REGULAR MEETING
ARVIN PLANNING COMMISSION

TUESDAY MARCH 19, 2019 6:00p.m.
CITY HALL COUNCIL CHAMBERS
200 CAMPUS DRIVE, ARVIN

CALL TO ORDER Vice Chairperson Zavala

PLEDGE OF ALLEGIANCE

****

ROLL CALL:	Janett Zavala	Vice Chairperson
	Yesenia Martinez	Planning Commissioner
	Miguel Rivera	Planning Commissioner
	Gerardo Tinoco	Planning Commissioner
	Arturo Hinojosa	Planning Commissioner
STAFF:	Jake Raper	City Planner
	Shannon L. Chaffin	City Attorney – Aleshire & Wynder
	Cecilia Vela	Secretary

PUBLIC COMMENTS:

The meetings of the City Council and all municipal entities, commissions, and boards ("the City") are open to the public. At regularly scheduled meetings, members of the public may address the City on any item listed on the agenda, or on any non-listed matter over which the City has jurisdiction. At special or emergency meetings, members of the public may only address the City on items listed on the agenda. The City may request speakers to designate a spokesperson to provide public input on behalf of a group, based on the number of people requesting to speak and the business of the City.

In accordance with the Brown Act, all matters to be acted on by the City must be posted at least 72 hours prior to the City meeting. In cases of an emergency, or when a subject matter needs immediate action or comes to the attention of the City subsequent to the agenda being posted, upon making certain findings, the City may act on an item that was not on the posted agenda.

AGENDA STAFF REPORTS AND HANDOUTS:

Staff reports and other disclosable public records related to open session agenda items are available at City Hall, 200 Campus Drive, Arvin, CA 93203 during regular business hours.

CONDUCT IN THE CITY COUNCIL CHAMBERS:

Rules of Decorum for the Public

Members of the audience shall not engage in disorderly or boisterous conduct, including the utterance of loud, threatening or abusive language, clapping, whistling, stamping of feet or other acts which disturb, disrupt, impede or otherwise render the orderly conduct of the City meeting infeasible. A member of the audience engaging in any such conduct shall, at the discretion of the presiding officer or a majority of the City, be subject to ejection from the meeting per Gov. Code Sect. 54954.3(c).

Removal from the Council Chambers

Any person who commits the following acts in respect to a meeting of the City shall be removed from the Council Chambers per Gov. Code Sect. 54954.3(c).

(a) Disorderly, contemptuous or insolent behavior toward the City or any member thereof, tending to interrupt the due and orderly course of said meeting;

(b) A breach of the peace, boisterous conduct or violent disturbance, tending to interrupt the due and orderly course of said meeting;

(c) Disobedience of any lawful order of the Mayor, which shall include an order to be seated or to refrain from addressing the City; and

(d) Any other unlawful interference with the due and orderly course of said meeting.

AMERICANS with DISABILITIES ACT:

In compliance with the ADA, if you need special assistance to participate in a City meeting or other services offered by the City, please contact the City Clerk's office, (661) 854-3134. Notification of at least 48 hours prior to the meeting or time when services are needed will assist the City staff in assuring that reasonable arrangements can be made to provide accessibility to the meeting or service.

1. Approval of Agenda As To Form. Motion _____ Second _____ Vote _____

Roll Call: PC Tinoco ____ PC Rivera _____ PC Martinez ____ PC Hinojosa ____ VC Zavala ____

2. PUBLIC COMMENTS

This portion of the agenda is reserved for persons wishing to address the Planning Commission. At regularly scheduled meetings, members of the public may address the Planning Commission on any matter that is not listed for review on the agenda. At special or emergency meetings, members of the public may only address the Planning Commission on matters that are listed for review on the agenda. Individuals must give their name and limit their comments to two minutes. Issues raised during Public Comments are informational only and the Planning Commission cannot take action at this time. All comments shall be directed towards the Chairperson and not to individual Commissioners or staff.

3. CONSENT AGENDA ITEM(S)

A. Approval of the Minutes of the Special Meeting of February 21, 2019.

Staff recommends approval of the Minutes of the Special Meeting of February 21, 2019.

Motion _____ Second _____ Vote _____

Roll Call: PC Tinoco ____ PC Rivera _____ PC Martinez ____ PC Hinojosa ____ VC Zavala ____

4. PUBLIC HEARING(S)

A. A Public Hearing to Consider Approval of A Resolution of the Planning Commission of the City of Arvin Recommending Approval of the Arvin Water Resources Element to the Arvin City Council.

Staff recommends the Planning Commission open the hearing; allow for public testimony; close the hearing; and approve the Resolution including a recommendation to adopt an Exemption pursuant to the California Environmental Quality Act Guidelines, Section 15061(b)(3).

Motion _____ Second _____ Vote _____

Roll Call: PC Tinoco ____ PC Rivera _____ PC Martinez ____ PC Hinojosa ____ VC Zavala ____

5. REPORTS FROM STAFF

6. PLANNING COMMISSIONER COMMENTS

7. ADJOURNMENT

I hereby certify, under penalty of perjury, under the laws of the State of California that the foregoing agenda was posted on the City Hall Bulletin Board, not less than 72 hours prior to the meeting. Dated: March 14, 2019.

Cecilia Vela, Secretary

SPECIAL MEETING MINUTES
ARVIN PLANNING COMMISSION

FEBRUARY 21, 2019

CALL TO ORDER @ 6:04 PM

PLEDGE OF ALLEGIANCE

ROLL CALL: PC Martinez and PC Hinojosa absent; All others present.

1. Approval of Agenda As To Form.

Motion to approve the Agenda.
Motion PC Rivera Second PC Tinoco Vote 3-0

2. PUBLIC COMMENTS

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NONE

3. CONSENT AGENDA ITEM(S)

A. Approval of the Minutes of the Regular Meeting of January 15, 2019.

Staff recommends approval of the Minutes of the Regular Meeting of January 15, 2019.

Motion to approve the Minutes of the Regular Meeting of January 15, 2019.
Motion PC Rivera Second PC Tinoco Vote 3-0

4. PUBLIC HEARING(S)

A. A Public Hearing to Consider Approval of A Resolution of the Planning Commission of the City of Arvin Recommending the City Council Add Subsection Q of Section 17.08.020 (Permitted Uses) of Chapter 17.08 (One-Family Dwelling Zone) of Title 17 (Zoning), of the Arvin Municipal Code to Establish Standards and Criteria for Neighborhood Serving Commercial Uses in Conjunction with Existing and/or Proposed Single Family Residential Uses Including a Recommendation to Adopt an Exemption Pursuant to the California Environmental Quality Act (CEQA) Guidelines, Section 15061(b)(3).

DRAFT

Staff recommends the Planning Commission open the hearing; allow for public testimony; close the hearing; and approve the Resolution.

Hearing opened.
No testimony.
Hearing closed.
Motion to approve the Resolution.
Motion PC Rivera Second PC Tinoco Vote 3-0
Resolution No. APC 2019-03

5. ELECTION OF CHAIRPERSON

Motion to table Agenda Item 5 to a future meeting once the new Planning Commissioner has been appointed.
Motion PC Rivera Second PC Tinoco Vote 3-0

6. REPORTS FROM STAFF

7. PLANNING COMMISSIONER COMMENTS

8. ADJOURNED @ 6:21PM

Respectfully submitted,

_____
Cecilia Vela, Secretary

DRAFT

CITY OF ARVIN
Agenda Report

Meeting Date: March 19, 2019

TO:	Arvin Planning Commission
FROM:	Greg Collins, Collins & Schoettler, Planning Consultants
SUBJECT:	**Public Hearing to Consider Approval of A Resolution of the Planning Commission of the City of Arvin Recommending Approval of the Arvin Water Resources Element to the Arvin City Council.**

RECOMMENDATION

Adoption of a Resolution recommending approval of an optional element to the Arvin General Plan, called the Water Resources Element, to the Arvin City Council, including a recommendation to adopt an Exemption pursuant to the California Environmental Quality Act Guidelines, Section 15061(b)(3).

BACKGROUND

The City of Arvin secured a Sustainable Communities Planning Grant from the California Department of Conservation in 2018. This Grant was used by the City to prepare a Water Resources Element, an optional element of the Arvin General Plan. The grant funds were used to research and analyze water issues facing Arvin and the greater San Joaquin Valley. The objective of the Element was to provide a comprehensive and sustainable approach to managing Arvin's short and long-term water needs. The Consultant coordinated with local stake holders, state water agencies, Veolia and the Arvin CSD in the formulation of the Element's goals, policies and implementation strategies, which is intended to ensure the long-term viability of the ground water system that Arvin depends upon.

The outreach process assisted the Consultant in the formulation of policies that focused on:

- improving drinking water quality, ground water replenishment;
- wastewater treatment and capacity;
- water conservation; and
- storm water management.

DISCUSSION

The Arvin Water Resources Element contains goals, policies, and implementation strategies that focus on a comprehensive and sustainable approach towards managing water resources in the Arvin area. The implementation strategies section of the Element focuses on specific projects, ordinances and funding opportunities that will assist in improving water resources in the community.

This Element begins with the premise that managing the ground water system under Arvin so that it remains in a sustainable state is not only important to the City but also to the larger agricultural community because urban and agricultural uses "drink" from the same ground water system. Arvin's economy and well-being, like most cities in the Valley, is tied to the local agricultural economy. When agriculture suffers due to lack of imported water or falling water tables, Arvin also suffers – higher unemployment rates, reduced property and sales taxes, and higher crime rates.

The issue of water in the Valley is complex, controversial and political. For this reason, the reader is directed to the Appendices of the Element so as to gain a better understanding of the topic of water as it relates to Arvin and the greater San Joaquin Valley.

While it is important to understand the big picture, which provides context, it is at the local level where action is most effective. In the case of the City of Arvin, the City Council sets policy and controls the budget. Staff implements that policy. The combined efforts of clear policy direction and consistent implementation of policy can create powerful and positive change in Arvin.

With the preparation of this Element, and discussion with various stakeholders, the Consultant has learned that there are several major water issues facing Arvin. Those issues include: planning for droughts, water supply, water quality, flood mitigation, the urban heat island, air quality, budget and SGMA (ground water regulations).

After study, two very powerful ideas surfaced. First, many of the solutions to water issues, which is the subject of this Water Resources Element, are also good solutions for mitigating the other Arvin issues listed above. Second, the solutions to these issues and problems, when fully implemented, could save the City money.

Guiding the Consultant's work in the preparation of this Element was the Arvin City Council's vision for the City of Arvin (established on March 28, 2015), which reads as follows:

"Arvin is safe, healthy, vibrant, and economically diverse with a sense of community and where quality of life is valued."

During the Council's work session, a mission statement was also crafted. This mission statement reads as follows:

Our mission is to provide responsive, quality service to our community; maintain an

accessible, safe, healthy, environmentally sound and culturally rich city; drive innovative solutions; create a partnership between the community and its government through respectful governance; and do so in an economically sustainable manner.

The management of water in the San Joaquin Valley and specifically in the City of Arvin is very complex, controversial and challenging. For example, the Arvin Community Services District has had to treat its water for arsenic and 1,2,3 TCP (trichloropropane), both of which require costly mitigation treatments, while simultaneously ensuring that the District's system is free of leaks, maintains proper water pressure and allows for future urban growth.

The health, safety and quality of life of residents in Arvin is closely tied to a sustainable and reliable domestic water source that is safe for drinking, bathing and outdoor irrigation. Further, water is important to Arvin's economy because of its close association with agriculture.

In the San Joaquin Valley water comes from two sources: ground water (aquifer) and surface water (imported and native). In the case of Arvin, ground water is its sole source of domestic water. This is the case for most cities in the Valley, however, there are some cities (Avenal, Orange Cove, Fresno and Lindsay) that utilize treated surface water from the California Aqueduct or the Friant-Kern Canal.

The Consultant has focused on water issues specific to Arvin but notes that water strategies tailored for Arvin are transferable to the other 58 cities in the San Joaquin Valley. Further, the Consultant realizes that no city is an “island” and that water management decisions for the San Joaquin Valley, including the Central Valley Water (CVP) Project, the State Water Project (SWP) and the Arvin-Edison Water Storage District (AEWSD) can also have implications for Arvin.

In order for the Consultant to focus on Arvin's water issues, five "Golden Goals” have been established for the city's Water Resources Element.

1. **The urgency of drought represents a unique opportunity. The status quo is NOT acceptable. Therefore, we will implement new innovative strategies.**

2. **We will increase City department and inter-agency collaboration moving toward multi-disciplined, multi-benefit and multi-funding project.**

3. **We will diversify our dependence on sources of water and utilize a fit-for-purpose approach to water use.**

4. **We will protect our safety, health and quality of life during drought periods and as water resources become scarce.**

5. **We will create and use tools to foster sustainable water use behavior by the public**

A goal is only as good as its implementation. Working together, the City and the Arvin Community Services District will need to focus on the following implementation strategies:

1. **Capture storm water by all means possible using multi-benefit designs; and then use that storm water to achieve multiple benefits.**

2. **Coordinate with Viola to expand and distribute reclaimed waste water to multi-benefit projects including parks and agricultural lands.**

3. **Require all infrastructure projects to achieve multi benefits and cost efficiencies including: expanding grant funding possibilities and utilization of multiple funding sources.**

4. **Create an Urban Forest in order to achieve multi benefits including: stormwater capture, aquifer recharge, storm water peak flow control, urban heat reduction, and mitigation of health issues resulting from dust and air pollution.**

ENVIRONMENTAL

Staff have assessed the adoption of the Arvin Water Resources Element, an optional element to the Arvin General Plan, and determined it is exempt from the California Environmental Quality Act Guidelines, pursuant to Section 15061(b)(3), as the adoption of the Element will not result in significant, adverse effects on the environment. This Element is a planning study on the topic of water management in Arvin and any future water projects including but not limited to water lines, pumps, and storage facilities; waste water treatment facilities; water treatment facilities; or water storage facilities. Actual construction or other operations shall require CEQA compliance on the actual facilities proposed to be constructed once those facilities become known and assessable.

CONCLUSION

To ensure that Arvin effectively implements strategies (watering regulations, infrastructure projects, water management technologies, etc.) that accomplish the above goals, Arvin needs to establish a "team" that will carry the ball in the implementation of the Water Resources Element. Ideally, this team would be composed of the city engineer and city planner; a representative from Veola, the Arvin Community Services District and the Arvin-Edison Water Storage District; and members from the public. This team would be responsible for meeting certain milestones such as water conservation percentages for Arvin households, reduction in storm water runoff, reduction in water usage inside the home and the volume of water recharged into the ground water system after treatment at the waste water treatment plant.

Arvin's efforts in the field of water management and conservation has the potential to become the standard by which other cities in the San Joaquin Valley are measured. Like so many other tasks and objectives facing cities in the Valley today the proof of success is best measured by long-term implementation. This implementation requires a team of individuals that are knowledgeable about water management and are committed to meeting certain milestones or objectives (e.g. ten percent reduction in household water consumption or increase in acre feet of water recharged).

Welcome!

Arvin Water Element
Planning Commission Meeting

March 19, 2019

Arvin Water Resources Element

PLANNING COMMISSION RECOMMENDATION

Adoption of Resolution No. _____ recommending approval of an optional element to the Arvin General Plan, called the Water Resources Element, to the Arvin City Council, including a recommendation to adopt an Exemption pursuant to the California Environmental Quality Act Guidelines, Section 15061(b)(3), because this Element constitutes a planning study on the topic of water management in Arvin and any future water projects including but not limited to water lines, pumps, and storage facilities; waste water treatment facilities; water treatment facilities; or water storage facilities shall require CEQA compliance on the actual facilities proposed to be constructed.

Arvin Water Resources Element

BACKGROUND

The City of Arvin secured a Sustainable Communities Planning Grant from the California Department of Conservation in 2018. This Grant was used by the City to prepare a Water Resources Element, an optional element of the Arvin General Plan. The grant funds were used to research and analyze water issues facing Arvin and the greater San Joaquin Valley. The objective of the Element was to provide a comprehensive and sustainable approach to managing Arvin's short and long-term water needs. The Consultant coordinated with local stake holders, state water agencies, Veolia and the Arvin CSD in the formulation of the Element's goals, policies and implementation strategies, which is intended to ensure the long-term viability of the ground water system that Arvin depends upon.

The outreach process assisted the Consultant in the formulation of policies that focused on:

improving drinking water quality, ground water replenishment;
wastewater treatment and capacity;
water conservation; and
storm water management.

Arvin Water Resources Element

RECENT NEWS

Water has been in the headlines - The Drought is over! Water conservation is on the rise. Significant acres of agricultural land is the San Joaquin Valley will be fallowed. LA will need less not more water from Northern California.

The following newspaper articles are examples of water-related stories that have implications for Arvin and the greater San Joaquin Valley.

abortion, just because the child will be born with Down syndrome was also enjoined by a federal judge and will be heard in an appellate court early next year.

It's stunning that a state would try to interfere with a woman's decision whether to take on the difficult and life-altering task of raising a child with a disability — or the related decision whether to subject a child to living with a severely disabling condition. Besides, as an ACLU attorney recently noted, allowing a state to pry into the reasons a woman decides to have an abortion strikes at the very heart of a woman's right to make this private decision for herself. Given that, legal experts think it's unlikely the Supreme Court will take up the issue.

But who knows? There seems to be a push to get more antiabortion state laws on the books in order to prompt more federal lawsuits and increase the chances that the Justices, with their new conservative majority, will seriously undermine — or overturn — Roe vs. Wade. In late November, U.S. District Judge Carlton Reeves said as much in a scathing rebuke of the state of Mississippi when he struck down its ban on abortions after 15 weeks.

Of more immediate concern than a broad Supreme Court ruling are the incremental state restrictions that manage to survive court challenges. Together, these are making it increasingly difficult for abortion clinics to stay open, intimidating doctors so that they won't provide abortions and generally reducing access in so many places that the procedure becomes almost unobtainable, particularly for poor women without the means to travel. In several states, there is, literally, only one abortion clinic.

It's unconscionable that states continue to obstruct access to abortion, and it's particularly galling when they cloak their laws in fake concerns about the health and safety of women. Abortion rights advocates must continue to challenge these laws in court, the judiciary must defend its critically important 50-year-old precedent and, ultimately, opponents must accept that abortion is a constitutional right that is not likely to go away.

Royal Court, I would use the platform to advocate for what I value, particularly for science education, for the importance of science informing public policy, and for inclusion. Four interview rounds later, they called my name from among 44 finalists.

Part of the tradition feels antiquated — the titles, the

experience in research labs and about the importance of scientific literacy.

Every day, young children approach us and tell us that they hope to study science, or that they will find ways to help others, or that they want to speak up for themselves, as we are doing. I am lucky to be part of this group of smart, inde-

The 2019 Royal Court is one of the most diverse in the tournament's history. We are of many different religious, racial and socioeconomic backgrounds. Personally, I am happy to be the first Rose Queen to wear glasses on the float (even though they clash with the crown), and the first Rose Queen to talk about being Jewish. I feel an additional

because I understand that acceptance also takes courage. I can't wait to see you at the Rose Parade. But more to the point, I hope you see yourself in the Rose Parade too.

LOUISE DEBER SISKEL is a senior at Sequoyah High School in Pasadena. She will attend the University of Chicago in the fall.

HERE'S HOPING

L.A. could import less water

By Mark Gold

This article is one in a series about reasons for optimism in 2019.

IT'S BEEN HARD TO SEE 2018 as a good year for water in California.

In November, voters rejected a bond that would have provided almost $9 billion for water resource infrastructure and protection projects across the state. Congress, with support from Gov. Jerry Brown and Sen. Dianne Feinstein, worked to sidestep important environmental protections for the San Francisco Bay and the Sacramento-San Joaquin River Delta. And the Trump administration rolled back protections for hundreds of miles of streams and rivers in the Southwest as well as thousands of acres of wetlands.

There's every reason to expect that 2019 will be far better, largely because of Measure W, which was passed by voters in November. The initiative imposes a Los Angeles County parcel tax that will generate $300 million per year to reduce pollution from runoff and capture storm water to add to the water supply.

Our local beaches, bays, rivers and lakes have been in violation of the Clean Water Act for decades. Every time it rains, the resulting runoff leaves beaches and rivers looking like trash dumps, and makes the ocean unsafe for swimming and surfing because of pathogens in the water pouring out of storm drains. Measure W gives Los Angeles County and its 88 cities the chance to transform urban hardscapes into more nature-based, green infrastructure that will reduce water pollution, augment local water supplies, ease the risk of flooding and beautify neighborhoods.

Having the money to transform a public system isn't the same as transforming the system, however, and spending the money effectively will be a key challenge.

Currently, Los Angeles County imports 58% of its water from more than 200 miles away, and the city of L.A. imports about 90% of its water. A key goal of Measure W spending must be to change that.

To take full advantage of this rare opportunity, local leaders will need to coordinate across agencies and jurisdictions. New spending should be planned in tandem with park projects funded by 2016's Measure A and with transportation infrastructure projects funded by Measures R and M, passed in 2008 and 2016, respectively.

Going forward, every street improvement initiative should be viewed as an opportunity for greener streets that facilitate water absorption and ensure that remaining runoff is treated. New park projects should include ways of capturing runoff on site for local irrigation or to augment groundwater supplies. With Measure W to supplement existing funds, these goals now seem possible.

Weaning ourselves from imported water is starting to seem possible. Santa Monica recently approved a plan that will enable it to be 100% water self-sufficient by 2023: a Herculean achievement given that the city was fully dependent on imported water just 20 years ago.

Storm water capture, done right as part of Measure W, has the potential to meet as much as 30% of the county's water demand. The city of Los Angeles and the Los Angeles County Sanitation Districts could become the source of another 30% of the county's water supply by turning all of their large, coastal sewage treatment plants into full water-recycling plants. Cleaning up the long-polluted San Fernando Valley aquifer, already underway, could further add to the local water supply.

Reliance on local water supplies will make L.A. County far more earthquake-resilient and will become increasingly important as climate change brings longer and more severe droughts to the region, and to our imported water sources in the Sierra and the Colorado River watershed.

MARK GOLD is associate vice chancellor of environment and sustainability at UCLA.

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BRIAN VAN DER BRUG Los Angeles Times

BUCKLED CONCRETE sits along the Delta-Mendota Canal near Los Banos, Calif. Ground levels have sunk due to tapping groundwater in times of drought.

Ground levels are sinking

A DWR report details how the Sacramento Valley's groundwater is being overtaxed.

BY MATTHEW ORMSETH

A Northern California community sank more than 2 feet in nine years, the starkest example of how tapping groundwater in times of drought has caused parts of the Sacramento Valley to sink, according to a report from the state Department of Water Resources.

Arbuckle, a Colusa County community of 3,028 people, sank 2.14 feet between 2008 and 2017.

While the subsidence was most severe in Arbuckle, it was widespread in Yolo County, where the DWR registered ground levels sinking from a third of a foot to 1 foot at 31 sites.

The DWR also measured areas in Glenn and Sutter counties where ground levels had sunk modestly.

DWR Director Karla Nemeth attributed the sinkage to overtaxing the valley's groundwater during the drought that desiccated California from 2012 to 2016. The agency will keep pushing for more sustainable use of the state's groundwater, she said in a news release.

The survey, conducted during 2017, found that groundwater levels in the Sacramento Valley had recovered an average of 7 feet since the drought's end. But the drought had depleted groundwater levels in parts of Colusa County by as much as 43 feet. In Glenn County, the groundwater was even more exhausted, dropping 58 feet in places.

When groundwater is extracted, soil and other sediments contract, causing subsidence — the sinking or settling of the ground's surface.

Subsidence can damage infrastructure such as roads, levees, pipelines and aquifers. Roads can crack. Canals can buckle and warp. Water operators are forced to lessen the flow of water to sunken aqueducts, for fear of overflowing their banks.

In 2017, the DWR and NASA found that aqueducts in the San Joaquin Valley had sunk more than 2 feet at key points, threatening the delivery of water to millions of acres of farmland.

One aqueduct in Kings County, having sunk more than 2 feet in places, could carry only 80% of the water it was designed to transport, the report found. William Croyle, the DWR's director at the time, called the subsidence "troubling and unsustainable."

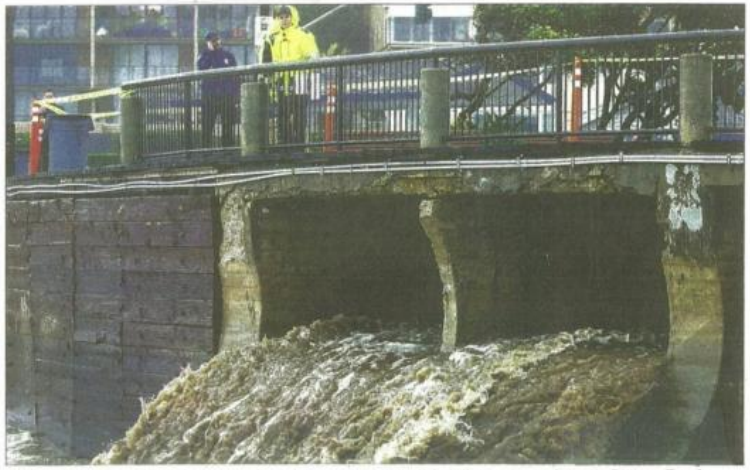
Stretches of the Eastside Bypass, which carries flood flow from the San Joaquin River in Fresno County, sank 16 to 20 inches in two years, the report found. The water system's surface had already fallen several feet in places between 2008 and 2012. Fixing those areas could cost $250 million, the DWR estimated.

In 2016, the DWR and NASA surveyed the South-Central Coast region. Using radar data, they found an area near Corcoran — about 50 miles south of Fresno — had sunk 22 inches between May 2015 and September 2016.

TIMES FEB. 6, 2019

Los Angeles

$2.75 DESIGNATED AREAS HIGHER © 2019 OCSE WEDNESDAY, FEBRUARY 20, 2019



MOST OF THE RAIN that falls in urban areas eventually reaches the ocean, as shown in Laguna Beach.

Wet winter mostly wasted

California has gotten a lot of rain, but much of it's been lost to the ocean. Experts are seeking how to capture more runoff.

By Hannah Fry
and Alejandra Reyes-Velarde

California's wet winter has dumped at estimated 18 trillion gallons of rain in February alone. But much of it is simply going down the drain.

In what has become a source of much concern in a state prone to droughts and water shortages, the vast majority of the rain that falls in urban areas flows into storm drains and is eventually lost to the Pacific Ocean.

"When you look at the Los Angeles River being between 50% and 70% full during a storm, you realize that more water is running down the river into the ocean than what Los Angeles would use in close to a year," said Mark Gold, associate vice chancellor for environment and sustainability at UCLA. "What a waste of water supply."

For Southern California, this is shaping up to be the wettest winter in years — serving as a reminder of how much water is wasted when the skies open up.

Local agencies did step up water-capture efforts after the region's most recent drought, but officials admit it's going to take time and a lot of money to save the significant amounts of rainwater now being lost.

Climatologist Bill Patzert estimates that more than 80% of the region's rainfall ends up diverted from urban areas in Southern California into the Pacific.

"All those trillions of gallons of rain, which sound so sweet, really end up in the ocean," he said. "There are some catchment basins, but it's been so dramatically dry for the past two decades that it's not filling them up. Roots and soil are sucking up the water and preventing it from getting to the groundwater basins."

The storms have significantly

[See **Wasted rain**, A12]

Storms rip up highways

Some roads in the San Bernardino and San Jacinto mountains face costly repairs from flooding. A12

Rainwater gets mostly wasted

[**Wasted rain,** from A1]
boosted the snowpack in the Sierra, which is a major source of California's water. As the snow melts, it's collected in a series of rivers, dams and reservoirs and sent to farms and cities.

Ideas explored

Cities have been exploring what can be done to capture urban runoff.

Among the ideas being tried are slowly feeding rainwater underground, a process known as aquifer recharge, and creating more permeable surfaces where the water flows, such as removing some of the concrete around the Los Angeles River bed.

But it hasn't been enough to make a significant dent.

"We still lose a tremendous amount of water to fast runoff that we know can be captured. We're not doing all the things we need to be doing," said Peter Gleick, president emeritus of the Pacific Institute. "We get our rain in big storms. The [river] flows get huge. We have to remove some of that water to prevent flooding, but we can also capture more of it."

In 2012, Los Angeles leaders passed an ordinance that requires most new developments to collect the runoff from three-quarters of an inch of rainfall and reuse it on site or let it percolate into the ground, in essence "un-paving Los Angeles and capturing more runoff," Gold said.

This happens when rain seeps into underground storage tanks through the soil and is pumped, treated and ultimately used to supplement the region's increasingly irregular imported water supply. Gold said there will be greater potential for rainwater capture when money collected through Measure W — a property tax passed by voters last year that's projected to raise about $300 million annually to capture and clean up stormwater — becomes available next year.

> 'We still lose a tremendous amount of water to fast runoff that we know can be captured. We're not doing all the things we need to be doing.'
>
> — Peter Gleick, president emeritus of the Pacific Institute

The Los Angeles Department of Water and Power said it was able to capture about 22 billion gallons of water during the recent storm, which officials said shows steady progress.

"This year, we're doing great," said Keith Lilley, assistant deputy director of stormwater planning at L.A. County Public Works.

Experts, however, say there is much room for improvement.

In its latest study in 2014, the Pacific Institute estimated that stormwater capture in Southern California and the Bay Area has the potential to increase the state's water supply by at least 420,000 acre-feet annually.

One acre-foot equals about 326,000 gallons, or enough water to cover an acre of land, about the size of a football field, one foot deep. An average California household uses between one-half and one acre-foot of water per year for indoor and outdoor use.

'Valuable resource'

Gleick said there has to be a shift in thinking about water that changes how cities are designed.

"It's the fault of 20th century thinking about water, which was to get rid of stormwater; get rid of wastewater, treat it as a liability," he said. "That's the infrastructure we built. We channeled our rivers and we lined them with concrete so we could get rid of water. Now we know that's a valuable resource."

In the early 20th century, rain was seen as a threat to Los Angeles' rapid economic development. Heavy rain spurred a deadly debris flow in the 1930s known as the Montrose flood, which swept away people and destroyed about 100 homes. Historical Society of Crescenta Valley photos show half-buried cars, houses and businesses sitting askew, as well as a 70-ton boulder sitting in the middle of a busy street.

Folk singer Woody Guthrie even wrote a song about the disaster, which was followed by another flood about four years later.

The great flood of 1938 caused widespread losses across Southern California

Flood-control efforts that began before the disasters were kicked into high gear. By 1960, the Los Angeles River had become a 51-mile engineered waterway stretching from the San Fernando Valley to the Pacific Ocean.

A series of storms, including a moisture-packed atmospheric river that slammed the state last week, has brought consistent rainfall in February that has reached nearly half the volume of Lake Tahoe. Los Angeles has received its fair share of the rain, with more than 4 inches falling on the Southland since Feb. 1.

San Diego has had more than 10 inches of rain this month, passing the city's average for the entire winter season.

The totals are likely to increase this week — though not by much — as another storm rolls into the region Wednesday night. That low-pressure system is expected to bring less than a quarter of an inch of precipitation through Thursday, said Lisa Phillips, a meteorologist with the National Weather Service in Oxnard.

Drought map better

The wet winter so far has helped keep much of the state out of serious drought conditions that have plagued California for years.

A third of the state was considered to be in normal conditions and more than half was considered only abnormally dry as of last week. None of the state is considered to be in extreme or exceptional drought, the worst conditions possible. However, experts caution that it's not a matter of whether another drought will hit, but when it will happen and how long it will stick around.

California is still reeling from the effects of the last drought. Groundwater basins that were greatly depleted when rain was scarce from 2012 to 2016 will take years to refill, experts say.

"In the short term, this rain is certainly sweet and we were overdue, but it took us years to get into a drought situation. And during those years, there's been tremendous population growth, so there's no quick fix for the underground drought," Patzert said. "Conservation is forever now. It's a new lifestyle."

GERARD MOLINA Los Angeles Times

A KEY ELEMENT in L.A.'s water recycling plan is the Hyperion water plant, which the city wants to upgrade so purified water can be pumped inland and injected into the aquifers that underlie the L.A. Basin.

L.A.'s bold goal to turn waste to drinkable water

Recycling plan lines up technology and political will, but lacks money

BY BETTINA BOXALL

Los Angeles has a new water project in mind that could cost $8 billion, take 15 years to complete and provide as much as one-third of the city's supply.

Local officials aren't talking about building a new dam or lining the coast with desalination plants or towing icebergs from the Arctic.

They are eyeing the river of treated sewage that pours into the Pacific Ocean, day in and day out, from L.A.'s wastewater plants.

In a dramatic shift for a city notorious for looking afar for most of its water, Mayor Eric Garcetti vowed this week that the city will be recycling all of its wastewater by 2035 and using it to reduce its need for imported supplies.

"It is really a game-changer," said Richard Harasick, senior assistant general manager at the L.A. Department of Water and Power.

Currently, recycling provides only 2% of the city's water.

The Garcetti administration says that figure can jump to 35% if Los Angeles stops dumping its treated effluent into the sea and instead uses it to replenish the local groundwater reserves that have supplied minimum customers.

Doing that will require costly equipment upgrades at the Hyperion Water Reclamation Plant, new groundwater wells, construction of a 15-mile pipeline and as much as $8 billion financed by DWP to pay for it all.

The plan will also require a change of heart by L.A. residents, who 18 years ago succeeded in killing a city project that would have

[See Water, B4]

Planting for the future

By R. Daniel Foster >>> Strip a street of its trees — those breathing sentinels powered by mere water, air and dirt — and you rip the very soul from a neighborhood. Bleak and barren, a sun-baked block turns desolate without its oxygen-rich canopy. ¶ The good news: greening your street or yard is free and easy — and now is the optimal planting season.

For its part, Los Angeles is providing trees for parkways, yards, schools and businesses free to city residents. "If you want a street tree in front of your house, all you have to do is sign up and one will appear in a few months; it couldn't be much easier," said Elizabeth Skrzat, executive director of City Plants, a public-private partnership funded by the L.A. Department of Water and Power, grants and corporations.

Other cities offer similar tree-planting programs — Long Beach was pleasantly surprised by the overwhelming response to its offer of free fruit trees to its city residents — so check to see if your municipality offers something similar. There are also tree-planting organizations, such as TreePeople, that help provide free trees to green neighborhoods.

The effort is desperately needed. A U.S. Forest Service survey predict that 38% of Southern California's 71 million urban trees could perish from invasive pests, a condition worsened by extreme heat and drought.

Los Angeles' urban forest — it's one of the world's largest — is the city's premier radiation defense system, shielding people and buildings from growing solar bombardment, as well as steep energy costs. The city's 700,000 street trees can literally help save lives with the shade they give us: Among all national weather events, extreme heat fatalities are often the highest.

Advocates say trees are also an environmental justice issue. A 2008 study by the U.S. Forest Service found that the city's poorest areas can have bare canopies — as low as 5% coverage, and wealthier neighborhoods have the highest, up to 37%. Those emerald-rich sunshades are proved to trigger lower incidence of asthma, hypertension, diabetes and obesity — among myriad other benefits, according to a 2016 study published in the journal Health & Place about the multiple health benefits of an urban tree canopy.

Given that the dynamos are seriously valuable (they also green property values), Los Angeles recently called for a "Tree Summit" of experts and advocates to recommend proposals to protect and enhance our urban forest.

Residents can join that effort: grab a few neighbors, get organized and welcome some towering pines (give them a few decades) among other species as your neighborhood's shadiest new friends.

Here's how it works for city of Los Angeles residents: City Plants, working with partners including TreePeople, works to site, permit, purchase and plant the street trees. (Click the "get free trees" link at *cityplants.org* to order a tree.)

Within a few months, you'll receive a door hanger with City Plants' decision to plant — or not to plant, based on an inspection. (A parkway is sometimes too narrow or it might be covered with cement, bricks or pavers; adjacent utilities can also scuttle a planting.)

Arvin Water Resources Element

- *Issues and Opportunities*
- *State of the art policy and technology*
- *Five Golden Goals – a new approach*
- *Low Impact Development and other great ideas*

Interviews with Advisory Committee revealed key issues and opportunities and information

Issues and Problems:

- Water Quality (arsenic)
- Air Quality
- Flood zones
- Urban heat island

Opportunities

Council Vision and Mission Statement (2015)

"If you don't know where you are going you might not get there – Yogi Berra"

Vision Statement:

"Arvin is safe, healthy, vibrant and economically diverse with a sense of community and where quality of life is valued."

Opportunities (cont.)

Mission Statement

"Our mission is to provide responsive, quality service to our community; maintain accessible, safe, healthy, environmentally sound and culturally rich city; drive innovative solutions; create a partnership between community and its government through respectful governance; and do so in an economically sustainable manner."

Opportunities (continued)

Grants:

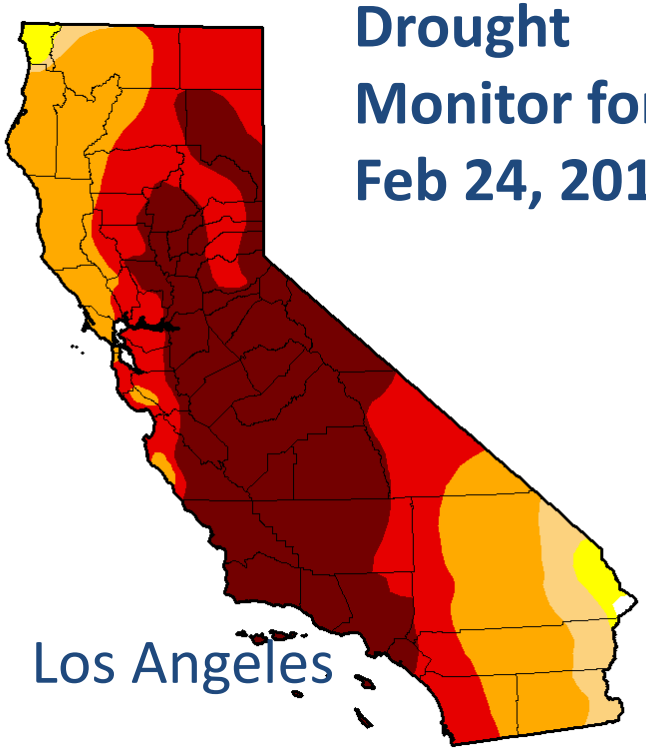
- Council implementation plan – hire a grant writer ☑
- Arvin is a criteria-rich city for grants ☑
- Opportunity zone status ☑
- Flood zone ☑

“And it never failed that during the dry years the people forgot about the rich years, and during the wet years they lost all memory of the dry years. It was always that way.”

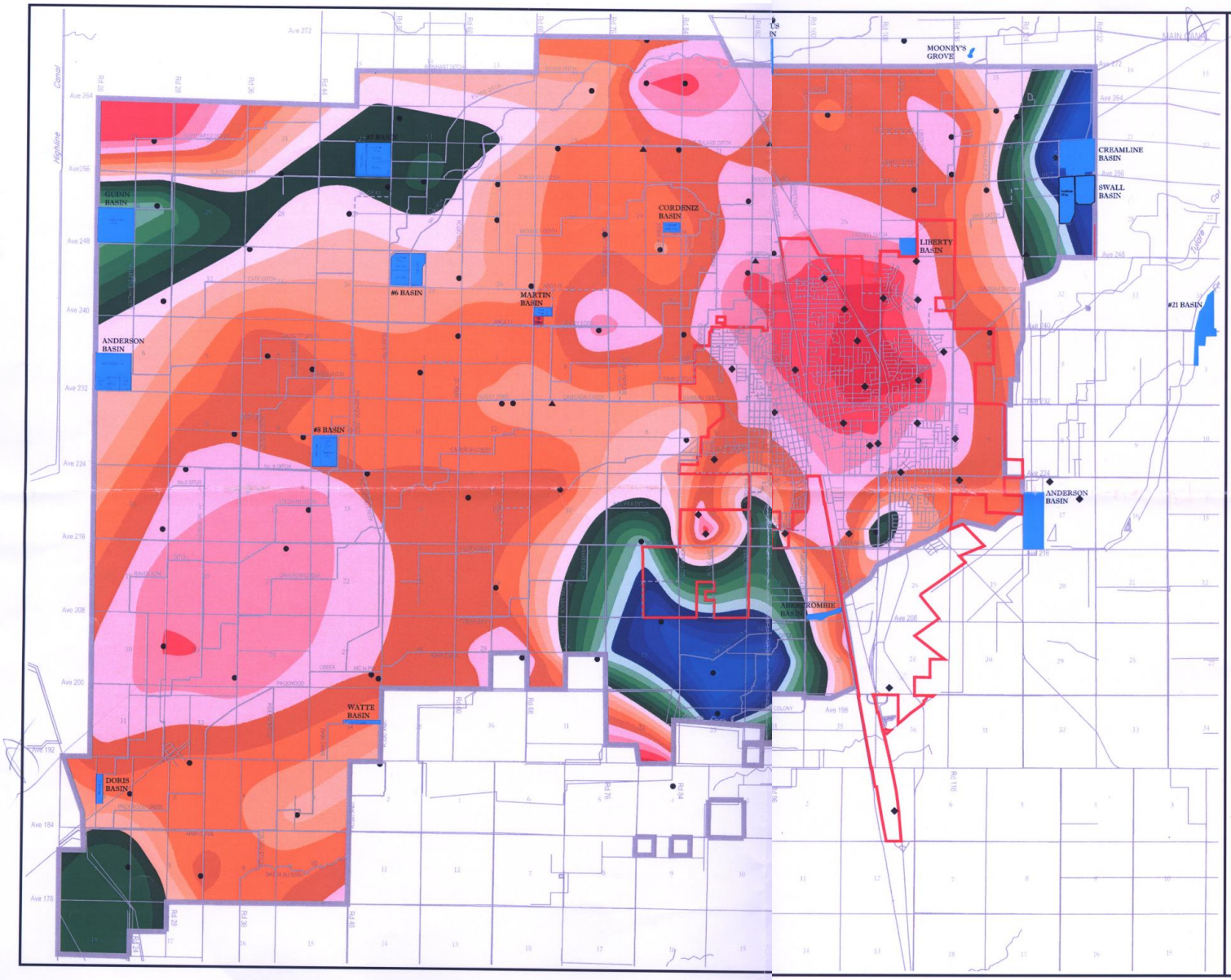
- John Steinbeck – East of Eden

California's Drought by 2015

- Going into fourth consecutive year of drought
- 2013 driest year on record; maybe for 500 years
- Reservoir capacity at 38% of average
- 90% of State in "Severe to exceptional drought"
- 11 trillion gallons to recover



Drought Monitor for Feb 24, 2015



NORTH

LEGEND

- Tulare Irrigation District
- City of Tulare Limits
- TID Wells
- City Wells
- New Conjuctive Use Project Monitoring Wells

100'	170'
105'	175'
110'	180'
115'	185'
120'	190'
125'	195'
130'	200'
135'	205'
140'	
145'	
150'	
155'	
160'	
165'	

TULARE IRRIGATION DISTRICT
TULARE, CALIFORNIA

Spring 2017
Depth to
Groundwater Map

TULARE IRRIGATION DISTRICT
FORMED IN 1889

Spring 2017 GW-1.dwg

WATER SHORTAGE CONTINGENCY PLANNING

WATER SUPPLY RELIABILITY

Groundwater provides a medium-to-good quality of water to the area. From the time of thecreation of the District until the present, and well into the future, groundwater will be the only source of water for the District.

Groundwater Quality

The District's old wells contain arsenic at concentrations over the maximum concentration limit of 10 ug/l (which was changed in 2006 from a maximum concentration limit 50 ug/l). The District applied for and received a grant for studying groundwater conditions in the area around the District. The study involved selection of locations that are thought to have lower concentrations of arsenic, and construction of three test wells to verify that low domestic wells can be drilled that will meet the arsenic standard. In the event that new wells with acceptable water quality cannot be drilled, it is planned to install centralized arsenic treatment to solve the problem.

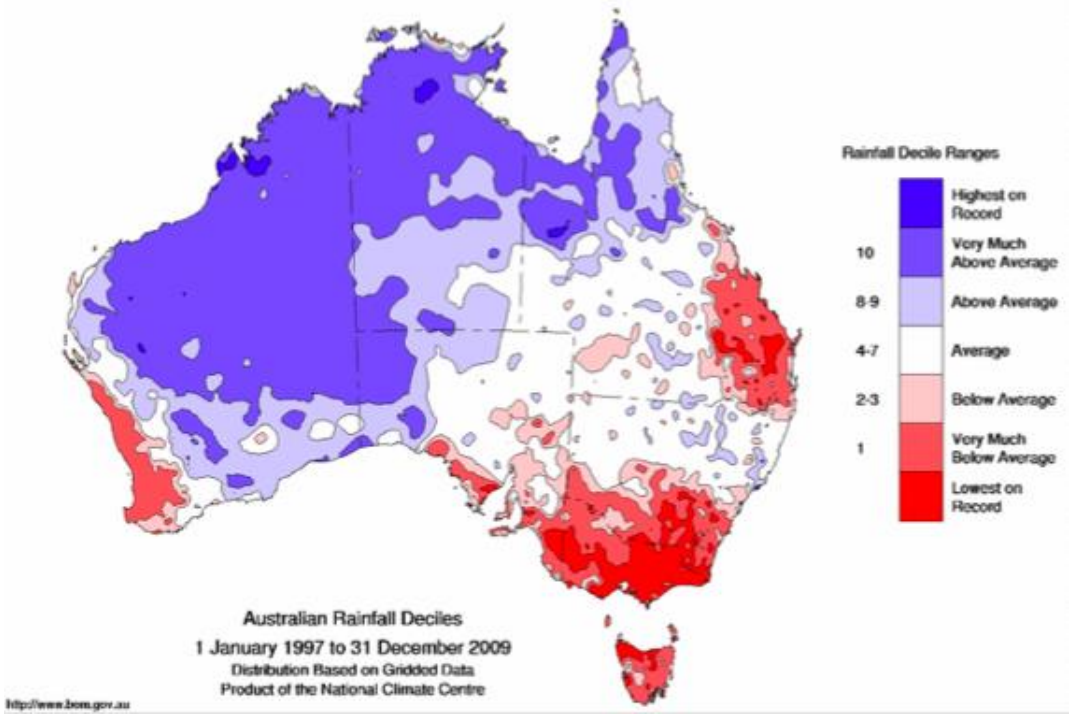
Drought

It has been previously noted that an extended drought can have an effect on groundwater pumping levels. The District has greatly benefitted from AEWSD's project, which has stabilized groundwater levels in the area. Therefore the District's exposure to effects of drought have been mitigated. However, that is not to say that groundwater levels will not drop due to an extended drought or other impacts reducing importation of surface water – but it is to say that groundwater levels will be much better than they would have been absent AEWSD's program, and the groundwater supply will be sustained – even through an extended period of drought.

Australia's Millenial Drought

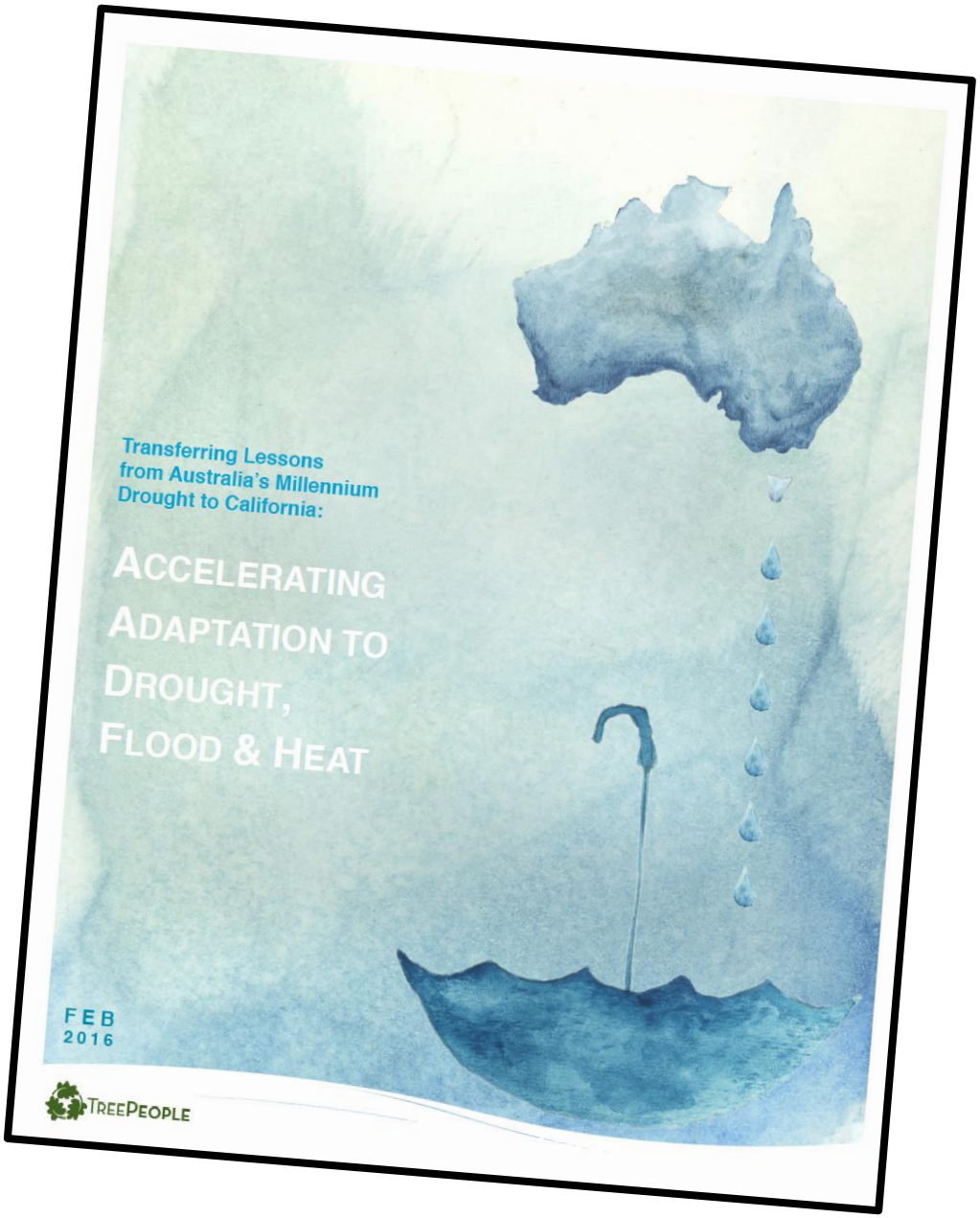
- 1997 – 2010: longest period of rainfall deficit on factor – 12 years
- Produced changes to the way Australia manages water, and created a political atmosphere supportive of innovation

- ***1997 – 2010:*** *longest period of rainfall deficit on record.*
- *Produced changes to the way Australia manages its water, and created a political atmosphere supportive of deep investment and rapid innovation.*
- *Accelerated reforms to water laws and institutions that were already underway.*
- *All of Australia impacted.*



Transferring lessons from Australia's Millenial Drought to California:

Accelerating Adaptation to Drought, Flood and Heat



5 Golden Goals

Lessons Learned – translated and applied to Arvin

1. When the status quo is NOT acceptable, this presents an opportunity to implement new innovative strategies.

2. Collaborate on multi-disciplinary/multi-benefit projects

3. Diversify dependence on water sources

4. Protect safety, health and quality of life during drought/climate change

5. Foster sustainable water use behavior

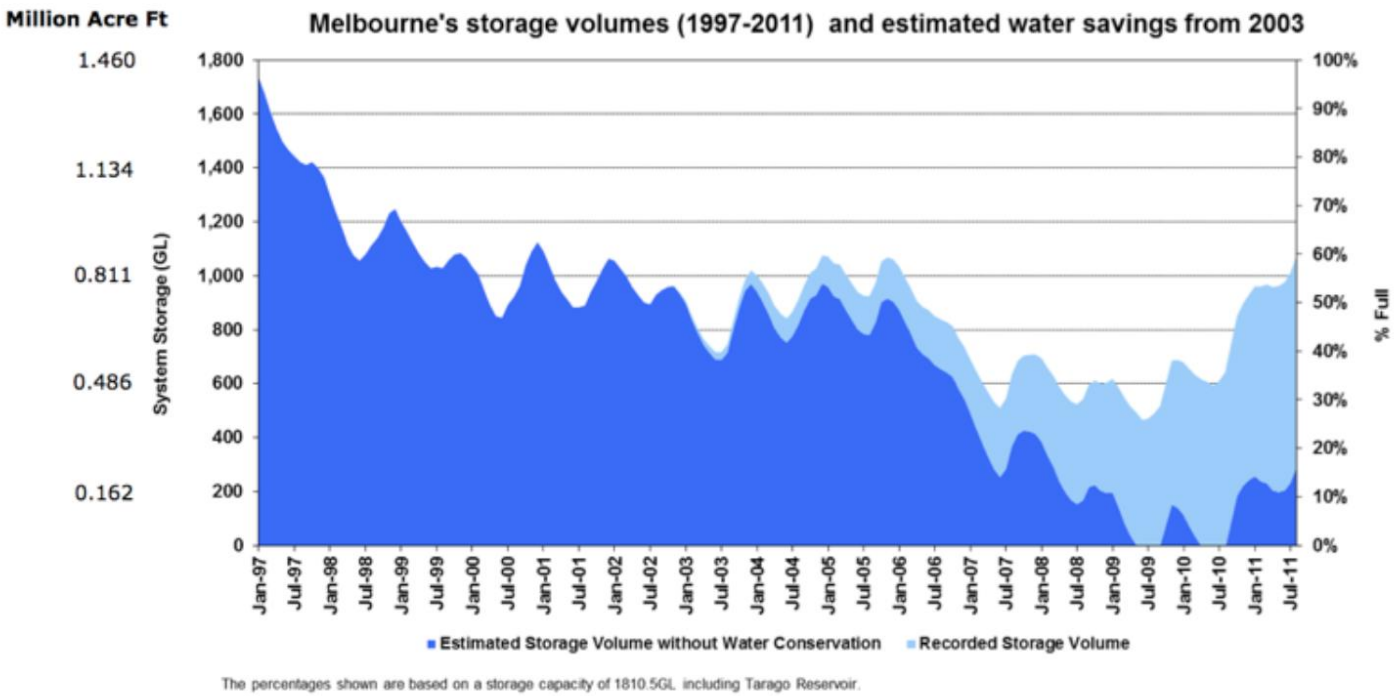
Drought urgency

Lesson 1

Drought urgency represents a unique opportunity to reshape water management and requires smart, swift action (status quo NOT acceptable)

- Melbourne would have run out of water if they did not act early on during the drought.

Figure 3: Melbourne's Water Supply With and Without Water Conservation Measures.[v]

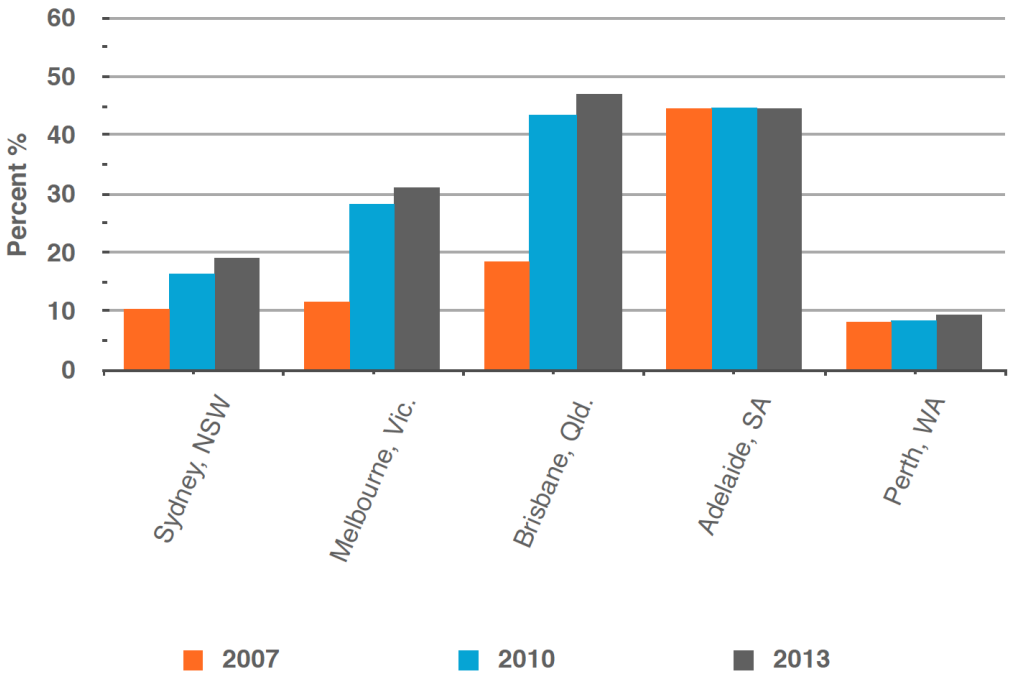


Public and political will is receptive to large changes in water policy during times of drought.

The Victorian and South Australian Governments:

- *Improved water use efficiency*
- *Implemented Tiered water pricing (double price of water)*
- *Implemented Water restrictions*
- *Set aggressive targets (water conservation; wastewater reuse; stormwater capture and reuse) Melbourne*
- *Built a desalination facility and interbasin transfer pipeline (Melbourne)*

Figure 6: Households with rainwater tanks installed in Australia's capital cities. Adapted from Australian Bureau of Statistics.[xiv]



Potential Policy Changes for Arvin:

Short term:

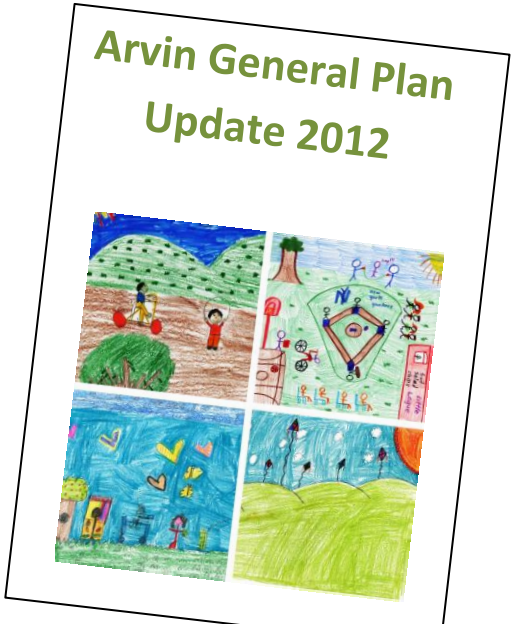
- Water use efficientcy (e.g. Building Code)
- Water restrictions phased in (no potable water for landscaping
- Conservation and sustainable practices

Long Term

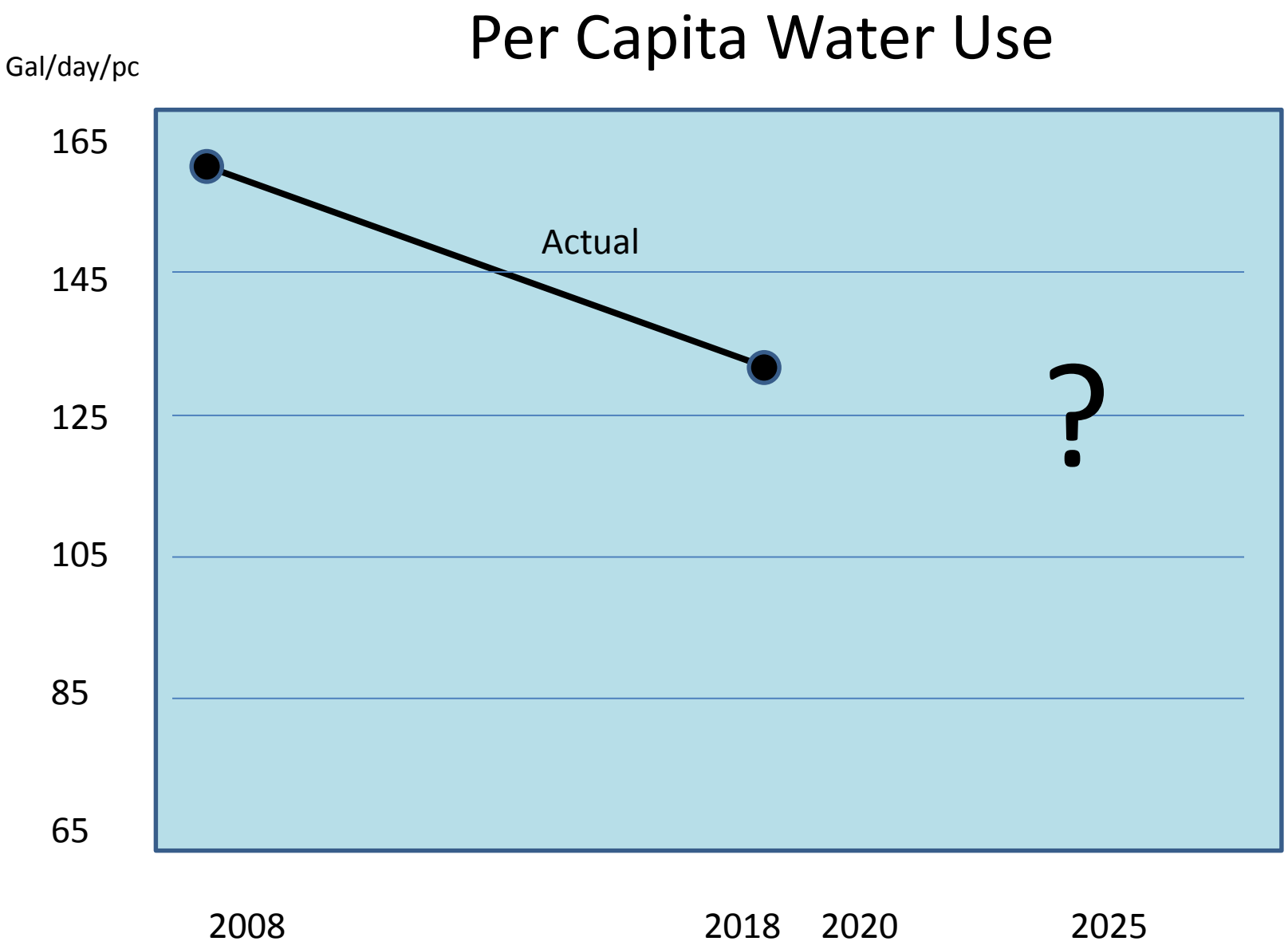
- Multi discipline/multi benefit
- Infrastructure Projects:
- Streets
- Storm drainage
- Recycling/wastewater
- Parks
- Bike paths
- Private development

Arvin is projected to grow 30% each decade.

Will double in size in 30 years



Arvin Water Data



Lesson 2

Collaborate using multi discipline/multi benefit projects to create efficiency and water resilience

- Plan integrated projects that maximize rainwater, storm water and recycled water resources

- Use Low Impact Development designs

  - Lower cost
  - Address NPDES
  - Recharges Aquifer

Traditional Storm Drain Design

Low Impact Development design

Arvin

- Storm water
- Wastewater
- Potable Water
- Vehicle Circulation
- Pedestrian circulation
- Water quality (arsenic)
- Air quality
- Urban heat islands

- Development management team emphasis
- Multi-discipline / multi-benefit / multi fund

14-0748

ENERGY & ENVIRONMENT

JUN 6 2014

MOTION

Streets convey not only automobiles and pedestrians but also water. When it rains, water flows from the street into catch basins and storm drains that then divert the runoff into our local tributaries, rivers and ocean. In the process, street pollution contaminates waterways, and stormwater that could be captured and reused is discharged into the ocean.

This system presents a number of challenges for the City of Los Angeles (City). First, it does not sufficiently address runoff pollution, which the City is mandated to mitigate. The City currently must satisfy 22 Total Maximum Daily Load (TMDL) regulations as part of its Municipal Separate Storm Sewer System (MS4) Permit. Failure to comply with the permit could result in extensive financial penalties.

Second, the current system fails to capitalize on stormwater capture and groundwater infiltration opportunities. Local efforts to bolster our local water supply, particularly in this time of drought, are necessary in order to meet the Mayor's goal of reducing City water imports by half.

Finally, it does not adequately protect against flooding. There are more than 400 known locations that have drainage problems causing localized flooding in our neighborhoods and exposing our residents, motorists, and bicyclists to potential safety hazards. In addition, poor drainage and chronic flooding can damage and undermine street pavement.

Incorporating Best Management Practices and green street infrastructure such as bioswales, curb cuts, and tree wells can mitigate a number of these concerns by infiltrating water where appropriate and removing contaminants from polluted water before discharge.

To achieve this, the Bureau of Street Services, Bureau of Sanitation, Bureau of Engineering, and the Department of Water and Power would need to collaborate and develop green infrastructure projects that provide multi-benefit solutions.

An estimated 2,400 centerline miles are currently failing or near failing. A new approach to capital expenditures should be pursued to maximize the public investment in infrastructure as opposed to today's patch-work approach.

City policy should prioritize multi-benefit solutions that improve transportation and safety, minimize flooding, reduce watershed pollution, and increase stormwater capture and local water supply. A multi-benefit approach also necessitates a review of current departmental performance metrics to better measure the efficiency and effectiveness of such projects.

I THEREFORE MOVE that Council instruct/request the Bureau of Street Services and the Bureau of Sanitation, in conjunction with the Bureau of Engineering, Department of Water and Power, Chief Legislative Analyst and the City Administrative Officer, to work with the City Attorney to develop a draft ordinance that requires all public street construction and reconstruction projects, irrespective of funding source, to incorporate *Stormwater Management Guidelines for Public Street Construction and Reconstruction* (as attached) consisting of the following components:

- Drainage capacity/flood mitigation;
- Stormwater infiltration feasibility;
- Water quality improvement and regulatory standards.

I FURTHER MOVE that the Bureau of Street Services and Bureau of Sanitation report to the Council in 45 days on the status of the working group and draft ordinance development.

PRESENTED BY: FELIPE FUENTES
Councilmember, 7th District

SECONDED BY:

JUN 6 2014

ORIGINAL

City of Los Angeles

Stormwater Management Guidelines for Public Street Construction and Reconstruction

t construction and reconstruction projects in the City of Los Angeles will utilize Best Management Practices and n street infrastructure standard plans to assess drainage, stormwater infiltration, and water quality needs. Street ojects will be coordinated among city departments to ensure efficiencies in implementation and will utilize Best Practices when appropriate.

of Streets

prioritizing street construction and reconstruction will give a weighted score to street segments based on criteria that owing:

ng/drainage deficiencies

water infiltration and/or capture feasibility for water supply augmentation

quality deficiencies required to be remediated under the City's Municipal Separate Storm Sewer System permit or to other regulations or community needs.

Infrastructure Implementation

anitation will review all street construction, reconstruction, and resurfacing projects and work with the Bureau of Bureau of Engineering, and the Department of Water and Power to incorporate green street infrastructure as

on or reconstruction project on a street segment with low to moderate flooding, staff will analyze the stormwater bility of the location based on its soil permeability, groundwater levels, slope, and contamination. Staff will rmwater should be captured onsite or treated and discharged and identify appropriate green infrastructure he Best Management Practices Tool Box. Treat and discharge practices (Tool Box 2) will only be utilized if infiltration re demonstrated as infeasible. All projects will be required to follow infiltration standards as determined by the tion, with the performance goal of infiltrating or capturing for use, at a minimum, the 85th percentile storm. ards will aim to maximize infiltration and ensure protection of groundwater quality.

Best Management Practices Tool Box*	
Volume Capture (Tool Box 1)	Treat and Discharge (Tool Box 2)
b/parkway retrofits tration trenches tration galleries wells nfiltration/bioretention without underdrains erns er Storage BMPs	– Bioswales – Curb/parkway retrofits – Bioretention with underdrains – Treatment train of BMPs with biofiltration prioritized – Trees

s

Box is not an exhaustive list and will be updated by Bureau of Sanitation as new standard plans are developed.

ent with severe flooding, staff will first conduct a storm drain analysis prior to construction or reconstruction, and the above stormwater infiltration feasibility analysis. The analysis shall include the ability for upstream capture to npacts. When construction or reconstruction begins, the performance goal of infiltrating or capturing for use will the 85th percentile storm standard.

ing projects, departments will coordinate on opportunities to implement parkway Best Management Practices curb/parkway retrofits, and trees that could be implemented either in conjunction with street resurfacing or on rallel process through contracting or local grants.

This policy will produce multi-benefit projects that protect against floods, replenish local water supplies through groundwater infiltration and capture for use, mitigate water pollutants, and provide community enhancements.

Lesson 3

Diversify water sources to increase water system resiliency.

Diversified solutions were encouraged by stateide performance targets and tight regulation around water quality and public health.

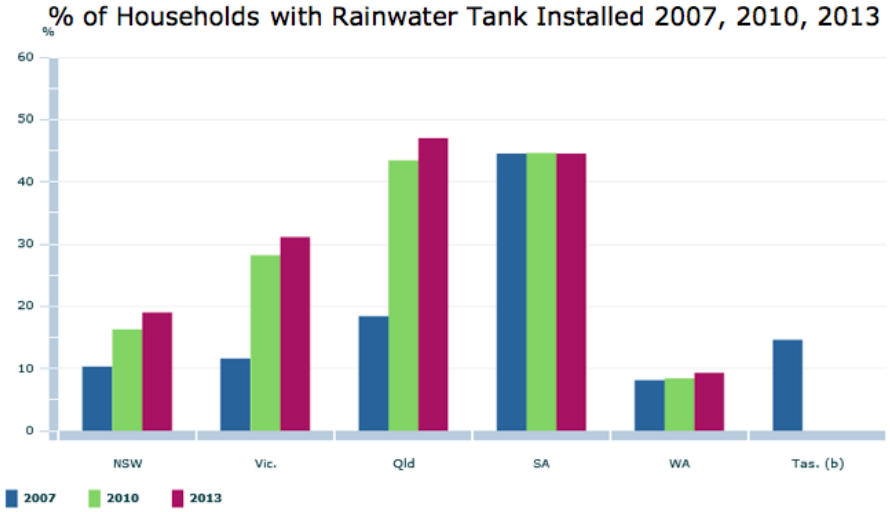
- Rainwater harvesting
- Stormwater capture and use
- Manage aquifer recharge

Diversify, then use “Fit for Purpose” approach

- Potable for drinking
- Manage aquifer recharge for irrigation
- Storm water capture for urban forest
- Rainwater capture for outdoor landscaping

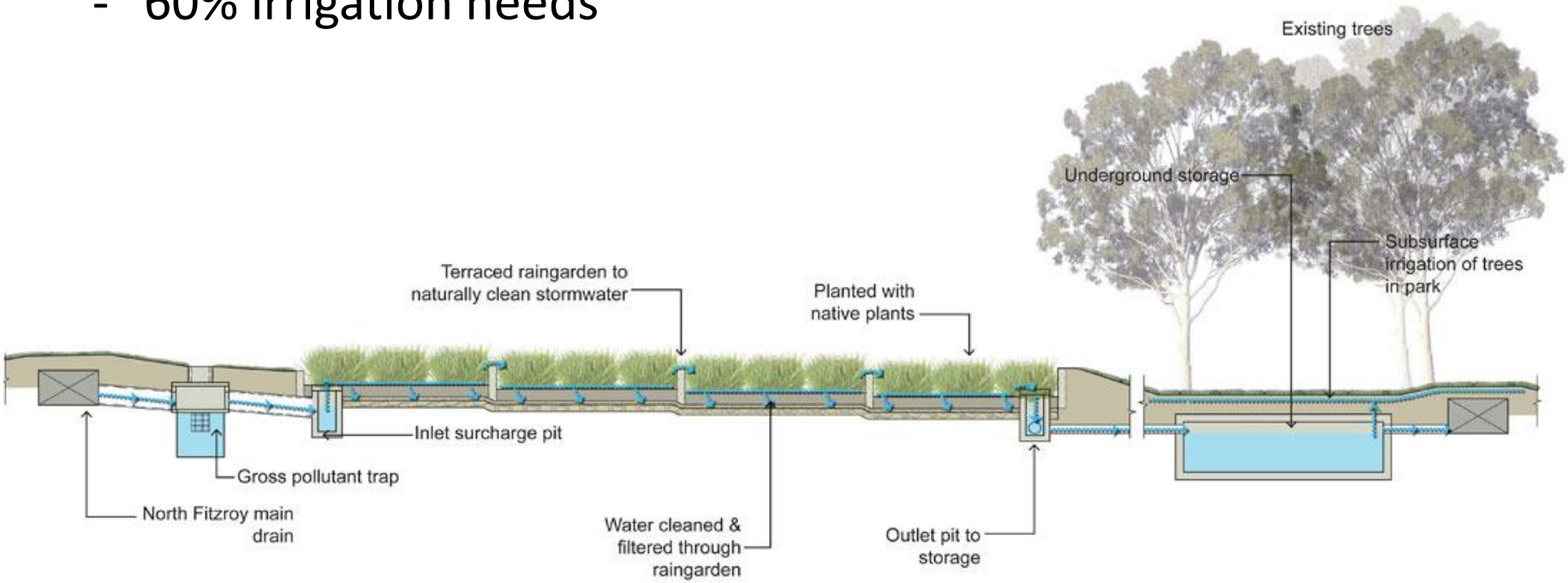
Rainwater harvesting (RWH)

- Severe water restrictions banned potable water for outdoor landscaping
- Public demanded incentives for RWH tanks and equipment (fave agencies mandate to invest in RWH programs
- End of drought = 50% of Adelaide household and 30% of Melbourne households



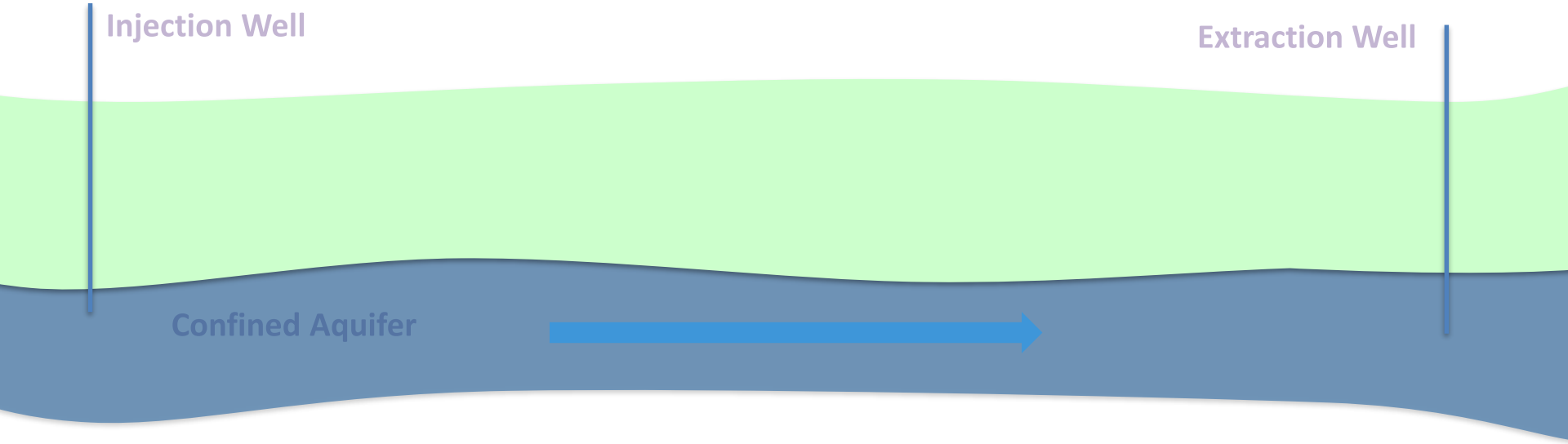
Stormwater capture and reuse – Edinburgh Gardens

- 1 million AUD
- Treated stormwater irrigates mature trees and sporting fields
- 200,000 liter (52,800 gallons)storage tank
- 60% irrigation needs



Managed Aquifer Recharge (Adelaide)

- Injects urban stormwater into aquifers to create freshwater reserves that are used for irrigation and non-potable water supplies throughout the city.



Trees as bioswales

Rain gardens

Lesson 4

Water scarecity issues are fundamentally tied to public health, safety and quality of life.

- Urban Heat Island

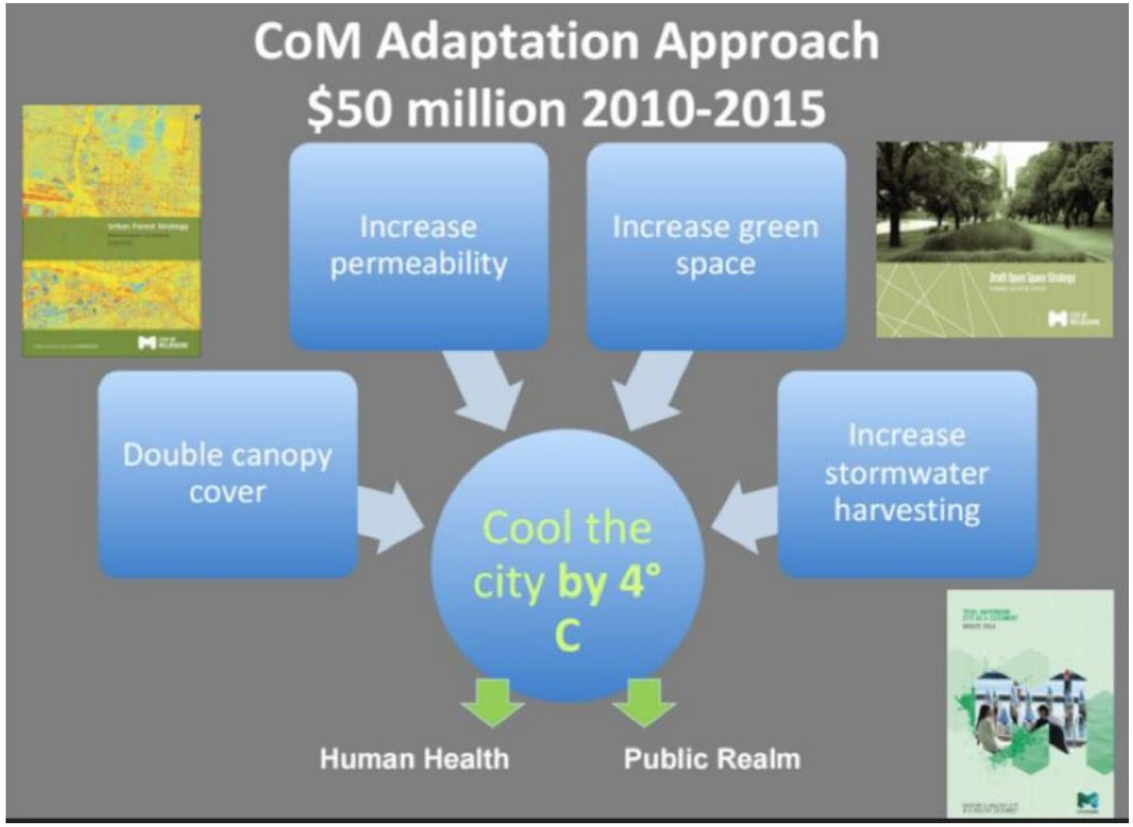
- January 2009 extreme heat events in Melbourne caused 62% mortality increase (980 deaths)
- Water restrictions had greatly reduced public green space and shade and urban heat island was exacerbated.

2004 2010

Adaption strategies

While drought restrictions were imperative on a citywide scale, the City learned a critical lesson; special attention must be paid to keeping public green spaces green, even during severe droughts.

Target: Cool the city by 7 degrees Fahrenheit



Cooling and Urban Heat Impacts Motion

R2

MOTION

ENERGY & ENVIRONMENT

City temperatures are expected to increase about 4 degrees Fahrenheit by mid-century due to climate change, according to research conducted by the Professor Alex Hall of the University of California Los Angeles. As a result, there will be more days of excessive heat each year. In the community of Sylmar, for example, there are currently 54 days a year that exceed 95 degrees Fahrenheit. Dr. Hall's research shows that by the year 2041, that number will increase to 96 days a year.

The expected increase in temperature is a concern, not just for the environment, but also for public health. Vulnerable populations suffer from heat-related deaths and illnesses each year. In Los Angeles County, 115 people were hospitalized due to heat in just a five-month period in 2012, according to the California Department of Public Health. Hotter temperatures can also increase the likelihood of brush fires, putting lives and property at risk.

The challenges presented by climate change are not unique to Los Angeles. Other regions are already working to address the negative consequences of a warmer world.

The Australian city of Melbourne has a goal to reduce the city's average temperature 7 degrees Fahrenheit by 2030. In response to a twelve-year drought, officials there increased the urban tree canopy to lower the city's surface temperature, created an open space strategy, and built centralized and distributed stormwater capture projects to water landscapes and trees using captured rain and to keep soil moisture high in urban areas. Such policies promoted livability and improved physical and psychological health in the face of drought and extreme heat.

As Los Angeles looks to become a more resilient city, it must mitigate the expected increase in temperature and take steps, like Melbourne, to reduce it. This calls for a coordinated strategy that can most effectively deploy resources in areas of the City where it is most needed.

A targeted campaign to cool the urban core would not only help to address the negative impacts of climate change, but also save lives and improve the quality of life.

I THEREFORE MOVE that Council instruct/request the Chief Legislative Analyst, in conjunction with the Department of Public Works, Department of Water and Power, Department of City Planning, and Department of Recreation and Parks to report in 45 days on the formation of a *Committee on Cooling and Urban Heat Impacts* comprised of relevant City departments, and experts in the field, to undertake the following objectives:

- Establish a cooling target for the City of Los Angeles;
- Identify regions within Los Angeles most vulnerable to excessive heat based on current and expected temperatures as well as deleterious air mass types; and current and historical data on heat-related deaths and illness;
- Recommend strategies for achieving the cooling target in Los Angeles; with a priority on strategies that will benefit communities that are identified as the most vulnerable to excessive heat;
- Develop guidance to protect livability and health, especially in drought situations, and identify public open spaces and corridors needed for cooling, including how to maintain such areas in drought situations.

PRESENTED BY: _____
FELIPE FUENTES
Councilmember, 7th District

SECONDED BY: _____

FEB 1 6 2015

ORIGINAL

How water scarecity in Arvin (and California) are tied to safety, health and quality of life.

FIRE SAFETY – numerous wildfires have lead to loss of life and property

HEALTH – Trees capture airborn pollution and clean the atmosphere

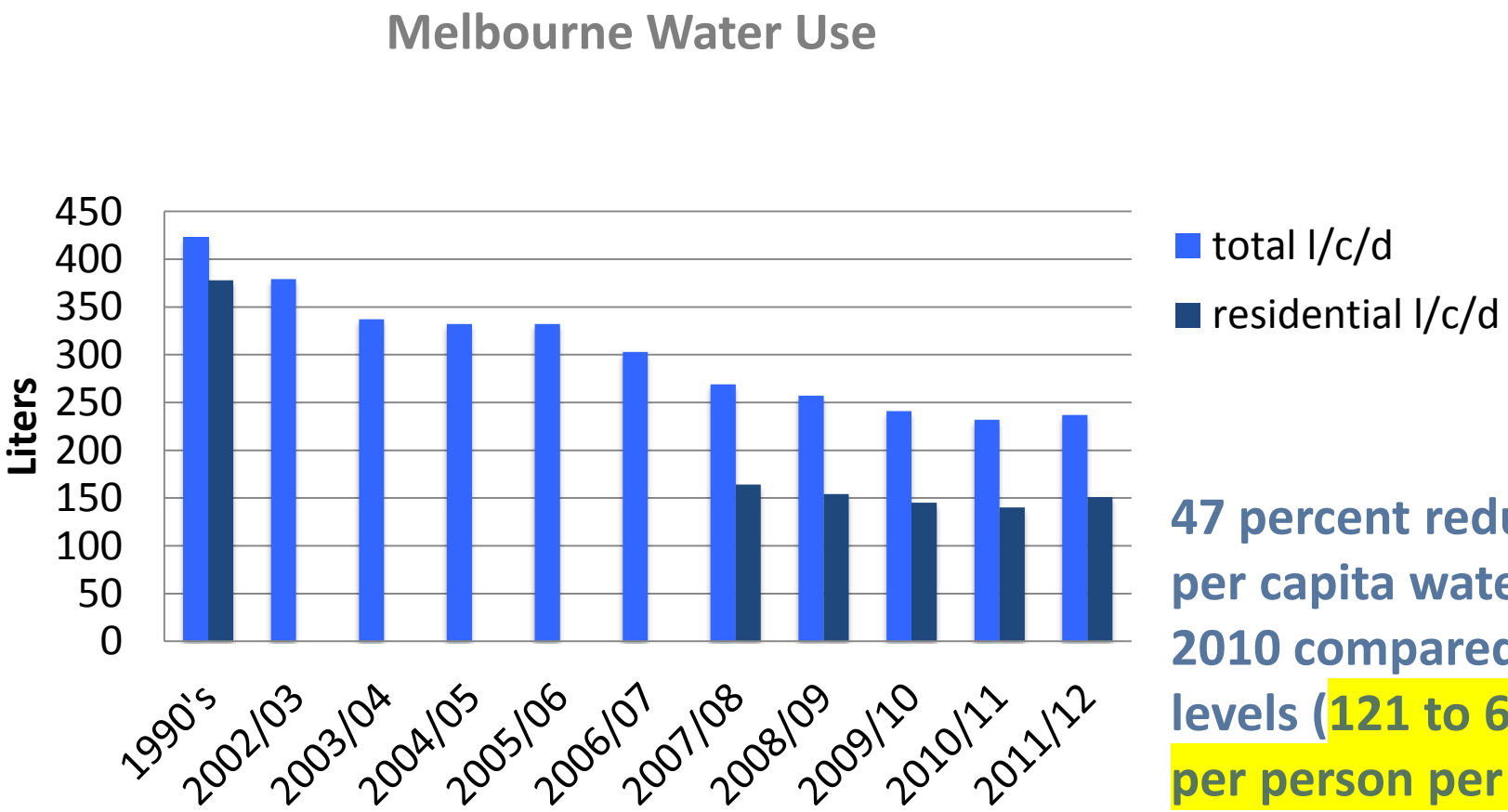
QUALITY OF LIFE – Conopy provides shade, relief from heat, and beautifies the city

SAVE TREES – INCREASE THE CANOPY

Figure 13: The City of Melbourne retrofitted hollow plastic road barricades into portable irrigation pods, filling them with rainwater or recycled water and connecting them to drip irrigation lines to save and protect the city's most valued heritage trees. Following Melbourne's example, in 2014 TreePeople worked with the City of Los Angeles Department of Recreation and Parks to test this method locally, deploying 'irricades' in several parks.

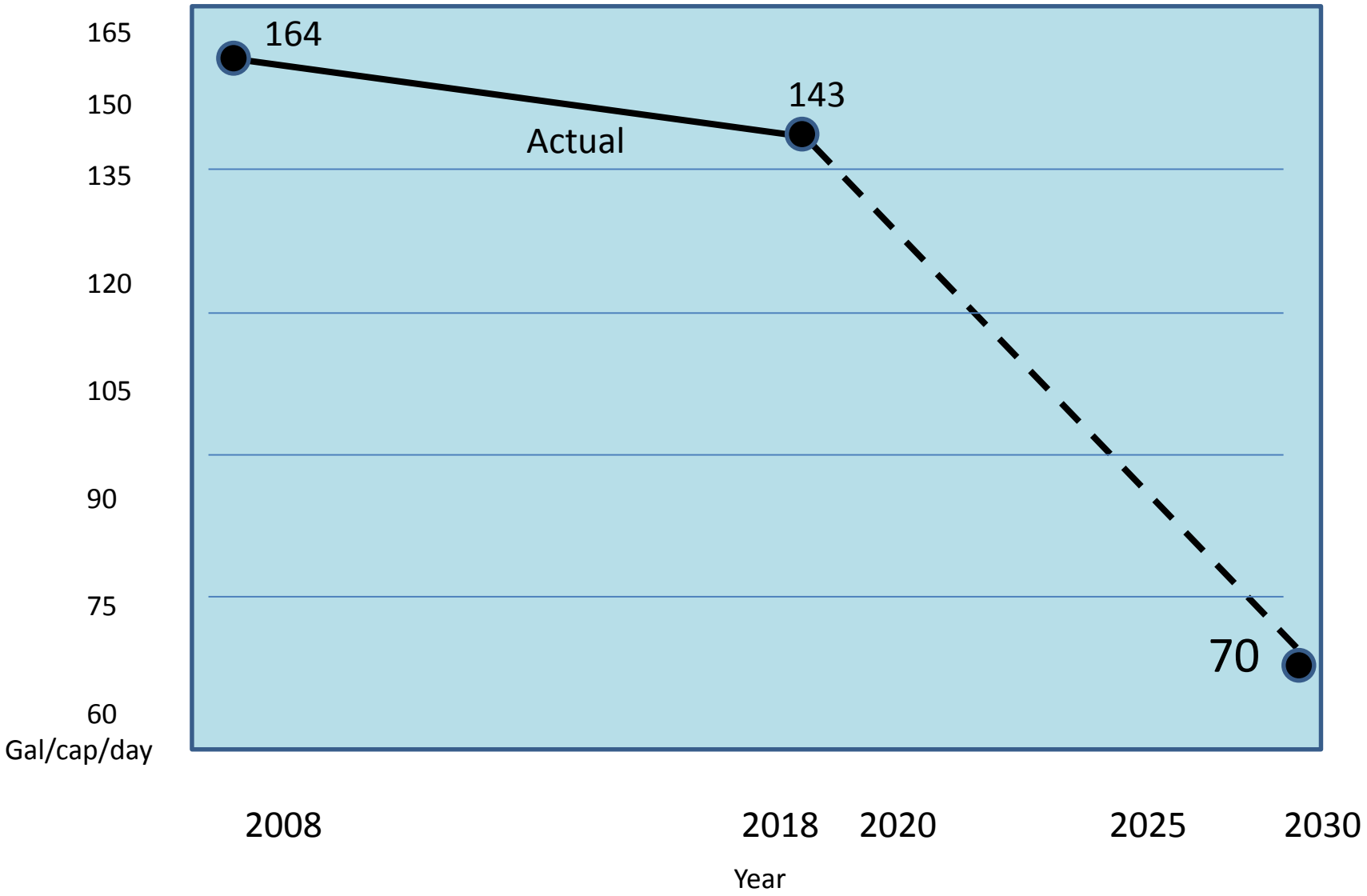
Lesson 5

Public behavior change programs around water conservation can be extremely effective



47 percent reduction in per capita water use in 2010 compared to 1990 levels (121 to 65 gallons per person per day)

Foster Sustainable water behavior in Arvin



To facilitate behavior change, use all the tools available

Establish an emotional connection to water.

Public education.

Rebates.

Coordinated and sustained mass media campaign.

Set aggressive targets

Sources City of Melbourne

Arvin's five Golden Goals

Goal 1

The urgency of drought represents a unique opportunity. The status quo is NOT acceptable. Therefore, we will implement new innovative strategies.

Goal 2

We will increase City department and inter-agency collaboration moving toward multi-disciplined, multi-benefit and multi-funding project.

Arvin's five Golden Goals (cont.)

Goal 3

We will diversify our dependence on sources of water and utilize a fit-for-purpose approach to water use.

Goal 4

We will protect our safety, health and quality of life during drought periods and as water resources become scarce;

Arvin's five Golden Goals (cont.)

Goal 5

We will create and use tools to foster sustainable water use behaviour by the public.

- Policies and implementation programs for the five Golden Rules to be developed.

- Questions and comments

RESOLUTION NO. _____

A RESOLUTION OF THE PLANNING COMMISSION OF THE CITY OF ARVIN RECOMMENDING APPROVAL OF THE ARVIN WATER RESOURCES ELEMENT TO THE ARVIN CITY COUNCIL

WHEREAS, The City of Arvin secured a Sustainable Communities Planning Grant from the California Department of Conservation in 2018, and

WHEREAS, said Grant was used by the City to prepare a Water Resources Element, an optional element of the Arvin General Plan, and

WHEREAS, said Element begins with the premise that managing the ground water system under Arvin so that it remains in a sustainable state is not only important to the City but also to the larger agricultural community because urban and agricultural uses "drink" from the same ground water system, and

WHEREAS, Arvin's economy and well-being, like most cities in the Valley, is tied to the local agricultural economy, and when agriculture suffers due to lack of imported water or falling water tables, Arvin also suffers – higher unemployment rates, reduced property and sales taxes, and higher crime rates, and

WHEREAS, grant funds were used to research and analyse water issues facing Arvin and the greater San Joaquin Valley, and

WHEREAS, the objectives of the Element were to provide a comprehensive and sustainable approach to managing Arvin's short and long-term water needs; coordinate with local stake holders, state water agencies, Veola and the Arvin CSD in the formulation of the Element's goals, policies and implementation strategies; and ensure the long-term viability of the ground water system that Arvin depends upon, and

WHEREAS, the Element fashioned five primary goals that would guide Arvin towards a more sustainable ground water system, which read as follows: (1) The urgency of drought represents a unique opportunity. The status quo is NOT acceptable. Therefore, we will implement new innovative strategies; (2) We will increase City department and inter-agency collaboration moving toward multi-disciplined, multi- benefit and multi-funding project; (3) We will diversify our dependence on sources of water and utilize a fit-for-purpose approach to water use; (4) We will protect our safety, health and quality of life during drought periods and as water resources become scarce; and (5) We will create and use tools to foster sustainable water use behaviour by the public; and

WHEREAS, the implementation of the above goals will be achieved by the following strategies, which read as follows: (1) Capture storm water by all means possible using multi-benefit designs; and then use that storm water to achieve multiple benefits; (2) Coordinate with Viola to expand and distribute reclaimed waste water to multi- benefit projects including parks and agricultural lands; (3) Require all infrastructure projects to achieve multi benefits and cost efficiencies including: expanding grant funding possibilities and utilization of multiple funding sources; and (4) Create an Urban Forest in order to achieve multi benefits including: storm

water capture, aquifer recharge, storm water peak flow control, urban heat reduction, and mitigation of health issues resulting from dust and air pollution, and

WHEREAS, the Planning Department has prepared a staff report and environmental finding for the Arvin Water Resources Element, and

WHEREAS, adoption of the Arvin Water Resources Element, an optional element to the Arvin General Plan, is exempt from the California Environmental Quality Act Guidelines, pursuant to Section 15061(b)(3), which finds that this Element constitutes a planning study on the topic of water management in Arvin and any future water projects including but not limited to water lines, pumps, and storage facilities; waste water treatment facilities; water treatment facilities; or water storage facilities shall require CEQA compliance on the actual facilities proposed to be constructed, and

WHEREAS, a public hearing notice on this matter was published 10 days prior to the Planning Commission's public hearing on this matter, and

WHEREAS, a public hearing was held by the Planning Commission on this matter; and

WHEREAS, the Planning Commission reviewed the Arvin Water Resources Element, the staff report prepared on said Element and considered public testimony provided on the Water Resources Element; and

WHEREAS, the Planning Commission now desires to recommend the City Council adopt the proposed Water Resources Element.

NOW, THEREFORE, BE IT RESOLVED that the Planning Commission as follows:

1. The Arvin Water Resources Element will effectively guide Arvin's decision-making on matters of water management.

2. The Arvin Water Resources Element will assist the City in formulating a 5-year capital improvement program for road, storm drainage and water system improvements.

3. The adoption of the Arvin Water Resources Element will not have an adverse impact on the environment and is categorically exempt under CEQA. The Planning Commission assessed the adoption of the Arvin Water Resources Element, an optional element to the Arvin General Plan, and recommends the City Council determined the project is exempt from the California Environmental Quality Act Guidelines, pursuant to Section 15061(b)(3), as the adoption of the Element will not result in significant, adverse effects on the environment. This Element is a planning study on the topic of water management in Arvin and any future water projects including but not limited to water lines, pumps, and storage facilities; waste water treatment facilities; water treatment facilities; or water storage facilities. Actual construction or other operations shall require CEQA compliance on the actual

facilities proposed to be constructed once those facilities become known and assessable.

4. The adoption of the Arvin Water Resources Element will not have an adverse impact the public health, safety or welfare, and is consistent with the overall goals, policies and objectives of the Arvin General Plan.

5. The Planning Commission recommends approval of the Arvin Water Resources Element to the Arvin City Council.

I HEREBY CERTIFY that the foregoing Resolution was passed and adopted by the Planning Commission of the City of Arvin at a regular meeting thereof held on the 19th day of March 2019, by the following vote:

AYES: _____

NOES: _____

ABSTAIN: _____

ABSENT: _____

ATTEST:

_____
CECILIA VELA, Secretary

ARVIN PLANNING COMMISSION

By: _____
JANETT ZAVALA, Vice Chairperson

APPROVED AS TO FORM:

By: _____
SHANNON L. CHAFFIN, City Attorney
Aleshire & Wynder, LLP

I, _____, Secretary of the Planning Commission of the City of Arvin, California, DO HEREBY CERTIFY that the foregoing is a true and accurate copy of the Resolution passed and adopted by the Planning Commission of the City of Arvin on the date and by the vote indicated herein.

Arvin Water Resources Element

Arvin Water Resources Element

And it never failed that during the dry years the people forgot about the rich years, and during the wet years they lost all memory of the dry years. It was always that way.

- East of Eden, John Steinbeck

Prepared for

City of Arvin

Prepared by

COLLINS & SCHOETTLER
PLANNING CONSULTANTS
URBAN PLANNING • PLANNING POLICY • DESIGN REVIEW

Jim Holloway Consulting

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Executive Summary

California's richest agricultural region is located in the San Joaquin Valley —a region stretching from the confluence of the Sacramento and San Joaquin Rivers (San Joaquin Delta) in the north to the Tehachapi Mountains in the south. The agricultural economy of this region is especially dependent on a ground water system (aquifer) that underlies the Valley, as is the City of Arvin and the other 57 cities in the Valley, which depend upon it for domestic uses.

Figure No. 1: A satellite image of the San Joaquin Valley. Arvin rests at the southern end of the Valley, 10 miles east of State Highway 99.

Arvin, population 21,696, is located at the southern end of the San Joaquin Valley, between State Highway 99 and the southern extension of the Sierra Nevada. Arvin's domestic water is provided by the Arvin Community Services District (ACSD) that secures its water by pumping from the local ground water system. Helping to maintain that ground water system is the Arvin-Edison

Water Storage District (AEWSD), which imports water to the region via the Friant-Kern Canal and the California Aqueduct.

The San Joaquin Valley is a global agricultural powerhouse. Valley farms produce half of California's total farm output—including most of its fruits, nuts, dairy, vegetables for processing, and livestock feed. These farms are major suppliers to national and international markets.

The Valley's farms and related manufacturing businesses account for 25 percent of the region's revenues, 16 percent of its jobs and 89 percent of its annual net water use. In Arvin, 52 percent of its labor force is employed in agriculture. Farming and related businesses are an important economic driver in the Valley, which is now home to more than four million people most of which live in the Valley's 58 cities.

The Valley faces significant challenges - high rates of unemployment and pockets of extreme rural poverty; public health challenges resulting from unsafe drinking water and poor air quality; and diminishing ground and surface water resources, which have resulted from excessive ground water pumping, climate change, conversion of crop types from field crops to permanent plantings (e.g. citrus, nuts, vines and stone fruit), increasing demand for surface water from urban water users in Southern California and regulatory actions that have reduced exports from the Delta.

The Valley's latest drought (2012 to 2016) underscored the region's vulnerability to long-term declines in groundwater reserves. The "drought" has led to increased well pumping costs, dry wells, fallowed land, land subsidence, and the declining reliability of domestic water systems especially for the numerous rural communities that are scattered throughout this region. For example, in East Porterville in Tulare County, which relied on shallow wells for their domestic water, a recent drop in ground water depths led to over 4,000 residents being without water for an extended period of time. If not for the City of Porterville and financial assistance from the State, residents in this unincorporated area would still be without domestic water.

The Valley's crop growing conditions are favorable so long as water is available to irrigate crops during the long, dry summers. Local water supplies are limited in much of the region, especially in the southern half of the Valley, due to the low precipitation in the winter and spring months and the dependency on imported water from wetter regions to the north.

For many decades, many farms have depended on water imported from the wetter Northern California through the Sacramento–San Joaquin Delta and from the Friant-Kern Canal that derives its water from the San Joaquin River watershed. In many parts of the Valley, water imports have not reduced the long-term reliance on the Valley's ground water system. In fact, throughout the Valley, ground water pumping by farming and urban interests has exceeded that system's ability to replenish itself, thereby causing water table levels to drop and land to subside in certain isolated areas. In Arvin, water table levels have remained relatively stable due to the efforts of the Arvin-Edison Water Storage District, which has been an effective importer of surface water via the Friant-Kern Canal.

"Water stress" has been on the rise among farmers and water providers in the San Joaquin Valley. Regulatory actions have reduced Delta water and Millerton Reservoir exports that supply water to Friant contractors like Arvin Edison. In addition, drought, climate change and regulatory actions in the Delta, which serve to protect threatened and endangered marine life in the Delta environs and minimize salt water intrusion, have infused the discussion on water with terms like change, sustainability, collapse, tipping point, and worry.

With so many changes underway, major questions loom about the future of the Valley's agriculture and the broader consequences for the region's economy, society, and environment. With the recent defeat of California's Proposition 3 (an $8.877 billion bond measure that could have been used for water projects and habitat restoration) in November of 2018, ground water resources in Arvin and the greater Kern County will continue to be under significant pressure. Proposition 3 would have provided funds to "fix" the Friant-Kern Canal south of the Tulare/Kern County line where land under the Canal has subsided which has reduced its capacity to convey water to the Kern County region.

This Element begins with the premise that managing the ground water system under Arvin so that it remains in a sustainable state is not only important to the City but also to the larger agricultural community, because urban and agricultural uses "drink" from the same ground water system. Arvin's economy and well-being, like most cities in the Valley, is tied to the local agricultural economy. When agriculture suffers due to lack of imported water or falling water tables, Arvin also suffers – higher unemployment rates, reduced property and sales taxes, and higher crime rates. This Element will not solve the Valley's agriculture/water dilemma, however, there are tools and strategies mentioned in this document that do lay a foundation for potential solutions.

The issue of water in the Valley is complex, controversial and political. In order for the reader to better understand this issue, this report will provide extensive amounts of background material, located in the Appendices, on water so that more informed decisions on the topic can be made going forward.

While it is important to understand the big picture, which provides context, it is at the local level where action is most effective. In the case of the City of Arvin, the City Council sets policy and controls the budget. Staff implements that policy. The combined efforts of clear policy direction and consistent implementation of policy can create powerful and positive change in Arvin.

With the preparation of this Element, and discussion with various stakeholders, the Consultant has learned that there are several major issues facing Arvin related to water management. Those issues include: planning for droughts, water supply, water quality, flood mitigation, urban heat island effects, air quality, budget and SGMA (ground water regulations).

After study, two very powerful ideas surfaced. First, many of the solutions to water issues, which is the subject of this Water Resources Element, are also good solutions for mitigating the other Arvin issues discussed above. Second, the solutions to these issues and problems, when fully implemented, could save hundreds of thousands of dollars for Arvin's general fund.

These issues and ideas are discussed in the chapter titled "Lessons Learned and Arvin". Following that chapter is the actual Water Resources Element, which includes five "Golden Goals", policies and implementation programs which will advance Arvin's Vision and Mission Statement, provide a higher "quality of life" in Arvin, and save hundreds of thousands of dollars for Arvin's general fund (see discussion on page 42).

Introduction

Collins & Schoettler, Planning Consultants, was selected to prepare a Water Resources Element for the City of Arvin. The preparation of this Element began with collaboration with state water agencies, Arvin-Edison Water Storage District (AEWSD), Arvin Community Services District (ACSD), Veola (the private contractor for the management of Arvin's waste water treatment facility) and city contract employees (city planner and engineer). The Consultant also reviewed water literature from early California water history to the Sustainable Groundwater Management Act (SGMA), and from California water law to publications describing how other countries have managed their water resources.

Guiding the Consultant's work in the preparation of this Element was the Arvin City Council's vision for the City of Arvin (established on March 28, 2015), which reads as follows:

"Arvin is safe, healthy, vibrant, and economically diverse with a sense of community and where quality of life is valued."

During the Council's work session, a mission statement was also crafted. This mission statement reads as follows:

Our mission is to provide responsive, quality service to our community; maintain an accessible, safe, healthy, environmentally sound and culturally rich city; drive innovative solutions; create a partnership between the community and its government through respectful governance; and do so in an economically sustainable manner.

The management of water in the San Joaquin Valley and specifically in the City of Arvin is very complex, controversial and challenging. For example, the Arvin Community Services District has had to treat its water for arsenic and 1,2,3 TCP (trichloropropane), both of which require costly mitigation treatments, while simultaneously ensuring that the District's system is free of leaks, maintains proper water pressure and allows for future urban growth.

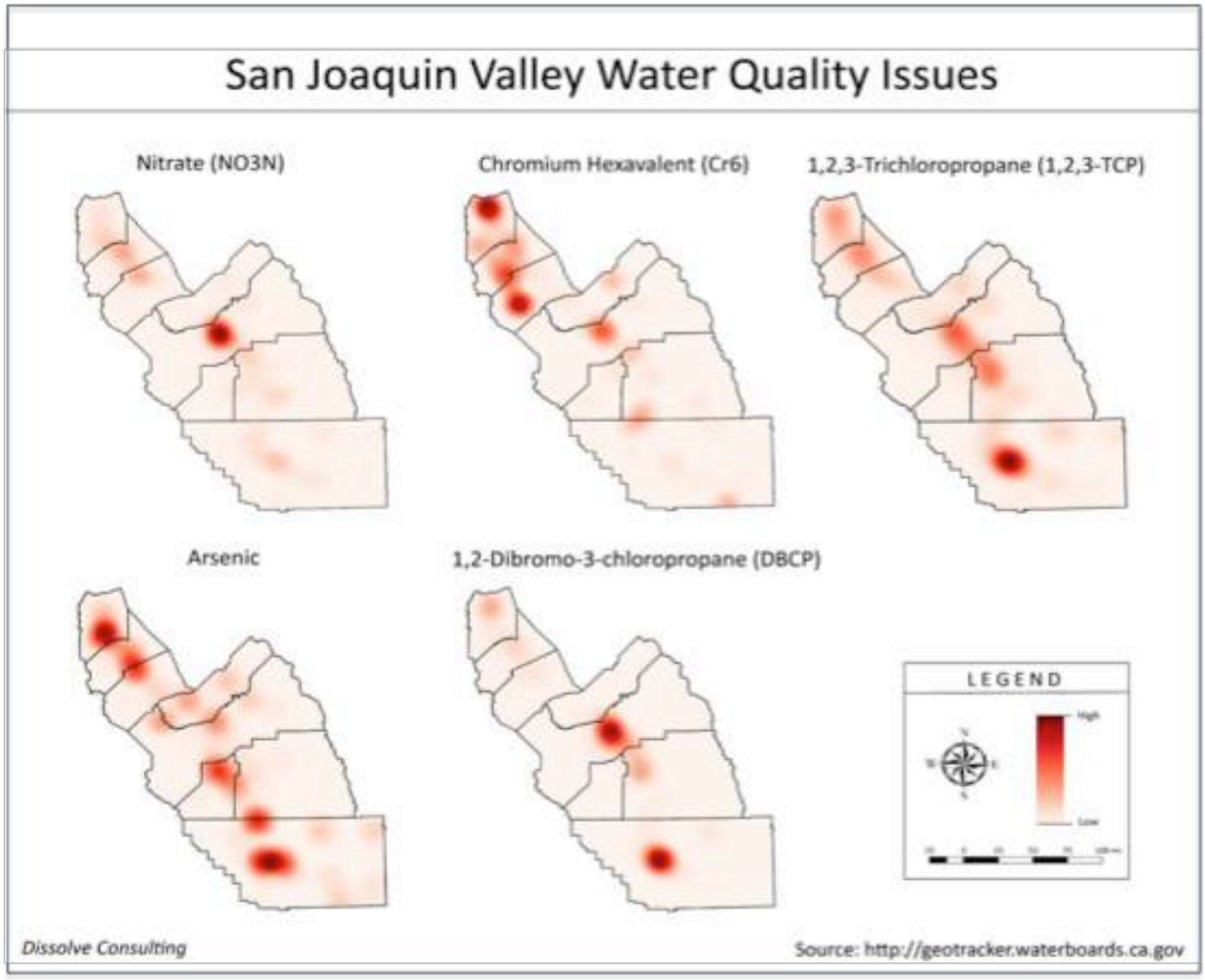


Figure No. 2: Valley cities and communities are subject to numerous contaminants some of which are naturally occurring and some the result of agricultural applications. Often disadvantaged communities (DACs) run into well contamination because their wells are shallow and must be extended deeper to avoid chemical contamination.

The health, safety and quality of life of residents in Arvin is closely tied to a sustainable and reliable domestic water source that is safe for drinking, bathing and outdoor irrigation. Further, water is important to Arvin's economy because of its close association with agriculture.

In the San Joaquin Valley water comes from two sources: ground water (aquifer) and surface water (imported and native). In the case of Arvin, ground water is its sole source of domestic water. This is the case for most cities in the Valley, however, there are some cities (Avenal, Orange Cove, Fresno and Lindsay) that utilize treated surface water from the California Aqueduct or the Friant-Kern Canal.

In the San Joaquin Valley there are a myriad of issues related to water including, quantity, quality, land subsidence, cost, distribution, storage, water rights, environmental quality, and of course, politics. If these issues were not enough, it gets more complicated because the regulation and management of water in the San Joaquin Valley is divided among three federal agencies (Bureau of Reclamation, Army Corps of Engineers, U.S Fish and Wildlife), five State agencies (Department of Water Resources, Water Resources Control Board, Department of Health Services, Department of Food and Agriculture and the Department of Fish and Wildlife), eight counties, 58 cities, and hundreds of smaller water-related entities including irrigation districts, ditch and mutual water companies, private and public water companies, and community services districts.

The Consultant will focus primarily on water issues specific to Arvin but notes that water strategies tailored for Arvin are transferable to the other 58 cities in the San Joaquin Valley. Further, the Consultant realizes that no city is an "island" and that water management decisions for the San Joaquin Valley, including the Central Valley Water (CVP) Project, the State Water Project (SWP) and the Arvin-Edison Water Storage District (AEWSD) can also have implications for Arvin.

Rather than attempting to solve all the water problems in the San Joaquin Valley, the Consultant has focused on the City of Arvin. However, this has not prevented the Consultant from wading into water issues in the greater San Joaquin Valley.

In order for the Consultant to focus on Arvin's water issues, five "Golden Goals" have been established for the city's Water Resources Element.

FIVE GOLDEN GOALS FOR ARVIN'S WATER RESOURCES ELEMENT

1. *When the status quo is NOT acceptable, this presents an opportunity to implement new innovative strategies.*
2. *Collaborate on and utilize multi-disciplinary/multi-benefit strategies on public and private projects*
3. *Diversity dependence on water sources*
4. *Protect safety, health and quality of life during drought/climate change*
5. *Foster sustainable water use behavior by the public*

Water issues for urban and agricultural users are distinctly different but, in some cases, the same - not enough water. Agriculture needs its water during the growing season while urban users need it throughout the year but more during the summer months when outdoor irrigation takes place.

According to the Water Association of Kern County (WAKC), 93 percent (2,294,000 ac. ft.) of the county's water is used for agriculture while urban uses consume the remaining 7 percent (166,000 ac. ft.). The sources of these waters are outlined in Table No. 1. The average annual percent of water from each source is dependent upon yearly weather conditions, which can have extreme ranges - droughts to floods

Table No. 1
Sources of Water in Kern County (average annual)

Kern River	20 percent
SWP (California Aqueduct)	26 percent
CVP (Friant-Kern Canal)	12 percent
local streams	6 percent
ground water	26 percent
TOTAL	**100 percent**

Source: Water Association of Kern County
Note: The City of Arvin receives all of its domestic water from ground water.

To clarify how urban and agricultural water users are interconnected, a description of Arvin's water system is as follows:

1. The Arvin Community Services District pumps water primarily for domestic use from the ground water system using a series of wells (Note: The District pumped 1,949 acre-feet of water in 2017.) The District has 4,000 connections and serves a population of 22,000 persons.

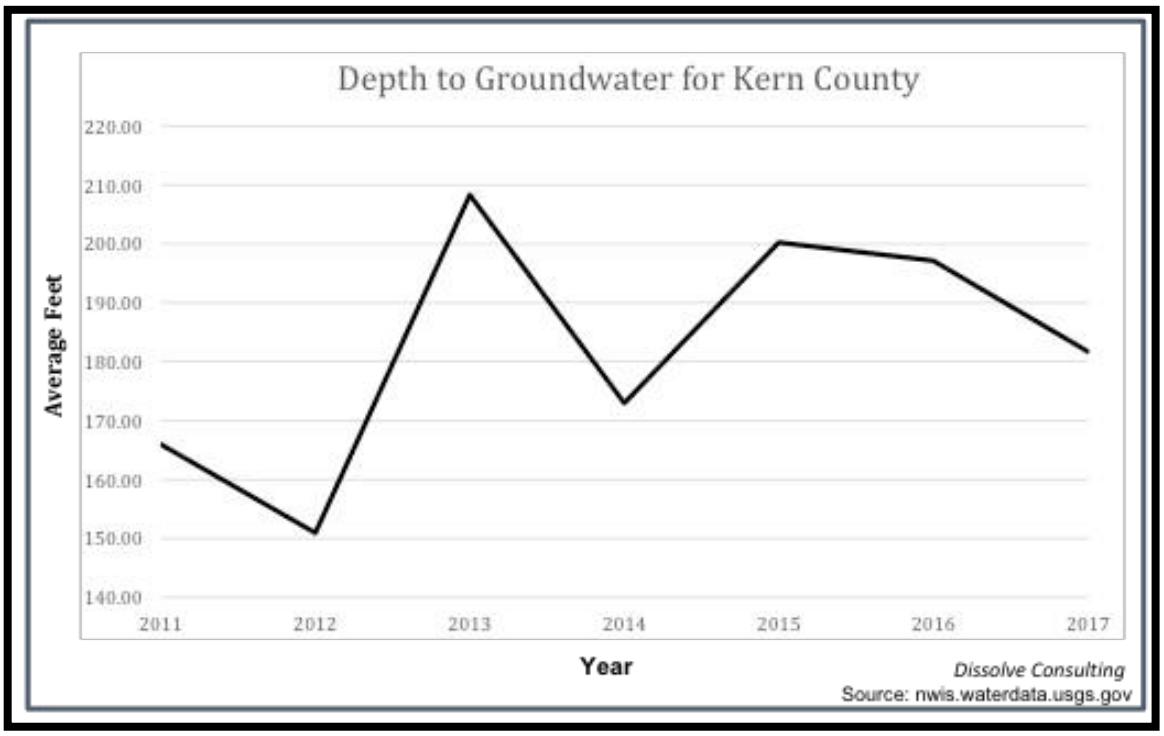
2. The ground water system under Arvin is managed by the Arvin-Edison Water Storage District for the benefit of its land owners. The District replenishes the ground water system by sinking water in its recharge basins (1,800 acres), which it receives from the CVP as well as in-lieu recharge with CVP water.

3. The Arvin-Edison Water Storage District (in addition to serving farmers in the District) also helps to ensure that the ground water system under Arvin remains in a sustainable condition. The District spreads water in its many basins when there is a "wet" year in the Valley.

In dry years farmers will pump ground water for irrigation because surface water being delivered to the District is limited. The District's system of "recharging in wet years and pumping in the dry years" has allowed Arvin to have an underlying ground water system that has escaped the major drops in ground water depth experienced by other cities throughout the Valley (Note: Between 1966 and 2002, AEWSD has imported 5.7 million acre feet of water from the CVP, and has

recharged approximately 1.6 million acre of water during this time period). Figure No. 2 shows that the water table under Kern County has remained fairly resilient throughout the Drought Years – 2012 to 2016.

Figure No. 3: Depth to Groundwater in Kern County



Even during drought years, the water table under most of Kern County remained stable.

4. The amount of water that AEWSD receives for "recharge" has recently been hampered by subsidence (resulting from over pumping of groundwater) along certain segments of the Friant-Kern Canal. Subsidence reduces the amount of water that can be conveyed to the District by this canal thereby reducing the amount of water it can recharge into the local ground water system, which in turn affects the ground water system under Arvin. Table No. 2 shows that the 858,000 acre-feet of water delivered down the Friant-Kern Canal in 2018 by the CVP could be in jeopardy due to subsidence along the Canal. During the drought years, CVP water deliveries along the Friant-Kern Canal fell from 928,007 acre-feet in 2009 to a low of 124,321 acre-feet in 2014, which was in the middle of California's five-year drought. Figure No. 4 shows areas in the San Joaquin Valley that are experiencing subsidence.

5. Politics (federal and state legislation) and regulatory action can also influence the amount of water diverted from the Delta for the State Water Project and the Central Valley Project. For example, the court ruling, which led to the San Joaquin River Restoration Program, requires a certain volume of water be released down the San Joaquin River. This reduced the amount of water that flowed south along the Friant-Kern Canal and subsequently the amount of water available for irrigation and recharge within the Arvin-Edison Water Storage District.

Table No. 2
Central Valley Water Project Water Deliveries

Central Valley Water Project Water Deliveries

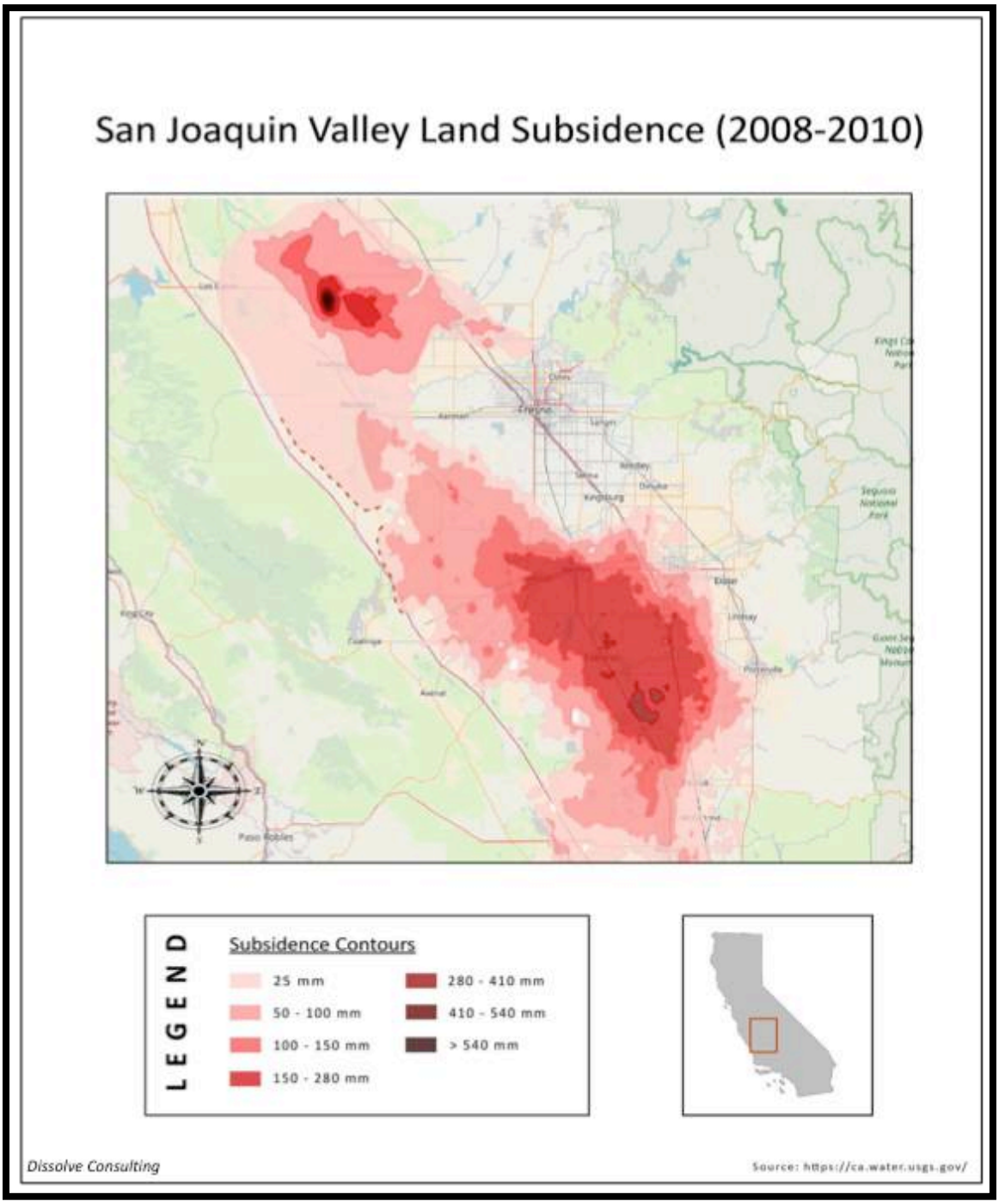
	2009	2014	2016	2018
CVP Total	4,900,789	2,937,198	5,568,511	7,070,216
North Delta	1,974,526	1,298,471	3,049,610	3,049,610
South Delta	1,297,960	968,325	1,335,902	2,237,606
Contra Costa in Delta	100,520	94,075	195,000	170,000
New Meiones East Side	599,776	452,006	0	155,000
East-Side Water Rights	0	0	600,000	600,000
Friant	928,007	124,321	388,000	858,000

Dissolve Consulting

Source: https://www.usbr.gov/mp/cvp-water/

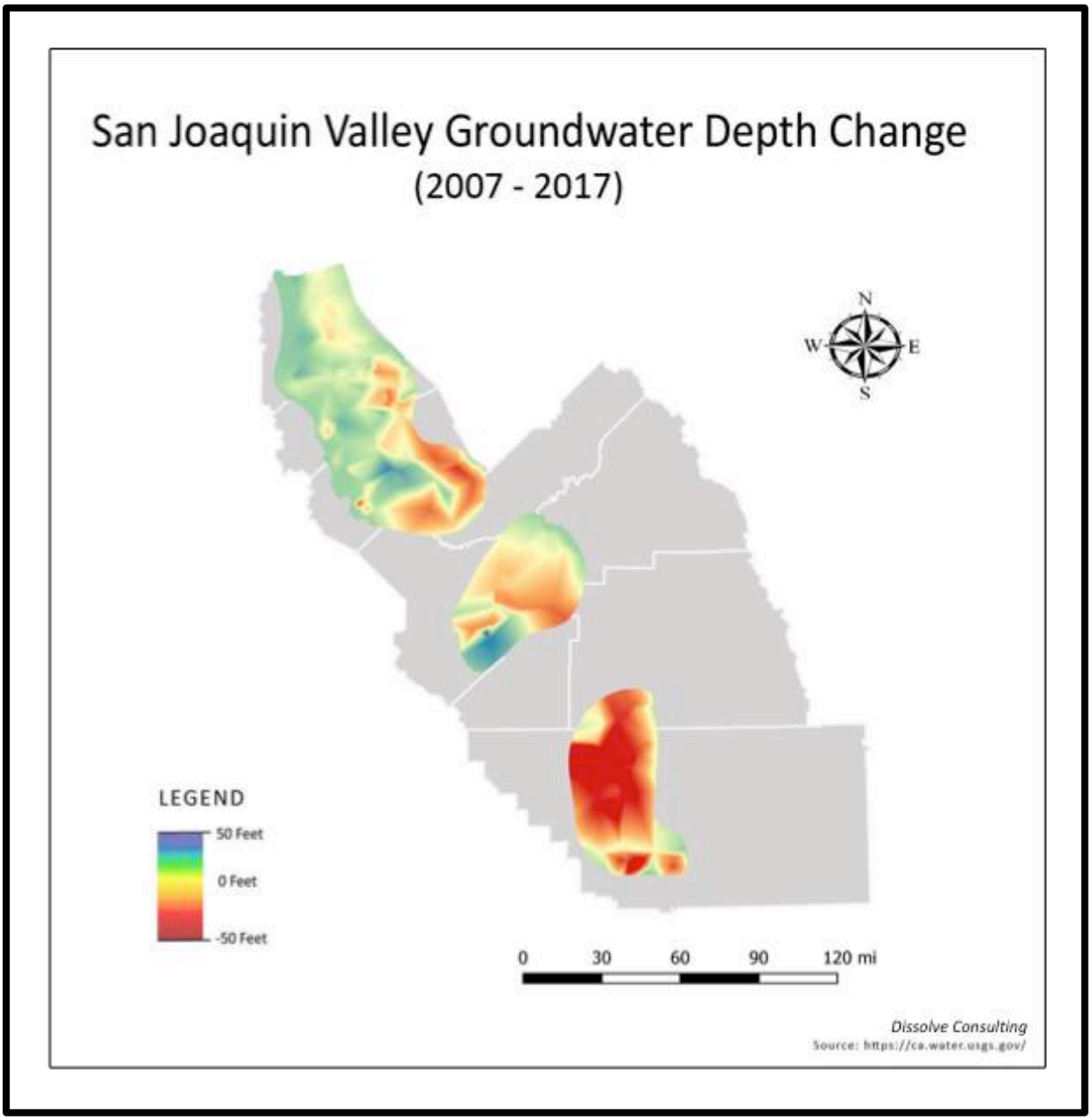
Source: United Stated Bureau of Reclamation

Figure 4: Land Subsidence in the San Joaquin Valley



Land subsidence along the southern reaches of the Friant-Kern Canal and California Aqueduct have reduced water deliveries to Kern County and the Arvin-Edison Water Storage District.

Figure 5: Groundwater Depth Change



Since 2007 and especially between the years of 2012 to 2016, the Valley's extended drought has caused water table depths to drop dramatically, especially in Kern County and southern Tulare County.

This Water Resources Element will provide tools (goals, policies and implementation strategies) for the City of Arvin and the Arvin Community Services District, which will contribute to sustainability and resiliency of the ground water system under Arvin.

Even with the construction of two monumental water projects - SWP (California Aqueduct) and CVP (Friant-Kern and Madera Canals); the construction of five federal reservoirs - Terminus Dam (Lake Kaweah), Friant Dam (Millerton Lake), Pine Flat Dam (Pine Flat Lake), Success Dam (Success Lake) and Isabella Dam (Isabella Lake); and the conservation efforts of hundreds of water agencies throughout the San Joaquin Valley, the Valley continues to suffer from an "overdraft" of its ground water system. These facts indicate that as currently managed, the Valley's ground water system is becoming less and less sustainable and could eventually collapse in the future.

The ground water crisis is not unique to the San Joaquin Valley. Cities in other countries and the American Southwest have had to contend with sinking water tables. These cities and communities have responded to this water crisis by adopting policies and strategies to overcome this crisis. "Lessons learned" from these entities will be incorporated into the Arvin Water Resources Element. It is not necessary to "reinvent the wheel" when other cities and communities have already fashioned reliable and tested water conservation strategies.

The Consultant has reviewed a number of case studies on how other cities and countries have managed their water resources, which not unlike the San Joaquin Valley, can be limited from year to year. Two case studies stood out:

Cities throughout Australia responded to a 12-year drought by embracing a multitude of water conservation strategies that markedly reduced per capita water consumption - Melbourne from 121 gallons per capita per day (gcpd) to 65 gcpd and Adelaide from 87 gcpd to 60 gcpd. These strategies are transferable to the City of Arvin as well as other cities in the San Joaquin Valley and will be discussed later in the next chapter, “Lessons Learned and Arvin.”

The second case study focused on the country of Israel. Their water management strategies are more applicable to the larger San Joaquin Valley. In Israel (population: 8,500,000), most of which is arid much like the San Joaquin Valley (population: 4,080,589), their entire history as a country (1948) has been devoted to utilizing their limited water resources efficiently - drip irrigation instead of flood or sprinkler irrigation, selected crops that are not high water users, and treatment of wastewater so that it can be utilized for crop irrigation. Today, Israel leads the world in

irrigation technology, much of which has been embraced by agriculture in the San Joaquin Valley.

Unlike the Valley, however, Israel formed a national system to manage the country's water resources, called the Israel Water Authority. This Authority promotes a national system that embraces redundancy and overlapping water supplies. The Authority promotes water conservation innovation, construction of desalinization plants, fixing leaky infrastructure, and formation of new companies that focus on irrigation and related technologies (e.g. Netafim). By contrast, the hundreds of water providers in the San Joaquin Valley have their own board, manager and set of policies.

The adoption of water-conserving irrigation technology in the San Joaquin Valley is evident in Table No. 3, which shows the trend from 1991 to 2010 regarding irrigation methods in the San Joaquin Valley. The Consultant suspects that the trend towards more water efficient irrigation methods have continued through 2018, especially given impending Sustainable Groundwater Management Act (SGMA) requirements.

For example, in the case of irrigation of almond orchards, micro sprinkler systems that are connected to satellite data are being used to manage irrigation water as compared to the traditional furrow irrigation approach. Today almonds require about 4 acre-feet of water per acre for irrigation but with more sophisticated satellite data, sprinkler design, and time management this irrigation requirement could be reduced.

Table No. 3 Trends in Irrigation Methods in the San Joaquin Valley, 1991-2010

Irrigation Method	**1991 (percent of acres)**	**2010 (percent of acres)**
gravity (furrow/flood)	67 percent	43 percent
sprinkler	17 percent	15 percent
drip, micro sprinkler	15 percent	39 percent
subsurface	<0.1	3 percent
Total	**100 percent**	**100 percent**

Source: DWR, California Water Plan Update 2013, Volume 3, Agricultural Water Use Efficiency.

According to the State Department of Water Resources (DWR), drip and micro-sprinkler irrigation systems are reported to have the highest irrigation efficiency (87.5 to 90.0 percent) when compared to furrow and gravity systems, (67.5 to 75.0 percent). In other words, improved irrigation technologies in the San Joaquin Valley should continue to mirror irrigation methods long used in Israel.

Lessons learned from Australian cities can be implemented by Arvin and other cities in the San Joaquin Valley. On a larger agricultural scale, Israel provides water conservation and irrigation strategies that are transferrable to San Joaquin Valley agriculture. These two water users, urban and agriculture, draw water from the same source - the Valley's ground water system. Therefore, they both benefit from a long-term water conservation strategy.

The Arvin Community Services District (ACSD), in collaboration with the City of Arvin, Veola and the Arvin-Edison Water Storage District, will be the primary beneficiaries of enhanced water conservation strategies recommended in this Element.

ACSD (the provider of domestic water to the City of Arvin) prepared their first Urban Water Management Plan in 2015. The State Water Resources Control Board, Division of Drinking Water, requires this Plan for all utilities that provide drinking water to the public. The Plan is designed to describe the District's water system; document the system's demands, supplies, and reliability; and detail for District residents the contingency plans for water shortages, contamination and water system deficiencies (e.g. leaky pipes; lack of backup generators, poor producing wells, and lack of pressure).

Table No. 4 below shows the District's water production and delivery statistics for the years 2001 to 2010 and 2017. Recently provided data from the District for 2017 shows that production and delivery numbers dropped to 1,949 acre-feet and 1,771 acre-feet, respectively, from higher acre-feet figures for 2010. According to the District, the differences between production and delivery may be due to two factors: pipe breaks and differences in the accuracy of the pump station metering and the individual service meters.

Table No. 4: ACSD Water Production and Deliveries

Historic			
Year	**Number of Connections**	**Water Production (Acre-Feet)**	**Water Deliveries (Acre-Feet)**
2001	2,624	2,578 afy	2,144
2002	2,758	2,686	2,256
2003	2,829	2,848	2,304
2004	2,892	2,885	2,302
2005	2,996	2,748	2,282
2006	3,194	3,010	2,501
2007	3,390	3,176	2,381
2008	3,448	2,903	2,398
2009	3,497	3,188	2,501
2010	3,446	2,946	2,299
2017	4,000	1,949	1,771

Source: Arvin Community Services District

Arvin's population in 2018 was 21,696 up 1.1 percent from 2017 (21,312). Since 2010, Arvin's population has been growing at an average annual rate of 1.3 percent. This is significantly slower than the decade from 2000 to 2010 when Arvin grew at an average annual rate of 4.9 percent.

Table No. 5 Arvin Population

	2000	2005	2010	2015	2018
Population	12,956	16,095	19,270	20,113	21,696

U.S. Census and State Department of Finance

While the population in Arvin increased 1.3 percent on average since 2010 (see Table No. 5), the District's totals for water production and delivery has decreased by 4.8 percent and 3.3 percent annually, respectively. The water production/delivery decrease could be attributable to a number of related factors including, a more water conservation-minded population, the Green Building Code and/or higher water rates, causing a reduction in consumption.

The best metric for accessing water conservation strategies is the gallons per capita per day (gpcd) figure. In 2013, Arvin's residents were consuming 152 gpcd. By 2018 that figure had dropped to 95 gpcd. In Arvin and the San Joaquin Valley, the month-to- month gallons per capita per day can range dramatically. In Arvin for example, during the winter months the water consumption is 45 gpcd (February); in the summer months when outdoor watering occurs this figure rockets to 106 gpcd (July) - a 135 percent increase!

Table No. 6
Residential Water Consumption by Cities in San Joaquin Valley

City	2013	2017
Arvin	**152 gcpd**	**95 gcpd**
Bakersfield	264	235
Bakersfield (Cal Water)	239	201
Clovis	246	205
Delano	114	84
Fresno	215	177
Hanford	140	82
Kingsburg	401	246
Madera	155	113
Merced	308	207
Modesto	249	184
Porterville	190	150
Shafter	187	156
Stockton	116	93
Tulare	201	182
Visalia	208	177

Source: State Water Board

The State Water Resources Control Board implemented conservation strategies for the entire State starting in July, 2014. The Board started a monitoring program for California's 361 water suppliers that provided domestic water to 93.5 percent of of the State's population. Water usage was documented by city and by hydrologic region. From May 2013 to May 2018, statewide water savings reached 20.2 percent.

The San Joaquin Valley exceeded statewide urban water conservation efforts during the years 2015 to 2018. It is important to note that the San Joaquin Valley, composed of the San Joaquin River and Tulare Lake basins, experienced significant groundwater overdraft conditions during this period of conservation. One could surmise that Valley residents responded to the State's call for heightened water conservation efforts due to their knowledge of the overdraft condition.

Table No. 7
Water Conservation by Percent in the San Joaquin Valley

	Year			
Hydrologic Region	**2015**	**2016**	**2017**	**2018**
San Joaquin River Basin	34.9 %	34.3 %	24.4 %	23.4 %
Tulare Lake Basin	31.5	31.1	23.1	18.3
Statewide	29 %	28.1 %	19.9 %	20.2 %

Note: Conservation measurements were documented during the month of May for each year. The above water conservation figures are based on a baseline figure for each basin as of May, 2014.
Source: State Water Board

Table No. 8
Water Consumption by Hydrologic Region

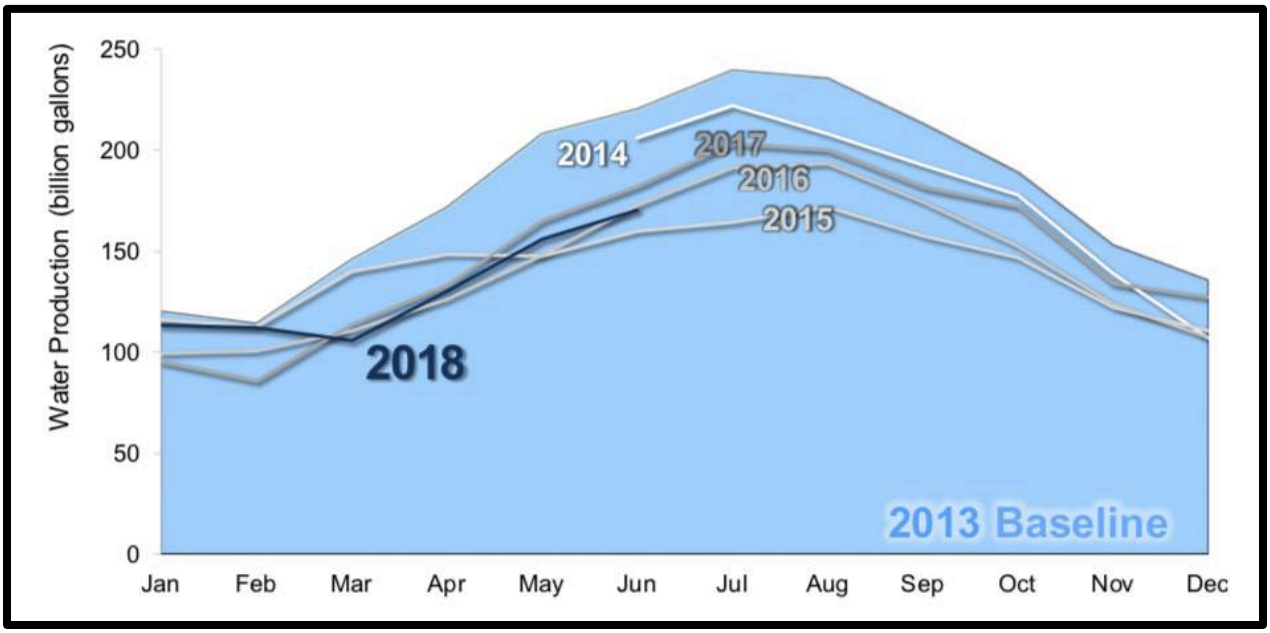
	Year				
Hydrologic Region	**2013**	**2015**	**2016**	**2017**	**2018**
San Joaquin River Basin	186	127	138	143	152
Tulare Lake Basin	220	155	167	182	184
Statewide	134 gcpd	98	105	111	109

Note: gcpd = gallons per capita per day
Source: State Water Board

Although the Valley responded well to the State's call for water conservation, it is apparent from Table No. 8 above that residents in the Valley typically exceeded the State as a whole in terms of gallons per capita per day (gcpd) water consumption.

Statewide water savings reached 16.8 percent in June 2018 (105,376 acre-feet, or 34.3 billion gallons) compared to June 2013 potable water production for the 360 suppliers reporting in both periods. The graph below shows the statewide urban potable water production from June 2014 through June 2018. For the 360 suppliers reporting for June 2018 (representing 93.4 percent of population served by urban water suppliers), the potable water production was 170.4 billion gallons (see Figure No. 6). The statewide water production in June 2013, for all 409 urban water suppliers, was 220.3 billion gallons.

Figure No. 6:
Water production for 360 statewide water producers by water production over time.



Source: State Water Board

Because the San Joaquin Valley has an arid environment (Note: by definition it is a desert) it would make sense that per capita water consumption should mirror the climatic conditions that Valley residents live under. In other words, Valley residents should have water consumption rates similar to other cities located in arid regions like the Southwest. For example, in 2015 Flagstaff consumed 116 gcpd; Tucson, 80 gcpd; Albuquerque, 127 gcpd; Sante Fe, 95 gcpd; and Phoenix, 108 gcpd. However, avoid emulating the champion of water guzzling cities (but not unexpected), Las Vegas at 219 gcpd.

If Valley cities were to consume water similar to cities in the Southwest such as Phoenix, Flagstaff, Tucson or Sante Fe, or equal the California average of 94.4 gcpd, the stress on the San Joaquin Valley's ground water system would be diminished. Obviously however, it is only major water conservation in the agricultural sector that will reverse the trend of overdrafting of the Valley's groundwater system, especially when one notes that water use statistics for Kern County show agriculture consuming 2,294,000 acre-feet annually while urban use was a proverbial "drop in the bucket" at 166,000 acre-feet annually. However, the existential threat to Arvin is overdraft of the

aquifer directly below the city.

Eighty-four percent of the Arvin Community Service District's water delivery was devoted to residential uses, 10 percent towards commercial/institutional uses and the balance for industrial users and open space (schools, parks, etc.).

The District receives its water from six wells that have well depths that range from 730 feet to 1080 feet. The recent static water table at the District's well sites range from 360 to 480 feet. The District's older wells are contaminated with arsenic, exceeding a concentration of 10 ug/l. Over time the District intends to replace the older wells that have arsenic contamination with newer wells that will produce water that complies with the State's Safe Drinking Water Standards. As a safety backup, the District could employ a centralized arsenic treatment system at each well site.

In addition to the District having to contend with arsenic contamination it also had to cope with two recent droughts: 1987-1992 and 2012-2016. While water tables around the Valley sank during these time periods, Arvin's ground water levels remained stable. However, this did not prevent the District from implementing various water conservation measures - from education and voluntary measures to mandatory measures that ceased all lawn watering.

The District has explored a number of strategies that could be implemented to reduce water demand, including plumbing retrofits, water meters, rebate programs for high-efficiency washing machines and education programs. These measures and others will be discussed in upcoming chapters.

Lessons Learned and Arvin

This Chapter discusses local state-of-the-art water policies that could make Arvin a "model" for long-term progressive water management in the Valley. As a backdrop to Arvin's interest in leading Valley cities towards a more sustainable water management model, the Consultant has analyzed Australia's historic 12-year drought, called the "Big Dry", and has determined that there are numerous lessons to be learned from Australia's response to the "Big Dry" many of which, are applicable to Arvin and other cities in the San Joaquin Valley.

The Consultant also learned from interviews with members of the Water Resources Element Advisory Committee that there were several overriding environmental issues and problems that Arvin faces that are water related including:

• long-term water supply dependability;

• water quality, especially related to problems with arsenic and 1,2,3 TCP;

• air quality, given Arvin has some of the worst air quality in the San Joaquin Valley;

• water infrastructure (e.g. pumps, back-up systems, water lines and water meters);

• urban heat island effects; and

• flooding because most of Arvin is in a designated flood zone.

Figure No. 7 shows a flood condition in Arvin. Most of Arvin is in a designated flood zone. Ineffective storm water management can aggravate local flooding conditions.

Water supply reliability was and is the key impetus for development of this Water Resources Element. The Arvin-Edison Water Storage District (AEWSD) has stated:

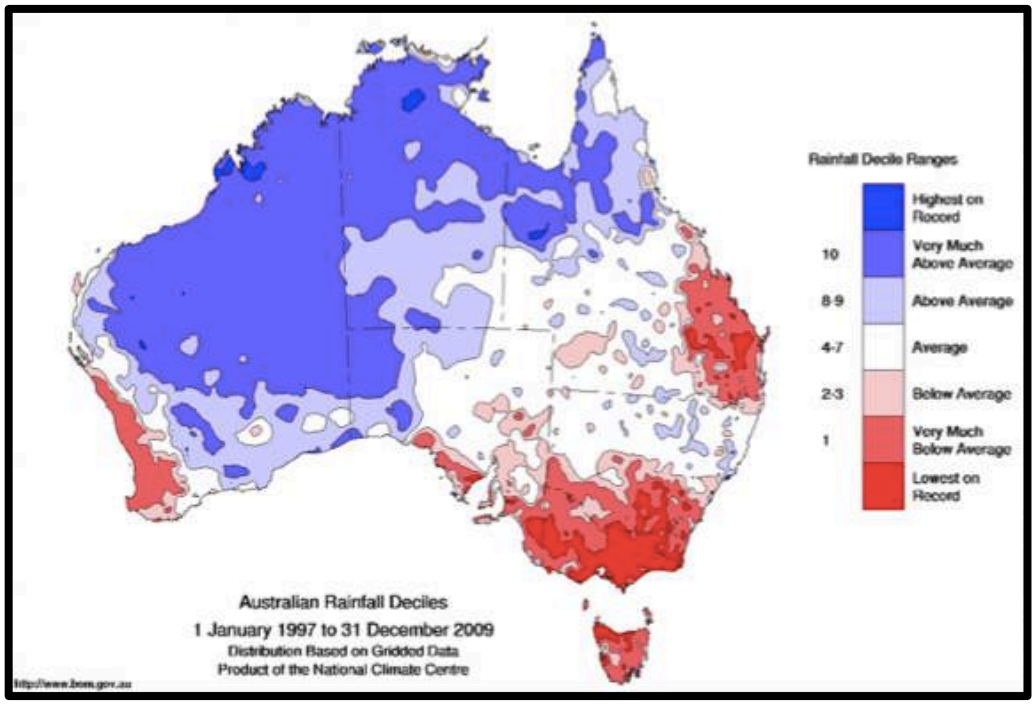
> "*Groundwater provides a medium-to-good quality of water to the area. From the time of the creation of the district until the present, and well into the future, groundwater will be the only source of water for the district."*

Arvin's water supplier, Arvin Community Services District, has noted that an extended drought can have an adverse effect on groundwater pumping levels. The District has benefited from the AEWSD's ground water management efforts, which has stabilized ground water levels in the Arvin area. For the time being, the District's exposure to the effects of drought have been mitigated. However, that is not to say that groundwater levels will not drop due to an extended drought or other actions reducing importation of surface water.

If the overriding water issue in Arvin and the San Joaquin Valley is making contingency plans for drought then the question becomes, what can we learn from other cities or countries who have experienced an extended drought? California's most recent drought extended for five years from 2012 to 2016 (Note: an earlier drought lasted from 1987 to 1992 but the granddaddy of all modern droughts in the Valley lasted from 1928 to 1934). Australia recently experienced a 12-year drought lasting from 1997 to 2010.

The "1997 to 2010 Drought" was Australia's greatest rainfall deficit on record. The Drought produced changes to the way Australia managed its water and created a political atmosphere that was supportive of investment, innovation in the field of water conservation and reforms in water law.

Figure No. 8: Rainfall in Australia during the Great Drought from 1997 to 2010.



A contingent from the Los Angeles Public Works Department and the nonprofit organization, Tree People, travelled to Australia to learn about the Drought and what lessons could be learned from Australia's experience. As a result of that visit a booklet was published entitled Transferring Lessons from Australia's Millennial Drought to California: Accelerating Adaptation to Drought Flood and Heat.

As noted above, several of Arvin's key environmental issues related to water include drought, flood, and heat. Rather than trying to reinvent the wheel, the Australian document, and others, were studied by the Consultants. Many of the ideas and policies that are contained in the Arvin Water Resources Element were adapted from the Australian document while other documents including, Stormwater to Street Trees: Engineering Urban Forest for Stormwater Management, were also influential.

The study group from Los Angeles noted that there were "Five Golden Goals" that were learned from the Australia experience. Those "lessons learned" are translated and applied to Arvin as follows:

1. When the status quo is NOT acceptable, this presents an opportunity to implement new innovative strategies.

2. Always collaborate on multidisciplinary / multi-benefit projects

3. Diversify dependence on water sources

4. Protect safety, health and quality of life during drought / climate change

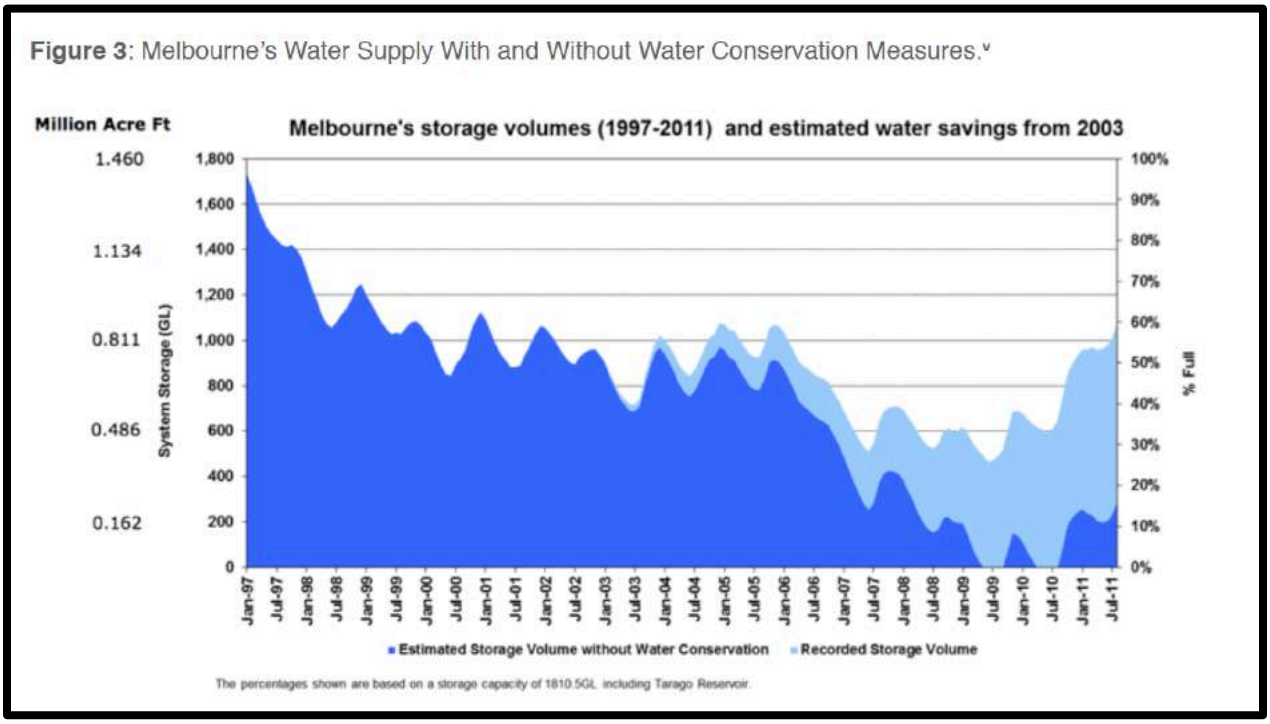
5. Foster sustainable water use behavior by the public

LESSON 1.

Drought urgency represents a unique opportunity to reshape water management and requires smart, swift action (the status quo is NOT acceptable).

Melbourne would have run out of water if they had not acted early on during the Drought. Figure No. 9 below vividly shows that without aggressive water conservation measures Melbourne would have been potentially destined for a "collapse" in terms of public health, the local economy and environmental resources.

Figure No. 9: Melbourne's water supply with and without water conservation measures.



The study group found that public and political will was receptive to significant changes in water policy during the Drought. For example, the Victorian and South Australian governments implemented the following:

•. water use **efficiency** through code amendments and other policy adjustments;

• tiered water pricing doubling the price of water;

• water restrictions (e.g. no use of potable water for ornamental domestic landscaping); and

• aggressive targets for water conservation; wastewater reuse; and stormwater capture and reuse.

While these are not necessarily appropriate recommendations for Arvin, it does show that public policy could be open to dramatic change in times of drought. Some potential policy changes for Arvin and the Arvin Community Services District might be:

SHORT TERM

• Continue to fully implement current Green Building Code requirements, which stress water use efficiency and energy use efficiency.

• Continue to promote conservation and sustainable water use practices.

LONG TERM

Require a multi-discipline / multi-benefit approach for all private projects and public infrastructure projects including streets, storm drainage, wastewater recycling and parks. Two approaches that Arvin and other Valley cities could implement include:

1. Establish stormwater catch, keep and reuse policies to:
    - reduce flood water impacts
    - irrigate public landscaping, which will reduce urban heat
    - recharge the local aquifer
2. Establish policies to develop an urban forest, which will:
    - reduce peak flood quantity flows (Q)
    - capture run off to recharge the local aquifer
    - reduce the urban heat island effect
    - improve Arvin's "quality of life"

LESSON 2.

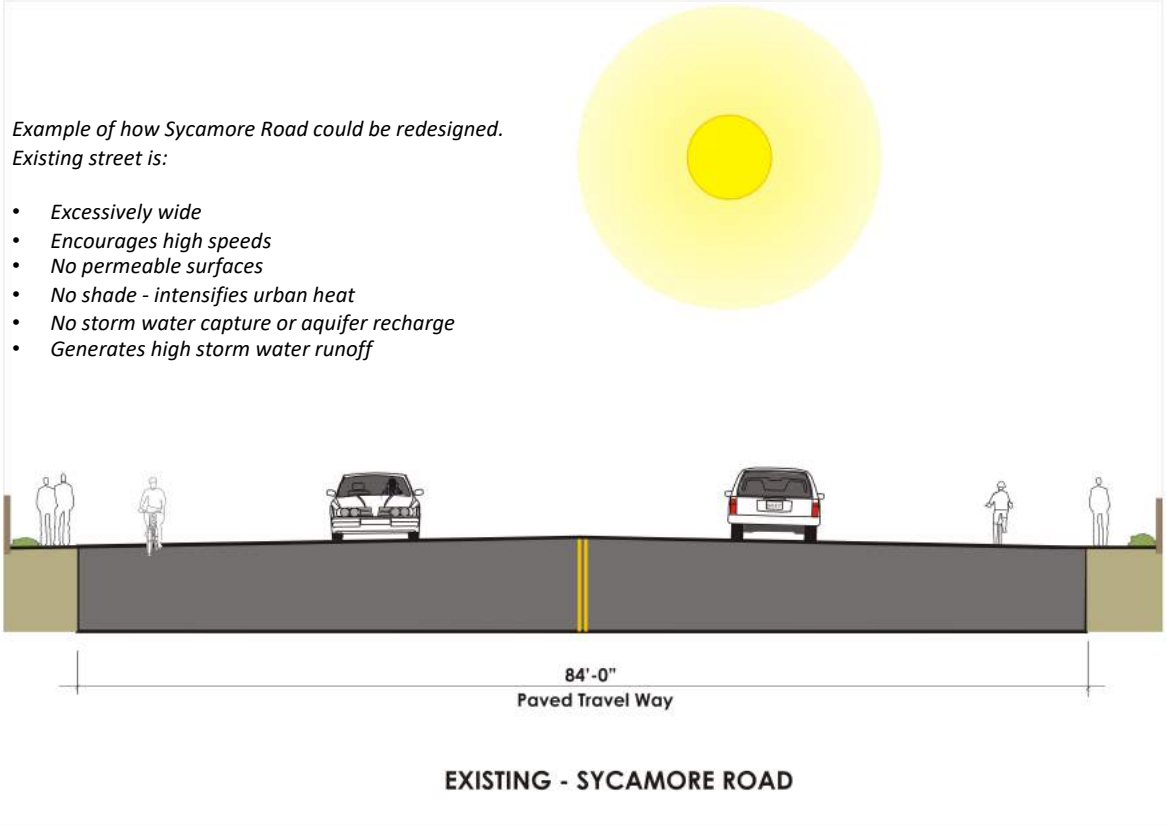
Collaborate using multi-discipline/multi-benefit projects to create efficiency and water resilience

- Plan integrated projects that maximize the efficient use of rainwater, stormwater and recycled water resources.
- Use multi-discipline/multi benefit designs, which lower cost and helps to recharge the aquifer.
- Design projects to reduce urban heat and reduce peak storm runoff.

(Note: The City of Los Angeles has already adopted policies requiring multi-benefit/ multi-discipline planning approaches for all public street construction and reconstruction. Besides this approach being beneficial from many environmental standpoints, this approach saves money).

Figure No. 10: Sycamore Road looking west

Figure 11: Example of how Sycamore Road could be redesigned



LESSON 3.

Diversify water sources to increase water system resiliency

Diversified solutions were encouraged by the Australian government. Performance targets and tight regulation regarding water quality were centered around the priority of maintaining public health. Rather than relying solely on pumping from local aquifers for all water requirements, use of alternative water sources was encouraged including:

- rainwater harvesting,
- stormwater capture and reuse, and
- managed aquifer recharge.

Stormwater capture and reuse – Edinburgh Gardens

- 1 million AUD
- Treated stormwater irrigates mature trees and sporting fields
- 200,000 liter (52,800 gallons)storage tank
- 60% irrigation needs

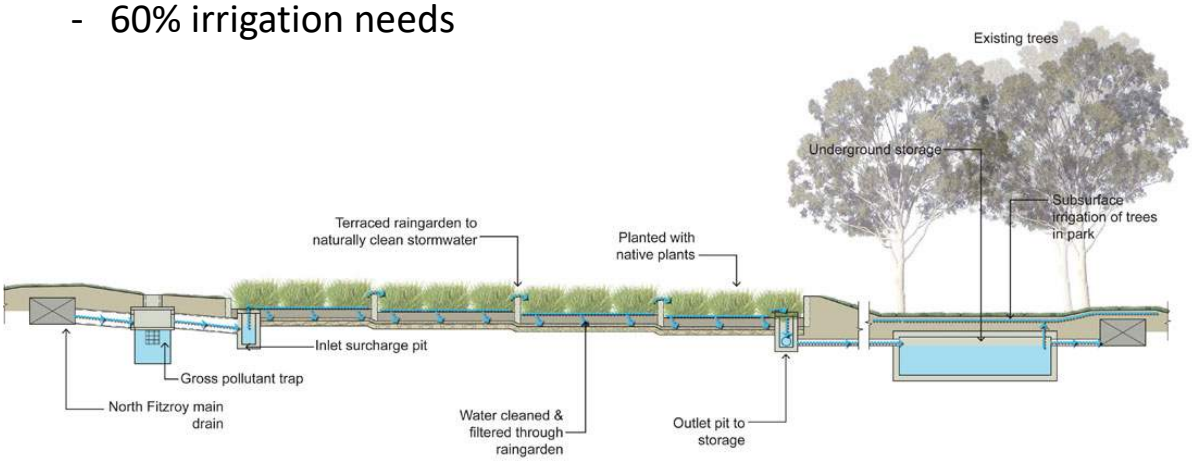


Figure No. 12 illustrates a mechanism for capturing stormwater runoff and providing irrigation for open space features. This capture system also integrates a treatment mechanism whereby certain contaminates are removed from the stormwater runoff.

Rainwater harvesting (RWH)

- Severe water restrictions banned potable water for outdoor landscaping
- Public demanded incentives for RWH tanks and equipment (fave agencies mandate to invest in RWH programs
- End of drought = 50% of Adelaide household and 30% of Melbourne households

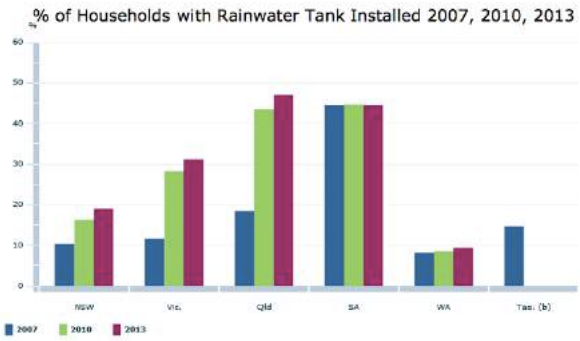


Figure No. 13 shows how rainwater harvesting can be employed in urban settings. This mechanism can reduce the demand for water for outdoor irrigation.

Once diversified water sources were identified and developed the concept of "fit for purpose" was utilized. For example:

- potable water was used only for drinking water and domestic uses;
- water destined for managed aquifer recharge, imported surface water or reclaimed wastewater, was also used for irrigating the urban forest;
- captured stormwater was used to irrigate the urban forest and then used to recharge the aquifer; and
- rainwater harvesting was used for outdoor landscaping, irrigation of the Urban Forest and local aquifer recharge.

Towards the end of the Drought some Australian cities had up to 50 percent of their homes using rainwater harvesting systems. Stormwater capture and storage was used to provide 60 percent of irrigation needs for mature trees and sporting fields.

Taken all together, the diversified alternative water source approach, and "Fit for Purpose" concepts reduced pressure on local aquifers. Pumping and energy cost were also decreased.

LESSON 4

Water scarcity issues are fundamentally tied to public health, safety and quality of life

During the Australian Drought the urban heat island effects became critical. By January 2009, extreme heat events in Melbourne caused a 62 percent increase in mortality rates (980 heat-related deaths). Waters restrictions had reduced public green space and shade and urban temperatures were consequently increasing. In particular, failure to take care of trees and tree canopies proved to be a fatal mistake.

While water restrictions were imperative on a city-wide scale, Melbourne learned the critical lesson that special attention must be paid to keeping public green spaces green even during severe droughts. In particular keeping trees healthy during the droughts was essential. There were a number of techniques and strategies that were used to save water but still provide sufficient water to maintain healthy trees.

As a result of "lessons learned" in Australia, strategies were adopted to cool the city's ambient temperature by 4° C, which is about 7 degrees Fahrenheit.

The adopted strategy was to double the city's tree canopy; increase water percolation, greenspace, and stormwater harvesting; and reduce ambient temperatures. By adopting these strategies, the City of Melbourne expected to achieve cooling of the city by 4 degrees Celsius during extreme heat events.

After studying the lessons learned from Australia, and through its experience with California's four-year drought, the City of Los Angeles has now adopted similar policies and targets for cooling the city and mitigating urban heat impacts.

Policies regarding how Arvin should address urban heat impacts are recommended in the Water Resources Element. Water scarcity in Arvin, and the San Joaquin Valley, has implications for public safety and health, and Arvin's "quality of life."

Keeping trees, and in particular public trees, healthy during times of drought has numerous benefits. Fire safety is improved when trees are healthy. Health issues related to airborne pollution and clean air is related to the size of the city's tree canopy and the health of the trees. Quality of life is improved when the tree canopies provide shade, relief from heat and beautification of the city.

The obvious policy implication is that Arvin should adopt strategies to increase the city's tree canopy. Several policies and implementation programs are recommended in the Water Resources Element that implement this strategy.

LESSON 5

Public Behavior change programs, centered around water conservation efforts, can be extremely effective.

The City of Melbourne, from 1990 to 2010, reduced their per capita water consumption by 47% - 121 gallons per person per day to 65 gallons per person per day.

Arvin has also been fairly successful in reducing its gallons per person per day consumption. In 2008, consumption was about 164 gallons per person per day. By 2013 consumption was down to 143 gallons per person today and by 2018 consumption was at about 95 gallons per person per day.

In both the case of the Australian cities and in Arvin this dramatic decrease in per capita water consumption was fueled by marketing, public education, and the public's awareness of the drought.

In addition to the issues of local water management there was also concern about Arvin's budget. Budgetary concerns included one-time capital expenses involving street and storm drainage projects as well as ongoing annual operating expenses associated with streets, storm drainage basins, sewer lines and lift stations. The City Council and staff will be pleased to see that implementation of the policies in the Water Resources Element will save a significant amount of general fund money for both capital expenses and annual operating expenses.

These same budgetary concerns also rest with the Arvin Community Service District. They must focus on the task of providing domestic water to Arvin's population of over 20,000. Water quantity and quality are the primary focus of the District but water line leaks, water pressure, and backup power also occupies the District's personnel.

Learning from the experiences of Australian cities and cities in the Southwest, and through local experiences following the drought, the following five Golden Goals for Arvin's Water Resources Element will serve as the foundation for a successful water management strategy. These goals and their accompanying policies and implementation strategies will be discussed in the following chapter, Goals, Policies and Implementation Strategies.

Goals, Policies and Implementation Strategies

GOAL 1

We will leverage increasing awareness that Arvin's Water Resource issues are critical. The status quo is NOT acceptable; therefore, this reality presents an opportunity to implement new Innovative strategies and policies.

GOAL 2

We will increase City and interagency collaboration, moving toward multi-discipline, multi-benefit and multi funding source design solutions and projects.

GOAL 3

We will diversify our dependence on sources of water. Rainwater capture, stormwater capture, and use of reclaimed water will be efficiently utilized and "fit for purposes" water use will become a priority concept.

GOAL 4

We will protect our safety, health and quality of life during drought periods and as future climate change impacts are felt. In particular we will increase our tree canopy and maintain the health of our trees at all times.

GOAL 5

We will create tools to foster sustainable water use behavior by the public

Goals, Policies and Implementation Strategies

For Arvin to have a meaningful, long-term water management program, the City along with the Arvin Community Services District will need a game plan, one that be translated into effective water conservation while also improving the Arvin's "quality of life".

Goal 1

The urgency of drought represents a unique opportunity. The status quo is NOT acceptable. Therefore, we will implement new innovative strategies.

1.1 The next General Plan update shall integrate and incorporate the goals, policies and implementation measures of the Arvin Water Resources Element into the General Plan.

1.2 As municipal codes, ordinances and development standards are updated, the goals and policies of the Arvin Water Resources Element shall be considered and implemented as appropriate. Water rates, water use regulations, water conservation requirements and Green Building Codes should be updated with the goals of water conservation and fit-for-purpose approaches in mind.

1.3 The City shall improve and emphasize catchment of storm water and rainwater.

1.4 The City shall develop an urban forest, which will reduce ambient temperatures, sequester carbon dioxide, and reduce storm water runoff while simultaneously improving the city's aesthetics.

1.5 The Zoning Ordinance shall be amended to include design guidelines and development standards for all districts that facilitate urban development. Design guidelines shall involve architectural guidelines that promote water conservation while development standards could regulate the amount of lawn area per single-family residential unit.

Arvin is entirely within FEMA's 100-year floodplain; it is often subjected to poor air quality; it suffers from extreme summer temperatures; and it depends entirely on an underlying aquifer for its domestic water requirements. Given these challenging conditions, it makes sense to tackle these issues using a Multi-Disciplined/Multi-Benefit Team (MDMBT) that will implement the following:

- The City of Arvin shall seek to "catch and retain" all storm water and rainfall, which should be used for irrigation and ground water recharge.

- The City of Arvin shall aggressively establish an urban forest throughout the community using urban storm water runoff and reclaimed water for irrigation whenever possible. This forest will cool the community, enhance its appearance, reduce peak storm water runoff flows, and slow traffic when the forest is part of the streetscape.

Goal 2

We will increase City department and inter-agency collaboration moving toward multi-disciplined, multi-benefit and multi-funding project.

2.1 City departments and utility districts includes Planning and Building, Engineering, Parks, Building, Veola and Arvin Community Services District (ACSD) functions will form a Multi-Disciplined, Multi-Benefit Team (MDMBT) to review all public projects. The MDMBT will be responsible for public project designs that will most effectively create multi-benefits for every public project, especially street construction and street reconstruction and parks. Photos and schematics of streets that have or could be reconstructed using a multi-benefit and multi-funding approach. This policy will produce multi-benefits that will protect against floods, replenish local water supplies through ground water infiltration and improve the "quality of life" in Arvin.

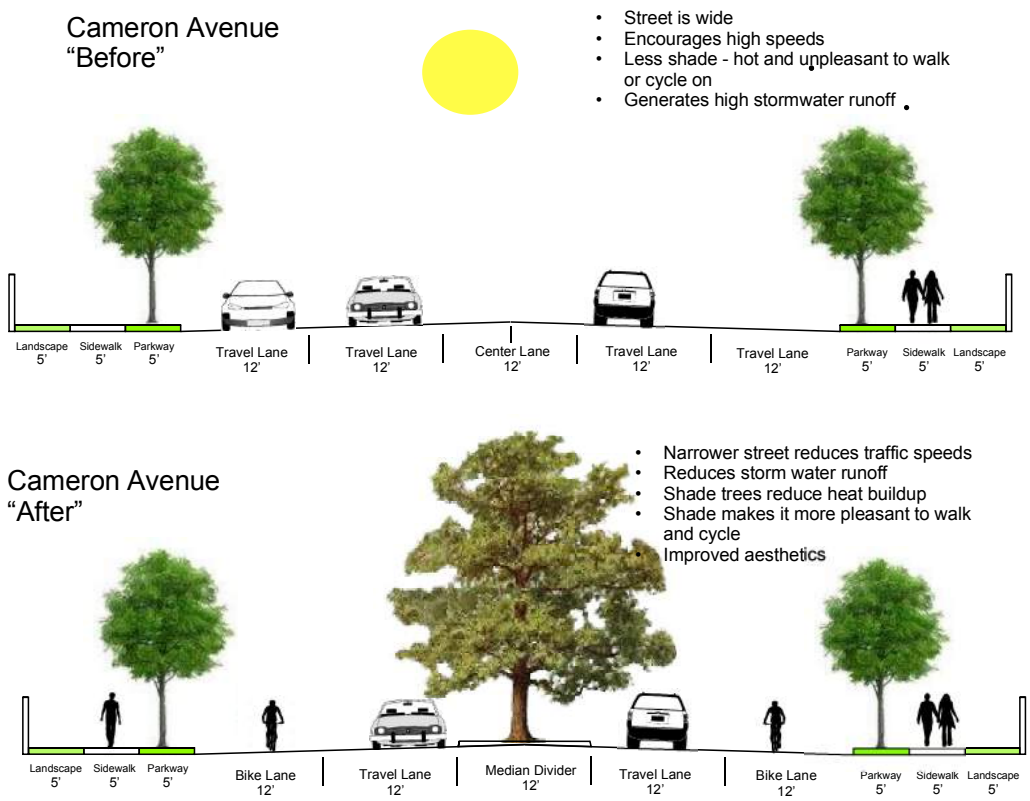


Figure No. 14: Above is an example of an overly wide street in Visalia, but every city in the Valley has one or more, which could be redesigned to incorporate a tree-line median. This median would slow traffic, catch and retain storm water, reduce the ambient temperature in adjacent neighborhoods and finally reduce the amount of storm water runoff being generated by this roadway. Note: Retrofit designs should plan for trees that will grow to 20' to 30' canopies (see Appendix E for recommendations). Existing street camber should flow to the new parkway or median swales to maximize storm water capture.

Figure 15: This photo in Visalia illustrates the benefits of tree-lined medians and parkways along a major street. The medians and parkways absorb rainwater, which recharges the groundwater system; they reduce storm water runoff; they reduce traffic speed by narrowing the street width and the trees reduce the ambient temperature, making for a cooler neighborhood during the summer months. Note: Tree canopies on this street are 20 to 30 feet wide.

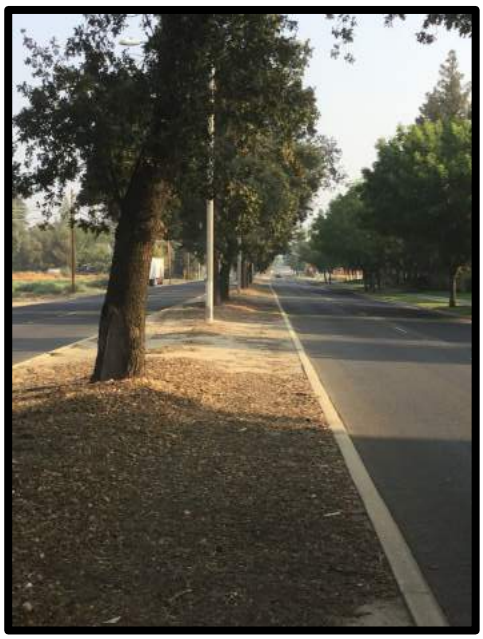


Figure No. 16: During periods of intense precipitation tree-lined medians and parkways reduce storm water runoff. This median in Visalia is lined with Valley Oaks (Quercus lobata). The exposed soil and the leaves of the tree catch and hold rainfall, thereby reducing the volume of runoff entering the city's storm water system; the narrow street reduces traffic speeds; and the shade reduces ambient temperatures in the local neighborhood.

2.1.1 For a construction or reconstruction project on a street segment with low to moderate flooding, the City will analyze the storm water infiltration feasibility of the location based upon its soil permeability, groundwater levels, slope, and contamination. Staff will determine if storm water should be captured and kept on site using Best Management Practices (BMP) Tool Box 1 (see below), or captured, treated and released, based upon BMP Tool Box 2 (see below). Capture treat and release options will only be utilized if catch-and-keep is infeasible. The performance goal will be to catch and keep, at a minimum, a 10-year/5-day storm runoff event.

Best Management Practices Tool Box:

Tool Box 1- Catch and Keep

- Curb/ Parkway retrofits
- infiltration trenches
- infiltration galleries
- dry wells
- bioinfiltration/bioretention without under drains cisterns other storage BMPs
- trees

Tool Box 2 - Catch, treat and release

- Curb/ Parkway retrofits
- Bioretention with underdrain treatment Train of BMPs with biofiltration prioritized
- Trees
- Bioswales

2.1.2 For a street segment with severe flooding, the City will first conduct a storm drain analysis prior to construction or reconstruction and then proceed with the storm water infiltration feasibility analysis described in 2.1.1 above (catch and keep or catch treat and release). The analysis shall include the ability of upstream capture to reduce flooding impacts. When construction begins the performance objective of capturing and keeping for use will be based on a runoff volume of a 10-year/5-day storm event.

2.1.3 For street resurfacing projects the MDMBT will collaborate on opportunities to implement Best Management Practices (BMP) such as bioswales, curb/parkway retrofits, and tree plantings that could be implemented, either in conjunction with the street resurfacing project or as an independent parallel project using a separate contract or grants. The MDMBT shall assess the ability of Arvin to maintain improvements in perpetuity (*See the MBRP Case Study of Sycamore Street for further discussion).*

2.1.4 The MDMBT should use the techniques and concepts contained in the United States Environmental Protection Agency EPA "Stormwater to Street Trees; Engineering Urban Forest for Stormwater Management" as a guideline for implementing use of trees as BMPs described in Tool Box 1 & 2, discussed in 2.1.1 above.

Designing tree plantings to accommodate the largest trees possible will increase its storm water utility function as well as providing significant shade value.

Source: Storm water to Street Trees: Engineering Urban Forests for Storm Water Management

2.2 The MDMBT will review private projects with water-conserving solutions in mind. The MDMBT and private developer will collaborate to achieve Low Impact Development (LID) projects that take advantage of investments that goes into site work, including storm water management systems, grading, curbs, catch basins, streets, sidewalks, and landscaping. Where appropriate, special districts such as Arvin's Lighting and Landscaping Districts shall be utilized, or projects shall be incorporated into existing districts to ensure sufficient funding is available after the developer completes the project.

Figure No. 17: Storm water management for residential projects should be incorporated on-site where possible. This multi-family project in Exeter includes a dual-purpose storm retention pond - a playground during the non-rainy season and a catch and hold basin during the winter months.

Figure No. 18: This landscaping design was integrated into the design of a multi-family project in Exeter. It retains rainwater on-site as well as introducing a number of landscaping features, including mulch, drought-tolerant plants and cobblestones. This feature could have been further improved with the addition of large trees, which would capture some of the precipitation as well as cooling this area of the residential development.

2.2.1 Use natural systems and work with natural site characteristics to maintain hydrologic functions and process, rather than attempting to mitigate impacts. For example, avoid the disturbance and grading of natural vegetated areas to significantly reduce the need for stormwater control and to increase groundwater recharge.

2.2.2 Minimize clearing and grading by clustering building sites.

2.2.3 Reduce road widths and shared-use driveways.

2.2.4 Use permeable paving and other permeable surface treatments. Amend the zoning code to require 15-20 percent permeable surfaces, depending upon type of use.

Figure No. 19: Permeable pavement (on right) can reduce storm water runoff from an urban site. This type of pavement installed in downtown parking lots in Visalia increases ground water recharge as well as reducing the cost of storm water improvements.

Figure No. 20: This reconstructed street in Kingsburg was very effective in saving mature trees while keeping the street narrow and providing shaded sidewalks. This street is 5 to 10 degrees cooler in the summer when compared to nearby streets that lack street trees.

2.2.5 Treat stormwater close to the source. This approach will remove pollutants, allow ground water infiltration, and slow down the rate of runoff.

2.2.6 Trees should be watered and maintained using grey water. Designs noted in the EPA document "Stormwater to Street Trees", and the Los Angeles Beautification Team document "Trees as Bioswales" should be used as guidelines for developing designs that will provide fit-for-purpose water for trees.

2.2.7 Use, for example, vegetated swales rather than conventional curbs and catch basins to provide better water quality treatment, ground water infiltration, site appearance and urban heat relief. All designs must consider capital and long-term maintenance cost, soil types and slope (*See MBRP (Multi-Benefit Road Plan) discussion).*

2.2.8 Use rooftop runoff to irrigate vegetated areas thereby lowering water bills and reducing storm water runoff.

2.2.9. Create multi-functional and multi-benefit landscape designs. Multi-function landscape designs might include storm water management components that provide: filtration treatment, ground water infiltration, open space and habitat, storm water for future irrigation use, reduced urban heat island effects, and enhanced aesthetics.

Trees are typically not considered part of gray or green stormwater management systems; they are generally and falsely, considered to be for landscaping value only. Planting a tree for just landscaping is not taking advantage of the stormwater utility benefits and other environmental advantages it provides.

Source: Stormwater to Street Trees; Engineering Urban Forest for Stormwater Management.

Figure No.21: This park/pond in Visalia doubles as useable open space most of the year but when storms hit the area it serves as a catch basin for storm water runoff that is generated from adjacent urban uses. This runoff percolates into the ground and helps recharge the ground water system.

Figure No. 22: Storm water basins do not have to be sterile, unattractive land use features. This basin in Visalia also serves as a wildlife preserve. Bird life at this basin is the highest of any site in the city.

2.2.10 Use native and drought-resistant plants to reduce demand for irrigation water, pesticides and fertilizers.

2.2.11 Consider long-term maintenance and sustainability when designing public and private projects that have a landscaping and irrigation component.

2.2.12 Provide information to residents and management companies on how to manage native and drought resistant vegetation. Educate about how to perform various maintenance tasks such as removal of sediments from swales.

2.2.13 Educate and provide a means to maintain healthy trees in times of drought (e.g. use of mulch, drip irrigation, water bladders, etc.)

Multi-benefit design often qualifies for multiple funding sources for capital costs. Long-term maintenance cost is often equal to or less than single purpose designs.

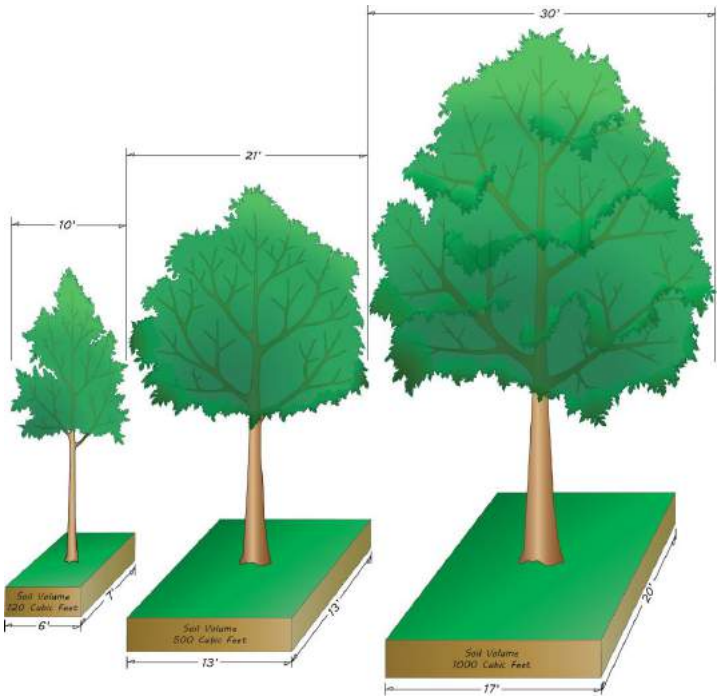


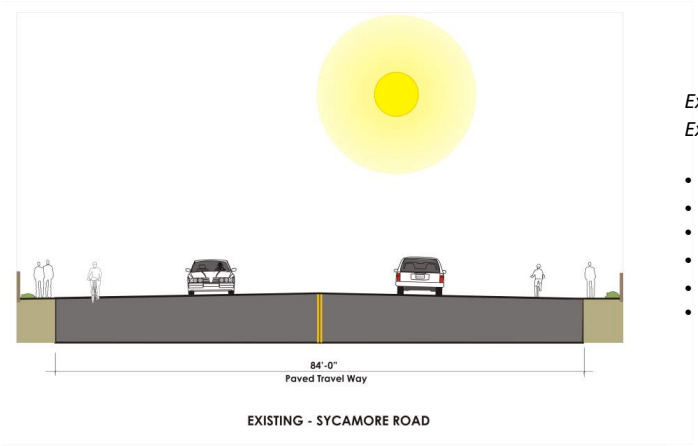
Figure No. 23: Relationship between tree growth and soil volume. Tree growth is limited by soil volume. To grow big trees, large amounts of uncompacted soil are needed. For a mature tree with a canopy of approximately 30 feet, 1,000 cubic feet of soil is needed.

Illustration from Casey Trees, 2008.

Figure No. 24: Sycamore Road is currently one mile long and has a right-of-way width of 104 feet and a curb to curb width of 84 feet. These photos show Sycamore Street looking east and west. The paving is in poor condition and in need of reconstruction, which makes it a candidate for using MDMBT strategies.

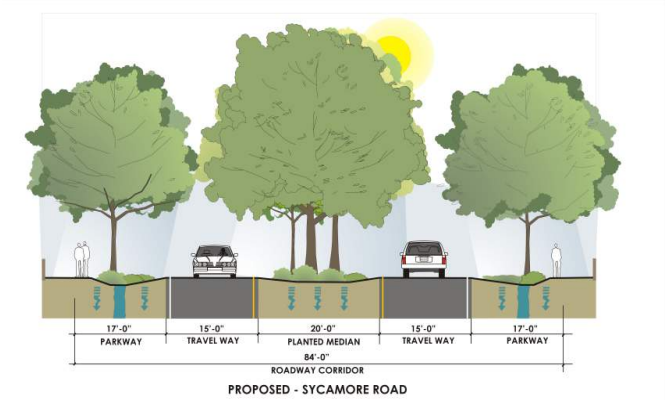
MDMBP (Multi-Discipline/Multi-Benefit Plan) for Case Study for Sycamore Road

If Arvin used a MDMBP for the reconstruction of Sycamore Street consistent with Figure 25, many benefits will be realized by the City.



Example of how Sycamore Road could be redesigned.
Existing street is:

- *Excessively wide*
- *Encourages high speeds*
- *No permeable surfaces*
- *No shade - intensifies urban heat*
- *No storm water capture or aquifer recharge*
- *Generates high storm water runoff*



Multi-benefit design:

- *Narrower street reduces traffic speeds*
- *Reduces or eliminates storm water runoff, high Q*
- *Recharges aquifer*
- *Reduces urban heat build up*
- *Improves Quality of life, walkability, and aesthetics*
- *Lowers capital and maintenance cost.*

Figure No. 25: After the reconstruction of Sycamore Road using MDMB strategies (Case Study), this major north/south roadway in Arvin will reduce less storm water runoff, it will be a safer roadway because traffic speeds will be reduced and it will be cooler and more aesthetically pleasing.

COST BENEFITS

Public Works Engineers have a formula that indicates maintenance cost for roadways range from $2.00 per square foot for slurry seal, to $10.00 per square foot for total reconstruction. In the case of Sycamore Street total reconstruction will be required at a cost of $10.00 per square foot. Sycamore Street is 84 feet wide. A mile of reconstruction will cost $4,434,200**.**

Traffic volumes on Sycamore Road could easily be accommodated by two, 15-foot wide travel lanes, with a total pavement surface width of only 30 feet. Reconstruction of a 30-foot wide

pavement surface would cost about **$1,586,400** per mile. So, a MDMBP for Sycamore Road would save about **$2,840,800** dollars per mile of the city's Capital Improvement Program.

Parkways 17 feet wide and a median 20 feet wide could be created, with two 15 foot wide traffic lanes. Initially the parkways/median areas could be treated with mulch. As grant funding becomes available, trees and trails could be installed. Grants for trees and trails are much more common and available than street paving grants. The parkway and median areas will support very large mature trees, (see Figure 23 for discussion).

MAINTENANCE BENEFITS

Maintenance for streets cost about a $1.80 per square foot over 20 years. The difference between maintaining an 84-foot asphalt street ($798,336 per mile) compared to a 30-foot wide asphalt surface ($285,120 per mile) is $513,216. per mile or about $26,000 per year per mile! Scheduled maintenance for streets should occur every 5 to 7 years. Tree trimming maintenance schedules typically occur every 15 years. However, experts point out: *"The wide median and parkways will allow trees and shrubs ample room to grow. Allow trees to reach full canopy height and width for full benefit of the tree's natural form, resistance to pests, overall health and growth. No pruning is needed unless branches are damaged, broken, or diseased."* Brian Hannegan, Landscape Architect, RRM Design group.

The numbers above indicate considerable money can be saved if a Multi-benefit design approach is taken. See Appendix E for Tree recommendations.

trimming maintenance schedules typically occur every 10 years. These numbers indicate that a MDMBP would save considerable capital and maintenance costs.

DUST AND EROSION BENEFITS

Erosion from the parkways will not be a problem because they can be constructed as swales. Drainage from the pavement services will flow downhill into the swales capturing water for recharge (see Figure No. 12 for an example of a swale adjacent to roadway).

Dust collects on flat smooth surfaces like roadways. As vehicles pass the dust is kicked up and pollutes the air. By reducing the roadway width from 84 feet to 30 feet much less roadway surface is available for dust collection. Trees in the parkways can capture much of the dust once the trees become mature.

STORM DRAINAGE BENEFITS

The 84-foot wide Sycamore Road contains 443,520 square feet of pavement (about 10 acres). When it rains, these 10 acres of paved surface generates a high volume of storm water runoff (measured as "Q" by civil engineers), which typically flows to the city's storm water system. This requires a storm drainage system that has significant capital and annual maintenance costs. However, if the street is reduced to a 30-foot wide roadway and the runoff flows into an adjacent 27-foot wide swale, located on each side of the roadway, the 10 acres of street area will

effectively catch much of the storm water that runs off the roadway. This catchment of stormwater will reduce or even eliminate the need for a separate storm water system. More detailed engineering studies based upon soil permeability, topography and other factors will determine a more precise cost-benefit for this example.

OTHER BENEFITS

The large parkways will support large trees that will reduce urban heat and provide shade for the vehicle travel lanes as well as shaded sidewalks. The narrowed street widths will help slow traffic to safer speeds and in 10 years, the roadway will be beautiful, in 20 years the roadway will inspire.

Goal 3

We will diversify our dependence on sources of water and utilize a fit-for-purpose approach to water use

3.1. Veolia, the wastewater treatment plant operator for the city of Arvin, working in collaboration with the Arvin Community Services District will develop a comprehensive regulatory framework that covers all water use and reuse options. Specific guidelines will include general guidelines for recycled water use, on-site reuse (rain harvest, gray water etc.), recycled water distribution policy (purple pipe development), rainwater harvesting uses and managed aquifer recharge using recycled water and stormwater.

Permitted Recycling Uses for Different Levels of Waste Water Treatment

Recycling Use	UnDisinfected Secondary	Current Disinfected Secondary 23	Disinfected Secondary 2.2	Design Disinfected Tertiary
Parks and playgrounds	No	No	No	Yes
School yards	No	No	No	Yes
Residential landscaping	No	No	No	Yes
Unrestricted access golf courses	No	No	No	Yes
Nonrestricted recreational impoundments	No	No	No	Yes
Cemetaries	No	Yes	Yes	Yes
Freeway landscaping	No	Yes	Yes	Yes
Restricted access golf courses	No	Yes	Yes	Yes
Industrial process water that may come into contact with workers	No	No	No	Yes
Food crops, including all edible root crops, where the recycled water comes into contact with the edible portion of the crop	No	No	No	Yes
Surface irrigation of food crops where the edible portion is produced above ground and not contacted by the recycled water	No	No	Yes	Yes
Fodder and fiber crops and pasture for animals not producing milk for human consumption	Yes	Yes	Yes	Yes

Figure No. 26: A tertiary waste water treatment plant, although expensive, provides a city with maximum flexibility in terms of the use of the "treated" effluent (see Design Disinfected Tertiary column).

3.2 Rainwater harvesting will be promoted. Rainwater harvesting refers to rainfall that has not come into contact with ground surfaces (e.g. Streets and parking lots). Rainwater, typically captured from roofs, will be used for on-site landscaping and other non-potable water uses.

3.2.1 The ACSD will consider providing rain barrels to individual parcel owners. Some cities and water districts have already initiated free distribution programs that may be used as models for an Arvin program.

3.2.2 The City and ACSD will provide demonstration projects and instructions about how to install water-conserving rain and stormwater collection landscape systems. City and District efforts will be coordinated through a collaborative education campaign.

3.3 Storm water capture and use will be promoted for all public and private projects. Policies collaboratively developed by the City and the water districts will be developed to decide how best to use captured storm water for non-potable water uses.

3.3.1 Storm water capture techniques will be utilized to comply with applicable NPDES requirements. The "Storm Water Quality Design Manual for Sacramento and South Placer Region" may be used as a model example as to how to design Low Impact Development (LID) for storm drainage facilities.

3.3.2 Low Impact Development (LID) designs will be used to capture and use stormwater. Collaborative multi-benefit designs will be required.

3.4 Managed Aquifer Recharge (MAR), the process of infiltrating or injecting water into aquifers under controlled conditions for later withdrawal, shall be encouraged. The Arvin Community Services District shall coordinate with the Arvin-Edison Water Storage District towards promoting ground water recharge up-gradient from the City of Arvin. Specifically, this policy aids in the recharge of the aquifer that underlies Arvin and from which ACSD draws its water.

3.5. Recycled wastewater capacity shall be expanded to the maximum extent that is economically feasible.

3.5.1 The recycled wastewater distribution system (purple pipes) in Arvin shall be extended to the maximum extent that is economically feasible. Examples where this type of water could be used include irrigation for parks, landscaped medians, and landscaped areas within landscaping and lighting districts.

3.5.2 Recycled water shall continue to be developed and utilized.

3.5.3 Arvin and Areola should begin discussions of converting the wastewater treatment facility from a secondary treatment to a tertiary plant. This level of treatment would permit the effluent to be used for irrigation on all types of crops.

The City of Arvin currently owns 260 acres of farmland, which is irrigated exclusively with undisinfected secondary effluent. This effluent is recharged into the groundwater system. The City also contracts for use of 400 acres of private property for agricultural use of treatment water. The current contract for the private property expires in 2021. At that time the City shall review its options for the use of this treated water.

Goal 4

We will protect our safety, health and quality of life during drought periods and as water resources become scarce.

4.1 Establish a cooling target, which will improve the quality of life, health and safety in Arvin by reducing outdoor temperatures using a multi-faceted approach to achieve the cooling target.

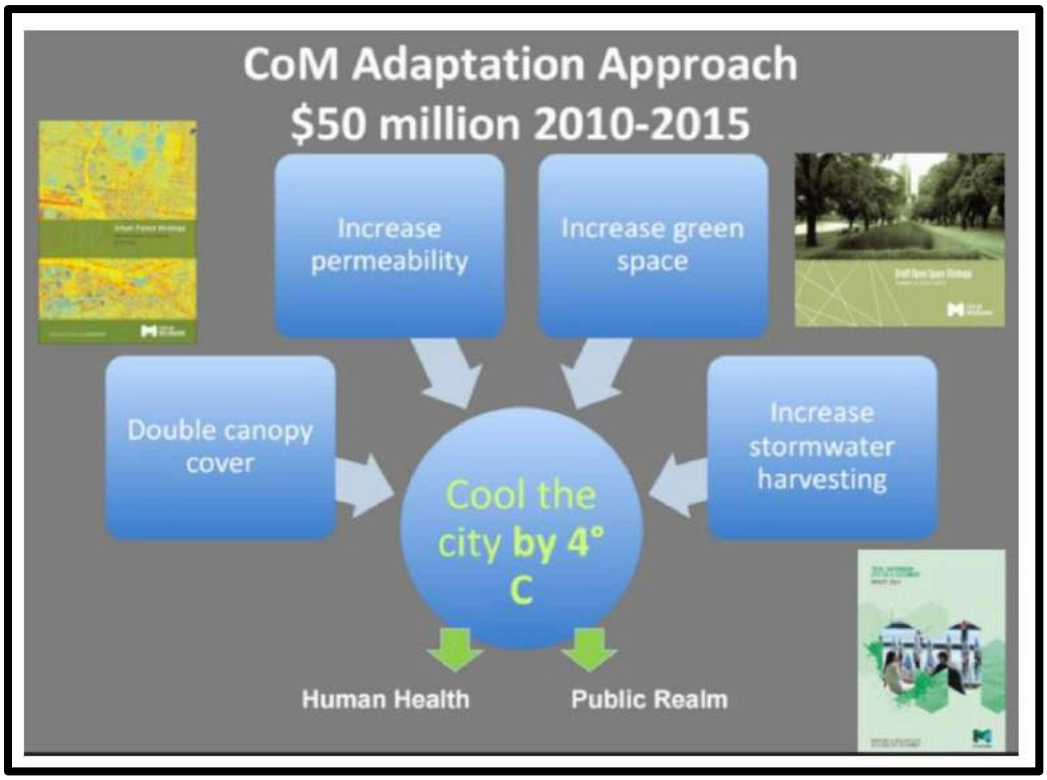


Figure No. 27 illustrates that by implementing programs that reduce impervious surfaces, increase tree canopies and harvest storm water runoff, a community can cool its ambient temperature by up to 7 degrees Fahrenheit.

Figure No. 28: Tree-lined streets reduce the ambient temperatures in the neighborhood as well as providing a pedestrian-friendly walking path that is shaded and separated from traffic on the street.

4.1.1 Identify areas within Arvin that are most vulnerable to excessive heat based on current and expected temperatures.

4.1.2 Priority will be given to strategies that will benefit areas that are identified as most vulnerable to excessive heat.

4.2 Guidelines will be developed to protect livability and health, especially in drought situations. Public open space areas and corridors needed for cooling will be identified. Plans and strategies will be developed regarding how to maintain these critical cooling areas during drought situations. This applies especially (but no exclusively) to trees along public streets, boulevards and parks.

4.2.1 Non- potable water will be used whenever possible to maintain healthy trees, which will help to improve air quality, and reduce urban heat effects.

4.2.2 Tree watering "donuts" and "bladders" will be used to maintain healthy trees during times of water scarcity when irrigation is turned off or curtailed. Reclaimed wastewater should be considered as a source for irrigation donuts and bladders.

4.2.3 Multi- benefit stormwater/street tree designs should be encouraged.

Figure No. 29: Street trees enhance the value of homes in a neighborhood as well as reducing ambient temperatures and reducing storm water runoff.

Figure No. 30: A tree irrigation bladder (or donut).

4.3 Develop strategies and guidelines to protect Arvin's "quality of life when water is scarce.

4.3.1 Plans should be made to protect open space areas in order to uplift the public psyche and offer a respite from the stresses of the urban heat island effect.

4.3.2 Special emphasis and priority should be given to street trees. Street tree priority will be emphasized due to the cooling effect on asphalt and adjacent urban uses.

4.4 Tree health should be maintained at all times in order to promote healthy air quality, mitigate pollution, provide urban cooling and a positive city image.

Figure No. 31: Street trees can enhance entryways into the community as well as setting a good image. This tree-lined roadway in Davis, California, also provides for a parkway swale (to collect storm water runoff) and beyond the swale a bikepath/pedestrian walkway has been installed.

Goal 5

We will create and use tools to foster sustainable water use behavior by the public

5.1 Create an integrated, clear and consistent messaging program on water conservation.

5.1.1 Water districts and wholesalers should be encouraged to contribute a portion of their conservation budgets toward funding a unified and consistent campaign, collaborating with the City.

5.1.2 A water conservation and sustainability campaign should use all media including TV, radio, print, digital media and posters over a sustained period of time.

5.2 Water districts and wholesalers should provide incentives and rebates for water efficient systems including rainwater harvesting systems, greywater systems, on-site stormwater capture systems, high-efficiency clothes washers, high-efficiency toilets, rotating irrigation nozzles, irrigation controllers and other water-efficient appliances

5.3 Set aggressive policies, laws and regulations. Educate people about existing enforcement efforts and how to report violations.

5.3.1 The City shall require full and consistent adherence to the 2016 California Green Building Codes (CAL Green Division 4.3 Water Efficiency and Conservation).

5.3.2 The City shall develop guidelines that discourage use of potable water for outdoor irrigation and encourage use of non-potable water for irrigation purposes for new and existing residential and commercial development.

5.3.3 The City shall prohibit the use of potable water not delivered by drip or micro-sprinkler systems for irrigation in newly-constructed homes and commercial buildings.

5.3.4 Establish a list of drought tolerant trees, shrubs and ground cover that shall be used in new commercial, industrial and residential development in Arvin.

5.3.5 The City shall promote the use of native and drought tolerant landscaping for all public projects when water-thirsty turf is not needed for recreation activities.

5.3.6 Whenever possible, utilize stormwater, rainwater, or treated wastewater for irrigation rather than relying on high quality, expensive well water.

Figure No. 32: Use of gravel and drought-tolerant plants in any urban landscape can significantly reduce irrigation consumption. The use of gravel or mulch also helps to keep weeds down.

Figure No. 33: Even fast food franchises are getting into the trend of using drought tolerant plants with different types and sizes of rock and gravel.

5.4 Set aggressive water use targets

5.4.1 Advertise per capita water use targets for potable and non-potable water use - 120 gal/capita/ day by 2020, 100 gal/capita/day by 2022, and 80 gal/capita/day by 2025 (current indoor and outdoor potable water use is about 143 gallons per capita per day).

5.4.2 Redesign water bills to clearly state targets and actual usage.

5.5 Consider increasing the cost of non-essential use of potable water

5.6 Provide comparisons of water consumption with other cities in the Valley, based upon potable gallons per capita per day consumption.

5.6.1 Compare consumer's usage with the desired norm and target, with messaging over a sustained period of time. Use water bills, posters, social media and other public information media tools to provide target and usage information.

Appendix A: Hydrologic Cycle and Water Budget of the San Joaquin Valley

According to the California Department of Water Resources the San Joaquin Valley is composed of two sub-basins - the San Joaquin River Basin and the Tulare Lake Basin. Arvin rests at the southeastern corner of the Tulare Lake Basin.

Figure No. 34 shows in detail the San Joaquin Valley watershed which extends south from the Cosumnes River and terminates at the Tehhapis south of Bakersfield. The City of Arvin is located south and east of Bakersfield.

Water in the San Joaquin Valley comes from three primary sources: local supplies from rivers that flow from the Sierra Nevada, Delta imports via the Central Valley Project (CVP) and State Water Project (SWP) canals, and the Valley's underlying groundwater system. Starting in the 1940s state and federal agencies with support from local water interests began to attempt to reverse falling water tables occurring in the drier Tulare Lake Basin by constructing massive water projects that

involved canals, dams and pumps.

To recharge the Valley's water tables (and provide new sources of water for this arid region) water was: 1) imported from Northern California through the California Aqueduct; 2) diverted from the San Joaquin River via the Friant-Kern Canal; and finally, 3) under the auspices of flood control many of the Valley's major rivers (San Joaquin, Kings, Kaweah and Kern) were dammed thereby providing more surface water for irrigation by controlling the rate and time of runoff from the Sierras.

In 2018, the water table condition in the San Joaquin Valley remains acute even with the completion of the major water projects discussed above. Shallow wells in the Valley are going dry (e.g. East Porterville), deeper wells are being drilled to chase the falling water table and the carrying capacity of certain canals is being reduced because of sections of the canals are subsiding.

The Tulare Lake Basin (a sub-basin of the San Joaquin Valley) receives water from four major rivers (Kings, Kaweah, Tule and Kern) that flow westward into the Valley from the Sierra Nevada Mountains. The low point of the Valley has an elevation of 207 feet while the four rivers that flow from the Sierra have their headwaters at 12,000 feet and higher. Arvin, with an elevation of 449 feet rests in the extreme southeast corner of the Valley, south of the Kern River and west of the Tehachapi Mountains.

The San Joaquin Valley (and the smaller Tulare Lake Basin) is subject to a Mediterranean type climate - hot dry summers and cool moist winters. The table below shows that most of the Valley's precipitation comes during the months of December, January, February and March while the regions higher temperatures and evapotranspiration rates occur during the months of June, July and August. It is during these summer months when irrigation intensifies both on the farm and residential yards. Most urban water users in the Valley pump from the ground water system. Agriculture users pump surface water when “wet” winters in the Sierra Nevada yield enough water to meet water contract obligations. When “dry” winters occur (2012 to 2016), agriculture shifts to ground water pumping to make up for the surface water shortfall. With some farming operations they may have the option of either water source.

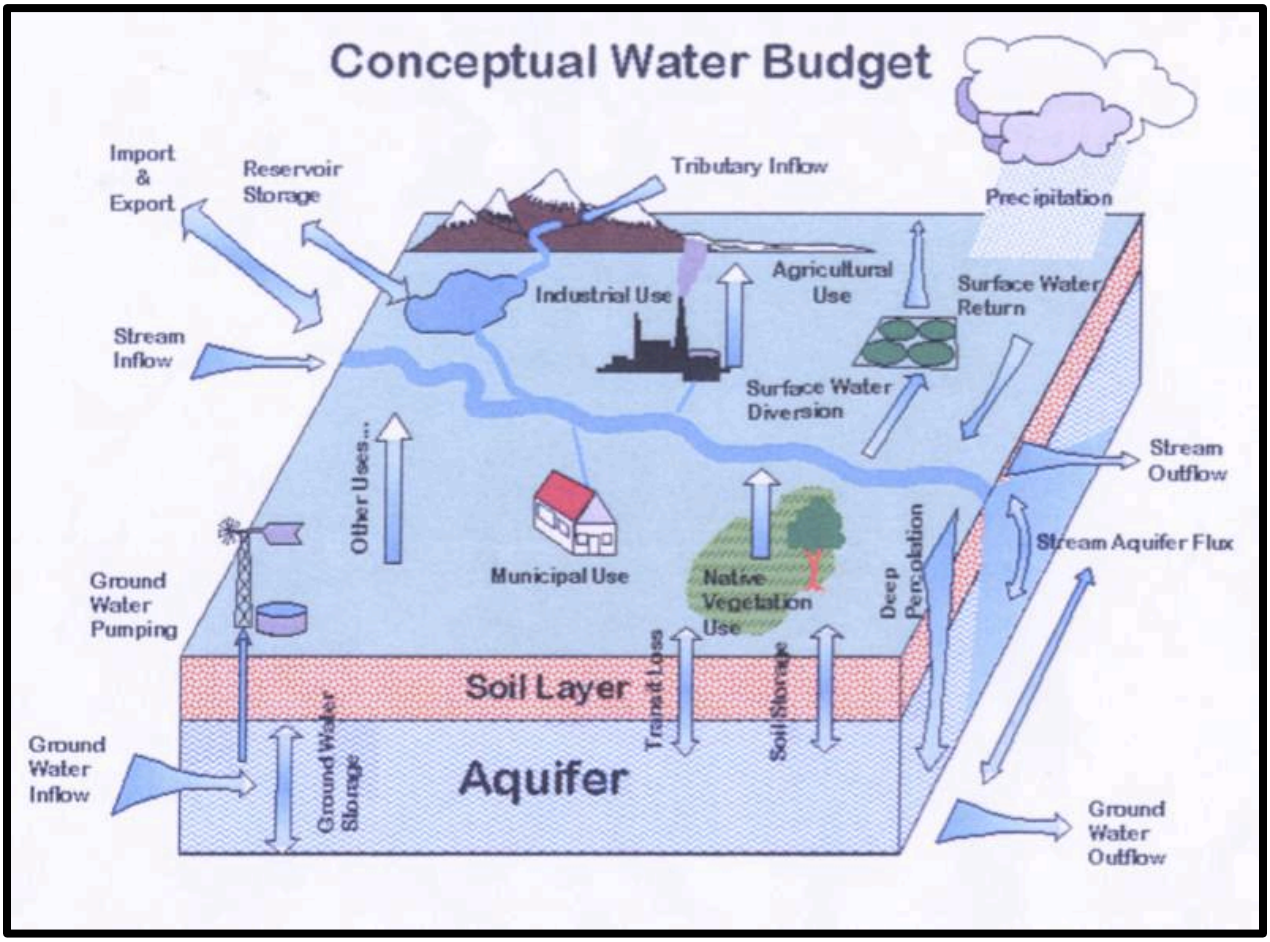


Figure 35: This illustration shows the many ways water is used in the San Joaquin Valley and how water moves through the environment.

This annual cycle of extracting more water from the groundwater system for irrigation and domestic purposes than can be recharged back into the ground continues to jeopardize the long-term viability of the Valley's aquifer. To better understand this prevailing cycle, it is important to know how water cycles throughout the Valley, called the hydrologic cycle.

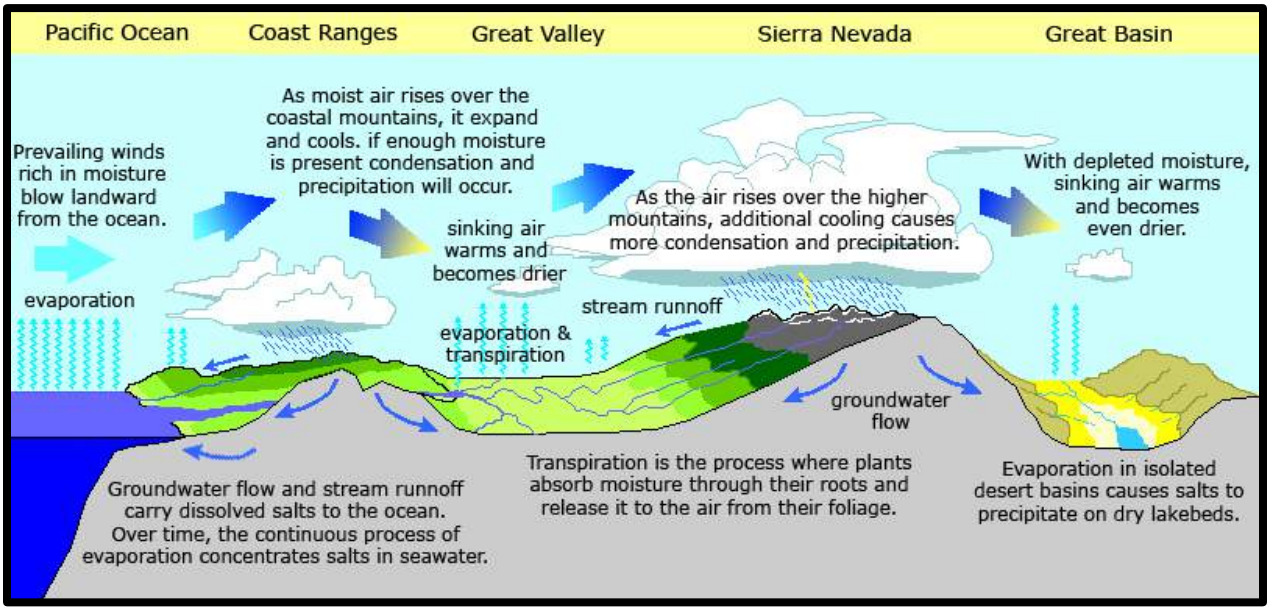


Figure No. 36 shows the hydrologic cycle for the San Joaquin Valley. The precipitation in the Sierra Nevada will fall as rain in the lower elevations and as snow in the higher elevations. The runoff from the Sierra Nevada recharges the ground water system that under lies the San Joaquin Valley.

Precipitation in the San Joaquin Valley generally occurs between the months of November through April. The precipitation comes from storms that come off the Pacific Ocean and strike the Sierra Nevada during the winter months - falling as snow at the higher elevations and rain on the Valley floor and the foothills. Runoff from snowmelt in the Sierra Nevada flows towards the Valley floor, replenishing rivers, creeks and eventually Tulare Lake bed. As water flows towards the Valley floor it percolates into the ground and replenishes the ground water system that lies below the Valley floor, called an aquifer. Agriculture and urban uses depend on both types of water systems (surface water and ground water) for irrigation and domestic water use.

Table No. 9 indicates that the Valley's Evapotranspiration (ET) far exceeds the region's average rainfall. This difference reflected in the table below indicates that the Valley is an arid environment (e.g. desert) and that both surface water (local and imported) and ground water are necessary for agricultural production and urban use.

Table No. 9
San Joaquin Valley Climatological Data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Monthly Avg. Eto (in)	1.25	2.07	3.85	5.69	7.48	7.98	8.23	7.4	5.78	4.11	2.04	1.18	57.06
Avg. Rainfall (in)	1.06	1.18	1.11	0.67	0.22	0.07	0.01	0.04	0.1	0.3	0.59	0.86	6.21
Avg. Temp. (° F)	47.9	52.8	57.2	62.9	70.4	77.7	83.8	82.1	76.9	67.3	55.6	48	-

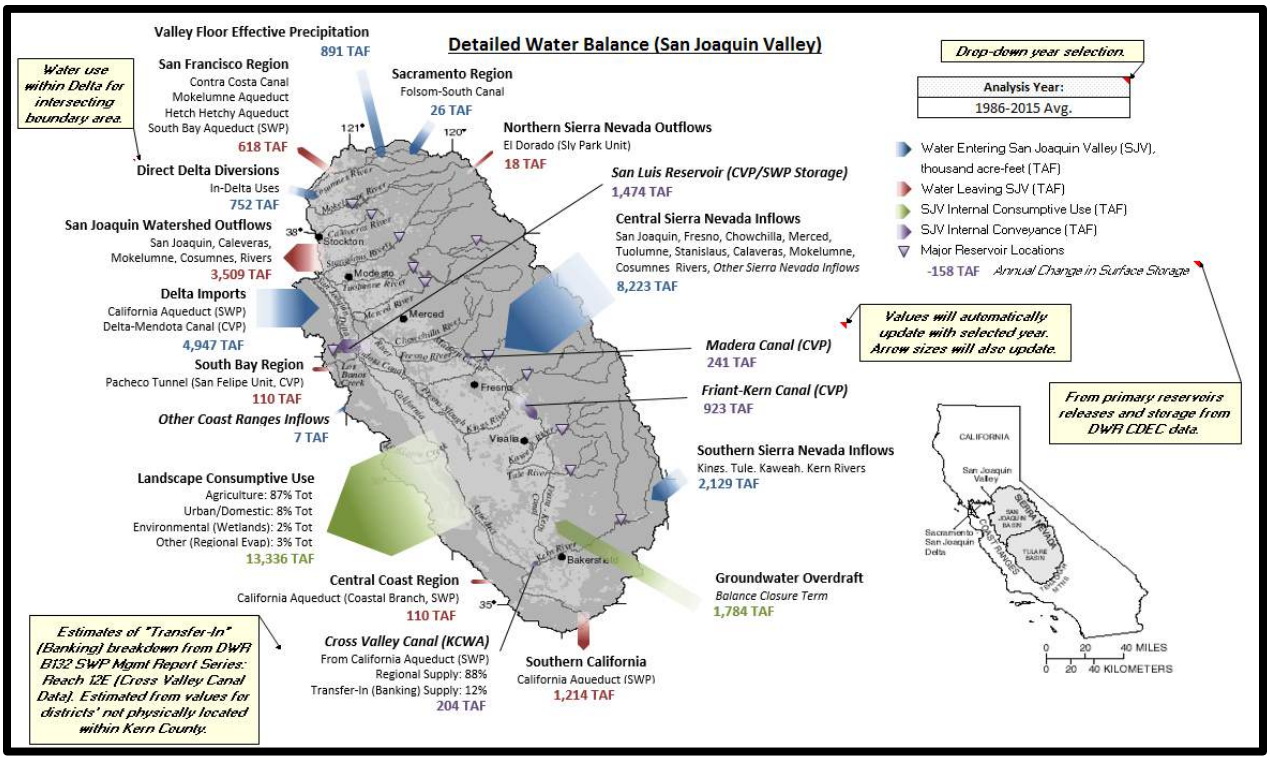
The Sierra snowpack is the Valley's water savings account. As snow melts and flows towards the Valley floor it feeds the riparian woodlands that line the rivers and creeks, and eventually quenches the thirst of urban users and thousands of farms. In Kern County, eight percent of the water that the county receives is budgeted for urban uses (e.g. the cities of Bakersfield, Arvin, Wasco, Shafter, etc.) while 92 percent is used for agriculture.

An 1880 map of the Valley showed a chain of four lakes that occupied the basin floor, starting with Kern Lake in the south and ending with Tulare Lake in the north. The intervening lakes were Buena Vista and Goose. Tulare Lake has had a storied past. In drought years the Lake has entirely dried up while in the largest of water years it ballooned in size to 570 square miles, and in the Great Flood of 1861-62 it exploded in size to cover 790 square miles - three times larger than the Great Salt Lake and four times larger than Lake Tahoe.

Some of the largest snow packs in the country are found in the Sierra Nevada. In recent times, the largest measured snow pack occurred in 1906, before the California Cooperative Snow Surveys were conducted. In 1952, the second largest snow pack occurred in the Sierra. For example, in March of that year Grant Grove received 37 inches in a 24-hour period and a total of 14 feet for the month.

Figure No. 37 provides an illustration of how water moves through the San Joaquin Valley, the source of this water and how much is consumed by various users. A close inspection of this Figure shows how complicated the water budget is in the San Joaquin Valley especially when the reader understands that numerous interests compete for this water including a population over four million people and an agricultural economy that is the most productive in the United States.

Figure No. 37 Water Budget of the San Joaquin Valley



Source: Californiawaterblog.

Because much of Kern County and Arvin are located in an arid environment (precipitation being less than evapotranspiration, or less than 10 inches of rainfall), and because the San Joaquin Valley experiences wild swings in weather patterns, vacillating between droughts and floods and everything in between, it is difficult for the water managers to plan from one year to another. The table below indicates what type of water year that could be experienced in any given year in the Valley (based on 111 years of data collection in the San Joaquin River Basin which would mirror the Kern River Basin).

Table No. 10
Water Year Characteristic in Tulare Lake Basin

Water Year Characteristic	Number of Years	Percent
Wet	37 years	33 percent
Above Normal	22 years	20 percent
Below Normal	18 years	16 percent
Dry	15 years	14 percent
Critical	19 years	17 percent
Total	**111 years**	**100 percent**

Source: Flood and Droughts in the Tulare Lake Basin, Austin

Because of Arvin's arid climate and the fluctuations in water year characteristics, Kern County and Arvin must rely on water being imported from regions outside of Kern County, either through the State Water Project (SWP) by means of the California Aqueduct or through the Central Valley Project (CVP) by means of the Friant-Kern Canal. The Cross-Valley Canal was built to connect these two systems in the 70s.

The CVP ensures that the Arvin-Edison Water Storage District has ample water to recharge the local groundwater system and in turn maintain Arvin's water table at sustainable levels. However, land subsidence along the Friant-Kern Canal and regulatory actions involving water releases from the San Joaquin River have reduced water deliveries to Kern County. These two conditions could jeopardize Arvin's groundwater system as well as that of the larger Arvin-Edison Water Storage District.

Arvin like most cities in the San Joaquin Valley receives its domestic water from the ground water system (aquifer). Agriculture on the other hand uses both surface and ground water for irrigation. During above normal water-years (e.g. 2016-2017 water year) agriculture depends upon surface waters for irrigation; during below normal water years, agriculture will shift to ground water for irrigation.

Groundwater conditions became acute in 2014 and 2015 when surface water deliveries were especially low. Farmers reduced irrigated acreage and total water use, but they also drilled a record numbers of new irrigation wells and pumped record volumes of groundwater in order to maintain their agricultural investments. This accelerated groundwater pumping raised numerous concerns: irreversible land subsidence, higher pumping costs and dry wells. Subsidence rates, with lands sinking by a foot per year in some places, are approaching records reached earlier in the 20th century, before Delta imports began. Since 2014, the drying up of more than 3,100 domestic and small community drinking water wells within the region has raised immediate public health concerns. Also, reduced flows through the CVP and SWP canals, which resulted from subsidence, has raised grave concern from Kern County irrigation districts, cities and water storage districts.

Unfortunately, the ground water in the Valley is being depleted at a rate faster than it can be replenished. The pumping of ground water started in the 1930s when farmers began to use the centrifugal pump. Unfortunately, this pumping was paralleled by California's worst drought in 200 years, from 1927 to 1935. It was during these decades that the condition of subsidence and lowering water tables began to surface as a "problem".

As more land came under irrigation and as permanent crops (orchards, nuts, citrus and tree fruit) replaced row crops, grain and pasture, the need for irrigation water on a yearly basis "hardened" - a term that indicates that permanent crops need irrigation water every year while row crop land can be fallowed if the water year is dry or critical.

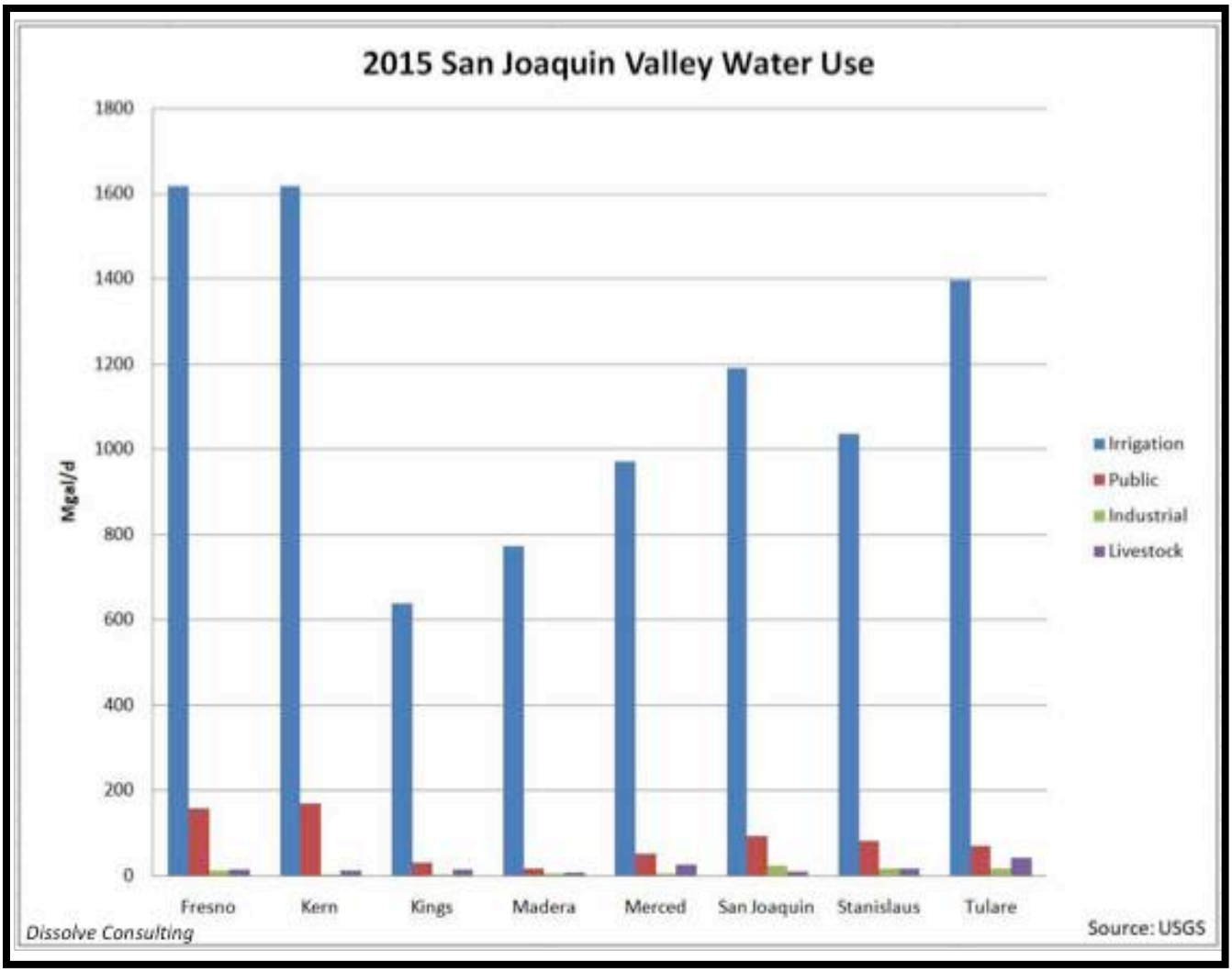
Compounding the drop-in ground water levels, causing farmers and cities to drill deeper wells, is the physical change in the landscape. As ground water is pumped in certain areas of the Valley, generally where clay soils exist, the pressure that is exerted upward is reduced and the elevation of the ground's surface level falls, called subsidence. In soils with high clay content, the ability of soil profiles to reabsorb ground water is reduced and therefore subsidence becomes an irreversible

physical change in the environment. In addition to reducing the capacity of the aquifer to store water it can also have serious ramifications regarding the transport of water. When land along a canal or ditch subsides the capacity of the canal or ditch to transport water is reduced. This condition has occurred along the Friant-Kern Canal and to a lesser extent along the California Aqueduct. This subsidence condition along the Friant-Kern Canal reduced the volume of water received by the Arvin-Edison Water Storage District.

Figure No. 38 Land Subsidence

Figure No. 38 validates the notion that for the San Joaquin Valley to move towards a sustainable water budget, agriculture, the largest consumer of water in the Valley, must begin reducing consumption using a variety of tools and strategies discussed under Appendix B: California's Sustainable Groundwater Management Act (SGMA).

Figure No. 39 Water Use in the San Joaquin Valley by User



Source: USGS

Appendix B: SGMA (Sustainable Groundwater Management Act of 2014)

California's Sustainable Groundwater Management Act (SGMA) calls upon local agencies to find a way to avoid six undesirable results associated with groundwater use - 1) the depletion of groundwater levels; 2) the reduction of groundwater storage; 3) land subsidence; 4) potentially adverse impacts on surface water use; 5) seawater intrusion; and 6) the degradation of water quality.

In 2014, California's Legislature passed a three-bill package that called on the California Department of Water Resources (DWR) to categorize each of California's 515 alluvial groundwater basins into one of four priorities and to put in place arrangements for those basins identified as either high priority or medium priority to progressively mitigate and eliminate six undesirable results from occurring.

The 2014 Act required the formation of a Groundwater Sustainability Agency (GSA) that will be responsible for implementing the provisions of the Act within each groundwater basin. Under the Act, each GSA will be responsible for submitting a Groundwater Sustainability Plan (GSP) to the California State Water Resources Board, which will eliminate the six undesirable effects listed above. Each GSA will have a board of directors, a technical advisory committee, a management committee and a professional staff. The GSA will disseminate information and findings through websites, newsletters, social media, brochures and fact sheets.

The DWR made the decision to base its initial SGMA prioritization results off of its CASGEM (California Statewide Groundwater Elevation Monitoring) Program. Of the state's basins, 127 were identified as being of medium or high priority. A subset of 21 groundwater basins has since been designated as critically over drafted, which included all of the San Joaquin Valley. In the southern San Joaquin Valley, it included the Wells Valley Sub-basin, the Kern County Sub-basin and the Cuyama Valley Basin. Arvin is within the Kern County Sub-basin. The Act requires that groundwater use in these 21 basins be brought under a Groundwater Sustainability Plan or suite of plans by January 31, 2020.

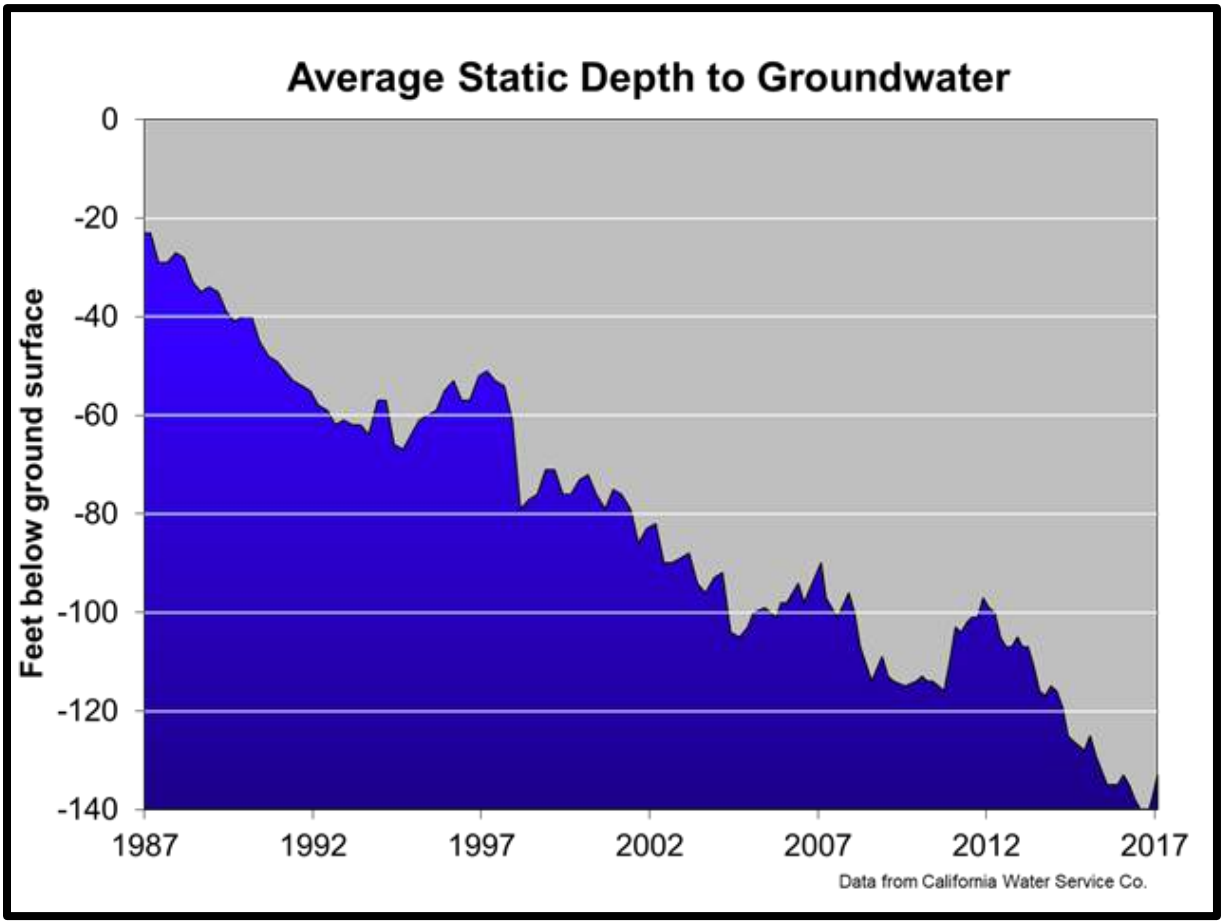


Figure 40 illustrates well what the trend line is in the water table below the City of Visalia. Although located well north of Arvin, this trend line could be a forecast for the water table under Arvin.

Figure No. 41 Groundwater Basins Subject to Overdraft

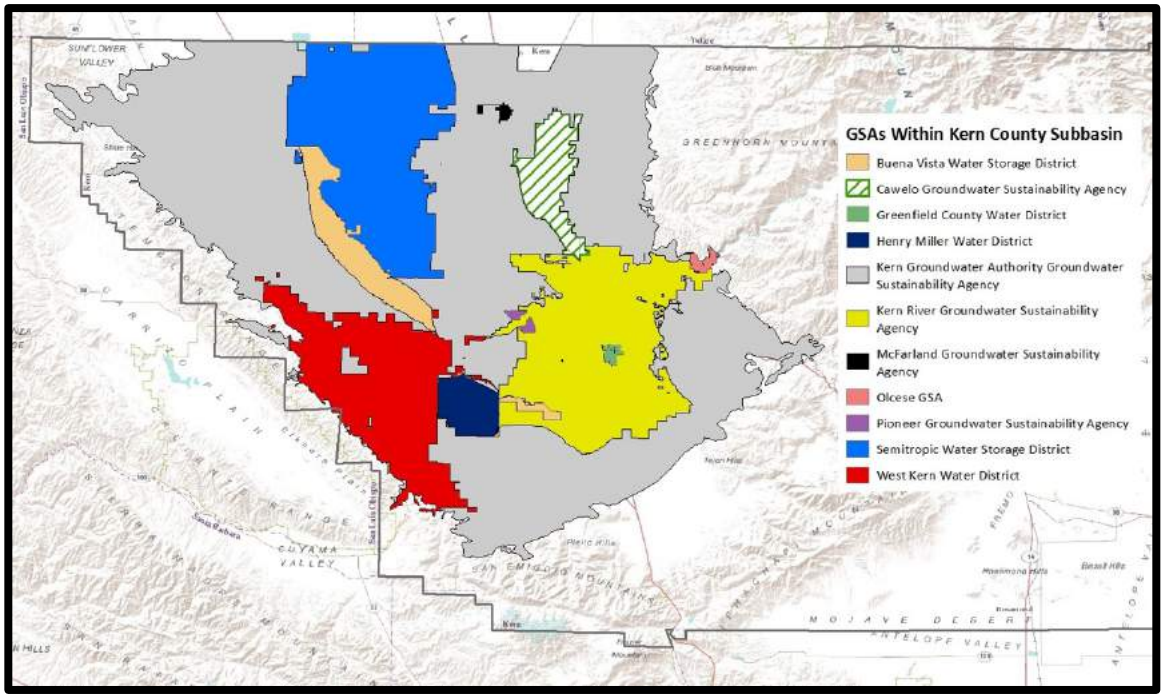


Figure No. 42 Groundwater Sustainable Agencies (GSAs) in Kern County

The GSA can implement as many of the legal tools provided by the Act and that are necessary to manage their basin. SGMA has enacted certain powers to each GSA to implement the following:

- Adopt rules, regulations, ordinances and resolutions to implement the Act.
- Monitor compliance and enforcement.
- Require registration of groundwater wells.
- Require appropriate measurement devices and reporting of extractions.
- Investigate, appropriate and acquire surface water rights, groundwater and groundwater rights into the Groundwater Sustainability Agency
- Acquire or augment local water supplies to enhance the sustainability of the ground water basin.
- Propose and collect fees.
- Adopt and fund a Groundwater Sustainability Plan according to existing laws.

The law gives local GSAs the authority to monitor and measure groundwater use and charge fees to cover the costs of basin management. At a minimum, GSAs are required to formulate reliable water accounting tools—including monitoring systems and models of how water moves within a basin and how much water is available and how much is being withdrawn. The GSA also needs the ability (and authority) to incentivize or require reductions in pumping when needed to attain long-term groundwater balance.

At a minimum, GSAs will need to collect enough funds from local groundwater users to cover the costs of monitoring and basin oversight. Ideally, they could also collect funds to cover the costs of ground water recharge, land retirement, investment in irrigation technology, etc.

To reach a point where the Valley's ground water system is considered "sustainable," the two primary consumers of this resource - agriculture and urban - need to formulate and implement a series of strategies that will resolve a resource depletion trend that has been occurring for over 80 years.

In Kern County, 92 percent of the water is consumed by agriculture; 8 percent by urban users. Below are strategies that could be employed by these two water users.

Agriculture

- accelerate ground water recharge efforts
- retire lands that could be used for habitat, solar or groundwater recharge
- continue to invest and utilize new irrigation technology
- raise crops that are more suited to an arid climate
- continue to fallow land during "dry" water years
- fix those sections of the Friant-Kern Canal and the California Aqueduct that are suffering from subsidence
- modify soils to improve the crop's ability to "take up" water.
- "flood irrigate" appropriate crops with surface water (e.g. walnuts, pecans, almonds, etc.)

Urban Uses

- continue to adhere to the California Green Building Code
- utilize treated wastewater for irrigation or ground water recharge
- reduce lawn irrigation by establishing programs that encourage homeowners to replace their lawn with drought-tolerant plants, mulch, gravel and cobblestones
- promote on-site storm water drainage using bio swales
- capture rainfall using rain barrels
- reduce impervious surfaces by installing parkways and landscaped medians, which will retain storm water runoff and recharge the groundwater system

Appendix C: Water Rights

The reader may wonder what water rights has to do with water conservation and ground water sustainability in Kern County and the City of Arvin. Actually, the understanding of water rights is extremely important to the conversation because the issue of water management is very "complex and controversial" and the reader needs to have a general understanding of how water gets allocated in the San Joaquin Valley from a "rule of law" perspective.

The earliest basic principle of allocating water in California came from Spain. The basic principle was "proportionality" - people obtaining an amount of water proportional to their legitimate need and in proportion to the amount of water available, which could change from year to year. The Plan of Pitic (created in 1783 in Hermosillo, Mexico) forebode a person's use of water from a watercourse if that use abused the rights of other individuals using water from the same watercourse. Water judges in early California prevented a resident from taking a greater volume of water when it caused injury to owners of land who also used the same source of water.

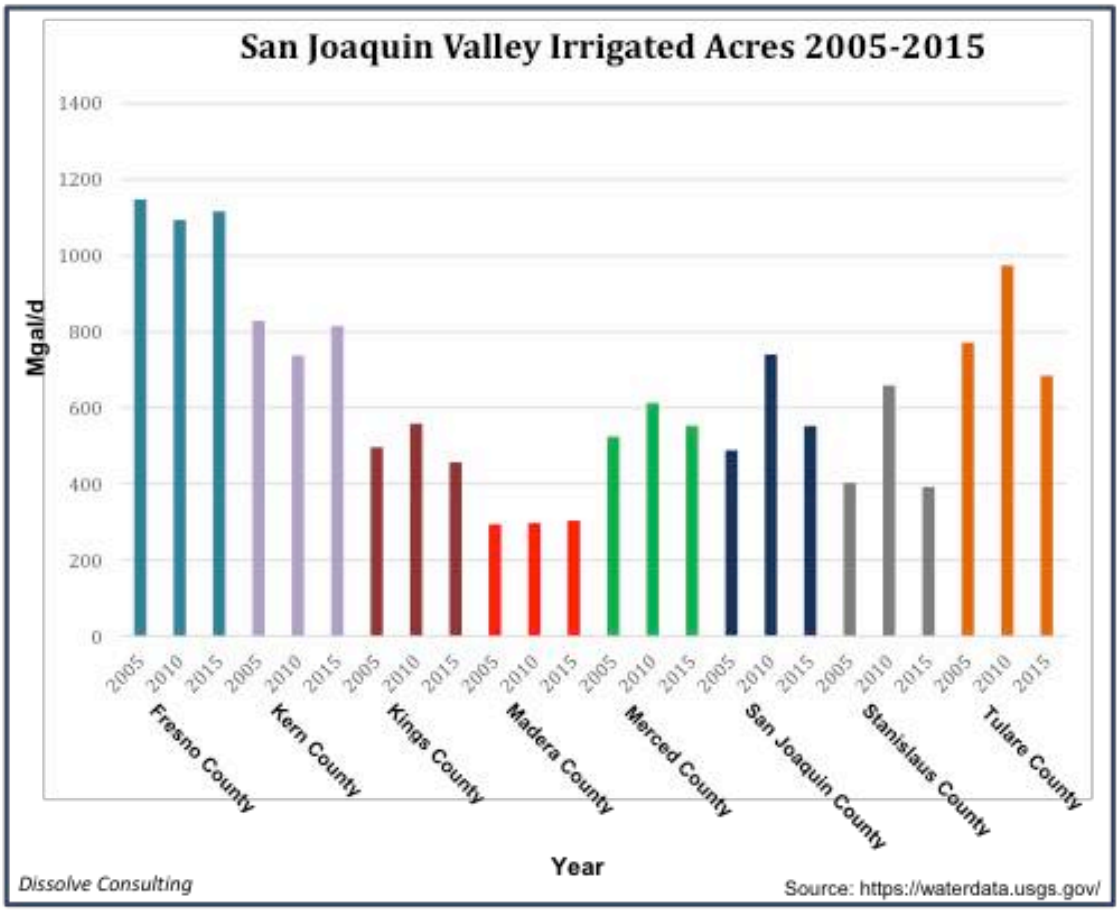
Early water law allowed persons occupying land adjacent to watercourses to claim a "riparian" water right. This law collided with "appropriation" water rights, which indicated that water from a watercourse could be diverted onto land for irrigation even if that land was not adjacent to the watercourse. Land speculators using appropriated water rights began to market land to small farmers around the country who wanted to move to California to start their farming business.

Appropriated and riparian water rights collided in a court case involving two land barons - Haggin and Lux (of Miller and Lux Land Company). Miller and Lux had riparian water rights at the lower end of the Kern River in Kern County. Haggin had appropriated water rights on the upper reaches of the Kern River. The settlement following the court decision (1886) that created the California Doctrine, which stated the following: - (1) riparian rights went with all lands that were located on a watercourse; and (2) an appropriated water right could be superior to a riparian water right if that user began using the water from the water before the riparian water right was secured downstream. In other words, timing determined which water right prevailed.

This new approach to irrigation of land enriched persons who played a role in water diversions - canal and ditch builders - and it intensified the acreage that was placed under surface water irrigation (60,000 acres in 1870, 300,000 in 1880 and one million acres in 1890). Since the 1930s when the centrifugal pump was put into use, irrigated acres in the San Joaquin Valley have sky rocketed. Figure No. 43 shows that about 4.8 million acres of land in the Valley are under irrigation. Fresno County ranks first in this category followed by Tulare and Kern counties. The amount of existing irrigated acreage in the Valley, and the reduction of imported surface water due to climate change and with the demand for water by Southern California, will place tremendous

pressure on the Valley's groundwater system. Potentially, farm lands will be required to be retired or fallowed in order to maintain sustainability within the system.

Figure No. 43 Irrigated Acres in the San Joaquin Valley



Paralleling the trend of diverting water for irrigation to non-riparian lands was the California's legislature approval of the Wright Act (1887), which allowed for community control of water (called irrigation districts) that irrigated large and small plots of land throughout California. The early precursor to the irrigation district was the mutual water company, which was formed to provide surface water irrigation to planned agricultural communities that were often composed of vineyards and orchards. The first mutual water company of any size was one in Anaheim started by German immigrants on a former land grant land.

Today there is multitude of irrigation and water districts managing water throughout the Valley along with other special districts including ditch companies, water conservation districts, water storage districts, and public and private water companies (e.g. California Water Service).

These irrigation entities have done a responsible job over the last 150 years in transporting surface water throughout their districts, even in drought years; however, it is the management of the groundwater system that has become challenging. Some districts have been active in recharging the ground water system in "wet" water years but even this effort has fallen well short of a well-managed San Joaquin Valley ground water system.

With the California Doctrine somewhat resolving the conflicts between "riparian" and "appropriation" water rights, the courts turned their attention to the management of the ground water system. In 1903, the State Supreme Court in *Katz v. Walkinshaw* created the "correlative" rights doctrine, which held that there were multiple owners above an aquifer - each had a "correlative" right or a "proportional" right to a reasonable volume of water. Obviously, the reasonable use of water can be debated especially when one farmer is raising trees on a drip irrigation system while an adjacent farmer is flood irrigating an alfalfa field; or one farmer is pumping with a 5-horsepower pump at 75 feet while the adjacent neighbor is pulling water from 150 feet using a 20- horsepower engine.

Katz v. Walkinshaw did not resolve the over pumping of the ground water system and so a half century later (1949) the court waded into the ground water controversy once again by creating the "mutual prescription" doctrine. This ruling established in *Pasadena v. Alhambra* awarded prescriptive rights to users of an over drafted aquifer and set a formula for the volume of water that was rightfully owned by each party pumping water. The court used a formula for each pumper of the aquifer based on that user's highest five years of pumping. The court then indicated that each user must reduce their pumping until pumping of the aquifer did not exceed the safe yield of the aquifer. This ruling was potentially workable in Southern California, but it did nothing to resolve the overdraft problem in the San Joaquin Valley.

Fast forward to 2018 and one could argue that neither the courts, the State or the hundreds of water agencies have formulated a sustainable water management strategy for the larger San Joaquin Valley and the smaller political entities of Kern County and the City of Arvin. This ineffective management strategy could potentially lead to the collapse of the Valley's ground water system, which is critical to the economic health of the Valley's agriculture and to the health and safety of the residents of this region. Land subsidence, overdraft conditions, contaminated water systems, and failed wells are all leading indicators of a system that is on the verge of collapse.

Appendix D: Urban Water Conservation Strategies

"Necessity is the Mother of Invention". Diminishing water resources in the Valley have spurred innovation in the field of water-savings strategies. Some of these water-saving strategies, which can be embraced by all cities in the Valley including Arvin, are detailed below.

Rain Barrels

Theoretical total annual capture of rain water for a 1,500 square foot roof area in Arvin is 11,175 gallons. This figure is obviously higher in other areas of the Valley where the average rainfall figure is higher. This volume of water is generated during the winter months but the need for irrigation water occurs in the summer months, June through September. How does one a utilize rain barrels in an arid environment like the San Joaquin Valley, especially when one understands that to store a year's worth of rainfall a 15,000-gallon storage tank (273 55-gallon barrels) and a pump system would be required? Stated another way, does rainwater harvesting make sense in a dry climate?

Jesse Froehlich, founder of BlueBarrel, discussed this question extensively. An abbreviated version of his conclusions and his supporting charts, narrative and graphs are provided below. Are rain barrels going to solve the problem? No. However, when integrated with an urban water conservation program they can reduce per capita water consumption, energy consumption and one's carbon footprint.

Jesse Froehlich, Blue Barrel, Rainwater Catchment Systems

WHERE DOES YOUR WATER COME FROM IN THE SUMMER?

Being in the rainwater harvesting business in arid California, I often hear comments like this:

"In our climate it rains in winter when we're not irrigating. Then when we need the water in summer, there's no rain. I just don't see how rainwater harvesting makes sense with such a long dry season."

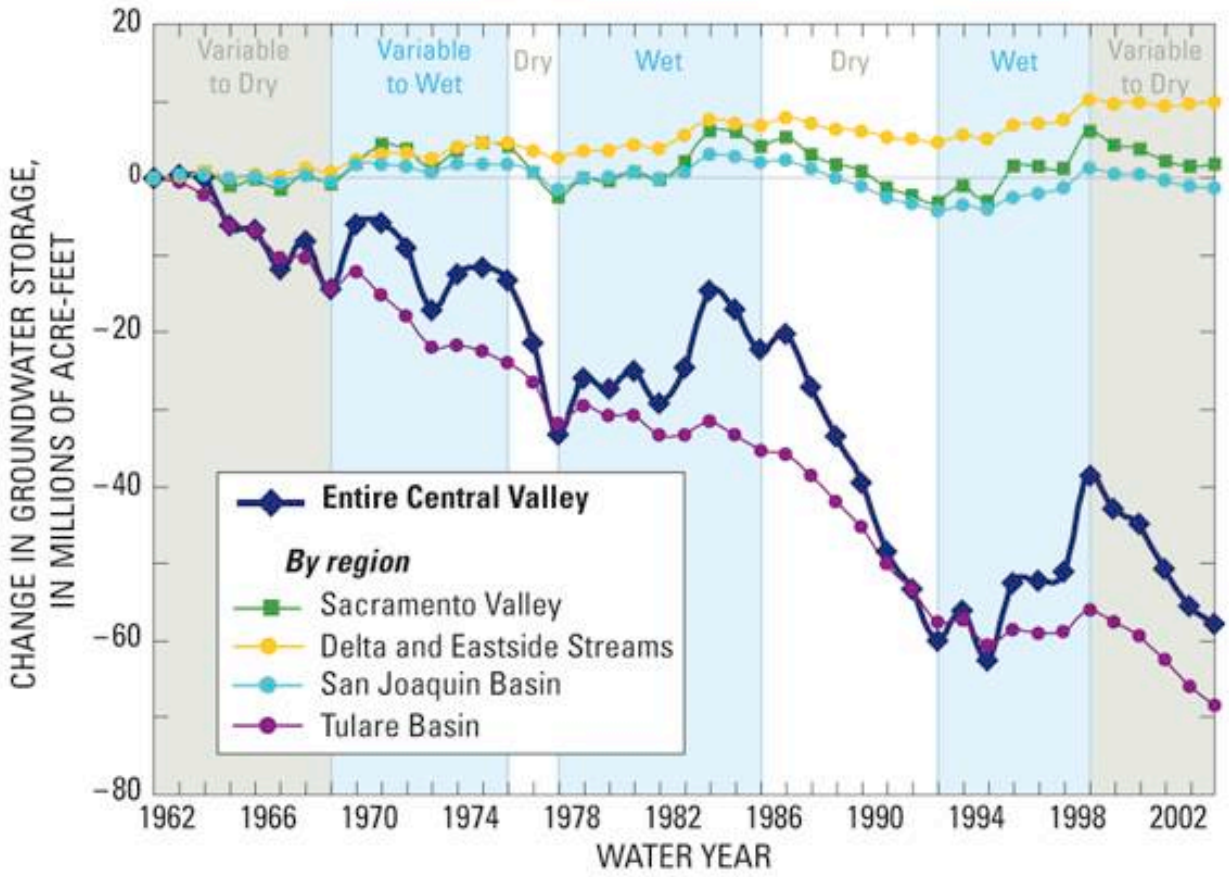
Let's dig into this predicament. We have to ask ourselves where our water comes from during this long, hot summer.

Whether you're a municipal ratepayer or on a private well, there's a good chance your water is pumped from underground aquifers. Or it comes from surface waters, or a combination. In any case, can you imagine what happens to these shared water sources as the dry summer drags on?

That's right: they draw **DOWN**, **DOWN**, **DOWN**!

And unfortunately, there's another compounding factor: when it finally does rain again, this abundant fresh water resource sheets off our hardscapes, and hurries **AWAY**, **AWAY**, **AWAY**!

See below for an illustration of the effect of our hardscapes on nature's hydrologic cycle. The water that is intended to infiltrate and recharge groundwater is prevented from doing so in our urban and semi-urban environments. The effect over time is overdraw, and in dry climates we are especially vulnerable.



That big downward-sloping blue line shows us what the California central valley aquifers have been up to (or "down" to) over a recent 40-year period: **a steep decline**. And with a rapidly growing population in this region, the problem is only getting worse.

So, let's consider this: What if you could do your share to counteract this trend by meeting even some of your summer irrigation demand with stored rainwater?

But this begs another question:

HOW MUCH WATER CAN I REALLY CATCH WHEN ITS SO DRY?

It is amazing just how much water you can catch off of a small rooftop surface, even in a dry climate. Every square foot of catchment surface will yield about 0.6 gallons for every inch of rain.

From a 1,000 square-foot rooftop, you can harvest this much water in an average year!:

Town/Area	Avg. Annual Rain	Gallons per 1,000 sq.ft.
Eureka	40.2"	24,120 gallons!
Santa Rosa	31"	18,600 gallons!
San Francisco	23.6"	14,160 gallons!
Sacramento	18.5"	11,100 gallons!
Los Angeles	15.1"	9,060 gallons!
San Diego	12"	7,200 gallons!

Now that you see the numbers in action, don't forget about garages, workshops and sheds! You really don't need much surface area to fill a rain barrel, or even a series of them.

With these numbers in mind, the question isn't about whether there's enough water to catch, it's about how much space you want to dedicate to water storage.

We all dream of a rainwater catchment system that can meet our year-round demand. (I sure do!) And as shown by the numbers above, that system may be possible even in arid California.

It is likely, however, that your budget and/or spatial constraints limit your ability to store that much water. **So, catch what you can and enjoy the benefits in proportion!**

There are three ways to manage a rainwater catchment system if you can't store enough water to meet your entire dry-season demand:

1. Store what you can, use it while it lasts (which may be longer than you think if you use gravity-fed drip irrigation), and switch back to your existing water source when your rainwater runs dry.
2. Store what you can, use it while it lasts, and then re-fill your rainwater tanks with your backup water source to continue using your gravity-fed drip system throughout the dry season.
3. Dedicate your rainwater catchment system to a particular garden zone, like a perennial border or raised vegetable beds, and size the system to meet that zone's irrigation need all summer long.

DON'T FORGET ABOUT ENERGY SAVINGS AND EMERGENCY PREPAREDNESS

If climate change is on your mind, it's worth noting the huge nexus between energy and water. Twenty percent of per capita energy use in the state of California is dedicated to pumping, treating, heating, and transporting water. And in turn, there is a large water demand associated with cleaning and cooling energy generating facilities. When you reduce your draw on pumped and treated water sources, you shrink your

carbon footprint as well. And with this energy savings, you contribute to a collective reduction in water needed for power delivery. Like many things in life, this is an interconnected cycle.

HOW LONG CAN I STORE RAINWATER?

Is it a concern that water may sit in tanks for months before being used? Not with a well-designed rainwater catchment system. Depending on your system's overflow handling, you may actually be pushing older water out as newer water enters.

But even if rainwater is held in storage for extended periods, there are a couple of best practices that help prevent problems in your tanks:

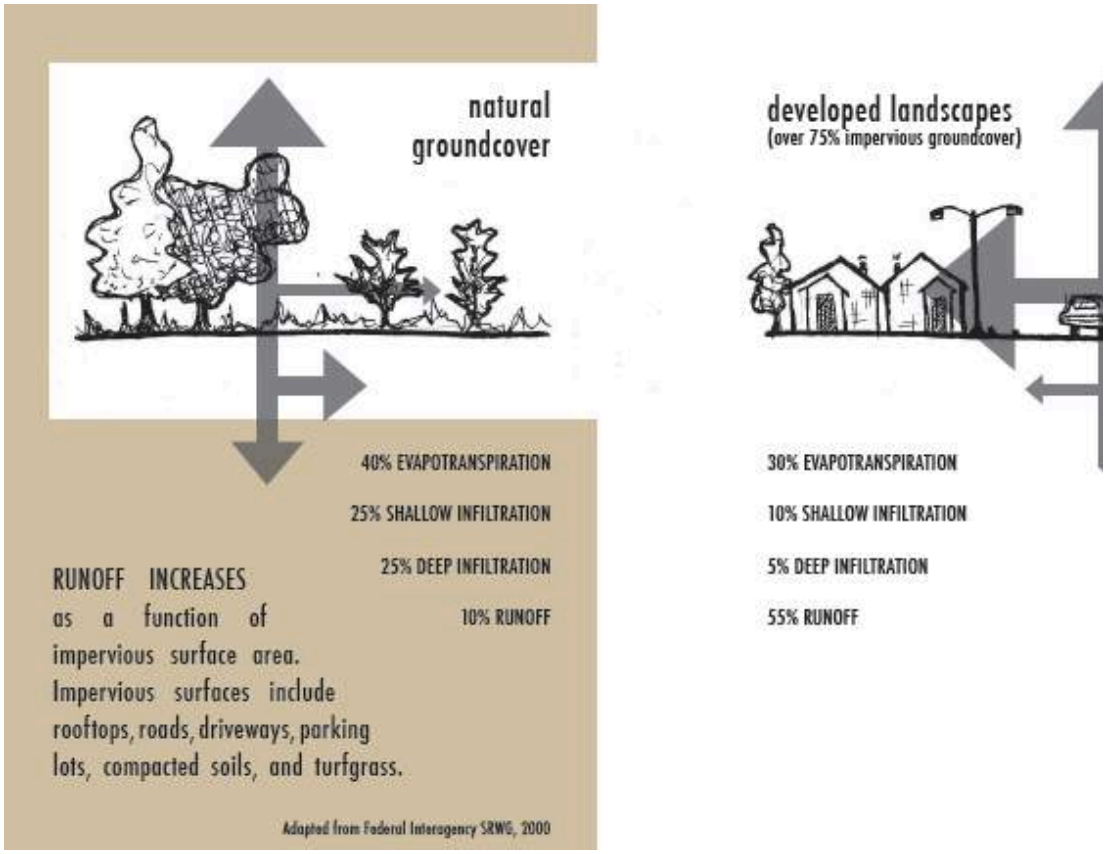
- **Use dark-colored, opaque tanks**. Sun exposure will quickly lead to algal growth, but this is completely prevented when sunlight is excluded.
- **Keep your tanks in the shade**. If tanks are kept out of direct sunlight the temperature will remain cool enough to prevent bacterial growth in the tanks.
- **Keep up with routine seasonal gutter clean-outs**. The most important time to sweep out your gutter is in the fall before the first rains.
- **Rough-filter the water on the way into the tanks**. This serves to keep out any major particulates that can cause in-tank water quality to decline.
- If storing for emergency purposes (i.e. holding the water and not drawing it down), **drain and recharge your system at least once per year**.

An optimized rainwater harvesting system (in a dry climate!) will drain by the end of the dry season so you'll get a fresh recharge at least every year. I say "at least" because this wonderful water source is also good for washing cars, defrosting windshields, rinsing boots, garden wares and lawn furniture, and watering pets, so you may find you draw down your tanks a bit (and in turn fill them up again!) even in the thick of the rainy season.

IN CONCLUSION

At this point my suspicion is that here in California we're just not dry **enough**! It's the very dry southwestern states (AZ, NM, TX) with annual rainfall averages as low as 8" – 12" that are spearheading the re-birth of rainwater harvesting in the USA with favorable policies, incentives, and active licensing programs. Many California jurisdictions are beginning to follow suit.

When its **really** dry, rainwater harvesting is a no-brainer. Of course, when it's really wet, it's a no-brainer, too. Let's not fall victim to the Goldilocks Complex. Let's harness this fresh abundant resource to improve our gardens, be prepared for emergencies, and restore the broken link in our urban hydrologic cycle before it's too late!



Our Broken Hydrologic Cycle

In our developed environments, groundwater doesn't recharge the way it would in nature.

In a natural landscape, about **50% of precipitation hits the ground and infiltrates** to hydrate soils and recharge groundwater. About **40% evaporates** (or evapotranspirates through the metabolic activity of plants and animals); and only about **10% becomes runoff**.

In a developed landscape however (including our towns and cities), with 75% impervious groundcover (think roads, parking lots, buildings, driveways, and even lawns), only **15% of water is allowed to infiltrate**, while a whopping **55% becomes runoff**. In an urban environment, this runoff sheets off the hardscape picking up automotive, industrial, and other pollutants along the way, rushing them to our sensitive waterways.

Rainwater Harvesting gives us the opportunity to hold this hardscape runoff onsite and allow it to infiltrate at a more natural rate if we use it to irrigate our gardens when it's not raining.

To Boot, Rainwater is Just Too Good!

As if all this weren't enough, serious gardeners know that rainwater is a good thing to have on hand, no matter how much rain (or how little!) you get.

Water Quality: Rainwater is the highest quality water source available to plants for three reasons:

1. Rainwater is free of the salts, minerals, and heavy metals that leach into groundwater and surface waters–a 100% soft water source.

2. If caught from a rooftop and stored in barrels, rainwater will accumulate a small amount of organic matter which can be very beneficial to your garden—a light application of fertilizer every time you water.

3. Rainwater is slightly acidic. Most organically grown plants prefer a soil pH of 5.5 – 6.5: on the acidic side of the neutral pH 7. Rainwater can help you maintain that perfect soil pH balance!

You will notice the difference, especially with young plants (they are particularly sensitive to salts and chemicals), and also with potted plants, whose containers tend to accumulate salts and minerals over time. In an open garden, you'll also get much less soil salinization and mineral buildup with rainwater.

Gravity Feed: And for the resource-conscious gardener there's even more! Stored rainwater is an ideal match for drip irrigation. In fact, drip irrigation will work by gravity feed, even on a flat site. Drip irrigation does not require pressure, it just requires water in the line. So as long as your water level is above the high-point on your drip line, you will get water to your garden with no added energy inputs!

Landscaped Medians

Most cities throughout the San Joaquin Valley contain overly wide streets the centers of which collect dust and debris, absorb heat and generate runoff that is tainted with oil and other chemicals. When these "wide" streets are adjacent to development that does not require left-hand turns into residential driveways or intersecting streets, this center area, which is 10 to 12 feet wide, can serve as a landscaped median that captures rainfall, reduces the area of heat-absorbing pavement and separates opposing traffic with a curb barrier.

Figure Nos. 44 and 45 show overly wide streets that are typical in many Valley cities.

The City of Visalia prepared a Case Study on the costs and benefits of converting paved medians to landscaped medians. The Case Study involved an overly wide street in Visalia that was a quarter mile in length and had a paved width of 12 feet. Figure 46 illustrates the before and after images of such a conversion.

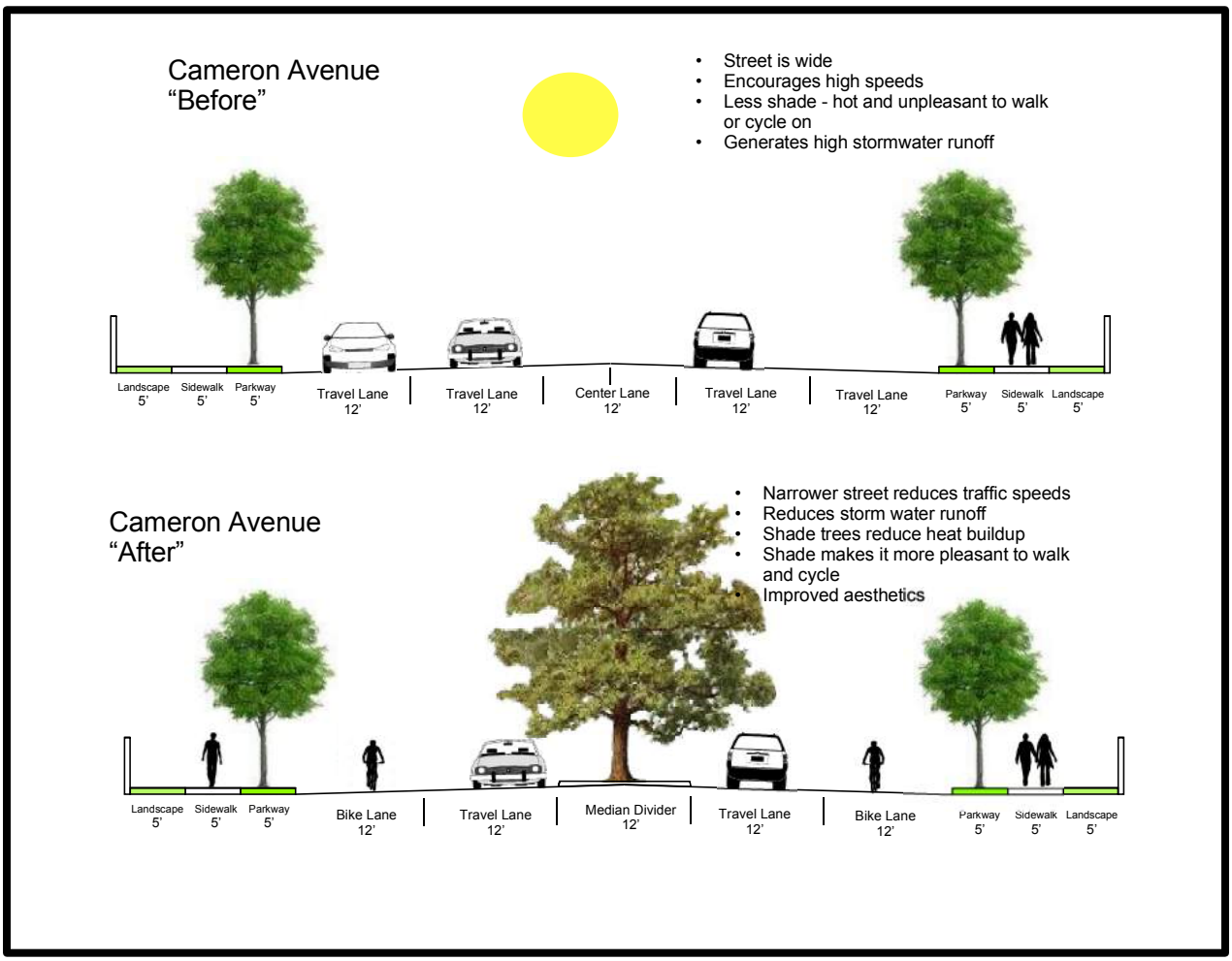


Figure No. 46: The "after" schematic of Cameron Avenue in Visalia shows a street that is cooler, more aesthetically pleasing and conveys slower moving traffic.

The project would involve removing the paved median and replacing it with a tree-lined dirt median absent an irrigation system. The median would be covered with mulch and Valley oak trees would be planted on 50-foot centers. The findings of this Case Study are as follows:

Findings for Constructing Landscaped Medians in Visalia

1. Estimated cost to construct a quarter-mile landscaped median: $425,000
2. Traffic would drive slower along this roadway segment thereby making the roadway safer to drive along.
3. Trees planted in the median would require pruning at around 20 years and every 5 years thereafter.
4. Ambient temperatures along the median would be reduced during the summer months because pavement would be replaced with dirt (mulch) and shade trees (Valley oaks)
5. Storm water runoff would be reduced because water hitting the median area would infiltrate into the ground water system. Further, mature trees would also reduce storm water runoff due to leaf capture of rain water.
6. The quality of storm water runoff would be better because fewer contaminants would be entering the storm water drainage system from the paved median
7. The quantity of water percolating into the ground would increase because impervious surface area would be reduced – 1,320 feet x 10 feet = 13,200 square feet or .30 acres.
8. Mature trees increase the value of real estate when compared to neighborhoods without a mature tree canopy.
9. .15 acre-foot would be recharged into the ground water system.

The White Paper concluded that installing landscaped medians in overly wide streets in Visalia would be expensive. However, when one reviews all the benefits and compare it to the cost of the project, it may begin to make sense in the long-term, especially as the cost of water and energy increases over time.

Grey Water Systems

Gary McDonald Homes, a homebuilder in Fresno, is introducing a home water catchment and recycling system that takes do-it-yourself gray water irrigation projects to the next level. This system is being proposed for all 44 homes at its new Copper Hill Estates in northeast Fresno according to a recent article in the Fresno Be

"Gone are buckets and small water-circulation pumps. Now, pipes incorporated into a new home carry shower and laundry water to underground storage tanks while a treatment system cleans it for landscaping use – not to drink." McDonald estimates that two out of every three gallons of water used inside the home can be recycled – used for outdoor irrigation.

A special set of pipes carry drain water from showers and washing machines to a 75-gallon in-ground collection tank. The water is then pumped into a treatment appliance that sits above ground, next to the house. Soap and solids are extracted, and the disinfected water goes into a 200-gallon underground tank. The system costs about $250 a year to operate.

The recycled water can irrigate about 1,600 square feet of landscaping a day, McDonald said. The homes at Copper Hill Estates will range in size from 2,864 to 4,194 square feet on lots between 8,715 to 18,226 square feet.

The system, which costs about $12,000 for the builder to buy and install, will add 10 percent to the resale value of a home, McDonald said.

Nexus is a start-up home water and energy recycler whose founders are from Australia, where a 12 year-long drought fueled the need for water-saving solutions. The company developed the water recycling system after a change in the California Building Code in 2013, called the Green Building Code.

The Green Building Code for the first-time permitted water recycling at the home level if the system is certified by the State.

Two out of every three gallons of water can be treated and used for irrigation. the average occupant creates 30 to 40 gallons of water a day that can be recycled. a family of four can have up to 160 gallons of recycled water available for reuse.

Here is how the recycling system works:

The recycled water is used to irrigate the grass, bushes, flowers and is safe to use on vegetable gardens. The water can even return into the house to be used in the toilet, although Gary McDonald Homes has not chosen this option, Hitchner said.

"About two of every three gallons first used indoors can be treated and reused for outdoor landscape," Hitchner said. "In an area like this, where irrigation is so big, it is probably the biggest water savings that you can have."

Installing the system into a new home is the most cost-effective solution. An existing house built on a raised foundation can be retrofitted for home water recycling, but there is no contractor in Fresno yet who can do the work, Hitchner said.

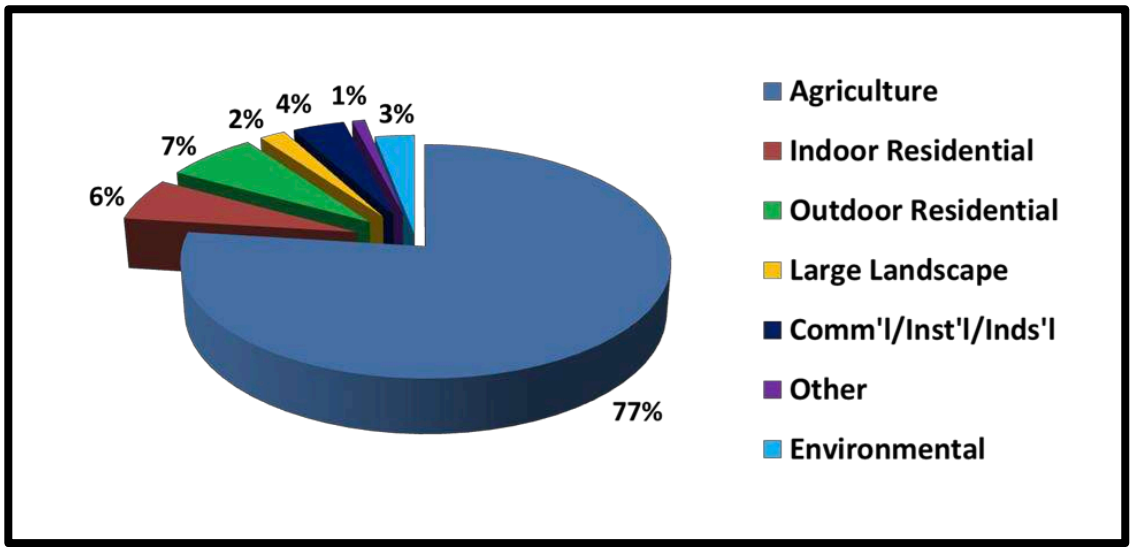
"Most of the things that motivate me personally was just reading in The Bee about the drought and people who are willing to make great sacrifices and effort to keep their landscaping, primarily their shrubs and trees if nothing else, alive," McDonald said.

"This is just a natural step. … What else can you say, but this is the gold standard right now of water conversation for residents."

Outdoor Irrigation

According to a paper prepared by Donald R. Hodel and Dennis R. Pittenge called, "9%: Perspective on the California drought and landscape water use", water used for outdoor landscaping amounts to 9 percent of the water used in California. Statewide, the major water user is agriculture at 77 percent. In the San Joaquin Valley, as a percentage of total, agriculture is closer to 92 percent and outdoor irrigation is around three percent.

Figure No. 47: Average percentages of developed water use in California during a non-drought year



Sources: Calif. Dept. of Water Resources, 2013 California Water Plan Update Chapter 3. UCLA Institute of Environment and Sustainability, So. Calif. Environmental Report Card, Fall 2009).

Hodel and Pittenge have found that statewide residential accounts for seven percent of outdoor water use while parks, golf courses and sports fields and consume about two percent.

Lawns are major users of water for outdoor irrigation. According to Hodel and Pittenge, 40 to 60 percent of the Valley's outdoor irrigation is used on lawns, and when all outdoor irrigation is included the percentage can increase to 75 percent.

Lawn types range from cool-weather grasses such as bluegrass and fescue to warm-weather grasses like Bermuda and buffalo grass. The cool-weather grasses require the most water while Bermuda grass actually goes dormant during the winter months and therefore does not require irrigation.

The authors argue that letting one's yard go dry has certain disadvantages – dead trees with falling branches and increased fire hazard. Other impacts that result from yards going dry include increased ambient temperatures and storm water runoff, adverse impact on aesthetics and property values, and reduced carbon sequestration. Without shade from trees the ambient temperatures

increase causing higher utility bills for the residents and less water holding capacity in under lying soils. Trees and shrubs help reduce storm water runoff from an urban site. A dry yard can introduce a blighting appearance to the neighborhood, causing property values to drop and discouraging persons from investing in the area.

For the urban resident to reduce their outdoor water consumption, strategies can range from the simple to the complex and expensive. Starting with the simple, a resident can save a significant amount of water (25 to 35 percent) by properly irrigating the yard area. Here are some simple water conservation solutions:

1. Deep water your trees., upper 12-inches.
2. Improve irrigation performance – fix leaks, adjust irrigation spray onto plant material not hard surfaces, run irrigation system between midnight and 6 a.m., and use drip systems on shrubs and perrenials.
3. Apply organic mulch around trees and shrubs.
4. Reduce lawn cover and replace with hardscape.

Complex strategies for reducing one's outdoor water consumption can range from installing a grey water recycling or rain barrel system (both discussed above) to replacing one's entire outdoor landscape with a drought tolerant (xeriscape) landscape. When one is going to convert their traditional landscaping (lawn, perennials/annuals, shrubs and trees) to a drought-tolerant landscaping scheme, it is important to save as many trees in the yard as possible because they provide shade, which reduces summer energy costs, and they maintain soil moisture under the tree canopy. There may be some trees that require removal because they are too close to the home or they could be replaced by a tree that is better adapted to the climate of the San Joaquin Valley (e.g. Palo Verde tree versus the coastal redwood).

In Kern County and Arvin specifically, 65 to 75 percent of the gallons per capita per day (gcpd) of water is used for outdoor irrigation. The following is a description a typical drought-tolerant landscape that incorporates a number of design strategies that will reduce outdoor water use. To have a water-efficient and aesthetically pleasing landscaped yard, a qualified landscape designer or architect should be retained to prepare such a plan.

Figures 48 and 49 are two homes located across the street from each other in Visalia. The yard in the lower photo contains cool lawn (fescue), trees and shrubs. The upper photo is a yard that contains trees, shrubs but no lawn. The lawn has been replaced with boulders, gravel and drought tolerant plants. All vegetation is watered with a drip system while the home with a lawn is watered with sprinklers. The difference in water consumption between the two yards is substantial - a difference of 3,000 gallons between the two yards over the summer months.

Conserving Water in Your Landscape

1. Replace lawn with hardscape (decomposed granite, cobble stones, concrete or pavers) or artificial turf.

2. Apply mulch to all planter beds and around the base of trees.

3. Plant shrubs that are adapted to Region 8 and 9 of the Sunset's Western Garden Book.

4. Install drip irrigation to all shrubs and trees.

5. Deep water trees by soaking during evening hours or by utilizing deep watering stakes.

6. Install a Smart Irrigation System irrigation system that detects weather patterns, soil type and temperatures by using the Cloud.

California Green Building Code

California Green Building Standards Code became effective in 2009. In addition to requiring the replacement of any non-compliant plumbing fixtures in single-family homes built before 1994, the law will extend the requirement to commercial and multifamily buildings in another two years, on January 1, 2019.

California, plagued by drought despite 2017's above average precipitation, has been aggressive about water conservation. The 2009 legislation set standards for toilets, urinals, showerheads, and interior faucets, but in response to a growing sense of urgency about water shortages the California Energy Commission toughened the regulations in 2015 with two new orders — one in April and another in August — that set new limits for a number of fixtures.

Now, the limits are as follows:

- Toilets: 1.28 gallons per flush (gpf).
- Residential lavatory faucets: 1.2 gallons per minute (gpm).
- Kitchen faucets: 1.8 gpm, with a "momentary" ability to increase to 2.2 gpm
- Showerheads: 2 gpm, dropping to 1.8 gpm in 2018.
- Faucets in public rest rooms: 0.5 gpm.

In upping the ante in 2015, the Energy Commission noted there were more than 45 million faucets and 30 million toilets in the state. Total water use between toilets, faucets, and urinals was about 443 billion gallons per year. Conservation measures would save 10 billion gallons in the first year and eventually reach 105 billion gallons annually, three times the amount of water used by the City of San Francisco each year.

Appendix E: Recommended Parkway/Median Trees

The following trees will achieve canopies of 30 feet, giving sufficient uncompacted soil volume.

"The wide median and parkways will allow trees and shrubs ample room to grow. Allow trees to reach full canopy height and width for full benefit of the tree's natural form, resistance to pests, overall health and growth. No pruning is needed unless branches are damaged, broken, or diseased." Brian Hannegan, Landscape Architect, RRM Design group.

*Quercus *lobata*, Valley Oak

*Quercus *agrifolia*, Coast Live Oak

*Quercus *weslizenii*, Interior Live Oak

Celtis *reticulata*, Netleaf Hackberry

Ebenopsis *ebano*, Texas Ebony

Pinus *eldorica*, Afghan Pine

Pistacia *chinensis*, Chinese Pistache

Pistacia 'Red Push')

Prosopis *glandulosa* x 'Maverick', Maverick Mesquite

Lagerstroemia *indica*, Crape Myrtle

Laurus *nobilis*, Sweet Bay 'Saratoga'

*Parkinsonia x 'Desert Museum', Desert Museum Palo Verde

Geijera *parviflora*, Australian Willow

Chilopsis *linearis*, Desert Willow

Ulmus *propinqua*, Emerald Sunshine Elm