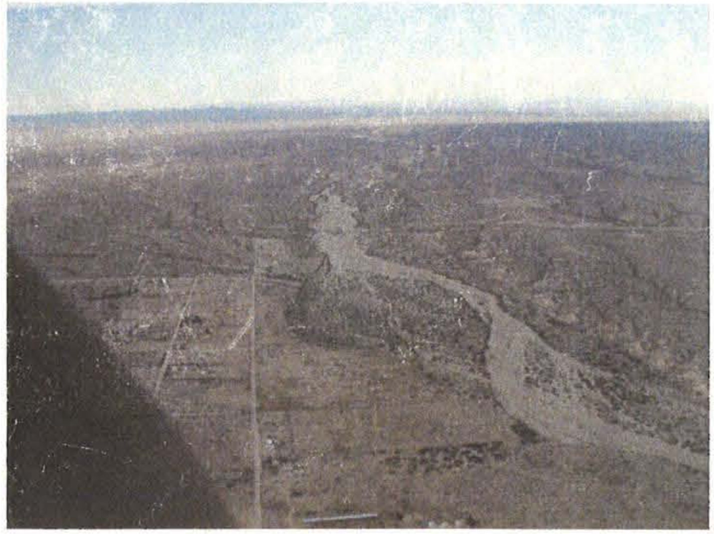
WESTCAPS STRATEGIC PLAN



REFINEMENT OF WEST MARICOPA COMBINE PIPELINE STUDY

WESTCAPS
our west valley water coalition

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

August 2002

Executive Summary

The Westcaps strategic plan, published in April 2001, presented population projections from the year 2000 to 2025 in five-year increments. From the projections, it was evident that growth in the west Phoenix valley would outstrip the water delivery capability of the region. In addition, the report helped to identify potential sources of water, and provided a layout for the infrastructure to deliver the water economically and efficiently.

The strategic plan identified a pipeline from the far west metropolitan area to deliver water toward Phoenix. The layout, feasibility, and economics of these efforts reflected previous assumptions that were not congruent with the latest version of the strategic plan. Subsequently, the results of planning efforts near the Buckeye, Arizona areas indicated the pace of growth originally anticipated was underestimated. The purpose of this report at this time is to present the feasibility of a West Maricopa Combine (WMC) water delivery system by identifying a "best" layout for the pipeline and estimating associated construction and operation costs.

The WMC water supply source is a well field located at the intersection of Palo Verde Road - Sun Valley Parkway and Van Buren if Van Buren were extended further west. From this location, the growth areas are in the southeastward direction. The areas of Buckeye, along Yuma road toward Goodyear, and along Tuthill Road and Cotton Lane south of Yuma Road are examples of areas identified for development.

Five potential alignments were hydraulically modeled from the WMC well field toward Goodyear. In every case the desire was to connect the WMC trunkline to the Sarival Road trunkline, as modeled in the 2001 strategic plan. This allows for the flow in the WMC pipeline to be reversed should outages occur, or when additional supplies in out years are needed in the WMC area. In general, the trunkline alignments modeled were along Yuma Road, or along the Tonopah-Salome Highway, the I-10 dike, and continuing along McDowell Road (see Figure 1 for a visual description of the layouts). From the main trunkline, the laterals traverse south along Miller Road, Tuthill Road, and Cotton Lane. As a quick reference, a description of the lengths and elevations for each alignment are provided in Figures AP A-1A through AP A-5A.

The preferred alignment is denoted in the report as Alignment 3 and traverses from the WMC well field south along Sun Valley Parkway, then eastward along the I-10 dike until the dike intersects Yuma Road. The trunkline continues eastward along Yuma Road until it intersects the planned trunkline traversing along Sarival Road (see Figure 4, Maricopa Combine Pipeline to the Future, Appraisal Study, Alignment 3).

Alignment 3 was chosen over the others because of the ability to use the slope of the terrain to maximize gravity pressure and because, compared to the other alignments, shorter laterals were needed which reduces construction costs. The following tables summarize the cost of construction and operation for each alignment in forward and reverse flow.

Table A-4
Cost Summary for Forward Flow Delivery

Item*	Alignment				
	1	2	3	4	5
Construction Cost*	$27,511,754	$26,108,603	$23,246,007	$23,856,052	$26,925,701
Capital Cost*	$40,283,455	$38,328,044	$34,164,409	$34,975,473	$39,509,982
20 Years' Amortized Cost*	$3,370,892	$3,207,265	$2,858,855	$2,926,724	$3,306,169
Annual O. & M. Cost*	$1,398,462	$1,139,400	$871,733	$1,128,137	$1,245,081
Total Annual Cost*	$4,769,354	$4,346,665	$3,730,588	$4,054,861	$4,551,250
Cost per Acre-Feet*	$191	$174	$149	162	$182
Cost per 1,000 Gallons*	$0.59	$0.53	$0.46	$0.50	$0.56

Note: *These cost totals only represent the cost of the delivery pipeline system and appurtenances. See Chapter 5 summary for the additional cost of delivery.

Table A-5
Cost Summary for Additional Pump for Reverse Flow Delivery

Item*	Alignment 1	Alignment 2	Alignment 3
Pump Construction Cost*	$485,650	$485,650	$439,400
Pump Capital Cost*	$679,910	$679,910	$615,160
20 Years' Amortized Cost*	$56,894	$56,894	$51,476
Annual Pump O. & M. Cost*	$599,072	$599,072	$350,347
Total Annual Pump Cost*	$655,966	$655,966	$401,823
Cost per Acre-Feet*	$34	$34	$24
Cost per 1,000 Gallons*	$0.10	$0.10	$0.07

Note: *These cost totals only represent the cost of the delivery pipeline system and appurtenances. See Chapter 5 summary for the additional cost of delivery.

The main disadvantage of Alignment 3 is the high relative cost of purchasing right-of-way land for the main trunkline. The estimated cost is $1,158,000. The next least expensive option is Alignment 5, at an estimated cost of $1,135,000 to acquire easements and purchase right-of-way property. The least expensive option was Alignment 1 at an estimated cost of $1,088,000.

Although the preferred alignment is the most expensive option in terms of purchasing land for the trunkline, it is the least expensive option for purchasing land for the laterals. The estimated cost is $462,000. The next least expensive option is Alignment 4, which is also estimated at $462,000. The most expensive options are Alignments 1 and 5 at an estimated cost of $679,000. The estimated costs to purchase land are provided in the report in Tables X and X1. Although purchasing land for the Alignment 3 trunkline is the most expensive option, Alignment 3 results in the least expensive alternative overall when purchasing land for laterals is considered.

The estimated cost to deliver water with forward and reverse flow capability is $578 per acre-foot, or $1.78 per 1,000 gallons (See Table 4 – Total Cost in Chapter 5). It should be noted that the WMC system does not include a cost for water treatment since water treatment is not necessary. This includes the capital and O&M costs for forward or reverse flow delivery, the cost to purchase CAP water, a recharge facility use fee, the cost to recover the water and the cost to provide a storage reservoir, and a profit and income tax margin. For comparison, the strategic plan presented the cost to deliver water at roughly $450 per acre-feet, or $1.38 per 1,000 gallons.

The following report is divided into six sections. An introduction to the purpose of the project, a thorough description of each alignment, the hydraulic analysis and associated costs, existing land ownerships and water quality conditions, a cost summary, and a conclusion and observations summary. The hope is that this report will be useful for planning purposes and that the project may one day become a reality along with the rest of WESTCAPs' strategic plan.

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Summary for Transient Years' Water Delivery along Preferred Alignment 3 (Flood Control Dike and Yuma Road, Forward Flow), with three laterals

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Reverse Flow, Transient Years' (2005, 2015, 2025) Water Delivery along Preferred Alignment 3 (Flood Control Dike and Yuma Road, Forward Flow), with three laterals

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8. Table AP D-S4, Annualized Pump Capital, and O and M Costs, (Costs per Acre-Foot and 1,000 Gallons of Water)

ABBREVIATIONS AND ACRONYMS

ACC	Arizona Corporation Commission
ADEQ	Arizona Department of Environmental Quality
ADWR	Arizona Department of Water Resources
AMA	Active management Area
amsl	above mean sea level
ac-ft	acre-foot
ac-ft/day	acre-foot per day
ac-ft/yr	acre-foot per year, acre-feet per year
AWBA	Arizona Water Banking Authority
AWS	assured water supply
BOL	beginning of line
BOR	U.S. Bureau of Reclamation
CAGRD	Central Arizona Groundwater Replenishment District
CAP	Central Arizona Project
CAWCD	Central Arizona Water Conservation District
CC&N	Certificate of Convenience and Need
cfs	cubic feet per second
CRIT	Colorado River Indian Tribes
D/DBPR	Disinfectant/Disinfection By-Products Rule
DOI	Department of the Interior
Elev.	elevation
EPA	Environmental Protection Agency
ESRV	East Salt River Valley
ESWTR	Enhanced Surface Water Treatment Rule
ft^3/day	cubic feet per day
GRIC	Gila River Indian Community
LAU	lower alluvial unit
MAU	middle alluvial unit
M&I	municipal and industrial
MCL	maximum contaminant level
MF	microfiltration
mg/L	milligrams per liter
MG	million gallons
MGD	million gallons per day
MWD	Maricopa County Municipal Water Conservation District No. 1

NB-WTP	North Beardsley Water Treatment Plant
NCI	Navigant Consulting, Incorporated
O&M	operation and maintenance
OM&R	operation, maintenance and replacement
ppb	parts per billion
ppm	parts per million
psi	pounds per square inch
PTTF	Pipeline To The Future
RID	Roosevelt Irrigation District
RO	reverse osmosis
ROW	Right-of-Way, Rights-of-Way
RUS	Rural Utilities Service
SB-WTP	South Beardsley Water Treatment Plant
SROG	Sub-Regional Operating Group
SRP	Salt River Project
SRV	Salt River Valley
TDS	total dissolved solids
THM	trihalomethanes
TOC	total organic carbon
UAU	upper alluvial unit
UF	ultrafiltration
USBR	U.S. Bureau of Reclamation
USDA	U.S. Department of Agriculture
USDOI	U.S. Department of the Interior
WESTCAPS	coalition of West Valley Central Arizona Project Subcontractors
WMC	West Maricopa Combine
WTP	water treatment plant
WSRV	West Salt River Valley
WPA	water planning area

CHAPTER I

INTRODUCTION

1.1 Study Purpose, Sizing, Layout and Objectives

Study Purpose

During the original appraisal evaluation of the WESTCAPS Strategic Plan, a study was completed in May 2001 to determine the source of water supplies; water treatment sites and the associated trunk lines, which would provide water to the WESTCAPS study area. See Figure "Excerpt from Original 9-15-00 Layout (Trunk Line in Blue and Red). The water source and capacity of the PTTF was noted as a water source of CAP water, but no further data was gathered as part of that original report. See Figure "Excerpt from Original 9-15-00 Layout (Trunk Line in Black).

Although the West Maricopa Combine pipeline (WMC) was originally part of the strategic plan, the layout provided in the strategic plan did not detail the WMC's layout. The intent of this report is to detail that layout as it would fit in with the strategic plan already provided for in April of 2001. This report identifies the pipeline delivery sites, the pipe, pipeline capacity, excess capacity available, operational limitations, and the unit cost for delivering the water. An in depth engineering analysis has not been completed for the well field or storage reservoir, but for purposes of this report an estimate has been included in order to complete the cost of water delivery.

How this case interacts with the strategic plan of 9/15/2000 is noted during this report. This report will be presented in a format similar to the strategic plan report.

Sizing and Layout

The delivery potential of the recovery field is 25,000 acre-feet per year. Therefore, the system is sized for a pipeline capable of delivering this capacity. The peaking capacity of the pipeline is estimated at 37,500 acre-feet per year, based on peaking capacity (a monthly average). Prior to sizing, other criteria such as seasonal, daily and municipal and industrial peaking would need to be integrated into the design. The quality of the water drawn meets clean drinking water guidelines and will not require treatment. The water transported will be potable drinking water.

The delivery areas are the Town of Buckeye, West Maricopa Combine, the Arizona Water Company and the City of Goodyear. The location of pipe laterals represent deliveries to the centroid of the water provider areas. These are only estimated delivery areas.

The pipeline is capable of reversible flows which at some point in the future will provide superior flexibility and add to the value of the estimated 25-year operational life cycle.

The construction alignment of a proposed pipeline is unknown at this time. However, various pipe alignments are modeled in this report and show the areas that should be considered for pipeline construction (See Figure " Summary of WMC Routes").

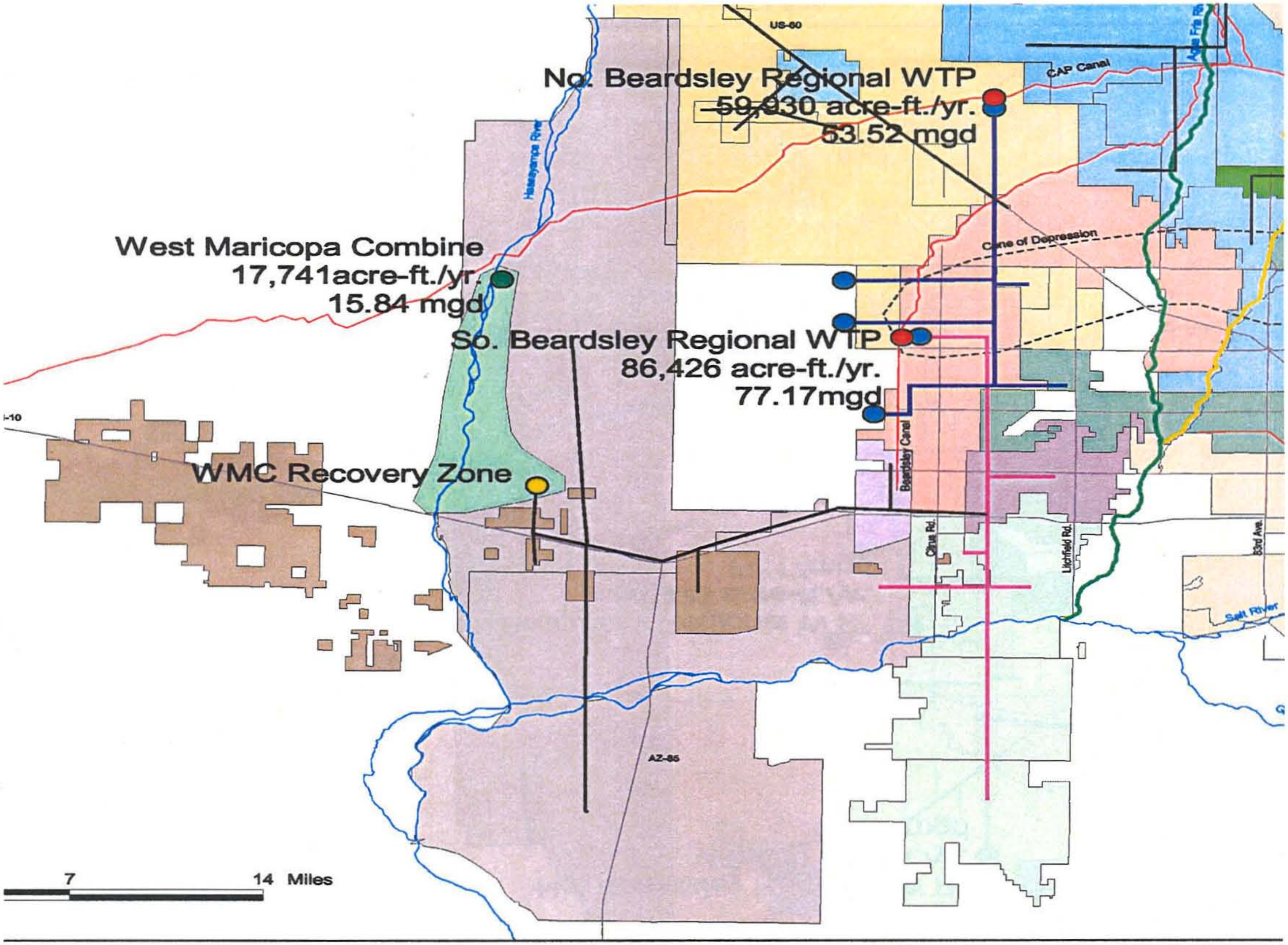
The system is modeled as an "on demand" system with no floating reservoir capability located along the pipeline alignment. The addition of in-line reservoirs would increase the operational capacity and flexibility of the system, up to the annual water supply available from the well field. Designs, equipment requirements or structure locations have not been completed except for the basic requirements for the pipeline control systems and pumps required.

Objectives

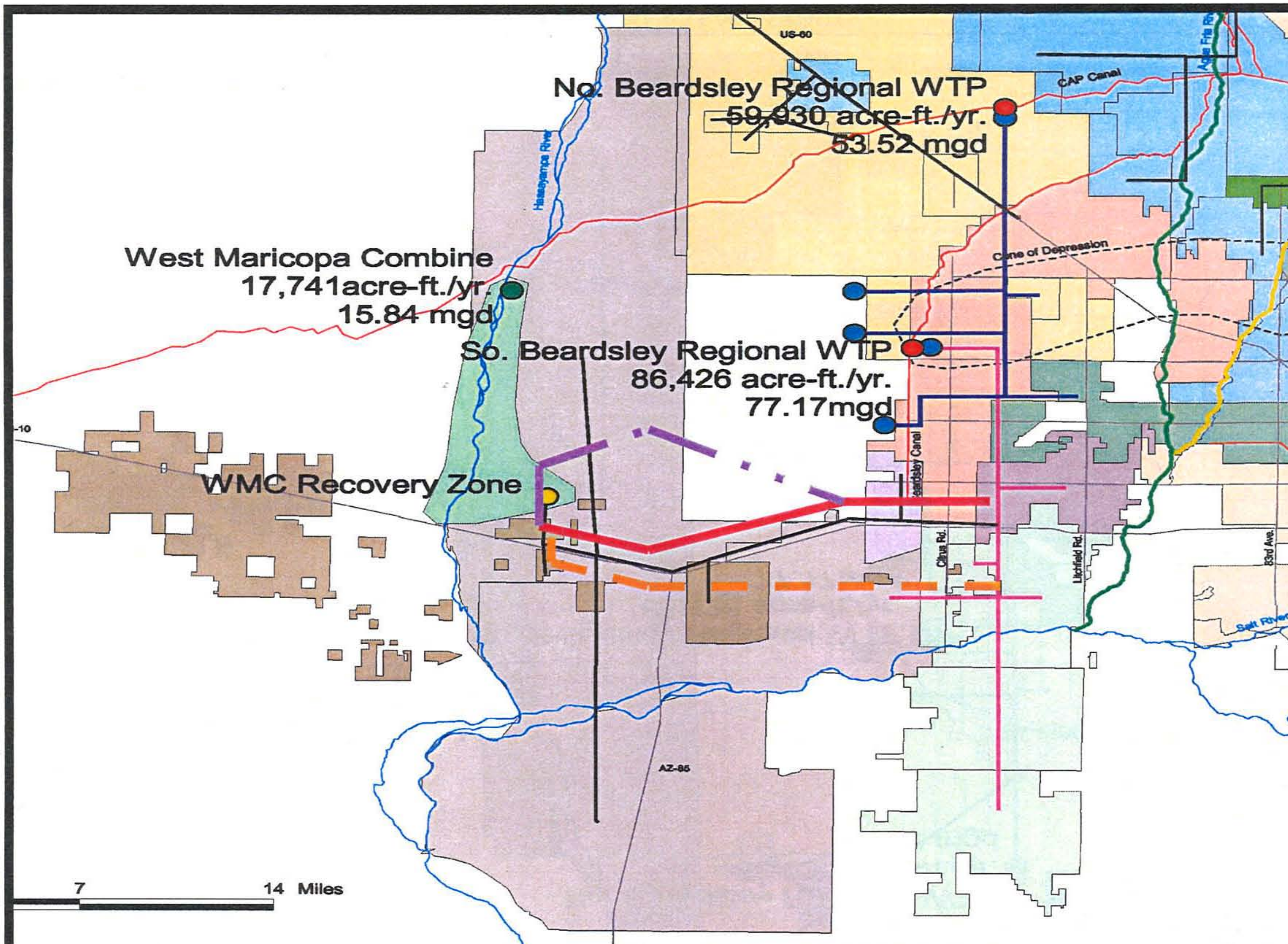
The objectives of this report are to determine the most probable area for a pipeline route by evaluating different delivery scenarios and evaluating each alignment with respects to right of way, cost, operations and future flexibility. The pipeline and appurtenant features (pumps, tanks, pressure reducers, etc) from the recovery reservoir to the intersection with the trunk line of the 9/15 alignments are also incorporated into the general layout. The cost of construction, capital costs and annual cost of operation and maintenance are presented in the same format as the analysis provided in the "WESTCAPS Strategic Plan for using Central Arizona Project Water in the West Salt River Valley, 2000 to 2025".

A summary report section and cost data are also provided as a comparison with the original 9/15 report in the next to last section in this report.

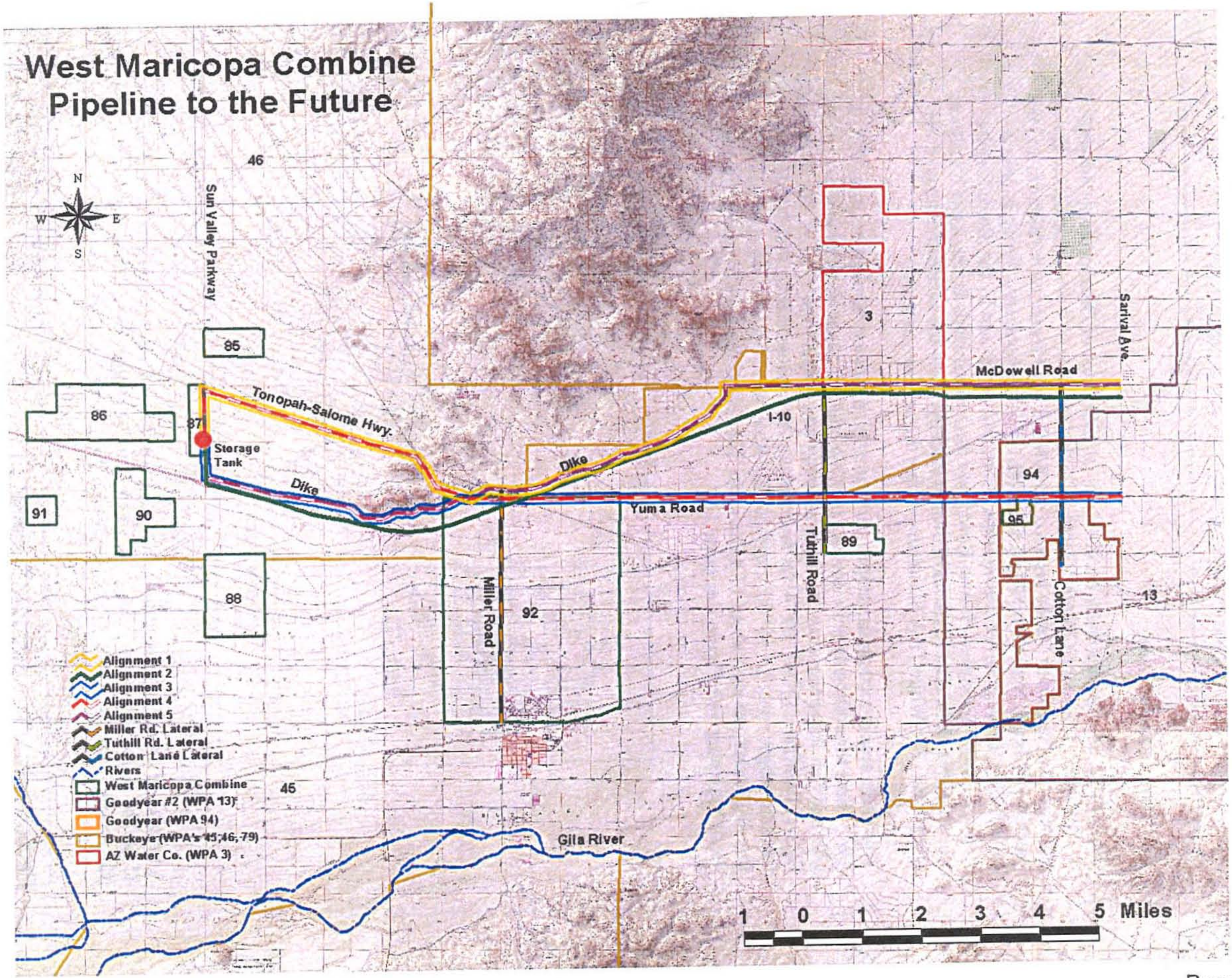
The following figure illustrates the final layout for the strategic plan report, commonly referred to as the 9/15 layout. The figure following the 9/15 layout overlays alternate routes as modeled for the WMC pipeline for this report. And the last figure on page five illustrates the five alignments hydraulically modeled from the WMC well field toward Goodyear.



EXCERPT FROM ORIGINAL 9-15-00 LAYOUT
Showing 2 WTP system and WMC



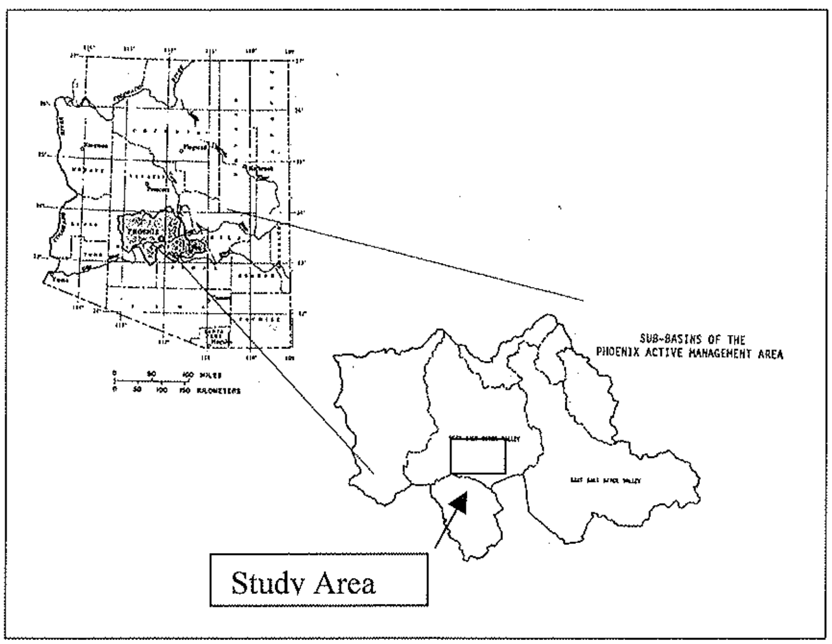
SUMMARY OF WMC ROUTES


West Maricopa Combine
Pipeline to the Future
46
N
W
E
S
Sun Valley Parkway
85
86
87
91
90
88
Storage Tank
Tonopah-Salome Hwy.
Dike
Dike
I-10
McDowell Road
Sarival Ave.
3
94
95
89
Yuma Road
Miller Road
92
Tuthill Road
Cotton Lane
13
45
Gila River
Alignment 1
Alignment 2
Alignment 3
Alignment 4
Alignment 5
Miller Rd. Lateral
Tuthill Rd. Lateral
Cotton Lane Lateral
Rivers
West Maricopa Combine
Goodyear #2 (WPA 13)
Goodyear (WPA 94)
Buckeye (WPA's 45,46,79)
AZ Water Co. (WPA 3)
1 0 1 2 3 4 5 Miles

1.2 Area of Study Area

The general area for this study occurs about 20 miles west of Phoenix along Buckeye Valley within Maricopa County. Buckeye Valley trends east-west across the southwest corner of the Salt River Valley between the White Tank Mountains to the north and the Buckeye Hills and Sierra Estrella on the south. Physiographically, the study area is bounded on the west by the Hassayampa River, and on the east by the Sierra Estrella range, Town of Goodyear (Sarival Road), and further eastwards by the Agua Fria River. The Buckeye Hills, Gila River and Town of Buckeye form the southern extents of the study area. The White Tank Mountains define the northern extents.

This study area is rectangular shaped with the five alignments contained within T1N, R2-4W. These three townships lie north of the Gila and Salt River Baseline and west of the Gila and Salt River Meridian. Geographic longitude ranges from 112^0 24' 00" W (about Sarival Road) to 112^0 41' 00"W (at the recovery zone water tank on Palo Verde Road). Latitude ranges from 33^0 20' 00" near the Gila River to 33^0 30' 00" on the north. The five alignments are each about 17 miles long. The five alignments are shown in more detail beginning with Figure 1 on page 23.



A number of prominent geographic features cross the study area. Interstate 10 and AZ-85 are the major highways. Principal roads referred to in this report are the Sarival, McDowell, Yuma, and Palo Verde Roads, and the Tonopah-Salome Highway. The

Southern Pacific Railroad line, Roosevelt and Buckeye Canals, and Maricopa County Flood Control Dikes (levee) all trend generally east-west through Buckeye Valley.

Ground elevations rise from south to north and slightly from west to east. Elevations along the Gila River vary from about 890 feet amsl near the Sierra Estrella to as low as 820 feet near Palo Verde. As one heads north outside the Gila River floodplain from about Buckeye approaching Interstate 10, the topography rises fairly uniformly about 200 feet in elevation until reaching the White Tank foothills. The highest point for any of the alignments is about elevation 1160. This is where Alignments 1 and 5 turn from the east terminus of the flood control dike onto McDowell Road.

1.3 PREVIOUS WESTCAPS STUDY - WMC BACKGROUND

The WMC is a water provider in the west valley and is owner and manager of the recharge and recovery facilities on the Hassayampa River, where the CAP crosses the river.

The WMC, managed underground storage, recharge and recovery project is capable of providing an alternative to traditional water supplies to the west Phoenix valley. Groundwater recharge of approximately 25,000 acre-feet per year of CAP water into the Hassayampa River bed, west of the White Tank Mountain range, will provide groundwater credits and offset groundwater pumping from other study areas.

The recovery well field is located approximately 12 miles south of the Hassayampa River recharge area, and is capable of delivering water by pipeline eastward to the WESTCAPS service areas. The recovered groundwater from the well field is expected to have a TDS of 170, fluorides of 1 ppm and arsenic of 0.0065 ppm. The depth of water is currently at approximately 150 feet below the ground surface.

The design of the project begins from the outlet of the WMC tank reservoir. The tank is considered an unlimited water source with a delivery capacity of 25,000-af/yr (total demand) and a peak demand of 37,500 ac-ft/yr (52 cfs). The peak demand incorporates a daily or monthly peaking factor based on the expected supply. This is the criteria when determining initial pipe sizing. No other system storage capacity is included along the pipeline route.

The entire water service study area boundaries are in Service Zones C, B and A, from ground elevations of 1100, 1000 and 900 feet, respectively. See Table A-8, "Regional Zone Boundaries and Highwater" and Figure A-13, "Topographic Elevations, Pressure Zones", from Appendix A of the WESTCAPS Strategic Plan.

The boundary areas of possible alignments for the study are determined in this report by the boundary of the 5 alternative alignments studied. This is also shown in the "Summary of WMC Routes", on page three.

This project will allow the use of credits, or use of CAP water in the southwestern valley by recharging CAP water in the Hassayampa river recharge site. These costs should be minimal since the water should not require water treatment. In addition, the planned trunk pipeline also delivers most of the water prior to reaching the intersection with the Sarival Road pipe alignment.

A summary of the water providers who will be recharging water at the Hassayampa site has not been gathered at the time of this publication.

WESTCAPS - General

Section 1.3 is a summary of the original study and is applicable since no notable deviations from the original strategic plan have occurred.

Although general water quality characteristics have been provided, the actual water quality from the WMC well field has not been analyzed for pipeline transport concerns. This may deserve consideration due to low flows (stagnant water) anticipated in the pipeline in the first 5 to 10 years. Additional chemical treatment for the system during the initial low flow years may be needed, but those concerns and costs have not been factored. See Haestads for discussion (Water Distribution Modeling, First Edition).

Another new recharge site could include CAWCD's Hieroglyphic Mountain located approximately at Sarival Road (163rd Ave.) and Dixlexia, by the CAP canal. This could be considered for WESTCAPS as part of a pump and deliver option.

Other data regarding the recharge and recovery, and reservoir storage is available from WESTCAPS.

CHAPTER II

DESCRIPTION OF POTENTIAL ALIGNMENTS

Five potential pipeline alignments were evaluated. Three are primary routes and two alignments are hybrids of Alignments 1 and 3 where the four "legs" of Alignments 1 and 3 meet at Miller Road (north of the Interstate I-10) by a substation. All of the options begin at the proposed WMC recovery zone/water tank on the northwest corner of Palo Verde Road (Sun Valley Parkway) and the west extension of Van Buren Road, and terminate at Sarival Road to the east. These five alignments are shown collectively on plan drawing Figure 1, and individually in Figures 2 through 6.

The following are descriptions of the primary alignments:

- **Alignment 1** – Traverses along the Buckeye-Salome Highway through the southern hills of the White Tank Mountains then along the Maricopa County Flood Control Dike to McDowell Road and east along McDowell Road to Sarival Road.
- **Alignment 2** – Traverses along the Interstate I-10 to Sarival Road.
- **Alignment 3** – Traverses along the Maricopa County Flood Control dike around the south terminus of the southern hills of the White Tank Mountains then east along Yuma Road to Sarival Road.

The following are descriptions of the hybrid alignments which are variations of Alignment 1 and Alignment 3 (Alignment 4 is a variation of Alignment 1, and Alignment 5 is a variation of Alignment 3.):

- **Alignment 4** – Traverses along the Buckeye-Salome Highway through the southern hills of the White Tank Mountains to Yuma Road then east along Yuma Road to Sarival Road.
- **Alignment 5** – Traverses along the Maricopa County Flood Control dike around the south terminus of the southern hills of the White Tank Mountains, then along the Maricopa County Flood Control Dike to McDowell Road, and finally along McDowell Road to Sarival Road.

Primary Alignments 1 and 3 were inspected by vehicle during a reconnaissance field trip on November 27, 2001. Narrative descriptions for these routes are provided. Narrative descriptions for the hybrid routes are borrowed from Alignments 1 and 3. Alignment 2 is described from a series of aerial photographs. Those aerial photos most descriptive of the project are included in this section of the report. Comparative advantages and disadvantages for each alignment follow.

2.1 Alignment 1

From the future recharge recovery site/water tank on the northwest corner of Palo Verde Road and the extension of Van Buren Road (elev. 1100), the alignment runs northwards on the east shoulder of Palo Verde Road to the 2-lane dirt Buckeye-Salome Highway (elev. 1143). From this point the trunkline runs southeastward along the south side of the Buckeye-Salome Highway gradually rising in elevation to a high point (elev. 1161) at the extension of Oglesby Road. The alignment then drops slightly (elev. 1153) as the pipeline approaches the foothills of the Blackhawk Mines Hills (unofficial name) and at the intersection of the high power lines. This area would be a potential storage or surge tank location.

The alignment continues along the southwest shoulder through the mountain pass. Excavation does not appear to be a major concern through the mountains as an (estimated) reasonable thickness of alluvium (alluvial fan /colluvium) should blanket the rock layer through the area. The dirt road is relatively planar (flat) and there are some homeowners along the south side of this reach to the Yuma Road intersection. From the Yuma Road intersection the alignment then bears northeast across the flats to around the north side of the electrical substation (North of Yuma Road on the Miller Road dirt extension, elev. 1102) where it connects to the O&M dirt road at the southside toe of the Maricopa County flood control dike.

From the trunkline on the Miller Road dirt extension, a lateral would be constructed and head south along the west shoulder, past the substation, and through an underpass at the I-10 interchange (see photograph 6). This lateral would extend 4.1 miles south to Baseline Road (terminus elev. 889) along the west shoulder of Miller Road. Most of the surrounding area is agriculture (cotton fields).

The main trunkline would continue eastward from Miller Road about 4 miles either between the flood control dike and a one- to two-lane O&M road, or on the south side of the O&M road approaching the dirt road extension of McDowell Road (highest point at elev. 1161). At this intersection (GPS elevation 1155, Lat. 33.46N/Long. 112.53W) the pipeline would traverse along the south side of McDowell Road (see photograph 4 on page 37). A 10 to 12 kV powerline runs NW-SE across the alignment and dike about ¼-mile south of McDowell Road.

The trunkline reach between the Miller Road substation and Watson Road extension was not inspected due to locked gates, but conditions appear to be similar from I-10. Future excavation should be relatively easy along the dike as unconsolidated alluvium and reworked dike and/or native soils exist, and undisturbed open desert space exists all the way to about the McDowell Road and Tuthill Road intersection.

At Tuthill Road and McDowell Road, a lateral line would be constructed along the west shoulder of Tuthill Road. A four-barrel box culvert and cattle underpass would allow easy pipeline access beneath I-10 (photograph 3). This lateral would extend 3 miles to Lower Buckeye Road at terminal elevation 967.

Continuing east along the south shoulder of McDowell Road (now a two-lane, paved road), the trunkline eventually intersects Jackrabbit Trail (195th Ave.). On the west side of Jackrabbit trail, there exists an approximate 30-foot wide concrete floodway extending N-S across McDowell Road (see photograph 2). The pipeline would require pipe jacking below the floodway, or installation using the cut-and-cover method. As a point of reference, several wells/water tanks owned by Arizona Water Co., one at Perryville Road and another ½ mile further east, and a 15Kv powerline, exist along the south side of McDowell Road.

Another lateral would be constructed from the trunkline heading south along the west side of Cotton Lane through an I-10 underpass. This lateral would be 3.24 miles long ending one-quarter mile south of Lower Buckeye Road at elevation 932 (at about Goodyear's 1 MGD tank). The trunk pipeline would continue east for one mile to its terminus at Sarival Road, elevation 1010 (see photo 1). The following are the listed advantages and disadvantages for Alignment 1.

Alignment 1 Advantages:

- Most of the alignment is relatively flat and traverses straight dirt roads.
- Most of the alignment traverses natural desert (open) space on one or both sides of the alignment and the majority of the alignment occurs along undeveloped areas.
- Excavation does not appear to be as big an obstacle as thought, and this includes the alignment through the Blackhawk Mines Hills.
- Power availability appears will be adequate as a number of existing powerlines cross the route.
- A good area for a storage/surge tank is in the saddle of the Blackhawk Mines Hills where the Buckeye-Salome Highway crosses under the high powerlines. Power is expected to be available.

Alignment 1 Disadvantages:

- Of the first four miles from Sun Valley Parkway (Palo Verde Road) and McDowell road, the alignment crosses State (first and third sections) and BLM (Blackhawk Mines Hills areas) land.

- Along much of the Buckeye-Salome Highway reach, the trunkline alignment could interfere with SPRINT fiber-optic easement (1-800-521-0579) if installed on the north side of the highway shoulder.
- There are some existing residents along the south side of the Buckeye-Salome Highway in the flats between the Blackhawk Mines Hills and Yuma Road who may be disrupted by potential pipeline construction.
- Minor booster pumping may be necessary at several locations along the trunkline such as the virtual intersection of Buckeye-Salome Highway and a line extending along Oglesby Road.
- Alignment 1 would require the longest laterals.

2.2 Alignment 2

This alignment is described with a series of aerial photographs panning from the Hassayampa River eastward to Sarival Road.

From the recharge recovery site/water tank location at the northwest corner of Palo Verde Road and the extension of Van Buren Road (elev. 1100), the alignment runs southwards on the west shoulder of Palo Verde Road towards the I-10 interchange dropping about 20 feet as it crosses under the Palo Verde Road overpass and I-10 at about elevation 1063. The pipeline would most likely have to be pipejacked so I-10 traffic would be unaffected. On the south side of I-10, the alignment would turn east and run along the south side shoulder of I-10 and along the south bifurcation of I-10 (east of Wilson Avenue past Turner Road) between along an easement. One to two miles east of Palo Verde Road (at Wilson Avenue and Turner Road), the land use from I-10 to the south is undeveloped desert, albeit still private property. Another option is to run the alignment between the east and westbound lanes.

Excavation in alluvial fan soils should not be a major problem. It is expected the excavation would be by common methods. The alluvial fan materials are typically gravelly sands with silt, clay, and cobbles, and can range from unconsolidated to strongly calcium-carbonate cemented (caliche). This deposit was shed from the White Tank range. The surface is dissected by south flowing washes some of which could require cross-drainage. Further to the east, the fan deposits are interfingered with finer-grained basin-fill type sediments, which would lead one to believe that the alluvium is probably thicker in this area.

Constructing a pipeline through the I-10/AZ-85 (Oglesby Road) interchange (interchange 112) does not appear would be particularly problematic. Aerial photo P22E2_4 shows a disturbed swath on the south side of the interchange. The pipeline would swing around either the south side of the overpass (most likely) or underneath the overpass. The alignment would have to cross the I-10 eastbound off-ramp to Oglesby Road, and also the Oglesby Road on-ramp.

As the alignment continues along the I-10 easement eastward, and follows the eastbound off-ramp, at the Miller Road intersection, the Miller Road lateral traverses south.

A lateral would be constructed from the Alignment 2 trunkline traversing south on the west shoulder of Miller Road (five miles from the beginning of line (BOL)). This lateral extends 3.8 miles due south to Baseline Road (elev. 889). As shown on aerial photo P54NE6_6, the first mile south of I-10 is mostly undeveloped, then the remainder of the lateral traverses mostly along cotton fields. Some urbanization exists 3 miles south of I-10 on the west side of Miller Road (see aerial photograph P31N4_7).

The Alignment 2 main trunkline continues east from Miller Road along the south easement of I-10. Undeveloped desert exists on the south side of I-10 to about the Tuthill Road intersection. From this area, the corridor east along Interstate 10 becomes more urbanized. Soil material in this area is composed of less alluvial fan and more basin-fill (finer grained) alluvial materials, which makes excavation and backfilling less challenging.

At the intersection of Tuthill Road and I-10 (elev. 1086), a lateral line would be constructed along the west shoulder of Tuthill Road. This lateral extends 2.8 miles south to Lower Buckeye Road at its terminal elevation of 967. Tuthill Road is relatively undeveloped, although the mile south of Roosevelt Irrigation District Canal (RID) is urbanized on the west side (see aerial photograph P42N5_3). The lateral would require crossing the RID canal.

Traversing east along the south shoulder of I-10 from Tuthill Road (the first mile is State trust land), the trunkline would either pass across the Jackrabbit Trail underpass by pipejacking below Jackrabbit Trail, or possibly along the eastbound off- and on-ramp roads (see aerial photo P14E1_1). The main trunkline continues east on I-10 along the south easement, toward the underpass on Perryville Road, and again toward the next underpass and lateral at Cotton Lane. Particularly toward the south side of I-10, between Jackrabbit Trail and Citrus Road, the land has become and is becoming urbanized.

The Cotton Lane lateral veers south along the west side of Cotton Lane (elev. 1014), across the RID which is 0.21 miles south of I-10, and terminates about 3 miles later, ending one-quarter mile south of Lower Buckeye Road (at about Goodyear's 1 MGD tank, elev. 932). An irrigation ditch is located on the south side of Yuma Road. The ditch is about one-quarter mile long from Cotton Lane back toward the west. A small canal is located on the north side of Yuma Road beginning just east of Cotton road and extending eastward about 2500 feet.

The Alignment 2 trunkline would continue east along the south easement of I-10 to its terminus at the Sarival Road (elev. 1000).

Alignment 2 Advantages:

- Most of the alignment is relatively flat.
- Most of the alignment is along undeveloped desert or farm fields on one or both sides.
- Earthen conditions should be relatively uniform with respect to excavation.
- The access to power is adequate in the area.
- Shorter laterals along Miller, Tuthill, and Cotton Lane Roads would lessen construction costs compared to Alignments 1 and 5.
- The line-of-site is favorable for construction.

Alignment 2 Disadvantages:

- Construction would involve having the main trunkline cross five underpasses.
- The I-10/AZ-85 (Oglesby Road) interchange would be costly and could be disruptive to interstate traffic.
- Working in the easement close to the interstate could be challenging due to safety concerns, disruptions, etc.
- Mixed land ownership exists along Interstate 10. This would eventually involve dealing with more entities.

2.3 Alignment 3

From the recharge recovery site/water tank location on the northwest corner of Palo Verde Road and the extension of Van Buren Road (elev. 1100), the alignment runs southward on the east shoulder of Palo Verde Road towards the I-10 interchange at elevation 1065 (photograph 7). Several hundred feet north of the interchange, the alignment would turn and veers southeastward along the north side (north dike toe) of the Maricopa County flood control dike about two miles eastward to some point east of the Turner Road extension near the west terminus of the Blackhawk Mines Hills (elev. 1090).

Earthwork conditions appear would not be a challenge on either side of the dike since a thin veneer of alluvium (alluvial fan /valley fill/colluvium) appear from I-10 and blankets the rock along the south toe of the Blackhawk Mine Hills. The alluvium along the dike alignment west of the Blackhawk Mines Hills is probably thicker with fan deposits interfingered with finer-grained basin-fill type sediments. These alluvial units are probably variably caliche cemented, but it is expected most excavation would be by common methods. The O&M dirt road on the south side of the dike is relatively planar. Four miles from the beginning of the line, the pipeline traverses east of the Rooks Road extension northeast across the flats where it intersects the gravel surfaced west terminus of Yuma Road.

A tee is constructed from this trunkline for the Miller Road lateral (five miles from the BOL) heading south on the west shoulder and through an underpass at the I-10 interchange. This lateral would extend nearly 4 miles due south to Baseline Road (elev. 889) along the west shoulder of Miller Road. Most of the surrounding area is cotton fields.

The main trunkline would continue due east between elevations 1100 to 1080 along the south shoulder of Yuma Road. At about the Miller Road intersection, Yuma Road becomes a two-lane asphalt road.

Other agencies and entities are developing the area and constructing pipelines along the proposed route. About one-half mile east of Apache Road (Cemetery Road extension) to Watson Road (elev. 1079 to 1070), steel pipe is stockpiled along the south shoulder of Yuma Road. It appears this is for a waterline. This pipe may be installed where the WMC trunkline may need to be buried. The steel pipe appears is being installed from Watson Road to Dean Road (elev. 1040, see photograph 8). Undeveloped desert exists on both sides of the road to about the Tuthill road intersection and earthwork should not be a big challenge in the unconsolidated alluvium.

At Tuthill Road and Yuma Road (elev. 1007), a lateral line is planned along the west shoulder of Tuthill Road. This lateral extends 1 mile south to Lower Buckeye Road at its terminal elevation of 967.

Continuing east along the south shoulder of Yuma Road (a two-lane, paved road with a powerline along it on the south and cotton fields on both sides), the trunkline could encounter a gas line at the Perryville Road intersection (elev. 980) as a gas line marker was seen from the road. Two miles further east, the trunkline connects to another lateral. This pipe lateral would provide water south along the west side of Cotton Lane (elev. 965) about 1.25 miles ending one-quarter mile south of Lower Buckeye Road (at about Goodyear's 1 MGD tank, elevation 932). At this location an irrigation ditch exists on the south side of Yuma Road about one-quarter of a mile long from Cotton Lane going back toward the west. A small canal is located on the north side of Yuma Road just east of Cotton road and extending eastward about 2500 feet. The trunkline reaches its terminus at Sarival Road (elev. 970) as shown in photograph 9.

Alignment 3 Advantages:

- Most of the alignment is relatively flat and traverses along straight dirt roads.
- Most of the alignment is adjacent to natural desert (open) or cotton field space on one or both sides.
- Earthwork does not appear challenging.
- Power availability is adequate as a number of existing powerlines cross along Yuma Road.
- Laterals along Miller, Tuthill, and Cotton Lane Roads are shorter than they would be for Alignment 1 and without multiple Interstate 10 underpasses.
- Compared to having several booster pumps in Alignment 1, this option may require only one pressure booster pumping plant since most of the alignment (except for the first eight miles) is downhill gravity flow. Thus, capital costs for boosters is less expensive.

Alignment 3 Disadvantages:

- The pipeline between Palo Verde Road and the Turner extension (on the north side of the flood control dike) would traverse through a large flood detention basin of the COE's right-of-way and BLM's (Blackhawk Mines Hills areas) land. Special provisions for pipeline flood protection may be required as part of the installation designs.
- Along much of Yuma Road, the trunkline could interfere with newly installed (or soon to be installed) pipeline. There is a gas line easement crossing the route at Perryville Road which would require a careful bypass.
- There is a new development or subdivision along the south side of Yuma Road between Cotton Lane and Sarival. Replacement of roadways and utility crossings through this area will be an additional cost. Disruption to area residents will also be a factor.
- The top of the first service delivery area (WPA 92) is at elevation 1090. This may require an additional lateral booster to meet minimum domestic pressure.

2.4 Alignment 4

From the recharge recovery site/water tank location (elev. 1100), Alignment 4 runs northward on the east shoulder of Palo Verde Road, to the 2-lane dirt Buckeye-Salome Highway (elev. 1143). The trunkline continues southeastwards and parallels the south side of the Buckeye-Salome Highway, gradually rising in elevation to a high point (elev.

1161) at the extension of Oglesby Road. This area could be the location of a future storage or surge tank. The pipeline drops to elevation 1153 as it approaches the foothills of the Blackhawk Mines Hills (unofficial name) and where it intersects the high-tension powerlines. Alignment 4 continues along the Tonopah-Salome Highway on the southwest shoulder through the mountain pass.

Earthwork through the mountain pass does not appear would be very challenging since a reasonable thickness of alluvium (alluvial fan /colluvium) is deep enough for a pipe trench. The dirt road is relatively planar and some residential housing currently exists along the south side of this reach to the Yuma Road intersection. Alignment 4 then bears east along Yuma Road.

A lateral is planned from the trunkline at the intersection of Miller Road and Yuma Road. The lateral would parallel Miller Road as it heads south on the west shoulder across the Interstate 10 underpass. This lateral extends 4.0 miles to Baseline Road (terminus elev. 889). Most of the surrounding area is cotton fields.

The main trunkline continues due east, between elevations 1100 to 1080, along the south shoulder of Yuma Road. At approximately the Miller Road intersection heading east, Yuma Road becomes a two-lane asphalt road. About one-half mile east of Apache Road (Cemetery Road extension) to Watson Road (elev. 1079 to 1070), steel pipe is stockpiled along the south shoulder of Yuma Road. It appears this is for a waterline. This pipe may be installed where the WMC trunkline may need to be buried. The steel pipe appears is being installed from Watson Road to Dean Road (elev. 1040, see photograph 8). Undeveloped desert exists on both sides of the road to about the Tuthill road intersection and earthwork should not be a big challenge in the unconsolidated alluvium.

At Tuthill Road and Yuma Road (elev. 1007), a lateral line is planned along the west shoulder of Tuthill Road. This lateral would extend 1 mile south to Lower Buckeye Road at its terminal elevation of 967.

Yuma Road is a two-lane, paved road with a powerline along the south and cotton fields on both sides. The trunkline traverses east along the south shoulder of Yuma Road and could encounter a gas line at the Perryville Road intersection (elev. 980) as a gas line marker was seen from the road.

Two miles further east another lateral is planned. This lateral traverses south along the west side of Cotton Lane (elev. 965) about 1.25 miles ending one-quarter mile south of Lower Buckeye Road (at about Goodyear's 1 MGD tank, elevation 932). An irrigation ditch is located on the south side of Yuma Road. A small canal is present on the north side of Yuma Road just east of Cotton road and extending eastward about 2500 feet. The trunkline continue to its terminus at Sarival Road (elev. 970) as shown in photograph 9.

Alignment 4 Advantages:

- Most of the alignment is relatively flat and along straight dirt roads.
- Most of the alignment is adjacent to natural desert (open) space on one or both sides of the road. The majority of the alignment occurs along undeveloped areas.
- Earthwork does not appear would be a big challenge and this includes the alignment through the Blackhawk Mines Hills.
- Power availability should be adequate as power exists in the area.
- An ideal area for a storage/surge tank occurs in the saddle of the Blackhawk Mines Hills where the Buckeye-Salome Highway crosses under the high powerlines. Adequate power would be available for the storage/surge tank in this area.
- Compared to having several booster pumps in Alignment 5, this option may require only one pressure booster pumping plant since most of the alignment (except for the first eight miles) is downhill gravity flow. Thus, capital costs for boosters is less expensive.
- The Tuthill and Cotton Lane laterals are shorter than the alternative Alignment 5. In addition, they would not have to extend through underpasses at Interstate 10.

Alignment 4 Disadvantages:

- For the first four miles from Sun Valley Parkway (Palo Verde Road) and extension of McDowell Road, the alignment crosses State (first and third sections) and BLM (Blackhawk Mines Hills areas) parcels.
- Along much of the Buckeye-Salome Highway reach, the trunkline alignment could interfere with SPRINT fiber-optic cable (1-800-521-0579) if the WMC pipeline is installed on the north side of the highway shoulder.
- Existing residents along the south side of the Buckeye-Salome Highway in the flats between the Blackhawk Mines Hills and Yuma Road may experience some construction disruption.
- Along much of Yuma Road, the trunkline alignment could interfere with newly installed (or soon to be installed) pipeline easements. A gas line crossing the route at Perryville Road would have to be bypassed.
- There is a new development or subdivision along the south side of Yuma Road between Cotton Lane and Sarival. Replacement of roadways and utility crossings through this area will be an additional cost. Disruption to area residents will also be a factor.
- The top of the first service delivery area (WPA 92) is at elevation 1090. This may require an additional lateral booster to meet minimum domestic pressure.

2.5 Alignment 5

From the recharge recovery site/water tank location (elev. 1100), Alignment 5 runs southward on the east shoulder of Palo Verde Road, towards the I-10 interchange at elevation 1065 (see photograph 7). Several hundred feet north of the interchange the alignment would turn and traverse southeastward along the north side (north dike toe) of the Maricopa County flood control dike for two miles. This location is at Turner Road extension near the west terminus of the Blackhawk Mines Hills (elev. 1090).

Earthwork does not appear would be a challenge in this area since a thin veneer of alluvium (alluvial fan /valley fill/colluvium) is present from I-10 to along the southwest toe of the Blackhawk Mine Hills. The alluvium along the dike alignment west of the Blackhawk Mines Hills is probably thicker with fan deposits interfingered with finer-grained basin-fill type sediments. These alluvial units are probably variably caliche cemented, but it is expected most excavation would be by common methods. The O&M dirt road on the south side of the dike is relatively planar.

The alignment traverses east of Rooks Road extension (four miles from the beginning of the line) to where it crosses the gravel surfaced, west terminus of Yuma Road, then continues northeast across the flats and around the north side of the electrical substation (North of Yuma Road and north of I-10 on the Miller Road dirt extension, elev. 1102). Here the alignment connects to the O&M dirt road at the southside toe of the Maricopa County flood control dike.

A lateral is planned from the trunkline on the Miller Road dirt extension, and heads south on the west shoulder, past the substation, and through an underpass at the I-10 interchange (photograph 6). This lateral extends 4.1 miles south to Baseline Road (terminus elev. 889) along the west shoulder of Miller Road. Most of the surrounding area is cotton fields.

From Miller Road the main trunkline heads eastward about 4 miles between the flood control dike, a one- to two-lane O&M road, or the south side of the O&M road approaching the dirt road extension of McDowell Road (highest point at elev. 1161). At the intersection of the flood control dike and McDowell Road (GPS elevation 1155, Lat. 33.46N/Long. 112.53W) the pipeline would traverse along the south side of McDowell Road (photograph 4). A 10 to 12 Kv powerline runs NW-SE across the alignment and dike about ¼-mile south of McDowell Road.

The trunkline reach between the Miller Road substation and Watson Road extension was not inspected due to locked gates. Conditions along the dike alignment appear to pose no outstanding construction issues, as determined by observations from I-10. Earthwork should not be challenging along the dike as unconsolidated alluvium and reworked dike and/or native soils exist. Undisturbed desert exists adjacent to about the McDowell Road and Tuthill Road intersection.

At Tuthill Road and McDowell Road, a lateral line would be constructed along the west shoulder of Tuthill Road. A four-barrel box culvert and cattle underpass would allow easy pipeline access beneath I-10 (photograph 3). This lateral would extend 3 miles to Lower Buckeye Road at terminal elevation 967.

As the pipeline continues east along the south shoulder of McDowell Road (a two-lane paved road), the trunkline intersects with Jackrabbit Trail (195th Ave.). An approximate 30-foot wide concrete floodway at Jackrabbit Trail (195th Ave.) is present extending N-S across McDowell Road (photograph 2). The pipeline would need to be pipejacked below the floodway or installed using the cut-and-cover method. Several wells/water tanks owned by Arizona Water Co. are located along McDowell Road, one at Perryville Road and another ½ mile further east. A 15Kv powerline exists along the south side of McDowell Road.

Another lateral is planned traversing south along the west side of Cotton Lane through an I-10 underpass. This lateral would be about 3.25 miles long ending one-quarter mile south of Lower Buckeye Road at elevation 932 (at about Goodyear's 1 MGD tank.). The trunk pipeline would continue east for one mile to its terminus at Sarival Road, elevation 1010 (photograph 1).

Alignment 5 Advantages:

- Most of the alignment is relatively flat and along straight dirt roads.
- Most of the alignment is adjacent to natural desert on one or both sides and the road. The majority of the alignment occurs along undeveloped areas.
- Power availability should be adequate as power exists in the area.
- Unlike Alternative 4 where much of the trunkline alignment along Yuma Road could interfere with new pipe (or soon to be installed pipe) and a gas line at Perryville Road, this option is mostly along undeveloped areas.

Alignment 5 Disadvantages:

- For the first four miles from Sun Valley Parkway (Palo Verde Road) and the apparent extension of McDowell Road, the alignment crosses State (first and third sections) and BLM (Blackhawk Mines Hills areas) parcels.
- Compared to one booster plant in hybrid Alignment 4, this option may require several pressure booster-pumping plants. Thus, capital costs may be higher as more equipment is needed.
- There is a new development or subdivision along the south side of Yuma Road between Cotton Lane and Sarival. Replacement of roadways and utility crossings through this area will be an additional cost. Disruption to area residents will also be a factor.
- The top of the first service delivery area (WPA 92) is at elevation 1090. This may require an additional lateral booster to meet minimum domestic pressure.
- The Tuthill and Cotton Lane laterals would be longer for this alignment than for Alternative 4 and would have to extend through the underpasses along Interstate10.

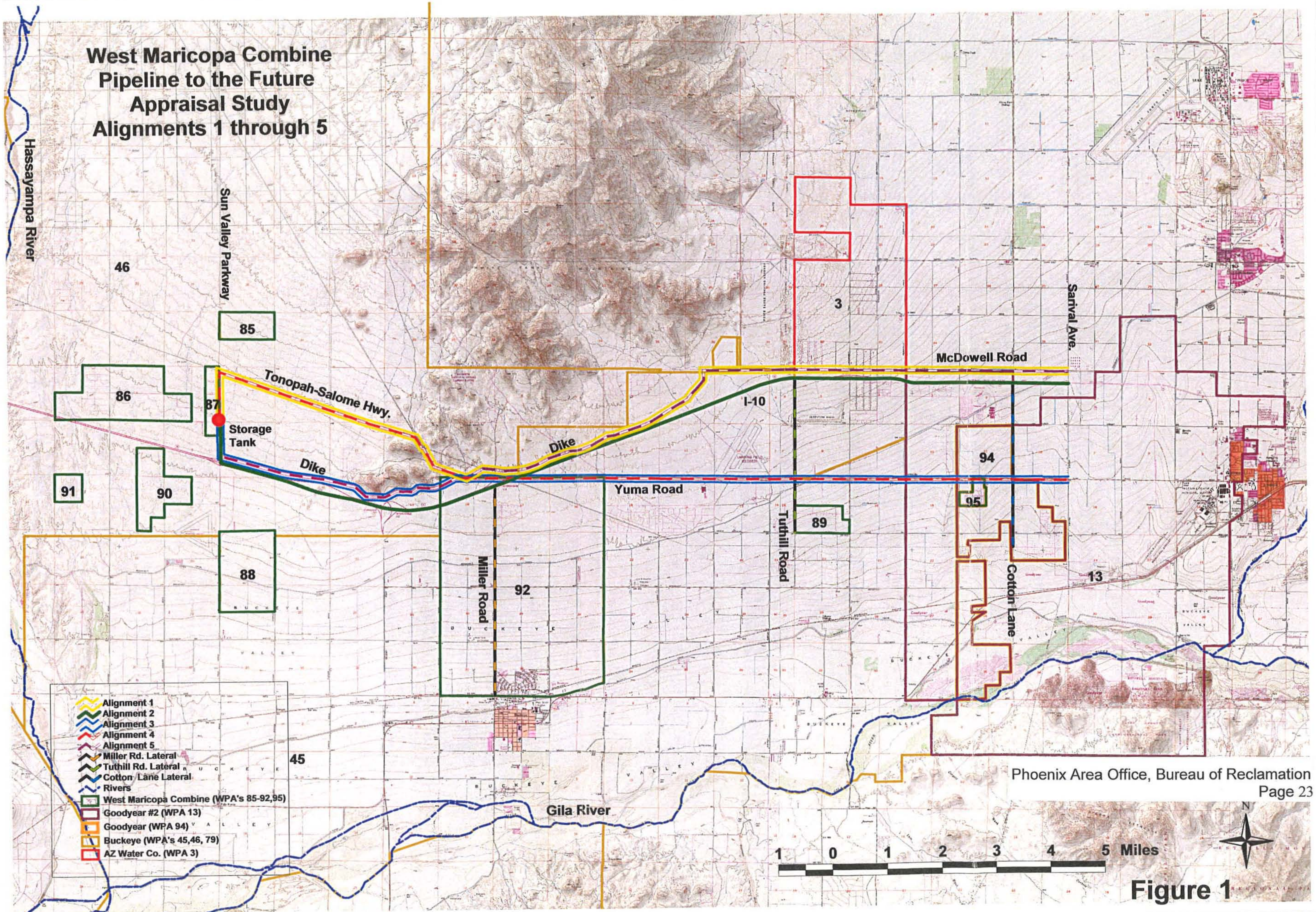


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Figure 1

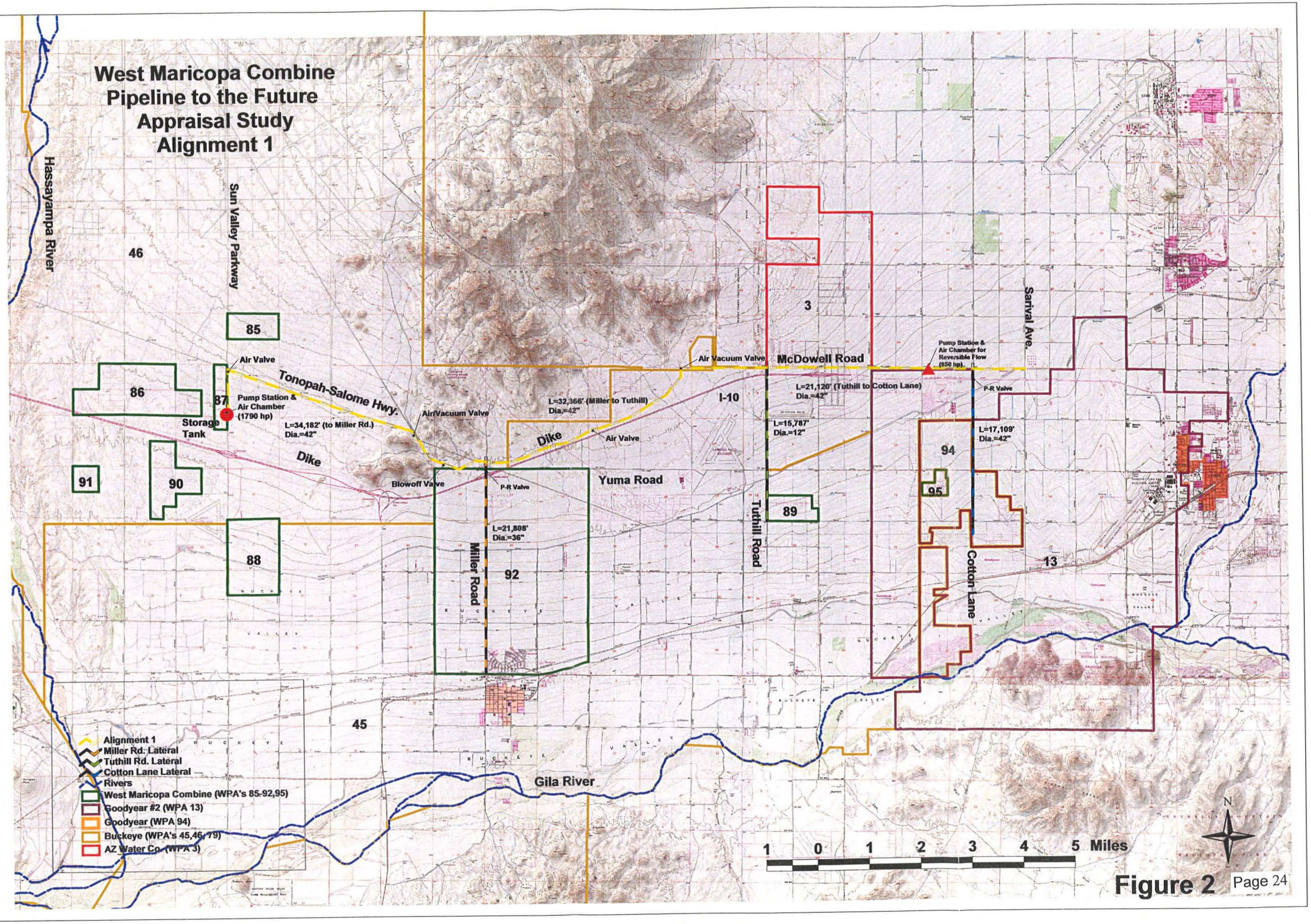

West Maricopa Combine
Pipeline to the Future
Appraisal Study
Alignment 1
Hassayampa River
Sun Valley Parkway
46
85
86
87
Air Valve
Tonopah-Salome Hwy.
Pump Station &
Air Chamber
(1790 hp)
Storage
Tank
L=34,182' (to Miller Rd.)
Dia.=42"
Dike
Air/Vacuum Valve
L=32,366' (Miller to Tuthill)
Dia.=42"
Air Vacuum Valve
McDowell Road
Pump Station &
Air Chamber for
Reversible Flow
(850 hp)
Sarival Ave.
3
I-10
L=21,120' (Tuthill to Cotton Lane)
Dia.=42"
P-R Valve
L=15,787'
Dia.=12"
Air Valve
L=17,109'
Dia.=42"
94
95
91
90
Blowoff Valve
P-R Valve
Yuma Road
89
L=21,808'
Dia.=36"
88
Miller Road
92
Tuthill Road
Cotton Lane
13
45
Gila River
Alignment 1
Miller Rd. Lateral
Tuthill Rd. Lateral
Cotton Lane Lateral
Rivers
West Maricopa Combine (WPA's 85-92,95)
Goodyear #2 (WPA 13)
Goodyear (WPA 94)
Buckeye (WPA's 45,46,79)
AZ Water Co. (WPA 3)
1 0 1 2 3 4 5 Miles
N

Figure 2

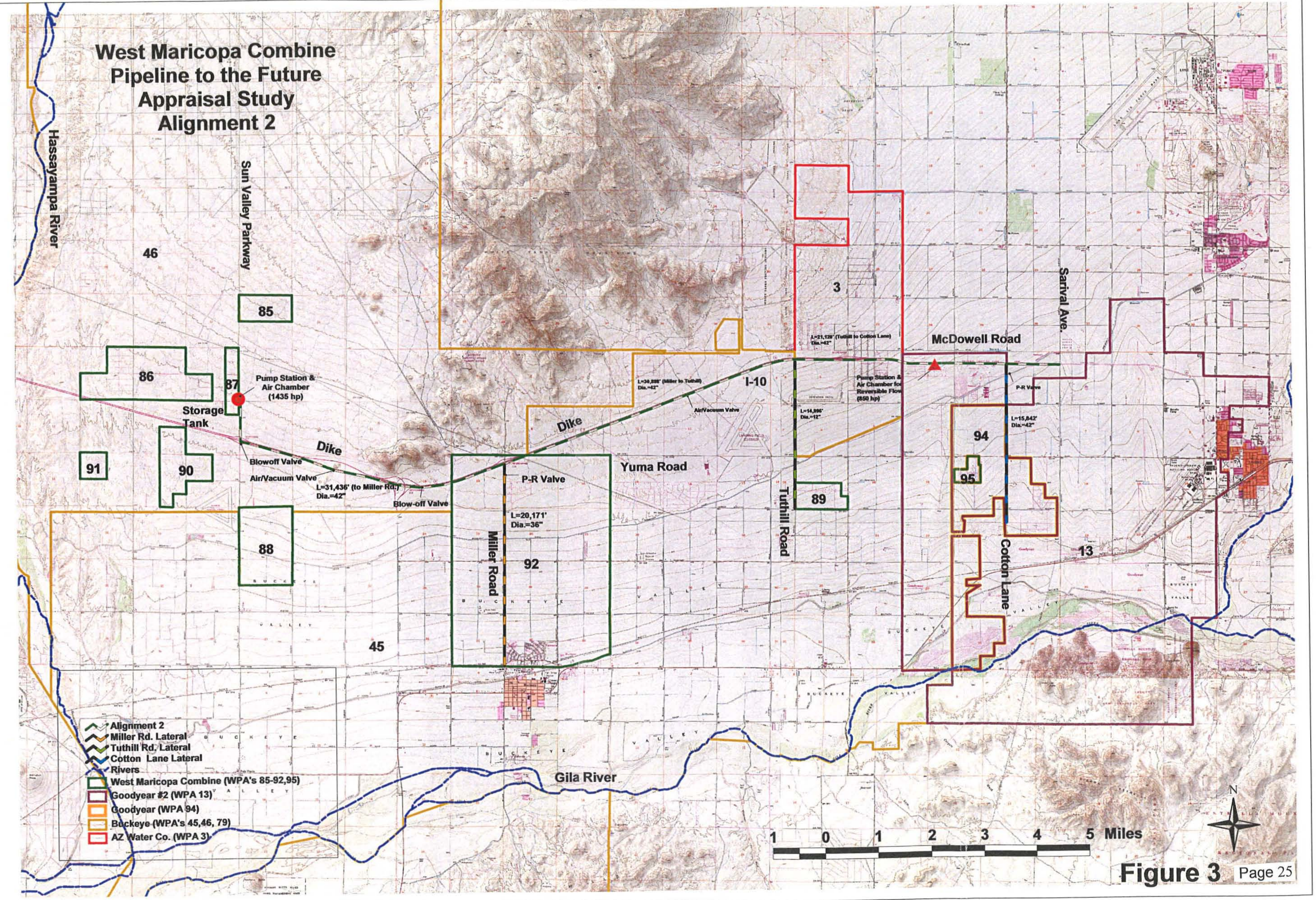

West Maricopa Combine
Pipeline to the Future
Appraisal Study
Alignment 2
Hassayampa River
Sun Valley Parkway
46
85
86
87
Pump Station & Air Chamber (1435 hp)
Storage Tank
Dike
Blowoff Valve
Air/Vacuum Valve
L=31,436' (to Miller Rd.) Dia.=42"
Blow-off Valve
91
90
88
45
P-R Valve
L=20,171' Dia.=36"
Miller Road
92
Dike
L=30,898' (Miller to Tuthill) Dia.=42"
Air/Vacuum Valve
I-10
Yuma Road
L=14,996' Dia.=12"
Tuthill Road
89
3
L=21,128' (Tuthill to Cotton Lane) Dia.=42"
McDowell Road
Pump Station & Air Chamber for Reversible Flow (850 hp)
P-R Valve
L=15,842' Dia.=42"
94
95
Cotton Lane
Sarival Ave.
13
Gila River
Alignment 2
Miller Rd. Lateral
Tuthill Rd. Lateral
Cotton Lane Lateral
Rivers
West Maricopa Combine (WPA's 85-92,95)
Goodyear #2 (WPA 13)
Goodyear (WPA 94)
Buckeye (WPA's 45,46, 79)
AZ Water Co. (WPA 3)
1 0 1 2 3 4 5 Miles
N

Figure 3

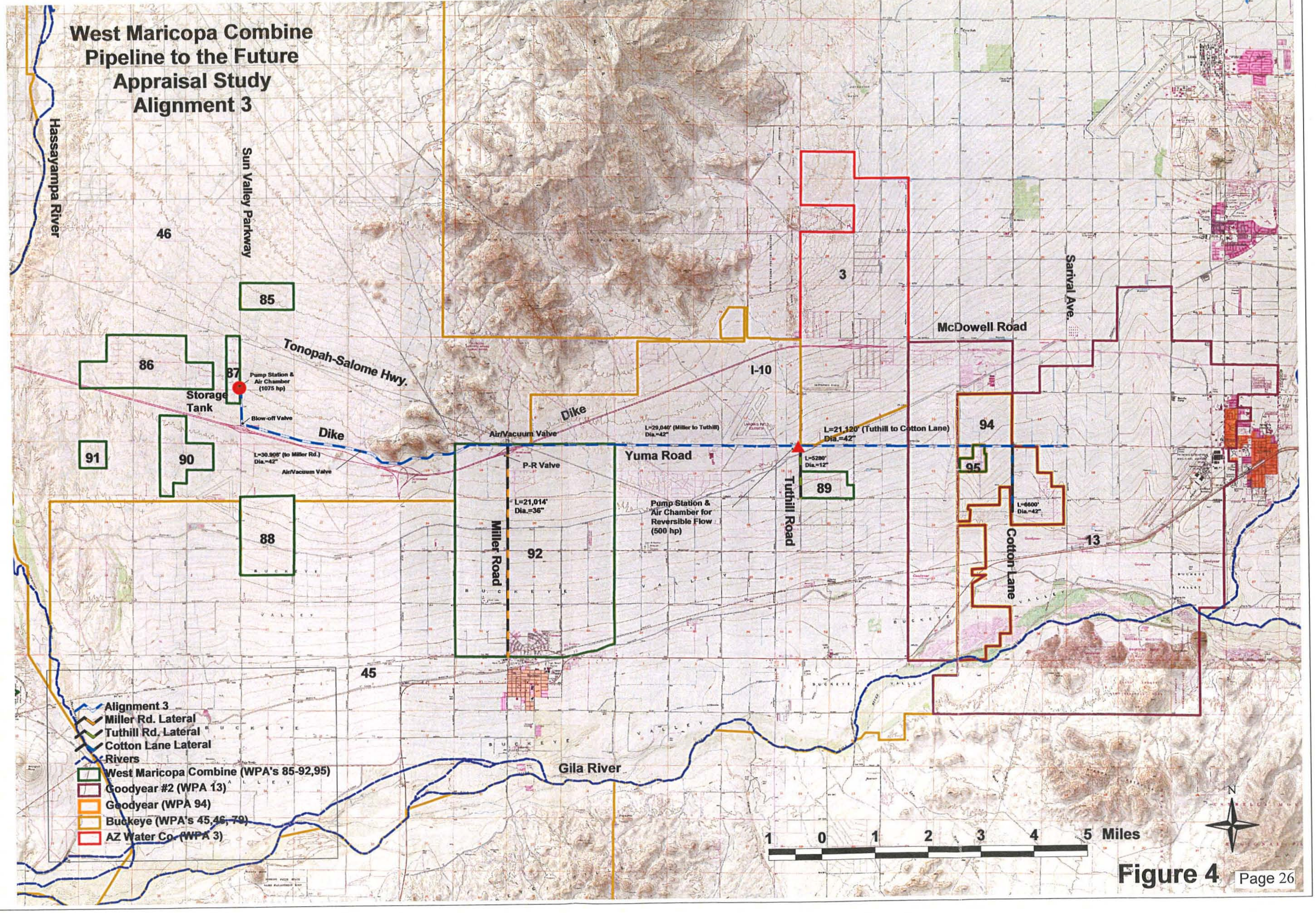
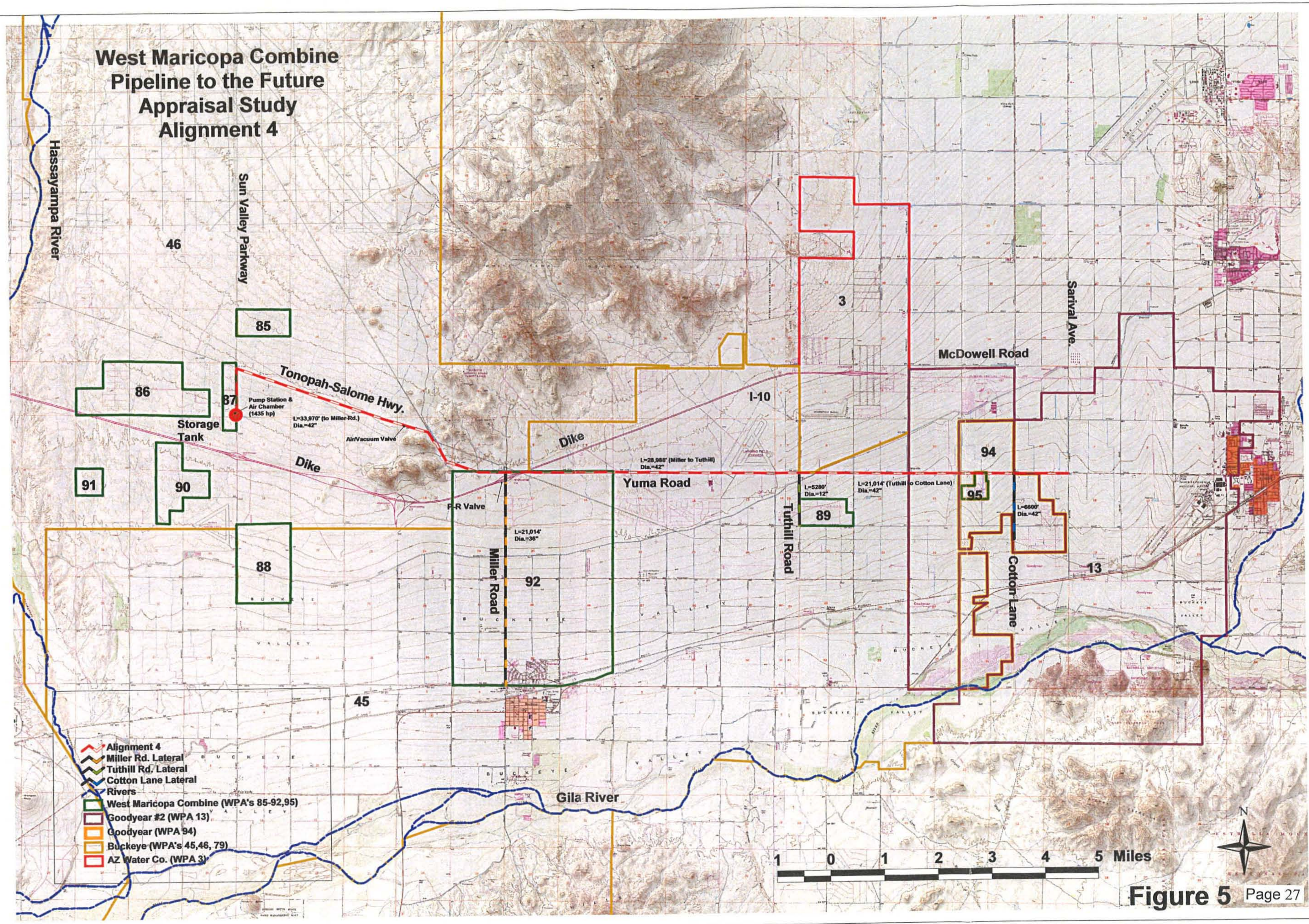
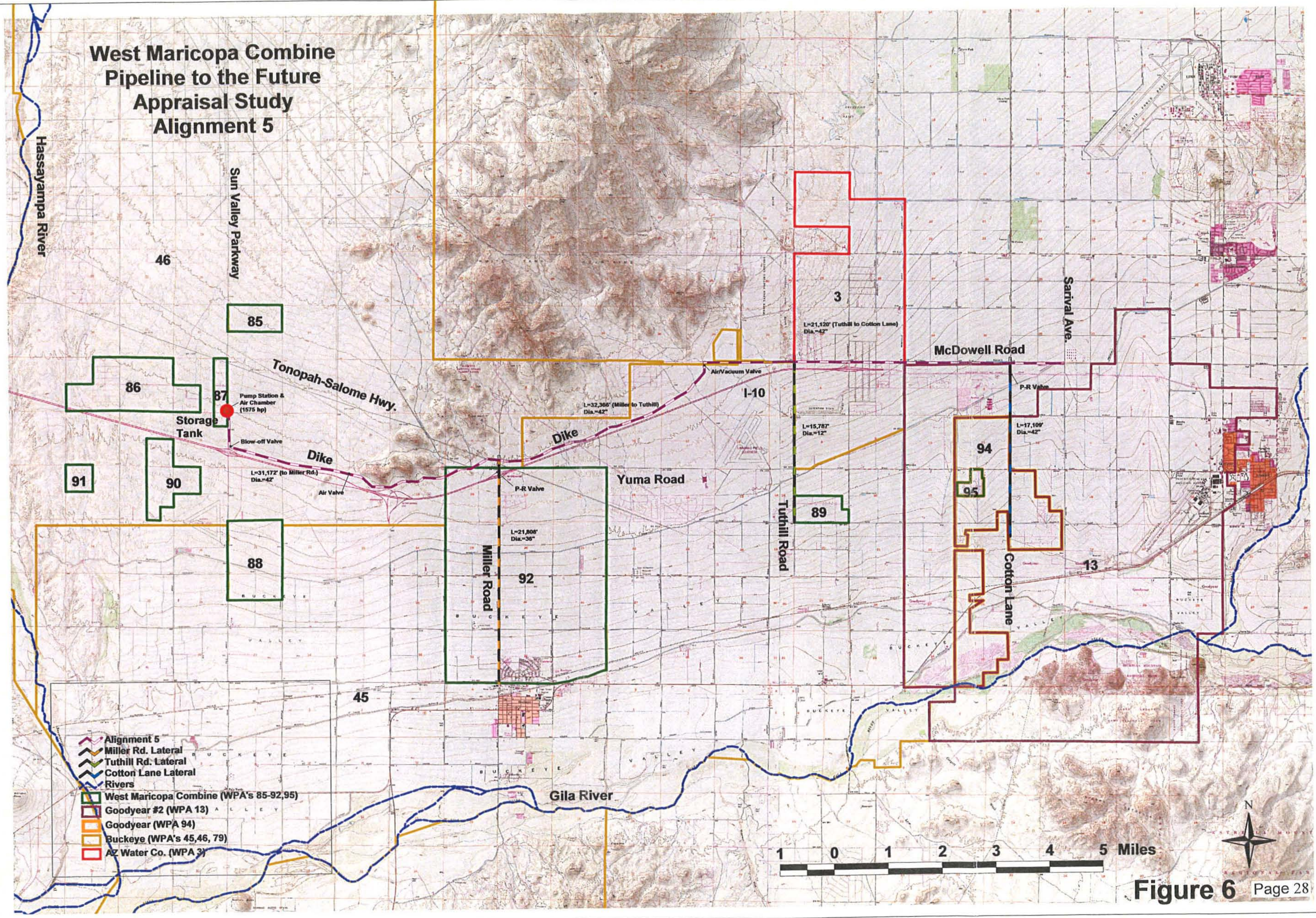

West Maricopa Combine
Pipeline to the Future
Appraisal Study
Alignment 3
Hassayampa River
Sun Valley Parkway
46
85
86
87
Pump Station & Air Chamber (1075 hp)
Storage Tank
Blow-off Valve
Tonopah-Salome Hwy.
Dike
L=30,908' (to Miller Rd.) Dia.=42"
Air/Vacuum Valve
91
90
88
Air/Vacuum Valve
P-R Valve
L=21,014' Dia.=36"
Miller Road
92
Dike
I-10
L=29,040' (Miller to Tuthill) Dia.=42"
Yuma Road
Pump Station & Air Chamber for Reversible Flow (500 hp)
3
L=21,120' (Tuthill to Cotton Lane) Dia.=42"
L=5280' Dia.=12"
Tuthill Road
89
McDowell Road
Sarival Ave.
94
95
L=6600' Dia.=42"
Cotton Lane
13
45
Gila River
Alignment 3
Miller Rd. Lateral
Tuthill Rd. Lateral
Cotton Lane Lateral
Rivers
West Maricopa Combine (WPA's 85-92,95)
Goodyear #2 (WPA 13)
Goodyear (WPA 94)
Buckeye (WPA's 45,46,79)
AZ Water Co. (WPA 3)
1 0 1 2 3 4 5 Miles
N

Figure 4



West Maricopa Combine
Pipeline to the Future
Appraisal Study
Alignment 4
Hassayampa River
Sun Valley Parkway
46
85
86
87
Storage Tank
Pump Station & Air Chamber (1435 hp)
Tonopah-Salome Hwy.
L=33,970' (to Miller Rd.) Dia.=42"
Air/Vacuum Valve
Dike
91
90
88
P-R Valve
L=21,014' Dia.=36"
Miller Road
92
45
Dike
I-10
3
L=28,988' (Miller to Tuthill) Dia.=42"
Yuma Road
L=5280' Dia.=12"
89
Tuthill Road
L=21,014' (Tuthill to Cotton Lane) Dia.=42"
McDowell Road
Sarival Ave.
94
95
L=6600' Dia.=42"
Cotton Lane
13
Gila River
Alignment 4
Miller Rd. Lateral
Tuthill Rd. Lateral
Cotton Lane Lateral
Rivers
West Maricopa Combine (WPA's 85-92,95)
Goodyear #2 (WPA 13)
Goodyear (WPA 94)
Buckeye (WPA's 45,46, 79)
AZ Water Co. (WPA 3)
1 0 1 2 3 4 5 Miles
N

Figure 5



West Maricopa Combine
Pipeline to the Future
Appraisal Study
Alignment 5
Hassayampa River
Sun Valley Parkway
46
85
86
87
Pump Station & Air Chamber (1575 hp)
Storage Tank
Blow-off Valve
Tonopah-Salome Hwy.
Dike
L=31,172' (to Miller Rd.) Dia.=42"
Air Valve
91
90
88
P-R Valve
L=21,808' Dia.=36"
Miller Road
92
Dike
L=32,366' (Miller to Tuthill) Dia.=42"
Air/Vacuum Valve
I-10
Yuma Road
3
L=21,120' (Tuthill to Cotton Lane) Dia.=42"
L=15,787' Dia.=12"
89
Tuthill Road
McDowell Road
Sarival Ave.
P-R Valve
L=17,109' Dia.=42"
94
95
Cotton Lane
13
45
Gila River
Alignment 5
Miller Rd. Lateral
Tuthill Rd. Lateral
Cotton Lane Lateral
Rivers
West Maricopa Combine (WPA's 85-92,95)
Goodyear #2 (WPA 13)
Goodyear (WPA 94)
Buckeye (WPA's 45,46, 79)
AZ Water Co. (WPA 3)
1 0 1 2 3 4 5 Miles
N

Figure 6

Figure AP A-1A

Alignment 1
From Recovery Storage Site along Tonopah-Salome HWY and McDowell Road to Sarival Road

West Maricopa Combine, WESTCAPS

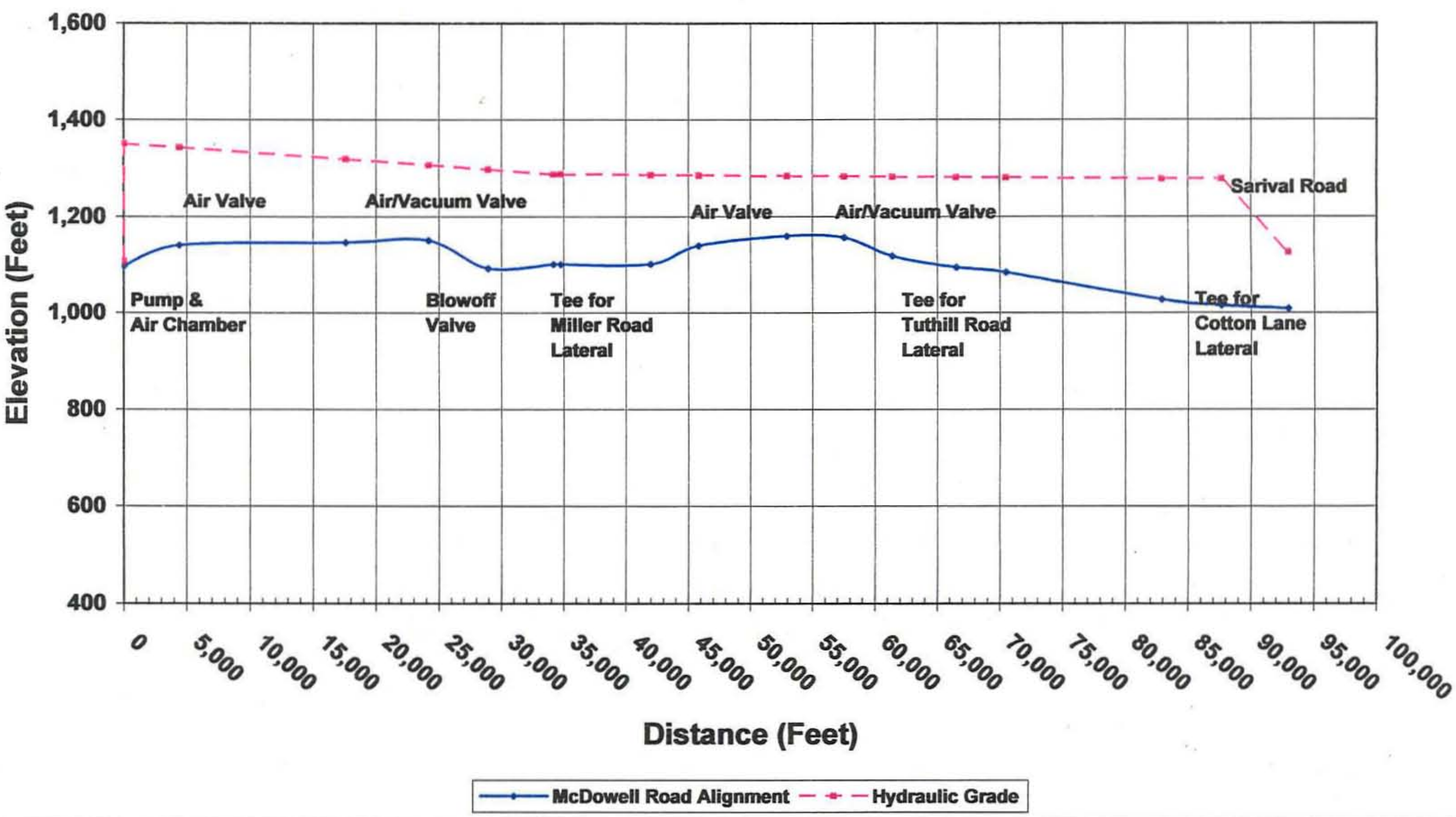
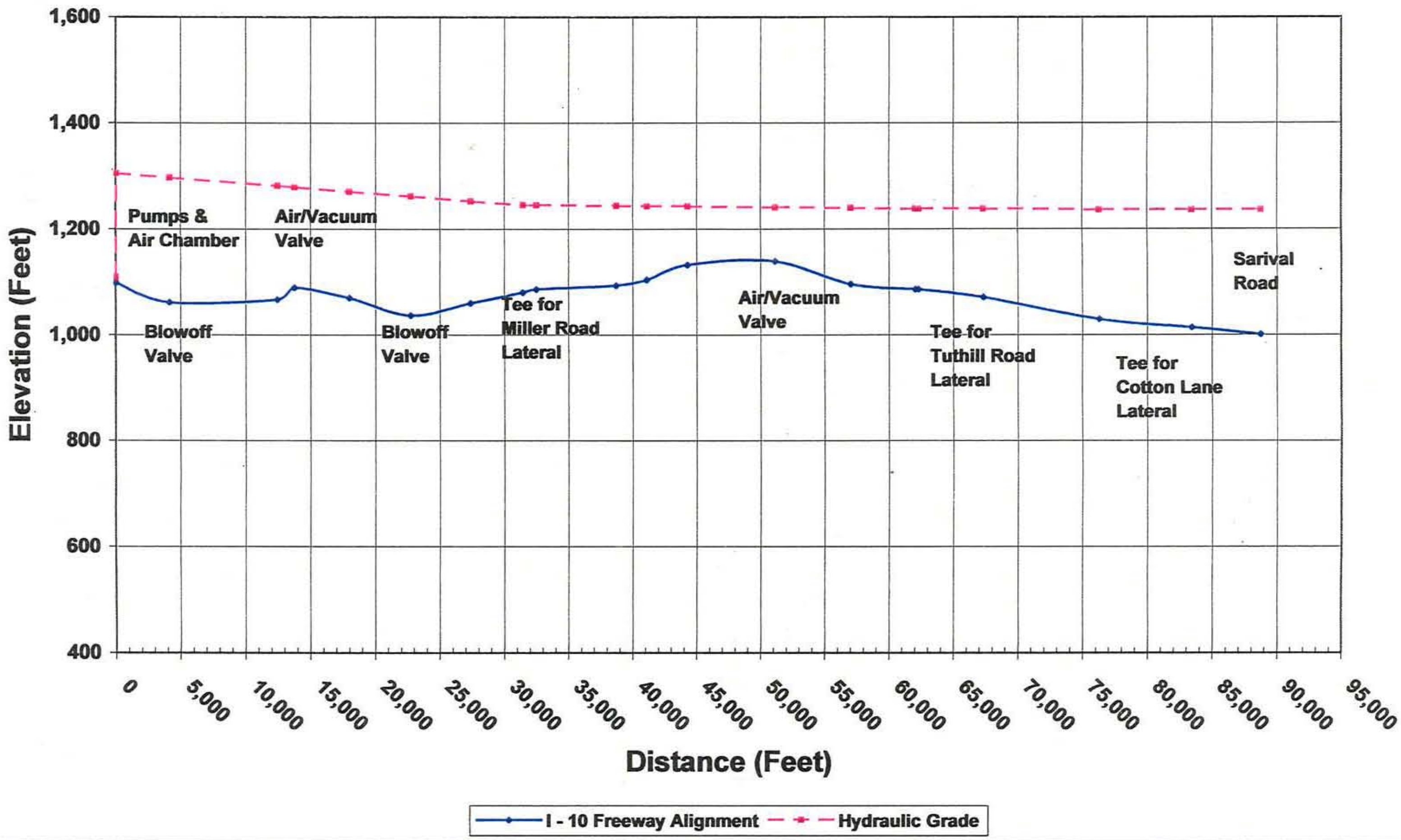


Figure AP A-2A

Alignment 2
From Recovery Storage Site along I - 10 to Sarival Road
West Maricopa Combine, WESTCAPS



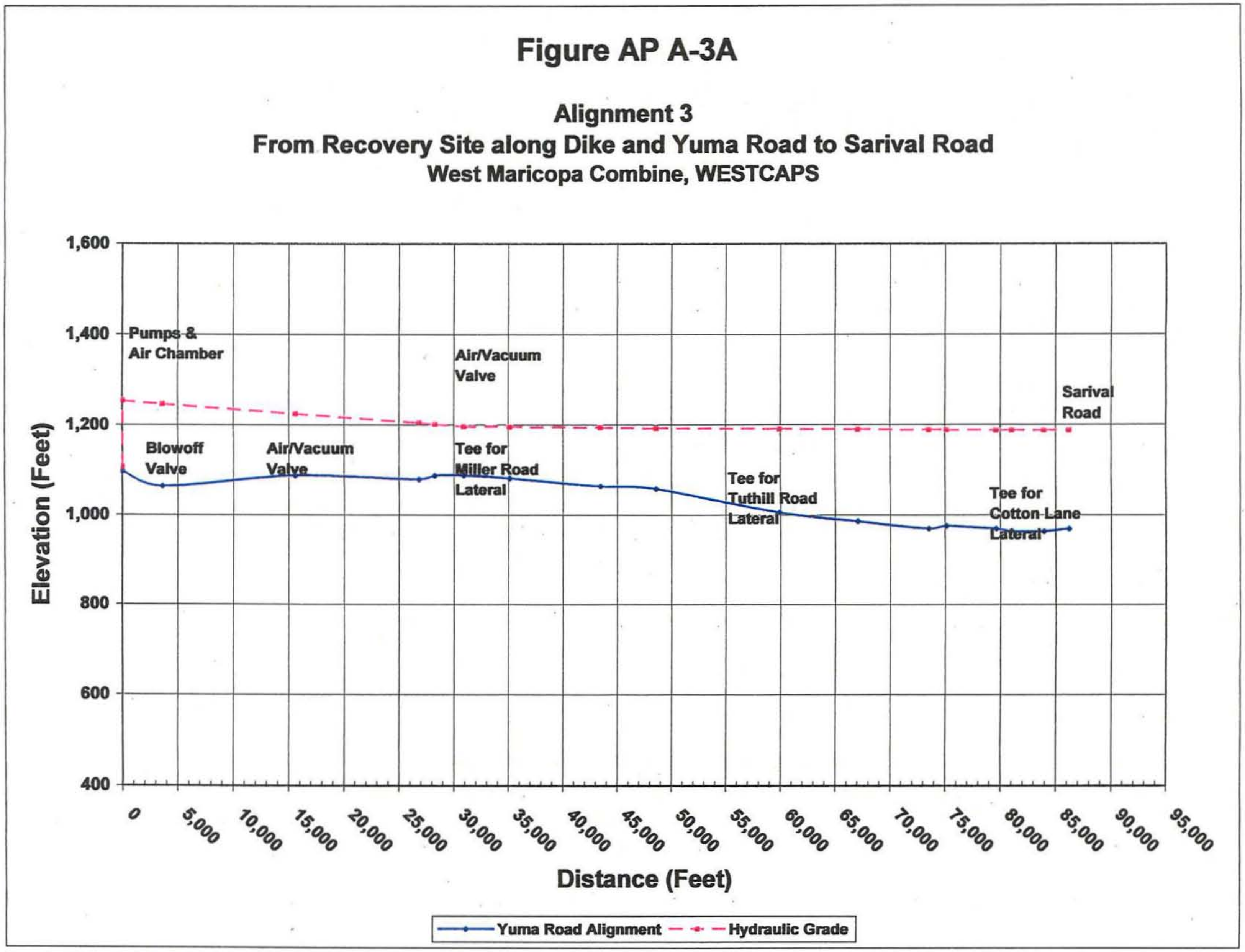


Figure AP A-3A
Alignment 3
From Recovery Site along Dike and Yuma Road to Sarival Road
West Maricopa Combine, WESTCAPS
Elevation (Feet)
1,600
1,400
1,200
1,000
800
600
400
Pumps &
Air Chamber
Blowoff
Valve
Air/Vacuum
Valve
Air/Vacuum
Valve
Tee for
Miller Road
Lateral
Tee for
Tuthill Road
Lateral
Tee for
Cotton Lane
Lateral
Sarival
Road
0
5,000
10,000
15,000
20,000
25,000
30,000
35,000
40,000
45,000
50,000
55,000
60,000
65,000
70,000
75,000
80,000
85,000
90,000
95,000
Distance (Feet)
Yuma Road Alignment
Hydraulic Grade

Figure AP A-4A

Alignment 4
From Recovery Storage Site along Tonopah-Salome HWY and Yuma Road to Sarival Road
West Maricopa Combine, WESTCAPS

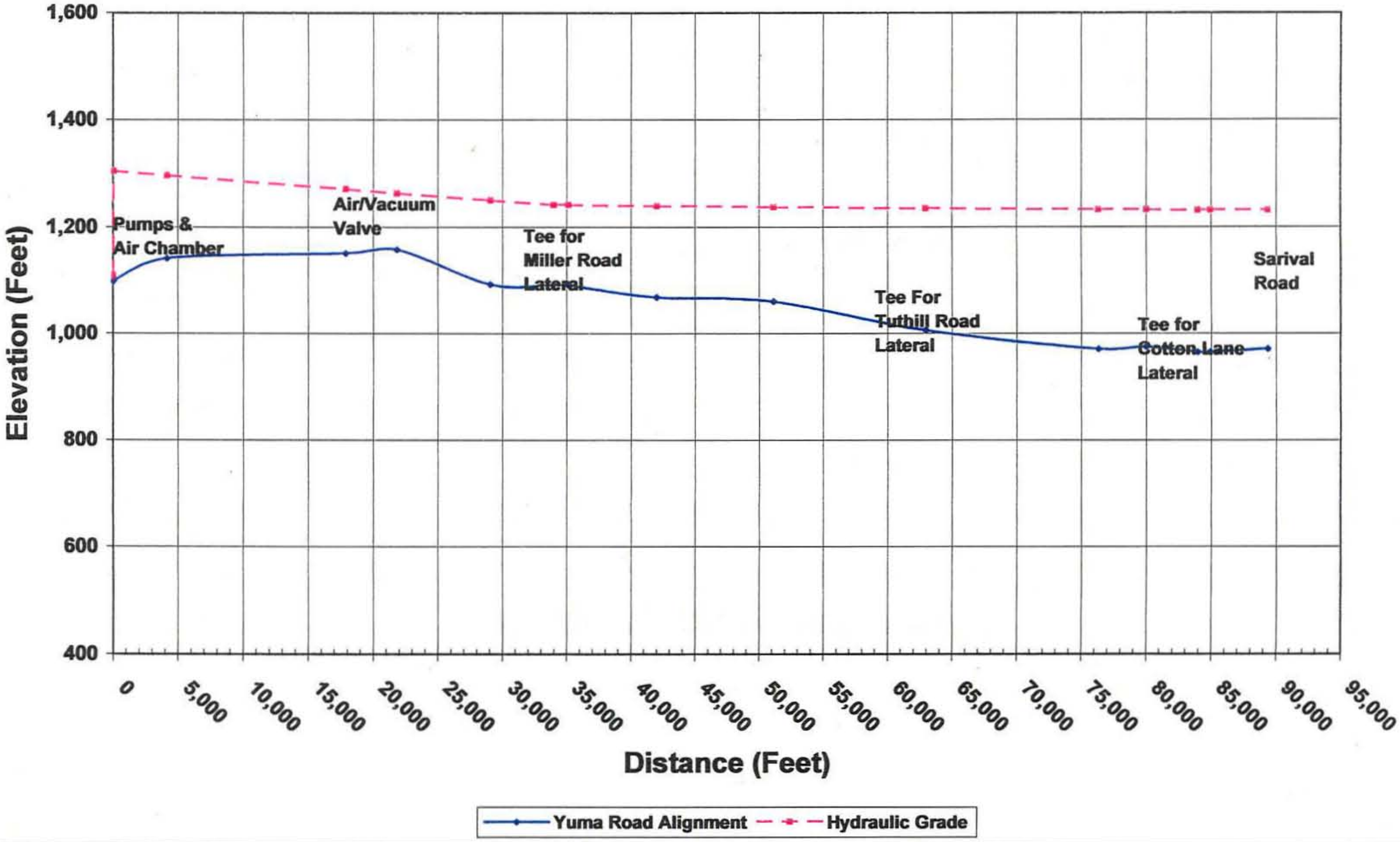
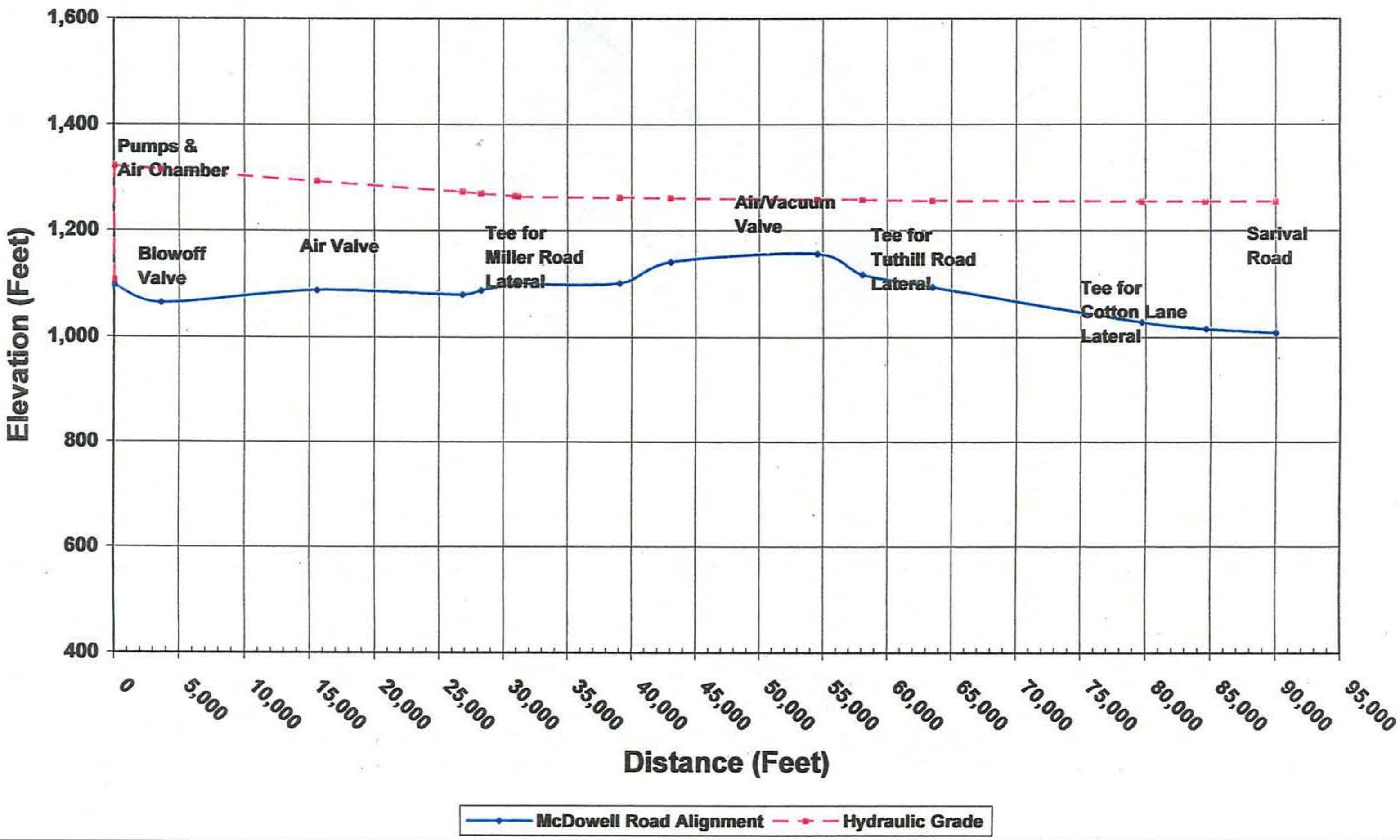
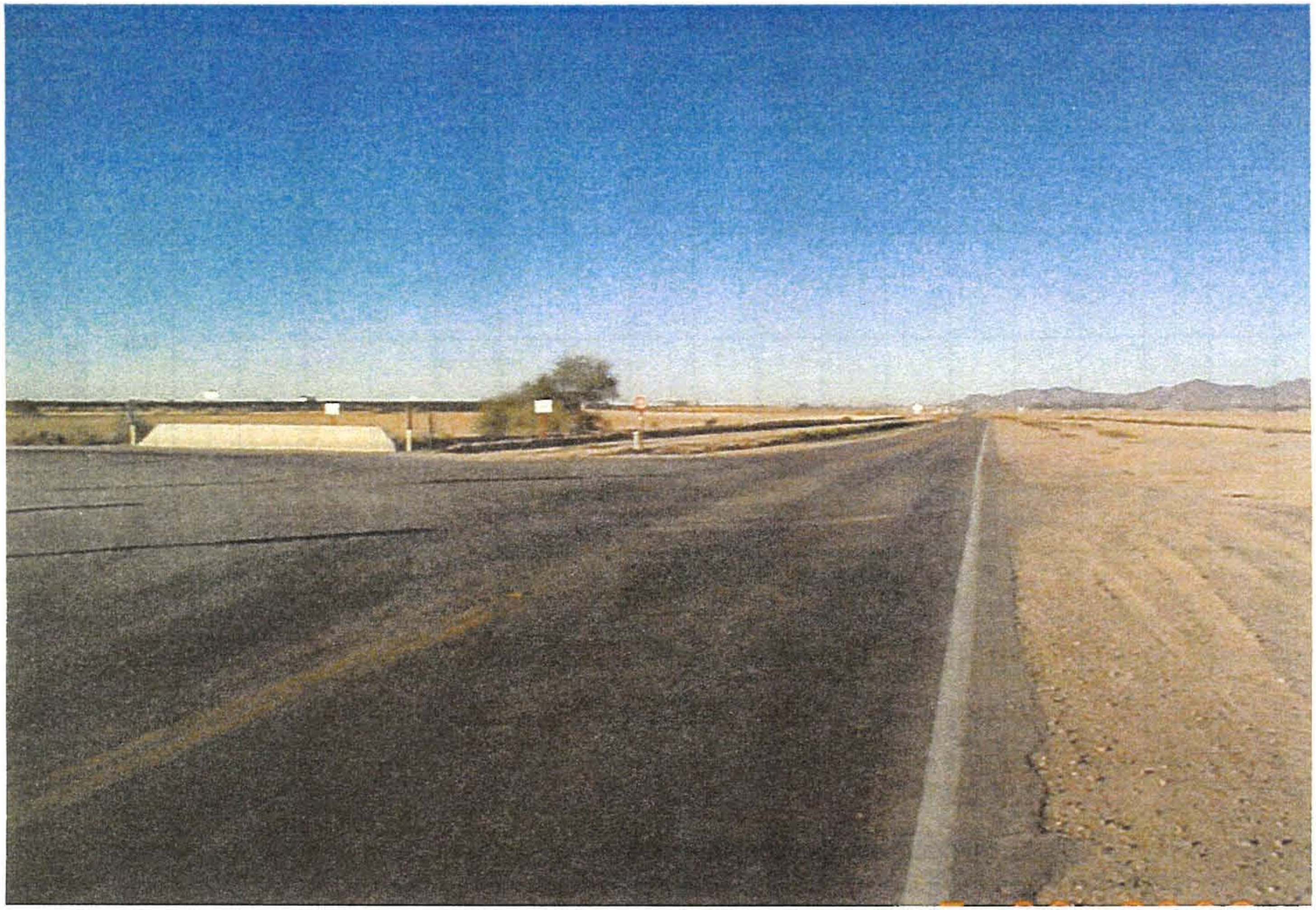


Figure AP A-5A

Alignment 5
From Recovery Site along Dike and McDowell Road to Sarival Road
West Maricopa Combine, WESTCAPS





Photograph 1: **Alignment 1** **November 27, 2001**

From just beyond Sarival Road, view looking west along McDowell Road. Bridge parapet on Sarival Road crosses the Roosevelt Canal. About ¼ mile from this point west, the canal veers off to the southwest. The proposed trunkline would run along the south (left) shoulder of McDowell Road.

Photograph 2 **Alignment 1** **November 27, 2001**

From the south shoulder of McDowell Road, view looking south along 30-foot wide floodway paralleling Jackrabbit Trail (195th Avenue). Trucks are going over the Interstate I-10 Underpass. The proposed trunkline would probably be pipejacked below this structure.

Photograph 3 **Alignment 1 & Tuthill Road Lateral** **November 27, 2001**

From the dirt road portion of McDowell Road (this point is 5.0 miles due west of Sarival Road in Photo 1), view looking south along Tuthill Road. A lateral pipeline would connect the trunkline at this site and extend southwards through the single barrel concrete cattle underpass of Interstate I-10. Note the 4-barrel box culvert at a lower elevation to the right (behind truck).

Photograph 4 **Alignment 1** **November 27, 2001**

From the western dirt road terminus of McDowell Road (this point is 6.7 miles due west of Sarival Road in Photo 1), view taken from top of Maricopa County Flood Control Dike looking south along dirt O&M road. Interstate I-10 is in the background. The proposed trunkline would follow along the downstream toe of this dike between the O&M road and dike.

Photograph 5 **Alignment 1** **November 27, 2001**

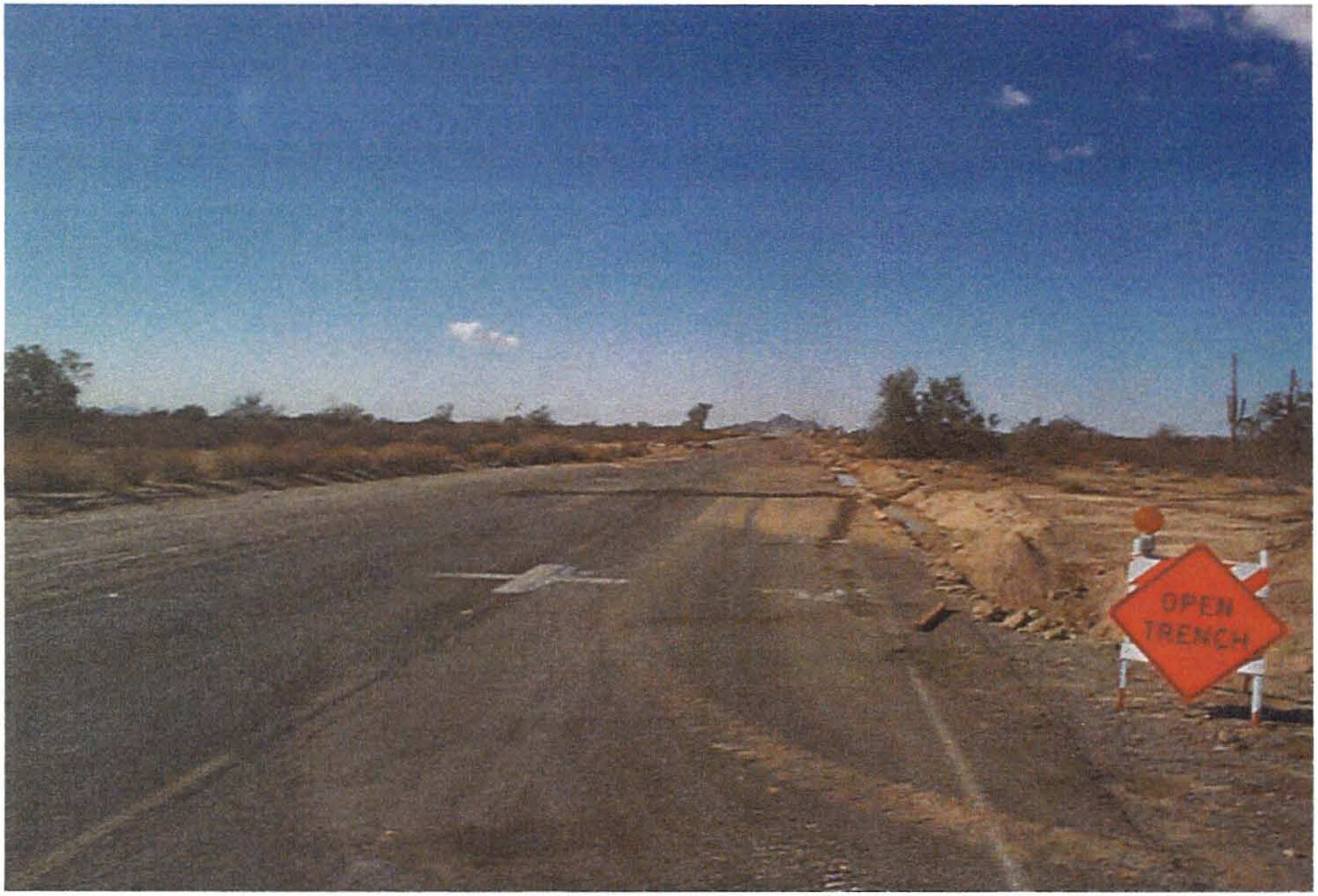
From the western dirt road terminus of McDowell Road (same vantage point as Photo 4), view from top of Maricopa County Flood Control Dike looking west across large wash along trail extension of McDowell Road. The proposed trunkline trench could possibly be excavated below the wash and the route continued along the trail but bedrock hills are only two miles further west.

Photograph 6 **Alignment 1 & Miller Road Lateral** **November 27, 2001**

From the top of the Maricopa County Flood Control Dike about 200 feet northeast of an electrical substation (just outside of the field of view on center-right of photo), view looking south along northern dirt road extension of Miller Road. Interstate I-10 is in the distance. The proposed trunkline would attach to a lateral in this area, and the lateral would extend along the west shoulder of Miller Road through the I-10 underpass about 4 miles to Baseline Road.

Photograph 7 **Alignment 3** **November 27, 2001**

On Palo Verde Road about 0.1 mile north of Interstate I-10, photo looks southeast along O&M road on upstream toe side of Maricopa County Flood Control Dike. The proposed alternate trunkline would come in from left of photo (from the recovery area storage tanks one mile north) and run along this O&M road southeastwards on the north side of the dike for about 1-3/4 miles before the route would transition to the south side of the dike near the Turner Road extension eventually merging with the Alignment 1.

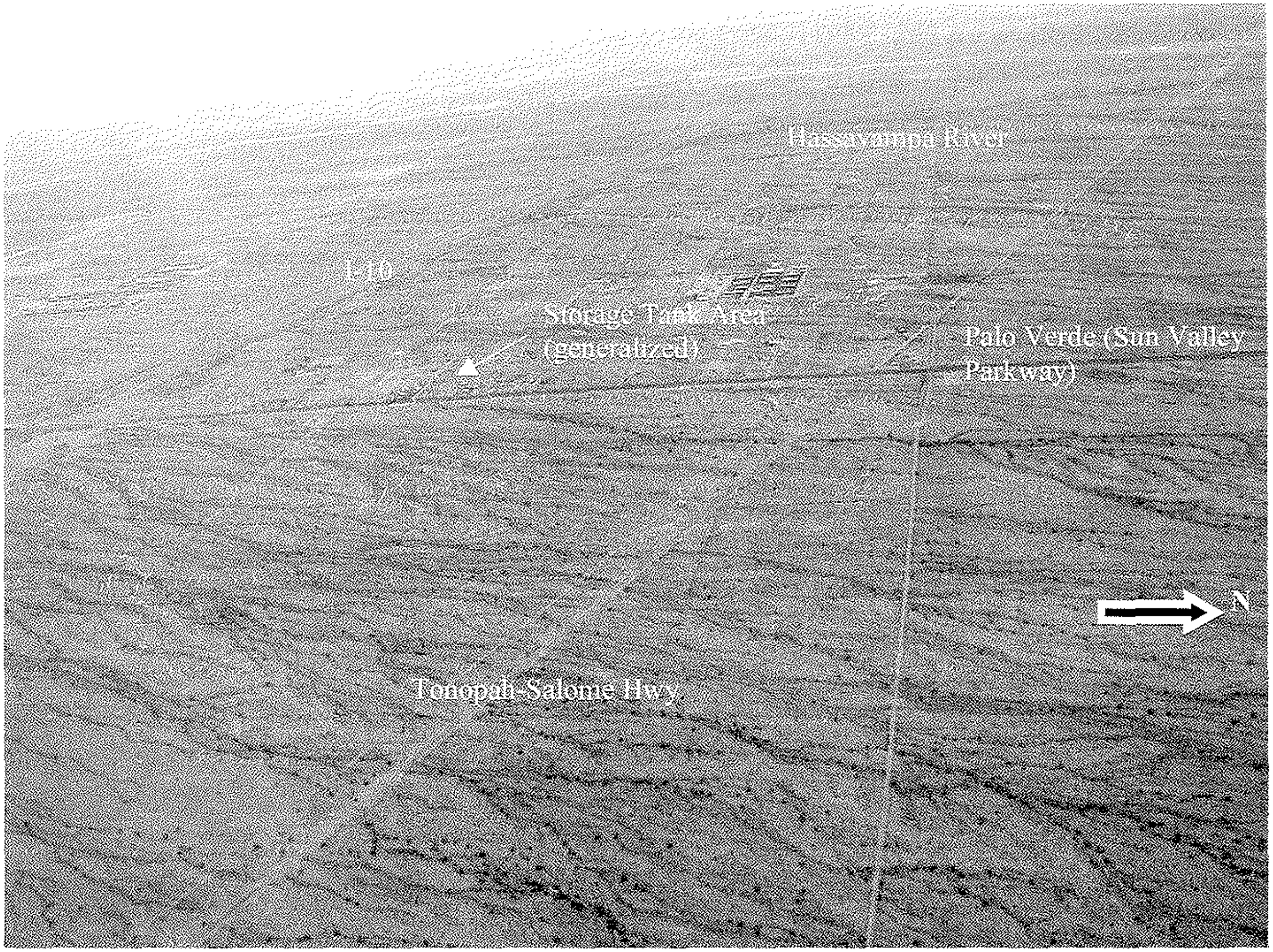


Photograph 8 **Alignment 3** **November 27, 2001**

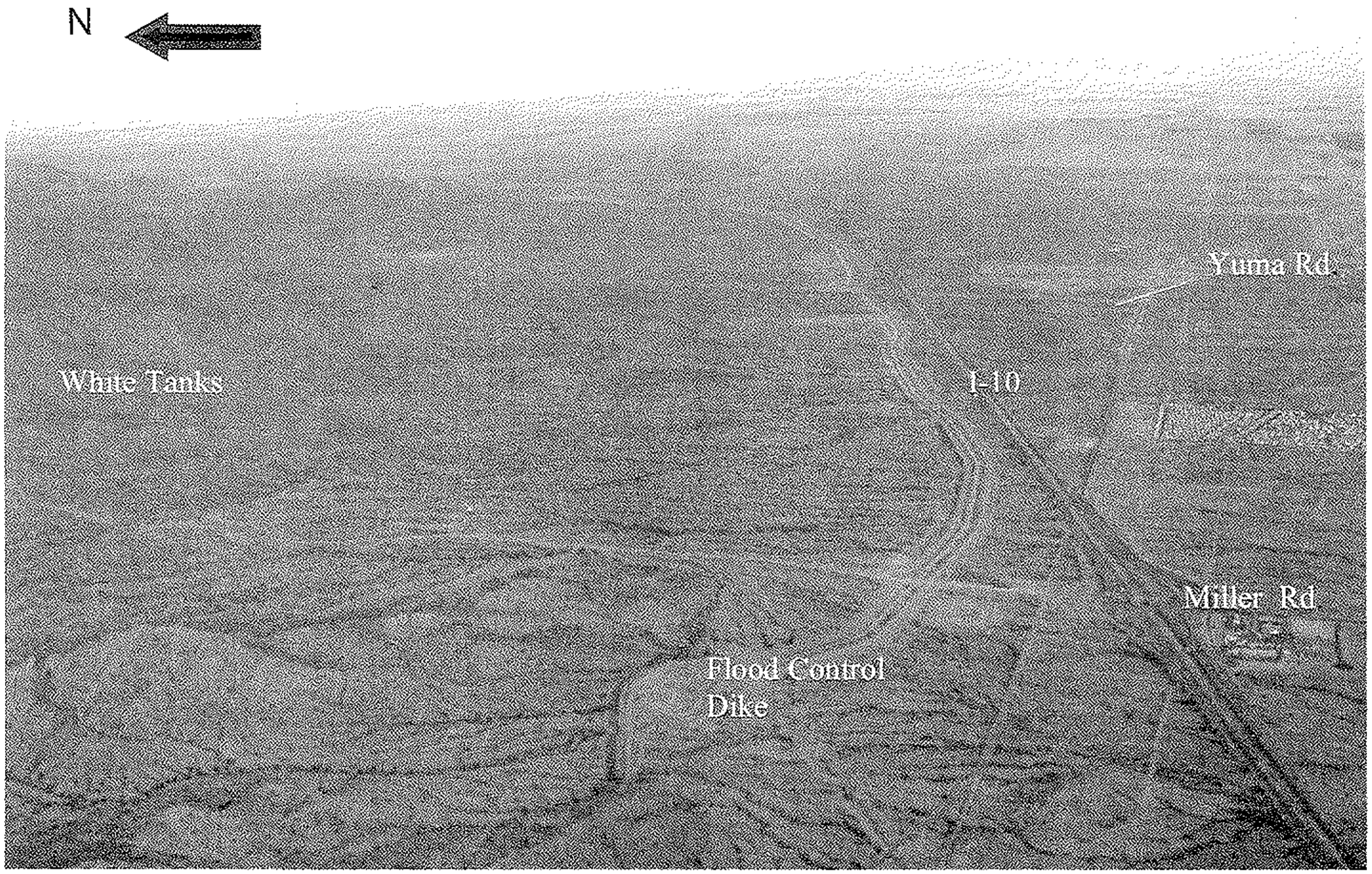
View looking west along Yuma Road with the Dean Road intersection behind the photographer, a new pipeline is going in on the north shoulder of Yuma Road. The proposed alternate trunkline would run on the south shoulder (left side of photo). Note the open desert space (at least for the time being).

Photograph 9 **Alignment 3** **November 27, 2001**

From the end-of-line at the Sarival Road intersection, view looking west along south shoulder of Yuma Road. The proposed alternate trunkline would run along this side (left side of photo).

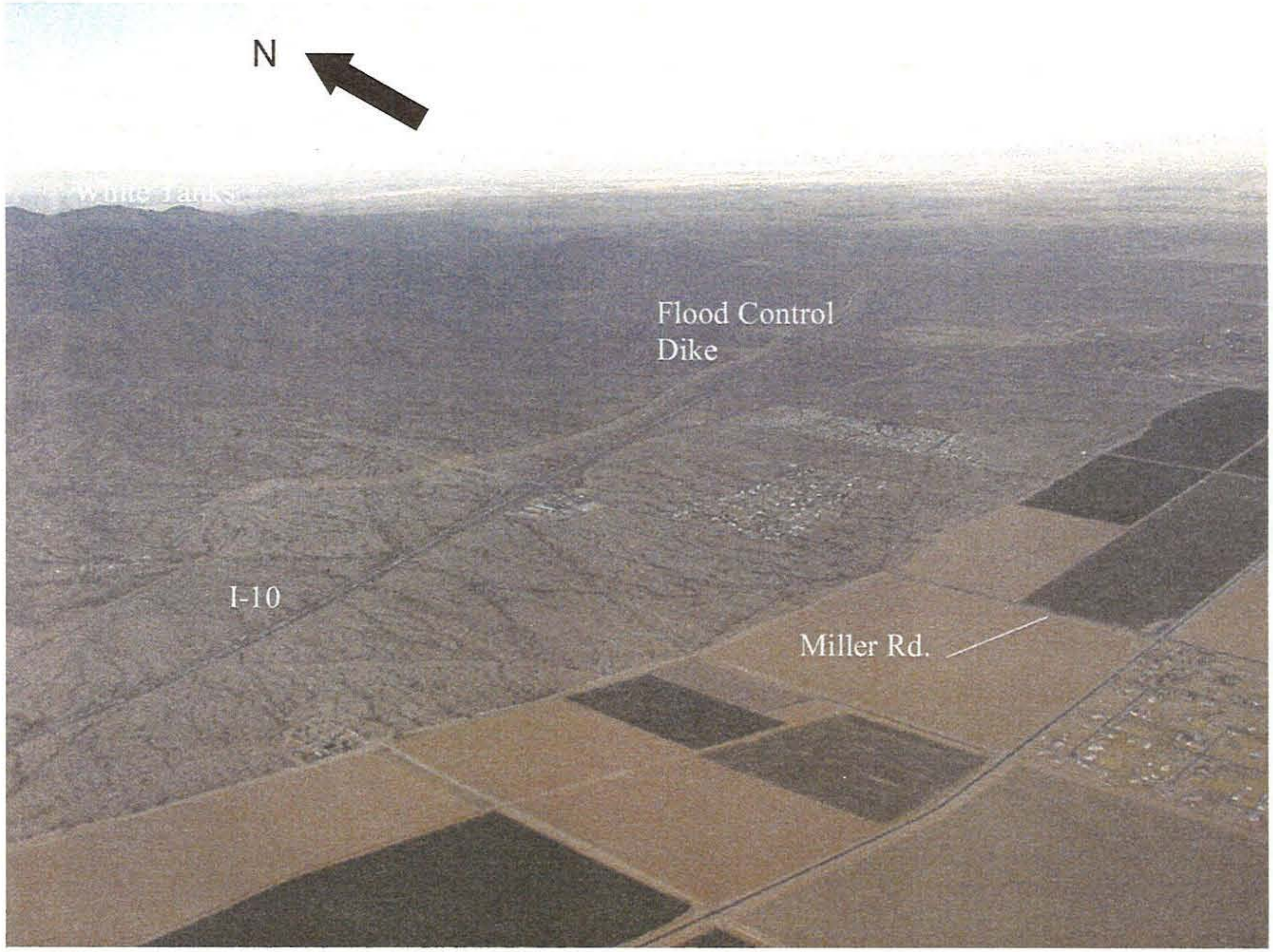


Aerial Photograph P57W7_2 West Maricopa Combine - PTTF Study February 21,2002
Looking west along Interstate I-10 and the Tonopah-Salome Highway towards the Hassayampa River.

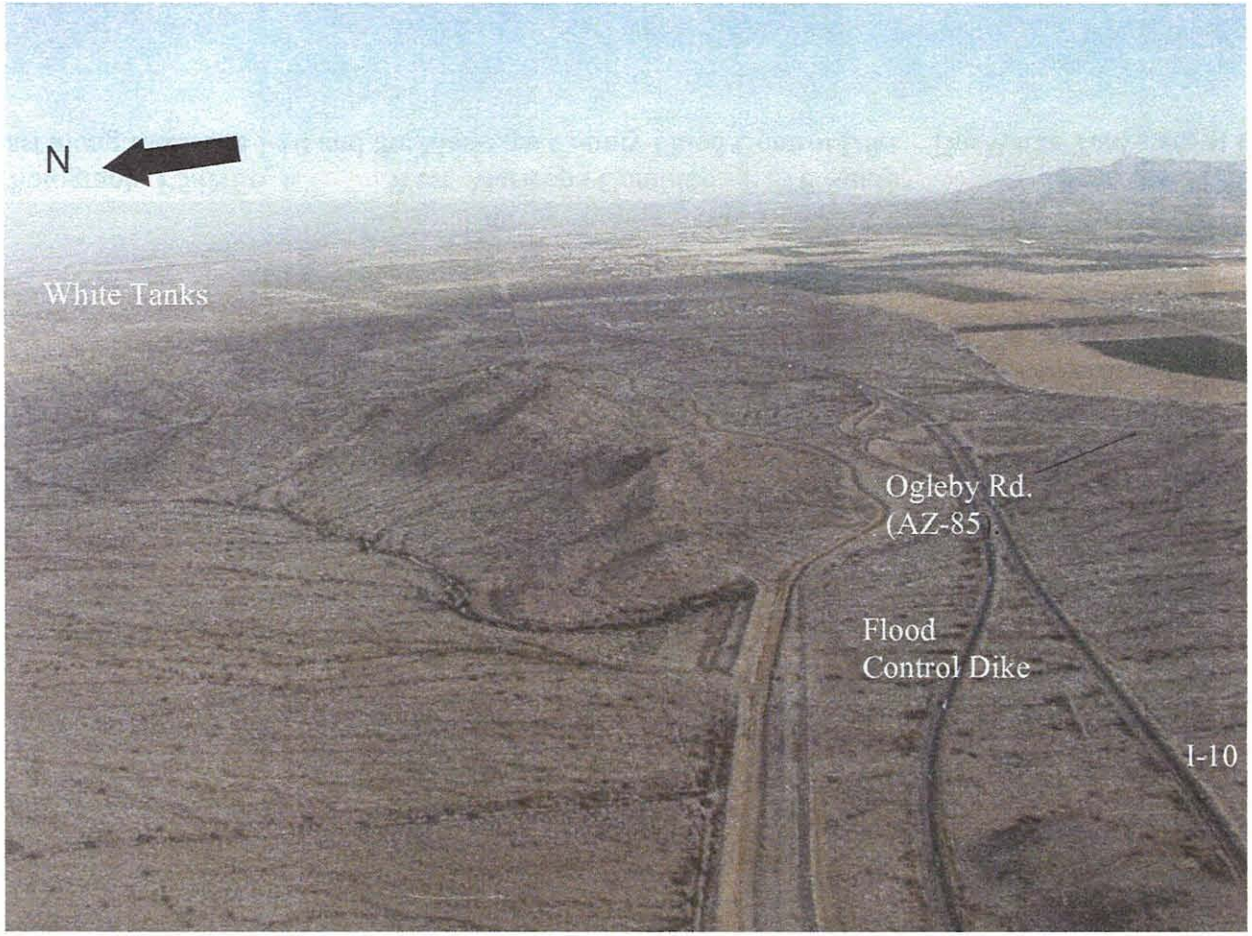


Aerial Photograph P55E6_7 West Maricopa Combine - PTTF Study February 21,2002

Looking east along Interstate I-10 and the Maricopa County Flood Control Dike. The White Tanks are at left.

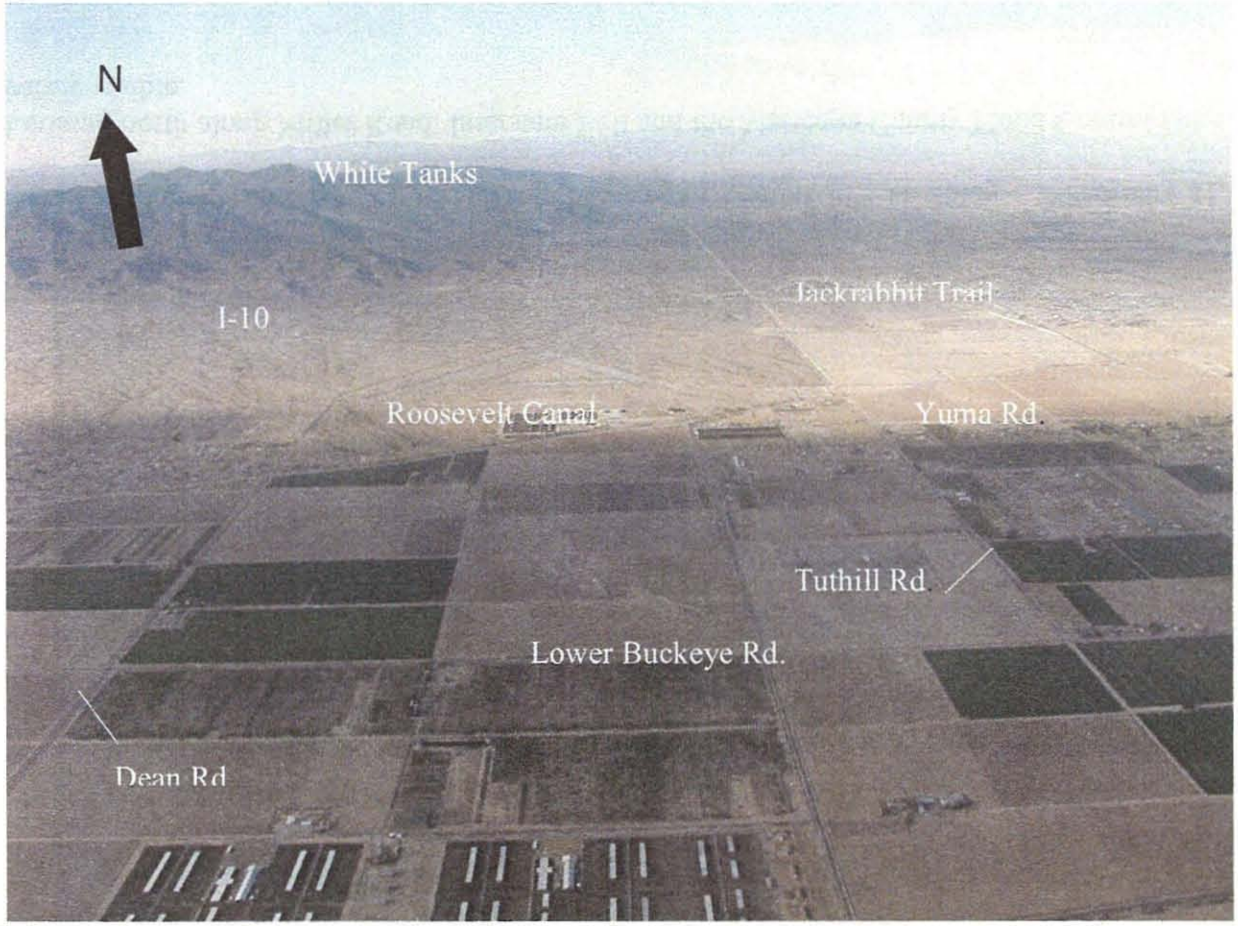


Aerial Photograph P54NE6_6 West Maricopa Combine - PTTF Study February 21,2002
Looking northeast along Interstate I-10 and the Maricopa County Flood Control Dike. The White Tanks are at left.



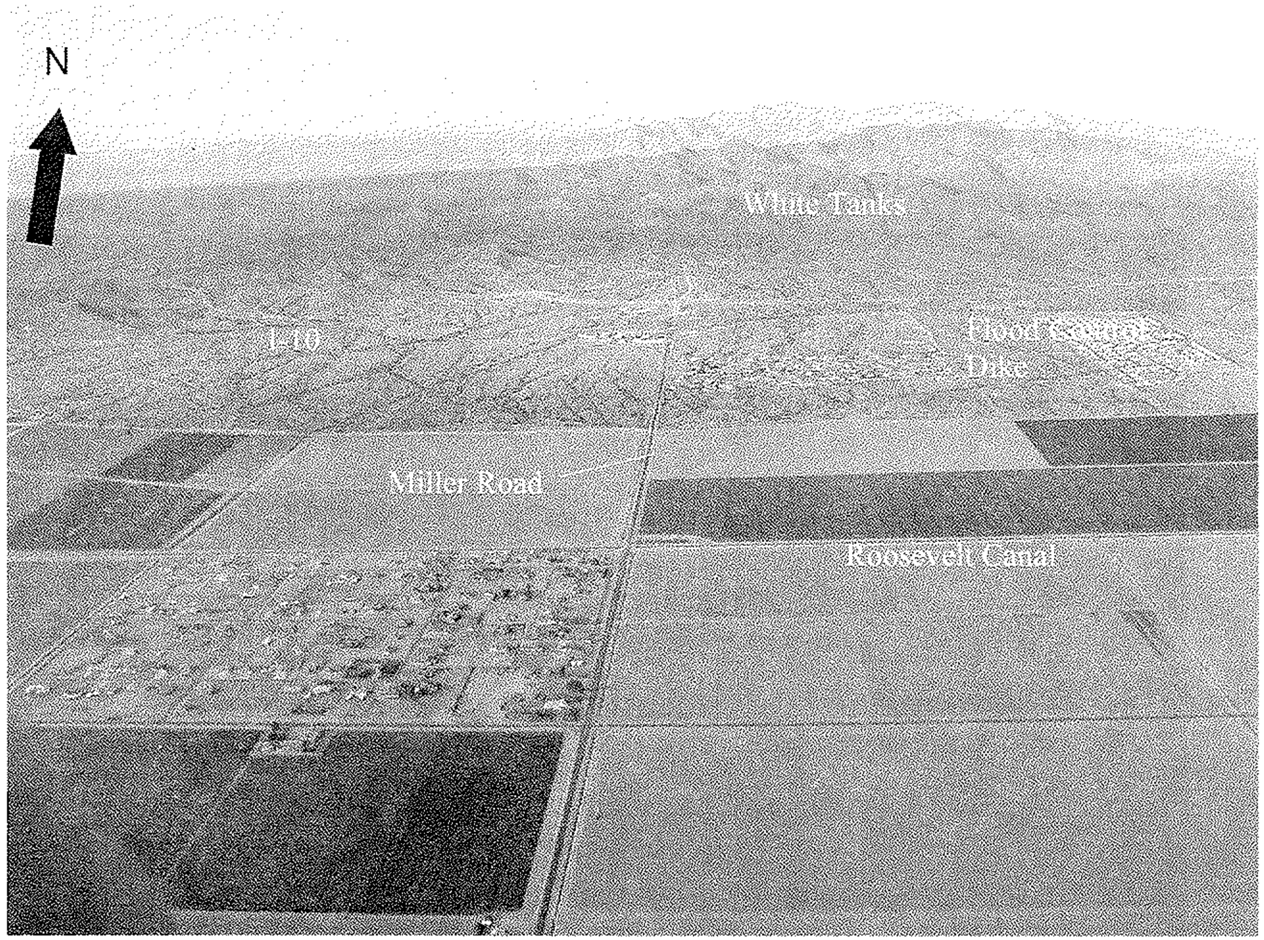
Aerial Photograph P22E2_4 West Maricopa Combine - PTTF Study February 21,2002

Looking east along Interstate I-10 and the Maricopa County Flood Control Dike. The White Tanks are at left.



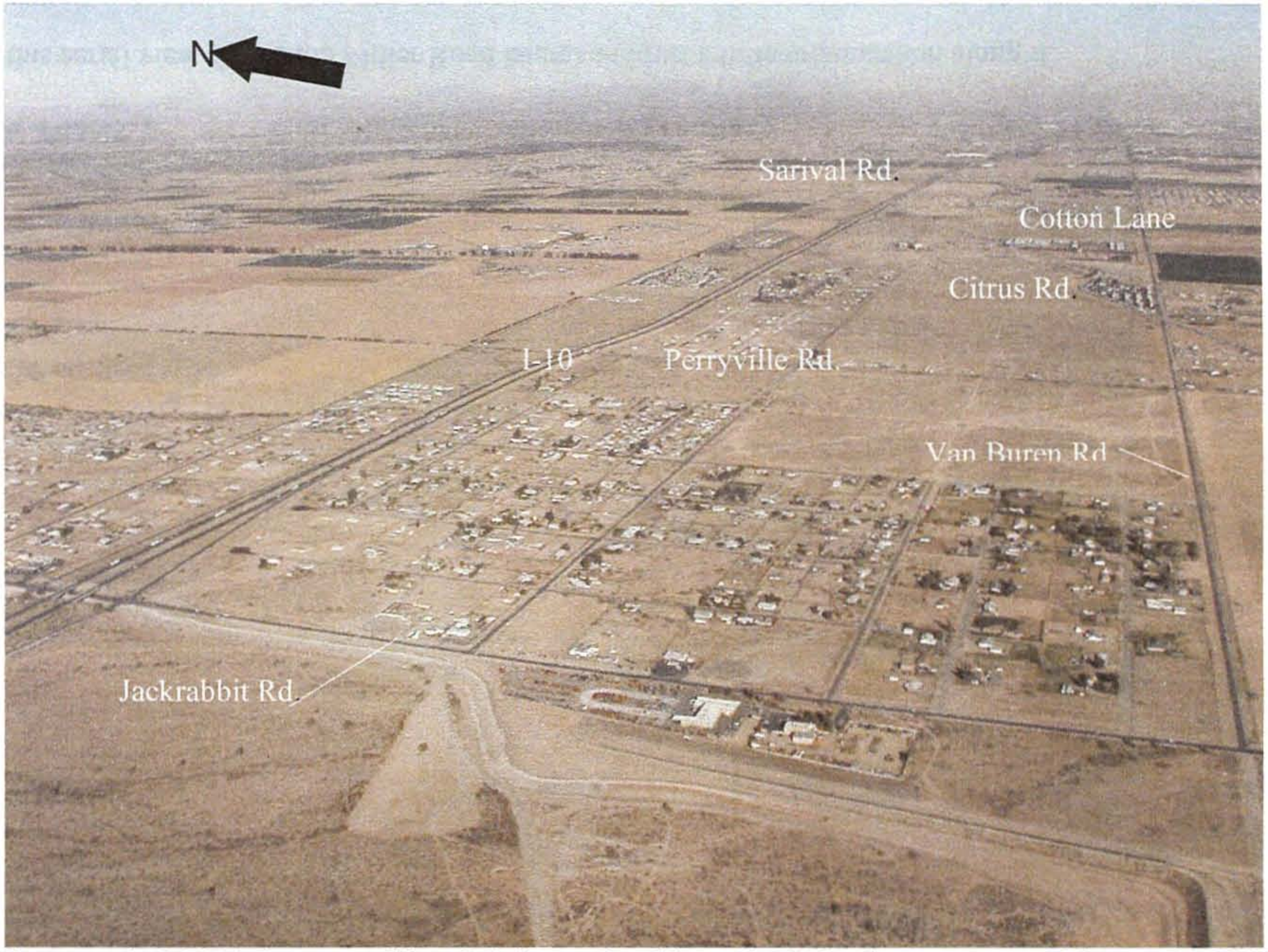
Aerial Photograph P42N5_3 West Maricopa Combine - PTTF Study February 21,2002

Looking north across I-10, the Roosevelt Canal, and Yuma Road. Note Tuthill Road, one of the laterals.



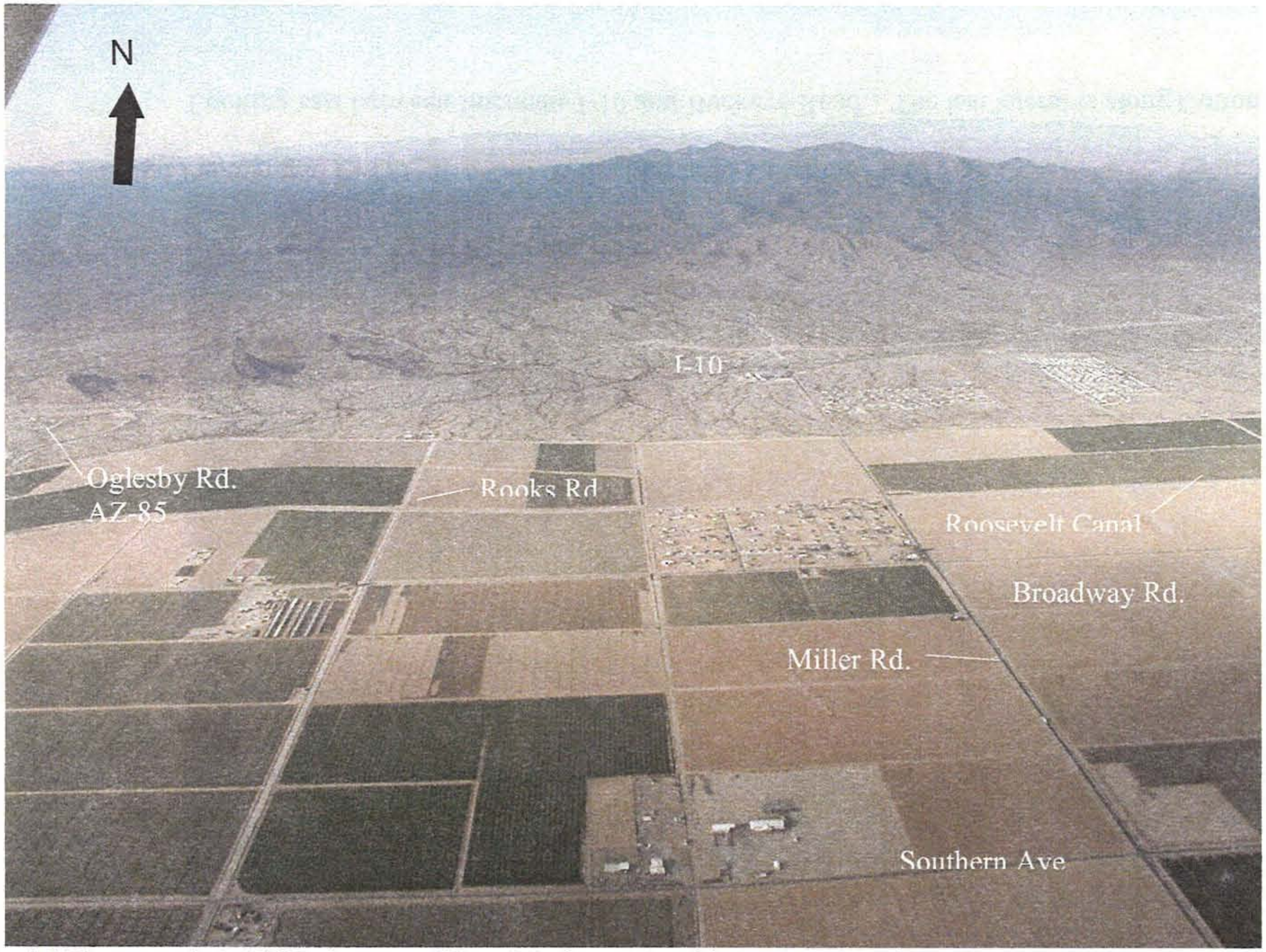
Aerial Photograph P31N4_7 West Maricopa Combine - PTTF Study February 21,2002

Looking north along Miller Road. Interstate I-10 and the Maricopa County Flood Control Dike are barely visible.



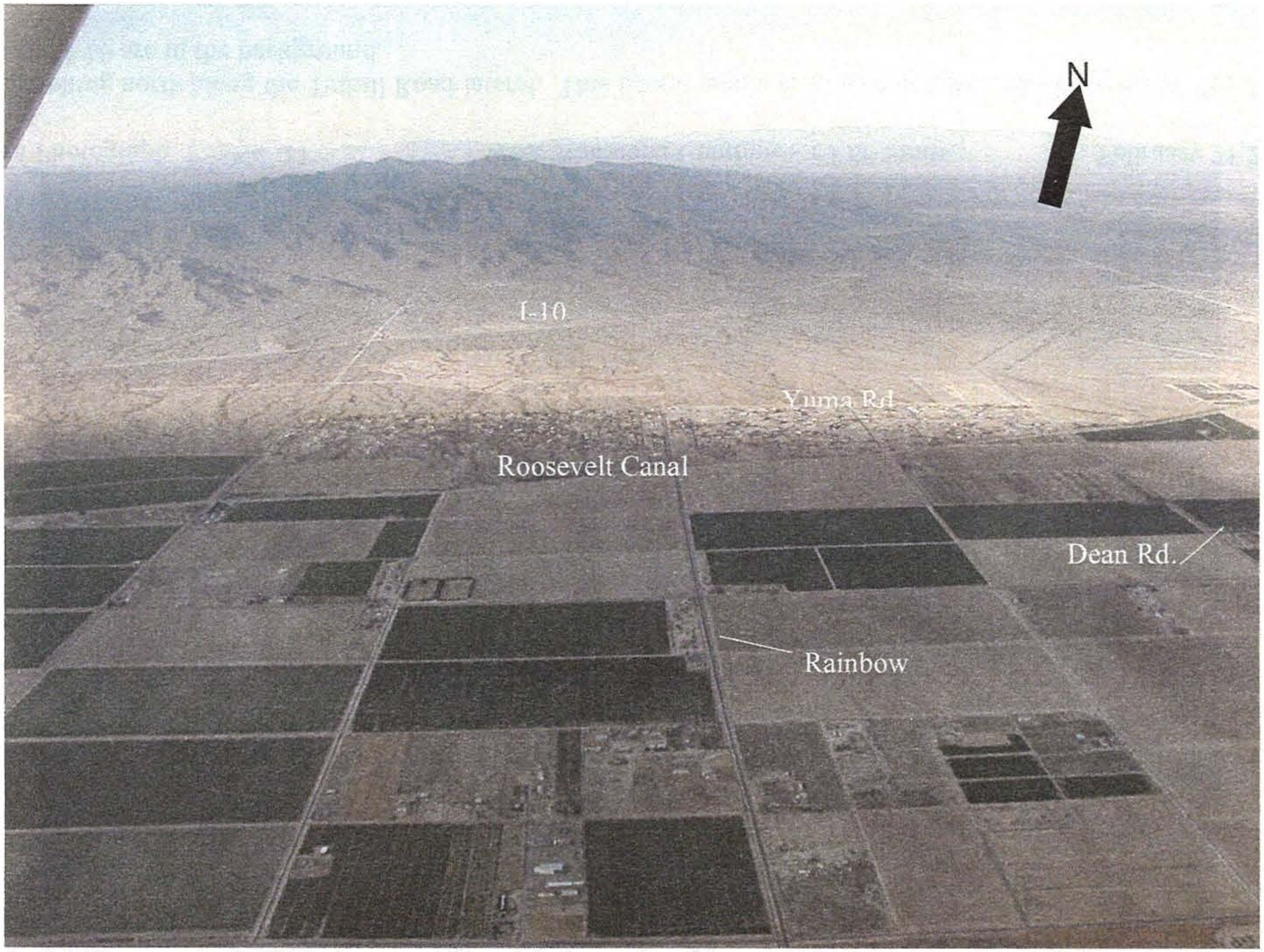
Aerial Photograph P14E1_1 West Maricopa Combine - PTTF Study February 21,2002

Looking east between Interstate I-10 and Buckeye Road. The last lateral is along Cotton Lane.



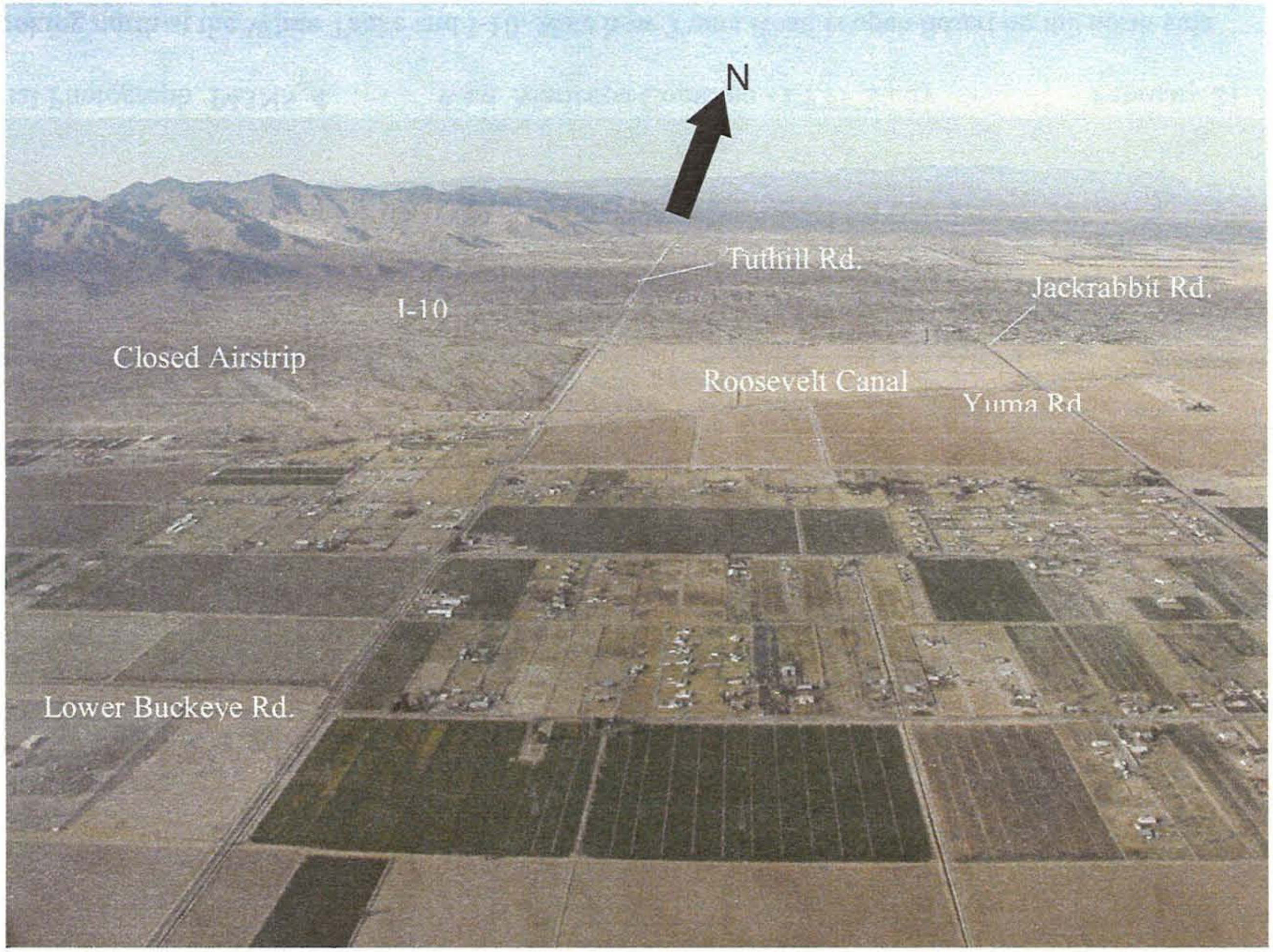
Aerial Photograph P45N5_6 West Maricopa Combine - PTTF Study February 21,2002

Looking north, this aerial view shows the Miller Road lateral and just a little urbanization along it.



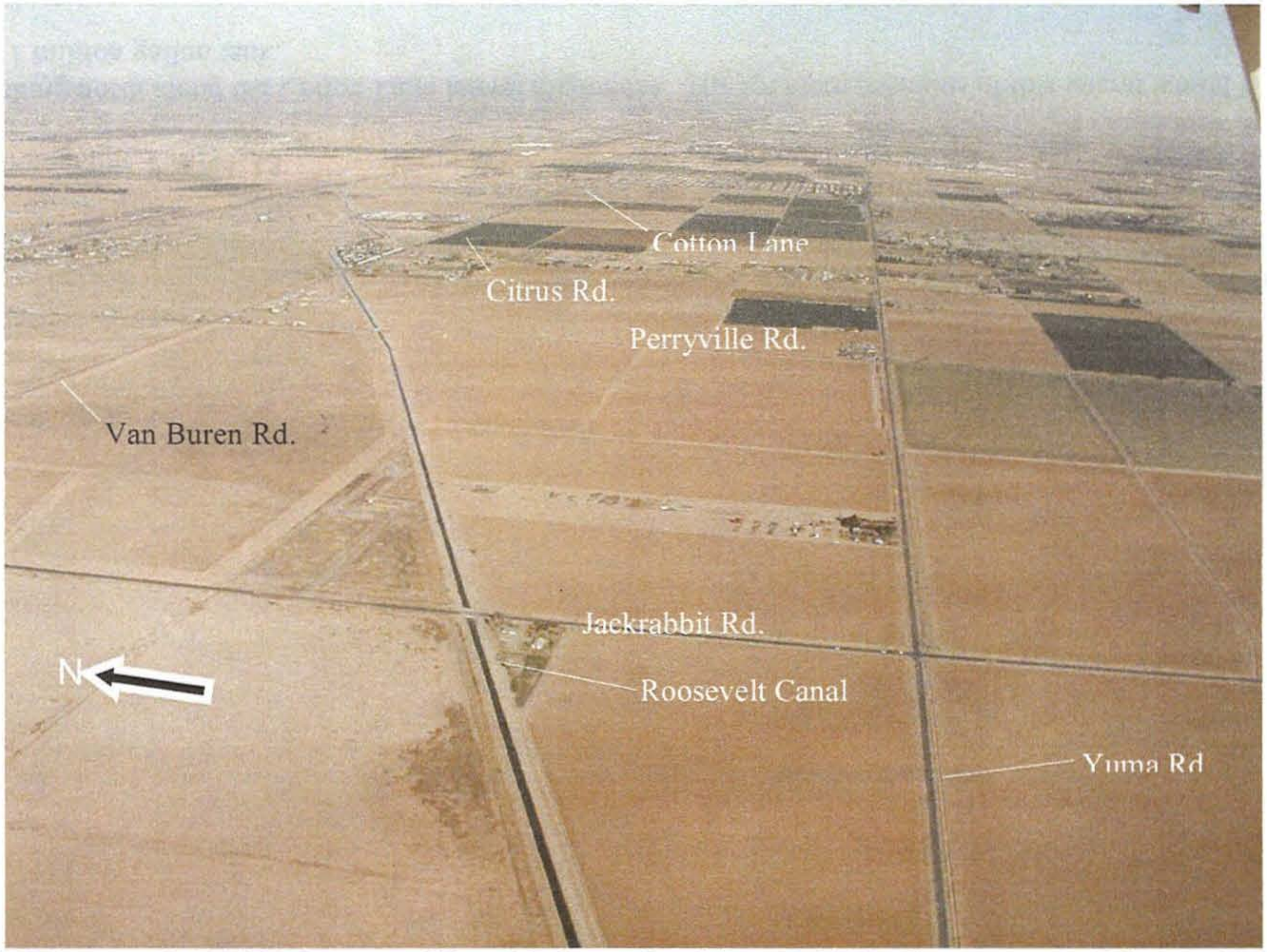
Aerial Photograph P43N5_4 West Maricopa Combine - PTTF Study February 21,2002

Looking north at the White Tanks and I-10. Note how Yuma Road is open desert on the north side.



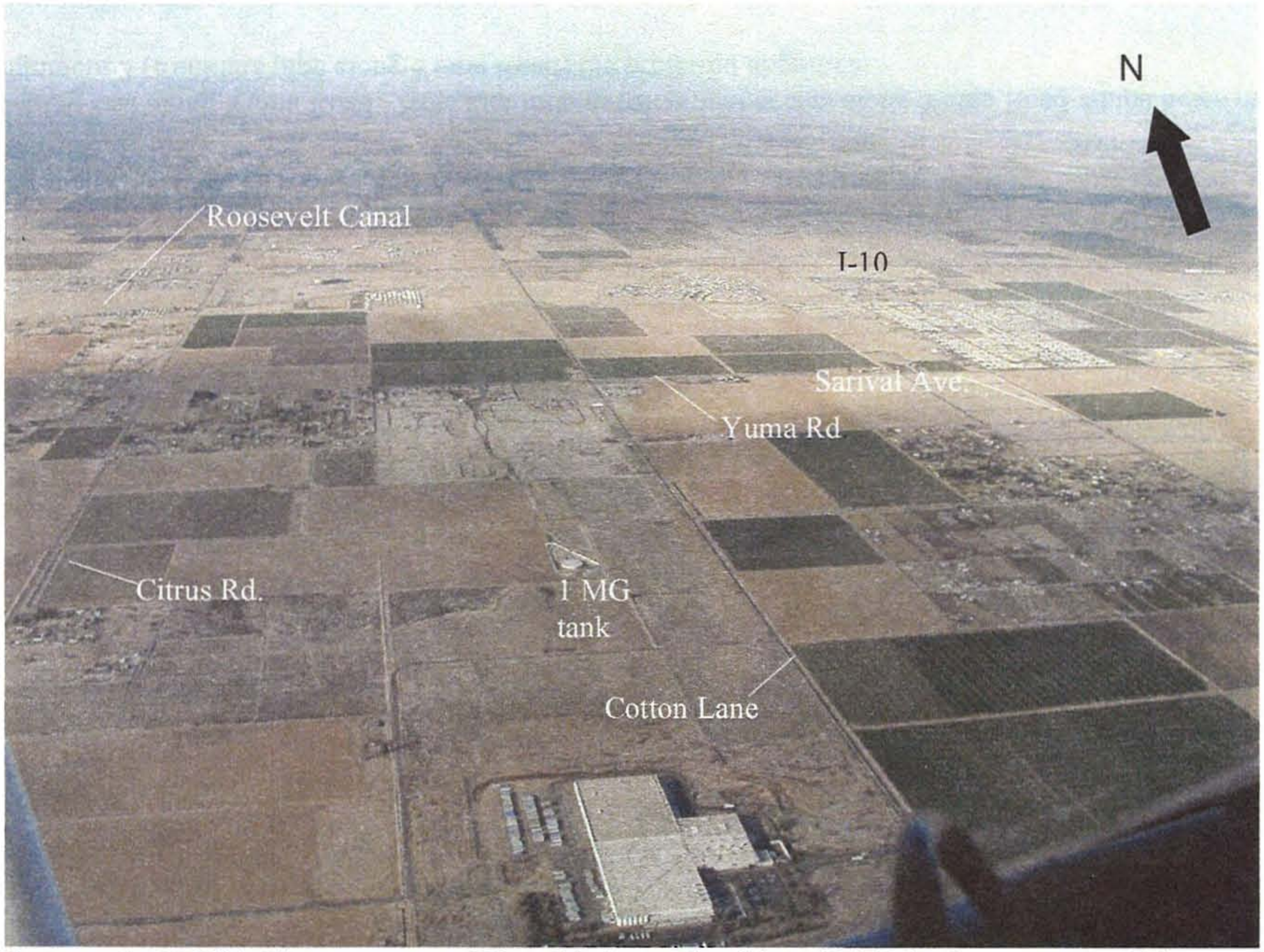
Aerial Photograph P35N4_11 West Maricopa Combine - PTTF Study February 21,2002

Looking north along the Tuthill Road lateral. This lateral would terminate at Lower Buckeye Road. The White Tanks and I-10 are in the background.



Aerial Photograph P15E1_2 West Maricopa Combine - PTTF Study February 21,2002

Looking east along Yuma Road. Note that little development occurs along Yuma Road which helps make Alignment 3 (trunkline pipe along Yuma Road) the preferred alignment.



Aerial Photograph P39N4_15 West Maricopa Combine - PTTF Study February 21,2002

Looking north along the Cotton Lane lateral alignment. The southern terminus of this lateral would be at the 1 million gallon tank.

CHAPTER III

HYDRAULIC ANALYSES AND COST ESTIMATIONS

3.1 Background

The Bureau of Reclamation, Phoenix Area Office has conducted this appraisal level hydraulic analyses for water delivery from the WMC recharge recovery storage area. The site is located on the northwest corner of Palo Verde Road (Sun Valley Parkway) and the extension of Van Buren Road to the various Water Planning Areas (WPAs) in the Buckeye Area. The main trunk pipeline flows from west to east and reverse flows are possible. The WPAs are discussed in Section 2 of this report in Section 2, "Description of Potential Alignments". The yearly water demand projections are consistent with the WESTCAPS Strategic Plan, and the WPAs and their yearly water demand projections are derived from Table A-6 in Appendix A in the Strategic Plan.

To deliver water from the well field toward the metropolitan area, five (5) major alignments and three (3) lateral pipelines are planned and are described in Section 2, "Description of Potential Alignments". This delivery from here forward will be referred to as "Forward Flow " delivery.

This analysis in this chapter and subsequent chapters also covers water deliveries from Sarival Road to the Buckeye Area (main trunk pipeline flows are reversed from east to west). The water is thus delivered from conceptual water treatment(s) plant(s) proposed in Appendix A of the Strategic Plan. From here forward, this water delivery is referred to as "Reverse Flow" delivery. The three major alignments considered are from Sarival Road to the Buckeye Area along McDowell Road, from Sarival Road to Buckeye Area along the I-10 Freeway, and from Sarival Road to the Buckeye Area along Yuma Road. These three major alignments are the same sections of alignments considered in the "Forward Flow" delivery.

The Forward Flow and Reverse Flow use the same trunkline and lateral alignments. Unfortunately, this means that the pump(s) and their locations with by-pass, and sizes chosen will be different.

The three lateral lines can be fed by any of the alignments chosen in either "Forward Flow" or "Reverse Flow". The three laterals extend south from the main trunkline which traverses along McDowell Road, I-10 Freeway and Yuma Road. The laterals extend south along Miller Road (Miller Road Lateral) ending at Baseline Road, along Tuthill Road (Tuthill Road Lateral) ending at Lower Buckeye Road and Cotton Lane (Cotton Lane Lateral) ending at the Storage Tanks at Lower Buckeye Road.

3.2 Water Demand Projections

The average yearly water demand projections for each WPA are shown in Table A-6 in the WESTCAPS Strategic Plan, Appendix A. The WPAs for this study are shown in Table 1. In addition, the future demands for the WPAs are also summarized in Table 1 below.

Calculations for water deliveries considered the following water planning areas.

1. Arizona Water Company-White Tank, WPA No. 3
2. Buckeye IM, WPA No. 45
3. Buckeye OM, WPA No. 46
4. Buckeye South, WPA No. 79
5. Goodyear # 2, WPA No. 13
6. Goodyear Outside, WPA No. 94
7. West Maricopa Combine (WMC) 85, WPA No. 85
8. West Maricopa Combine (WMC) 86, WPA No. 86
9. West Maricopa Combine (WMC) 87, WPA No. 87
10. West Maricopa Combine (WMC) 88, WPA No. 88
11. West Maricopa Combine (WMC) 89, WPA No. 89
12. West Maricopa Combine (WMC) 90, WPA No. 90
13. West Maricopa Combine (WMC) 91, WPA No. 91
14. West Maricopa Combine (WMC) 92, WPA No. 92
15. West Maricopa Combine (WMC) 95, WPA No. 95

Table 1

Yearly Water Demand Projections (Acre-Feet) by WPA

(Excerpt from WESTCAPS, Appendix A, Table A-6, Demand Data From Scenario 23 Basecase (Revised 2/23/00))

WPA Name	WPA No.	Year					
		2000	2005	2010	2015	2020	2025
WMC 85	85	0	0	0	0	0	0
WMC 86	86	16	16	16	47	99	152
WMC 87	87	2	2	2	8	16	24
WMC 88	88	3	3	3	4	4	6
WMC 90	90	6	6	7	10	12	16
WMC 91	91	2	2	2	2	3	4
WMC 92	92	792	937	1,139	1,529	2,344	3,157
Buckeye IM	45	1,272	1,627	1,938	3,541	5,984	8,427
Buckeye OM	46	84	86	126	312	959	1,602
Buckeye So	79	0	35	174	794	2,149	3,508
AZ. W. Co.	3	489	652	873	1,170	1,568	2,099
WMC 89	89	9	27	42	66	135	204
WMC 95	95	2	2	3	5	16	28
Goodyear #2	13	7,619	15,675	23,322	32,867	45,570	58,288
Goodyear Outside	94	966	2,130	3,215	4,301	5,383	6,482
Total		11,262	21,200	30,862	44,656	64,242	83,997

The 15 WPAs are geographically separated into three main groups in order to plan for the three laterals and their associated water delivery. The three lateral lines are shown below.

1. Miller Road Lateral.
   WMC 85, WMC 86, WMC 87, WMC 88, WMC 90, WMC 91, WMC 92, Buckeye IM, Buckeye OM, and Buckeye South.

2. Tuthill Road Lateral.
   Arizona Water Company-White Tank, and WMC 89.

3. Cotton Lane Lateral.
   WMC 95, Goodyear #2, and Goodyear Outside.

The average yearly water demands by lateral are shown in Table A–2 below and Figure 1, page 60.

Table A-2
Yearly Water Demands (Acre-Feet) by Lateral

	Year					
Lateral	2000	2005	2010	2015	2020	2025
Miller Road	2,177	2,714	3,407	6,247	11,570	16,896
Tuthill Road	498	679	915	1,236	1,703	2,303
Cotton Lane	8,587	17,807	26,540	37,173	50,969	64,798
Total	11,262	21,200	***30,862***	***44,656***	***64,242***	***83,997***

Note: The total yearly water demands exceed the average water supply available in the year 2010. This will have a bearing in the supply study and the reverse flow conditions through the main supply line.

3.3 Design Criteria

The following are the assumptions for the hydraulic analyses.

1. The maximum average water delivery is 25,000 acre-feet per year (34.53 cfs) for either forward flow or reverse flow.
2. When the yearly total demand is more than 25,000 acre-feet, the water supply for Goodyear #2 and Goodyear Outside are reduced to meet the maximum 25,000 acre-feet delivery. Refer to Table A-3 below.
3. The multiplier for the peak time demand is 1.5 times the average demand.
4. Reinforced concrete pipe (max. pressure rating is 200 psi) and the Hazen-Williams equation friction factor of 135 is used.
5. Flow velocities were designed to range from approximately 4 feet per second to 6 feet per second to reduce pipe cost, pumping energy cost, and hydraulic water hammer effect.
6. Pipeline pressures range from 40 psi to 120 psi.
7. Floating reservoirs are not considered for the delivery lines.
8. Water does not need to be treated and water treatment is not considered for this report.

9. Water pressures along Sarival Road at the intersections with the three potential alignments for reverse flows are based on the previous Hydraulic Analyses in the WESTCAPS Strategic Plan, Appendix A. In other words, the hydraulic head available (above sea level datum) at McDowell Road, the I-10 Freeway, and Yuma Road are at elevations 1,209, 1,219, and 1,230 feet, respectively.
10. The unit costs for materials including furnishing and installation, and system operating costs are consistent with those in the Strategic Plan, Appendix A. Refer to Table AP A-S2 in Appendix A. Note that the system replacement costs and their annual costs are not considered. This is consistent with the way the Strategic Plan was assembled.
11. Contingencies for unknown items, and engineering and administration costs are each assumed to be 20 percent of the estimated construction costs, respectively.
12. The value used for amortizing the annual interest rate and duration are 5.5 percent and 20 years.
13. Overall motor and pump efficiency is assumed to be 80 percent.
14. The electrical cost is 60 mills ($0.06) per kwh.
15. Pipes will be buried at 5 feet below ground level.

The average yearly water demands are adjusted to meet 25,000 acre-feet a year and is shown in Table A–3, and Figure 2 on page 62.

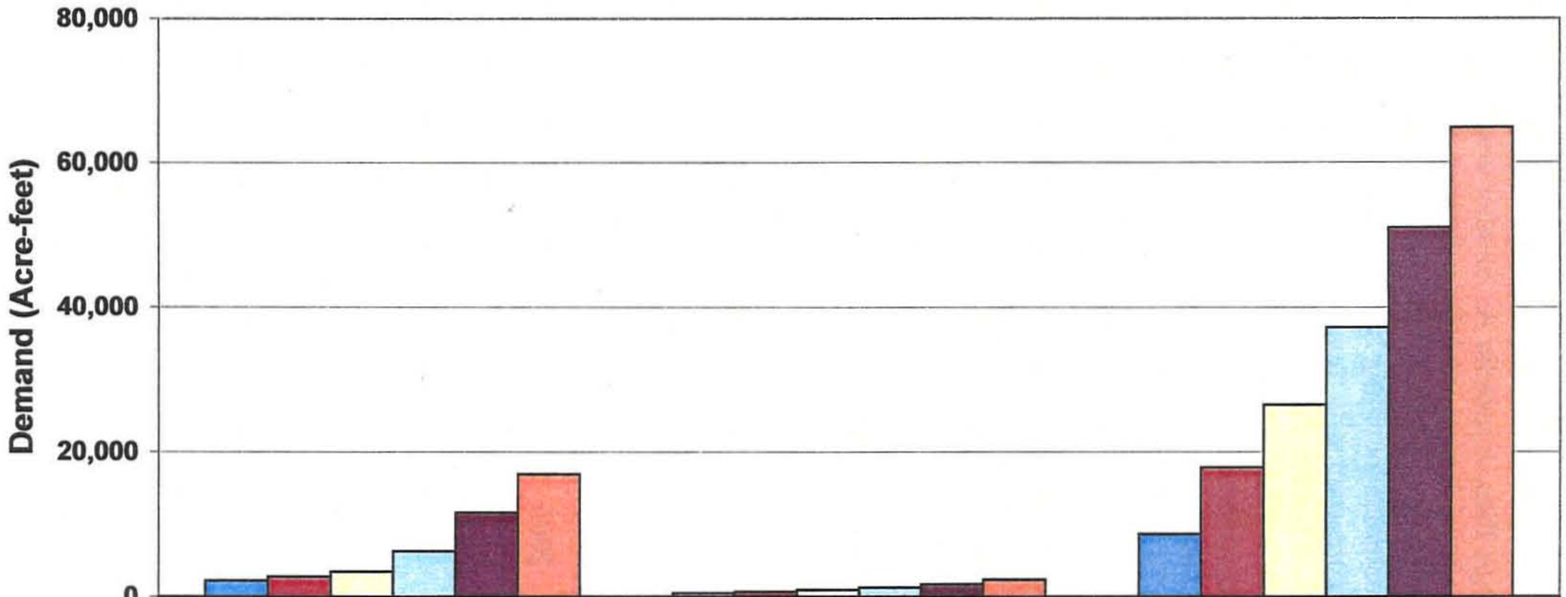
Table A-3
Adjusted Yearly Average Water Demands by Lateral to Meet 25,000 Acre-Feet a Year

Lateral	Year					
	2000	2005	2010	2015	2020	2025
Miller Road	2,177	2,714	3,407	6,247	11,570	16,896
Tuthill Road	498	679	915	1,236	1,703	2,303
Cotton Lane	8,587	17,807	20,678	17,517	11,727	5,801
Total	11,262	21,200	***25,000***	***25,000***	***25,000***	***25,000***

Note: The water demand has been limited to 25,000 acre-feet per year for the years 2010 through 2025.

Figure 1

Yearly Average Water Demand by Lateral



	Miller Road	Tuthill Road	Cotton Lane
2000	2,177	498	8,587
2005	2,714	679	17,807
2010	3,407	915	26,540
2015	6,247	1,236	37,173
2020	11,570	1,703	50,969
2025	16,896	2,303	64,798

Lateral

2000 2005 2010 2015 2020 2025

The reductions of water delivery to the Goodyear #2 and Goodyear Outside are 5,862 acre-feet in year 2010, 19,656 acre-feet in year 2015, 39,242 acre-feet in year 2020, and 58,997 acre-feet in year 2025. The assumption is that these water deliveries will be supplied in some other way. However, by increasing the size of the pipeline sections from Sarival Road to the intersection with the Cotton Lane Lateral, these reduced deliveries can be met for the Reverse Flow case only since the water supply is unlimited. For more information refer to the Section V. Results A.3.c (Unlimited Water Supply by Reverse Flow from Sarival Road) for the pipe sizes and their associated costs.

3.4 Method of Analyses

The hydraulic analyses was conducted by using a water distribution modeling tool called Cybernet by HAESTAD to optimize pressure distribution, pump locations, and necessary hydraulic features such as pressure reducing valve (PRV), etc. The Hazen-Williams equation for pressurized pipe flow is incorporated in the modeling.

The Cotton Lane receives its maximum supply from the well field in the year 2010. The pipeline sizes are determined based on the quantity of water to be delivered through the Miller Road and Tuthill Road laterals in the year 2025 with any remaining supply fed to the Cotton Lane lateral. The Cotton lane lateral is therefore sized for the year 2010 supply available. This is the maximum supply quantity available to be delivered in the time frame considered here (refer to Table A–3 and Figure 2). In as much as the water delivery to the Cotton Lane lateral is reduced in later years due to the maximum water supply of 25,000 acre-feet a year from the recovery storage site (refer to Design Criteria No. 2), the additional water supply required to meet the Cotton Lane lateral demands after the year 2010 will be from the Sarival main trunkline and laterals of the 9/15 plan.

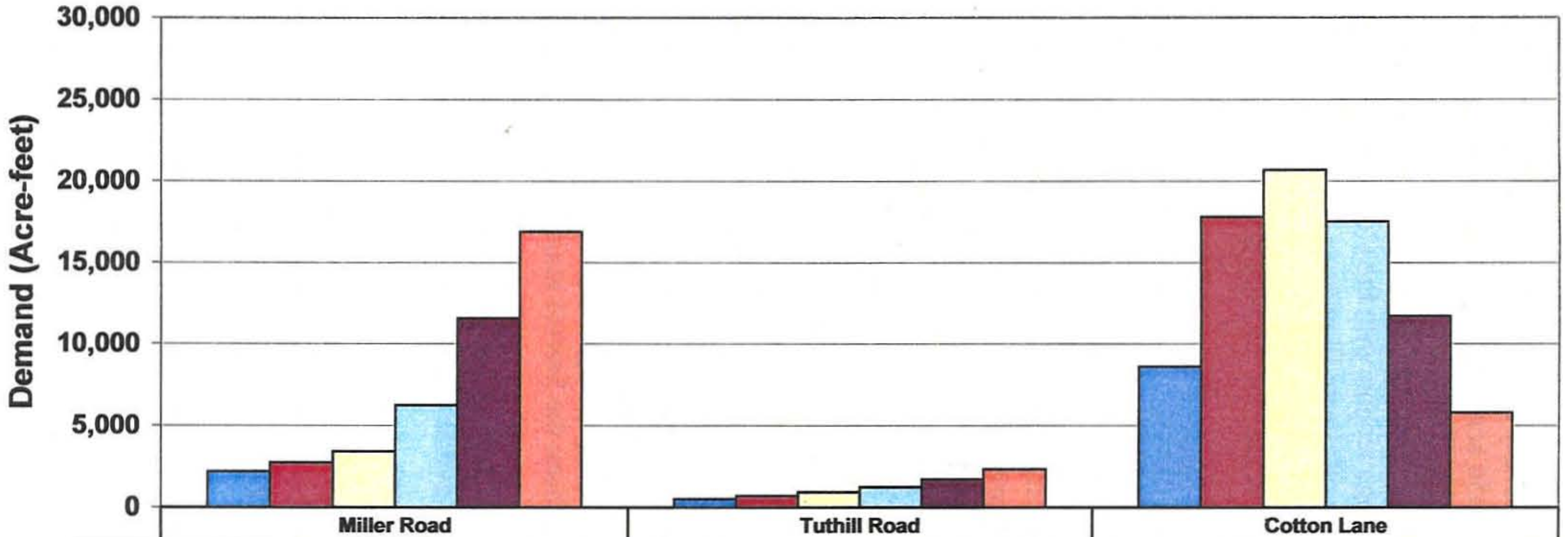
The estimate of the costs for the various pipeline alignments (trunk line and laterals) for the "Forward Flow" and "Reverse Flow" are based on the pipe sizes necessary to meet the design criteria of flow.

The various pipeline alignments and associated laterals require various pump sizes and various hydraulic features for proper operations. These are applicable particularly in the growth years of 2005 and 2015. The results of these various sizes are shown in Section 3.5, Results.

Figure 2

Yearly Average Water Demand by Lateral

(Maximum Total 25,000 AF/Year)



	Miller Road	Tuthill Road	Cotton Lane
2000	2,177	498	8,587
2005	2,714	679	17,807
2010	3,407	915	20,678
2015	6,247	1,236	17,517
2020	11,570	1,703	11,727
2025	16,896	2,303	5,801

Lateral

2000 2005 2010 2015 2020 2025

Scenario: Yea[illegible]25 Peak Demand

Alignment 3
Recovery Storage Site to Sarival Road along Dike and Yuma Road
West Maricopa Combine Pipeline to The Future (PTTF)
(Forward Flow)

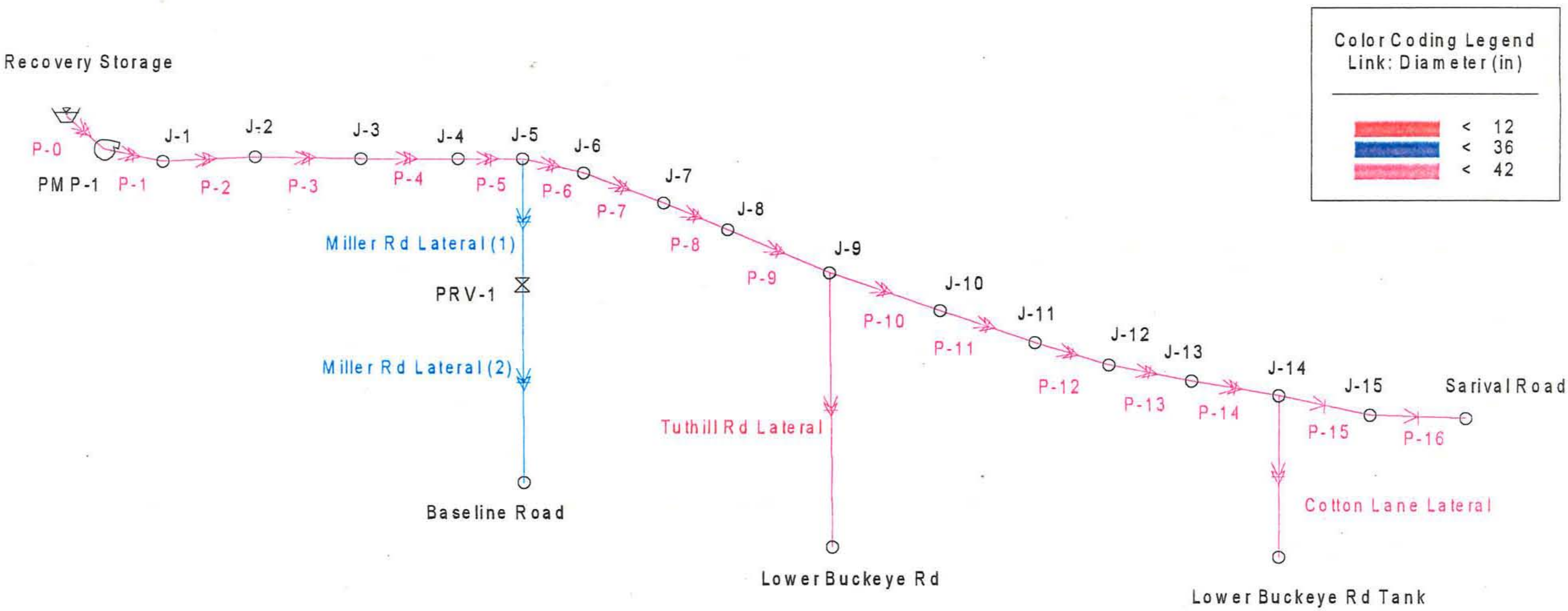
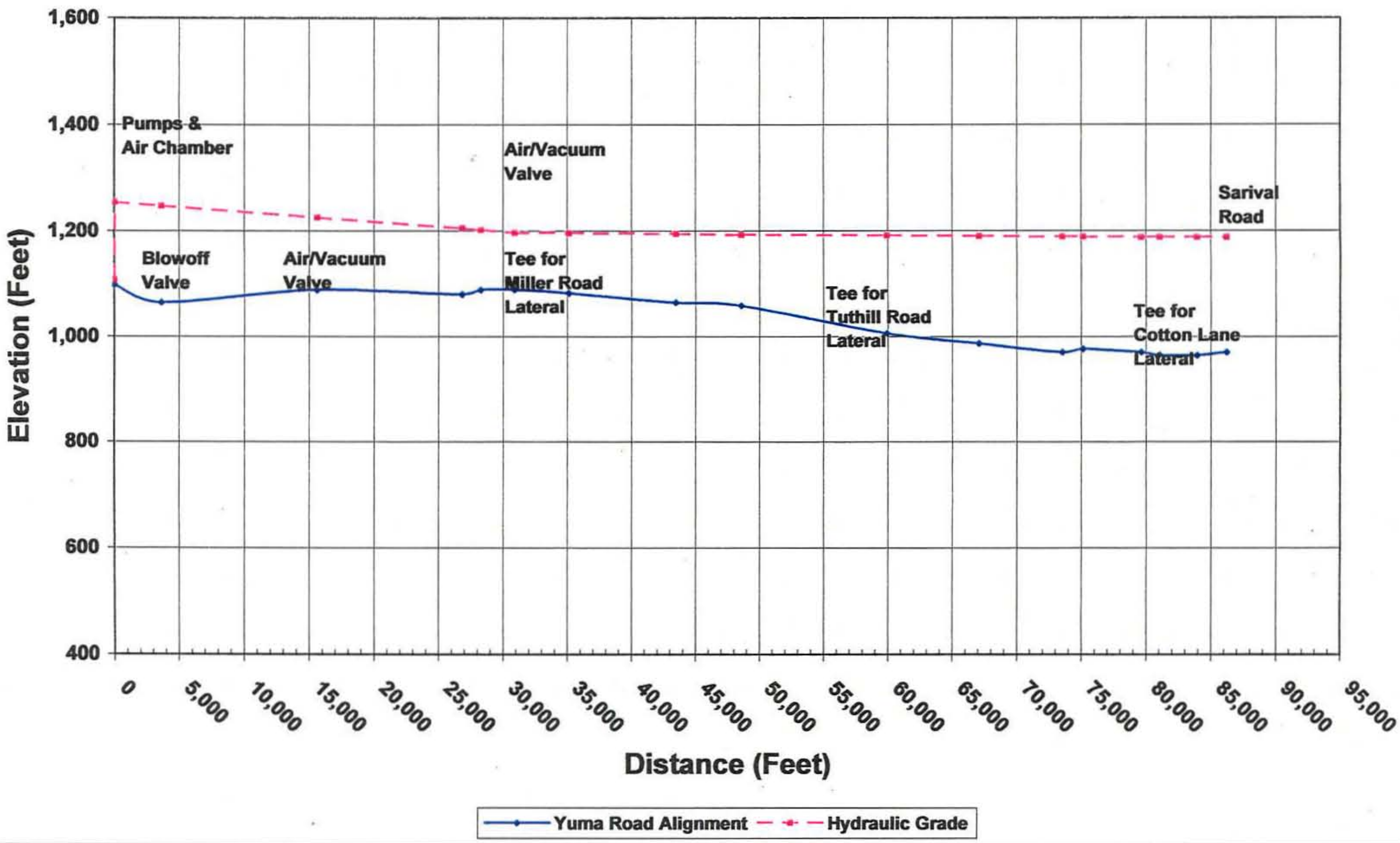


Figure AP A-3A

Alignment 3
From Recovery Site along Dike and Yuma Road to Sarival Road
West Maricopa Combine, WESTCAPS



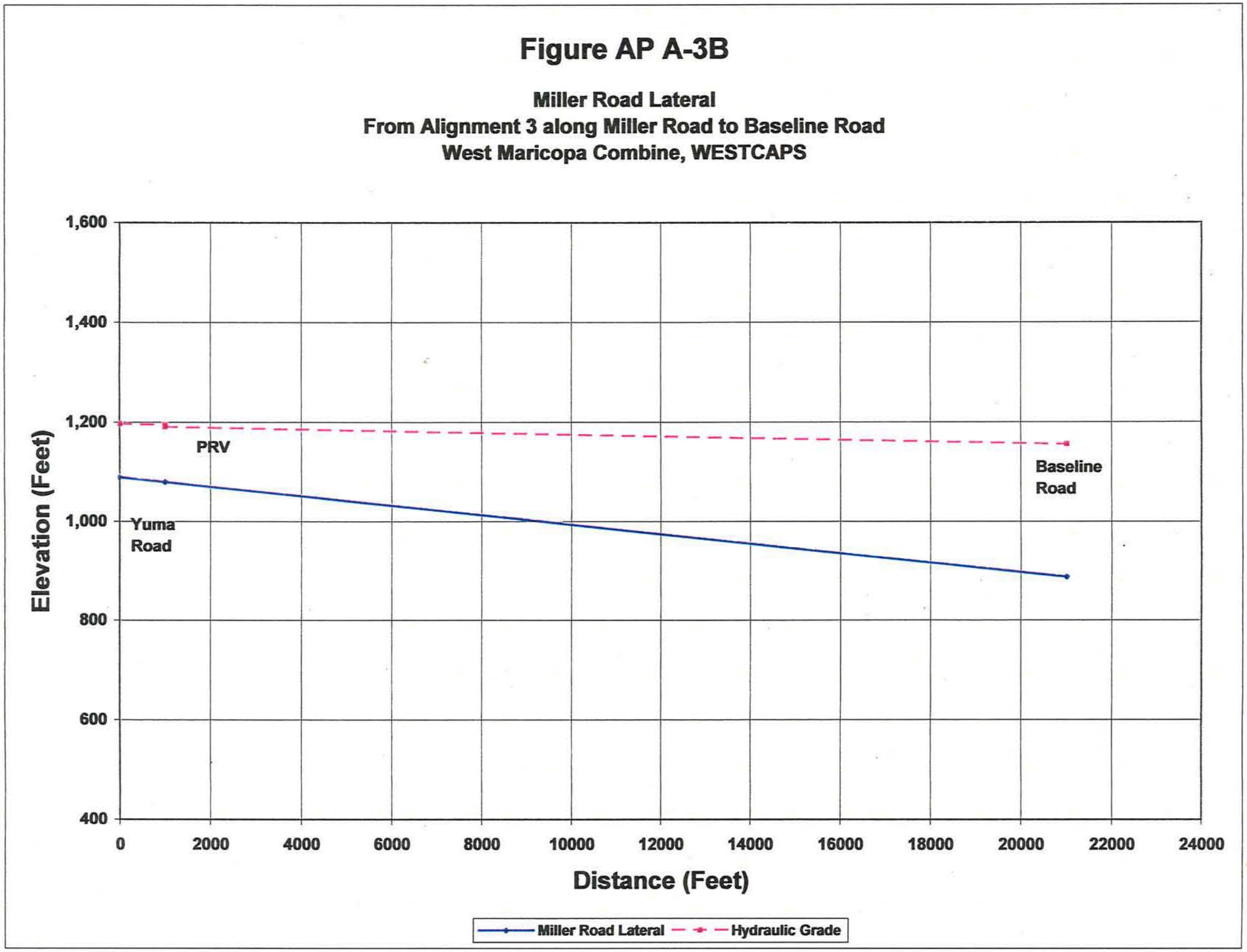


Figure AP A-3B
Miller Road Lateral
From Alignment 3 along Miller Road to Baseline Road
West Maricopa Combine, WESTCAPS
1,600
1,400
1,200
1,000
800
600
400
Elevation (Feet)
PRV
Baseline
Road
Yuma
Road
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
22000
24000
Distance (Feet)
Miller Road Lateral
Hydraulic Grade

Figure AP A-3C

Tuthill Road Lateral
From Alignment 3 along Tuthill Road to Lower Buckeye Road
West Maricopa Combine, WESTCAPS

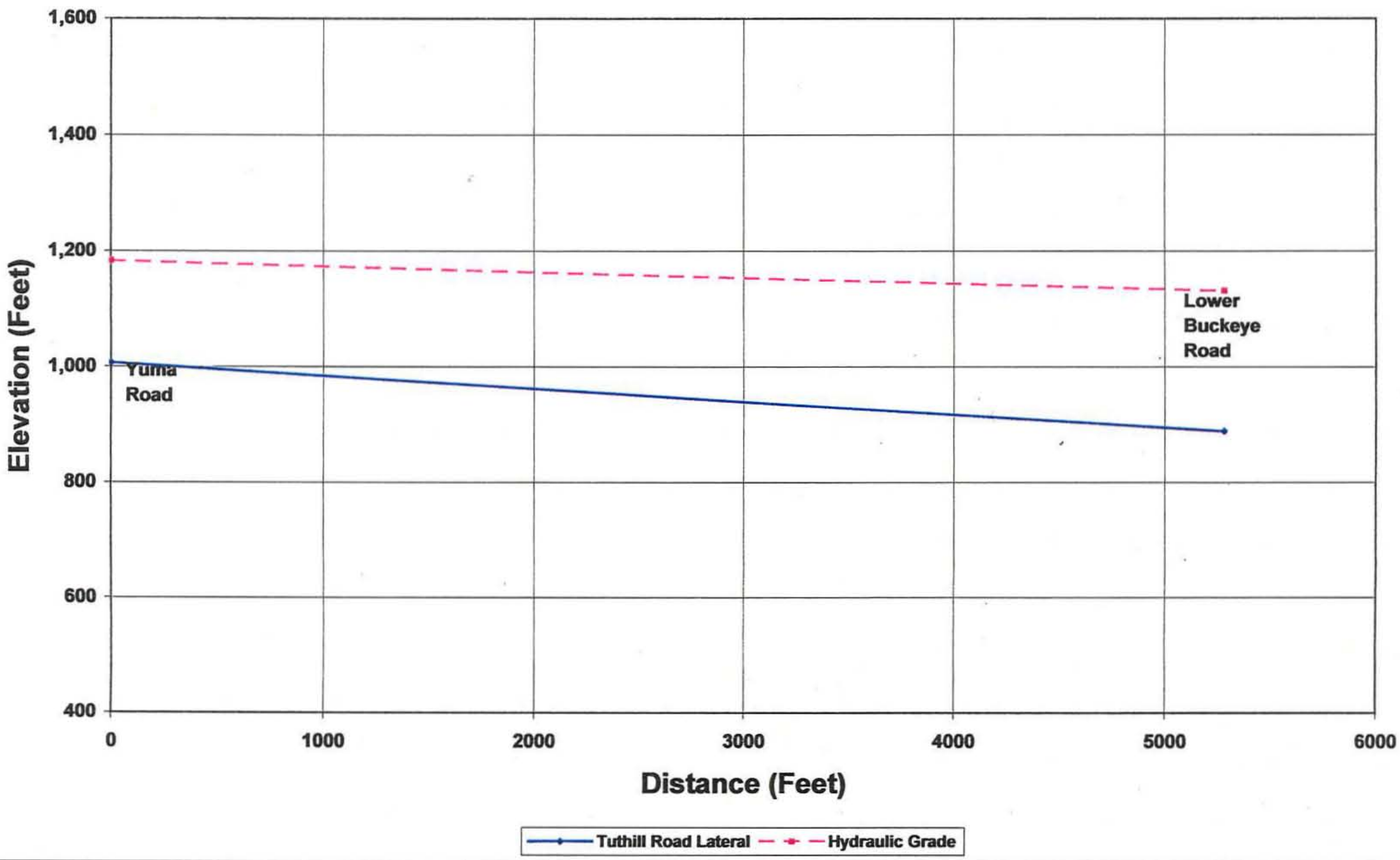
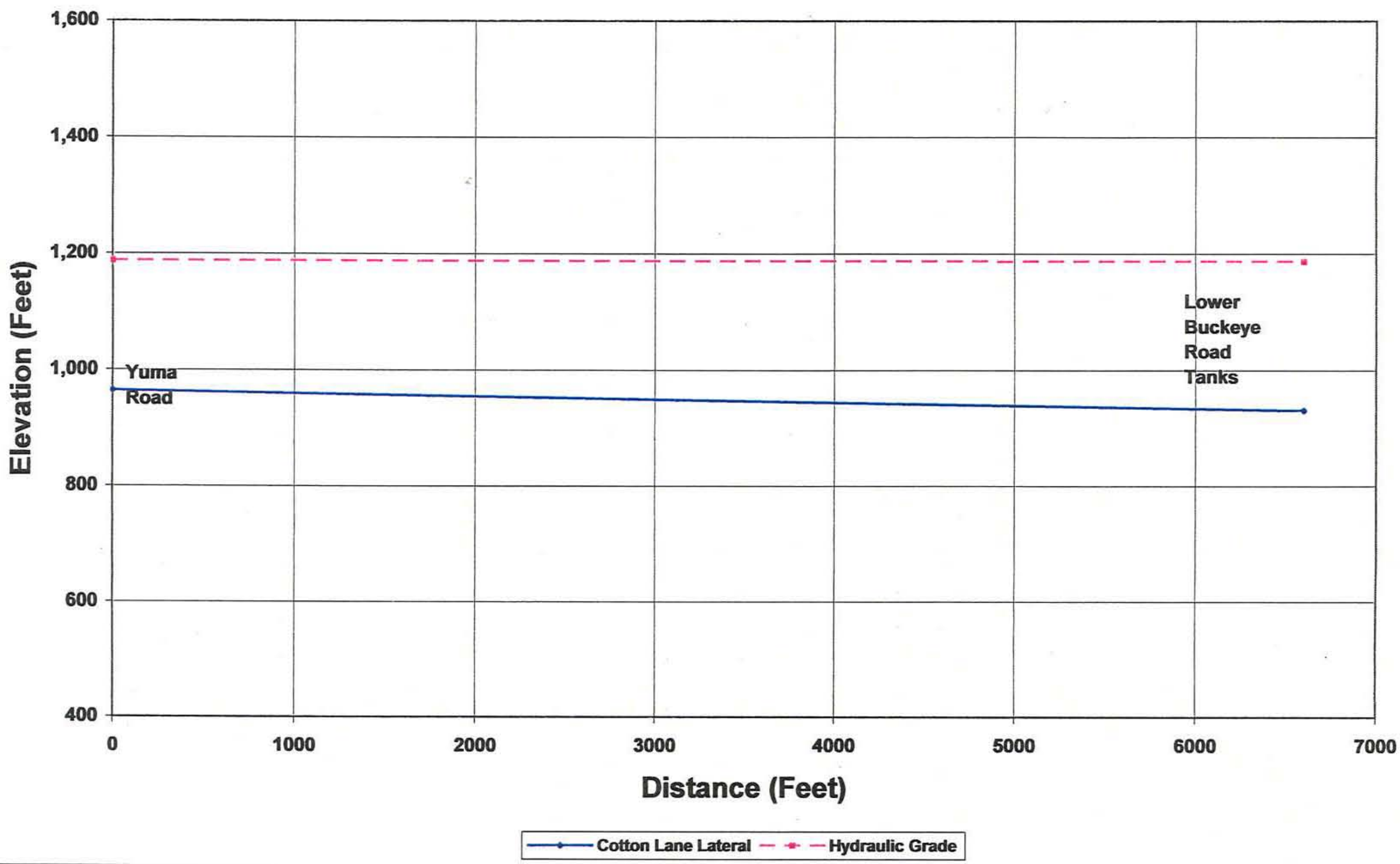


Figure AP A-3D

Cotton Lane Lateral
From Alignment 3 along Cotton Lane to Lower Buckeye Road Tanks
West Maricopa Combine, WESTCAPS



3.5 Results - Forward Flow Delivery System Alignments (West to East Flow)

The hydraulic results for the water delivery of 25,000 acre-feet/year in the year 2025 are as follows.

Forward Flow Delivery System

1. The pipe sizes required are 42 inches for all five alignments from the recovery storage site to Sarival Road. The pipe size for the Miller Road lateral is 36 inches, the size for the Tuthill Road lateral is 12 inches, and the size for the Cotton Lane lateral is 42 inches. All of the pipe sizes are in terms of inside diameter. Refer to the tables in Appendix A for specifics on diameters for the five alignments.
2. The anticipated water pressure distribution for each trunkline and lateral alignment ranges from approximately 40 psi to 120 psi. Refer the to tables and figures in Appendix A.
3. One pump/booster station is required at the recharge recovery storage site no matter which alignment is used, and pumping power ranges from 1,075 horse power to 1,790 horse power. The total dynamic head ranges from 146 feet to 244 feet. Refer to the summary Table in Appendix A.
4. One pressure-reducing valve is generally required for all of the alignments at the upstream side of the Miller Road lateral and the Cotton Lane Lateral to maintain the required pressure distribution for any major alignment considered. Refer to the tables and Figures in Appendix A for more information.
5. The estimated capital costs range from approximately $34 million to $40 million. See Table A-4 below. Refer also to the Summary Table and Figure in Appendix A.
6. The estimated annual operating costs range from approximately $900,000 to $1.4 million. See Table A-4 below. Refer also to the summary tables and figures in Appendix A.
7. The estimated costs per acre-feet of water delivered range from approximately $149 to $191 which is equivalent to approximately $0.46 to $0.59 per 1,000 gallon of water delivered. See Table A-4 below. Refer also to summary tables and figures in Appendix A.
8. Note: These cost totals only represent the cost of the delivery pipeline system and appurtenances. See Chapter 5 summary for the additional cost of delivery.

Table A-4
Cost Summary for Forward Flow Delivery

Item*	Alignment 1	Alignment 2	Alignment 3	Alignment 4	Alignment 5
Construction Cost*	$27,511,754	$26,108,603	$23,246,007	$23,856,052	$26,925,701
Capital Cost*	$40,283,455	$38,328,044	$34,164,409	$34,975,473	$39,509,982
20 Years' Amortized Cost*	$3,370,892	$3,207,265	$2,858,855	$2,926,724	$3,306,169
Annual O. & M. Cost*	$1,398,462	$1,139,400	$871,733	$1,128,137	$1,245,081
Total Annual Cost*	$4,769,354	$4,346,665	$3,730,588	$4,054,861	$4,551,250
Cost per Acre-Feet*	$191	$174	$149	162	$182
Cost per 1,000 Gallons*	$0.59	$0.53	$0.46	$0.50	$0.56

Note: *These cost totals only represent the cost of the delivery pipeline system and appurtenances. See Chapter 5 summary for the additional cost of delivery.

3.6 Three Reverse Flow Delivery System Alignments (East to West Flow)

a. Three alignments were analyzed for reversible flow delivery. The three reverse flow alignments reflect the highest, lowest and median cost of reverse flow and pumping.
b. All of the pipe sizes are the same as those for the Forward Flow Delivery System. For example, 42 inches is the size for the trunk line from Sarival Road to the connection with the Miller Road lateral, 36 inches is the size for the Miller Road Lateral, 42 inches is the size for the Cotton Lane Lateral and a 12-inch pipeline for the Tuthill Road Lateral. The pipe sizes designate the inside diameter. Refer to the tables in Appendix B.
c. The anticipated pressure distributed along each possible trunkline and lateral alignment range from approximately 40 psi to 120 psi. Refer to the tables and figures in Appendix B.
d. One pump/booster station is required at approximately one and a half miles west, of the Cotton Lane lateral, for Alignments 1 and 2, and just after the Tuthill Road lateral intersection for Alignment 3. Pumping capacity ranges from 500 horse power (H.P.) to 850 horse power (H.P.). The pumps' total dynamic heads range

from 100 feet to 151 feet. Refer to sketch figure on page 78 of alignment 3 and the summary tables in Appendix B for all three reverse flow alignments.

e. One pressure-reducing valve is required at the upstream side of the Miller Road lateral to maintain the required pressure distribution for any of the major alignments considered. Refer to the tables and figures in Appendix B.

f. The estimated additional capital costs for pumps range from approximately $600,000 to $700,000. See Table A-5 below. Refer also to the summary tables and figures in Appendix B.

g. The estimated annual pump operating and maintenance costs range from approximately $400,000 to $600,000. See Table A-5 below. Refer to the summary tables and figures in Appendix B.

h. The additional cost of reverse flow pumping, per acre-foot of water delivered ranges from $24 to $34 which is equivalent to approximately $0.07 to $0.10 per 1,000 gallon of water delivered. See Table A-5 below. Refer also to the summary tables and figures in Appendix B.

i. Note: These cost totals only represent the reverse pumping component of the delivery pipeline system and appurtenances. See Chapter 5 summary for the additional cost of delivery.

Table A-5

Cost Summary for Additional Pump for Reverse Flow Delivery

Item*	Alignment		
	1	2	3
Pump Construction Cost*	$485,650	$485,650	$439,400
Pump Capital Cost*	$679,910	$679,910	$615,160
20 Years' Amortized Cost*	$56,894	$56,894	$51,476
Annual Pump O. & M. Cost*	$599,072	$599,072	$350,347
Total Annual Pump Cost*	$655,966	$655,966	$401,823
Cost per Acre-Feet*	$34	$34	$24
Cost per 1,000 Gallons*	$0.10	$0.10	$0.07

Note: *These cost totals only represent the cost of reverse flow pumping. See Chapter 5 summary for the additional cost of delivery.

3.7 Conclusion and Observations

3.7.1 Preferred Forward Flow Water Delivery System (for Year 2025), Based on Overall Hydraulic Performance and Costs.

Alignment 3 (Yuma Road Alignment) appears to be the preferred choice compared to the other alignments. The selection is based on construction costs and operating costs.

The order of preferred alignments is 3 (along Yuma Road), 4 (along Yuma Road), 2 (along I-10 Freeway), 5 (along McDowell Road), and 1 (along McDowell Road).

The difference in cost between alignments 3 and 4, and alignments 1and 5 is approximately $2.7 million. The difference in cost between alignments 3 and 4, and alignment 2 is approximately $2.4 million. The length of the laterals has an appreciable affect on the overall cost. Though the elevation of the connecting points for the laterals for alignments 2, 3 and 4 (I-10 and Yuma Road) are at lower elevations than those of alignment 1 and 5 (along McDowell Road) the cost of additional pumping head for alignment 2, 3 and 4 is offset by the shorter lateral lengths. These criteria would not hold true if there were demand areas at other locations along the length of the lateral or to the north of the trunklines.

The disadvantage of shorter laterals is the inability to be able to deliver water to areas north of the installed trunkline. The additional cost associated with being able to pump to areas north of the trunkline may be desirable. Therefore, other considerations such as right-of-way availability and environmental obstructions, etc. are ultimately factors when selecting the location of a pipeline water distribution system.

The geographical and environmental advantages and disadvantages of the five alignments with three laterals are discussed in the previous section, Potential Alignments.

3.7.2 Forward Flow Delivery System for Growth (Transient) Years 2000 to 2025 for the Preferred Alignment (Alignment 3 along Yuma Road)

The hydraulic results for the water delivery of 25,000 acre-feet a year for years 2005, 2015 and 2025 are as follows.

The hydraulic data for the pipe sizes and the other features are the same data used to determine the forward flow analysis. The one difference is in reservoir booster pump size due to differing quantities of water being delivered during the different years.

The following are the hydraulic criteria (ranges) for the forward flow concept.

a. The design water pressure distribution for each trunkine and lateral alignment range from approximately 40 psi to 120 psi. As a reference see the tables and figures in Appendix C.
b. One booster/pump station is required at the recovery storage site, and the pump capacity ranges from 1,075 horse power to 1,470 horse power. The total dynamic heads range from 146 feet to 195 feet. For more information refer to the tables in Appendix C.
c. One pressure reducing valve is required at the upstream side of the Miller Road lateral and the Cotton Lane Lateral to maintain the required pressure distribution. For more information refer to the tables and figures in Appendix C.
d. The estimated pump capital cost is approximately $800,000. Although pump sizes differ depending on the alignment, the cost for pumps is based on the pressure and quantity of delivered water. Refer to the tables and figures in Appendix C.
e. The estimated annual pump operating and maintenance costs range from approximately $800,000 to $1.0 million. For more information refer to the tables and figures in Appendix C.
f. The estimated costs of water delivery per acre-foot to pump by the various alignments range from approximately $33 to $44, which is equivalent to approximately $0.10 to $0.14 per 1,000 gallon of water delivered. For more information refer to the tables and figures in Appendix C.

3.7.3 Preferred Reverse Flow Water Delivery System though Year 2025 and Overall Hydraulic Performance and Costs.

Based on the layout, the costs to construct, and the cost to operate, Alignment 3 along Yuma Road is the preferred reverse flow delivery alternative compared to the other alignments. The order, based on these variables, is Alignment 3 along Yuma road, Alignment 2 along the I-10 Freeway, and Alignment 1 along McDowell Road. As a point of reference, Alignments 3 is approximately 2 miles south of Alignment 1, and Alignment 2 is approximately one-quarter mile south of Alignment 1.

The main difference in cost comes from being able to use a smaller sized pump for Alignment 3 than the pump needed for Alignments 1 and 2.

The location of the Tee for the laterals to Alignments 3 and Alignment 2 are also at lower elevations than those of Alignment 1.

When estimating the cost of future pumping to areas north of each alignment, it appears that the cost difference is small among each alignment. Other factors, besides cost, would influence the decision on where to place pumps for laterals delivering water north of the main trunkline.

The geographical and environmental advantages and disadvantages for each of the five alignments and three laterals are described in detail in the section, Potential Alignment.

The following are e hydraulic criteria (ranges) for the reverse flow concept.

a. The design water pressure distribution for each trunkline and lateral alignment ranges from approximately 40 psi to 120 psi. As a reference see the tables and figures in Appendix D.
b. One booster/pump station is required after (west of) the Tuthill Road lateral point for the years in consideration, and the pump rating needed ranges from 100-horse power (H.P.) to 500 H.P. The total dynamic heads ranges from 100 feet to 130 feet. As a reference, see the tables in Appendix D.
c. One pressure-reducing valve is required at the upstream side of the Miller Road lateral to maintain the required pressure distribution. Refer to the tables and figures in Appendix D.
d. The estimated pump capital costs range from approximately $20,000 to $300,000. Refer to the tables and figures in Appendix D for more concise information.
e. The estimated annual pump operating and maintenance costs range from approximately $70,000 to $400,000. Refer to the table and figure in Appendix R for more concise information. The estimated costs of water delivery per acre-feet by the various pumps range from approximately $24 to $27, which is equivalent to approximately $0.07 to $0.10 per 1,000 gallons of water delivered. Refer to the tables and figures in Appendix D.

Scenario:Yea 25 Peak Demand

Alignment 3

Sarival Road to Buckeye Area along Yuma Road

West Maricopa Combine Pipeline to The Future (PTTF)

(Reversal Flow)

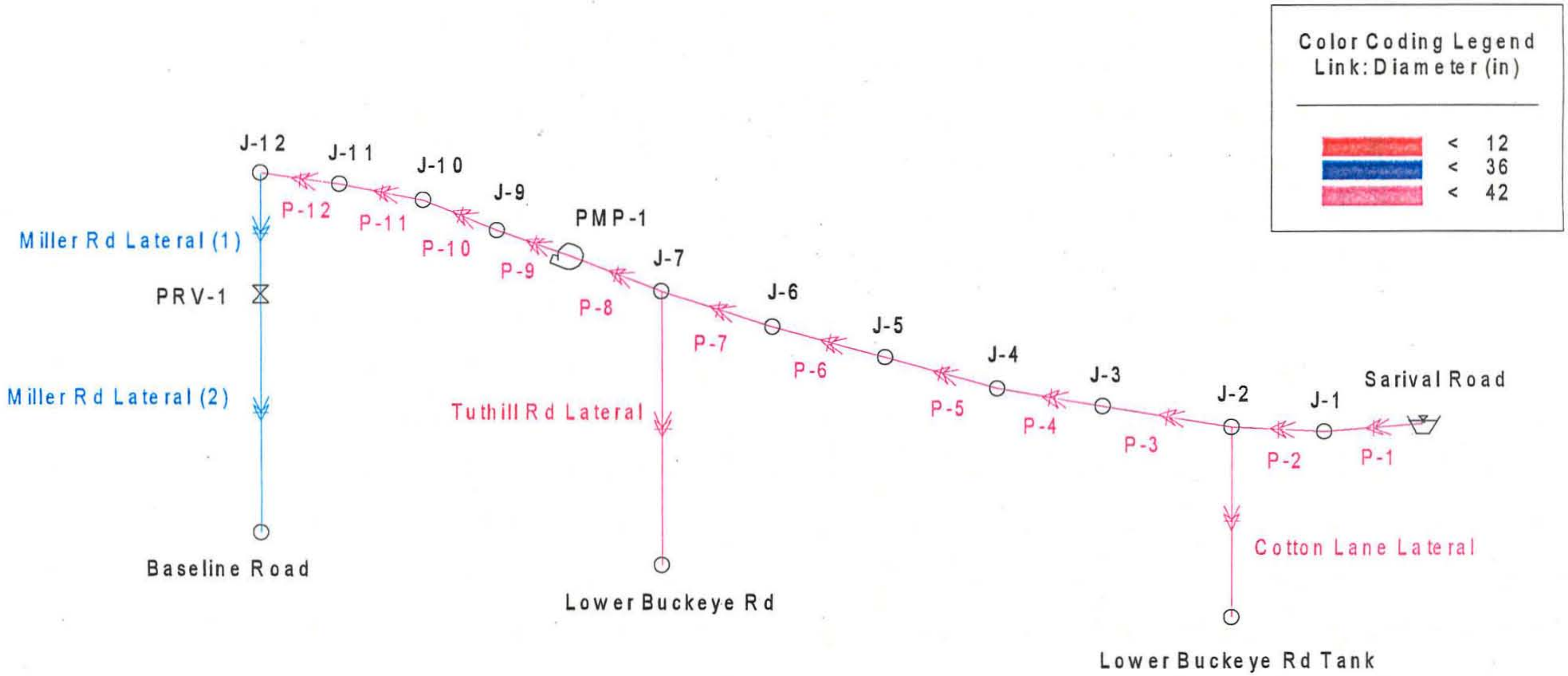
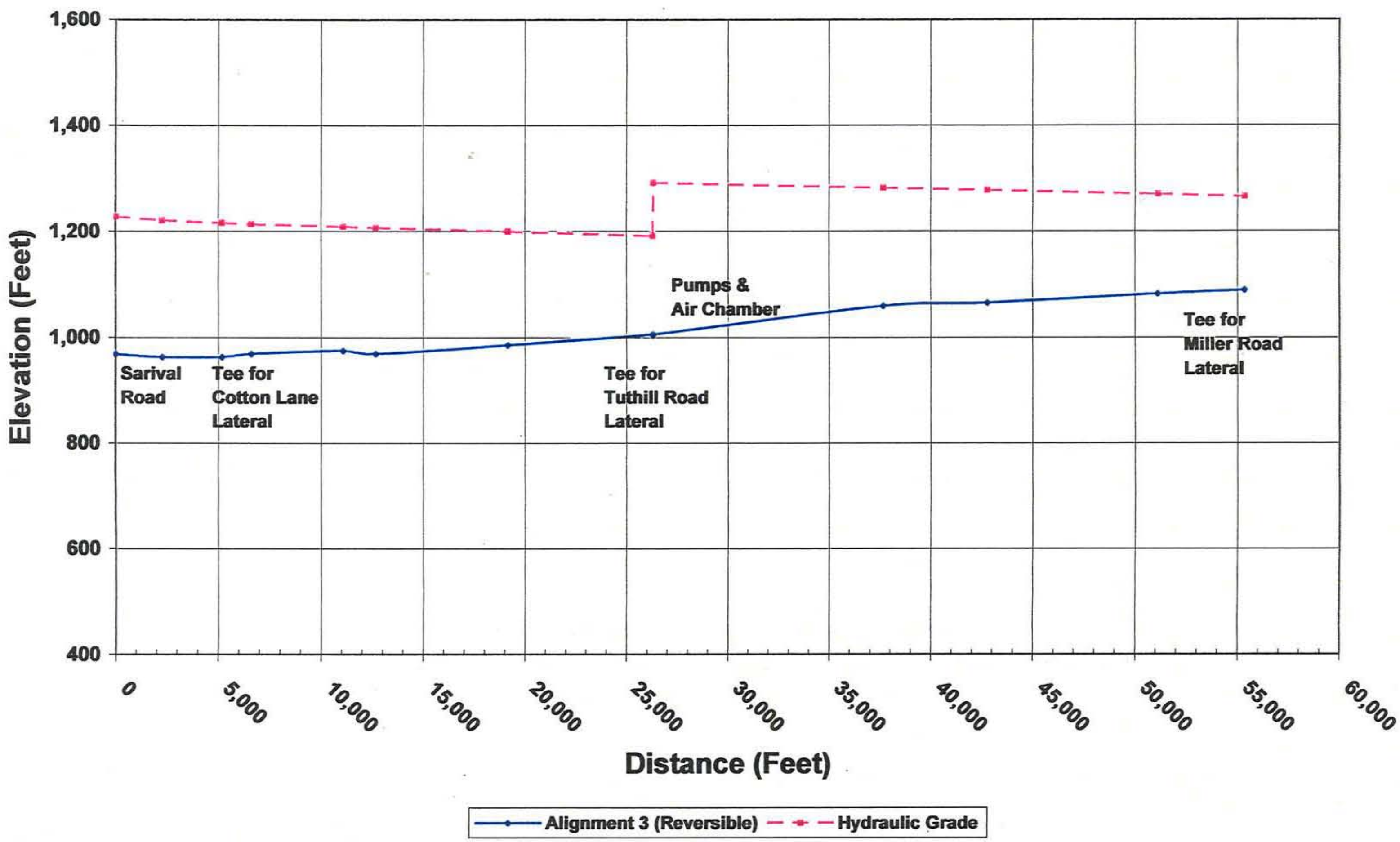


Figure AP B-3A

Alignment 3 (Reversal)
From Sarival Road along Yuma Road to Buckeye Area
West Maricopa Combine, WESTCAPS



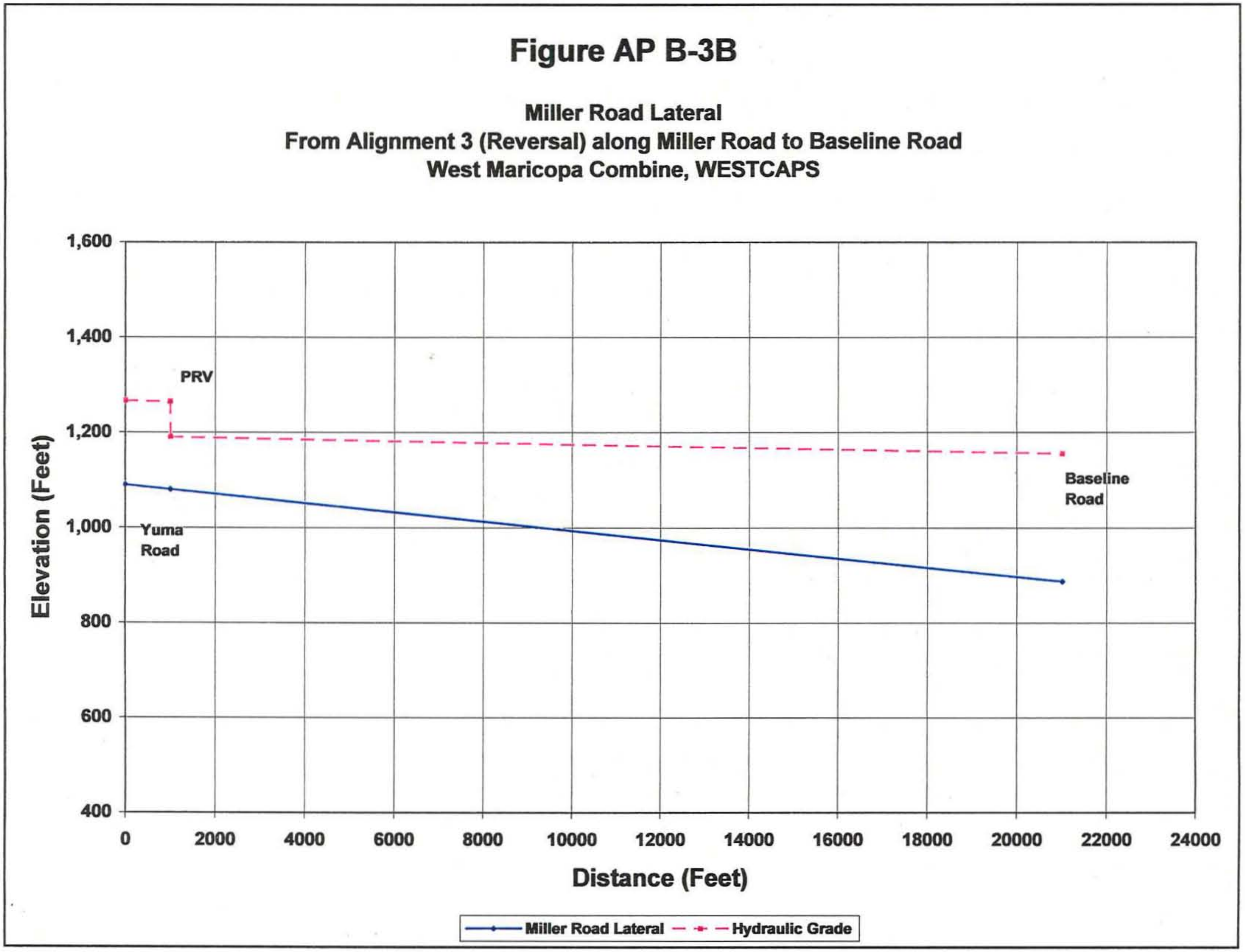


Figure AP B-3B
Miller Road Lateral
From Alignment 3 (Reversal) along Miller Road to Baseline Road
West Maricopa Combine, WESTCAPS
1,600
1,400
1,200
1,000
800
600
400
Elevation (Feet)
PRV
Yuma Road
Baseline Road
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
22000
24000
Distance (Feet)
Miller Road Lateral
Hydraulic Grade

Figure AP B-3C

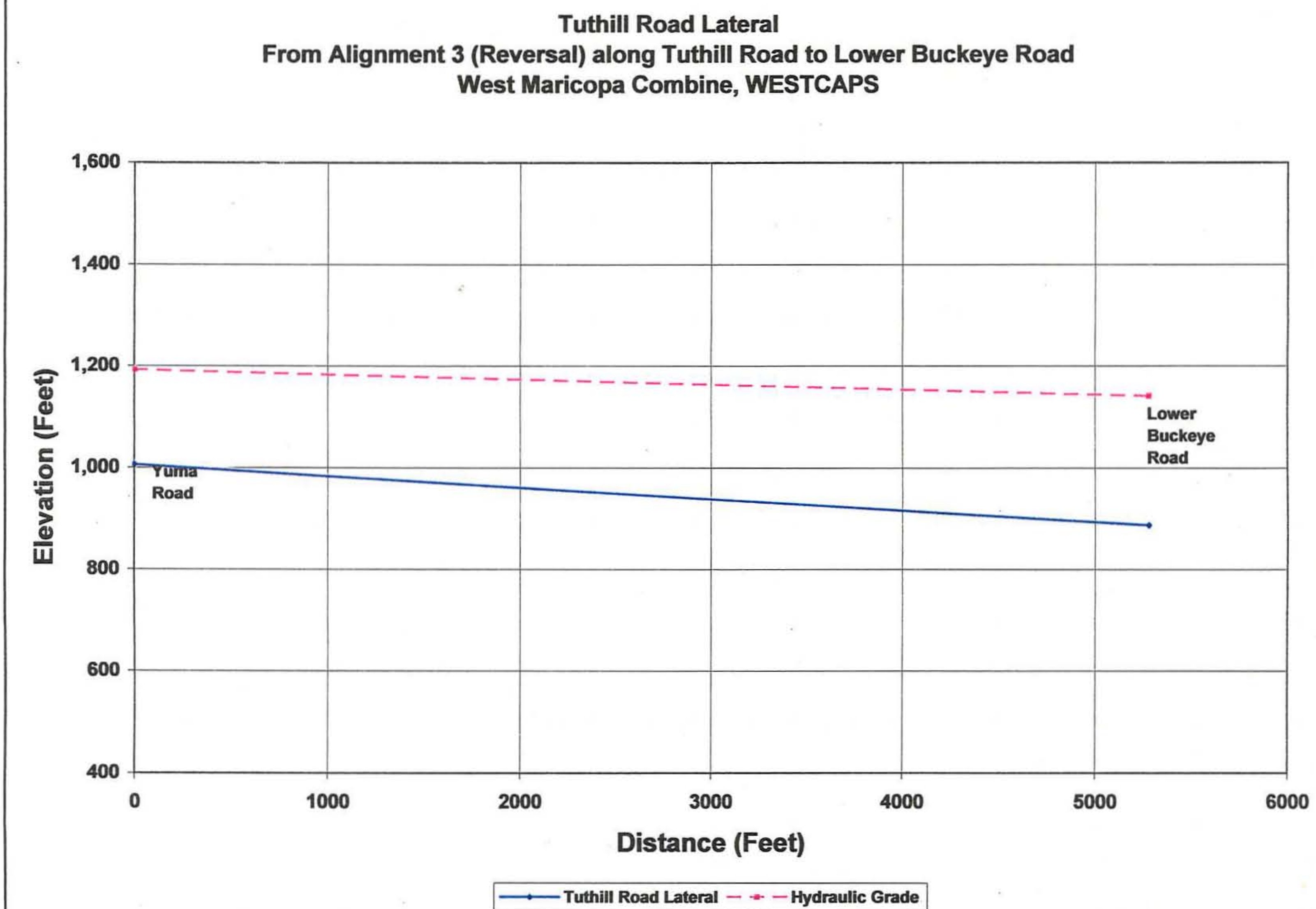
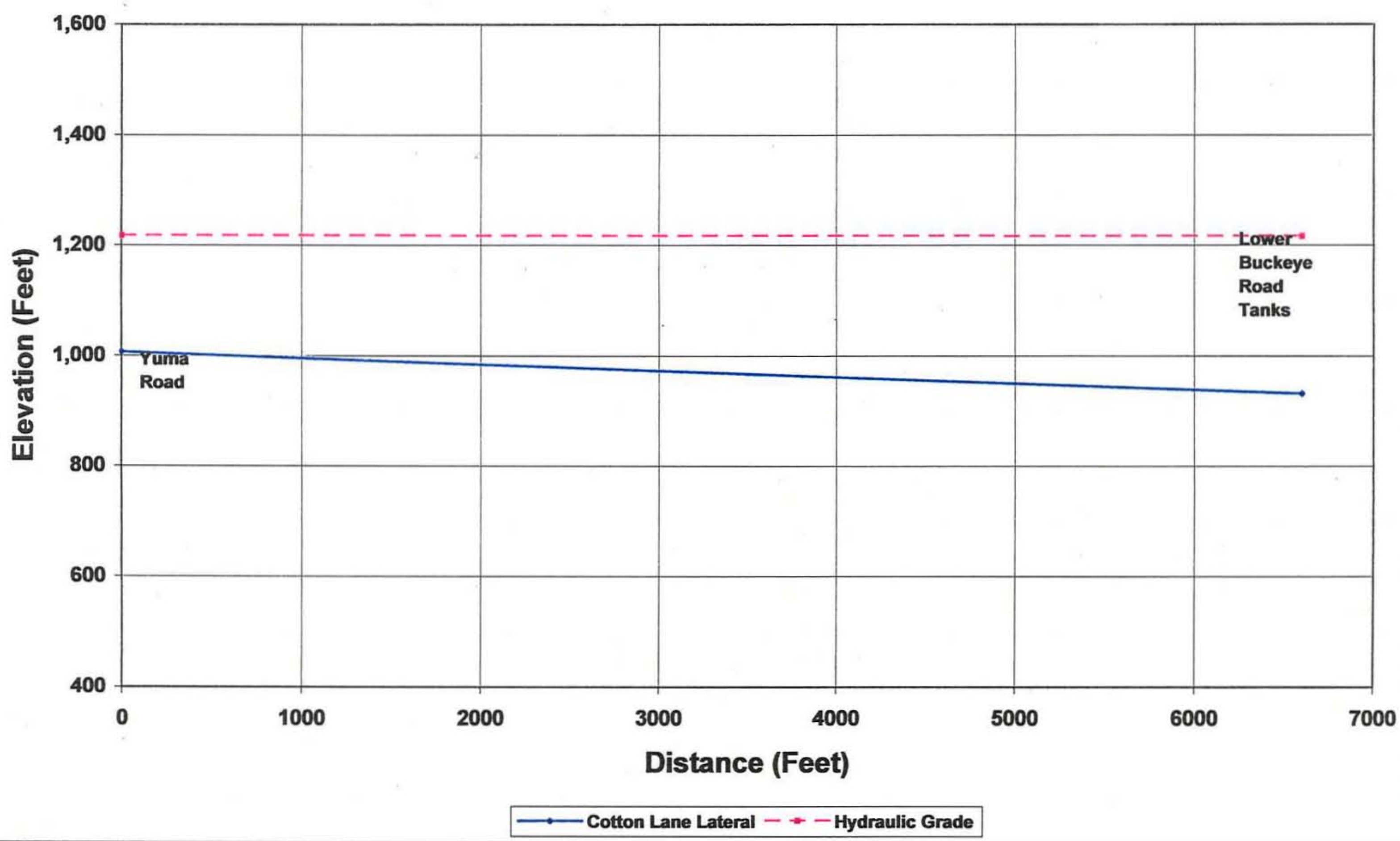


Figure AP B-3D

Cotton Lane Lateral
From Alignment 3 (Reversal) along Cotton Lane to Lower Buckeye Road Tanks
West Maricopa Combine, WESTCAPS



3.8 Unlimited Water Supply By Reverse Flow From Sarival Road

A summary and estimated cost were also prepared for an unlimited supply scenario from the Sarival Road main pipeline and providing all of the demands for the WPAs along the Cotton Lane lateral. The flow direction for this scenario is in reverse flow (east to west) mode. The following are the details of the summary.

a. By increasing the size of the pipeline from Sarival Road to the tee section point with the Cotton Lane lateral pipeline (approximately 1 mile) from 42 inches to 80 inches, and the Cotton Lane lateral (length varies depending on trunk line alignments) from 42 inches to 70 inches, the projected year 2025 average water demand in Goodyear #2 and Goodyear Outside of 64,770 acre-feet (89.47 cfs) can be delivered without any booster pumps from Sarival Road. All sizes are inside diameters.

b. The total increase in larger pipeline cost ranges from approximately $4.8 to $8.8 million. The pipeline cost increases will be approximately $2.5 to $4.5 million. The 20-year annual amortizing cost increases range approximately from $210,000 to $370,000. The increased cost per acre-foot for the water delivery (58,997 acre-feet or 81.49 cfs) for the year 2025 averages from approximately $42 to $76. This is equivalent to $0.13 to $0.23 per 1,000 gallons of water delivered due only to the increased pipe cost. See Table A-6 below for specifics on the cost of unlimited reverse flow delivery to Cotton Lane lateral.

Table A-6
Cost Summary for Unlimited Water Supply by Reverse Flow From Sarival Road

Item	Pipe Size (Inches)	Alignment 1	Alignment 2	Alignment 3
Sarival Road to Cotton Lane Main Pipeline	42	$1,019,040	$1,029,269	$998,582
Sarival Road to Cotton Lane Main Pipeline – Upsized Pipe	80	$2,302,080	$2,325,188	$2,255,864
Difference (Increase)		$1,283,040	$1,295,919	$1,257,282
Cotton Lane Lateral	42	$3,302,037	$3,057,506	$1,273,800
Cotton Lane Lateral – Upsized Pipe	70	$6,484,311	$6,004,118	$2,501,400
Difference (Increase)		$3,182,274	$2,946,612	$1,227,600
Net Difference (Increase)		$4,465,314	$4,242,531	$2,484,882
20 Years' Amortized Cost Increase		$373,654	$355,012	$207,933
Increased Cost per Acre-Feet (58,997 AF/Yr)		$76	$72	$42
Cost per 1,000 Gallons		$0.23	$0.22	$0.13

CHAPTER IV

EXISTING CONDITIONS

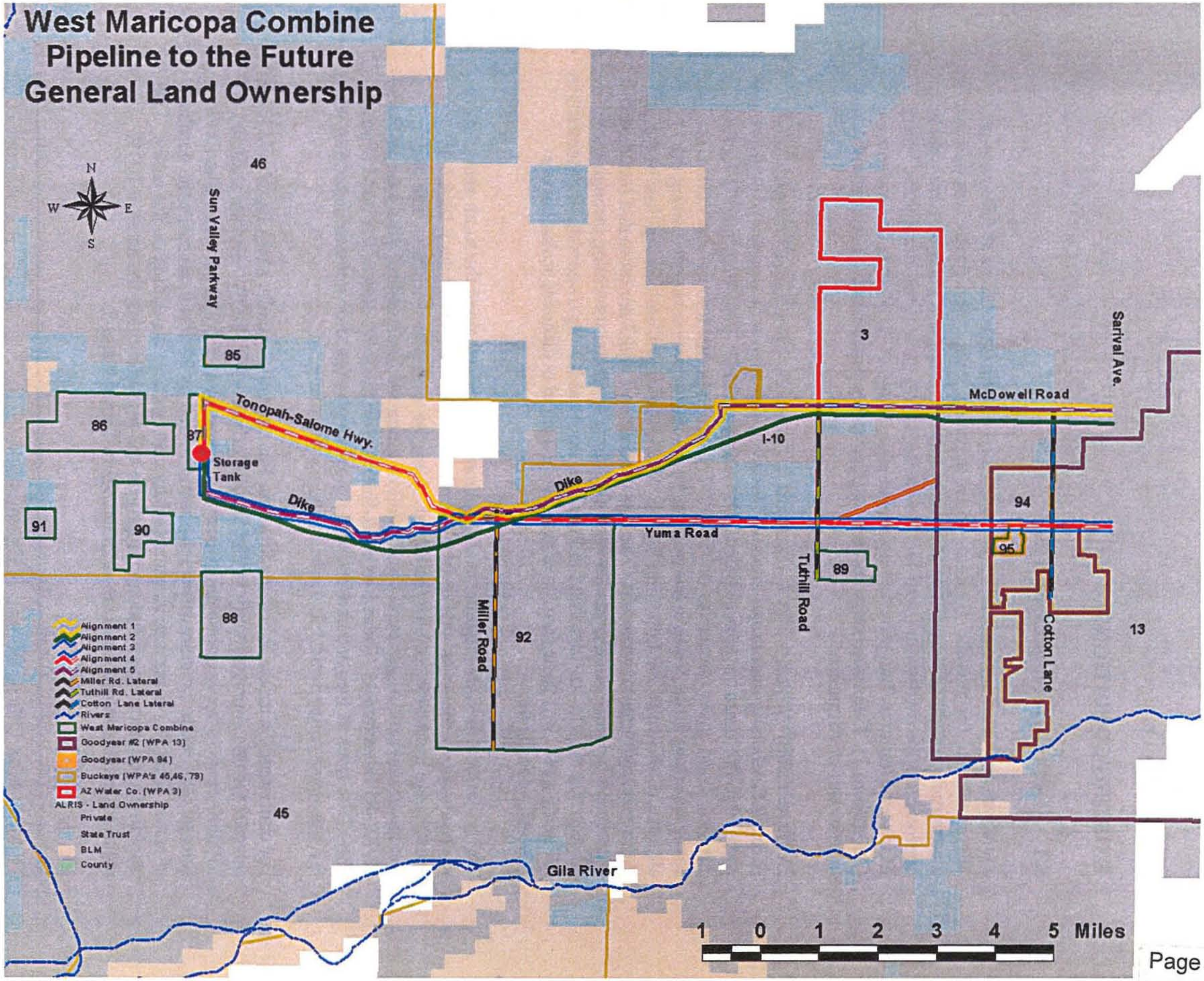
4.1 Land Ownership/Right-of-Way

Land was evaluated for ownership and cost when planning the layout for the pipeline alignments and the laterals. By doing so, an appraisal level cost estimate was derived for a construction right-of-way (ROW). Several sources (maps and listings) were used to approximate the ownership lineal footage needed along each of the alignments. West Maricopa Combine, Inc. provided a detailed assemblage of ROW data for one route (Alignment 1). This ownership data also applied to the western half of Alignment 4 and eastern half of Alignment 5.

Delorme's 2001 Arizona Atlas & Gazetteer shows public ownership (State and BLM parcels) for the alignments and laterals. However, this map is at a scale of 1:250,000 and ownership limits are not very detailed. The Arizona State Land Department's ALRIS Arc/Info Land cover (current as of 1994-1997) was imported into the ArcView GIS. This cover was used in ArcView to show State, BLM, and private ownership along the alignments shown in the following figure, "West Maricopa Combine Pipeline to the Future General Land Ownership. The costs in Tables 2 and 3 are estimated based on the cumulative lengths of segments for each alignment or lateral traversing through those entities that ALRIS has identified in their land cover as having ownership or easements in the study area. All three sources of data are presented at different scales but are generally consistent.

The proposed trunkline alignments are assumed will follow along the south shoulders of the roads, along the south side of the flood control dike from about the I-10/AZ-85 Interchange eastwards, and for the lateral, along the west side shoulders. The one exception is where Alignments 1 and 5 follow along the flood control dike west of the I-10/AZ-85 Interchange. These two trunk-lines are on the north side of the flood control dike. The sides of the road chosen for the pipeline was based on a visual inspection while driving along Alignments 1,3, 4, and 5, and the three laterals.

For consistency with the Westcaps Strategic Plan Appraisal study, a unit ROW width was selected for this appraisal study as 20 feet, and private entity ROW costs are assumed at \$30,000 per acre while public entity costs are assumed at \$10,000 per acre. The ROW acreage required is the cumulative lengths multiplied by 20 feet to compute the number of acres. This ROW acreage is multiplied by cost per acre depending on the entity. The trunkline and lateral lengths along the private and public entities, the acres of ROW required, and estimated costs are summarized in Tables 2 and 3.



West Maricopa Combine
Pipeline to the Future
General Land Ownership
N
W
E
S
46
Sun Valley Parkway
85
86
87
Storage Tank
Tonopah-Salome Hwy.
Dike
Dike
91
90
88
3
McDowell Road
Sarival Ave.
I-10
Yuma Road
94
95
89
Tuthill Road
Miller Road
92
Cotton Lane
13
45
Gila River
Alignment 1
Alignment 2
Alignment 3
Alignment 4
Alignment 5
Miller Rd. Lateral
Tuthill Rd. Lateral
Cotton Lane Lateral
Rivers
West Maricopa Combine
Goodyear #2 (WPA 13)
Goodyear (WPA 94)
Buckeye (WPA's 45,46, 79)
AZ Water Co. (WPA 3)
ALRIS - Land Ownership
Private
State Trust
BLM
County
1 0 1 2 3 4 5 Miles

Table 2 – Estimated Trunkline Lengths, Acres, and Right-of-way Costs

Entity/Easement	**State** Feet Acres Cost	Private Feet Acres Cost	**BLM** Feet Acres Cost	Total Estimated Cost
Alignment 1	14,165 6.5 $65,000	71,842 33 $990,000	7,265 3.3 $33,000	$1,088,000
Alignment 2	10,540 4.8 $48,000	78,480 36 $1,080,000		$1,128,000
Alignment 3	1,250 0.6 $6000	82,500 38 $1,140,000	2,560 1.2 $12,000	$1,158,000
Alignment 4	5,010 2.3 $23,000	76,840 35.3 $1,059,000	7,265 3.3 $33,000	$1,115,000
Alignment 5	9,290 4.3 $43,000	78,601 36 $1,080,000	2,560 1.2 $12,000	$1,135,000

Table 3 – Estimated Lateral Lengths, Acres, and Right-of-way Costs

Entity/Easement	**State** Feet Acres Cost	Private Feet Acres Cost	**BLM** Feet Acres Cost	Total Estimated Cost
Miller Road Lateral (All Alignments)		21,760 10 $300,000		$300,000
Tuthill Road Lateral Alignments 1 & 5	5,410 2.5 $25,000	10,411 4.8 $144,000		$169,000
Alignments 3 & 4		5,231 2.4 $72,000		$72,000
Alignment 2	5,210 2.4 $24,000	9,590 4.4 $132,000		$156,000
Cotton Lane Lateral Alignments 1 & 5	2,590 1.2 $12,000	14,370 6.6 $198,000		$210,000
Alignments 3 & 4		6,550 3 $90,000		$90,000
Alignment 2	2,590 1.2 $12,000	13,140 6 $180,000		$192,000

4.2 Water Quality Summary

In 1996 Montgomery Watson prepared a water quality report – Technical Memorandum No. 1 (Duren and Brand, 1996) for the West Maricopa Combine, Inc. Pipeline to the Future Project. This memo was entitled "Additional Documentation of Ground Water Quality in the Vicinity of the Proposed Recovery wellfield." The following is summarized from that memo.

The memo report was written to help characterize the water quality and estimate the long-term impacts of pumping 25,000 acre-feet per year of groundwater from the recovery wellfield and supplied by the pipeline. In the study, a Theis analysis was performed to determine the approximate hydrologic extent of the study area (at a wellfield drawdown of 10 feet, Montgomery Watson estimated the radial extent from the wellfield to be 10 miles). A subsequent Theis analysis estimated the cone of depression extents after 20 and 40 years of pumping. From the pump testing analyses, Montgomery Watson considered a representative transmissivity for the wellfield area to be 250,000 gpd/ft.

Wells within the study area were identified and existing inorganic constituent sampling results tabulated from a number of sources to determine the distribution of groundwater exceeding primary and secondary MCL standards for drinking water. These sampling results were dated between 1974 and 1992 depending on the well. Montgomery Watson concluded that in general, the ambient groundwater quality for the wellfield area was much better than the CAP water to be recharged excluding two generalized areas, which exceeded water quality (Technical Memorandum No.1, figure 1). One area of poor quality groundwater occurs from about lower Buckeye Road southwards along the Gila River. The other area is about seven to twelve miles due west of the recovery wellfield in the Hassayampa Riverbed.

These poor quality groundwater areas typically showed elevated levels of nitrates, chloride, fluoride, sulfate, and TDS levels ranging from about 530 to over 4500 mg/l. However, the aquifer was not differentiated (e.g., whether a sample came from the upper, middle, or lower alluvial aquifer). Three hydrogeologic cross-sections attached to the memo show that most of the wells terminate in the lower alluvial unit. Table 2 in Technical Memorandum No. 1 lists the perforated well depths but most wells appear to be screened from the bottom up into the upper portion of the lower aquifer and probably many wells draw water from the middle alluvial unit as well. Table 1 in Technical Memorandum No. 1 shows sampling results (generalized across the board) show that TDS, chloride, sulfate, sodium, and magnesium (all in mg/L), and boron (in ug/L), concentrations are relatively greater than for the other sampled parameters.

Montgomery Watson concluded that the 10-foot drawdown cone of depression would probably not intercept these areas after pumping 25,000 acre-feet annually for 20 years but would after having pumped for 40 years. Their travel-time analysis showed it could take 100 years for groundwater constituents from the two poor quality areas to actually reach the recovery wellfield wellscreens under pumping conditions. They anticipate the TDS levels to range from 170 to 500 mg/l in the wellfield area in the first 20 years.

CHAPTER V

COST SUMMARY

5.1 Cost Summary of Preferred Alignment

Scope of Costing Summary
The facilities defined for this study are the 42-inch main pipeline from the intersection of Palo Verde Road (Sun Valley Parkway) and the extension of Van Buren Road eastward to Sarival Road and the delivery lateral pipelines to the centroid of the three service areas.

Alignment 3 has been selected as the preferred alignment and the least cost solution as determined by the scope of the criteria given for this study and the current site conditions evaluated. Additional details of the process to price the pipeline system can be found in Section 3 and Appendices A through D.

There are other features and costs that were not in the scope of work required for this report. These additional costs are included in the summary to give a better representation of the total cost for water delivery. Those items are Recharge Facility Use Fee, Cost of Recovery to Storage Reservoir, Other Charges, and 10% Profit and 33% Income Tax. These items are presented as part of the total cost, but are not verified as part of this study.

Table 4 - TOTAL COST
Summary of Costs – Alignment #3 – Preferred Alignment

SUMMARY OF TOTAL COST PER UNIT		
DESCRIPTION OF COST	**$/Acre-Foot**	**$/1000 Gallons**
Pipeline System and Facilities, (Forward Flow) Capital and O&M Cost	$149	$0.46
Recharge Facility Use Fee*	$13	$0.04
Cost of Recovery to Storage Reservoir*	$169	$0.52
Other Charges**	$0	$0
SUBTOTAL	$331	$1.02
10% Profit and 33% Income Tax***	$57	$0.18
SUBTOTAL	$388	$1.20
CAP Water Cost****	$150	$0.46
TOTAL COST – FORWARD FLOW	$538	$1.66
Additional Facilities for Reverse Flow, Capital and O&M Cost	$34	$0.10
10% Profit and 33% Income Tax***	$6	$0.02
SUBTOTAL	$40	$0.12
TOTAL COST – FORWARD AND REVERSE FLOW	$578	$1.78

*Cost of recharge is from West Maricopa Combine data provided to WESTCAPS.
*Recovery costs were calculated on 6/11/02. The original scope of work did not include verifying the cost of recharge or recovery in this study.
** Other Charges may include other controlling agency costs. To be determined by other agencies.
***Allowable for private companies.
****Cost of CAP Water was agreed at a cost of $150 as part of the 9/15 plan.

Additional evaluation information regarding the selection of Alignment 3, based on costs, are discussed with table and graphic representation as follows.

Total Construction Cost
The cost comparisons for Forward Flows of the five alignments are shown on page 91, Table AP A-S3, Construction and Capital Costs. The table shows the description and costs of the major features. Also shown are the subtotals for pipelines, pumps and related structures, other major control structures, pressure-reducing valves and a simple supervisory control and data acquisition (SCADA) system. The total of these items are shown as the Total Construction Cost.

Total Capital Cost
To determine the Total Capital Cost, the sum of the Total Construction Cost, Contingencies, Engineering and Administration, and Right of Way Acquisition are totaled. This cost represents the minimum capitalized amount for completion of the defined delivery system. Shown in Figure AP A-S1 is the Summary Bar graph of the Construction and Capital Costs for the five alignments.

Annual Operation and Maintenance Costs
Table AP A-S4 shows the major annual operation and maintenance (O&M) costs for each of the alignments. The major O&M costs are the annual operation and maintenance of the pipeline, pumps, and the pump energy costs. The totals represent the major annual cost for Operation and Maintenance of the system studied. A bar graph is also included with the table to show the relative total Annual O&M costs.

Total Annualized Costs
To combine and amortize the capital costs and the Operation and Maintenance costs, a 20-year recovery period was used for the project at an annual percentage rate of 5.5%. This duplicates the cost basis that was used in the prior WESTCAPS report. To determine a comparable cost per unit volume, the costs were further broken down to reflect the delivery of 25,000 acre-feet per year through the system. Table AP A-S5 shows the summary of the Total Annualized Costs for the five alignments studied, the resultant cost per acre-foot and cost per 1,000 gallons. Note that these costs only represent the cost of the pipeline system and appurtenances in the forward flow, from west to east.

The apparent lowest cost per delivery amount is Alignment 3. This apparent lowest cost alignment is summarized at the end of this chapter. The other four alignments are also detailed and summarized in Appendix A, Hydraulic and Cost Study.

Additional Reverse Flow Costs
(Construction, Capital, Annual Operation and Maintenance, Annualized)
Also a part of this study is the pump back, or reverse flow of a portion of the system to meet future water demands beyond the 25,000 acre-feet per year supply of the PTTF and recharge-recovery system. Table AP B-S1 shows the criteria used for sizing the reverse

flow pumps, the volume of water and the head and energy required for the system to function and meet all system water demands. Note that Alignments 1, 2 and 3 are the only systems studied. These three alignments show the typical range of head and capacity required for the reverse flow system.

Table AP B-S2 shows the additional construction and capital costs required to integrate the reversible flow capability into each of the three alignments.

Table AP B-S3 shows the annual reverse pumping operating and maintenance costs for each of the three alignments. Also included is a bar graph to show the costs relative to one another.

The same criteria used for the forward flow cost basis were applied to combine and amortize the reverse pump flow capital costs and the operation and maintenance costs. To determine a comparable cost per unit volume, the costs were further broken down to reflect the delivery of the required acre-foot amount per year as shown on AP B-S1, "Pumpage, Maximum in acre-feet a year". Table AP B-S4 shows the summary of the Total Annualized Costs for alignments 1, 2 and 3 studied for reverse flow. The results are derived in cost per acre-foot and cost per 1,000 gallons. Note that these costs only represent the cost of the reversible pumping system and appurtenances, from east to west.

5.2 Additional Study added

The unlimited water supply by reverse flow from Sarival Road scenario, which requires the resizing of the pipeline system, was requested by WMC. The summary of this portion of the study can be found at the end of Section 3 and the table entitled (TABLE A-6), "Cost Summary for the Unlimited Water Supply by Reverse Flow From Sarival Road".

Table AP A-S3

Construction & Capital Cost Estimation
Water Delivery from the Recovery Site Storage (Forward)
West Maricopa Combine Pipeline to the Future (PTTF)

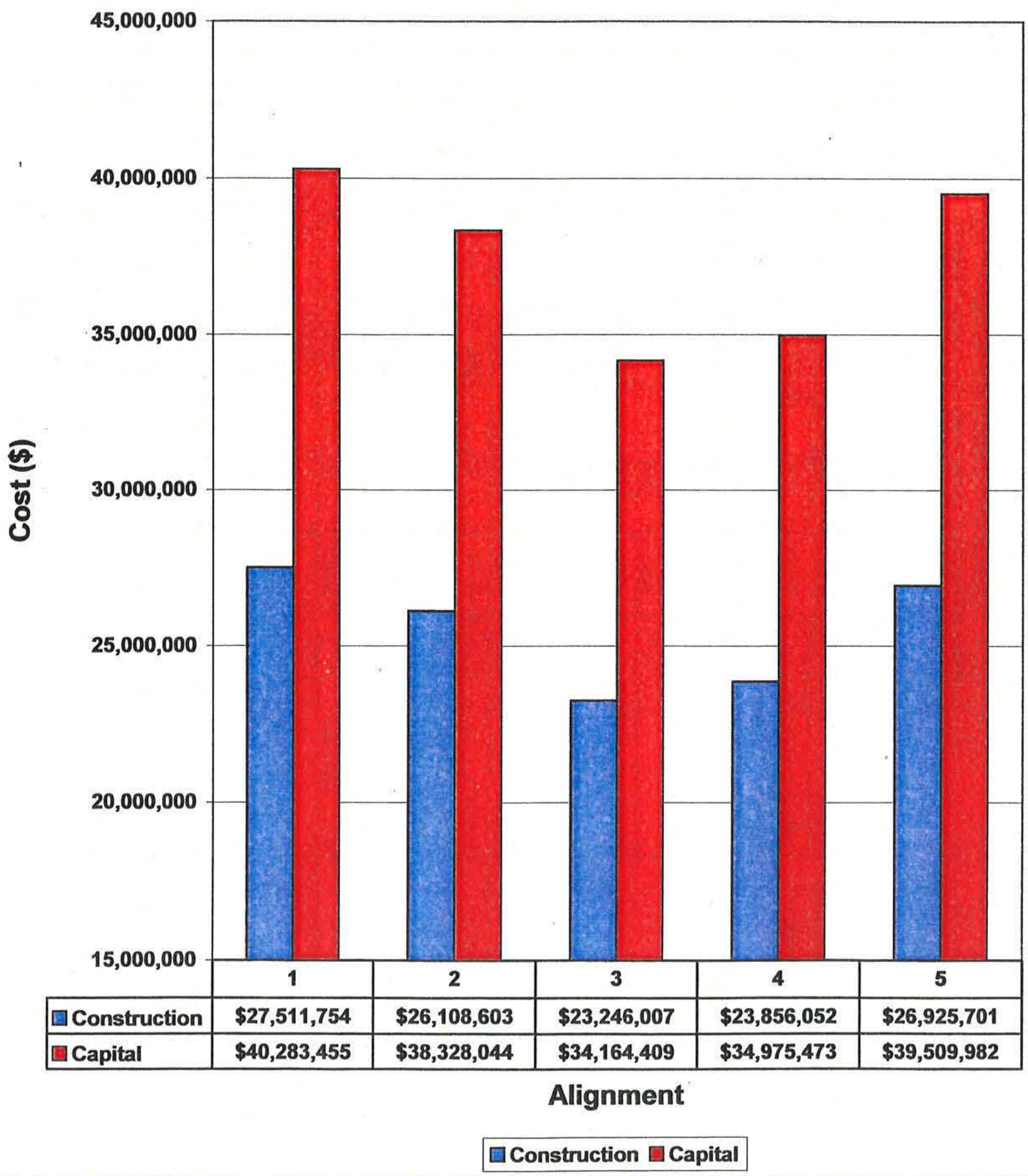
				Construction Cost ($)				
				Alignment (see Note)				
Item	Description	Unit	Size	1	2	3	4	5
Reinforced Concrete Pipe in Feet	Trunk line	(Inches)	42	$17,957,554	$17,151,716	$16,661,954	$17,263,000	$17,396,501
Sizes are for inside diameter	Cotton Lane Lateral	(Inches)	42	$3,305,459	$3,060,674	$1,275,120	$1,275,120	$3,305,459
	Miller Road Lateral	(Inches)	36	$3,791,975	$3,507,333	$3,654,262	$3,654,262	$3,791,975
	Tuthill Road Lateral	(Inches)	12	$1,074,147	$1,020,260	$359,251	$359,251	$1,074,147
Subtotal				$26,129,135	$24,739,984	$21,950,588	$22,551,633	$25,568,082
Pumps (80 % Efficiency)	near Recharge site storage	(H.P.)	1,075	NA	NA	$602,200	NA	NA
including housing structures	near Recharge site storage	(H.P.)	1,435	NA	$602,200	NA	$602,200	NA
		(H.P.)	1,575	NA	NA	NA	NA	$602,200
	near Recharge site storage	(H.P.)	1,790	$602,200	NA	NA	NA	NA
Subtotal				$602,200	$602,200	$602,200	$602,200	$602,200
Air Chamber	on pumps' discharge line	$Feet^3$	2,500	$90,000	$90,000	$90,000	$90,000	$90,000
Air Valve	Trunk line	(Inches)	42	$10,000	NA	NA	NA	$5,000
Air / Vacuum Valve	Trunk line	(Inches)	42	$10,000	$10,000	$10,000	$5,000	$5,000
Blow-off Valve	Trunk line	(Inches)	42	$6,000	$12,000	$6,000	$0	$6,000
Gate Valves (see Note 6)	Trunk line	(Inches)	42	$360,000	$340,000	$320,000	$340,000	$340,000
	Cotton Lane Lateral	(Inches)	42	$60,000	$60,000	$40,000	$40,000	$60,000
	Miller Road Lateral	(Inches)	36	$80,000	$80,000	$80,000	$80,000	$80,000
	Tuthill Road Lateral	(Inches)	12	$60,000	$60,000	$40,000	$40,000	$60,000
Subtotal				$560,000	$540,000	$480,000	$500,000	$540,000
Pressure Reducing Valve	on Cotton Lane Lateral	(Inches)	42	$7,200	$7,200	$7,200	$7,200	$7,200
	on Miller Road Lateral	(Inches)	36	$7,200	$7,200	NA	NA	$7,200
Subtotal				$14,400	$14,400	$7,200	$7,200	$14,400
S.C.A.D.A.		Lump sum	NA	$100,000	$100,000	$100,000	$100,000	$100,000
Total Construction Cost				$27,511,754	$26,108,603	$23,246,007	$23,856,052	$26,925,701
Contingency: %	Percent of Total Construction Cost	%	20	$5,502,351	$5,221,721	$4,649,201	$4,771,210	$5,385,140
Engineering & Administration, %	Percent of Total Construction Cost	%	20	$5,502,351	$5,221,721	$4,649,201	$4,771,210	$5,385,140
Right-of-Way Acquisition								
a. Public land (Federal and State)	Trunk line and Laterals	acres		$135,000	$84,000	$18,000	$56,000	$92,000
b. Private land	Trunk line and Laterals	acres		$1,632,000	$1,692,000	$1,602,000	$1,521,000	$1,722,000
Subtotal				$1,767,000	$1,776,000	$1,620,000	$1,577,000	$1,814,000
Total Capital Cost				$40,283,455	$38,328,044	$34,164,409	$34,975,473	$39,509,982

Note

Alignment 1:	From Recovery Storage Site to Sarival Road along Tonopah-Salome Highway and McDowell Road
Alignment 2:	From Recovery Storage Site to Sarival Road along I - 10 Freeway
Alignment 3:	From Recovery Storage Site to Sarival Road along Dike and Yuma Road
Alignment 4:	From Recovery Storage Site to Sarival Road along Tonopah-Salome Highway and Yuma road
Alignment 5:	From Recovery Storage Site to Sarival Road along Dike and McDowell Road
6	Gate valves are assumed to be located at about every one mile interval.

Figure AP A-S1

Construction & Capital Costs
(Forward Flow)



	1	2	3	4	5
Construction	$27,511,754	$26,108,603	$23,246,007	$23,856,052	$26,925,701
Capital	$40,283,455	$38,328,044	$34,164,409	$34,975,473	$39,509,982

Table AP A-S4

Annual Operating and Maintenance Cost
Water Delivery from the Recovery Storage Site (Forward)
West Maricopa Combine Pipeline to the Future (PTTF)

Item	Alignment				
	1	2	3	4	5
Pipe O.& M. Cost	$137,559	$130,543	$116,230	$119,280	$134,629
Pump O.& M. Cost	$793,000	$633,750	$474,500	$633,750	$698,750
Pumping Energy Cost	$467,903	$375,107	$281,003	$375,107	$411,702
Total O.& M. Cost	$1,398,462	$1,139,400	$871,733	$1,128,137	$1,245,081

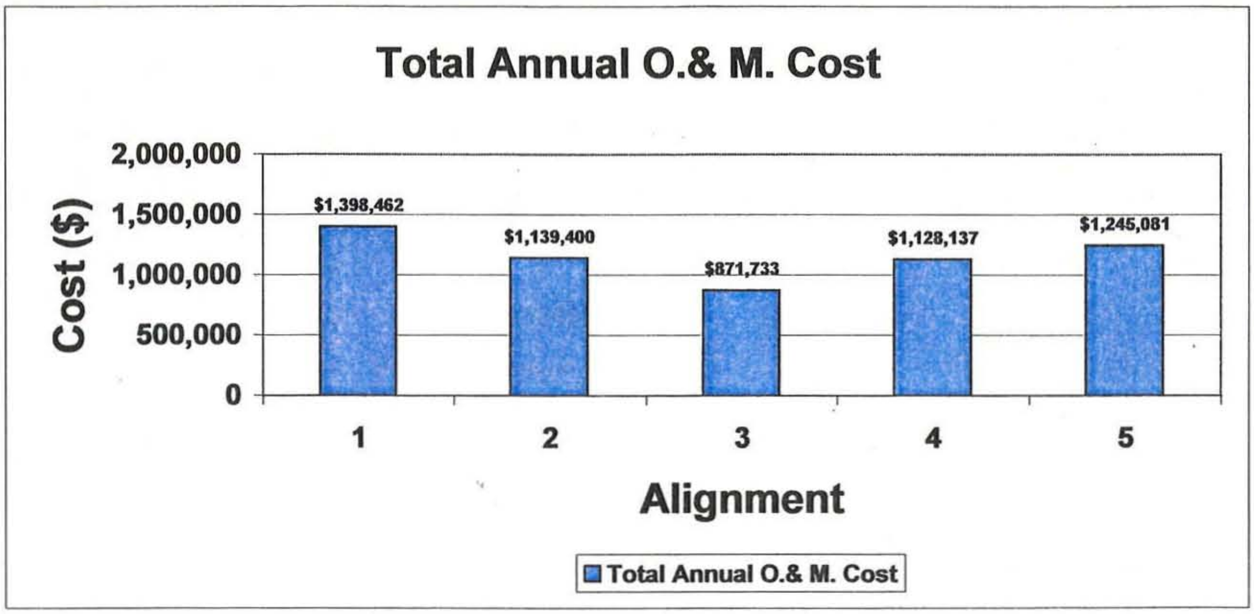
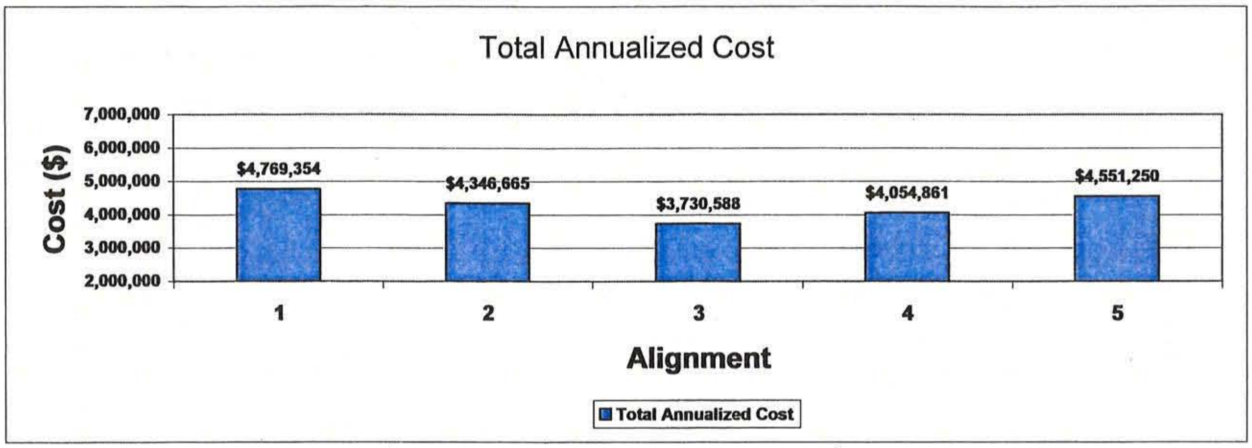


Table AP A-S5

Annualized Capital, and O.& M. Costs
Water Delivery from the Recovery Storage Site (Forward)
West Maricopa Combine Pipeline to the Future (PTTF)

Item	Alignment				
	1	2	3	4	5
Annual Water Delivered (Acre-Feet)	25,000	25,000	25,000	25,000	25,000
20 Years' Amortized Capital Cost	$3,370,893	$3,207,265	$2,858,855	$2,926,724	$3,306,169
Annual O.& M. Cost	$1,398,462	$1,139,400	$871,733	$1,128,137	$1,245,081
Total Annualized Cost	$4,769,354	$4,346,665	$3,730,588	$4,054,861	$4,551,250
Cost per Acre-Foot	$191	$174	$149	$162	$182
Cost per 1,000 Gallons	$0.59	$0.53	$0.46	$0.50	$0.56



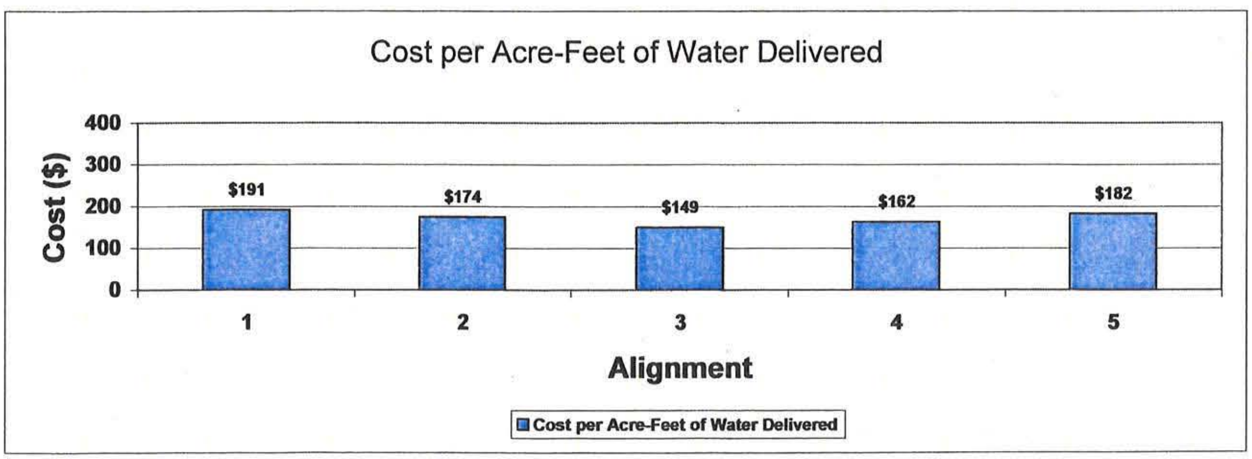


Table AP B-S1

Quantity Estimation
Water Delivery (Year 2025 Adjusted Demand) from Sarival Road (Reversible)
West Maricopa Combine Pipeline to the Future (PTTF)

I. Pumps' Summary

Item	Description	Unit	Size	Alignment		
				1	2	3
Number of Pump		each		1	1	1
Pumpage	Maximum in cfs	cfs		39.78	39.78	35.01
	Maximum in acre-feet a year	AF/Yr		28,799	28,799	25,344
Total Dynamic Head	Energy head required	Feet		151	151	100
Power	Horse power	H.P.		850	850	500

Table AP B-S2

Pumps Construction & Capital Costs Estimation
Water Delivery from Sarival Road (Reversible)
West Maricopa Combine Pipeline to the Future (PTTF)

Item	Description	Unit	Size	Construction & Caoital Costs ($)		
				Alignment		
				1	2	3
Pumps (80 % Efficiency)	near Recharge site storage	(H.P.)	500			$439,400
including housing structures	near Recharge site storage	(H.P.)	850	$485,650	$485,650	
Subtotal				$485,650	$485,650	$439,400
Contingency: %	Percent of Total Construction Cost	%	20	$97,130	$97,130	$87,880
Engineering & Administration, %	Percent of Total Construction Cost	%	20	$97,130	$97,130	$87,880
Total Capital Cost				$679,910	$679,910	$615,160

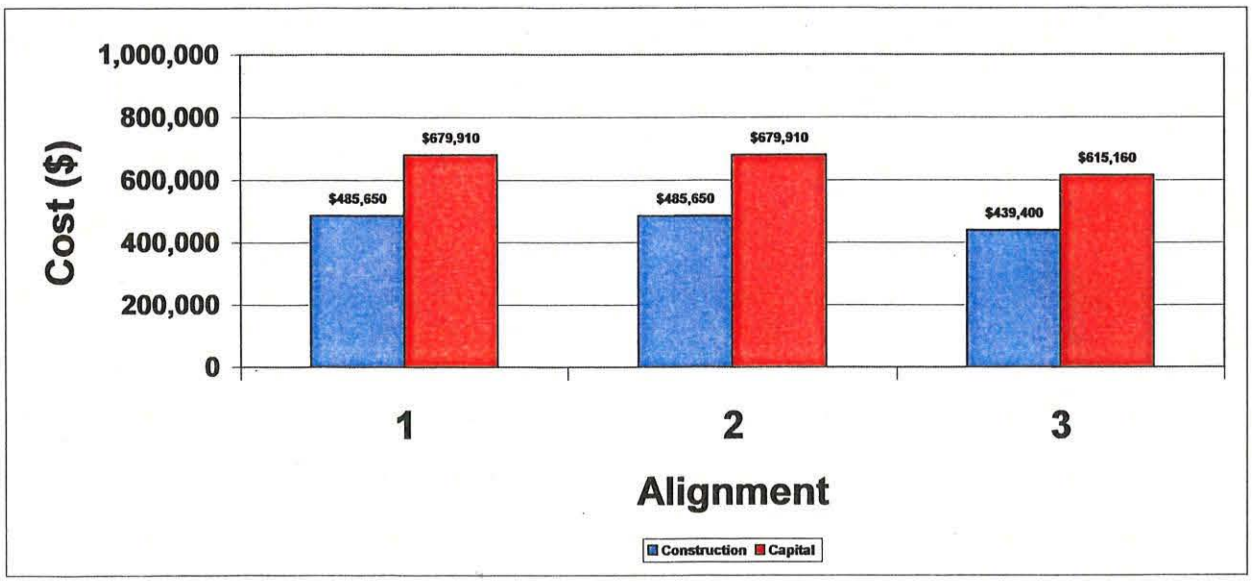


Table AP B-S3

Annual Pumps Operating and Maintenance Cost
Water Delivery from Sarival Road (Reversible)
West Maricopa Combine Pipeline to the Future (PTTF)

Item	Alignment		
	1	2	3
Pump O.& M. Cost	$376,883	$376,883	$219,648
Pumping Energy Cost	$222,189	$222,189	$130,699
Total PumpsO.& M. Cost	$599,072	$599,072	$350,347

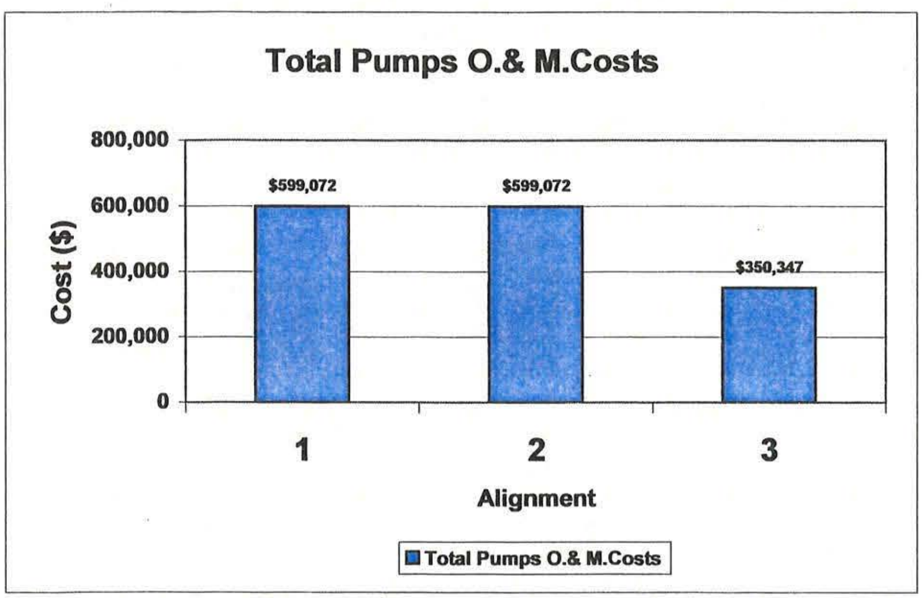
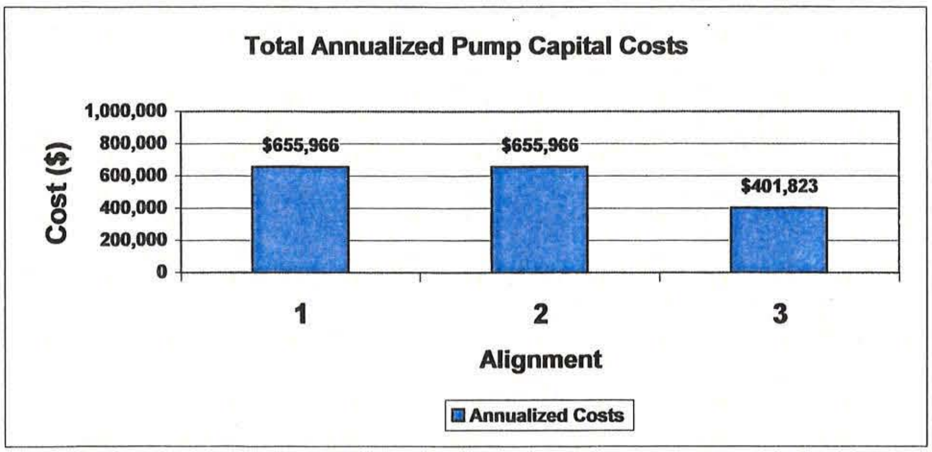
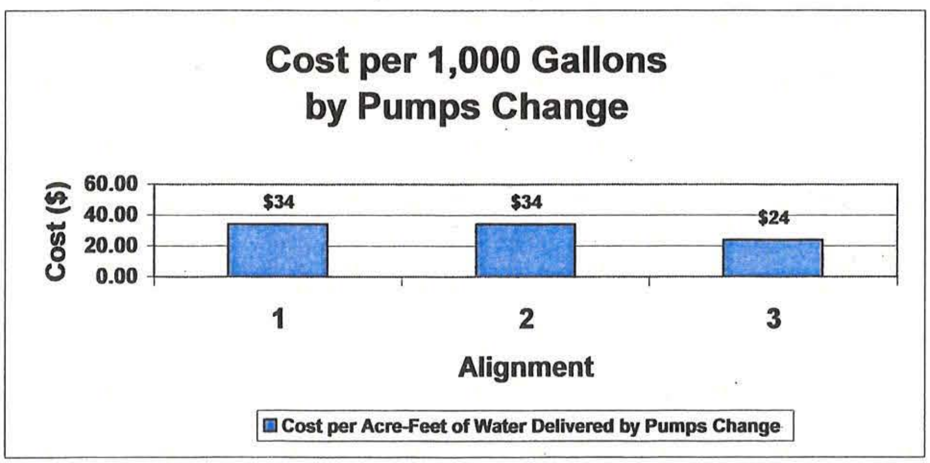


Table AP B-S4

Annualized Pump Capital, and O.& M. Costs
Water Delivery from Sarival Road (Reversible)
West Maricopa Combine Pipeline to the Future (PTTF)

Item	Alignment		
	1	2	3
Annual Water Delivered	19,199	19,199	16,896
20 Years' Amortized Capital Cost	$56,894	$56,894	$51,476
Annual Pump O.& M. Cost	$599,072	$599,072	$350,347
Total Annualized Cost	$655,966	$655,966	$401,823
Cost per Acre-Foot	$34	$34	$24
Cost per 1,000 Gallons	$0.10	$0.10	$0.07





CHAPTER VI

SUMMARY

6.1 Analysis Summary

The results of the WMC pipeline costs are shown in Table A-4 on page 69, and Table A-5 on page 70. When comparing the costs of the various alignments in terms of construction and operation, the preferred system is Alignment 3.

Not mentioned, but included in the study is the consideration of a No Action Alternative, which is compared with the preferred alignment. Presented below are the No Action, and Alignment 3 alternative, with the summary of operations.

6.1.1 Impacts of a No Action Alternative

The following is a summary of impacts if the pipeline was not constructed and a water source was not provided to these areas.

In general, the current WESTCAPS strategy of alternative water supplies would be insufficient to meet the future needs of users. Resizing the other surface water supplies and re-taxing groundwater supplies to meet demands would be needed to make-up the supply capacity shortfall. Although possible, the other features of operating a water delivery system would be lacking with respect to expansion, reliability, redundancy, flexibility and opportunities. These issues are discussed below.

The expansion of the WESTCAPS system would not occur, which would prevent the use of surface water supplies of the CAP by all the users of this study (particularly the West Maricopa Combine Area) except for possibly the Goodyear area.

The reliability of the overall system would decrease. Only the surface water supplies of the original study would be accessible from a great distance, or the use of individual well supplies.

The redundancy of the supply is decreased, taxing the capacity of the existing Sarival pipeline system, if it were accessible, or the use of individual well systems.

Future flexibility of the overall system would be decreased, or rather non-existent, for the southwestern area water delivery system(s).

No opportunities for blending of water types are known to exist at this time to lower the threshold levels of low quality waters essentially making certain groundwater wells unusable without additional wellhead treatments.

Water treatment facilities will be required for the continued use of wells with impaired water.

Other surface water supplies would need to be imported to these areas in order to make-up for the declining groundwater levels.

The following are emerging issues for the Phoenix west metropolitan valley that should be addressed as the population growth rises.

- The depth to groundwater will continue to increase (get deeper), and as it does, the quantity and quality concerns will intensify.
- Declining water quality will affect consumers and businesses as an indirect cost when household facilities and equipment do not meet their expected useable life.
- The future available groundwater has not been calculated with respect to the expected growth and increased use.
- Public opinion regarding water transfers and ownerships of imported water, as well as groundwater.
- ADWR regulations for resource management of groundwater are becoming stricter.
- The new cost of water will include expenses in terms of credits, maintenance or use fees, and importation of a water source with rights.
- Public education and initiatives for the practical use of water resources.

6.1.2 Summary of Impacts and Enhancements for the Preferred Alignment.

Construction of the trunkline for Alignment 3 is approximately 16 miles long, and a total of 7 miles of laterals are needed to deliver water to the centroids of the delivery areas. Operationally, this system is enhanced by system operations through the following factors.

- The water quality is better than the water in the current service area or the imported CAP water.
- Avenues for access to the surface water supplies of the CAP canal are created, as is a utilization of surface water supplies through water rights.
- The WMC in general is a reliability component to the CAP since the CAP may one day face a water shortage or may be hampered with a system delivery outage.

- The WMC is an improvement over accessing the existing well supplies and taxing the water quality of the area.
- Delivery performance enhancements by importation of an additional water supply, additional gravity service pressure and increasing the area of availability by construction of the trunkline. Water system networking and loops would be possible.
- Expands the water distribution for the southwestern Phoenix metropolitan area, where there currently is very little water distribution.
- Excess capacity is available until the year 2010, which will provide additional capacity, supply, and storage with the installation of the trunkline and laterals.
- The WMC is an increased reliability for west Phoenix by insuring water delivery from multiple sources.
- By drawing from multiple water supplies at the Hassayampa well field, the local well fields, and the CAP surface water supplies transported through the Sarival Road Alignment, a redundancy is achieved further guaranteeing the delivery of water.
- By drawing from various sources, dilution by blending of the sources may occur to some degree allowing for an increased water supply.
- Reverse flows of the pipeline are possible to balance system pressure and demands.
- The system is layed out so that pressures can be achieved through gravity, and booter pumping is minimized. Minimum pressures along laterals to delivery areas could be met through gravity to those areas (see figure of the hydraulic profile graph).

6.2 Operational Considerations - For the WMC Pipeline

1. The preferred alignment is Alignment number 3. Though this alternative exceeds the other alternatives in terms of location, cost and operations, any of the alignments were acceptable in terms of cost to construct, operate and maintain.

2. The installation of the pipeline could have traversed any of the 5 alignment areas studied. The limits for a feasible alignment are within the boundaries of the northern most and the southernmost alignments. The northern boundary is denoted by the White Tank mountain range and the park reserve boundaries. The southern boundary is delineated by the southern most trunk alignment and laterals.

3. The use of storage reservoirs located along the alignments were not considered in the layout or a part of this report. However, reservoirs could increase the peaking capacity of the system and add to the flexibility of the system. The reservoirs could either be

elevated and some distance from the trunk line, or be located along the alignment, but not necessarily be elevated.

4. The water delivery capability for the WMC pipeline is consumed by the year 2010 per projected demands. The areas closest to the water supply were assumed as the highest priority for future water deliveries. Water provider areas farther from the supply area, such as Goodyear Outside and Goodyear #2, were areas with an alternative surface water supply by their proximity to the Sarival Road trunkline as shown in the strategic plan. Therefore, the delivery capability of the WMC pipeline is constructed prior to, or concurrent to, the Sarival trunk line prior to the year 2010.

5. The well field and collection system is the majority of the cost with respects to pumping equipment and energy costs for the forward flow scenario. This cost has been compiled from various sources of information.

6. The cost of water delivery is proportional to the distance from the source supply. The study shows that the cost per unit of water delivered is highly dependent on the cost of the pipe. Additional cost/benefit beyond the cost for the extension of the PTTF should be considered for this distribution system that can be networked with others to increase service for reliability, performance, maximizing wellhead delivery, expansion, delivery flexibility and access to alternative water sources.

7. Booster pumping along the trunkline has been designed, calculated, and priced based on criteria previously provided (see the figure "Alignment 3: From the Recovery Site along the Dike and Yuma Road to Sarival Road" on the following page, the graph of the Yuma Road Alignment ground elevations (in blue) and the Hydraulic Grade (in red) for the preferred Alignment 3). The head required for delivery (red line) could be much lower than shown, as no actual deliveries were required in the higher elevations of the main pipeline. The system is principally a gravity system that has been enhanced to be a pressure system with a booster pump at the supply source to add 150 feet of head pressure. Selected booster pumping at the source is necessary, and booster pumping along the trunkline and the addition of tanks would also be incorporated in the system. In the future, the desire will be to add booster pumps to increase capacity and pressure for proper operation of the system.

8. Other groundwater wells in the area will be required for blending, peaking, reliability and backup. This was also presented for consideration in the original WESTCAPS report. Detailed operational discussions or pricing has not been included in this report regarding scheduling, system incorporation, operation, ownership or maintaining "stand-by" wells.

9. See Chapter VI of "Appendix. A, WESTCAPS Strategic Plan for using Central Arizona Project Water in the West Salt River Valley" for additional data regarding operational reliability and flexibility for the system defined in the strategic plan.

6.3 WMC Operational Description Summary

A steady state analysis of the pipeline operation is shown for the years 2000, 2010, 2015, and 2025 in forward flow (from west to the east) and in reverse flow (from east to west) for the year 2025. These years in particular represent changes in operation. Designed into the operation is an average annual water delivery of 25,000 acre-feet and a peaking delivery capacity of 37,500 acre-feet (51.8 cfs). Additional peaking capability is met by the existing groundwater well system or reservoir systems that are not a part of this report.

Year 2000 Forward Flow

The forward flow for the year 2000 shows the capability of the supply from the reservoir (elevation 1100 feet) at the well field to the three laterals (see the figure on following page, "Alignment 3 Schematic, Year 2000 Forward Flow"). A booster pump is shown in line and will provide system pressure for any point along the pipeline. Enough water is delivered to provide an excess supply to the Sarival Road pipeline at elevation 960. The volume is 28.5 cfs of additional supply that could be diverted either north and/or south of the Tee intersection delivery point. The excess head available to deliver service pressure at this intersection up to service elevation 1200 is a service pressure of 25 psi during the year 2000 period.

Year 2010 Forward Flow

The year 2010 forward flow demand meets the capacity of the supply from the well field reservoir, with no excess capacity available for the Sarival Road pipe alignment (see figure on page 107, "Alignment 3 Schematic, Year 2010 Forward Flow"). In 2010, each of the delivery areas has greater demands. The demands are projected to increase to such an extent that the Sarival Road trunkline would be required to partially supply the WMC trunkline from Sarival Road to Cotton Lane. Note that a flow from the Sarival Road pipeline provides water to the WMC delivery areas shown in the strategic plan of 9/15/00.

Year 2015 Forward Flow

The year 2015 forward flow demand exceeds the capacity of the supply from the well field reservoir, with no excess capacity available for the Sarival Road pipe alignment (see figure on page 108, "Alignment 3 Schematic, Year 2015 Forward Flow"). In 2015, each of the delivery areas has greater demands. However, the Cotton Lane lateral has had to be supplied more water from the Sarival Road pipeline. This has the following operational implications.

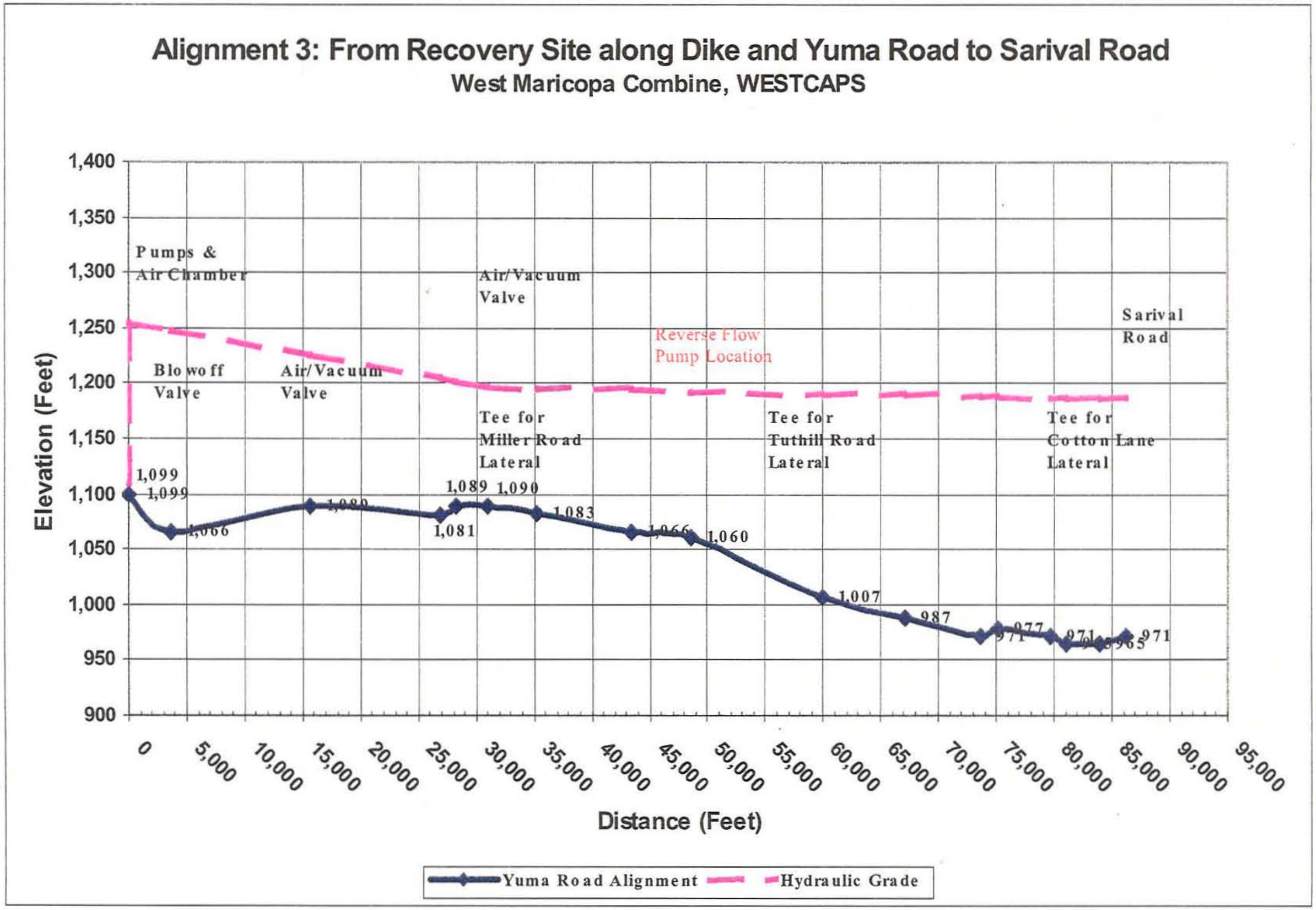
a. The Sarival pipeline, laterals and supply system infrastructure is needed by 2015 to meet the additional demands of WPA's between Cotton Lane lateral and Sarival Road.
b. If the well field has the additional production capacity, additional booster pumping could be installed to supply additional water to the WMC area. However, the booster pump would not be able to fulfill the total demand in terms of pressure or delivery, and thus, the 42-inch pipeline becomes the constraint for delivery from the well field in the year 2015.
c. If the projected demand for this area is correct, a consideration should be given to increase the main pipeline size if the well field could supply more water (an increase of 40.7 cfs peak supply – an 80% increase from the present planned capacity).
d. Note that the Sarival Road alignment provides the supply to the Cotton Lane WPAs that were included in the 9/15/00 strategic plan.

Year 2025 Forward Flow

The year 2025 forward flow demand meets the capacity of the supply from the well field reservoir for two of the three laterals, with very little being supplied to the Cotton Lane lateral (see the figure on page 109, " Alignment 3 Schematic, Year 2025 Forward Flow"). In 2025, each of the delivery areas has greater demands. However, the Cotton Lane lateral receives less than 10 percent of their supply from the well field. Subsequently, the water supply for the Cotton Lane area should come from the Sarival Road pipeline. Note that the capacity of the WMC pipeline between Cotton lane and Sarival Road has only the flow capability to meet half (55 cfs) of the Cotton Lane demand. The balance of the supply is assumed to come from the Sarival Road alignment that will feed laterals connecting to the Cotton Lane WPAs.

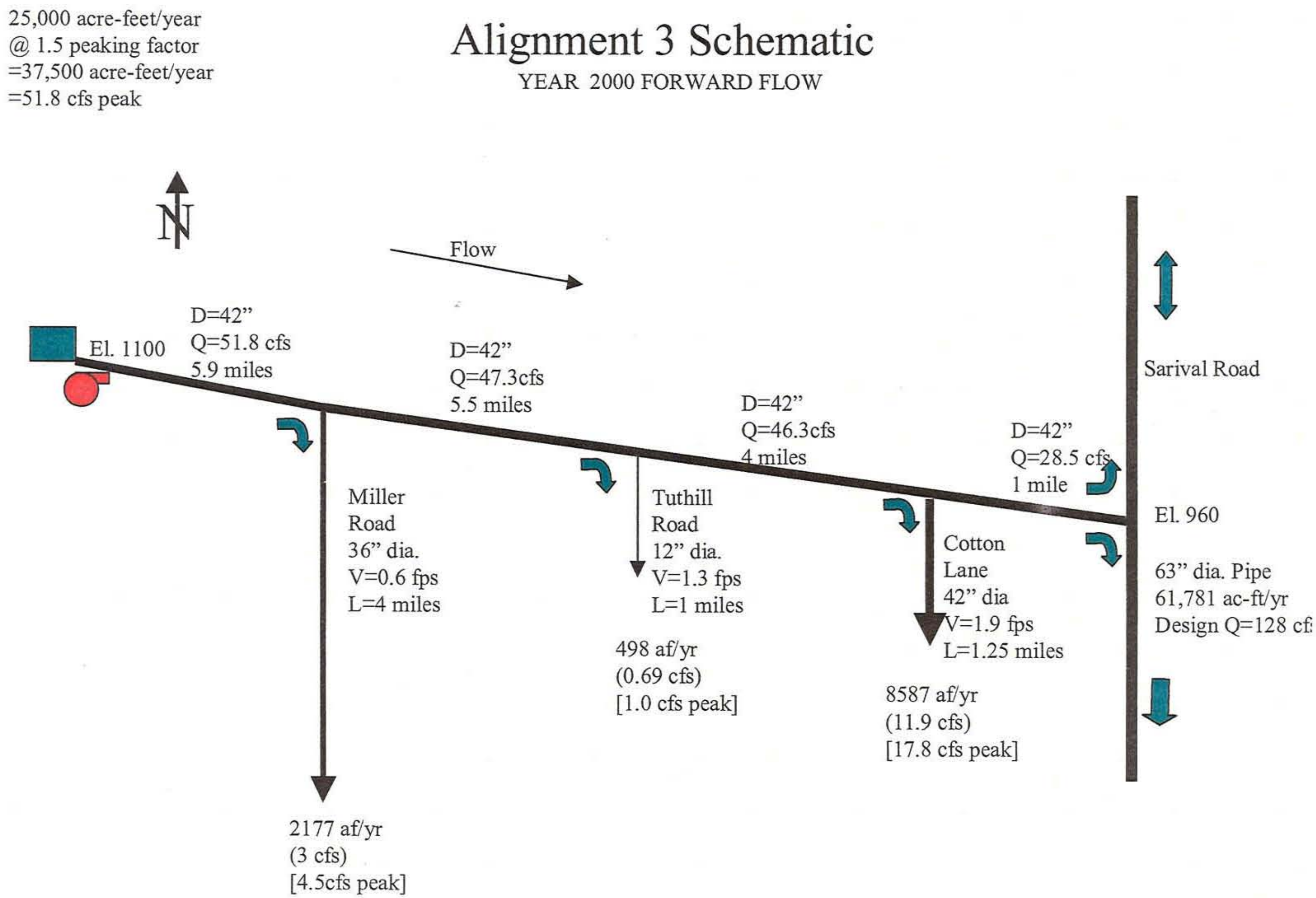
Year 2025 Reverse Flow

Also calculated was a year 2025 reverse flow analysis (east to west from the Sarival Road pipeline to the entire WMC system). This scenario assumes a well field and supply reservoir outage (see the figure on page 110, " Alignment 3 Schematic, Year 2025 Reverse Flow"). The Sarival trunkline has the ability to make peak deliveries for the WMC areas. The only major addition required for reverse flow is the addition of a booster pump located between the Tuthill and Miller Road laterals. The total dynamic head required would be 100 feet. The 42" diameter pipeline is of a sufficient size to handle reverse flow for the full capacity to meet WMC water demands for year 2025.


Alignment 3: From Recovery Site along Dike and Yuma Road to Sarival Road
West Maricopa Combine, WESTCAPS
Elevation (Feet)
Distance (Feet)
Pumps & Air Chamber
Blowoff Valve
Air/Vacuum Valve
Air/Vacuum Valve
Tee for Miller Road Lateral
Reverse Flow Pump Location
Tee for Tuthill Road Lateral
Tee for Cotton Lane Lateral
Sarival Road
1,099
1,099
1,066
1,089
1,090
1,081
1,083
1,060
1,007
987
977
971
965
971
Yuma Road Alignment
Hydraulic Grade

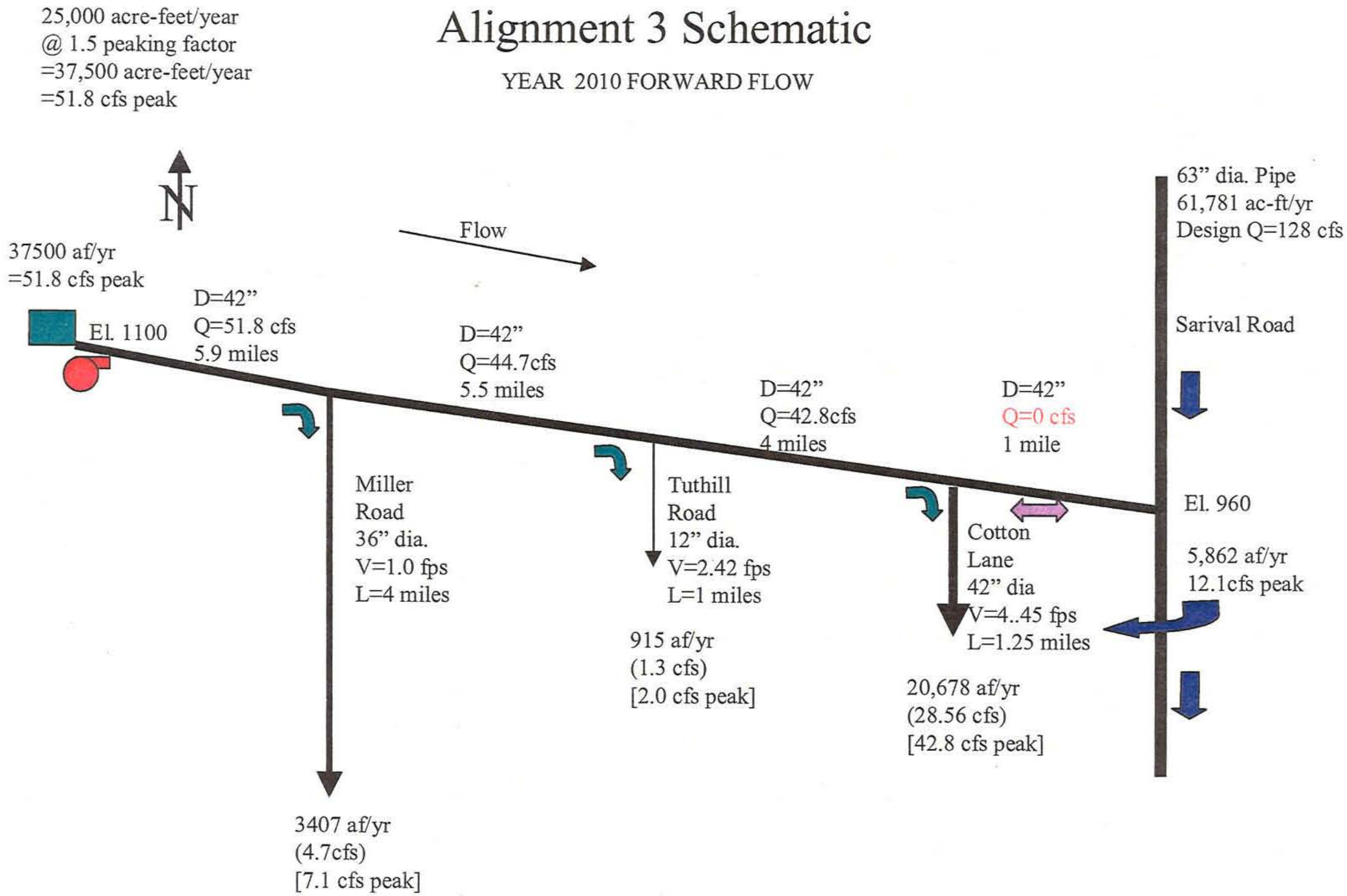
Alignment 3 Schematic

YEAR 2000 FORWARD FLOW



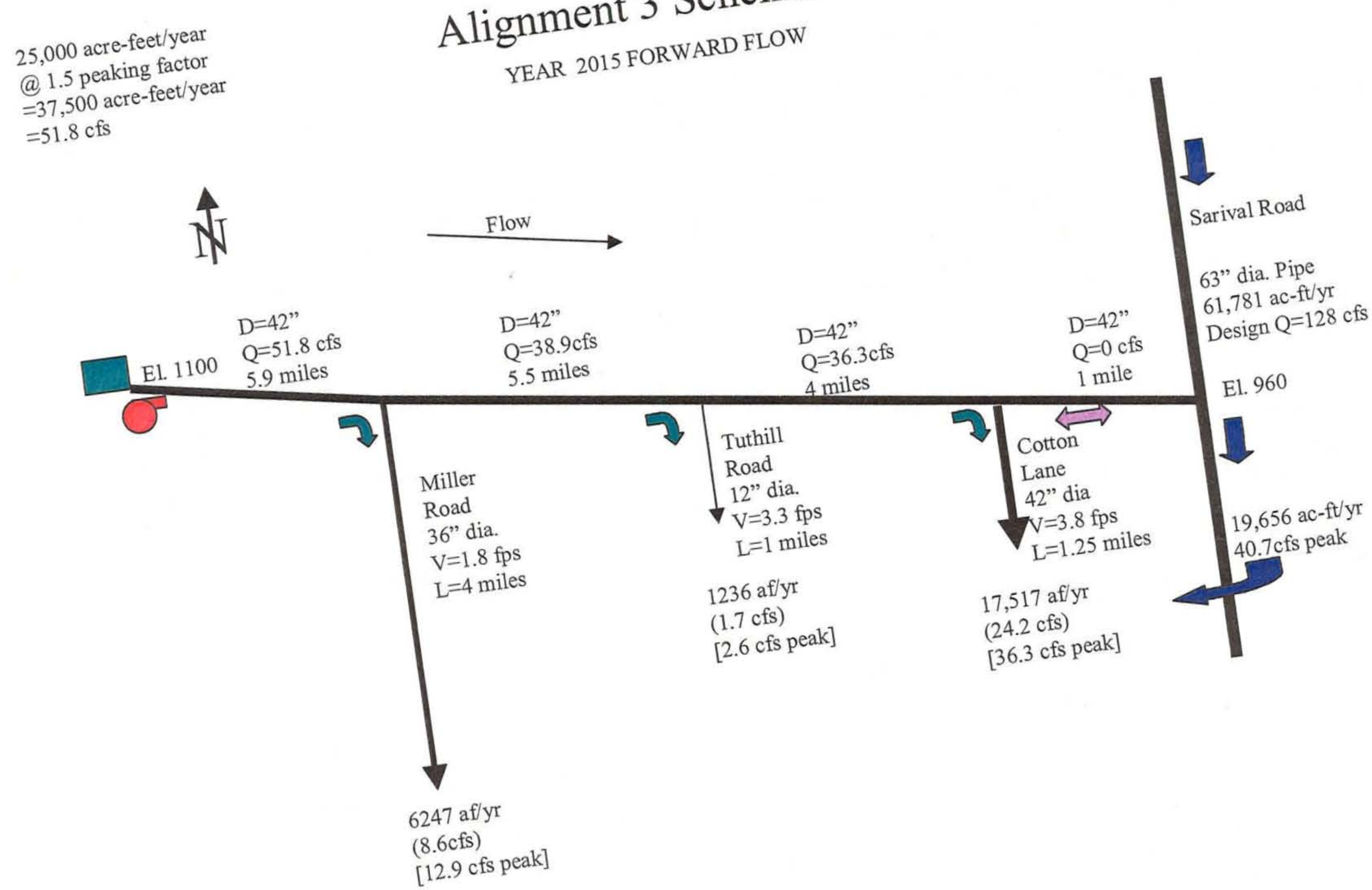
Alignment 3 Schematic

YEAR 2010 FORWARD FLOW



Alignment 3 Schematic

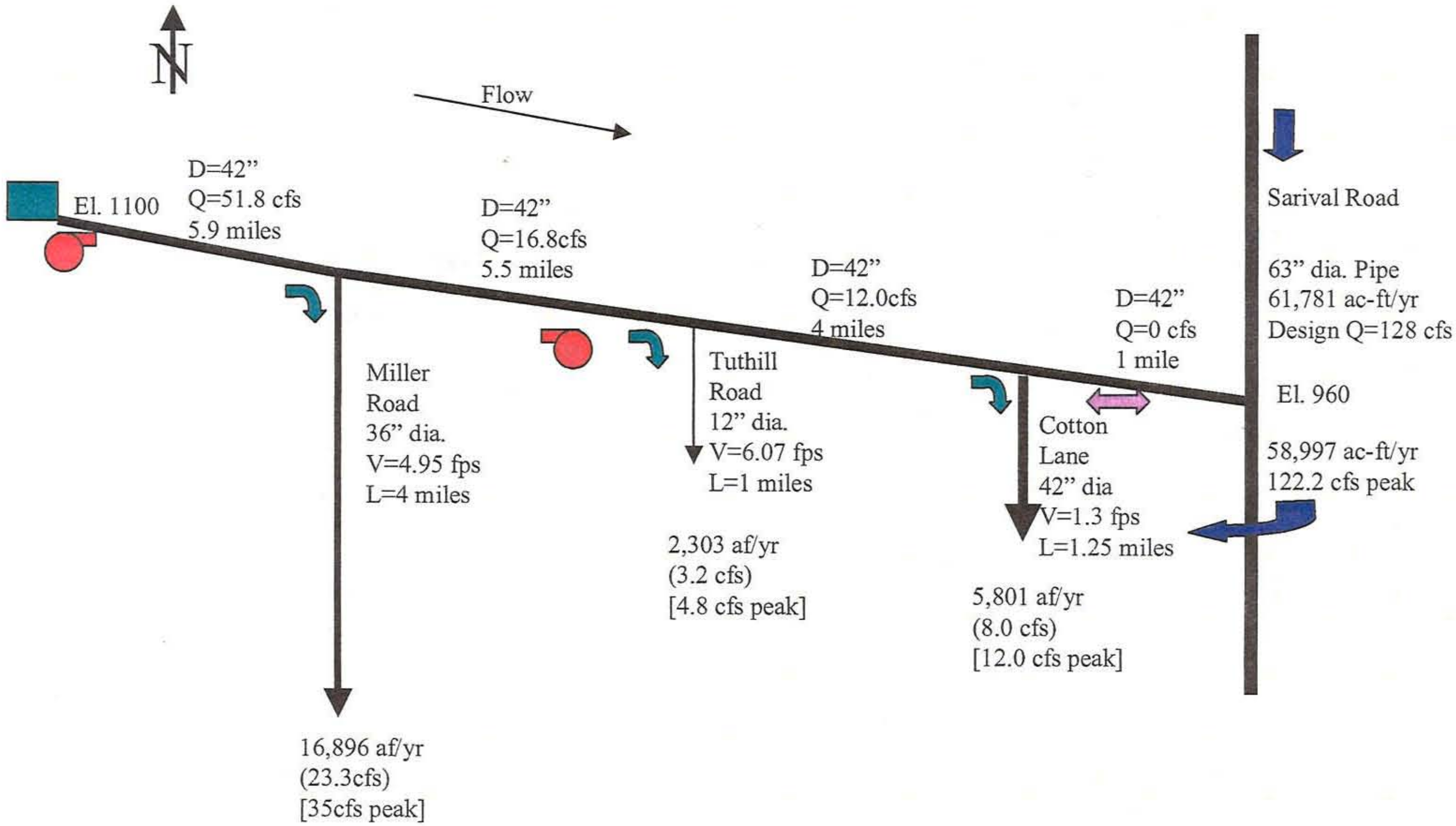
YEAR 2015 FORWARD FLOW



Alignment 3 Schematic

YEAR 2025 FORWARD FLOW

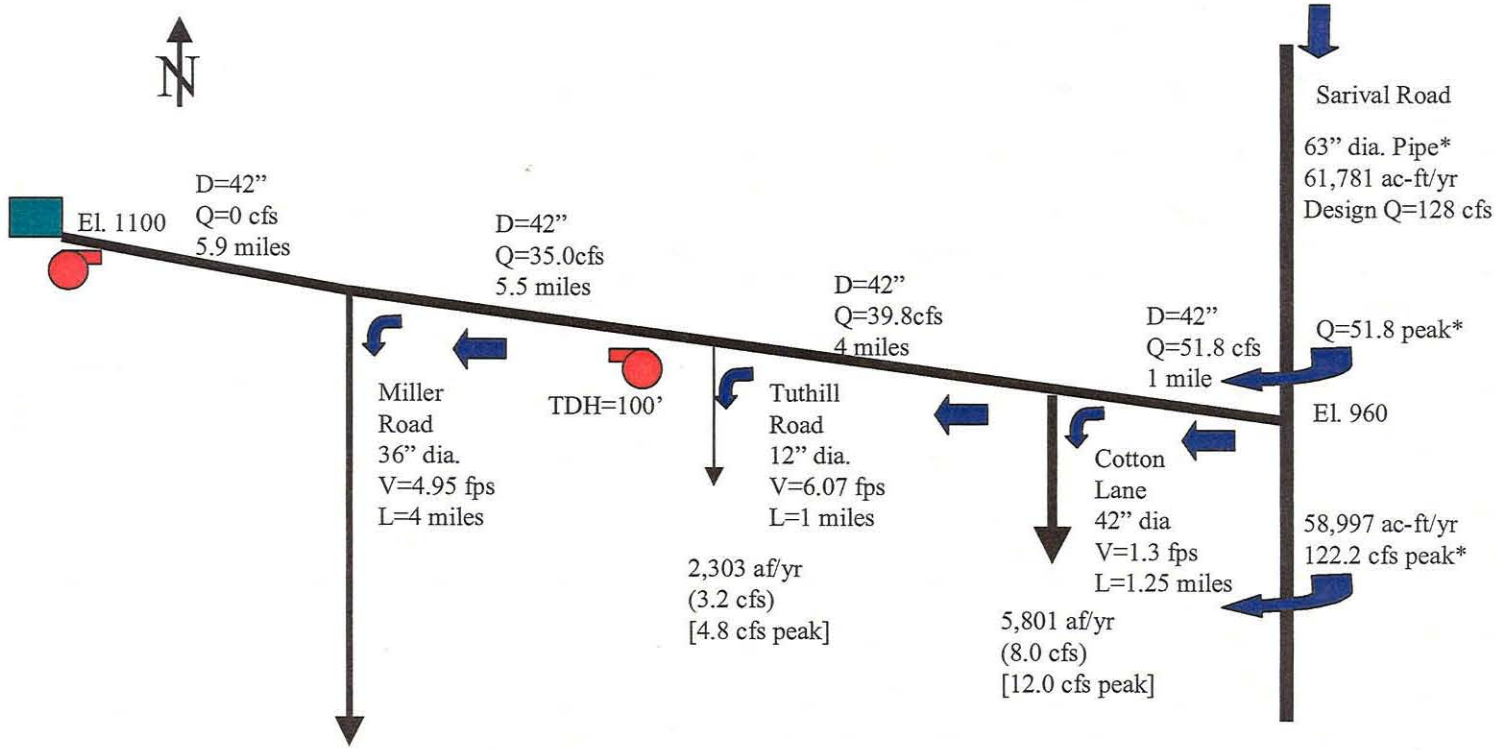
25,000 acre-feet/year
@ 1.5 peaking factor
=37,500 acre-feet/year
=51.8 cfs



Alignment 3 Schematic

YEAR 2025 REVERSE FLOW

25,000 acre-feet/year
@ 1.5 peaking factor
=37,500 acre-feet/year
=51.8 cfs



*Note: The capacity of the Saraval Road trunk Line has capacity greater than design to provide Reverse flow capabilities to the west.

CHAPTER VII

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