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STAFF REPORT

TO: **Raymond Basin Management Board**

FROM: **Stetson Engineers Inc.**

SUBJECT: **A Cooperative Pumping Reduction Plan for the Parties with Water Rights in the Pasadena Subarea**
Performance Evaluation

JOB NO.: **1927-13**

DATE: **June 26, 2017**

BACKGROUND

The Raymond Basin Management Board (RBMB) identified the Pasadena Subarea as an area of concern due to apparent significant reductions of stored groundwater in the Subarea. The Pasadena Subarea groundwater elevation experienced approximately a 100-foot decrease between 1980 and 2008 and had not shown signs of recovery. Due to the decreasing groundwater levels, a "Baseline Study on the Raymond Basin" was prepared dated February 2, 2004. The Baseline Study indicated groundwater levels had generally declined in the Pasadena Subarea since the Judgment was entered and had not recovered, even during sustained wet periods.

In a Technical Memorandum dated December 12, 2007 (see Attachment A), the impacts of the Pasadena Subarea historical hydrology and groundwater production were evaluated. A 20-year projection (Fiscal Year 2006-07 to 2025-26) of groundwater elevations was created assuming continued production at historical rates and a 50 percent reduction to the historical production, as shown on Plate 8 in Attachment A. The projected groundwater levels appeared to stabilize under the 50 percent reduction over the 20-year period. Subsequently, in a cooperative effort to stabilize the groundwater levels and manage the water supplies in the Pasadena Subarea, the RBMB formed a

Pasadena Subarea subcommittee and ultimately adopted Resolution No. 42-0109 entitled, "Resolution of the Board of Directors of the Raymond Basin Management Board Adopting a Cooperative Pumping Reduction Plan for the Parties with Water Rights in the Pasadena Subarea" (Reduction Plan), on January 27, 2009, as shown on Attachment B. Section 2(a) of Resolution No. 42-0109 states, in part "…The re-determination of the Safe Yield in 1955, which resulted in an increase in production rights along with the adoption of the Long Term Storage Policy by the Board in 1993 played a major role in lower overall groundwater levels the Pasadena Subarea is experiencing today." Exhibit A of the Reduction Plan notes the long-term goal of the Reduction Plan is "…a 30% reduction in production of all 1955 Decreed Rights (Decreed Rights) in the area of the Raymond Basin Western Unit, known as the Pasadena Subarea, from 17,843 Acre Feet to 12,493 Acre Feet and to ultimately dissolve remaining Long Term Storage accounts."

Exhibit A of the Reduction Plan states, "The overall intended benefit received from the 30% reduction will be the stabilization and eventual increase in groundwater levels throughout the Pasadena Subarea. It is recognized that the Pasadena Subarea will most likely never return to the higher groundwater levels experienced in first half of the twentieth-century (approximately 1910 to 1955) without importation of supplemental replenishment water. It is also recognized that there may be a reasonable operating range higher than current levels and still lower than early twentieth century levels, which is manageable until replenishment water is available. For this reason the working group has established an increase in the Basin of 50 feet above current levels as its initial goal." The Woodbury Well, owned by the City of Pasadena, was designated as the key well for determining the groundwater level of the Pasadena Subarea. The water level in the Woodbury Well is measured by Raymond Basin staff. Exhibit A of the Reduction Plan further states "…initially, it will take at least three years to have any valuable comparative data." These provisions were included in an effort to establish a sustainable groundwater supply for the Pasadena Subarea. This approach also assumed "average annual" hydrologic conditions would occur.

Section 3 of the Reduction Plan notes, "The Board resolves to collect sufficient groundwater level and production data as to evaluate the effectiveness of the Reduction Plan on July 1, 2012."

Fiscal year 2015-16 represented the third year of the full 30 percent reduction of the 1955 Decreed Rights in the Pasadena Subarea. The purpose of this Staff Report is to review the data collected from 2009 through 2016 and to evaluate the Pasadena Subarea response to the Reduction Plan.

PLANNED OPERATION OF PASADENA SUBAREA

The Reduction Plan's long-term goal of a 30 percent reduction of all 1955 Decreed Rights is to 1) dissolve remaining Long Term Storage accounts, and 2) increase the Raymond Basin groundwater level, as measured at the Woodbury Well, 50 feet above "current levels," which is defined in the Reduction Plan as the water level on July 1, 2009. The Reduction Plan specified the following accounting procedures regarding use of water rights within the Pasadena Subarea commencing July 1, 2009.

1. Reductions of Pasadena Subarea Decreed Rights "…will be implemented each year for five years until the 30% reduction is reached."
2. "Spreading credits will continue to be applied as in the past and will follow the exact protocol set forth in the Judgment."
3. "Producers having water in Long Term Storage can use these accounts to make up the difference between the total required reduction and plus or minus 10 percent of their 1955 Decreed Right until such time all of their water in Long Term Storage is exhausted."
4. "Producers who cannot produce all of their Decreed Rights or Reduced Decreed Rights may lease those rights to other parties. These and other Decreed Rights must be produced that same year and cannot be carried over beyond the provisions set forth in the Judgment."
5. "Producers will be allowed to lease excess Decreed Rights and water in Long Term Storage to other producers but they will not be allowed to "replenish" or add to their Long Term Storage."
6. "Additions to Long Term Storage will be discontinued and individual accounts will be capped at the June 30, 2008, amount and Long Term Storage accounts cannot be added to for any reason."
7. "Transfer of Long Term Storage water from the Monk Hill Subarea to the Pasadena Subarea on behalf of the City of Pasadena will be discontinued…"
8. "…total aggregate production from the Pasadena Subarea (including leases) shall not exceed 16,773 acre-feet or 17,843 acre-feet – 1,070 acre-feet in the first year (fiscal year 2009-10) and will be reduced by an additional 1,070 acre-feet each subsequent year for five consecutive years to a total allowable amount of 12,493 acre-feet in any single fiscal year, until the Basin sufficiently recovers."
9. "The Woodbury Well, owned by the City of Pasadena, will be used as the Key Well for the Pasadena Subarea."

BASELINE CONDITIONS AS OF JULY 1, 2009 (INITIAL YEAR OF REDUCTION)

Static Water Elevation at the Key Well

The Reduction Plan states, "The Woodbury Well, owned by the City of Pasadena, will be used as the key well for the Pasadena Subarea. The level in the Woodbury Well will

be measured at regular intervals by Raymond Basin staff to track the impacts of the re-adjusted pumping." The static groundwater elevation in the Woodbury Well for the period May 1, 1980 to April 2014 is shown on Figure 1. According to City of Pasadena staff the groundwater elevation in the Woodbury Well could not be measured between October 2007 and April 2011 and only four measurements were collected between April 2011 and April 2014. No measurements have been conducted since April 2014. Consequently, the City of Pasadena's Monte Vista Well, located about 2,200 feet northerly from the Woodbury Well, was used to analyze the static water elevation for the Pasadena Subarea. The static groundwater elevation in the Monte Vista Well for the period May 1, 1980 to April 2016 is shown on Figure 2. Figure 2 shows the water elevation at the Monte Vista Well as of July 1, 2009, at 409.7 feet above mean sea level (msl) and for the purpose of this analysis, is considered to represent "current" groundwater levels for the Pasadena Subarea, as noted in Item 8 under "Planned Operation of Pasadena Subarea".

Precipitation

Precipitation in the Pasadena Subarea impacts surface water runoff, local water replenishment and groundwater elevations measured by the Raymond Basin staff at the Woodbury Well and the Monte Vista Well. The RBMB Annual Report uses Station 610B to represent precipitation within the Pasadena Subarea. Station 610B is located at the City of Pasadena's City Hall. The baseline condition for precipitation is based on the 50-year average annual rainfall prior to July 1, 2009 and the five-year average annual rainfall prior to July 1, 2009. As shown on Figure 3, the 50-year average annual rainfall (fiscal years 1958-59 to 2008-09) is about 20.1 inches and the five-year average annual rainfall (fiscal years 2004-05 to 2008-09) is about 23.8 inches.

Local Water Replenishment

Surface water replenishment within the Pasadena Subarea occurs in the Los Angeles County Department of Public Works Eaton Spreading Grounds using local runoff; and from local water diverted and replenished by Kinneloa Irrigation District and by the City of Pasadena in the Eaton Canyon area. The baseline condition for local water replenishment is based on the five-year average annual replenishment prior to July 1, 2009. As shown in Figure 4, the five-year average annual replenishment (fiscal years 2004-05 to 2008-09) is about 3,000 acre-feet per year.

Groundwater Production

The Pasadena Subarea groundwater producers include the City of Alhambra, City of Arcadia, California-American Water Company, East Pasadena Water Company, H.E. Huntington Library and Art Gallery, Kinneloa Irrigation District, City of Pasadena, San Gabriel County Water District and Sunny Slope Water Company. The baseline

condition for groundwater production is based on the five-year average annual production prior to July 1, 2009. As shown in Figure 5, the five-year average annual production (fiscal years 2004-05 to 2008-09) is about 19,800 acre-feet. (Note: 1955 Decreed Rights on the Pasadena Subarea total 17,843 acre-feet per year.)

SUMMARY OF THE PASADENA SUBAREA REDUCTION PLAN (2009-16)

Static Groundwater Level

The static groundwater level measured at the Monte Vista Well (replaced Woodbury Well) for the period May 1, 1980 to April 2016 is shown on Figure 2. Figure 2 shows the water elevation at the Monte Vista Well as of July 1, 2009, at 409.7 feet above mean sea level (msl) and for the purpose of this analysis, is considered to represent "current" (starting) groundwater levels for the Pasadena Subarea, as noted in Item 8 under "Planned Operation of Pasadena Subarea". As of April 14, 2016, the static groundwater level at the Monte Vista Well was reported as 396.7 feet msl, representing a net 13-foot decrease from the beginning of the Reduction Plan.

Precipitation

During the past seven years of implementation of the Reduction Plan, precipitation has averaged 15.61 inches at rainfall station 610B, compared to the long-term average of 20.06 inches, and has averaged only 11.26 inches over the past five years. The precipitation is indicative of the drought conditions which occurred over the past five years.

Local Water Replenishment

The local Water replenishment over the period 1954-55 through 2008-09 has averaged about 4,600 acre-feet per year as shown on Figure 6, which also shows the accumulated departure from average. Over the seven years of the Reduction Plan local water replenishment has averaged about 1,300 acre-feet, representing an annual deficit of about 3,300 acre-feet per year. This deficit is also shown on Figure 6. Based on prior studies, about 2,500 acre-feet groundwater in storage represents one foot of elevation in the Pasadena Subarea. Assuming local water replenishment had been "average" over the past seven years, there could have been an additional 23,100 acre-feet (3,300 X 7) replenished and groundwater levels actually may have increased by about 10 feet (23,100/2,500), considering the decreased groundwater production under the Reduction Plan. **Consequently, the impacts of the Reduction Plan would have been more successful regarding the long-term goal of stabilizing or increasing the groundwater level through the reduction in groundwater extractions had there been average annual precipitation.**

Groundwater Production

The Pasadena Subarea Reduction Plan was initially implemented at the beginning of fiscal year 2009-10. A key provision of the Reduction Plan states, "…total aggregate production from the Pasadena Subarea (including leases) shall not exceed 16,773 acre-feet or 17,843 acre-feet – 1,070 acre-feet in the first year (fiscal year 2009-10) and will be reduced by an additional 1,070 acre-feet each subsequent year for five consecutive years to a total allowable amount of 12,493 acre-feet in any single fiscal year, until the Basin sufficiently recovers." However, while this provision was applied to the use of 1955 Decreed Rights, it appears groundwater production of "Spreading Credit" and "Long Term Storage" continued to occur outside of this restriction. As shown on Figure 5, actual groundwater production under the "baseline" condition was 19,758 acre-feet (which exceeds the 1955 Decreed Rights of 17,843 acre-feet. Much of the additional production during the baseline condition was the result of "Spreading Credit" production.

During the initial three years of implementation of the Reduction Plan, "aggregate production" was less than the reduced 1955 Decreed Rights. However, commencing with fiscal year 2012-13 (second year of the recent drought and fourth year of the implementation of the Reduction Plan), aggregate production exceeded the Reduction Plan goal in each of the subsequent four years as a result of the Producers' use of Spreading Credits and Long Term Storage. During the seven years of operation under the Reduction Plan the average annual production was about 15,200 acre-feet. The Reduction Plan primarily placed a limitation on the use of 1955 Decreed Rights, but allowed Producers to continue to produce groundwater against their Long Term Storage. Consequently, it is likely actual production would have been the same whether or not the Reduction Plan was enacted. However, Long Term Storage, as of July 1, 2009, was 27,021.1 acre-feet and the ending balance, as of June 30, 2016, was 23,933.7 acre-feet, as shown on Table 1. After seven years of implementation of the Reduction Plan, the Long Term Storage decreased by 3,087.4 acre-feet, of which about 1,400 acre-feet occurred in fiscal year 2013-14. With the 30 percent reduction phase now in place, further reductions to the Long Term Storage accounts are expected going forward. **The Reduction Plan has been a success regarding the long-term goal of reducing and eliminating Long Term Storage.**

The following is a brief summary of the previous Pasadena Subarea Reduction Plan evaluations, along with the current evaluation.

2012 Evaluation

Pursuant to the terms of the Reduction Plan, RBMB staff prepared a 2012 Staff Report, dated May 31, 2012. Key findings from that Staff Report are summarized below.

- Following two years of operation under the Reduction Plan, the Long Term Storage accounts collectively decreased from 27,021.1 acre-feet as of July 1, 2009, to 26,786.4 acre feet as of June 30, 2011, a net reduction of 234.7 acre-feet.
- The "current" groundwater level (as of July 1, 2009) at the Monte Vista Well was 409.7 feet. The groundwater elevation at the Monte Vista Well increased by about four feet to 413.7 feet as of April 22, 2010, which appears to be primarily influenced by reduced groundwater production. During fiscal year 2010-11 groundwater levels increased by about one foot, while the groundwater production remained essentially unchanged from the prior year. It appears groundwater levels have increased about two feet for every 6 percent reduction in groundwater rights, under these hydrologic conditions.
- Based upon the Reduction Plan, long-term goals of reducing the Pasadena Subarea water rights by 30 percent to increase the basin groundwater levels by about 50 feet, each step of the Reduction Plan (6 percent water rights reduction) should increase the groundwater level by about 10 feet, assuming all other conditions remain relatively constant. As noted above, after two years of water rights reductions (a total of 12% reduction), the groundwater level has increased only five feet as compared to the 12 percent goal of about a 20-foot increase.
- After two years of implementation of the Reduction Plan, the producers have successfully reduced their pumping, but have not needed to utilize the Long Term Storage. Implementation of the remaining 18 percent (3,210 acre-feet) of the Reduction Plan may require the producers to use Long Term Storage (about 27,000 acre-feet) to provide the necessary water rights to make up the difference between production and water rights. Therefore, the goal of dissolving the remaining Long Term Storage accounts may require several years of operation under reduced Decreed Rights.

2015 Evaluation

Pursuant to the terms of the Reduction Plan, RBMB staff prepared a 2015 Staff Report dated March 23, 2015. Key findings from that Staff Report are summarized below.

- During the five years of operation under the Reduction Plan, groundwater production has averaged 15,300 acre-feet compared to the prior 5-year baseline average of about 19,800 acre-feet.
- During the five years of operation under the Reduction Plan, replenishment has averaged about 1,700 acre-feet per year compared to the prior 5-year baseline average of about 3,000 acre-feet per year.

- Following five years of operation under the Reduction Plan, the Long Term Storage accounts collectively decreased from 27,021.1 acre-feet as of July 1, 2009, to 24,784.7 acre feet as of June 30, 2014, a net reduction of 2,236.4 acre-feet.
- The "current" groundwater level (as of July 1, 2009) at the Monte Vista Well was 409.7 feet. The groundwater elevation at the Monte Vista Well decreased by about 14 feet to 395.7 feet as of April 21, 2014, which appears to be primarily influenced by below average rainfall and reduced replenishment.
- Based upon the Reduction Plan, long-term goals of reducing the Pasadena Subarea water rights by 30 percent to increase the basin groundwater levels by about 50 feet, each step of the Reduction Plan (6 percent water rights reduction) should increase the groundwater level by about 10 feet, assuming all other conditions remain relatively constant. As noted above, after five years of water rights reductions (a total of 30% reduction), the groundwater level has <u>decreased</u> about 14 feet as compared to the 30 percent goal of about a 50-foot <u>increase</u>.
- After five years of implementation of the Reduction Plan, the Producers have successfully reduced their pumping and have used the Long Term Storage. At the end of fiscal year 2013-14 Producers had no carryover rights and had used about 1,400 acre-feet from Long Term Storage and the year-end balance was about 24,800 acre-feet. With the 30 percent reduction of Decreed Rights in-place, continued reductions of the Long Term Storage accounts are expected to continue going forward.

<u>Evaluation for Fiscal Years 2014-15 and 2015-16</u>

<u>Precipitation</u>

During the past two years of full implementation of the Reduction Plan (fiscal years 2014-15 to 2015-16), precipitation at Station 610B (see Figure 3) averaged 12.7 inches. The average annual rainfall during those two years was 63 percent of the 50-year average annual rainfall of 20.1 inches, and 53 percent of the baseline 5-year average annual rainfall of 23.8 inches. Below average precipitation often results in reduced local water runoff, reduced local water replenishment and may result in decreasing groundwater levels, assuming groundwater production remains constant. Below average precipitation may also contribute to increased groundwater demands due to increased irrigation requirements.

Local Water Replenishment

During the past two years of full implementation of the Reduction Plan (fiscal years 2014-15 to 2015-16), local water replenishment averaged about 304 acre-feet per year, which is 2,696 acre-feet per year below the prior 5-year baseline condition of 3,000 acre-feet, as shown on Figure 4. During those two years of the Reduction Plan period, about 222 acre-feet, (of the 304 acre-feet) was replenished by the City of Pasadena and Kinneloa Irrigation District as a Spreading Credit and subsequently pumped in the following year by the City of Pasadena and Kinneloa Irrigation District. Consequently, an average of only about 82 acre-feet per year was replenished in the Pasadena Subarea for general benefit.

Groundwater Production

During the past two years of full implementation of the Reduction Plan (fiscal years 2014-15 to 2015-16), groundwater production throughout the Pasadena Subarea averaged about 14,805 acre-feet. As shown on Figure 5, total groundwater production (including production of Spreading Credits and Long Term Storage) exceeded the reduced Decreed Rights (12,493 acre-feet) during fiscal years 2014-15 and 2015-16 , but was less than the collective 1955 Decreed Rights (17,843 acre-feet).

Changes in Long Term Storage Accounts

As previously discussed, the RBMB adopted the Long Term Storage Policy in 1993 which allowed groundwater producers to store water in the Raymond Basin. The Pasadena Subarea Reduction Plan includes elimination of Long Term Storage. Exhibit A of the Reduction Plan's Long-Term goal is "a 30% reduction in production of all 1955 Decreed Rights…" and "…to ultimately dissolve remaining Long-Term Storage accounts." In addition, Exhibit A of the Reduction Plan describes conditions for use of the Long-Term Storage accounts. "Producers having water in Long Term Storage can use these accounts to make-up the difference between the total required reduction and plus or minus 10% of their 1955 Decreed Right until such time as all of their water in Long Term Storage is exhausted…Additions to Long Term Storage will be discontinued and individual accounts will be capped at the June 30, 2008, amount and Long Term Storage accounts cannot be added for any reason." As shown in Table 1, the Long-Term Storage account was capped at the June 30, 2008 amount of 27,148.6 acre-feet.

One of the goals of the Reduction Plan was to evaluate the effectiveness of capping the Long Term Storage accounts. The Long Term Storage had a beginning balance, as of July 1, 2009, of 27,021.1 acre-feet. As shown on Table 1, fiscal years 2009-10 through 2011-12 had reductions of about 120 acre-feet per year, primarily as a result of the accounting of an annual one percent storage loss deduction from Long Term Storage accounts. However, commencing fiscal year 2012-13 and continuing into fiscal year

2015-16, Producers used water rights held in Long Term Storage accounts as a result of production in excess of the reduced Decreed Rights. In summary, the beginning balance of the Long Term Storage as of July 1, 2009 was 27,021.1 acre-feet and the ending balance as of June 30, 2016 was 23,933.7 acre-feet, as shown on Table 1. After seven years of implementation of the Reduction Plan, the Long Term Storage decreased by 3,087.4 acre-feet, of which about 1,400 acre-feet occurred in fiscal year 2013-14. With the 30 percent reduction phase now in place, further reductions to the Long Term Storage accounts are expected going forward. The long-term goal of the Reduction Plan is to eliminate all 27,021.1 acre-feet, which had been in Long Term Storage as of July 1, 2009 and dissolve Long Term Storage.

Table 2 provides a summary of Pasadena Subarea water rights (including Decreed Rights, Spreading Credits, Long Term Storage and carryover of Decreed Rights) and annual production. Table 2 indicates that during fiscal years 2014-15 and 2015-16 annual production used all available reduced Decreed Rights (under the Reduction Plan), all carryover and results in Producers actively using water rights in their Long Term Storage Accounts to balance with production.

Impacts to Groundwater Levels

Exhibit A of the Reduction Plan indicated the overall intended benefit from the 30 percent reduction "…will be the stabilization and eventual increase in groundwater levels throughout the Pasadena Subarea. It is recognized that the Pasadena Subarea will most likely never return to the higher groundwater levels experienced in first half of the twentieth-century without importation of replenishment water…For this reason the working group has established an increase in the Basin of 50 feet above current levels as its initial goal." As shown in Figure 2, the "current" groundwater level at the Monte Vista Well was at 409.7 feet, as of July 1, 2009.

During fiscal year 2014-15 (the sixth year of the Reduction Plan and second year of full implementation), precipitation was below the baseline condition, as shown on Figure 3. In addition, local water replenishment was below the baseline condition, as shown in Figure 4. Decreed Rights of 17,843 acre-feet were reduced by 30 percent to 12,493 acre-feet. However, actual groundwater production was only reduced by about 14 percent from the Decreed Rights of 17,843 acre-feet, to about 15,400 acre-feet, a reduction of about 4,400 acre-feet from the baseline condition (19,800 – 15,400) and about 2,600 acre-feet from fiscal year 2008-09. These conditions resulted in an increase of the groundwater level at the Monte Vista Well by about three feet from 395.7 feet, as of April 21, 2014, to 398.7 feet, as of April 24, 2015. The April 2015 elevation represents a decrease of 11 feet below the "current" (start of Reduction Plan) groundwater level of 409.7 feet (July 1, 2009), as shown in Figure 2.

During fiscal year 2015-16 (the seventh year of the Reduction Plan and third year of full implementation), precipitation was below the baseline condition, as shown on Figure 3. In addition, local water replenishment was below the baseline condition, as shown in Figure 4. Decreed Rights of 17,843 acre-feet were reduced by 30 percent to 12,493 acre-feet. However, actual groundwater production was only reduced by about 20 percent from the Decreed Rights of 17,843 acre-feet, to about 14,200 acre-feet, a reduction of about 5,600 acre-feet from the baseline condition (19,800 – 14,200) and about 3,800 acre-feet from fiscal year 2008-09. These conditions resulted in a decrease of the groundwater level at the Monte Vista Well by about two feet from 398.7 feet as of April 24, 2015 to 396.7 feet as of April 14, 2016. The April 2016 elevation represents a decrease of 13 feet below the "current" groundwater level of 409.7 feet (July 1, 2009), as shown in Figure 2.

The change in groundwater levels appears to be most influenced by the groundwater production and replenishment of the Pasadena Subarea. During the two years after the five-year Reduction Plan period (2014-15 through 2015-16) groundwater extractions have averaged about 14,800 acre-feet, including Spreading Credit and use of Long Term Storage credits. Total groundwater extractions were reduced by about 17 percent from the 1955 Decreed Rights, while the goal was a 30 percent reduction. The average annual replenishment was about 300 acre-feet, which is about 10 percent of the baseline average of 3,000 acre-feet. During the Reduction Plan period (2009-10 through 2015-16) groundwater levels decreased by about 13 feet (409.7 – 396.7) from the "current" groundwater condition that existed as of July 1, 2009. For five consecutive years (2011-12 through 2015-16) there has been below average rainfall and groundwater levels in the Pasadena Subarea have not increased. However, without the Reduction Plan in place, groundwater levels could have decreased even more.

CONCLUSIONS

The goal of this Staff Report is to evaluate the impacts to the static water levels in the past seven years of operation under the Reduction Plan, evaluate the effectiveness of reducing the Long Term Storage accounts, and reducing groundwater production to ultimately increase basin storage and groundwater levels. The following is a discussion of how the Pasadena Subarea was impacted by the Reduction Plan for the seven years (fiscal years 2009-10 through 2015-16).

1. The Raymond Basin Management Board adopted Resolution No. 42-0109 entitled, "Resolution of the Board of Directors of the Raymond Basin Management Board Adopting a Cooperative Pumping Reduction Plan for the Parties with Water Rights in the Pasadena Subarea" on January 27, 2009. The long-term goal of the Reduction Plan is a 30 percent reduction in production of all Decreed Rights in the Pasadena Subarea. In addition, the Reduction Plan had a long-term goal of 1) ultimately dissolving the remaining Long Term Storage

accounts, and 2) to increase groundwater levels to 50 feet above the "current" conditions as of July 1, 2009.

2. During the past seven years of operation under full implementation of the Reduction Plan, groundwater production has averaged 15,200 acre-feet compared to the prior 5-year baseline average of about 19,800 acre-feet and the Reduction Plan goal of 12,493 acre-feet. This represents a 15 percent reduction compared to the goal of 30 percent.

3. During the past seven years of operation under full implementation of the Reduction Plan, replenishment has averaged about 1,300 acre-feet compared to a long-term average of about 4,600 acre-feet. Had there been average precipitation, resulting in average replenishment, an additional 23,100 acre-feet of stormwater runoff may have been replenished resulting in about a 10-foot increase in groundwater levels.

4. Following past seven years of operation under the Reduction Plan, the Long Term Storage accounts collectively decreased from 27,021.1 acre-feet as of July 1, 2009, to 23,933.7 acre feet as of June 30, 2016, a net reduction of 3,087.4 acre-feet. However, production over the past seven years has been lower due to increased retail customer water conservation.

5. The "current" (start of Reduction Plan) groundwater level (as of July 1, 2009) at the Monte Vista Well was 409.7 feet. The groundwater elevation at the Monte Vista Well decreased by about 13 feet to 396.7 feet as of April 21, 2016, which appears to be primarily influenced by below average rainfall and reduced replenishment.

6. Based upon the Reduction Plan, long-term goals of reducing the Pasadena Subarea water rights by 30 percent to increase the basin groundwater levels by about 50 feet, each step of the Reduction Plan (6 percent water rights reduction) should increase the groundwater level by about 10 feet, assuming all other conditions remain relatively constant. As noted above, after seven years of water rights reductions (a total of 30% reduction), the groundwater level has <u>decreased</u> about 13 feet as compared to the 30 percent goal of about a 50-foot <u>increase</u>.

7. After seven years of implementation of the Reduction Plan, the Producers have successfully reduced their pumping and have used the Long Term Storage. At the end of fiscal year 2015-16, the Long Term Storage year-end balance was about 23,900 acre-feet. With the 30 percent reduction of Decreed Rights in-place, continued reductions of the Long Term Storage accounts are expected to continue going forward.

8. Had hydrology been “normal” during the seven years of the Reduction Plan, the Pasadena Subarea:

    a. May have had an additional 23,100 acre-feet of stormwater runoff replenishment resulting in about a 10-foot increase in groundwater levels.
    b. May have had reduced demands for groundwater supply.

9. Had the RBMB not implemented the Reduction Plan over the past seven years, the Pasadena Subarea:

    a. May have experience continued historical production of about 19,700 acre-feet per year compared to the average annual production of about 15,200 acre-feet per year, a reduction of about 4,500 acre-feet per year. Over the seven year period, this would have been about 31,500 acre-feet or about 13 feet of decreased groundwater elevation.
    b. The Long Term Storage would not have been decreased by about 3,100 acre-feet.

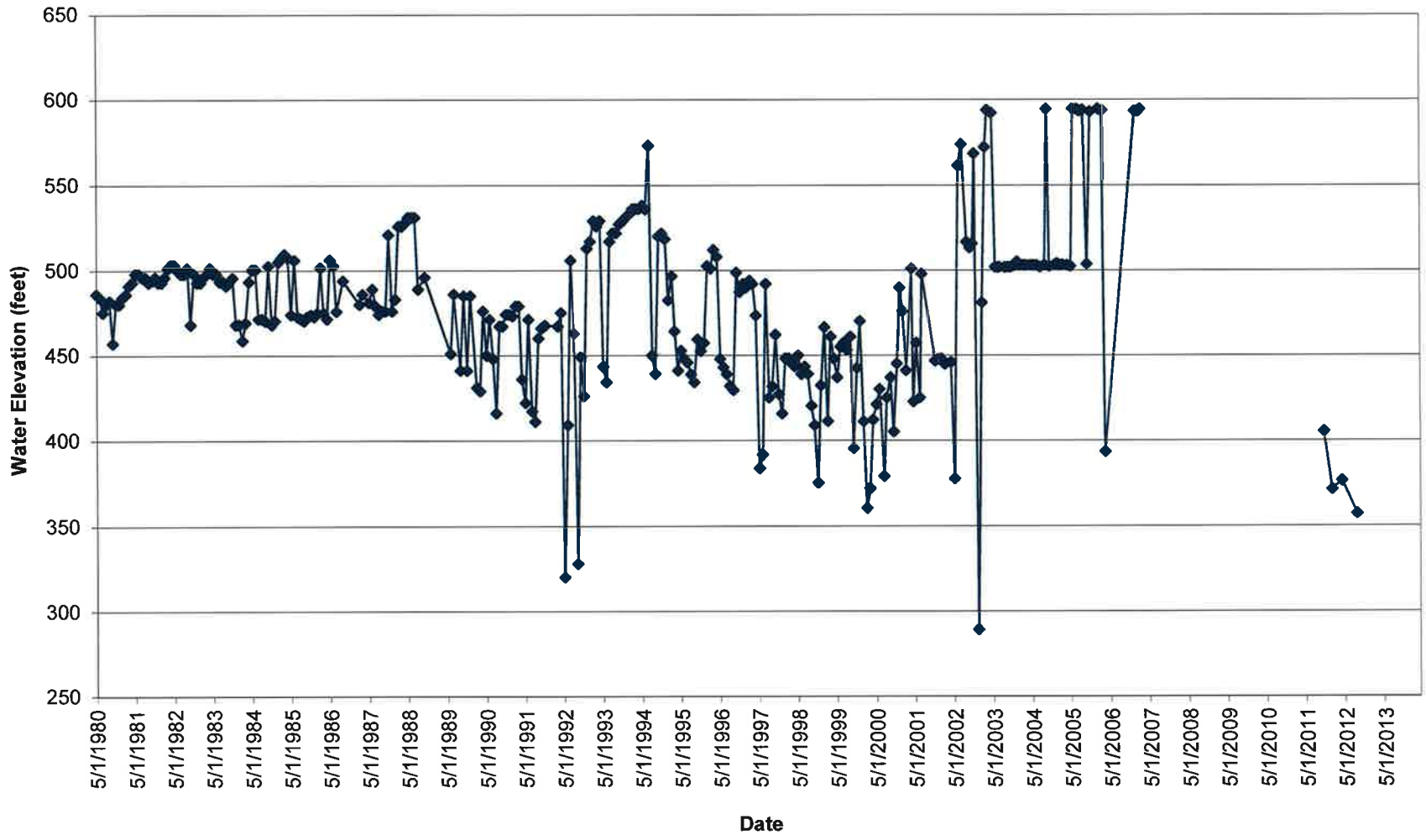
RECOMMENDATIONS

It is recommended RBMB continue to implement the Reduction Plan until such time the stated goals of 1) dissolving remaining Long Term Storage accounts, and 2) increasing the Raymond Basin groundwater level, as measured at the Woodbury Well, 50 feet above “current levels,” are achieved.

Table 2
Pasadena Subarea Operations
(acre-feet)

Fiscal Year	Carry Over from Previous Year (1)	Decreed Rights, 1955 (2)	Surface Water Spread Credit (3)	Long-term Storage			Total Water Rights 1/ (7)	Groundwater Extraction (8)	Balance at End of Year (9)=(7)-(8)	Carry Over to Next Year (10)
				Beginning Balance (4)	Loss (5)	Ending Balance (6)				
2008-09	928.1	17,843.0	990.7	27,148.6	127.5	27,021.1	22,252.0	17,979.5	4,272.5	945.0
2009-10	945.0	16,772.4	484.4	27,021.1	115.6	26,905.5	20,393.7	15,860.2	4,533.5	950.0
2010-11	950.0	15,701.8	915.7	26,905.5	119.1	26,786.4	19,318.1	15,622.7	3,695.4	930.1
2011-12	930.1	14,631.3	1,711.1	26,786.4	121.2	26,665.2	17,447.8	14,085.9	3,361.9	819.0
2012-13	819.0	13,560.7	548.8	26,665.2	436.1	26,229.1	18,164.0	16,498.4	1,665.6	480.1
2013-14	480.1	12,490.1	342.1	26,229.1	1,417.7	24,811.4	14,549.0	14,597.9	-48.9	-48.9
2014-15	-48.9	12,490.1	331.4	24,811.4	511.8	24,299.6	15,697.2	15,362.5	334.7	334.7
2015-16	334.7	12,490.1	193.4	24,299.6	365.9	23,933.7	15,727.3	14,247.1	1,480.2	650.1

Note:
1/ Includes adjustments made between City of Pasadena in Pasadena Subarea and in Monk Hill Subarea.



STETSON ENGINEERS INC.

Covina San Rafael Mesa, Arizona

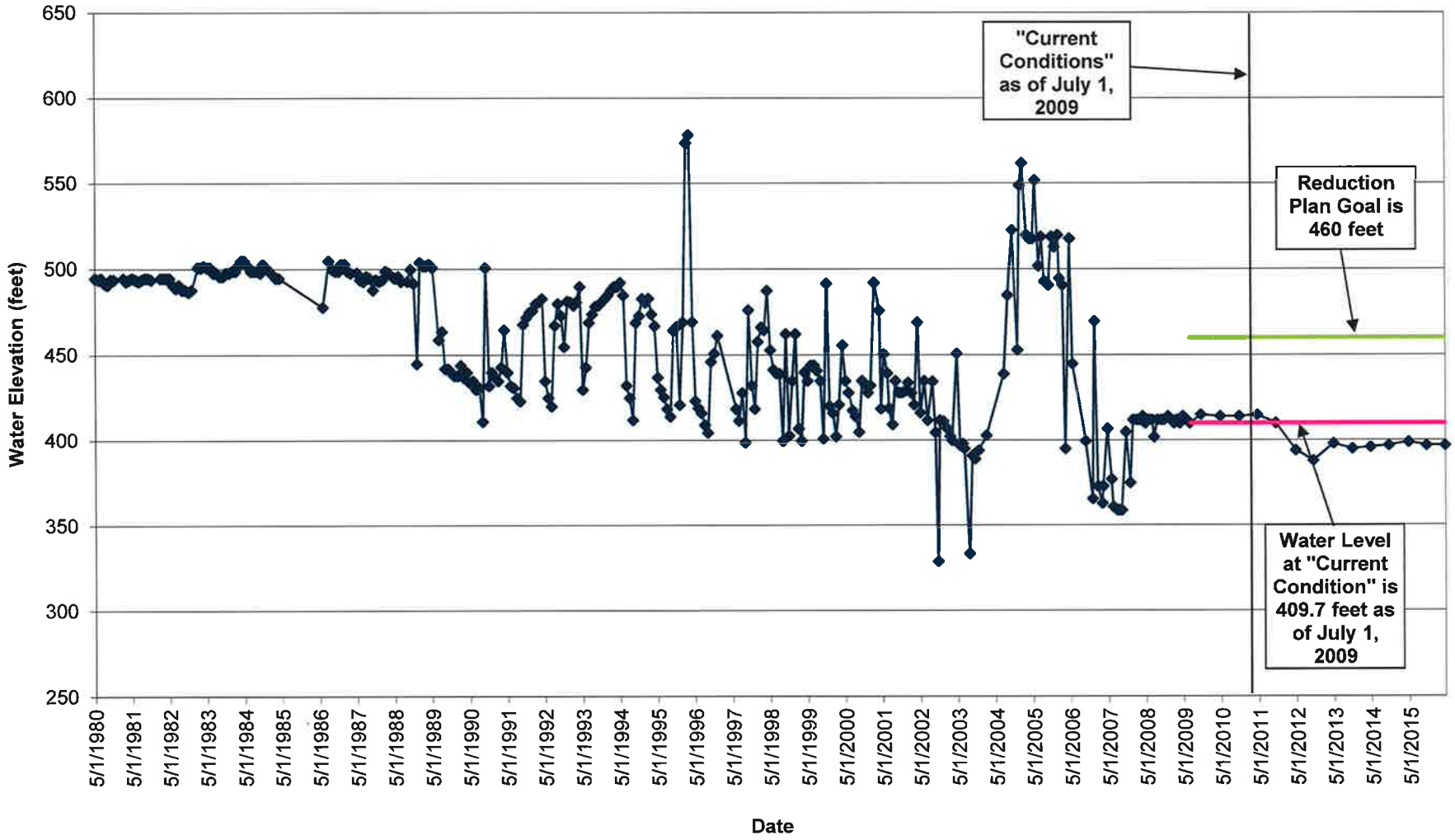
WATER RESOURCE ENGINEERS

RAYMOND BASIN MANAGEMENT BOARD

STATIC WATER ELEVATION AT WOODBURY WELL

FIGURE 1

Z:\Jobs\1927\13-Pasadena Subarea evaluation\Reduction Plan review 2017\Figure 1 - Woodbury Well



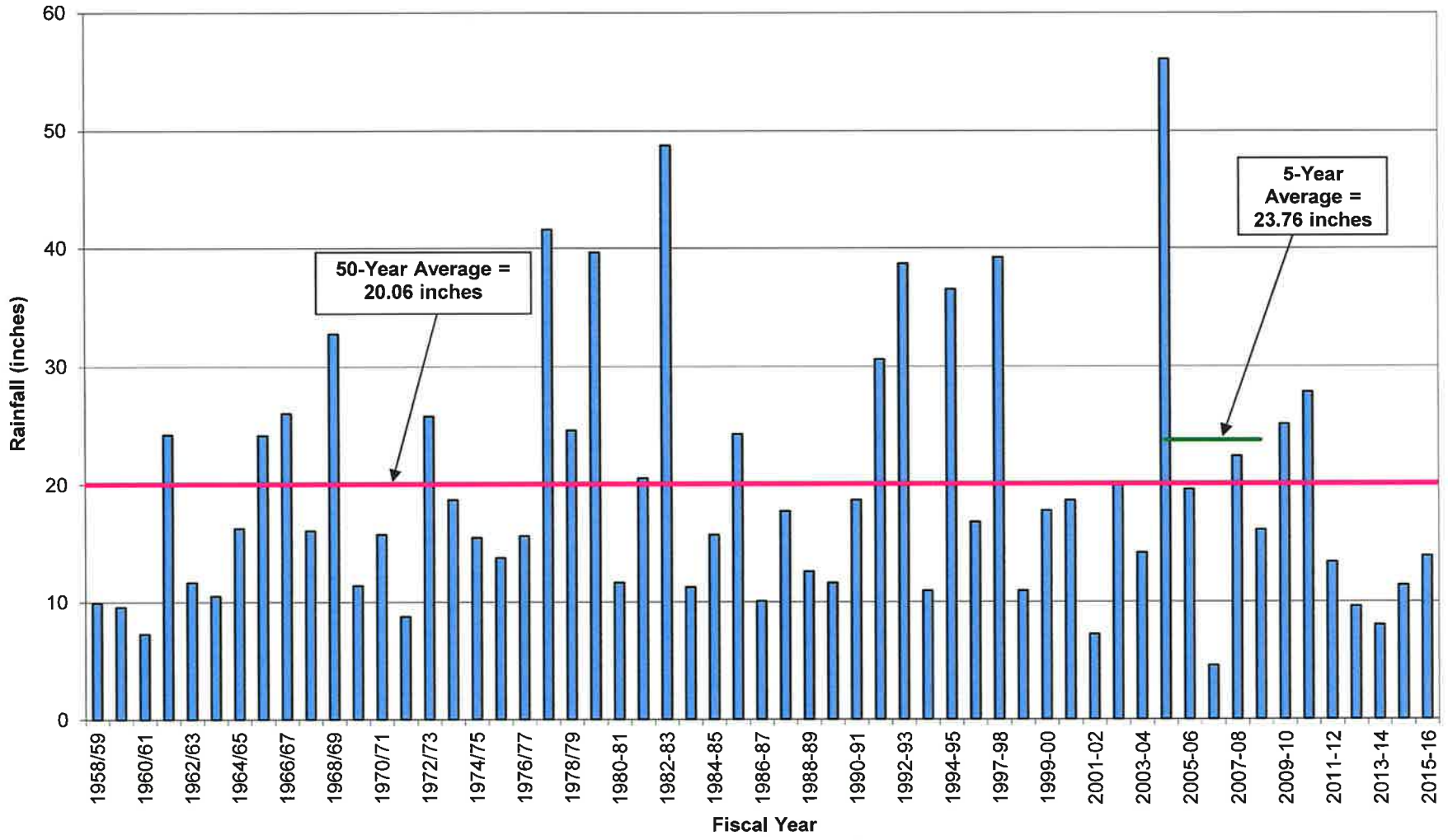
STETSON ENGINEERS INC.
Covina San Rafael Mesa, Arizona
WATER RESOURCE ENGINEERS

RAYMOND BASIN MANAGEMENT BOARD

STATIC WATER ELEVATION AT MONTE VISTA WELL

FIGURE 2

Z:\Jobs\1927\13-Pasadena Subarea evaluation\Reduction Plan review 2017\Figure 2 - Monte Vista Well



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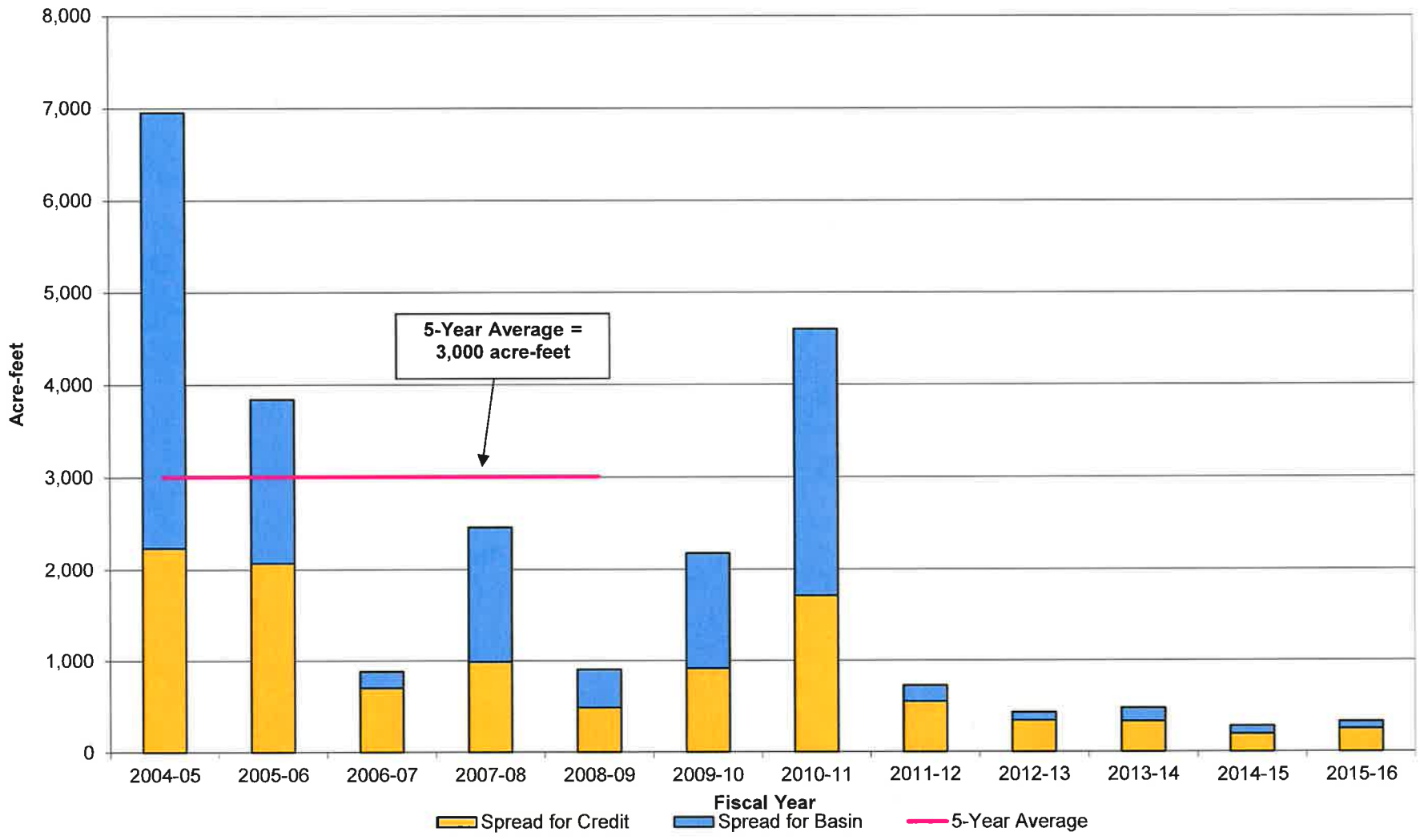
RAYMOND BASIN MANAGEMENT BOARD

RAINFALL AT STATION 610B IN PASADENA SUBAREA

FIGURE 3

Z:\Jobs\1927\13-Pasadena Subarea evaluation\Reduction Plan review 2017\Figure 3 - Rainfall 610 B



STETSON ENGINEERS INC.
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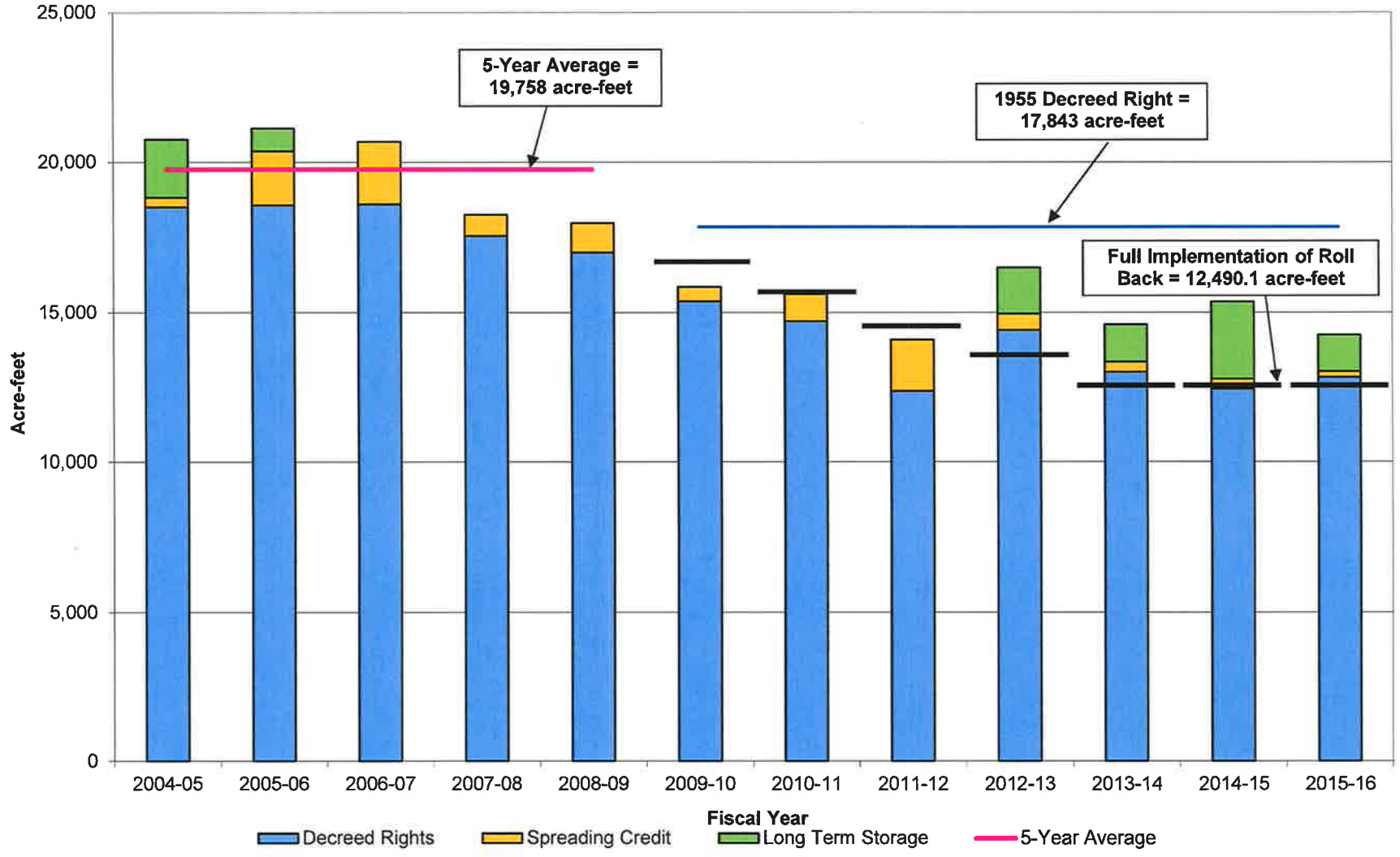
RAYMOND BASIN MANAGEMENT BOARD

REPLENISHMENT IN PASADENA SUBAREA

FIGURE 4

Z:\Jobs\1927\13-Pasadena Subarea evaluation\Reduction Plan review 2017\Figure 4 - Replenishment



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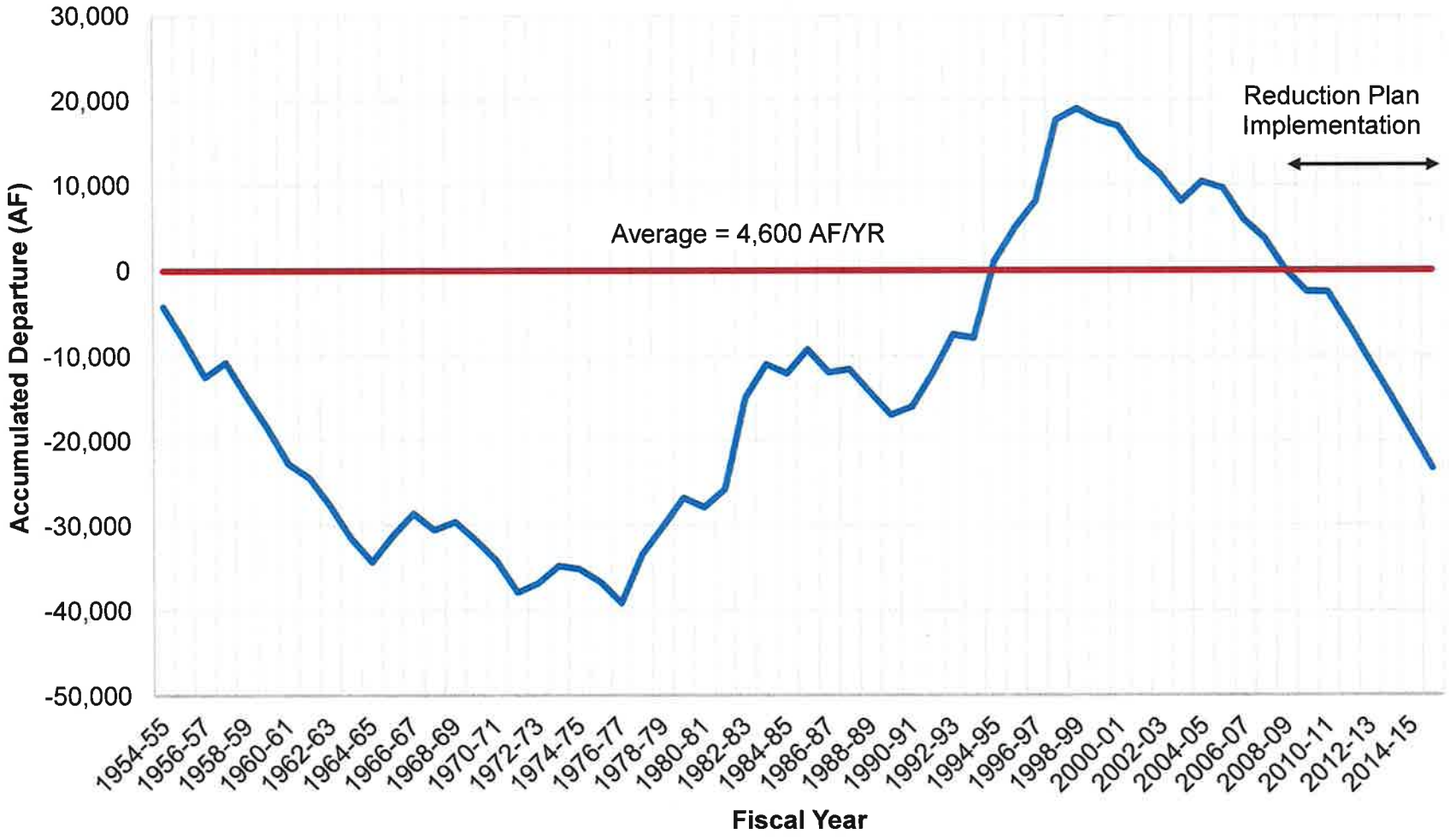
RAYMOND BASIN MANAGEMENT BOARD

GROUNDWATER EXTRACTIONS AT PASADENA SUBAREA

FIGURE 5

Z:\Jobs\1927\13-Pasadena Subarea evaluation\Reduction Plan review 2017\Figure 5 - Extractions



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PASADENA SUBAREA
LOCAL WATER REPLENISHMENT
ACCUMULATED DEPARTURE FROM AVERAGE

FIGURE 6

J:\Jobs\1927\13-Pasadena Subarea evaluation\Reduction Plan review 2017\Figure 6 - Accum. Departure.xlsx

ATTACHMENT A

TECHNICAL MEMORANDUM

TO: **TONY ZAMPIELLO**
RAYMOND BASIN MANAGEMENT BOARD

FROM: **STETSON ENGINEERS, INC.**

SUBJECT: **EVALUATION OF GROUNDWATER PRODUCTION IN THE PASADENA SUBAREA OF THE RAYMOND BASIN**

JOB NO.: **1927-05**

DATE: **DECEMBER 12, 2007**

On August 17, 2007, Stetson Engineers Inc. (Stetson) submitted a scope of work and budget to the Raymond Basin Management Board (Board) for development of a groundwater monitoring and management plan for the Raymond Basin (RBGWMP). The RBGWMP was developed in part to support the Raymond Basin Conjunctive Use Project (RBCUP) and the RBGWMP was intentionally developed and implemented in phases. This scope of work, which was prepared for Phase I of the RBGWMP, includes the development of a groundwater elevation monitoring network (Task 1) and an evaluation of groundwater production in the Pasadena Sub-Area, where groundwater levels at selected wells have been declining since 1955 (Task 2). The scope of work was approved by the Board on September 5, 2007.

As part of the scope of work, Stetson is to prepare a short technical report to document the results of the RBGWMP Phase I work. The draft report will include, but is not limited to, data and information collected for Tasks 1.1 and 1.2, such as drillers' logs and geophysical logs, the recommended monitoring network including potential locations and estimated costs for the proposed exploratory boreholes and new monitoring wells. The draft technical report was submitted to the Board on November 30, 2007.

Stetson is also to prepare a separate technical memorandum to document the results of Tasks 2.1 and 2.2 and to review the Board's management actions in the Raymond Basin that that may be affecting the overdraft conditions in the Pasadena Sub-Area. This technical memorandum was prepared to present the evaluation's results and findings and to make recommendations for future activities (Phase II).

I. RESULTS AND FINDINGS

1. Obtain Available Data and Information

Historic data for the evaluation of groundwater production in the Pasadena Sub-Area include groundwater production and injection at production wells located within the subbasin, groundwater level data, surface water spreading data, and precipitation for the Raymond Basin. The data were primarily obtained from the database developed by Geoscience Support Services, Inc. (Geoscience) and then supplemented and/or updated with data obtained from other sources as described below.

- Groundwater production and injection were supplemented and updated with data from the Board's annual reports for watermaster service.
- Surface water spreading by the water producers was supplemented and updated with data from the Board's annual reports for watermaster service and the hydrologic reports (pre-1994) published by the Los Angeles County Department of Public Works (LACDPW), and with spreading data (post-1994) obtained from LACDPW. Surface water spreading data by LACDPW was added because this data was not included in the Geoscience database.
- Historic annual precipitation at several stations within the Raymond Basin was reviewed to select a representative precipitation station for the evaluation. Historic annual precipitation for the selected station, which is the Altadena station, was obtained from the Board's annual reports and supplemented by data obtained from annual summaries for the climatological data in California published by the National Oceanic and Atmospheric Administration (NOAA).
- Groundwater levels were supplemented by hydrographs in the Board's annual reports for watermaster service.

Data used for this evaluation were compiled in tabular format and included in the Attachment.

2. Evaluate Groundwater Production in the Pasadena Sub-Area

a. Review of Available Data and Information

- Annual Groundwater Production

Annual groundwater production from individual wells in the Raymond Basin were compiled from monthly groundwater production data and organized in tabular format, as shown in Table 1. The groundwater production between 1939-40 and 1943-44 could not be found. The annual groundwater production from each water producer and the annual groundwater production for the Raymond Basin were then calculated from these individual well production data. The annual groundwater production for the three subareas and the entire Raymond Basin, published in the Board's annual reports, were also included at the bottom of the table. As can be seen, the calculated annual groundwater production is compatible, but not identical, with the published annual groundwater production for the Raymond Basin.

The annual groundwater production in the Raymond Basin varied from 18,514.00 acre feet in 1913-14 to 34,539.74 acre feet in 2006-07 with an annual average of 29,016.52 acre feet per year, a maximum production of 40,855.80 acre feet in 1998-99, and a minimum production of 16,700.00 acre feet in 1937-38. In the Monk Hill Sub-Area, the annual groundwater production varied from 4,530.00 acre feet in 1913-14 to 6,247.05 acre feet in 2006-07 with an annual average of 7,050.58 acre feet per year, a maximum production of 13,012.40 acre feet in 1995-96, and a minimum production of 3,208.47 acre feet in 1989-90. In the Pasadena Sub-Area, the annual groundwater production varied from 13,851.00 acre feet in 1913-14 to 20,678.35 acre feet in 2006-07 with an average of 17,340.61 acre feet per year, a maximum production of 24,124.10 acre feet in 1998-99, and a minimum production of 8,913.78 acre feet in 1949-50. In the Santa Anita Sub-Area, the annual groundwater production varied from 133.00 acre feet in 1913-14 to 7,614.34 acre feet in 2006-07 with an average of 4,625.33 acre feet per year, a maximum production of 8,104.66 acre feet in 1993-94, and a minimum production of 133.00 acre feet in 1913-14. The fluctuation of the annual groundwater production in the Raymond Basin and its subareas is shown on Plate 1.

The annual groundwater production in the Monk Hill Sub-Area appears to be reasonably stable, but the annual groundwater production in the other two subbasins appears to have increased significantly. The annual groundwater production in the Pasadena and Santa Anita Sub-Areas varied from 13,984.00 acre feet in 1913-14 to 28,292.69 acre feet in 2006-07 with an average of 21,965.94 acre feet per year, a maximum of 31,382.70 in 1998-99, and a minimum of 12,750.05 acre feet in 1949-50. The fluctuation of the annual groundwater production in the Pasadena and Santa Anita Sub-Areas is shown on Plate 2.

❖ Annual Groundwater Injection

Annual groundwater injection from individual wells in the Raymond Basin were compiled from monthly groundwater injection and organized in tabular format, as shown in Table 2. The annual groundwater injection in the Raymond Basin varied from 1,517.32 acre feet in 1992-93 to 945.92 acre feet in 2006-07 with an average of 901.04 acre feet per year, a maximum injection of 2,072.51 acre feet in 1993-94, and a minimum injection of 195.89 acre feet in 1994-95. In the Monk Hill Sub-Area, the annual groundwater injection varied from zero acre feet in 1992-93 to 945.92 acre feet in 2006-07 with an average rate of 659.63 acre feet per year, a maximum injection of 1,478.78 acre feet in 2005-06, and a minimum injection of zero acre feet in 1992-93. In the Pasadena Sub-Area, the annual groundwater injection varied from 1,517.32 acre feet in 1992-93 to zero acre feet in 2006-07 with an average of 241.41 acre feet per year, a maximum injection of 2,072.51 acre feet in 1993-94, and a minimum injection of zero acre feet in 1994-95 and from 1996-97 to 2006-07.

❖ Annual Surface Water Spreading

Annual surface water spreading from individual water producers at each spreading facility in the Raymond Basin were compiled from monthly surface water spreading and organized in tabular format, as shown in Table 3. The annual surface water spreading in the Raymond Basin varied from 337.00 acre feet in 1944-45 to 8,470.8 acre feet in 2005-06 with an average of 6,251.77 acre feet per year, a maximum spreading of 26,754.3 acre feet in 1994-95, and a minimum

spreading of zero acre feet in 1945-46. In the Monk Hill Sub-Area, the annual surface water spreading varied from zero acre feet in 1944-45 to 3,175.9 acre feet in 2005-06 with an average of 1,994.72 acre feet per year, a maximum spreading of 13,122.3 acre feet in 1994-95, and a minimum spreading of zero acre feet in 1944-45. In the Pasadena Sub-Area, the annual surface water spreading varied from zero acre feet in 1944-45 to 4,155.6 acre feet in 2005-06 with an average of 2,388.56 acre feet per year, a maximum injection of 11,527.36 acre feet in 1982-83, and a minimum spreading of zero acre feet in 1944-45. In the Santa Anita Sub-Area, the annual surface water spreading varied from 337.0 acre feet in 1944-45 to 1,139.3 acre feet in 2005-06 with an average of 1,868.49 acre feet per year, a maximum spreading of 5,799.0 acre feet in 1966-67, and a minimum spreading of 337.0 acre feet in 1944-45. The fluctuation of the annual surface water spreading in the Raymond Basin is shown on Plate 3.

❖ Annual Precipitation

Annual precipitation at the selected stations within the Raymond Basin since 1900-01 is shown in Table 4. The precipitation from 1900-01 through 1937-38 at the station No. 4092 and from 1938-39 to 2005-06 at the station No. 144 in Altadena was used as the representative precipitation in the Raymond Basin for this evaluation. The representative precipitation varied from 24.95 inches in 1900-01 to 21.21 inches in 2005-06 with an average precipitation of 21.87 inches per year, a maximum precipitation of 56.43 inches in 2004-05, and a minimum precipitation of 5.38 inches in 1972-73. The fluctuation of the representative precipitation is shown on Plate 4 and the cumulative departure from the average precipitation is shown on Plate 5.

❖ Water Level

Historic water level data for the City of Pasadena's Woodbury Wells (C-52 and C-52a) and Craig Well (C-44) were used for the evaluation. The hydrographs of the water level for these wells are shown on Plate 6. These wells were selected because they are located in the central portion of the Pasadena Sub-Area and because they have long-term record covering periods with different hydrologic and basin management conditions. As can be seen, the water level at Woodbury Wells consistently declined from approximately 142 feet below ground surface (bgs) in 1916 to approximately 260 feet bgs in 1936. The water level at Craig Well also declined from approximately 269 feet bgs in 1925 to approximately 344 feet bgs 1936 then stabilized and slightly recovered to approximately 319 feet bgs in 1956. Since then, the water level in this well declined consistently and reached 435 feet bgs in 1995.

❖ Review Findings

- Groundwater production in the Raymond Basin, especially in the Pasadena-Santa Anita Sub-Areas, has increased significantly since 1910-11. During the last 60 years, the groundwater production in these subareas increased from 14,419.80 acre feet in 1944-45 to 28,292.69 acre feet in 2006-07 (96% increase), as shown on Plate 6.

- The increasing groundwater production in the Pasadena-Santa Anita Sub-Areas appears to be the primary factor for the continuing declination of the water level in these

subareas. During the last 60 years, the water level in the City of Pasadena's Craig Well declined from approximately 320 feet bgs in 1944-45 to approximately 419 feet bgs in 1996-97, a decline of essentially 100 feet.

- Precipitation within the Raymond Basin does not appear to have significant direct impacts on the groundwater level. In fact, the wet period from 1912-13 to 1919-20, as indicated by the cumulative departure curve on Plate 6, did not have any impacts on the groundwater level at Woodbury Well. The very wet period from 1935-36 to 1947-48 appears to stabilize the water level in Craig Well, but the water level did not recover more than 5 feet, as shown on Plate 6.

- Surface water spreading appears to have positive impacts on the water level in the Raymond Basin. During the period from 1914-15 to 1930-31, without surface water spreading, the water level in Woodbury Well declined from approximately 150 feet bgs to approximately 230 feet bgs at an average annual rate of approximately 3.2 feet per year. During the period from 1951-52 to 1979-80, with surface water spreading, the water level in Craig Well declined from approximately 320 feet bgs to approximately 370 feet bgs at an average rate of approximately 0.6 feet per year.

- Impacts of groundwater injection in the Pasadena-Santa Anita Sub-Areas on the water level in these subareas could not be evaluated because of a lack of long term data.

b. Evaluation Methodology

Based on the correlation between the groundwater production and water level in the Raymond Basin and assuming that the Pasadena and Santa Anita Sub-Areas are hydraulically connected (based on the findings during the development of the preliminary groundwater monitoring network), a spreadsheet groundwater balance model was developed to evaluate the relationship between the groundwater production in the Pasadena and Santa Anita Sub-Areas and the water level at the City of Pasadena's Craig Well.

The spreadsheet groundwater balance model, as shown in Table 5, includes components such as net recharge from precipitation, surface water spreading, subsurface inflow from the La Canada Flintridge-Altadena subbasin and the Sawpit watershed, subsurface outflow to the San Gabriel Basin, and groundwater production and injection. The missing annual groundwater production between 1938-39 and 1943-44 was assumed to be 12,000 acre feet per year (consistent with annual averages).

The groundwater balance model was calibrated for the period from 1913 to 1938 using the water level at the City of Pasadena's Woodbury Wells (C-52 and C-52a). Calibration involved adjusting the net-recharge coefficient from precipitation on the valley floor, the coefficients for the subsurface inflow from the La Canada Flintridge-Altadena subbasin and the Sawpit watershed, and the coefficient for the subsurface outflow to the San Gabriel Basin until the simulated water level matches with the measured water level at Woodbury Wells. The calibration results indicate that the match between the simulated and measured water levels at Woodbury Wells is excellent, as shown on Plate 7.

The calibrated groundwater balance model was then verified for the period from 1944 to present using the water level at the City of Pasadena's Craig Well (C-44). During the verification process, the net-recharge coefficients from precipitation on the valley floor, the coefficients for the subsurface inflow from the La Canada Flintridge-Altadena subbasin and the Sawpit watershed, and the coefficient for the subsurface outflow to the San Gabriel Basin generated during the calibration process were kept unchanged. Initially, the groundwater balance model was verified without receiving recharge water from surface water spreading as specified in the scope of work, but the simulated results were not consistent with the measured water level in the Craig Well, as shown on Plate 7. The simulated water level in the Craig Well, however, appears to be consistent with the measured water level when the groundwater balance model was verified with recharge water from surface water spreading, as shown on Plate 7.

c. Evaluation Findings

- The Pasadena-Santa Anita Sub-Areas of the Raymond Basin have been overdrafted significantly since probably the beginning of 1900's. According to available historic data since 1910, the groundwater production in these subareas averaged approximately 20,400 acre feet per year, which is almost double the estimated net recharge of approximately 11,400 acre feet per year; including 5,100 acre feet per year from precipitation on the valley floor, 2,200 acre feet per year from surface water spreading, 2,300 acre feet per year from subsurface flow from the Monk Hill Sub-Area, and 1,800 acre feet per year from subsurface flow from the Sawpit watershed.

- The surface water spreading appears to be an important factor in alleviating the declination of the water level in these subareas.

- The impacts of the groundwater injection in the Pasadena-Santa Anita Sub-Areas could not be evaluated due to a lack of long-term data.

- The subsurface flow from the Raymond Basin to the Main San Gabriel Basin is absent in the groundwater balance model.

- Correlation between the groundwater production in the Pasadena-Santa Anita Sub-Areas and the water level in the City of Pasadena's Woodbury and Craig Wells appears to exist.

II. RECOMMENDATIONS

Although the groundwater balance model is considered qualitative, the Board may consider using the model as a guide in managing the groundwater resources in the Raymond Basin, especially the Pasadena-Santa Anita Sub-Areas. It is useful in comparing management scenarios, as demonstrated on Plate 8. In these scenarios, the groundwater balance model was simulated under a 20-year average condition with the average groundwater productions similar to and 50% of the 2005-06 groundwater production for the next 20 years. The results of this simulation show dramatic impacts on the basin water level, as shown on Plate 8.

The Board may also consider using the City of Pasadena's Craig Well as a key well to monitor the water level of the Pasadena-Santa Anita Sub-Areas. Since the water level in this well is very deep (currently exceeding 400 feet), a dedicated sounding tube may be installed to facilitate the water level measurements. If possible, a water level recorder may be installed to obtain adequate water level data to evaluate the response of the water level in this well to the management measures such as surface spreading and ground water injection.

Attachments

Attachment 1: Monthly Groundwater Production in Raymond Basin
Attachment 2: Monthly Groundwater Injection in Raymond Basin
Attachment 3: Monthly Surface Water Spreading in Raymond Basin

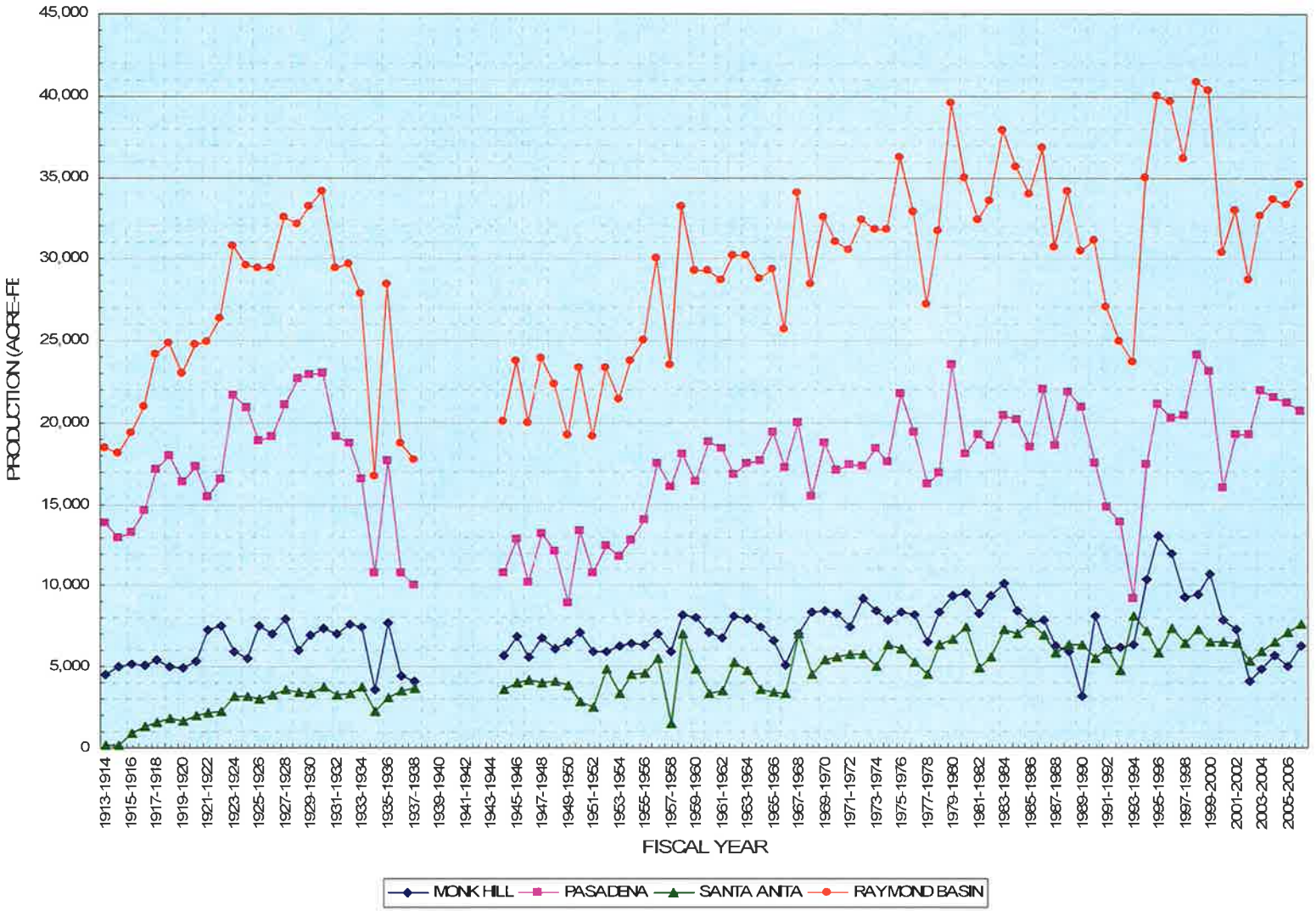

PLATE 1 HISTORIC GROUNDWATER PRODUCTION IN RAYMOND BASIN

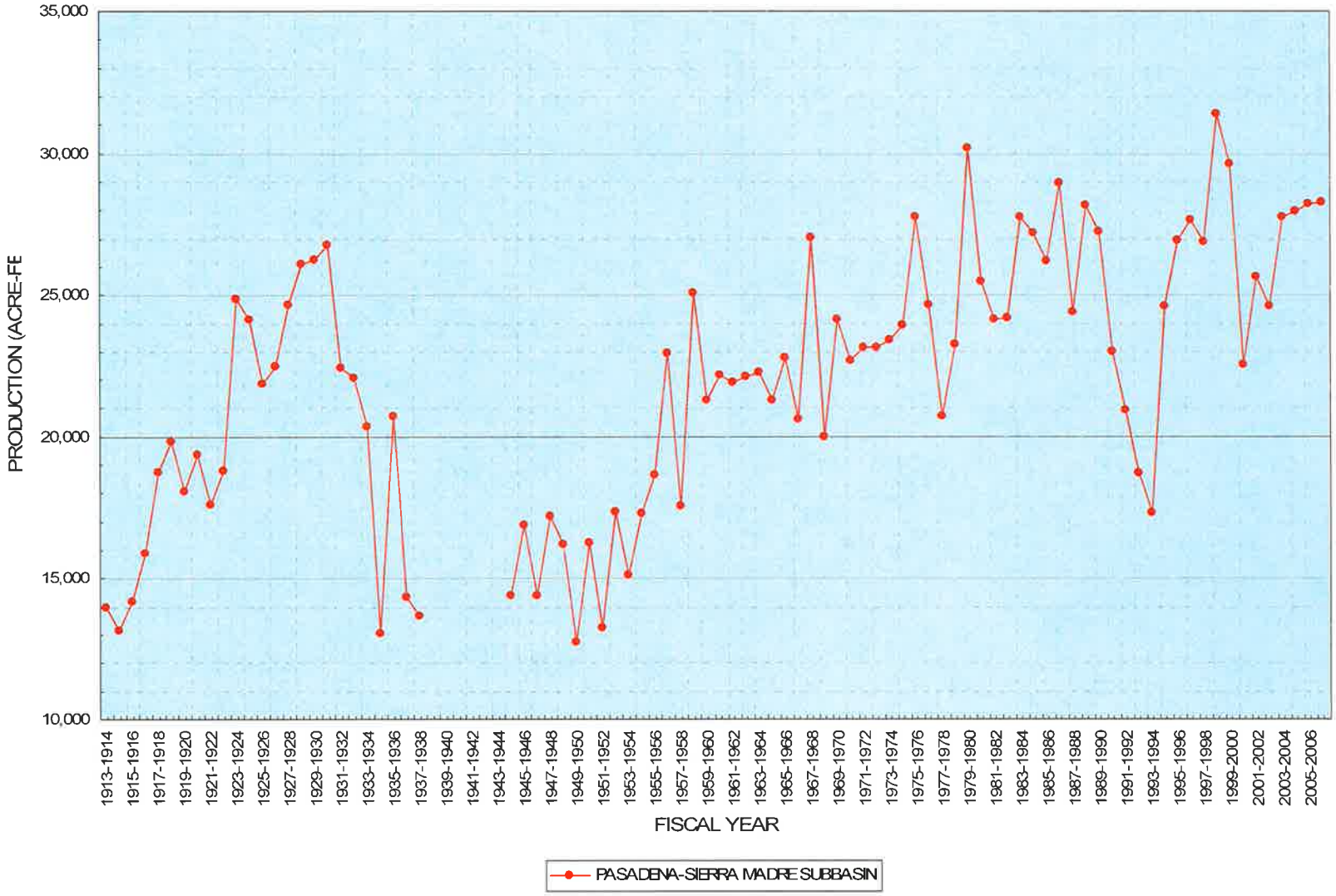

PLATE 2 HISTORIC GROUNDWATER PRODUCTION IN PASADENA AND SANTA ANITA SUB-AREAS

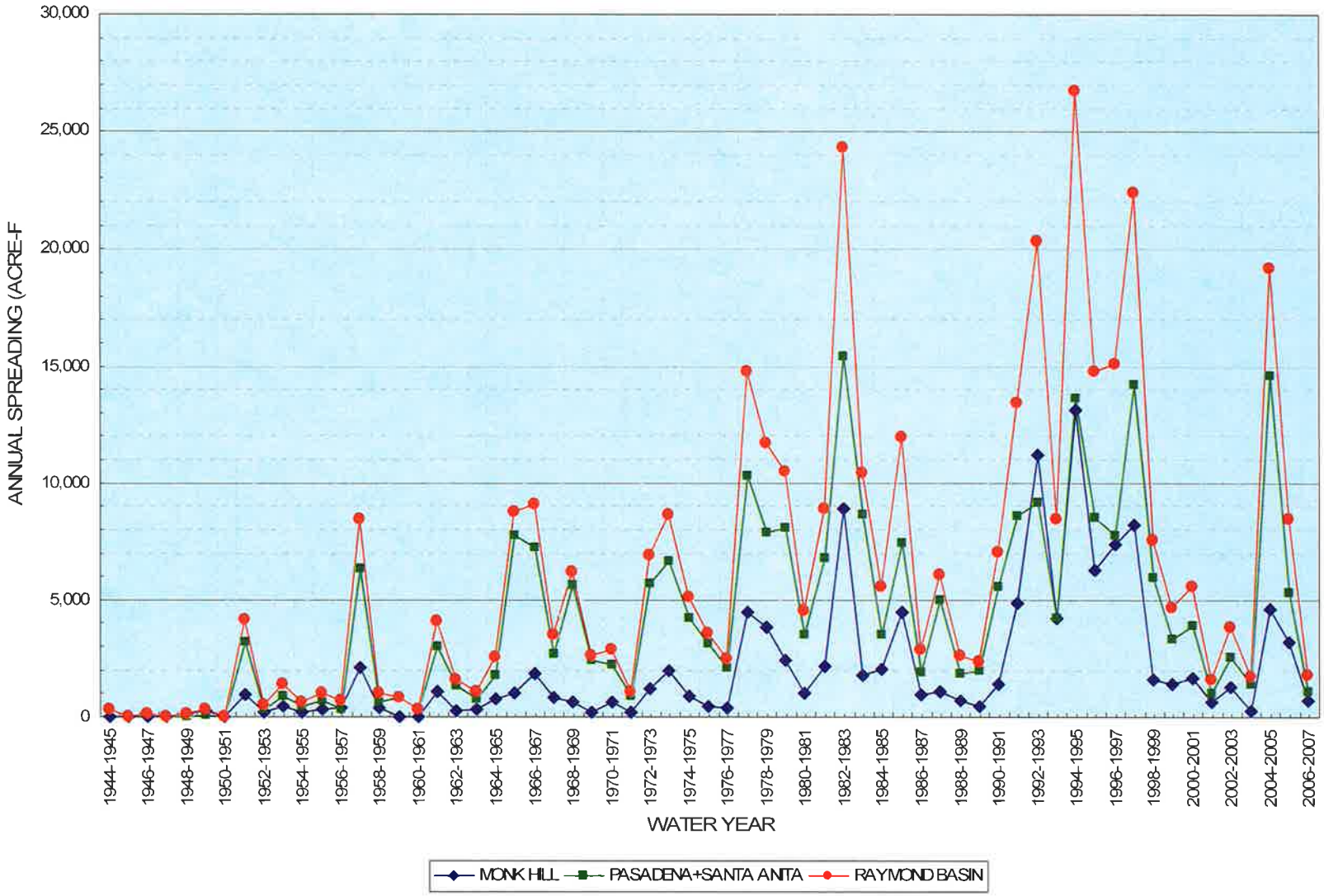

PLATE 3 SURFACE WATER SPREADING IN RAYMOND BASIN

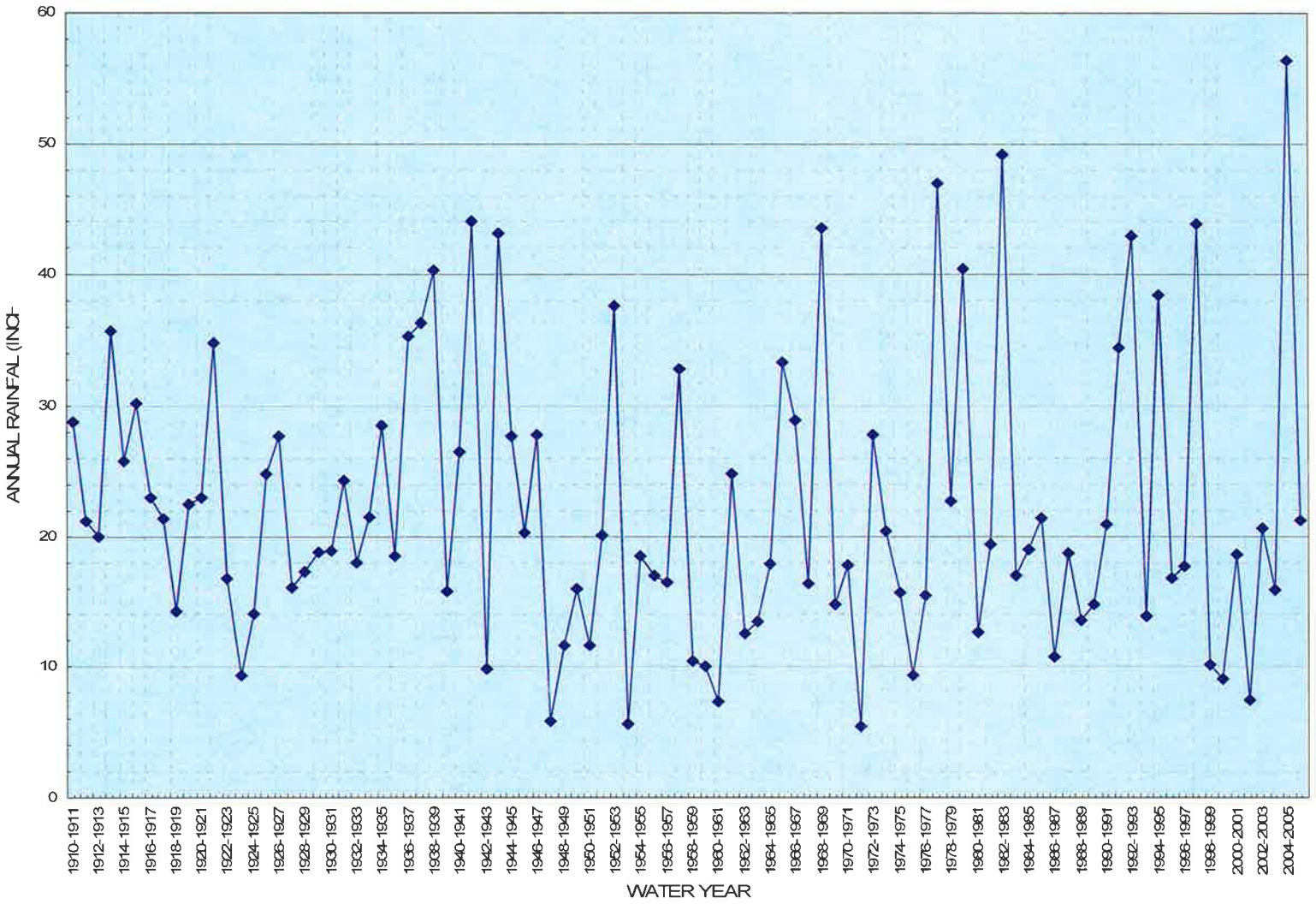

PLATE 4 HISTORIC PRECIPITATION AT ALTADENA STATION

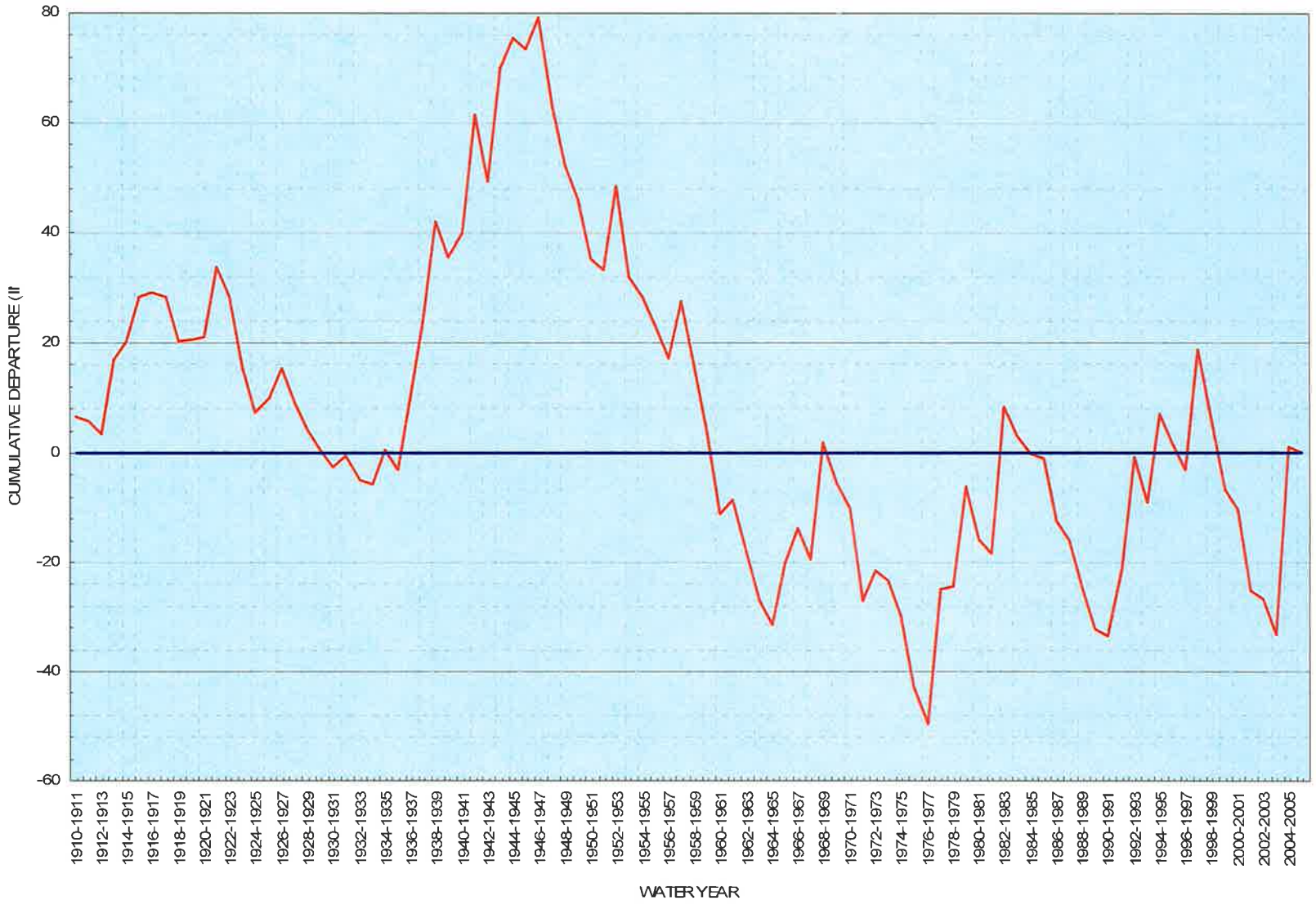

PLATE 5 CUMULATIVE DEPARTURE FROM AVERAGE PRECIPITATION AT ALTADENA STATION

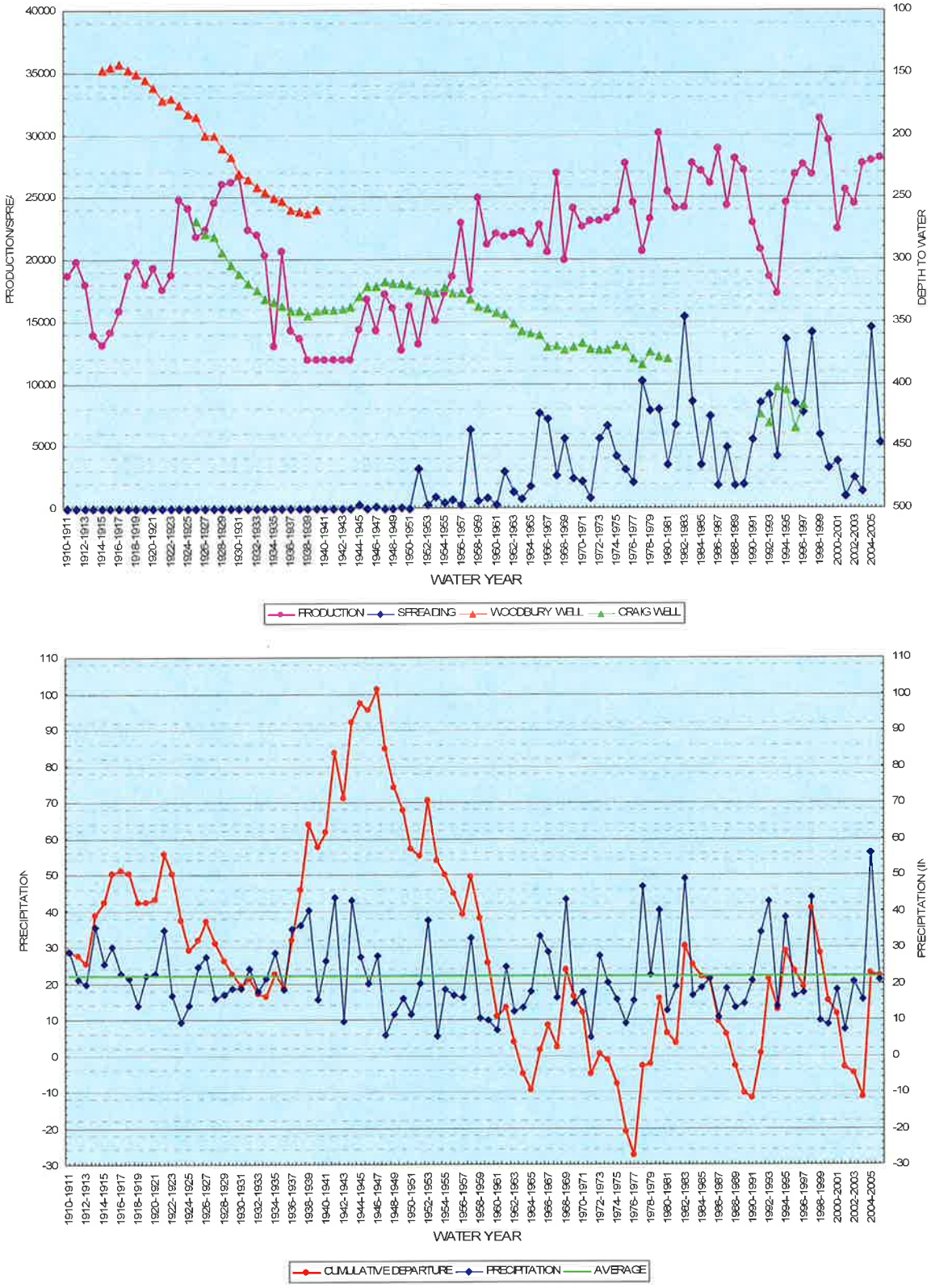

PLATE 6 EVALUATION OF GROUNDWATER PRODUCTION IN RAYMOND BASIN

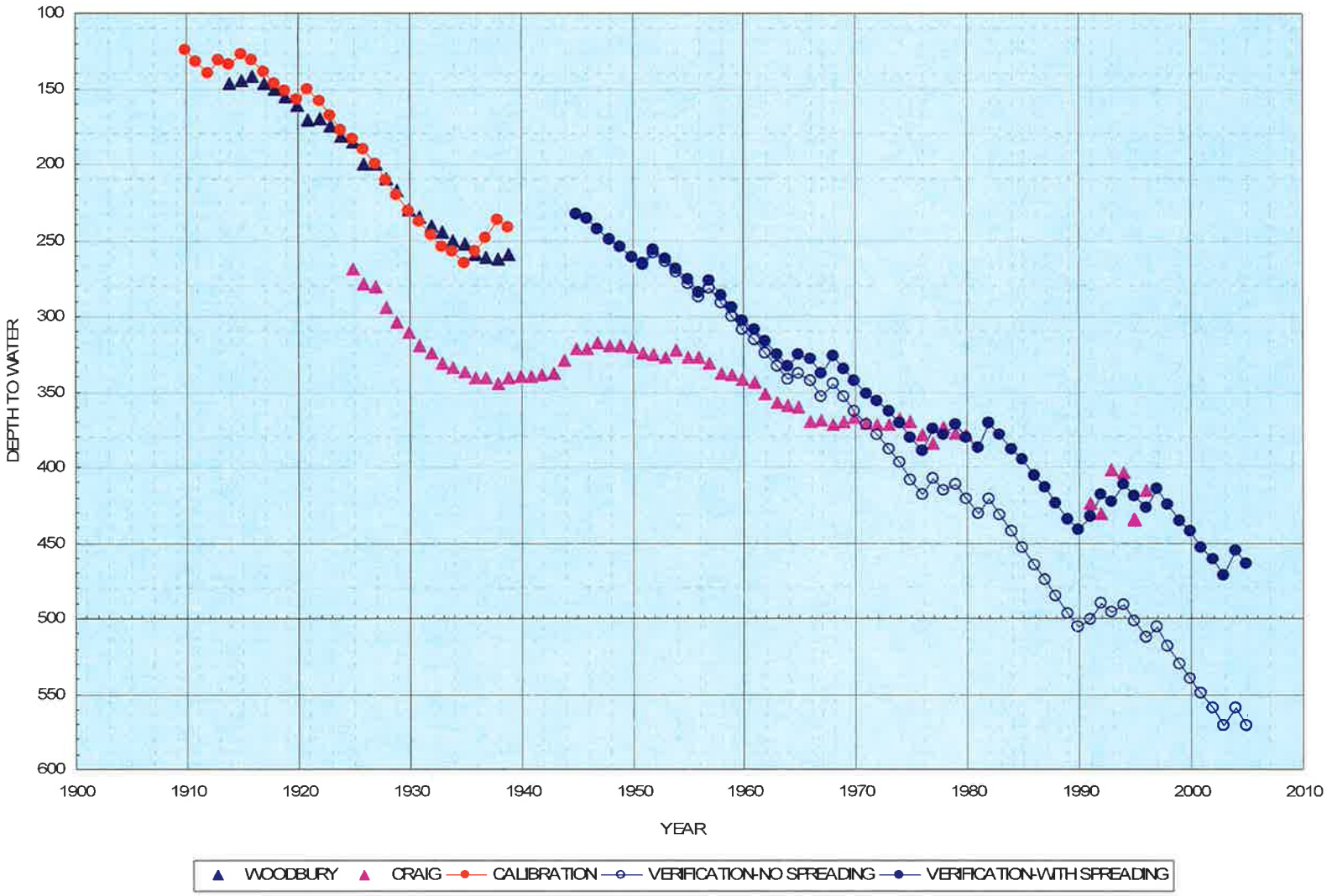

PLATE 7 CALIBRATION AND VERIFICATION OF THE GROUNDWATER BALANCE MODEL

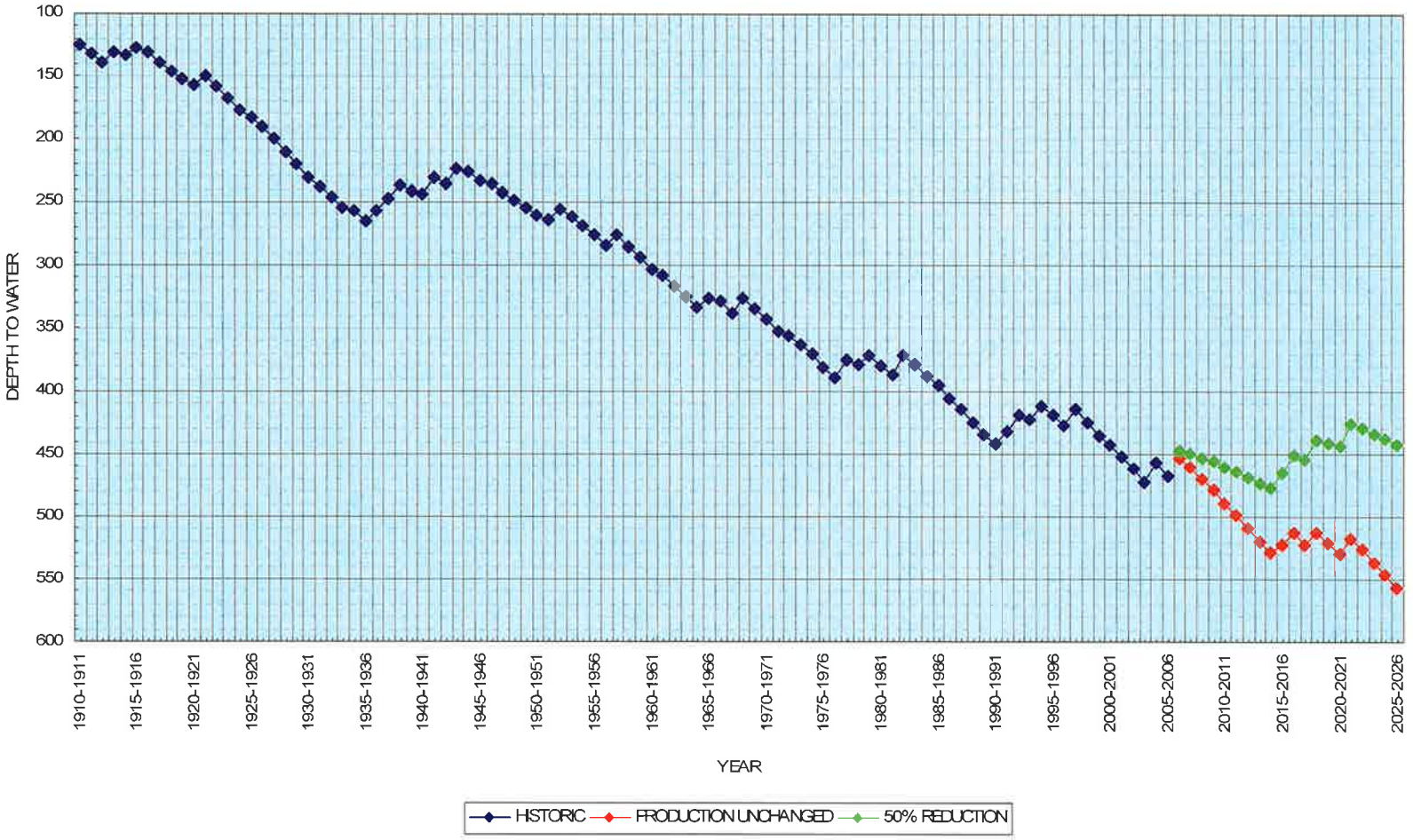

PLATE 8 APPLICATION OF THE GROUNDWATER BALANCE MODEL

ATTACHMENT B

RESOLUTION NO. 42-0109

RESOLUTION OF THE BOARD OF DIRECTORS OF THE RAYMOND BASIN MANAGEMENT BOARD ADOPTING A COOPERATIVE PUMPING REDUCTION PLAN FOR THE PARTIES WITH WATER RIGHTS IN THE PASADENA SUBAREA

BE IT RESOLVED BY THE RAYMOND BASIN MANAGEMENT BOARD OF DIRECTORS as follows:

Section 1. Purpose.

The Raymond Basin Management Board ("Board") desires to implement an interim solution to slow declining water levels in the area of the Raymond Basin, Western Unit, known as the Pasadena Subarea with the goal of a reduction of water produced below 1955 Decreed Rights from 17,843 Acre Feet to 12,493 Acre Feet, dissolution of remaining Long-Term Storage accounts and increased groundwater levels. In order to meet this goal, water production reductions will be implemented incrementally at a rate of 1,070 Acre Feet per year for five years until a 30% reduction is achieved. Implementation will begin July 1, 2009. Spreading credits will continue to be applied as in the past and will follow the exact protocol set forth in the Judgment. The reduction plan implemented by this resolution is not intended to supersede any provisions of the judgment but is intended as a means to improve water supply conditions and avoid disputes between impacted parties. This reduction plan has been developed cooperatively by the water rights holders in the Pasadena Subarea and is included as Exhibit "A" of this resolution.

Section 2. Findings.

(a) The Judgment of the Los Angeles Superior Court in *City of Pasadena v. City of Alhambra* (LASC No. C1323) ("Judgment") governs management of the Basin. The Board was appointed Watermaster to the Basin in 1984 when the Judgment was modified. As Watermaster, the Board has determined that the adjustment in Decreed Rights in 1955 was based on a snapshot of conditions during the first ten years the

judgment was in place and represented roughly a 30% increase in allowable production rights. The re-determination of the Safe Yield in 1955, which resulted in an increase in production rights along with the adoption of the Long-Term Storage Policy by the Board in 1993 played a major role in lower overall groundwater levels the Pasadena Subarea is experiencing today.

(b) The Raymond Basin and the Los Angeles area have experienced below-normal rainfall for eight of the past ten years, resulting in decreased storm water capture and runoff available for groundwater recharge.

(c) Producers within the Pasadena Subarea have been struggling to meet current demands and manage declining water levels.

(d) The Water Rights Holders within the Pasadena Subarea seek to find a cooperative solution to over drafting of the Pasadena Subarea.

(e) The Board, as Watermaster, seeks to establish a cooperative solution to over drafting of the Pasadena Subarea.

(f) The general consensus of the Board that the most effective method of managing the supply under current conditions is to look at each Subarea within the Basin independently or semi-independently when developing short-term or interim solutions.

(g) State of California, Department of Water Resources Bulletin 104-6, (June of 1971) indicated that maintaining the 1955 Decreed Rights as the Safe Yield benchmark without supplementing local supplies with imported recharge would eventually result in reduced overall storage in the Basin and the Pasadena Subarea.

(h) The Board authorized the Raymond Basin Baseline Study which was completed on February 2, 2004.

(i) The Baseline Study confirmed that groundwater levels have generally declined in the Pasadena Subarea since the Judgment was entered into and have not recovered proportionate to production, even during sustained wet periods.

(j) Stetson Engineers were retained to work with the Board in developing overall monitoring and management strategies for the Basin and the Pasadena Subarea based on the findings in the Baseline Study

(k) A mass balance analysis was done as part of Stetson's work which indicated that water levels have been impacted by certain modifications to Basin operations since the initial Judgment was entered into in 1944.

(l) Although more specific groundwater level data is required in the Pasadena Subarea to identify acute impact areas or pumping holes, enough data does currently exist to warrant immediate action to slow and eventually reverse the overall decline in water levels.

Section 3. Resolution.

NOW, THEREFORE, BE IT RESOLVED that the Raymond Basin Management Board will implement the Pasadena Subarea Reduction Plan (Reduction Plan) as described in Exhibit "A", attached hereto, effective July 1, 2009. The Board resolves to collect sufficient groundwater level and production data as to evaluate the effectiveness of the Reduction Plan on July 1, 2012. The Board further resolves to review the findings and consider any appropriate modifications or adjustments to the Reduction Plan at its first regular meeting thereafter. The Board reserves the right to review the Reduction Plan and consider appropriate action prior to July 1, 2012, should conditions require such action.

PASSED, APPROVED, AND ADOPTED on JANUARY 22, 2009.

Shan Kwan
Chairman

ATTEST:

Robert Hayward
Secretary

[SEAL]

EXHIBIT "A"
Pumping Reductions
Pasadena Subarea

The long term goal is a 30% reduction in production of all 1955 Decreed Rights (Decreed Rights) in the area of the Raymond Basin Western Unit, known as the Pasadena Subarea from 17,843 Acre Feet* to 12,493 Acre Feet and to ultimately dissolve remaining Long-Term Storage accounts. In order to meet this objective reductions will be implemented each year for five years until the 30% reduction is reached. Spreading credits will continue to be applied as in the past and will follow the exact protocol set forth in the Judgment. This means spreading credits must be produced within the same fiscal year they accrue or the following fiscal year and cannot be further carried over. Producers having water in Long Term Storage can use these accounts to make-up the difference between the total required reduction and plus or minus 10% of their 1955 Decreed Right** until such time as all of their water in Long Term Storage is exhausted. Water in Long Term Storage accounts will continue to be subject to Basin losses and those losses will be applied at the end of each fiscal year***.

Producers who cannot produce all of their Decreed Rights or Reduced Decreed Rights may lease those rights to other parties. These and other Decreed Rights must be produced that same year and cannot be carried over beyond the provisions set forth in the Judgment. Producers will be allowed to lease excess Decreed Rights and water in Long Term Storage to other producers but they will not be allowed to "replenish" or add to their Long Term Storage.

Additions to Long Term Storage will be discontinued and individual accounts will be capped at the June 30, 2008, amount and Long Term Storage accounts cannot be added to for any reason. Transfer of Long Term Storage water from the Monk Hill Subarea to the Pasadena Subarea on behalf on the City of Pasadena will be discontinued at the same time. Spreading credits aside, total aggregate production from the Pasadena Subarea (including leases) shall not exceed 16,773 Acre Feet or 17,843 minus 1,070 in the first year and will be

reduced by an additional 1,070 Acre Feet each subsequent year for five consecutive years to a total allowable amount of 12,493 Acre Feet in any single fiscal year, until the Basin sufficiently recovers.

The overall intended benefit received from the 30% reduction will be the stabilization and eventual increase in groundwater levels throughout the Pasadena Subarea. It is recognized that the Pasadena Subarea will most likely never return to the higher groundwater levels experienced in first half of the twentieth-century without importation of replenishment water. It is also recognized that there may be a reasonable operating range higher than current levels and still lower than early twentieth century levels, which is manageable until replenishment water is available. For this reason the working group has established an increase in the Basin of 50 feet above current levels as its initial goal. The Woodbury Well, owned by the City of Pasadena, will be used as the key well for the Pasadena Subarea. The level in the Woodbury Well will be measured at regular intervals by Raymond Basin staff to track the impacts of the re-adjusted pumping. Initially, it will take at least three years to have any valuable comparative data.

**The City of Pasadena has 12,807 Acre Feet of total 1955 Decreed Right in the Western Unit. 4,464 Acre Feet are in the Monk Hill portion of the Western Unit and 8,343 Acre Feet are in the Pasadena Subarea portion of the Western Unit. As adopted, this reduction plan applies to the 8,343 Acre Feet designated as Pasadena Subarea 1955 Decreed Right and any portion of the 4,464 Acre Feet of Monk Hill 1955 Decreed Right produced from the Pasadena Subarea.*

***Allowable Carryover will remain at 10% of each Party's original 1955 Decreed Right and will not be impacted by the agreed upon reductions.*

****Any Party having water stored in existing Long-Term Storage under Metropolitan Water District's (MWD) Cooperative Storage Program (CSP) can produce this water beyond reduction limits, if called upon by MWD to do so, with the concurrence of the Raymond Basin Management Board (Board). This CSP water will be accounted for separate from Long Term Storage and will still be subject to basin losses as determined each year by the Board.*