State Water Board Staff Preface to Task 5 Report: Trees and Parklands

Introduction

Water conservation and efficiency save water and energy, reduce the need for infrastructure investments, allow current water supplies to accommodate additional housing, and mitigate longer-term water rate increases. Transitioning to more efficiently irrigated, California-friendly landscapes can additionally protect water quality, protect human health, create healthy soils, reduce short-lived climate pollutants, protect air quality, reduce noise pollution, protect biodiversity, and support ecosystem health.

These benefits will be increasingly important as our climate changes. For these reasons and more, making conservation a California way of life is critical. In 2018, the Legislature recognized the many benefits of water conservation and efficiency with the passage of Assembly Bill 1668 and Senate Bill 606.

In this preface to the accompanying Trees and Parklands section of the draft Task 5 report, State Water Board staff present key findings from an analysis of effects of potential water use efficiency standards on urban trees and parklands, provide context for the results, summarize the scope of the analysis done, and present updated results using data that were not available when the report was written.

The draft Task 5 report was developed by a team of researchers for the State Water Board under contract number 19-058-240 to help inform the State Water Board's understanding of how potential water use efficiency standards could impact local wastewater management, developed and natural parklands, and urban tree health.

Methods and Key findings

Urban Trees

In assessing impacts to urban trees, the researchers created an inventory of urban trees in California, measured the extent of tree coverage in Suppliers' service areas, and estimated tree water demand. The research team estimated water demand for turf, conifers, broadleaf trees, and palms in the service area for each Urban Retail Water Supplier. The researchers found:

- Turf was the largest component of vegetation water demand for all months in all climate zones.
- Many of the most common urban tree species in California are rated as medium-water use, suggesting these trees may need substantial irrigation during dry summer months.
- In all climate zones, the greatest percentage of low water-use trees was in the largest (i.e., oldest) class size, suggesting that the planting low water-use trees has not been prioritized.

The researchers analyzed how the water use efficiency standards may affect urban trees under several scenarios, including a scenario in which the 2030 residential indoor standard is 42 gallons per capita per day (GPCD) and the 2030 residential outdoor standard is an evapotranspiration factor (ETF) of 62%, applied to 100% of "irrigable irrigated" area and 20% of "irrigable not irrigated" area. In this scenario, the impacts to urban trees were:

- For 1% of Suppliers, estimated reductions in outdoor water use appear to exceed the combined water needs of turf and trees within the supplier's service area, suggesting trees may be "at risk" of negative impacts such as reduced health, growth, and/or survival.
- For 36% of Suppliers, reductions in outdoor water use are substantial but could be achieved by prioritizing trees and reducing the irrigation of turf across the supplier's service area.
- For 27% of Suppliers, minimal reductions in outdoor water use are possible and are unlikely to, but could, pose some risk to urban trees.
- For 36% of Suppliers, no reductions would be needed, and trees would presumably be unaffected.

Parklands

The research team conducted semi-structured interviews with park managers throughout the state to understand how regulations, drought, climate change, and public preferences affect park management practices. Park managers were asked about issues and concerns around water management for parklands. The semi-structured interviews provided qualitative results for a sample of park agencies and are described in Section 2.3.3 of the Trees and Parklands chapter of the draft Task 5 report.

The State Water Board recognizes that the urban canopy and parklands are under a range of pressures as the need for water conservation increases and the impacts of climate change become more prominent. However, water conservation can co-exist with thriving urban forests and parklands. Moreover, the State Water Board will continue to support the municipal leadership in climate resilience, including the expansion of green stormwater infrastructure, the use of recycled water, the protection of water quality, and through the development of the natural and working lands strategy.

Context

While urban outdoor water use has been declining, the greatest opportunities for using water more efficiently in cities remain within the outdoor sector.[1] Continued declines in per capita outdoor demand are expected through 2030 and, if carried out wisely, will substantially benefit society. See Table 1.

[1] The Pacific Institute estimated that the greatest potential for urban water savings comes from the residential outdoor sector, ranging from 0.64 million Acre Foot per Year (AFY) for a moderate efficiency scenario to 1.1 million AFY for a high efficiency scenario; outdoor savings from the CII landscapes range from 0.35 million AFY for a moderate efficiency scenario and 0.4 million AFY for a high efficiency scenario (Cooley et al. 2022).

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Protect water quality	Dry-weather runoff, such as over-irrigation water, sends pesticides, nutrients, bacteria, and metals into water bodies; efficiently irrigating landscapes reduces dry-weather runoff, preventing water pollution and protecting water resources. When it comes to slowing, spreading, and sinking stormwater, mulch-enriched landscapes planted with deeply rooted shrubs and trees are more effective than turf. Minimizing wet-weather runoff also helps to prevent water pollution and protect water resources.
Protect human health.	Over-irrigation water makes sidewalks slip-hazards for children and the elderly; it also leads to pooled water, creating breeding grounds for disease-carrying mosquitos.
Lower household bills	Maintaining less turf reduces household water expenses as well as energy and chemical costs (i.e., less gasoline to run the mower and less fertilizer to keep the lawn green).
Create healthy soils	Planting more deeply rooted trees and shrubs and enriching soils with compost and mulch enhances the ability of our urban soils to sequester carbon, retain water, cycle nutrients, and filter pollutants.
Reduce short-lived climate pollutants	Expanding markets for mulch and compost supports local and statewide goals to divert organic waste from landfills and reduce greenhouse gas emissions.
Protect air quality and reduce noise pollution	Maintaining less turf reduces the demand for lawnmowers and leaf blowers.
Protect biodiversity and support ecosystems	Pollinator-friendly, low water-using annual and perennial plants provide food and shelter to imperiled species.

Table 1: Benefits associated with more efficiently irrigated, California-friendly landscapes.

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Some of the decline in outdoor water use between now and 2030 will result from urban retail water suppliers taking actions to meet the annual urban water use objectives called for by the 2018 water conservation legislation. These objectives will be calculated by summing the volumetric budgets associated with water use efficiency standards, including the standard for residential outdoor water use and the standard for commercial, industrial, and institutional landscapes with dedicated irrigation meters.

As part of the process of implementing AB 1668 and SB 606 (2018), the Department of Water Resources (Department) led a series of workshops and comment periods to refine recommendations that the Department will make to the State Water Board regarding the State Water Board’s adoption standards for the efficient use of water. The State Water Board will consider those standards for adoption late 2023.

Given the importance and complexity of potential impacts on urban landscapes resulting from changes in per-capita outdoor water use in the areas served by urban retail water suppliers, the Legislature directed the State Water Board to identify and consider the possible effects of proposed water use efficiency standards on urban tree health as well as natural and developed parklands and to allow for public comment on those potential effects (California Water Code §10609.2(c)).

The State Water Board recognizes that trees provide many societal benefits such as saving energy by shading homes and buildings and thereby reducing cooling needs; they reduce storm-water runoff, improving water quality; they improve local air quality, reduce atmospheric carbon dioxide, improve public health, and provide wildlife habitat. We also recognize that natural and developed parklands contribute to a healthier and richer quality of life and that equitable access ensures more Californians from all walks of life can reap the benefits for their hearts, minds, and bodies for generations to come. In short, trees and parklands improve the quality of life in our urban environments which, increasingly, are where Californians live, work, and play. The forthcoming rulemaking and public engagement will honor and reflect the essential role of urban trees and parklands.

The State Water Board is committed to engagement with interested parties and careful consideration before action. To establish a common understanding of issues as a foundation for continuing engagement, staff provide this preface and the accompanying report. Prior state engagement with interested parties included the aforementioned Department working groups and workshops as well as conversations and State Water Board-led efforts, including workshops held in December 2021 and coordination between State Water Board contractors and parkland managers. Subsequent state engagement with urban landscape interested parties will include an analysis of the economic impacts of the standards, at least one State Water Board staff workshop as part of the regular rulemaking process, discussion at a State Water Board meeting, and additional opportunities for public comment.

Considering the effects on parklands and urban trees

The following sections summarize important caveats associated with the modeling approach, provide a brief description of regional and statewide urban outdoor water use trends, share the preliminary estimates of how much transitioning to California-friendly landscapes may cost, and present updates to some of the tree-related tables in the accompanying report.

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Limitations and caveats of modeling

For Trees and Parklands

- This analysis is based on existing landscape area. As the amount of landscaped area within Urban Retail Water Suppliers' service areas changes, urban water use objectives will change too. The water use objective is the sum of several standard-based budgets. The standards for residential outdoor water use and for Commercial, Industrial, and Institutional (CII) landscapes with Dedicated Irrigation Meters (DIMs) are based on landscape area. If landscape areas increase, objectives would increase; if landscape areas decreased, objectives would decrease. Many urban areas, particularly those in disadvantaged communities, lack adequate green space and tree cover. This new framework will not prevent the important transition from grey-to-green. As hardscapes are removed to make way for California-friendly landscapes, urban water use objectives would also grow. While the Trees and Parklands analysis does not take into consideration the expansion of permeable areas in California's cities, State Water Board staff wanted to recognize that Making Conservation a California Way of Life is compatible with efforts to make cities more livable.

For Developed and Natural Parklands

- Because parkland areas will be deemed Special Landscape Areas per the Model Water Efficiency Landscape Ordinance, they are unlikely to be significantly affected by the standard for CII landscapes with DIMs. However, AB 1668 and SB 606 directed the State Water Board to adopt Performance Measures for CII water use. It's possible that these Performance Measures, specifically the implementation of best management practices, could impact parklands by, for example, requiring irrigation systems to be better maintained which could increase maintenance costs.

- Semi-structured interviews provide qualitative and quantitative data for a sample of parkland agencies. The analysis did not evaluate qualitative data for all urban parklands in California.

For Urban Trees

- This analysis was undertaken to understand impacts at the statewide level. Researchers believe that findings at the statewide level are robust but acknowledge that, when looking at specific suppliers, the analysis may overestimate or understate risk to urban tree health.
- For several of the suppliers categorized as at high risk, their risk is overstated due to data issues. Reasons include unavoidable data gaps in residential indoor values which affect estimates of residential outdoor values, disagreement between the vegetation area calculated for this analysis and irrigable area calculated by the Department's LAM project, as well as the assumption that majority of water savings potential lies in outdoor water use reductions (i.e., 85% of savings needed to meet the objective will come from the outdoor sector).
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- As part of the analysis to analyze mitigation and adaptation actions by Suppliers to achieve compliance, the researchers assumed that 85% of the savings needed to achieve objectives would come from reducing outdoor water use. This assumption was based on extensive outreach with the Supplier community and modeling.
- There are many site-specific factors that affect how trees, and the people who care for them, would respond to water use reductions occurring as a result of AB 1668 and SB 606 implementation. Many trees in California are located on residential properties, while others are maintained by municipalities; this analysis included both municipal street trees in residential areas and trees on residential properties.
- There are many factors that influence the vulnerability of a given tree to changes in landscapes, including location, access to groundwater, historical watering patterns, species, and site location. The combination of social and ecological factors makes it impossible to predict exactly how trees may be affected, nor how many trees may be affected.
- The forecast assumed, absent the implementation of AB 1668 and SB 606, that Californians would overall make small changes in landscape irrigation efficiency, which reduce outdoor residential per capita use by 8% through 2030.
- The model assumed that all non-canopy vegetation is turf, and that 50% of the area under canopy is turf. While turf is prominent in residential landscapes, there is also a mix of lower water using plants not captured in this assumption. The model also calculated transpiration under fully irrigated conditions, which may be greater than actual use.
- Researchers used Supplier boundaries provided by the Department's Landscape Area Measurement (LAM) project. However, because the Department could not specifically provide each Supplier's residential boundaries, the researchers had to independently create those, which led to some discrepancies in total vegetated areas. Furthermore, since this work concluded, some Suppliers have provided updated service area boundaries to the Department (e.g., in some cases, suppliers had initially shared jurisdictional boundaries, rather than service area boundaries).

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- For some Suppliers, unavoidable data gaps led the water demand forecasting model to rely on residential indoor values based on regional averages or estimates derived from the minimum-month method. This may have in turn led to overestimates or underestimates for outdoor water use, which would have propagated errors in the tree risk analysis.
- The modeling approach assumed that current outdoor water use is adequate to meet current landscape needs. The difference between current outdoor water demand and current outdoor water use is assumed to be met by non-irrigation sources (e.g., precipitation and groundwater).

Effects on trees were analyzed for three scenarios:

Parameter	Scenario 1	Scenario 2	Scenario 3
Indoor residential	Until 2025: 55 GPCD 2025 to 2030: 52.5 GPCD After 2030: 50 GPCD	Until 2025: 55 GPCD 2025 to 2030, 47 GPCD After 2030, 42 GPCD	Until 2025: 50 GPCD 2025 to 2030, 42.5 GPCD After 2030, 35 GPCD
Outdoor Residential	100% of Irrigable Irrigated (II) area @ 70% of Reference Evapotranspiration (II @ 70%).	Until 2030: II @ 70% After 2030: II @ 62%	Through 2025: II @ 70% Through 2030: II @ 62% After 2030: II @ 55%

Table 2: Indoor residential and outdoor residential parameters used for the three scenarios analyzed. 20% of Irrigable Not Irrigated (INI) area is included for Outdoor Residential in all scenarios.

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Residential outdoor water use: Results of the Department's analysis and provisional, draft recommendations[2]

As part of the LAM project, Department of Water Resources staff and contractors used imagery from 2018 to analyze residential areas for each Supplier's service area and quantify landscape area, categorizing landscapes as either irrigable irrigated, irrigable not irrigated, or not irrigable area *(*See *Understanding the Analytical Approach: Terms and Concepts* section below). In spring of 2021, the Department delivered preliminary landscape area to each Supplier.

Using several methods, the Department found, when considering Irrigable Irrigated (II) area only, that 2018 average statewide residential outdoor water use ranged from a low of 62% to a high of 79%, with the average being 70% of Reference evapotranspiration (ETo). 70% suggests, for example, an expanse of warm-season turf, deficit-irrigated by an overhead spray system. Figure 1 shows the statewide range of residential outdoor use, based on data for 249 Suppliers and the application of water to II area.

[2] For an explanation of the terms used in this section, see "Understanding the Analytical Approach: Terms and Concepts" at the end of the document.

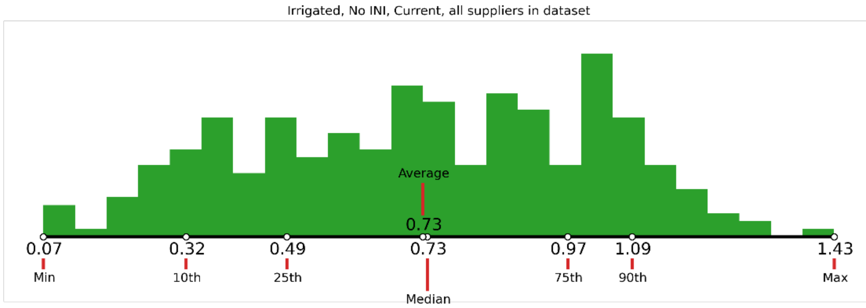

Figure 1: Range of residential outdoor water use in California using irrigable irrigated area for 249 suppliers, based on 2018 imagery. Note that the average shown here does not match the Department's estimated statewide average (70%) for two reasons. First, one of the Department's methods used standard agronomic rates to model a hypothetical residential landscape; the State Board Staff analysis does not. Second, in order create the histogram, State Water Board staff used Supplier averages; the Department used the statewide average.

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In Summer 2021, the Department proposed a draft, preliminary recommendation for the residential outdoor standard: An *Evapotranspiration Factor* (ETF) of 70%. The Department proposed that the ETF factor be applied to II area and, as needed, up to 20% of Irrigable Not Irrigated (INI). In Fall 2021, the Department revised their preliminary draft recommendation, provisionally proposing that the residential outdoor standard be an ETF of 80% until 2030 and 65% thereafter. Further, the Department proposed that the ETF factor be applied to II and, always, 20% of INI. When average 2018 residential outdoor water use is applied to II and 20% of INI area, the statewide average drops from 73% to 65% of ETo. See Figure 2 below.

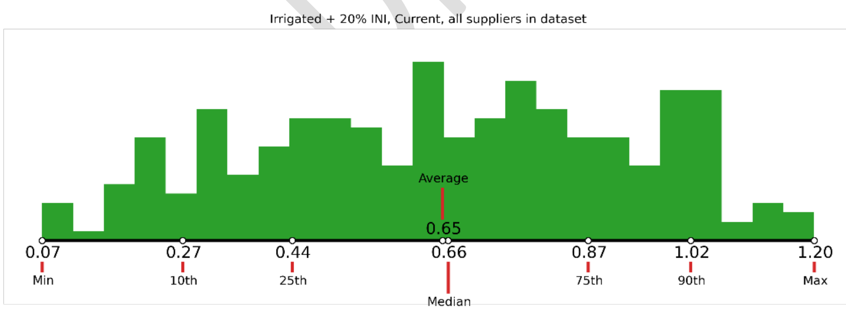

Figure 2: Range of residential outdoor water use in California, using II area and 20% of INI area, for 249 suppliers.

The Department has recommended the standard for CII landscapes with DIMs be the same as the residential outdoor standard, except for Special Landscapes Areas, which would, as under the Model Water Efficiency Landscape Ordinance (MWELO), receive an ETF of 100%.

Updated tables

This section presents updates to select tables in the accompanying report which summarizes impacts on urban trees. The results presented in the Final Task 5d report delivered to the State Water Board under contract number 19-058-240 relied on older data. In consultation with the research team that wrote that report, State Water Board staff used more up-to-date and accurate water delivery data, developed in coordination with the Department, to rerun the models developed for the §10609.2(c) analysis. The methods used in these updates are the same as those described in the report.

Table 7-8. Number of Suppliers in each level of risk of negative impacts (e.g., reduced health, growth and/or survival) for urban trees under three objective scenarios.

Risk Level	Scenario 1 (Indoor std. = 50 GPCD, Outdoor std. = 0.70)	Scenario 2 (Indoor std. = 42 GPCD, Outdoor std. = 0.62)	Scenario 3 (Indoor std. = 35 GPCD, Outdoor std. = 0.55)
No risk	247	135	89
Low risk	88	99	66
Moderate risk	35	134	198
High risk	3	5	20

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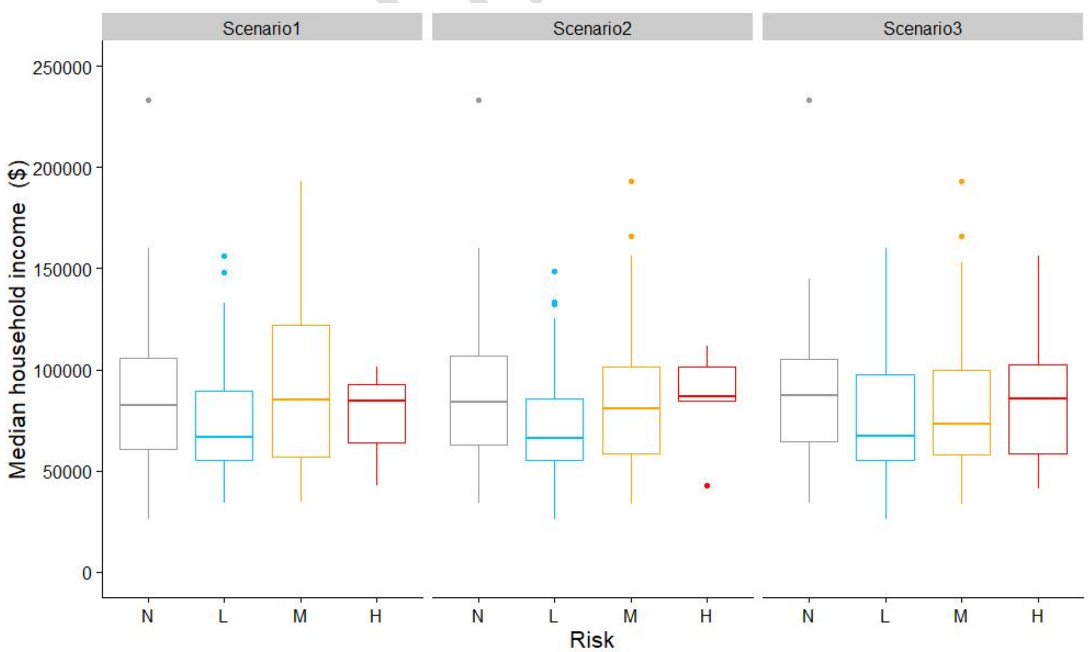
Figure 7-11. Median household income for Suppliers at different levels of risk of negative impacts for urban trees in the three objective scenarios.



Note: For risk levels, N = no risk, L = low risk, M = moderate risk, and H = high risk. Scenario 1:

indoor standard = 50, outdoor standard = 0.7. Scenario 2: indoor standard = 42, outdoor standard = 0.62. Scenario 3: indoor standard = 35, outdoor standard = 0.55

Table 7-9. For the three objective scenarios, the number of Suppliers in each level of risk serving communities with different income levels.

		Scenario 1			Scenario 2			Scenario 3		
		SDAC	*DAC*	*Other*	*SDAC*	*DAC*	*Other*	*SDAC*	*DAC*	*Other*
Risk level	High	1	0	2	1	0	4	2	4	14
	Moderate	3	8	23	12	24	93	16	39	138
	Low	8	25	51	7	29	62	6	18	38
	None	17	40	183	9	20	100	5	12	69
	Total	29	73	259	29	73	259	29	73	259

Note: SDAC = Severely Disadvantaged Community, median household income < $45,141; DAC = Disadvantaged Community, median household income < $60,188.

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Fiscal Impacts of Implementing AB 1668 and SB 606 for Communities

The following describes potential costs that might be incurred by municipalities under Scenario 2, which assumed that, in 2030, the residential indoor standard would be 42 GPCD and the residential outdoor standard would be an ETF of 62%, applied to 100% of II and 20% of INI area.

Specific standards related to trees and parklands were not available during the periods when the research team was conducting outreach with Suppliers and park managers. It is not clear how either sector may respond to any given proposed variance. The fiscal impact assessments below describe potential costs and benefits that could ensue if a variance were proposed to promote planting of climate-appropriate trees and Suppliers and local government agencies responded by slightly increasing the number of urban trees. It is a scenario-based estimate with nominal costs that is quantified for purposes of demonstrating potential costs and benefits.

Under scenario 2, urban forests within the service areas of 139 Suppliers may be at high (5) or moderate (134) risk as a result of AB 1668 and SB 606 implementation. It was assumed that potentially affected municipalities within the service areas of these Suppliers may develop or update urban forestry management plans and tree inventories to prioritize spending on trees. Mitigation actions are presumed to include improved public education programs for irrigation management and new investments in irrigation technologies adapted to tree watering needs.[3] If all the municipalities in the potentially affected areas pursued these mitigation actions, the incurred costs are estimated to be:

- $2.8 million per year for education and outreach focused on urban tree irrigation and planting
- $83 million through 2030 to update urban tree inventories.
- $7 million through 2030 to update urban forestry management plans

Because developed and natural parklands areas would be deemed Special Landscape Areas per MWELO (with an ETF of 100%), they would experience no to limited effects as a result of the outdoor standard for CII landscapes with dedicated irrigation meters. Potential parkland costs attributable to the regulation have not been estimated at this time.

Understanding the Analytical Approach: Terms and Concepts

Outdoor water use can be expressed as a percentage of reference evapotranspiration (ETo). *Reference evapotranspiration* (ETo) is a standard measurement of environmental parameters which affect the water use of plants. ETo, expressed in inches per year, is an estimate of the evapotranspiration of well-watered cool season grass.

An *Evapotranspiration Factor* (ETF) is a factor applied to ETo to adjust for landscape plant composition and irrigation efficiency. ETF is calculated by dividing the landscape's *plant factor* (which describes a plant's water use) by the landscape's *irrigation efficiency*. The lower the plant factor, the less water the plant requires. Conversely, the lower the irrigation efficiency, the more inefficient the irrigation system is.

Plant Water Use Type	**Plant Factor**	Sacramento examples
Very low	**0.0 - 0.1**	Coast live oak
Low	**0.2 - 0.3**	Strawberry tree
Medium	**0.4 - 0.6**	Big tooth maple
High	**0.7- 1.0**	Five-finger fern
Special landscape Area	**1.0**	Cool season turf on a baseball field

Table 3: Categories of plant water use, their associated plant factors, and Sacramento plant examples.

Irrigation type	**Irrigation efficiency**	**Example**
Very inefficient	Less than 0.4	Urban drool
Inefficient	0.4 - 0.64	Lawn sprinklers and traditional/fixed spray
Average	0.65 - 0.75	Rotors and stream rotators
Efficient	0.76 - 0.89	Microspray, pressure compensating drip
Efficient + managed	.9 - 1	Efficiently installed and maintained system

Table 4: Categories of irrigation efficiency, their associated irrigation efficiency value, and examples of irrigation systems.

[3] It is worth noting that spending on landscape conversion would also be part of the economic impacts in these areas but is counted as a direct fiscal impact for Suppliers. Landscape conversions would likely instigate irrigation equipment changes that preserve existing trees and, in some instance, plant new climate-appropriate trees.

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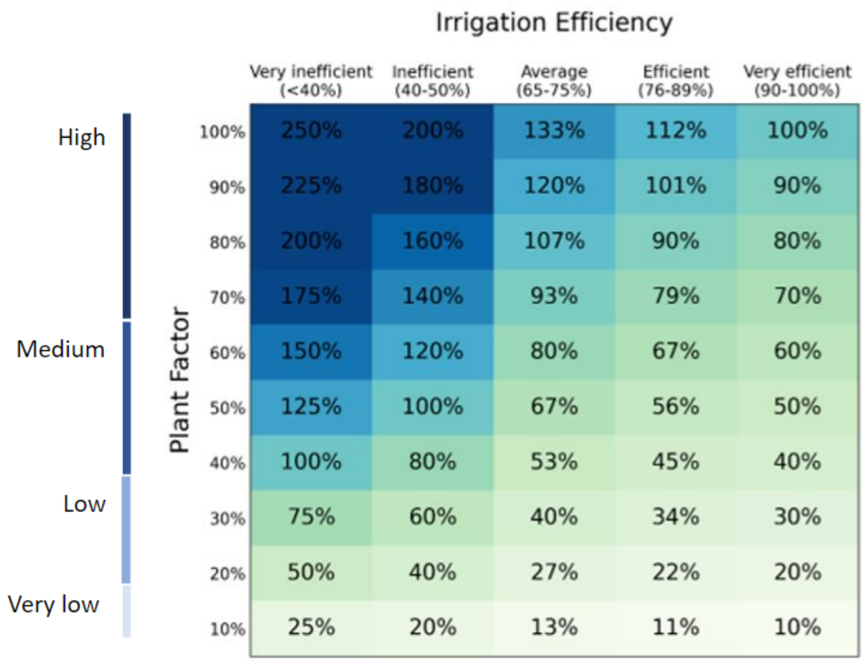

Figure 4: How PF and IE determine ET factors.

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A lower ET factor can be achieved with low water-using plants and an efficient irrigation system. A higher ET factor represents higher water using plants and a less efficient irrigation system. An ET factor can be used to calculate how much water a landscape requires. Under the Model Water Efficient Landscape Ordinance, the *Maximum Applied Water Allowance* (MAWA) is the upper limit of annual applied water for an established landscaped area. It is based on the area's reference evapotranspiration, ET factor, and size of the landscape area.

The Department, as part of the Landscape Area Measurement project, measured residential landscapes area, categorizing residential landscape area as either Irrigable Irrigated, Irrigable Not Irrigated, or Not Irrigable.

Irrigable Irrigated (II) area is where vegetation appears to be in growth and the area is presumed to be maintained and managed through active irrigation. This also includes swimming pools and other constructed water features.

Irrigable Not Irrigated (INI) area is where vegetation appears to have been previously managed but is now water stressed. The areas are not currently being irrigated but were irrigated in the past or are intended to be managed with irrigation in the future.

Not Irrigable (NI) area is native or undeveloped areas within, or adjacent to, a developed lot that show no signs of active or previous irrigation, are not adjacent to irrigated vegetation, and generally not located adjacent to structures. Impervious, solid or compacted materials are 'not irrigable' because they cannot directly support growing vegetation or hold water.