HYDROGEOLOGY AND WATER SUPPLY

OF SALINAS VALLEY

A White Paper prepared by

Salinas Valley Ground Water Basin
Hydrology Conference

For
Monterey County Water Resources Agency

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CONCLUSIONS

- No member of this panel has any substantive disagreement with the conclusions of previous reports.
- The panel reached unanimous agreement on all major issues.
- Data that are available have been useful in determining regional and local surface water and ground water relationships and quality.
- Based on all the studies completed to date, there appears to be an adequate supply of water within Salinas Valley to meet all existing and projected future requirements.
- Despite this abundance, past and present water distribution and management practices have caused seawater intrusion, declining ground water levels in the East Side Area, and nitrate contamination.
- The solution for the seawater intrusion and declining ground water levels in Salinas Valley that was recommended in 1946 is so compelling we could not refrain from recommending it.
- Some form of extraction and conveyance system should be constructed.
- More recent studies conducted by Monterey County Water Resources Agency (MCWRA) since 1946 have reaffirmed and endorsed the original concepts.
- Residents of Salinas Valley are fortunate that an in-valley conjunctive use solution is available to them.

RECOMMENDATIONS

Monterey County Water Resources Agency should:

- Complete the extraction facilities and conveyance system, similar to those that were outlined in California Department of Water Resources Bulletin 52 in 1946, that are integral components of a total project.
- Continue studies to determine the relationships between fertilizer application, irrigation practices, plant growth, movement of water past the root zone, and ground water contamination under growing conditions prevalent in Salinas Valley.
- Use these studies to develop and demonstrate improved irrigation and fertilizer management methods that farmers can adopt with confidence.
- Continue to evaluate seawater intrusion monitoring data.
- MCWRA should continue their surface water and ground water monitoring program for quantity and quality. The data should be evaluated to ensure that the information is adequate for effective management of water resources.

INTRODUCTION

Purpose and Scope

The Monterey County Water Resources Agency (MCWRA) convened a panel of 10 geologists, hydrogeologists, and engineers familiar with Salinas Valley ground water basin to attempt to reach agreement on the basic physical characteristics of the basin, and the surface and ground water flow within the basin. Agreement on the completeness and accuracy of existing data and previous hydrogeological studies was seen as an important first step in identifying and implementing a technically sound solution acceptable to the public that would stop seawater intrusion that began some 60 years ago.

Mike Armstrong, General Manager of MCWRA, instructed the panel to review and, if possible, reach consensus on the hydrogeological characteristics of the basin, define clearly the water resources problems in the basin, and determine surface water and ground water flow within the basin. We were not requested to discuss specific local projects or political and institutional aspects of the problems.

The panel met in a closed-door session in Monterey on May 24 and 25, 1995. The session was closed to the public and the press to enable the panelists to discuss and explore ideas and opinions freely without worrying about statements, questions, and hypotheses being repeated out of context.

Members of the panel believe the process worked very well. This report presents our findings, conclusions, and recommendations. We were able to achieve more than our original scope of work. There was remarkable unanimity of opinion on our understanding of the physical characteristics of the basin, the hydrologic system, the interaction between surface water and ground water, and definition of the specific ground water problems in the basin.

In summary, the facts we agreed upon point so compellingly toward an already identified *regional* solution to the Valley's ground water resources problems that the panel has included a potential solution. We have included a strong recommendation in this White Paper for implementing that regional solution.

Panel Members

The panel consisted of 9 members and 1 facilitator/editor:

Mr. Carl Hauge, California Department of Water Resources, Sacramento, facilitator/editor.

Dr. Steven Bachman, Integrated Water Technologies, Santa Barbara.

Mr. Tim Durbin, HCI Hydrologic Consultants, Davis.

Mr. Martin Feeney, Fugro West, Monterey.

Mr. Joseph Scalmanini, Luhdorff and Scalmanini, Woodland.

Mr. Jim Schaaf, Schaaf & Wheeler, San Jose (attended May 25 only).

Dr. Dennis Williams, GEOSCIENCE, Claremont.

Mr. Gus Yates, Jones & Stokes Associates, Sacramento.

Dr. Young Yoon, Montgomery Watson, Sacramento.

Mr. Matt Zidar, Monterey County Water Resources Agency, Salinas.

Previous Reports

One of the first reports published on the hydrology of Salinas Valley was California Department of Water Resources Bulletin 52, *Salinas Basin Investigation,* released in 1946. Bulletin 52 recommended construction of a project consisting of dams to provide additional recharge and yield throughout the Valley, ground water extraction facilities, and a water conveyance facility to transport some of the additional yield to the area near the coast.

Other recent reports include:

Durbin, T.J. Kapple, G.W., and Freckleton, J.R., 1978, *Two-dimensional and three-dimensional digital flow models of the Salinas Valley ground water basin, California*; U.S. Geological Survey Water-Resources Investigation 78-113, 134 p.

Leedshill-Herkenhoff, Inc., 1985, *Salinas Valley Seawater Intrusion Study.*

Montgomery Watson, 1994, *Salinas River Basin Water Resources Management Plan, Task 1.09 SalinasValley Groundwater Flow and Quality Model Report.*

Todd, D.K., Consulting Engineers, Inc., 1989, *Sources of Saline Intrusion in the 400-Foot Aquifer, Castroville Area, California.*

Yates, E.B., 1988, *Simulated Effects of Ground-Water Management Alternatives for the Salinas Valley, California,* United States Geological Survey Water Resources Investigation Report 87-4066.

PROBLEM STATEMENT

The water resources problem in Salinas Valley is not a water supply problem. It is a water distribution problem. The basin has enough surface and ground water to meet existing and projected future average annual agricultural, and municipal and industrial (M & I) water demand through the year 2030. The problem lies in managing those supplies to meet water demands at all locations in the Valley at all times.

The overall water resources problem has three principal components:

- Seawater intrusion

  Seawater intrusion occurs near the coast principally because extraction of fresh ground water in the northern part of Salinas Valley exceeds recharge in the northern part of the Valley.

  In recent decades, the annual volume of intrusion has ranged from 2,000 to 30,000 acre feet per year (afy) and has averaged 17,000 acre feet per year.

  Seawater has advanced about 6 miles inland.

  About 20,000 acres of agricultural land near the coast are underlain by one or more aquifers that contain water too salty to use for irrigation.

- Declining ground water levels in the East Side Area

  Ground water levels continue to decline in the East Side Area.

  Lower ground water levels in the East Side Area induce additional recharge from the Pressure Area and the Forebay Area but also cause conditions for potential movement of additional seawater inland into the coastal area.

- Nitrate contamination

  Nitrate has contaminated ground water to varying concentrations throughout the Valley, but the level of contamination is especially high in the East Side, Forebay, and Upper Valley Areas.

  The maximum contaminant level (MCL) for drinking water is 45 mg/l as nitrate. In 50 percent of the wells sampled throughout the Valley, nitrate exceeds 45 mg/l; in some wells nitrate has reached several hundred mg/l.

High concentrations of nitrate limit beneficial use of the ground water for potable uses and for some agricultural uses.

An additional long-range problem is the build up of salts in the basin that is occurring because there is no subsurface outflow from the basin. Although the impacts of such a condition are manifested much more slowly than other problems, there is a long-term increase in salt concentration within the aquifer system. At some time in the future, such a build up will render the aquifer system unusable for certain beneficial uses.

These water resources problems result in economic and institutional consequences primarily because of water quality standards and the loss of supply associated with violation of those standards. The severity of the economic and institutional problems is not the same for all 3 of the problems and is dependent on the specific location and the use of the water.

The variability of precipitation and runoff is an important component of water supply planning and management. Water supply issues may appear to be non-existent when the *average* annual water supply is used for planning purposes. But in dry years, which are also a part of that average, those same supply issues become critical.

DESCRIPTION OF THE BASIN

Hydrogeology

The Salinas Valley ground water basin is one hydrologic unit. Four subareas based on differences in local hydrogeology and recharge have been identified: Upper Valley Area, Forebay Area, East Side Area and Pressure Area (which includes the area near the coast). All information collected to date indicates there are no barriers to the horizontal flow between these subareas, although aquifer characteristics decrease the rate of ground water flow in certain parts of the basin (for example, from the Pressure Area to the East Side Area, and especially from the Forebay Area to the Pressure Area). Ground water can move between the East Side and Pressure Areas, and between the Forebay and Pressure Areas, the Forebay and East Side Areas, and the Upper Valley and Forebay Areas. The "boundaries" between these areas have been identified as zones of transition between different depositional environments in past millennia.

While Salinas Valley ground water basin is one hydrologic unit, the impacts of ground water use are not distributed uniformly throughout the Valley. The impacts of ground water extraction occur mostly within the local area of the extraction. The impacts diminish rapidly with distance from the extraction, and the impacts tend to be very small at large distances from the extraction.

The alluvial fill in Salinas Ground Water Basin encompasses approximately 344,000 acres. The Upper Valley and Forebay Areas are unconfined and in direct hydraulic connection with Salinas River. The Upper Valley Area covers an area of approximately 92,000 acres near the south end of Salinas Valley from Greenfield to Bradley. Primary ground water recharge to the Upper Valley Area occurs from percolation in the channel of Salinas River.

The Forebay Area from Gonzales to Greenfield, consists of approximately 87,000 acres (including Arroyo Seco Cone) of unconsolidated alluvium. Principal recharge to the Forebay Area is from percolation of water from Salinas River and Arroyo Seco Cone, and ground water outflow from the Upper Valley.

Arroyo Seco Cone is located on the west side of southern Salinas Valley and is a part of the Forebay Area. Arroyo Seco Cone receives recharge from percolation in channels of Arroyo Seco and tributaries. The Cone covers approximately 26,000 acres of the Forebay Areas. The Arroyo Seco Cone may provide some opportunity for additional recharge.

The Pressure Area covers an area of approximately 91,000 acres between Gonzales and Monterey Bay. The Pressure Area is composed primarily of confined and semi-confined aquifers separated by clay layers (aquitards) that limit the amount of vertical recharge. Three primary water bearing strata have been identified in the Pressure Zone: the 180 Foot Aquifer, the 400 Foot Aquifer, and the Deep Zone. These aquifers are separated by aquitards, although some vertical recharge occurs locally where the aquitards are thin or missing. The uppermost aquitards allow some limited recharge from Salinas River directly to the 180-foot aquifer in the area near Spreckels. The areas of thin or missing aquitards also allow some interconnection between the shallow (180 foot) and deeper (400 foot) aquifers.

The exact nature of the connection between the Deep Zone and the ocean is unknown. Seawater intrusion has not been detected in Deep Zone wells, but there is no evidence indicating that the Deep Zone is not connected to the ocean. Lacking this evidence, it must be assumed that the deep zone, like the 180-foot and 400-foot aquifers above it, is connected to the ocean and vulnerable to seawater intrusion if ground water levels fall below sea level. Similarly, the aquitards between the 400-foot and the Deep Zone are subject to leakage of degraded water downward to the Deep Zone as the water level is lowered.

The Deep Zone is currently undefined both geologically and areally. In some locations, it is considered to be Purisima Formation, in others, lower Paso Robles Formation. Some recent evidence suggests that it may be Santa Margarita Formation. Water levels in Deep Zone wells have fallen approximately 60 feet since the late 1970s and are now substantially below sea level. Total extraction over this period of time has averaged less than 5,000 acre-feet per year. Water quality in the Deep Zone is unsuitable for agriculture because of extremely high sodium-adsorption ratios (SAR).

The East Side Area consists of 74,000 acres and contains unconfined and semiconfined aquifers in the northern portion of the Basin that historically received recharge from percolation from stream channels on the west slope of the Gabilan Range. As a result of extraction in excess of recharge, the decline in ground water level in the East Side Area has induced subsurface recharge from the Pressure Area, as well as from Salinas River and the Forebay Area. This inflow is now a larger source of recharge than the stream channels coming from the Gabilan Range.

Sources of Recharge

Ground water recharge in Salinas Valley is principally from infiltration from Salinas River, Arroyo Seco Cone, and, to a much lesser extent, from deep percolation of rainfall. Minor amounts are derived from infiltration from small streams and inflow from bedrock areas adjoining the basin. Deep percolation of applied irrigation water is the second largest component of the ground water budget, but because it represents recirculation of existing ground water rather than an inflow of "new" water, it is not considered a source of recharge for this discussion. Seawater intrusion is another source of inflow to the basin, but because it is not usable fresh water it is also excluded as a source of recharge for this discussion.

Infiltration from Salinas River and deep percolation of rainfall would occur under natural conditions, but both are increased by present water use patterns in the Valley. Ground water extraction increases the amount of infiltration from the river upstream of Salinas. Irrigation increases the amount of rainfall that percolates past the root zone by increasing antecedent soil moisture at the beginning of the rainy season. The low permeability of the Salinas Valley aquitard in the Pressure Area decreases but does not altogether eliminate deep percolation of rainfall and irrigation return flow directly to the 180-foot aquifer in the Pressure Area.

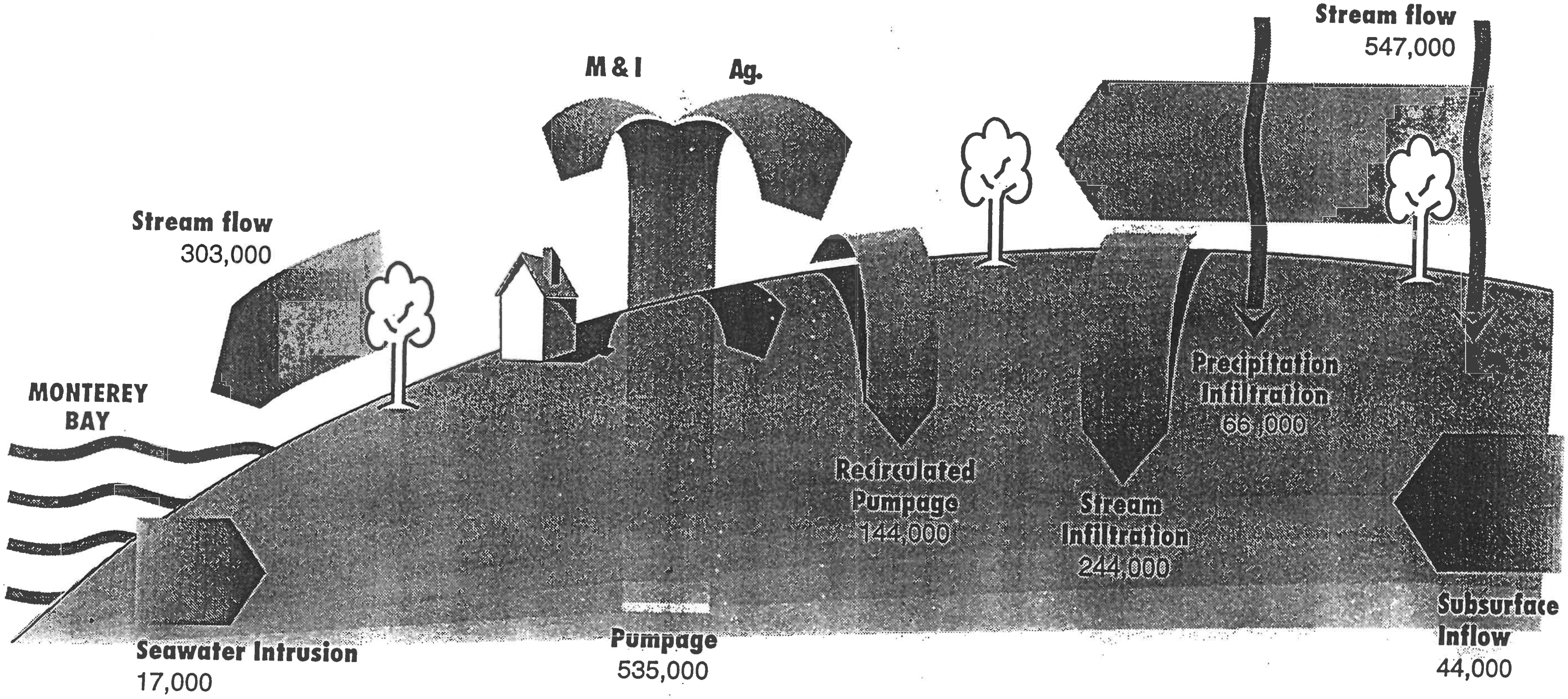
Figure 1 shows estimates of the average annual amounts of recharge derived from each source during 1970-1992 for the entire Valley. Average annual recharge, including irrigation return flow and seawater intrusion, totals 514,000 afy.

The estimates of items in the water budget are derived from a combination of direct measurement and extrapolation using three different and independently designed ground water models. It is important to recognize that the models include all available measured data and that all three of the modeling efforts completed to date have resulted in very similar estimates of the average annual basin-wide water budget. Our confidence in the general magnitude and proportion of flows in the budget is fairly high.

The water budget shown in Figure 1 is an average annual budget indicative of the long-term balance of components of the budget. It does not reveal the large amount of variation in annual flows in the water budget. These annual variations are an important factor in management of water resources and must be considered in any solution to water management in Salinas Valley.

The water budget indicates that ground water storage in the Valley has declined by 460,000 acre feet from 1970 to 1992, an average rate of 20,000 afy. However this decline was

Average Annual Basin-Wide Surface and Ground-Water Flows in Salinas Valley (AFY, 1970-1992 average flows)



Change in Ground Water Storage = -20,000 AFY

caused largely by the 1987 through 1992 drought.

Infiltration of water from Salinas River is relatively constant from year to year, partly because river flows are partially regulated by Nacimiento and San Antonio reservoirs and partly because ground water extraction--which induces a substantial amount of infiltration from the river--also remains fairly constant. In contrast, rainfall recharge is much more variable, with little, if any, recharge occurring in below-average rainfall years and large amounts occurring in wet years.

In the Upper Valley and Forebay Areas recharge from Salinas River is a rapid process, so that the effects of dry years on ground water levels are rapidly reversed in subsequent normal and wet years. After declining somewhat during the 1976-1977 and 1986-1992 droughts, water levels in the Upper Valley and Forebay Areas recovered fully within 1 to 2 years following the resumption of normal streamflow, including reservoir releases. This demonstrates the feasibility of conjunctively using ground water storage capacity in those areas to increase overall system yield.

BASIN MANAGEMENT

Seawater Intrusion

Analysis of water samples from wells in the Pressure Area has indicated that seawater has been intruding the aquifers for the last 60 or so years. The intrusion has moved progressively landward within the 180-foot and 400-foot aquifers during this time. To date, there has been no observed intrusion in the Deep Zone. The intrusion has moved as much as 6 miles inland in the 180-foot aquifer and 2 miles inland in the 400-foot aquifer, rendering wells in the intruded area unusable and decreasing usable basin storage. Between 1970 and 1992, the annual decrease in usable basin storage for ground water because of seawater intrusion has amounted to an average of 17,000 acre feet per year. While the average is 17,000 acre feet per year, it has varied from 2,000 acre feet per year to 30,000 acre feet per year. The cumulative total of seawater intrusion during the period 1970 to 1992 is about 374,000 acre feet.

Seawater intrudes coastal aquifers when ground water levels in the aquifers in contact with seawater decline below sea level. When this occurs, the normal gradient that produces ground water discharge into Monterey Bay is reversed. This reversal of ground water gradient in the Pressure Area resulted from extraction of ground water in excess of recharge in that Area. Seawater has intruded the aquifer in response to the reversed gradient that was caused by lowered ground water levels.

This saline water can move both horizontally within the aquifer or vertically through breaches in the various aquitards or through improperly constructed wells, wells that were abandoned but not destroyed, or through failed well casings. Most of the salinity is caused by intrusion of seawater through the offshore outcrops of the aquifers. An additional source of salinity may be the dewatering of salty marine clays within or between the aquifers in response to the lowered pressure levels in the aquifer system.

If the intrusion of seawater is left unchecked, seawater will continue to advance inland, eventually contaminating the East Side and Pressure Areas as far inland as Salinas. This will degrade the water supply of additional agricultural areas and will also degrade municipal drinking water supplies.

The only effective solution to controlling seawater intrusion in Salinas Basin is the re-establishment of higher ground water levels by relieving pumping stresses in the coastal portion of the aquifer. This can most efficiently be achieved by the cessation of pumping and the delivery of an alternative source of water to this area. This solution will allow recovery of water levels in the aquifer, thereby halting the advance of seawater intrusion and restoring normal aquifer pressures. The re-establishment of these conditions will also control the other possible sources of saline degradation such as the dewatering of marine clays and interaquifer leakage.

If a solution other than the delivery of water to the coastal area is to be considered, additional information regarding the components of the saline intrusion may be advisable.

Overdraft

In general, the term overdraft has been used to describe conditions where extraction from a ground water basin exceeds the perennial yield over a period of time, resulting in undesirable conditions. Undesirable conditions may include subsidence, seawater or other saline water intrusion, lower ground water level, and depletion of the supply. Perennial yield is sometimes called the safe yield or the sustained yield of the basin.

In Salinas Valley, the undesirable conditions lowered ground water levels and seawater intrusion. The conditions are the result of:

a) the physical characteristics of ground water occurrence in the Valley,

b) physical connection between the aquifers and seawater,

c) areal distribution of extraction from the aquifer system, and

d) water use practices.

These conditions require that management of ground water in different parts of the Valley recognize local hydrogeologic issues specific to each area.

There is a difference between total ground water in storage and usable ground water storage. The **total** storage of ground water in Salinas Valley is in the millions of acre feet. The **usable** storage is only a portion of the total volume in storage because all of the ground water is not available for extraction without causing some of the undesirable impacts that were listed above. Usable storage can be greatly influenced by the distribution of extraction and recharge facilities, water management practices, and physical facilities for storage and distribution of surface water and ground water.

Valley-wide, the ground water basin is only slightly out of balance because total inflow to the aquifer system is less than total outflow. Fresh water inflow consists of recharge from precipitation, streamflow, and recirculated irrigation water. Outflow consists of ground water extraction, which totals 20,000 afy more than total fresh water inflow.

Seawater is another source of inflow because of the lowering of ground water levels near the coast. The high chloride content, however, makes this water unusable. The average seawater intrusion totals about 17,000 afy. Thus, the Valley-wide water budget shows an average fresh water deficit of 37,000 afy.

In addition to the overdraft in the East Side Area and seawater intrusion in the Pressure Area, 2 other factors exacerbate the ground water supply problem in the Valley. First, nitrate concentrations in ground water are increasing in many areas of the Valley. Second, the basin is hydraulically closed to subsurface outflow, leading to long-term salt accumulation.

The undesirable conditions in the Valley include: seawater intrusion near the coast, decreasing ground water in storage in the East Side Area, nitrate increases in the Forebay and Upper Valley Area, and the salt build-up caused because the Valley is hydraulically closed. These conditions are occurring despite the fact that an essentially full aquifer system has existed under the major portion of the Valley.

The solution to these problems lies in focused relief of the pumping stresses. Such relief could include reduced local extraction in the areas where intrusion and declining water levels are occurring, development of a supplemental water supply to replace the reduced extraction, while maintaining current beneficial uses.

Nitrate

Nitrate contamination of ground water poses a significant threat to the beneficial use of ground water for drinking water and for some agricultural water uses. Nitrate concentrations exceed drinking water standards in many parts of the basin. The principal source of nitrates to ground water is almost certainly excess fertilizer that is leached by rainfall and applied irrigation water. Nitrates also originate from animal and human waste. The contribution of nitrate from various sources has been estimated at 90 percent from agriculture and 10 percent from urban sources. Contamination by nitrate has been observed in the unconfined aquifer and in some locations in the 180-foot aquifer of the Pressure Area.

Nitrate contamination can best be controlled by integrated on-farm fertilizer and water management practices. Such practices may require the voluntary implementation of improved water and fertilizer management by growers, possibly with incentives from MCWRA.

Water Conservation

There are probably some water supply benefits that can be achieved by implementing agricultural and urban water conservation measures. In agriculture, the potential savings would be achieved by decreasing direct evaporative losses during irrigation and by minimizing outflow of irrigation return flow from coastal areas to Monterey Bay. The potential for agricultural conservation of irrigation water is closely linked with interactions in the plant root zone, crop yield, and salt build-up. Any attempt to improve irrigation efficiency must evaluate each of these factors.

Water conservation by itself would not be sufficient to solve the problems of seawater intrusion near the coast and overdraft in the East Side Area.

PROBLEM SOLUTION

Seawater Intrusion and Overdraft

The only reasonable and effective solution for controlling seawater intrusion and overdraft in Salinas Valley is re-establishment of higher ground water levels by relieving pumping stresses in the aquifers in the Pressure and East Side Areas. The 2 alternatives for relieving pumping stresses are either 1) fallow land in the Pressure and East Side Areas, or 2) deliver an alternate supply of water to replace the reduced pumpage. If present agricultural and urban beneficial uses of water are to continue, the obvious solution is some sort of program to deliver water in lieu of ground water extraction. The Castroville Seawater Intrusion Project is a step in this direction, but it will not provide enough water to replace current extraction sufficiently to halt seawater intrusion.

Two approaches could be used to relieve overdraft in the East Side Area. One approach would be to allow water levels to continue declining. They would eventually stabilize near a level low enough to induce increased inflow from the Forebay and Pressure Areas at a rate sufficient to balance ground water extractions. This approach would result in high ground water extraction costs for the indefinite future and continued seawater intrusion in the Pressure Area.

An alternative approach would be to deliver in-lieu water to the East Side Area by means of a surface conveyance facility. This approach would decrease local ground water extraction costs and avoid the intrusion risk but would incur construction and pumping costs for the surface water facility.

The water-supply problem in Salinas Valley is the result of a water distribution problem. The water supply in Salinas Valley is the streamflow runoff from Salinas River watershed and the deep infiltration of precipitation on the Salinas Valley floor. However, a substantial part of this water supply is not captured at present and discharges to Monterey Bay from Salinas River. This discharge occurs mostly during storm periods, and the largest part of the discharge occurs during extreme flood events. The water-management solution to stop overdraft consists of facilities and management practices that use part of the discharge to Monterey Bay from Salinas River, while providing protection for instream uses in the River and in wetlands.

Valley-wide water management in Salinas Valley could best be accomplished by the conjunctive use of surface water and ground water storage. Storage could be used to retain some storm runoff from Salinas Valley watershed and the stored water could be made available for beneficial use within Salinas Valley. At present, runoff is stored in San Antonio and Nacimiento Reservoirs and within the ground water basin, but the current use of ground water storage is not adequate to resolve the problems of seawater intrusion into the Pressure Area and water-level declines within the East Side Area. More intensive management is required to address such conjunctive operation of surface water and ground water storage.

The need for conjunctive operation of surface water and ground water storage was recognized as early as 1946. In 1946, the California Department of Water Resources published a report on Salinas Valley that described the occurrence of seawater intrusion and declining ground water levels. The report recommended a project to eliminate these problems that included development of surface water and ground water storage. Surface water storage was to be accomplished by the construction of dams on tributaries to Salinas River, and ground water storage was to be accomplished by ground water transfers from the Forebay Area to the Pressure Area and East side Area. The Department recommended transfer facilities that included wells in the Forebay Area, conveyance facilities from the Forebay Area to the Pressure and East Side Areas, and distribution facilities within the Pressure and East Side Areas.

In such a conjunctive operation, the increased extraction in the Forebay Area and conveyance of water to the Pressure and East Side Areas would vacate ground water storage in the Forebay Area. This empty storage space would be refilled by additional infiltration from Salinas River. This mode of operation would effectively capture some of the water that presently flows to the ocean and would make it available for conveyance to the Pressure and East Side areas. The well-documented rapid recovery of ground water levels in the Forebay and Upper Valley Areas following recent drought years demonstrates the physical feasibility of this type of conjunctive use.

Part of the recommended facilities for surface water and ground water storage have been completed by the construction of the dams for SanAntonio and Nacimiento reservoirs, but the facilities for the effective use of ground water storage have not been completed. The operation of San Antonio and Nacimiento reservoirs has produced benefits to salinas Valley, but the ultimate benefits that would result from the construction and operation of transfer facilities have not been realized.

The panel concluded that the facilities recommended in 1946 by the California Department of Water Resources should be completed immediately. The Department recommended both dams and transfer facilities. Since that time, additional studies conducted by MCWRA have served to reaffirm and validate the original recommendations.

The dams that were recommended have been constructed, but the companion transfer facilities have not been constructed. The result of partially completing the project has been an uneven distribution of benefits throughout the Valley. The Forebay Area and Upper Valley Areas have enjoyed relatively large benefits from San Antonio and Nacimiento reservoirs that would have been shared equally with the Pressure and East Side Areas if the intended transfer facilities had been built. In the absence of the transfer facilities, seawater intrusion into the Pressure Area and water-level declines within the East Side Area have not been mitigated.

Instead, within the Forebay Area ground water levels are 20 to 30 feet higher than would have occurred without the dams. The Upper Valley Area has also benefited from somewhat higher ground water levels, and has used the yield of the 2 reservoirs to significantly increase the amount of irrigated land in this Area. Benefits have accrued also to the Pressure Area where seawater intrusion is 30 percent less than would have occurred. Benefits to the Pressure and East Side Areas have been relatively small

When Nacimiento and San Antonio dams were built, the effect of the additional water on seawater intrusion could not be predicted, and a "wait and see" attitude was adopted. Since the 2 dams have been operating, it has become clear that the Forebay Area has benefitted from essentially "full" ground water storage, but the ground water flow into the Pressure and East Side Areas has not been sufficient to stop the seawater intrusion and overdraft in these 2 areas. The remaining components of the solution proposed originally, an overland transfer of water directly to the intruded and overdrafted areas, are necessary to solve those problems.

The California Department of Water Resources recommended an effective plan for water-supply management within the Salinas Valley. That plan has been partly implemented. We recommend in the strongest terms that the transfer component be implemented immediately. Transfer of ground water from the Forebay Area to the Pressure and East Side Areas is the only feasible approach to eliminating seawater intrusion into the Pressure Area and water-level declines within the East Side Area. As recommended by the Department and others, transfers would be accomplished by extraction within the Forebay Area, conveyance of the extracted ground water to the Pressure Area, and distribution of water within the Pressure and East Side Areas.

The transfer facilities would produce minor water level declines within the Forebay Area. However, studies estimate that the solution can be accomplished by limiting the average decline to about 5 feet, and maximum localized decline to about 20 feet. The Forebay Area has enjoyed an average water-level rise of 25 feet due to operation of San Antonio and Nacimiento reservoirs. With transfer facilities, the average annual water-level rise, relative to pre-project conditions within the Forebay Area, would still be about 20 feet, seawater intrusion into the Pressure Area would be eliminated or severely curtailed, and water-level declines would be stopped within the East Side Area. With transfers, benefits would be distributed more uniformly throughout the Valley. Without transfers, the benefits would continue to be weighted toward the Forebay and Upper Valley Areas.

Nitrate

MCWRA knows enough about the nitrate problem to recommend initial steps to manage it. However, additional study is needed to understand the complex interrelationships of crop, irrigation, fertilizer, and soil management under conditions prevalent in Salinas Valley. Additional research into the plant-water-soil-nutrient relationships on specific soils in Salinas Valley will be required to maintain an acceptable salt balance and acceptable crop yields.

Critical information is not available to encourage growers to adopt best management practices for the mitigation of nitrate contamination of ground water. An intensive program must be undertaken by MCWRA to provide information on the effectiveness of practices for the management of soils for water conservation and the mitigation of nitrate contamination. Information is available to make initial steps toward developing best management practices, but additional information is critical to the long-term success of improved soils management.

Water Conservation

Some water supply benefits can probably be achieved by implementing agricultural and urban water conservation measures. In agriculture, the potential savings would be achieved by decreasing direct evaporative loss during irrigation and minimizing outflow of irrigation return flow from coastal areas to Monterey Bay, while maintaining a favorable salt balance.

On-farm management of irrigation needs to be done jointly with management of fertilizer application and salt leaching requirements. We recommend that MCWRA undertake studies to further understand these interrelated issues and develop best management practices tailored to growing conditions in Salinas Valley.

However, water conservation by itself would not be sufficient to solve the problems of seawater intrusion near the coast and overdraft in the East Side Area.

LAST WORD

The solution to the water resource problems within the Salinas Valley has been known since at least 1946. The solution that was proposed then by the California Department of Water Resources recognized that sufficient supplemental water could be developed within the basin. That proposal also recognized the need to transfer water from the Forebay Area to the Pressure and East Side Areas. The solution proposed in 1946 remains the best solution even today.

We urge the MCWRA to focus its attention on the completion of the original plan by the construction and operation of water transfer facilities. The MCWRA should avoid diverting its attention to suggested alternatives that are less viable economically or less effective technically. These less viable and less effective alternatives would <u>not</u> provide the same benefits as the original plan, would be more expensive, and the projected price of water would be significantly higher for all parties.

The panel believes strongly that Salinas Valley is fortunate that an in-Valley solution is available. We urge the Salinas Valley community to support the MCWRA in this effort to distribute the available water supplies for more efficient water management and lasting benefits for all residents of the Valley.