**GSI Water Solutions, Inc., "Assessment of Future Surface Water Conditions in the Dry Gap of the Santa Clara River" (April 2008)**

*Report*

# Assessment of Future Surface Water Conditions in the Dry Gap of the Santa Clara River

Prepared for

**Newhall Land and Farming Company**

April 2008

Prepared by

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# Contents

# Abbreviations and Acronyms

| | |
|---|---|
| AF | acre-feet |
| AF/yr | acre-feet per year |
| cfs | cubic feet per second |
| DAA | Draft Additional Analysis |
| GSI | GSI Water Solutions, Inc. |
| I-5 | Interstate 5 |
| LACSD | Sanitation Districts of Los Angeles County |
| LARWQCB | California Regional Water Quality Control Board – Region 4, Los Angeles Region |
| mgd | million gallons per day |
| Newhall | Newhall Land and Farming Company |
| NRWRP | Newhall Ranch Water Reclamation Plant |
| Specific Plan | Newhall Ranch Specific Plan |
| WRP | Water Reclamation Plant |

# Introduction

This report presents an evaluation of whether future discharges of reclaimed water from the approved Newhall Ranch Water Reclamation Plant (NRWRP) and the existing upstream water reclamation plants (Valencia and Saugus) are likely to cause the “dry gap” portion of the Santa Clara River to become perennial downstream of the NRWRP. The Santa Clara River is a perennial stream (contains water on a year-round basis) in the reach from Interstate 5 (I-5) downstream to just west of the Los Angeles/Ventura County line (see Figure 1). Beginning about 3.5 river miles downstream of the county line, the river is dry most of the year, with water present only when rainfall events create sufficient stormwater runoff into the river. This dry ephemeral reach of the river extends beyond the mouth of Piru Creek and is informally known as the “dry gap” in the Santa Clara River.

At the request of the Newhall Land and Farming Company (Newhall), GSI Water Solutions, Inc. (GSI) has reviewed historical aerial photos and streamflow records to assist in evaluating the significance of the future NRWRP flows. In particular, our evaluation has focused on whether future seasonal discharges of reclaimed water from the NRWRP, combined with discharges from the existing Valencia and Saugus WRPs, are likely to create perennial flow conditions in the dry gap. The report presents the following information:

- A summary of the groundwater basins and watersheds that provide flow to the Santa Clara River

- Future conditions upstream of the dry gap, including the timing and magnitude of the future NRWRP discharge; how this discharge compares with historical and future discharges from the upstream WRPs (Valencia and Saugus), and how this discharge compares with historical river flows during multi-year dry periods and during years of above-normal rainfall

- The methodology for evaluating historic and future potential conditions in the dry gap, using historical aerial photos and river flow data

- A summary of the historic conditions observed in the aerial photos, and how those conditions compare with historical river flows and the timing of upstream development activities

- The principal conclusions from the analysis

# Groundwater Basins and Watersheds

Figure 1 shows the groundwater basins and watersheds that lie immediately upstream and downstream of the dry gap. From downstream to upstream, the groundwater basins are the Fillmore, Piru, and Santa Clara River Valley East. The dry gap that is the subject of this report lies in the Piru groundwater basin. Dry gaps are present in other reaches of the river as well. Also, as shown in Figure 1, the California Regional Water Quality Control Board – Region 4, Los Angeles Region (LARWQCB) has divided the Santa Clara River into four reaches in and upstream of the dry gap. The LARWQCB has defined these reaches based on the locations of existing WRPs. However, to some extent, certain reach boundaries also correspond to the groundwater basin boundaries.

Key characteristics of the groundwater basins are as follows:

- The Santa Clara River Valley East groundwater basin lies upstream of the dry gap. This groundwater basin underlies the City of Santa Clarita and areas within unincorporated Los Angeles County and extends downstream to the Los Angeles/Ventura County line. For several decades, stream gages have been maintained on the Santa Clara River at the upstream and downstream limits of the groundwater basin, at locations where bedrock is present at shallow depths. The gage at Lang Station is located east of the City of Santa Clarita and measures the amount of river flow entering the groundwater basin from the upstream portion of the watershed. A gage at the Los Angeles/Ventura County line measures the amount of water leaving this groundwater basin, with the flow consisting of (1) alluvial groundwater discharges into the river, (2) flows from existing WRPs, and (3) stormwater runoff.

- The Piru groundwater basin underlies the dry gap that is the subject of this report. The eastern boundary of the Piru groundwater basin lies just west of the Los Angeles/Ventura County line. The western boundary of the Piru basin corresponds to the western end of the dry gap and lies west of the Piru WRP. The western boundary of the Piru groundwater basin coincides with the eastern boundary of the Fillmore groundwater basin. At this location, bedrock is shallow, causing groundwater in the Piru groundwater basin to rise toward the surface and discharge to the river.

The Santa Clara River Valley East groundwater basin contains three of the Santa Clara River reaches designated by the LARWQCB. The farthest upstream reach (Reach 7) begins at the eastern (upgradient) limit of the groundwater basin, and the farthest downstream reach (Reach 5) ends just downstream of the Los Angeles/Ventura County line. The NRWRP will be located just east of the Los Angeles/Ventura County line, in Reach 5. The LARWQCB-designated Reach 4 of the river lies in the Piru groundwater basin and the eastern-most portion of the Fillmore groundwater basin.

# Future River Flows and Discharges Upstream of the Dry Gap

The timing and magnitude of future discharges from the NRWRP originally were identified from water demand projections for the Newhall Ranch community that were developed and presented in documents supporting the Newhall Ranch Specific Plan (Specific Plan) (FORMA, 2003), which was approved by Los Angeles County on May 27, 2003. As discussed in the Draft Additional Analysis (DAA) for the Specific Plan (Impact Sciences, 2001), the NRWRP will be a near-zero discharge facility. Most of the treated water generated by the NRWRP will be recycled to meet nonpotable (outdoor irrigation) demands of the Specific Plan. Based on a detailed water demand analysis presented in the DAA, the inflows to the NRWRP will average 5,630 acre-feet per year (AF/yr), of which 5,344 AF/yr will be recycled. The remaining 286 AF will be discharged to the Santa Clara River during the wettest (winter) months, at a rate of between 0.6 and 2.0 million gallons per day (mgd), which is equivalent to rates of 0.9 to 3.1 cubic feet per second (cfs). This discharge will occur primarily during December and January. Additionally, during wet years (when rainfall is significantly above average because of heavy winter storms), nonpotable demands may be lower than average during the winter and early spring months, resulting in NRWRP discharge volumes greater than 286 AF. This discharge volume could amount to as much as 1,025 AF, based on a 5- to 6-month discharge period (beginning as early as October or November and potentially extending through March) and the discharge limit of 2 mgd that is specified in the permit for the NRWRP (LARWQCB, 2007).

Two WRPs are located upstream of the future NRWRP. These two WRPs are the Valencia WRP and the Saugus WRP, which are operated by the Sanitation Districts of Los Angeles County (LACSD), the agency that will operate the NRWRP. Both upstream WRPs discharge reclaimed water to the Santa Clara River. Discharges from the Saugus WRP began in 1966, and discharges from the Valencia WRP began in 1967. The Saugus WRP, located near the Bouquet Canyon Road bridge, has a permitted dry weather average design capacity of 6.5 mgd, and the Valencia WRP has a permitted dry weather average design capacity of 21.6 mgd. The combined average discharge of treated water from the Saugus and Valencia WRPs was approximately 20 mgd during the period January 2004 through June 2007. In 2006, the combined discharge volume from these two WRPs was 22,913 AF. Figure 2 compares the average NRWRP discharge volume (286 AF) with the historical annual volume of reclaimed water discharged to the river from the Saugus and Valencia WRPs, combined. Compared with the 2006 discharge of 22,913 AF from the two existing WRPs, the future NRWRP discharge of 286 AF is low (about 1.25 percent). Additionally, future discharges from the Saugus and Valencia WRPs will increase over time. A recent study (CH2M HILL, 2005a) estimated that the annual discharges to the river from the Saugus and Valencia WRPs could increase to about 24,300 AF in the future, an increase of 1,400 AF/yr compared with 2006 flows.

The future NRWRP discharge is also negligible compared with the total river flow volume, which consists of WRP discharges, groundwater discharges to the river, and storm flows. Figure 3 shows the WRP flows plus other non-storm flows (groundwater discharges to the river) that have been estimated from daily streamflow and rainfall records (CH2M HILL, 2005b). During a recent 5-year period of low rainfall (calendar years 1999 through 2003), total annual flow, as measured at the Los Angeles/Ventura County line, ranged from about 25,000 to 44,000 AF/yr, and the non-storm flow (groundwater discharge and WRP flows) ranged from about 23,000 to 30,000 AF/yr. For this period of dry conditions, the future NRWRP average discharge of 286 AF/yr would have been between 0.6 and 1.1 percent of the total annual flow volume in the river. The NRWRP flows would be even more negligible during relatively wet years, when the annual volume of river flow at the county line can exceed 100,000 AF/yr – and even 200,000 AF/yr – because of high rainfall runoff from the watershed. For example, historical streamflow measurements at the Los Angeles/Ventura County line during the period 1977 through 2006 show that the 90$^{th}$ and 95$^{th}$ percentile values of November-March streamflow, which are indicative of significant rainfall years, are 385 and 692 cfs, respectively. These flows are substantially greater than the future discharges from the NRWRP. Specifically, the future average discharge from the NRWRP (0.6 mgd [0.9 cfs]) is 0.13 percent to 0.23 percent of these streamflows, while the future potential maximum discharge from the NRWRP (2.0 mgd [3.1 cfs]) is 0.45 percent to 0.81 percent of these streamflows. Additionally, as shown in Figure 3, the total non-storm flow during wet years can exceed 50,000 AF/yr, with the year-to-year variability reflecting the influence of groundwater discharges to the river (which vary according to rainfall-induced fluctuations in the water table elevation). In summary, the future NRWRP discharges will be very small compared with future river flows, comprising 1 percent or less of river flow during average and dry years, and only 0.1 percent to 0.8 percent of river flows during wet years.

## Methodology for Evaluating Conditions within the Dry Gap Area

As discussed above, a simple comparison of future NRWRP flows with total river flows indicates that the future NRWRP flows will be negligible in volume and will be short-lived in duration (approximately 2 to 5 months each year) and, therefore, will not cause the dry gap to become perennial. Nonetheless, at Newhall's request, GSI conducted additional reviews of conditions in the dry gap area itself to further evaluate the potential for changes in this area. Specifically, GSI reviewed aerial photos to determine if notable historical changes were visible in the morphology of the dry gap – in particular, the occurrence of water and vegetation. Aerial photos were reviewed for time periods as early as 1927, to evaluate conditions before urbanization (and subsequent WRP discharges) began occurring upstream of the dry gap (in the Santa Clarita Valley). GSI also reviewed aerial photos from the early years of upstream urbanization, continuing through recent years. Aerial photos were reviewed for years when the coverage was over a sufficiently long reach to allow for meaningful comparisons of conditions from year to year. As a result, the aerial photos that were used in the analysis were for the following time periods:

- Before upstream urban development: 1927 and 1945
- During the first three decades of upstream urban development: 1966, 1989, and 1998
- Current conditions: 2004 and an unknown time afterward[1]

[1] The last aerial photo was the image available on Google Earth during the late spring and early summer of 2007. GSI believes that this photo was taken in 2005 or later, based on a significant change in vegetation that is visible compared with the 2004 photos.

Additionally, the hydrologic conditions corresponding to these years are as follows:

- 1927 photo: Generally below-normal rainfall since 1919, and no WRP flows
- 1945 photo: Generally above-normal rainfall since 1938, and no WRP flows
- 1966 photo: Generally below-normal rainfall since 1945, and WRP flows of 550 AF/yr
- 1989 photo: Above-normal rainfall from 1978 through 1983, below-normal rainfall starting in 1984, and WRP flows rising to 13,500 AF/yr by 1989
- 1998 photo: Above-normal rainfall from 1993 through 1998, and WRP flows rising to 17,700 AF/yr by 1998
- 2004 photo: Below-normal rainfall from 1999 through mid-December 2004, and WRP flows rising to 21,300 AF/yr by 2004
- Post-2004 photo: Generally below-normal rainfall, except for significant rainfall and flooding in late December 2004 through January 2005, and WRP flows rising to 22,913 AF/yr in 2006. The 2005 flood event was an “episodic re-set” flow event that removed most of the vegetation in the river corridor and sediment and reconfigured flow channels in the riverbed (Balance Hydrologics, Inc., 2005).

The mouth of Piru Creek, which is a tributary to the Santa Clara River, is located in the middle of the dry gap area. Piru Creek is an ephemeral stream, flowing only after large storm events or after water is released into the creek upstream (from Piru Dam). Consequently, GSI’s analysis of the aerial photos focused on both the upper reach of the dry gap (above the mouth of Piru Creek) and the lower reach of the dry gap (below the mouth of Piru Creek).

## Aerial Photo Analysis in the Upper Reach of the Dry Gap (Above Piru Creek)

Figures 4 through 9 compare the aerial photos for the upper reach of the dry gap. These photos show the following:

- **Figure 4 (1927 and 1945).** The 1927 photo shows that the dry riverbed begins where the alluvial valley widens and the vegetation disappears. The 1945 photo shows similar conditions, though the river’s flow continues about halfway down to Piru Creek from the point where the alluvial valley widens. Farther downstream, Piru Creek contributes notable flow in 1945, and minor flow in 1927.

- **Figure 5 (1945 and 1966).** Compared with 1945, the river’s flow in 1966 does not occur as far downstream, likely because of an extended period of generally below-average rainfall. Additionally, Piru Creek is dry. Minimal WRP flows began from the Saugus plant in 1966 (550 AF/yr).

- **Figure 6 (1966 and 1989).** Compared with 1966, the vegetated zone near the river is more prominent and extends farther downstream in 1989, likely because of a period of generally above-average rainfall from 1978 through 1983. However, in 1989, the river does not show visible flow beyond the western limit of the vegetated corridor. WRP flows had risen to 13,500 AF/yr by 1989. Minor inflow is visible from Piru Creek in 1989.

- **Figure 7 (1989 and 1998).** The 1998 photo was taken at the end of a 7-year period of generally above-average rainfall. Vegetated conditions are similar to 1989. The only difference in 1998 is a small reach of flow that is visible above Piru Creek, and notably more flow in Piru Creek itself. WRP flows had risen to 17,700 AF/yr by 1998.

- **Figure 8 (1998 and 2004).** These two photos show generally similar conditions, though the short reach of flow that is visible in the Santa Clara River just above Piru Creek is not present in 2004 likely because of the generally below-average rainfall that occurred from 1999 through 2004. Additionally, Piru Creek was dry at the time of the 2004 photo. WRP flows had risen to 21,300 AF/yr by 2004.

- **Figure 9 (2004 and Post-2004).** These two photos show notable differences in vegetation. The vegetation that was present in the 2004 photo is gone in the post-2004 photo, having been removed by the episodic flood of January 2005. The river is flowing farther downstream in the post-2004 photo than in 2004, most likely reflecting drainage of shallow groundwater following this episodic flood. Specifically, the excessive rainfall and flooding increased groundwater levels in the Santa Clarita Valley, at and upstream of Blue Cut, which in turn increased the amount of groundwater discharging to the river upstream of Blue Cut. The greater river flow is not attributable to WRP flows because the reach containing the dry gap has been completely dry since that time (except during infrequent rainfall events) because of below-normal rainfall.

## Summary of Conditions in the Upper Reach of the Dry Gap (Above Piru Creek)

Two distinct zones are present in the upper reach of the dry gap (from Blue Cut downstream to Piru Creek). In the zone at and immediately below Blue Cut, the Santa Clara River lies in a narrow corridor that is vegetated in most years and in which the river occupies a single well-defined channel. At a point about halfway between Blue Cut and Piru Creek, the river corridor changes rather abruptly. From this point down to Piru Creek, the river corridor is much wider and devoid of vegetation. The river channel is more braided and shows relict channels. In most of the aerial photos, the river flow disappears in this zone before reaching Piru Creek. Specifically, in this zone, the water in the river infiltrates through the alluvial fill and recharges the underlying alluvial groundwater system within the Piru Basin.

The aerial photos show that the transition between these two zones is abrupt and is located in the same general area in each year that the aerial photos were taken. The consistent nature of this transition's location over time is attributable to the underlying geology. Specifically, the transition location coincides with the physical boundary of the eastern limit of the Piru groundwater basin. On the upstream side of this boundary, the alluvial fill is thin and the underlying bedrock lies at a shallow depth. As a result, the water table is shallow, and little or no leakage occurs from the river to the underlying shallow groundwater. In contrast, on the downstream side of this boundary, in the Piru groundwater basin, the alluvium is thicker and the underlying bedrock is much deeper. As a result, the water table in the alluvium is deeper, and the alluvial sediments are able to rapidly infiltrate the entire flow of the river.

The only significant change that is visible over time in this group of aerial photos occurred recently. The aerial photos through 2004 show significant vegetation at and below Blue Cut. After 2004, this vegetation is absent. The vegetation was scoured out by large episodic flood flows that occurred because of unusually heavy rainfall from December 2004 through February 2005.

In summary, during the historical period for which aerial photos are available, the Santa Clara River has been ephemeral in the area immediately above the mouth of Piru Creek. This ephemeral reach is a dry gap in the river, which extends from downstream of Piru Creek to a point about 2 miles upstream of Piru Creek. This dry gap is present despite the increase in flows that has occurred since the mid-1960s because of reclaimed water discharges to the river in the Santa Clarita Valley. Since that time, the WRP flows have not only increased (to 22,913 AF/yr by 2006), but the flows at the Los Angeles/Ventura County line during the driest seasons (summer and fall) have increased over time. Despite these changes at and above Blue Cut, the dry gap has persisted upstream of Piru Creek and has shown no significant changes in its location or morphology.

## Aerial Photo Analysis in the Lower Reach of the Dry Gap (Above Piru Creek)

Figures 10 through 16 compare the aerial photos for the lower reach of the dry gap. These photos show the following:

- **Figure 10 (1927).** The 1927 photo shows that the small flow volume entering the river from Piru Creek disappears into the riverbed shortly downstream, resulting in a dry riverbed in the dry gap portion of the Santa Clara River.

- **Figure 11 (1945).** The 1945 photo shows greater flow from Piru Creek and a decrease in flow below the mouth of Piru Creek. However, not all of the Piru Creek flow infiltrates within the view frame.

- **Figure 12 (1966).** Interpretations are limited because of the quality of the photo. However, no flow is visible in Piru Creek or in the Santa Clara River upstream of Piru Creek.

- **Figure 13 (1989).** Only minor flow enters the river from Piru Creek, and this flow disappears shortly downstream, resulting in a dry riverbed in the Santa Clara River.

- **Figure 14 (1998).** A well-defined flow channel enters the river from Piru Creek, and water is present in the Santa Clara River below the mouth of Piru Creek. However, no flow is present in the Santa Clara River upstream of the mouth of Piru Creek.

- **Figure 15 (2004).** Piru Creek and the Santa Clara River are both dry.

- **Figure 16 (Post-2004).** Flow is visible in the Santa Clara River at the time of the photo because of the episodic flood in January 2005. Little if any flow is visible in a short reach downstream of Piru Creek, indicating that most of the river flow has infiltrated to groundwater. As discussed earlier in this report, the dry gap has since completely reappeared in the river.

## Summary of Conditions in the Lower Reach of the Dry Gap (Below Piru Creek)

Conditions below Piru Creek are relatively unchanged throughout the study period and are as follows:

- The river has a relatively uniform appearance over the reach immediately below Piru Creek. In this reach, the river lies in a broad alluvial corridor and shows braided and relict channels. The river is dry except when Piru Creek is contributing flow or when residual storm flow is occurring (see Figure 16).

- The river transitions back into a heavily vegetated condition in the western-most portion of the view area. This occurs because of rising groundwater that seeps from the alluvium. In this area, the alluvium is thin and the bedrock is shallow, marking the western limit of the Piru groundwater basin.

# Conclusions

Future discharges of reclaimed water to the Santa Clara River from the NRWRP are not expected to eliminate the dry gap because:

1. Historical increases in the river baseflow upstream of the dry gap have not appreciably changed conditions in the dry gap, where there is little vegetation and little, if any, water (except during storm runoff periods).

2. The dry gap has never closed permanently in the past (i.e., become perennial), even with the onset of, and increase in, WRP flows into the river (to present-day volumes of about 23,000 AF/yr). The historical discharges from the upstream WRPs are 80 times greater than the average incremental contribution (286 AF/yr) that will be added to the river from the NRWRP.

3. Discharges from the future NRWRP will be small compared with other flows entering the Piru groundwater basin from the Santa Clarita valley (storm flows, groundwater baseflow, and discharges from the two existing WRPs that lie upstream of the future NRWRP).

In summary, future discharges of reclaimed water to the Santa Clara River from the NRWRP and existing upstream WRPs are not expected to have a significant influence on the dry gap.

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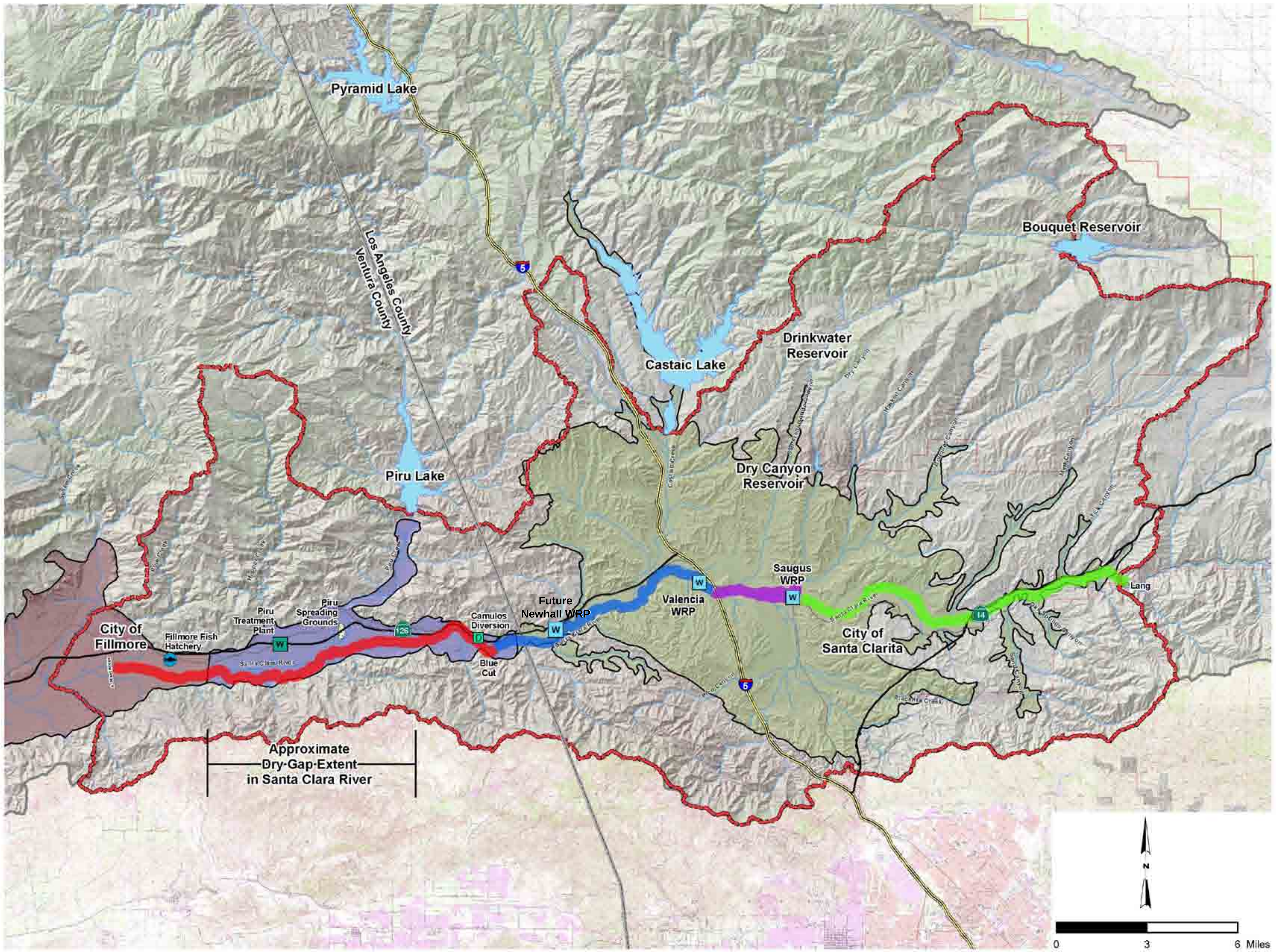
# FIGURES

Newhall
Ranch

Santa Clarita

Ventura County

Los Angeles County




LEGEND

LEGEND

WATER RECLAMATION PLANT

SANTA CLARA RIVER LOCAL WATERSHED BOUNDARY

STUDY AREA

SANTA CLARA RIVER REGIONAL WATERSHED

SANTA CLARA RIVER WATERSHED

STREAM

RAILROAD

**GROUNDWATER BASIN**

SANTA CLARA RIVER VALLEY EAST

PIRU

FILLMORE

**SANTA CLARA RIVER REACHES**

REACH 4

REACH 5 (chloride TMDL reach)

REACH 6 (chloride TMDL reach)

REACH 7

# Figure 1

Watershed and Groundwater Basin
Boundaries Along the Santa Clara River
Los Angeles and Ventura Counties, CA

Newhall Land and Farming Company

GSI Water Solutions, Inc.

Original Map Prepared From
Figures By LACSD (2007)
and CH2M HILL

April 2008

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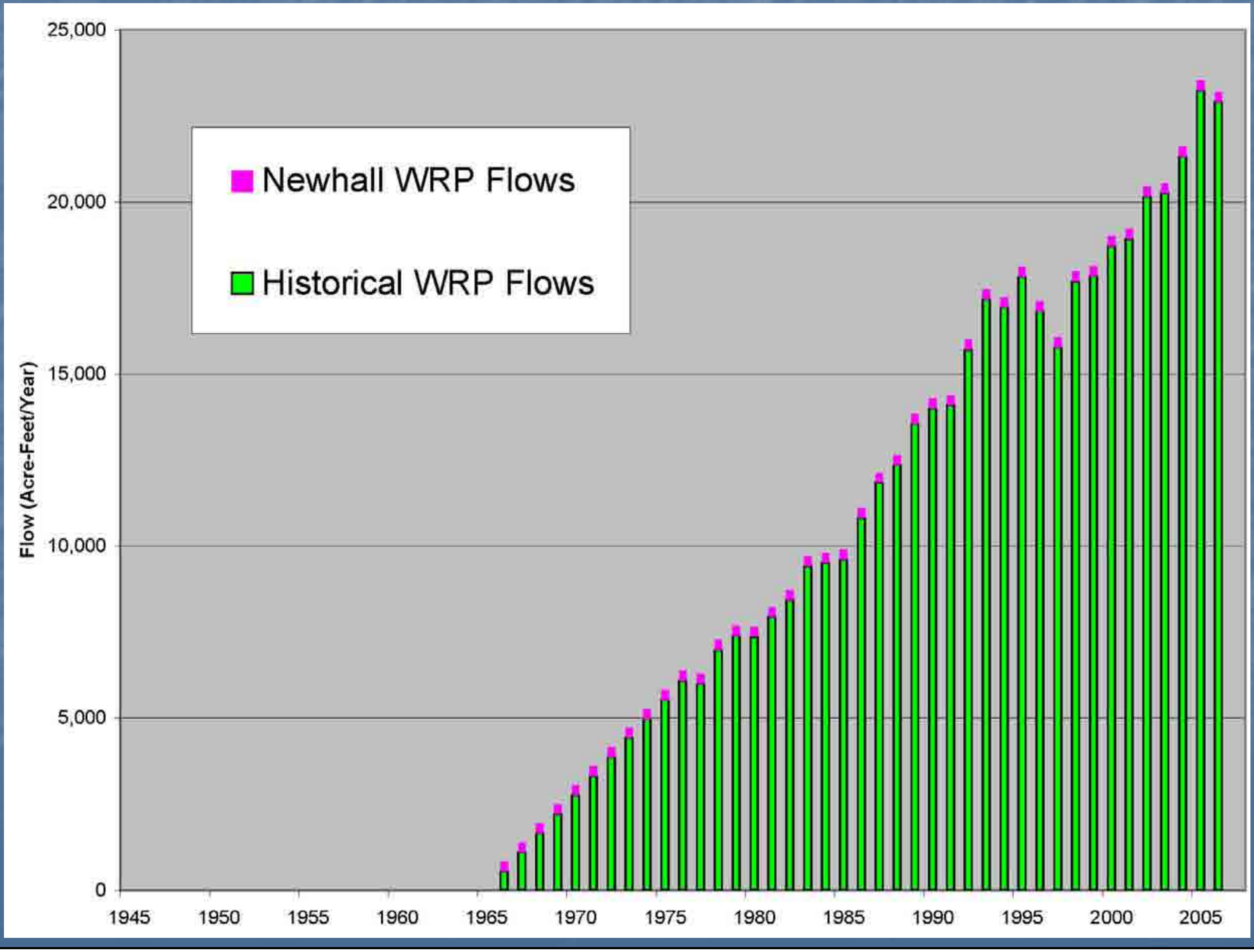
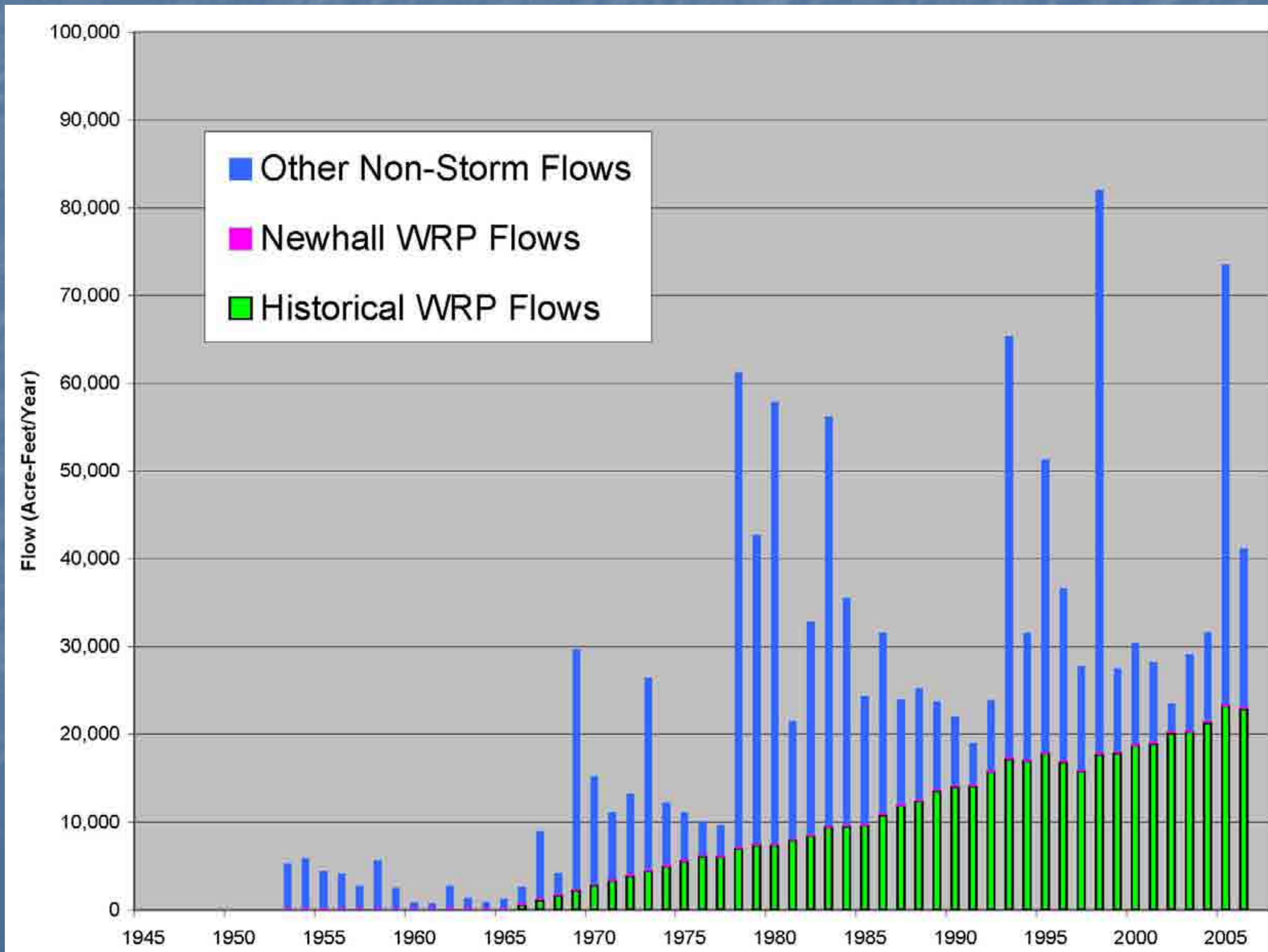
# Figure 2

## Newhall WRP Flows and Historical Flows From Upstream WRPs



# Figure 3

## Historical Flows from Upstream WRPs, Future Newhall WRP Flows, and Other Non-Storm Flows



# Figure 4

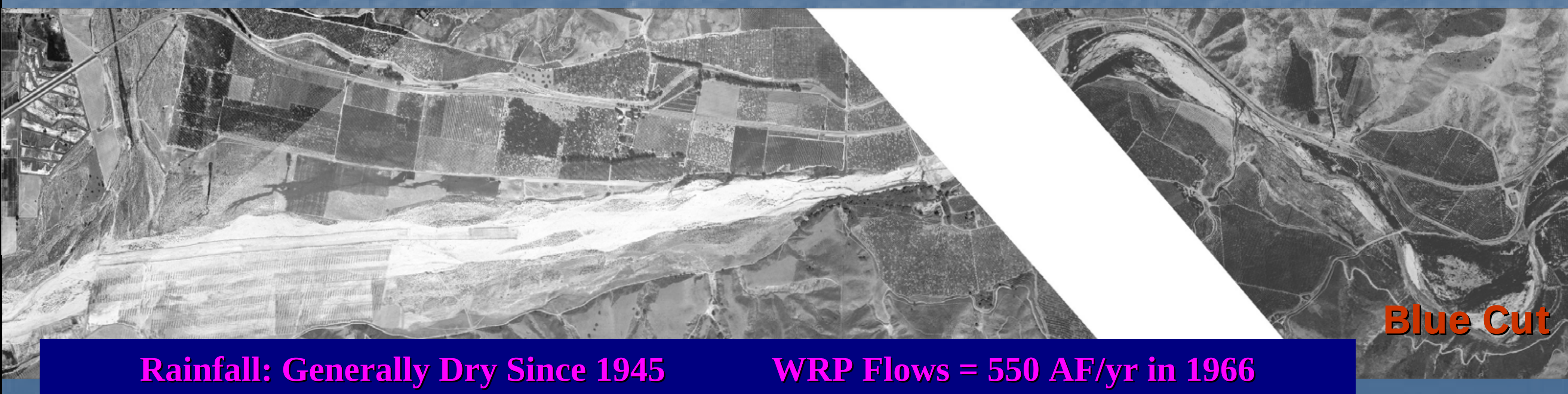
## Pre-Development Photos At and Above Piru Creek (1927 to 1945)

Rainfall: Generally Dry Since 1919 — No WRP Flows


Rainfall: Generally Wet Since 1938 — No WRP Flows

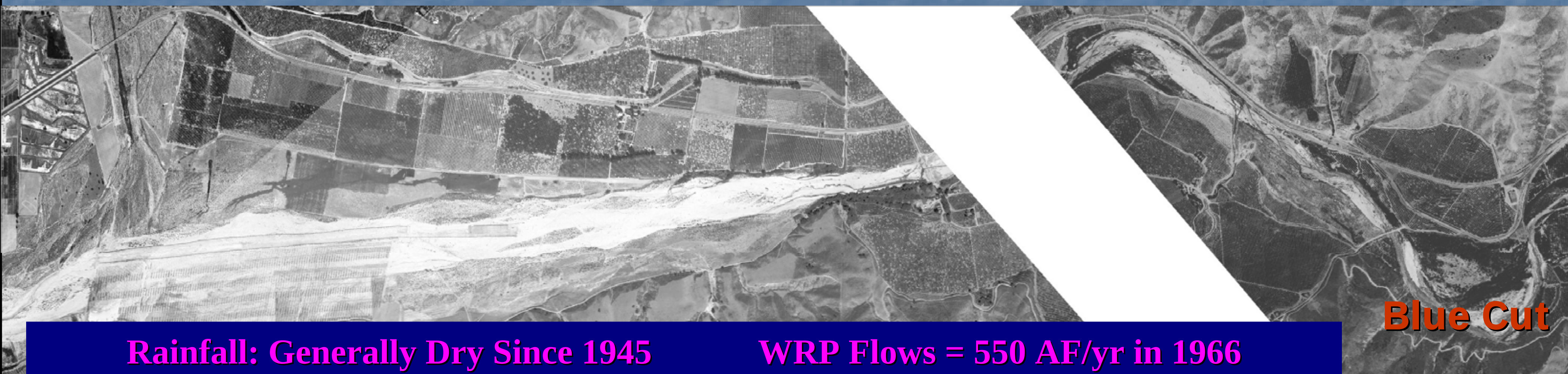
# Figure 5

## Pre-Development Photos At and Above Piru Creek (1945 to 1966)

# Figure 6

## Historical Development Photos At and Above Piru Creek (1966 to 1989)



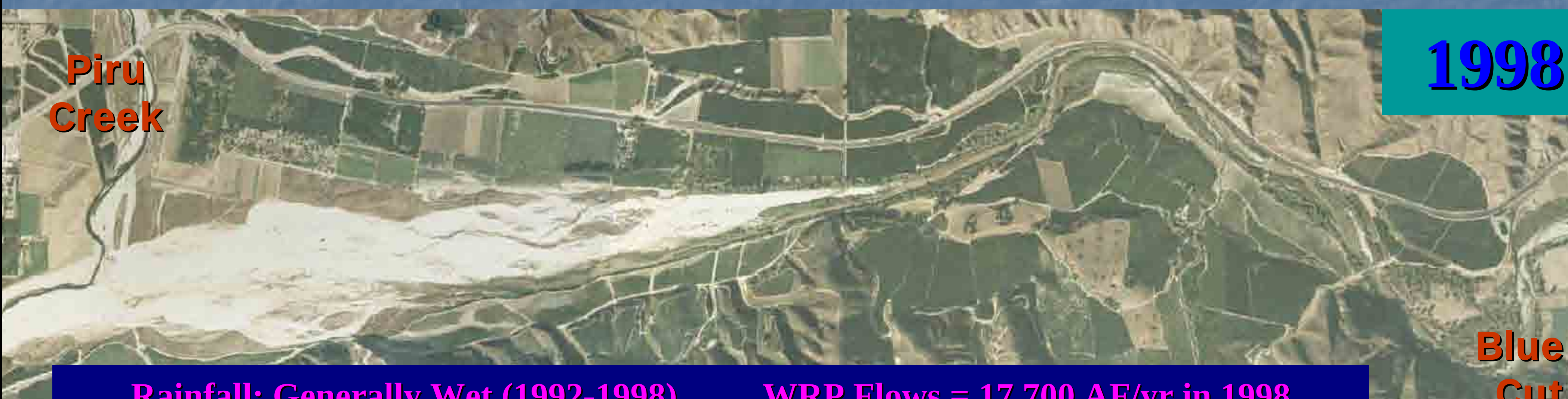

Rainfall: Generally Dry Since 1945 WRP Flows = 550 AF/yr in 1966


Rainfall: Generally Wet (1978-1983), Then Dry WRP Flows = 13,500 AF/yr in 1989

# Figure 7

## Historical Development Photos At and Above Piru Creek (1989 to 1998)


**Rainfall: Generally Wet (1978-1983), Then Dry** **WRP Flows = 13,500 AF/yr in 1989**




**Rainfall: Generally Wet (1992-1998)** **WRP Flows = 17,700 AF/yr in 1998**

# Figure 8

## Historical and Recent Photos At and Above Piru Creek (1998 to 2004)


# Figure 9

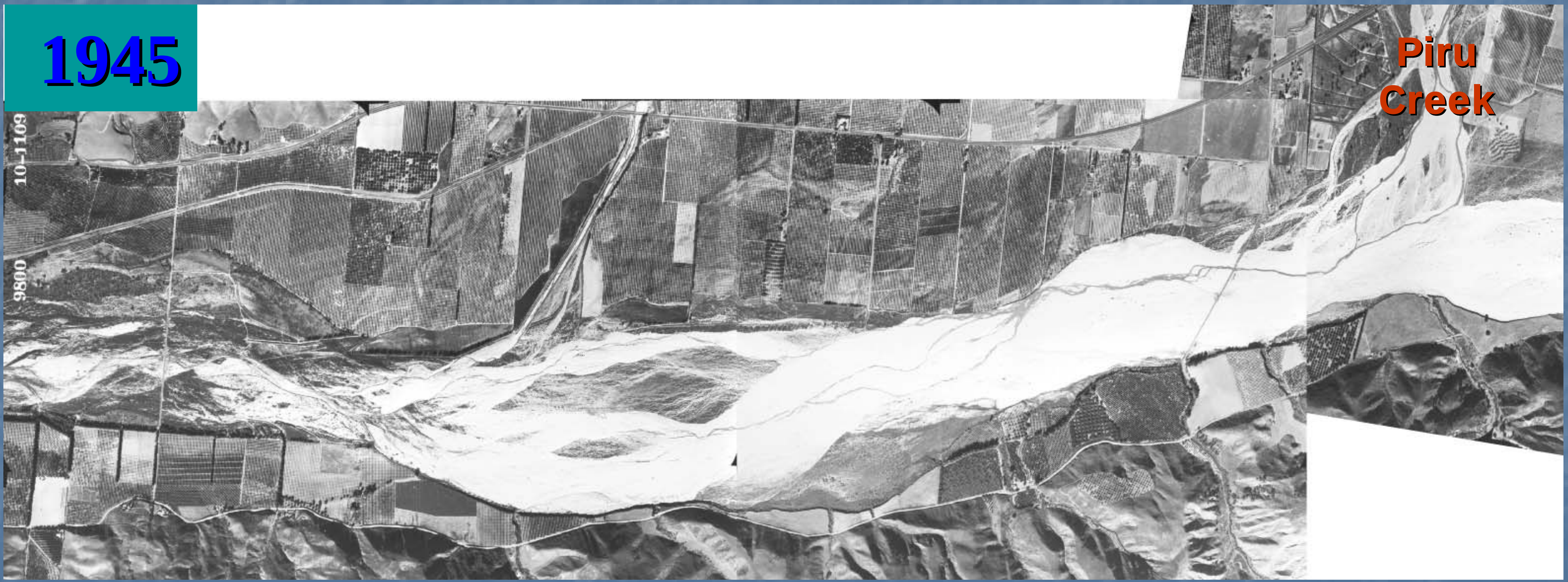
## Recent / Current Conditions At and Above Piru Creek (2004 and Later)


# Figure 10
## Pre-Development Conditions Below Piru Creek (1927)


**Rainfall: Generally Dry Since 1919** **No WRP Flows**

# Figure 11

## Pre-Development Conditions Below Piru Creek (1945)




**Rainfall: Generally Wet Since 1938** **No WRP Flows**

# Figure 12

## Historical Development Conditions Below Piru Creek (1966)


**Rainfall: Generally Dry Since 1945** **WRP Flows = 550 AF/yr in 1966**

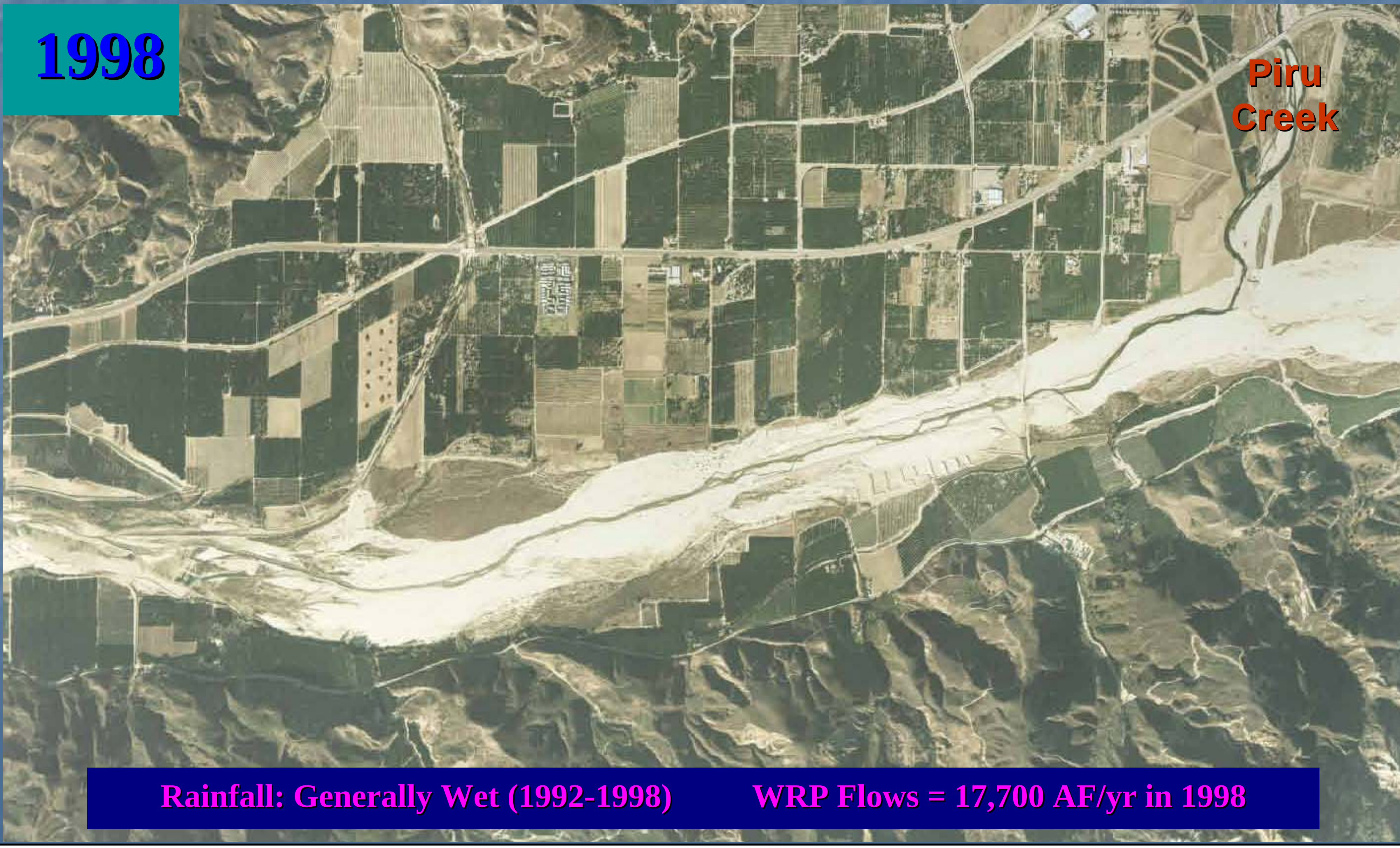
# Figure 13

## Historical Development Conditions Below Piru Creek (1989)


**Rainfall: Generally Wet (1978-1983), Then Dry** **WRP Flows = 13,500 AF/yr in 1989**

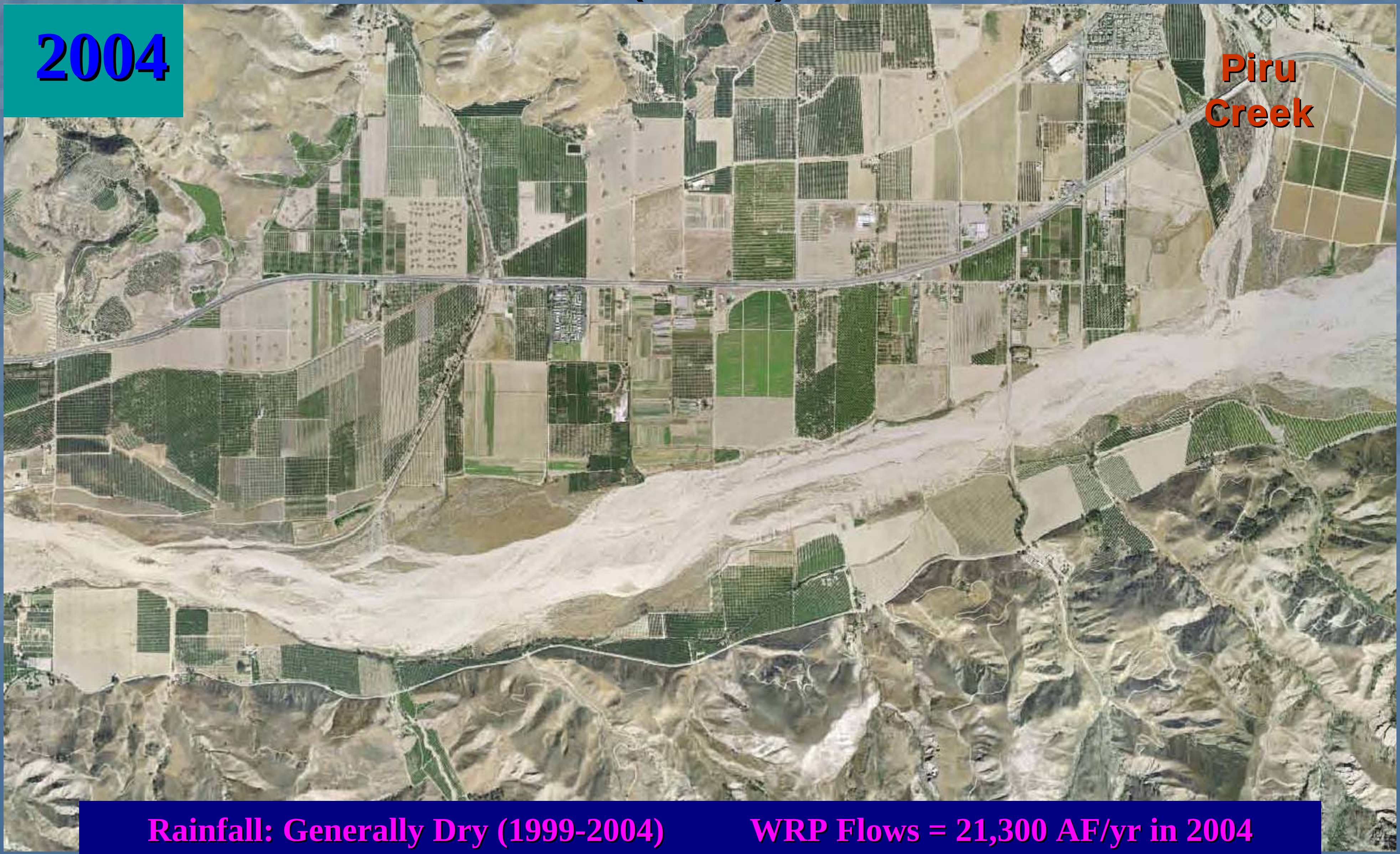
# Figure 14

## Historical Development Conditions Below Piru Creek (1998)



# Figure 15

## Recent/Current Conditions Below Piru Creek (2004)




**Rainfall: Generally Dry (1999-2004)** **WRP Flows = 21,300 AF/yr in 2004**

# Figure 16
## Recent/Current Conditions Below Piru Creek (Post-2004)