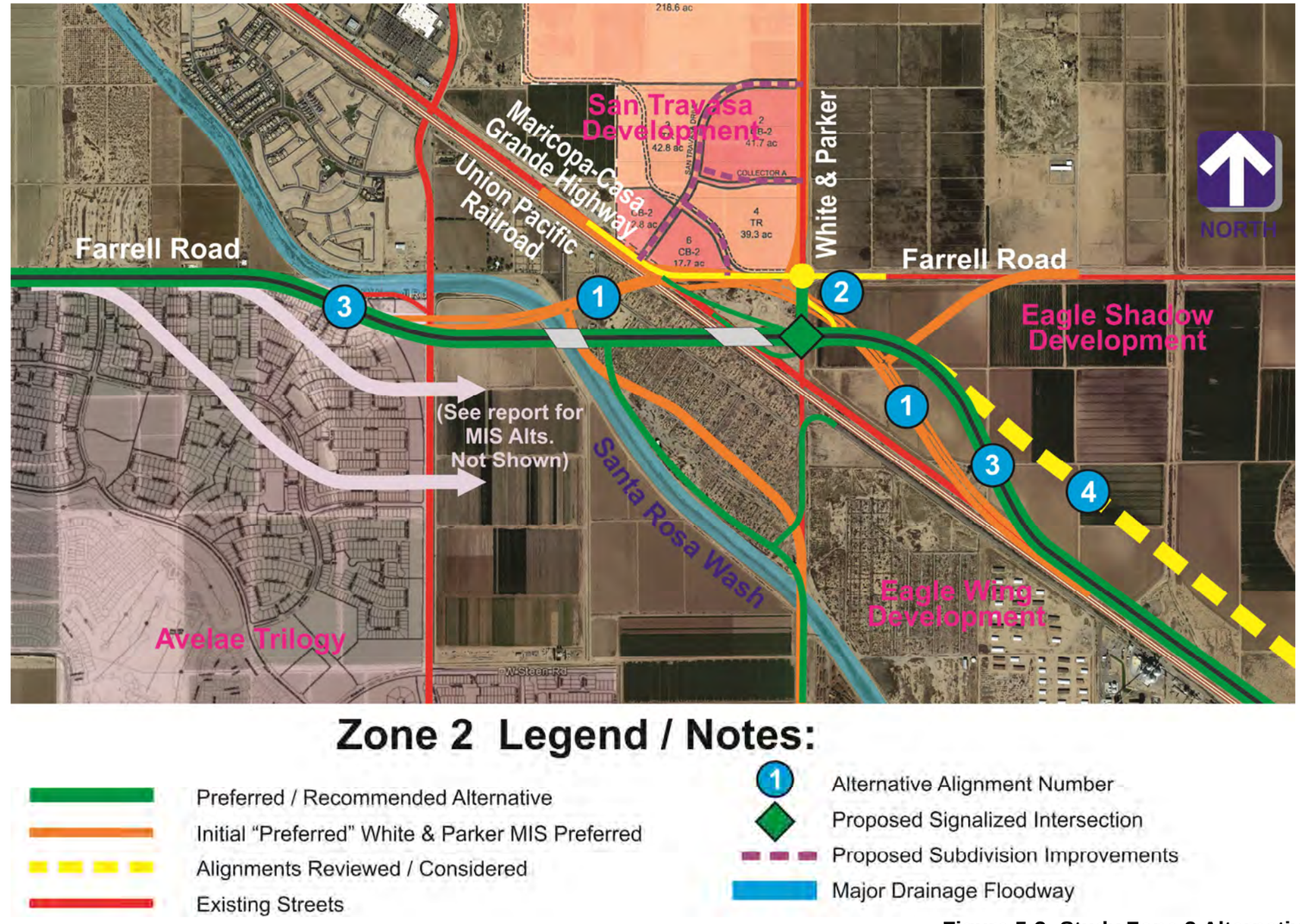


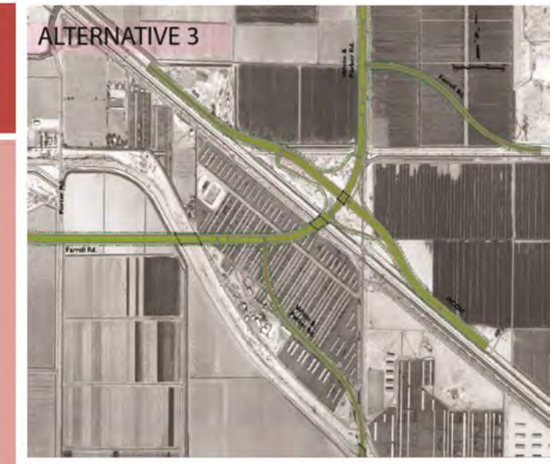
Figure 5-3: Study Zone 2 Alternatives

5.3 Zone 2 Alternatives

Zone 2 is where the alignment transitions from Farrell Road to the MCGH. The alignment will cross over both the Santa Rosa Wash, and the UPRR. As this is an improved crossing over the railroad, it must incorporate a grade-separated crossing, building all roadway improvements over the UPRR R/W. The vertical clearance of the crossing is 23-feet.

The City of Maricopa, before participating in this study, developed a study of interchange improvements over the UPRR at the White & Parker Road Intersection. The purpose of the Major Investment Study (MIS) was to develop alternatives for the intersection of the MCGH, White & Parker Road, and Farrell Road which would provide a grade-separated intersection over the UPRR. They eventually narrowed down their alternatives to three different concepts, shown in **Figure 5-4**.

Alternatives	Project Costs	New Right-of-Way	Bridge Structures	Intersection LOS 2040	Operational Conditions of Roadway Network	Utility Improvements
Alternative 3: **Direct parkway to parkway connection between Farrell Rd. and White & Parker Road.**	$60,660,000	101 acres	-Two bridges crossing Santa Rosa wash. -Three-span concrete girder bridge over the UPRR. -Two-span concrete girder bridge over the MCGH	-AM: Level C or better Average LOS B+ -PM: Level C or better Average LOS B	-AM: Total Delay Time (hours) = 71 -PM: Total Delay Time (hours) = 151	*Overhead Electric:* 19x - 12kv power poles 15x - 69kv power poles Gas: Regulator station Irrigation: 1220 LF channel 5190 LF irrigation ditch metering structure
Alternative 6: **Direct parkway to parkway connection between Farrell Road and MCGH.**	$55,180,000	81 acres	-Two bridges crossing Santa Rosa wash. -Four-span concrete girder bridge over the UPRR and MCGH	-AM: Level B or better Average LOS B+ -PM: Level B or better Average LOS B+	-AM: Total Delay Time (hours) = 71 -PM: Total Delay Time (hours) = 203	Overhead Electric: 19x - 12kv power poles 17x - 69kv power poles Irrigation: 1460 LF channel 530 LF of box culvert 5390 LF irrigation ditch
Alternative 8: **Realigned MCGH, at-grade intersection between White & Parker Road and MCGH.**	$58,850,000	91 acres	-Two bridges crossing Santa Rosa wash. - Three-span concrete girder bridge over the UPRR	-AM: Level B or better Average LOS B+ -PM: Level C or better Average LOS B-	-AM: Total Delay Time (hours) = 72 -PM: Total Delay Time (hours) = 151	Overhead Electric: 16x - 12kv power poles 18x - 69kv power poles 1x - 230kv power pole Gas: Regulator station Irrigation: 3350 LF channel relocation 5920 LF irrigation ditch
No Build **Improves roadways as outlined in the RTP.**	$46,130,000	63 acres	-Two bridges crossing Santa Rosa wash.	Level of Service F for the following intersections: -White & Parker/ MCGH -White & Parker/ Farrell Road	-AM: Total Delay Time (hours) = 950 -PM: Total Delay Time (hours) = 960	Overhead Electric: 31x - 12kv power poles 16x - 69kv power poles



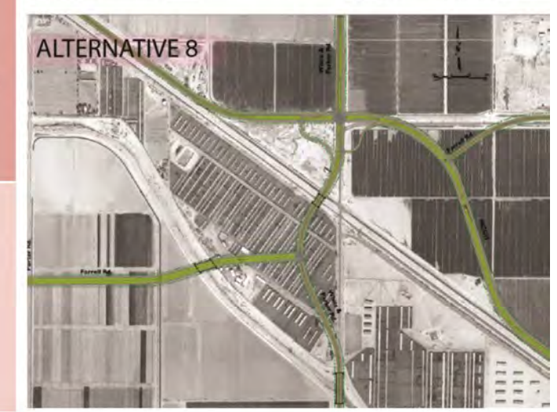


Figure 5-4: MIS Study Recommendations

The MIS alternatives were not formally concluded, as the MIS study, while involving the community and public, did not formally follow the NEPA process. Therefore, the information collected was rolled into this study as part of the scoping alternatives.

Alternatives 3, 6 and 8, along with the no-build, are part of the detailed review for this particular zone. The MIS implied that Alternative 6 was the highest ranking solution developed. As such, it was the initial alignment considered once alignment issues were investigated.

Alternative 2-1: This is Alternative 6 in the MIS investigation. Shown in orange in the previous **Figure 5-3**, the parkway alignment is the primary traffic movement, transitioning from the MCGH alignment to the south, and climbing over the UPRR tracks in the alignment of Farrell Road and continuing west to SR 347. Access to the MCGH and downtown Maricopa is maintained via slip ramps located between White & Parker and the MCGH lanes.

Access to White & Parker Road to the north was a "T" intersection to the north. A separate "T" intersection was provided for Farrell Road to the east. Today, this is an at-grade 4-way intersection. With the bridge crossing of the UPRR, the vertical elevation of these improvements will be much higher than the current intersection of White & Parker Road and Farrell Road. Separate connections with elevated approaches are necessary for both roadways. Access to the south of White & Parker Road was maintained with a similar "T" intersection facing the south just before crossing the Santa Rosa Wash.

Common to all of the MIS alternatives, including **Alternative 2-1** was the location of the improvements with respect to Farrell Road. All of the improvements were constructed either on or over Farrell in the vicinity of White & Parker Road. At the same time the Study Team investigated these alignments, the team met with the City of Maricopa to address comments provided by representatives of the San Travasa development team. This team had planned on making improvements to the lands north of the proposed intersection improvements. Their improvements include using Farrell Road as one of the main access points into the improved properties. Since all of the MIS concepts conflicted with Farrell Road, the City requested that new concepts be developed that retained the primary movement of Alternative 6, but shifted them south of Farrell Road such that it would not impact those development plans. This request essentially eliminated all of the previous MIS concepts from further consideration.

Alternative 2-2 was developed shifting the primary east-west portion of the new parkway 800-ft or more south of Farrell Road. The location of where the parkway departed from the MCGH to the southeast, and where it crossed the Santa Rosa Wash were all kept similar to the original MIS Alternative 6.

With this concept, all access to the MCGH, Farrell and White & Parker Roads will be made from the same access point on the Parkway. North of this access point, a roundabout intersection at Farrell Road was proposed since the intersection would likely include so many turning movements.

This concept was undesirable as it did not provide the direct ramps from the parkway towards the downtown area of Maricopa via the MCGH.

Alternative 2-3, the currently preferred alternative, has the same parkway geometry as **Alternative 2-2**, however the access between downtown Maricopa is provided by slip ramps between the mainline and the MCGH.

The alignment of the parkway introduces a reversing curve starting nearly 7/8-mile southeast of the current White & Parker Road Intersection, so it can gain the necessary elevation to cross over the UPRR. The offset from Farrell Road was developed to allow the connection between the parkway and Farrell to match near existing grades. The parkway alignment is maintained due west of the intersection until it crosses over the Santa Rosa Wash. Once over the wash, crossing over Porter Road, the alignment hugs the southern banks of the Santa Rosa Wash until it aligns with Farrell Road, and continues east to Zone 1.

Access to the south from White & Parker Road is developed from a new "T" intersection located just east of the Santa Rosa Wash crossing. The offset of the intersection to the west allows the property between the UPRR and the Wash to be fully utilized, with the new access located parallel to and just north of the wash. The White & Parker alignment, as it heads southeast, continues as the primary roadway, turning to cross over the Santa Rosa Wash near the same alignment of the White & Parker Road crossing today. Access to the north and east of this access road is provided from a "T" intersection to the new White & Parker alignment north. As the majority of the traffic is heading north/south, the primary movement is the White & Parker Road movement, not to the properties between this roadway and the lands south of the UPRR.

Alternative 2-4: Crossing the UPRR requires the parkway to gain over 23-ft in vertical clearance over the tracks. The alignment of the parkway must "bulge" away from the MCGH to have enough room to gain elevation and have room for the resulting embankment slopes. The desired alignment over the UPRR is to be as close to perpendicular as possible thereby keeping the bridge design efficient and cost effective. To the developers adjacent to this intersection, the "bulge" creates an inaccessible area of land surrounded by the parkway and the UPRR. In coordination with the Eagle Shadow Development Group, the development desired that the parkway alignment be pushed further away from the MCGH, to allow a greater, more marketable space between these facilities. **Alternative 2-4** was schematically developed to note that it could be pushed further into the development, but the result would not take advantage of the existing pavement section as all of the parkway would need to be constructed.

No formal design was provided for this solution, as the developers of the Eagle Shadow development have not advanced a concept at the time of this DCR. The final solution can be adjusted working with the developers, but it depends on which improvement is constructed first. With no other constraints or goals provided, **Alternative 2-3** provides the minimum encroachment onto private lands and still accommodates the separation over the UPRR.

5.4 Zone 3 Alternatives

Zone 3 extends primarily through the northeast corner of the Ak-Chin Community lands, starting around the intersection of Fuqua Road and the MCGH, and extending southeast to Val Vista Boulevard.

The current easement for the MCGH is a 150-ft wide easement or highway deed for this entire segment. Between the limits of Peters and Nall and Anderson Roads, the MCGH is passing formally through the Ak-Chin lands on a 150-ft easement to the County. Widening the R/W outside of the Tribe lands is not restricted, as there are generally farm lands or private lands with no structures located on them. No structures also make the acquisition efforts for these lands economical. Widening to the south is not possible, as the UPRR is immediately to the south of the existing MCGH R/W. Widening through the Community may be possible, if there is added value to the County and its stakeholders, as well as the Community.

Within this zone, there are two competing requirements; the need for a high-capacity, high efficiency transportation facility, and a means of conveying storm water runoff to the Santa Cruz Wash. Unfortunately the two goals co-exist through the Community lands, and cannot be easily accommodated within 150-ft or 200-ft of R/W.

Appendix D includes our drainage report and drainage summaries. The hydrology and conveyance requirements for are included in this appendix. The current corridor has a well-established history of flooding, as runoff from the northeast is conveyed to the Santa Cruz as it backs up behind the UPRR embankment between Murphy and Russell Roads. Through this reach, there are no culverts conveying runoff to the south under the railroad tracks.

To address the drainage needs through this zone, either a lined channel approximately 100-ft in width is required to collect and convey the runoff to the Santa Cruz Wash, or a detention basin could be constructed upstream of the project to capture and detain the peak while allowing a remainder of the flow to continue to the Wash. The later solution requires the acquisition and maintenance of a retention basin, and still requires a 50-ft of channel to collect the on-site runoff and drain the basin.

Two concepts were developed to address the needs for this zone.

Alternative 3-1: This alternative begins and ends as the standard parkway, but between the limits of the Santa Cruz Wash crossing and Russell Road, drainage is intercepted by the 77-ft wide channel and its associated maintenance roads. This leaves approximately 100-ft for the transportation facility which is a 4-lane roadway separated by a paved flush median. Outside of the undivided section are the parkway U-turn opportunities. Within the undivided section, to best facilitate the continuous through movements, left turns from the highway to the adjacent properties are permitted. Left turns onto the highway are restricted. Because the need for making left turns cannot be prolonged for the entire 2.5-mile restricted section, left turns will be allowed at Anderson and Russell Roads with the use of signals. These signals will still only operate in a 2-phase mode as to limit the delays to the through parkway travel.

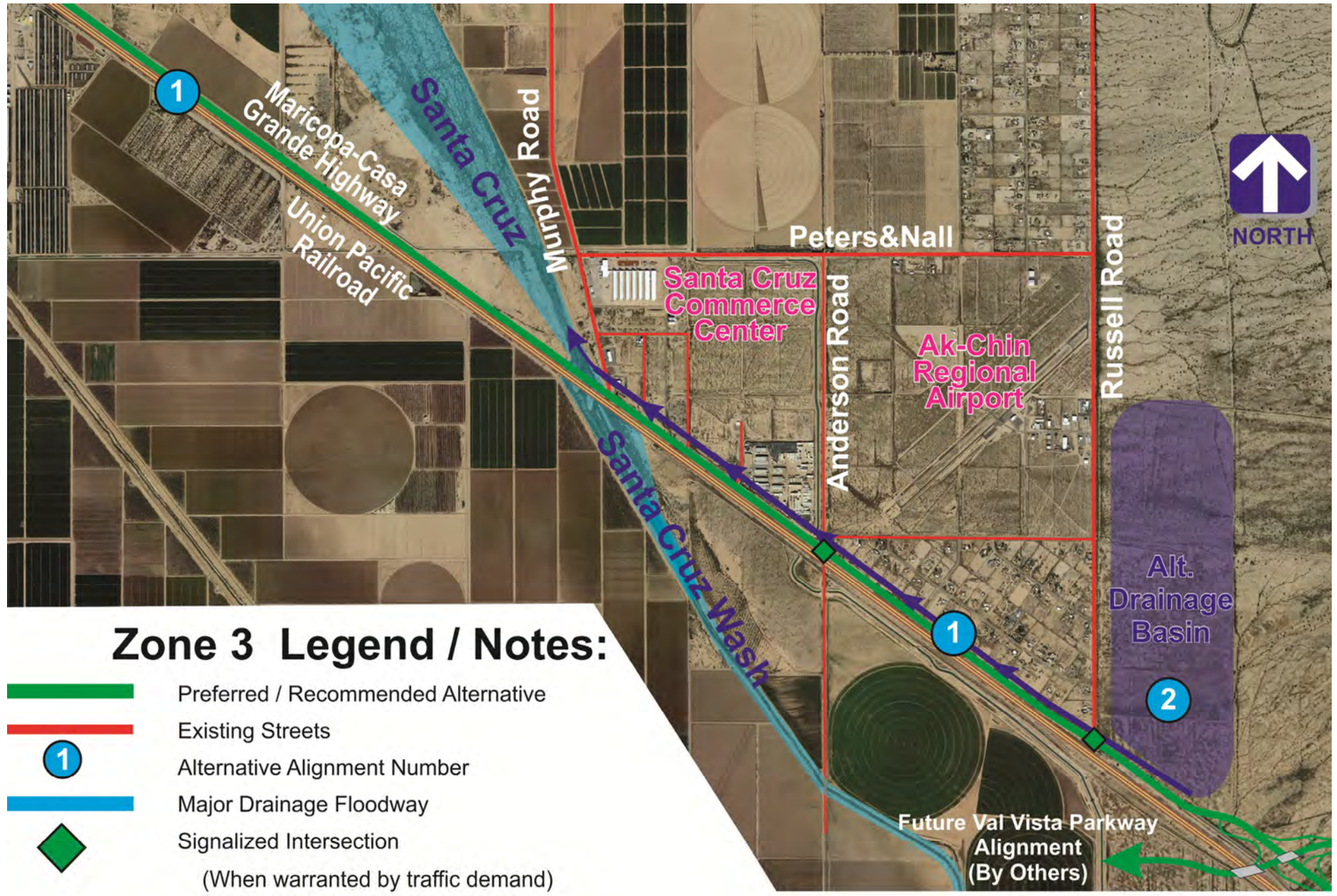


Figure 5-5: Study Zone 3 Alternatives

Anderson Road is currently a 2-lane road that has a crossing of the UPRR. Expanding the roadway would require that the UPRR crossing be grade-separated. Building a grade separated facility over the UPRR at the end of the Ak-Chin Regional Airport will likely have conflicts with the FAA and the approach triangles to the landing strip. Therefore, for the purposes of this study, no improvement to Anderson Road is assumed and will remain a 2-lane, at-grade simple intersection. As traffic demands increase, a signalized intersection will be necessary.

The design team attempted to develop the full parkway concept through the Ak-Chin lands by building a retention basin upstream of the roadway area, and then allowing the basin to bleed off over time through a smaller culvert within the roadway prism. The concept is shown in *Appendix C: Drainage Alternatives (AK-CHIN)*. Unfortunately, there is so much on-site runoff that is generated within these limits, that a parallel channel is necessary simply to collect and convey the on-site runoff to the main wash. While developed, this concept was determined to be insufficient for the design events. (It was left in the appendix as a means of showing all concepts considered and studied).

Alternative 3-2: This concept provides for a divided roadway section and a smaller channel, sufficient in size to capture the on-site flows discussed previously. The peak off-site flows are retained in a detention basin. The bleed-off and the on-site flows are captured and conveyed in a parallel, lined channel. The channel is reduced from 77-ft to 49-ft, allowing for a safer, and wider median separation for the parkway traffic, but does not allow enough room for the desired U-turns. Hence, operationally, this operates the same as Alternative 3-1.

As Alternative 3-2 operates the same as 3-1, but requires extensively more R/W and with a drainage system that requires much more maintenance, Alternative 3-2 was discontinued from further consideration.

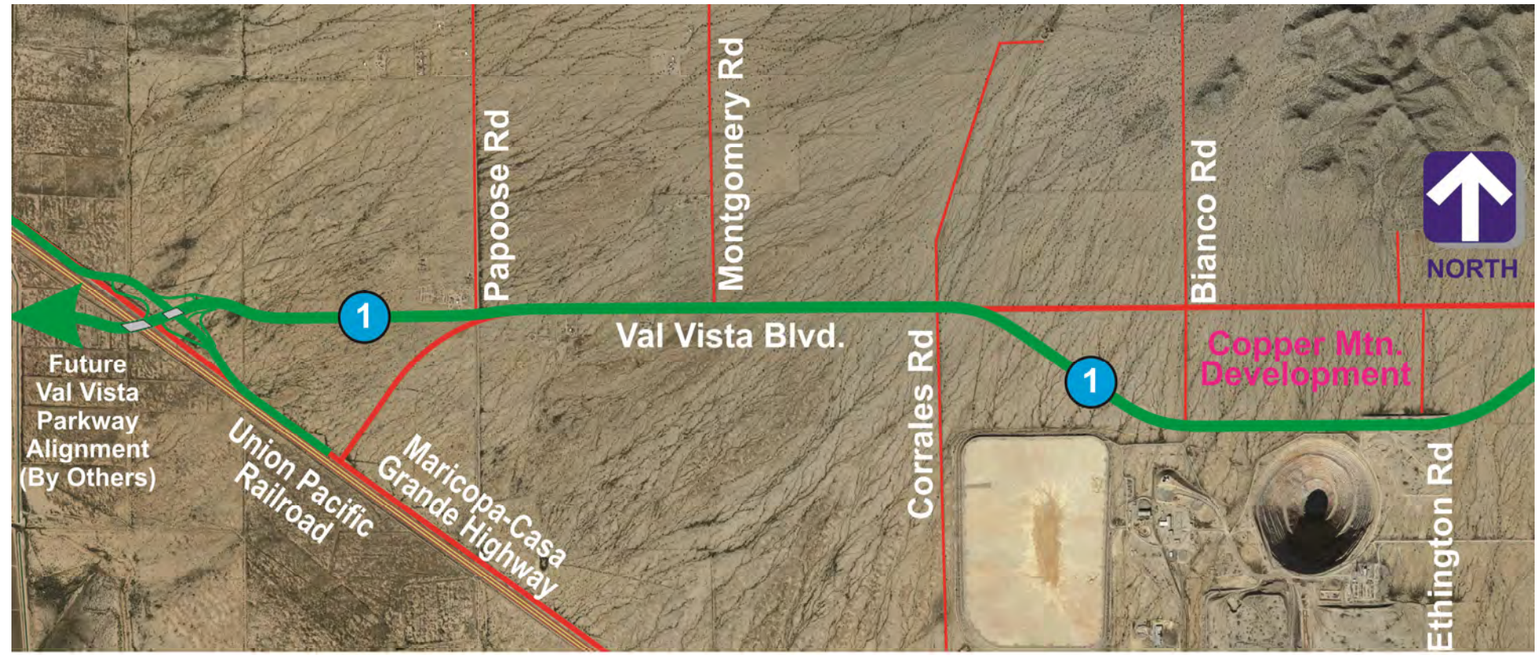
5.5 Zone 4 Alternatives

Zone 4 transitions from the MCGH to the Val Vista Boulevard corridor. At this intersection, a parkway to parkway interchange providing a grade-separated crossing of the future Val Vista Boulevard Parkway over the UPRR is required, adjacent to the intersection of the East-West parkway to the north, Val Vista Boulevard Parkway to the east, and the MCGH to the south.

The layout of the interchange follows the guidelines for the Arizona Parkway.

This zone has only one simple alternative; building the parkway section on the Val Vista Boulevard section line. As the alignment approaches the planned community of Copper Mountain, the alignment departs from the section line and follows the perimeter of the subdivision, at the request of the subdivision planners.

To take advantage of the existing pavement section for use as one half of the parkway while avoiding homes and personal property, the improvements are shifted throughout the corridor. Between the MCGH and Papoose Road, the parkway is widened to the south of the existing roadway easement, to avoid private, developed property located just before the Papoose intersection. Through the Papoose intersection, the improvements are shifted to the north side of Val Vista Boulevard, to avoid taking homes and personal property that exist on the south side of Val Vista Boulevard.



Zone 4 Legend / Notes:

Preferred / Recommended Alternative

Existing Streets

1 Alternative Alignment Number

5.6 Zone 5 Alternatives

Zone 5 continues the Val Vista Boulevard corridor to the eastern terminus of the project; the intersection with I-10.

Alternative 5-1: As an extension of Zone 4, the alignment continues around the southern limits of the planned community of Copper Mountain. The alignment returns to the section line of Val Vista Boulevard and follows within the existing corridor for the balance of the zone. Minor shifts are made lessen private property takes or to better accommodate drainage. These shifts include the following:

- From Burris Rd. to Pinal Ave: Retain the existing road for the westbound parkway lanes and hold the northern existing R/W. The new lanes will be constructed for the eastbound travel lanes with the 200-ft of R/W extending to the south.

- Avalon Subdivision: Retain the existing 150-ft of R/W, and reduced the roadway section to fit. U-turns for the parkway will be constructed outside and just beyond the limits of the Avalon subdivision. Geronimo Drive north of Avalon will be allowed right-in, right-out access, but no cross-median access to the subdivision. A left-turn into the Avalon subdivision will be allowed, but no left-out, consistent with the AZ Parkway standards.

- From Pinal Ave. to Trekell Road: Shift the improvements to the north, holding the existing R/W limits to the south. The shift will avoid impacts to the existing police/fire facility, and better accommodate the existing drainage channel. See the plans for accommodating the drainage both leading into the median, and draining it out, in *Appendix A and B*.

- From Trekell Road to I-10: Retain the existing road for the westbound parkway lanes and hold the northern existing R/W. The new lanes will be constructed for the eastbound travel lanes with the 200-ft of R/W extending to the south.

There are several driveways, access points, and streets intersecting the parkway on this alignment. While there are many access points, the majority are accommodated as right-in, right-out ingress/egress points. The major ½-mile streets are allowed to cross, but no provision for left turns are necessary. Even so, with the volumes anticipated, signals will eventually be needed. They are shown at the anticipated intersections. All of the U-turns are provided in accordance with the AZ Parkway design standards.

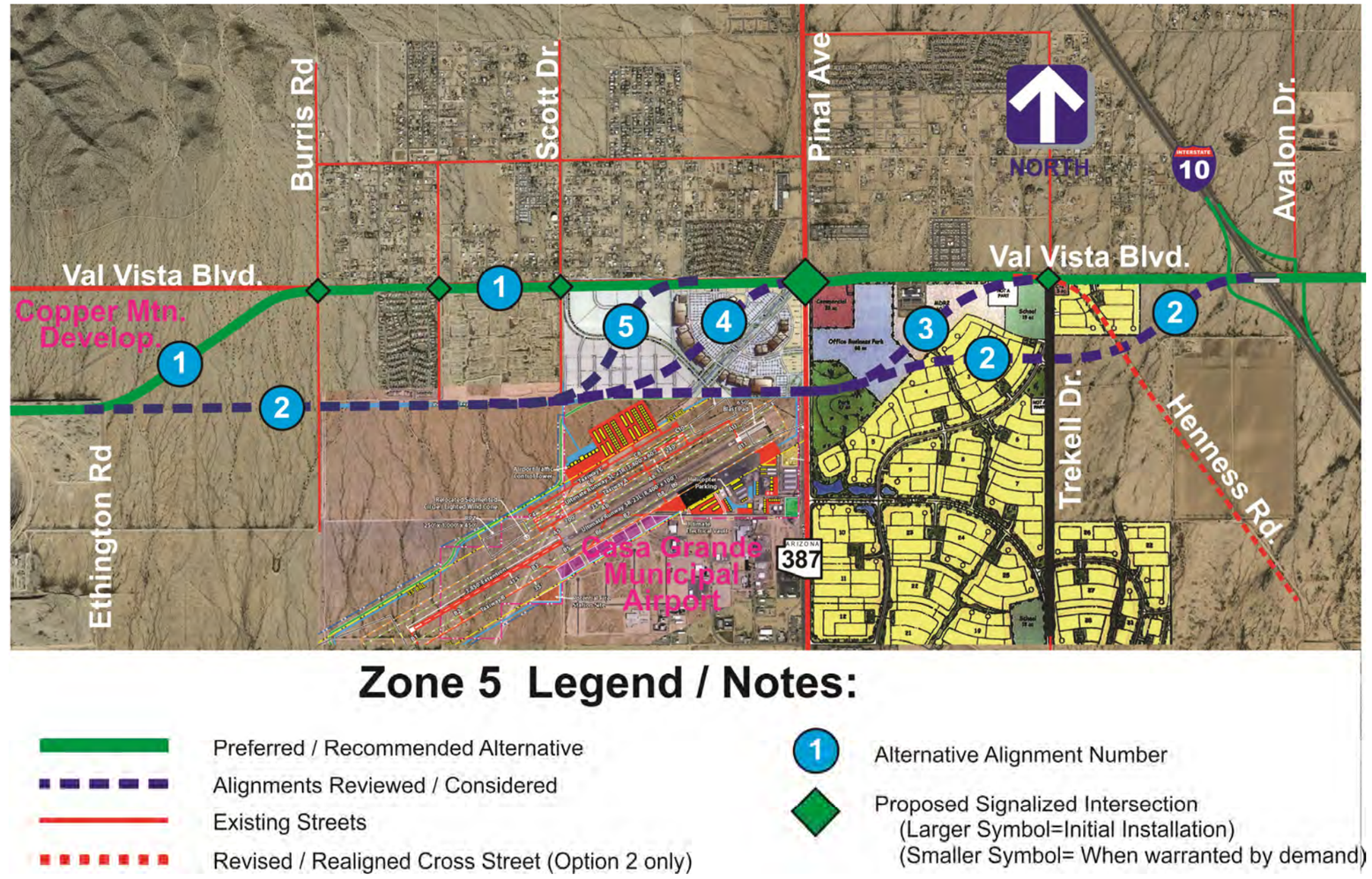


Figure 5-7: Study Zone 5 Alternatives

In reviewing concept alternatives for this corridor, the goal was to avoid the existing development along Val Vista Boulevard and build the new corridor on an alignment ½-mile to the south. Several concepts were developed, but they were not well received when reviewed with the City staff, or developers.

The improvements associated with Villago (Pinal Avenue to Trekell Drive) encroached into the park/open space which is already constructed, and their future commercial properties. However, getting the Villago meant building a major parkway adjacent to the municipal airport. The airport has expansion plans (shown above) as well as development plans associated with the private properties to the north of the airport.

While it could be presented that adjustments to these development plans could be made to accommodate the parkway in these alternative configurations, operationally the parkway is better suited to remain on the Val Vista Boulevard alignment. Adding traffic signals at the end of the runway could be confusing to the pilots on final approach, eliminating Options 2 and 3. Options 4 and 5 would restrict commercial plane access and storage by bisecting the private property from the adjacent airport. These changes did not need to be pursued as **Alternative 5-1** met all of the project goals and objectives, and was consistent with the original RSRSM concepts when these developments were planned.

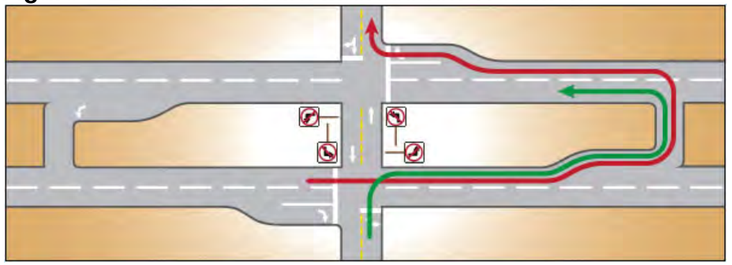
6.0 ARIZONA PARKWAY OVERVIEW

6.1 Introduction

The Arizona Parkway is a relatively new concept to Arizona although it has recently been successfully implemented in other US States such as Florida, Maryland, New Jersey, and Louisiana. However, this is not new technology; the Parkway Concept has been successfully used in Michigan for over 40-years. The basis of its design and recommended use is to provide a solution to the following problem. How can a roadway provide significantly greater capacity while maintaining unrestricted access to local communities and businesses without severing the connectivity of local arterial cross-streets?

A Parkway is generally characterized by a large median with the elimination of the left-turn movements at arterial intersections. For vehicles wishing to turn-left, they would have to utilize strategically placed U-Turn facilities along the Parkway which effectively reverses their direction of travel. An example of this turning movement can be seen in **Figure 6-1** by the turning movement in green. By implementing the Parkway Concept, efficiency of intersections are greatly enhanced as there is effectively only two phases of operation.

Figure 6-1: Median U-Turn Intersection Treatment



Safety is enhanced by the implementation of the Parkway Concept. As discussed previously a Parkway reduces the signal phases at intersections by eliminating the left-turn movements. By removing the left-turn movements at intersections, the probability of head-on and angled collisions is significantly reduced. These types of incidents are commonly known to have higher risk of bodily injury.

As communities continue to grow, traffic will grow respectively impacting the existing roadway systems requiring the need for further roadway improvements. Although the Parkway Concept does not necessarily have the higher speeds commonly found in freeways or highways, Parkways are more efficient than normal arterials as they give preference for the through movement. This preference is primarily achieved by strategic signal timing in combination with the elimination of the left-turn movement signal phase. This translates to less time spent waiting at intersections and more time getting to your destination.

This section will detail the design considerations of the Parkway Concept and its suitability for implementation for the EWC.

Figure 6-2: Example of an Implemented Parkway

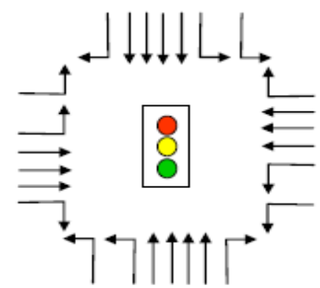
6.2 Intersection Control

In a traditional sense, signalized intersections allow for traffic movements in all directions. An example of a traditional signalized intersection can be seen in **Figure 6-3** below. Left-turn movements at arterial intersections generally require a protected left which virtually doubles the number of signal phases. For every signal phase, there are many considerations that are needed to safely pass vehicles through intersections. Examples of these considerations are:

- Green Time –Time required to clear queued vehicles.
- Clearance Time – Time vehicles to safely traverse through an intersection.
- Loss Time – Time required for a vehicle to accelerate from the stopped condition.
- Cycle Time – Frequency of all signal phases required to efficiently allow all movements to operate within an intersection with minimal delays.
- Progression Time – Time required to coordinate between adjacent intersections to allow for predominate movements to have preferential treatment.

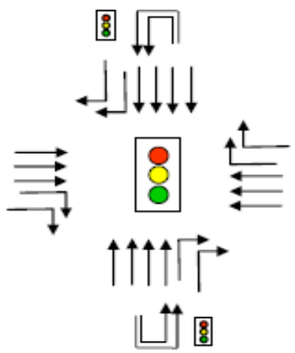
Each one of these considerations translates to delay for the through movement as all these factors require time to clear traffic that has queued to wait for their turn to pass through an intersection.

Figure 6-3: Arterial to Arterial Intersection Turning Movements



Unlike traditional signalized intersections, with the Parkway Design, left-turn movements are eliminated all-together from signalized intersections. Instead, vehicles wishing to turn-left must first turn right and utilize a U-Turn facility to reverse their direction of travel. The U-Turn facility must be implemented nearby the signalized parkway intersection in order to encourage their proper use by users of the roadway system. In the event that traffic demand becomes too severe –to allow vehicles adequate opportunity to perform a U-Turn, these facilities may also be signalized as warranted. An example of a parkway configuration can be seen in **Table 6-4** below. By removing the left-turn movement from busy intersections, preference is given to the through-movement thereby reducing travel delay.

Figure 6-4: Arterial to Parkway Intersection Turning Movements



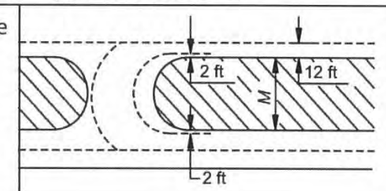
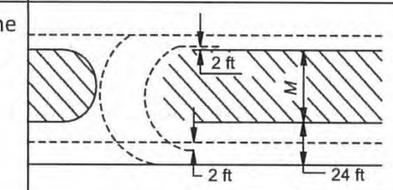
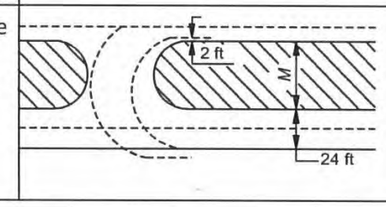
6.3 Requirements of the Arizona Parkway

Despite the benefits of the Arizona Parkway, there are special requirements necessary for the implementation of a Parkway Concept. The primary requirements for a parkway are a wide median and the right-of-way required to fit the facility.

6.3.1 Median Width

The Arizona Parkway requires a wider than normal median in order to allow the design vehicle adequate space to execute the U-Turn movement. The width of the median is dependent on the design vehicle selected for the project and the anticipated turning movement. Design vehicles may be allowed to perform a U-Turn from the inner lane to either the inner or outer lane. In extreme cases, a "loon" could be considered which designates an area of the shoulder as extra room for large vehicles to perform the U-Turn maneuver. **Figure 6-5** contains information recommended by AASHTO for median width depending on design vehicle and turning movement allowed.

Figure 6-5: Arterial to Parkway Intersection Turning Movements

U.S. Customary								
		M—Minimum Width of Median (m) for Design Vehicle						
		P	WB-40	SU-30	BUS	SU-40	WB-62	WB-67
		Length of Design Vehicle (ft)						
Type of Maneuver		19	50	30	40	40	63	68
Inner Lane to Inner Lane		30	61	63	63	76	69	69
Inner Lane to Outer Lane		18	49	51	51	64	57	57
Inner Lane to Shoulder		8	39	41	41	54	47	47

As can be seen from **Figure 6-5**, a substantial amount of space is required in order to implement the Arizona Parkway. For example, using the largest design vehicle, WB-67, and an inner lane to inner lane U-Turn movement, a median width of 69-feet would be required. The values for median width and design vehicles for this project will be discussed in the next section of this document.

6.3.2 Design Vehicle

When it comes to sizing the left-turn bay for the U-Turn movement usually found in a parkway, the median width is dependent on the anticipated design vehicle that the parkway would experience. For the EWC, a larger than normal design vehicle is anticipated due to the fact that the EWC runs through prime farmland where it is not unusual to see large trucks turning onto the roadway. This is more commonly found along the MCGH as trucks turn either west or east to head to SR 347 or I-10, respectively to deliver their goods. For this reason, the design vehicle for the EWC will be designated as a WB-67.

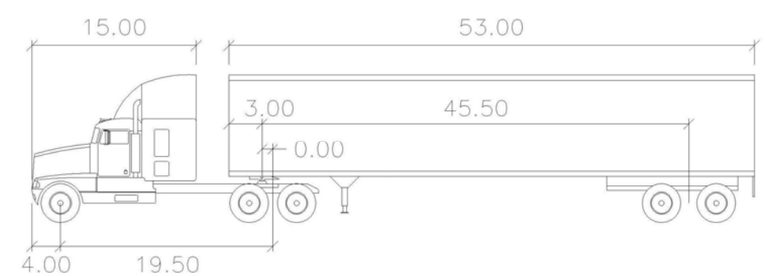


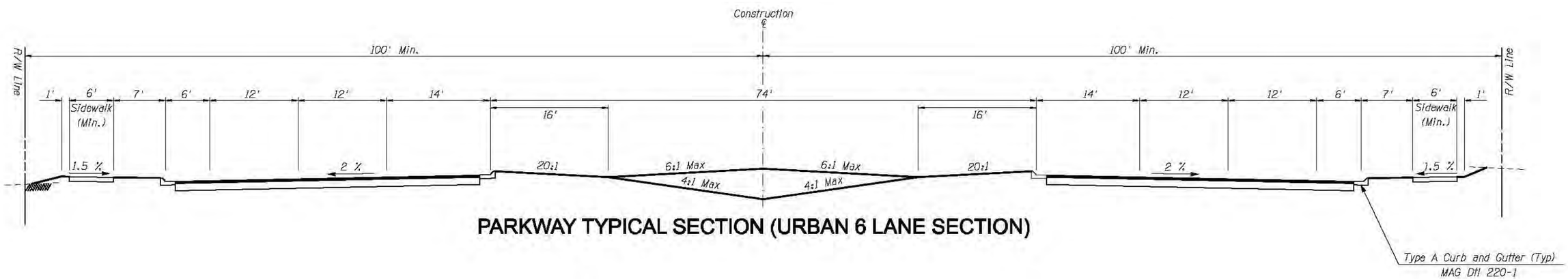
Figure 6-6: WB-67 Design Vehicle

6.3.3 Right-of-Way

As discussed in *Section 6.3.*1, a 69-feet median requires a lot of space to construct once items such as traffic lanes and sidewalk are considered. A minimum of 200-feet of right-of-way (R/W) will be required in order to construct an Arizona Parkway. In the event that 200-feet of R/W cannot be attained, additional design considerations will be required such as restricting U-Turn movements within constrained areas.

Figure 6-7 contains the recommended typical section for both a four-lane rural and six-lane urban parkway as detailed in the *MCDOT: Design Guideline Recommendations for the Arizona Parkway*.

Figure 6-7: BQAZ Recommended Parkway Typical Sections



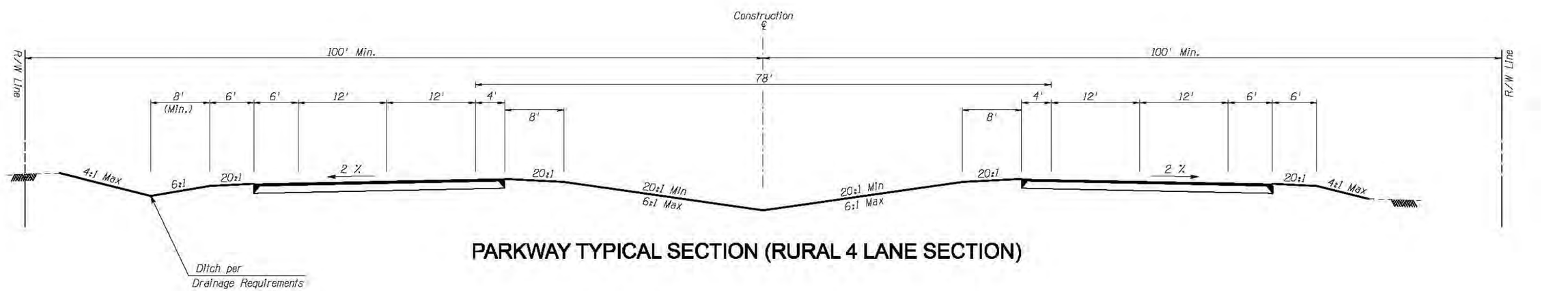
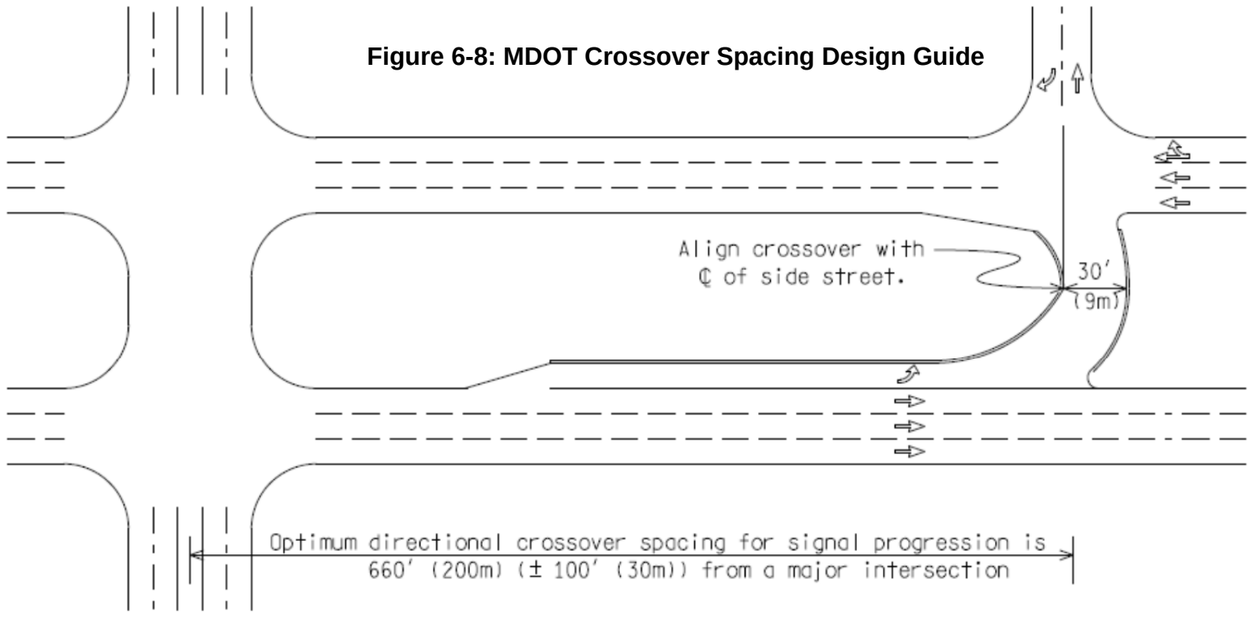


Figure 6-8: MDOT Crossover Spacing Design Guide



The number of crossovers per mile (km) is determined by need. Generally, 1/8 mile (0.2km) spacing is used in urban areas and 1/4 mile (0.4km) spacing is used in rural areas.

6.3.4 Median Crossover Spacing

The placement and spacing of the median crossover are imperative to encouraging operators to appropriately use the parkway facility without presenting any hindrance to the traveling public. The *Michigan Department of Transportation* (MDOT) *Traffic and Safety Geometric Design Guides* specifies optimal spacing for the implementation of crossovers in the design of a parkway. See **Figure 6-8** for an excerpt of the MDOT Standard Detail.

The optimal median crossover from a major intersection is 660-feet (1/8-mile). Generally the amount of median crossovers is dependent on need, however 1/8-mile spacing is recommended in urban areas and 1/4-mile spacing is recommended in rural areas.

The spacing of the median crossovers will be discussed in the next portion of this document and can be seen in the plans in the appendix of this document.

6.4 Benefits of the Arizona Parkway

The introduction of the Parkway Concept offers numerous capacity and safety enhancements to the traveling public. These findings were supported in the *FHWA TechBrief: Synthesis of the Median U-Turn Intersection Treatment, Safety, and Operational Benefits.* A summary of the benefits as discussed in this document are as follows.

6.4.1 Traffic

The majority of the traffic benefits stem from the elimination of the left-turn movements along the parkway corridor. By the elimination of this movement, and implementation of two-phase traffic, significant benefits can be realized. As detailed in the *FHWA TechBrief*, some of these benefits are as follows:

- Enhanced through movement allowing higher capacity along the parkway corridor.
- Shorter signal cycle lengths and additional flexibility of signal progression.
- Increased capacity at the main intersection. The capacity increase range from 20% to 50%.
- Fewer stops for through traffic, especially where intersections are stop-controlled intersections.
- General upgrade of one Level of Service (LOS).
- Total network travel time savings usually outweigh the additional travel time required for left-turning vehicles from the major road and cross streets.

6.4.2 Safety

Through the elimination of the left-turn movements, safety is enhanced as there are fewer conflict points at intersections. As detailed in the *FHWA TechBrief*, some of these benefits are as follows:

- 36% reduction in average collisions across entire route.
- 32% reduction of head-on and angle collisions that have high probabilities of injuries.
- 37% reduction in rear-end collisions.
- 60-75% reduction if total collisions of signalized intersections.
- Reduced risk to crossing pedestrians.
- Fewer and more separated conflict points.

6.5 Challenges of the Arizona Parkway

6.5.1 Traffic

The parkway concept is a relatively new idea for Arizona. Similar to roundabouts, there will be some time of driver confusion with the elimination of the left-turn movements. However, just like roundabouts, with its positive performance in many other states, the parkway concept will eventually be embraced by the traveling public.

6.5.2 Cost

Due to the increased R/W demands by the parkway concept, there is naturally an increased R/W costs for implementing a parkway. This being said, the required R/W for a parkway is very similar to the R/W requirements of urban arterials within the study area. However, the 200-feet of R/W for a parkway ensures that there's enough room for median crossovers while additional room is available should a six-lane segment be warranted in the future.

7.0 MAJOR DESIGN FEATURES

7.1 Introduction

The EWC passes through many different regions each with their own design standards and criteria that must be identified and analyzed for implementation with the Recommended Alternative. This section will list the major design features found throughout the Corridor and identify the design criteria utilized with the Recommended Alternative.

7.2 Design Criteria Comparison

Beginning in the west, the EWC begins in the City of Maricopa, traverses through Pinal County, through the City of Casa Grande, and ultimately terminates at I-10 which is managed by ADOT. Each one of these entities has design criteria that must be identified for comparison. The following references were used in the compiling of the project design criteria:

- American Association of State Highway and Transportation Officials (AASHTO): A Policy on Geometric Design of Highways and Streets, 2011 6th Edition
- AASHTO: Roadside Design Guide, 2011 4th Edition
- Manual on Uniform Traffic Control Devices, 2009 Edition
- Arizona Department of Transportation: Roadway Design Guidelines, May 2012
- Pinal County Subdivision & Infrastructure Design Manual
- Maricopa Association of Governments Uniform Standard Specifications and Details for Public Works Construction, 2015 Edition
- City of Casa Grande Engineering Design Manual for Infrastructure and Development Design
- Union Pacific: Technical Specifications for Construction of Industrial Tracks

Table 7-1 contains a comparison of a portion of the crucial controlling design elements. This table is meant to serve as a comparison basis for the design criteria. Selected criteria for the design of the Arizona Parkway follows in *Section 7.3*.

Table 7-1: Design Criteria Comparison

Design Element	City of Maricopa / MAG	Pinal County	City of Casa Grande	ADOT	AASHTO	Arizona Parkway	Remarks
Lane Width	12'	Refer to MAG	12'	12'	12'	12'	
Shoulder Width	6' Outside 4' Inside	Refer to MAG	10' Outside 8' Inside	10' Outside 4' Inside	6' - 8' Desired 2' Min.	6' Outside 4' Inside	
Median Width	78'	Refer to MAG	30'	46'	As wide as practical	82'	Median width set by design vehicle.
Design Speed	55 MPH	Refer to AASHTO	55 MPH	30 - 60 MPH	55 MPH	55 MPH	
Normal Cross Slope	2%	2%	2%	2%	2%	2%	
Maximum Vertical Grade	5%	6%	5%	5%	5%	5%	
Minimum Vertical Grade		0.25%	0.4%	0.4%	0.3%	0.3%	
Minimum Vertical Clearance	16'-6" Min.	16'-6" Min.	16'-6" Min.	16'-6" Min.	16'-6" Min.	16'-6" Min.	23'-0" Min. Required for Railroad Crossing
Maximum Superelevation	6% Max.	6% Max.	6% Max.	6% Max.	6% Max.	4% Urban 8% Rural	
Minimum Horizontal Curve Radius	1060'	1500'	1060'	1060'	1060'	1060'	
Right-of-Way	200' Minimum	200'	140'	250' Desirable 180' Minimum	N/A	200' Minimum	
Public Utility Easements	--	8'	8'	N/A	N/A	8'	
Median Crossover Interval							
- Urban	1/8 Mile Spacing	1/8 Mile Spacing	1/4 Mile Spacing	As Warranted	As Warranted	1/8 Mile Spacing	
- Rural	1/4 Mile Spacing	1/4 Mile Spacing	1/4 Mile Spacing	As Warranted	As Warranted	1/4 Mile Spacing	
Pavement Section	Dependent on geotechnical design	6" AC / 10" AB	4" AC / 10" AB	Dependent on geotechnical design	Dependent on geotechnical design	Dependent on geotechnical design	Pavement structural section pending geotechnical investigation and design.

7.3 Recommended Design Criteria

The following design controls were used in the development of the design concept for the Recommended Alternative:

- Overall Design Criteria
  - Design Year: 2040
  - Design Speed: 55 mph – Minimum
  - Design Vehicle: WB-67
  - Pavement Design Life: 20 years
- Geometry
  - Slope guidelines: ADOT Std. Det. C-02 Series
  - Vertical Gradient:
    - 6% Maximum (UPRR Crossings)
    - 5% Desired
    - 0.3% Minimum
  - Vertical Clearance
    - 16'-6" Minimum
    - 23'-0" Railroad Crossings
  - Maximum Superelevation: 6%
  - Clear Zone: AAHSTO Roadside Design Guide Standard
- Widths
  - Number of Traffic Lanes: 4 Lanes
  - Traffic Lane: 12-feet
  - Shoulder: Variable, refer to RSRSM
  - Median: 82-feet
- Drainage
  Design Frequency
  - Pavement: 10 years
  - Cross Culverts: 50 years
  - Bridges: 50 years
  - Medians: 50 years
  - Storm Drain: 10 years
  - Channels: 50 years
  - Maximum Velocity: Evaluate erodibility of native soil
  - Minimum Velocity: Evaluate deposition of soil
  - Allowable Headwater: To within three inches of lowest elevation of top of pavement
  - FEMA Considerations: Evaluate per ADOT Roadway Design Guidelines, Section 602
  - Erosion Control: To be determined per HEC-14 and HEC-15
  - Pavement Drainage: Evaluate per HEC-12
- Traffic
  - Signing Permanent: MUTCD Standard
  - Signing Temporary: MUTCD Standard
  - Signalization: ADOT Traffic Signal and Lighting Standards

7.4 Recommended Typical Sections

Utilizing the design criteria established in the previous sections along with the ICO's established in *Section 1*, a series of typical sections have been established for the EWC. This section will cover the typical section treatments and their anticipated function throughout the EWC.

7.4.1 Arizona Parkway Typical Section

In locations where the 200-foot R/W is feasible, the Arizona Parkway Typical Section shall be implemented. The median width was established in *Section 6.3* to be 82-feet wide in order to accommodate the WB-67 design vehicle turning movement. This width allows the design vehicle to turn from an inside left-turn lane into the inside lane of opposing traffic.

- Typical Sections Properties
  - Four-lane Divided Roadway with Graded Median
  - Number of Lanes: Two lanes in each direction.
  - Lane Width: 12-feet
  - Shoulder Width: 6-feet outside
    4-feet inside
  - Median Width: 82-feet

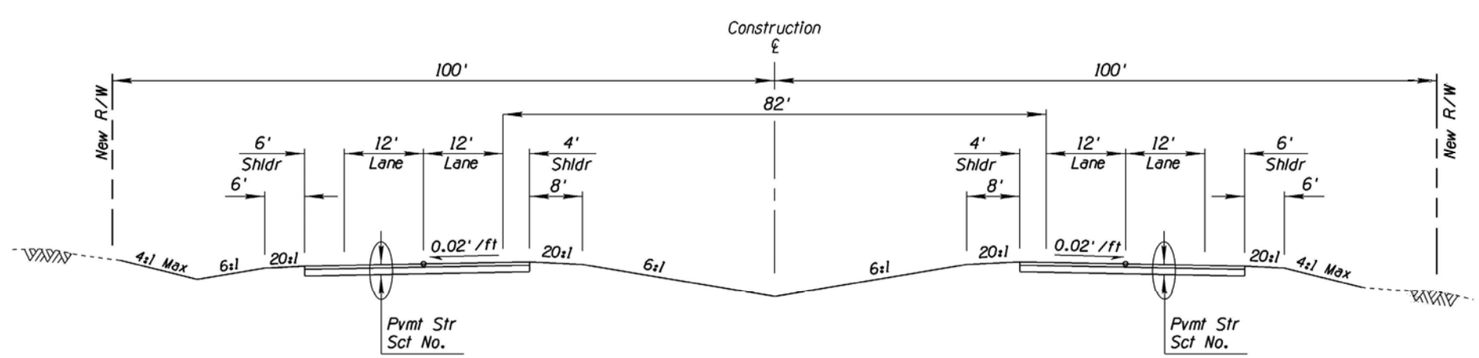


Figure 7-1: Arizona Parkway Typical Section

7.4.2 Ak-Chin Undivided Typical Section

Where the EWC passes through the Ak-Chin Indian Community, there is a drainage channel that is located to the north of the roadway. This channel is fed from drainage from the Sacaton Mountains. In order to maintain the existing drainage channel capacity, while also allowing provisions for the Tribe to access their local community and businesses, a typical section has been proposed that transitions the Arizona Parkway to a more traditional rural arterial roadway. The drainage channel will be maintained on the northern side of the roadway to mitigate impacts to the existing drainage structures.

- Typical Section Properties
  - Four lanes undivided with a shared median
  - Number of Lanes: Two lanes in each direction
  - Lane Width: 12-feet
  - Shoulder Width: 6-feet
  - Median Width: 14-feet
  - Channel Width: 77-feet with 12-feet of maintenance access on each side.

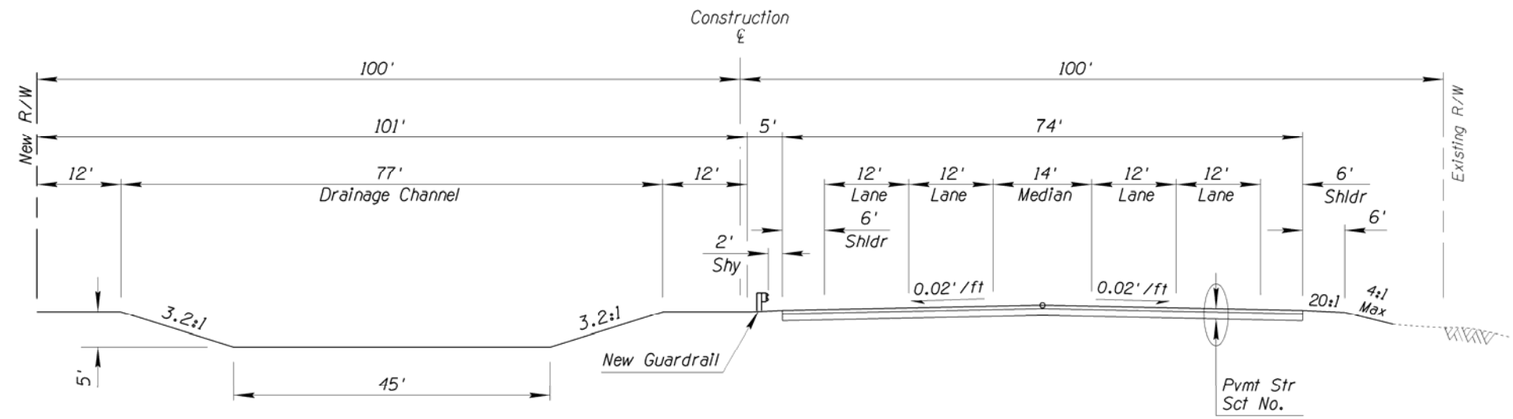


Figure 7-2: Ak-Chin Undivided Typical Section

7.4.3 Arizona Parkway Compressed Typical Section

There are two areas within the EWC where R/W cannot be acquisitioned without major impacts to the local community. In these areas, a compressed section is proposed that would maintain the existing R/W and affect the local communities as little as possible. U-Turn provisions will need to be placed on both sides of the compressed section in order to maintain the flow of local traffic.

- Typical Section – Compressed Parkway
  - Four lanes divided with a graded median
  - Number of Lanes: Two lanes in each direction
  - Lane Width: 12-feet
  - Shoulder Width: 6-feet outside
    4-feet inside
  - Median Width: 36 feet

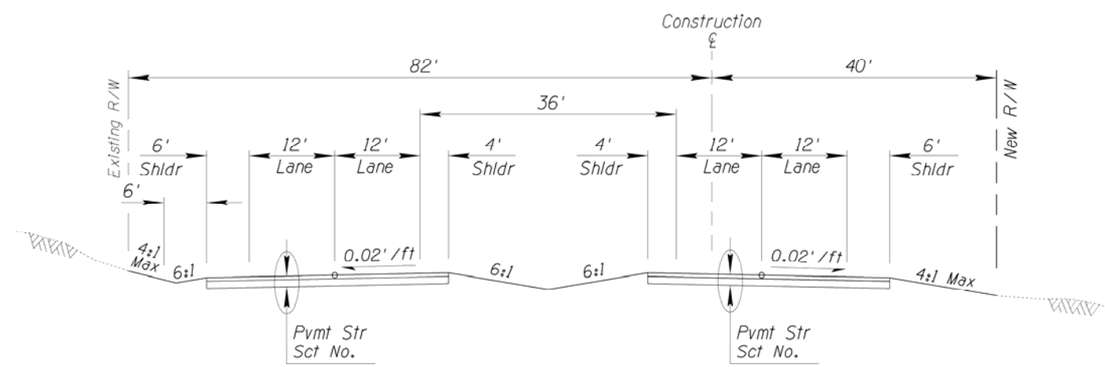


Figure 7-3: Arizona Parkway Compressed Typical Section

7.4.4 Arizona Parkway Typical Section (Interior Drainage Channel)

Located near the terminus of the project, there is an existing drainage channel that must be maintained as it intercepts sheet flow drainage from the north while conveying roadside drainage parallel to the EWC. This typical section is virtually similar to the *Arizona Parkway Typical Section* with the exception that there is a drainage channel between the eastbound and westbound roadways. As the drainage channel in the median is within the clear zone, guardrail will have to be installed on the inside of the eastbound and westbound lanes. The median has been sized to allow for the U-Turn movements within this section, however, the drainage channel will have to be conveyed underneath the U-Turn facility by the installation of a box culvert.

- Typical Section – Drainage Channel in Median
  - Four lanes divided with a channel in the median
  - Number of Lanes: Two lanes in each direction
  - Lane Width: 12-feet
  - Shoulder Width: 6-feet outside
    4-feet inside
  - Median Width: 82-feet
  - Channel Width: 40-feet with 12-feet of maintenance access on each side.

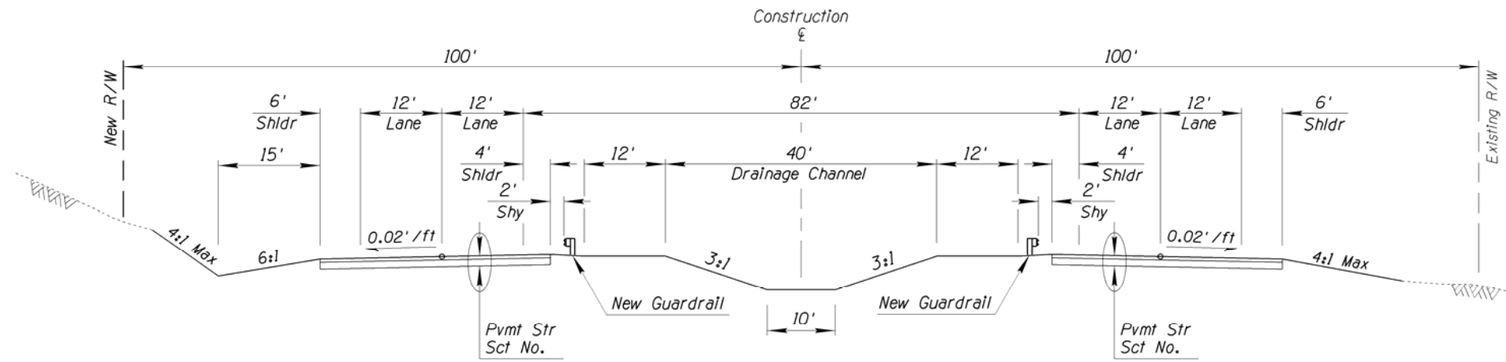


Figure 7-4: Arizona Parkway Typical Section (Interior Drainage Channel)

7.5 Horizontal and Vertical Alignments

With the exception of the interchange locations and the City of Maricopa terminus of the project, the majority of the improvements follow the existing infrastructure of Pinal County. This section will detail the methods used to establish the horizontal and vertical alignment considerations of this Study. A more detailed analysis will be discussed further in this Study.

7.5.1 Horizontal Alignment

The majority of the proposed alignment follows the existing roadway infrastructure by utilizing the existing two lane facility as a part of the EWC. For example, once the EWC intercepts the MCGH, the proposed eastbound lanes utilize the existing roadway while the westbound lanes will be new construction. Some of the benefits to this approach are as follows:

- Limits the need for additional R/W.
- Limits the environmental disturbance to the undeveloped areas.
- Offers a convenient approach to traffic control during construction by allowing traffic to be maintained on the existing alignment while the divided roadway is being constructed.
- Limits the need for improvement to the existing drainage culverts.
- Minimizes earthwork requirements.

Horizontal control for the EWC can be found in *Appendix A*. More detailed survey of the existing condition shall be required once the EWC proceeds to the final design stage.

7.5.2 Vertical Alignment

For the purposes of this Study, design grade survey was not utilized to analyze the vertical grades of the EWC. However, field review of the existing field conditions and elevations provided by Geographic Information System (GIS) have concluded that the Study Area is relatively flat. More detailed survey shall be required once the EWC proceeds to the final design stage. The vertical alignment of the proposed EWC should remain close to the existing ground in an effort to reduce earthwork requirements.

7.6 Proposed Structures

There are nine structures anticipated for the construction of the EWC. For the purposes of this Study, the proposed structures are assumed to be precast girders of varying span lengths. Due to the median separation of the parkway, it is cost prohibitive to construct a single wide bridge for both directions of travel. Instead, individual structures will be constructed for each direction of travel to save on structure cost. The particulars of the Bridge Structures will need to be assessed during final design.

This section details the bridge structures encountered beginning from the west end of the project and venturing to the east.

7.6.1 WB and EB Santa Rosa Wash Bridges #1 and #2

Located at Sta 1128+00, the proposed EWC must cross the Santa Rosa Wash via two multi-span bridges for the westbound and eastbound direction. Drainage design shall be conducted to determine the required height of the structure to convey the design year flow underneath the bridges. The proposed location of the structure attempted to find the optimal location that crossed the Santa Rosa Wash as perpendicular as possible in order to limit the span length.

As an alternative during final design, the drainage engineer may also look at opportunities to replace the Santa Rosa Wash Bridges with a series of multi-cell reinforced concrete box culverts.

7.6.2 WB and EB MCGH UPRR Bridges #3 and #4

Located at Sta 1152+00, the proposed EWC must cross over the Union Pacific Railroad (UPRR) and MCGH before turning to run parallel with the MCGH. It should be noted that this crossing requires that the EWC have a vertical clearance of 23’-0” plus the thickness of the bridge section over the railroad and 16’-6” plus the thickness of the bridge section over MCGH. It is anticipated that the vertical clearance over the UPRR will control the design of the vertical alignment. Vertical grades should be maximized as allowed by the design criteria to ascend to the required vertical clearance as quickly as possible to limit borrow earthwork.

It should also be noted that there is a median crossover located at Sta 1162+19 that allows traffic access to White and Parker Road. This median crossing will be above grade as the alignment is currently descending from the structures over the Union Pacific Railroad. It is anticipated that this location will require large amounts of borrow.

7.6.3 WB and EB MCGH and Val Vista Boulevard Bridges #5 and #6

Located at Sta 1533+00, the MCGH is planned to go under the new Val Vista Bridges. It should be noted that this underpass location can occur after the construction of the entire EWC as these structures are only required once Val Vista Road expands to the west. This underpass will be constructed at-grade with the overpass section having a vertical clearance of 16’-6” plus the thickness of the bridge section.

7.6.4 WB and EB Val Vista Boulevard UPRR Bridges #7 and #8

Located at Sta 3051+50, the proposed access to Val Vista Boulevard must cross over the UPRR and MCGH before continuing along the future expansion of Val Vista Boulevard. It should be noted that these improvements can occur after the construction of the entire EWC as these structures are only required once Val Vista Boulevard expands to the west. Similar to the other crossing of the UPRR, this crossing requires that Val Vista Boulevard have a vertical clearance of 23’-0” plus the thickness of the bridge section over the railroad. Vertical clearance over the existing MCGH is not considered to be a design factor at this time as the existing MCGH should be obliterated at the time of construction of the Val Vista Boulevard UPRR Bridges #7 and #8.

7.6.5 EB I-10 Underpass Bridge #9

Located at the terminus of the project, the existing underpass between the EWC and I-10 will remain in place and become the westbound lanes of the parkway. For the eastbound lanes, a new structure is required to the south of the existing bridge. This crossing requires a vertical clearance of 16’-6” plus the thickness of the bridge section over I-10.

7.7 Access Management

Per the *RSRSM:*

"The purpose of major transportation corridors such as the Pinal County Regionally Significant Routes is to provide for the safe and efficient movement of people and goods at a high level of service. If access to these corridors is limited, then safety and mobility will be maintained along the corridors. However, if access to adjacent property is not limited and adjacent property develops, the addition of traffic signals and curb cuts often has an adverse effect on mobility and safety. As land is developed along transportation corridors, vehicle access to property adjacent to the corridor is often achieved directly to and from the transportation corridors. As a result, more trips are forced onto the corridor due to insufficient internal access systems serving these land use activities. As traffic congestion increases, the level of service provided by the transportation facility decreases. In addition, crashes along such a corridor generally increase due to the large number of turning and other conflicts along the corridor."

Partial access control is recommended along the entire EWC in order to enhance traffic operations and safety as well as to preclude uncontrolled future access and random strip development. Properties that had previous rights of entry will maintain these rights to the extent reasonable. It should be noted, that properties that currently have access to the EWC will lose the ability to turn left from their properties. In order to do so, a U-Turn movement would have to be utilized.

For the purposes of this Study, all of the U-Turn facilities have been sized with 200-feet of storage. While this length of storage meets design criteria, detailed traffic analysis should be conducted to determine if this capacity is sufficient for efficient operation.

Table 7-2 contains a summary of all the U-Turn facilities located throughout the EWC.

Table 7-2: Summary of Turning Movements

No.	Station	Turning Movement Allowed
1	1047+69	U-Turn Both Directions
2	1062+90	U-Turn Both Directions
3	1101+83	U-Turn Both Directions
4	1117+05	U-Turn Both Directions
5	1133+86	U-Turn WB Only and Left to White and Parker
6	1141+77	U-Turn Both Directions
7	1162+49	U-Turn EB Only and Left to White and Parker
8	1175+28	U-Turn Both Directions
9	1197+62	U-Turn Both Directions
10	1225+24	U-Turn Both Directions
11	1258+82	U-Turn Both Directions
12	1283+65	U-Turn Both Directions
13	1309+38	U-Turn Both Directions
14	1346+45	U-Turn Both Directions
15	1374+50	U-Turn EB Only and Left to Murphy Road
16	1392+00	U-Turn EB Only and Left to Antone Street
17	1404+60	U-Turn EB Only and Left to Maricopa Industrial
18	1516+83	U-Turn Both Directions and Left to Val Vista Blvd
19	1536+26	U-Turn EB Only and Left to Val Vista Blvd
20	3056+23	U-Turn WB Only and Left to MCGH
21	3064+55	U-Turn EB Only and Left to MCGH
22	3121+09	U-Turn Both Directions
23	3136+36	U-Turn Both Directions
24	3174+26	U-Turn Both Directions
25	3189+47	U-Turn Both Directions
26	3227+23	U-Turn Both Directions
27	3242+51	U-Turn Both Directions
28	3265+58	U-Turn Both Directions
29	3287+58	U-Turn Both Directions
30	3303+01	U-Turn Both Directions
31	3328+58	U-Turn Both Directions
32	3356+04	U-Turn Both Directions
33	3378+58	U-Turn Both Directions
34	3401+01	U-Turn Both Directions
35	3415+50	U-Turn Both Directions
36	3428+30	U-Turn WB Only and Left to Geronimo Drive
37	3442+49	U-Turn Both Directions
38	3453+39	U-Turn Both Directions and Left to Encore Drive
39	3469+15	U-Turn Both Directions
40	3481+11	U-Turn Both Directions
41	3494+14	U-Turn Both Directions

Table 7-2: Summary of Turning Movements (cont.)

No.	Station	Turning Movement Allowed
42	3500+56	U-Turn EB Only and Left to Crane Place
43	3507+39	U-Turn Both Directions
44	3521+91	U-Turn Both Directions
45	3546+28	U-Turn EB Only and Left to RV Park
46	3561+05	U-Turn WB Only
47	3575+54	U-Turn Both Directions
48	3598+57	U-Turn Both Directions
49	3630+27	U-Turn Both Directions

As discussed in *Section 6*, U-Turn facilities have been proposed utilizing a 1/8-mile to 1/4-mile spacing depending on need and merit. As can be seen in the plans in *Appendix A*, U-Turn facilities are omitted in areas where there is no existing development. These locations would have to be constructed in the future at the cost of the developer.

In some instances, the U-Turn location was placed strategically so that drivers had the option of executing a U-Turn maneuver or left-turn into an adjacent sub-division access. See Sta 3500+00 of **Figure 7-5** for an example of this arrangement. It should be noted that this configuration meets the requirements of the parkway design as the U-Turn facility does not inhibit the through movement of the EWC while also preventing motorists leaving the sub-division from turning left in the EB direction.

As a U-Turn is not possible within the compressed sections (where the available median opening was less than 82-ft), U-Turn facilities have been implemented on either side of the compressed section as close as possible to provide drivers with an opportunity to make a U-Turn movement at the earliest convenient. This can be seen in **Figure 7-6**. It should be noted that there are properties in this area that have existing access to Val Vista Boulevard. This existing access must be maintained with the proposed improvements.

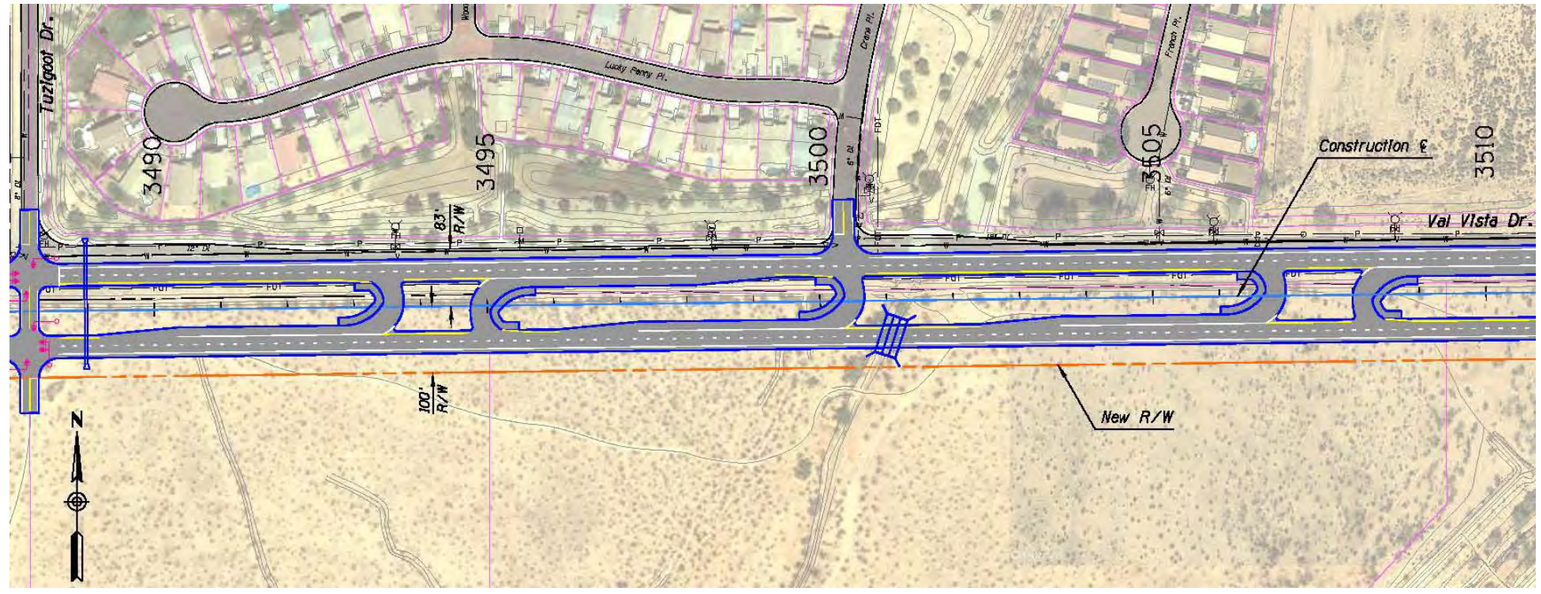


Figure 7-5: Arizona Parkway Proposed U-Turn at Tuzigoot Drive

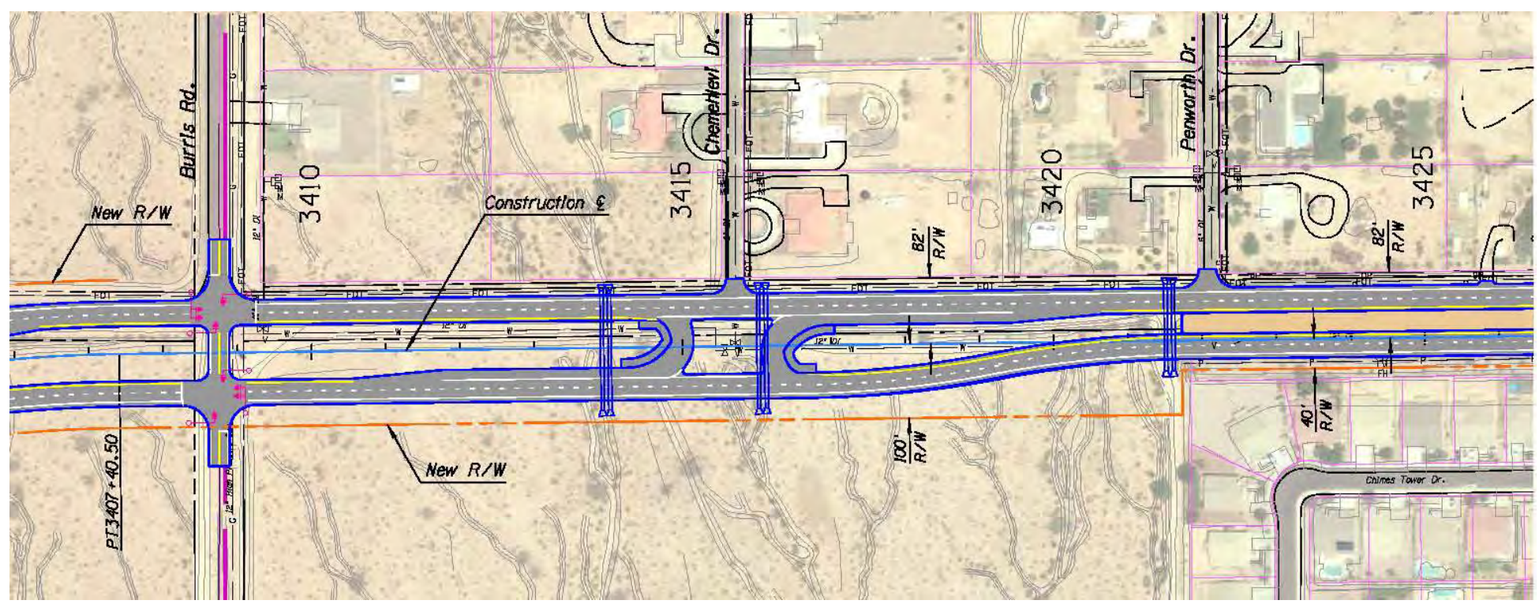


Figure 7-6: Arizona Parkway Proposed U-Turn after Compressed Section

7.8 Right-of-Way

Throughout the EWC, the existing R/W is typically 66-feet or 33-feet on each side of the centerline. As noted above, the proposed facility will require 200-feet total of R/W where feasible. **Table 7-3** lists the estimated R/W required from each parcel adjacent to the EWC. It should be noted that the proposed alignment does not require the complete take of any properties within the Corridor.

It should be noted that Tribe lands are not typically acquired for the construction of roadway projects. In this case, an easement would have to be granted from the Ak-Chin Indian Community in order to construct the EWC through Tribe land.

Table 7-3: Estimated Right-of-Way Requirements

Parcel Number			Owner	Approx. Take (acres)
BK	Map	Par.		
510	73	001K	SP DUNN/AK CHIN, LLC	5.46
510	73	001L	SP DUNN/AK CHIN, LLC	3.73
510	73	001H	PROPERTY RESERVE ARIZONA, LLC	6.93
510	12	7020	N/A	1.71
510	12	017B	LEWIS ANDREW A REV TRUST	1.73
510	12	017F	LEWIS ANDREW A REV TRUST	1.04
510	48	005M	PROPERTY RESERVE ARIZONA LLC	14.12
510	12	018F	SUNSET TARTESSO LLC	11.18
510	12	017D	ARP BOBBIE JEAN	0.39
510	12	018A	GUBIN FAM TRUST	0.61
510	49	003B	SMITH JD LIV TRUST	1.05
510	49	003B	SMITH JD LIV TRUST	8.69
NAP			N/A	0.98
510	49	002B	EAGLE SHADOW LLC	6.16
510	49	0050	N/A	1.56
510	49	001A	PHILLIPS PAUL JOSEPH TR ETAL	1.73
NAP			N/A	1.56
510	49	001B	PHILLIPS PAUL JOSEPH TR ETAL	2.18
502	42	001K	EAGLE SHADOW LLC	28.86
502	42	001J	MARICOPA INDUSTRIAL PARK 422	0.01
502	06	003E	EAGLE SHADOW LLC	0.66
502	06	0080	EAGLE SHADOW LLC	6.69
502	08	003A	IOTA EAGLE LLC	0.17
502	08	002C	IOTA EAGLE LLC	3.67
NAP			N/A	13.40
502	10	001A	AK-CHIN INDIAN COMMUNITY	1.43
502	10	001D	MOBILE MINI INC	1.89
502	11	0010	AK-CHIN INDIAN COMMUNITY	0.13
502	12	005A	COPPER MOUNTAIN RANCH COMMUNITY FACILITI	0.05
502	44	041E	ROBBINS WARREN N & GEORGINA	0.31
502	44	041D	LARA GUILLERMINA	0.12
502	44	041B	AIRPARAMO LLC	0.12
502	44	0420	TULL JEFFERY P	0.26

Table 7-3: Estimated Right-of-Way Requirements (cont.)

Parcel Number			Owner	Approx. Take (acres)
BK	Map	Par.		
502	44	0430	TULL JANET J	0.24
502	44	0440	SALAZAR JOSE & GUADALUPE	0.28
502	44	0450	GARCIA RAUL F & MARIA R	0.28
502	44	0460	MAY JIMMIE O	0.28
502	44	0470	CANZANO ROBERT A	0.28
502	44	0480	GUTIERREZ VINCENT	0.28
502	44	0490	KINDY LEON W & PATRICIA A	0.28
502	44	0500	LABA ROBERT	0.28
502	44	0510	MAYERHOFER ROBERT G	0.28
502	44	0520	GARDNER WILLIAM C REV TRUST	0.28
502	44	0530	MYERS GREGORY L AND/OR KAREN J	0.28
502	44	0540	DOMING GLENN R & TERESA R	0.28
502	44	0550	MILLER ELIZABETH M	0.28
502	44	0560	SILVA JOSE L & MARISELA P	0.28
502	44	0570	GOODWIN RICHARD L	0.28
502	44	0580	RICO ASCENCION & BELEN	0.28
502	44	0590	FLYNN NANCY	0.28
502	44	0600	BRYAN KRIS	0.28
502	44	0610	BEEMAN BETTY J	0.28
502	44	0630	BEEMAN BETTY J	0.09
502	44	0640	BEEMAN BETTY J & CABLE JEANETTE M	0.94
502	12	0030	SPRR	0.47
502	13	003D	RUSSELL HIGHWAY LLC	1.86
502	13	003A	RUSSELL ROAD 79 LLC	0.19
502	14	0010	ANDERSON RUSSELL LLC	10.05
502	06	016D	RUSSELL & TEEL FIRST MORTGAGE LLC	12.03
502	06	016G	C/O GRANDE VALLEY MULTI-FAMILY LLC	0.25
502	06	0310	SPRR	0.70
502	06	014G	VESTAR GVC LLC	1.57
502	31	7000	N/A	0.88
502	39	0050	GRANDE VALLEY SINGLE FAMILY LLC	4.03

Table 7-3: Estimated Right-of-Way Requirements (cont.)

Parcel Number			Owner	Approx. Take (acres)
BK	Map	Par.		
502	39	002A	GRANDE VALLEY SINGLE FAMILY LLC	4.07
502	39	0010	GRANDE VALLEY SINGLE FAMILY LLC	8.06
502	32	006E	GRANDE VALLEY SINGLE FAMILY LLC	3.80
502	32	006A	KRONWALD CAROL CHILDREN S IRR TRUST	4.01
502	32	0080	GRANDE VALLEY SINGLE FAMILY LLC	3.86
502	32	009D	VAL VISTA & MONTGOMERY LLC	3.66
502	33	0040	ARCUS & ARETE CAPITAL INVESTMENTS LLC	18.58
502	37	001A	ARCUS & ARETE CAPITAL INVESTMENTS LLC	0.01
502	35	002H	140 VAL VISTA BURRIS LTD PSHIP	0.09
502	34	0050	ANCCC LLC	1.01
502	36	0030	TB SPECIAL ASSET I LLC	4.20
502	36	0020	TB SPECIAL ASSET I LLC	7.19
502	36	001B	TB SPECIAL ASSET I LLC	5.35
502	36	004B	TB SPECIAL ASSET I LLC	0.20
502	36	001A	WHM COPPER MOUNTAIN INVESTMENTS LLC	2.03
502	36	009A	WHM COPPER MOUNTAIN INVESTMENTS LLC	5.56
502	36	0080	ASARCO MULTI-STATE CUSTODIAL TRUST	0.74
502	25	008A	ASARCO MULTI-STATE CUSTODIAL TRUST	5.96
502	25	008C	LKY/COPPER MOUNTAIN INVESTMENT LTD PSHIP	6.01
502	25	007A	ASARCO MULTI-STATE CUSTODIAL TRUST	5.94
502	25	007D	LKY/COPPER MOUNTAIN INVESTMENT LTD PSHIP	2.75
502	25	007C	ASARCO MULTI-STATE CUSTODIAL TRUST	3.25

Table 7-3: Estimated Right-of-Way Requirements (cont.)

Parcel Number			Owner	Approx. Take (acres)
BK	Map	Par.		
502	25	005A	ASARCO MULTI-STATE CUSTODIAL TRUST	2.76
502	25	005B	LKY/COPPER MOUNTAIN INVESTMENT LTD PSHIP	10.84
502	25	0040	LKY/COPPER MOUNTAIN INVESTMENT LTD PSHIP	13.39
509	84	0090	VVB 80 LTD PSHIP	3.37
509	84	348A	AVALON COMMUNITY ASSOCIATION	0.29
509	84	348A	AVALON COMMUNITY ASSOCIATION	0.25
509	84	875A	GILA BUTTES COMMUNITY ASSOCIATION	0.36
509	84	6450	D R HORTON INC - DIETZ-CRANE	0.04
509	84	6440	D R HORTON INC - DIETZ-CRANE	0.11
509	84	6430	D R HORTON INC - DIETZ-CRANE	0.07
509	84	6420	D R HORTON INC - DIETZ-CRANE	0.07
509	84	6410	D R HORTON INC - DIETZ-CRANE	0.07
509	84	875A	AVALON COMMUNITY ASSOCIATION	0.69
509	84	6390	D R HORTON INC - DIETZ-CRANE	0.07
509	84	6380	D R HORTON INC - DIETZ-CRANE	0.07
509	84	6370	D R HORTON INC - DIETZ-CRANE	0.07
509	84	6360	D R HORTON INC - DIETZ-CRANE	0.07
509	84	6350	D R HORTON INC - DIETZ-CRANE	0.07
509	84	6340	D R HORTON INC - DIETZ-CRANE	0.07
509	84	6330	D R HORTON INC - DIETZ-CRANE	0.07
509	84	6320	D R HORTON INC - DIETZ-CRANE	0.07
509	84	6310	D R HORTON INC - DIETZ-CRANE	0.07
509	84	6300	D R HORTON INC - DIETZ-CRANE	0.07
509	84	6290	D R HORTON INC - DIETZ-CRANE	0.12
509	84	6630	D R HORTON INC - DIETZ-CRANE	0.01
509	84	3640	D R HORTON INC - DIETZ-CRANE	0.01
509	84	3630	D R HORTON INC - DIETZ-CRANE	0.12
509	84	3620	D R HORTON INC - DIETZ-CRANE	0.08
509	84	3610	D R HORTON INC - DIETZ-CRANE	0.07
509	84	3600	D R HORTON INC - DIETZ-CRANE	0.07
509	84	3590	D R HORTON INC - DIETZ-CRANE	0.07
509	84	3580	D R HORTON INC - DIETZ-CRANE	0.07

Table 7-3: Estimated Right-of-Way Requirements (cont.)

Parcel Number			Owner	Approx Take (acres)
BK	Map	Par.		
509	84	3570	D R HORTON INC - DIETZ-CRANE	0.07
509	84	875A	AVALON COMMUNITY ASSOCIATION	0.33
509	84	3560	D R HORTON INC - DIETZ-CRANE	0.07
509	84	3550	D R HORTON INC - DIETZ-CRANE	0.07
509	84	3540	D R HORTON INC - DIETZ-CRANE	0.07
509	84	3530	D R HORTON INC - DIETZ-CRANE	0.07
509	84	3520	D R HORTON INC - DIETZ-CRANE	0.07
509	84	3510	D R HORTON INC - DIETZ-CRANE	0.07
509	84	3500	D R HORTON INC - DIETZ-CRANE	0.10
509	84	3490	D R HORTON INC - DIETZ-CRANE	0.14
509	84	4700	D R HORTON INC - DIETZ-CRANE	0.00
509	84	001A	WVVB 80 LTD PSHIP LLLP	0.99
509	46	001A	LAT PROPERTY LLC	10.87
509	46	0020	WALSH MICHAEL A & ROSA LEE TRS	1.85
509	46	7000	N/A	1.08
NAP			N/A	9.37
515	28	004A	EVERGREEN-PINAL & VAL VISTA SEC LLC	1.61
515	28	004C	CASA GRANDE ACQUISITIONS LLC	1.00
515	28	0020	ASARCO MULTI-STATE CUSTODIAL TRUST	0.01
515	28	0010	VLAND4 LLLP	1.09
509	44	0060	VLAND4 LLLP	5.34
509	44	0050	51 BUCKEYE LTD PSHIP	1.82
509	44	0040	DTD-DEVCO 4 LLC	0.91
509	44	0030	DTD-DEVCO 4 LLC	0.45
509	44	0020	51 BUCKEYE LTD PSHIP	0.45
509	44	0010	DALEY WOODRUFF LLC	0.55
NAP			N/A	2.97
509	44	0010	DALEY WOODRUFF LLC	0.69
509	43	0040	I-10/WOODRUFF 300 LTD PSHIP LLLP	2.75

Approximate total R/W or easement required to construct EWC = **313-Acres**

7.9 Drainage

Drainage has been evaluated in a separate report for the EWC, and this section will summarize the findings of this report. The full report is attached to this document and can be seen in *Appendix D.*

7.9.1 Existing Conditions

The primary drainage features of this project are the Santa Rosa Wash and the Santa Cruz Wash. These washes convey a flow from roughly the southeast towards the northwest, while crossing the proposed East-West Corridor. These drainage features are Federal Emergency Management Agency (FEMA) delineated floodplains as shown on the *Flood Insurance Rate Maps*.

7.9.2 Vegetation

The study area lies almost entirely within the Lower Colorado River Valley Subdivision of Sonoran desertscrub (Turner and BR/Wn 1994, Figure 4). The common creosote bush *(Larrea tridentata)* is the dominant native vegetation species in this plant subdivision. Most of the study area has been disturbed, either by agricultural practices or commercial and residential development. Native vegetation generally is limited to scattered patches throughout much of the study area. Native plant communities that do exist in these areas are limited in diversity with some exceptions, such as along ephemeral drainages.

The northeastern portion of the study area, where the Sacaton Mountains foothills are located, presents a different native plant community, the Arizona Upland subdivision of Sonoran desertscrub (Turner and BR/Wn 1994). Within this upland area, the vegetation consists of foothill paloverde *(Parkinsonia microphylla),* mesquite (*Prosopis* spp.), and cat-claw acacia (*Acacia greggii*). Protected native plants include cacti, such as saguaro (*Carnegiea gigantea*), barrel cactus (*Ferocactus* spp.), and several varieties of cholla (C*ylindropuntia* spp., *Opuntia* spp.).

7.9.3 Topography

The study area lies between 1,130 and 2,235 feet above mean sea level in the western portion of Pinal County, Arizona. The study area's terrain is generally flat to gently sloping downward to the north and west. One topographical exception is the foothills of the Sacaton Mountains that extend into the northeastern portion of the study area and present significant variations in topography.

7.9.4 Soil Types

Soils in the study area include Denure Sandy Loam, Casa Grande Fine Sandy Loam, Trix Clay Loam, and Vaiva-Rock Outcrop Complex at a 15 to 50 percent slope. These are well-drained to somewhat excessively drained, very deep, medium coarse-textured soils on nearly level to steep soils. These soils occur above buried argillic horizons, on relic basin floors, stream terraces, fan terraces, or steep slopes. These soils, which were formed in stratified stream or fan alluvium, were derived from igneous rock (NRCS 2011; 2012).

Soils within the study area are well-suited to moderately-suited for using the natural surface of the soil for road construction. The well-suited soils pose no known limitations to road construction, and the moderately-suited soils would perform fairly well for road construction.

7.9.5 Existing Drainage Structures

Within the project limits, there are several box culverts and pipes that convey drainage underneath the roadway. It should be noted that there are multiple instances along the MCGH where dip sections allow drainage to pass the roadway during storm events.

The runoff from the Santa Cruz Wash passes under the UPRR at a 2-span bridge with 56' length, a 6-span bridge with 180' length and another 2-span bridge with 56' length. The previous roadway had one long dip section with 2-24" corrugated metal pipes (CMP). Recently, the MCGH has been improved with a 6-barrel 10'x6' concrete box culvert, an 18-barrel 10'x6' concrete box culvert and another 6-barrel 10'x6' concrete box culvert on a 45° skew. This allows for the MCGH to be an all-weather crossing diverting the Santa Cruz Wash underneath the roadway. To the west of the bridges is a crossing with 5-60" corrugated metal pipes under the UPRR. The dip section with 24" culvert under the roadway has been replaced with 5-24" corrugated metal pipes.

Running parallel to the MCGH, there is an existing drainage channel north of the roadway that conveys drainage to the Santa Cruz Wash. This drainage is crossed at multiple locations by the utilization of concrete box culverts or arch culvert systems.

Running parallel to Val Vista Boulevard between Pinal Avenue and Trekell Road, there is a roadside channel that crosses underneath Pinal Ave by means of a 5-barrel 10'x7' concrete box culvert.

7.9.6 Proposed Drainage Structures

The proposed drainage structures including extensions of existing culverts are shown on the roadway plans in *Appendix A.* Segment A consists of a bridge spanning the Santa Rosa Wash. Other culverts will typically be 24" CMPs to drain the roadway and minor off-site sub basins. The roadway will have V-ditches to collect the off-site runoff and convey to culvert crossings of the roadway. During final design, the outlets for all culverts will need to be evaluated for outlet protection. If needed, this will be provided with riprap aprons.

Alternative systems have been evaluated for Segment B. In all of the options the runoff from Segment C is conveyed to the Santa Cruz Wash. A portion of the runoff will be drained to the existing culverts under the UPRR. The proposed culverts at those locations will match the existing culverts. Therefore Segment B will require an open channel north of the proposed alignment within the proposed R/W. At each side street crossing, culverts will be needed. Since the existing structures are undersized, new culverts have been proposed. The open channel was sized based on either a concrete lined channel or an unlined earthen channel. In addition, a proposed detention basin was evaluated. This basin would be located at the west limits of Segment C and would enable the downstream channels and culverts to be reduced in size. This analysis is included within the Drainage Report. The results show that the most practical alternative is a concrete lined channel with no detention basin.

As shown on the roadway plans, Segment C will have a series of pipe culverts and concrete box culverts. In the developed areas, existing structures will be extended as needed. The off-site runoff drains to the southwest so the typical section has a V-ditch on that side of the roadway to collect runoff and convey it to the proposed structures. The roadway plans also show areas where a larger channel will be required. Those ditches will typically be unlined trapezoidal channels with a bottom width of 8-feet. If the right-of-way is not adequate for an unlined channel, a concrete channel will be constructed. As in the other segments, all culverts will be evaluated for the need of outlet protection. Based on the projected flows, riprap aprons will most likely be sufficient. The proposed drainage structures are shown as follows.

Table 7-4 summarizes the proposed drainage features for the EWC. These locations can also be seen in the plan sheets attached in *Appendix A.*

Table 7-4: Proposed Drainage Structures

Station	Proposed Structure
1091+00	2 – 10’x6’ RCBC
1129+00	Santa Rosa Bridge
1346+40	5 – 24” CMPs Extension
1365+63	6 – 10’x6’ RCBC Extension
1370+44	18 – 10’x6’ RCBC Extension
1371+98	6 – 10’x6’ RCBC Extension
1374+47	5 – 10’x6’ RCBC
1392+09	5 – 10’x6’ RCBC
1404+64	5 – 10’x6’ RCBC
1425+23	5 – 10’x6’ RCBC
1453+00	4 – 36” CMPs
1471+31	4 – 60” CMPs
1489+03	4 – 10’x6’ RCBC
1510+44	5 – 36” CMPs
1529+84	6’x6’ RCBC
1533+43	6’x6’ RCBC
1536+24	6’x6’ RCBC
1338+83	6’x6’ RCBC
1555+54	8’x5’ RCBC
1555+56	8’x4’ RCBC Extension
1568+88	2 – 6’x3’ RCBC Extension
3074+18	2 – 54” CMPs
3084+58	2 – 54” CMPs
3102+11	2 – 54” CMPs
3128+75	60” CMP
3144+86	60” CMP
3152+50	60” CMP

Table 7-4: Proposed Drainage Structures (cont.)

Station	Proposed Structure
3182+30	60” CMP
3196+84	60” CMP
3233+54	60” CMP
3242+83	2 – 54” CMPs
3257+34	2 – 54” CMPs
3280+02	2 – 54” CMPs
3290+91	2 – 54” CMPs
3301+83	2 – 60” CMPs
3339+17	60” CMP
3350+36	2 – 60” CMPs
3360+85	60” CMP
3375+79	60” CMP
3389+27	60” CMP
3397+37	60” CMP
3413+86	2 – 54” CMPs
3415+97	2 – 54” CMPs
3421+46	2 – 54” CMPs
3439+71	2 – 54” CMPs
3457+17	5 – 24” CMPs
3460+12	4 – 24” CMPs
3461+96	2 – 24” CMPs
3472+90	48” RCP
3481+14	48” RCP
3488+87	48” RCP
3500+96	3 – 10’x5’ RCBC
3513+50	RCBC Extension
3526+50	3 – 10’x5’ RCBC
3536+75	3 – 10’x5’ RCBC

Table 7-4: Proposed Drainage Structures (cont.)

Station	Proposed Structure
3560+95	3 – 10’x5’ RCBC
3593+17	48” CMP
3600+58	48” CMP
3607+97	3 – 10’x5’ RCBC

7.9.7 Hydrology and Hydraulics Methodology

Computations for the design peak discharges at minor subbasins and on-site will be developed in the final design using the Rational Method. These computations will be performed in accordance with ADOT procedures. Rainfall intensities will be taken from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14. Time of concentration, T_C, will be computed with the minimum being 10 minutes; therefore the rainfall intensities will be 6.07 inches per hour or less. For the runoff coefficient, the subbasins were determined to be rural desert with one hour precipitation equal to 2.09 inches. As specified by ADOT, the runoff coefficient, C, is equal to 0.53. Peak discharges will be computed as follows:

$$Q = CiA$$

Where:

Q = Peak Discharge (cubic feet per second)
C = Runoff Coefficient, 2.09”
i = Rainfall Intensity (inches per hour), 6.07
A = Basin Area (acres)

7.9.8 Drainage Requirements

50-Year and 100-Year hydrology was determined for this project. These values can be located within the “*Preliminary Drainage Report*”. Due to limited right-of-way in Segment B, alternative drainage concepts were developed. These alternatives included a detention basin, concrete lined channels, and unlined earthen channels.

7.10 Earthwork

7.10.1 General Geologic Setting

The project vicinity is located in the Sonoran Desert and the Basin and Range Province (Chronic 1983). The Basin and Range province is characterized as a series of discontinuous, north-south trending, moderately rugged mountain ranges separated by broad flat basins. Typically the mountains comprise intrusive and extrusive igneous rocks, sedimentary rocks, and metamorphic rocks. The basins comprise uncemented to weakly cemented, poorly sorted erosional deposits of clay, silt, sand, and boulders that were deposited as a series of alluvial fans. Older alluvial apron fans formed as terrace deposits located against the mountain ranges while younger alluvial deposits are associated with the low-lying stream channels and floodplains. The project vicinity comprises Quaternary-age geological deposits (Arizona Geological Survey, 2013).

7.10.2 Earthwork Factors

Without geotechnical investigation, it is difficult to determine factors such as shrink and swell to be used in evaluating the earthwork requirements. For the purposes of this study, shrink and swell will not be evaluated for any earthwork quantities. Formal geotechnical investigation shall be conducted during final design of the corridor improvements.

The geotechnical report: *Geotechnical Investigation: Maricopa-Casa Grande Highway Crossing Improvements Project* developed some insights into the types of soil conditions that can be anticipated for this project. This roadway improvement project was located along the MCGH at the intersection of the Santa Cruz Wash and Murphy Road Intersection. For this project, it was recommended that constructed slopes be no steeper than 2.5:1 due to the subsurface information obtained from boring investigations. It was anticipated that earthwork material excavated from the wash would shrink between 10 to 20 percent, however this material was deemed suitable for engineered fill as long as the soils exhibited low plasticity and very low to low expansion potential.

7.10.3 Earthwork Balancing

The majority of the EWC is expected to be balanced as the proposed improvements are to be constructed at-grade. Therefore it is assumed that a minimal amount of roadway excavation will be required for the entirety of the project in order to install the finished grade. For the purposes of cost estimating for this project, the excavation quantity will assume that 1-foot of excavation will occur over all pavement sections after the existing roadway surface has been obliterated. The material cut from these sections is assumed to be suitable for use as engineered fill where necessary and the project is assumed to be balanced.

For the construction of the overpass sections where the EWC intersects with White and Parker and Val Vista Boulevard, earthwork material is assumed to be imported borrow. A review of the Study Area has determined an absence of readily available earthwork material that can be excavated during normal roadway construction activities.

It is imperative that any earthwork operations within Tribe lands utilize the earthwork material generated on-site properly. The Ak-Chin Indian Community does not permit surplus material generated by construction activities to leave Tribe lands. If there is surplus material left after construction activities, coordinate with the Ak-Chin Indian Community to determine a suitable location for disposing of the material.

7.10.4 Cut and Fill Slope Recommendations

As discussed above, the majority of the roadway improvements will be constructed at-grade in order to minimize the need for significant amounts of earthwork operations. Cut and fill slopes are recommended to be 4:1 or flatter in order to maintain clear-zone requirements while also limiting the need for installation of guardrail. In the overpass locations, guardrail will be implemented so fill slopes may be steepened to 2:1 behind the guardrail.

See the *Typical Sections* in *Appendix A* for more information regarding side-slope treatment.

7.11 Pavement Structural Section

As discussed in *Section 7.10.2*, the geotechnical investigation and the resultant pavement design report were made available to the Study Team. These reports shed some insights into the existing conditions that can be expected within the EWC and a recommended pavement structural section. This information remains particularly valid in regard to the pavement structural section as the existing and anticipated traffic movements along MCGH can be applied directly to the EWC.

The *Pavement Design Summary, Maricopa-Casa Grande Highway Crossing Improvements* conducted by Ninyo and Moore found that a 16-inch thick structural section would be adequate for the vast amounts of truck traffic that is currently seen and planned for along the MCGH. This pavement structural section incorporates 10-inches of aggregate base material on top of two lifts of asphaltic concrete, 3.5-inches and 2.5-inches, respectively. The proposed structural section for the *Maricopa-Casa Grande Highway Crossing Improvements* Project can be seen in **Figure 7-5**. This structural section will be used for the entirety of the EWC as it represents a conservative approach to handling the truck traffic that this corridor regularly experiences and will be used as the basis for cost estimating.

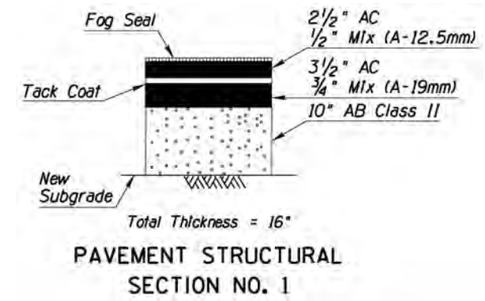


Figure 7-5: Recommended Pavement Structural Section

7.12 Intersections

Table 7-5 summarizes the intersections identified along the EWC where median crossovers will be located. As discussed in *Section* 6, the location of median crossovers and the U-Turn facilities are imperative to the operation of a parkway. Typically U-Turn facilities were located within an 1/8-mile spacing from median crossovers. See the plans in *Appendix A* for the location of the U-Turn facilities.

Table 7-5: Intersection / Median Crossover Locations

Station	Intersection Description	Intersection Treatment
1000+00	N. Maricopa Road	Signalized Intersection
1012+40	Unnamed Road (future)	Signalized Intersection
1055+31	Unnamed Road (future)	Arizona Parkway
1109+46	N. Porter Road	Arizona Parkway
1134+17	N. White and Parker Road	Arizona Parkway
1162+19	N. White and Parker Road	Arizona Parkway
1374+50	Murphy Road	Left-Turn from Parkway Only
1392+09	Antone Street	Left-Turn from Parkway Only
1404+63	N. Maricopa Industrial Parkway	Left-Turn from Parkway Only
1426+53	N. Anderson Road	Signalized Intersection
1489+04	N. Russell Road	Signalized Intersection
1517+90	Val Vista Boulevard	Arizona Parkway
1536+15	Val Vista Boulevard	Arizona Parkway

Table 7-5: Intersection and Median Crossover Locations (cont.)

Station	Intersection Description	Intersection Treatment
3056+32	Maricopa Casa Grande Highway	Arizona Parkway
3064+45	Maricopa Casa Grande Highway	Arizona Parkway
3128+70	N. Papoose Road	Arizona Parkway
3181+87	N. Montgomery Road	Arizona Parkway
3234+84	N. Corrales Rd	Arizona Parkway
3295+40	Blanco Road	Arizona Parkway
3408+65	N. Burris Road	Arizona Parkway
3428+38	Geronimo Drive	Left-Turn from Parkway Only
3434+89	N. Faldale Road	Arizona Parkway
3452+38	Encore Drive	Left-Turn from Parkway Only
3461+54	N. Scott Drive	Signalization
3474+67	N. Hualapai Drive	Arizona Parkway
3481+30	N. Battleford Drive	Arizona Parkway
3488+03	N. Tuzigoot Drive	Arizona Parkway
3500+26	N. Crane Place	Left-Turn from Parkway Only
3514+51	N. Pinal Avenue	Arizona Parkway
3545+99	Unnamed Road (RV Park Access)	Left-Turn from Parkway Only
3567+93	N. Trekell Road	Arizona Parkway
3598+57	I-10	Arizona Parkway
3630+27	I-10	Arizona Parkway

7.13 Utilities

At the onset of this Study, Blue Stake was contacted to identify the existing utilities within the EWC. Blue Stake conducted a Quality Level D Subsurface Utility Engineering (SUE) Investigation. Quality Level D SUE Investigation is the most basic level of information for utility locations; it comes from existing utility records and it is typically used for project planning and route selection activities. This investigation provided the Study Team with contact information for each utility provider.

Each utility company was contacted via electrinic mail correspondence to request as-built documents. In the event that there were no as-built documents, Jacobs sent hard copy plan sheets so that the existing utility could be horizontally located. As a result of this process, the existing utilities are as shown in the roadway plans and are discussed below:

7.13.1 Arizona Department of Transportation

ADOT has traffic signals and storm drain facilities along SR 347 (Maricopa Road) and SR 387 (Pinal Ave). Traffic signals as-builts were obtained for the intersection of SR 387 and Val Vista Boulevard.

Contact: ADOT Engineering Records Section
1655 W Jackson
Phoenix, AZ 85007
(602) 712-8216

7.13.2 Arizona Public Service

APS has the majority of their facilities on the eastern half of the project along Val Vista Boulevard. Facilities in this area include:

- Overhead power on the south side of Val Vista Boulevard from Papoose Road to Montgomery Road.
- Overhead power on the north side of Val Vista Boulevard from Penworth Drive to Geronimo Drive.
- Underground facilities on the south side of Val Vista Boulevard from Penworth Drive to Faldale Road.
- Overhead power on the north side of Val Vista Road from Faldale Road to I-10.
- Other miscellaneous crossings located thoughout Val Vista Boulevard corridor.

Near Farrell Road and MCGH, most facilities belong to Electrical District No. 3 (ED3). APS has minor facilities tapped into ED3's facilities but these facilities are not located within the Study Area.

Contact: Ronald V Passannanti
Arizona Dept of Transportation
Traffic Operations Blue Stake
1444 West Grant Road
Tucson, AZ 85745

7.13.3 CenturyLink

CenturyLink has facilities throughtout most of the project area including fiber optic lines, coaxial lines, and overhead lines near I-10. A detail description of its facilities:

Buried/UG coax/FO lines near Farrell Road and MCGH:

- North side of Farrell Road from SR 347 to 1/2 mile east.
- East side of Porter Road crossing Farrell Road.
- West side of MCGH from White and Parker Road to Fuqua Road.
- West side of MCGH from Hartman Road to Antone Road
- East side of MCGH from Maricopa Industrial Parkway to Anderson Road.
- Perpendicular crossings of MCGH at the Peters and Nall Road and Murphy Road intersections.

Buried/UG coax/FO line parallel and west of the UPRR (no conflict with project):

- West side of the UPRR from White and Parker Road to Hartman Road.
- West side of the UPRR from Antone Road to Val Vista Boulevard alignment.

Buried/UG line near Val Vista Boulevard:

- South of Val Vista Boulevard from Papoose Road to Bianco Road.
- North of Val Vista Boulevard from Corrales Road to ~700' west of I-10. Beginning from the RV Park entrance to west of I-10 is overhead.
- South of Val Vista Boulevard from Penworth Drive to Scott Drive.
- South of Val Vista Boulevard from Tuzigoot Road to the RV Park Entrance.

Contact: Kelly Cadle
Engineering Assistant for FTTN/Accounting/Facility Maps
135 W. Orion Street
Tempe, Arizona 85283
(480) 768-4594

7.13.4 City of Casa Grande

The city of Casa Grande has multiple utilities per the Blue Stake research including communications, electric, telephone, fiber optic, sanitary sewer, street lights, traffic signals and water. Multiple as-builts drawings were provided for the developments adjacent to Val Vista Boulevard. Water lines are described under Arizona Water Company's description. Most of the sewer lines are within the development and drain south of Val Vista Boulevard. A 12" sewer line crosses Val Vista Boulevard approximately 200' west of SR 387 (Pinal Ave).

Contact: Mr. Terrence McKeon
(520) 421-8625

7.13.5 El Paso Natural Gas Company (EPNG)

EPNG has high pressure gas transmission lines crossing Val Vista Boulevard. These lines are described below:

- 12-inch high pressure natural gas transmission line running north-south on Burris Road.
- 2-10-inch high pressure natural gas transmission lines running approximatelly ¾-mile west and parallel to I-10.

EPNG is a federally regulated interstate transmission company. Under the Pipeline Safety Act of 2002, due to the volatile nature of the product being transported under high pressure, in the interest of public safety, historical as-built data cannot be given out to third parties. The gas line must be potholed, with an El Paso representative present, to determine depth and location under current surface conditions.

Contact: Mr. Russell E. Williams
Damage Prevention Supervisor
(602) 438-4249 (O) / (480) 270-2392 (C)

Mr. Franch Sanchez
Operations Supervisor
francisco_sanchez@kindermorgan.com

Mr. James Pigg
Operations Crew Lead
james_pigg@kindermorgan.com

Project Management Engineering Group PM
WestEncroachments@kindermorgan.com

Mr. Garry Zieske
Right-of-Way
garry_zieske@kindermorgan.com

7.13.6 Electrical District No. 3

ED3 has electric and irrigation facilities servicing mainly the western half of the project corridor in the vicinity of Farrell Road and the MCGH. These electric facilities include overhead conductors, underground conductors and 69-kV conductors. According to the facility maps, the electric facilities near the Study Area are as follows:

- Overhead facilities on Farrell Rodd from SR 347 to west of Porter Road.
- Overhead and 69-kV conductors on Porter Road crossing Farrell Road.
- Overhead and 69-kV conductors on White and Parker Road crossing Farrell Road and MCGH.
- Ovehead and 69-kV conductors on Cowtown Road from White and Parker Rodd to Pinal Energy Electric Plant on Fuqua Road. Cowtown Road is west of the UPRR and does not impact the project.
- Overhead conductor on MCGH from Fuqua Road to Peters and Nall Road alignment where the ED3 service area borders the Ak-Chin Indian Reservation. Overhead conductor continues on MCGH north of Anderson Road and terminates south of Russell Road.

Contact: Mr. Tony Solano
Operations Manager
(520) 424-9276

7.13.7 Global Water

According to the Blue Stake Research, Global Water may have reclaimed water, sewer, and water facilities in the area of Farrell Road near the City of Maricopa. Jacobs made several attempts to get in touch with Global Water personnel but was unable to obtain as-built information. This information needs to be obtained during the final design.

Contact: Mr. Jeff McDonald
Conflict Review
21410 N. 19th Avenue
Phoenix, AZ 85027
(480) 999-4536
Jeff.mcdonald@gwresources.com

7.13.8 Kinder Morgan

Kinder Morgan Pipeline Inquiries has been contacted in order to obtain as-built drawings in the vicinity of the EWC. As-built drawings and a file reference number were provided for future correspondence. The File Reference No. is **13-144**.

Kinder Morgan has 12-inch high pressure petroleum products pipeline in the Study Area. This pipeline is referenced as System SFPP_SOUTH, Sub System EP-TU-PX 12IN, Line LS-117; Tucson-Phoenix 12-inch. This pipeline runs parallel and northeast of MCGH north of Peters and Nall Road; then turns east into Peters and Nall Road and continues south on the Anderson Road alignment. The 12-inch petroleum products pipeline crosses MCGH and the UPRR at the Anderson Road alignment and continues parallel and west of the UPRR, approximatelly 50- to 90-feet offset from the track.

Kinder Morgan also has an abandoned 8-inch pipeline (LS-7) parallel to the UPRR. Portions of this pipeline falls inside the UPRR R/W. In this area, UPRR maintains ownership of the pipeline.

In the interest of public safety and for pipeline protection, the following provisions must be considered in the design and subsequent construction of improvements affecting Kinder Morgan pipeline facilities:

1. Adherence to the applicable provisions enumerated in the L-OM200-29 “Guideline for Design and Construction” relating to the proposed projects affecting Kinder Morgan pipelines.
2. Exact pipeline location and depths can only be determined by pothole at a maximum of 50-feet intervals or at the other locations as required by Kinder Morgan’s onsite representative. The pothole work must be performed by hand excavation in the presence of the Kinder Morgan representative.

When preliminary project plans have been formulated, based upon the filed determination (surveyed potholes) or existing substructures, forward a full-sized set of drawings to Kinder Morgan Pipeline Engineering showing Kinder Morgan’s 12-inch pipeline in plan and profile relative to the proposed improvement and existing conditions. Necessary provisions for pipeline protection will be provided by Kinder Morgan.

Contact: Mr. Mark Sabeti
Senior Project Manager
(714) 560-4770

7.13.9 Southwest Gas Corporation

Southwest Gas has gas lines at various locations througout the Study Area:

- West of MCGH, 4-inch steel gas line on Farrell Road from SR 347 to Porter Road.
- An 8-inch steel gas line crossing MCGH and the UPRR at the White and Parker Road alignment.
- A 2-inch and 4-inch steel gas lines crossing MCGH and the UPRR at the Anderson Road alignment.

Contact: Mr. Jesse Gonzalez
(520) 316-5022

8.0 ITEMIZED COST ESTIMATE

8.1 Estimate Items

A detailed cost estimate has been prepared for the selected alternative as detailed in previous sections. This cost summary assumes that the project will be constructed in its entirety. It is more likely that the EWC will be constructed in multiple segments. These segments are their associated costs will be elaborated further in *Section 9.0*.

The unit prices are based on recent bid results with adjustments made to reflect the project location and the difficulty of the work anticipated. There were a few assumptions that had to be made before an itemized cost estimate could be made. These assumptions are as follows:

- The pavement quantities are based on the pavement structural section previously discussed in this report. Roughly 10-inches of aggregate base over two lifts of asphalt concrete to make a total structural section of 16-inches.
- Without a detailed geotechnical investigation, shrink and swell factors have not been factored into the earthwork quantities.
- As the majority of the improvements will be constructed at-grade, there is limited earthwork necessary for the construction of the improvements.
- The borrow earthwork material is based on solely the overpass structure locations as it is assumed that the roadway excavation will yield enough material to construct the remainder of the improvements. Differing from the project typical sections, 2:1 fill side slopes are assumed for the overpass locations.
- The structural concrete and steel quantities are solely for the construction of the concrete box culverts. The bridge structures will be based on an area of bridge deck as quantified by the project plans.

The basis for the quantity estimates and unit prices are summarized as follows.

Bid Items

Removals:

- Clearing and Grubbing (Acre)
  - It is assumed that all of the undeveloped area within the proposed R/W will have all vegetation removed in preparation of the establishment of subgrade.
- Removal of Structures and Obstructions (Lump Sum).
- Removal of Asphaltic Concrete Pavement (Sq. Yd.)
  - This quantity covers the removal of all of the existing asphaltic concrete within the project area.

Earthwork:

- Roadway Excavation* (Cu. Yd.)
  - This quantity assumes that the existing ground underneath the proposed subgrade will be excavated to a 1-foot depth across the entire project. Also included in this quantity is the excavation of the drainage ditches proposed along MCGH and Val Vista Boulevard.
- Borrow* (Cu. Yd.)
  - This quantity is based on the vertical grade at all of the overpass locations required to meet vertical clearance over either the UPRR, MCGH, or I-10.

  *As discussed in the previous section, shrink and swell factors are not considered in the computed quantities for Roadway Excavation and Borrow.

Paving:

- Aggregate Base, Class 2 (Cu. Yd.)
  - This quantity is based on 10-inches of AB material.
- Portland Cement Concrete Pavement (Sq. Yd.)
  - This quantity is based on the concrete required to construct to U-Turn facilities.
- Asphaltic Concrete (Ton)
  - This quantity is based on 6-inches of AC pavement.

Drainage Structures:

- Pipe Culvert (various sizes) (Ln. Ft.)
- Pipe Culvert End Sections (various sizes) (Each)
- Structural Concrete (Box Culverts) (Cu. Yd.)
- Reinforcing Steel (Box Culverts) (Lb.)

Traffic Control

- Traffic Signal (Per Intersection) (Each)
- Signing and Marking (Mile)
  - This quantity is based per mile within the project area times an estimates cost for mile. This estimated cost assumes six stripes at $0.50 per Ln. Ft. plus an estimated $10,000 for signing per mile.

Barriers:

- Guardrail, W-Beam, Single Face (Ln. Ft.)
- Guardrail, End Terminal Assembly (Each)
- Concrete Barrier (Single Face) (Ln. Ft.)

Riprap:

- Riprap (Dumped Outfall Protection) (Cu. Yd.)
  - Without detailed drainage analysis, it is difficult to estimate the quantity of riprap needed at each culvert. This quantity assumes that a 20-foot by 20-foot by 1-foot riprap splash pad will be constructed at each culvert. For the box culverts, a 30-foot splash pad is assumed to be required for the entire width of the box.

Bridges:

- Retaining Wall (Reinforced Concrete) (Sq. Ft.)
  - This quantity covers the retaining walls necessary to construct the overpass structures while keeping embankment fills within the proposed R/W. Each wall quantity assumes that the bottom portion of the wall will be buried 2-feet.
- New Bridges (Sq. Ft.)

Adjustment Items

- Furnish Water (2%)
- Maintenance of Traffic (10%)
- Environmental Impact Mitigation (4%)
  - This item includes the cost of any required landscaping and erosion control such as seeding and mulching.
- Mobilization (10%)
- Contractor Quality Control (2%)
- Construction Surveying and Layout (2%)

Non-Bid Items

- Asphalt Concrete Smoothness Incentive - $11,000 per lane mile
- Asphalt Concrete Materials Quality Incentive - $1.50 per ton of AC
- Construction Engineering – 10% of Construction Items
- Contingency – 30% of Construction Items

Other Items

- Design Engineering – 10% of Construction Items
- Right of Way Acquisition – See **Table 8.1**
- Utility Relocations
  - This item is for the relocation of 90 utility poles at an estimated cost of $5,000 each.

8.2 Right-of-Way and Easement Estimate

In order to construct the EWC, additional R/W and Easements are required from many different land owners. As discussed previously, R/W is not typically acquired from the Ak-Chin Indian Community. Instead, the roadway is built on an easement granted by the Tribe. In other areas, the EWC requires the R/W from an assortment of owners such as private property, prime farmland, or undeveloped areas. The following **Table 8-1** details the different means of acquiring the land necessary for the construction of the EWC and their related costs for construction. This cost will be carried forward into **Table 8-2**.

Table 8-1: Right-of-Way and Easement Estimate

ESTIMATED RIGHT-OF-WAY REQUIRED				
Item Description	**Unit Of**	**Quantity**	**Unit Price**	**Total**
Private Property	Acre	12.03	30,000.00	360,900.00
Farmland	Acre	98.06	10,000.00	980,600.00
Undeveloped Lands	Acre	198.15	5,000.00	990,750.00
State	Acre	5.23	5,000.00	26,150.00
ESTIMATED EASEMENT REQUIRED				
Ak-Chin Indian Community	Acre	1.56	10,000.00	15,600.00
			GRAND TOTAL	**2,374,000.00**

8.3 Itemized Estimate

Based on the plans as provided in *Appendix A*, quantities can be gathered in order to start to get a picture of how much it will cost to construct the EWC. These quantities have been inserted into **Table 8-2** to provide an estimated cost estimate for this DCR. It should be noted that there is a 30% Construction Contingency assessed at this point of the design to account for any unforeseen design features realized during final design.

Table 8-2: EWC Itemized Estimate

BID ITEMS						
ITEM DESCRIPTION	**UNIT OF MEASURE**	**PCT**	**QUANTITY**	**UNIT PRICE**	**TOTAL**	**REMARKS**
CLEARING AND GRUBBING	ACRE		450	500.00	225,000.00	
REMOVAL OF STRUCTURES AND OBSTRUCTIONS	L.SUM		1	500,000.00	500,000.00	
REMOVAL OF ASPHALTIC CONCRETE PAVEMENT	SQ.YD.		255,300	4.00	1,021,200.00	
ROADWAY EXCAVATION	CU.YD.		370,000	10.00	3,700,000.00	
BORROW	CU.YD.		390,000	12.00	4,680,000.00	
AGGREGATE BASE, CLASS 2	CU.YD.		310,000	30.00	9,300,000.00	
PORTLAND CEMEND CONCRETE PAVEMENT (12")	SQ.YD.		12,500	35.00	437,500.00	
ASPHALTIC CONCRETE	TON		361,000	75.00	27,075,000.00	
PIPE, REINFORCED CONCRETE, 48"	L.FT.		420	150.00	63,000.00	
PIPE CULVERT, 24"	L.FT.		1,465	85.00	124,525.00	
PIPE CULVERT, 36"	L.FT.		1,102	120.00	132,240.00	
PIPE CULVERT, 48"	L.FT.		342	160.00	54,720.00	
PIPE CULVERT, 54"	L.FT.		3,796	200.00	759,200.00	
PIPE CULVERT, 60"	L.FT.		3,257	240.00	781,680.00	
PIPE CULVERT END SECTION (MISC. SIZES)	EACH		133	800.00	106,400.00	
STRUCTURAL CONCRETE (BOX CULVERTS)	CU.YD.		7,500	350.00	2,625,000.00	
REINFORCING STEEL (BOX CULVERTS)	LB.		1,175,000	1.25	1,468,750.00	
TRAFFIC SIGNAL (TYPICAL INTERSECTION)	EACH		6	200,000.00	1,200,000.00	
SIGNING AND MARKING	MILE		23	25,000.00	575,000.00	
GUARDRAIL, W-BEAM, SINGLE FACE	L.FT.		29,700	25.00	742,500.00	
GUARDRAIL, END TERMINAL ASSEMBLY	L.FT.		28	2,000.00	56,000.00	
CONCRETE BARRIER (SINGLE FACE)	L.FT.		3,050	80.00	244,000.00	
RIPRAP (DUMPED OUTFALL PROTECTION)	CU.YD.		3,100	100.00	310,000.00	
RETAINING WALL (REINFORCED CONCRETE)	SQ. FT.		50,300	60.00	3,018,000.00	
NEW BRIDGE (COMPLETE NEW STRUCTURES)	SQ. FT.		127,200	150.00	19,080,000.00	
				BID ITEMS TOTAL:	**78,280,000.00**	Rounded to nearest $1,000

Table 8-3: EWC Cost Adjustments

BID ITEM ADJUSTMENTS						
ITEM DESCRIPTION	**UNIT OF MEASURE**	**PCT**	**QUANTITY**	**UNIT PRICE**	**TOTAL**	**REMARKS**
FURNISH WATER	COST	2%		1,566,000.00	1,566,000.00	Rounded to nearest $1,000
MAINTENANCE AND PROTECTION OF TRAFFIC	COST	10%		7,828,000.00	7,828,000.00	Rounded to nearest $1,000
ENVIRONMENTAL IMPACT MITIGATION	COST	4%		3,132,000.00	3,132,000.00	Rounded to nearest $1,000
MOBILIZATION	COST	10%		7,828,000.00	7,828,000.00	Rounded to nearest $1,000
CONTRACTOR QUALITY CONTROL	COST	2%		1,566,000.00	1,566,000.00	Rounded to nearest $1,000
CONSTRUCTION SURVEYING AND LAYOUT	COST	2%		1,566,000.00	1,566,000.00	Rounded to nearest $1,000
	BID ITEM ADJUSTMENTS TOTAL:				**23,486,000.00**	Rounded to nearest $1,000
NON-BID ITEMS						
AC SMOOTHNESS INCENTIVE	LANE MILE		92	11000.00	1,012,000.00	Rounded to nearest $1,000
ASPHALT CONCRETE MATERIALS QUALITY INCENTIVE	TON		361,000	1.50	542,000.00	Rounded to nearest $1,000
CONSTRUCTION ENGINEERING	COST	10%		7,828,000.00	7,828,000.00	Rounded to nearest $1,000
CONTINGENCY	COST	30%		23,484,000.00	23,484,000.00	Rounded to nearest $1,000
	NON-BID ITEMS TOTAL:				**32,866,000.00**	
OTHER COSTS						
DESIGN	COST	10%		7,828,000.00	7,828,000.00	Rounded to nearest $1,000
ESTIMATED RIGHT OF WAY	COST			2,374,000.00	2,374,000.00	Rounded to nearest $1,000
UTILITY RELOCATIONS	COST			50,000.00	50,000.00	Rounded to nearest $1,000
	OTHER COSTS TOTAL:				**10,252,000.00**	
GRAND TOTAL:					**144,884,000.00**	

9.0 IMPLEMENTATION PLAN

The total cost of the EWC improvements are projected to be nearly $145,000,000 using 2015 unit price values and historical bid data. While the corridor improvements have been justified throughout this document and construction is desired to be completed as soon as possible, Pinal County and the Cities of Maricopa and Casa Grande have limited funds available each year. Adding to this, each one of these agencies has several worthwhile improvement and maintenance projects competing for these funds. It is therefore unrealistic to assume that all of the EWC improvements can be constructed as a single project. It is more likely that a series of projects will be funded to complete the improvements over an extended period of time. This section lays out the implementation strategies for completing the EWC improvements. Ultimate buildout will be determined by the projected needs along the corridor. Phases will be developed in a logical manner to cause the least amount of impact and inconvenience to the traveling public while preventing the amount of rework necessary.

The section discusses the goals and issues relative to implementing the proposed EWC improvements and recommends various construction projects consistent with policy and corridor needs.

The following guidelines were utilized in evaluating and recommending each phase of construction for implementing the EWC improvements.

- Priority was given to projects that could improve safety in high accident areas.
- Priority was given to projects that improve capacity consistent with the need outlined within *Section 2.0* of this report.
- Priority was given to sequencing projects to achieve contiguous stretches of roadway improvements, wherever possible.
- Priority was given to projects that would later experience constructability issues as traffic volumes increased.
- Project construction size was limited to smaller packages wherever feasible to correlate with expected funding availability.
- As there are nine structures listed within this corridor, priority was given to construction phases which separated the construction of bridges, wherever feasible. However, there were a couple of cases where completing the construction of multiple bridges were required to allow for a contiguous corridor.

For estimating purposes, the assumptions as stated in *Section 8.0* remain valid for the cost estimating for each of the construction phases. It should be noted that construction costs are based on 2015 unit prices as utilized in the cost estimate of this report. As stated in *Section 8.1*, the following assumptions were made for estimating the costs of each construction phase:

- The pavement quantities are based on the pavement structural section previously discussed in this report. Roughly 10-inches of aggregate base over two lifts of asphalt concrete to make a total structural section of 16-inches.
- Without a detailed geotechnical investigation, shrink and swell factors have not been factored into the earthwork quantities.
- As the majority of the improvements will be constructed at-grade, there is limited earthwork necessary for the construction of the improvements.
- The borrow earthwork material is based on solely the overpass structure locations as it is assumed that the roadway excavation will yield enough material to construct the remainder of the improvements. Differing from the project typical sections, 2:1 fill side slopes are assumed for the overpass locations.
- The structural concrete and steel quantities are solely for the construction of the concrete box culverts. The bridge structures will be based on an area of bridge deck as quantified by the project plans.
- Each phase of construction assumes that the R/W and easements necessary for construction of the improvements can be acquired in a timely manner without any construction delays or changes to construction sequencing.

While the order in which these segments are proposed will likely change to meet the current funding and transportation needs, for planning purposes, this summary provides a baseline for programming and planning of smaller, likely constructible segments.

Segments 1 and 2 were selected first as they are through the Ak-Chin lands that are currently experiencing both drainage and capacity issues that require the participation of Pinal County. Outside of these projects, the others are influenced by the rate of development and regional funding that they receive. There are no stronger compelling reasons to construct in the order provided.

The EWC improvements are proposed to be constructed in 12 phases as detailed below and in **Figures 9-1 and 9-2**:

- Phase 1 - Sta 1325+00 to Sta 1500+00
- Phase 2 - Sta 1234+00 to Sta 1325+00
- Phase 3 - Sta 1046+00 to Sta 1110+00
- Phase 4 - Sta 1000+00 to Sta 1046+00
- Phase 5 - Sta 1110+00 to Sta 1234+00
- Phase 6 - Sta 3410+00 to Sta 3515+27
- Phase 7 - Sta 3515+27 to Sta 3568+13
- Phase 8 - Sta 3605+00 to Sta 3647+00
- Phase 9 - Sta 3568+13 to Sta 3605+00
- Phase 10 - Sta 3235+15 to Sta 3410+00
- Phase 11 - Sta 3130+00 to Sta 3235+15
- Phase 12 - Sta 1500 to Sta 1600+00
  Sta 3000+00 to Sta 3130+00

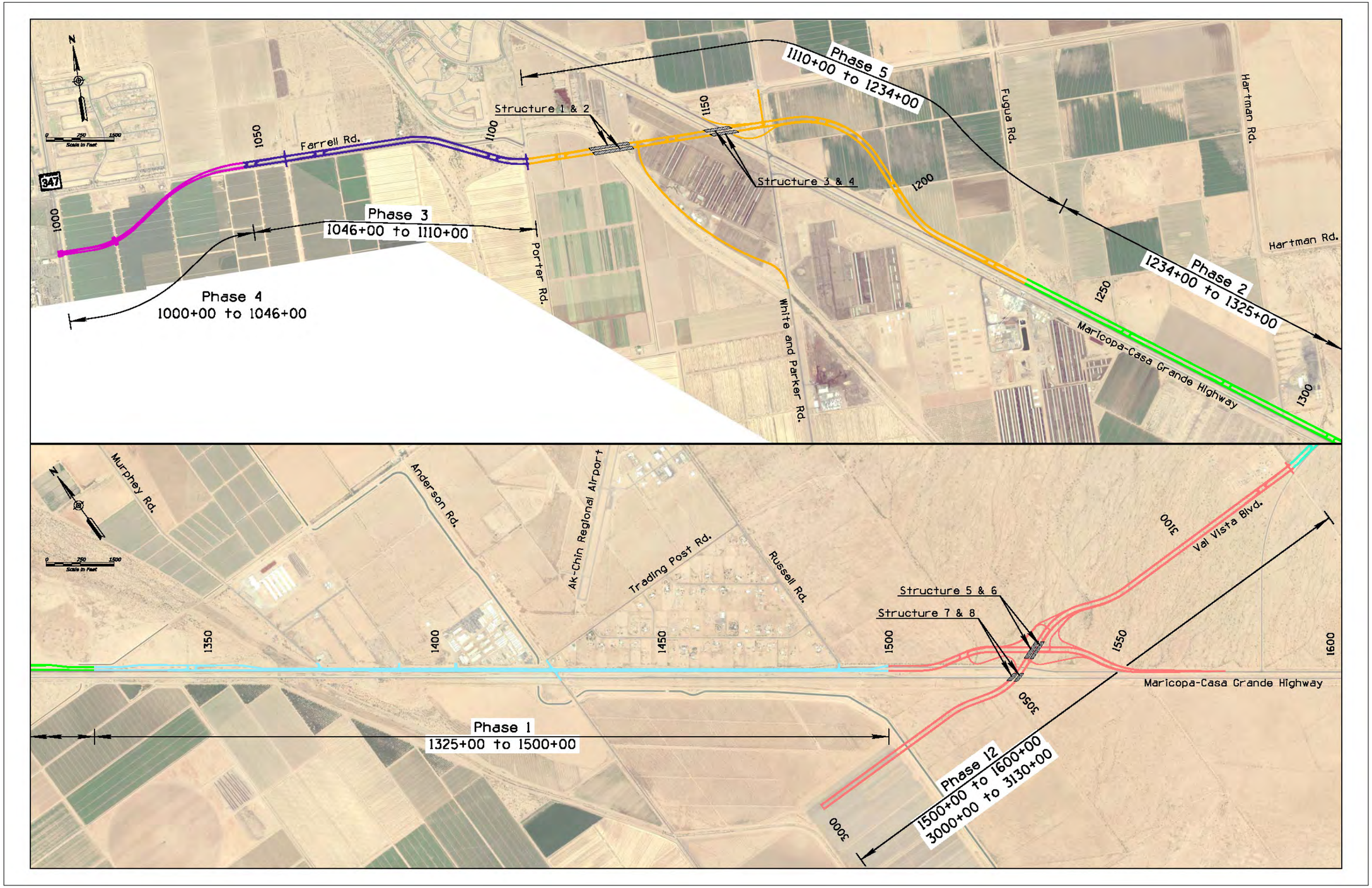


Figure 9-1: EWC Implementation Plan – MCGH Segment

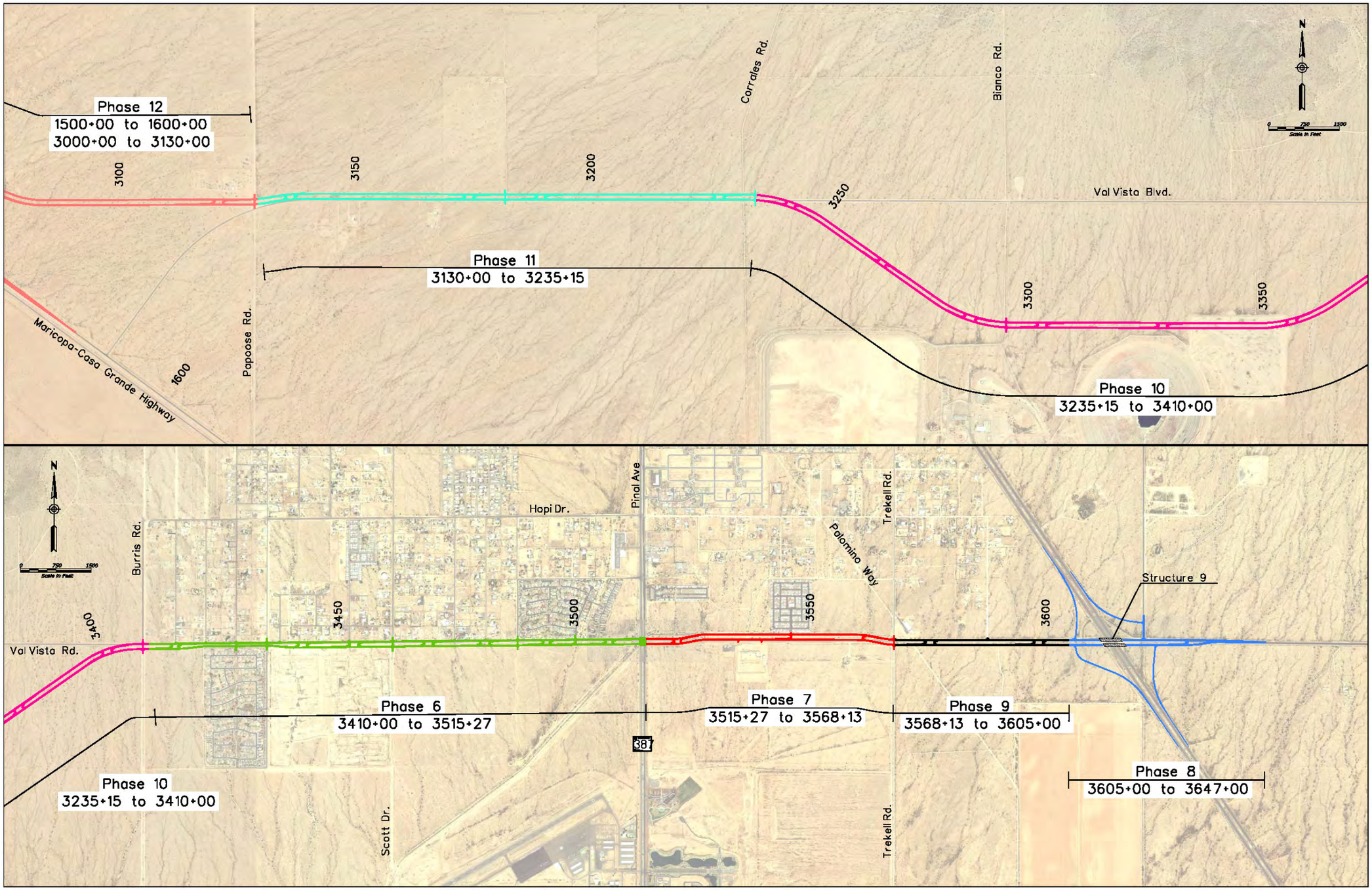


Figure 9-2: EWC Implementation Plan – Val Vista Boulevard Segment

9.1 Phase 1 – Ak-Chin Compressed Segment

Approximate Segment Limits: Sta 1325+00 to Sta 1500+00

Description: This construction phase focuses on the EWC improvements within the Ak-Chin Indian Community. As discussed in *Section 7.0*, this section involves the construction of a drainage canal and multiple reinforced concrete box culverts at all crossings. This segment begins at the western border of Tribe lands and terminates east of Russell Road on Pinal County R/W.

Implementation Issues:

- The beginning and ending of this construction phase will require tapers to drop two-lanes of traffic and transition from a divided roadway back to the existing MCGH undivided roadway. As tapers will require a long distance to transition back to existing, it is preferable to implement a series of curves to prevent the amount of rework necessary.
- Maintaining access will be an issue as the construction of the box culverts effectively terminates access to existing businesses and residential properties. This issue can be mitigated by timing the construction of the box culverts so that access to existing communities is not severed. Temporary access points may be required during this phase.
- Traffic control along the MCGH will need to be maintained at all times. This issue can be mitigated by constructing half of the divided roadway at a time followed by a shift of traffic.
- Although two signalized intersections are specified during this phase, these items may be omitted until traffic warrants their construction.
- As this phase involves work adjacent to the UPRR, coordinate with the UPRR to ensure that the proper rights-of-entry and permits are acquired prior to the beginning of construction activities.
- As this phase involves work within Ak-Chin lands, coordinate with the Tribe to ensure proper rights-of-entry are acquired prior to the beginning of construction activities.

Major Construction Items:

- Multiple drainage items including the drainage channel, culverts, reinforced concrete box culverts and pipe extensions required at this phase.
- Riprap bank protection will be required at the end of this phase to divert off-site flows into the drainage channel.
- The overhead power lines south of MCGH will need to be shifted outside of the roadway improvements.

Table 9-1: EWC Phase 1 Itemized Estimate

PHASE 1 BID ITEMS						
ITEM DESCRIPTION	**UNIT OF MEASURE**	**PCT**	**QUANTITY**	**UNIT PRICE**	**TOTAL**	**REMARKS**
CLEARING AND GRUBBING	ACRE		52	500.00	26,000.00	
REMOVAL OF STRUCTURES AND OBSTRUCTIONS	L.SUM		1	40,000.00	40,000.00	
REMOVAL OF ASPHALTIC CONCRETE PAVEMENT	SQ.YD.		50,548	4.00	202,192.00	
ROADWAY EXCAVATION	CU.YD.		53,087	10.00	530,870.00	
AGGREGATE BASE, CLASS 2	CU.YD.		39,307	45.00	1,168,815.00	
PORTLAND CEMEND CONCRETE PAVEMENT (12")	SQ.YD.		320	35.00	11,200.00	
ASPHALTIC CONCRETE	TON		48,350	100.00	4,835,000.00	
PIPE CULVERT, 24"	L.FT.		640	85.00	54,400.00	
PIPE CULVERT, 36"	L.FT.		202	120.00	24,240.00	
PIPE CULVERT, 60"	L.FT.		408	240.00	97,920.00	
PIPE CULVERT END SECTION (MISC. SIZES)	EACH		17	800.00	13,600.00	
STRUCTURAL CONCRETE (BOX CULVERTS)	CU.YD.		4,299	350.00	1,504,650.00	
STRUCTURAL STEEL (BOX CULVERTS)	LB.		683,000	1.25	853,750.00	
TRAFFIC SIGNAL (TYPICAL INTERSECTION)	EACH		2	200,000.00	400,000.00	
SIGNING AND MARKING	MILE		3.3	25,000.00	82,500.00	
GUARDRAIL, W-BEAM, SINGLE FACE	L.FT.		13,000	25.00	325,000.00	
GUARDRAIL, END TERMINAL ASSEMBLY	L.FT.		5	2,000.00	10,000.00	
RIPRAP (DUMPED OUTFALL PROTECTION)	CU.YD.		913	100.00	91,300.00	
				PHASE 1 BID ITEMS TOTAL:	**10,872,000.00**	Rounded to nearest $1,000
PHASE 1 BID ITEM ADJUSTMENTS						
FURNISH WATER	COST	2%		218,000.00	218,000.00	Rounded to nearest $1,000
MAINTENANCE AND PROTECTION OF TRAFFIC	COST	10%		1,088,000.00	1,088,000.00	Rounded to nearest $1,000
ENVIRONMENTAL IMPACT MITIGATION	COST	4%		435,000.00	435,000.00	Rounded to nearest $1,000
MOBILIZATION	COST	10%		1,088,000.00	1,088,000.00	Rounded to nearest $1,000
CONTRACTOR QUALITY CONTROL	COST	2%		218,000.00	218,000.00	Rounded to nearest $1,000
CONSTRUCTION SURVEYING AND LAYOUT	COST	2%		218,000.00	218,000.00	Rounded to nearest $1,000
				PHASE 1 BID ITEM ADJUSTMENTS TOTAL:	**3,265,000.00**	Rounded to nearest $1,000
PHASE 1 NON-BID ITEMS						
AC SMOOTHNESS INCENTIVE	LANE MILE		13.2	11000.00	145,000.00	Rounded to nearest $1,000
ASPHALT CONCRETE MATERIALS QUALITY INCENTIVE	TON		48,350	1.50	73,000.00	Rounded to nearest $1,000
CONSTRUCTION ENGINEERING	COST	10%		1,088,000.00	1,088,000.00	Rounded to nearest $1,000
CONTINGENCY	COST	30%		3,262,000.00	3,262,000.00	Rounded to nearest $1,000
				PHASE 1 NON-BID ITEMS TOTAL:	**4,568,000.00**	
PHASE 1 OTHER COSTS						
DESIGN	COST	10%		1,088,000.00	1,088,000.00	Rounded to nearest $1,000
RIGHT OF WAY	COST			99,000.00	99,000.00	Rounded to nearest $1,000
UTILITY RELOCATIONS	COST			2,000.00	2,000.00	Rounded to nearest $1,000
				PHASE 1 OTHER COSTS TOTAL:	**1,189,000.00**	
				PHASE 1 GRAND TOTAL:	**19,894,000.00**	

9.2 Phase 2 – MCGH Segment

Approximate Segment Limits: Sta 1234+00 to Sta 1325+00

Description: This construction phase focuses on the construction of the EWC improvements along the MCGH alignment beginning at Fugua Road and terminates at the previously constructed Phase 1 improvements. After construction of the Phase 2 improvements, the majority of the MCGH alignment of the EWC will contain a divided four-lane roadway.

Implementation Issues:

- The beginning of this construction phase will require tapers to drop two-lanes of traffic and transition from a divided roadway back to the existing MCGH alignment.
- Traffic control along the MCGH will need to be maintained at all times. This issue can be mitigated by constructing half of the divided roadway at a time followed by a shift of traffic.
- As this phase involves work adjacent to the UPRR, coordinate with the UPRR to ensure that the proper rights-of-entry and permits are acquired prior to the beginning of construction activities.

Major Construction Items:

- The overhead power lines and irrigation canal north of the MCGH alignment will need to be shifted outside of the roadway improvements.

Table 9-2: EWC Phase 2 Itemized Estimate

PHASE 2 BID ITEMS						
ITEM DESCRIPTION	**UNIT OF MEASURE**	**PCT**	**QUANTITY**	**UNIT PRICE**	**TOTAL**	**REMARKS**
CLEARING AND GRUBBING	ACRE		26	500.00	13,000.00	
REMOVAL OF STRUCTURES AND OBSTRUCTIONS	L.SUM		1	30,000.00	30,000.00	
REMOVAL OF ASPHALTIC CONCRETE PAVEMENT	SQ.YD.		21,593	4.00	86,372.00	
ROADWAY EXCAVATION	CU.YD.		27,348	10.00	273,480.00	
AGGREGATE BASE, CLASS 2	CU.YD.		20,382	50.00	1,019,100.00	
PORTLAND CEMEND CONCRETE PAVEMENT (12")	SQ.YD.		960	35.00	33,600.00	
ASPHALTIC CONCRETE	TON		24,962	115.00	2,496,200.00	
SIGNING AND MARKING	MILE		1.7	25,000.00	42,500.00	
				PHASE 2 BID ITEMS TOTAL:	**3,995,000.00**	Rounded to nearest $1,000
PHASE 2 BID ITEM ADJUSTMENTS						
FURNISH WATER	COST	2%		80,000.00	80,000.00	Rounded to nearest $1,000
MAINTENANCE AND PROTECTION OF TRAFFIC	COST	10%		400,000.00	400,000.00	Rounded to nearest $1,000
ENVIRONMENTAL IMPACT MITIGATION	COST	4%		160,000.00	160,000.00	Rounded to nearest $1,000
MOBILIZATION	COST	10%		400,000.00	400,000.00	Rounded to nearest $1,000
CONTRACTOR QUALITY CONTROL	COST	2%		80,000.00	80,000.00	Rounded to nearest $1,000
CONSTRUCTION SURVEYING AND LAYOUT	COST	2%		80,000.00	80,000.00	Rounded to nearest $1,000
				PHASE 2 BID ITEM ADJUSTMENTS TOTAL:	**1,200,000.00**	Rounded to nearest $1,000
PHASE 2 NON-BID ITEMS						
AC SMOOTHNESS INCENTIVE	LANE MILE		6.8	11000.00	75,000.00	Rounded to nearest $1,000
ASPHALT CONCRETE MATERIALS QUALITY INCENTIVE	TON		24,962	1.50	37,000.00	Rounded to nearest $1,000
CONSTRUCTION ENGINEERING	COST	10%		400,000.00	400,000.00	Rounded to nearest $1,000
CONTINGENCY	COST	30%		1,199,000.00	1,199,000.00	Rounded to nearest $1,000
				PHASE 2 NON-BID ITEMS TOTAL:	**1,711,000.00**	
PHASE 2 OTHER COSTS						
DESIGN	COST	10%		400,000.00	400,000.00	Rounded to nearest $1,000
RIGHT OF WAY	COST			85,000.00	85,000.00	Rounded to nearest $1,000
UTILITY RELOCATIONS	COST			3,000.00	3,000.00	Rounded to nearest $1,000
				PHASE 2 OTHER COSTS TOTAL:	**488,000.00**	
				PHASE 2 GRAND TOTAL:	**7,394,000.00**	

9.3 Phase 3 – Farrell Road Segment

Approximate Segment Limits: Sta 1046+00 to Sta 1110+00

Description: This construction phase focuses on the construction of the EWC improvements tangent to the Farrell Road alignment north of the Avelae Trilogy development as it proceeds easterly towards the Santa Rosa Wash and terminates at Porter Road. As discussed in previous sections, this phase involves the realignment of Farrell Road further to the south to incorporate a new crossing of the Santa Rosa Wash (constructed during Phase 5). This phase will require coordination with the Avelae Trilogy development and represents an opportunity to share in the costs of the development of the EWC improvements.

Implementation Issues:

- The beginning of this construction phase will require tapers to not only drop two-lanes of traffic, but will also require tapers to transition from a divided roadway back to the existing Farrell Road alignment.
- Maintenance of traffic along Farrell Road will remain a challenge while construction efforts are underway. The connection to Porter Road will need to be maintained until after Phase 5 construction has been completed.

Major Construction Items:

- One reinforced concrete box culvert will be required at this phase.
- The overhead power lines south of Farrell Road will need to be shifted outside of the roadway improvements.

Table 9-3: EWC Phase 3 Itemized Estimate

PHASE 3 BID ITEMS						
ITEM DESCRIPTION	**UNIT OF MEASURE**	**PCT**	**QUANTITY**	**UNIT PRICE**	**TOTAL**	**REMARKS**
CLEARING AND GRUBBING	ACRE		19	500.00	9,500.00	
REMOVAL OF STRUCTURES AND OBSTRUCTIONS	L.SUM		1	25,000.00	25,000.00	
REMOVAL OF ASPHALTIC CONCRETE PAVEMENT	SQ.YD.		14,164	4.00	56,656.00	
ROADWAY EXCAVATION	CU.YD.		19,304	10.00	193,040.00	
AGGREGATE BASE, CLASS 2	CU.YD.		15,733	50.00	786,650.00	
PORTLAND CEMEND CONCRETE PAVEMENT (12")	SQ.YD.		960	35.00	33,600.00	
ASPHALTIC CONCRETE	TON		19,238	100.00	1,923,800.00	
STRUCTURAL CONCRETE (BOX CULVERTS)	CU.YD.		423	350.00	148,050.00	
STRUCTURAL STEEL (BOX CULVERTS)	LB.		70,000	1.25	87,500.00	
SIGNING AND MARKING	MILE		1.2	25,000.00	30,000.00	
RIPRAP (DUMPED OUTFALL PROTECTION)	CU.YD.		15	100.00	1,481.48	
				PHASE 3 BID ITEMS TOTAL:	**3,296,000.00**	Rounded to nearest $1,000
PHASE 3 BID ITEM ADJUSTMENTS						
FURNISH WATER	COST	2%		66,000.00	66,000.00	Rounded to nearest $1,000
MAINTENANCE AND PROTECTION OF TRAFFIC	COST	10%		330,000.00	330,000.00	Rounded to nearest $1,000
ENVIRONMENTAL IMPACT MITIGATION	COST	4%		132,000.00	132,000.00	Rounded to nearest $1,000
MOBILIZATION	COST	10%		330,000.00	330,000.00	Rounded to nearest $1,000
CONTRACTOR QUALITY CONTROL	COST	2%		66,000.00	66,000.00	Rounded to nearest $1,000
CONSTRUCTION SURVEYING AND LAYOUT	COST	2%		66,000.00	66,000.00	Rounded to nearest $1,000
				PHASE 3 BID ITEM ADJUSTMENTS TOTAL:	**990,000.00**	Rounded to nearest $1,000
PHASE 3 NON-BID ITEMS						
AC SMOOTHNESS INCENTIVE	LANE MILE		4.8	11000.00	53,000.00	Rounded to nearest $1,000
ASPHALT CONCRETE MATERIALS QUALITY INCENTIVE	TON		19,238	1.50	29,000.00	Rounded to nearest $1,000
CONSTRUCTION ENGINEERING	COST	10%		330,000.00	330,000.00	Rounded to nearest $1,000
CONTINGENCY	COST	30%		989,000.00	989,000.00	Rounded to nearest $1,000
				PHASE 3 NON-BID ITEMS TOTAL:	**1,401,000.00**	
PHASE 3 OTHER COSTS						
DESIGN	COST	10%		330,000.00	330,000.00	Rounded to nearest $1,000
RIGHT OF WAY	COST			286,000.00	286,000.00	Rounded to nearest $1,000
UTILITY RELOCATIONS	COST			5,000.00	5,000.00	Rounded to nearest $1,000
				PHASE 3 OTHER COSTS TOTAL:	**621,000.00**	
				PHASE 3 GRAND TOTAL:	**6,308,000.00**	

9.4 Phase 4 – Ak-Chin Casino Segment

Approximate Segment Limits: Sta 1000+00 to Sta 1046+00

Description: This construction phase focuses on the construction of the EWC improvements from the Harrah's Ak-Chin casino and intersection with SR 347 and proceeds to the northeast towards Farrell Road ultimately terminating at the previously constructed Phase 3 improvements. This phase will require coordination with the Ak-Chin Indian Community as well as the developer located east of SR 347 and represents an opportunity to share in the costs of the development of the EWC improvements.

Implementation Issues:

- Coordination will be required with the Ak-Chin Indian Community to ensure that the roadway network from SR 347 and beyond is compatible with the EWC improvements. Construction activities should be scheduled to be completed before the EWC improvements are open to the public.
- Although two signalized intersections are specified during this phase, one of these signals may be omitted until traffic warrants its construction. The intersection between SR 347 and the EWC will certainly require a signalized intersection at this phase.
- As this phase involves work within Ak-Chin lands, coordinate with the Tribe to ensure proper rights-of-entry are acquired prior to the beginning of construction activities.

Major Construction Items:

- The signalized intersection between the EWC and SR 347 will need to be constructed during this phase.

Table 9-4: EWC Phase 4 Itemized Estimate

PHASE 4 BID ITEMS						
ITEM DESCRIPTION	**UNIT OF MEASURE**	**PCT**	**QUANTITY**	**UNIT PRICE**	**TOTAL**	**REMARKS**
CLEARING AND GRUBBING	ACRE		13	500.00	6,500.00	
REMOVAL OF STRUCTURES AND OBSTRUCTIONS	L.SUM		1	25,000.00	25,000.00	
REMOVAL OF ASPHALTIC CONCRETE PAVEMENT	SQ.YD.		9,835	4.00	39,340.00	
ROADWAY EXCAVATION	CU.YD.		14,478	10.00	144,780.00	
AGGREGATE BASE, CLASS 2	CU.YD.		9,392	55.00	516,560.00	
ASPHALTIC CONCRETE	TON		11,563	115.00	1,329,745.00	
TRAFFIC SIGNAL (TYPICAL INTERSECTION)	EACH		2	200,000.00	400,000.00	
SIGNING AND MARKING	MILE		0.9	25,000.00	22,500.00	
				PHASE 4 BID ITEMS TOTAL:	**2,485,000.00**	Rounded to nearest $1,000
PHASE 4 BID ITEM ADJUSTMENTS						
FURNISH WATER	COST	2%		50,000.00	50,000.00	Rounded to nearest $1,000
MAINTENANCE AND PROTECTION OF TRAFFIC	COST	10%		249,000.00	249,000.00	Rounded to nearest $1,000
ENVIRONMENTAL IMPACT MITIGATION	COST	4%		100,000.00	100,000.00	Rounded to nearest $1,000
MOBILIZATION	COST	10%		249,000.00	249,000.00	Rounded to nearest $1,000
CONTRACTOR QUALITY CONTROL	COST	2%		50,000.00	50,000.00	Rounded to nearest $1,000
CONSTRUCTION SURVEYING AND LAYOUT	COST	2%		50,000.00	50,000.00	Rounded to nearest $1,000
				PHASE 4 BID ITEM ADJUSTMENTS TOTAL:	**748,000.00**	Rounded to nearest $1,000
PHASE 4 NON-BID ITEMS						
AC SMOOTHNESS INCENTIVE	LANE MILE		3.6	11000.00	40,000.00	Rounded to nearest $1,000
ASPHALT CONCRETE MATERIALS QUALITY INCENTIVE	TON		11,563	1.50	17,000.00	Rounded to nearest $1,000
CONSTRUCTION ENGINEERING	COST	10%		249,000.00	249,000.00	Rounded to nearest $1,000
CONTINGENCY	COST	30%		746,000.00	746,000.00	Rounded to nearest $1,000
				PHASE 4 NON-BID ITEMS TOTAL:	**1,052,000.00**	
PHASE 4 OTHER COSTS						
DESIGN	COST	10%		249,000.00	249,000.00	Rounded to nearest $1,000
RIGHT OF WAY	COST			70,000.00	70,000.00	Rounded to nearest $1,000
UTILITY RELOCATIONS	COST			5,000.00	5,000.00	Rounded to nearest $1,000
				PHASE 4 OTHER COSTS TOTAL:	**324,000.00**	
				PHASE 4 GRAND TOTAL:	**4,609,000.00**	

9.5 Phase 5 – White and Parker Road Interchange Segment

Approximate Segment Limits: Sta 1110+00 to Sta 1234+00

Description: This construction phase focuses on the construction of the EWC crossings over the Santa Rosa Wash and the MCGH / UPRR. This phase also involves the construction of the ramps maintaining access to White and Parker Road and MCGH to the north. With the completion of this phase, the improvements to the east and west are connected effectively completing the rerouting of the MCGH to terminate at the Harrah's Ak-Chin Casino. Maintenance of traffic during this phase is not anticipated to be significant issue as the majority of the improvements lie on either farmland or undeveloped land.

Implementation Issues:

- Coordinate with the City of Maricopa to provide adequate signage that the access to the MCGH has been shifted to the south of the UPRR tracks at the Harrah's Ak-Chin Casino. The existing MCGH in this area will be maintained in place to preserve community inter-connectivity.
- This phase will require the construction of multiple structures and a large amount of embankment to elevate the roadway section over the Santa Rosa wash and MCGH / UPRR. At this time, a material source has not been identified to create this embankment.
- As this phase involves work adjacent to the UPRR, coordinate with the UPRR to ensure that the proper rights-of-entry and permits are acquired prior to the beginning of construction activities.

Major Construction Items:

- Santa Rosa Wash and MCGH / UPRR crossing structures and related retaining walls and guardrail will be constructed during this phase.
- Significant quantities of borrow will be required during this phase of construction in order to construct the embankment leading up to the MCGH / UPRR Structures.

Table 9-5: EWC Phase 5 Itemized Estimate

ITEM DESCRIPTION	UNIT OF MEASURE	PCT	QUANTITY	UNIT PRICE	TOTAL	REMARKS
PHASE 5 BID ITEMS						
CLEARING AND GRUBBING	ACRE		101	500.00	50,500.00	
REMOVAL OF STRUCTURES AND OBSTRUCTIONS	L.SUM		1	80,000.00	80,000.00	
REMOVAL OF ASPHALTIC CONCRETE PAVEMENT	SQ.YD.		25,053	4.00	100,212.00	
ROADWAY EXCAVATION	CU.YD.		37,000	10.00	370,000.00	
BORROW	CU.YD.		136,500	12.00	1,638,000.00	
AGGREGATE BASE, CLASS 2	CU.YD.		33,697	50.00	1,684,850.00	
PORTLAND CEMEND CONCRETE PAVEMENT (12")	SQ.YD.		1,920	35.00	67,200.00	
ASPHALTIC CONCRETE	TON		41,226	100.00	4,122,600.00	
SIGNING AND MARKING	MILE		2.3	25,000.00	57,500.00	
GUARDRAIL, W-BEAM, SINGLE FACE	L.FT.		2,975	25.00	74,375.00	
GUARDRAIL, END TERMINAL ASSEMBLY	L.FT.		9	2,000.00	18,000.00	
CONCRETE BARRIER (SINGLE FACE)	L.FT.		1,450	80.00	116,000.00	
RETAINING WALL (REINFORCED CONCRETE)	SQ. FT.		22,700	75.00	1,702,500.00	
NEW BRIDGE (COMPLETE NEW STRUCTURES)	SQ. FT.		72,468	150.00	10,870,200.00	
				PHASE 5 BID ITEMS TOTAL:	**20,952,000.00**	Rounded to nearest $1,000
PHASE 5 BID ITEM ADJUSTMENTS						
FURNISH WATER	COST	2%		420,000.00	420,000.00	Rounded to nearest $1,000
MAINTENANCE AND PROTECTION OF TRAFFIC	COST	10%		2,096,000.00	2,096,000.00	Rounded to nearest $1,000
ENVIRONMENTAL IMPACT MITIGATION	COST	4%		839,000.00	839,000.00	Rounded to nearest $1,000
MOBILIZATION	COST	10%		2,096,000.00	2,096,000.00	Rounded to nearest $1,000
CONTRACTOR QUALITY CONTROL	COST	2%		420,000.00	420,000.00	Rounded to nearest $1,000
CONSTRUCTION SURVEYING AND LAYOUT	COST	2%		420,000.00	420,000.00	Rounded to nearest $1,000
				PHASE 5 BID ITEM ADJUSTMENTS TOTAL:	**6,291,000.00**	Rounded to nearest $1,000
PHASE 5 NON-BID ITEMS						
AC SMOOTHNESS INCENTIVE	LANE MILE		9.2	11000.00	101,000.00	Rounded to nearest $1,000
ASPHALT CONCRETE MATERIALS QUALITY INCENTIVE	TON		41,226	1.50	62,000.00	Rounded to nearest $1,000
CONSTRUCTION ENGINEERING	COST	10%		2,096,000.00	2,096,000.00	Rounded to nearest $1,000
CONTINGENCY	COST	30%		6,286,000.00	6,286,000.00	Rounded to nearest $1,000
				PHASE 5 NON-BID ITEMS TOTAL:	**8,545,000.00**	
PHASE 5 OTHER COSTS						
DESIGN	COST	10%		2,096,000.00	2,096,000.00	Rounded to nearest $1,000
RIGHT OF WAY	COST			381,000.00	381,000.00	Rounded to nearest $1,000
UTILITY RELOCATIONS	COST			2,000.00	2,000.00	Rounded to nearest $1,000
				PHASE 5 OTHER COSTS TOTAL:	**2,479,000.00**	
				PHASE 5 GRAND TOTAL:	**38,267,000.00**	

9.6 Phase 6 – Val Vista Boulevard, West of Pinal Avenue Segment

Approximate Segment Limits: Sta 3410+00 to Sta 3515+27

Description: This construction phase focuses on the construction of the EWC improvements along the Val Vista Boulevard alignment between Burris Road and Pinal Avenue. As discussed in *Section7.0*, this section involves the construction of the compressed section north of the Avalon community and traverses through a primarily residential area.

Implementation Issues:

- The beginning and ending of this construction phase will require tapers to drop two lanes of traffic and transition from a divided roadway back to the existing undivided roadway. As tapers will require a long distance to transition back to existing, it is preferable to implement a series of curves to prevent the amount of rework necessary.
- The extension of the box culvert underneath Pinal Avenue will be an issue as it
- Coordination will be required with the City of Casa Grande to ensure that access is maintained to the police department at all times.
- Access to residential properties must be maintained at all times, however many of the traffic control issues can be mitigated by constructing the southern portion of the divided roadway followed by a shift of traffic.
- Although two signalized intersections are specified during this phase, one of these signals may be omitted until traffic warrants its construction. The intersection between Pinal Avenue and the EWC will certainly require the reconstruction of the signalized intersection at this phase.
- The existing power and telephone lines north of Val Vista Boulevard may require relocation. This utility relocation may be mitigated by maintaining all improvements to the south of the existing alignment.

Major Construction Items:

- The signalized intersection between the EWC and Pinal Avenue will need to be constructed during this phase.
- Multiple drainage items including culverts, reinforced concrete box culverts, and the box culvert extension at Pinal Avenue.

Table 9-6: EWC Phase 6 Itemized Estimate

PHASE 6 BID ITEMS						
ITEM DESCRIPTION	**UNIT OF MEASURE**	**PCT**	**QUANTITY**	**UNIT PRICE**	**TOTAL**	**REMARKS**
CLEARING AND GRUBBING	ACRE		33	500.00	16,500.00	
REMOVAL OF STRUCTURES AND OBSTRUCTIONS	L.SUM		1	50,000.00	50,000.00	
REMOVAL OF ASPHALTIC CONCRETE PAVEMENT	SQ.YD.		40,643	4.00	162,572.00	
ROADWAY EXCAVATION	CU.YD.		32,174	10.00	321,740.00	
AGGREGATE BASE, CLASS 2	CU.YD.		27,619	50.00	1,380,950.00	
PORTLAND CEMEND CONCRETE PAVEMENT (12")	SQ.YD.		2,400	35.00	84,000.00	
ASPHALTIC CONCRETE	TON		33,676	100.00	3,367,600.00	
PIPE, REINFORCED CONCRETE, 48"	L.FT.		420	150.00	63,000.00	
PIPE CULVERT, 24"	L.FT.		825	85.00	70,125.00	
PIPE CULVERT, 54"	L.FT.		1,202	200.00	240,400.00	
PIPE CULVERT END SECTION (MISC. SIZES)	EACH		44	800.00	35,200.00	
STRUCTURAL CONCRETE (BOX CULVERTS)	CU.YD.		969	350.00	339,150.00	
STRUCTURAL STEEL (BOX CULVERTS)	LB.		157,000	1.25	196,250.00	
TRAFFIC SIGNAL (TYPICAL INTERSECTION)	EACH		2	200,000.00	400,000.00	
SIGNING AND MARKING	MILE		2.0	25,000.00	50,000.00	
RIPRAP (DUMPED OUTFALL PROTECTION)	CU.YD.		178	100.00	17,800.00	
				PHASE 6 BID ITEMS TOTAL:	**6,796,000.00**	Rounded to nearest $1,000
PHASE 6 BID ITEM ADJUSTMENTS						
FURNISH WATER	COST	2%		136,000.00	136,000.00	Rounded to nearest $1,000
MAINTENANCE AND PROTECTION OF TRAFFIC	COST	10%		680,000.00	680,000.00	Rounded to nearest $1,000
ENVIRONMENTAL IMPACT MITIGATION	COST	4%		272,000.00	272,000.00	Rounded to nearest $1,000
MOBILIZATION	COST	10%		680,000.00	680,000.00	Rounded to nearest $1,000
CONTRACTOR QUALITY CONTROL	COST	2%		136,000.00	136,000.00	Rounded to nearest $1,000
CONSTRUCTION SURVEYING AND LAYOUT	COST	2%		136,000.00	136,000.00	Rounded to nearest $1,000
				PHASE 6 BID ITEM ADJUSTMENTS TOTAL:	**2,040,000.00**	Rounded to nearest $1,000
PHASE 6 NON-BID ITEMS						
AC SMOOTHNESS INCENTIVE	LANE MILE		8.0	11000.00	88,000.00	Rounded to nearest $1,000
ASPHALT CONCRETE MATERIALS QUALITY INCENTIVE	TON		33,676	1.50	51,000.00	Rounded to nearest $1,000
CONSTRUCTION ENGINEERING	COST	10%		680,000.00	680,000.00	Rounded to nearest $1,000
CONTINGENCY	COST	30%		2,039,000.00	2,039,000.00	Rounded to nearest $1,000
				PHASE 6 NON-BID ITEMS TOTAL:	**2,858,000.00**	
PHASE 6 OTHER COSTS						
DESIGN	COST	10%		680,000.00	680,000.00	Rounded to nearest $1,000
RIGHT OF WAY	COST			170,000.00	170,000.00	Rounded to nearest $1,000
UTILITY RELOCATIONS	COST			10,000.00	10,000.00	Rounded to nearest $1,000
				PHSAE 6 OTHER COSTS TOTAL:	**860,000.00**	
				PHASE 6 GRAND TOTAL:	**12,554,000.00**	

9.7 Phase 7 – Val Vista Boulevard, East of Pinal Avenue Segment

Approximate Segment Limits: Sta 3515+27 to Sta 3568+13

Description: This construction phase focuses on the construction of the EWC improvements along the Val Vista Boulevard alignment between Pinal Avenue and Trekell Road and connecting to the previously constructed Phase 6 improvements. This segment involves the construction of the median drainage channel which requires multiple box culverts to divert flows underneath the roadway section is three locations.

Implementation Issues:

- Coordination will be required with the City of Casa Grande to ensure that access is maintained to the police department at all times.
- Due to clear zone requirements, guardrail protection is anticipated within the median for both lanes of traffic.
- Coordination will be required with the City of Casa Grande to ensure that access is maintained to the police department at all times. The U-Turn facility located at Sta 3546+28 must be operational before guardrail is installed to ensure that police vehicle direction of travel is not restricted.
- This segment will need to be constructed in multiple phases to ensure that the flow of the roadside channel is not impeded possibly resulting in the flooding of the Val Vista RV Park or police department facility.

Major Construction Items:

- Multiple drainage items including the drainage channel and multiple reinforced concrete box culverts.

Table 9-7: EWC Phase 7 Itemized Estimate

ITEM DESCRIPTION	UNIT OF MEASURE	PCT	QUANTITY	UNIT PRICE	TOTAL	REMARKS
PHASE 7 BID ITEMS						
CLEARING AND GRUBBING	ACRE		11	500.00	5,500.00	
REMOVAL OF STRUCTURES AND OBSTRUCTIONS	L.SUM		1	25,000.00	25,000.00	
REMOVAL OF ASPHALTIC CONCRETE PAVEMENT	SQ.YD.		16,205	4.00	64,820.00	
ROADWAY EXCAVATION	CU.YD.		16,087	10.00	160,870.00	
AGGREGATE BASE, CLASS 2	CU.YD.		12,270	55.00	674,850.00	
PORTLAND CEMEND CONCRETE PAVEMENT (12")	SQ.YD.		640	35.00	22,400.00	
ASPHALTIC CONCRETE	TON		15,020	115.00	1,727,300.00	
STRUCTURAL CONCRETE (BOX CULVERTS)	CU.YD.		954	350.00	333,900.00	
STRUCTURAL STEEL (BOX CULVERTS)	LB.		154,000	1.25	192,500.00	
SIGNING AND MARKING	MILE		1.0	25,000.00	25,000.00	
GUARDRAIL, W-BEAM, SINGLE FACE	L.FT.		7,625	25.00	190,625.00	
GUARDRAIL, END TERMINAL ASSEMBLY	L.FT.		4	2,000.00	8,000.00	
RIPRAP (DUMPED OUTFALL PROTECTION)	CU.YD.		1,257	100.00	125,700.00	
				PHASE 7 BID ITEMS TOTAL:	**3,557,000.00**	Rounded to nearest $1,000
PHASE 7 BID ITEM ADJUSTMENTS						
FURNISH WATER	COST	2%		72,000.00	72,000.00	Rounded to nearest $1,000
MAINTENANCE AND PROTECTION OF TRAFFIC	COST	10%		356,000.00	356,000.00	Rounded to nearest $1,000
ENVIRONMENTAL IMPACT MITIGATION	COST	4%		143,000.00	143,000.00	Rounded to nearest $1,000
MOBILIZATION	COST	10%		356,000.00	356,000.00	Rounded to nearest $1,000
CONTRACTOR QUALITY CONTROL	COST	2%		72,000.00	72,000.00	Rounded to nearest $1,000
CONSTRUCTION SURVEYING AND LAYOUT	COST	2%		72,000.00	72,000.00	Rounded to nearest $1,000
				PHASE 7 BID ITEM ADJUSTMENTS TOTAL:	**1,071,000.00**	Rounded to nearest $1,000
PHASE 7 NON-BID ITEMS						
AC SMOOTHNESS INCENTIVE	LANE MILE		4.0	11000.00	44,000.00	Rounded to nearest $1,000
ASPHALT CONCRETE MATERIALS QUALITY INCENTIVE	TON		15,020	1.50	23,000.00	Rounded to nearest $1,000
CONSTRUCTION ENGINEERING	COST	10%		356,000.00	356,000.00	Rounded to nearest $1,000
CONTINGENCY	COST	30%		1,068,000.00	1,068,000.00	Rounded to nearest $1,000
				PHASE 7 NON-BID ITEMS TOTAL:	**1,491,000.00**	
PHASE 7 OTHER COSTS						
DESIGN	COST	10%		356,000.00	356,000.00	Rounded to nearest $1,000
RIGHT OF WAY	COST			28,000.00	28,000.00	Rounded to nearest $1,000
UTILITY RELOCATIONS	COST			10,000.00	10,000.00	Rounded to nearest $1,000
				PHASE 7 OTHER COSTS TOTAL:	**394,000.00**	
				PHASE 7 GRAND TOTAL:	**6,513,000.00**	

9.8 Phase 8 – Val Vista Boulevard & I-10 Interchange Segment

Approximate Segment Limits: Sta 3605+00 to Sta 3647+00

Description: This construction phase focuses on the construction of the EWC improvements from the Coolidge terminus of the EWC to the east and approximate Sta 3605+00 to the west. This segment involves the construction of the interchange with I-10.

Implementation Issues:

- The beginning of this construction phase will require tapers to drop two-lanes of traffic and transition from a divided roadway back to the existing Val Vista Boulevard undivided roadway. As tapers will require a long distance to transition back to existing, it is preferable to implement a series of curves to prevent the amount of rework necessary. This issue may be mitigated by combining this construction phase with Phase 9 in order to make one continuous section that matches to the Phase 7 improvements.
- Maintenance of traffic along I-10 will be a challenge while construction efforts are underway.
- As there are multiple agencies involves with the construction of the Phase 8 improvements, extra care shall be taken to ensure that FHWA, ADOT, and the Cities of Casa Grande and Coolidge are active participants throughout all phases of design and ultimate construction.
- Coordinate with the City of Coolidge to ensure that the eastern terminus of the EWC improvements is compatible with the planned improvements of the City.

Major Construction Items:

- Multiple drainage items including culverts and reinforced concrete box culverts.
- The I-10 underpass structure and related retaining walls and guardrail will be constructed during this phase. The existing structure over I-10 is anticipated to remain in function at this time.
- The overhead power lines on both sides of Val Vista Boulevard may require relocation outside of the roadway improvements.

Table 9-8: EWC Phase 8 Itemized Estimate

PHASE 8 BID ITEMS						
ITEM DESCRIPTION	**UNIT OF MEASURE**	**PCT**	**QUANTITY**	**UNIT PRICE**	**TOTAL**	**REMARKS**
CLEARING AND GRUBBING	ACRE		16	500.00	8,000.00	
REMOVAL OF STRUCTURES AND OBSTRUCTIONS	L.SUM		1	50,000.00	50,000.00	
REMOVAL OF ASPHALTIC CONCRETE PAVEMENT	SQ.YD.		13,838	4.00	55,352.00	
ROADWAY EXCAVATION	CU.YD.		8,043	10.00	80,430.00	
BORROW	CU.YD.		39,000	12.00	468,000.00	
AGGREGATE BASE, CLASS 2	CU.YD.		14,085	55.00	774,675.00	
PORTLAND CEMEND CONCRETE PAVEMENT (12")	SQ.YD.		160	35.00	5,600.00	
ASPHALTIC CONCRETE	TON		17,320	115.00	1,991,800.00	
STRUCTURAL CONCRETE (BOX CULVERTS)	CU.YD.		215	350.00	75,250.00	
STRUCTURAL STEEL (BOX CULVERTS)	LB.		34,000	1.25	42,500.00	
SIGNING AND MARKING	MILE		0.5	25,000.00	12,500.00	
GUARDRAIL, W-BEAM, SINGLE FACE	L.FT.		1,500	25.00	37,500.00	
GUARDRAIL, END TERMINAL ASSEMBLY	L.FT.		4	2,000.00	8,000.00	
CONCRETE BARRIER (SINGLE FACE)	L.FT.		800	80.00	64,000.00	
RIPRAP (DUMPED OUTFALL PROTECTION)	CU.YD.		104	100.00	10,400.00	
RETAINING WALL (REINFORCED CONCRETE)	SQ. FT.		15,600	75.00	1,170,000.00	
NEW BRIDGE (COMPLETE NEW STRUCTURES)	SQ. FT.		15,880	150.00	2,382,000.00	
				PHASE 8 BID ITEMS TOTAL:	**7,237,000.00**	Rounded to nearest $1,000
PHASE 8 BID ITEM ADJUSTMENTS						
FURNISH WATER	COST	2%		145,000.00	145,000.00	Rounded to nearest $1,000
MAINTENANCE AND PROTECTION OF TRAFFIC	COST	10%		724,000.00	724,000.00	Rounded to nearest $1,000
ENVIRONMENTAL IMPACT MITIGATION	COST	4%		290,000.00	290,000.00	Rounded to nearest $1,000
MOBILIZATION	COST	10%		724,000.00	724,000.00	Rounded to nearest $1,000
CONTRACTOR QUALITY CONTROL	COST	2%		145,000.00	145,000.00	Rounded to nearest $1,000
CONSTRUCTION SURVEYING AND LAYOUT	COST	2%		145,000.00	145,000.00	Rounded to nearest $1,000
				PHASE 8 BID ITEM ADJUSTMENTS TOTAL:	**2,173,000.00**	Rounded to nearest $1,000
PHASE 8 NON-BID ITEMS						
AC SMOOTHNESS INCENTIVE	LANE MILE		2.0	11000.00	22,000.00	Rounded to nearest $1,000
ASPHALT CONCRETE MATERIALS QUALITY INCENTIVE	TON		17,320	1.50	26,000.00	Rounded to nearest $1,000
CONSTRUCTION ENGINEERING	COST	10%		724,000.00	724,000.00	Rounded to nearest $1,000
CONTINGENCY	COST	30%		2,172,000.00	2,172,000.00	Rounded to nearest $1,000
				PHASE 8 NON-BID ITEMS TOTAL:	**2,944,000.00**	
PHASE 8 OTHER COSTS						
DESIGN	COST	10%		724,000.00	724,000.00	Rounded to nearest $1,000
RIGHT OF WAY	COST			21,000.00	21,000.00	Rounded to nearest $1,000
UTILITY RELOCATIONS	COST			2,000.00	2,000.00	Rounded to nearest $1,000
				PHASE 8 OTHER COSTS TOTAL:	**747,000.00**	
				PHASE 8 GRAND TOTAL:	**13,101,000.00**	

9.9 Phase 9 – Val Vista Boulevard, East of Trekell Road Segment

Approximate Segment Limits: Sta 3568+13 to Sta 3605+00

Description: This construction phase focuses on the construction of the EWC improvements from the previously constructed Phase 7 improvements at Trekell Road, to the previously constructed Phase 8 improvements at the I-10 interchange.

Implementation Issues:

- As discussed in Section 9.8, this construction phase may be combined with Phase 8 in order to limit the amount of rework necessary and provide a smooth transition to the Section 7 improvements.
- Access to residential properties must be maintained at all times, however many of the traffic control issues can be mitigated by constructing the southern portion of the divided roadway followed by a shift of traffic.

Major Construction Items:

- There is an existing crossing of high pressure gas and overhead power lines over Val Vista Boulevard in this segment and may require relation outside of the roadway improvements.

Table 9-9: EWC Phase 9 Itemized Estimate

PHASE 9 BID ITEMS						
ITEM DESCRIPTION	**UNIT OF MEASURE**	**PCT**	**QUANTITY**	**UNIT PRICE**	**TOTAL**	**REMARKS**
CLEARING AND GRUBBING	ACRE		7	500.00	3,500.00	
REMOVAL OF STRUCTURES AND OBSTRUCTIONS	L.SUM		1	25,000.00	25,000.00	
REMOVAL OF ASPHALTIC CONCRETE PAVEMENT	SQ.YD.		10,136	4.00	40,544.00	
ROADWAY EXCAVATION	CU.YD.		11,261	10.00	112,610.00	
AGGREGATE BASE, CLASS 2	CU.YD.		12,701	55.00	698,555.00	
PORTLAND CEMEND CONCRETE PAVEMENT (12")	SQ.YD.		640	35.00	22,400.00	
ASPHALTIC CONCRETE	TON		15,550	115.00	1,788,250.00	
PIPE CULVERT, 48"	L.FT.		342	160.00	54,720.00	
PIPE CULVERT END SECTION (MISC. SIZES)	EACH		4	800.00	3,200.00	
SIGNING AND MARKING	MILE		0.7	25,000.00	17,500.00	
RIPRAP (DUMPED OUTFALL PROTECTION)	CU.YD.		30	100.00	3,000.00	
				PHASE 9 BID ITEMS TOTAL:	**2,770,000.00**	Rounded to nearest $1,000
PHASE 9 BID ITEM ADJUSTMENTS						
FURNISH WATER	COST	2%		56,000.00	56,000.00	Rounded to nearest $1,000
MAINTENANCE AND PROTECTION OF TRAFFIC	COST	10%		277,000.00	277,000.00	Rounded to nearest $1,000
ENVIRONMENTAL IMPACT MITIGATION	COST	4%		111,000.00	111,000.00	Rounded to nearest $1,000
MOBILIZATION	COST	10%		277,000.00	277,000.00	Rounded to nearest $1,000
CONTRACTOR QUALITY CONTROL	COST	2%		56,000.00	56,000.00	Rounded to nearest $1,000
CONSTRUCTION SURVEYING AND LAYOUT	COST	2%		56,000.00	56,000.00	Rounded to nearest $1,000
				PHASE 9 BID ITEM ADJUSTMENTS TOTAL:	**833,000.00**	Rounded to nearest $1,000
PHASE 9 NON-BID ITEMS						
AC SMOOTHNESS INCENTIVE	LANE MILE		2.8	11000.00	31,000.00	Rounded to nearest $1,000
ASPHALT CONCRETE MATERIALS QUALITY INCENTIVE	TON		15,550	1.50	23,000.00	Rounded to nearest $1,000
CONSTRUCTION ENGINEERING	COST	10%		277,000.00	277,000.00	Rounded to nearest $1,000
CONTINGENCY	COST	30%		831,000.00	831,000.00	Rounded to nearest $1,000
				PHASE 9 NON-BID ITEMS TOTAL:	**1,162,000.00**	
PHASE 9 OTHER COSTS						
DESIGN	COST	10%		277,000.00	277,000.00	Rounded to nearest $1,000
RIGHT OF WAY	COST			78,000.00	78,000.00	Rounded to nearest $1,000
				PHASE 9 OTHER COSTS TOTAL:	**355,000.00**	
				PHASE 9 GRAND TOTAL:	**5,120,000.00**	

9.10 Phase 10 – Copper Mountain Segment

Approximate Segment Limits: Sta 3235+15 to Sta 3410+00

Description: This construction phase focuses on the construction of the EWC improvements of the relocated Val Vista Boulevard alignment as it passes adjacent to the Copper Mountain Development. This segment begins roughly at the Corrales Road intersection to the west and terminates at the previously constructed Phase 6 improvements at Burris Road to the east. This phase will require coordination with the Copper Mountain Development and represents an opportunity to share in the costs of the development of the EWC improvements. Maintenance of traffic during this phase is not anticipated to be significant issue as the majority of the improvements lie on undeveloped land.

Implementation Issues:

- The beginning of this construction phase will require tapers to not only drop two-lanes of traffic, but will also require tapers to transition from a divided roadway back to the existing Val Vista Boulevard alignment. As tapers will require a long distance to transition back to existing, it is preferable to implement a series of curves to prevent the amount of rework necessary.
- Coordinate with the City of Casa Grande and the Copper Mountain Developer to determine whether any additional signalized intersections are warranted at the time of construction.

Major Construction Items:

- This section involves the construction of multiple culverts.

Table 9-10: EWC Phase 10 Itemized Estimate

PHASE 10 BID ITEMS						
ITEM DESCRIPTION	**UNIT OF MEASURE**	**PCT**	**QUANTITY**	**UNIT PRICE**	**TOTAL**	**REMARKS**
CLEARING AND GRUBBING	ACRE		73	500.00	36,500.00	
REMOVAL OF STRUCTURES AND OBSTRUCTIONS	L.SUM		1	50,000.00	50,000.00	
REMOVAL OF ASPHALTIC CONCRETE PAVEMENT	SQ.YD.		3,148	4.00	12,592.00	
ROADWAY EXCAVATION	CU.YD.		53,087	10.00	530,870.00	
AGGREGATE BASE, CLASS 2	CU.YD.		44,180	50.00	2,209,000.00	
PORTLAND CEMEND CONCRETE PAVEMENT (12")	SQ.YD.		2,580	35.00	90,300.00	
ASPHALTIC CONCRETE	TON		54,041	100.00	5,404,100.00	
PIPE CULVERT, 54"	L.FT.		1,380	200.00	276,000.00	
PIPE CULVERT, 60"	L.FT.		1,586	240.00	380,640.00	
PIPE CULVERT END SECTION (MISC. SIZES)	EACH		34	800.00	27,200.00	
SIGNING AND MARKING	MILE		3.3	25,000.00	82,500.00	
RIPRAP (DUMPED OUTFALL PROTECTION)	CU.YD.		193	100.00	19,300.00	
				PHASE 10 BID ITEMS TOTAL:	**9,120,000.00**	Rounded to nearest $1,000
PHASE 10 BID ITEM ADJUSTMENTS						
FURNISH WATER	COST	2%		183,000.00	183,000.00	Rounded to nearest $1,000
MAINTENANCE AND PROTECTION OF TRAFFIC	COST	10%		912,000.00	912,000.00	Rounded to nearest $1,000
ENVIRONMENTAL IMPACT MITIGATION	COST	4%		365,000.00	365,000.00	Rounded to nearest $1,000
MOBILIZATION	COST	10%		912,000.00	912,000.00	Rounded to nearest $1,000
CONTRACTOR QUALITY CONTROL	COST	2%		183,000.00	183,000.00	Rounded to nearest $1,000
CONSTRUCTION SURVEYING AND LAYOUT	COST	2%		183,000.00	183,000.00	Rounded to nearest $1,000
				PHASE 10 BID ITEM ADJUSTMENTS TOTAL:	**2,738,000.00**	Rounded to nearest $1,000
PHASE 10 NON-BID ITEMS						
AC SMOOTHNESS INCENTIVE	LANE MILE		13.2	11000.00	145,000.00	Rounded to nearest $1,000
ASPHALT CONCRETE MATERIALS QUALITY INCENTIVE	TON		54,041	1.50	81,000.00	Rounded to nearest $1,000
CONSTRUCTION ENGINEERING	COST	10%		912,000.00	912,000.00	Rounded to nearest $1,000
CONTINGENCY	COST	30%		2,736,000.00	2,736,000.00	Rounded to nearest $1,000
				PHASE 10 NON-BID ITEMS TOTAL:	**3,874,000.00**	
PHASE 10 OTHER COSTS						
DESIGN	COST	10%		912,000.00	912,000.00	Rounded to nearest $1,000
RIGHT OF WAY	COST			586,000.00	586,000.00	Rounded to nearest $1,000
				PHASE 10 OTHER COSTS TOTAL:	**1,498,000.00**	
				PHASE 10 GRAND TOTAL:	**17,230,000.00**	

9.11 Phase 11 – Val Vista Boulevard, West of Corrales Road Segment

Approximate Segment Limits: Sta 3130+00 to Sta 3235+15

Description: This construction phase focuses on the construction of the EWC improvements along the Val Vista Boulevard alignment between Papoose Road to the west and the previously constructed Phase 10 improvements at Corrales Road to the east. Maintenance of traffic during this phase is not anticipated to be a significant issue as the majority of the improvements lie on undeveloped land.

Implementation Issues:

- Access to residential properties must be maintained at all times, however many of the traffic control issues can be mitigated by constructing the northern portion of the divided roadway followed by a shift of traffic.

Major Construction Items:

- This section involves the construction of multiple culverts.

Table 9-11: EWC Phase 11 Itemized Estimate

PHASE 11 BID ITEMS						
ITEM DESCRIPTION	**UNIT OF MEASURE**	**PCT**	**QUANTITY**	**UNIT PRICE**	**TOTAL**	**REMARKS**
CLEARING AND GRUBBING	ACRE		4	500.00	2,000.00	
REMOVAL OF STRUCTURES AND OBSTRUCTIONS	L.SUM		1	25,000.00	25,000.00	
REMOVAL OF ASPHALTIC CONCRETE PAVEMENT	SQ.YD.		31,467	4.00	125,868.00	
ROADWAY EXCAVATION	CU.YD.		32,174	10.00	321,740.00	
AGGREGATE BASE, CLASS 2	CU.YD.		24,745	50.00	1,237,250.00	
PORTLAND CEMEND CONCRETE PAVEMENT (12")	SQ.YD.		1,280	35.00	44,800.00	
ASPHALTIC CONCRETE	TON		30,291	100.00	3,029,100.00	
PIPE CULVERT, 60"	L.FT.		1,037	240.00	248,880.00	
PIPE CULVERT END SECTION (MISC. SIZES)	EACH		10	800.00	8,000.00	
SIGNING AND MARKING	MILE		2.0	25,000.00	50,000.00	
RIPRAP (DUMPED OUTFALL PROTECTION)	CU.YD.		133	100.00	13,300.00	
				PHASE 11 BID ITEMS TOTAL:	**5,106,000.00**	Rounded to nearest $1,000
PHASE 11 BID ITEM ADJUSTMENTS						
FURNISH WATER	COST	2%		103,000.00	103,000.00	Rounded to nearest $1,000
MAINTENANCE AND PROTECTION OF TRAFFIC	COST	10%		511,000.00	511,000.00	Rounded to nearest $1,000
ENVIRONMENTAL IMPACT MITIGATION	COST	4%		205,000.00	205,000.00	Rounded to nearest $1,000
MOBILIZATION	COST	10%		511,000.00	511,000.00	Rounded to nearest $1,000
CONTRACTOR QUALITY CONTROL	COST	2%		103,000.00	103,000.00	Rounded to nearest $1,000
CONSTRUCTION SURVEYING AND LAYOUT	COST	2%		103,000.00	103,000.00	Rounded to nearest $1,000
				PHASE 11 BID ITEM ADJUSTMENTS TOTAL:	**1,536,000.00**	Rounded to nearest $1,000
PHASE 11 NON-BID ITEMS						
AC SMOOTHNESS INCENTIVE	LANE MILE		8.0	11000.00	88,000.00	Rounded to nearest $1,000
ASPHALT CONCRETE MATERIALS QUALITY INCENTIVE	TON		30,291	1.50	45,000.00	Rounded to nearest $1,000
CONSTRUCTION ENGINEERING	COST	10%		511,000.00	511,000.00	Rounded to nearest $1,000
CONTINGENCY	COST	30%		1,532,000.00	1,532,000.00	Rounded to nearest $1,000
				PHASE 11 NON-BID ITEMS TOTAL:	**2,176,000.00**	
PHASE 11 OTHER COSTS						
DESIGN	COST	10%		511,000.00	511,000.00	Rounded to nearest $1,000
RIGHT OF WAY	COST			257,000.00	257,000.00	Rounded to nearest $1,000
UTILITY RELOCATIONS	COST			10,000.00	10,000.00	Rounded to nearest $1,000
				PHASE 11 OTHER COSTS TOTAL:	**778,000.00**	
				PHASE 11 GRAND TOTAL:	**9,596,000.00**	

9.12 Phase 12 – MCGH & Val Vista Interchange Segment

Approximate Segment Limits: Sta 1500+00 to Sta 1600+00
Sta 3000+00 to Sta 3130+00

Description: This construction phase focuses on the construction of the Val Vista Boulevard and MCGH interchange which involves multiple ramps between both parkway alignments. This segment is bounded by the previously constructed Phase 1 improvements to the west and the previously constructed Phase 11 improvements to the east. Maintenance of traffic during this phase is not anticipated to be a significant issue as the majority of the improvements lie on undeveloped land. Access for detour traffic can be maintained at the existing intersection between Val Vista Boulevard and MCGH at approximate Sta 1583+65.

Implementation Issues:

- As shown in *Figure 1-3*, Val Vista Boulevard west of the UPRR is currently designated as a future potential parkway per the RSRSM and will not be constructed as a part of this study. Coordinate with Pinal County and local stakeholders to determine whether Val Vista Boulevard west of the UPRR will be necessary for this Phase of construction.
- As this phase involves work adjacent to the UPRR, coordinate with the UPRR to ensure that the proper rights-of-entry and permits are acquired prior to the beginning of construction activities.

Major Construction Items:

- MCGH / UPRR and the MCGH underpass structures and related retaining walls and guardrail will be constructed during this phase.
- Multiple drainage items including culverts and reinforced concrete box culverts.
- Significant quantities of borrow will be required during this phase of construction in order to construct the embankment leading up to the MCGH / UPRR Structures.

Table 9-12: EWC Phase 12 Itemized Estimate

PHASE 12 BID ITEMS						
ITEM DESCRIPTION	**UNIT OF MEASURE**	**PCT**	**QUANTITY**	**UNIT PRICE**	**TOTAL**	**REMARKS**
CLEARING AND GRUBBING	ACRE		95	500.00	47,500.00	
REMOVAL OF STRUCTURES AND OBSTRUCTIONS	L.SUM		1	75,000.00	75,000.00	
REMOVAL OF ASPHALTIC CONCRETE PAVEMENT	SQ.YD.		18,646	4.00	74,584.00	
ROADWAY EXCAVATION	CU.YD.		65,955	10.00	659,550.00	
BORROW	CU.YD.		214,500	12.00	2,574,000.00	
AGGREGATE BASE, CLASS 2	CU.YD.		49,317	50.00	2,465,850.00	
PORTLAND CEMEND CONCRETE PAVEMENT (12")	SQ.YD.		640	35.00	22,400.00	
ASPHALTIC CONCRETE	TON		49,251	100.00	4,925,100.00	
PIPE CULVERT, 36"	L.FT.		900	120.00	108,000.00	
PIPE CULVERT, 54"	L.FT.		1,214	200.00	242,800.00	
PIPE CULVERT, 60"	L.FT.		226	240.00	54,240.00	
PIPE CULVERT END SECTION (MISC. SIZES)	EACH		24	800.00	19,200.00	
STRUCTURAL CONCRETE (BOX CULVERTS)	CU.YD.		640	350.00	224,000.00	
STRUCTURAL STEEL (BOX CULVERTS)	LB.		77,000	1.25	96,250.00	
SIGNING AND MARKING	MILE		4.1	25,000.00	102,500.00	
GUARDRAIL, W-BEAM, SINGLE FACE	L.FT.		4,600	25.00	115,000.00	
GUARDRAIL, END TERMINAL ASSEMBLY	L.FT.		6	2,000.00	12,000.00	
CONCRETE BARRIER (SINGLE FACE)	L.FT.		800	80.00	64,000.00	
RIPRAP (DUMPED OUTFALL PROTECTION)	CU.YD.		178	100.00	17,800.00	
RETAINING WALL (REINFORCED CONCRETE)	SQ. FT.		12,000	75.00	900,000.00	
NEW BRIDGE (COMPLETE NEW STRUCTURES)	SQ. FT.		38,891	150.00	5,833,650.00	
	PHASE 12 BID ITEMS TOTAL:				**18,634,000.00**	Rounded to nearest $1,000
PHASE 12 BID ITEM ADJUSTMENTS						
FURNISH WATER	COST	2%		373,000.00	373,000.00	Rounded to nearest $1,000
MAINTENANCE AND PROTECTION OF TRAFFIC	COST	10%		1,864,000.00	1,864,000.00	Rounded to nearest $1,000
ENVIRONMENTAL IMPACT MITIGATION	COST	4%		746,000.00	746,000.00	Rounded to nearest $1,000
MOBILIZATION	COST	10%		1,864,000.00	1,864,000.00	Rounded to nearest $1,000
CONTRACTOR QUALITY CONTROL	COST	2%		373,000.00	373,000.00	Rounded to nearest $1,000
CONSTRUCTION SURVEYING AND LAYOUT	COST	2%		373,000.00	373,000.00	Rounded to nearest $1,000
	PHASE 12 BID ITEM ADJUSTMENTS TOTAL:				**5,593,000.00**	Rounded to nearest $1,000
PHASE 12 NON-BID ITEMS						
AC SMOOTHNESS INCENTIVE	LANE MILE		16.4	11000.00	180,000.00	Rounded to nearest $1,000
ASPHALT CONCRETE MATERIALS QUALITY INCENTIVE	TON		49,251	1.50	74,000.00	Rounded to nearest $1,000
CONSTRUCTION ENGINEERING	COST	10%		1,864,000.00	1,864,000.00	Rounded to nearest $1,000
CONTINGENCY	COST	30%		5,591,000.00	5,591,000.00	Rounded to nearest $1,000
	PHASE 12 NON-BID ITEMS TOTAL:				**7,709,000.00**	
PHASE 12 OTHER COSTS						
DESIGN	COST			1,864,000.00	1,864,000.00	Rounded to nearest $1,000
RIGHT OF WAY	COST			317,000.00	317,000.00	Rounded to nearest $1,000
UTILITY RELOCATIONS	COST			1,000.00	1,000.00	Rounded to nearest $1,000
	PHASE 12 OTHER COSTS TOTAL:				**2,182,000.00**	
				PHASE 12 GRAND TOTAL:	**34,118,000.00**	

9.13 Implementation Plan – Cost Comparison

As stated at the beginning of this section, the cost for the construction of the entire EWC proposed improvements are projected to nearly $145,000,000 using 2015 unit price values and historical bid data. It should be noted that the 2015 unit prices used for the cost estimate assumed that the project would be constructed it its entirety. Typically, unit prices decrease as the quantity of an item increases. If the corridor were to be broken up as discussed in the previous sections, the quantities for each construction item would be reduced resulting in an increase of cost for each construction item. This cost estimate only accounts for a project that is constructed today. Should the improvements be constructed in the future, this cost estimate and unit bid prices must be revisited to account for the revised unit bid prices anticipated for that construction year.

As seen in *Table 9-13*, the cost to construct the entire EWC proposed improvements is $145,000,000 while the total costs to construct the improvements in phases cost nearly $175,000,000. While these limits will likely change as construction funds become available, these estimates provide a baseline for the smaller, constructible segments that can be used for future programming and planning purposes.

Table 9-13: EWC Cost Comparison

EWC COST ESTIMATE VS IMPLEMENTED COST		
COST ESTIMATE	**TOTAL**	**SOURCE**
EWC Estimate	$144,844,000	*Table 8-3*
EWC Phase 1 Estimate	$19,894,000	*Table 9-1*
EWC Phase 2 Estimate	$7,394,000	*Table 9-2*
EWC Phase 3 Estimate	$6,308,000	*Table 9-3*
EWC Phase 4 Estimate	$4,609,000	*Table 9-4*
EWC Phase 5 Estimate	$38,267,000	*Table 9-5*
EWC Phase 6 Estimate	$12,554,000	*Table 9-6*
EWC Phase 7 Estimate	$6,513,000	*Table 9-7*
EWC Phase 8 Estimate	$13,101,000	*Table 9-8*
EWC Phase 9 Estimate	$5,120,000	*Table 9-9*
EWC Phase 10 Estimate	$17,230,000	*Table 9-10*
EWC Phase 11 Estimate	$9,596,000	*Table 9-11*
EWC Phase 12 Estimate	$34,118,000	*Table 9-12*
PHASED COST TOTAL	**$174,704,000**	

APPENDIX A:
PROPOSED CONCEPT PLAN SET
(400 SCALE)

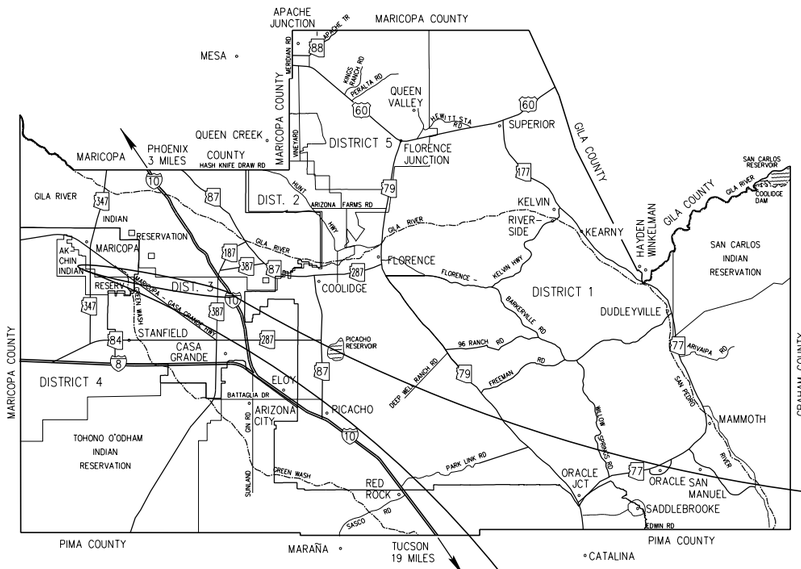
REVIEW NOT FOR CONSTRUCTION OR RECORDING	F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
	9	AZ		1		
	DESIGNED DATE:		DRAWN DATE:		CHECKED DATE:	

11/30/2015 ccccccDGNcSPECcccccc

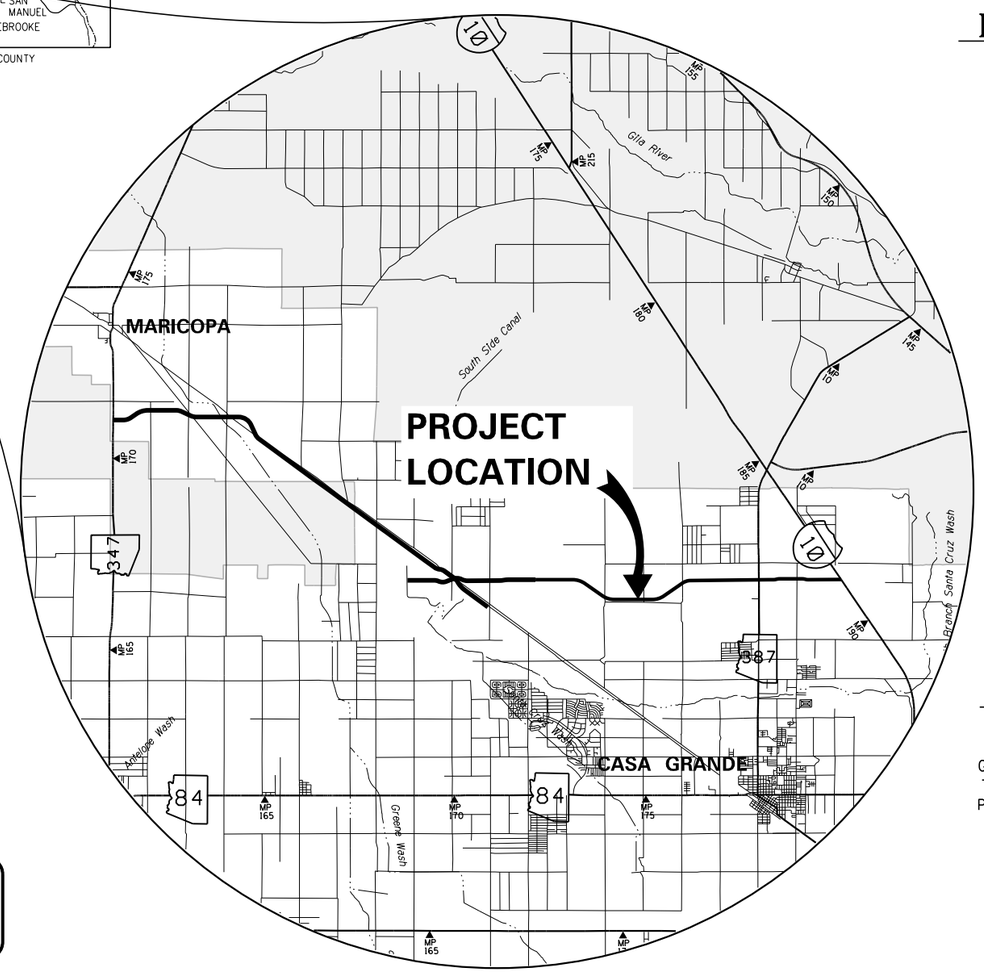
JACOBS™
101 NORTH FIRST AVENUE, SUITE 2600
PHOENIX, ARIZONA 85003 U.S.A.
PHONE: (602) 253-1200
FAX: (602) 253-1202

East-West Corridor Study
(SR 347 to I-10)
PROJECT NO. xxxxxxxx

PINAL • COUNTY
wide open opportunity



PINAL COUNTY



PINAL COUNTY BOARD OF SUPERVISORS

DISTRICT ONE – PETE RIOS
DISTRICT TWO – CHERYL CHASE
DISTRICT THREE – STEVE MILLER
DISTRICT FOUR – ANTHONY SMITH
DISTRICT FIVE – TODD HOUSE

MANAGEMENT

COUNTY MANAGER – GREG STANLEY
COUNTY ENGINEER – SCOTT BENDER, P.E., C.F.M.

PROJECT MANAGER

Travis Ashbaugh
Transportation Planning
31 N Pinal Street, Bulding F
Florence, AZ 85132
TEL: 520.866.6407
FAX: 520.866.6511

DESIGN CONSULTANT

JACOBS
101 NORTH FIRST AVENUE, SUITE 2600
PHOENIX, ARIZONA 85003
PHONE: (602) 253-1200
FAX: (602) 253-1202

INDEX TO SHEETS

DRAWING NO	DESCRIPTION	SHEET NO
CS-1	COVER SHEET	1
GN-1	GENERAL NOTES / LEGEND	2
GM-1 to GM-8	GEOMETRIC SHEETS	3 – 10
TY-1 to TY-2	TYPICAL SECTIONS	11 – 12
PL-1 to PL-13	PLAN SHEETS	13 – 25

Call at least two full working days before you begin excavation.
ARIZONA 811
Arizona Blue Stake, Inc.
Dial 8-1-1 or 1-800-STAKE-IT (782-5348)
in Maricopa County: (602) 263-1100

P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\EWcfacesheet.dgn
11/30/2015

11/24/2015 EWcgn01.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	AZ	------			

GENERAL NOTES

1. ALL MATERIALS, CONSTRUCTION & METHODS SHALL CONFORM TO THE LATEST EDITION OF THE MARICOPA ASSOCIATION OF GOVERNMENTS (MAG) UNIFORM STANDARD SPECIFICATIONS AND DETAILS FOR PUBLIC WORKS CONSTRUCTION AND THE PINAL COUNTY SUBDIVISION REGULATIONS & REQUIREMENTS & MINIMUM STANDARDS FOR SUBDIVISION STREET PAVING.
2. CONTRACTOR/DEVELOPER IS RESPONSIBLE FOR BLUE STAKE MARKING DAILY AS CONSTRUCTION IS IN PROGRESS.
3. ALL RESIDENTS TO BE NOTIFIED IN PERSON 24 HOURS PRIOR TO DRIVEWAY CROSSING.
4. TRAFFIC CONTROL AND BARRICADING SHALL BE ACCORDING TO THE 2009 MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES (MUTCD) OR PINAL COUNTY REQUIREMENTS.
5. ANY WORK ON ARTERIAL OR COLLECTOR ROADS MAY REQUIRE AN OFF-DUTY PINAL COUNTY SHERIFF'S OFFICER FOR TRAFFIC CONTROL. CONTACT SHALL BE MADE THROUGH THE PCSO REPRESENTATIVE.
6. ANY WORK DONE IN A DRAINAGE CHANNEL OR WASH MUST COMPLY WITH STATE AND FEDERAL REGULATIONS.
7. A STORMWATER POLLUTION PREVENTION PLAN SHALL BE SUBMITTED TO PINAL COUNTY PRIOR TO ISSUANCE OF CONSTRUCTION PERMITS.
8. THE CONTRACTOR/DEVELOPER IS RESPONSIBLE FOR OBTAINING AN AIR POLLUTION CONTROL PERMIT FROM THE PINAL COUNTY DEPARTMENT OF AIR QUALITY AND FOR COMPLYING WITH ALL FEDERAL, STATE AND LOCAL DUST CONTROL REGULATIONS AND REQUIREMENTS.
9. IT SHALL BE THE CONTRACTOR/DEVELOPER'S RESPONSIBILITY TO REMOVE ALL ABANDONED (RETIRED) UTILITIES THAT INTERFERE WITH THIS CONSTRUCTION PROJECT.
10. THE CONTRACTOR/DEVELOPER IS RESPONSIBLE FOR COORDINATING THE RELOCATIONS OF ALL UTILITIES, POWER POLES, PRIVATE IRRIGATION DITCHES, TURNOUTS, GATES. ETC.
11. CONTRACTOR/DEVELOPER SHALL COMPLY WITH APPLICABLE FEDERAL, STATE, AND LOCAL LAWS, STATUES AND ORDINANCES, RESPECTIVELY.
12. THE CONTRACTOR/DEVELOPER SHALL COMPLY WITH THE REQUIREMENTS FOR A U.S. EPA NPDES STORMWATER POLLUTION CONTROL PERMIT AND ANY OTHER APPLICABLE PERMITS AND REQUIREMENTS BY FEDERAL REGULATORY AGENCIES.
13. IT IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR/DEVELOPER TO OBTAIN AT HIS OWN EXPENSE ALL PERMITS REQUIRED FOR THIS PROJECT FROM THE APPROPRIATE AGENCIES.
14. THE GRADING CONTRACTOR/DEVELOPER SHALL CLEAR AND GRUB SITE PRIOR TO GRADING.
15. CONTRACTOR/DEVELOPER SHALL OBTAIN A PINAL COUNTY RIGHT-OF-WAY USE PERMIT PRIOR TO ANY WORK BEING PERFORMED WITHIN THE COUNTY RIGHT-OF-WAY.
16. EXISTING UTILITIES ARE SHOWN FROM BEST AVAILABLE RECORDS. CONTRACTOR/DEVELOPER SHALL LOCATE AND POT-HOLE IN THE AREA OF KNOWN EXISTING UTILITIES TO VERIFY SIZE, LOCATION AND TYPE PRIOR TO PERFORMING ANY WORK. CONTRACTOR SHALL ADEQUATELY PROTECT AND MAINTAIN ALL EXISTING UTILITIES. ANY UTILITY (WHETHER SHOWN OR NOT) DAMAGED DUE TO CONSTRUCTION SHALL BE REPAIRED IMMEDIATELY AT CONTRACTOR/DEVELOPERS/RS EXPENSE. ANY EXISTING FIRE HYDRANTS, MANHOLES, ETC. TO BE RAISED OR LOWERED SHALL BE DONE SO BY THE CONTRACTOR/DEVELOPER. THE CONTRACTOR/DEVELOPER SHALL BE RESPONSIBLE FOR REMOVING AND REPLACING ANY EXISTING FENCES, DRIVEWAYS, ETC., DAMAGED OR REMOVED BY HIM DURING CONSTRUCTION. ALL AREAS DISTURBED BY CONSTRUCTION SHALL BE RETURNED TO THEIR ORIGINAL CONDITION PRIOR TO FINAL ACCEPTANCE.
17. THE PROJECT ENGINEER IS NOT RESPONSIBLE FOR THE CONTRACTOR/DEVELOPER'S UTILIZATION OF MEN, MATERIAL, EQUIPMENT OR SAFETY MEASURES IN PERFORMANCE OF ANY WORK FOR THIS CONSTRUCTION. THE CONTRACTOR/DEVELOPER SHALL FURNISH ALL OF THESE ITEMS AND PERFORM ALL WORK, INCLUDING RESTORATION FOR THE COMPLETED INSTALLATION OF THE UTILITY SYSTEMS AND ALL OTHER IMPROVEMENTS SHOWN OR IMPLIED, AS NECESSARY FOR THE COMPLETED FACILITY READY FOR USE. THE CONTRACTOR/DEVELOPER ASSUMES ALL RESPONSIBILITY FOR PERFORMING THE WORK CORRECTLY AND IN CONFORMANCE WITH ALL CODE REQUIREMENTS.
18. WHEN REMOVING EXISTING CURB, GUTTER, OR SIDEWALK, REMOVE TO NEAREST JOINT.
19. SHOULD THE CONTRACTOR/DEVELOPER DISCOVER DISCREPANCIES BETWEEN THE PLANS AND FIELD CONDITIONS. THE PROJECT ENGINEER IS TO BE NOTIFIED IMMEDIATELY TO RESOLVE THE SITUATION. SHOULD THE CONTRACTOR/DEVELOPER MAKE FIELD CORRECTION OR ADJUSTMENTS WITHOUT NOTIFYING THE PROJECT ENGINEER, THEN THE CONTRACTOR/DEVELOPER ASSUMES ALL RESPONSIBILITY FOR THOSE CHANGES.
20. THE COUNTY ENGINEER'S OFFICE SHALL BE NOTIFIED 24 HOURS PRIOR TO THE BEGINNING OF ANY CONSTRUCTION.
21. WORK PERFORMED WITHOUT THE APPROVAL OF THE COUNTY ENGINEER AND/OR ALL WORK AND MATERIAL NOT IN CONFORMANCE WITH THE PLANS AND SPECIFICATIONS IS SUBJECT TO REMOVAL AND REPLACEMENT AT THE CONTRACTOR/DEVELOPER'S EXPENSE.
22. NO JOB WILL BE CONSIDERED COMPLETE UNTIL ALL NEW PAVEMENT AREAS HAVE BEEN SWEPT CLEAN OF ALL DIRT AND DEBRIS.
23. THE CONTRACTOR/DEVELOPER SHALL KEEP SUITABLE EQUIPMENT ON HAND AT THE JOB SITE FOR MAINTENANCE OF DUST CONTROL AND SHALL CONTROL DUST AS DIRECTED BY THE APPROPRIATE AGENCIES.
24. THE QUANTITIES SHOWN ARE AN ESTIMATE BY THE ENGINEER. THE CONTRACTOR/DEVELOPER SHALL MAKE HIS OWN INDEPENDENT ESTIMATE OF QUANTITIES AND BASE HIS BID THEREON.
25. THE CONTRACTOR/DEVELOPER IS REQUIRED TO CONTACT BLUE STAKE 48 HOURS PRIOR TO COMMENCEMENT OF CONSTRUCTION. BLUESTAKE'S PHONE NUMBER IS 1-800-STAKE-IT.
26. ALL OBSTRUCTIONS WITHIN THE RIGHT-OF-WAY SHALL BE REMOVED PRIOR TO ANY CONSTRUCTION BY THE CONTRACTOR/DEVELOPER.
27. ALL TEMPORARY FACILITIES SHALL BE REMOVED PRIOR TO FINAL ACCEPTANCE BY OWNER.
28. ALL FRAMES, COVERS, VALVE BOXES, AND MANHOLES SHALL BE ADJUSTED TO FINISHED GRADE UPON COMPLETION OF PAVING OR RELATED CONSTRUCTION.
29. THE CONTRACTOR/DEVELOPER SHALL NOTIFY THE PROJECT ENGINEER BEFORE BACKFILLING ANY UNDERGROUND IRRIGATION PIPE OR SERVICES IN ORDER THAT THE ENGINEER MAY VERIFY THE "AS-BUILT' LOCATION OF THE SERVICE.
30. THE DESIGN SPEED IS 55 M.P.H. FOR THIS PROJECT.
31. FILL SHALL BE FREE OF OVERSIZED MATERIAL (GREATER THAN 3'), DEBRIS AND OTHER DELETERIOUS MATERIAL (957. COMP., 6' MAX LIFTS).
32. ALL STANDARD DETAILS ARE PINAL COUNTY UNLESS OTHERWISE NOTED.
33. IF SOFT SPOTS ARE ENCOUNTERED IN THE FIELD. THE UNSUITABLE SUBGRADE MATERIAL SHALL BE REMOVED AND REPLACED WITH SUITABLE MATERIAL. NO MEASUREMENT WILL BE MADE FOR THIS WORK. THE COST BEING CONSIDERED INCLUDED IN THE PRICE OF THE CONTRACT ITEMS.
34. RIGHT-OF-WAY MARKERS SHALL BE PLACED AT EVERY BREAK POINT, AT EVERY PC, PT ON CURVES, AND AT INTERVALS OF 800 FT. ON TANGENTS ON THE PROPOSED RIGHT-OF-WAY.
35. ALL PLANS REVISED AFTER THE ORIGINAL APPROVAL SHALL BE SUBMITTED TO PINAL COUNTY PUBLIC WORKS FOR RE-APPROVAL. CHANGES ON EACH PLAN SHEET SHALL BE HIGHLIGHTED WITH "CLOUDING" AND BE LABELED WITH A NUMERAL WITHIN A TRIANGLE (DELTA REVISIONS). THE ORIGINAL PLAN SHEET SHALL REMAIN THE SAME SHEET NUMBER AND THE PLAN SHEET SHOWING THE REVISIONS SHALL BE LABELED WITH THE SAME NUMBER BUT WITH AN "A" AFTER THE NUMBER. PINAL COUNTY ENGINEER'S RE- APPROVAL BLOCK INDICATING THE DELTA REVISION SHALL BE PLACED ON THE COVER SHEET.

LEGEND

- Existing Monument
- Existing Bollard
- Existing Sign
- Existing Double Sign
- Existing Telephone Ped
- Existing Pole
- Existing Street Light
- New Guardrail
- New Guardrail End Treatment
- New Headwall/Wign Wall

	NAME	DATE
DESIGN	MKO / TJJ	08-15
DRAWN	SR / JLM	08-15
CHECKED	BSW	08-15

JACOBS

GENERAL NOTES

LOCATION

EAST - WEST CORRIDOR STUDY

REVIEW

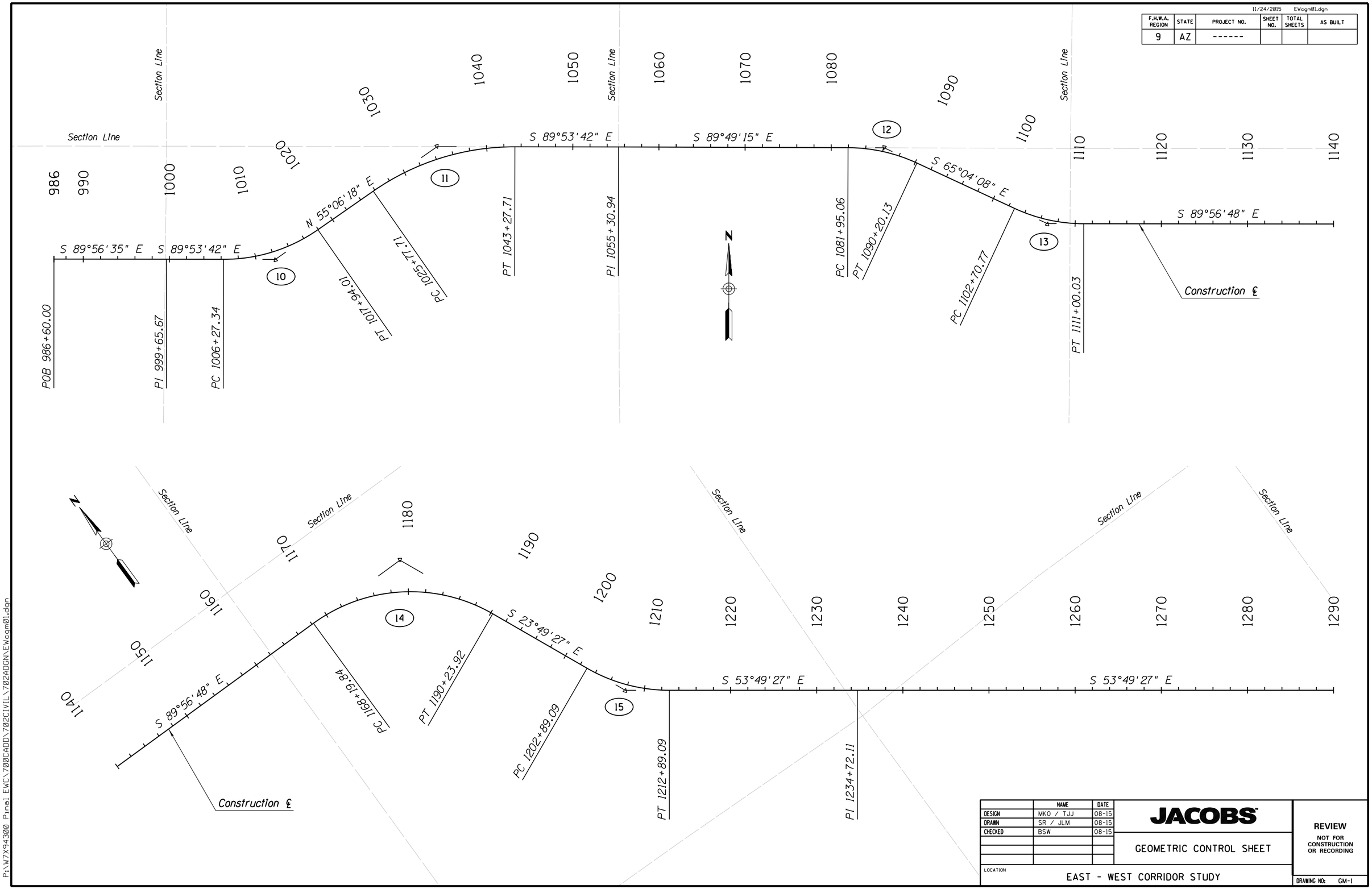
NOT FOR CONSTRUCTION OR RECORDING

DRAWING NO: GN-1

P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\EWcgn01.dgn

11/24/2015 EWcgm01.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	AZ	------			



	NAME	DATE
DESIGN	MKO / TJJ	08-15
DRAWN	SR / JLM	08-15
CHECKED	BSW	08-15

JACOBS

GEOMETRIC CONTROL SHEET

LOCATION

EAST - WEST CORRIDOR STUDY

REVIEW

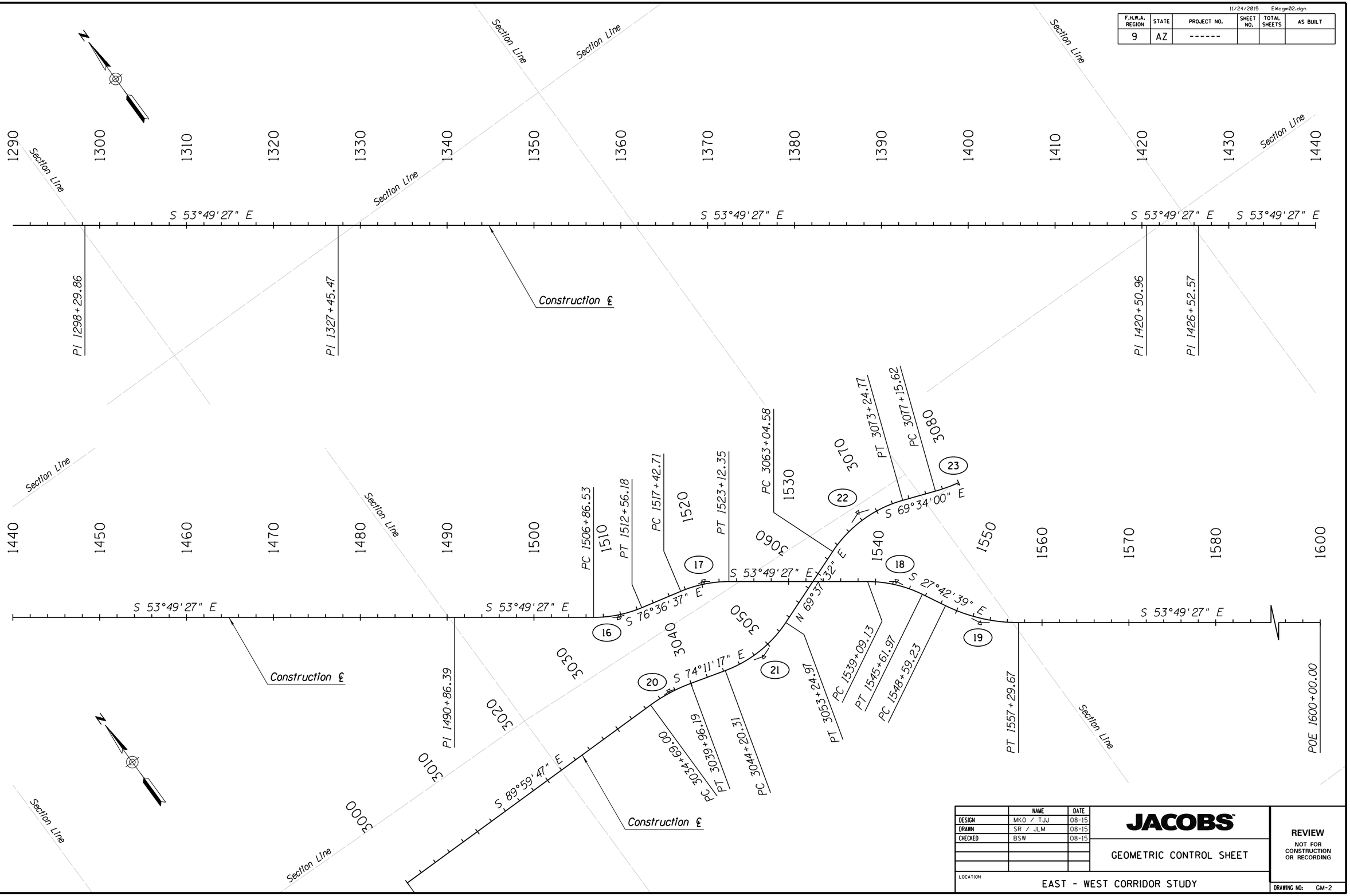
NOT FOR CONSTRUCTION OR RECORDING

DRAWING NO: GM-1

P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\EWcgm01.dgn

11/24/2015 EWcgm02.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	AZ	------			



	NAME	DATE
DESIGN	MKO / TJJ	08-15
DRAWN	SR / JLM	08-15
CHECKED	BSW	08-15

JACOBS

GEOMETRIC CONTROL SHEET

LOCATION

EAST - WEST CORRIDOR STUDY

REVIEW

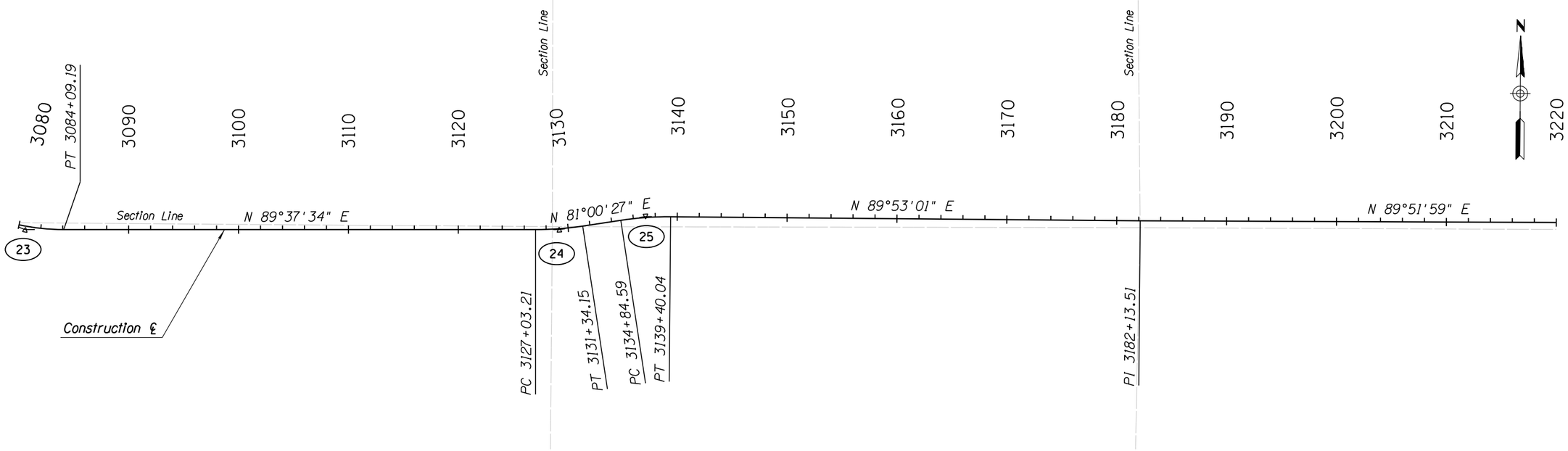
NOT FOR CONSTRUCTION OR RECORDING

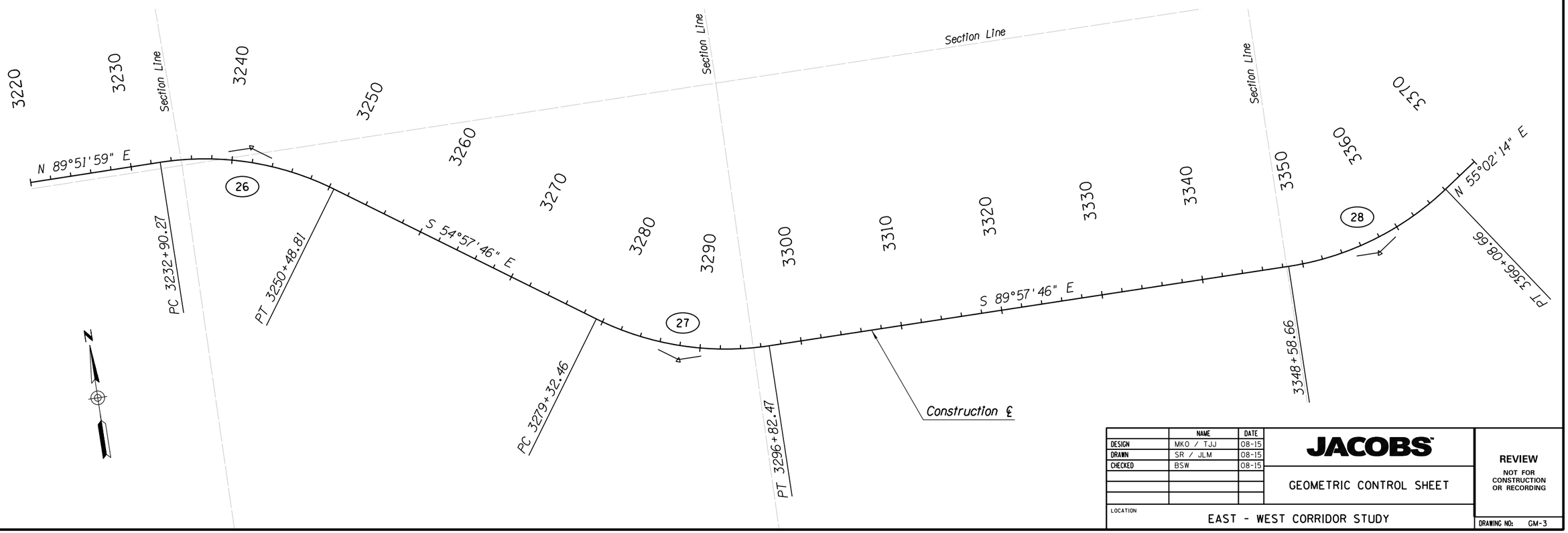
DRAWING NO: GM-2

P:\W7X94300 Final EWC\700CADD\702CIVIL\702ADGN\EWcgm02.dgn

11/24/2015 EWcgm03.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	AZ	------			





	NAME	DATE
DESIGN	MKO / TJJ	08-15
DRAWN	SR / JLM	08-15
CHECKED	BSW	08-15

JACOBS

GEOMETRIC CONTROL SHEET

LOCATION

EAST - WEST CORRIDOR STUDY

REVIEW

NOT FOR CONSTRUCTION OR RECORDING

DRAWING NO: GM-3

P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\EWcgm03.dgn

11/24/2015 EWcgm04.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	AZ	------			

	NAME	DATE
DESIGN	MKO / TJJ	08-15
DRAWN	SR / JLM	08-15
CHECKED	BSW	08-15

JACOBS

GEOMETRIC CONTROL SHEET

LOCATION

EAST - WEST CORRIDOR STUDY

REVIEW

NOT FOR CONSTRUCTION OR RECORDING

DRAWING NO: GM-4

P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\EWcgm04.dgn

PLAN REF NO.	DESCRIPTION	Point Type	STATION	COORDINATES		Circular Curve						
				Northing	Easting	Δ	D	R	L	T	Ext	Super
	Construction ℄	POB	986+60.00	736815.85	658468.61							
	Construction ℄	PI	999+65.67	736814.55	659774.29							
10	Construction ℄	PI	1012+29.52	736812.23	661038.13	35°00'00"Lt	03°00'00"	1909.86'	1166.67'	602.18'	92.68'	*.***'/ft
	Construction ℄	PC	1006+27.34	736813.34	660435.95							
	Construction ℄	PT	1017+94.01	737156.72	661532.03							
11	Construction ℄	PI	1034+80.98	738121.79	662915.69	35°00'00"Rt	02°00'00"	2864.79'	1750.00'	903.26'	139.03'	*.***'/ft
	Construction ℄	PC	1025+77.71	737605.06	662174.83							
	Construction ℄	PT	1043+27.71	738120.14	663818.95							
	Construction ℄	PI	1055+30.94	738117.93	665022.18							
12	Construction ℄	PI	1086+14.13	738108.30	668105.36	24°45'07"Rt	03°00'00"	1090.86'	825.07'	419.07'	45.44'	*.***'/ft
	Construction ℄	PC	1081+95.06	738109.61	667686.29							
	Construction ℄	PT	1090+20.13	737931.65	668485.38							
13	Construction ℄	PI	1106+92.04	737226.89	670001.49	24°52'40"Lt	03°00'00"	1909.86'	829.26'	421.27'	45.91'	*.***'/ft
	Construction ℄	PC	1102+70.77	737404.47	669619.48							
	Construction ℄	PT	1111+00.03	737226.50	670422.76							
14	Construction ℄	PI	1180+63.02	737220.02	677385.75	66°07'21"Rt	03°00'00"	1909.86'	2204.08'	1243.18'	368.97'	*.***'/ft
	Construction ℄	PC	1168+19.84	737221.17	676142.57							
	Construction ℄	PT	1190+23.92	736082.77	677887.91							
15	Construction ℄	PI	1208+00.84	734457.27	678605.67	30°00'00"Lt	03°00'00"	1909.86'	1000.00'	511.75'	67.37'	*.***'/ft
	Construction ℄	PC	1202+89.09	734925.41	678398.95							
	Construction ℄	PT	1212+89.09	734155.20	679018.75							
	Construction ℄	PI	1234+72.11	732866.65	680780.90							
	Construction ℄	PI	1298+29.86	729113.90	685912.94							
	Construction ℄	PI	1327+45.47	727392.92	688266.45							
	Construction ℄	PI	1420+50.96	721900.22	695777.94							
	Construction ℄	PI	1426+52.57	721545.11	696263.57							
	Construction ℄	PI	1490+86.39	717747.46	701457.02							

11/24/2015 EWcgm05.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	AZ	------			

P:\W7X94300 Final EWC\700CADD\702CIVIL\702ADGN\EWcgm05.dgn

	NAME	DATE
DESIGN	MKO / TJJ	08-15
DRAWN	SR / JLM	08-15
CHECKED	BSW	08-15

JACOBS

GEOMETRIC DATA SHEET

LOCATION

EAST - WEST CORRIDOR STUDY

REVIEW

NOT FOR CONSTRUCTION OR RECORDING

DRAWING NO: GM-5

PLAN REF NO.	DESCRIPTION	Point Type	STATION	COORDINATES		Circular Curve						
				Northing	Easting	Δ	D	R	L	T	Ext	Super
16	Construction ℄	PI	1509+75.17	716632.58	702981.65	22°47'09"Lt	04°00'00"	1432.39'	569.65'	288.64'	28.79'	*.***'/ft
	Construction ℄	PC	1506+86.53	716802.96	702748.66							
	Construction ℄	PT	1512+56.18	716565.74	703262.45							
17	Construction ℄	PI	1520+31.34	716386.23	704016.54	22°47'09"Rt	04°00'00"	1432.40'	569.65'	288.64'	28.79'	*.***'/ft
	Construction ℄	PC	1517+42.71	716453.07	703735.75							
	Construction ℄	PT	1523+12.35	716215.86	704249.54							
18	Construction ℄	PI	1542+41.32	715077.26	705806.62	26°06'48"Rt	04°00'00"	1432.39'	652.84'	332.19'	38.01'	*.***'/ft
	Construction ℄	PC	1539+09.13	715273.34	705538.47							
	Construction ℄	PT	1545+61.97	714783.17	705961.09							
19	Construction ℄	PI	1553+02.14	714127.89	706305.28	26°06'48"Lt	03°00'00"	1909.86'	870.44'	442.91'	50.69'	*.***'/ft
	Construction ℄	PC	1548+59.23	714520.01	706099.32							
	Construction ℄	PT	1557+29.67	713866.45	706662.80							
	Construction ℄	POE	1600+00.00	711345.82	710109.85							

11/30/2015 EWcgm06.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	AZ	------			

	NAME	DATE
DESIGN	MKO / TJJ	08-15
DRAWN	SR / JLM	08-15
CHECKED	BSW	08-15

JACOBS

GEOMETRIC CONTROL SHEET

LOCATION

EAST - WEST CORRIDOR STUDY

REVIEW

NOT FOR CONSTRUCTION OR RECORDING

DRAWING NO: GM-6

P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\EWcgm06.dgn

PLAN REF NO.	DESCRIPTION	Point Type	STATION	COORDINATES		Circular Curve						
				Northing	Easting	Δ	D	R	L	T	Ext	Super
	Construction ℄	POB	3000+00.00	715601.28	699213.52							
20	Construction ℄	PI	3037+34.28	705601.51	702947.80	15°48'56"Rt	03°00'00"	1909.86'	527.19'	265.28'	18.34'	*.***'/ft
	Construction ℄	PC	3034+69.00	705601.49	702682.52							
	Construction ℄	PT	3039+96.19	715529.22	703203.04							
21	Construction ℄	PI	3048+88.30	715286.14	704061.39	36°11'11"Lt	04°00'00"	1432.39'	904.66'	467.99'	74.51'	*.***'/ft
	Construction ℄	PC	3044+20.31	715413.66	703611.11							
	Construction ℄	PT	3053+24.97	715449.07	704500.11							
22	Construction ℄	PI	3068+37.40	715975.63	705917.91	40°48'27"Rt	04°00'00"	1432.39'	1020.19'	532.81'	95.89'	*.***'/ft
	Construction ℄	PC	3063+04.58	715790.13	705418.44							
	Construction ℄	PT	3073+24.77	715789.62	706417.20							
23	Construction ℄	PI	3080+66.27	715530.75	707112.04	20°48'26"Lt	03°00'00"	1909.86'	693.57'	350.65'	31.92'	*.***'/ft
	Construction ℄	PC	3077+15.62	715653.17	106783.45							
	Construction ℄	PT	3084+09.19	715533.04	707462.68							
24	Construction ℄	PI	3129+19.09	715562.47	711972.48	8°37'07"Lt	02°00'00"	2864.79'	430.93'	215.87'	8.12'	*.***'/ft
	Construction ℄	PC	3127+03.21	715561.07	711756.61							
	Construction ℄	PT	3131+34.15	715596.22	712185.70							
25	Construction ℄	PI	3137+12.80	715686.66	712757.24	9°06'33"Rt	02°00'00"	2864.79'	455.45'	228.21	9.08'	*.***'/ft
	Construction ℄	PC	3134+84.59	715650.99	712531.83							
	Construction ℄	PT	3139+40.04	715686.20	71295.44							
	Construction ℄	PI	3182+13.51	715677.51	717258.91							
26	Construction ℄	PI	3241+98.23	715691.46	723243.61	35°10'15"Rt	02°00'00"	2864.79'	1758.54'	907.96'	140.44'	*.***'/ft
	Construction ℄	PC	3232+90.27	715689.34	722335.65							
	Construction ℄	PT	3250+48.81	715170.19	723987.02							
27	Construction ℄	PI	3288+35.73	712996.09	727087.68	35°00'00"Lt	02°00'00"	2864.79'	1750.00'	903.26'	139.03'	*.***'/ft
	Construction ℄	PC	3279+32.46	713514.66	726348.10							
	Construction ℄	PT	3296+82.47	712995.50	727990.94							
28	Construction ℄	PI	3357+61.92	712991.54	734070.40	35°00'00"Lt	02°00'00"	2864.79	1750.00'	903.26'	139.03'	*.***'/ft
	Construction ℄	PC	3348+58.66	712992.13	733167.13							
	Construction ℄	PT	3366+08.66	713509.15	734810.65							

11/30/2015 EWcgm07.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	AZ	------			

	NAME	DATE
DESIGN	MKO / TJJ	08-15
DRAWN	SR / JLM	08-15
CHECKED	BSW	08-15

JACOBS

GEOMETRIC CONTROL SHEETS

LOCATION

EAST - WEST CORRIDOR STUDY

REVIEW

NOT FOR CONSTRUCTION OR RECORDING

DRAWING NO: GM-7

P:\W7X94300 Final EWC\700CADD\702CIVIL\702ADGN\EWcgm07.dgn

PLAN REF NO.	DESCRIPTION	Point Type	STATION	COORDINATES		Circular Curve						
				Northing	Easting	Δ	D	R	L	T	Ext	Super
29	Construction ℄	PI	3401+76.95	715553.94	737734.95	34°14'19"Rt	03°00'00"	1909.86'	1141.29'	588.25'	88.54'	*.***'/ft
	Construction ℄	PC	3395+88.69	715216.84	737252.86							
	Construction ℄	PT	3407+29.98	715561.37	738323.15							
	Construction ℄	PI	3461+54.26	715629.92	743747.00							
	Construction ℄	PI	3514+51.28	715696.14	749043.60							
30	Construction ℄	PI	3521+86.15	715696.12	749778.47	10°45'34"Lt	04°00'00"	1432.39'	268.98'	134.89'	6.34'	*.***'/ft
	Construction ℄	PC	3520+51.26	715696.13	749643.59							
	Construction ℄	PT	3523+20.24	715721.30	749910.99							
31	Construction ℄	PI	3527+35.39	715798.79	750318.85	10°45'34"Rt	04°00'00"	1432.39	268.98'	134.89'	6.34'	*.***'/ft
	Construction ℄	PC	3526+00.51	715773.62	750186.33							
	Construction ℄	PT	3528+69.49	715798.79	750453.73							
32	Construction ℄	PI	3561+47.69	715798.71	753731.94	10°56'16"Rt	04°00'00"	1432.39'	273.44'	137.14'	6.55'	*.***'/ft
	Construction ℄	PC	3560+10.55	715798.72	753594.80							
	Construction ℄	PT	3562+84.00	715772.69	753866.58							
33	Construction ℄	PI	3567+06.63	715692.49	754281.54	11°05'18"Lt	04°00'00"	1432.40'	277.21'	139.04'	6.73'	*.***'/ft
	Construction ℄	PC	3565+67.59	715718.87	754145.03							
	Construction ℄	PT	3568+44.80	715692.85	754420.58							
	Construction ℄	POE	3647+00.00	715713.33	762275.75							

11/30/2015 EWcgm08.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	AZ	------			

P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\EWcgm08.dgn

	NAME	DATE
DESIGN	MKO / TJJ	08-15
DRAWN	SR / JLM	08-15
CHECKED	BSW	08-15

JACOBS

GEOMETRIC CONTROL SHEETS

LOCATION

EAST - WEST CORRIDOR STUDY

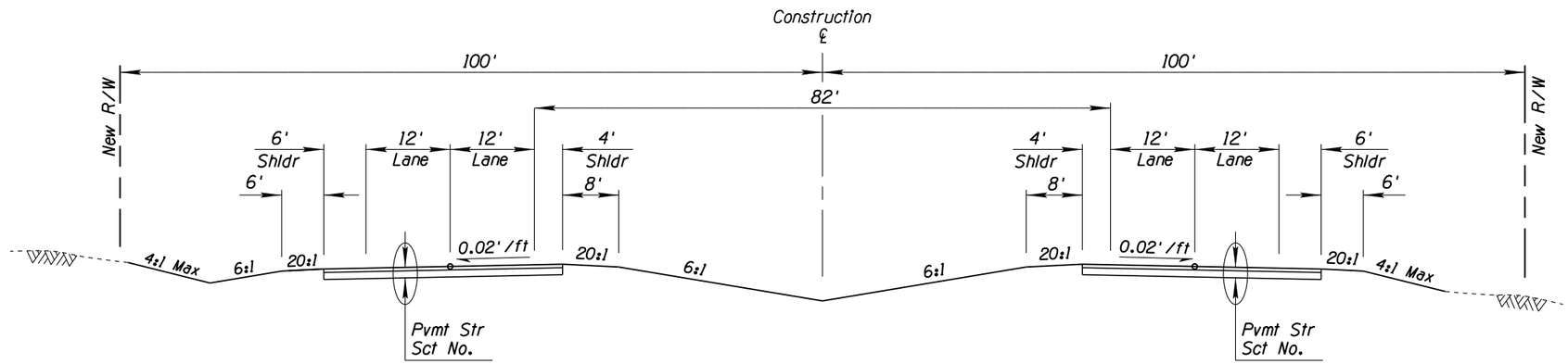
REVIEW

NOT FOR CONSTRUCTION OR RECORDING

DRAWING NO: GM-8

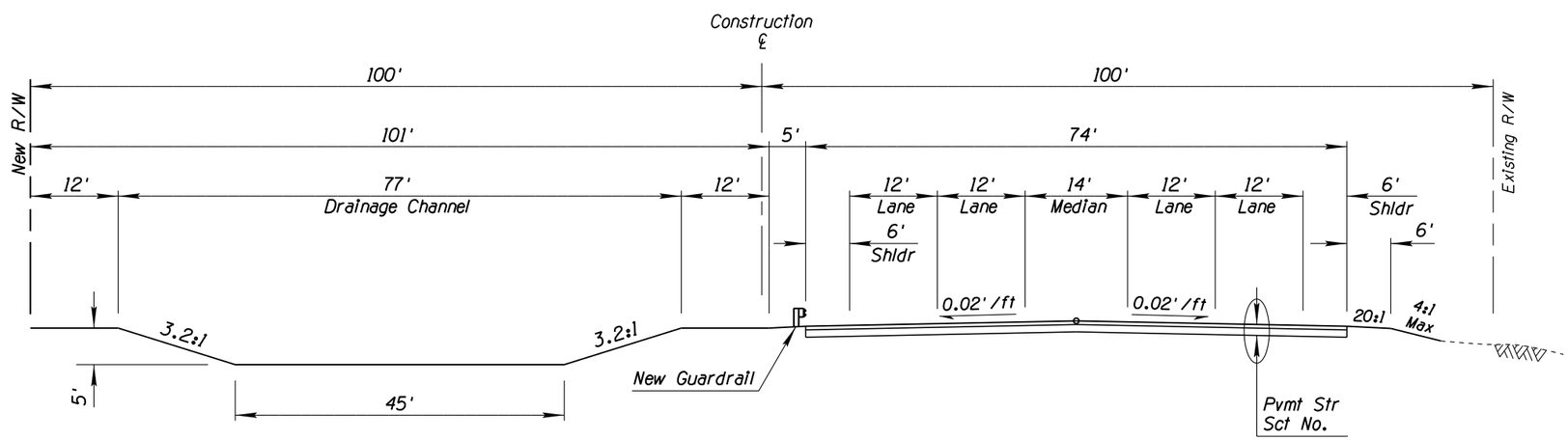
11/24/2015 EWcty01.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	AZ	------			



TYPICAL SECTION
(PARKWAY SECTION)

Sta 1042+17.19 to Sta 1314+67.71
Sta 1334+80.71 to Sta 1356+63.71
Sta 1501+14.06 to Sta 1547+87.46
Sta 3000+00.00 to Sta 3416+50.71
Sta 3440+63.16 to Sta 3527+33.91
Sta 3560+10.55 to Sta 3630+56.75



TYPICAL SECTION
(5-LANE SECTION)

Sta 1356+63.71 to Sta 1501+14.06

	NAME	DATE
DESIGN	MKO / TJJ	08-15
DRAWN	SR / JLM	08-15
CHECKED	BSW	08-15

JACOBS

TYPICAL SECTIONS

LOCATION

EAST - WEST CORRIDOR STUDY

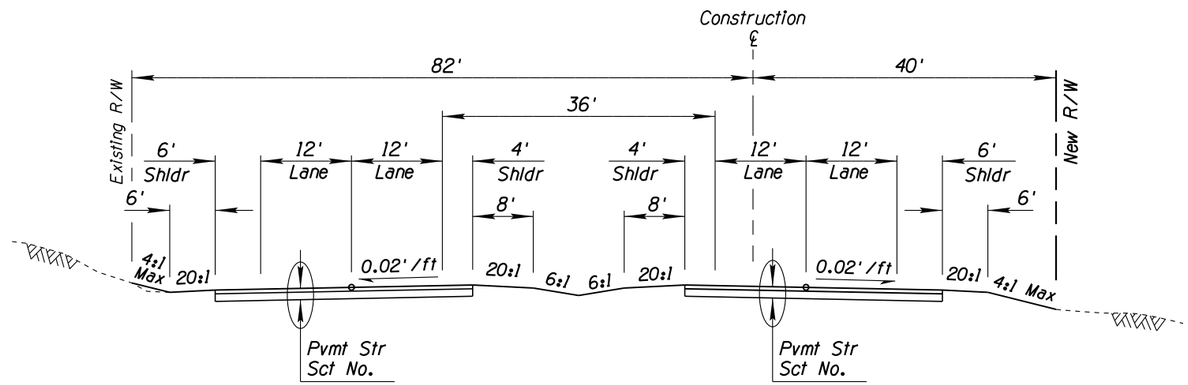
REVIEW
NOT FOR CONSTRUCTION OR RECORDING

DRAWING NO: TY-1

P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\EWcty01.dgn

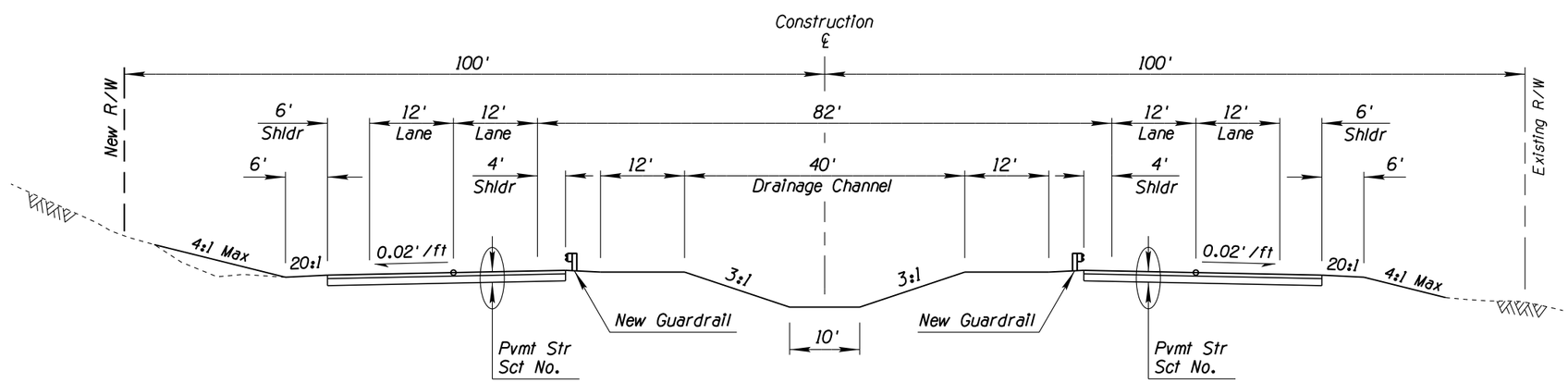
11/24/2015 EWcty01.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	AZ	------			



TYPICAL SECTION
(COMPRESSED PARKWAY SECTION)

Sta 1314+67.71 to Sta 1334+80.71
Sta 3416+50.71 to Sta 3440+63.16



TYPICAL SECTION
(DRAINAGE CHANNEL IN MEDIAN)

Sta 3527+33.19 to Sta 3560+10.55

	NAME	DATE
DESIGN	MKO / TJJ	08-15
DRAWN	SR / JLM	08-15
CHECKED	BSW	08-15

JACOBS

TYPICAL SECTIONS

LOCATION

EAST - WEST CORRIDOR STUDY

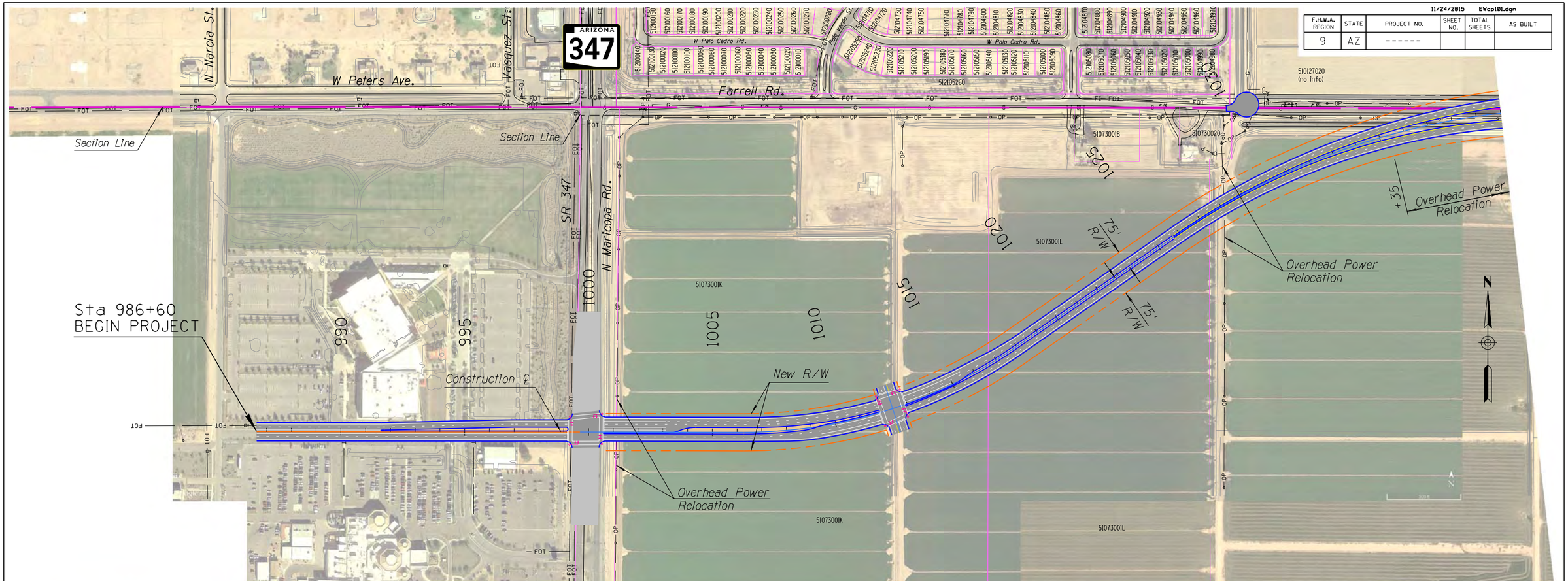
REVIEW
NOT FOR CONSTRUCTION OR RECORDING

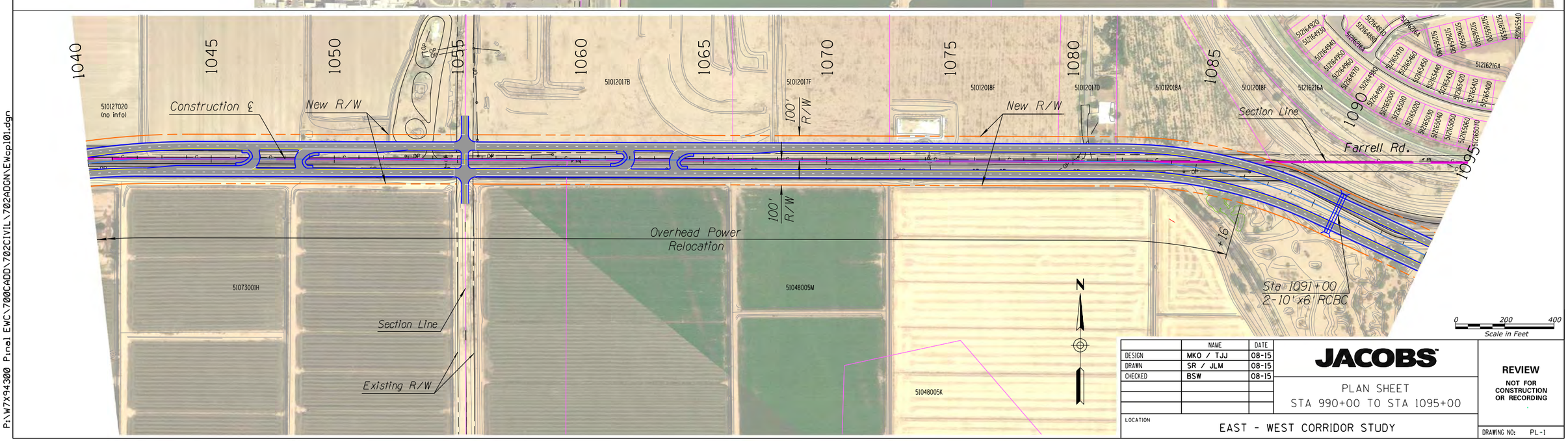
DRAWING NO: TY-2

P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\EWcty01.dgn

11/24/2015 EWcpl01.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	AZ	------			





	NAME	DATE
DESIGN	MKO / TJJ	08-15
DRAWN	SR / JLM	08-15
CHECKED	BSW	08-15

JACOBS

PLAN SHEET
STA 990+00 TO STA 1095+00

LOCATION
EAST - WEST CORRIDOR STUDY

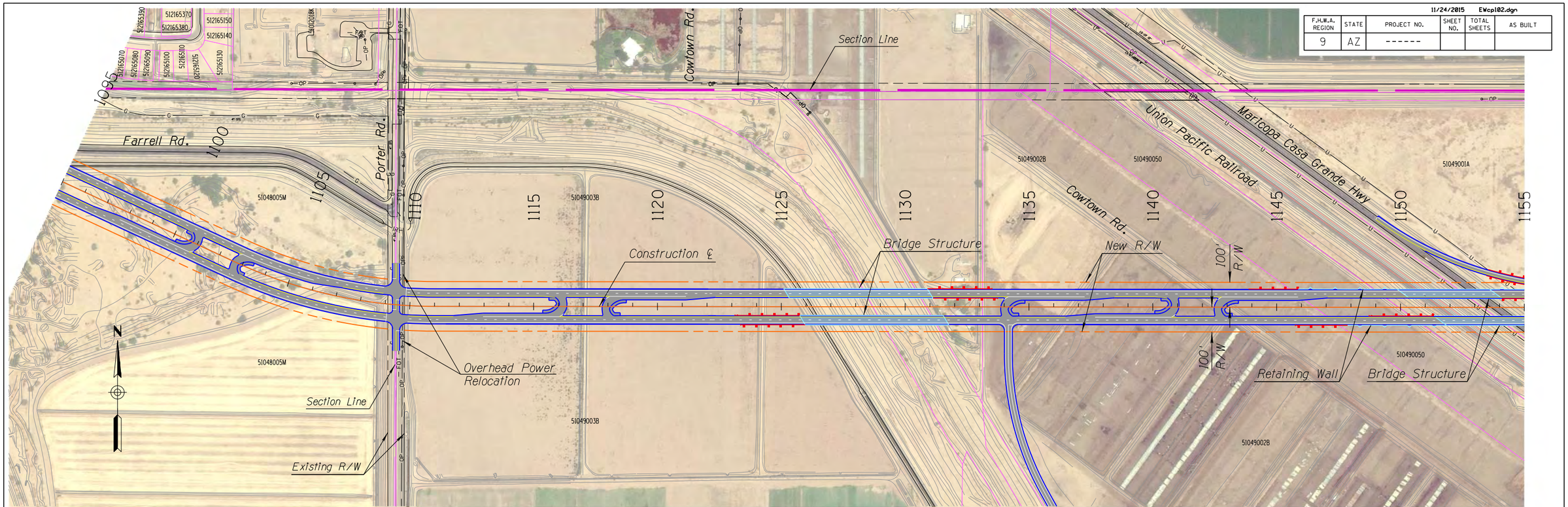
REVIEW
NOT FOR CONSTRUCTION OR RECORDING

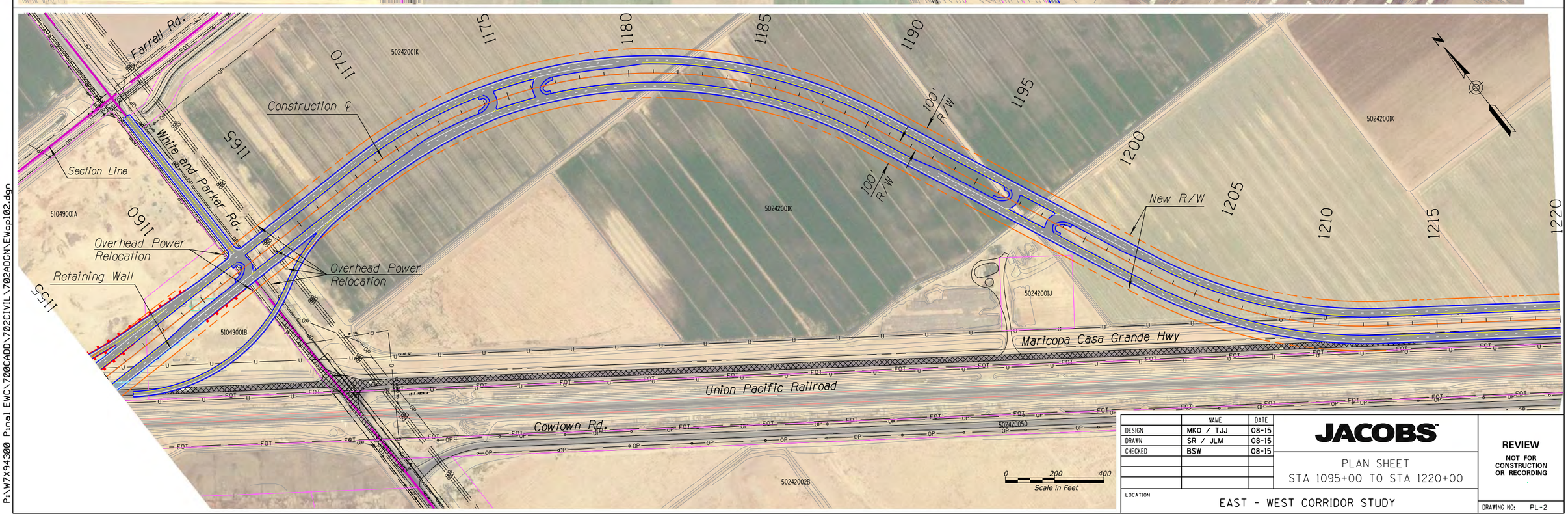
DRAWING NO: PL-1

P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\EWcpl01.dgn

11/24/2015 EWcpl02.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	AZ	------			





	NAME	DATE
DESIGN	MKO / TJJ	08-15
DRAWN	SR / JLM	08-15
CHECKED	BSW	08-15

JACOBS

PLAN SHEET
STA 1095+00 TO STA 1220+00

LOCATION
EAST - WEST CORRIDOR STUDY

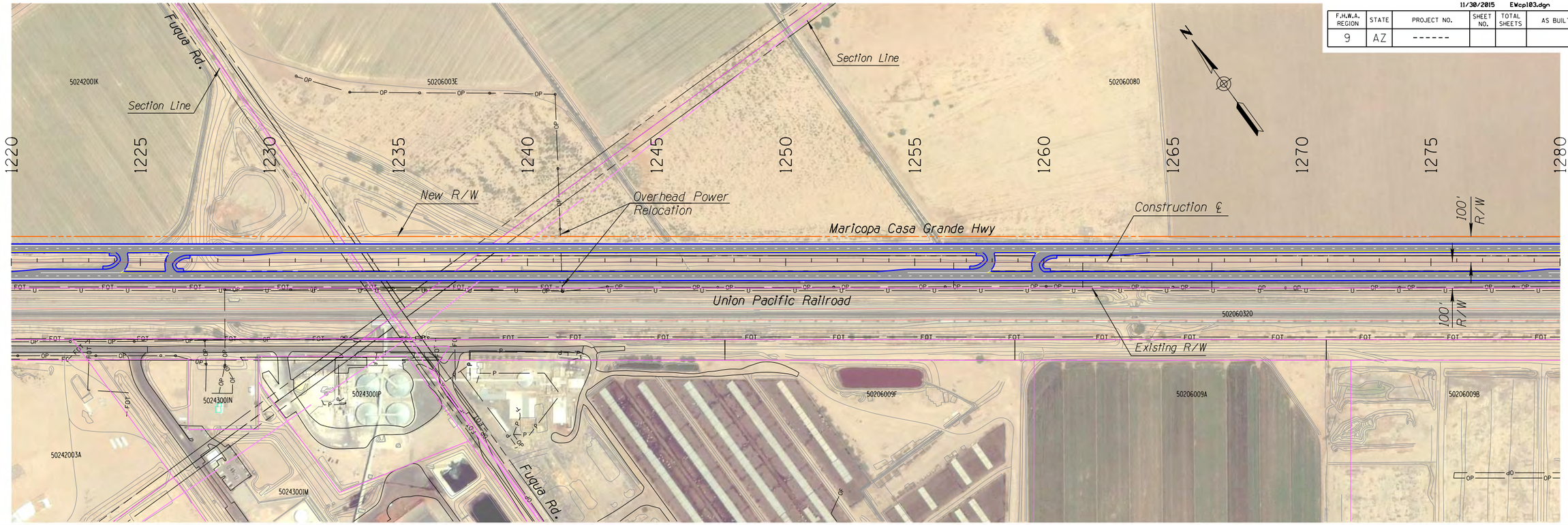
REVIEW
NOT FOR CONSTRUCTION OR RECORDING

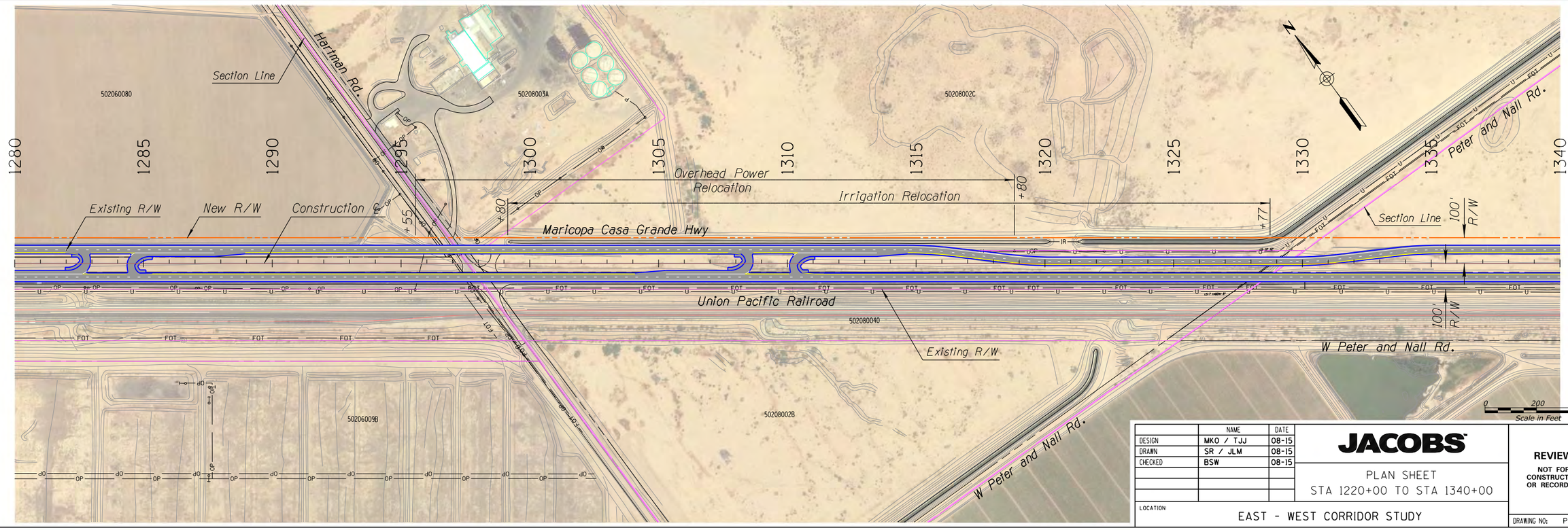
DRAWING NO: PL-2

P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\EWcpl02.dgn

11/30/2015 EWcpl03.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	AZ	------			





	NAME	DATE
DESIGN	MKO / TJJ	08-15
DRAWN	SR / JLM	08-15
CHECKED	BSW	08-15

JACOBS

PLAN SHEET
STA 1220+00 TO STA 1340+00

LOCATION
EAST - WEST CORRIDOR STUDY

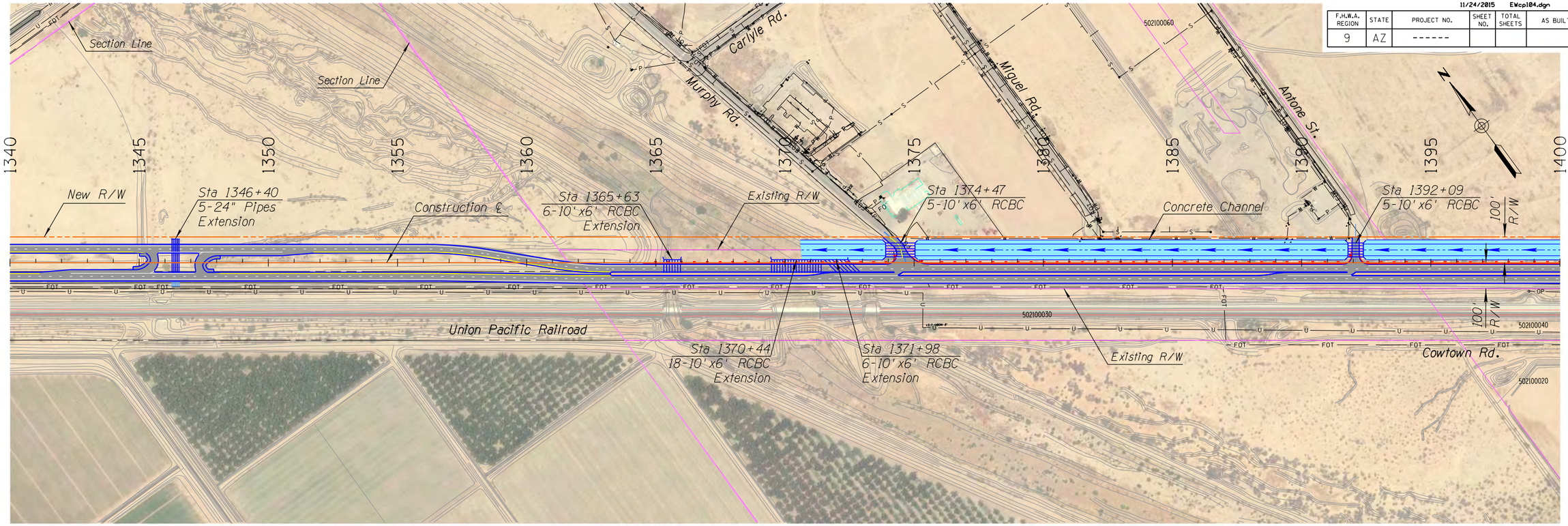
REVIEW
NOT FOR CONSTRUCTION OR RECORDING

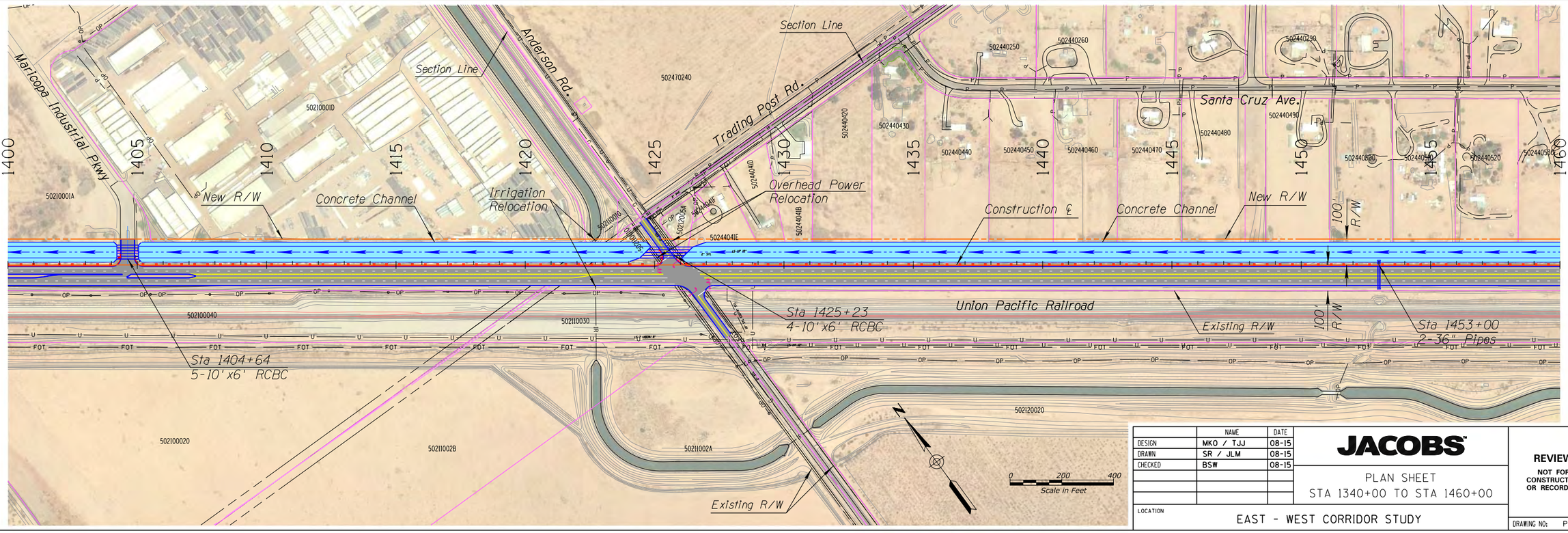
DRAWING NO: PL-3

P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\EWcpl03.dgn

11/24/2015 EWcpl04.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	AZ	------			





	NAME	DATE
DESIGN	MKO / TJJ	08-15
DRAWN	SR / JLM	08-15
CHECKED	BSW	08-15

JACOBS

PLAN SHEET
STA 1340+00 TO STA 1460+00

LOCATION
EAST - WEST CORRIDOR STUDY

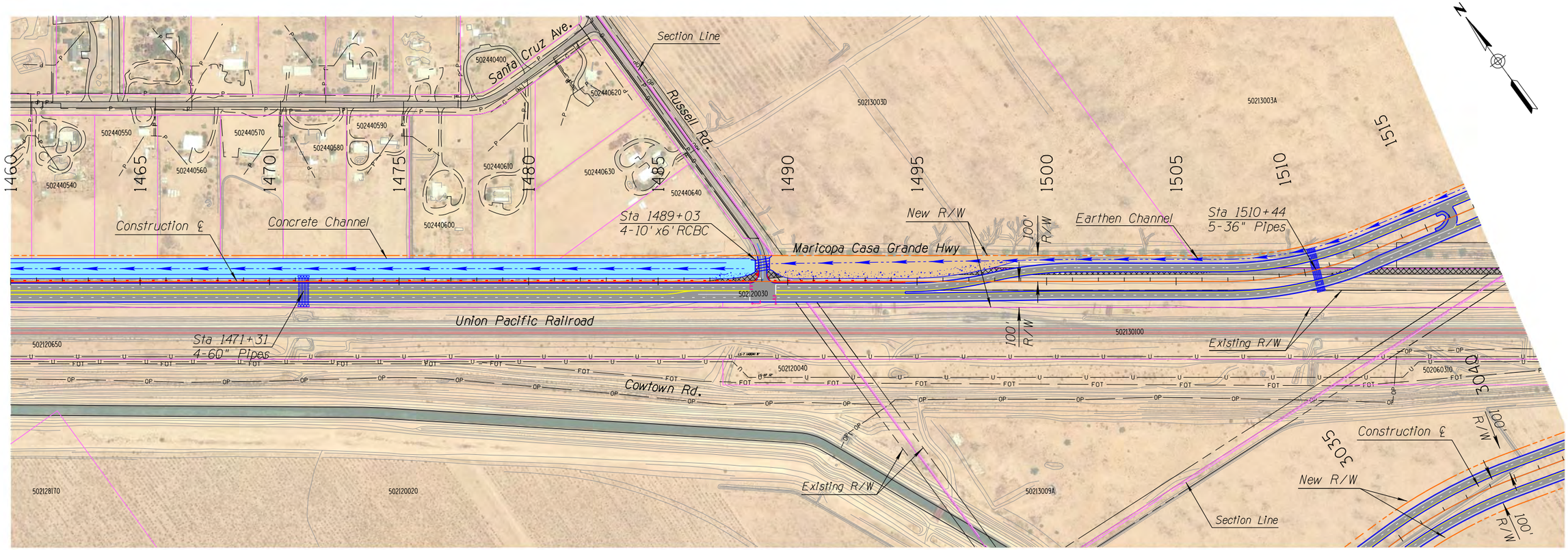
REVIEW
NOT FOR CONSTRUCTION OR RECORDING

DRAWING NO: PL-4

P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\EWcpl04.dgn

11/30/2015 EWcpl05.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	AZ	------			



0 200 400
Scale in Feet

	NAME	DATE
DESIGN	MKO / TJJ	08-15
DRAWN	SR / JLM	08-15
CHECKED	BSW	08-15

JACOBS

PLAN SHEET
STA 1460+00 TO STA 1517+00

LOCATION
EAST - WEST CORRIDOR STUDY

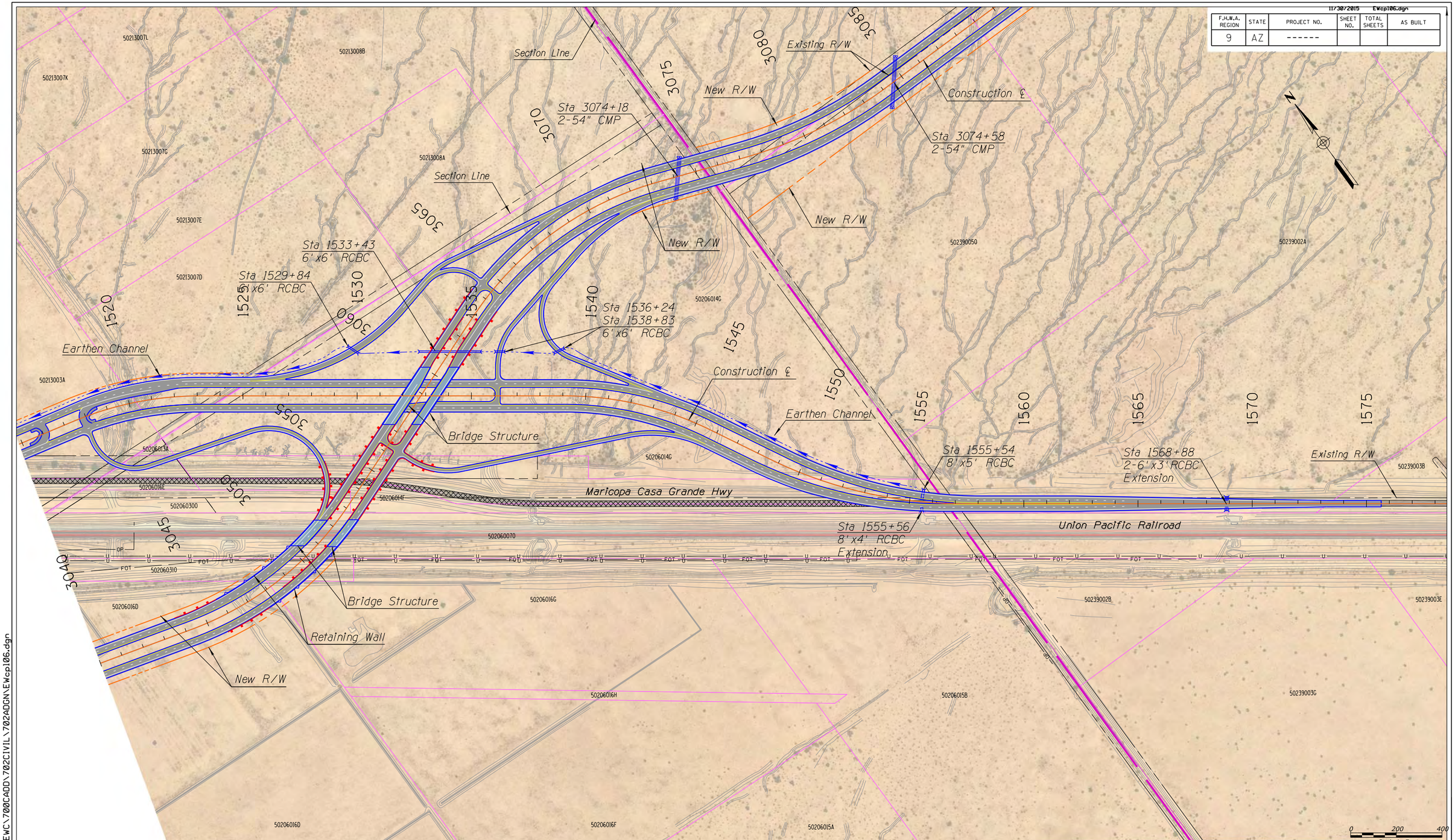
REVIEW
NOT FOR CONSTRUCTION OR RECORDING

DRAWING NO: PL-5

P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\EWcpl05.dgn

11/30/2015 EWcpl06.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	AZ	------			



	NAME	DATE
DESIGN	MKO / TJJ	08-15
DRAWN	SR / JLM	08-15
CHECKED	BSW	08-15

JACOBS

PLAN SHEET
STA 1517+00 TO STA 1578+00
STA 3040+00 TO STA 3080+00

LOCATION
EAST - WEST CORRIDOR STUDY

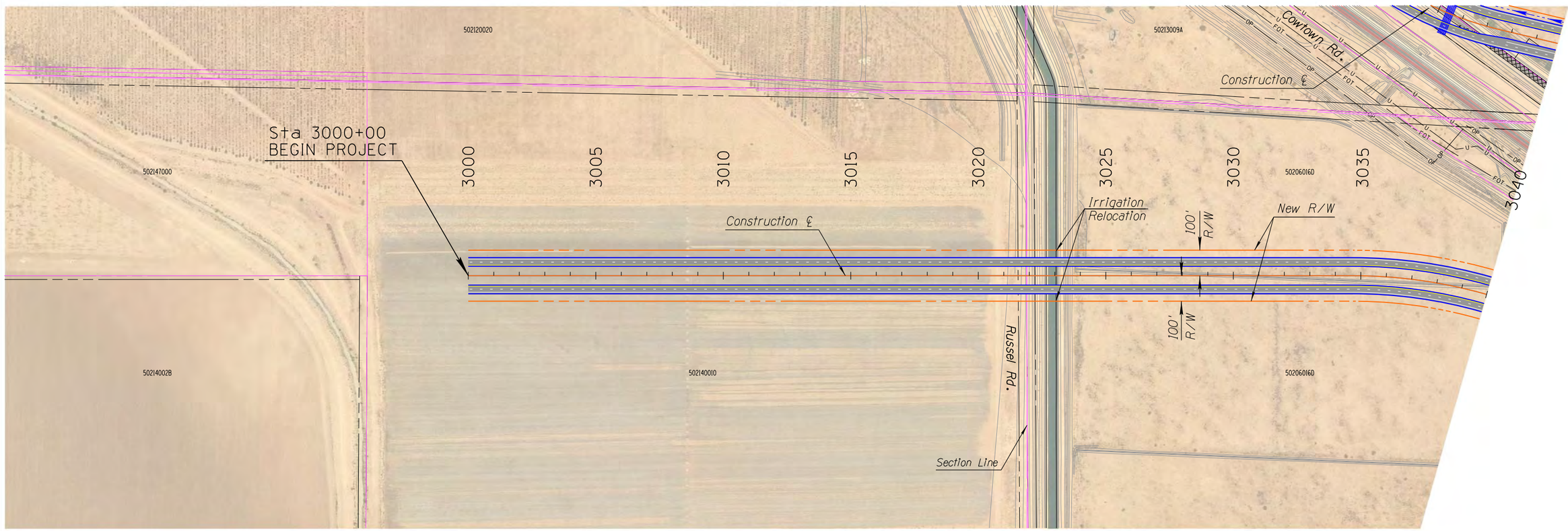
REVIEW
NOT FOR CONSTRUCTION OR RECORDING

DRAWING NO: PL-6

P:\W7X94300 Final EWC\700CADD\702CIVIL\702ADGN\EWcpl06.dgn

11/30/2015 EWcpl07.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	AZ	------			



NOTE:
ALL WORK WEST OF THE UPRR IS PART OF THE VAL VISTA PARKWAY. THESE IMPROVEMENTS ARE A PLACE-HOLDER FOR THE FUTURE DETAILED ALIGNMENT INVESTIGATION.

0 200 400
Scale in Feet

	NAME	DATE
DESIGN	MKO / TJJ	08-15
DRAWN	SR / JLM	08-15
CHECKED	BSW	08-15

JACOBS

PLAN SHEET
STA 3000+00 TO STA 3040+00

LOCATION
EAST - WEST CORRIDOR STUDY

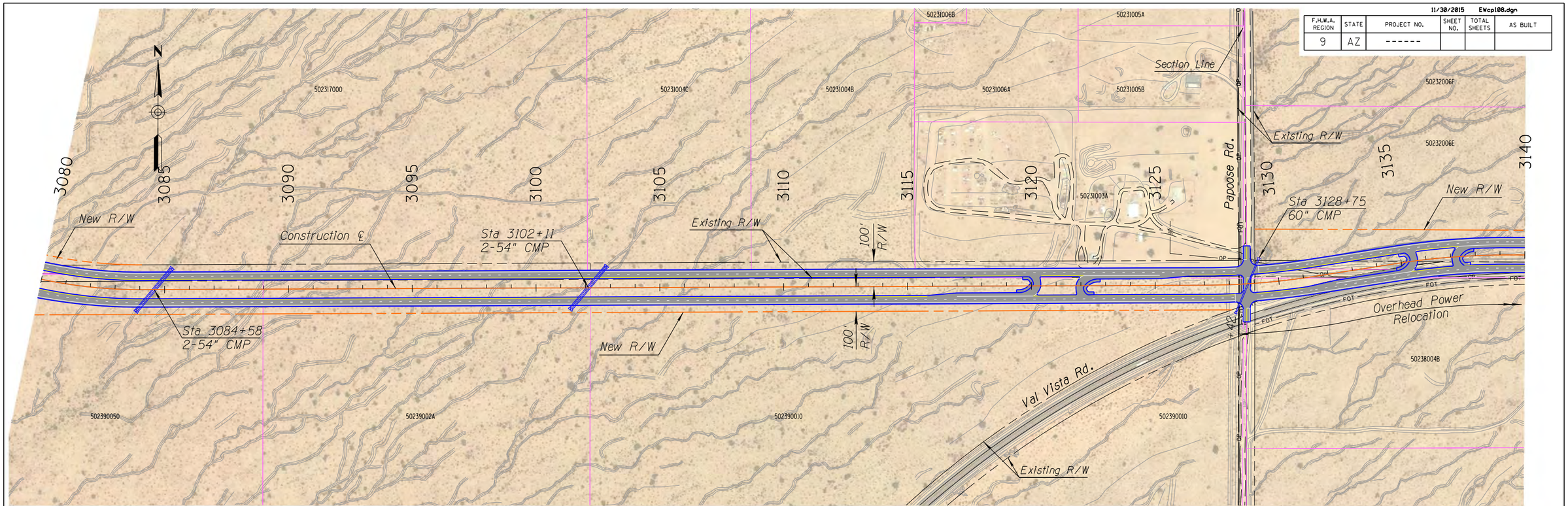
REVIEW
NOT FOR CONSTRUCTION OR RECORDING

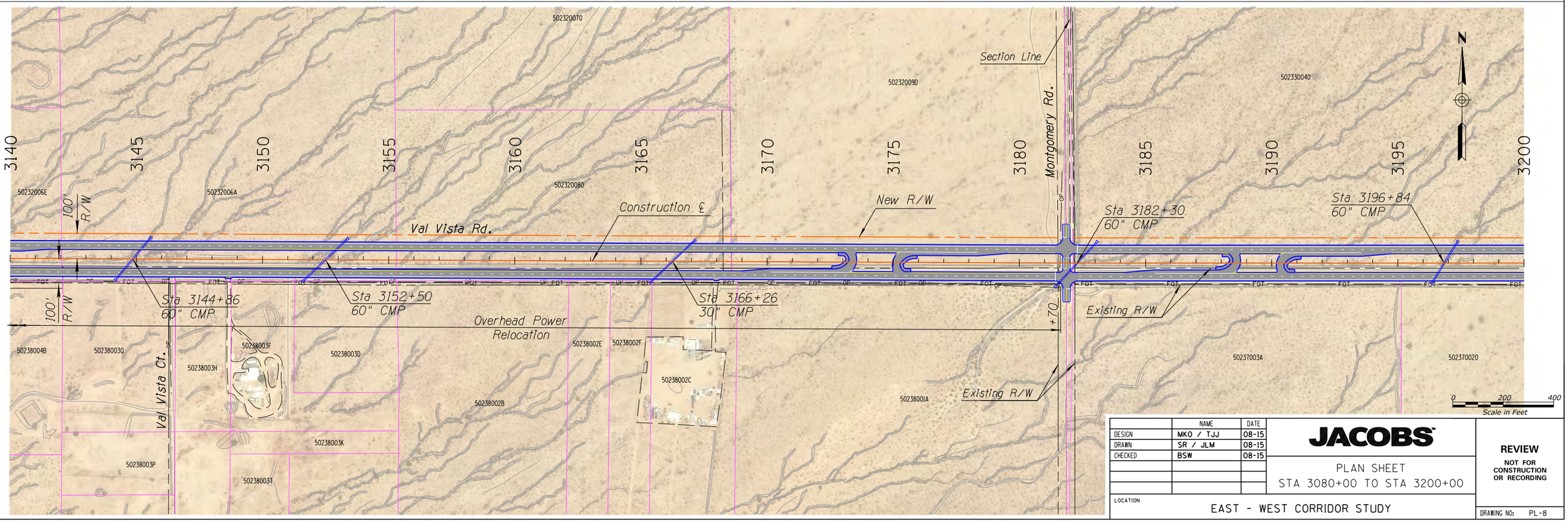
DRAWING NO: PL-7

P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\EWcpl07.dgn

11/30/2015 EWcp108.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	AZ	------			





	NAME	DATE
DESIGN	MKO / TJJ	08-15
DRAWN	SR / JLM	08-15
CHECKED	BSW	08-15

JACOBS

PLAN SHEET
STA 3080+00 TO STA 3200+00

LOCATION
EAST - WEST CORRIDOR STUDY

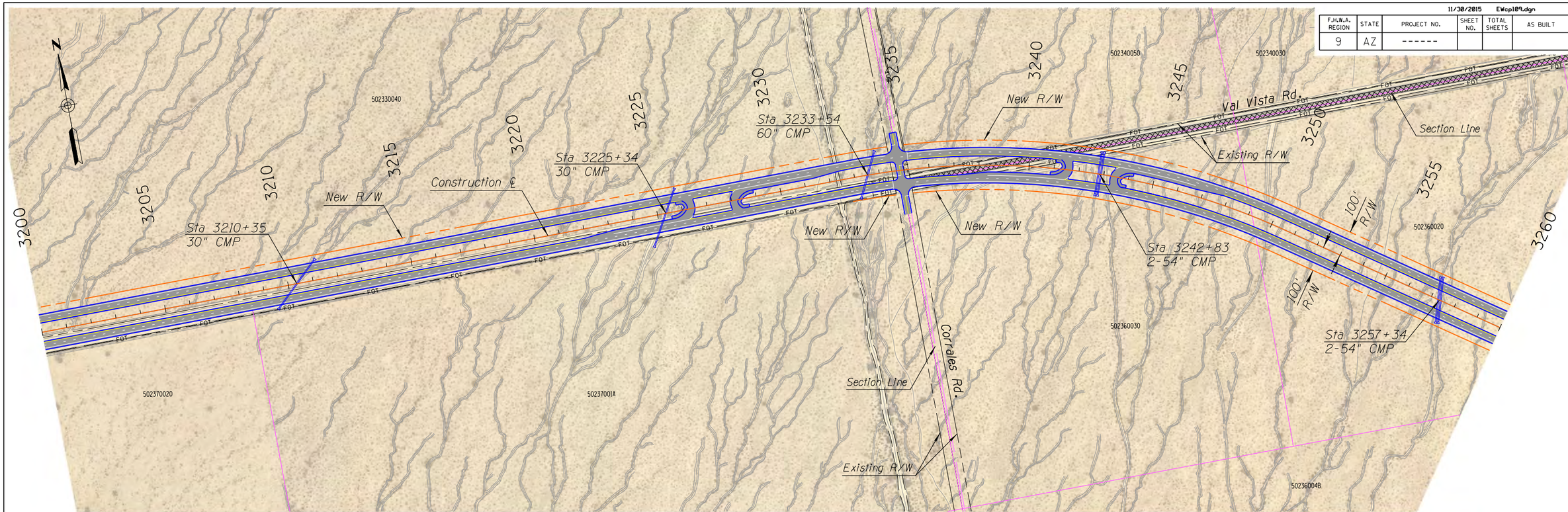
REVIEW
NOT FOR CONSTRUCTION OR RECORDING

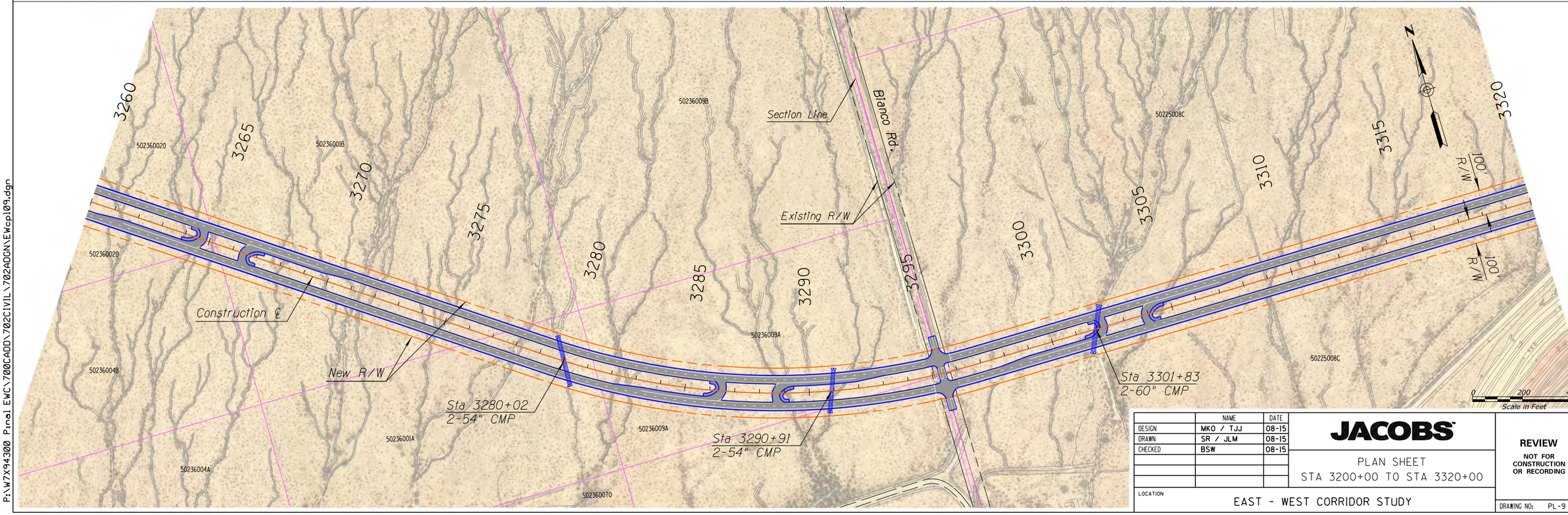
DRAWING NO: PL-8

P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\EWcp108.dgn

11/30/2015 EWcpl09.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	AZ	------			





	NAME	DATE
DESIGN	MKO / TJJ	08-15
DRAWN	SR / JLM	08-15
CHECKED	BSW	08-15

JACOBS

PLAN SHEET
STA 3200+00 TO STA 3320+00

LOCATION
EAST - WEST CORRIDOR STUDY

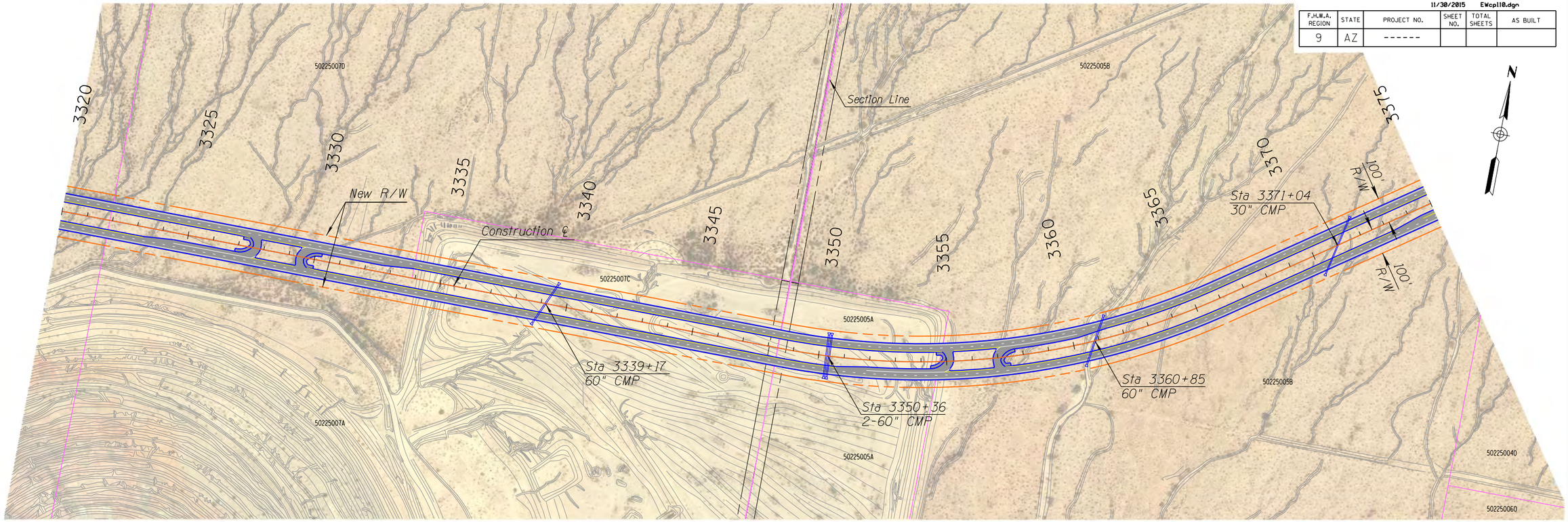
REVIEW
NOT FOR CONSTRUCTION OR RECORDING

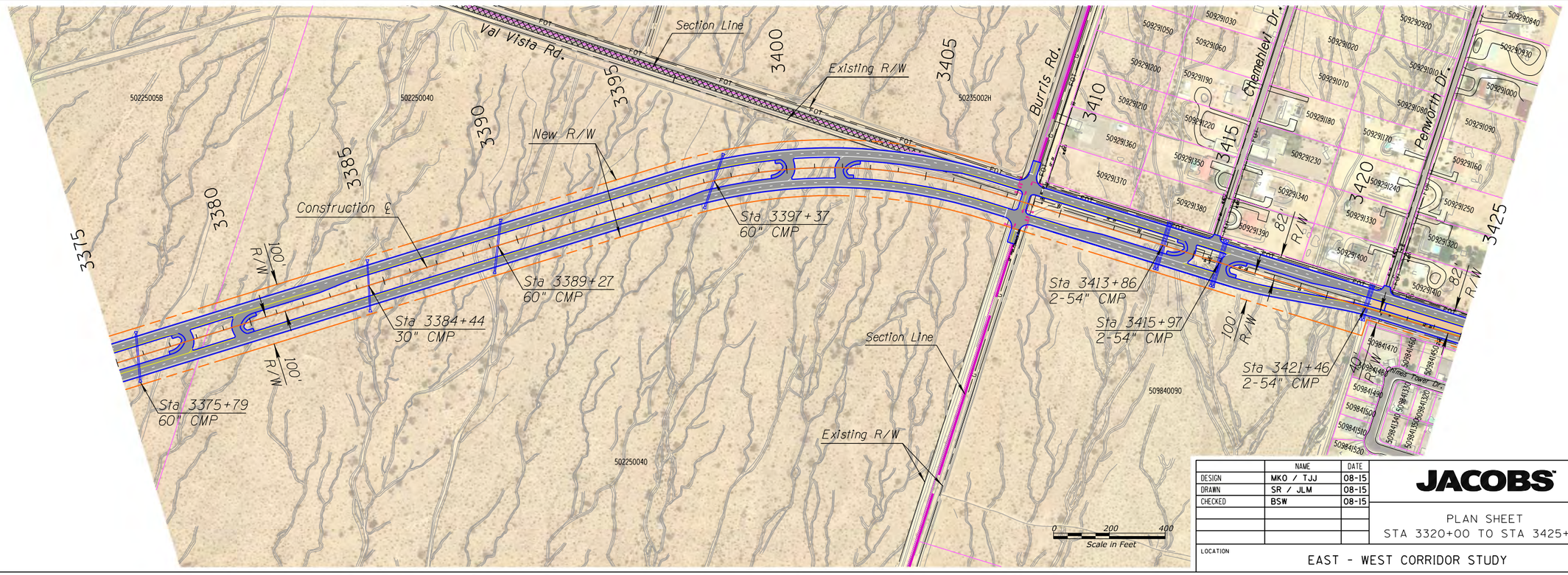
DRAWING NO: PL-9

P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\EWcpl09.dgn

11/30/2015 EWcpl10.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	AZ	------			





	NAME	DATE
DESIGN	MKO / TJJ	08-15
DRAWN	SR / JLM	08-15
CHECKED	BSW	08-15

JACOBS

PLAN SHEET
STA 3320+00 TO STA 3425+00

LOCATION
EAST - WEST CORRIDOR STUDY

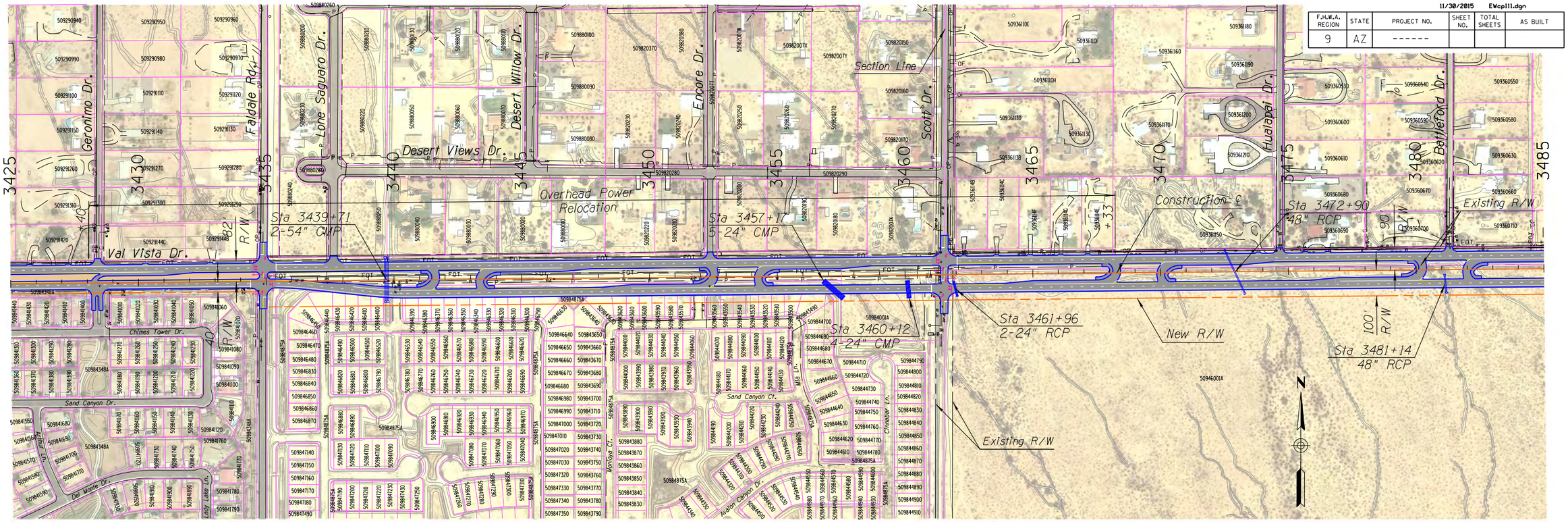
REVIEW
NOT FOR CONSTRUCTION OR RECORDING

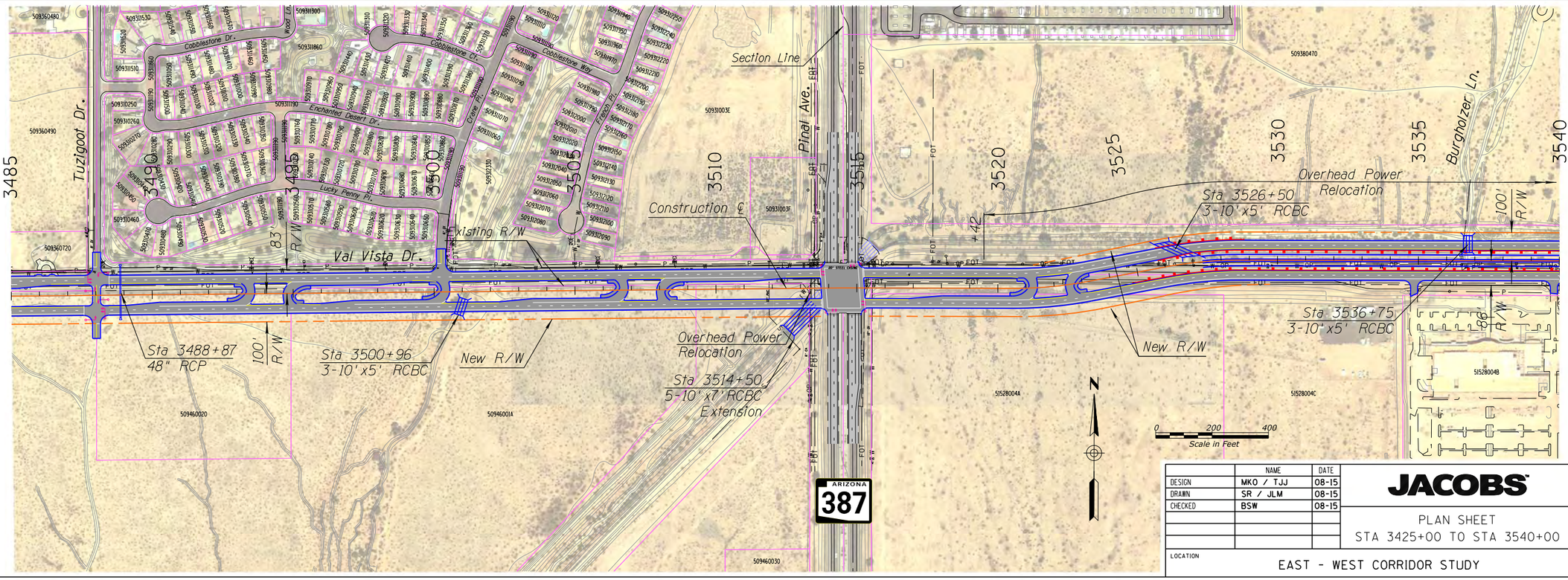
DRAWING NO: PL-10

P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\EWcpl10.dgn

11/30/2015 Ewcpl11.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	AZ	------			





	NAME	DATE
DESIGN	MKO / TJJ	08-15
DRAWN	SR / JLM	08-15
CHECKED	BSW	08-15

JACOBS

PLAN SHEET
STA 3425+00 TO STA 3540+00

LOCATION
EAST - WEST CORRIDOR STUDY

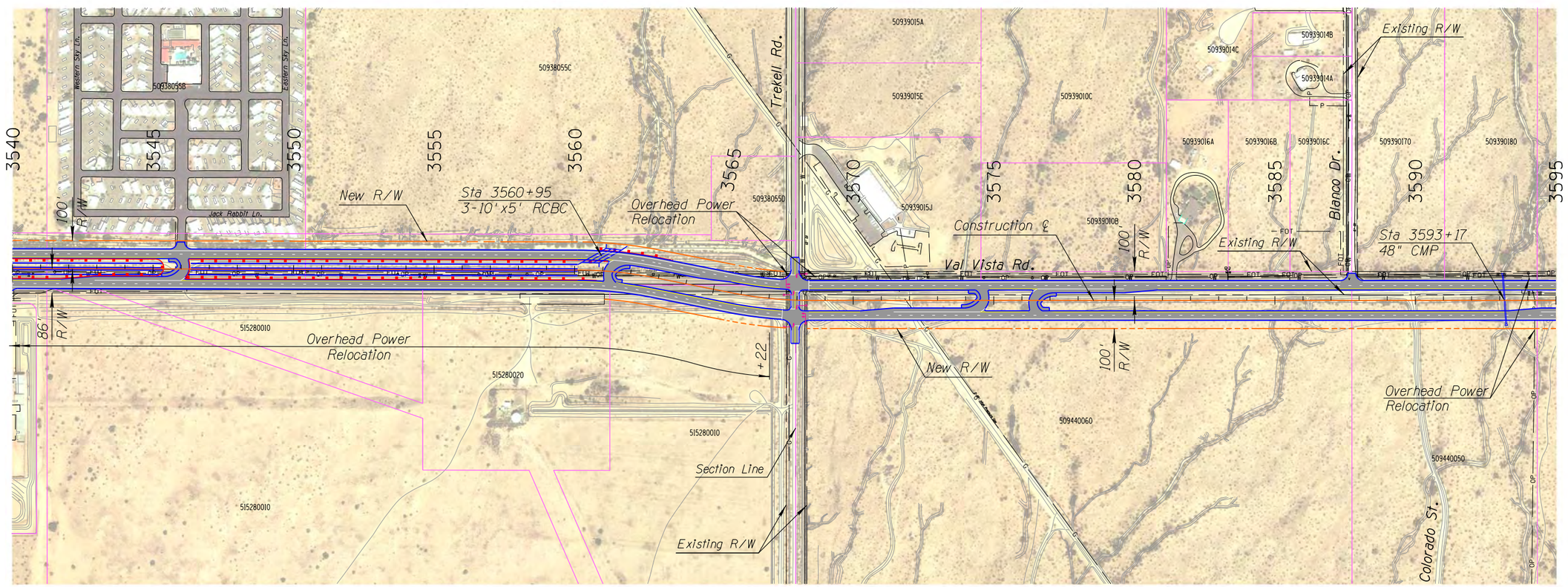
REVIEW
NOT FOR CONSTRUCTION OR RECORDING

DRAWING NO: PL-11

P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\EWcpl11.dgn

11/30/2015 EWcpl12.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	AZ	------			



0 200 400
Scale in Feet

	NAME	DATE
DESIGN	MKO / TJJ	08-15
DRAWN	SR / JLM	08-15
CHECKED	BSW	08-15

JACOBS

PLAN SHEET
STA 3540+00 TO STA 3595+00

LOCATION
EAST - WEST CORRIDOR STUDY

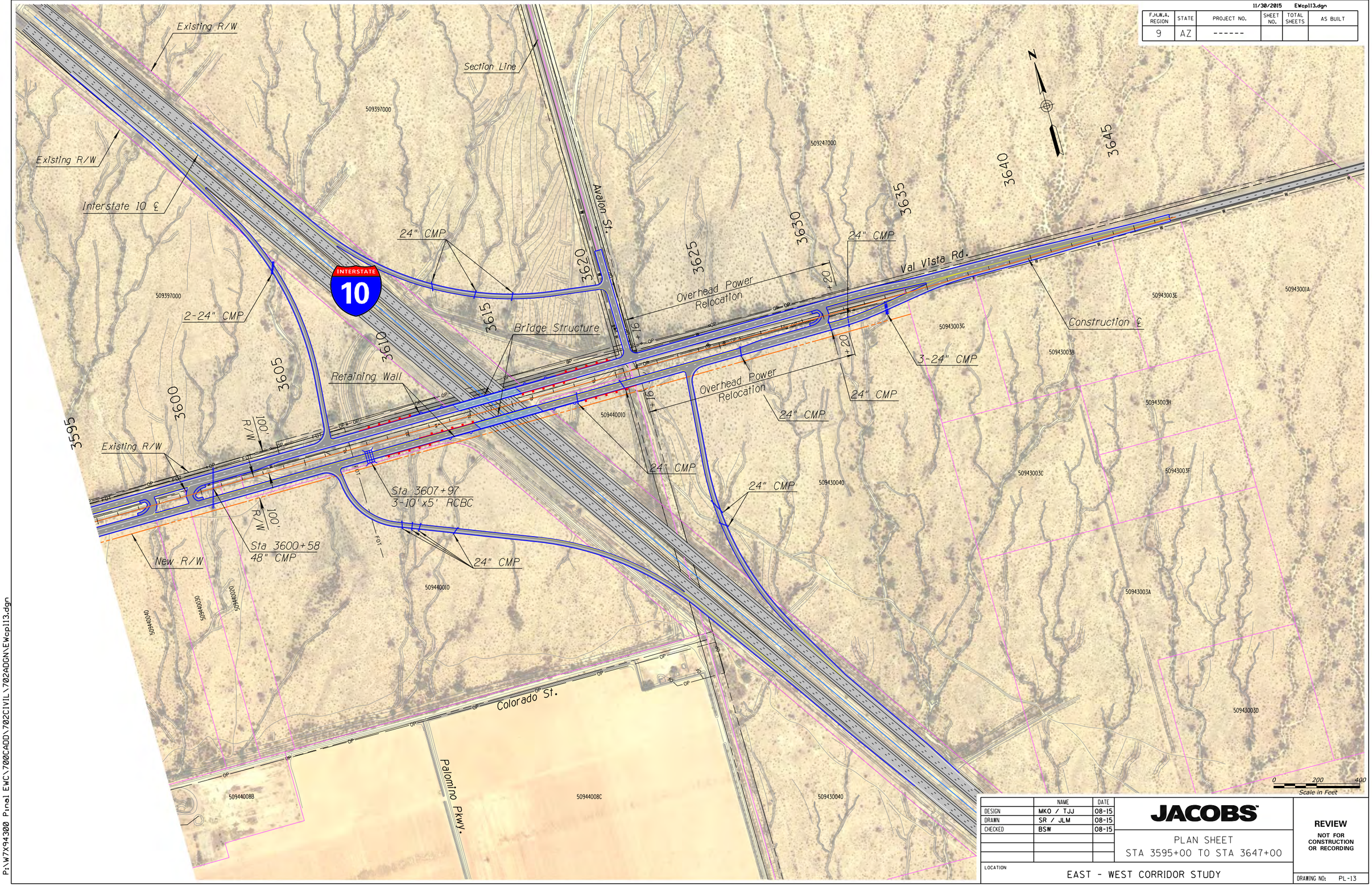
REVIEW
NOT FOR CONSTRUCTION OR RECORDING

DRAWING NO: PL-12

P:\W7X94300 Final EWC\700CADD\702CIVIL\702ADGN\EWcpl12.dgn

11/30/2015 EWcpl13.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	AZ	------			



	NAME	DATE
DESIGN	MKO / TJJ	08-15
DRAWN	SR / JLM	08-15
CHECKED	BSW	08-15

JACOBS

PLAN SHEET
STA 3595+00 TO STA 3647+00

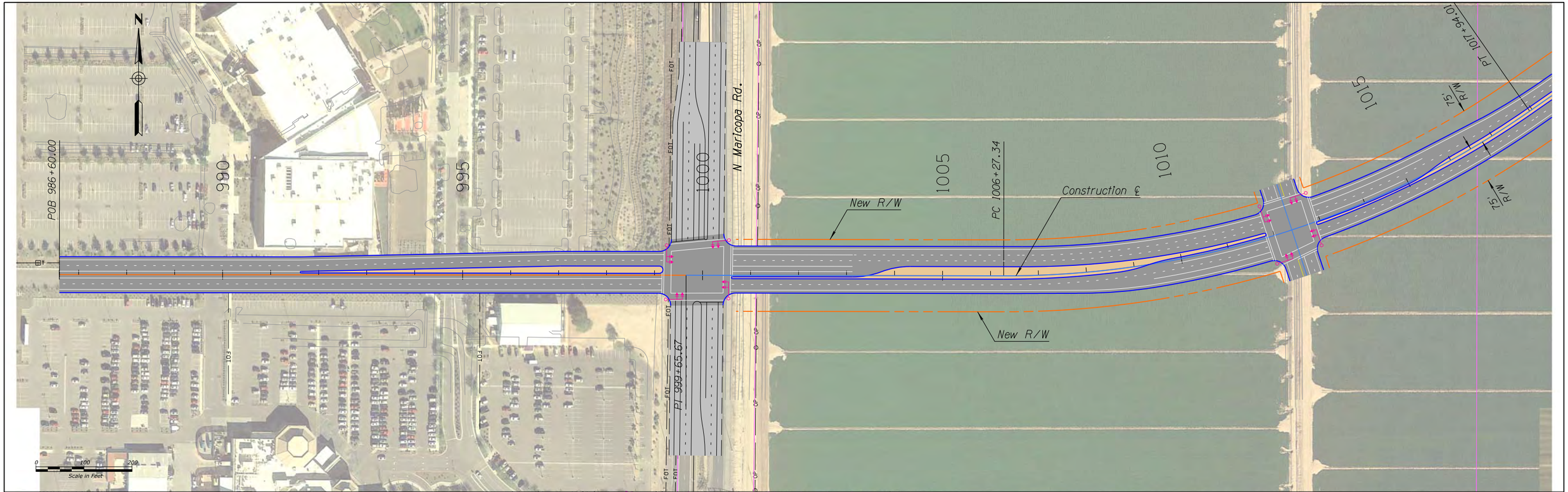
LOCATION
EAST - WEST CORRIDOR STUDY

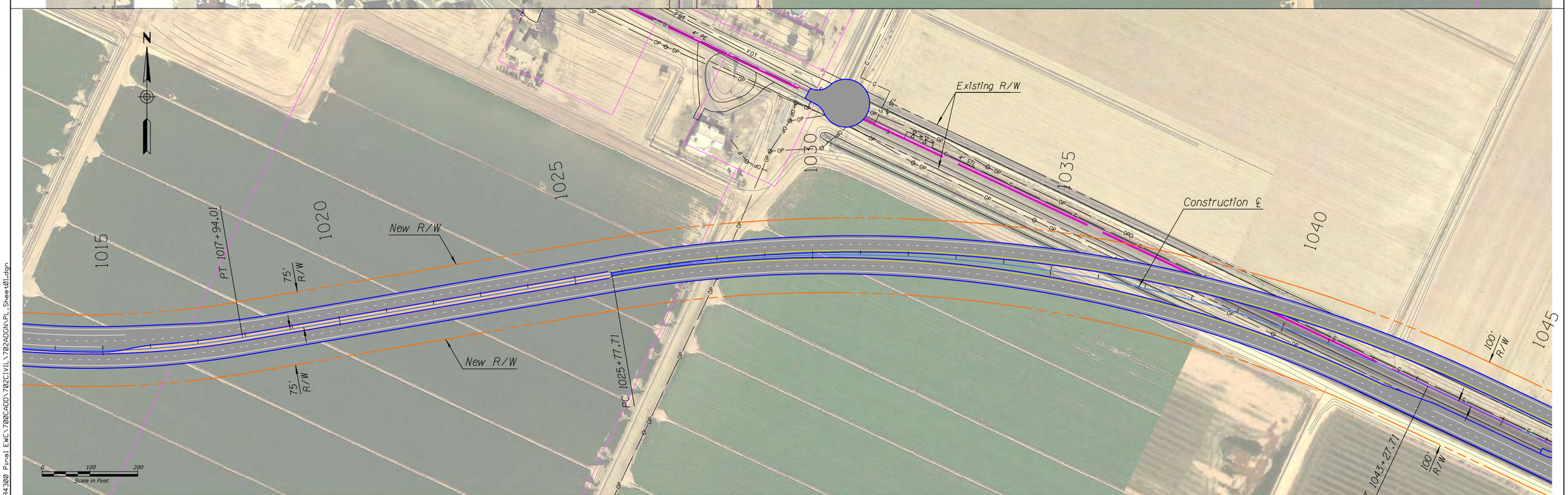
REVIEW
NOT FOR CONSTRUCTION OR RECORDING

DRAWING NO: PL-13

P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\EWcpl13.dgn

APPENDIX B:
PROPOSED CONCEPT
ENLARGED PLAN EXHIBITS
(200 SCALE)



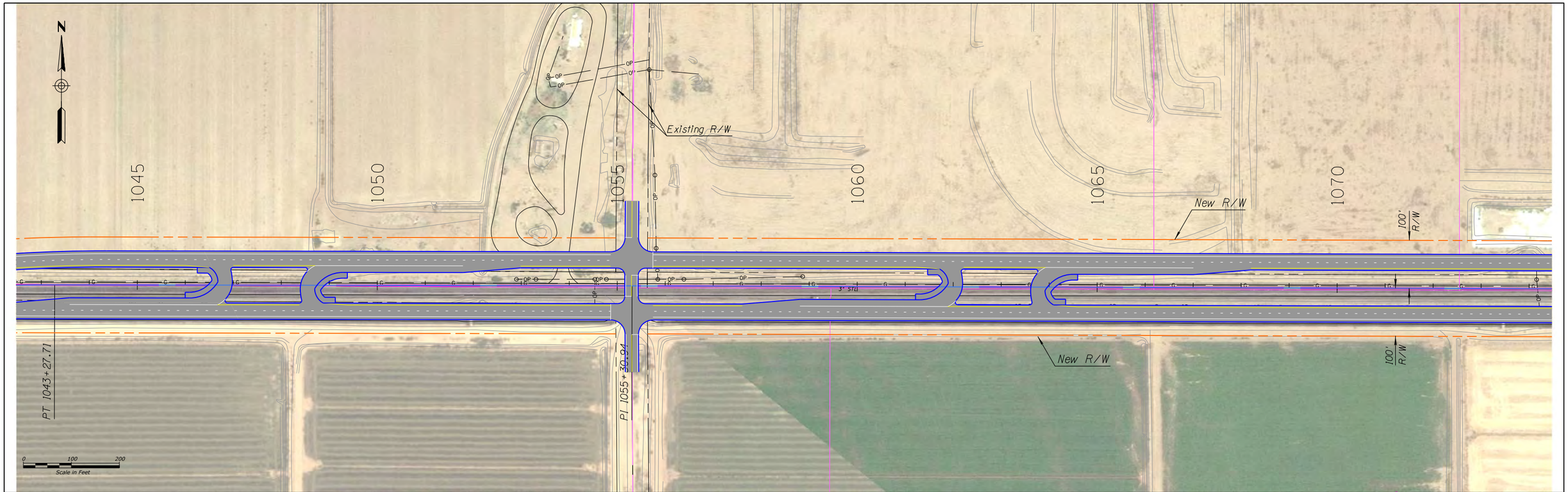


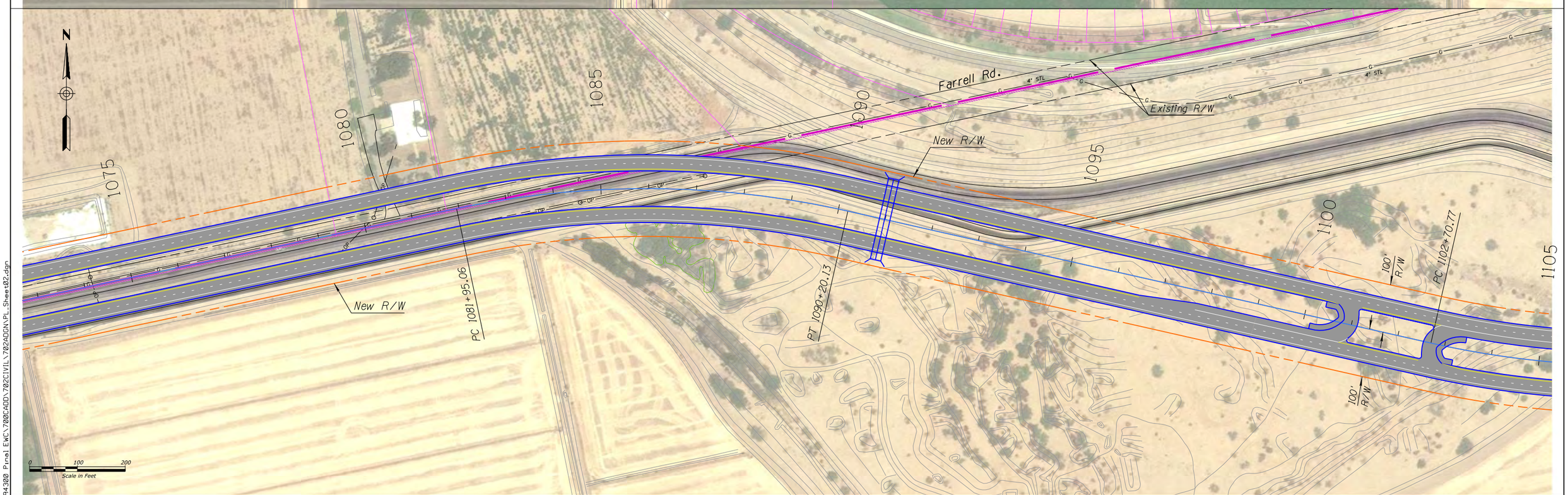
P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGNPL_Sheet01.dgn

Prepared by: JACOBS

Prepared for: PINAL•COUNTY wide open opportunity

East-West Corridor Study



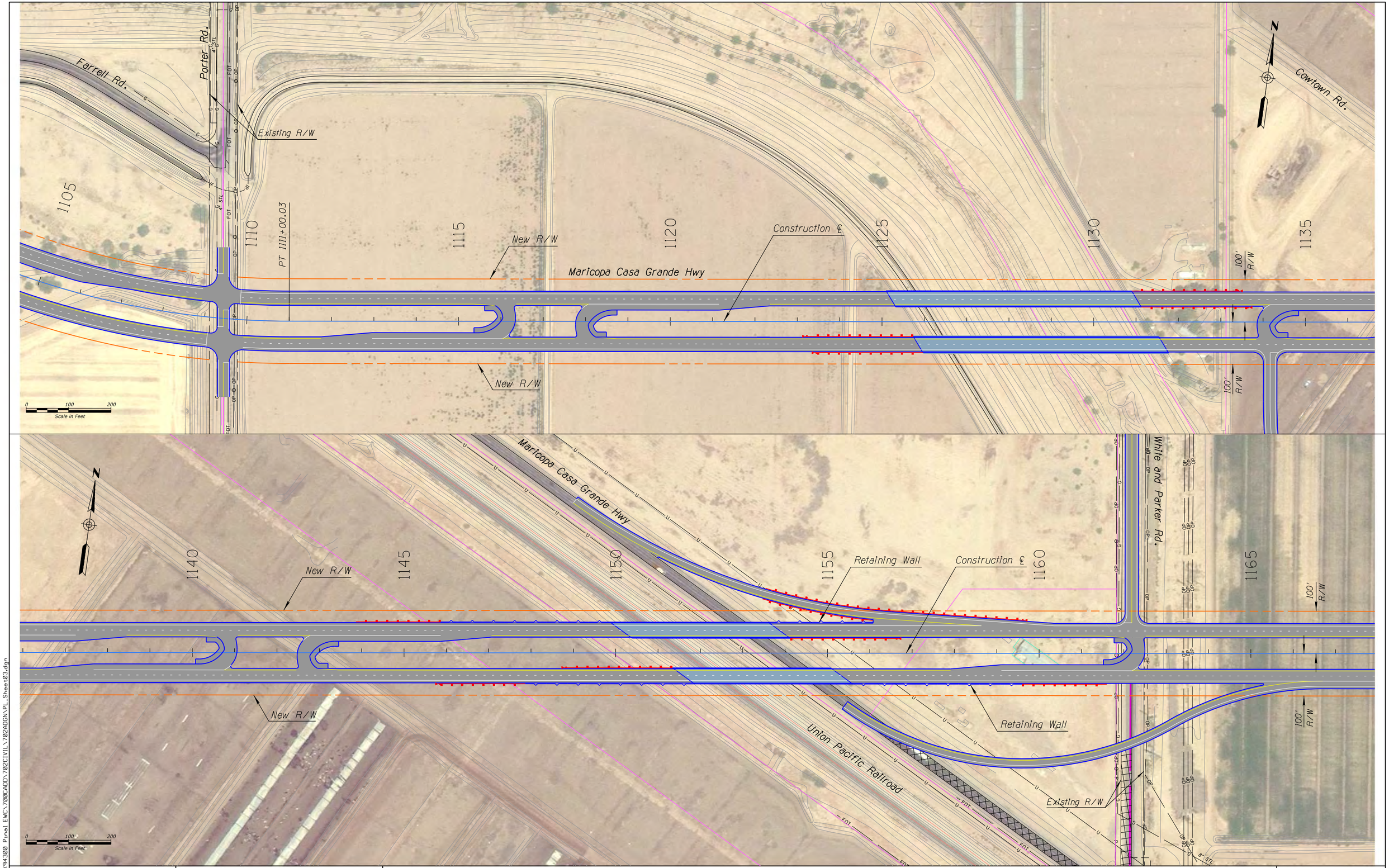


P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\PL_Sheet02.dgn

Prepared by: JACOBS

Prepared for: PINAL•COUNTY wide open opportunity

East-West Corridor Study

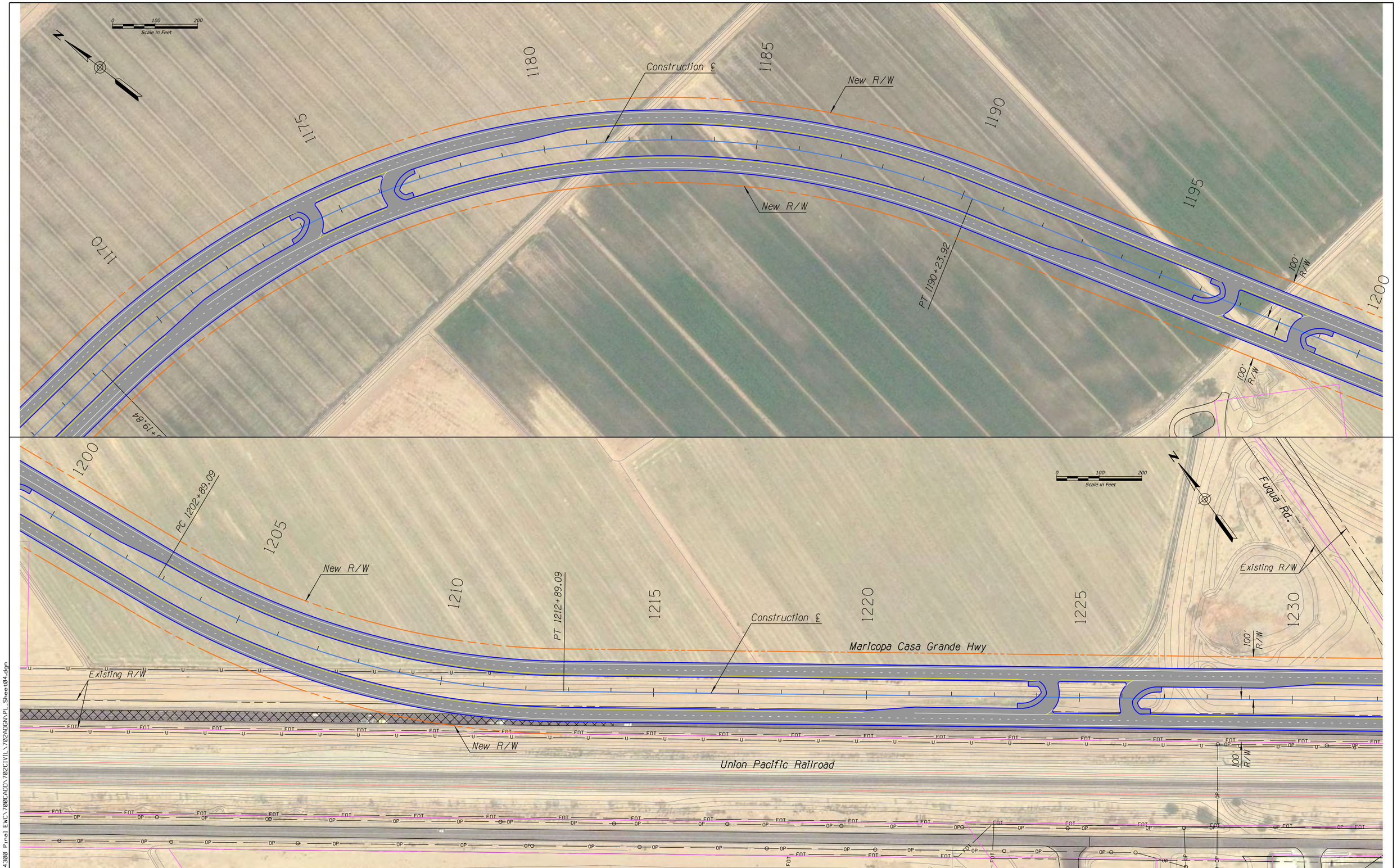


P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\PL_Sheet03.dgn

Prepared by: JACOBS

Prepared for: PINAL•COUNTY wide open opportunity

East-West Corridor Study

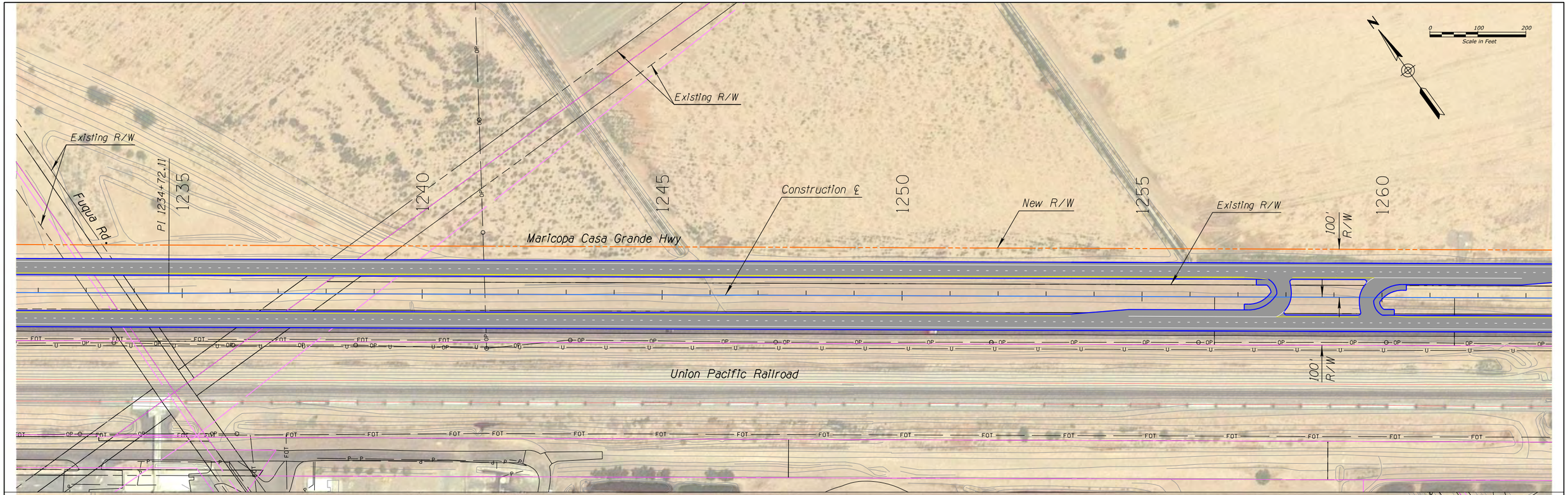


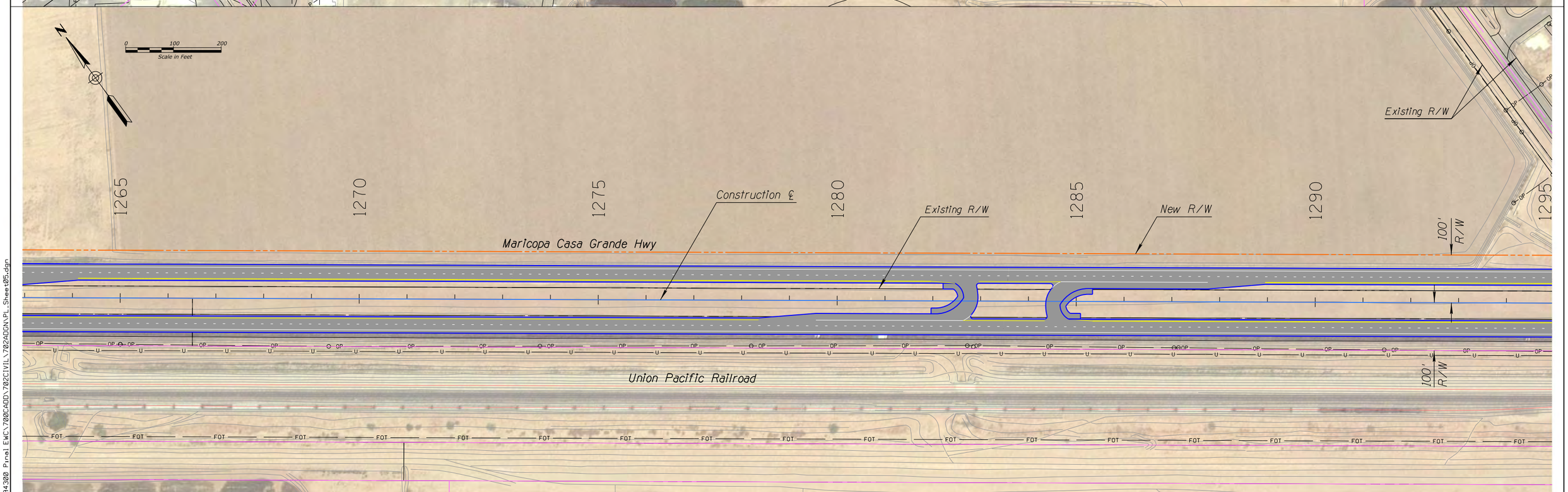
P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\PL_Sheet04.dgn

Prepared by: JACOBS

Prepared for: PINAL•COUNTY wide open opportunity

East-West Corridor Study



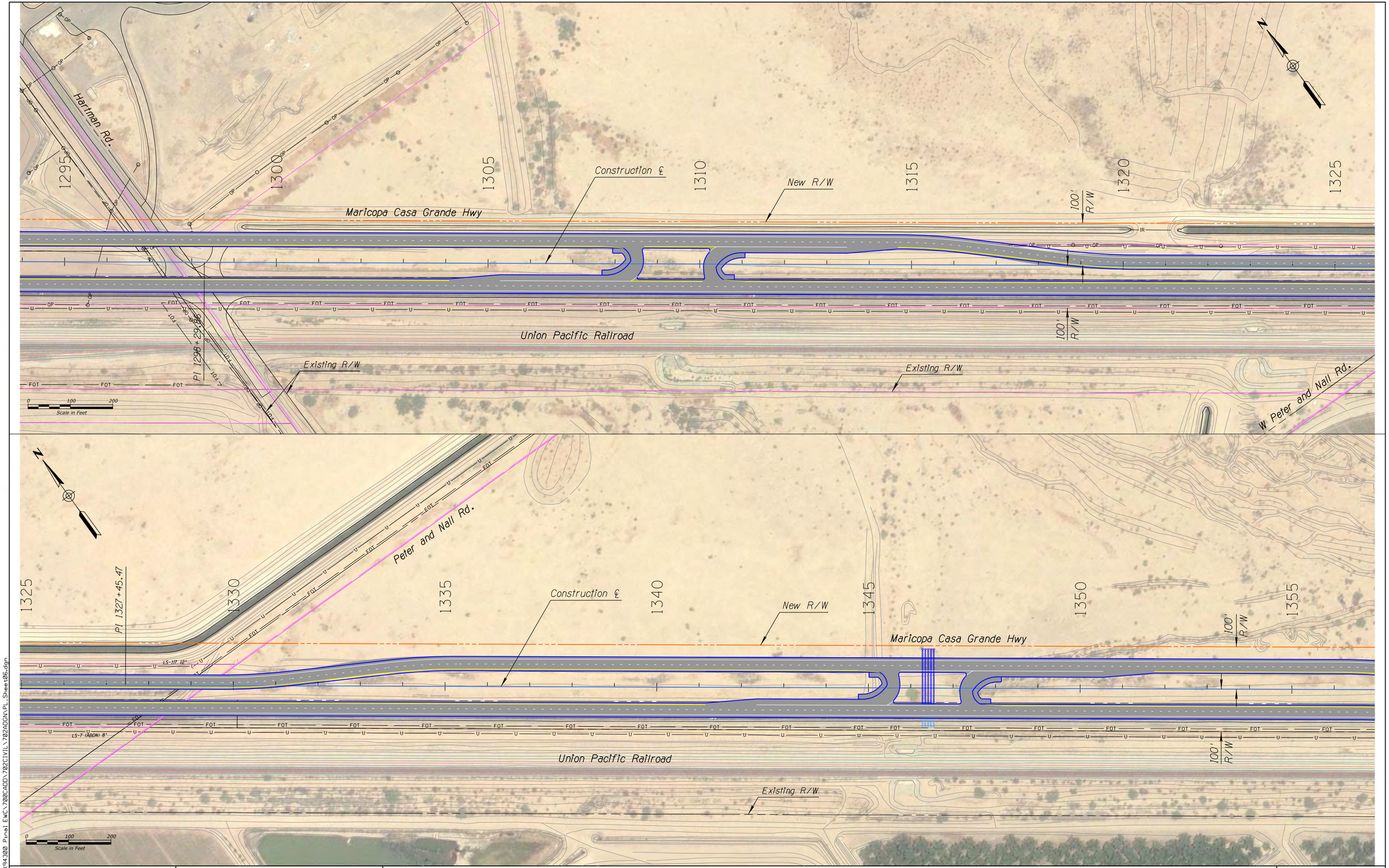


P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\PL_Sheet05.dgn

Prepared by: JACOBS

Prepared for: PINAL•COUNTY wide open opportunity

East-West Corridor Study

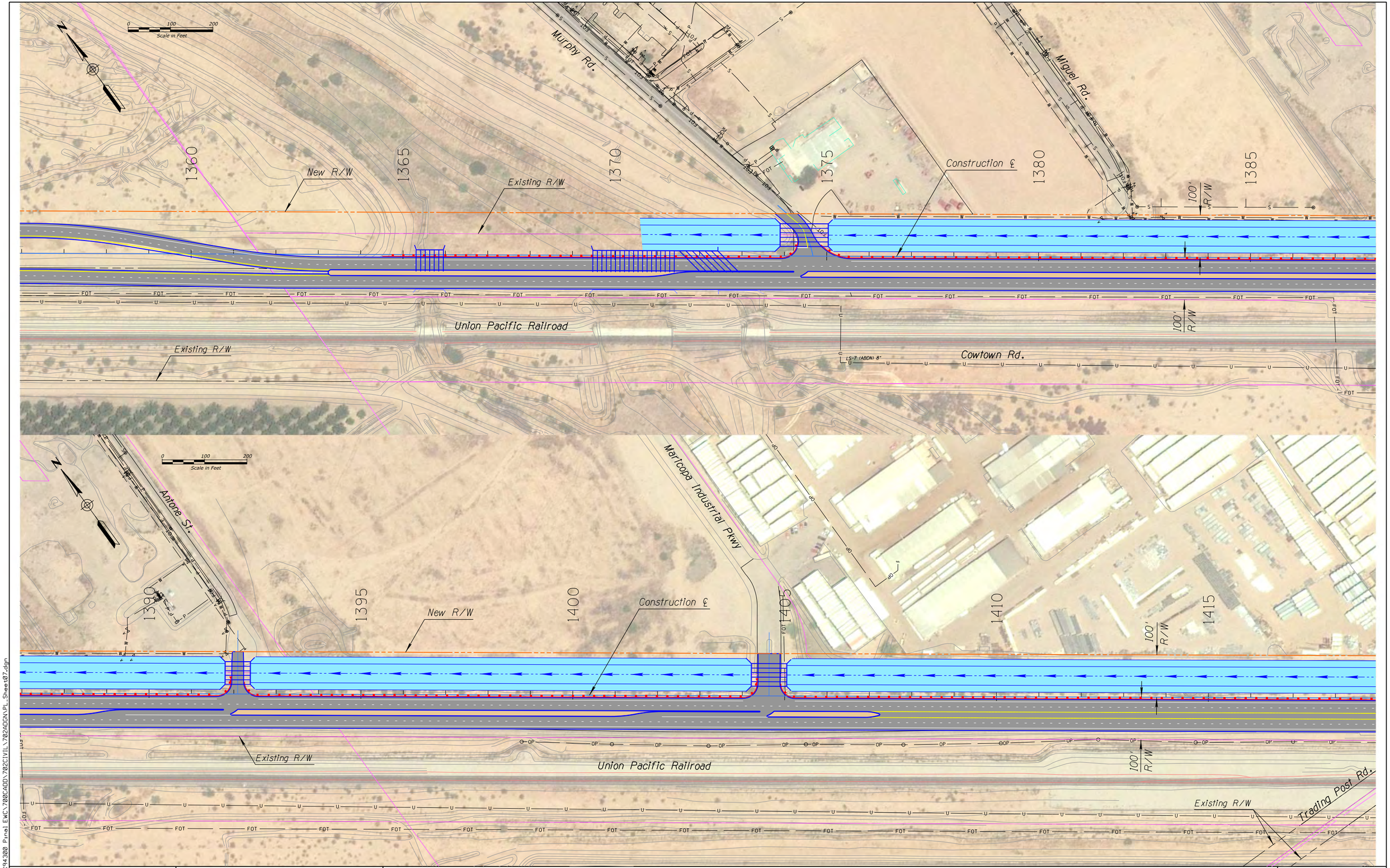


P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\PL_Sheet06.dgn

Prepared by: JACOBS

Prepared for: PINAL•COUNTY wide open opportunity

East-West Corridor Study

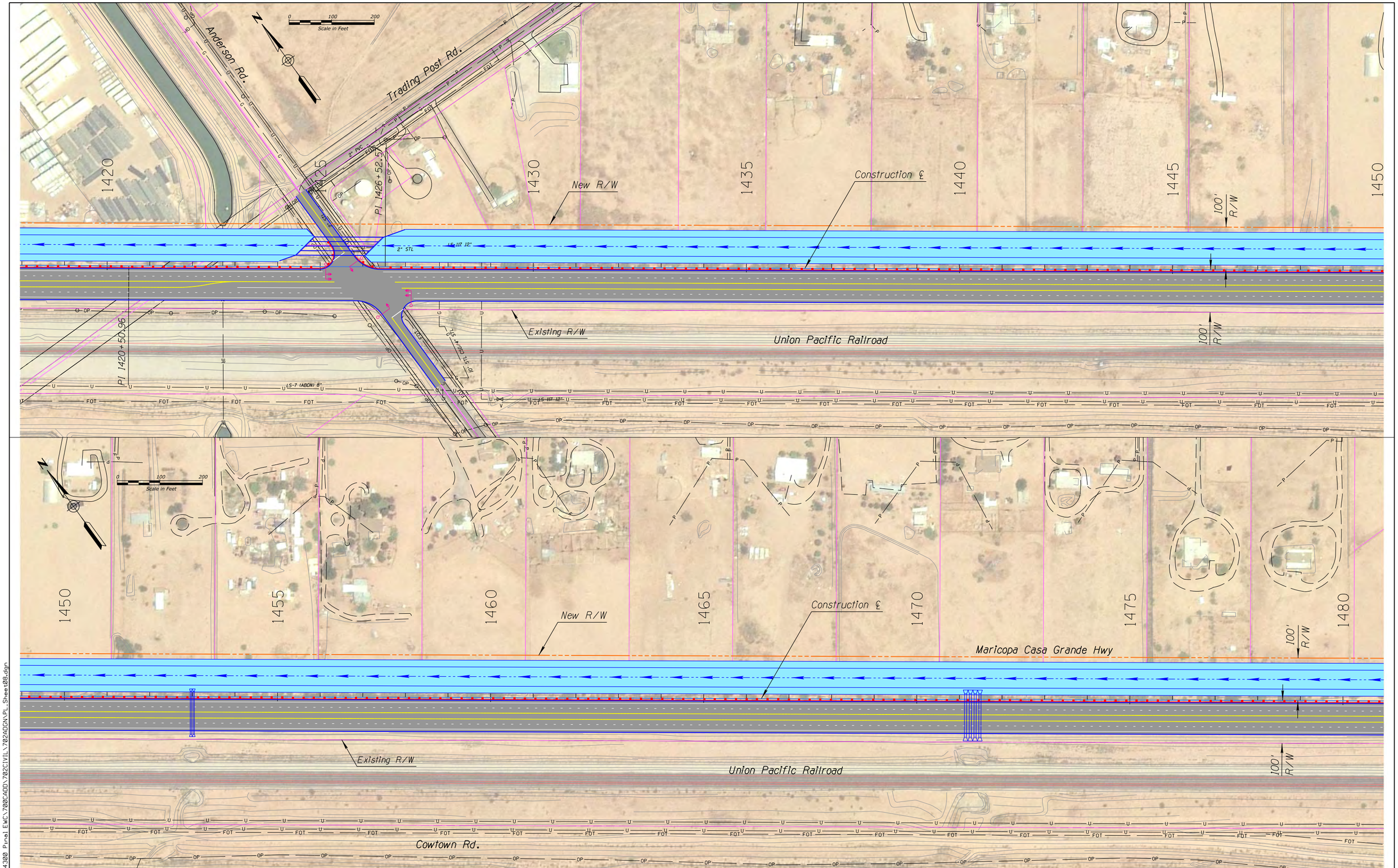


P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\PL_Sheet07.dgn

Prepared by: JACOBS

Prepared for: PINAL•COUNTY wide open opportunity

East-West Corridor Study

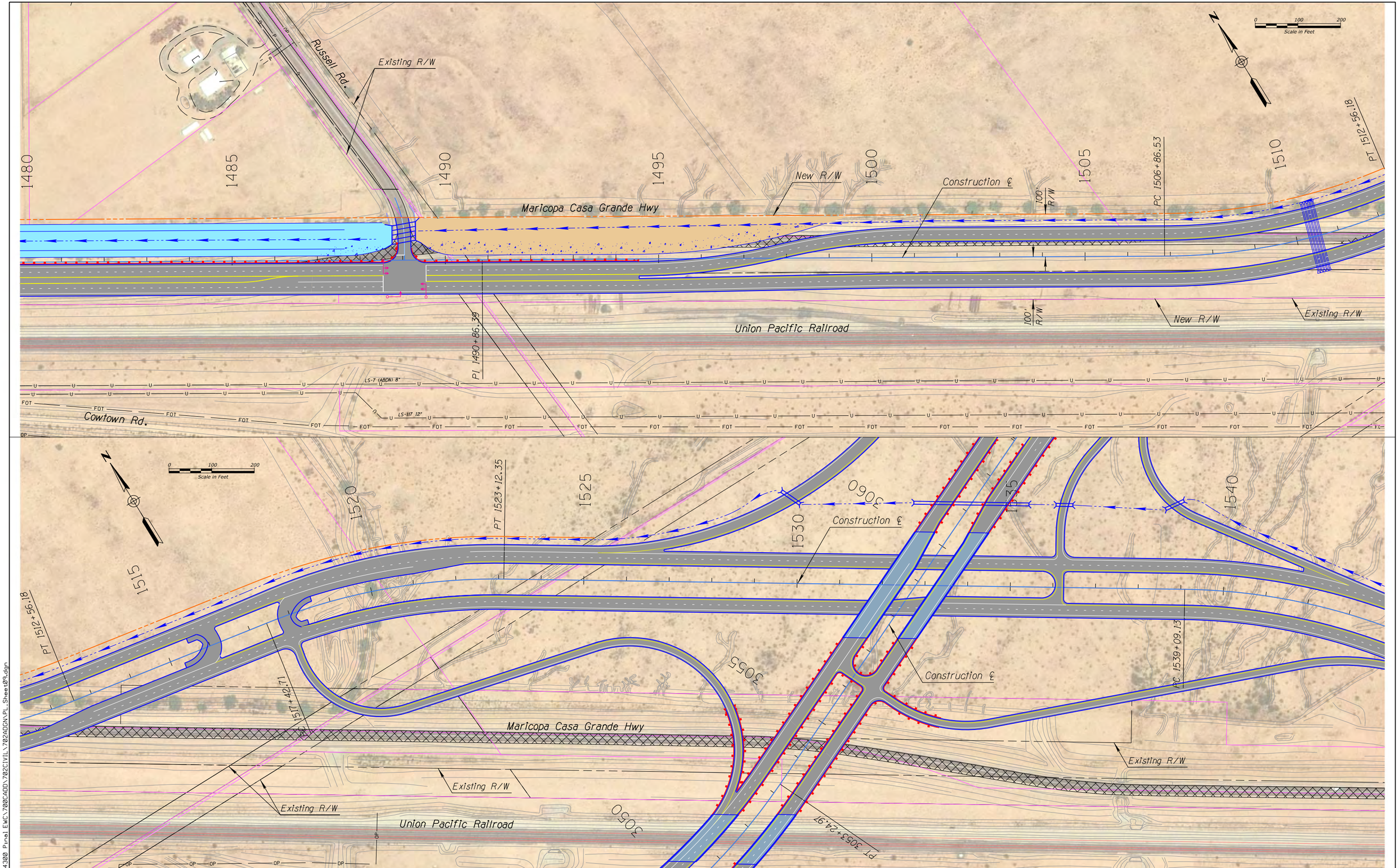


P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\PL_Sheet08.dgn

Prepared by: JACOBS

Prepared for: PINAL•COUNTY wide open opportunity

East-West Corridor Study

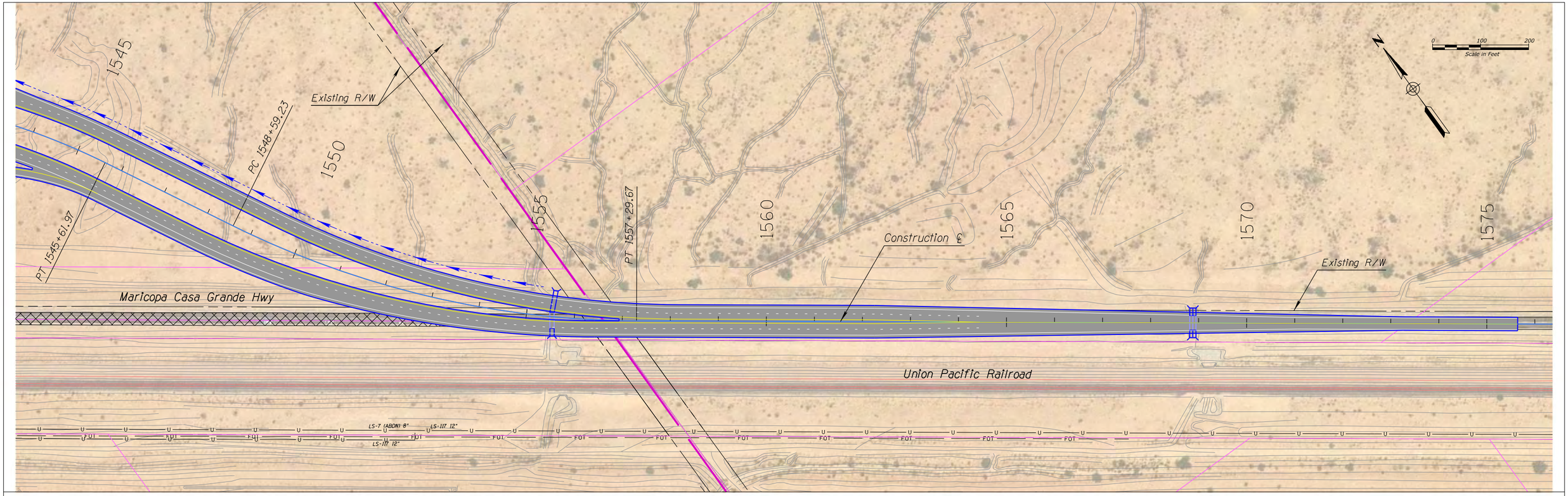


Prepared by: JACOBS

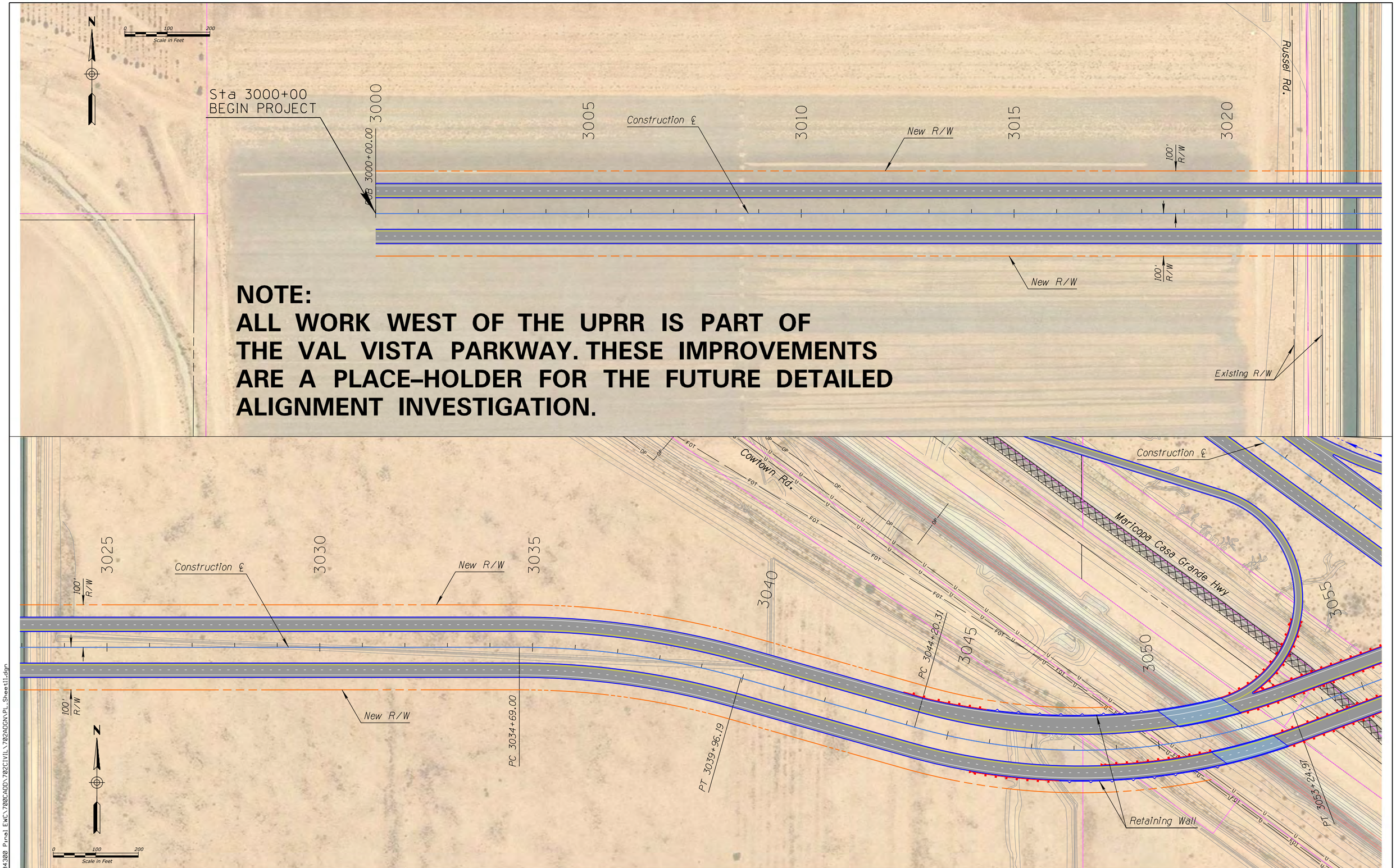
Prepared for: PINAL•COUNTY wide open opportunity

East-West Corridor Study

P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\PL_Sheet09.dgn

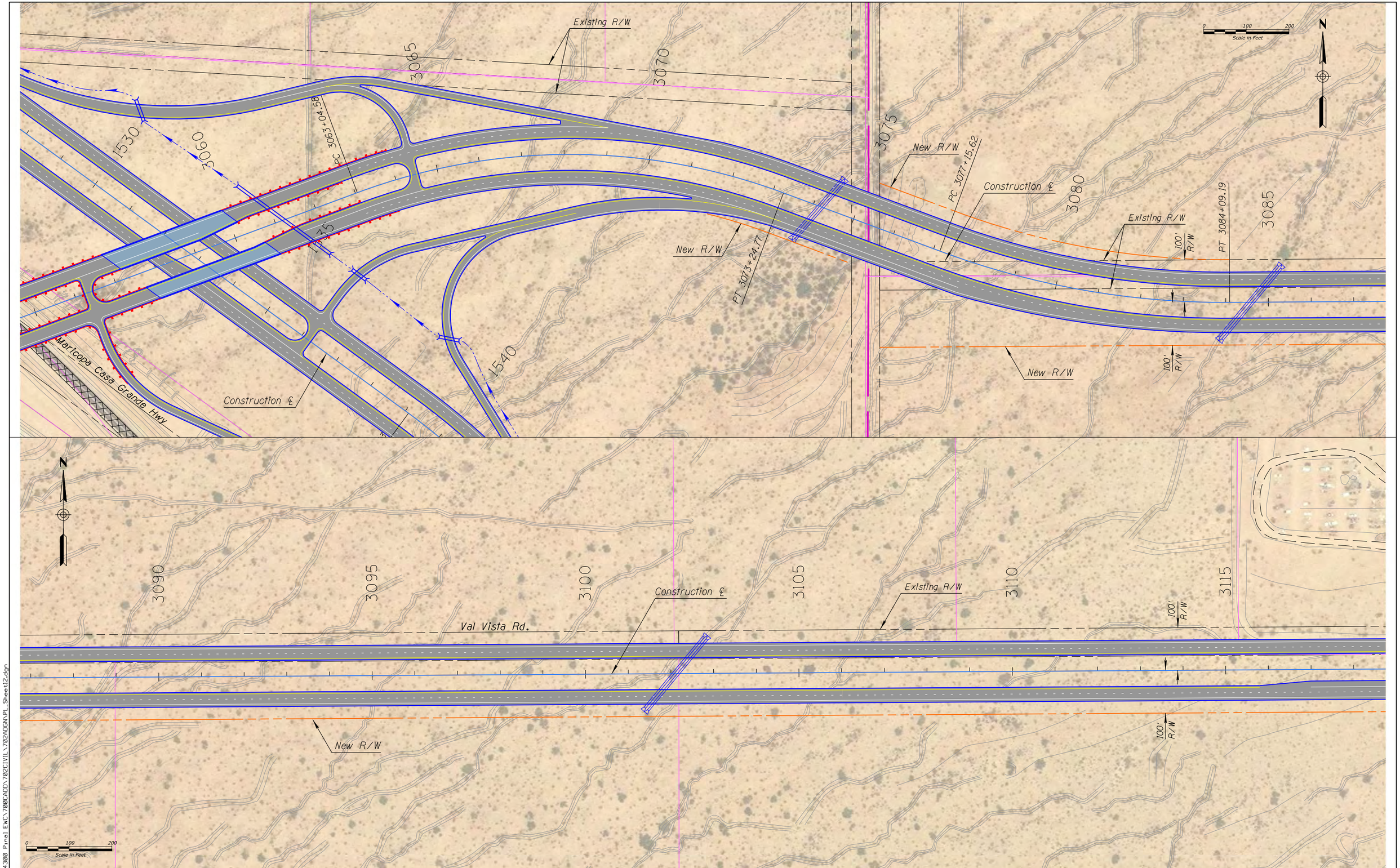


P:\W7X94300 Pinal EWCY700CADD\702CIVIL\702ADDN\PL_Sheet10.dgn



NOTE:
ALL WORK WEST OF THE UPRR IS PART OF THE VAL VISTA PARKWAY. THESE IMPROVEMENTS ARE A PLACE-HOLDER FOR THE FUTURE DETAILED ALIGNMENT INVESTIGATION.

P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\PL_Sheet11.dgn

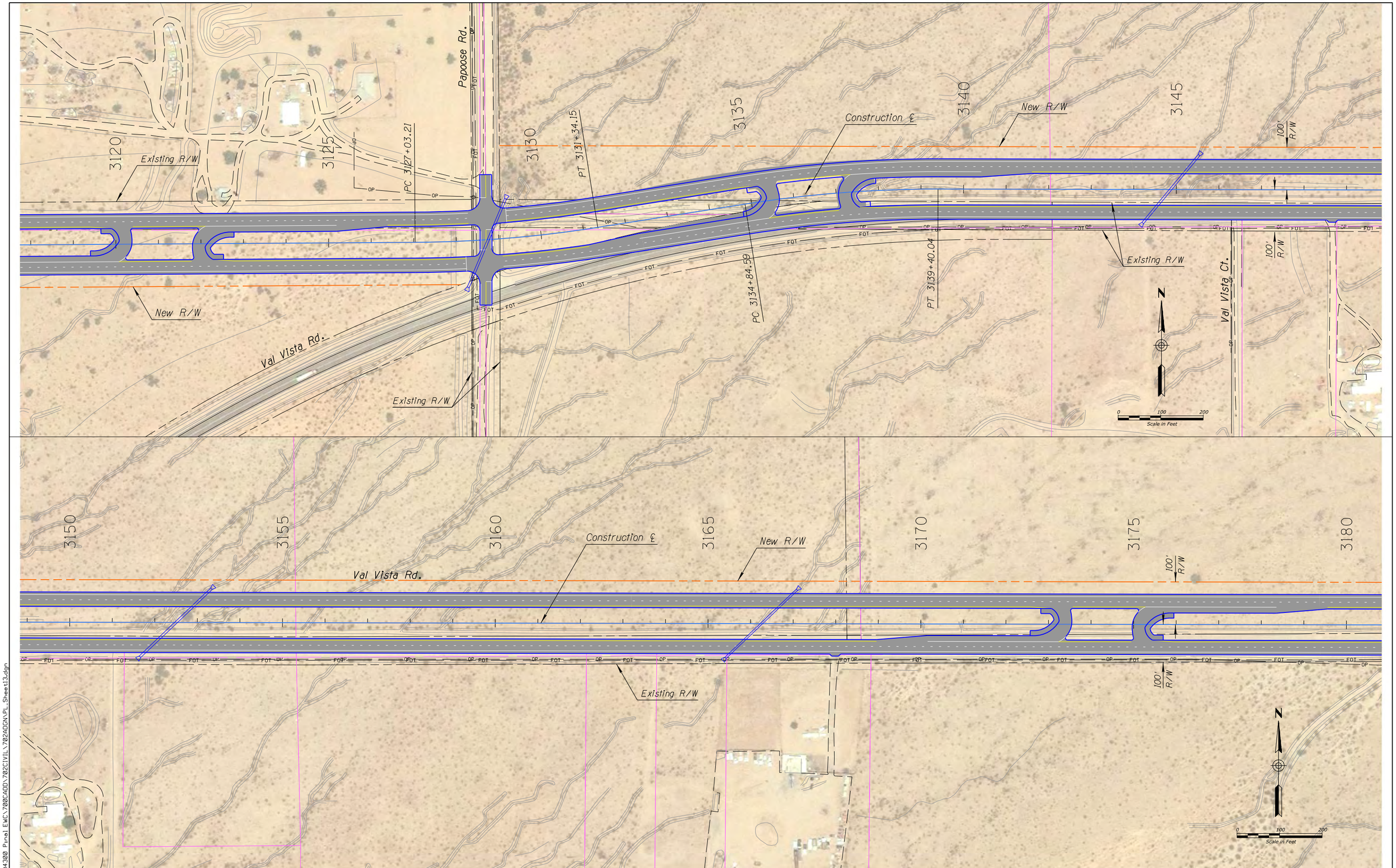


P:\W7X943300 Pinal EWC\700CADD\702CIVIL\702ADGNPL_Sheet12.dgn

Prepared by: JACOBS

Prepared for: PINAL•COUNTY wide open opportunity

East-West Corridor Study

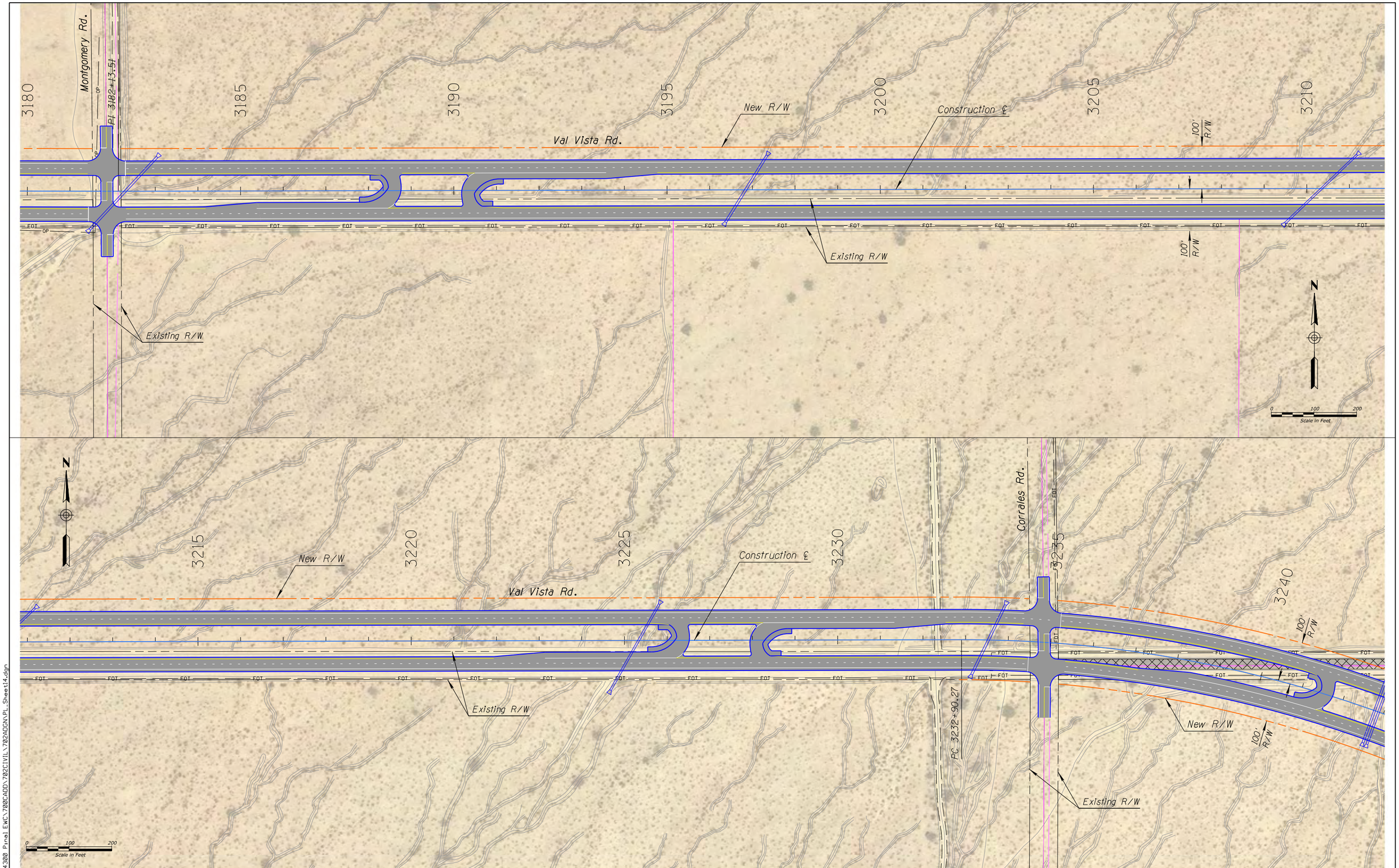


P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\PL_Sheet13.dgn

Prepared by: JACOBS

Prepared for: PINAL•COUNTY wide open opportunity

East-West Corridor Study

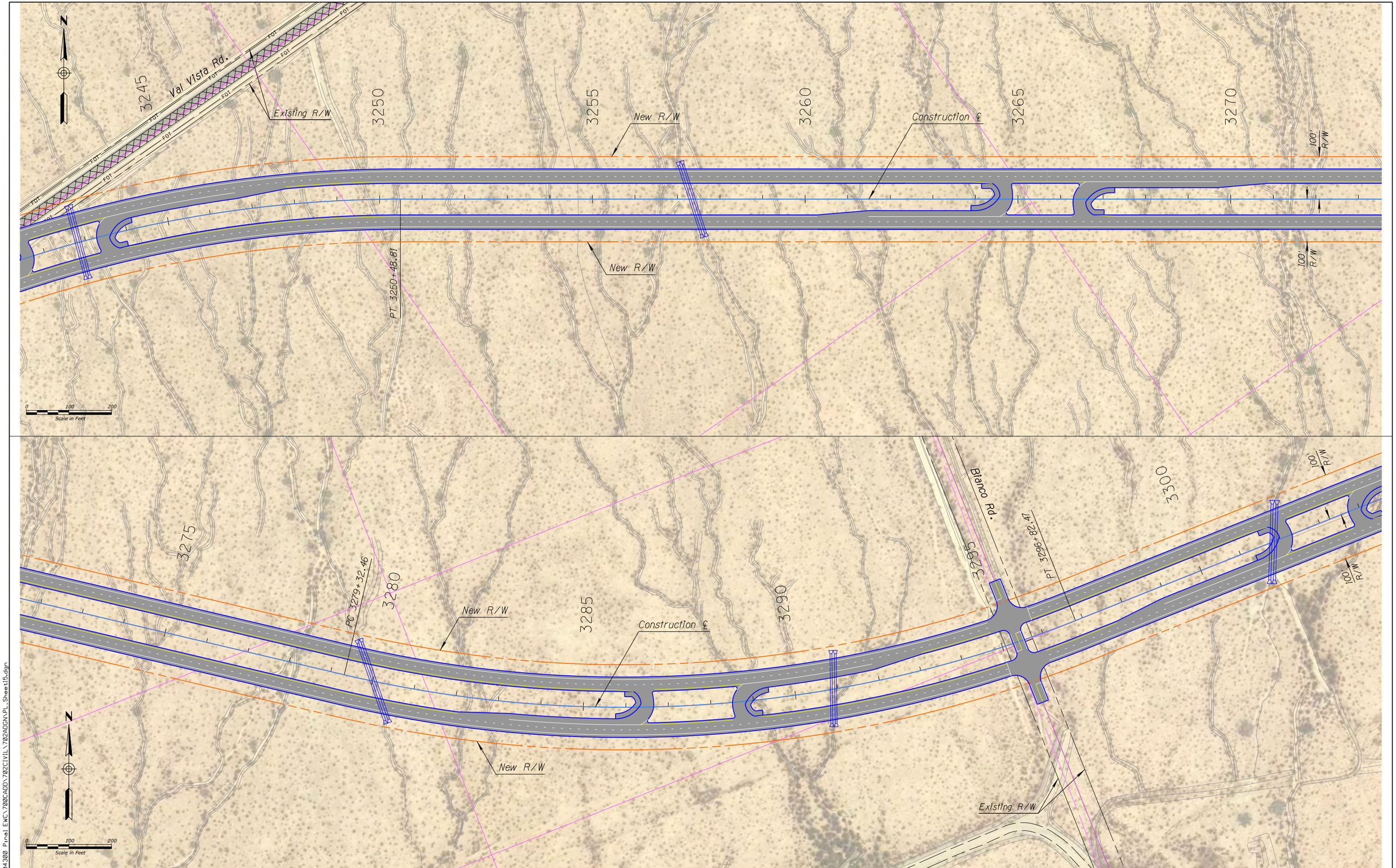


P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADCN\PL_Sheet14.dgn

Prepared by: JACOBS

Prepared for: PINAL•COUNTY wide open opportunity

East-West Corridor Study

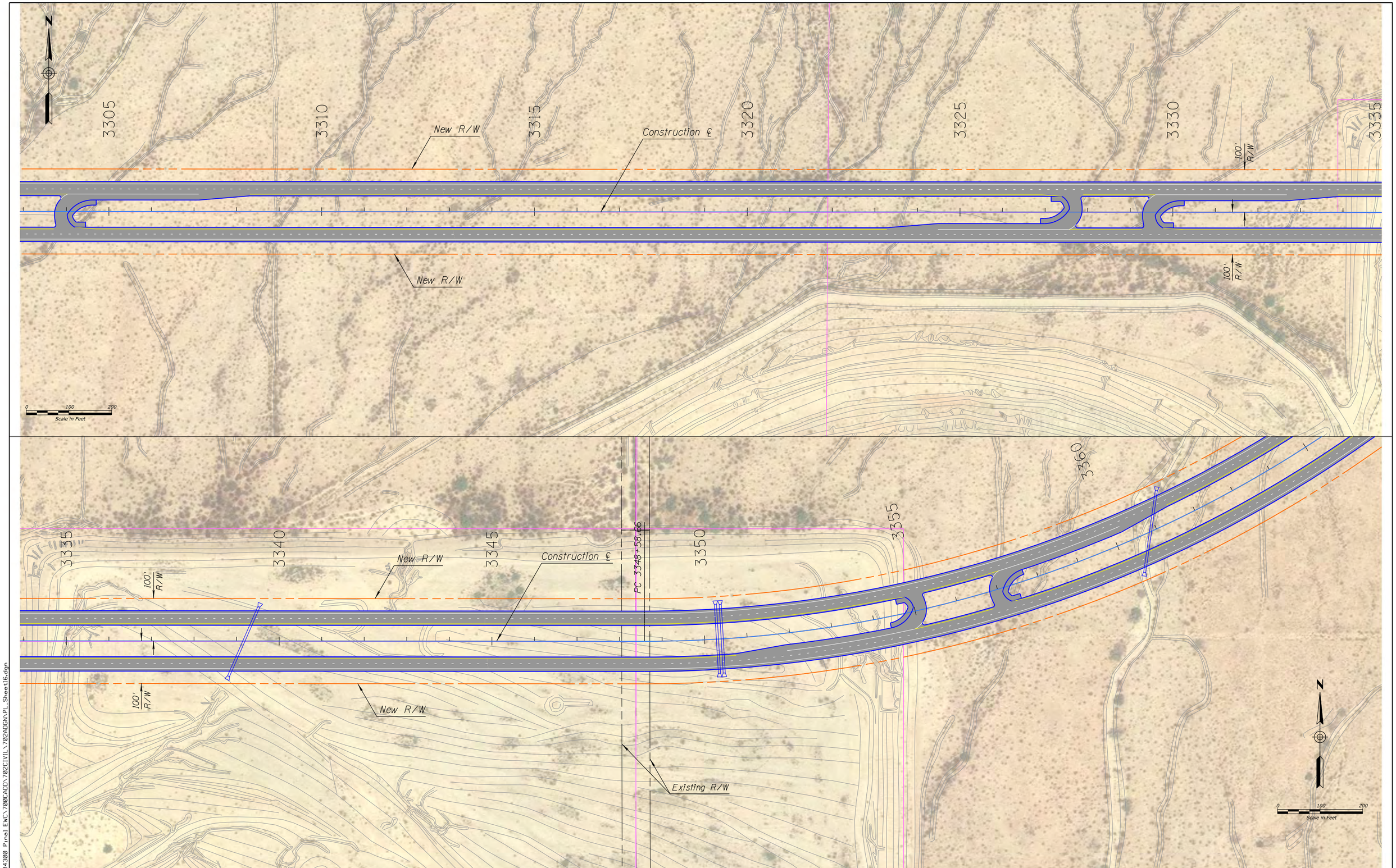


P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\PL_Sheet15.dgn

Prepared by: JACOBS

Prepared for: PINAL COUNTY wide open opportunity

East-West Corridor Study

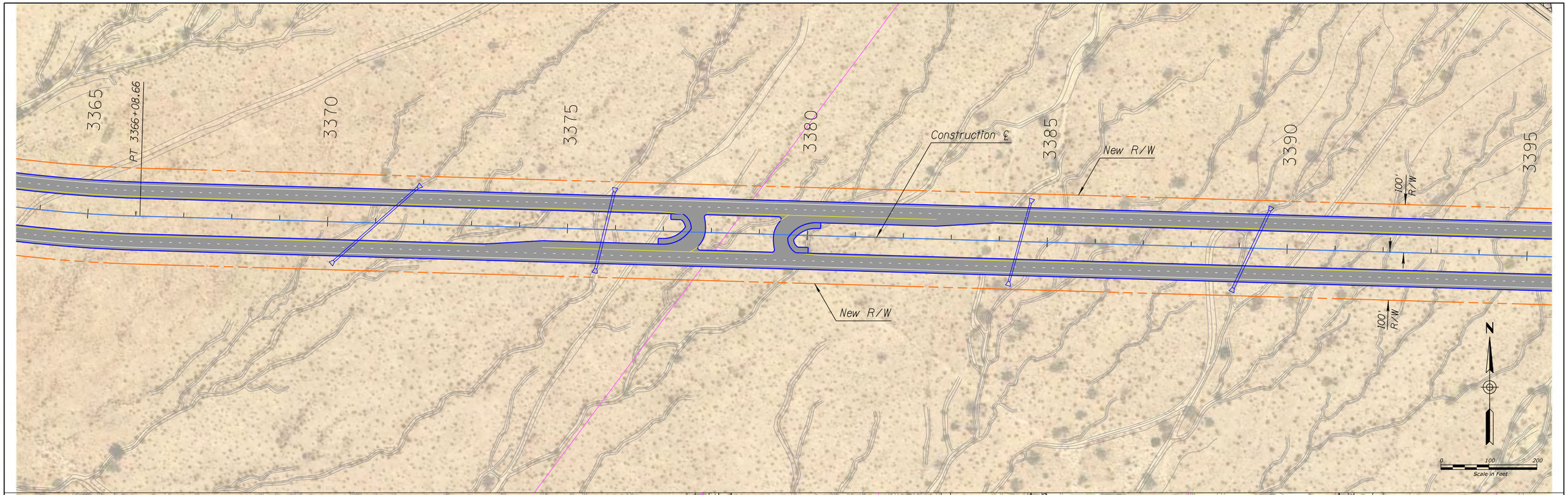


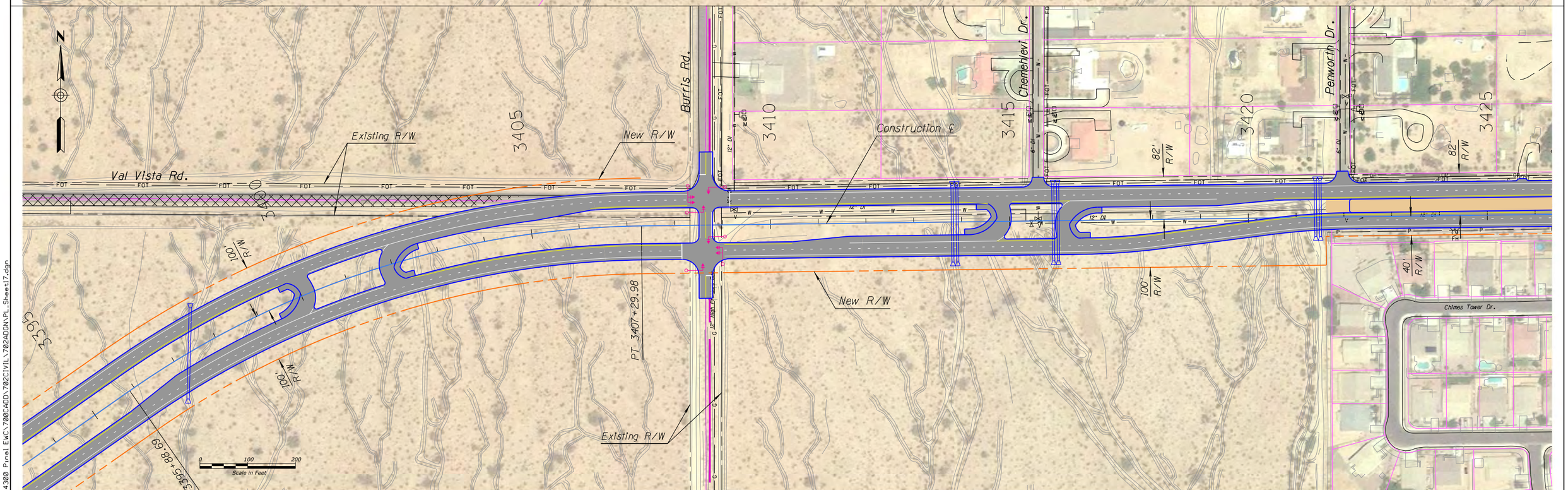
P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\PL_Sheet16.dgn

Prepared by: JACOBS

Prepared for: PINAL•COUNTY wide open opportunity

East-West Corridor Study





P:\W7X94300 Pinal EWCY700CADD\702CIVIL\702ADDN\PL_Sheet17.dgn

Prepared by: JACOBS

Prepared for: PINAL•COUNTY wide open opportunity

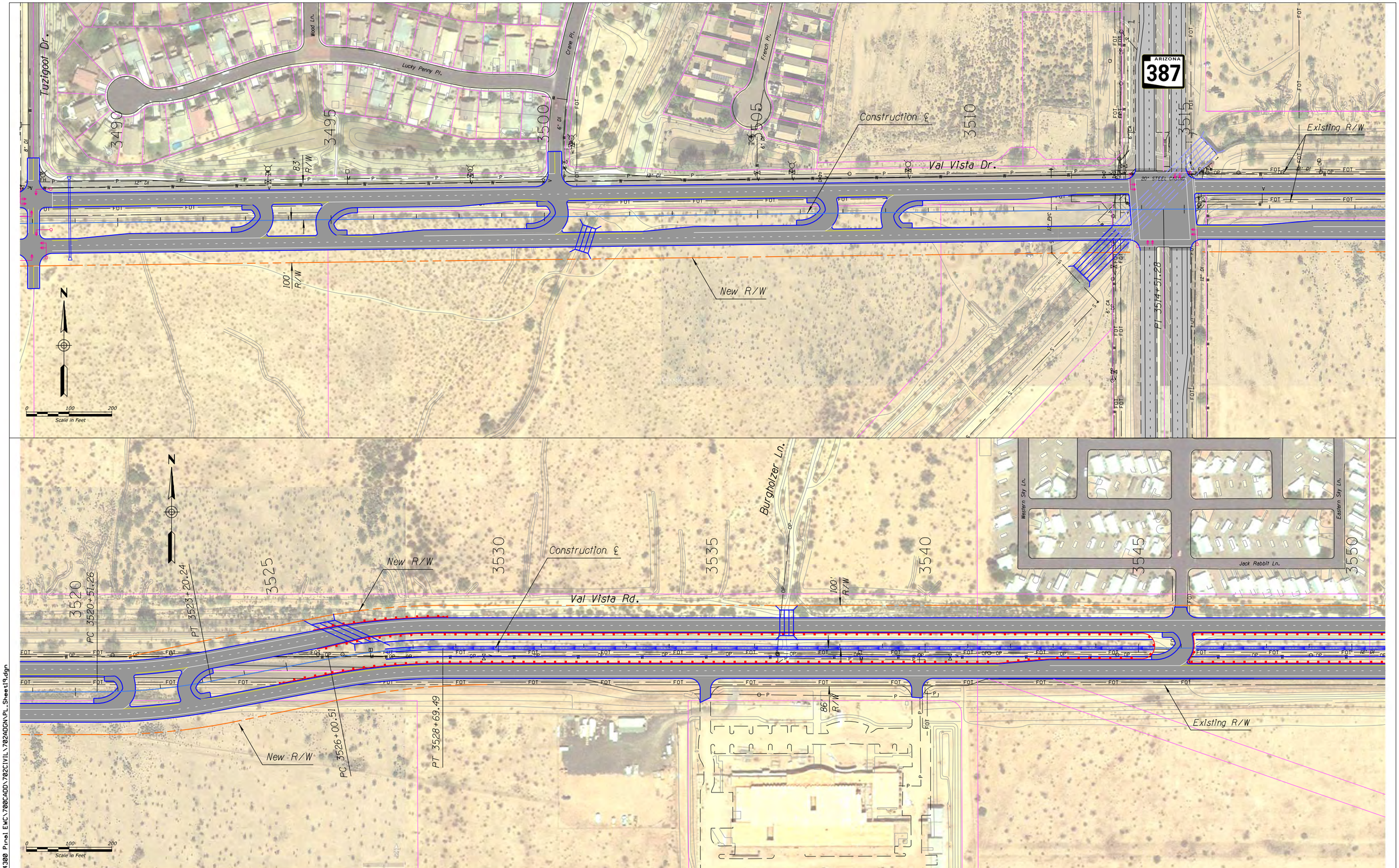
East-West Corridor Study

P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\PL_Sheet18.dgn

Prepared by: JACOBS

Prepared for: PINAL • COUNTY wide open opportunity

East-West Corridor Study

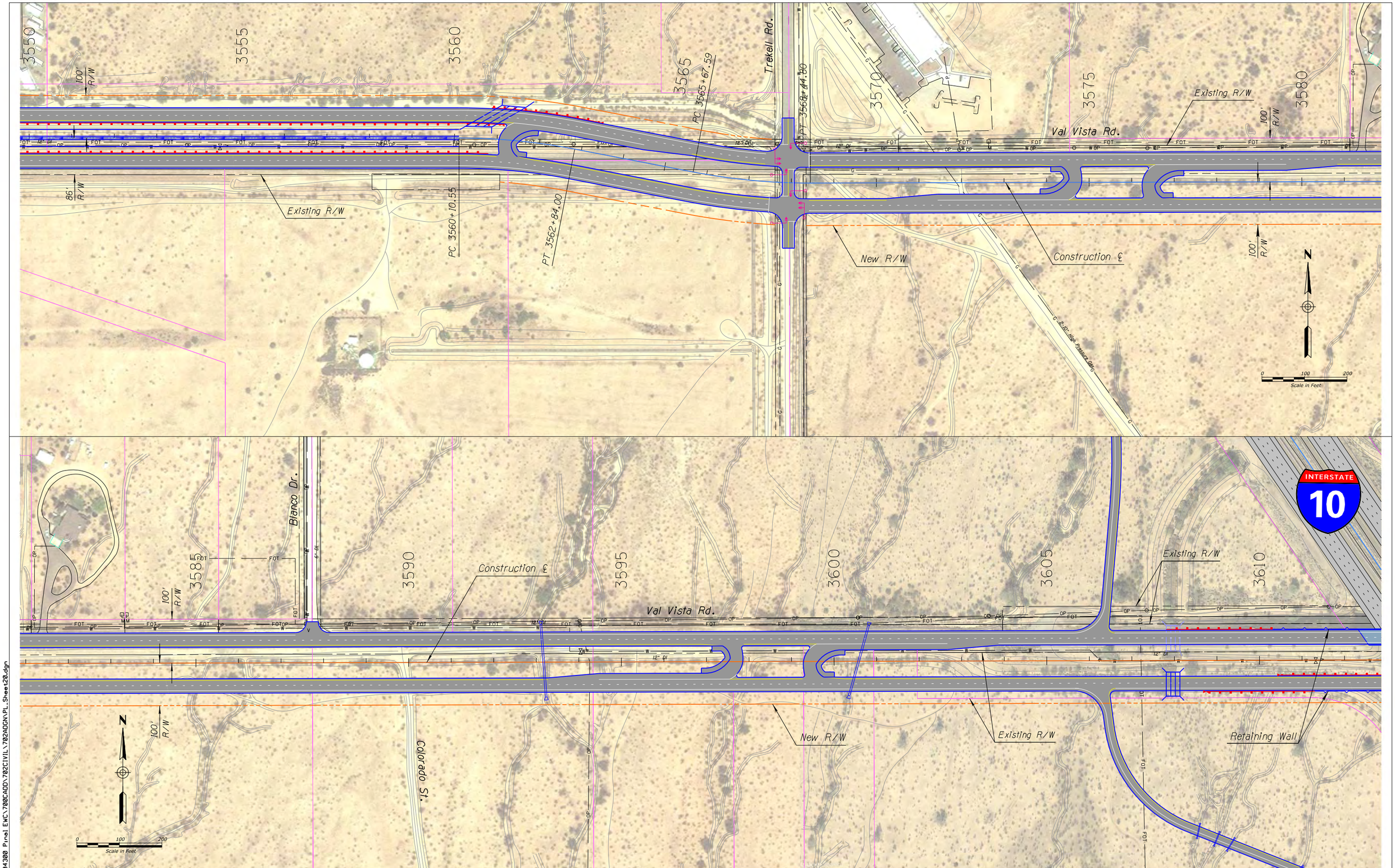


P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\PL_Sheet19.dgn

Prepared by: JACOBS

Prepared for: PINAL • COUNTY *wide open opportunity*

East-West Corridor Study

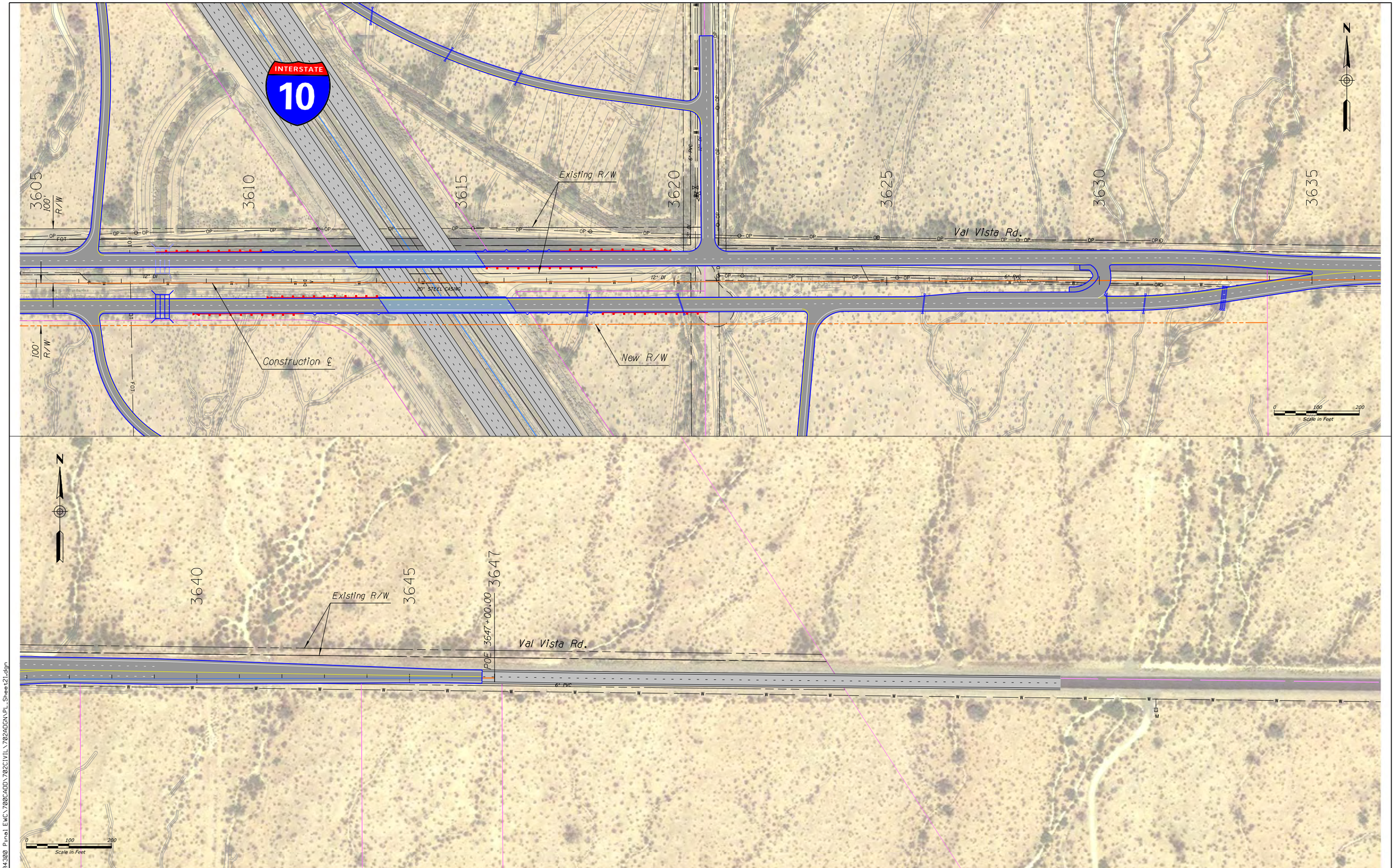


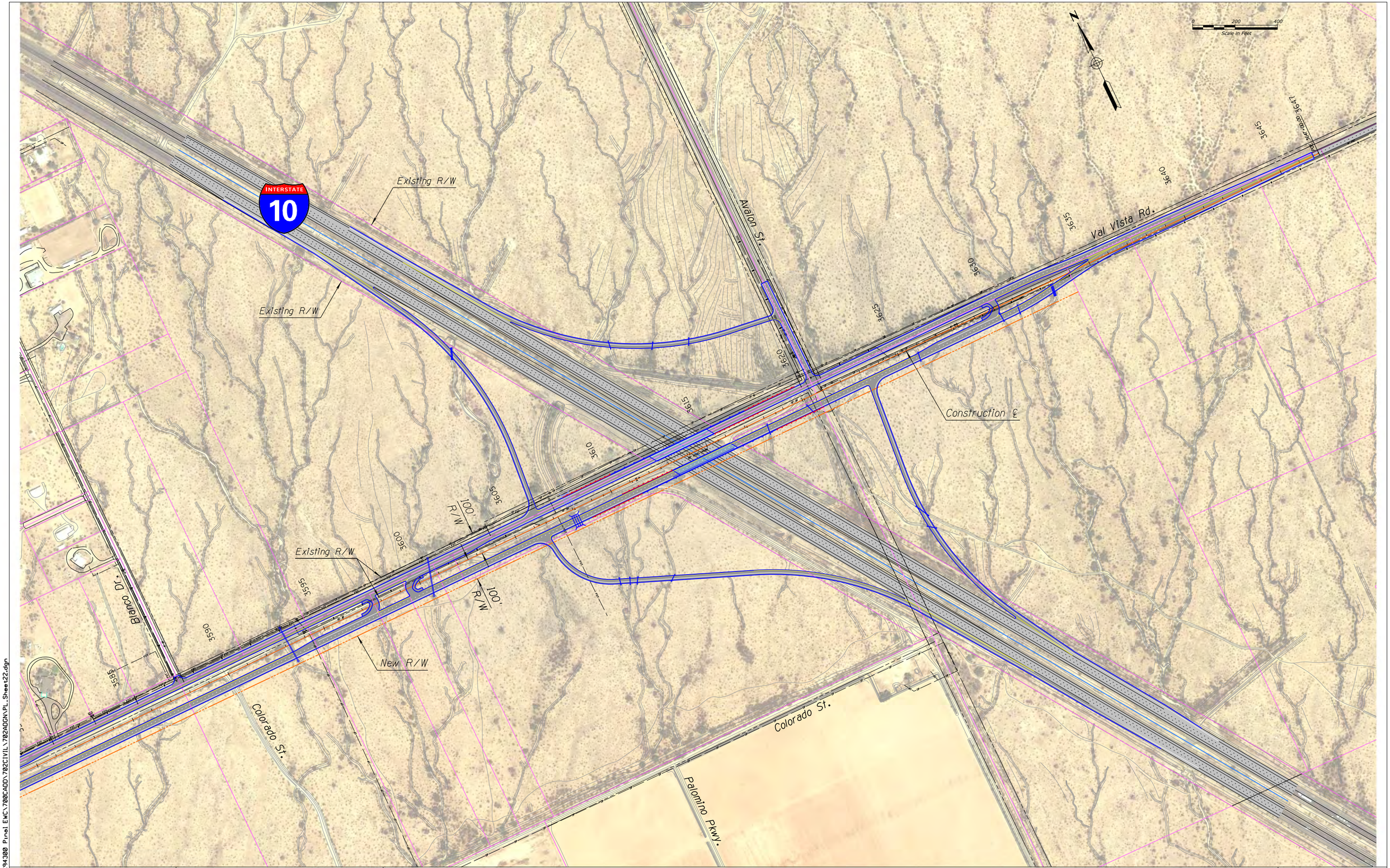
P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\PL_Sheet20.dgn

Prepared by: JACOBS

Prepared for: PINAL COUNTY wide open opportunity

East-West Corridor Study


INTERSTATE
10
3605
3610
3615
3620
3625
3630
3635
3640
3645
3647
100' R/W
Existing R/W
Construction ℄
New R/W
Val Vista Rd.
12" DI
20" STEEL CASING
6" PVC
POE 3647+00.00
N
0 100 200
Scale in Feet



P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\PL_Sheet22.dgn

Prepared by: JACOBS

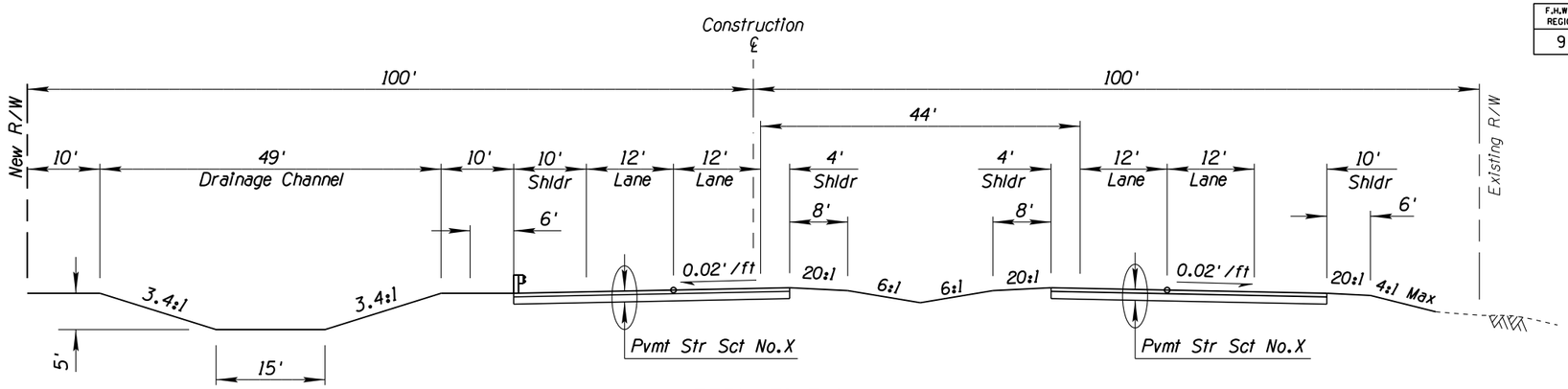
Prepared for: PINAL COUNTY *wide open opportunity*

East-West Corridor Study

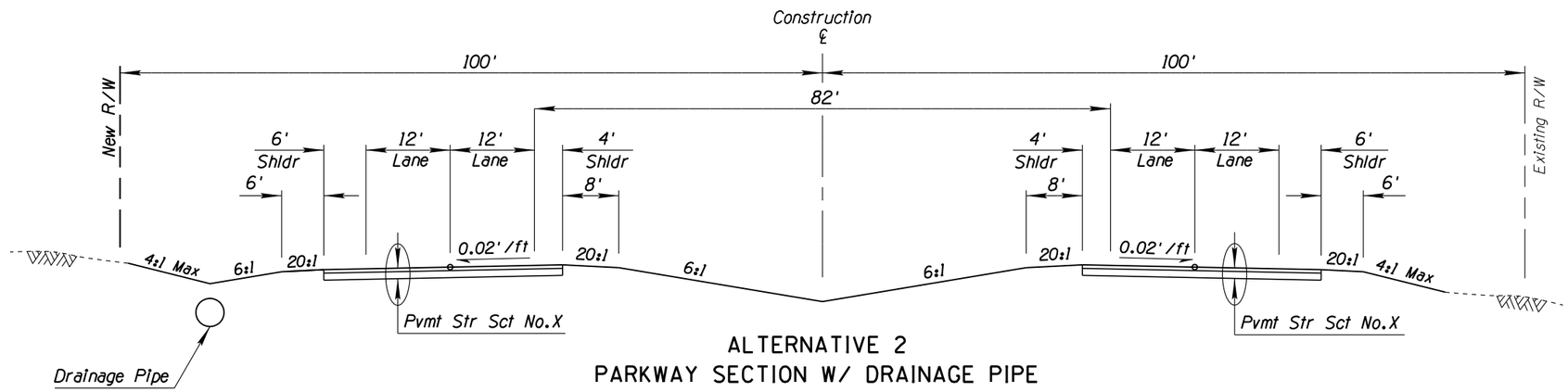
APPENDIX C:
AK-CHIN DRAINAGE ALTERNATIVES

11/24/2015 EWcty01_ekchin.dgn

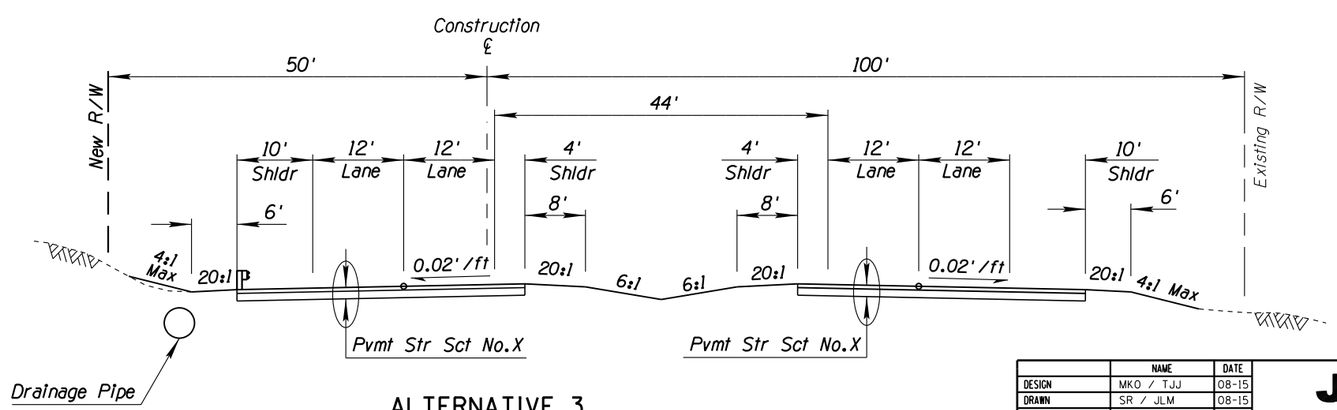
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	AZ	------			



ALTERNATIVE 1
DIVIDED ROADWAY SECTION W/ DRAINAGE CHANNEL



ALTERNATIVE 2
PARKWAY SECTION W/ DRAINAGE PIPE



ALTERNATIVE 3
DIVIDED ROADWAY SECTION W/ DRAINAGE PIPE

	NAME	DATE
DESIGN	MKO / TJJ	08-15
DRAWN	SR / JLM	08-15
CHECKED	BSW	08-15

JACOBS

TYPICAL SECTIONS

NOT FOR CONSTRUCTION OR RECORDING

LOCATION

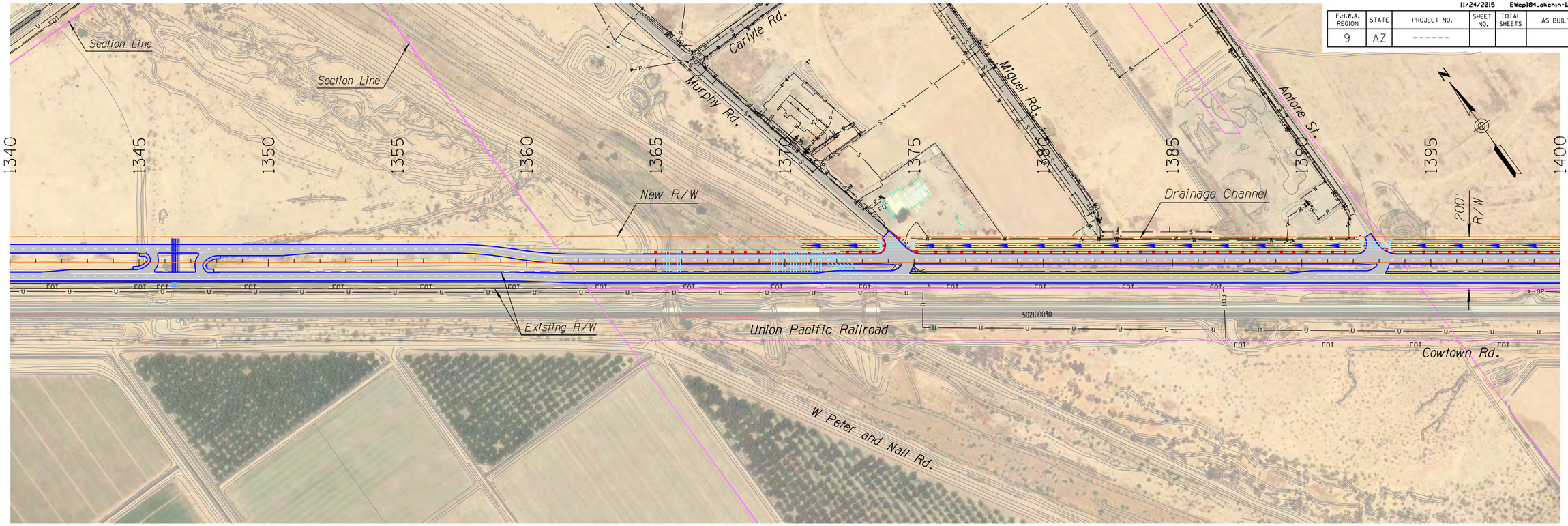
EAST - WEST CORRIDOR STUDY

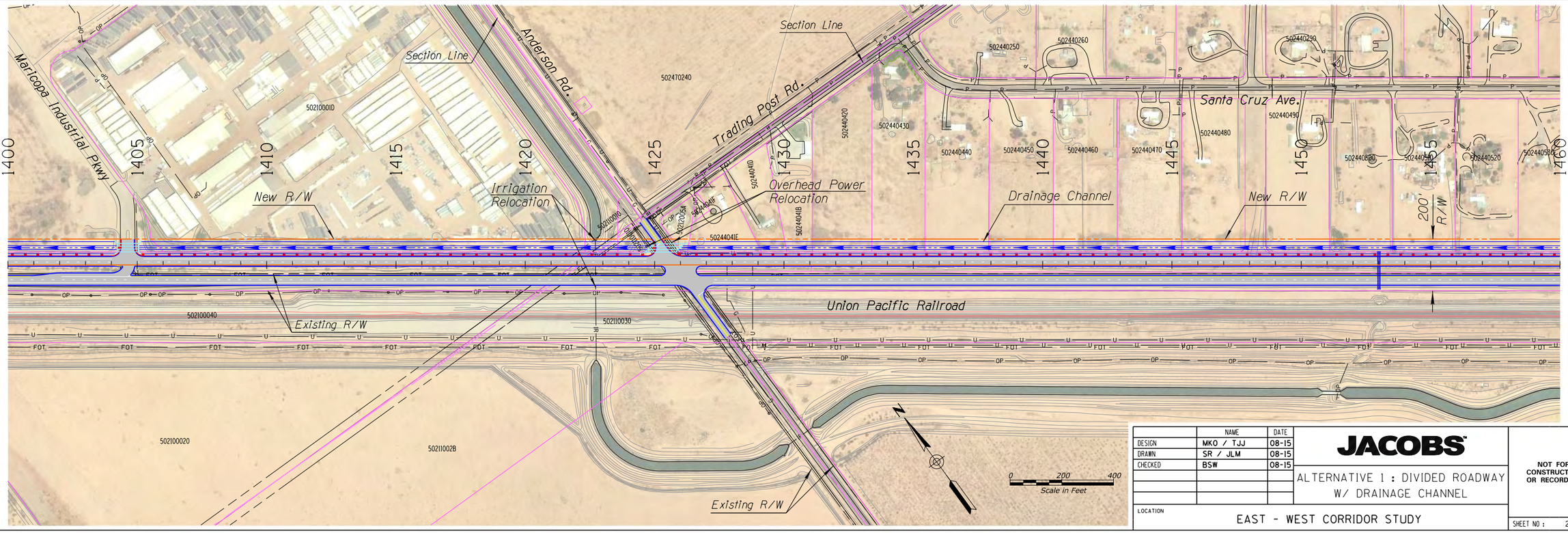
SHEET NO : 1

P:\W7X94300 Final EWC\700CADD\702CIVIL\702ADGN\EWcty01_ekchin.dgn

11/24/2015 EWcp104_akchin-1.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	AZ	------			





	NAME	DATE
DESIGN	MKO / TJJ	08-15
DRAWN	SR / JLM	08-15
CHECKED	BSW	08-15

JACOBS

ALTERNATIVE 1 : DIVIDED ROADWAY W/ DRAINAGE CHANNEL

LOCATION

EAST - WEST CORRIDOR STUDY

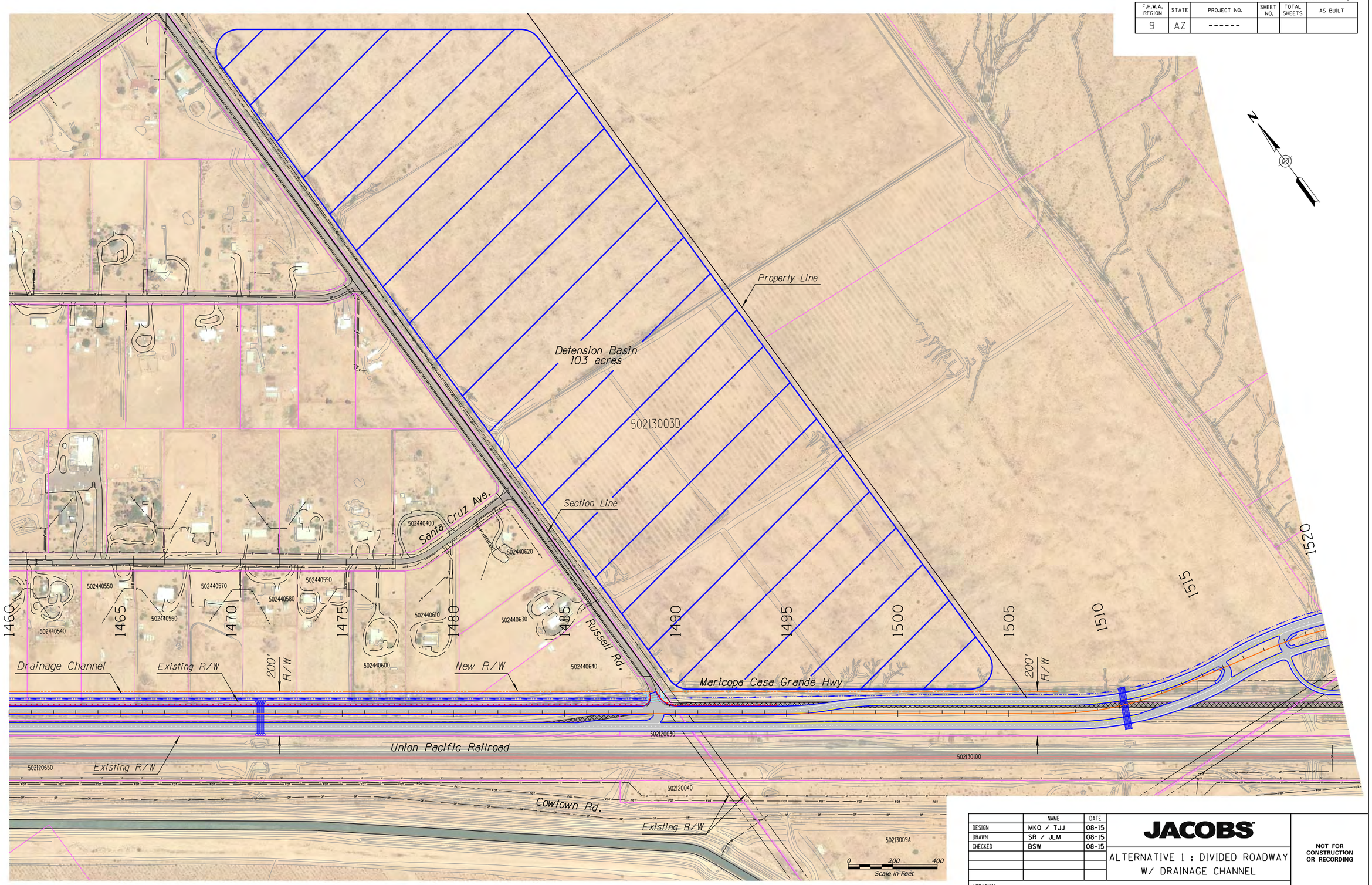
NOT FOR CONSTRUCTION OR RECORDING

SHEET NO : 2

P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\EWcp104_akchin-1.dgn

11/24/2015 EWcp105.akchin-1.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	AZ	------			



	NAME	DATE
DESIGN	MKO / TJJ	08-15
DRAWN	SR / JLM	08-15
CHECKED	BSW	08-15

JACOBS

ALTERNATIVE 1 : DIVIDED ROADWAY W/ DRAINAGE CHANNEL

LOCATION

EAST - WEST CORRIDOR STUDY

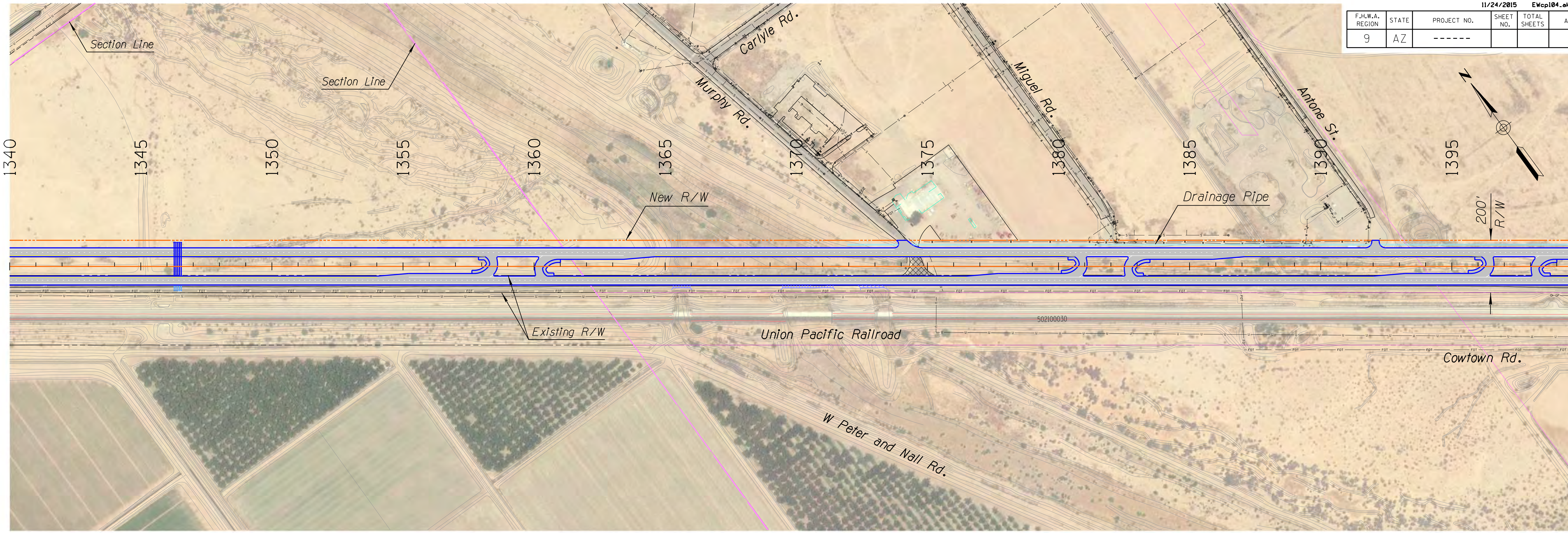
NOT FOR CONSTRUCTION OR RECORDING

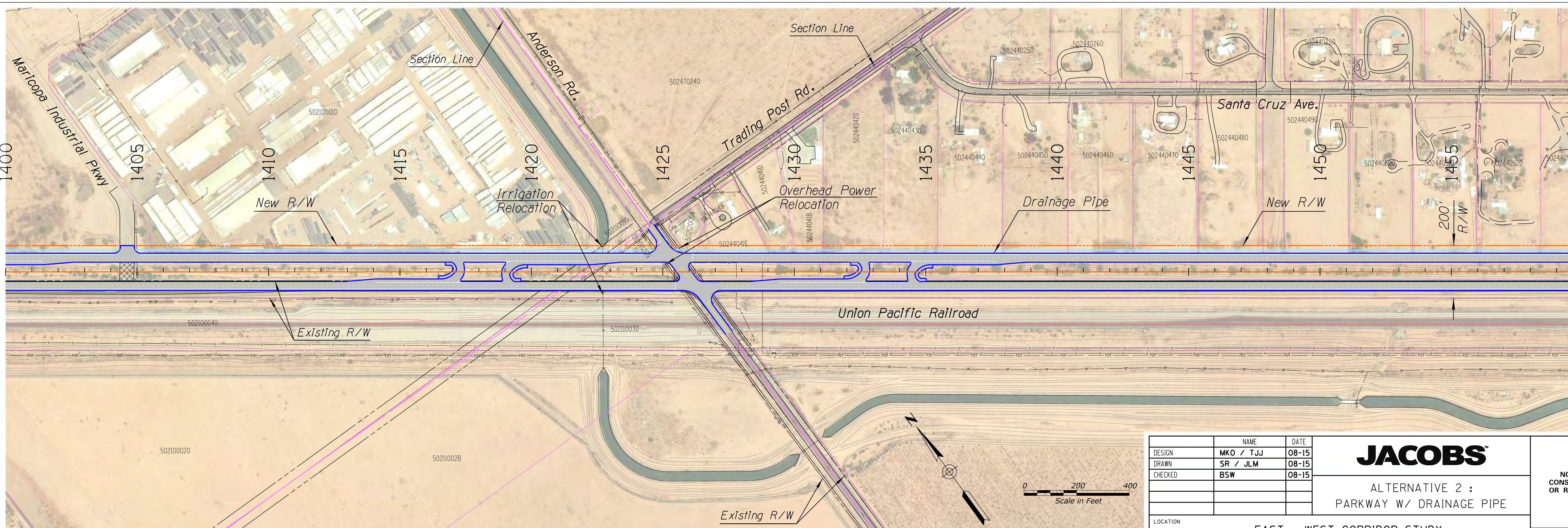
SHEET NO : 3

P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\EWcp105_akchin-1.dgn

11/24/2015 EWcp104_akchin-2.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	AZ	------			





	NAME	DATE
DESIGN	MKO / TJJ	08-15
DRAWN	SR / JLM	08-15
CHECKED	BSW	08-15

JACOBS

ALTERNATIVE 2 : PARKWAY W/ DRAINAGE PIPE

NOT FOR CONSTRUCTION OR RECORDING

LOCATION

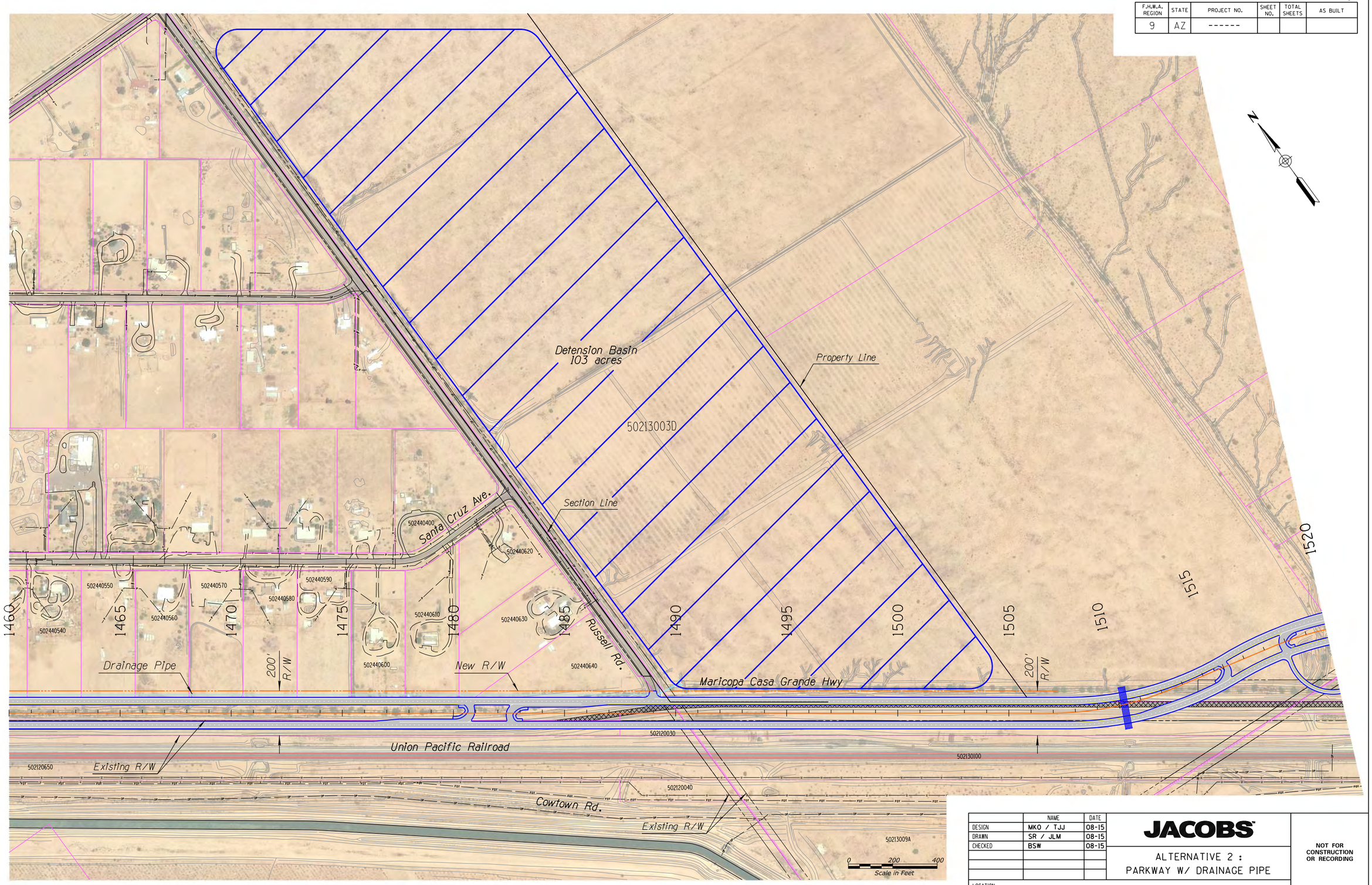
EAST - WEST CORRIDOR STUDY

SHEET NO : 4

P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\EWcp104_akchin-2.dgn

11/24/2015 EWcpl05.akchin-2.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	AZ	------			



	NAME	DATE
DESIGN	MKO / TJJ	08-15
DRAWN	SR / JLM	08-15
CHECKED	BSW	08-15

JACOBS

ALTERNATIVE 2 :
PARKWAY W/ DRAINAGE PIPE

NOT FOR CONSTRUCTION OR RECORDING

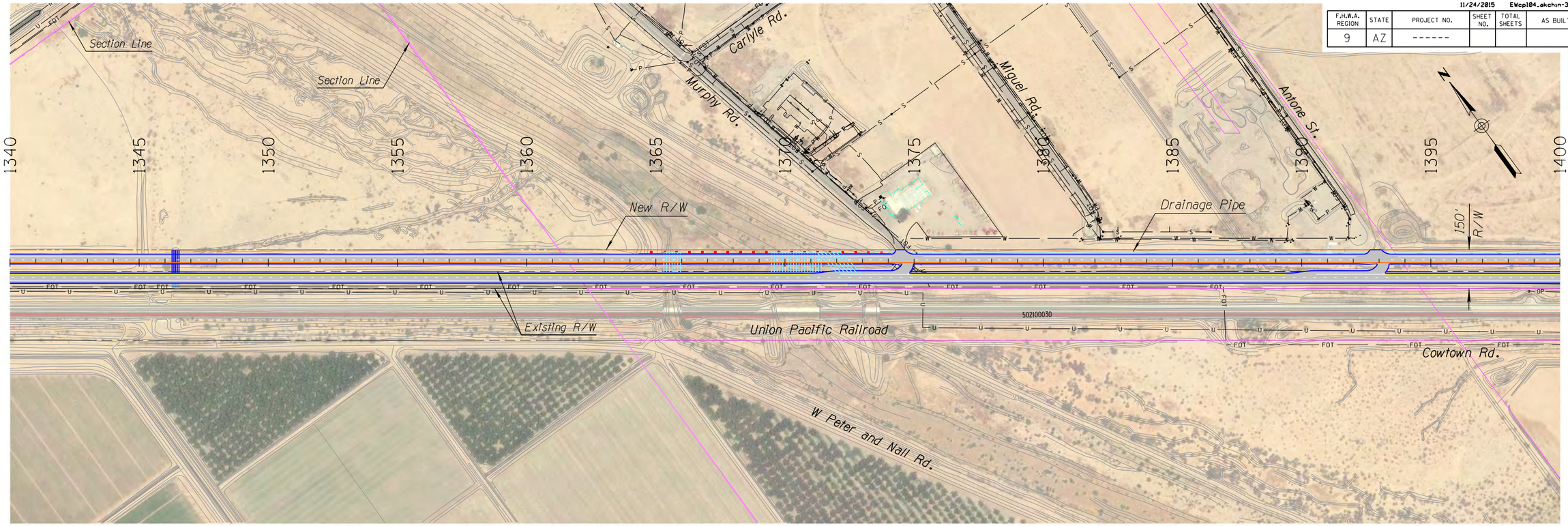
LOCATION
EAST - WEST CORRIDOR STUDY

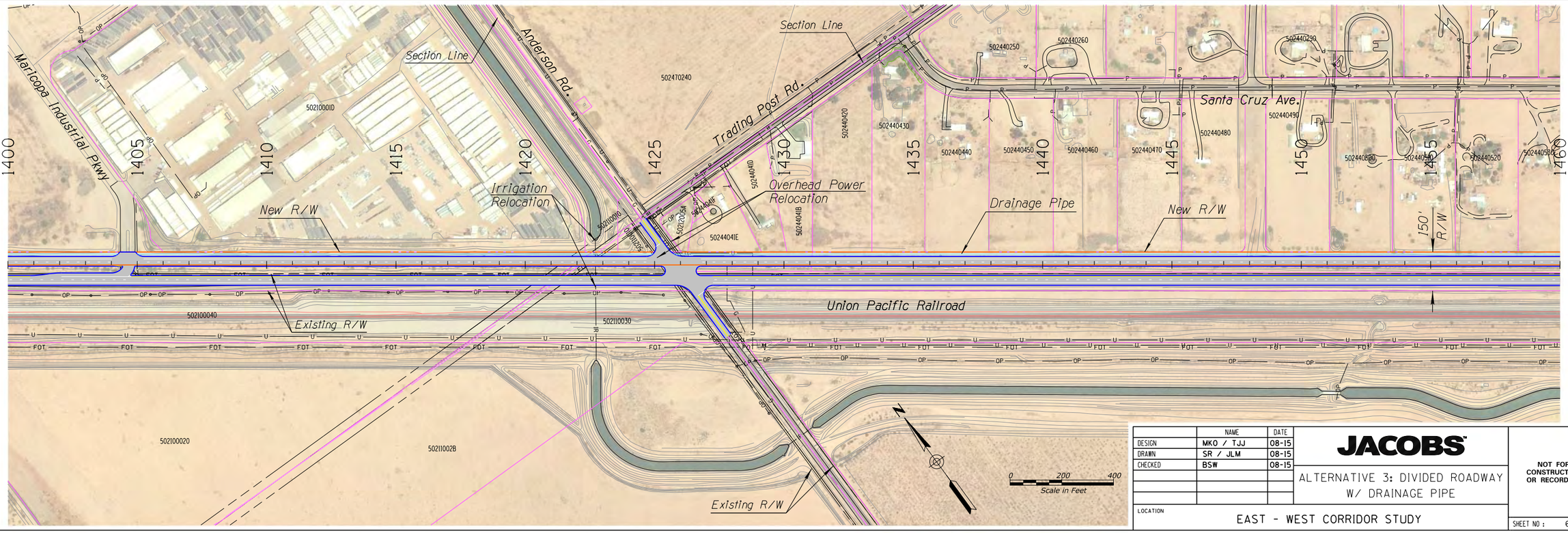
SHEET NO : 5

P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\EWcpl05_akchin-2.dgn

11/24/2015 EWcpl04_akchin-3.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	AZ	------			





	NAME	DATE
DESIGN	MKO / TJJ	08-15
DRAWN	SR / JLM	08-15
CHECKED	BSW	08-15

JACOBS

ALTERNATIVE 3: DIVIDED ROADWAY W/ DRAINAGE PIPE

LOCATION

EAST - WEST CORRIDOR STUDY

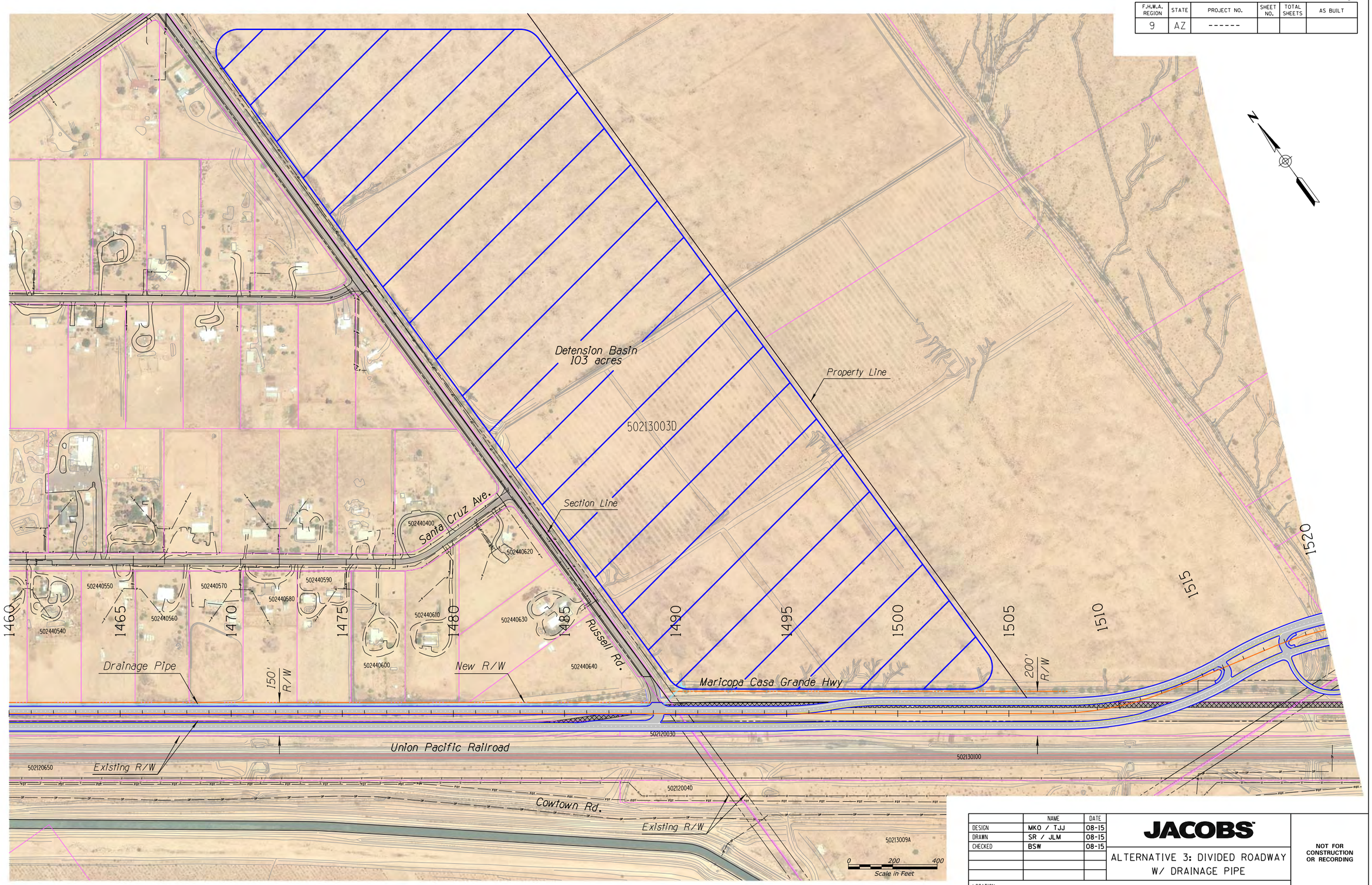
NOT FOR CONSTRUCTION OR RECORDING

SHEET NO : 6

P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\EWcpl04_akchin-3.dgn

11/24/2015 EWcpl05.akchin-3.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	AZ	------			



	NAME	DATE
DESIGN	MKO / TJJ	08-15
DRAWN	SR / JLM	08-15
CHECKED	BSW	08-15

JACOBS

ALTERNATIVE 3: DIVIDED ROADWAY W/ DRAINAGE PIPE

NOT FOR CONSTRUCTION OR RECORDING

LOCATION

EAST - WEST CORRIDOR STUDY

SHEET NO : 7

P:\W7X94300 Pinal EWC\700CADD\702CIVIL\702ADGN\EWcpl05_akchin-3.dgn

APPENDIX D:
DRAINAGE SUMMARY

JACOBS™

Pinal County's East-West Corridor Study

Project Document:

Preliminary Drainage Report

Submitted to:
Pinal County
Department of Public Works

Submitted:
September 2015

PINAL • COUNTY
Wide open opportunity

City of
Casa Grande

CITY OF MARICOPA
PROUD • HISTORY • PROSPEROUS FUTURE

MARICOPA
CASA GRANDE
PINALCOUNTY

Submitted by:
Jacobs
101 N. 1ST Avenue, Suite 2600
Phoenix, AZ 85003
P: 602.253.1200
F: 602.253.1202
www.jacobs.com

TABLE OF CONTENTS

1.0 INTRODUCTION 1
2.0 HYDROLOGY 5
3.0 EXISTING DRAINAGE STRUCTURES 14
4.0 PROPOSED DRAINAGE STRUCTURES 18
5.0 SUMMARY 20
6.0 RERERENCES 21

FIGURES

1 Project Vicinity Map 1
2 FEMA Firmette Santa Rosa Wash 6
3 FEMA Firmette Santa Cruz Wash 7
4 FEMA Firmette Santa Cruz Wash 8
5 Segment B and Segment C Subbasins 10
6 Segment C Subbasins 11
7 Segment C Subbasins 12

APPENDICES

Appendix I	Segment B and Segment C Hydrology
Appendix II	Roadway Plans
Appendix III	Segment B Drainage Alternatives
Appendix IV	Maricopa – Casa Grande Highway Final Drainage Report w/o appendices

1.0 INTRODUCTION

Pinal County, in cooperation with the City of Maricopa and the City of Casa Grande, has initiated a design concept study and related environmental studies to identify and evaluate alternatives for the development of an East-West transportation improvement between the City of Maricopa and Interstate 10 (I-10). The Alternatives Selection Report for the East-West Corridor Study has identified and evaluated alternative alignments and configurations for an access controlled roadway that will begin at its intersection with State Route 347 (SR 347) in the City of Maricopa and will proceed east, ending at an intersection with I-10 in the City of Casa Grande. See Figure 1, Project Vicinity Map.

The evaluation of alternatives identified alternatives to be carried into the Design Concept Study phase. The proposed roadway will be a partial access controlled parkway. The study corridor is located in Pinal County and passes through portions of the City of Maricopa and the City of Casa Grande. Alternative corridor locations may pass through Arizona State Trust land, the Ak-Chin Indian Community, private property and other jurisdictional properties. Pinal County, the City of Maricopa and the City of Casa Grande will each have jurisdiction over the portion of the East-West roadway within their jurisdictional limits. Pinal County will also have jurisdiction over any portions of the roadway located within the Ak-Chin Indian Community.

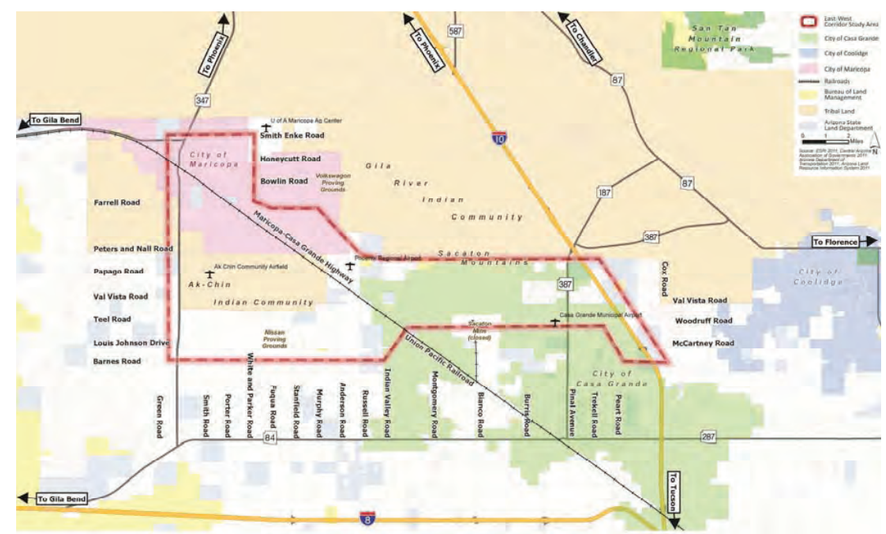


Figure 1 - Project Vicinity Map

This Preliminary Drainage Report summarizes the existing drainage data and provides a summary of drainage assumptions and approaches used in the preliminary drainage design. This report was also prepared to determine the 50-year and 100-year hydrology for the project and to develop a design for the proposed drainage structures. At locations where alternative systems are possible, those systems have been evaluated. The proposed structures shown are for the purpose of developing preliminary construction plans and an accurate cost estimate for the project. Final designs will be included in a Final Drainage Report.

The purpose of this report was to document the analysis of the existing hydrologic and hydraulic conditions for the proposed corridor study area based on a review of existing reports and documentation. Flow rates were identified based on the studies collected, Federal Emergency Management Agency (FEMA) accepted regression equations based on Pinal County defined contributing drainage areas and HEC-1 analyses. The results of these analyses were used to develop conceptual level sizes of major drainage structures and prepare a preliminary cost for drainage improvements. FEMA floodplains within the project limits were identified based on readily available published information.

The study limits are from SR347 to I-10. The study alignment is approximately described as follows: from SR347 to the east along Farrell Road to Maricopa-Casa Grande Highway (MCGH), then southeast along MCGH to approximately one-half mile east of Russell Road, then east along Val Vista Boulevard to I-10. The project was further divided into three parts: Segment A from the project beginning to the Santa Cruz Wash, Segment B from the Santa Cruz Wash to the start of Val Vista Road, and Segment C from Val Vista Road to the project end at I-10. At the Santa Cruz Wash, a recent project was completed to make the MCGH an all-weather facility. Data from that project's final drainage report has been included in this report. Due to the limited right-of-way in Segment B, alternative drainage concepts were developed. These alternatives included a detention basin, concrete lined channels and unlined earthen channels.

As-built and record drawings were not located; however, a field reconnaissance of the entire study alignment was performed and field measurements of drainage crossing structures are documented in this report.

An evaluation of FEMA regulated floodplain and floodway boundaries was developed based on the Flood Insurance Rate Map (FIRM) Panels 0745E, 0775E, 1150E, 1175E and 1200E of 2575. The following section describes the existing flood hazard zones encountered along the study alignment from west, SR347, to east, I-10.

The segment of the study alignment from SR 347 to approximately one-half mile west of Porter Road is coincident with the existing Farrell Road alignment and is located within Zone X. Zone X is defined on the FIRM as "Areas determined to be outside the 0.2% annual chance flood". Within this segment, the study alignment crosses a portion of the Vekol Wash Tributary which lies immediately east of and parallel to SR 347. The

floodplain for this wash is designated as Zone AE based on the "*Vekol Wash Tributary Floodplain Delineation Study"*, April 2012, by Wood/Patel. Zone AE is defined as areas subject to inundation by the 1-percent-annual-chance flood event determined by detailed methods. Base Flood Elevations (BFEs) are shown.

Between Porter Road and White & Parker Road, the study alignment crosses the Santa Rosa Wash. In the vicinity of this crossing, the study alignment crosses several flood zone designations including Zone X Shaded, Zone A and Zone AO. Zone X Shaded is defined on the FIRM as "Areas of 0.2% chance annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood". Zones A and AO are defined on the FIRM as Special Flood Hazard Areas (SFHA) subject to inundation by the 1% annual chance flood. The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. Zone A is defined as a SFHA with "No base flood elevations determined". Zone AO is defined as a SFHA with "Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined".

The study alignment from White and Parker Road to approximately one-half mile east of Russell Road is coincident with the existing MCGH alignment. This portion of the study alignment from White and Parker Road to east of Fuqua Road is located within the Zone A associated with the Santa Rosa Wash. Between Hartman Road and Murphy Road, the study alignment crosses the North Santa Cruz Wash which is also designated as Zone A. The remainder of this segment is designated as Zone X including a reach approximately one mile long between Fuqua Road and Hartman Road that lies between the Santa Rosa Wash Zone A and Santa Cruz Wash Zone A. The study alignment diverges from the highway and continues to the east approximately along the Val Vista Blvd. alignment to I-10. This entire segment is designated as Zone X.

There are several distinct drainage patterns along the study alignment. Between SR347 and the North Santa Cruz Wash, the flow direction is generally from south to north with concentrated flow conveyed within three significant wash corridors. East of the North Santa Cruz Wash the flow is generally conveyed within shallower split flow areas the direction of which is determined by the Sacaton Mountains. From the North Santa Cruz Wash to approximately Russell Road, the flow direction is almost due west. The flow direction transitions to the southwest between Russell Road and Bianco Road, to south between Bianco Road and Faldale Road and to the southeast from Faldale Road to I-10.

As previously noted, the study alignment crosses three significant wash corridors. The effective FEMA Flood Insurance Study (FIS), dated December 4, 2007, includes 100-year peak flow information for two of these crossings, the Santa Rosa Wash and the North Santa Cruz Wash, and is the basis of the current floodplain delineation at these locations. The off-site flow for the Vekol Wash Tributary was developed by Wood/Patel as part of the "*Hydrology Update Report for Vekol Wash Tributary"*, August 2011. The proposed wash crossings are further described in the following section.

The study alignment crosses the Vekol Wash Tributary immediately east of SR 347. A FEMA flood delineation study defining the Vekol Wash Tributary floodplain limits was conducted by BakerAECOM in 2011. This study uses previous defined flows from the *City of Maricopa Master Drainage Study and Plan*, by HDR, dated August 2009. However, the City chose to appeal the FEMA study. Wood/Patel has re-evaluated the hydrology and hydraulics and has developed new 100-year peak flows and floodplain limits as documented in the *City of Maricopa Vekol Wash Tributary Floodplain Delineation Study Technical Data Notebook* (TDN), dated April 2012. This TDN is currently under review by the City. It's anticipated that once the City's review is completed and all comments are addressed, the TDN will be submitted to FEMA as part of the appeal process. The FEMA appeal period is a 90 day process which began on May 11, 2012. The 100-year peak flow from this study is 1,627 cfs at the study alignment crossing.

The study alignment crosses the Santa Rosa Wash between Porter Road and White & Parker Road. The 100-year peak flow from the published FIS at this location is 14,800 cfs. It also crosses the North Santa Cruz Wash between Hartman Road and Murphy Road. The 100-year peak flow from the published FIS at this location is 9,800 cfs.

2.0 HYDROLOGY

The objective of the hydrologic analysis was to quantify the existing off-site flows contributing to the project corridor within the study limits. This information was used in the development of storm water management alternatives for the proposed roadway improvements. Where existing drainage studies and hydrologic analyses are available, the efforts have focused on utilizing this information where practical. In the remaining areas where comprehensive hydrologic modeling had not been developed, new analyses were performed as part of this study based on Pinal County defined drainage areas. It should be noted that several alluvial fans and fissure risk zones have been identified within the watershed but are not located directly along the study alignment.

The primary drainage features of this project are the Santa Rosa Wash and the Santa Cruz Wash and which flow from the southeast to the northwest crossing the proposed East-West Corridor. These drainage features are FEMA delineated floodplains as shown on the FIRMs, see Figures 2, 3 and 4. The 100-year peak discharges were based on the Pinal County FIS as follows.

Tributary	100-year Peak Discharge
Santa Rosa Wash	14,800 cfs
Santa Cruz Wash	7,600 cfs

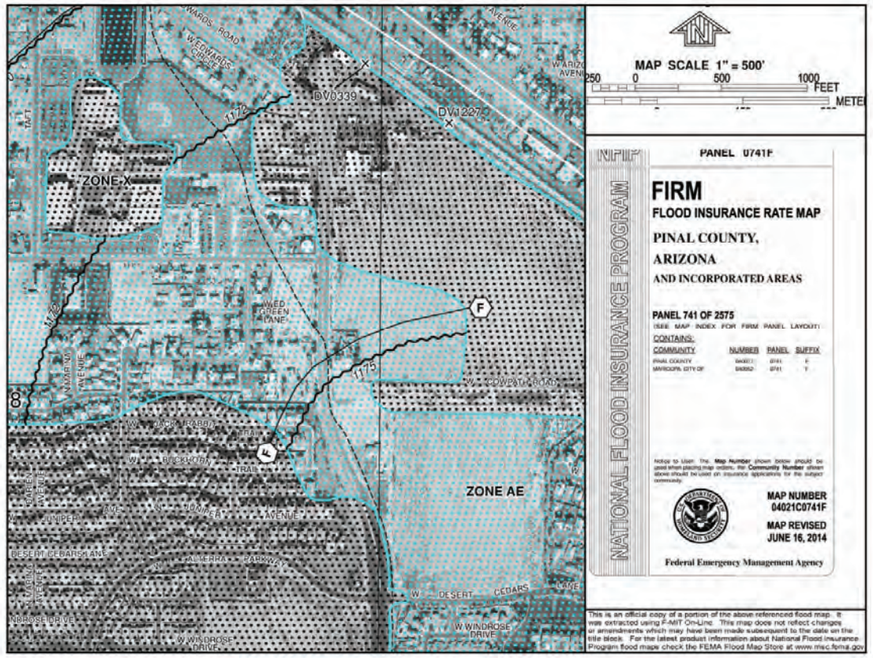


Figure 2 – FEMA Firmette Santa Rosa Wash

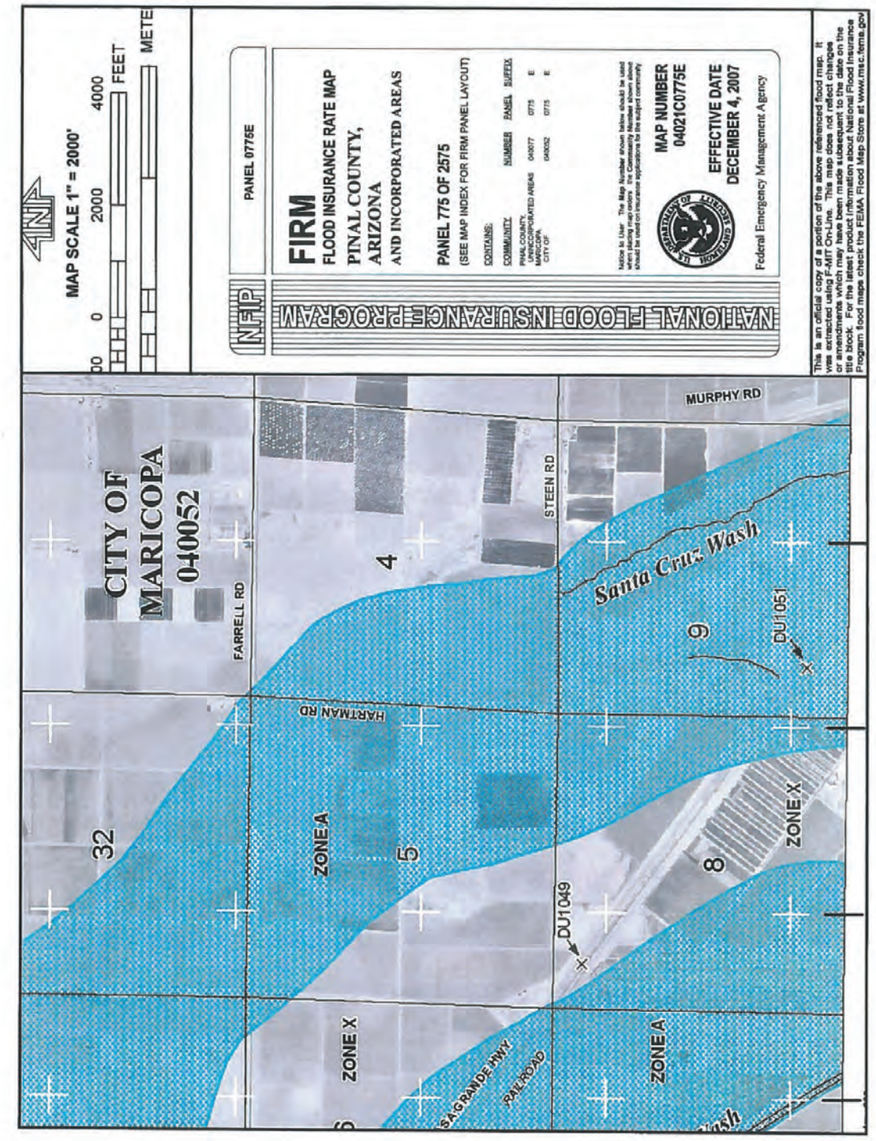


Figure 3 – FEMA Firmette Santa Cruz Wash

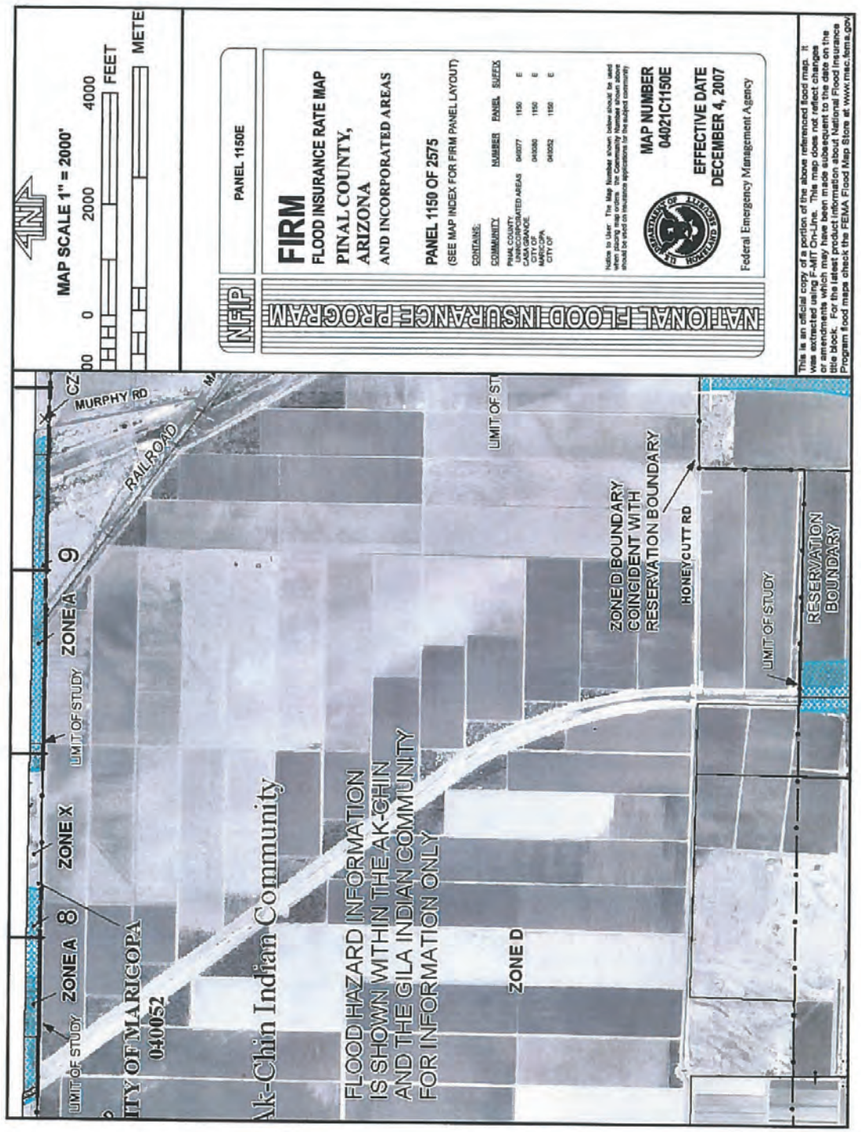


Figure 4 – FEMA Firmette Santa Cruz Wash

For Segment B and Segment C, a HEC-1 model was prepared by J2, see Appendix A. Subbasins were developed representing the offsite flow areas extending into the Sacaton Mountains. Flows conveyed along the north side of the highway within the existing ditch were modeled in HEC-1 using routing cards. Flows spilling over the highway to the south due to the undersized ditch and culvert crossings were modeled using diversion cards. The overtopping highway flow leaves the HEC-1 model and is assumed that it remains south of the highway within the corridor between the UPRR railroad and the highway then conveyed south thru railroad culverts. The HEC-1 model defines the flow overtopping the highway but does not track this flow further south. See Figures 5, 6 and 7 for the subbasin delineations. The table below summarizes the 50-year and 100-year flow at key locations. See Appendix A for the HEC-1 model input and output data.

	Peak Discharges		
Description ID	50-Year	100-Year	Flow Direction
SUB1a	662	816	southwest
SUB1b	745	910	southwest
SUB2a	1276	1557	southwest
SUB2b	488	597	southwest
SUB3	1296	1616	southwest
RW-SC	765	824	west at Santa Cruz Wash
DS-1A	556	710	south flow diverted south[1]
DW-1B	686	758	west flow[2]
DS-1B	741	912	south flow diverted south[3]
DW-2A	846	969	west flow[4]
DS-2A	480	701	south flow diverted south[5]
RW-2B	172	225	west flow

1 diverted south over highway between Industrial Parkway and Anderson Road
2 north of highway at Anderson Road
3 diverted south over highway between Anderson Road and Russell Road
4 north of highway at Russell Road
5 diverted south over highway between Russell Road and Indian Valley Road

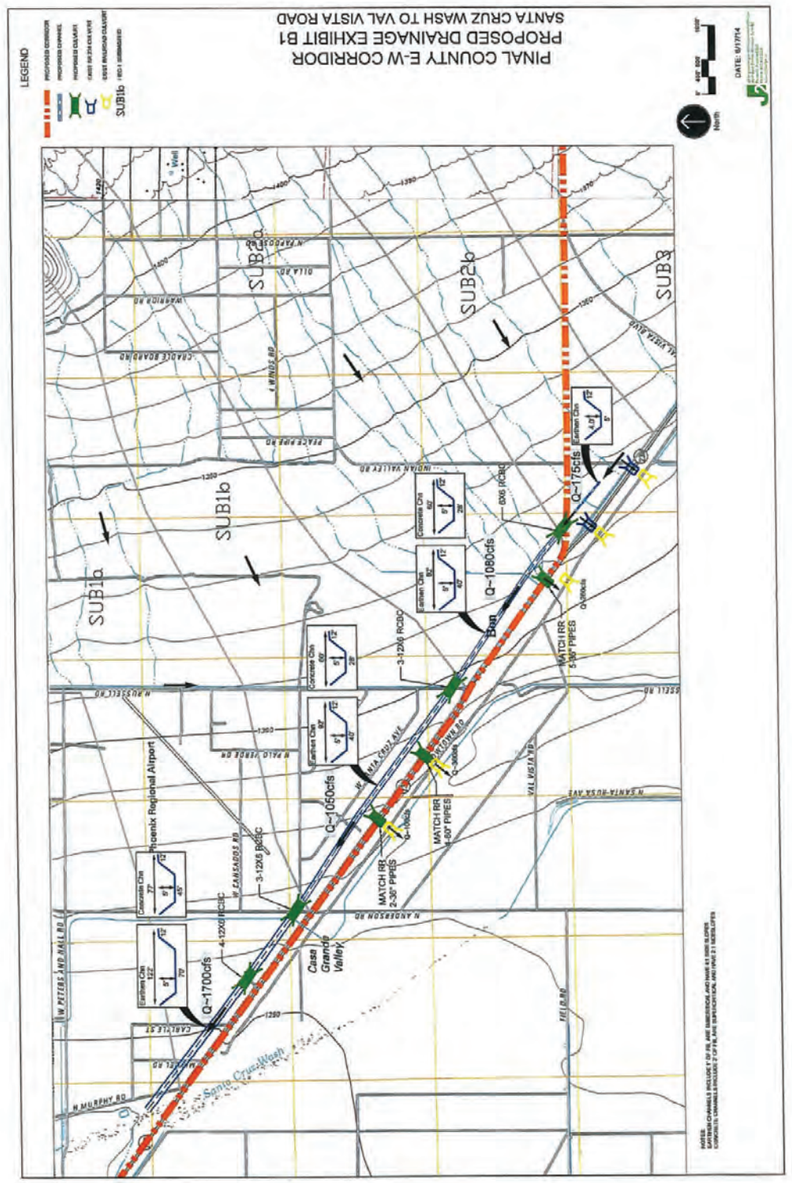


Figure 5 – Segment B and Segment C Subbasins

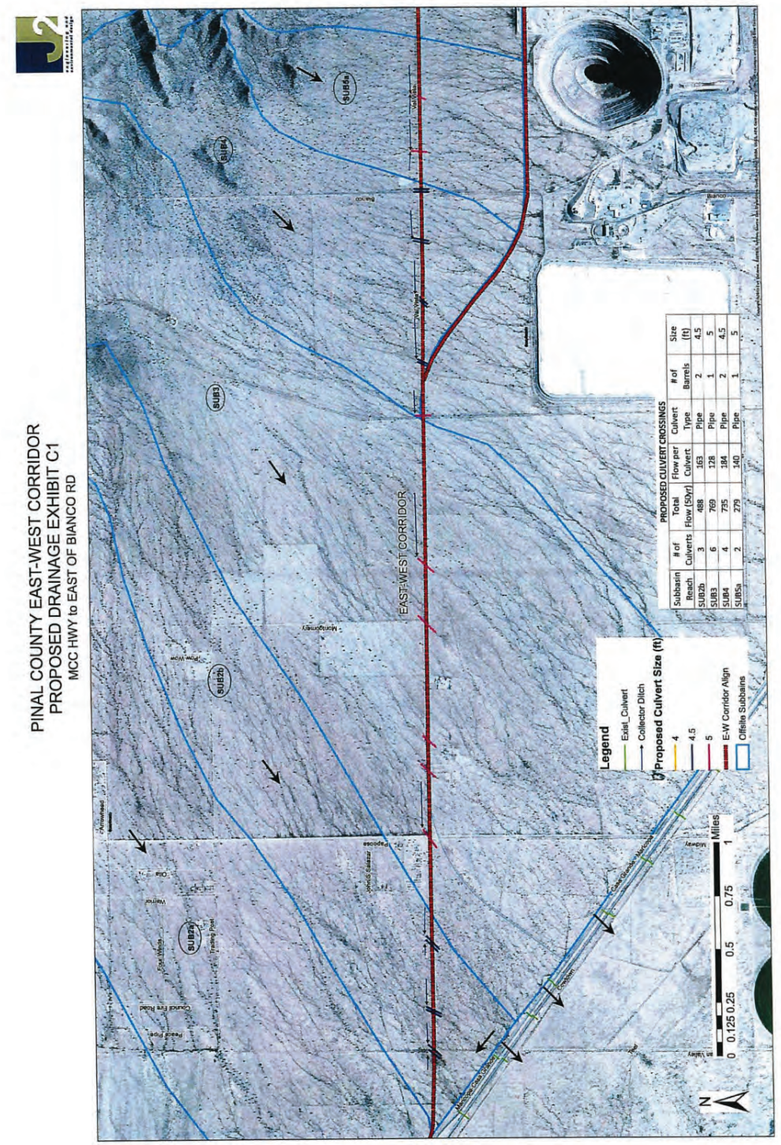
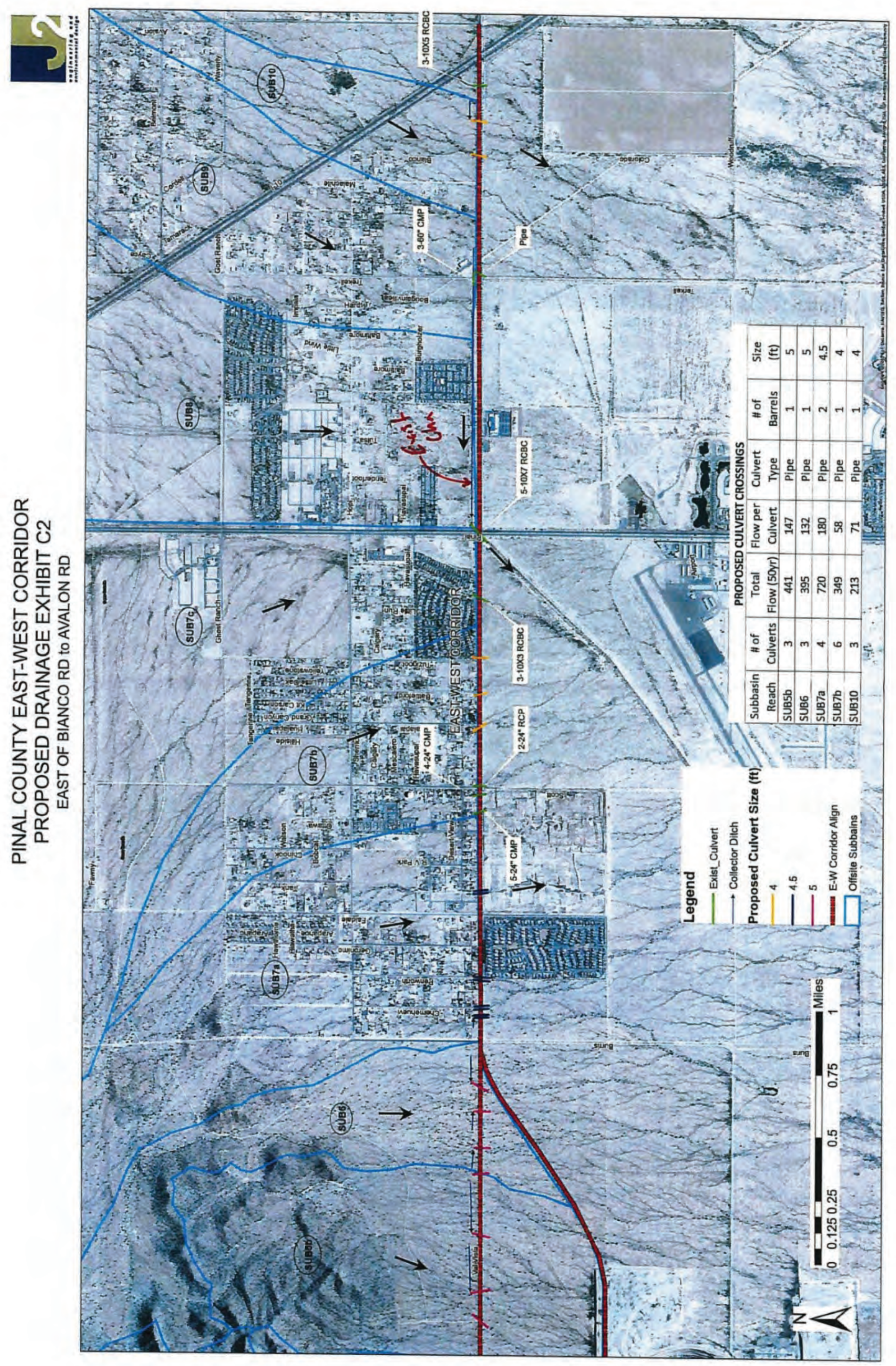


Figure 6 – Segment C Subbasins



Subbasin Reach	# of Culverts	Total Flow (50yr)	Flow per Culvert	Culvert Type	# of Barrels	Size (ft)
SUB5b	3	441	147	Pipe	1	5
SUB6	3	395	132	Pipe	1	5
SUB7a	4	720	180	Pipe	2	4.5
SUB7b	6	349	58	Pipe	1	4
SUB10	3	213	71	Pipe	1	4

Figure 7 – Segment C Subbasins

Computations for the design peak discharges at minor subbasins and on-site will be developed in the final design using the Rational Method. These computations will be performed in accordance with ADOT procedures. Rainfall intensities will be taken from NOAA Atlas 14. The time of concentration, T_C, will be computed with the minimum being 10 minutes; therefore the rainfall intensities will be 6.07 inches per hour or less. For the runoff coefficient, the subbasins were determined to be rural desert with one hour precipitation equal to 2.09 inches. As specified by ADOT, the runoff coefficient, C, equals 0.53. Peak discharges will be computed as follows.

$Q = C\ i\ A$

Where:

Q = peak discharge (cubic feet per second)

C = runoff coefficient = 2.09

i = rainfall intensity (inches per hour) = 6.07

A = basin area (acres).

3.0 EXISTING DRAINAGE STRUCTURES

There is an existing box culvert under Farrell Road immediately east of SR347 at the Vekol Wash Tributary. Currently, Farrell Road terminates at Porter Road and does not cross the Santa Rosa Wash. However, the study alignment will cross the Santa Rosa Wash west of White & Parker Road.

The MCGH lies north of and parallel to the Union Pacific Railroad (UPRR) along this portion of the study alignment. There is a number of existing UPRR drainage structures constructed upstream of the MCGH. Flow from these structures cross the MCGH via either dipped roadway crossings or culvert crossings at the following locations:

- Near the Fuqua Road alignment, there is a dipped roadway crossing immediately downstream of a UPRR culvert consisting of four 60" plate metal pipes.

- Approximately half way between Fuqua Road and Hartman Road, there is a dipped roadway crossing immediately downstream of a UPRR bridge crossing approximately 25 feet wide.

- Approximately one-quarter mile west of Hartman Road, there is a dipped roadway crossing immediately downstream of a UPRR bridge crossing approximately 30 feet wide.

- Approximately 1,000 feet east of Hartman Road, there is a dipped roadway crossing immediately downstream of a UPRR culvert consisting of three 58" wide x 36" high plate metal arches.

- Approximately 2,500 feet east of Hartman Road, there is a dipped roadway crossing immediately downstream of a UPRR culvert consisting of three 58" plate metal pipes.

- Approximately 4,900 feet east of Hartman Road, there is a dipped roadway crossing immediately downstream of a UPRR culvert consisting of five 58" plate metal pipes.

The North Santa Cruz Wash crosses the MCGH immediately west of Murphy Road. The flow from the wash is conveyed under the UPRR through three separate bridges and over the MCGH by dipped crossings.

- Approximately one-half mile east of Anderson Road, there is a dipped roadway crossing immediately downstream of a UPRR culvert consisting of two 36" plate metal pipes.

- Approximately 4,500 feet east of Anderson Road, there is a dipped roadway crossing immediately downstream of a UPRR culvert consisting of four 58" plate metal pipes.

The study alignment diverges from the MCGH and continues to the east approximately along the Val Vista Boulevard alignment to I-10. There are a number of dipped roadway crossings and culvert crossings along this reach of the study alignment at the following locations:

- The study alignment between MCGH and Midway Road is not coincident with the existing Val Vista Boulevard alignment; therefore, there are no dipped sections or culverts within this reach.

- There are dipped roadway crossings along the study alignment at the Montgomery Road, Carales Road and Bianco Road alignments.

- There are seven dipped roadway crossings between Corrales Road and Bianco Road alignments located at approximately 100', 1100', 1700', 1800', 2800', 3000', 4350' and 4550' east of Corrales Road.

- There are four dipped roadway crossings between Bianco Road and Burris Road alignments located at approximately 2900', 5400', 7850' and 9600' east of Bianco Road.

There are four dipped roadway crossings and three culvert crossings between Burris Road and Scott Drive alignments. The dipped crossings are located at approximately 700', 1300', 3100' and 3550' east of Burris Road. The culvert crossings in this reach are located near Scott Drive. There is a 5-24" culvert crossing approximately 530' west of Scott Drive and a 4-24" culvert crossing approximately 150' west of Scott Drive. There is a dipped crossing located immediately west of Scott Drive and a 2-24" culvert crossing located immediately east of Scott Drive.

- There is a dipped roadway crossing located at approximately Hualapai Drive and 2-24" culvert crossings at both Battleford Drive and Tuzigoot Drive. There is a 3 barrel, 10' x 5' concrete box culvert located immediately east of Crane Drive in the Copper Vista subdivision.

- There is a 5-24" culvert crossing located approximately 200' west of Pinal Avenue (SR 387). There is also a box culvert crossing under Pinal Avenue from the northeast to the southwest.

- At Turkell Road there are two culverts crossing on the east side of road that have bulkheads with small openings in the invert to allow minor flows to the south. There are three 60" pipes crossing Turkell Road located parallel to and immediately north of Val Vista Drive. Between Terkell Road and I-10, there are three dipped crossings locate approximately 1,800, 2,500 and 3,000 feet east of Terkell Road. There is a 3 barrel - 10' x 5' box culvert located approximately 600' west of the centerline of I-10.

Santa Cruz Wash

The runoff from the Santa Cruz wash passes under the UPRR at a 2-span bridge with 56' length, a 6-span bridge with 180' length and another 2-span bridge with 56' length. The previous roadway had one long dip section with 2-24" corrugated metal pipes. The MCGH has been improved with a 6-barrel 10'x6' concrete box culvert, an 18-barrel 10'x6' concrete box culvert and another 6-barrel 10'x6' concrete box culvert on a 45° skew.

2-Span Bridge

6-Span Bridge

To the west of the bridges is a crossing with 5-60" corrugated metal pipes under the UPRR. The dip section with 24" culvert under the roadway has been replaced with 5-24" corrugated metal pipes.

6-Span Bridge

Murphy Road and Upstream

The Murphy Road drainage crossing at the MCGH lies immediately northeast of the intersection. Murphy Road has a reinforced concrete box culvert. Upstream from this location, to the southeast, is a 3-10'x4' box culvert at an undeveloped parcel, 4-80"x60" arch culvert at North Maricopa Industrial Parkway, a 3-80"x60" arch culvert at North Anderson Road and a 4-80"x60" arch culvert at North Russell Road.

Box Culvert at Undeveloped Parcel

Arch Culvert at Maricopa Industrial Pkwy

Arch Culvert at Anderson Road

Arch Culvert at Russell Road

In Segment B there are existing pipe culverts under the UPRR as follows.

Station	Existing Structure
1453+00	2-36" pipes
1471+31	4-60" pipes
1510+25	3-36" pipes
1555+53	8'x4' RCBC
1568+85	2-6'x3' RCBC

4.0 PROPOSED DRAINAGE STRUCTURES

The proposed drainage structures including extensions of existing culverts are shown on the roadway plans, see Appendix II. Segment A consists of a bridge spanning the Santa Rosa Wash. Other culverts will typically be 24” CMPs to drain the roadway and minor off-site subbasins. The roadway will have V-ditches to collect the off-site runoff and convey to the culverts. In the final design, the outlets for all culverts will be evaluated for the need of outlet protection. If needed, this will be provided with riprap aprons.

Alternative systems have been evaluated for Segment B. In all of the options the runoff from Segment C is conveyed to the Santa Cruz Wash. A portion of the runoff will be drained to the existing culverts under the UPRR. The proposed culverts at those locations will match the existing culverts. Therefore Segment B will require an open channel along the roadway north right of way. At each side street crossing, culverts will be needed. Since the existing structures are undersized, new culverts have been proposed. The open channel was sized based on either a concrete lined channel or an unlined earthen channel. In addition, a proposed detention basin was evaluated. This basin would be located at the west limits of Segment C and would enable the downstream channels and culverts to be reduced in size. This analysis is included in Appendix III. The results show that the most practical alternative is a concrete lined channel with no detention basin.

As shown on the roadway plans, Segment C will have a series of pipe culverts and concrete box culverts. In the developed areas, existing structures will be extended as needed. The off-site runoff drains to the southwest so the typical section has a V-ditch on that side of the roadway to collect runoff and convey it to the proposed structures. The roadway plans also show areas where a larger channel will be required. Those ditches will typically be unlined trapezoidal channels with a bottom width of 8 feet. If the right-of-way is not adequate for an unlined channel, a concrete channel will be constructed. As in the other segments, all culverts will be evaluated for the need of outlet protection. Based on the projected flows, riprap aprons will most likely be sufficient. The proposed drainage structures are shown as follows.

Station	Proposed Structure	Station	Proposed Structure
1091+00	2 – 10’x6’ RCBC	3233+54	60” CMP
1129+00	Santa Rosa Bridge	3242+83	2 – 54” CMPs
1346+40	5 – 24” CMPs extension	3257+34	2 – 54” CMPs
1365+63	6 – 10’x6’ RCBC extension	3280+02	2 – 54” CMPs
1370+44	18 – 10’x6’ RCBC extension	3290+91	2 – 54” CMPs
1371+98	6 – 10’x6’ RCBC extension	3301+83	2 – 60” CMPs
1374+47	5 – 10’x6’ RCBC	3339+17	60” CMP
1392+09	5 – 10’x6’ RCBC	3350+36	2 - 60” CMP
1404+64	5 – 10’x6’ RCBC	3360+85	60” CMP
1425+23	4 – 10’x6’ RCBC	3375+79	60” CMP
1453+00	2 – 36” CMPs	3389+27	60” CMP
1471+31	4 – 60” CMPs	3397+37	60” CMP
1489+03	4 – 10’x6’ RCBC	3413+86	2 – 54” CMPs
1510+44	5 – 36” CMPs	3415+97	2 – 54” CMPs
1529+84	6’x6’ RCBC	3421+46	2 – 54” CMPs
1533+43	6’x6’ RCBC	3439+71	2 – 54” CMPs
1534+79	6’x6’ RCBC	3457+17	5 – 24” CMPs
1536+24	6’x6’ RCBC	3460+12	4 – 24” CMPs
1538+83	6’x6’ RCBC	3461+96	2 – 24” CMPs
1555+54	8’x5’ RCBC	3472+90	48” RCP
1555+56	8’x4’ RCBC extension	3481+14	48” RCP
1568+88	2 - 6’x3’ RCBC extension	3488+87	48” RCP
3074+58	2 – 54” CMPs	3500+96	3 – 10’x5’ RCBC
3084+58	2 – 54” CMPs	3513+50	RCBC extension
3102+11	2 – 54” CMPs	3526+50	3 – 10’x5’ RCBC
3128+75	60” CMP	3536+75	3 – 10’x5’ RCBC
3144+86	60” CMP	3560+95	3 – 10’x5’ RCBC
3152+50	60” CMP	3593+17	48” CMP
3182+26	60” CMP	3600+58	48” CMP
3196+95	60” CMP	3607+97	3 - 10’x5’ RCBC

5.0 SUMMARY

The hydrology results in this report have been used in the preliminary design of the East-West Corridor major drainage improvements. Peak discharges for Santa Rosa Wash and Santa Cruz Wash have been taken for the Pinal County Flood Insurance Study. Flow rates for Segment B and Segment C were established using HEC-1 after alternate systems had been evaluated. As previously stated, the Rational Method will be used to compute peak discharge rates for minor culverts and channels.

Box culvert sizes had been developed for the MCGH at the Santa Cruz Wash. These existing structures will be extended for the East-West Corridor. Preliminary sizes of drainage facilities in Segment B and Segment C were determined in the alternative study. In final design when pipe profiles are established, the pipe and culvert sizes will be adjusted. In addition, all major ditches and culvert outlet protection will be designed.

Therefore this Preliminary Drainage Report was used to determine initial structure sizes and the right-of-way requirements for drainage improvements. It is understood that a bridge will be required at the Santa Rosa Wash. The design of that structure will be included in a separate report.

6.0 REFERENCES

Initial Drainage Report for the East-West Corridor Study, Wood, Patel & Associates, Inc.

Pinal County Drainage Manual, Pinal County.

Drainage Design Manual for Maricopa County, Arizona, Volume I – Hydrology, Flood Control District of Maricopa County, January 1995.

Drainage Design Manual for Maricopa County, Arizona, Volume II – Hydraulics, Flood Control District of Maricopa County, January 2009 (draft).

Drainage Design Manual for Maricopa County, Arizona, Volume II – Hydraulics, Flood Control District of Maricopa County, January 1996.

Drainage Policies and Standards for Maricopa County, Arizona, Flood Control District of Maricopa County, January 2007.

FIRM Flood Insurance Rate Map, Pinal County, Arizona and Incorporated Areas, Map No. 04021C1150E, December 4, 2007.

FIRM Flood Insurance Rate Map, Pinal County, Arizona and Incorporated Areas, Map No. 04021C0775E, December 4, 2007.

FIRM Flood Insurance Rate Map, Pinal County, Arizona and Incorporated Areas, Map No. 04021C0741F, June 16, 2014.

Ak-Chin Indian Community Economic Development Zone Drainage Study, Dibble Engineering.

East-West Corridor Existing Drainage Draft Technical Memorandum, J2 Engineering, April 30, 2014.

E-W Corridor Drainage Cost Estimate Draft Technical Memorandum, J2 Engineering, May 6, 2015.

Final Drainage Report for the Maricopa-Casa Grande Highway at Santa Cruz Wash, Jacobs Engineering, December 2014.

Appendix I

Segment B and Segment C Hydrology

J2 Engineering and Environmental Design, LLC
4649 E. Cotton Gin Loop
Suite B2
Phoenix, Arizona 85040
Phone: 602.438.2221
Fax: 602.438.2225

DRAFT Memorandum

To:	John Pat Fyie	Fax:	602-253-1202
Organization:	Jacobs	Phone:	602-530-1667
From:	Darren Forstie	Date:	April 30, 2014
Re:	East-West Corridor Existing Drainage	Pages	4
CC:	Jeff Holzmeister	Project Number:	110537

This Memo briefly summarizes the existing drainage conditions/offsite hydrology and HEC-1 modeling for the East-West Corridor project in Pinal County, Arizona. The purpose of this memo is to summarize the existing drainage analysis and offsite hydrologic understanding to date, to provide documentation in order to advance drainage discussions with the County (if needed), and to serve as a foundation for future drainage conceptual designs and discussions.

General:
For purposes of this memo, the Corridor is divided into three segments from west to east. Segment A is from SR 347 to the Santa Cruz Wash; Segment B is from the Santa Cruz Wash to approximately Val Vista Road; and Segment C is from approximately the start of Val Vista Road to Avalon Street (just east of I-10). See Figure 1 for illustrated segments.

To gain a better understanding of the existing drainage conditions and the offsite flows that impact the project, a HEC-1 model was developed for both the 50-year and 100-year storm events. The methodology as outlined in the ADOT manual (Highway Drainage Design Manual Hydrology, Final Report, March 1993) was performed using the Green and Ampt equations for rainfall losses and the Clark unit hydrograph. The Flood Control District of Maricopa County's (FCDMC) Drainage Design Management System (DDMSW) software was utilized to determine the average rainfall depths (NOAA Atlas 14) and to assist in the development of some of the hydrologic parameters. The HEC-1 schematic is illustrated in the attached exhibit (*Existing Drainage Conditions & HEC-1 Schematic*). Note the subbasin delineation and labeling is based on Pinal County defined contributing drainage areas. Some of the subbasins are truncated and further sub-divided to better define the flow at the Corridor alignment to assist future roadway conceptual level design.

Figure 1

Segment A:
This segment extends from the SR 347 to the Santa Cruz Wash and is influenced by three major washes; the Vekol Wash Tributary, the Santa Rosa Wash, and the Santa Cruz Wash. The general land slope is from south to north. There appears to be no other significant offsite flow impacting the Corridor except the area adjacent to and west of the Santa Rosa Wash. This area has been delineated and is defined as subbasin SUB20 in the HEC-1 model. The offsite flow at the Corridor alignment for this segment is summarized in Table 1 below. See the attached *Subbasin Exhibit* for wash locations, subbasin configurations and flow rates.

Table 1

Offsite Flow	Flow (cfs)		Description
ID	50-Yr	100-Yr	
Vekol Wash Tributary[1]	unknown	1627	Flow at Farrell Road
SUB20[2]	730	882	Flow from HEC-1 Model
Santa Rosa Wash[3]	not defined	14800	Flow upstream of Union Pacific RR
Santa Cruz Wash[3]	not defined	7600	Flow downstream of Union Pacific RR

Notes:

1. Peak discharge from the report *Hydrology Update Report for Vekol Wash Tributary* (dated April 2011).
2. Peak discharge from the existing conditions HEC-1 model
3. Peak discharge from the effective FEMA FIS

Segment B:
This segment extends from the Santa Cruz Wash to approximately the start of Val Vista Road. The existing drainage conditions along this segment are described as follows. The offsite flow originates in the Sacaton Mountains and travels in a southwest direction. A roadside ditch exists along SR 238 (proposed East-West Corridor alignment) north side, is trapezoidal in shape, varies in size and conveys flow to the west out-letting into the Santa Cruz Wash. Culverts within the ditch at Russell Road, Anderson Road, and Maricopa Industrial Parkway are undersized for the 50-year and 100-year flows. South of and adjacent to the highway is the Union Pacific Railroad. Due to the elevated highway and railroad, flow can convey westward within this corridor. The railroad contains multiple culvert crossings (sloping north to south) along this segment while the highway contains none until close proximity to Val Vista Road. Note that multiple highway culvert crossings exist east of Indian Valley Road which align with the railroad culvert crossings.

During a 50-year or 100-year rainfall event, runoff generates north of the highway within the Sacaton Mountains and is conveyed southwestwardly as sheet flow and within small washes. The roadside ditch north of the highway conveys a portion of the flow westward along the highway but at the culvert crossings of the lateral roadways (Russell Road, Anderson Road, and Maricopa Industrial Parkway), a portion of the flow will overtop the highway and spill to the south. South of the highway, the corridor between the highway and the railroad will convey the flow (from highway overtopping) to the west and possibly south by overtopping the railroad at some locations. Additionally, culvert crossings of the railroad will split a portion of this flow to the south and out of the project limits.

The HEC-1 model attempts to simulate the existing flow dynamics. Subbasins were developed representing the offsite flow area extending into the Sacaton Mountains (see attached *Subbasin Exhibit*). Flow conveying along the north side of the highway within the existing ditch is modeled in HEC-1 using routing cards. Flow spilling over the highway to the south due to the undersized

P:\110537\Admin\Reports\Memo_Existing Drainage.doc

ditch and culvert crossing is modeled using diversion cards. The overtopping highway flow leaves the HEC-1 model and is assumed that it remains south of the highway within the corridor between the railroad and the highway and conveys south thru railroad culverts. The HEC-1 model defines the flow overtopping the highway but does not track this flow further south. The table below summarizes the 50-year and 100-year flow at key locations. The HEC-1 model input and output data is attached. The below flows are also displayed on the attached HEC-1 Schematic exhibit.

Table 2 – Flow Summary at Key Locations

HEC-1	Flow (cfs)		Flow	Description
ID	50-Yr	100-Yr	Direction	
SUB1a	662	816	southwest	Subbasins extend northeast into the Sacaton Mountains. See Subbasin Exhibit for layout.
SUB1b	745	910	southwest	
SUB2a	1276	1557	southwest	
SUB2b	488	597	southwest	
SUB3	1296	1616	southwest	
RW-SC	765	824	west	Flow (north of Hwy) at the Santa Cruz Wash
DS-1A	556	710	south	Flow diverted south over Hwy between Industrial Pkwy & Anderson Rd
DW-1B	686	758	west	Western flow (north of Hwy) at Anderson Rd
DS-1B	741	912	south	Flow diverted south over Hwy between Anderson Rd & Russell Rd
DW-2A	846	969	west	Western flow (north of Hwy) at Russell Rd
DS-2A	480	701	south	Flow diverted south over Hwy between Russell Rd & Indian Valley Rd
RW-2B	172	225	west	Western flow (north of Hwy) west of Indian Valley Rd

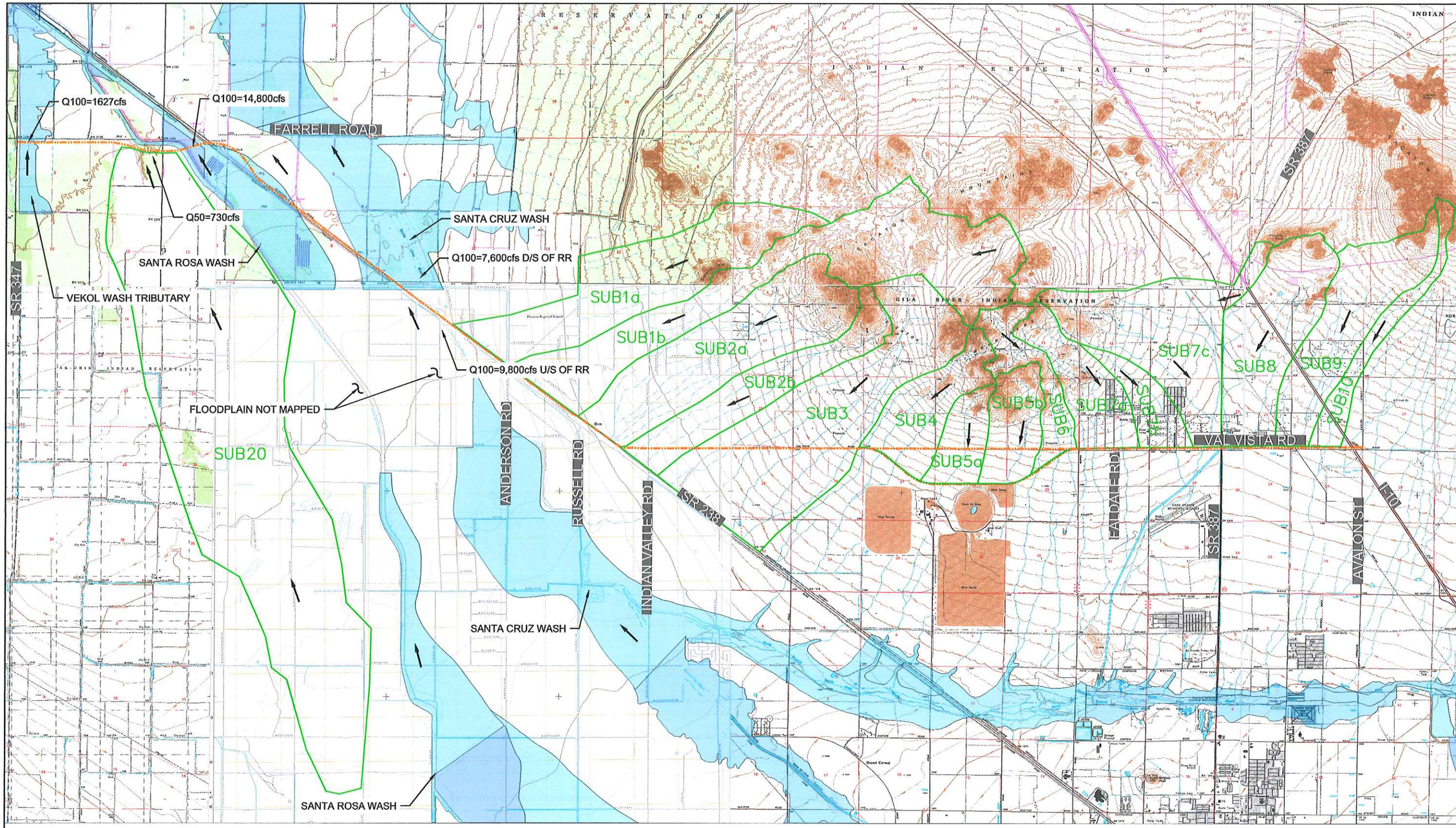
Drainage Considerations for Proposed East-West Corridor Design (Segment B):
It is our understanding that the design frequency of the proposed East-West Corridor is for a 50-year rainfall event. In the existing conditions, it appears the 50-year flow overtops the highway as outlined in this Memo. In the proposed conditions however, this flow overtopping will violated the design standards thus significantly more flow will need to be conveyed westward on the north side of the highway. Preliminary analyses indicate this westward flow to be approximately 1,050 cfs at Russell Road and 1,700 cfs at the Santa Cruz Wash thus requiring significant channel improvements. Additionally, the 100-year flow should be considered in the area between Anderson Road and Russell Road due to the adjacent homes. These homes cannot be adversely impacted during a 100-year storm event.

Segment C:
Segment C extends from approximately the start of Val Vista Road to Avalon Street (just east of I-10) along the Val Vista Road alignment (proposed East-West Corridor alignment). The existing drainage conditions are as follows. Offsite flow originates within the Sacaton Mountains from the north. From the start of Val Vista Road to Faldale Road, the offsite flows pass over Val Vista as sheet flow or within dip crossings. From Faldale Road to Avalon Street, flow conveys south of Val Vista Road thru a combination of dip crossings and culverts. There are significant box culvert crossings at Crane Place, SR 387 and I-10 (just west of). A trapezoidal roadside channel exists along the north side of Val Vista Road extending from east of Trekell Road and west to SR 387. At SR 387, a large box culvert outlets the discharge to the southwest corner. At Trekell Road, a flow split occurs in which the flow travels west and south thru 2 separate culvert systems.

Subbasins were developed for the HEC-1 model representing the offsite flow area extending into the Sacaton Mountains (see attached *Subbasin Exhibit*). Subbasins SUB4 thru SUB7c and SUB10 contain only hydrographs with a peak discharge in the HEC-1 model. However, subbasins SUB8 & SUB9 are followed by routing and diversion cards to simulate the channel along Val Vista Road and the flow split at Trekell Road. Refer to the attached exhibit *Existing Drainage Conditions & HEC-1 Schematic* (page 2 of 2). It's assumed that once flow travels south of Val Vista Road, any flow impacts are negligible and leave the HEC-1 model. The table below summarizes the 50-year and 100-year flow at key locations. The HEC-1 model input and output data is attached.

Table 3 – Flow Summary at Key Locations

HEC-1	Flow (cfs)		Flow	Description
ID	50-Yr	100-Yr	Direction	
SUB4	735	902	southwest	Subbasins extend north into the Sacaton Mountains. See Subbasin Exhibit for layout.
SUB5a	489	599	south	
SUB5b	627	761	south	
SUB6	395	483	south	
SUB7a	720	868	southeast	
SUB7b	349	423	southeast	
SUB7c	936	1157	south	
C8-9	1428	1773	NA	Flow combine at NE corner of SR 387 & Val Vista Rd
DW-9	660	820	west	Western flow diversion at Trekell Rd
DS-9	35	43	south	Southern flow diversion at Trekell Rd
SUB10	213	261	southwest	Subbasin extends northeast into the Sacaton Mountains.



PINAL COUNTY E-W CORRIDOR
SUBBASIN EXHIBIT

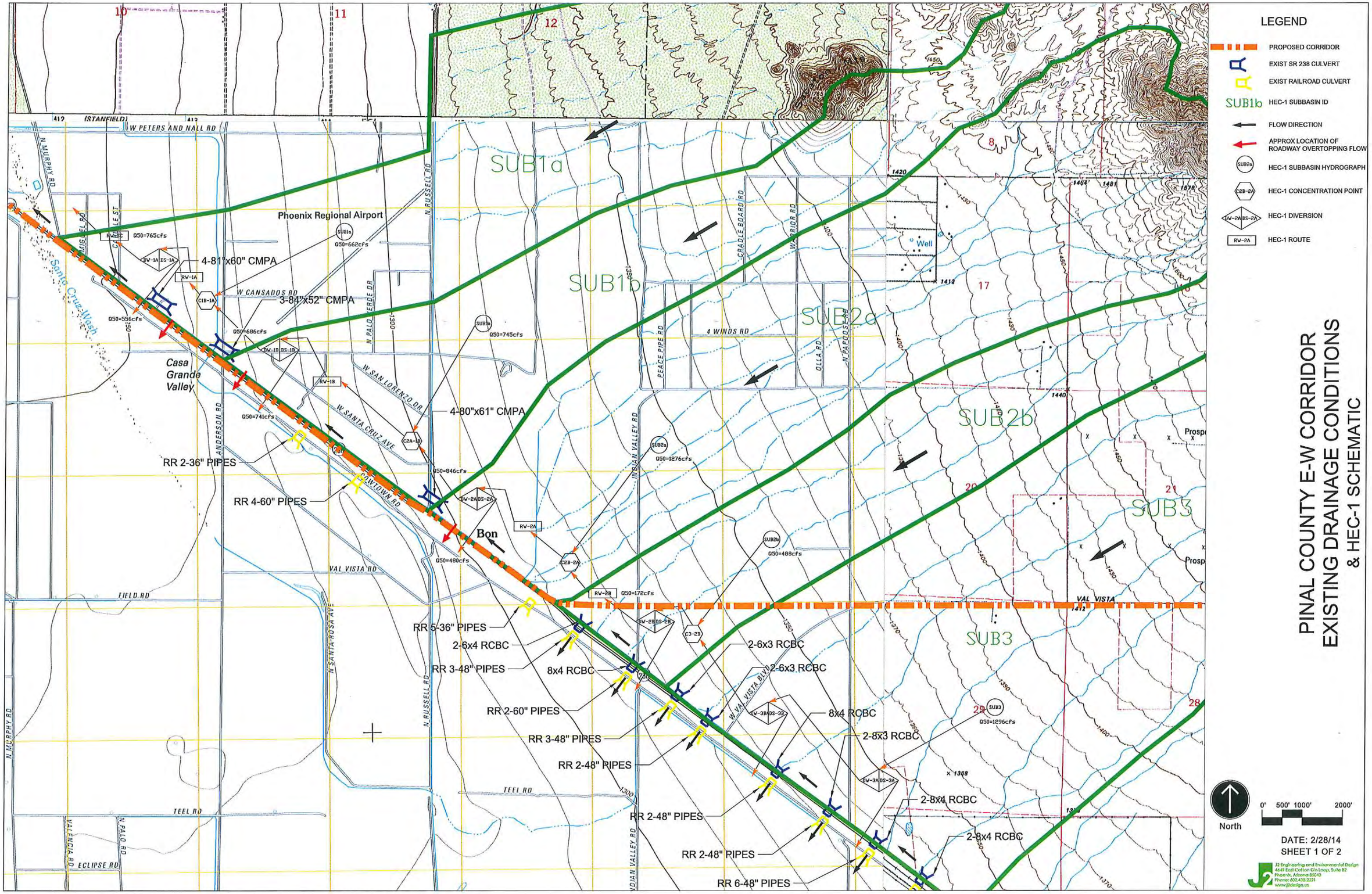
LEGEND

- PROPOSED EAST-WEST CORRIDOR
- SUB1b — HEC-1 SUBBASIN ID
- GENERAL FLOW DIRECTION
- 100-YEAR EFFECTIVE FLOODPLAIN

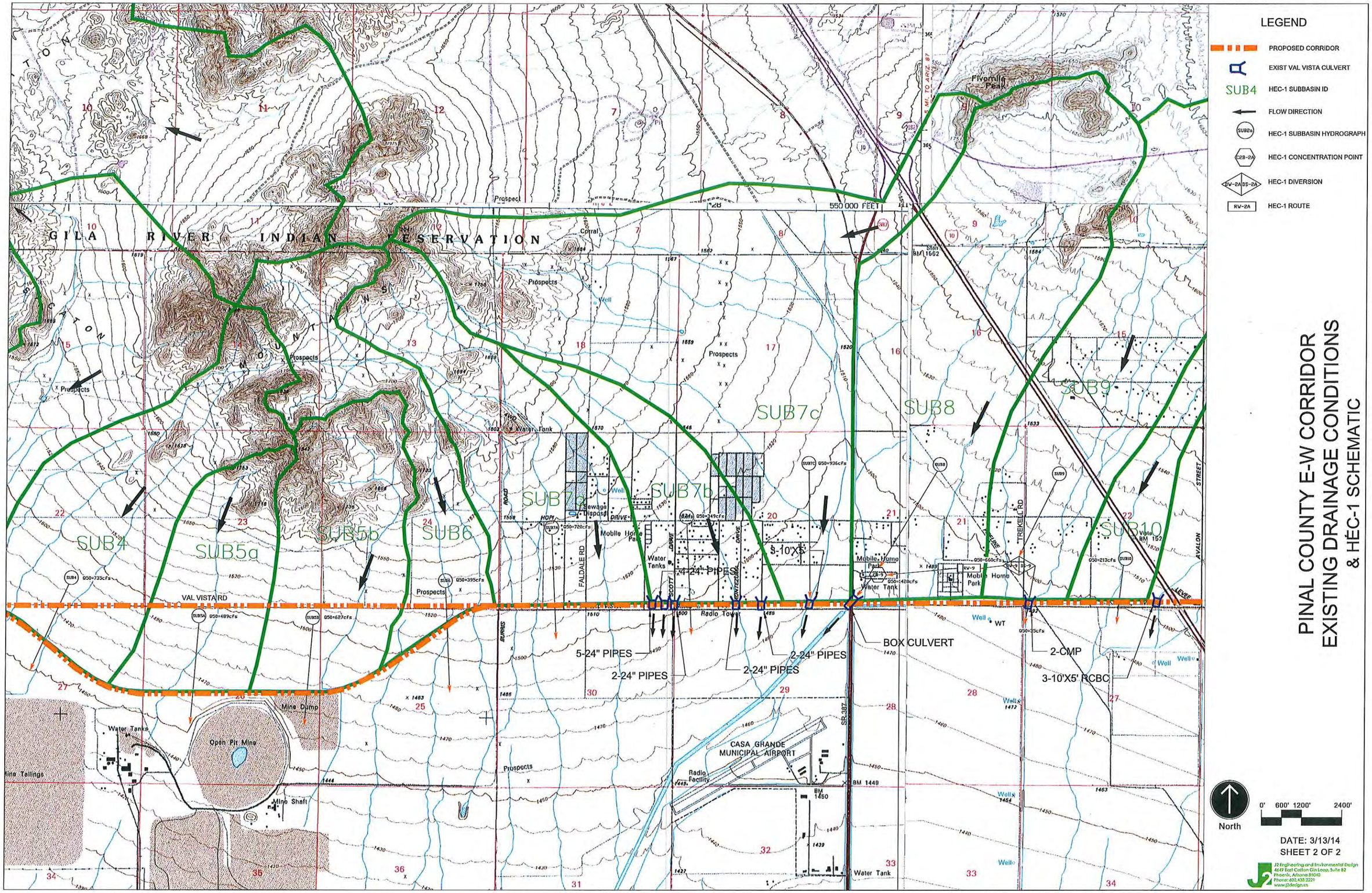
North

DATE: 3/05/14

J2 Engineering and Environmental Design
4447 East Cotton Gin Loop, Suite B2
Phoenix, Arizona 85040
Phone: 602 438 2221
www.j2design.us



PINAL COUNTY E-W CORRIDOR
EXISTING DRAINAGE CONDITIONS
& HEC-1 SCHEMATIC



PINAL COUNTY E-W CORRIDOR
EXISTING DRAINAGE CONDITIONS
& HEC-1 SCHEMATIC

Flood Control District of Maricopa County
Drainage Design Management System
RAINFALL DATA
Project Reference: E-W CORRIDOR

 3/13/2014

ID	Method	Duration	2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
DEFAULT	NOAA14	5 MIN	0.261	0.355	0.426	0.521	0.593	0.666
	NOAA14	10 MIN	0.397	0.541	0.648	0.793	0.903	1.014
	NOAA14	15 MIN	0.493	0.670	0.804	0.983	1.119	1.257
	NOAA14	30 MIN	0.664	0.903	1.082	1.323	1.507	1.692
	NOAA14	1 HOUR	0.821	1.117	1.339	1.638	1.865	2.094
	NOAA14	2 HOUR	0.931	1.247	1.487	1.811	2.061	2.320
	NOAA14	3 HOUR	0.988	1.301	1.549	1.898	2.172	2.459
	NOAA14	6 HOUR	1.163	1.493	1.757	2.117	2.402	2.698
	NOAA14	12 HOUR	1.304	1.658	1.936	2.315	2.606	2.906
	NOAA14	24 HOUR	1.526	1.976	2.333	2.827	3.217	3.623

HEC-1 INPUT DATA (50-YEAR), SCHEMATIC & OUTPUT TABLE (50 & 100-YEAR)

Major Basin ID: 01

Area ID	Book Number	Map Unit	Soil ID	Area (sq mi)	Area (%)	XKSAT	Rock Percent (%)	Effective Rock (%)
10	658	13	65813	0.061	6.60	0.35	-	100
	658	26	65826	0.056	6.10	0.72	-	100
	658	27	65827	0.094	10.30	0.72	30.00	100
	658	29	65829	0.024	2.60	0.41	-	100
	658	36	65836	0.039	4.20	0.77	-	100
	659	16	65916	0.615	67.10	0.39	-	100
	659	19	65919	0.014	1.50	0.00	100.00	100
	659	25	65925	0.013	1.50	0.40	-	100
20	659	13	65913	2.181	15.20	0.25	-	100
	659	17	65917	0.231	1.60	0.24	-	100
	659	18	65918	0.055	0.40	0.04	-	100
	659	21	65921	1.240	8.60	0.26	-	100
	659	22	65922	0.199	1.40	0.04	-	100
	659	24	65924	7.768	54.10	0.04	-	100
	659	29	65929	0.091	0.60	0.04	-	100
	659	40	65940	1.027	7.10	0.39	-	100
	659	42	65942	0.938	6.50	0.12	-	100
	659	45	65945	0.641	4.50	0.04	-	100
4	659	11	65911	0.619	39.30	0.39	-	100
	659	16	65916	0.338	21.40	0.39	-	100
	659	25	65925	0.045	2.90	0.40	-	100
	659	34	65934	0.169	10.70	0.34	-	100
	659	46	65946	0.151	9.60	0.27	20.00	100
	659	47	65947	0.253	16.10	0.61	30.00	100
5A	659	11	65911	0.375	45.20	0.39	-	100
	659	16	65916	0.185	22.30	0.39	-	100
	659	34	65934	0.128	15.40	0.34	-	100
	659	46	65946	0.032	3.90	0.27	20.00	100
	659	47	65947	0.109	13.10	0.61	30.00	100
5B	659	16	65916	0.469	40.90	0.39	-	100
	659	19	65919	0.016	1.40	0.00	100.00	100
	659	34	65934	0.153	13.30	0.34	-	100
	659	37	65937	0.022	1.90	0.14	-	100
	659	46	65946	0.057	5.00	0.27	20.00	100
	659	47	65947	0.430	37.60	0.61	30.00	100
6	658	27	65827	0.008	0.80	0.72	30.00	100
	659	16	65916	0.349	33.20	0.39	-	100
	659	34	65934	0.297	28.30	0.34	-	100
	659	37	65937	0.007	0.70	0.14	-	100
	659	46	65946	0.045	4.20	0.27	20.00	100
	659	47	65947	0.345	32.80	0.61	30.00	100
7A	658	27	65827	0.006	0.40	0.72	30.00	100
	659	11	65911	0.323	21.80	0.39	-	100
	659	16	65916	0.339	22.80	0.39	-	100
	659	25	65925	0.201	13.50	0.40	-	100
	659	34	65934	0.198	13.30	0.34	-	100
	659	46	65946	0.303	20.40	0.27	20.00	100
	659	47	65947	0.116	7.80	0.61	30.00	100
7B	659	11	65911	0.357	44.30	0.39	-	100
	659	16	65916	0.421	52.30	0.39	-	100
	659	25	65925	0.007	0.80	0.40	-	100
	659	34	65934	0.012	1.50	0.34	-	100
	659	46	65946	0.009	1.10	0.27	20.00	100
7C	658	13	65813	0.292	8.50	0.35	-	100
	658	14	65814	0.132	3.90	0.32	-	100
	658	26	65826	0.213	6.20	0.72	-	100
	658	27	65827	0.105	3.10	0.72	30.00	100
	658	36	65836	0.172	5.00	0.77	-	100
	659	11	65911	0.857	25.00	0.39	-	100
	659	16	65916	0.973	28.40	0.39	-	100
	659	17	65917	0.007	0.20	0.24	-	100
	659	25	65925	0.032	0.90	0.40	-	100

Major Basin ID: 01

Area ID	Book Number	Map Unit	Soil ID	Area (sq mi)	Area (%)	XKSAT	Rock Percent (%)	Effective Rock (%)
7C	659	30	65930	0.172	5.00	0.39	-	100
	659	34	65934	0.043	1.30	0.34	-	100
	659	37	65937	0.041	1.20	0.14	-	100
	659	44	65944	0.031	0.90	0.15	-	100
	659	46	65946	0.181	5.30	0.27	20.00	100
	659	47	65947	0.175	5.10	0.61	30.00	100
8	658	13	65813	0.006	0.20	0.35	-	100
	658	14	65814	0.170	5.90	0.32	-	100
	658	26	65826	0.313	10.90	0.72	-	100
	658	27	65827	0.128	4.50	0.72	30.00	100
	658	36	65836	0.323	11.30	0.77	-	100
	659	11	65911	0.193	6.70	0.39	-	100
	659	16	65916	1.627	56.80	0.39	-	100
	659	30	65930	0.081	2.80	0.39	-	100
	659	46	65946	0.019	0.70	0.27	20.00	100
	659	47	65947	0.006	0.20	0.61	30.00	100
9	658	13	65813	0.045	1.70	0.35	-	100
	658	26	65826	0.301	11.30	0.72	-	100
	658	27	65827	0.088	3.30	0.72	30.00	100
	658	29	65829	0.512	19.10	0.41	-	100
	658	36	65836	0.252	9.40	0.77	-	100
	659	11	65911	0.081	3.00	0.39	-	100
	659	16	65916	1.345	50.20	0.39	-	100
	659	25	65925	0.004	0.10	0.40	-	100
	659	30	65930	0.049	1.80	0.39	-	100
SUB1A	659	3	6593	0.001	0.00	0.26	-	100
	658	13	65813	0.356	9.30	0.35	-	100
	658	26	65826	0.513	13.30	0.72	-	100
	658	27	65827	0.331	8.60	0.72	30.00	100
	658	29	65829	0.248	6.40	0.41	-	100
	658	36	65836	0.345	9.00	0.77	-	100
	659	13	65913	0.017	0.40	0.25	-	100
	659	16	65916	2.036	52.90	0.39	-	100
SUB1B	658	5	6585	0.339	6.10	1.20	-	100
	658	11	65811	0.208	3.70	0.17	-	100
	658	13	65813	0.029	0.50	0.35	-	100
	658	26	65826	0.826	14.80	0.72	-	100
	658	27	65827	1.418	25.40	0.72	30.00	100
	658	29	65829	0.182	3.30	0.41	-	100
	658	36	65836	0.813	14.50	0.77	-	100
	659	16	65916	1.666	29.80	0.39	-	100
	659	44	65944	0.018	0.30	0.15	-	100
	659	47	65947	0.092	1.60	0.61	30.00	100
SUB2A	659	3	6593	0.166	4.30	0.26	-	100
	658	11	65811	0.323	8.40	0.17	-	100
	658	13	65813	0.045	1.20	0.35	-	100
	658	27	65827	0.268	7.00	0.72	30.00	100
	658	29	65829	0.008	0.20	0.41	-	100
	658	36	65836	0.066	1.70	0.77	-	100
	659	16	65916	2.492	65.10	0.39	-	100
	659	37	65937	0.244	6.40	0.14	-	100
	659	44	65944	0.037	1.00	0.15	-	100
	659	46	65946	0.145	3.80	0.27	20.00	100
	659	47	65947	0.035	0.90	0.61	30.00	100
SUB2B	658	26	65826	0.005	0.20	0.72	-	100
	658	27	65827	0.060	2.90	0.72	30.00	100
	659	16	65916	1.563	75.00	0.39	-	100
	659	30	65930	0.032	1.50	0.39	-	100
	659	37	65937	0.225	10.80	0.14	-	100
	659	46	65946	0.076	3.70	0.27	20.00	100
	659	47	65947	0.121	5.80	0.61	30.00	100
SUB3	658	26	65826	0.102	1.80	0.72	-	100
	658	27	65827	0.039	0.70	0.72	30.00	100

Area ID	Book Number	Map Unit	Soil ID	Area (sq mi)	Area (%)	XKSAT	Rock Percent (%)	Effective Rock (%)
Major Basin ID: 01								
SUB3	658	36	65836	0.188	3.30	0.77	-	100
	659	11	65911	0.273	4.80	0.39	-	100
	659	16	65916	4.256	74.90	0.39	-	100
	659	25	65925	0.059	1.00	0.40	-	100
	659	30	65930	0.188	3.30	0.39	-	100
	659	34	65934	0.144	2.50	0.34	-	100
	659	37	65937	0.060	1.10	0.14	-	100
	659	46	65946	0.162	2.90	0.27	20.00	100
	659	47	65947	0.209	3.70	0.61	30.00	100

Sub Basin	Land Use Code	Area (sq mi)	Area (%)	Initial Loss (IA)	Percent Impervious (RTIMP)	Vegetation Cover (%)	DTHETA	Kb
Major Basin ID: 01								
10	130	0.143	15.6	0.30	15	50.0	NORMAL	0.023
	730	0.774	84.4	0.10	0	90.0	NORMAL	0.117
		0.916	**100.0**					
20	750	14.371	100.0	0.50	0	85.0	NORMAL	0.025
		14.371	**100.0**					
4	730	1.576	100.0	0.10	0	90.0	NORMAL	0.110
		1.576	**100.0**					
5A	730	0.829	100.0	0.10	0	90.0	NORMAL	0.118
		0.829	**100.0**					
5B	730	1.146	100.0	0.10	0	90.0	NORMAL	0.114
		1.146	**100.0**					
6	730	1.050	100.0	0.10	0	90.0	NORMAL	0.115
		1.050	**100.0**					
7A	130	0.555	37.3	0.30	15	50.0	NORMAL	0.021
	730	0.931	62.7	0.10	0	90.0	NORMAL	0.111
		1.486	**100.0**					
7B	130	0.495	61.5	0.30	15	50.0	NORMAL	0.023
	150	0.014	1.7	0.25	30	50.0	NORMAL	0.023
	730	0.296	36.8	0.10	0	90.0	NORMAL	0.119
		0.806	**100.0**					
7C	130	0.187	5.5	0.30	15	50.0	NORMAL	0.019
	150	0.072	2.1	0.25	30	50.0	NORMAL	0.019
	200	0.021	0.6	0.10	80	60.0	NORMAL	0.019
	730	3.146	91.8	0.10	0	90.0	NORMAL	0.100
		3.426	**100.0**					
8	130	0.284	9.9	0.30	15	50.0	NORMAL	0.020
	150	0.309	10.8	0.25	30	50.0	NORMAL	0.020
	730	2.272	79.3	0.10	0	90.0	NORMAL	0.102
		2.866	**100.0**					
9	130	0.720	26.9	0.30	15	50.0	NORMAL	0.020
	150	0.019	0.7	0.25	30	50.0	NORMAL	0.020
	730	1.937	72.4	0.10	0	90.0	NORMAL	0.103
		2.677	**100.0**					
SUB1A	130	0.002		0.30	15	50.0	NORMAL	0.019
	200	0.008	0.2	0.10	80	60.0	NORMAL	0.019
	300	0.257	6.7	0.15	55	60.0	NORMAL	0.019
	730	2.836	73.8	0.10	0	90.0	NORMAL	0.098
	750	0.743	19.3	0.50	0	85.0	NORMAL	0.033
		3.845	**100.0**					
SUB1B	110	0.197	3.5	0.30	5	30.0	NORMAL	0.018
	130	0.379	6.8	0.30	15	50.0	NORMAL	0.018
	730	4.447	79.5	0.10	0	90.0	NORMAL	0.093
	750	0.568	10.2	0.50	0	85.0	NORMAL	0.031
		5.591	**100.0**					
SUB2A	110	0.801	20.9	0.30	5	30.0	NORMAL	0.019
	730	2.840	74.2	0.10	0	90.0	NORMAL	0.098
	750	0.188	4.9	0.50	0	85.0	NORMAL	0.033

Flood Control District of Maricopa County
Drainage Design Management System
LAND USE
Project Reference: E-W CORRIDOR

Sub Basin	Land Use Code	Area (sq mi)	Area (%)	Initial Loss (IA)	Percent Impervious (RTIMP)	Vegetation Cover (%)	DTHETA	Kb
Major Basin ID: 01								
		3.828	**100.0**					
SUB2B	110	0.075	3.6	0.30	5	30.0	NORMAL	0.020
	730	2.009	96.4	0.10	0	90.0	NORMAL	0.106
		2.083	**100.0**					
SUB3	730	5.681	100.0	0.10	0	90.0	NORMAL	0.093
		5.681	**100.0**					

* Non default value

(stLuDataCG.rpt)

Clark Unit Hydrograph
ADOT Hydrology Manual

By: df
Date: 10/3/2013
Checked By:
Project Number: 110537

J2 Design and Environmental Design

Project Name: **East-West Corridor**
Existing Conditions
Segment of roadway from the Santa Cruz Wash and southeast approximately 4 miles

	Basin Information								Shape Factor		Imperv.	HEC-1 Input			Longest Flow Path					
Sub-basin I.D.	Basin Type, (d,a,u)	Basin Area, acres	Basin Area, sq.mi.	Reference Map Utilized	High Pt. Elev., ft.	Intermed. Pt. Elev., ft.	Low Pt. Elev., ft.	1st Elev. Difference, ft.	2nd Elev. Difference, ft.	1st Length, ft.	2nd Length, ft.	Total Length, mi.	Average Slope, ft./ft.	Average Slope, ft./mi.	Lca, ft.	Lca, mi.	Area RTIMP (if urban)	Sub-basin I.D.	Tc, hours	Storage Coeff., R, Hours
SUB1a	d	2461	3.845	Topo	1520	n/a	1250	270	n/a	29437		5.575	0.009	48	14719	2.788	0.000	SUB1a	2.51	1.89
SUB1b	d	3578	5.591	Topo	1700	n/a	1270	430	n/a	40810		7.729	0.011	56	20405	3.865	0.000	SUB1b	2.98	2.40
SUB2a	d	2459	3.828	Topo	1600	n/a	1310	290	n/a	19795		3.749	0.015	77	9898	1.875	0.000	SUB2a	1.87	0.99
SUB2b	d	1333	2.083	Topo	1650	n/a	1315	335	n/a	22940		4.345	0.015	77	11470	2.172	0.000	SUB2b	1.90	1.61
SUB3	d	3636	5.681	Topo	1700	n/a	1330	370	n/a	26987		5.111	0.014	72	13494	2.556	0.000	SUB3	2.31	1.28
SUB4	d	1009	1.577	Topo	1850	n/a	1460	390	n/a	12589		2.384	0.031	164	6295	1.192	0.000	SUB4	1.18	0.69
SUB5a	d	531	0.830	Topo	1700	n/a	1460	240	n/a	8144		1.542	0.029	156	4072	0.771	0.000	SUB5a	0.90	0.52
SUB5b	d	733	1.145	Topo	1750	n/a	1477	273	n/a	10277		1.946	0.027	140	5139	0.973	0.000	SUB5b	1.06	0.62
SUB6	d	672	1.050	Topo	1850	n/a	1520	330	n/a	13715		2.598	0.024	127	6858	1.299	0.000	SUB6	1.24	0.98
SUB7a	d	951	1.486	Topo	1850	n/a	1520	330	n/a	12905		2.444	0.026	135	6453	1.222	0.000	SUB7a	1.23	0.76
SUB7b	d	516	0.806	Topo	1625	n/a	1490	135	n/a	10556		1.999	0.013	68	5278	1.000	0.000	SUB7b	1.20	0.89
SUB7c	d	2193	3.427	Topo	1750	n/a	1480	270	n/a	21090		3.994	0.013	68	10545	1.997	0.000	SUB7c	1.96	1.17
SUB8	d	1834	2.866	Topo	1700	n/a	1477	223	n/a	18817		3.564	0.012	63	9409	1.782	0.000	SUB8	1.85	1.11
SUB9	d	1713	2.677	Topo	1900	n/a	1490	410	n/a	21630		4.097	0.019	100	10815	2.048	0.000	SUB9	1.79	1.25
SUB10	d	587	0.917	Topo	2000	n/a	1500	500	n/a	20200		3.826	0.025	131	10100	1.913	0.000	SUB10	1.48	1.75
SUB20	a	9197	14.370	Topo	1295	n/a	1200	95	n/a	49486		9.372	0.002	10	24743	4.686	0.000	SUB20	15.23	9.97
	Total:	9822.5	15.348																	

Notes:
Basin Type: d = desert/mountain, a = agriculture, u = urban
Default Lca = L/2 (L in miles)
Average slope calculated using Equation 2-4, ADOT Highway Drainage Design Manual, Hydrology, March 1993, where intermediate points are identified.

CLARK-UH

Pinal County East-West Corridor

Diversion Rating Tables for HEC-1

SUB2b, Divert DW-2B & DS-2B

South Divert								West Divert	
8x4		2-6x4		weir over hwy		Combined		weir over embankment	
Q (cfs)	Hwi (ft)	Q (cfs)	Hw (ft)	Q (cfs)	Hw (ft)	Q (cfs)	Hw (ft)	Q (cfs)	Hw (ft)
0	10	0	10			0	10	0	10
20	11	30	11			50	11	0	11
55	12	83	12			138	12	0	12
102	13	153	13			255	13	0	13
157	14	235	14			392	14	0	14
219	15	329	15	0	15.5	548	15	212	15
276	16	414	16	2127	16	2817	16	637	16

Diversion Rating Curve to HEC-1

DI	DQ (DS-2B)	check
Total Q (cfs)	South Q (cfs)	West Q (cfs)
0	0	0
50	50	0
138	138	0
255	255	0
392	392	0
760	548	212
3454	2817	637

SUB2a, Divert DW-2A & DS-2A

	South Divert		West Divert					
	weir over Hwy		4-83"x53"		Weir over Russel Rd		Combined	
	Q (cfs)	Hw (ft)	Q (cfs)	Hw (ft)	Q (cfs)	Hwi (ft)	Q (cfs)	Hw (ft)
			0	10.0			0	10.0
			66	12.0			66	12.0
			145	13.0			145	13.0
			248	14.0			248	14.0
			390	15.0			390	15.0
culvert top	0	15.5	457	15.5	0	15.5	457	15.5
	59	16	533	16.0	80	16	613	16.0
	933	17	679	17.0	419	17	1098	17.0

Diversion Rating Curve to HEC-1

DI	DQ (DS-2A)	check
Total Q (cfs)	South Q (cfs)	West Q (cfs)
0	0	0
66	0	66
145	0	145
248	0	248
390	0	390
457	0	457
672	59	613
2031	933	1098

SUB1b, Divert DW-1B & DS-1B

South Divert		West Divert					
weir over Hwy		3-83"x53"		Weir over Anderson Rd		Combined	
Q (cfs)	Hwi (ft)	Q (cfs)	Hwi (ft)	Q (cfs)	Hwi (ft)	Q (cfs)	Hw (ft)
		0	10.0			0	10.0
		0	11.0			0	11.0
		50	12.0			50	12.0
		108	13.0			108	13.0
		186	14.0			186	14.0
0	15.0	293	15.0	0	15.0	293	15.0
56	16.0	400	16.0	43	16.0	443	16.0
871	17.0	509	17.0	223	17.0	732	17.0
1452	18.0	616	18.0	481	18.0	1097	18.0

Diversion Rating Curve to HEC-1

DI	DQ (DS-1B)	check
Total Q (cfs)	South Q (cfs)	West Q (cfs)
0	0	0
0	0	0
50	0	50
108	0	108
186	0	186
293	0	293
499	56	443
1603	871	732
2549	1452	1097

Pinal County East-West Corridor

Diversion Rating Tables for HEC-1

SUB1a, Divert DW-1A & DS-1A

South Divert		West Divert					
weir over Hwy		4-83"x53"		Weir over Industrial Pkw		Combined	
Q (cfs)	Hwi (ft)	Q (cfs)	Hwi (ft)	Q (cfs)	Hwi (ft)	Q (cfs)	Hw (ft)
		0	10.0			0	10.0
		0	11.0			0	11.0
		66	12.0			66	12.0
		145	13.0			145	13.0
		248	14.0			248	14.0
0	15	390	15.0	0	15	390	15.0
57	16	533	16.0	43	16	576	16.0
910	17	679	17.0	223	17	902	17.0

Diversion Rating Curve to HEC-1

DI	DQ (DS-1A)	check
Total Q (cfs)	South Q (cfs)	West Q (cfs)
0	0	0
0	0	0
66	0	66
145	0	145
248	0	248
390	0	390
633	57	576
1812	910	902

SUB3, Divert DW-3A & DS-3A

	South Divert																West Divert	
	2-8x4		2-8x4		2-8x3		8x4		2-6x3		2-6x3		weir over hwy		Combined		channel	
Height	Q (cfs)	Hwi (ft)	Q (cfs)	Hwi (ft)	Q (cfs)	Hwi (ft)	Q (cfs)	Hwi (ft)	Q (cfs)	Hwi (ft)	Q (cfs)	Hwi (ft)	Q (cfs)	Hw (ft)	Q (cfs)	Hw (ft)	Q (cfs)	Hw (ft)
0	0	10.0	0	10.0	0	10.0	0	10.0	0	10.0	0	10.0			0	10.0	0	10
1	40	11.0	40	11.0	30	11.0	20	11.0	30	11.0	30	11.0			190	11.0	39	11
2	111	12.0	111	12.0	83	12.0	55	12.0	83	12.0	83	12.0			526	12.0	135	12
3	204	13.0	204	13.0	153	13.0	102	13.0	153	13.0	153	13.0			969	13.0	290	13
4	314	14.0	314	14.0	235	14.0	157	14.0	235	14.0	235	14.0			1490	14.0	464	14
5	438	15.0	438	15.0	329	15.0	219	15.0	301	15.0	301	15.0	0	15.0	2026	15.0	994	15
6	552	16.0	552	16.0	414	16.0	276	16.0	358	16.0	358	16.0	2127	16.0	4637	16.0	1321	16
7	650	17.0	650	17.0	487	17.0	325	17.0	407	17.0	407	17.0	11170	17.0	14096	17.0	2069	17

Diversion Rating Curve to HEC-1

DI	DQ (DS-3A)	check
Total Q (cfs)	South Q (cfs)	West Q (cfs
0	0	0
229	190	39
661	526	135
1259	969	290
1954	1490	464
3020	2026	994
5958	4637	1321
16165	14096	2069

SUB3, DW-3B & DS-3B

South Divert			West Divert	
weir over Hwy			weir over Val Vista Blvd	
Q (cfs)	Hwi (ft)		Q (cfs)	Hwi (ft)
0	14.0		0	14.0
0	15.0		128	15.0
434	16.0		714	16.0
2468	17.0		2622	17.0

Diversion Rating Curve to HEC-1

DI	DQ (DS-3A)	check
Total Q (cfs)	South Q (cfs)	West Q (cfs)
0	0	0
128	0	128
1148	434	714
5090	2468	2622

```
ID      Pinal County East-West Corridor Project
ID      ADOT Methodology from "Highway Drainage Design Manual Hydrology," 03/93
ID      HEC-1 model covers watershed north of the Maricopa Casa Grande (MCG) Hwy
ID      from east of the Santa Cruz Wash to I-10, and south of MCG from east of
ID      White & Parker Road to the Santa Rosa Wash,
ID      Model covers the length of the East-West Corridor Project within Pinal C
ID      The model assumes any flow that conveys to or orginates south of the MCG
ID      Hwy will travel south and west and not impact the Corridor (for the
ID      portion east of the Santa Cruz Wash), for the portion west of the Santa
ID      Rosa Wash, the opposite is true (flows originate from the south).
ID      50 Year, Existing Drainage Conditions
ID      24 Hour Storm, NOAA Atlas 14
ID      Unit Hydrograph: Clark
ID2/7/2014
IT     5                    2000
IO     5
*DIAGRAM
*
*
KK SUB10   BASIN
PH                   0.59   1.113   1.855   2.054   2.162   2.396   2.603   3.229
BA 0.916
LG  0.13    0.25    3.90    0.76       7
UC  1.48    1.75
UA     0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
UA   100
*
KK  SUB9   BASIN
BA 2.677
LG  0.15    0.26    3.75    0.81       5
UC  1.79    1.25
UA     0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
UA   100
*
KK  DW-9  DIVERT
KMDivert flow south thru existing 2 barrel CMPs (conc plugs with low flow
KMopenings), west flow continues in roadside channel and crosses Trekell Rd
KMvia 3 barrel CMP, estimated that 95% of the flow conveys west (5% to
KMthe south) based on field observations and usgs maps.
DT  DS-9
DI     0     100    1000   10000
DQ     0       5      50     500
*
KK  RW-9   ROUTE
KMRoute remainder flow west into SUB8 within roadside channel
KMChannel geometry based on field observations
RS     3    FLOW      -1       0
RC   .04     .03     .04    3750  0.0040
RX     0      25      34      40      41      49      58      83
RY  15.5      13      10      10      10      10      13    15.5
*
KK  SUB8   BASIN
BA 2.866
LG  0.14    0.26    3.75    0.83       6
UC  1.85    1.11
UA     0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
UA   100
*
KK  C8-9 COMBINE
KMFlow leaves model SW thru large culvert at intersection of
KMSR 387 & Val Vista Rd
KO     1
HC     2
*
KK SUB7C   BASIN
BA 3.426
LG  0.11    0.25    3.95    0.76       5
UC  1.96    1.17
UA     0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
UA   100
*
KK SUB7B   BASIN
BA 0.806
LG  0.23    0.25    4.03    0.63      10
UC   1.2    0.89
UA     0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
UA   100
*
KK SUB7A   BASIN
```



```
BA 1.486
LG  0.17    0.25    4.12    0.64      12
UC  1.23    0.76
UA     0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
UA   100
*
KK CDUM1 COMBINE
KMDummy combine
HC     4
*
KK  SUB6   BASIN
BA 1.050
LG  0.10    0.25    3.86    0.81      11
UC  1.24    0.98
UA     0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
UA   100
*
KK SUB5B   BASIN
BA 1.146
LG  0.10    0.25    3.90    0.79      14
UC  1.06    0.62
UA     0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
UA   100
*
KK SUB5A   BASIN
BA 0.829
LG  0.10    0.25    3.99    0.76       5
UC   0.9    0.52
UA     0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
UA   100
*
KK  SUB4   BASIN
BA 1.576
LG  0.10    0.25    3.99    0.76       7
UC  1.18    0.69
UA     0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
UA   100
*
KK CDUM2 COMBINE
KMDummy combine
HC     4
*
KK  SUB3   BASIN
KO     1
BA 5.681
LG  0.10    0.25    3.99    0.76       2
UC  2.31    1.28
UA     0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
UA   100
*
KK DW-3A  DIVERT
KMDivert flow south thru existing culverts, west flow continues
KMin roadside channel; slopes, channel geometry, etc were estimated based on
KMfield observations and usgs maps.
DT DS-3A
DI     0     229     661    1259    1954    3020    5958   16165
DQ     0     190     526     969    1490    2026    4637   14096
*
KK DW-3B  DIVERT
KMAt Val Vista Road and MCG Hwy, flow must overtop both roads to continue
KMVal Vista Road is slightly lower than MCG Hwy
KMThe 18" pipe under Val Vista Road was disregarded due to small size and
KMthe likely hood of sedmimentation clogging pipe.
KMFlow diversion was determined using weir calcs
DT DS-3B
DI     0     128    1148    5090
DQ     0       0     434    2468
*
KK SUB2B   BASIN
KO     1
BA 2.083
LG  0.11    0.25    4.17    0.67       4
UC   1.9    1.61
UA     0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
UA   100
*
KK C3-2BCOMBINED
KMCombine flow from SUB3 with SUB2b
HC     2
```

```
*
KK DW-2B  DIVERT
KMDivert flow south thru exist culverts (2-6x4, 8X4), west flow must weir over
KMchannel embankment; slopes, channel geometry, etc were estimated based on
KMfield observations and usgs maps.
DT DS-2B
DI     0      50     138     255     392     760    3454
DQ     0      50     138     255     392     548    2817
*
KK RW-2B   ROUTE
KMRoute remainder flow west into SUB2a within roadside channel
KMChannel geometry based on field observations
RS     3    FLOW      -1       0
RC   .04     .03     .04    3550  0.0028
RX     0      25      34      40      41      49      58      83
RY  15.5      13      10      10      10      10      13    15.5
*
KK SUB2A   BASIN
KO     1
BA 3.828
LG  0.16    0.25    4.22    0.61       4
UC  1.87    0.99
UA     0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
UA   100
*
KKC2B-2ACOMBINED
KMCombine routed flow from SUB2b with SUB2a
HC     2
*
KK RW-2A   ROUTE
KMRoute flow west to SUB1b boundary within roadside channel
KMChannel geometry based on field observations
KO     1
RS     1    FLOW      -1       0
RC   .04     .03     .04    2220  0.0045
RX     0      25      34      40      41      59      68      93
RY  15.5      13      10      10      10      10      13    15.5
*
KK DW-2A  DIVERT
KMDivert south flow over MCG Hwy as weir flow due to culvert backwater,
KMWest flow travels thru exit culvert (field measured, approximately 4-83"x53")
KMat Russel Road
DT DS-2A
DI     0      66     457     672    2031
DQ     0       0       0      59     933
*
KK SUB1B   BASIN
KO     1
BA 5.591
LG  0.16    0.27    3.39    1.06       9
UC  2.98     2.4
UA     0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
UA   100
*
KKC2A-1BCOMBINED
KMCombine routed flow from SUB2a with SUB1b
HC     2
*
KK RW-1B   ROUTE
KMRoute flow west to SUB1A boundary within roadside channel
KMThere are no culvert crossings of Hwy within this subbasin
KMChannel geometry based on field observations
RS     4    FLOW      -1       0
RC   .04     .03     .04    6222  0.0048
RX     0      25      34      40      41      54      62      87
RY  15.5      13      10      10      10      10      13    15.5
*
KK DW-1B  DIVERT
KMDivert south flow over MCG Hwy as weir flow due to culvert backwater,
KMtravels thru exit culvert (field measured, approximately 3-83"x53")
KMat Anderson Road
DT DS-1B
DI     0      50     293     499    1603    2549
DQ     0       0       0      56     871    1452
*
KK SUB1A   BASIN
KO     1
BA 3.845
LG  0.18    0.26    3.72    0.87       6
```



```
UC  2.51    1.89
UA     0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
UA   100
*
KKC1B-1ACOMBINED
KMCombine routed flow from SUB1b with SUB1a
HC     2
*
KK RW-1A   ROUTE
KMRoute flow west to Industrial Pkwy within roadside channel
KMChannel geometry based on field observations
RS     2    FLOW      -1       0
RC   .04     .03     .04    2159  0.0046
RX     0      25      34      40      41      59      68      93
RY  15.5      13      10      10      10      10      13    15.5
*
KK DW-1A  DIVERT
KMDivert south flow over MCG Hwy as weir flow due to culvert backwater
KMWest flow travels thru exit culvert (field measured, approximately 4-83"x53")
KMat Industrial Pkwy
DT DS-1A
DI     0      66     390     633    1812
DQ     0       0       0      57     910
*
KK RW-SC   ROUTE
KMRoute flow west to Santa Cruz Wash within roadside channel
KMChannel geometry based on field observations
RS     2    FLOW      -1       0
RC   .04     .03     .04    3160  0.0032
RX     0      25      34      40      41      49      58      83
RY  15.5      13      10      10      10      10      13    15.5
*
KK SUB20   BASIN
BA14.371
LG  0.50    0.15    7.58    0.15       0
UC 15.23    9.97
UA     0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
UA   100
*
ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   17       SUB10
                .
                .
   24           .        SUB9
                .           .
                .           .
   35           .           .------->    DS-9
   30           .        DW-9
                .           V
                .           V
   38           .        RW-9
                .           .
                .           .
   45           .           .        SUB8
                .           .           .
                .           .           .
   51           .        C8-9............
                .           .
                .           .
   56           .           .       SUB7C
                .           .           .
                .           .           .
   62           .           .           .       SUB7B
                .           .           .           .
                .           .           .           .
   68           .           .           .           .       SUB7A
                .           .           .           .           .
                .           .           .           .           .
   74           .       CDUM1...................................
                .           .
                .           .
   77           .           .        SUB6
                .           .           .
                .           .           .
   83           .           .           .       SUB5B
                .           .           .           .
                .           .           .           .
   89           .           .           .           .       SUB5A
                .           .           .           .           .
                .           .           .           .           .
   95           .           .           .           .           .        SUB4
                .           .           .           .           .           .
                .           .           .           .           .           .
  101           .           .       CDUM2...................................
                .           .           .
                .           .           .
  104           .           .           .       SUB3
                .           .           .           .
                .           .           .           .
  115           .           .           .           .------->   DS-3A
  111           .           .           .       DW-3A
                .           .           .           .
                .           .           .           .
  124           .           .           .           .------->   DS-3B
```



```
  118           .           .           .       DW-3B
                .           .           .           .
                .           .           .           .
  127           .           .           .           .       SUB2B
                .           .           .           .           .
                .           .           .           .           .
  134           .           .           .       C3-2B...........
                .           .           .           .
                .           .           .           .
  141           .           .           .           .------->   DS-2B
  137           .           .           .       DW-2B
                .           .           .           V
                .           .           .           V
  144           .           .           .       RW-2B
                .           .           .           .
                .           .           .           .
  151           .           .           .           .       SUB2A
                .           .           .           .           .
                .           .           .           .           .
  158           .           .           .      C2B-2A...........
                .           .           .           V
                .           .           .           V
  161           .           .           .       RW-2A
                .           .           .           .
                .           .           .           .
  173           .           .           .           .------->   DS-2A
  169           .           .           .       DW-2A
                .           .           .           .
                .           .           .           .
  176           .           .           .           .       SUB1B
                .           .           .           .           .
                .           .           .           .           .
  183           .           .           .      C2A-1B...........
                .           .           .           V
                .           .           .           V
  186           .           .           .       RW-1B
                .           .           .           .
                .           .           .           .
  198           .           .           .           .------->   DS-1B
  194           .           .           .       DW-1B
                .           .           .           .
                .           .           .           .
  201           .           .           .           .       SUB1A
                .           .           .           .           .
                .           .           .           .           .
  208           .           .           .      C1B-1A...........
                .           .           .           V
                .           .           .           V
  211           .           .           .       RW-1A
                .           .           .           .
                .           .           .           .
  222           .           .           .           .------->   DS-1A
  218           .           .           .       DW-1A
                .           .           .           V
                .           .           .           V
  225           .           .           .       RW-SC
                .           .           .           .
                .           .           .           .
  232           .           .           .           .       SUB20
```

50-Year

RUNOFF SUMMARY

FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	SUB10	213.	13.33	82.	23.	8.	.92		
+	HYDROGRAPH AT	SUB9	694.	13.50	226.	60.	20.	2.68		
+	DIVERSION TO	DS-9	35.	13.50	11.	3.	1.	2.68		
+	HYDROGRAPH AT	DW-9	660.	13.50	214.	57.	19.	2.68		
+	ROUTED TO	RW-9	647.	13.67	214.	57.	19.	2.68		
+									14.03	13.67
+	HYDROGRAPH AT	SUB8	798.	13.50	245.	66.	22.	2.87		
+	2 COMBINED AT	C8-9	1428.	13.58	459.	123.	41.	5.54		
+	HYDROGRAPH AT	SUB7C	936.	13.58	300.	80.	27.	3.43		
+	HYDROGRAPH AT	SUB7B	349.	13.08	85.	23.	8.	.81		
+	HYDROGRAPH AT	SUB7A	720.	13.08	161.	44.	15.	1.49		
+	4 COMBINED AT	CDUM1	3047.	13.50	1003.	270.	90.	11.26		
+	HYDROGRAPH AT	SUB6	395.	13.08	103.	28.	10.	1.05		
+	HYDROGRAPH AT	SUB5B	627.	12.92	120.	34.	11.	1.15		
+	HYDROGRAPH AT	SUB5A	489.	12.75	76.	20.	7.	.83		
+	HYDROGRAPH AT	SUB4	735.	13.00	148.	39.	13.	1.58		
+	4 COMBINED AT	CDUM2	2136.	12.92	446.	121.	41.	4.60		
+	HYDROGRAPH AT	SUB3	1296.	13.83	453.	118.	39.	5.68		
	DIVERSION TO									

50-Year

+		DS-3A	997.	13.83	358.	94.	31.	5.68		
+	HYDROGRAPH AT	DW-3A	299.	13.83	95.	25.	8.	5.68		
+	DIVERSION TO	DS-3B	73.	13.83	12.	3.	1.	5.68		
+	HYDROGRAPH AT	DW-3B	226.	13.83	83.	22.	7.	5.68		
+	HYDROGRAPH AT	SUB2B	488.	13.58	187.	51.	17.	2.08		
+	2 COMBINED AT	C3-2B	702.	13.75	270.	72.	24.	7.76		
+	DIVERSION TO	DS-2B	523.	13.75	240.	65.	22.	7.76		
+	HYDROGRAPH AT	DW-2B	179.	13.75	29.	7.	2.	7.76		
+	ROUTED TO	RW-2B	172.	13.92	29.	7.	2.	7.76		
+									12.17	13.92
+	HYDROGRAPH AT	SUB2A	1276.	13.50	362.	94.	32.	3.83		
+	2 COMBINED AT	C2B-2A	1336.	13.67	392.	102.	34.	11.59		
+	ROUTED TO	RW-2A	1326.	13.75	391.	102.	34.	11.59		
+									14.58	13.75
+	DIVERSION TO	DS-2A	480.	13.75	77.	19.	6.	11.59		
+	HYDROGRAPH AT	DW-2A	846.	13.75	314.	82.	28.	11.59		
+	HYDROGRAPH AT	SUB1B	745.	14.50	396.	124.	42.	5.59		
+	2 COMBINED AT	C2A-1B	1439.	14.17	701.	206.	69.	17.18		
+	ROUTED TO	RW-1B	1427.	14.50	700.	206.	69.	17.18		
+									15.08	14.50
+	DIVERSION TO	DS-1B	741.	14.50	246.	62.	21.	17.18		
+	HYDROGRAPH AT	DW-1B	686.	14.50	454.	145.	49.	17.18		
+	HYDROGRAPH AT	SUB1A	662.	14.08	297.	85.	29.	3.85		

50-year

Untitled

+	2 COMBINED AT	C1B-1A	1324.	14.25	751.	230.	77.	21.03	
+	ROUTED TO	RW-1A	1322.	14.33	751.	230.	77.	21.03	
+									14.55 14.33
+	DIVERSION TO	DS-1A	556.	14.33	190.	48.	16.	21.03	
+	HYDROGRAPH AT	DW-1A	767.	14.33	560.	182.	61.	21.03	
+	ROUTED TO	RW-SC	765.	14.50	560.	182.	61.	21.03	
+									14.58 14.50
+	HYDROGRAPH AT	SUB20	730.	24.25	674.	370.	124.	14.37	

100-year

Untitled

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

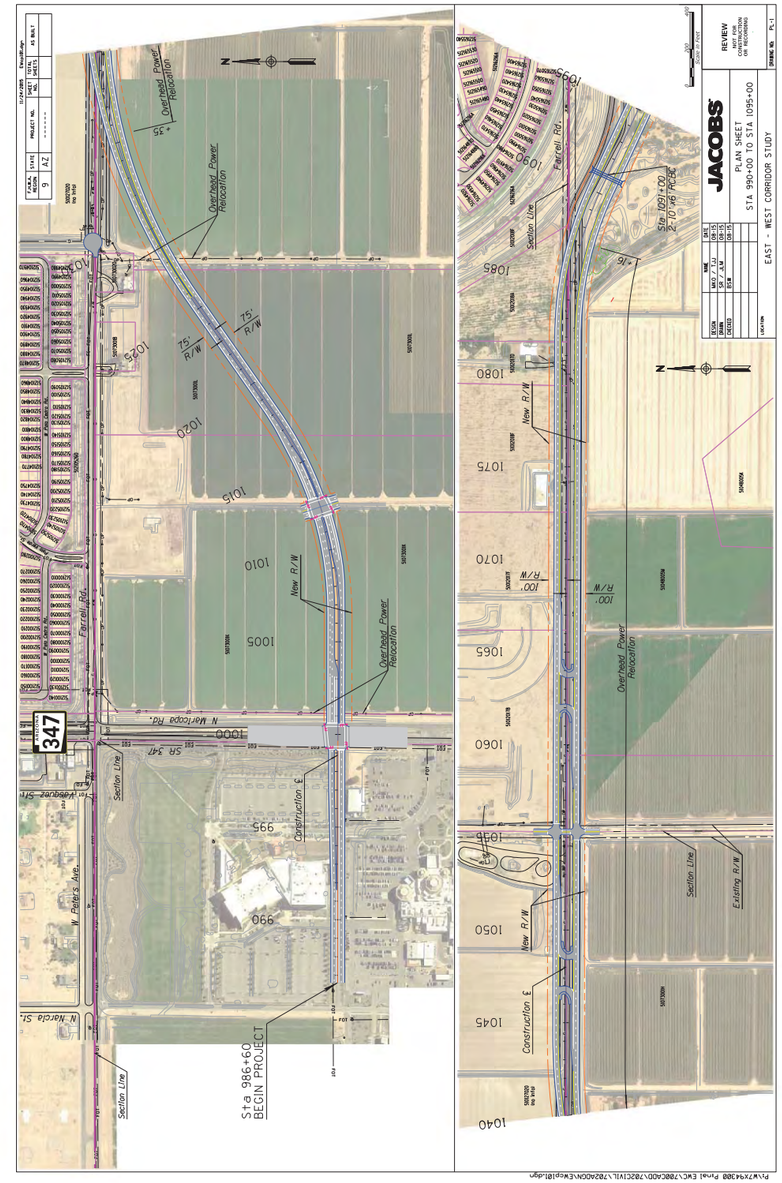
	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	SUB10	261.	13.33	101.	28.	9.	.92		
+	HYDROGRAPH AT	SUB9	863.	13.50	280.	75.	25.	2.68		
+	DIVERSION TO	DS-9	43.	13.50	14.	4.	1.	2.68		
+	HYDROGRAPH AT	DW-9	820.	13.50	266.	71.	24.	2.68		
+	ROUTED TO	RW-9	805.	13.67	266.	71.	24.	2.68		
+									14.46	13.67
+	HYDROGRAPH AT	SUB8	989.	13.50	303.	81.	27.	2.87		
+	2 COMBINED AT	C8-9	1773.	13.58	569.	152.	51.	5.54		
+	HYDROGRAPH AT	SUB7C	1157.	13.58	370.	98.	33.	3.43		
+	HYDROGRAPH AT	SUB7B	423.	13.08	103.	28.	9.	.81		
+	HYDROGRAPH AT	SUB7A	868.	13.08	194.	53.	18.	1.49		
+	4 COMBINED AT	CDUM1	3752.	13.50	1233.	330.	110.	11.26		
+	HYDROGRAPH AT	SUB6	483.	13.08	126.	35.	12.	1.05		
+	HYDROGRAPH AT	SUB5B	761.	12.92	146.	40.	14.	1.15		
+	HYDROGRAPH AT	SUB5A	599.	12.75	93.	24.	8.	.83		
+	HYDROGRAPH AT	SUB4	902.	13.00	182.	48.	16.	1.58		
+	4 COMBINED AT	CDUM2	2611.	12.92	545.	147.	49.	4.60		
+	HYDROGRAPH AT	SUB3	1616.	13.83	565.	147.	49.	5.68		
	DIVERSION TO									

+		DS-3A	1237.	13.83	443.	116.	39.	5.68		
+	HYDROGRAPH AT	DW-3A	379.	13.83	122.	31.	10.	5.68		
+	DIVERSION TO	DS-3B	107.	13.83	20.	5.	2.	5.68		
+	HYDROGRAPH AT	DW-3B	272.	13.83	101.	26.	9.	5.68		
+	HYDROGRAPH AT	SUB2B	597.	13.58	228.	62.	21.	2.08		
+	2 COMBINED AT	C3-2B	854.	13.75	330.	88.	29.	7.76		
+	DIVERSION TO	DS-2B	627.	13.75	281.	76.	25.	7.76		
+	HYDROGRAPH AT	DW-2B	227.	13.75	48.	12.	4.	7.76		
+	ROUTED TO	RW-2B	225.	13.92	48.	12.	4.	7.76		
+									12.51	13.92
+	HYDROGRAPH AT	SUB2A	1557.	13.50	442.	115.	38.	3.83		
+	2 COMBINED AT	C2B-2A	1690.	13.58	491.	127.	42.	11.59		
+	ROUTED TO	RW-2A	1670.	13.75	490.	127.	42.	11.59		
+									15.11	13.75
+	DIVERSION TO	DS-2A	701.	13.75	124.	31.	10.	11.59		
+	HYDROGRAPH AT	DW-2A	969.	13.75	367.	96.	32.	11.59		
+	HYDROGRAPH AT	SUB1B	910.	14.50	482.	150.	50.	5.59		
+	2 COMBINED AT	C2A-1B	1681.	14.17	837.	246.	82.	17.18		
+	ROUTED TO	RW-1B	1670.	14.50	836.	246.	82.	17.18		
+									15.46	14.50
+	DIVERSION TO	DS-1B	912.	14.50	332.	83.	28.	17.18		
+	HYDROGRAPH AT	DW-1B	758.	14.50	504.	163.	55.	17.18		
+	HYDROGRAPH AT	SUB1A	816.	14.08	365.	104.	35.	3.85		

+	2 COMBINED AT	C1B-1A	1537.	14.25	869.	267.	90.	21.03		
+	ROUTED TO	RW-1A	1536.	14.33	868.	267.	90.	21.03		
+									14.89	14.33
+	DIVERSION TO	DS-1A	710.	14.33	259.	65.	22.	21.03		
+	HYDROGRAPH AT	DW-1A	826.	14.33	610.	202.	68.	21.03		
+	ROUTED TO	RW-SC	824.	14.50	609.	202.	68.	21.03		
+									14.74	14.50
+	HYDROGRAPH AT	SUB20	882.	24.25	815.	448.	150.	14.37		

Appendix II

Roadway Plans

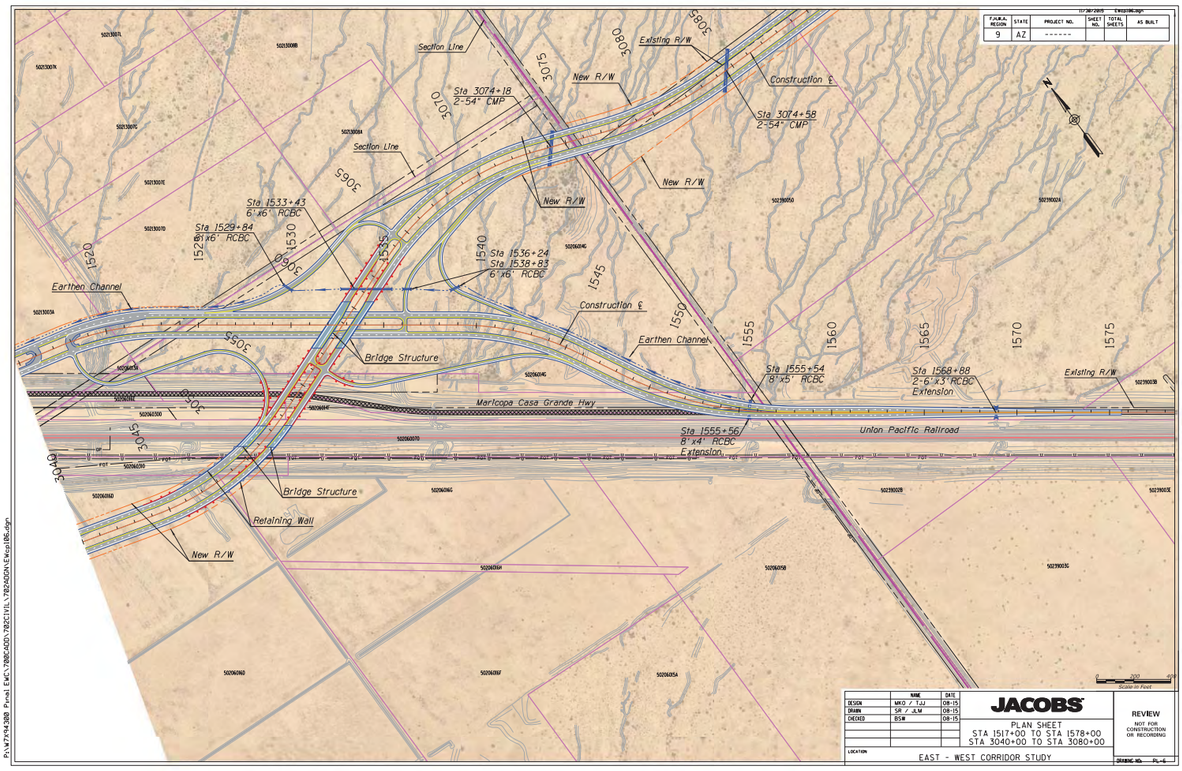


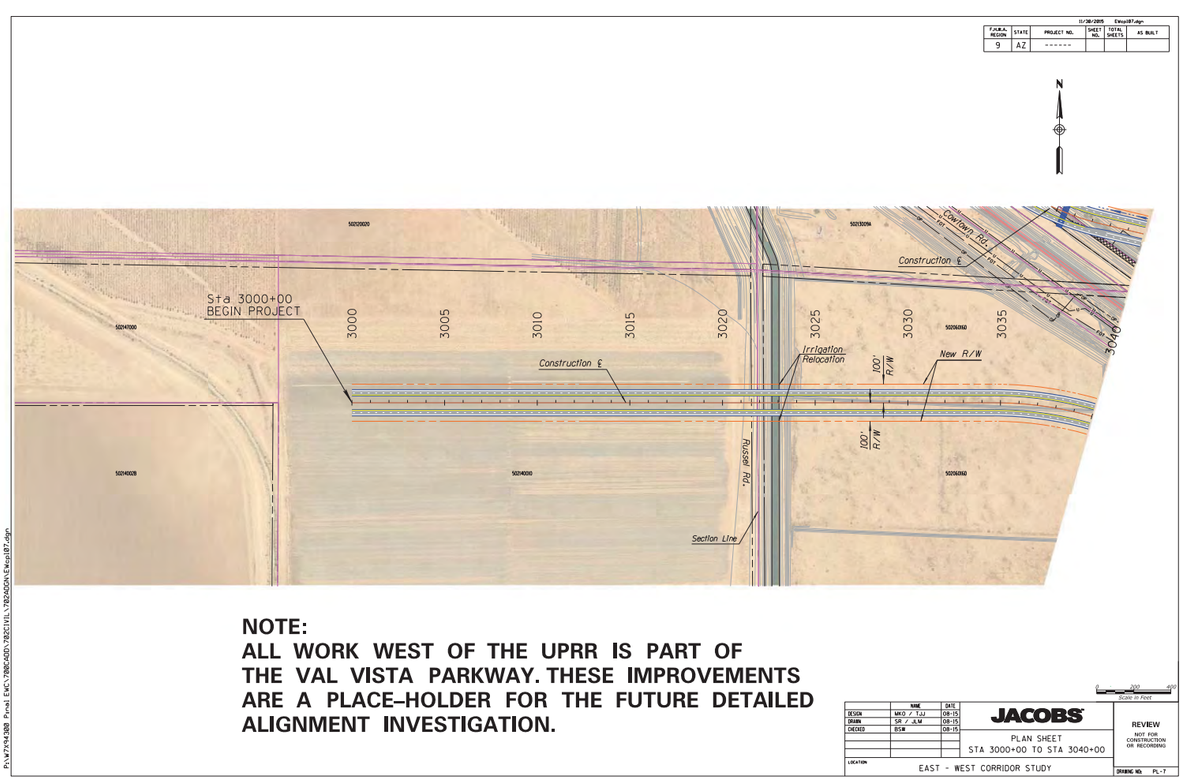
Maricopa Casa Grande Hwy
Union Pacific Railroad
Cowtown Rd.
New R/W
Bridge Structure
Retaining Wall
Section Line
Construction ℄
Overhead Power Relocation
Existing R/W
Porter Rd.
Farrell Rd.
Hatfield and Parker Rd.
JACOBS
PLAN SHEET
STA 1095+00 TO STA 1220+00
EAST - WEST CORRIDOR STUDY
REVIEW
NOT FOR CONSTRUCTION OR RECORDING
DRWG NO. R-2

Fuqua Rd.
Maricopa Casa Grande Hwy
Union Pacific Railroad
Construction ℄
Existing R/W
New R/W
Overhead Power Relocation
Section Line
Irrigation Relocation
W Pete and Nell Rd.
Harlman Rd.
JACOBS
PLAN SHEET
STA 1220+00 TO STA 1340+00
EAST - WEST CORRIDOR STUDY
REVIEW
NOT FOR CONSTRUCTION OR RECORDING
DRWG NO. R-3

Sta 1392+09
5-10'x6' RCBC
Sta 1374+47
5-10'x6' RCBC
Sta 1371+98
5-10'x6' RCBC
Extension
Sta 1370+44
(8-10'x6' RCBC
Extension
Sta 1366+63
6-10'x6' RCBC
Extension
Sta 1346+40
5-54" Pipes
Extension
Sta 1453+00
2-36" Pipes
Sta 1425+23
4-10'x6' RCBC
Sta 1404+64
5-10'x6' RCBC
Union Pacific Railroad
Construction ℄
Concrete Channel
Existing R/W
New R/W
Section Line
Cowtown Rd.
Murphy Rd.
Mitchell Rd.
Antone St.
Santa Cruz Ave.
Anderson Rd.
Maricopa Industrial Pkwy
Overhead Power Relocation
Irrigation Relocation
Scale in Feet
JACOBS
PLAN SHEET
STA 1340+00 TO STA 1460+00
EAST - WEST CORRIDOR STUDY
REVIEW
NOT FOR CONSTRUCTION OR RECORDING
DRWG NO. PL-4

Sta 1510+44
5-36" Pipes
Sta 1489+03
4-10'x6' RCBC
Sta 1471+31
4-60" Pipes
Earthen Channel
Concrete Channel
Construction ℄
Existing R/W
New R/W
Section Line
Cowtown Rd.
Russell Rd.
Union Pacific Railroad
Maricopa Casa Grande Hwy.
Scale in Feet
JACOBS
PLAN SHEET
STA 1460+00 TO STA 1517+00
EAST - WEST CORRIDOR STUDY
REVIEW
NOT FOR CONSTRUCTION OR RECORDING
DRWG NO. PL-5





NOTE:
ALL WORK WEST OF THE UPRR IS PART OF THE VAL VISTA PARKWAY. THESE IMPROVEMENTS ARE A PLACE-HOLDER FOR THE FUTURE DETAILED ALIGNMENT INVESTIGATION.

FEDERAL REGION 9
STATE AZ
PROJECT NO. ------
SHEET NO.
TOTAL SHEETS
AS BUILT
Section Line
Existing R/W
New R/W
Poppose Rd.
Vai Vista Rd.
Overhead Power Relocation
Sta 3128+75 60" CMP
Sta 3102+11 2-54" CMP
Sta 3094+58 2-54" CMP
Construction ℄
100' R/W
Montgomery Rd.
Vai Vista Dr.
Sta 3195+84 60" CMP
Sta 3192+30 30" CMP
Sta 3166+26 30" CMP
Sta 3152+90 60" CMP
Sta 3144+36 60" CMP
Sewer
REVIEW
NOT FOR CONSTRUCTION OR RECORDING
JACOBS
PLAN SHEET
STA 3080+00 TO STA 3200+00
EAST - WEST CORRIDOR STUDY
DESIGN
DRAWN
CHECKED
LOCATION
DRAWING NO. PL-9
PW74430B Panel EWC7200CA00720CIVIL7202A00NEXPIB4.dgn

FEDERAL REGION 9
STATE AZ
PROJECT NO. ------
SHEET NO.
TOTAL SHEETS
AS BUILT
Section Line
Existing R/W
New R/W
Vai Vista Rd.
Corrales Rd.
Blanco Rd.
Construction ℄
100' R/W
Sta 3242+83 2-54" CMP
Sta 3233+54 60" CMP
Sta 3226+34 30" CMP
Sta 3210+35 30" CMP
Sta 3301+83 2-60" CMP
Sta 3292+91 2-54" CMP
Sta 3280+02 2-54" CMP
REVIEW
NOT FOR CONSTRUCTION OR RECORDING
JACOBS
PLAN SHEET
STA 3200+00 TO STA 3320+00
EAST - WEST CORRIDOR STUDY
DESIGN
DRAWN
CHECKED
LOCATION
DRAWING NO. PL-9
PW74430B Panel EWC7200CA00720CIVIL7202A00NEXPIB4.dgn

P:\WZ94300 Panel EAC\200CADD\202CIVIL\202ADGN\Ekegil1.dgn

P:\WZ94300 Panel EAC\200CADD\202CIVIL\202ADGN\Ekegil1.dgn

F.A.P.N.	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	AZ	------			

11-20-2009 RevisionDate

JACOBS

PLAN SHEET

STA 3540+00 TO STA 3595+00

EAST - WEST CORRIDOR STUDY

DESIGN	MKD / TJJ	05-15
DRAWN	SF / AM	05-15
CHECKED	RFB	05-15

LOCATION

REVIEW
NOT FOR CONSTRUCTION OR RECORDING

DRAWING NO. PL-13

Scale in Feet

P:\W74430D Panel EWC\200CADD\202CIVIL\202ADCN\EWcgpl13.dgn

F.A.P.N.	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	AZ	------			

11-20-2009 RevisionDate

JACOBS

PLAN SHEET

STA 3595+00 TO STA 3647+00

EAST - WEST CORRIDOR STUDY

DESIGN	MKD / TJJ	05-15
DRAWN	SF / AM	05-15
CHECKED	RFB	05-15

LOCATION

REVIEW
NOT FOR CONSTRUCTION OR RECORDING

DRAWING NO. PL-13

Scale in Feet

P:\W74430D Panel EWC\200CADD\202CIVIL\202ADCN\EWcgpl13.dgn

Appendix III

Segment B Drainage Alternatives

J2 Engineering and Environmental Design, LLC
4649 E. Cotton Gin Loop
Suite B2
Phoenix, Arizona 85040
Phone: 602.438.2221
Fax: 602.438.2225

DRAFT Memorandum

To:	Berwyn Wilbrink	Fax:	602-253-1202
Organization:	Jacobs	Phone:	602-530-1667
From:	Darren Forstie	Date:	May 6, 2015
Re:	E-W Corridor Drainage Cost Estimate	Pages	4 text pages
CC:	Jeff Holzmeister	Project Number:	110537

The purpose of this memo is to briefly summarize the proposed drainage solutions to manage offsite flow for a portion of the East-West Corridor project in Pinal County, Arizona and an engineering cost estimate comparison. The drainage analysis in the proposed condition was summarized in a Draft Memo dated June 19, 2014, published by J2 Engineering and Environmental Design (J2).

General:
This Memo looks at three proposed drainage options for the East-West Corridor segment from approximate west of Val Vista Blvd. to the Santa Cruz Wash (see Figure 1, Segment B) and associated construction/project cost items for each option.

An existing drainage analysis was completed and documented in the Draft Memorandum dated April 30, 2014 by J2 and serves as the basis for the proposed drainage improvements. A proposed condition HEC-1 model was developed for both the 50-year and 100-year storm events. Generally, offsite flow reaches the East-West Corridor from the northeast as sheet flow with watersheds extending into the Sacaton Mountains.

Generally the proposed improvements are sized for flow from the 50-year storm unless the improvements are within FEMA 100-year floodplain where a 100-year storm frequency will govern.

Figure 1

Earthen Channel Option:
This option will manage the 50-year discharge and consider the 100-year discharge in the area between Anderson Road and Russell Road due to the adjacent homes. These homes cannot be adversely impacted during a 100-year storm event. The proposed drainage improvements consist of expanding the current roadside ditch and upgrading the culverts at the lateral roadways (Anderson Rd., Russell Rd., & Maricopa Industrial Pkwy.). The channel for this option is earthen at a slope shallow enough to limit high velocities. Three culvert systems will bleed-off channel flow to the south at existing railroad culverts at a flow rate that matches railroad culvert capacity. *Exhibit B1* illustrates the earthen channel option for this segment.

Due to the significant offsite flow rates and the requirement to limit velocities, the channel top width varies from 92 feet to 122 feet with the inclusion of a 12-foot maintenance road. The maximum channel depth is 5 feet which includes 1-foot of freeboard. Significant right-of-way will be required and maintenance will be higher for this option.

Concrete Channel Option:
This option will manage the offsite flows similar to the earthen channel option and upgrade the culverts at the lateral roadways. The roadside channel will be concrete and with higher design velocities the channel width will be narrower than the earthen channel option. The channel top width varies from 60 feet to 77 feet with the inclusion of a 12-foot maintenance road. The maximum channel depth is 5 feet which includes 2-foot of freeboard. Significant right-of-way will be required for this option but a lower requirement than what is needed in the earthen channel option. Maintenance will also be lower when compared to the earthen channel option.

Retention Basin and Channel Option:
This option will manage the offsite flows similar to the earthen channel option and upgrade the culverts at the lateral roadways. A detention basin is proposed at the northeast corner of Russell Road and the highway. The detention basin will fit within a 130 ac parcel and is sized to detain the upstream offsite watershed (approximately 411 ac-ft). Downstream of Russell Road, a channel will be needed to intercept the offsite flow west of Russell Road. The channel and culvert sizes are significantly reduced from the earthen channel option. The channel top width if considering an earthen structure varies from 44 feet to 74 feet with the inclusion of a 12-foot maintenance road and the maximum channel depth is 5 feet which includes 1-foot of freeboard. If concrete is used, the channel top width varies from 32 feet to 47 feet. The channel top width upstream of the detention basin (east of Russell Road) is 92 feet for an earthen channel and 60 feet for a concrete channel. The right-of-way requirements for the channel adjacent to the highway are lower than the other 2 options. Maintenance of an earthen channel will be higher than that of a concrete channel. Note this option could also mix and match between an earthen and concrete channel to balance right-of-way acquisition and construction costs. See *Exhibit B1* for an illustration of this option.

Estimate Option Cost:
The estimated cost of major construction/project items for each option is attached. The estimated cost are for comparison purposes only and do not reflect all the construction cost associated with each option nor is there an added contingency. It was assumed that gaining right-of-way for the channel adjacent to the roadway is more costly than buying an entire parcel outright as needed for the detention basin option. Using a qualified real estate agent to estimate land costs is recommended. Additional assumptions regarding the cost estimate are as follows:

- Channel excavation assumes none of the existing roadside ditch/channel can be utilized.
- Some or a majority of the excavation volume will need to be hauled away. It was assumed 50% of the excavation will be hauled away for each option.
- Land acquisition assumes none of the existing right-of-way can be utilized but rather the entire channel footprint including a maintenance road will need to be purchased.

- The retention basin and channel option assumes the use of a concrete channel to reflect the more costly alternative in regards to construction costs. If land acquisition is more expensive than the unit price in the estimate, than the earthen channel option with more right-of-way needs becomes higher in project cost.

ESTIMATE OF MAJOR CONSTRUCTION COSTS COMPARISON TABLE
PINAL COUNTY EAST-WEST CORRIDOR (SEGMENT EAST OF SANTA CRUZ WASH)
EARTHEN CHANNEL VS CONCRETE CHANNEL & RETENTION BASIN OPTION

PRELIMINARY ESTIMATE BY J2 ENGINEERING & ENVIRONMENTAL DESIGN

May 2015

OPTION 1 - EARTHEN CHANNEL PROBABLE COST

SEGMENT	ITEM DESCRIPTION	QUANTITY	UNIT	PRICE	TOTAL
1 thru 3	Channel Excavation	CY	235,556	$6.00	$1,413,333
	Spoils Haul Away (50% of excavation)	CY	117,778	$4.00	$471,111
	Land Acquisition	AC	43	$25,000.00	$1,066,116
	Box Culverts (two 3-12'x6' & 4-12'x6')	LS	1	$500,000.00	$500,000
	Drop Structure	EA	12	$15,000.00	$180,000
	Hydroseeding	SY	206,400	$0.65	$134,160
				SUBTOTAL	$3,764,720

OPTION 2 - CONCRETE CHANNEL PROBABLE COST

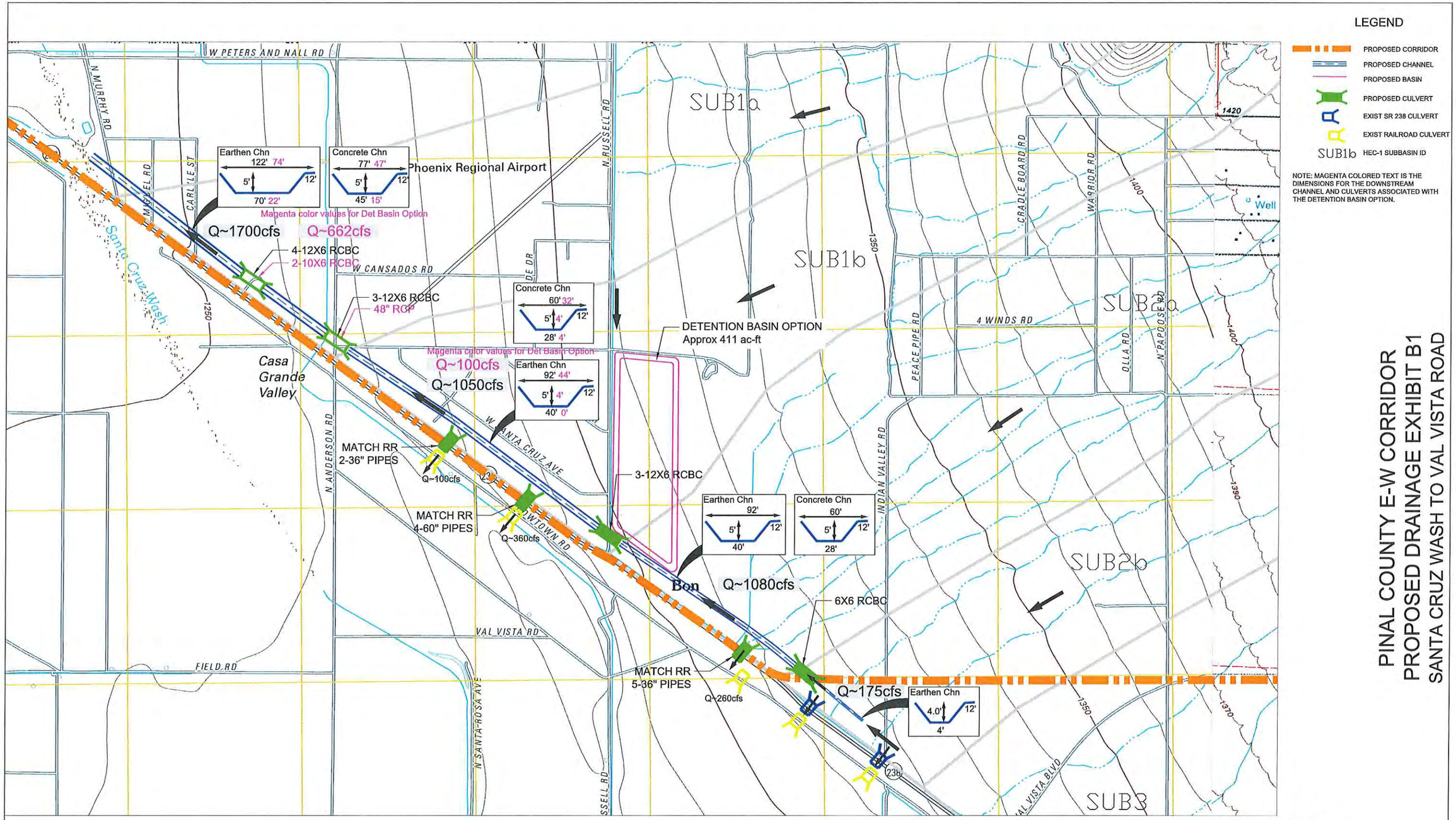
SEGMENT	ITEM DESCRIPTION	QUANTITY	UNIT	PRICE	TOTAL
1 thru 3	Channel Excavation	CY	147,037	$6.00	$882,222
	Spoils Haul Away (50% of excavation)	CY	73,519	$4.00	$294,074
	Land Acquisition	AC	27	$25,000.00	$686,754
	Box Culverts (two 3-12'x6' & 4-12'x6')	LS	1	$500,000.00	$500,000
	Drop Structure	EA	4	$10,000.00	$40,000
	Concrete Lining	SY	113,356	$54.00	$6,121,203
				SUBTOTAL	$8,524,253

OPTION 3 - DETENTION BASIN & CONCRETE CHANNEL PROBABLE COST

SEGMENT	ITEM DESCRIPTION	QUANTITY	UNIT	PRICE	TOTAL
1 thru 3	Channel Excavation	CY	63,704	$6.00	$382,222
	Retention Basin Excavation	CY	698,889	$3.00	$2,096,667
	Spoils Haul Away (50% of excavation)	CY	381,296	$4.00	$1,525,185
	Channel Land Acquisition	AC	17	$25,000.00	$423,669
	Detention Basin Land Acquisition	AC	130	$10,000.00	$1,298,960
	Culverts (2-10'x6' RCBC & 48" RCP)	LS	1	$100,000.00	$100,000
	Drop Structure	EA	5	$15,000.00	$75,000
	Concrete Lining	SY	56,921	$54.00	$3,073,714
	Hydroseeding	SY	628,697	$0.65	$408,653
				SUBTOTAL	$9,384,069

Assumptions:

1. Channel excavation assumes none of the existing roadside ditch/channel can be utilized. Therefore channel excavation volumes are based on the full channel cross section and depth.
2. Its assumed some of the excavation volume will need to be removed. The percent removal is based on engineering judgment.
3. Land acquisition assumes none of the existing right-of-way can be utilized. Rather the entire channel footprint including a 12' maintenance road will need to be purchased.
4. See Exhibit B1 for segment IDs and channel layout



NOTES:
EARTHEN CHANNELS INCLUDE 1' OF FB, ARE SUBCRITICAL AND HAVE 4:1 SIDE SLOPES
CONCRETE CHANNELS INCLUDE 2' OF FB, ARE SUPERCRITICAL AND HAVE 2:1 SIDESLOPES

PINAL COUNTY E-W CORRIDOR
PROPOSED DRAINAGE EXHIBIT B1
SANTA CRUZ WASH TO VAL VISTA ROAD

DATE: 5/05/15

J2 Engineering and Environmental Design
4619 East Cotton Gin Loop, Suite B2
Phoenix, Arizona 85040
Phone: 602.438.2221
www.j2design.us

Appendix IV

Maricopa – Casa Grande Highway Final Drainage Report

PINAL COUNTY

MC-CG HIGHWAY

CROSSING IMPROVEMENTS
PROJECT NO. 60671157

FINAL DRAINAGE REPORT

December 2013

Prepared for:

PINAL COUNTY
Public Works Division

PINAL • COUNTY
Wide open opportunity

Registered Professional Engineer (Civil)
CERTIFICATE NO.
18509
JOHN PATRICK
FYIE
Date Signed 12/6/13
ARIZONA, U.S.A.
Expires 12-31-2014

By:

JACOBS ENGINEERING GROUP

JACOBS

On-Call Contract Number: EV11-06
Task Number: 2012-001

TABLE OF CONTENTS

1.0 INTRODUCTION 1
2.0 HYDROLOGY 3
3.0 EXISTING DRAINAGE STRUCTURES 11
4.0 PROPOSED DRAINAGE STRUCTURES 13
5.0 SUMMARY 16
6.0 RERERENCES 17

FIGURES

1 Project Vicinity Map 1
2 FEMA Firmettes 4
3 Pinal County FIS 5
4 Location 2 Flow Patterns 6
5 East-West Corridor Hydrology 8
6 Murphy Road/Airport Basin 9

APPENDICES

Appendix I Hydrology
Appendix II Santa Cruz Wash Tailwater Depth
Appendix III Location 1 Drainage Calculations
Appendix IV Location 2 Drainage Calculations
Appendix V Location 3 Drainage Calculations

Registered Professional Engineer (Civil)
CERTIFICATE NO. 18509
JOHN PATRICK FYIE
Date Signed 12/18/13
ARIZONA, U.S.A.
Expires 12-31-2014

1.0 INTRODUCTION

The Maricopa-Casa Grande Highway (MC-CG) is located in the northern portion of Pinal County connecting the cities of Maricopa and Casa Grande. The existing highway is a two-lane paved roadway located parallel to the Union Pacific Railroad (UPRR) on the northeast side, see *Figure 1 – Project Vicinity Map*. The portion of the highway being studied in this project is approximately seven miles southeast of Maricopa and nine miles northwest of Casa Grande at the highway crossing of the Santa Cruz Wash.

The purpose of this project is to construct an all-weather roadway at the Santa Cruz Wash. To meet this goal it will be necessary to improve the roadway section and install drainage structures. In addition it will be necessary to reconstruct the highway intersection at Murphy Road to meet the proposed highway alignment.

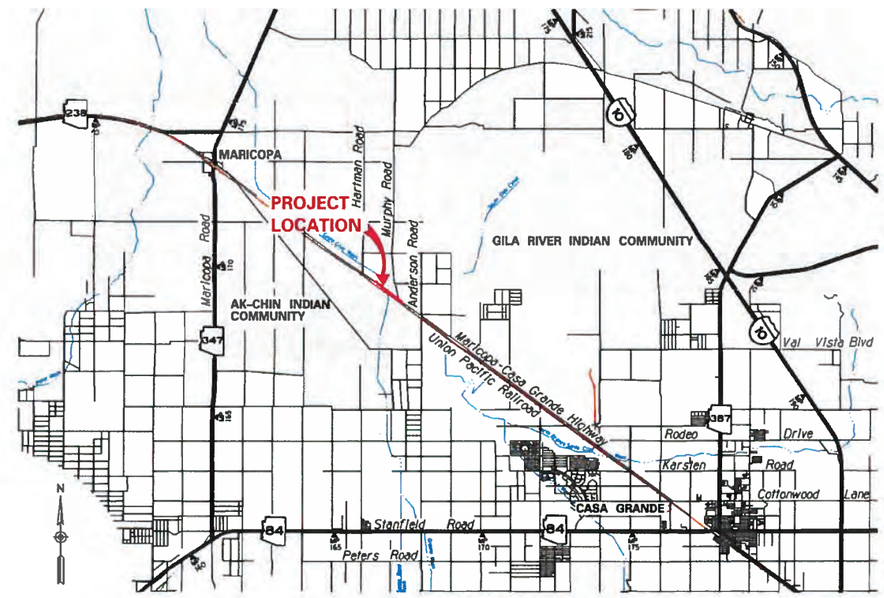


Figure 1 - Project Vicinity Map

This Final Drainage Report summarizes the existing drainage data and provides a summary of drainage assumptions and approaches used in the final drainage design. This report was also prepared to determine the 50-year and 100-year hydrology for the project and to develop a final design for the proposed drainage structures. The proposed structures shown are for the purpose of developing final construction plans and an accurate cost estimate for the project.

It is recognized that these designs are greatly impacted by the flows in the Santa Cruz Wash. An estimate of those flow conditions was included in this report by a detailed analysis using Manning's Equation.

2.0 HYDROLOGY

The primary feature of this project is the Santa Cruz Wash which flows from the southeast to the northwest crossing under the UPRR just west of Murphy Road. Sub-basins east of Murphy Road drain southwest to the MC-CG and then flow northwest parallel to the roadway to the Santa Cruz Wash. Sub-basins south of the UPRR flow directly into the Santa Cruz Wash.

Storm water impacting the project was evaluated for the 50-year and 100-year peak discharge. This runoff has concentration points at three locations. Location 1 is the storm water flow in the main channel of the Santa Cruz Wash at the existing bridges under the UPRR. These bridges are centered at MC-CG Station 137+94, Station 142+75 and Station 145+63. Location 2 is at the existing 5-60" CMPs under the UPRR at MC-CG Station 118+18. Location 3 is at Murphy Road near Station MC-CG 147+00. These locations are shown on the FEMA firmettes for the project vicinity included in *Figure 2-FEMA Firmettes*.

Computations for the design peak discharges at Locations 1, 2 and 3 are included in Appendix I. Calculations using the Rational Method were based on NOAA Atlas 14 rainfall depths and runoff intensities.

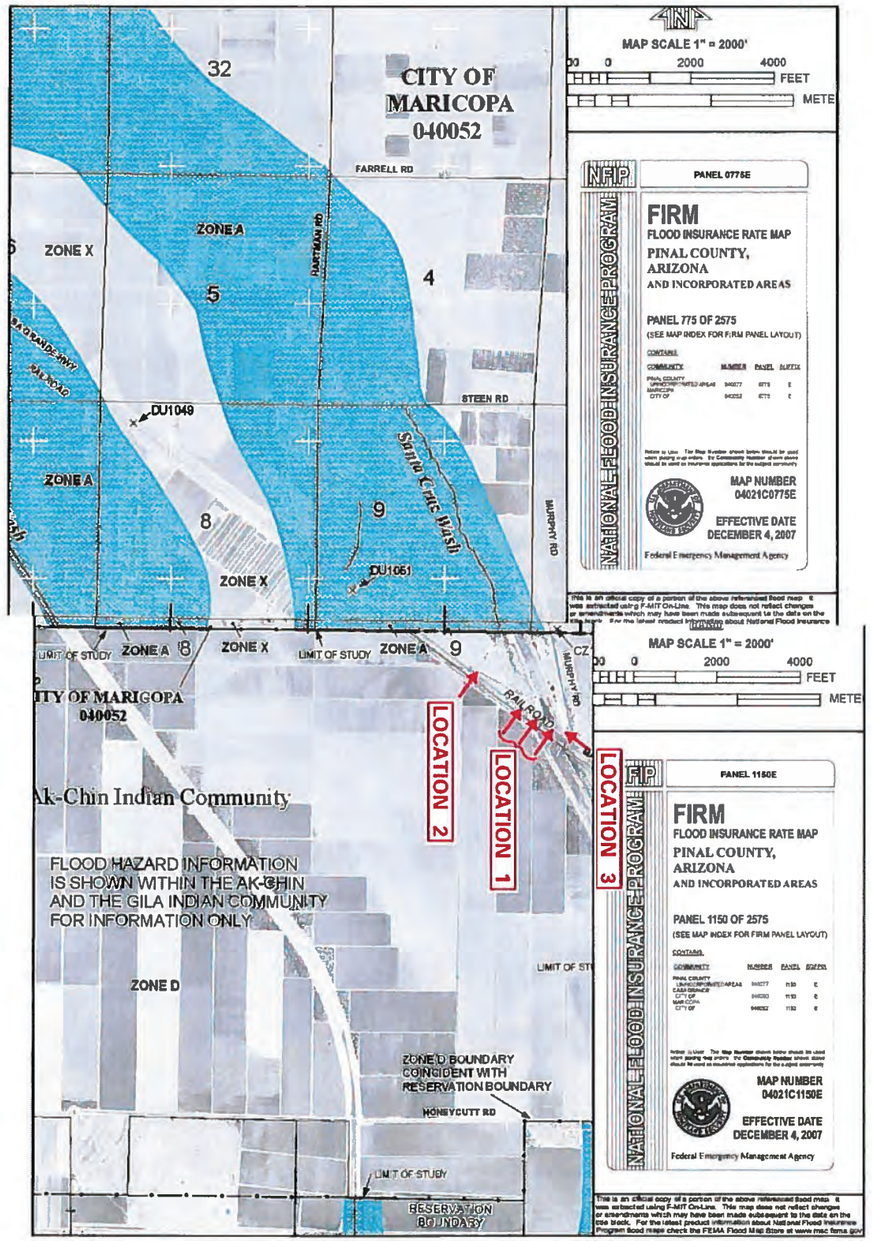


Figure 2 – FEMA Firmettes

LOCATION 1

The 100-year peak discharge was based on the Pinal County Flood Insurance Study (FIS) as shown in *Figure 3-Pinal County FIS*. The total flow rate passing under the UPRR at this location is 7,600 cubic feet per second (cfs). The peak discharge at each bridge was determined by dividing the total flow based on each bridge's length. To estimate the 50-year peak discharge, the ratio of 50-year rainfall to 100-year one-hour rainfall was used. The rainfall data was obtained from NOAA Atlas 14; therefore the 50-year flow was computed to be (1.86/2.09) x 7,600 cfs = 6,764 cfs. The resulting flow rate at each bridge is shown below.

Bridge Location	Bridge Length (feet)	100-Year Flow (cfs)	50-Year Flow (cfs)
137+94	56	1,458	1,297
142+75	180	4,685	4,170
145+63	56	1,458	1,297
	Total =	**7,600**	**6,764**

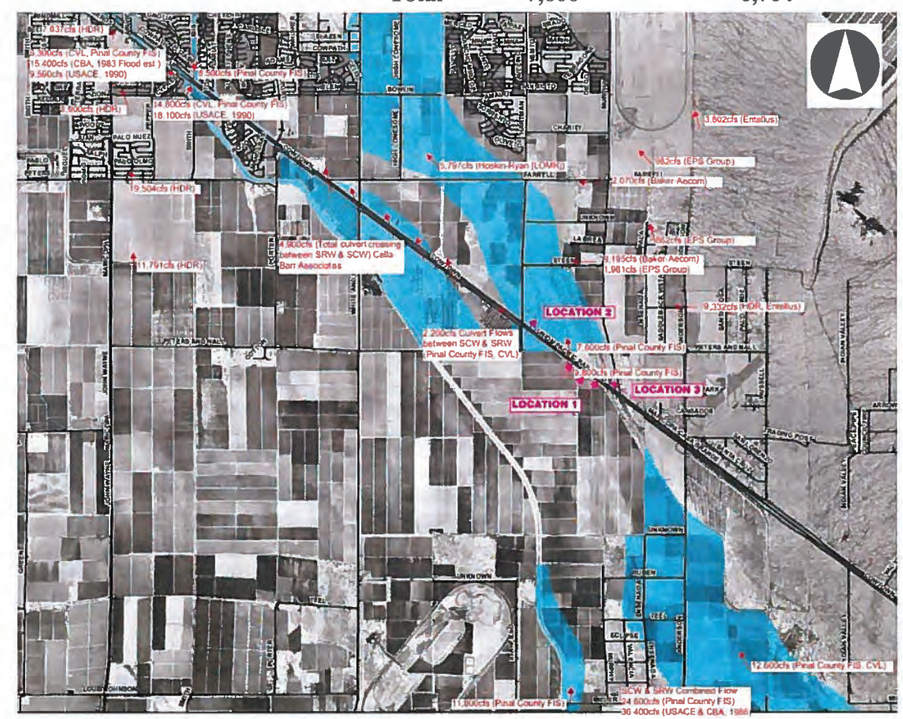


Figure 3 – Pinal County FIS

LOCATION 2

As indicated on the Pinal County FIS, the flows in the Santa Cruz Wash are split at the UPRR with 2,200 cfs flowing northwest parallel to the railroad (A_{total}). At Station 118+18, Point A, the runoff is split between a swale continuing northwest and 5-60" CMPs which divert a portion of these flows under the railroad toward the existing roadway, see *Figure 4-Location 2 Flow Patterns*.

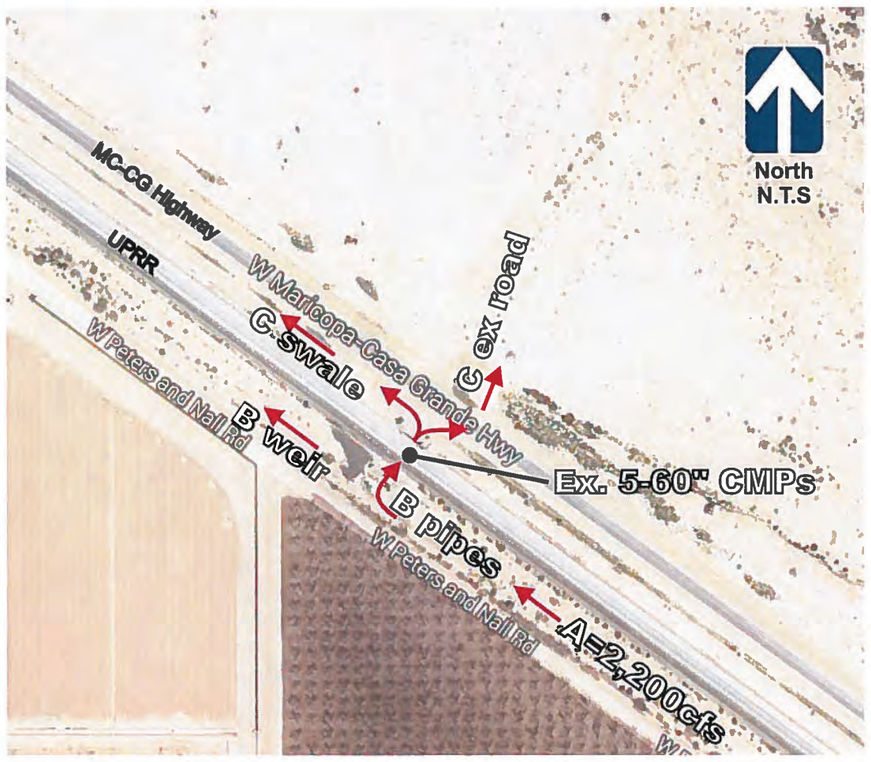


Figure 4 – Location 2 Flow Patterns

An analysis of the topography indicates that up to elevation 1239.22 all of the runoff is conveyed to the existing corrugated metal pipes (B_{pipes}). Above this elevation, a portion of the runoff breaks out over a weir (B_{weir}) and flows northwest in a swale. Flows in the pipes are conveyed under the UPRR and split at Point C. At this location, the runoff either crosses the MC-CG in a dip section ($C_{ex\ road}$) or continues northwest in a swale between the UPRR and MC-CG (C_{swale}).

Flows in the existing pipes were computed using the ADOT Pipe Culvert Computer Program which is based on HY-8. Flows in the swale were computed using Manning's Equation. Flows crossing the weir and existing roadway were computed using the broadcrested weir equation. It was necessary to calculate the flows by iterations until the tailwater elevation equaled the swale and dip section elevation and the headwater elevation equaled the breakout weir elevation. This was accomplished by first selecting a trial tailwater elevation. This was used to compute the flows that crossed the existing roadway in a dip section ($C_{ex\ road}$) and the flows that continued in the swale (C_{swale}). The total of these flows were used as (B_{pipes}). From this the necessary headwater elevation was calculated and then used to compute the breakout flows (B_{weir}). Adjustments were made to the trial tailwater until the total of the flows ($B_{pipes} + B_{swale}$) equaled the total flow at that location, 2,200 cfs. This occurred at elevation 1241.69 as shown below.

Headwater Elevation	B-pipes	B-swale	B-total
1239.22	347	0	347
1241.69	865	1,349	2,214

Tailwater Elevation	C-ex road	C-swale	C-total
1238.63	0	303	303
1239.53	222	643	865

The existing dip section in the highway will be removed and replaced with pipe culverts. For design purposes, the 50-year peak discharge was determined from the 100-year peak discharge by a ratio of the rainfall data. Since Q_{100} equals 222 cfs, the 50-year rate was computed as follows.

$$Q_{50} = Q_{100} \times (1.86 / 2.09) = 198 \text{ cfs}$$

LOCATION 3

At Location 3, storm water runoff is conveyed from an area between Murphy Road and the Ak-Chin Regional Airport and from Subbasin 2 and Subbasin 3 as identified in the *Initial Drainage Report for the East-West Corridor Study* prepared by Wood, Patel & Associates, Inc. These drainage basins have been shown on Figures 5 and 6.

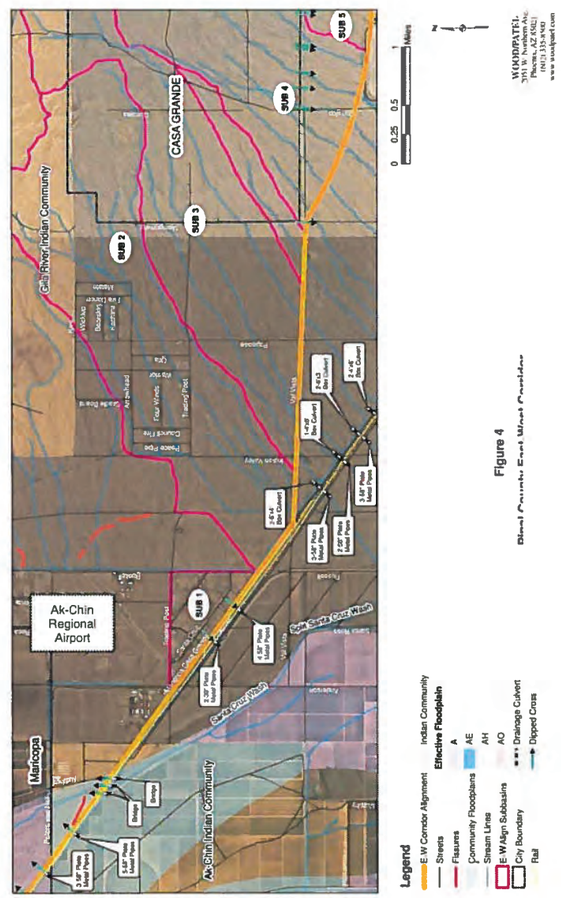


Figure 5 – East-West Corridor Hydrology

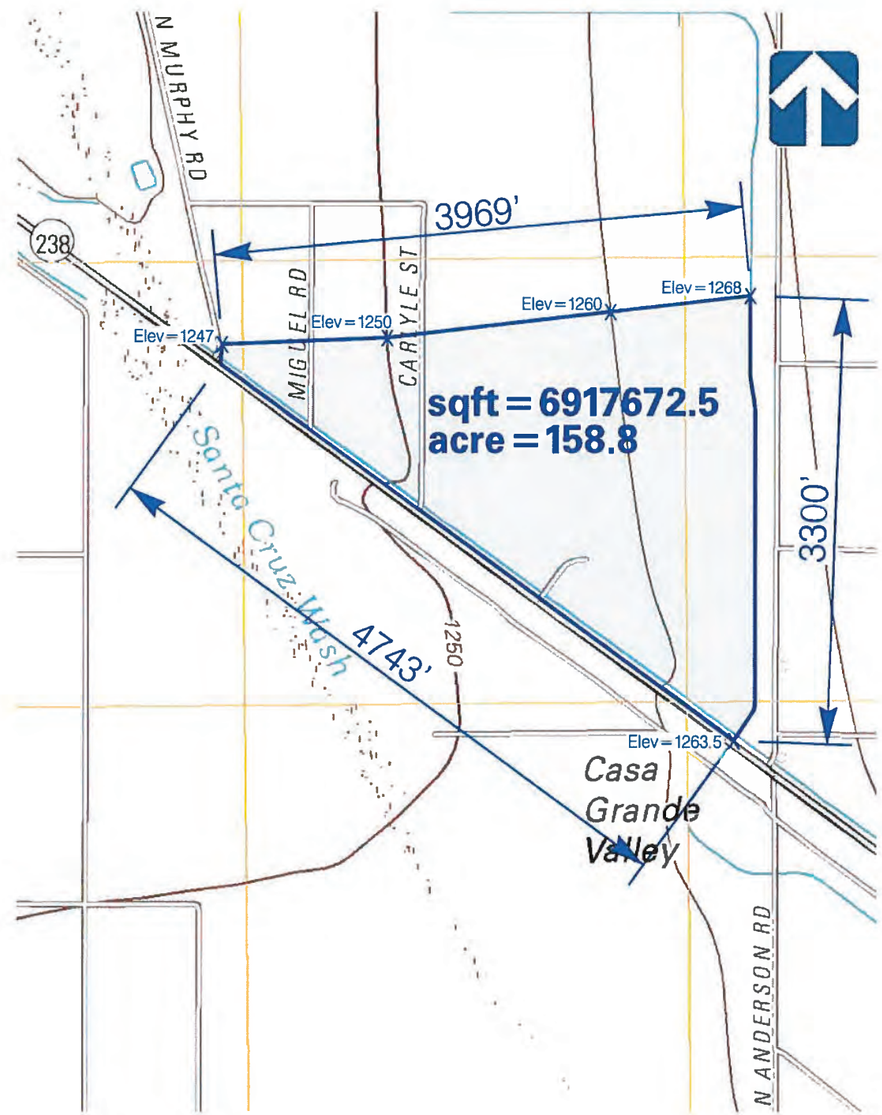


Figure 6 – Murphy Road/Airport Basin

The Murphy Road intersection was designed to ensure flood conditions are not made more severe on adjoining properties; therefore, only 100-year peak discharges were evaluated. Computation of the 100-year peak discharge from the Murphy Road/airport basin was performed using the Rational Method in accordance with ADOT procedures. Rainfall intensity was taken from NOAA Atlas 14. Time of Concentration, T_C, was set at the minimum and equals 10 minutes; therefore rainfall intensity equals 6.07 inches per hour. For the runoff coefficient, the sub-basin was determined to be rural desert with one hour precipitation equal to 2.09 inches. As specified by ADOT, the runoff coefficient, C, equals 0.53. Sub-basin area as shown in Figure 6 is 158.8 acres. Computations have been performed as follows.

$Q = C \times i \times A$ $\qquad Q_{100} = 0.53 \times 6.07 \times 158.8 = 511$ cfs

where

Q = peak discharge (cubic feet per second)

C = runoff coefficient

i = rainfall intensity (inches per hour)

A = basin area (acres)

Runoff from Subbasin 2 and Subbasin 3 was taken from the *Initial Drainage Report for the East-West Corridor Study* prepared by Wood, Patel & Associates, Inc. as follows.

Sub-basin 2	$Q_{100} = 2{,}224$ cfs
Sub-basin 3	$Q_{100} = 2{,}141$ cfs

The total peak discharge at Location 3 for the 100-year event was conservatively estimated to be the sum of these three subbasins.

$$Q_{100} = 511 \text{ cfs} + 2{,}224 \text{ cfs} + 2{,}141 \text{ cfs} = 4{,}876 \text{ cfs}$$

This estimated peak discharge rate was compared to the results of *Ak-Chin Indian Community Economic Development Zone Drainage Study* by Dibble Engineering. That report showed a 100-year peak rate of 3,969 cfs at Murphy Road. Therefore the rate identified in this report appears to be more conservative and will be used for design purposes.

In the final design, a more detailed analysis of the Santa Cruz Wash was made to accurately determine flow depths and velocities. Adjustments to drainage structure locations and elevations were made to those identified in the Preliminary Drainage Report.

3.0 EXISTING DRAINAGE STRUCTURES

LOCATION 1

The existing bridges under the UPRR at Location 1 consist of a 2-span bridge with 56' length, a 6-span bridge with 180' length and another 2-span bridge with 56' length. The existing roadway has one long dip section with 2-24" corrugated metal pipes.

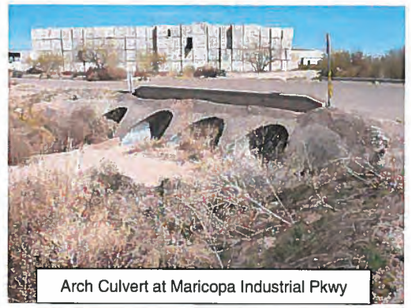
LOCATION 2

This location has 5-60" corrugated metal pipes under the UPRR and a dip section in the existing roadway.

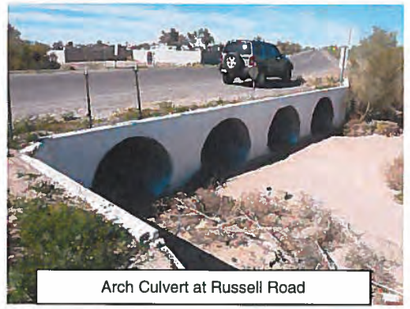
LOCATION 3

The Murphy Road drainage crossing at the MC-CG is Location 3 and it lies immediately northeast of the intersection. Murphy Road has a dip section at this location. Upstream from this location, to the southeast, is a 3-10'x4' box culvert at an undeveloped parcel, 4-80"x60" arch culvert at North Maricopa Industrial Parkway, a 3-80"x60" arch culvert at North Anderson Road and a 4-80"x60" arch culvert at North Russell Road.

Box Culvert at Undeveloped Parcel


Arch Culvert at Maricopa Industrial Pkwy

Arch Culvert at Anderson Road


Arch Culvert at Russell Road

4.0 PROPOSED DRAINAGE STRUCTURES

To analyze the proposed structures at Locations 1 and 3, it was necessary to estimate the normal flow depth in the Santa Cruz Wash. This was used as the tailwater depth for the design of the proposed structures. The tailwater analysis was performed using Manning's Equation. Longitudinal slope was computed using the USGS map for the area and verifying the data with topography provided by Pinal County. Cross sectional dimensions were taken from project topography. Manning's coefficient of friction, n, was determined using ADOT procedures. The results for the 50-year and 100-year peak discharge indicate flow depths of 5.31 and 5.67 feet, respectively. These computations have been included in Appendix II.

In final design, it was necessary to confirm the tailwater depths by using the Federal Highway Administration (FHWA) Culvert Hydraulic Analysis Program, HY-8 to compute the depths and velocities downstream of each structure. In the case of any significant difference, the higher tailwater depth was used. In accordance with the Pinal County Drainage Manual, drainage structures at Location 1 and Location 2 were designed for the 50-year peak discharge and checked for the 100-year peak discharge. At Location 3, only the 100-year peak discharge was used in the drainage computations.

LOCATION 1

Located downstream of the existing railroad bridges, three sets of ADOT standard box culverts are proposed for construction under the MC-CG. At Station 137+94, a set of 6-barrel 10'x6' concrete box culverts will be constructed with a length of 44' and aligned with the existing bridge under the UPRR. The proposed finished grade of the roadway asphalt course would be placed on top of the box culvert. Details of the guardrail placement and end of box culvert modifications have been included. At Station 142+75, three sets of 6-barrel 10'x6' concrete box culverts would be constructed, also aligning with the existing UPRR bridge. At Station 145+00, a set of 6-barrel 10'x6' concrete box culverts has been proposed. Due to the location of the existing berm on the north side of the highway, it was necessary to shift the proposed box culvert northwest and place it on a 45° skew. The ADOT design program was used to size the box culverts and provide design computations. These computations have been included in Appendix III. As shown in these calculations, the 50-year and the 100-year peak discharges will pass the box culverts without pressure flow and with no overtopping of the highway.

Standard ADOT inlet and outlet wing walls will be used on all structures. At the inlet wing walls, the box culvert cut-off wall would be placed at the end of the wing walls. From the cut-off wall to the box culvert entrance slope paving will be required. The outlet wing walls will have standard ADOT outlet aprons. A review of the flow velocities at the box culvert outlets and the tailwater velocity indicated only minor protection was required. It is proposed that riprap be placed 25' beyond the end of the apron. The riprap shall have $D_{50} = 6"$ and be placed to a thickness of 12".

Location	Proposed Structure	Skew	Length	Slope	Inlet	Outlet
137+94	6 – 10'x6' RCBC	0°	44'	0.50%	SD 6.08-3	SD 6.08-1
142+75	18 – 10'x6' RCBC	0°	44'	0.50%	SD 6.08-3	SD 6.08-1
145+00	6 – 10'x6' RCBC	45°	62.2'	0.34%	SD 6.08-7	SD 6.08-6

LOCATION 2

A detailed examination of the topography in the vicinity of Location 2 confirmed the drainage patterns described in Section 3.0. Since the topography to the north of MC-CG is near the dip section elevation, it was necessary to design culverts with a flow line lower than the north area. To drain the pipes and the nuisance water on the north side, the pipe culverts slope south toward the UPRR. During large storm events, the culverts will be in pressure flow and convey the 50-year discharge to the north. The pipes will be 24" diameter. Hydraulic calculations included in Appendix IV show that five pipes are adequate. It is proposed to install concrete end sections on the inlets and outlets. Outlet protection shall consist of rip rap with D_{50} = 6" placed to a total depth of 12". The apron calculations have been included in Appendix IV.

Location	Proposed Structure	Skew	Length	Slope	Inlet	Outlet
118+72	5 – 24" CMP	0°	53'	0.20%	MAG 545	MAG 545

LOCATION 3

Since the MC-GH will be raised at Murphy Road, the existing dip section on Murphy Road must be altered. So that the flow depth over Murphy Road is not increased for the 100-year peak discharge, a drainage structure will be constructed under Murphy Road to make the future conditions match or improve the existing conditions. For overtopping flow depths greater than the proposed highway elevation, the drainage conditions will not be changed; therefore overtopping flows up to the highway elevation at Murphy Road was computed for existing and proposed conditions. The difference is the result of blockage caused by the raised Murphy Road. This reduction of flow will be mitigated by drainage culverts under Murphy Road. The computations were made with the high-water elevation set at the MC-CG centerline elevation of 1244.37. Tailwater depth was 5.31 feet as determined for the Santa Cruz Wash. It was calculated that raising Murphy Road reduced the overtopping flow by 322.5 cfs requiring a culvert that would suit this capacity. The results have been summarized as follows.

Condition	Overtopping Flow (cfs)	Culvert Flow (cfs)	Total Flow (cfs)
Existing	1,190.6	0	1,190.6
Proposed	868.1	322.5	1,190.6

To provide the necessary culvert flow, 3-48" pipe culverts would be required. Due to the limited cover on the pipes, it was proposed to use 3-58"x36" corrugated metal arch culverts. See Appendix V for these computations. Outlet protection will be required using rip rap with D_{50} = 6" with a total depth of 12". Apron calculations have also been included in Appendix V.

Location	Proposed Structure	Skew	Length	Slope	Inlet	Outlet
200+60	3 – 58"x36" CMP	5°	85'	0.80%	MAG 501-3	MAG 501-3

It should be noted that the 100-year peak discharge flowing from the east (4,876 cfs) is much greater than the overtopping flow (1,190.6 cfs) of Murphy Road at a depth equal to the MC-CG centerline elevation. The existing culverts upstream are inadequate to convey this flow and will be overtopped as well during the 100-year event. This condition was identified in the Dibble report. Their drawing with the flooding extents have been included in Appendix I. Therefore the highway will continue to be flooded southeast of this project. Improvements to correct those problems are beyond the scope of this project and will have to be addressed in the future.

Since a new entrance drive was added to the project east of Murphy Road, the required drainage structures will match those at Sta 200+60.

ROADWAY DRAINAGE

At Location 1, the roadway asphalt pavement will be placed on the top of the box culverts slab. With a modification to the ADOT box culvert details, the asphalt will match the box culvert ends flush. Therefore the pavement will have a cross slope matching the box culvert slope, 0.5%, draining right to left.

A normal crown with 2.0% cross slope will be provided at Location 2. Runoff will drain to existing ditches on each side of the roadway.

At Murphy Road, the proposed pavement will have a normal crown with runoff draining to the pavement edge and across the ribbon curb.

5.0 SUMMARY

The hydrology results in this report have been used in the final design of the MC-CG Highway drainage improvements. As previously stated, a more detailed analysis of the Santa Cruz Wash using Manning's Equation was needed to confirm the drainage structure sizes shown in this report. Adjustments to the proposed highway section affected the design calculations and were incorporated into the final design.

As described in the previous section, the existing drainage problems southeast of Murphy Road will not be corrected by this project and should be undertaken in future projects.

6.0 REFERENCES

Initial Drainage Report for the East-West Corridor Study, Wood, Patel & Associates, Inc.

Pinal County Drainage Manual, Pinal County.

Drainage Design Manual for Maricopa County, Arizona, Volume I – Hydrology, Flood Control District of Maricopa County, January 1995.

Drainage Design Manual for Maricopa County, Arizona, Volume II – Hydraulics, Flood Control District of Maricopa County, January 2009 (draft).

Drainage Design Manual for Maricopa County, Arizona, Volume II – Hydraulics, Flood Control District of Maricopa County, January 1996.

Drainage Policies and Standards for Maricopa County, Arizona, Flood Control District of Maricopa County, January 2007.

FIRM Flood Insurance Rate Map, Maricopa County, Arizona and Incorporated Areas, Map No. 04021C1150E.

Ak-Chin Indian Community Economic Development Zone Drainage Study, Dibble Engineering.

Preliminary Drainage Report for the Maricopa-Casa Grande Highway at Santa Cruz Wash, Jacobs Engineering, August 2013.

Appendix I

Hydrology

NOAA Atlas 14, Volume 1, Version 5
Location name: Casa Grande, Arizona, US*
Coordinates: 32.9573, -111.8916
Elevation: 1314 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.199 (0.168-0.240)	0.260 (0.221-0.314)	0.355 (0.299-0.425)	0.425 (0.356-0.507)	0.520 (0.429-0.618)	0.592 (0.482-0.701)	0.665 (0.532-0.786)	0.739 (0.582-0.873)	0.836 (0.642-0.991)	0.911 (0.685-1.08)
10-min	0.303 (0.256-0.365)	0.396 (0.336-0.478)	0.540 (0.454-0.647)	0.647 (0.541-0.772)	0.791 (0.652-0.940)	0.901 (0.734-1.07)	1.01 (0.810-1.20)	1.12 (0.886-1.33)	1.27 (0.977-1.51)	1.39 (1.04-1.65)
15-min	0.376 (0.317-0.452)	0.491 (0.417-0.593)	0.669 (0.563-0.802)	0.802 (0.671-0.957)	0.981 (0.809-1.17)	1.12 (0.910-1.32)	1.25 (1.00-1.48)	1.39 (1.10-1.65)	1.58 (1.21-1.87)	1.72 (1.29-2.04)
30-min	0.506 (0.427-0.609)	0.662 (0.562-0.798)	0.901 (0.759-1.08)	1.08 (0.903-1.29)	1.32 (1.09-1.57)	1.50 (1.23-1.78)	1.69 (1.35-2.00)	1.88 (1.48-2.22)	2.12 (1.63-2.52)	2.31 (1.74-2.75)
60-min	0.626 (0.528-0.754)	0.819 (0.695-0.988)	1.11 (0.939-1.34)	1.34 (1.12-1.59)	1.64 (1.35-1.94)	1.86 (1.52-2.20)	2.09 (1.67-2.47)	2.32 (1.83-2.75)	2.63 (2.02-3.12)	2.87 (2.15-3.41)
2-hr	0.716 (0.613-0.848)	0.930 (0.798-1.10)	1.25 (1.06-1.47)	1.49 (1.26-1.75)	1.81 (1.51-2.13)	2.06 (1.70-2.42)	2.32 (1.88-2.71)	2.58 (2.05-3.02)	2.92 (2.27-3.44)	3.20 (2.43-3.78)
3-hr	0.771 (0.661-0.916)	0.987 (0.851-1.18)	1.30 (1.11-1.55)	1.55 (1.32-1.83)	1.90 (1.59-2.23)	2.17 (1.79-2.55)	2.46 (1.99-2.89)	2.76 (2.19-3.24)	3.17 (2.44-3.74)	3.51 (2.63-4.15)
6-hr	0.914 (0.799-1.07)	1.16 (1.02-1.35)	1.49 (1.30-1.73)	1.75 (1.52-2.03)	2.11 (1.80-2.43)	2.40 (2.02-2.75)	2.70 (2.23-3.10)	3.00 (2.43-3.45)	3.42 (2.69-3.94)	3.74 (2.88-4.33)
12-hr	1.03 (0.910-1.17)	1.30 (1.15-1.48)	1.66 (1.46-1.88)	1.93 (1.69-2.19)	2.31 (2.00-2.61)	2.60 (2.23-2.94)	2.90 (2.45-3.28)	3.21 (2.66-3.63)	3.62 (2.93-4.13)	3.95 (3.12-4.54)
24-hr	1.20 (1.08-1.33)	1.52 (1.38-1.69)	1.97 (1.78-2.19)	2.33 (2.09-2.58)	2.82 (2.52-3.12)	3.21 (2.85-3.54)	3.61 (3.19-3.99)	4.03 (3.52-4.45)	4.61 (3.98-5.10)	5.07 (4.33-5.62)
2-day	1.28 (1.15-1.42)	1.63 (1.47-1.81)	2.14 (1.93-2.37)	2.54 (2.29-2.82)	3.11 (2.78-3.44)	3.55 (3.16-3.93)	4.03 (3.55-4.46)	4.52 (3.95-5.01)	5.21 (4.50-5.79)	5.76 (4.92-6.43)
3-day	1.35 (1.23-1.50)	1.73 (1.57-1.91)	2.27 (2.06-2.51)	2.71 (2.44-2.99)	3.32 (2.98-3.67)	3.81 (3.40-4.21)	4.34 (3.84-4.79)	4.89 (4.29-5.40)	5.66 (4.91-6.27)	6.29 (5.39-6.99)
4-day	1.43 (1.30-1.57)	1.82 (1.66-2.01)	2.40 (2.19-2.65)	2.87 (2.60-3.17)	3.54 (3.19-3.89)	4.08 (3.65-4.48)	4.65 (4.13-5.12)	5.26 (4.63-5.79)	6.12 (5.31-6.75)	6.81 (5.86-7.54)
7-day	1.57 (1.44-1.74)	2.01 (1.83-2.22)	2.65 (2.42-2.92)	3.18 (2.88-3.49)	3.91 (3.52-4.29)	4.50 (4.03-4.94)	5.13 (4.56-5.63)	5.80 (5.10-6.37)	6.74 (5.86-7.42)	7.50 (6.45-8.27)
10-day	1.72 (1.56-1.89)	2.20 (2.00-2.42)	2.90 (2.64-3.19)	3.46 (3.14-3.81)	4.25 (3.84-4.67)	4.88 (4.38-5.37)	5.56 (4.94-6.10)	6.26 (5.53-6.89)	7.25 (6.32-8.00)	8.05 (6.95-8.89)
20-day	2.10 (1.91-2.31)	2.71 (2.47-2.97)	3.57 (3.25-3.91)	4.23 (3.83-4.63)	5.11 (4.62-5.58)	5.78 (5.21-6.33)	6.47 (5.80-7.09)	7.17 (6.39-7.86)	8.11 (7.16-8.92)	8.84 (7.73-9.73)
30-day	2.45 (2.24-2.68)	3.15 (2.89-3.44)	4.15 (3.80-4.53)	4.91 (4.48-5.35)	5.93 (5.39-6.46)	6.72 (6.08-7.32)	7.52 (6.77-8.19)	8.33 (7.45-9.09)	9.43 (8.35-10.3)	10.3 (9.03-11.3)
45-day	2.85 (2.60-3.11)	3.67 (3.35-4.02)	4.83 (4.41-5.28)	5.69 (5.19-6.21)	6.83 (6.19-7.44)	7.68 (6.94-8.37)	8.54 (7.68-9.30)	9.40 (8.41-10.3)	10.5 (9.35-11.5)	11.4 (10.0-12.5)
60-day	3.17 (2.89-3.46)	4.09 (3.73-4.47)	5.38 (4.90-5.87)	6.32 (5.75-6.89)	7.54 (6.83-8.21)	8.44 (7.62-9.19)	9.34 (8.40-10.2)	10.2 (9.15-11.2)	11.4 (10.1-12.4)	12.2 (10.8-13.4)

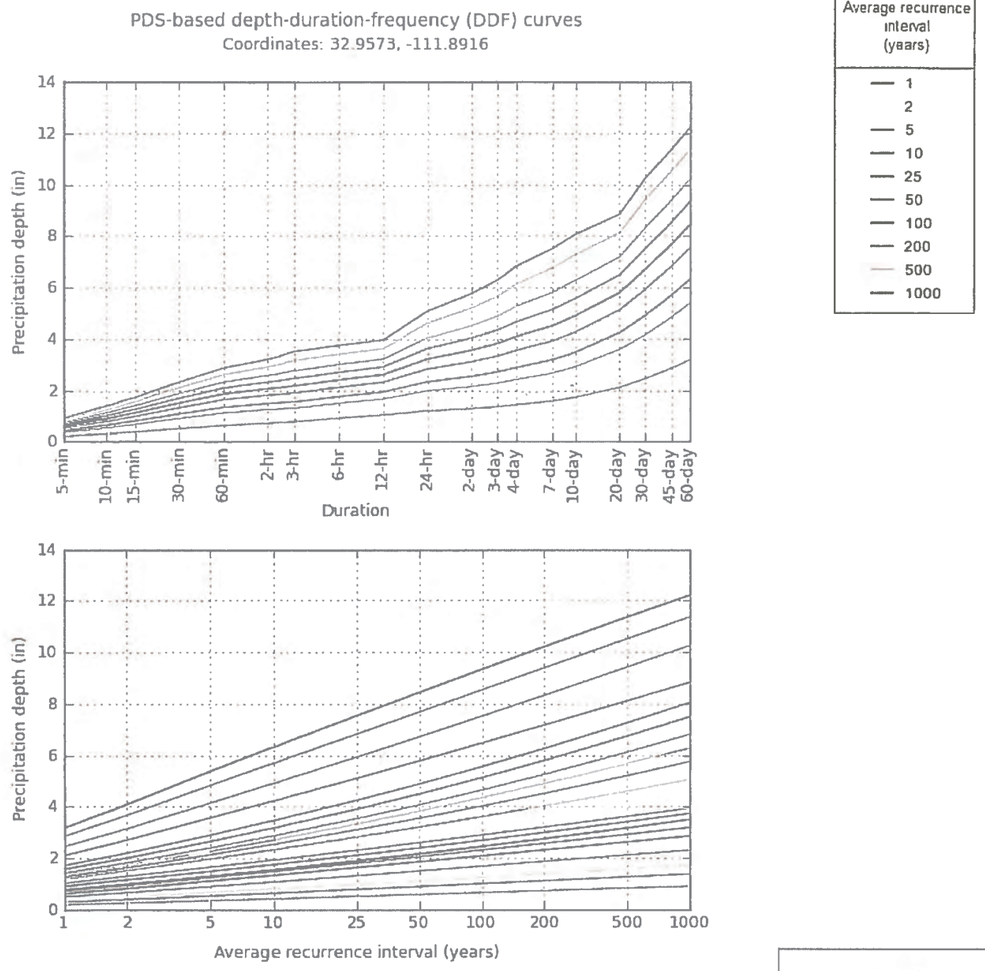
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Back to Top

PF graphical



Duration: 5-min, 10-min, 15-min, 30-min, 60-min, 2-hr, 3-hr, 6-hr, 12-hr, 24-hr, 2-day, 3-day, 4-day, 7-day, 10-day, 20-day, 30-day, 45-day, 60-day

NOAA/NWS/OHD/HDSC

Created (GMT): Tue Oct 22 21:49:58 2013

NOAA Atlas 14, Volume 1, Version 5
Location name: Casa Grande, Arizona, US*
Coordinates: 32.9573, -111.8916
Elevation: 1314 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	2.39 (2.02-2.88)	3.12 (2.65-3.77)	4.26 (3.59-5.10)	5.10 (4.27-6.08)	6.24 (5.15-7.42)	7.10 (5.78-8.41)	7.98 (6.38-9.43)	8.87 (6.98-10.5)	10.0 (7.70-11.9)	10.9 (8.22-13.0)
10-min	1.82 (1.54-2.19)	2.38 (2.02-2.87)	3.24 (2.72-3.88)	3.88 (3.25-4.63)	4.75 (3.91-5.64)	5.41 (4.40-6.40)	6.07 (4.86-7.18)	6.74 (5.32-7.97)	7.63 (5.86-9.05)	8.32 (6.26-9.90)
15-min	1.50 (1.27-1.81)	1.96 (1.67-2.37)	2.68 (2.25-3.21)	3.21 (2.68-3.83)	3.92 (3.24-4.66)	4.47 (3.64-5.29)	5.02 (4.02-5.93)	5.58 (4.39-6.59)	6.31 (4.84-7.48)	6.88 (5.17-8.18)
30-min	1.01 (0.854-1.22)	1.32 (1.12-1.60)	1.80 (1.52-2.16)	2.16 (1.81-2.58)	2.64 (2.18-3.14)	3.01 (2.45-3.56)	3.38 (2.70-3.99)	3.75 (2.96-4.44)	4.25 (3.26-5.04)	4.63 (3.48-5.51)
60-min	0.626 (0.528-0.754)	0.819 (0.695-0.988)	1.11 (0.939-1.34)	1.34 (1.12-1.59)	1.64 (1.35-1.94)	1.86 (1.52-2.20)	2.09 (1.67-2.47)	2.32 (1.83-2.75)	2.63 (2.02-3.12)	2.87 (2.15-3.41)
2-hr	0.358 (0.306-0.424)	0.465 (0.399-0.552)	0.623 (0.531-0.737)	0.743 (0.628-0.878)	0.905 (0.757-1.06)	1.03 (0.849-1.21)	1.16 (0.940-1.36)	1.29 (1.03-1.51)	1.46 (1.14-1.72)	1.60 (1.21-1.89)
3-hr	0.257 (0.220-0.305)	0.329 (0.283-0.393)	0.433 (0.371-0.516)	0.515 (0.438-0.611)	0.631 (0.528-0.744)	0.723 (0.595-0.849)	0.819 (0.662-0.962)	0.918 (0.729-1.08)	1.06 (0.813-1.25)	1.17 (0.876-1.38)
6-hr	0.153 (0.133-0.178)	0.194 (0.170-0.226)	0.249 (0.217-0.289)	0.293 (0.254-0.339)	0.353 (0.301-0.406)	0.401 (0.337-0.460)	0.450 (0.372-0.517)	0.501 (0.406-0.576)	0.570 (0.449-0.657)	0.625 (0.480-0.724)
12-hr	0.085 (0.076-0.097)	0.108 (0.096-0.123)	0.137 (0.121-0.156)	0.160 (0.141-0.182)	0.192 (0.166-0.217)	0.216 (0.185-0.244)	0.241 (0.203-0.272)	0.266 (0.221-0.302)	0.301 (0.243-0.343)	0.328 (0.259-0.376)
24-hr	0.050 (0.045-0.056)	0.064 (0.057-0.071)	0.082 (0.074-0.091)	0.097 (0.087-0.108)	0.118 (0.105-0.130)	0.134 (0.119-0.148)	0.151 (0.133-0.166)	0.168 (0.147-0.185)	0.192 (0.166-0.213)	0.211 (0.181-0.234)
2-day	0.027 (0.024-0.029)	0.034 (0.031-0.038)	0.045 (0.040-0.049)	0.053 (0.048-0.059)	0.065 (0.058-0.072)	0.074 (0.066-0.082)	0.084 (0.074-0.093)	0.094 (0.082-0.104)	0.108 (0.094-0.121)	0.120 (0.102-0.134)
3-day	0.019 (0.017-0.021)	0.024 (0.022-0.027)	0.032 (0.029-0.035)	0.038 (0.034-0.042)	0.046 (0.041-0.051)	0.053 (0.047-0.058)	0.060 (0.053-0.066)	0.068 (0.060-0.075)	0.079 (0.068-0.087)	0.087 (0.075-0.097)
4-day	0.015 (0.014-0.016)	0.019 (0.017-0.021)	0.025 (0.023-0.028)	0.030 (0.027-0.033)	0.037 (0.033-0.041)	0.042 (0.038-0.047)	0.048 (0.043-0.053)	0.055 (0.048-0.060)	0.064 (0.055-0.070)	0.071 (0.061-0.079)
7-day	0.009 (0.009-0.010)	0.012 (0.011-0.013)	0.016 (0.014-0.017)	0.019 (0.017-0.021)	0.023 (0.021-0.026)	0.027 (0.024-0.029)	0.031 (0.027-0.034)	0.034 (0.030-0.038)	0.040 (0.035-0.044)	0.045 (0.038-0.049)
10-day	0.007 (0.007-0.008)	0.009 (0.008-0.010)	0.012 (0.011-0.013)	0.014 (0.013-0.016)	0.018 (0.016-0.019)	0.020 (0.018-0.022)	0.023 (0.021-0.025)	0.026 (0.023-0.029)	0.030 (0.026-0.033)	0.034 (0.029-0.037)
20-day	0.004 (0.004-0.005)	0.006 (0.005-0.006)	0.007 (0.007-0.008)	0.009 (0.008-0.010)	0.011 (0.010-0.012)	0.012 (0.011-0.013)	0.013 (0.012-0.015)	0.015 (0.013-0.016)	0.017 (0.015-0.019)	0.018 (0.016-0.020)
30-day	0.003 (0.003-0.004)	0.004 (0.004-0.005)	0.006 (0.005-0.006)	0.007 (0.006-0.007)	0.008 (0.007-0.009)	0.009 (0.008-0.010)	0.010 (0.009-0.011)	0.012 (0.010-0.013)	0.013 (0.012-0.014)	0.014 (0.013-0.016)
45-day	0.003 (0.002-0.003)	0.003 (0.003-0.004)	0.004 (0.004-0.005)	0.005 (0.005-0.006)	0.006 (0.006-0.007)	0.007 (0.006-0.008)	0.008 (0.007-0.009)	0.009 (0.008-0.009)	0.010 (0.009-0.011)	0.011 (0.009-0.012)
60-day	0.002 (0.002-0.002)	0.003 (0.003-0.003)	0.004 (0.003-0.004)	0.004 (0.004-0.005)	0.005 (0.005-0.006)	0.006 (0.005-0.006)	0.006 (0.006-0.007)	0.007 (0.006-0.008)	0.008 (0.007-0.009)	0.008 (0.008-0.009)

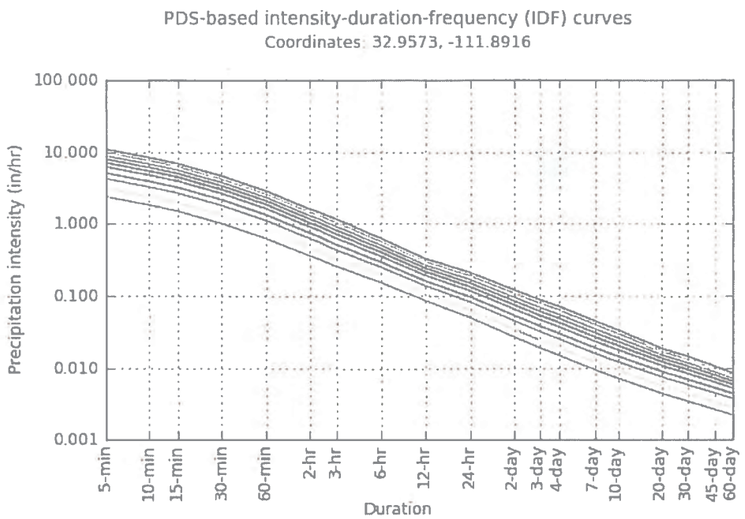
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

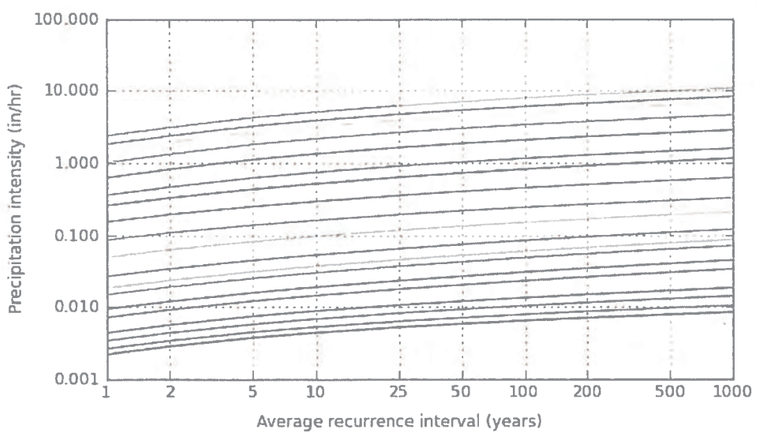
Please refer to NOAA Atlas 14 document for more information.

Back to Top

PF graphical



Average recurrence interval (years)
1
2
5
10
25
50
100
200
500
1000



NOAA/NWS/OHD/HDSC

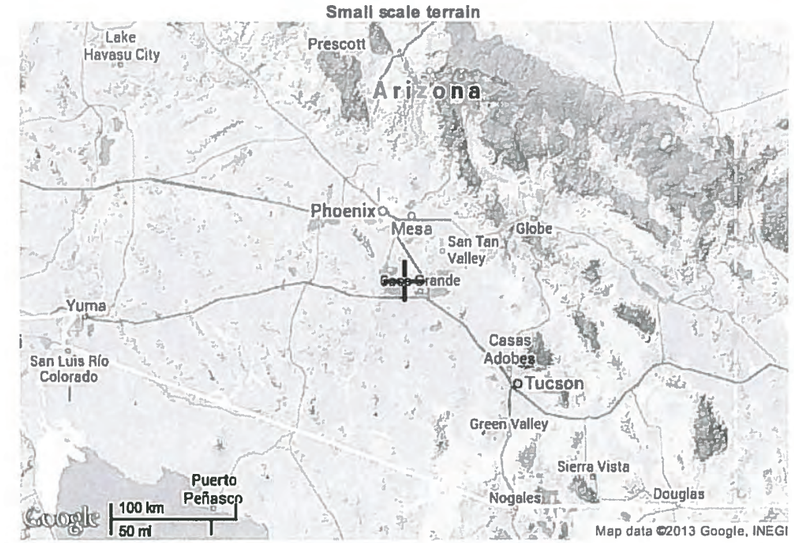
Created (GMT): Tue Oct 22 21 51 24 2013

Duration	
5-min	2-day
10-min	3-day
15-min	4-day
30-min	7-day
60-min	10-day
2-hr	20-day
3-hr	30-day
6-hr	45-day
12-hr	60-day
24-hr	

Back to Top

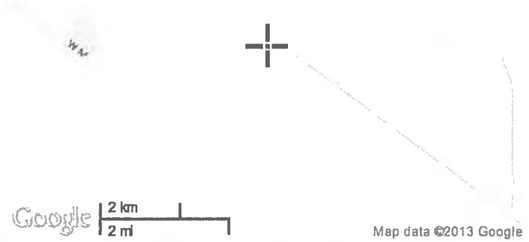
Maps & aerials

Small scale terrain

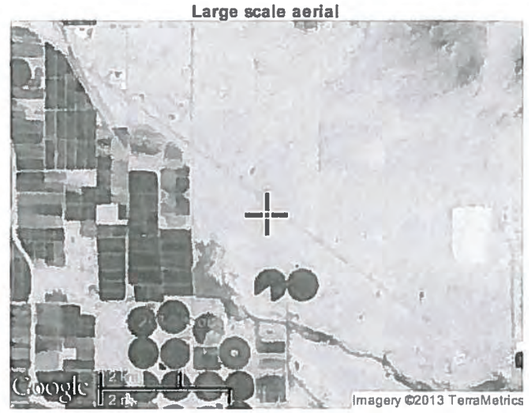


Large scale terrain

Large scale map



Large scale aerial



Back to Top

US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
Office of Hydrologic Development
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

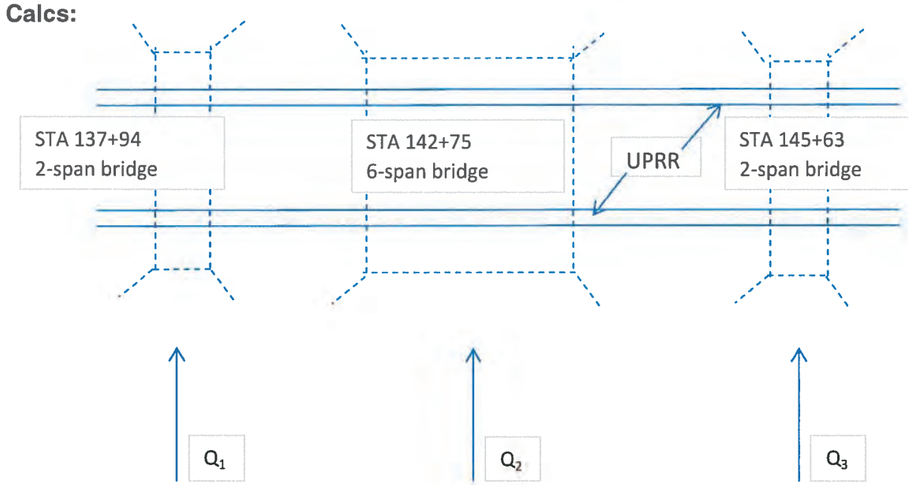
JACOBS

Project:	Maricopa - Casa Grande Highway	By:	JPF
Subject:	Santa Cruz Wash	Date:	10/24/2013
	Location 1	Checked:	
	Hydrology	Jacobs Project No.:	W7X97700

Remarks:

Compute the 100-year peak discharge at each bridge for Location 1
Per Pinal County FIS total flow = 7,600 cfs
Existing bridges have lengths = 56', 180' and 56'
50-year peak discharge estimated as ratio of 50-year rainfall and 100-year rainfall NOAA Atlas 14

Calcs:



50-year peak discharge

$(Q_1 + Q_2 + Q_3) \times (1.86 / 2.09) = 6{,}764$ cfs

$Q_1 = Q_3 = (56' / 292') \times 6{,}764$ cfs $= 1{,}297$ cfs

$Q_2 = (180' / 292') \times 6{,}764$ cfs $= 4{,}170$ cfs

Total Bridges = 56' + 180' + 56' = 292'

100-year peak discharge

$Q_1 + Q_2 + Q_3 = 7{,}600$ cfs

$Q_1 = Q_3 = (56' / 292') \times 7{,}600$ cfs $= 1{,}458$ cfs

$Q_2 = (180' / 292') \times 7{,}600$ cfs $= 4{,}685$ cfs

Total Bridges = 56' + 180' + 56' = 292'

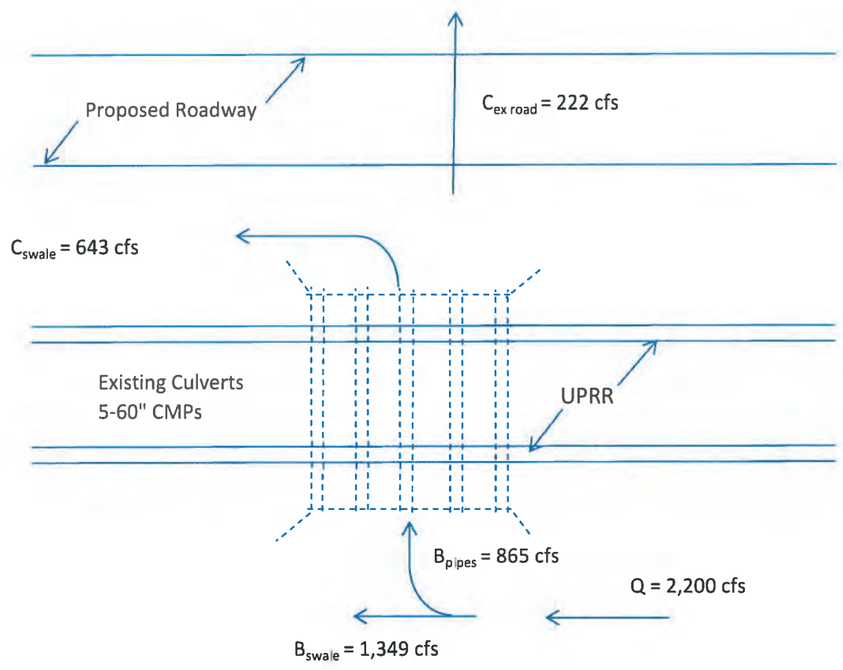
JACOBS

Project:	Maricopa - Casa Grande Highway	By:	JPF
Subject:	Santa Cruz Wash	Date:	12/18/2013
	Location 2	Checked:	
	Hydrology	Jacobs Project No.:	W7X97700

Remarks:

Compute the 100-year peak discharge at Station 118+72 for Location 2
Per Pinal County FIS total flow = 2,200 cfs
Existing culverts under UPRR are 5-60" CMPs and dip section in roadway

Calcs:



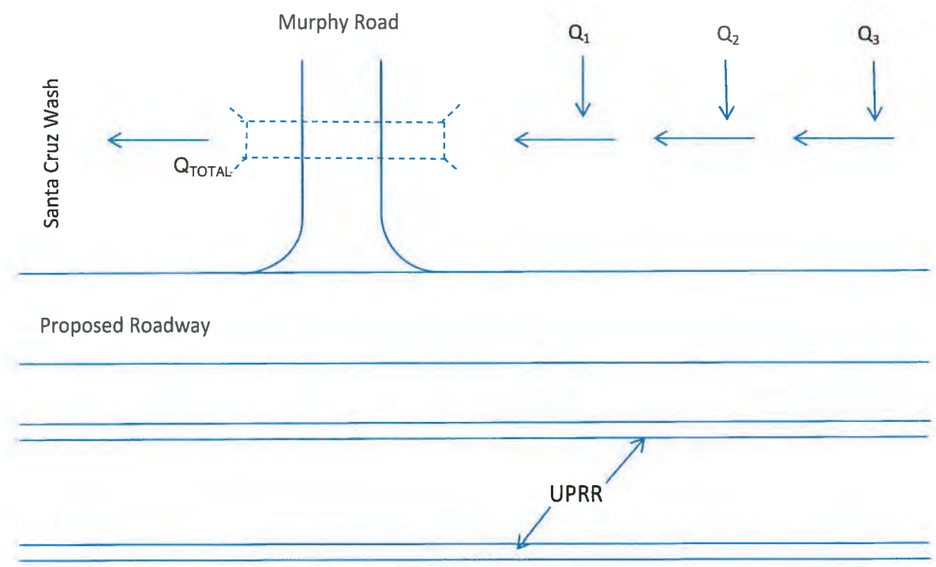
JACOBS

Project:	Maricopa - Casa Grande Highway	By:	JPF
Subject:	Murphy Road	Date:	11/1/2013
	Location 3	Checked:	
	Hydrology	Jacobs Project No.:	W7X97700

Remarks:

Compute the 100-year peak discharge at the proposed culvert uder Murphy Road for Location 3
Per Drainage Technical Memorandum runoff from area between Murphy Road and Anderson Road (Q_1)
Subbasin 1 by Rational Method
Per *Initial Drainage Report* by Wood, Patel & Associates, Inc. Subbasin 2 = 2,224 cfs (Q_2) and
Subbasin 3 = 2,141 cfs (Q_3)

Calcs:



Subbasin 1:

Area = 158.8 ac		Rural, Desert, 10% Cover
100-year	P1 = 2.09	C = 0.53
T_C = 10 min	Intensity = 6.07	Q_1 = 511 cfs

$Q_1 = Q_iA = (0.53)(6.07)(158.8) = 511$ cfs
$Q_{TOTAL} = Q_1 + Q_2 + Q_3 = 511$ cfs + 2,224 cfs + 2,141 cfs = 4,876 cfs

Appendix II

Santa Cruz Wash Tailwater Depth

JACOBS

Project:	Maricopa - Casa Grande Highway	By:	JPF
Subject:	Santa Cruz Wash	Date:	12/18/2013
		Checked:	
	Tailwater	Jacobs Project No.:	W7X97700

Remarks:

Estimate tailwater depth for proposed box culverts in Santa Cruz Wash

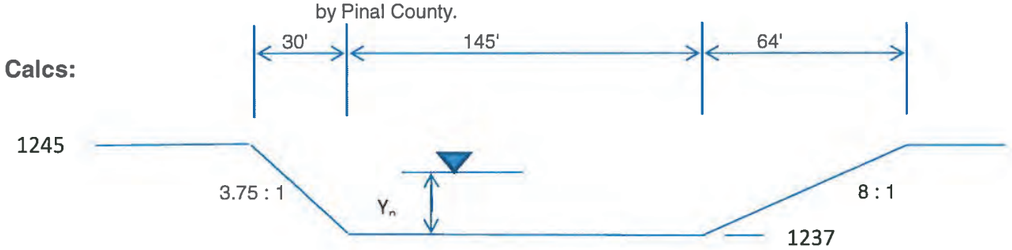
Per Pinal County FIS Q_{100} = 7,600 cfs Per Pinal County FIS Q_{50} = 6,764 cfs

Typical cross section taken from topography in roadway plans at a point downstream where bridge flows converge

Wash has a small amount of vegetation, use n = 0.025

Longitudinal slope taken from USGS Stanfield Quadrangle and verified with topography provided by Pinal County.

Calcs:



from USGS map, longitudinal slope = 0.0020 ft/ft

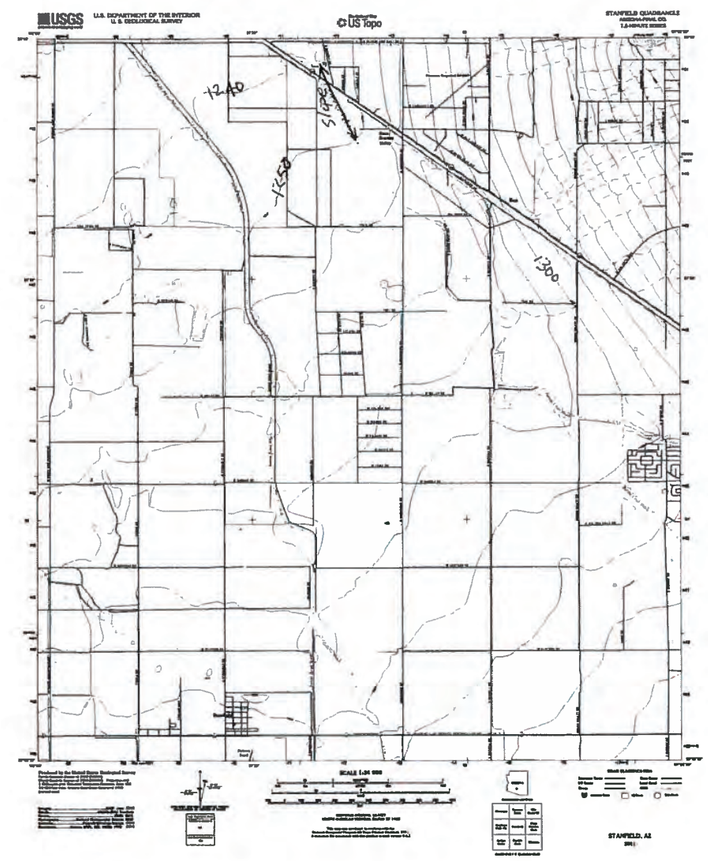
Using Manning's Equation 50-year flow: Y_n = 5.31 ft Velocity = 7.23 ft/sec

Using Manning's Equation 100-year flow: Y_n = 5.67 ft Velocity = 7.51 ft/sec

Tailwater Elevation = 1237.00 + 5.67' = 1242.67

JACOBS

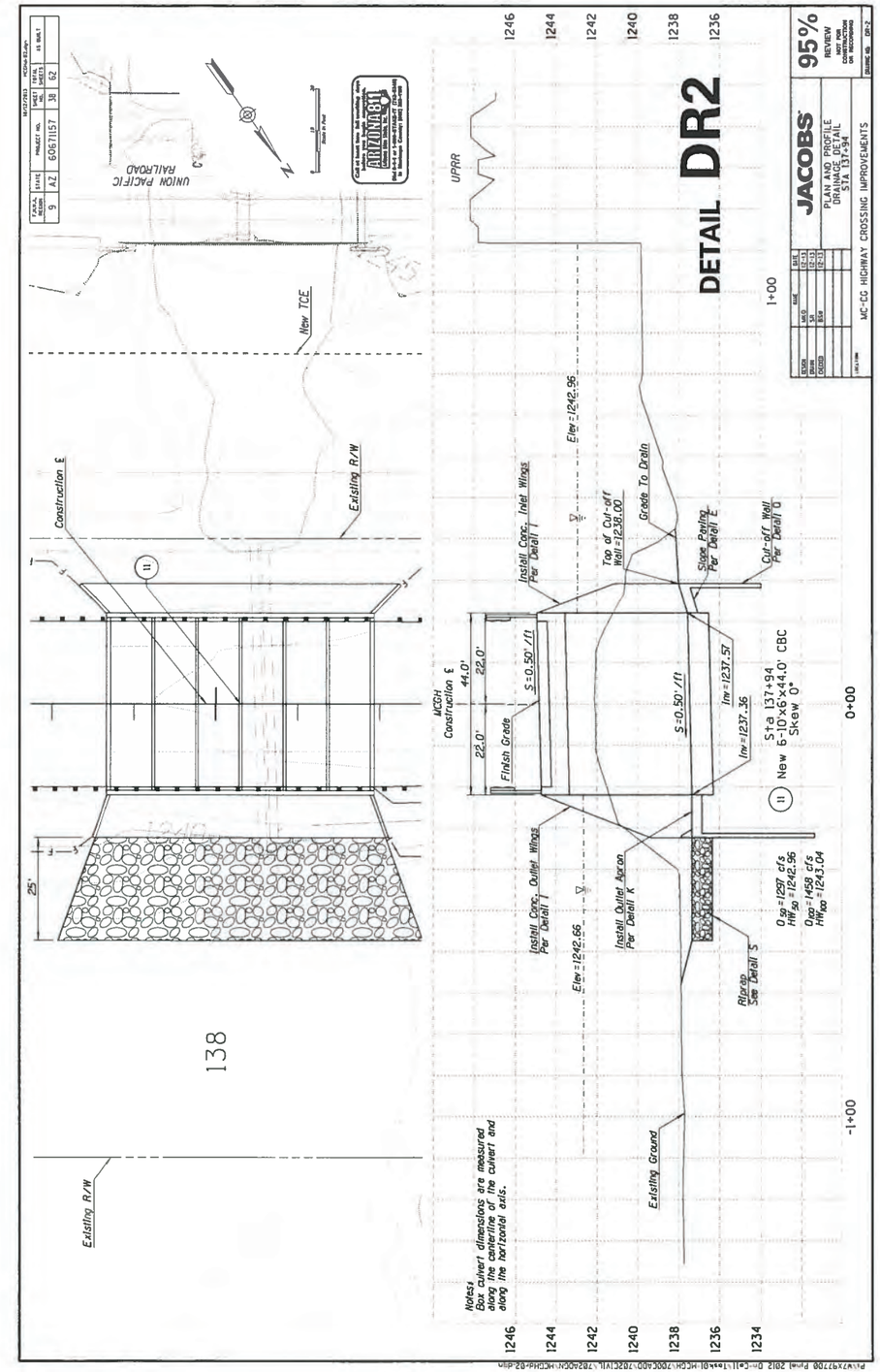
Project:	Maricopa - Casa Grande Highway	By:	JPF
Subject:	Santa Cruz Wash	Date:	12/18/2013
		Checked:	
	Tailwater	Jacobs Project No.:	W7X97700



Slope = 10' / 5,004' = 0.0020 ft/ft

Appendix III

Location 1 Drainage Calculations



Box Culvert Calculations

10-22-2013

PROJECT NAME - MCG Highway PROJECT NO. - W7X97700
HIGHWAY NAME - Location 1 DESIGNER - JPF
LOCATION - Proposed RCBC Sta 137+94 CHECKER - _____ PAGE
VBVer 1.2: August 2008

***** INPUT DATA *****
1: SQUARE-EDGE CULVERT: HDS-5 CHART 8(1)
WINGWALL @ 30-75 Degrees
6- Barrel- 10.00 FT. Wide x 6.00 Ft. High

LENGTH =44.00 Ft.
SLOPE = 0.0050 Ft./Ft.
Length*Slope = 0.22Ft.
TOTAL DISCHARGE: 1,297 Cfs.
FREQUENCY = 50 Years

Entrance Co-eff. (Ke) =0.4
Inlet Invert Elev: 1,237.57 Ft.
Allowable Headwater Elev: 1,244.86 Ft.
Tailwater Depth = 5.31 Ft.
Calculated Tailwater Elev: 1,242.66 Ft.

---------- HYDRAULIC ANALYSIS ----------

INLET CONTROL DATA	OUTLET CONTROL DATA	
Hw/D =0.63	Hw/D = 0.90	H = 0.30 Ft.
Hw = 3.77 Ft.	Hw = 5.39 Ft.	Ho= 5.31 Ft.

** OUTLET CONTROL GOVERNS **
HEADWATER COMPUTATION

Controling Hw. = 5.39 Ft.
Design Hw/D = 0.90
Design HEADWATER Elev. 1,242.96 Ft.
Freeboard = 1.90 Ft.

Dn = 1.96 Ft.
Dc = 2.44 Ft.
(Dc+D)/2 = 4.22 Ft.

Outlet Velocity 4.07 Ft/Sec
based on depth = 5.31 Ft.
Sequent depth <= Tailwater.

Box Culvert Calculations

10-22-2013

PROJECT NAME - MCG Highway PROJECT NO. - W7X97700
HIGHWAY NAME - Location 1 DESIGNER - JPF
LOCATION - Proposed RCBC Sta 137+94 CHECKER - _____ PAGE
VBVer 1.2: August 2008

***** INPUT DATA *****
1: SQUARE-EDGE CULVERT: HDS-5 CHART 8(1)
WINGWALL @ 30-75 Degrees
6- Barrel- 10.00 FT. Wide x 6.00 Ft. High

LENGTH =44.00 Ft.
SLOPE = 0.0050 Ft./Ft.
Length*Slope = 0.22Ft.
TOTAL DISCHARGE: 1,458 Cfs.
FREQUENCY = 100 Years

Entrance Co-eff. (Ke) =0.4
Inlet Invert Elev: 1,237.57 Ft.
Allowable Headwater Elev: 1,244.86 Ft.
Tailwater Depth = 5.31 Ft.
Calculated Tailwater Elev: 1,242.66 Ft.

---------- HYDRAULIC ANALYSIS ----------

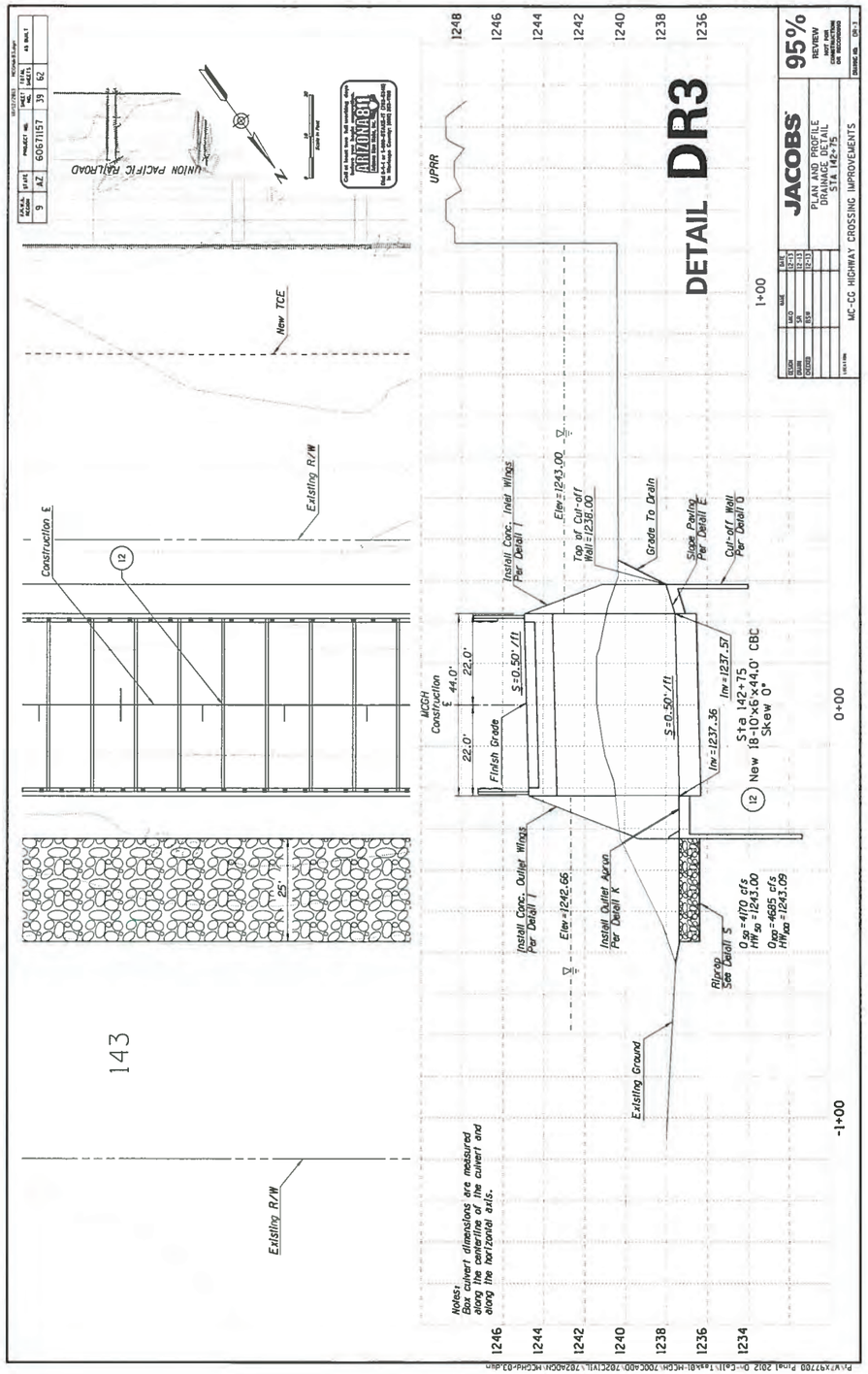
INLET CONTROL DATA	OUTLET CONTROL DATA	
Hw/D =0.68	Hw/D = 0.91	H = 0.38 Ft.
Hw = 4.08 Ft.	Hw = 5.47 Ft.	Ho= 5.31 Ft.

** OUTLET CONTROL GOVERNS **
HEADWATER COMPUTATION

Controling Hw. = 5.47 Ft.
Design Hw/D = 0.91
Design HEADWATER Elev. 1,243.04 Ft.
Freeboard = 1.82 Ft.

Dn = 2.12 Ft.
Dc = 2.64 Ft.
(Dc+D)/2 = 4.32 Ft.

Outlet Velocity 4.58 Ft/Sec
based on depth = 5.31 Ft.
Sequent depth <= Tailwater.



Box Culvert Calculations

10-22-2013

PROJECT NAME - MCG Highway
PROJECT NO. - W7X97700
HIGHWAY NAME - Location 1
DESIGNER - JPF
LOCATION - Proposed RCBC Sta 142+75
CHECKER - _____ PAGE
VBVer 1.2: August 2008

***** INPUT DATA *****
1: SQUARE-EDGE CULVERT: HDS-5 CHART 8(1)
WINGWALL @ 30-75 Degrees
18- Barrel- 10.00 FT. Wide x 6.00 Ft. High

LENGTH =44.00 Ft.
SLOPE = 0.0050 Ft./Ft.
Length*Slope = 0.22Ft.
TOTAL DISCHARGE: 4,170 Cfs.
FREQUENCY = 50 Years

Entrance Co-eff. (Ke) =0.4
Inlet Invert Elev: 1,237.57 Ft.
Allowable Headwater Elev: 1,244.86 Ft.
Tailwater Depth = 5.31 Ft.
Calculated Tailwater Elev: 1,242.66 Ft.

---------- HYDRAULIC ANALYSIS ----------

INLET CONTROL DATA

Hw/D =0.66
Hw = 3.95 Ft.

OUTLET CONTROL DATA

Hw/D = 0.91 H = 0.34 Ft.
Hw = 5.43 Ft. Ho= 5.31 Ft.

** OUTLET CONTROL GOVERNS **
HEADWATER COMPUTATION

Controling Hw. = 5.43 Ft.
Design Hw/D = 0.91
Design HEADWATER Elev. 1,243.00 Ft.
Freeboard = 1.86 Ft.

Dn = 2.06 Ft.
Dc = 2.55 Ft.
(Dc+D)/2 = 4.28 Ft.

Outlet Velocity 4.36 Ft/Sec
based on depth = 5.31 Ft.
Sequent depth <= Tailwater.

Box Culvert Calculations

10-22-2013

PROJECT NAME - MCG Highway
HIGHWAY NAME - Location 1
LOCATION - Proposed RCBC Sta 142+75
VBVer 1.2: August 2008

PROJECT NO. - W7X97700
DESIGNER - JPF
CHECKER - _____ PAGE

***** INPUT DATA *****
1: SQUARE-EDGE CULVERT: HDS-5 CHART 8(1)
WINGWALL @ 30-75 Degrees
18- Barrel- 10.00 FT. Wide x 6.00 Ft. High

LENGTH =44.00 Ft.
SLOPE = 0.0050 Ft./Ft.
Length*Slope = 0.22Ft.
TOTAL DISCHARGE: 4,685 Cfs.
FREQUENCY = 100 Years

Entrance Co-eff. (Ke) =0.4
Inlet Invert Elev: 1,237.57 Ft.
Allowable Headwater Elev: 1,244.86 Ft.
Tailwater Depth = 5.31 Ft.
Calculated Tailwater Elev: 1,242.66 Ft.

---------- HYDRAULIC ANALYSIS ----------

INLET CONTROL DATA

Hw/D =0.71
Hw = 4.27 Ft.

OUTLET CONTROL DATA

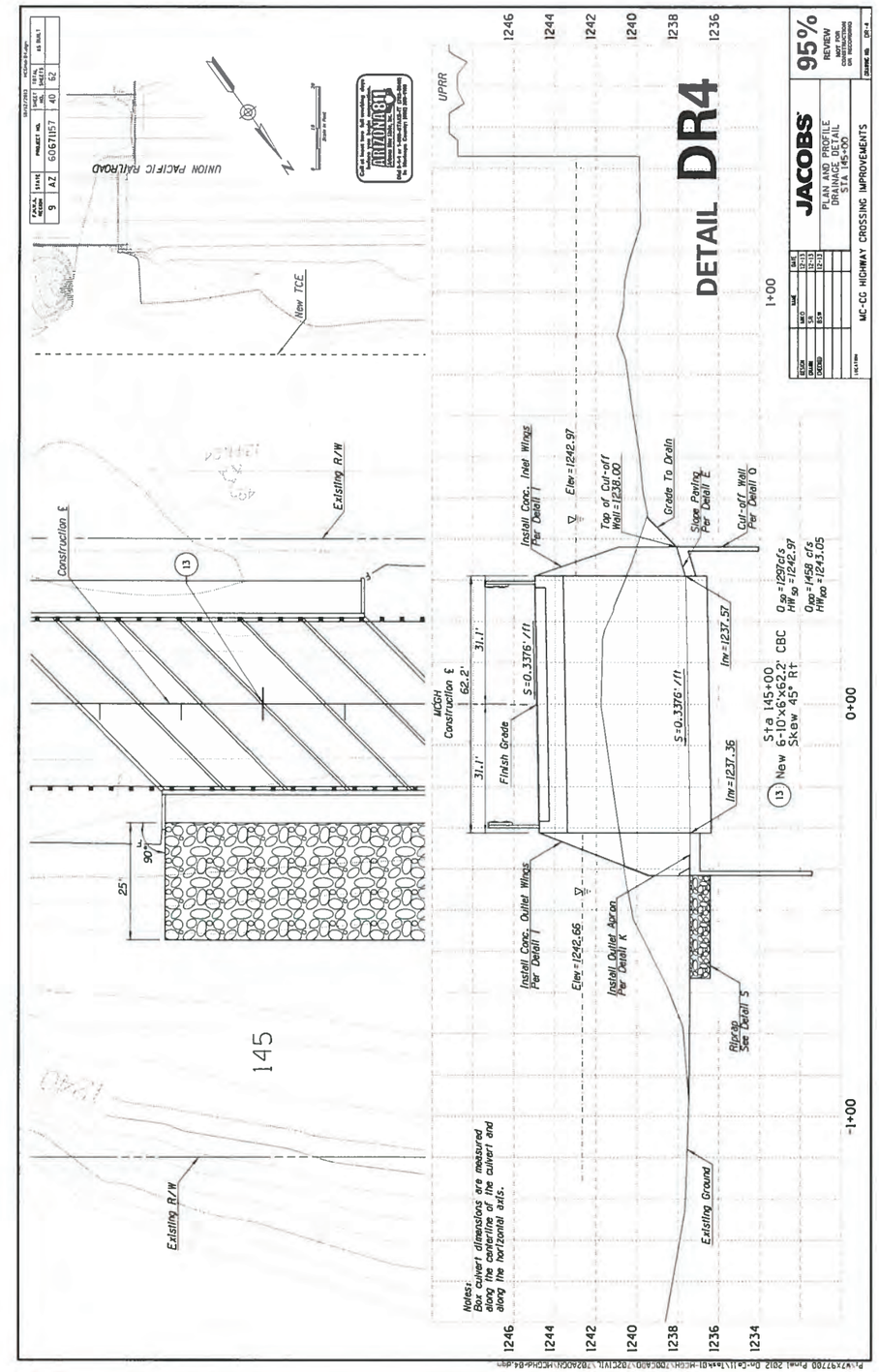
Hw/D = 0.92 H = 0.43 Ft.
Hw = 5.52 Ft. Ho= 5.31 Ft.

** OUTLET CONTROL GOVERNS **
HEADWATER COMPUTATION

Controling Hw. = 5.52 Ft.
Design Hw/D = 0.92
Design HEADWATER Elev. 1,243.09 Ft.
Freeboard = 1.77 Ft.

Dn = 2.23 Ft.
Dc = 2.76 Ft.
(Dc+D)/2 = 4.38 Ft.

Outlet Velocity 4.90 Ft/Sec
based on depth = 5.31 Ft.
Sequent depth <= Tailwater.



Box Culvert Calculations

10-22-2013

PROJECT NAME - MCG Highway PROJECT NO. - W7X97700
HIGHWAY NAME - Location 1 DESIGNER - JPF
LOCATION - Proposed RCBC Sta 145+00 CHECKER - _____ PAGE
VBVer 1.2: August 2008

***** INPUT DATA *****
1: SQUARE-EDGE CULVERT: HDS-5 CHART 8(1)
WINGWALL @ 30-75 Degrees
6- Barrel- 10.00 FT. Wide x 6.00 Ft. High

LENGTH =62.20 Ft.
SLOPE = 0.0034 Ft./Ft.
Length*Slope = 0.21Ft.
TOTAL DISCHARGE: 1,297 Cfs.
FREQUENCY = 50 Years

Entrance Co-eff. (Ke) =0.4
Inlet Invert Elev: 1,237.57 Ft.
Allowable Headwater Elev: 1,244.86 Ft.
Tailwater Depth = 5.31 Ft.
Calculated Tailwater Elev: 1,242.67 Ft.

---------- HYDRAULIC ANALYSIS ----------

INLET CONTROL DATA	OUTLET CONTROL DATA	
Hw/D =0.63	Hw/D = 0.90	H = 0.31 Ft.
Hw = 3.77 Ft.	Hw = 5.40 Ft.	Ho= 5.31 Ft.

** OUTLET CONTROL GOVERNS **
HEADWATER COMPUTATION

Controling Hw. = 5.40 Ft.
Design Hw/D = 0.90
Design HEADWATER Elev. 1,242.97 Ft.
Freeboard = 1.89 Ft.

Dn = 2.24 Ft.
Dc = 2.44 Ft.
(Dc+D)/2 = 4.22 Ft.

Outlet Velocity 4.07 Ft/Sec
based on depth = 5.31 Ft.
Sequent depth <= Tailwater.

Box Culvert Calculations

10-22-2013

PROJECT NAME - MCG Highway PROJECT NO. - W7X97700
HIGHWAY NAME - Location 1 DESIGNER - JPF
LOCATION - Proposed RCBC Sta 145+00 CHECKER - _____ PAGE
VBVer 1.2: August 2008

***** INPUT DATA *****
1: SQUARE-EDGE CULVERT: HDS-5 CHART 8(1)
WINGWALL @ 30-75 Degrees
6- Barrel- 10.00 FT. Wide x 6.00 Ft. High

LENGTH =62.20 Ft.
SLOPE = 0.0034 Ft./Ft.
Length*Slope = 0.21Ft.
TOTAL DISCHARGE: 1,458 Cfs.
FREQUENCY = 100 Years

Entrance Co-eff. (Ke) =0.4
Inlet Invert Elev: 1,237.57 Ft.
Allowable Headwater Elev: 1,244.86 Ft.
Tailwater Depth = 5.31 Ft.
Calculated Tailwater Elev: 1,242.67 Ft.

---------- HYDRAULIC ANALYSIS ----------

INLET CONTROL DATA	OUTLET CONTROL DATA	
Hw/D =0.68	Hw/D = 0.91	H = 0.39 Ft.
Hw = 4.08 Ft.	Hw = 5.48 Ft.	Ho= 5.31 Ft.

** OUTLET CONTROL GOVERNS **
HEADWATER COMPUTATION

Controling Hw. = 5.48 Ft.
Design Hw/D = 0.91
Design HEADWATER Elev. 1,243.05 Ft.
Freeboard = 1.81 Ft.

Dn = 2.42 Ft.
Dc = 2.64 Ft.
(Dc+D)/2 = 4.32 Ft.

Outlet Velocity 4.58 Ft/Sec
based on depth = 5.31 Ft.
Sequent depth <= Tailwater.

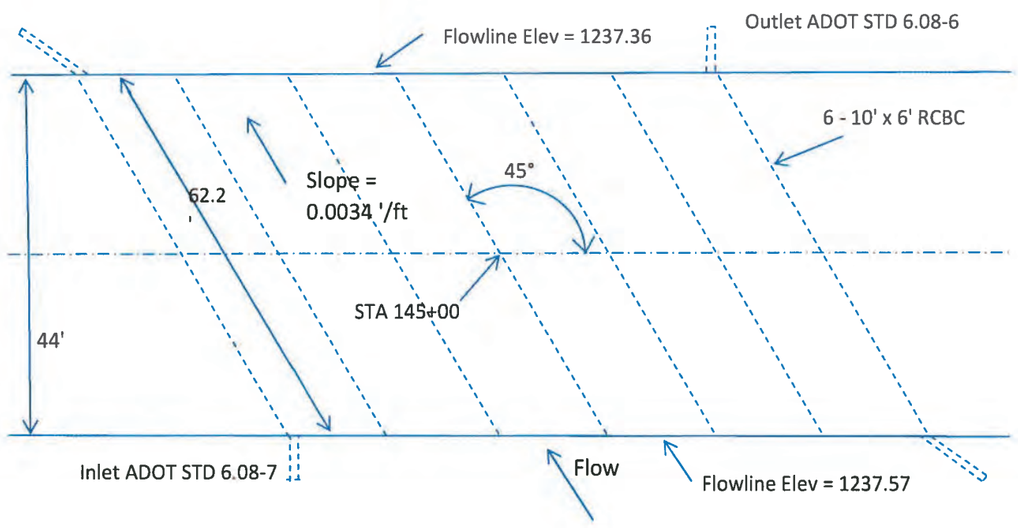
JACOBS

Project:	Maricopa - Casa Grande Highway	By:	JPF
Subject:	Proposed Box Culvert	Date:	12/18/2013
	Location 1	Checked:	
	Station 145+00	Jacobs Project No.:	W7X97700

Remarks:

Standard ADOT concrete box culvert details - six barrel.
Proposed skew is 45° from roadway centerline.
Roadway centerline elevation equals 1244.75.
Roadway pavement is 5" and box culvert top slab is 10½".

Calcs:



Roadway Centerline Elevation =	1244.75
Roadway Cross Slope = 22' @ 0.5% =	+0.11
Asphalt Thickness = 5" =	-0.42
Box Culvert Top Slab = 10½" =	-0.89
Box Culvert Height =	-6.00
Box Culvert Inlet Flowline =	1237.57
Box Culvert Slope = 62.2' @ 0.34% =	-21
Box Culvert Outlet Flowline =	1237.36

Appendix IV

Location 2 Drainage Calculations

JACOBS

Project:	Maricopa - Casa Grande Highway	By:	JPF
Subject:	Overtopping	Date:	12/18/2013
	Location 2 - B_{weir}	Checked:	
	Existing Conditions	Jacobs Project No.:	W7X97700

Remarks:

Breakout Flows

Assume Broadcrested Weir

Overtopping calculation procedures in accordance with Drainage Design Manual for Maricopa County.
$Q = C L H^{1.5}$

Low point of dip section = 1239.22

Calcs:

Trial HW = 1241.69

Depth 1 (ft)	Depth 2 (ft)	HW_f (ft)	C	L	Q_o (cfs)
0.00	1.88	0.94	2.77	12.00	30.3
1.88	1.58	1.73	2.77	14.00	88.2
1.58	0.99	1.29	2.77	36.00	145.3
0.99	1.60	1.30	2.77	12.00	49.0
1.60	2.47	2.04	2.77	13.00	104.5
2.47	2.45	2.46	2.77	15.00	160.3
2.45	2.13	2.29	2.77	31.00	297.6
2.13	1.63	1.88	2.77	28.00	199.9
1.63	1.48	1.56	2.77	24.00	128.9
1.48	1.04	1.26	2.77	21.00	82.3
1.04	0.99	1.01	2.77	24.00	32.0
0.99	0.00	0.50	2.77	32.00	30.9
				Q_{TOTAL} =	1,349.2

Pipe Culvert CALCULATIONS

12-18-2013

PROJECT NAME - MCGH PROJECT NO. - W7X97700
HIGHWAY NAME - Existing DESIGNER - JPF
LOCATION - 2 Bpipes CHECKER - PAGE
VBVer 1.03: December 2008

***** INPUT DATA *****

Number of Pipes=5
Diameter = 5.0 Ft.
LENGTH = 64.00 Ft.
SLOPE = 0.0020 Ft./Ft.
Length*Slope = 0.13 Ft.
TOTAL DISCHARGE = 865.1 Cfs.
FREQUENCY = 100 Years

Manning's 'n'= 0.024
Entrance Co-eff. Ke= 0.5
Inlet Invert Elev: 1,234.55 Ft.
Allowable Headwater Elev: 1,242.00 Ft.
Tailwater depth = 4.50 Ft.
Calculated Tailwater Elev: 1,238.92 Ft.

---------- HYDRAULIC ANALYSIS ----------

INLET CONTROL DATA:

Hw/D = 1.28
Hw = 6.41 Ft.

OUTLET CONTROL DATA:

Hw/D = 1.43 H = 2.77 Ft.
Hw = 7.14 Ft. Ho= 4.50 FT.

***** OUTLET CONTROL GOVERNS *****

HEADWATER COMPUTATION

Controling Hw = 7.14 Ft.
Design Hw/D = 1.43

DESIGN HEADWATER Elev. 1,241.69
Freeboard =0.31

Dn = 5.00 Ft.
Dc = 3.77 Ft.
(Dc+D)/2 = 4.39 Ft.

Outlet Velocity = 9.30 fps.
based on depth = 4.50 Ft.
Tailwater.

TRAP. CHANNEL CALCULATIONS

12-18-2013

PROJECT NAME - MC - CG PROJECT NO. - W7X97700
HIGHWAY NAME - Existing DESIGNER - JPF
LOCATION - 2 Cswale CHECKER - PAGE
VBVer 1.3: January 2011

Channel Bottom Width (Ft.) =48.00
Lt. side slope (Horiz. to 1) =6.40
Rt. side slope (Horiz. to 1) =2.30
Channel Slope,(Ft./Ft.) =0.003600
Manning's 'n' =0.035

==>Discharge (CFS) =643.27

Normal Depth (Ft.) =2.57
Area of Normal Depth (Sq. Ft.) =152.09
Normal Depth Velocity (Ft./Sec.) =4.23

Critical Depth (Ft.) =1.68
Critical Depth Velocity (Ft./Sec.) =6.92
Critical Slope (Ft./Ft.) =0.015837

Sequent Depth-Ft. =1.02
Froude Number =0.51

JACOBS

Project:	Maricopa - Casa Grande Highway	By:	JPF
Subject:	Overtopping	Date:	12/18/2013
	Location 2 - $C_{ex\ road}$	Checked:	
	Existing Conditions	Jacobs Project No.:	W7X97700

Remarks:

Breakout Flows

Assume Broadcrested Weir

Overtopping calculation procedures in accordance with Drainage Design Manual for Maricopa County.
$Q = C L H^{1.5}$

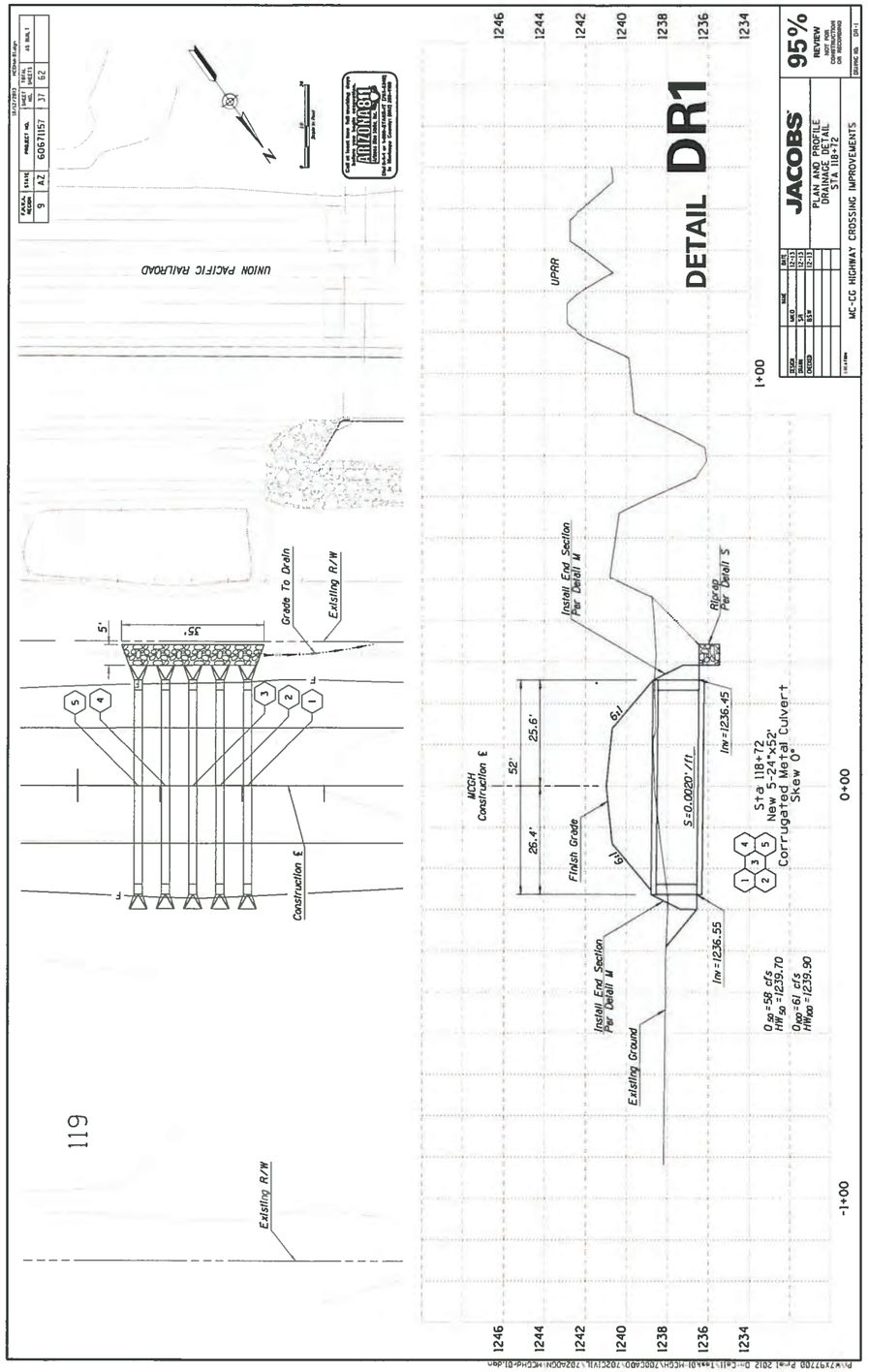
Low point of dip section = 1238.63

Calcs:

Trial HW = 1239.53

Depth 1 (ft)	Depth 2 (ft)	HW_f (ft)	C	L	Q_o (cfs)
0.00	0.90	0.45	2.77	78.00	65.2
0.90	0.80	0.85	2.77	56.00	121.6
0.80	0.00	0.40	2.77	50.00	35.0

Q_{TOTAL} = 221.8



TRAP. CHANNEL CALCULATIONS

12-18-2013

PROJECT NAME - MC-CG
PROJECT NO. - W7K97700
HIGHWAY NAME - Proposed Conditions
DESIGNER - JPF
LOCATION - 2 Grade Q50
CHECKER - _____ PAGE _____
VBVer 1.3: January 2011

Channel Bottom Width (Ft.) =48.00
Lt. side slope (Horiz. to 1) =6.40
Rt. side slope (Horiz. to 1) =2.30
Channel Slope,(Ft./Ft.) =0.003600
Manning's 'n' =0.035

==>Discharge (CFS) =720.42

Normal Depth (Ft.) =2.74
Area of Normal Depth (Sq. Ft.) =164.18
Normal Depth Velocity (Ft./Sec.) =4.39

Critical Depth (Ft.) =1.81
Critical Depth Velocity (Ft./Sec.) =7.15
Critical Slope (Ft./Ft.) =0.015528

Sequent Depth-Ft. =1.10
Froude Number =0.51

TRAP. CHANNEL CALCULATIONS

12-18-2013

PROJECT NAME - MC-CG PROJECT NO. - W7X97700
HIGHWAY NAME - Proposed Conditions DESIGNER - JPF
LOCATION - 2 Cswale Q100 CHECKER - _____ PAGE_____
VBVer 1.3: January 2011

Channel Bottom Width (Ft.) =48.00
Lt. side slope (Horiz. to 1) =6.40
Rt. side slope (Horiz. to 1) =2.30
Channel Slope,(Ft./Ft.) =0.003600
Manning's 'n' =0.035

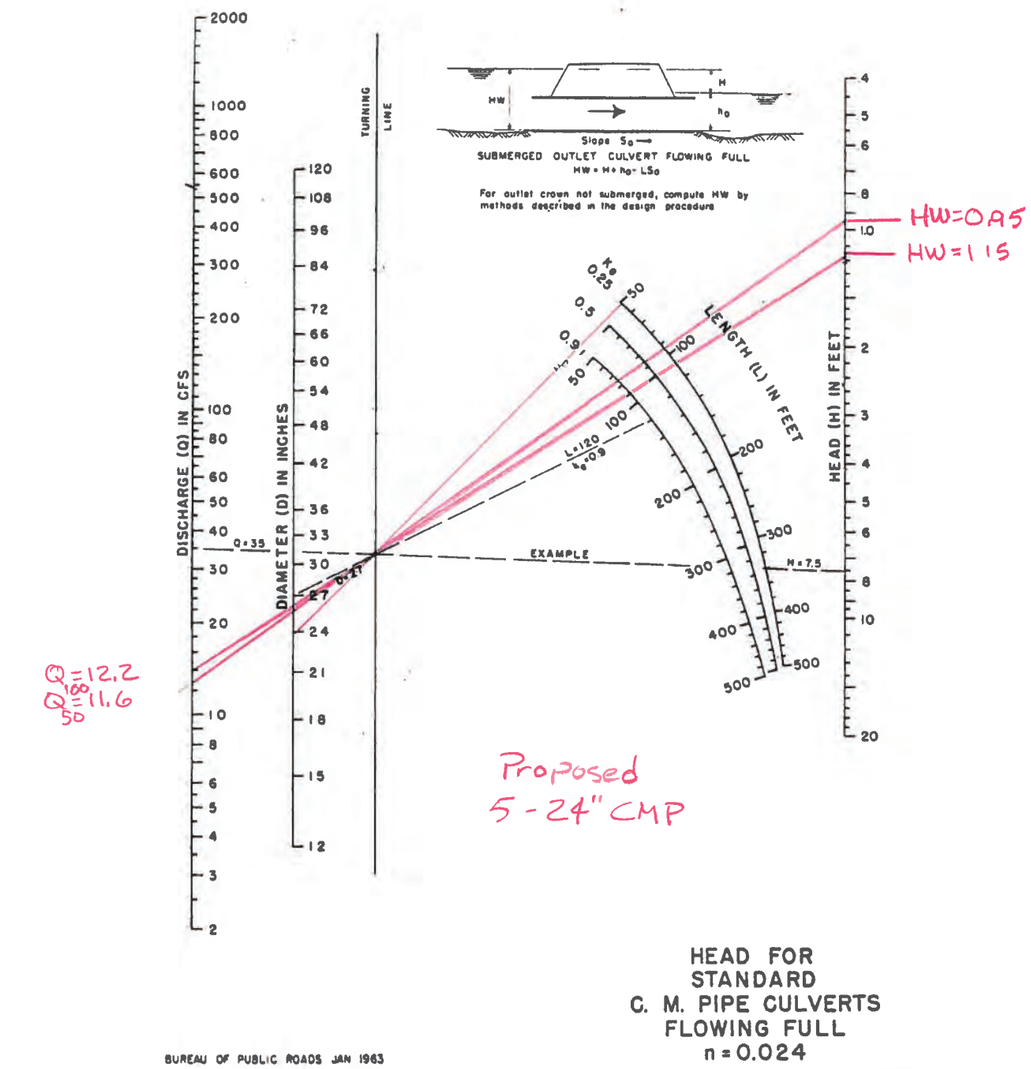
==>Discharge (CFS) =816.47

Normal Depth (Ft.) =2.94
Area of Normal Depth (Sq. Ft.) =178.72
Normal Depth Velocity (Ft./Sec.) =4.57

Critical Depth (Ft.) =1.95
Critical Depth Velocity (Ft./Sec.) =7.40
Critical Slope (Ft./Ft.) =0.015171

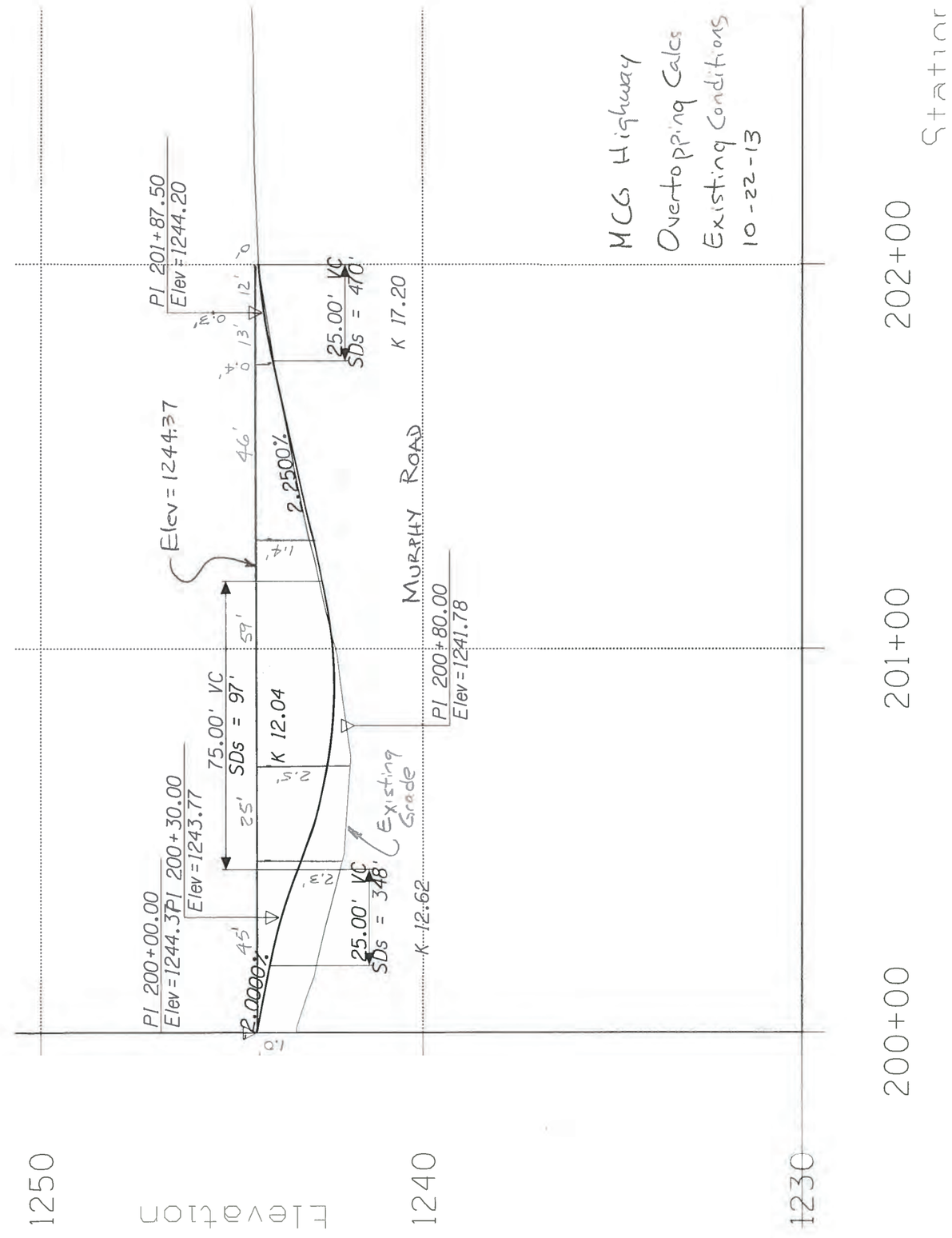
Sequent Depth-Ft. =1.20
Froude Number =0.52

CHART 11



Appendix V

Location 3 Drainage Calculations



JACOBS

Project:	Maricopa - Casa Grande Highway	By:	JPF
Subject:	Overtopping	Date:	10/21/2013
	Murphy Road	Checked:	
	Existing Conditions	Jacobs Project No.:	W7X97700

Remarks:

Murpy Road profile, existing and proposed, prepared 7/29/2013.

Assume conveyance above MCGH centerline elevation, 1244.36 is unchanged.

Assume conveyance north of tie-down point, 200' Rt, is unchanged.

Assume tailwater elevation to be 1242.67

Overtopping calculation procedures in accordance with Drainage Design Manual for Maricopa County.

$Q_o = K_t C_r L_x (HW_f)^{1.5}$

Calcs:

$L_r = 40'$

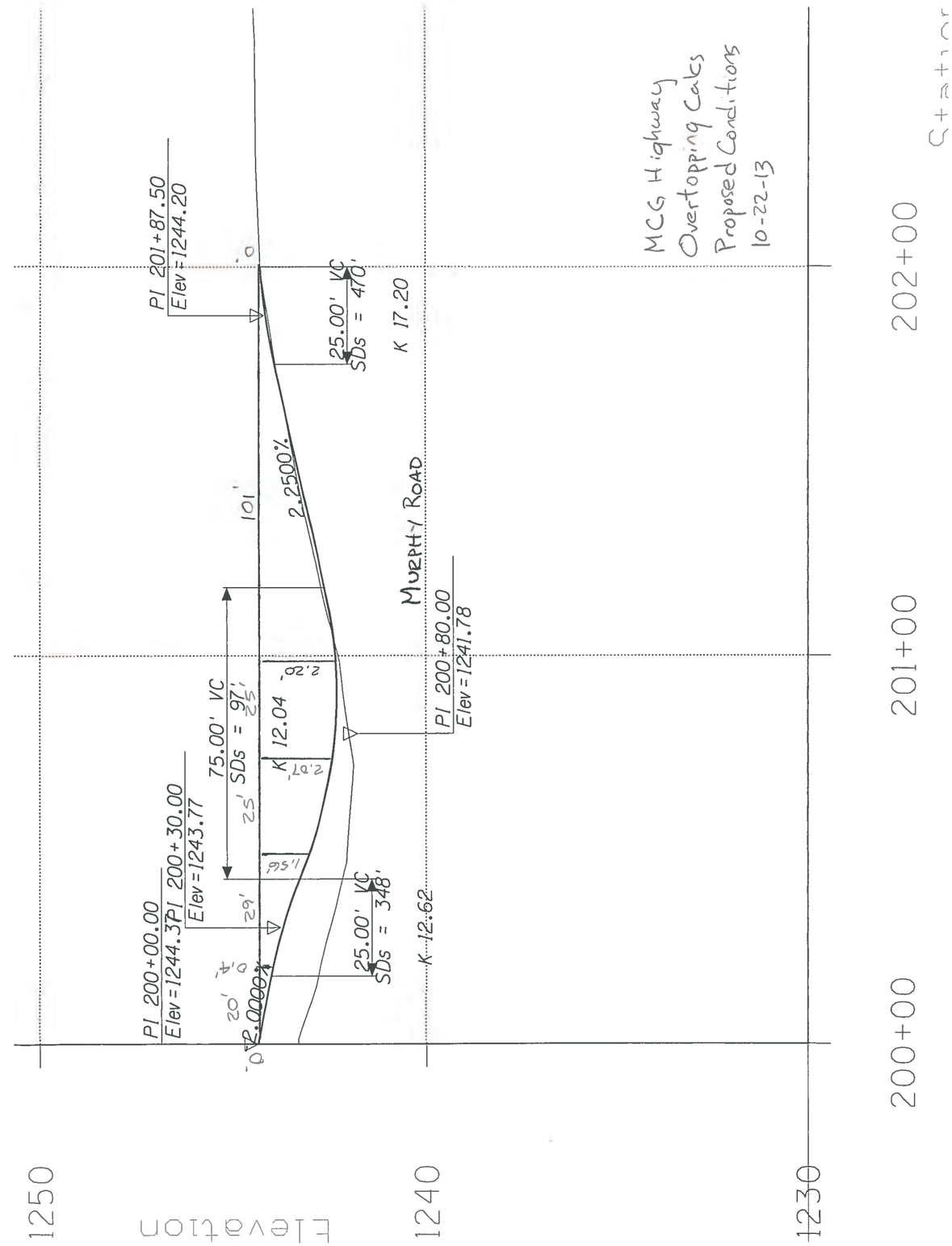
$h_r = 1242.67 - 1241.85 = 0.82'$

$HW_r = 1244.36 - 1241.85 = 2.51'$

$h_r / HW_r = 0.82' / 2.51' = 0.33$ therefore $K_t = 1.0$

$HW_r / L_r = 2.51' / 40.00' = 0.06$ therefore $C_r = 3.04$

Depth 1 (ft)	Depth 2 (ft)	HW_f (ft)	Kt	C_r	L_r	Q_o (cfs)
1.00	2.30	1.65	1.00	3.04	45.00	289.9
2.30	2.50	2.40	1.00	3.04	25.00	282.6
2.50	1.40	1.95	1.00	3.04	59.00	488.4
1.40	0.40	0.90	1.00	3.04	46.00	119.4
0.40	0.30	0.35	1.00	3.04	13.00	8.2
0.30	0.00	0.15	1.00	3.04	12.00	2.1
					Q_{TOTAL} =	1,190.6



JACOBS

Project:	Maricopa - Casa Grande Highway	By:	JPF
Subject:	Overtopping	Date:	10/21/2013
	Murphy Road	Checked:	
	Proposed Conditions	Jacobs Project No.:	W7X97700

Remarks:

Murpy Road profile, existing and proposed, prepared 8/19/2013.

Assume conveyance above MCGH centerline elevation, 1244.36 is unchanged.

Assume conveyance north of tie-down point, 200' Rt, is unchanged.

Assume tailwater elevation to be 1242.67

Overtopping calculation procedures in accordance with Drainage Design Manual for Maricopa County.

$Q_o = K_t C_r L_x (HW_f)^{1.5}$

Calcs:

$L_r = 40'$

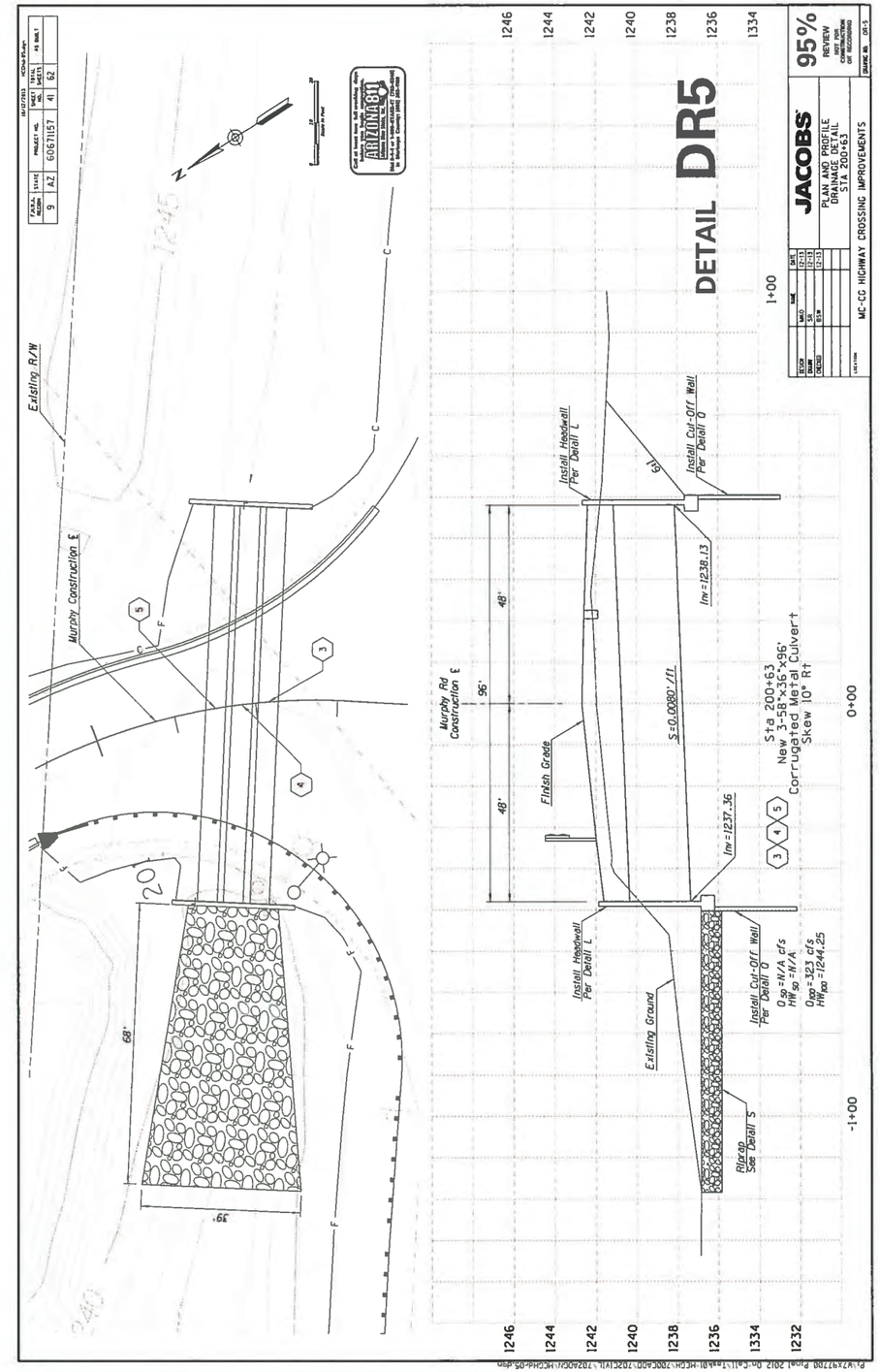
$h_r = 1242.67 - 1242.29 = 0.38'$

$HW_r = 1244.36 - 1242.29 = 2.07'$

$h_r / HW_r = 0.38' / 2.07' = 0.18$ therefore $K_t = 1.0$

$HW_r / L_r = 0.90' / 40.00' = 0.02$ therefore $C_r = 3.04$

Depth 1 (ft)	Depth 2 (ft)	HW_f (ft)	Kt	C_r	L_r	Q_o (cfs)
0.00	0.40	0.20	1.00	3.04	20.00	5.4
0.40	1.56	0.98	1.00	3.04	29.00	85.5
1.56	2.07	1.82	1.00	3.04	25.00	185.8
2.07	2.20	2.14	1.00	3.04	25.00	237.1
2.20	0.00	1.10	1.00	3.04	101.00	354.2
					Q_{TOTAL} =	868.1



Pipe Culvert CALCULATIONS

10-24-2013

PROJECT NAME - MCG Highway PROJECT NO. - W7X97700
HIGHWAY NAME - Location 3 DESIGNER - JPF
LOCATION - Proposed Culverts Sta 200+60 CHECKER - _____ PAGE_____
VBVer 1.03: December 2008

***** INPUT DATA *****

Number of Pipes=3
Diameter = 4.0 Ft.
LENGTH = 80.00 Ft.
SLOPE = 0.0080 Ft./Ft.
Length*Slope = 0.64 Ft.
TOTAL DISCHARGE = 322.5 Cfs.
FREQUENCY = 100 Years

Manning's 'n'= 0.024
Entrance Co-eff. Ke= 0.5
Inlet Invert Elev: 1,238.16 Ft.
Allowable Headwater Elev: 1,244.36 Ft.
Tailwater depth = 3.00 Ft.
Calculated Tailwater Elev: 1,240.52 Ft.

---------- HYDRAULIC ANALYSIS ----------

INLET CONTROL DATA:

Hw/D = 1.39
Hw = 5.55 Ft.

OUTLET CONTROL DATA:

Hw/D = 1.54 H = 3.23 Ft.
Hw = 6.16 Ft. Ho= 3.57 FT.

***** OUTLET CONTROL GOVERNS *****

HEADWATER COMPUTATION

Controling Hw = 6.16 Ft.
Design Hw/D = 1.54

DESIGN HEADWATER Elev. 1,244.32
Freeboard =0.04

Dn = 4.00 Ft.
Dc = 3.14 Ft.
(Dc+D)/2 = 3.57 Ft.

Outlet Velocity = 10.17 fps.
based on depth = 3.14 Ft.
Dc at oulet.

JACOBS

Project:	Maricopa - Casa Grande Highway	By:	JPF
Subject:	Rip Rap Apron	Date:	10/22/2013
	Station 200+60	Checked:	
		Jacobs Project No.:	W7X97700

Reference: Drainage Design Manual for Maricopa County, Volume 2: January 28, 1996

RESULTS			
D50 (in)	T (in)	La	Wa
6	12	68.0	39.0

From HY-8 Output						
Q100 (per barrel) (cfs)	Number of Barrels	Pipe Diameter (ft)	Yo Outlet Depth (ft)	Vo Outlet Velocity (ft/s)	TW Tailwater Depth (ft)	Existing Channel Velocity (ft/s)
107.5	3	4	3.57	8.55	5.31	7.51

Riprap Apron Basin Design

Step 1: Determine TW condition (TW< D/2 or TW > D/2)

TW = 5.31 ft
D/2 = 2 ft

Condition: Hi TW TW>D/2

Step 2: Determine the lenghth of Apron, La

for low TW: La = 1.8*Q/D^(3/2)+7*D
for hi TW: La = 3.0*Q/D^(3/2)+7*D

La = 68 ft

JACOBS

Project:	Maricopa - Casa Grande Highway	By:	JPF
Subject:	Rip Rap Apron	Date:	10/22/2013
	Station 200+60	Checked:	
		Jacobs Project No.:	W7X97700

Reference: Drainage Design Manual for Maricopa County, Volume 2: January 28, 1996

RESULTS			
D50 (in)	T (in)	La	Wa
6	12	68.0	39.0

Step 3: Determine Basin Width, Wa. Is to be used if there are no defined drainage channel dowstream.

for low TW: Wa = 3*D+La
for hi TW: Wa = 3*D+0.4*La

Wa = 39 ft

Step 4: Size D50

D50 = 0.02*Q^(4/3)/TW/D (no preformed scour hole)

D50 = 6 inches D50 calced is less than 6 inches, use 6 inches.

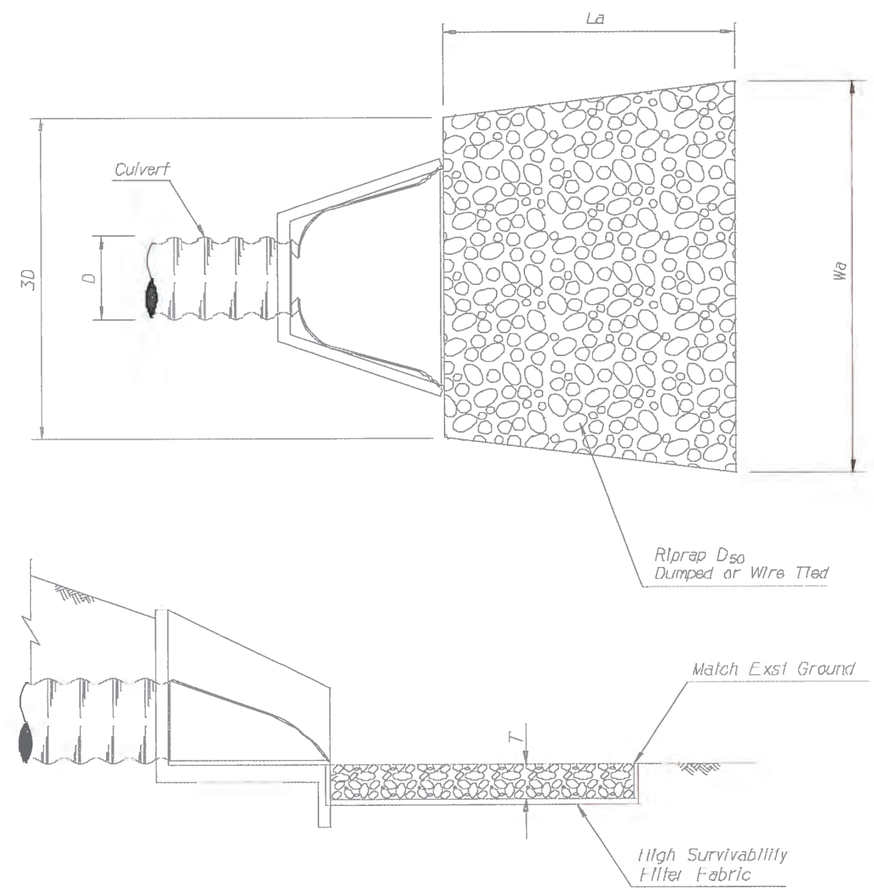
Thickness = 12 inches (2*D50)

Step 5: Estimate Quantities

Vol. Riprap = 64.22 yd^3 (3*D+Wa)/2*La*T/12/27

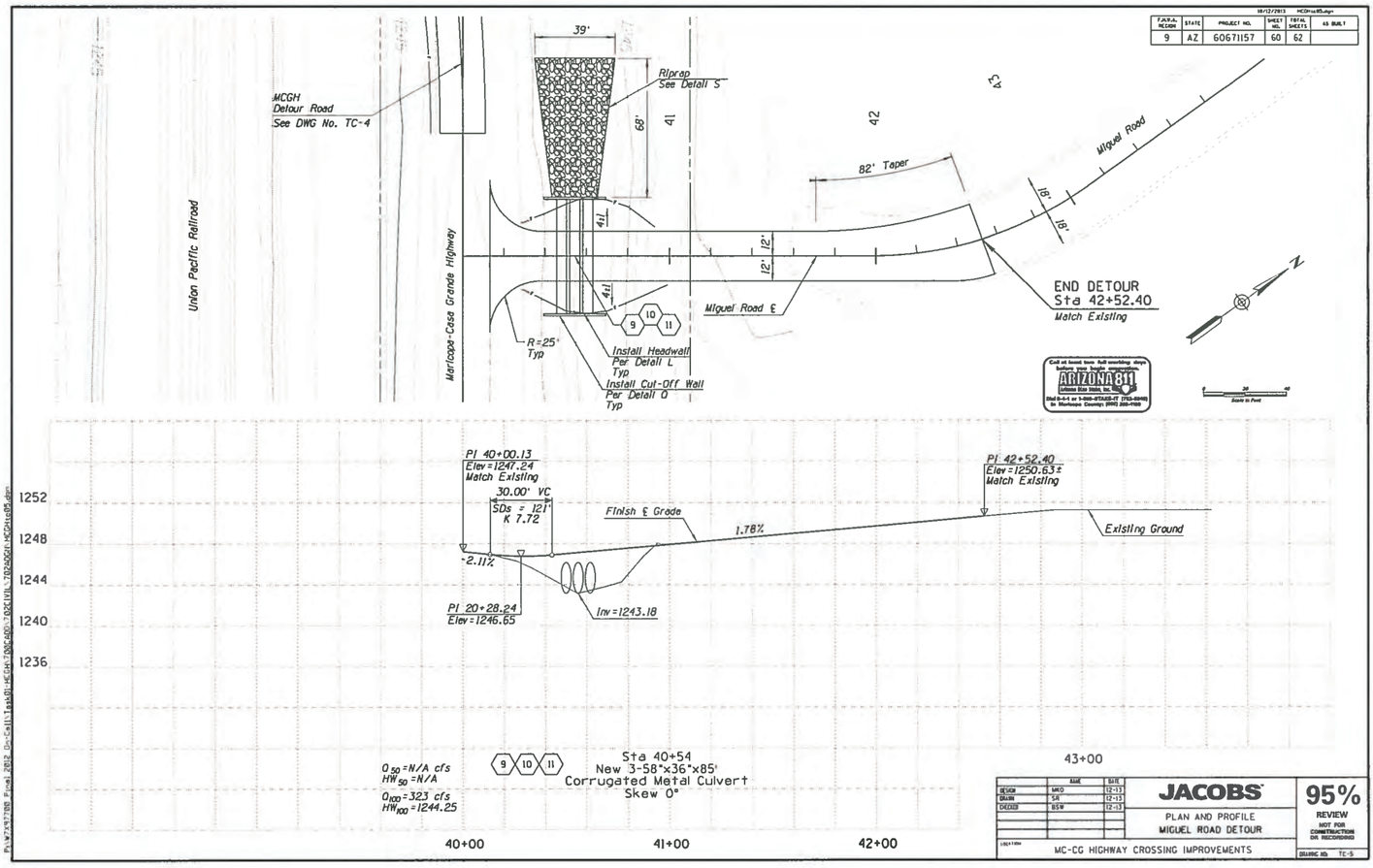
JACOBS

Project:	Maricopa - Casa Grande Highway	By:	JPF
Subject:	Rip Rap Apron	Date:	10/22/2013
	Configuration	Checked:	
		Jacobs Project No.:	W7X97700



Note:

The geometric shape of the apron may be warped to match the existing wash.



F.A.P.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	AZ	60671157	60	62	

10/17/2013 MCDPrint5.dgn

Q_{50}=N/A cfs
HW_{50}=N/A
Q_{100}=323 cfs
HW_{100}=1244.25

9 10 11

Sta 40+54
New 3-58"x36"x85'
Corrugated Metal Culvert
Skew 0°

	NAME	DATE
DESIGN	MKO	12-13
DRAWN	SJA	12-13
CHECKED	BSW	12-13

JACOBS

PLAN AND PROFILE
MIGUEL ROAD DETOUR

MC-CG HIGHWAY CROSSING IMPROVEMENTS

95%
REVIEW
NOT FOR CONSTRUCTION
DO RECORDING

DRAWING NO. TC-5

P:\W2X7788_Fred 2013 On-Call\Task01-CG-TOPO-400\DGN\TC-5\MCGHwyRR.dgn