Attachment B. Technical Memorandum 1 Alternative Options for Potential Attainment of Effluent and Receiving Water Temperature Limits

Los Angeles River and Burbank Western Channel Temperature Study

TECHNICAL MEMORANDUM 1

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November 2025 / FINAL

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Abbreviations

BWRP	Burbank Water Reclamation Plant
C	Celsius
DCTWRP	Donald C. Tillman Water Reclamation Plant
DO	dissolved oxygen
F	Fahrenheit
GHG	greenhouse gases
HVAC	heating, ventilation, and air conditioning
LAR	Los Angeles River
LAGWRP	Los Angeles-Glendale Water Reclamation Plant
mgd	million gallons per day
NPDES	National Pollutant Discharge Elimination System
RWQCB	Regional Water Quality Control Board
TM	Technical Memorandum
TTSA	Tahoe-Truckee Sanitation Agency
USACE	United States Army Corps of Engineers
WDR	waste discharge requirement
WRP	water reclamation plant
WWTP	wastewater treatment plant

TM 1 ALTERNATIVE OPTIONS FOR POTENTIAL ATTAINMENT OF EFFLUENT AND RECEIVING WATER TEMPERATURE LIMITS

1.1 Background

The Donald C. Tillman Water Reclamation Plant (DCTWRP) and Los Angeles-Glendale Water Reclamation Plant (LAGWRP), operated by the City of Los Angeles, LA Sanitation & Environment, and the Burbank Water Reclamation Plant (BWRP), operated by the City of Burbank Public Works Department, discharge tertiary-treated disinfected wastewater effluent to the Los Angeles River (LAR) watershed. The DCTWRP and LAGWRP discharge into the mainstem of the LAR, while the BWRP discharges to the Burbank Western Channel, which is a tributary to the LAR. Per the National Pollutant Discharge Elimination System (NPDES) permits CA0053953 (Order No. R4-2022-0343, LAGWRP), CA0056227 (Order No. R4-2022-0341, DCTWRP), and CA0055531 (Order No. R4-2023-0358, BWRP), effluent from the water reclamation plants (WRPs) must meet the following limits:

- 80 degree Fahrenheit (F) Effluent Limit - Effluent discharges must meet the effluent temperature limit of 80 degrees F.
- Delta 5 - Effluent discharges shall not alter receiving water temperatures by more than 5 degrees F above the natural temperature.

This technical memorandum (TM) summarizes a high-level review of alternative temperature reduction options such as nature-based solutions, evaporative cooling, in-plant process changes, and source control to comply with the 80 degree F Effluent Limit and Delta 5 requirement at each of the three WRPs. A separate TM summarizes an evaluation of evaluate traditional engineering solutions (i.e., cooling towers and chillers) to reduce effluent temperatures to meet limits.

1.2 Summary of Data Analysis and Preliminary Design Criteria

The following section provides the design criteria to size the cooling alternative to meet the 80 degree F Effluent Limit and Delta 5 requirement for each WRP. For the purpose of this TM, the cooling technology will be sized for the maximum effluent flow and maximum temperature reduction (i.e., worst case conditions to ensure consistent compliance with the limits).

The preliminary design criteria used for evaluating effluent cooling options at each WRP are captured in Table 1.1. A more detailed description of the cooling needs for each WRP is included later in this TM.

Table 1.1 Summary of Worst Case Condition Design Criteria for Effluent Cooling(1,2)

Design Criteria	LAGWRP	DCTWRP	BWRP
Maximum Effluent Flow Rate (mgd)	15.9	30.9	5.9
80 Degree F Effluent Limit			
Maximum Temperature Reduction to Meet 80 degrees F (degrees F)	8	7	9
Cooling Capacity (tons)	3,100	6,230	1,530
Delta 5			
Maximum Temperature Reduction to Meet Delta 5 (degrees F)	35	32	37
Cooling Capacity, tons	16,100	28,500	6,290

Notes:
mgd - million gallons per day
(1) Temperature data was evaluated between 2000 and 2024 for all the WRPs.
(2) Flow data was evaluated between 2019 and 2024 for all the WRPs.

1.3 Temperature Control Options Considered

Several non-traditional effluent cooling options were identified to address the 80 degrees F and Delta 5 limits at each WRP. The options are grouped into the following overall categories:

- Natural Heat Flow.
- Evaporative Cooling.
- Source Control.
- In-Plant Process Changes.

Additional non-traditional options, including reducing effluent discharge and shading of the receiving water, are being considered as part of a separate effort. Therefore, this TM does not summarize these types of options and focuses only on effluent cooling with non-mechanical processes.

Each of these categories and options that fall within them is discussed briefly in the following sections.

1.3.1 Natural Heat Flow

Effluent cooling through natural heat flow systems takes advantage of environmental media such as soil, air, or groundwater of colder temperatures to cool down the effluent without mechanical cooling systems. The effluent cools through the heat gradient between the effluent and the environmental medium, and the cooling efficiency is determined by the contact surface area, the retention time during cooling, the temperature gradient, and the thermal conductivity (k) of both media. Figure 1.1 shows the principle of the natural heat flow.

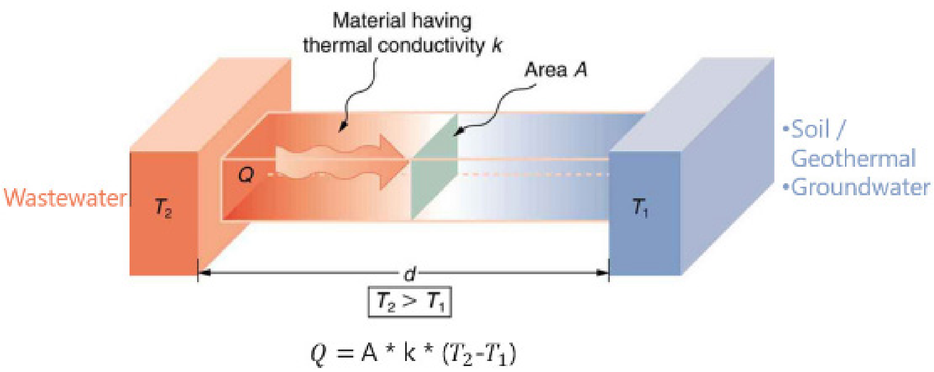


Figure 1.1 Natural Heat Flow

1.3.1.1 Cooling With Groundwater Using Heat Exchanger

In this option, cooler groundwater is pumped to an aboveground heat exchanger, where cooling water passes in the opposite flow direction to the effluent, requiring cooling, as illustrated on Figure 1.2. The heat exchange will reduce the effluent temperature. The cooling water could be groundwater or cooler surface water from lakes, ponds, etc., and will be discharged back to the source after passing through the heat exchanger.

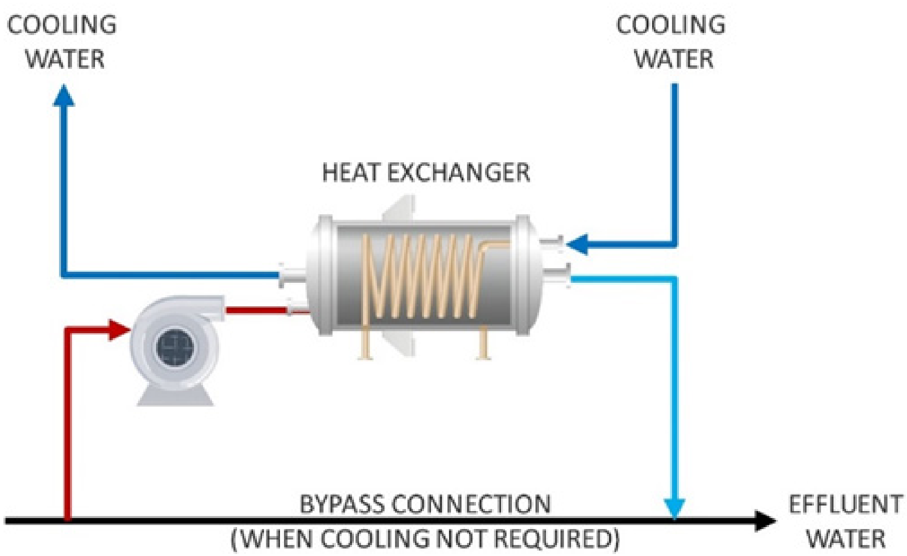


Figure 1.2 Cooling With Groundwater Using Heat Exchanger

1.3.1.2 Blending With Deep Groundwater Source

Blending effluent water with colder water from a separate source (e.g., groundwater well, lake water, municipal drinking water) will produce a blended stream lower than the initial effluent temperature, as shown on Figure 1.3. From a heat transfer perspective, any cold water source can be blended with effluent to reduce the overall temperature; however, the water quality of the blend source is an important environmental consideration. Blending is a form of natural heat transfer that relies on the dispersion of thermal energy by mixing.

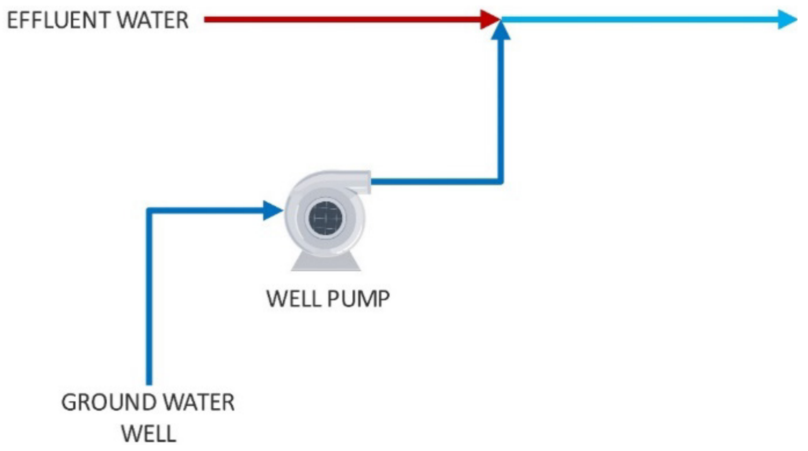


Figure 1.3 Blending With Deep Groundwater

1.3.1.3 Geothermal Cooling

This process relies on a combination of conduction and convection to transfer heat from the wastewater into the soil and groundwater. As shown on Figure 1.4, a geothermal loop is a feature where pipes or tubes act as a heat exchanger and are buried or installed in the ground to dissipate or draw heat into the soil and groundwater, if present, using natural heat flow. The ground loop can be installed vertically (piping loops buried in bored holes typically 100 to 500 feet deep) or horizontally (piping loops buried in long shallow trenches).

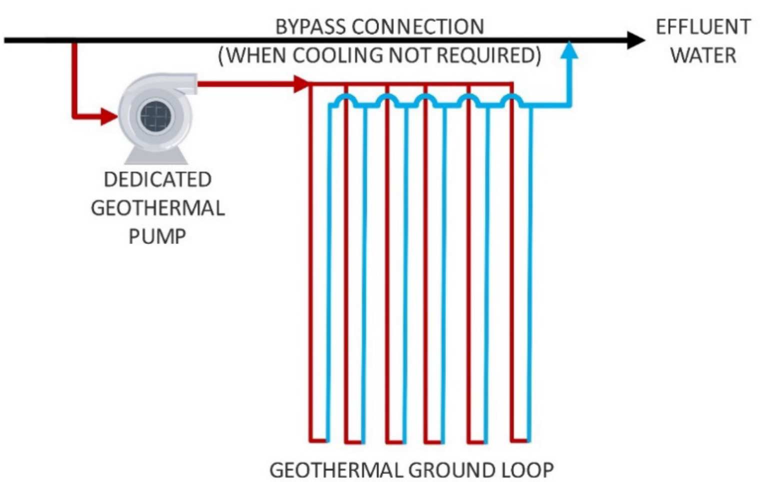
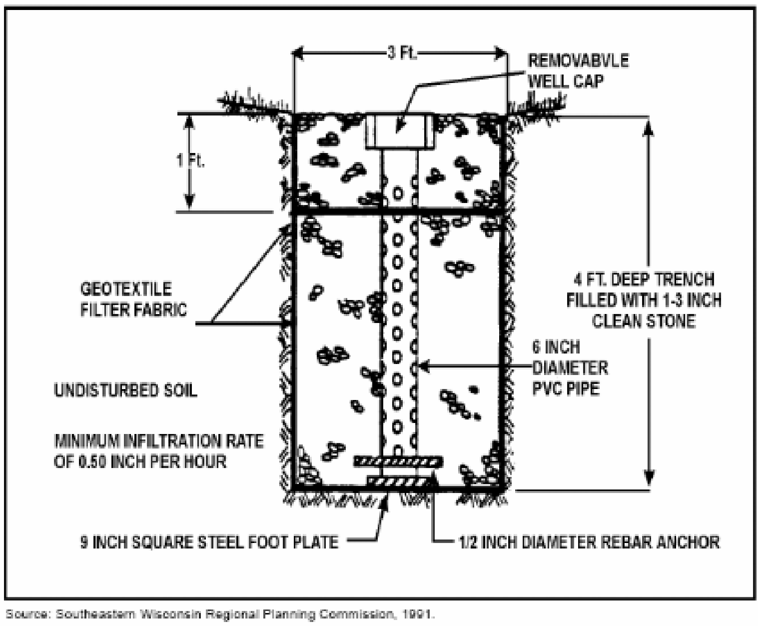


Figure 1.4 Geothermal Cooling

1.3.1.4 Infiltration Trenches

A trench is excavated to 3 to 12 feet deep and filled with gravel to provide sufficient infiltration area. Effluent discharged to the trench travels through subsurface layers towards the receiving stream, essentially becoming a ground discharge. Lower ground temperatures lower the effluent temperature before discharge to the receiving stream. Essentially, this is another method to transfer heat into the soils and groundwater using natural heat flow. Soil permeability rates may also impact infiltration trenches.

Additional permitting requirements or modifications may be associated with discharging to groundwater, depending on the degree of hydrologic connection between surface water and groundwater. Figure 1.5 shows a typical infiltration trench (please note that the figure is based on a stormwater infiltration trench, but is generally representative of an infiltration trench that could be used for the purposes of cooling WRP effluent).



Typical stormwater infiltration trench design

Source: U.S. Environmental Protection Agency, September 1999

Figure 1.5 Stormwater Infiltration Trench

1.3.1.5 Aquifer Storage and Recovery

Effluent is temporarily injected or infiltrated into the aquifer while, at the same time, water is extracted at a lower temperature from the aquifer for discharge to the receiving water. This is another method to transfer heat into the soils and groundwater using natural heat flow, as shown on Figure 1.6. Additional permitting requirements or modifications will likely be associated with discharging to groundwater.

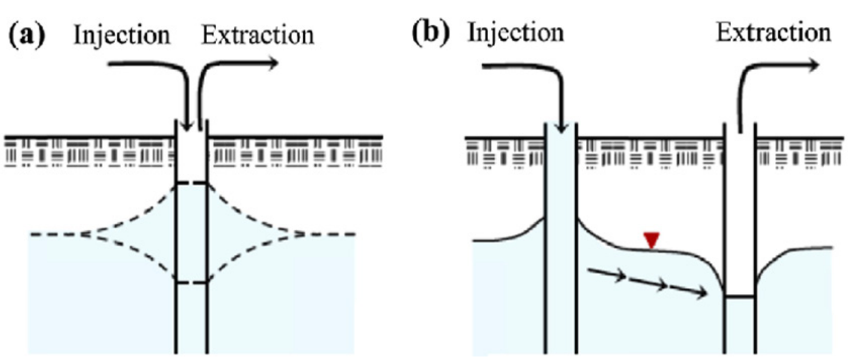


Figure 1.6 Aquifer Storage and Recovery

1.3.1.6 Hyporheic Zone Injection

As shown on Figure 1.7, the effluent injected into the hyporheic zone of a stream bank flows through this zone to the receiving stream and is cooled along the way. Essentially, this is another method to transfer heat into the soils and groundwater/surface water using natural heat flow. Injection to the hyporheic zone is dependent on permeability.

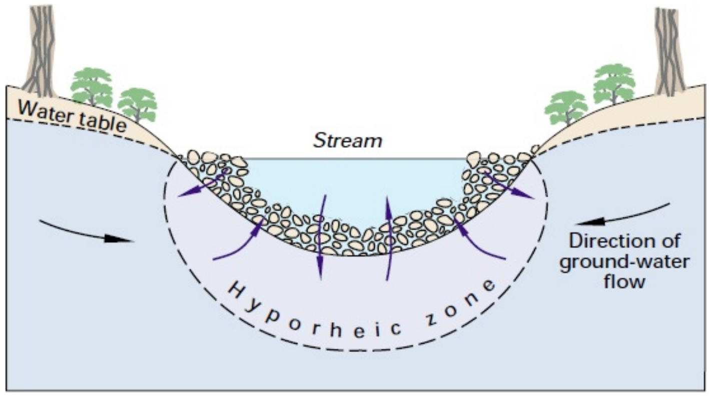


Figure 1.7 Hyporheic Zone Injection

1.3.2 Evaporative Cooling

Evaporative cooling technologies work like large swamp coolers used in residential or commercial buildings. A portion of the effluent to be cooled is allowed to evaporate and extracts heat from the remaining liquid, resulting in cooling. The efficiency of evaporative cooling technologies is determined by the factors previously listed for natural heating systems (contact surface area, retention time, temperature gradient, and thermal conductivity of media) and air humidity. The evaporative cooling capacity is based on the wet bulb temperature, which combines the two drivers for evaporative cooling: the temperature difference and the air humidity. It's measured with a thermometer covered in a water-soaked cloth over which air is passed. At 100 percent humidity, the wet bulb temperature is equal to the air temperature (also called dry bulb temperature). The lower the air humidity, the lower the wet bulb temperature, evaporation, and cooling efficiency.

1.3.2.1 Passive Cooling Wetlands/Ponds, Seasonal Ponds, Spray Ponds, and Pipe in Cooling Pond

Passive cooling with a pond or wetlands consists of effluent being diverted to a storage pond or wetland to reduce temperature before discharge. Discharging effluent into a pond or constructed treatment wetlands can allow heat dissipation to the ambient atmosphere, primarily through evaporation. Subsurface wetlands may reduce the amount of water loss to evaporation, which would require heat to be absorbed into soils and likely require a larger area. A constructed wetland system used for cooling is likely to require a similar or greater area than a passive cooling pond, but may provide other water quality improvements for achieving compliance with other parameters. Wetlands for effluent cooling may require year-round usage to maintain the ecological system, even if cooling is not required year-round. Passive cooling pond system is shown on Figure 1.8.

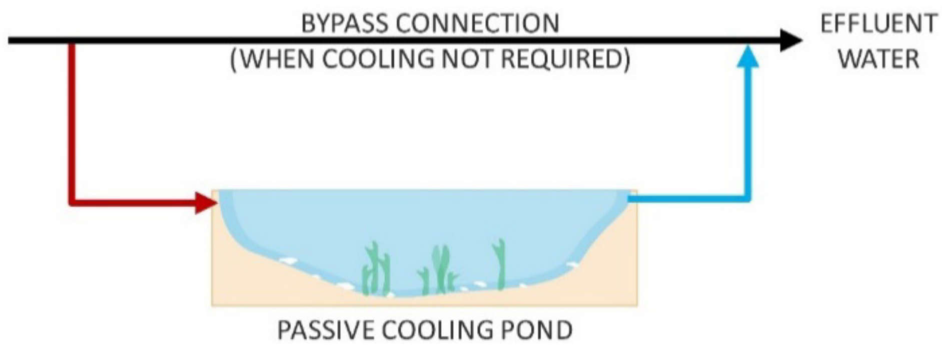


Figure 1.8 Passive Cooling Pond

Seasonal storage ponds are similar to passive cooling ponds. The treated effluent is stored in the pond until a critical temperature period has passed. A pond sized for this approach will likely require a volume sufficient to hold wastewater for multiple weeks, which is much larger than necessary for a passive cooling pond. Since seasonal storage ponds will likely need several weeks of detention time compared to a passive or spray cooling pond, which may only need several hours to a few days of detention time, the evaporation from seasonal storage is likely to exceed the amount of evaporation in a passive or spray cooling pond. The impacts of effluent flow interruption on the receiving stream are also an important consideration.

In the spray ponds, effluent is sprayed into the passive cooling pond, which allows for partial cooling, as shown on Figure 1.9. Spray ponds are based on the concept of increasing the contact of air and water to increase evaporation rates.

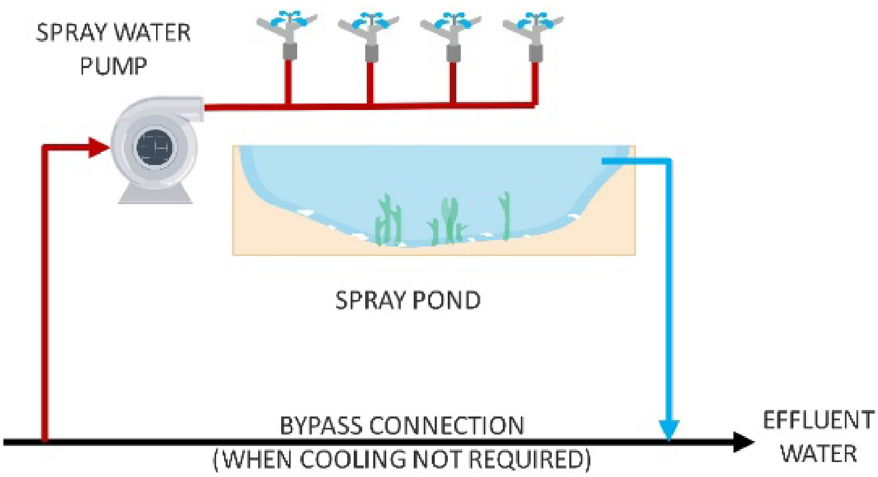


Figure 1.9 Spray Ponds

As shown on Figure 1.10, an effluent pipe submerged in the pond water body is another method of passive cooling. The heat from the effluent will be rejected into the pond water using the pipe as a heat exchanger, which, in turn, will reject the heat to the ambient atmosphere primarily through evaporation. This is essentially a heat exchanger in a passive cooling pond. This approach may be advantageous where a cooling pond is feasible, but there are concerns of water quality degradation or other regulatory compliance implications associated with discharging directly to a cooling pond.

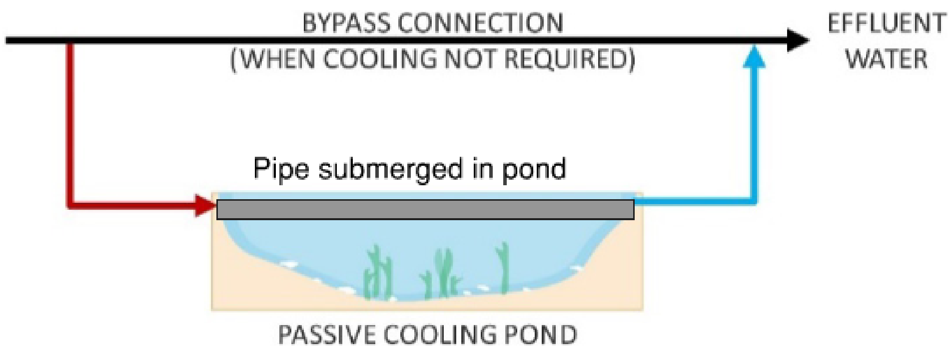


Figure 1.10 Pipe in Passive Cooling Pond

1.3.2.2 Effluent Discharge Structure Modification or Enhanced Mixing of Effluent and Receiving Stream

As shown on Figure 1.11, modifying the effluent outfall structure to increase turbulence or air/water contact could provide heat dissipation to the ambient atmosphere primarily through evaporation. However, there is no data available on the effectiveness of this approach. Adding structures to promote more rapid mixing of treated effluent with the receiving stream has trade-offs. The mixing may reduce zones of warm water, but the mixing may also eliminate refuge zones for aquatic life. Another consideration for enhanced mixing with the receiving stream is evaporation. When warm effluent is discharged into the stream, it will likely increase the evaporation rate in the stream river until ambient conditions are reached. The amount of evaporation that occurs in the stream may be similar to the amount that would occur using an optimized cooling pond or cooling tower, therefore, limited by ambient air temperature.

Figure 1.11 Effluent Discharge Structure Modification

1.3.3 Source Control

Heat is added to wastewater from various sources, including single- and multi-family housing, commercial businesses, and industries. Heat source reduction is currently only rarely practiced by communities, but needs to be considered and discussed in light of efforts to protect the ecology of streams. Voluntary or mandatory strategies could be directed at:

1. Limiting the use of hot water for non-essential purposes. For example, cities could consider ordinances and revisions to building codes so that institutions such as administrative buildings, city government, and educational facilities provide only cold water in public restrooms.
2. Provide incentives for residential- and commercial-scale heat recovery systems (e.g., drain water heat recovery device - see Figure 1.12 (Drain-Water Heat Recovery | Department of Energy).
3. Recovering heat from sewers for building-scale use. There are several successful examples of heat recovery systems in multi-family complexes and commercial buildings in North America, and it is a common and economic approach in Central Europe. This practice is effective in colder climates, where there is an indoor heating demand.

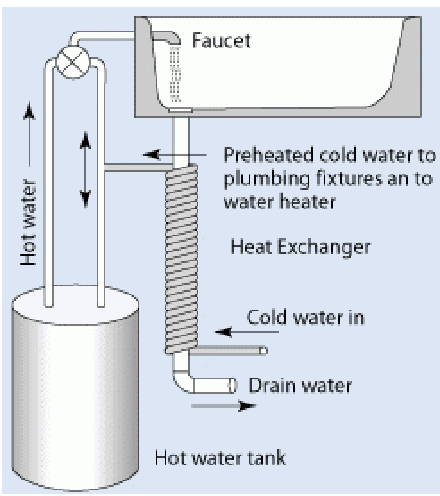


Figure 1.12 Drain-Water Heat Recovery

Heat source control and recovery would require significant coordination with the city government, boards and commissions, developers, and other stakeholders in the WRP communities.

1.3.4 In-Plant Process Changes

Open aeration tanks, hot air from the blowers, or biological activity may increase the wastewater temperature. However, based on data from other wastewater treatment plants, the wastewater temperature does not increase significantly across the treatment processes. Therefore, process changes are unlikely to reduce the temperature profile noticeably. Using energy-efficient mechanical equipment may minimize friction losses and help with temperature reduction.

1.4 Screening of Alternatives

1.4.1 Screening Criteria

Cooling alternatives for each WRP were evaluated on a pass/fail basis using the screening criteria summarized in Table 1.2. For many of these options, there is little information available about actual operating systems, so the term "unknown" was included in the screening criteria. Since there are few systems installed to reduce the effluent temperature, cost is not readily available. Therefore, the cost criterion was used to describe what costs would be incurred for implementing the option. Other benefits were identified as Yes/No and a description of the benefit.

Table 1.2 Screening Criteria

Screening Criteria	Criteria Description	Metric
Ability to Meet Regulations	Complies with NPDES requirements for effluent temperature (no more than 80 degrees F) and not altering receiving water by more than 5 degrees F.	Pass/Fail/Unknown
Technology Implementation (at this size)	Proposed technology/approach has at least one proven installation in the United States for water/wastewater application.	Pass/Fail/Unknown
Site Constraints	Structures, equipment, etc., fit within the existing WRP boundaries.	Pass/Fail
Cost	Descriptions of infrastructure required to calculate costs.	N/A
Operations	Facilities can be fully operated by staff (i.e., contract operations are not required). Not overly complicated operationally.	Pass/Fail
Provides Other Benefits	Recreation, treatment, GHG reduction, etc.	Yes/No

Notes:
GHG - greenhouse gases; N/A - not applicable

1.5 Screening Analysis

1.5.1 Evaluation

All options discussed above were evaluated on their ability to meet the regulations, technology implementation, site constraints, cost, and operability. Evaluations of options and the reasons for potential implementation or failure to pass screening were developed for each WRP. Additional details on the evaluation for each option category are provided in the sections below.

1.5.1.1 Natural Heat Flow

Natural heat flow options depend on the availability of external surface or groundwater flow, groundwater rights, cooling water temperature, groundwater temperature, groundwater water quality, and land availability.

There are no known applications similar in size to any of the three WRPs using geothermal cooling or groundwater to cool the effluent. While this option may provide cooling to near groundwater temperatures, there is very limited space available at or near any of the WRPs. Analyses of the potential for geothermal cooling systems to cool effluent at other WRPs within the Los Angeles Basin show that these systems alone may only provide partial cooling and are not expected to meet the temperature limits. Aquifer storage and recovery will likely be treated as groundwater recharge and subject to stringent reuse regulations.

Hyporheic zone injection may reduce peak temperature effects and provide delays of effluent discharge's thermal effects during critical periods to receiving waters. An investigation on the temperature impact of hyporheic flow along the Willamette River in Oregon found that hyporheic zone injection could reduce peak temperature effects of warm effluent by 100-fold (e.g., increasing river temperature by 0.001 degrees Celsius (C) rather than 0.1 degrees C). Observed delays in peak river temperatures also imply that hyporheic zone injection could provide a significant delay in thermal effects in order to avoid the most critical period for river temperatures. The natural riverbeds in the Sepulveda Basin adjacent to the discharge points at DCTWRP make hyporheic zone injection potentially viable; therefore, it is carried forward as a potential alternative in conjunction with other options to meet required temperature reductions at DCTWRP. However, further investigations are necessary, as injection to the hyporheic zone is dependent on soil permeability and may have adverse impacts. Furthermore, there are likely other restrictions for an alternative discharge in the Sepulveda Basin, which is owned and operated by the United States Army Corps of Engineers (USACE)for flood control purposes. Groundwater modeling is needed to confirm whether heightened groundwater levels from injection to the hyporheic zone will cause surface flooding during higher-rainfall years or potentially cause damage to nearby subsurface infrastructure and building foundations. This option also has the potential to be treated as intentional groundwater recharge and be subject to groundwater recharge regulations, depending on the discharge’s travel time to nearby downgradient potable groundwater wells. Also, it is unclear how compliance with the temperature requirement will be measured/monitored. The LAR adjacent to the LAGWRP has a natural bottom contained with a concrete trapezoidal channel and there is limited space available between the plant and LAR for infiltration, potentially limiting this option. Additional study would be required to understand the impact of the natural bottom for infiltration. As the BWRP directly discharges to a concrete channel, hyporheic injection is not applicable.

Groundwater blending, although promising at BWRP given relatively low effluent flows, is not a viable option due to nearby groundwater contamination. A large amount of groundwater will be required to blend with LAGWRP and DCTWRP effluent, which makes this option infeasible, to meet the temperature requirements. Irrespective of WRP-specific constraints, groundwater temperatures typically found in the LA region of about 60 degrees F make it very unlikely that groundwater-based solutions will provide substantial help in meeting the Delta 5 limit at the WRPs.

1.5.1.2 Evaporative Cooling

Evaporative cooling depends on the wet bulb air temperature. Passive and spray ponds require large amounts of land, and the temperature reduction is dependent on the local climatic conditions, evaporation, solar radiation, etc. Continuous monitoring at the lakes in the Sepulveda Basin has shown mixed results for temperature reductions across Lake Balboa and Wildlife Lake. During the summer months, maximum daily water temperatures in Lake Balboa varied between 2.9 degrees F lower to 6.5 degrees F greater compared to DCTWRP effluent temperatures. Similarly, maximum daily water temperatures in Wildlife Lake varied between 5.6 degrees F lower to 4.0 degrees F greater compared to DCTWRP effluent temperatures during summer months. This analysis is discussed in detail in a separate report being developed by Larry Walker Associates. While cooling ponds and wetlands may, at times, reduce temperatures, it is not a reliable method for compliance.

For evaporative cooling with spray ponds, challenges include nozzle maintenance, associated public health risks with spraying of tertiary treated effluent, water loss, and maintaining water quality in the ponds. Due to the size of a spray pond and number of sprayers required to achieve the necessary evaporation rates, it is unlikely that spraying will sufficiently reduce the effluent temperature. Due to the space limitations at LAGWRP and BWRP and the uncertainty in meeting the temperature limit reliably in all seasons, all alternatives with cooling ponds are not considered potential alternatives. Because of inconsistent temperature reduction through the lakes at DCTWRP, pond options are considered as a potential option at this plant either.

Modifying the existing outfall structures may not solely reduce the effluent temperature to the required limits, but is considered a potential partial solution for all WRPs if other solutions are implemented to meet the temperature limits. It is relatively a lower cost option compared to other non-traditional solutions but will require additional space and significant modifications to the existing outfall structures. Also, the temperature reduction achieved through this option is unknown and depends on the local temperature conditions.

1.5.1.3 Source Control

Source control can reduce influent wastewater temperature, but it alone may not help meet the effluent limits. Significant outreach and incentives is required to make progress on reducing influent temperatures. Industrial control through local or site-specific limits are an important tool in managing the existing temperatures and preventing industries in the future from exceeding these limits, but it is unlikely to reduce effluent temperature at the WRPs.

Source control with a focus on the residential sector through home-based heat recovery devices is difficult to implement, and rebate programs will require extensive outreach and a high-percent adoption and continued implementation to potentially achieve the limits. For these reasons, domestic/residential source control is not considered a viable solution for any of the WRPs.

1.5.1.4 In-Plant Process Changes

Based on investigations of other wastewater treatment plants (WWTPs) in southern California, temperature rises across the treatment processes are typically limited to 2 to 3 degrees F, so implementing any changes to the treatment processes does not provide a significant enough effluent temperature reduction to meet the limits. Biological activity in the treatment processes, which are necessary to meet other effluent limits (e.g., ammonia) is known to increase temperature, and is likely not controllable.

1.5.2 Los Angeles-Glendale Water Reclamation Plant Criteria and Screening

Effluent and receiving water data collected between 2000 and 2024, and effluent flow data from the last five years (to be reflective of current recycling levels and decreased influent flows from conservation) were evaluated for this analysis. An overview of historical monthly effluent temperatures and flows at LAGWRP and river temperatures near the discharge point is summarized in Table 1.3.

Effluent temperatures exceeded 80 degrees F historically from May through November at LAGWRP, as shown in red in Table 1.3. Effluent flows reached a maximum of 13.3 mgd during these months. To meet the 80 degree F Effluent Limit, LAGWRP will be required to reduce the effluent temperature of up to 13.3 mgd by 8 degrees F before discharging into the LAR.

Delta 5 was historically exceeded during the months of January through May and October through December, as shown in red in Table 1.3. Maximum effluent flows during this period of exceedance were 15.9 mgd. To ensure receiving waters are not warmed by more than 5 degrees F above the natural temperature, LAGWRP will be required to reduce the effluent temperature by up to 35 degrees F for up to 15.9 mgd of effluent before discharging to the LAR.

Table 1.4 summarizes the screening analysis of options considered for temperature reduction for LAGWRP.

Table 1.3 Summary Temperature Exceedance Calculations for LAGWRP(1)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Maximum Effluent Flow Rate (mgd)	15.89	15.77	14.73	15.29	13.33	10.49	8.77	11.07	11.3	10.1	12.82	14.71
80 Degree F Effluent Limit												
Maximum Effluent Temperature (degrees F)	76	77	78	80	83	86	87	88	87	87	85	79
Target Effluent Temperature (degrees F)	80	80	80	80	80	80	80	80	80	80	80	80
$\Delta T_{80F\ Effluent\ Limit}$ (degrees F)(2,3)	-	-	-	-	3	6	7	8	7	7	5	-
Delta 5												
Maximum River Temperature Delta 5 (degrees F)(4)	8	7	8	6	7.2	3.6	5	5	4.7	14	10.8	11
Minimum Upstream River Temperature (degrees F)	42	42	51	51	59	61	64	64	61	47	46	40
Target Effluent Temperature (degrees F)(5)	47	47	56	56	64	66	69	69	66	52	51	45
$\Delta T_{Delta\ 5}$ (degrees F)(6)	29	30	22	24	19	20	18	19	21	35	34	34

Notes:
(1) Red text indicates months when temperature limit was exceeded.
(2) $\Delta T_{80F\ Effluent\ Limit}$ = Maximum Effluent Temperature - 80 degrees F.
(3) Only calculated for months where 80 degree F Effluent Limit was exceeded.
(4) River Temperature Delta = Downstream River Temperature - Upstream River Temperature.
(5) Target Effluent Temperature = Minimum Upstream Temperature + 5 degrees F.
(6) $\Delta T_{Delta\ 5}$ = Maximum Effluent Temperature - (Minimum Upstream River Temperature + 5 degrees F).

Table 1.4 Screening Analysis for LAGWRP

Classification	Examples	Screening						Justification Notes for Screening
		Ability to Meet Limits	Technology Implementation	Site Constraints	Cost	Operations	Provides Other Benefits	
Natural Heat Flow	Cooling with groundwater using a heat exchanger and geothermal cooling.	Pass Depends on groundwater temperature and available flow. Typical groundwater temperature in the LA region is about 60 degrees F. May help with 80 degree F Effluent Limit. Fail Based on the temperature reduction needed and the available information for this option, Delta 5 will not be met.	Unknown No known implementation at this scale for wastewater. Heat exchangers and geothermal cooling are typically used in residential and commercial application.	Fail Significant space required, limited space available.	Cost depends on land availability and requires significant pumping and underground piping.	Fail More complex, likely need additional staff.	No	**FAIL** Does not meet the limits. Large space requirement, unknown applications, cost-effectiveness unknown. Groundwater temperatures likely not low enough to meet Delta 5 limit (typically in low 60 degrees F).
	Aquifer storage and recovery.	Unknown Depends on groundwater temperature. May help with 80 degree F Effluent Limit. Based on the temperature reduction and the available information for this option, Delta 5 will not be met. Very unlikely to meet Delta 5.	Fail Used for potable water and reuse, but not for temperature reduction.	Fail Significant space required, limited space available.	Cost includes multiple wells, pumping, and treatment to potable reuse standards.	Fail More complex, likely need additional staff.	Yes Increased water supply from aquifer storage and recovery.	**FAIL** Does not meet the limits. Aquifer storage and recovery likely requires higher level of treatment and WDR to meet potable reuse standards.
	Hyporheic zone injection or infiltration trenches.	Unknown Modeling simulations done for a river in Oregon that is not comparable to the LAR but no actual implementation.	Pass TTSA and Los Osos are implementing trenches for effluent disposal, but not for temperature control. TTSA has shown temperature reductions.	Fail Although non-channelized riverbed is available for hyporheic zone injection, there is not adequate space to discharge 16-mgd effluent flow.	Cost includes perforated piping below grade, infiltration trenches.	Fail More complicated operations.	Yes Groundwater recharge from infiltration trenches.	**FAIL** Does not meet the limits Requires a WDR for land discharge, unknown if RWQCB would grant permit. May be required to meet potable reuse standards. Need groundwater modeling to evaluate travel path and time to nearest potable wells.
	Blending with deep groundwater water source.	Unknown Depends on groundwater temperature and available flow. Typical groundwater temperature in the LA region is about 60 degrees F. May help meet 80 degree F Effluent Limit. Fail Based on the temperature reduction needed and the available information for this option, Delta 5 will not be met.	Unknown No known implementation, but technically feasible if groundwater is cool enough and there is sufficient groundwater volume.	Pass Little space requirements for mixing box. Unlikely that large volumes of water can be found to blend LAGWRP flows.	Cost includes piping, modification of outfall to accommodate larger flows, and possible construction of a new groundwater well. Depends on availability and access to groundwater.	Pass	Yes Provides instream flow augmentation, recreational benefits.	**FAIL** Does not meet the limits Requires groundwater extraction permits, flow availability, temperature of groundwater unknown, cost-effectiveness unknown. Blending with deep groundwater may affect effluent water quality (e.g. contaminated soils). Volume of water required to blend makes this unfeasible and may cause overdraft and subsidence. Groundwater temperatures likely not low enough for Delta 5 (typically in low 60 degrees F).

Classification	Examples	Screening						Justification Notes for Screening
		Ability to Meet Limits	Technology Implementation	Site Constraints	Cost	Operations	Provides Other Benefits	
Evaporative Cooling	Passive cooling wetlands/pond, seasonal pond storage, spray pond cooling system, pipe in pond cooling.	Fail May help meet 80 degree F Effluent Limit. Based on the temperature reduction needed and the available information for this option, Delta 5 will not be met.	Fail Existing lakes at DCTWRP produce inconsistent temperature reductions.	Fail Requires significant space, but no land available	Cost depends on land availability, offsite, piping, pumping.	Fail Additional operations outside fence line.	Yes Provides recreational and habitat benefits.	**FAIL** Does not meet the limits Large space required outside of plant; cost-effectiveness unknown.
	Effluent discharge structure modifications.	Fail May help meet 80 degree F Effluent Limit Based on the temperature reduction needed and the available information for this option, Delta 5 will not be met.	Fail Aeration structures are not designed for temperature reduction.	Pass Limited space requirements.	Low investment when compared to other non-traditional temperature reduction options.	Pass Limited operations.	Pass Improves DO in receiving stream.	**FAIL** Does not meet the limits Unknown temperature reduction, requires additional space near the outfall, low investment when compared to other options and can be implemented on-site.
Source Control	Limiting the use of hot water for non-essential purposes.	Unknown Ability to meet either limit unknown.	Unknown No known implementation of hot water limitations.	Pass Not on-site.	Increase in staffing requirements to implement source control limits.	Fail Difficult to implement/ enforce.	Unknown	**FAIL** Does not meet the limits Unknown applications, unknown temperature control. Also depends on the depth of the sewer from the ground.
	Recovering heat in buildings or in large sewer trunks and interceptors in the service area.	Fail May help meet 80 degree F Effluent Limit, Based on the temperature reduction needed and the available information for this option, Delta 5 will not be met.	Fail Used in colder climates for indoor heating in winter.	Pass Not on-site, in collection system.	Cost includes adding heat exchangers, sewer modifications, and modifications to end-user HVAC systems.	Fail Added complexity.	Yes Reduction in heat usage which will also reduce GHG emissions.	**FAIL** Does not meet the limits This is a concept used where heat can be harvested from the sewer in cold environments. Not suitable for warm climates.
	Public outreach and residential rebate programs.	Unknown Focus on residential sector, which is the source of most heat load.	Fail Home-based heat recovery devices but difficult to implement.	Pass Not on-site. In residential homes.	Cost to establish outreach and rebate/incentive program to retrofit all existing homes.	Pass Belong to homeowners and requires regular maintenance.	Yes Cities may provide residential rebates to customers.	**FAIL** Does not meet the limits Unknown applications, cost-effectiveness unknown. Difficult to implement. Also depends on the depth of the sewer from the ground.
	Industrial source control through local limit or site-specific limit.	Fail Given comparatively small industrial flows, unlikely to meet either limit. Local limit is important in managing the influent temperatures to the WRP	Pass Local limit is established way to control industrial discharges.	Pass Not on-site.	Relatively low cost for LAGWRP. May require significant capital expenditures for industrial sources.	Pass No operations.	No	**FAIL** Does not meet the limits May provide some reduction, but will not meet limits. May impact industries. Also depends on the depth of the sewer from the ground.

Classification	Examples	Screening						Justification Notes for Screening
		Ability to Meet Limits	Technology Implementation	Site Constraints	Cost	Operations	Provides Other Benefits	
In-Plant Process Changes	Identifying processes that increase wastewater temperature, Using alternatives processes/technology for wastewater treatment, Using energy-efficient mechanical equipment to minimize losses due to friction.	Fail Typical temperature rises through treatment by 2 to 3 degrees F.	Fail No known implementation for in-process cooling.	Pass Control on-site WWTP.	Unknown	Fail Changes would impact operations.	Yes Reduction in energy usage, which will also reduce GHG emissions.	**FAIL** Does not meet the limits The ability to control temperature increases from biological treatment is unlikely. Equipment temperature rises may not be controllable.

Notes:
DO - dissolved oxygen; HVAC - heating, ventilation, and air conditioning; RWQCB - Regional Water Quality Control Board; TTSA - Tahoe-Truckee Sanitation Agency; WDR - waste discharge requirement

1.5.3 Donald C. Tillman Water Reclamation Plant

Effluent and receiving water data collected between 2000 and 2024 and effluent flow data from the last five years (to be reflective of current recycling levels and decreased influent flows from conservation) were evaluated for this analysis. An overview of historical effluent temperatures and flows at DCTWRP and receiving water temperatures across the Sepulveda Basin are summarized in Table 1.5.

Maximum effluent flows during the periods of exceedance for both the 80 degree F Effluent Limit and Delta 5 were 30.9 mgd. Effluent temperatures exceeded 80 degrees F historically during the month of February and from May through November at DCTWRP, as shown in red in Table 1.5. To meet the 80 degree F Effluent Limit, DCTWRP will be required to reduce the effluent temperature by 7 degrees F for up to 30.9 mgd before discharging into the LAR.

Delta 5 was historically exceeded during all months of the year, as shown in red in Table 1.5. To ensure receiving waters are not warmed by more than 5 degrees F above the natural temperature, DCTWRP will be required to reduce the effluent temperature by up to 32 degrees F for up to 30.9 mgd before discharging to the LAR.

Table 1.6 summarizes the options considered for temperature reduction for DCTWRP.

Table 1.5 Summary Temperature Exceedance Calculations for DCTWRP[1]

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Maximum Effluent Flow Rate (mgd)	26.1	30.89	29.91	28.48	30.55	27.14	25.69	25.89	25.92	28.27	28.95	28.16
80 Degree F Effluent Limit												
Maximum Effluent Temperature (degrees F)	77	82	78	79	81	84	86	87	87	85	83	79
Target Effluent Temperature (degrees F)	80	80	80	80	80	80	80	80	80	80	80	80
$\Delta T_{80F\ Effluent\ Limit}$ (degrees F)[2,3]	-	2	-	-	1	4	6	7	7	5	3	-
Delta 5												
Maximum River Temperature Delta (degrees F)[4]	14	13	15	12	13	8	8	9	10	13	17	22
Minimum Upstream River Temperature (degrees F)	43	48	50	48	62	66	72	71	68	56	48	42
Target Effluent Temperature (degrees F)[5]	48	53	55	53	67	71	77	76	73	61	53	47
$\Delta T_{Delta\ 5}$ (degrees F)[6]	29	29	23	26	14	13	9	11	14	24	30	32

Notes:
(1) Red text indicates months when temperature limit was exceeded.
(2) $\Delta T_{80F\ Effluent\ Limit}$ = Maximum Effluent Temperature - 80 degrees F.
(3) Only calculated for months where 80 degree F Effluent Limit was exceeded.
(4) River Temperature Delta = Downstream River Temperature - Upstream River Temperature.
(5) Target Effluent Temperature = Minimum Upstream Temperature + 5 degrees F.
(6) $\Delta T_{Delta\ 5}$ = Maximum Effluent Temperature - (Minimum Upstream River Temperature + 5 degrees F).

Table 1.6 Screening Analysis for DCTWRP

Classification	Examples	Screening						Justification Notes for Screening
		Ability to Meet Limits	Technology Implementation	Site Constraints	Cost	Operations	Provides Other Benefits	
Natural Heat Flow	Cooling with groundwater using heat exchanger, geothermal cooling.	Pass Depends on groundwater temperature. Typical groundwater temperature in the LA region is about 60 degrees F. May help with 80 degree F Effluent Limit. Fail Based on the temperature reduction needed to meet the Delta 5 limits and the available information for this option, Delta 5 will not be met.	Unknown No known implementation at this scale for wastewater. Heat exchangers and geothermal cooling are typically used in residential and commercial application.	Pass Space available to meet significant space required.	Cost depends on land availability and requires significant pumping and underground piping.	Fail More complex, likely need additional staff.	No	**FAIL** Does not meet the limits. Large space requirement, unknown applications, cost-effectiveness unknown. Groundwater temperatures likely not low enough to meet Delta 5 limit (typically in low 60 degrees F).
	Aquifer storage and recovery.	Unknown Depends on groundwater temperature. May help with 80 degree F Effluent Limit. Fail Based on the temperature reduction needed to meet the Delta 5 limits and the available information for this option, Delta 5 will not be met.	Fail Used for potable water and reuse, but not for temperature reduction.	Pass Space available to meet significant space required.	Cost includes multiple wells, pumping, and treatment to potable reuse standards.	Fail More complex, likely need additional staff.	Yes Increased water supply from aquifer storage and recovery.	**FAIL** Does not meet the limits. Aquifer storage and recovery likely requires higher level of treatment and WDR to meet potable reuse standards.
	Hyporheic zone injection or infiltration trenches.	Unknown Modeling simulations done for a river in Oregon that is not comparable to the LA River but no actual implementation.	Pass TTSA and Los Osos are implementing infiltration for effluent disposal, but not for temperature control. TTSA has shown temperature reductions.	Pass Non-channelized riverbed is available for hyporheic zone injection, assumed sufficient space within the Sepulveda Basin to discharge 31 mgd effluent flow. Space is available for infiltration trenches, but in floodplain.	Cost includes perforated piping below grade, infiltration trenches.	Fail More complicated operations.	Yes Groundwater recharge from infiltration trenches.	**FAIL** Does not meet the limits Land space available for infiltration trenches, but it is the floodplain Requires a WDR for land discharge - unknown if RWQCB would grant permit. Would be sited on USACE land and within floodplain, needing USACE approval for land use and associated permits. Additional investigation (groundwater modeling) required to see if surface flooding occurs Effect of warm effluent in the hyporheic zone is unknown.

Classification	Examples	Screening						Justification Notes for Screening
		Ability to Meet Limits	Technology Implementation	Site Constraints	Cost	Operations	Provides Other Benefits	
	Blending with deep groundwater water source.	Pass Depends on groundwater temperature. Typical groundwater temperature in the LA region is about 60 degrees F. May help meet 80 degree F Effluent Limit. Fail Based on the temperature reduction needed and the available information for this option, Delta 5 will not be met.	Unknown No known implementation, but technically feasible if groundwater is cool enough and there is sufficient groundwater volume.	Pass Little space requirements for mixing box. Unlikely that large volumes of water can be found to blend DCTWRP flows.	Cost includes piping, modification of outfall to accommodate larger flows, and possible construction of a new groundwater well. Depends on availability and access to groundwater.	Pass	Yes Provides instream flow augmentation, recreational benefits.	**FAIL** Requires groundwater extraction permits, flow availability, temperature of groundwater unknown, cost-effectiveness unknown. Blending with deep groundwater may affect effluent water quality. Volume of water required to blend make this unfeasible and may cause overdraft and subsidence. Groundwater temperatures likely not low enough for Delta 5 (typically in low 60 degrees F).
Evaporative Cooling	Passive cooling wetlands/pond, seasonal pond storage, spray pond cooling system, pipe in pond cooling.	Fail Current lakes help meet 80 degree F Effluent Limit at certain times. Based on the temperature reduction needed and the available information for this option, Delta 5 will not be met.	Fail Existing lakes at DCTWRP produce inconsistent temperature reductions and are not designed for this purpose.	Fail Ability to create new ponds limited by USACE.	Cost depends on land availability, offsite, piping, pumping.	Fail Additional operations outside fence line.	Yes Provides recreational and habitat benefits.	**FAIL** Does not meet the limits Large space required outside of plant; cost-effectiveness unknown.
	Effluent discharge structure modifications.	Fail May help meet 80 degree F Effluent Limit Based on the temperature reduction needed the available information for this option, Delta 5 will not be met	Fail Aeration structures are not designed for temperature reduction.	Pass Limited space requirements.	Low investment when compared to other non-traditional temperature reduction options.	Pass Limited operations.	Yes Improves DO in receiving stream.	**FAIL** Does not meet the limits Unknown temperature reduction, requires additional space near the outfall, low investment when compared to other options and can be implemented on-site.
Source Control	Limiting the use of hot water for non-essential purposes.	Unknown Ability to meet either limit unknown.	Unknown No known implementation of hot water limitations.	Pass Not on-site.	Increase in staffing requirements to implement source control limits.	Fail Difficult to implement/ enforce.	Unknown	**FAIL** Does not meet the limits Unknown applications, unknown temperature control. Depends on the depth of the sewer from the ground.
	Recovering heat in buildings or in large sewer trunks and interceptors in the service area.	Fail May help meet 80 degree F Effluent Limit, unlikely to help Delta 5.	Fail Used in colder climates for indoor heating in winter.	Pass Not on-site, in collection system.	Cost includes adding heat exchangers, sewer modifications, and modifications to end user HVAC systems.	Fail Added complexity.	Yes Reduction in heat usage, which will also reduce GHG emissions.	**FAIL** Does not meet the limits This is a concept used where heat can be harvested from the sewer in cold environments. Not suitable for warm climates.
	Public outreach and residential rebate programs.	Unknown Focus on residential sector which is the source of most heat load.	Fail Home-based heat recovery devices but difficult to implement.	Pass Not on-site. In residential homes.	Cost to establish outreach and rebate/incentive program to retrofit all existing homes.	Pass Belong to homeowners and requires regular maintenance.	Yes Cities may provide residential rebates to customers.	**FAIL** Does not meet the limits Unknown applications, cost-effectiveness unknown. Difficult to implement. Depends on the depth of the sewer from the ground.

Classification	Examples	Screening						Justification Notes for Screening
		Ability to Meet Limits	Technology Implementation	Site Constraints	Cost	Operations	Provides Other Benefits	
	Industrial source control through local limit or site specific limit.	Fail Given comparatively small industrial flows, unlikely to meet either limit. Local limit is important in managing the influent temperatures to the WRP	Pass Local limit is established way to control industrial discharges.	Pass Not on-site.	Relatively low cost to DCTWRP. May require significant capital expenditures for industrial sources.	Pass No operations.	No	**FAIL** Does not meet the limits May provide some reduction, but will not meet limit. May impact industries. Depends on the depth of the sewer from the ground.
In-Plant Process Changes	Identifying processes that increase wastewater temperature, Using alternatives processes/technology for wastewater treatment, Using energy-efficient mechanical equipment to minimize losses due to friction.	Fail Typical temperature rises through treatment by 2 to 3 degrees F.	Fail No known implementation for in-process cooling.	Pass Control on-site WWTP.	Unknown	Fail Changes would impact operations.	Yes Reduction in energy usage, which will also reduce GHG emissions.	**FAIL** Does not meet the limits The ability to control temperature increases from biological treatment is unlikely. Equipment temperature rises may not be controllable.

1.5.4 Burbank Water Reclamation Plant

Effluent and receiving water data collected between 2000 and 2024 and effluent flow data from the last five years (to be reflective of current recycling levels and decreased influent flows from conservation), excluding 2022 flows due to construction, were evaluated for this analysis. An overview of historical effluent temperatures and flows at BWRP and receiving water temperatures near the discharge point are summarized in Table 1.7.

Effluent temperatures exceeded 80 degrees F historically during all months of the year at BWRP, as shown in red in Table 1.7. To meet the 80-degree F Effluent Limit, BWRP will be required to reduce the effluent temperature by up to 9 degrees F before discharging into the Burbank Western Channel. Similarly, Delta 5 was historically exceeded during all months of the year, as shown in red in Table 1.7. To ensure receiving waters are not warmed by more than 5 degrees F above the natural temperature, BWRP will be required to reduce the effluent temperature by up to 37 degrees F before discharging. Maximum effluent flows during the periods of exceedance for both the 80 degree F Effluent Limit and Delta 5 were 5.9 mgd. Table 1.8 summarizes the options considered for temperature reduction for BWRP.

Table 1.7 Summary Temperature Exceedance Calculations for BWRP[1]

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Maximum Effluent Flow Rate (mgd)	5.89	5.81	5.54	5.49	5.41	5.36	4.32	4.35	4.16	4.17	3.75	5.45
80 Degree F Effluent Limit												
Maximum Effluent Temperature (degrees F)	84	86	83	84	84	84	87	89	87	85	86	84
Target Effluent Temperature (degrees F)	80	80	80	80	80	80	80	80	80	80	80	80
$\Delta T_{80F\ Effluent\ Limit}$ (degrees F)[2,3]	4	6	3	4	4	4	7	9	7	5	6	4
Delta 5												
Maximum River Temperature Delta (degrees F)[4]	21	17.2	16	16	17	12	12	13	14.2	15	17	18.9
Minimum Upstream River Temperature (degrees F)	46	44	49	50	57	55	62	66	58	55	46	46
Target Effluent Temperature (degrees F)[5]	51	49	54	55	62	60	67	71	63	60	51	51
$\Delta T_{Delta\ 5}$ (degrees F)[6]	33	37	29	29	22	24	20	18	24	25	35	33

Notes:
(1) Red text indicates months when temperature limit was exceeded.
(2) $\Delta T_{80F\ Effluent\ Limit}$ = Maximum Effluent Temperature - 80 degrees F.
(3) Only calculated for months where 80 degree F Effluent Limit was exceeded.
(4) River Temperature Delta = Downstream River Temperature - Upstream River Temperature.
(5) Target Effluent Temperature = Minimum Upstream Temperature + 5 degrees F.
(6) $\Delta T_{Delta\ 5}$ = Maximum Effluent Temperature - (Minimum Upstream River Temperature + 5 degrees F).

Table 1.8 Screening Analysis for BWRP

Classification	Examples	Screening						Justification Notes for Screening
		Ability to Meet Limits	Technology Implementation	Site Constraints	Cost	Operations	Provides Other Benefits	
Natural Heat Flow	Cooling with groundwater using heat exchanger, geothermal cooling.	Pass Depends on groundwater temperature. Typical groundwater temperature in the LA region is about 60 degrees F. May help with 80 degree F Effluent Limit. Fail Based on the temperature reduction needed and the available information for this option, Delta 5 will not be met.	Unknown No known implementation at this scale for wastewater. Heat exchangers and geothermal cooling are typically used in residential and commercial application.	Fail Limited space available, but significant space required. Groundwater is contaminated near BWRP.	Cost depends on land availability and requires significant pumping and underground piping.	Fail More complex, likely need additional staff.	No	**FAIL** Does not meet the limits Local groundwater contamination makes this infeasible. Large space requirement, unknown applications, cost-effectiveness unknown. Groundwater temperatures likely not low enough for Delta 5 (typically in low 60 degrees F).
	Aquifer storage and recovery.	Fail Depends on groundwater temperature. May help with 80 degree F Effluent Limit Based on the temperature reduction needed and the available information for this option, Delta 5 will not be met.	Fail Used for potable water and reuse, but not for temperature reduction.	Fail Limited space available, but significant space required. Groundwater is contaminated near BWRP.	Cost includes multiple wells, pumping, and treatment to potable reuse standards.	Fail More complex, likely need additional staff.	Yes Increased water supply from aquifer storage and recovery.	**FAIL** Does not meet the limits Local groundwater contamination makes this infeasible. Aquifer storage and recovery likely requires higher level of treatment and WDR to meet potable reuse standards.
	Hyporheic zone injection or infiltration trenches.	Unknown Modeling simulations done for a river in Oregon that is not comparable to the LA River but no actual implementation.	Pass TTSA and Los Osos are implementing trenches for effluent disposal, but not for temperature control. TTSA has shown temperature reductions.	Fail Riverbed is channelized, not enough space for infiltration trenches. Groundwater is contaminated near BWRP.	Cost includes perforated piping below grade, infiltration trenches.	Fail More complicated operations.	Yes Groundwater recharge from infiltration trenches.	**FAIL** Does not meet the limits Local groundwater contamination makes this infeasible. Insufficient space for trenches. Requires a WDR for land discharge - unknown if RWQCB would grant permit.
	Blending with deep groundwater water source.	Pass Depends on groundwater temperature. Typical groundwater temperature in the LA region is about 60 degrees F. May help meet 80 degree F Effluent Limit. Fail Based on the temperature reduction needed and the available information for this option, Delta 5 will not be met.	Unknown No known implementation, but technically feasible if groundwater is cool enough and there is sufficient volume.	Fail Little space requirements for mixing box. Possible to find volumes of water that can be blended with 6-mgd effluent flows. Groundwater is contaminated near BWRP.	Cost includes piping, modification of outfall to accommodate larger flows, and possible construction of a new groundwater well. Depends on availability and access to groundwater.	Pass	Yes Provides instream flow augmentation, recreational benefits.	**FAIL** Does not meet the limits Local groundwater contamination makes this infeasible. Groundwater temperatures likely not low enough for Delta 5 (typically in low 60 degrees F).

Classification	Examples	Screening						Justification Notes for Screening
		Ability to Meet Limits	Technology Implementation	Site Constraints	Cost	Operations	Provides Other Benefits	
Evaporative Cooling	Passive cooling wetlands/pond, seasonal pond storage, spray pond cooling system, pipe in pond cooling.	Fail May help meet 80 degree F Effluent Limit Based on the temperature reduction needed and the available information for this option, Delta 5 will not be met.	Fail Existing lakes at DCTWRP produce inconsistent temperature reductions and are not designed for this purpose.	Fail No land available, requires significant space.	Cost depends on land availability, offsite, piping, pumping.	Fail Additional operations outside fence line.	Yes Provides recreational and habitat benefits.	**FAIL** Does not meet the limits Large space required outside of plant; cost-effectiveness unknown.
	Effluent discharge structure modifications.	Fail May help meet 80 degree F Effluent Limit Based on the temperature reduction needed and the available information for this option, Delta 5 will not be met.	Fail Aeration structures are not designed for temperature reduction.	Pass Limited space requirements.	Low investment.	Pass Limited operations.	Pass Improves DO in receiving stream.	**FAIL** Does not meet the limits Unknown temperature reduction, requires additional space near the outfall, low investment when compared to other options and can be implemented on-site.
Source Control	Limiting the use of hot water for non-essential purposes.	Unknown Ability to meet either limit unknown.	Unknown No known implementation of hot water limitations.	Pass Not on-site.	Increase in staffing requirements to implement source control limits.	Fail Difficult to implement/ enforce.	Unknown	**FAIL** Does not meet the limits Unknown applications, unknown temperature control. Depends on the depth of the sewer from the ground.
	Recovering heat in buildings or in large sewer trunks and interceptors in the service area.	Fail May help meet 80 degree F Effluent Limit Based on the temperature reduction needed and the available information for this option, Delta 5 will not be met.	Fail Used in colder climates for indoor heating in winter.	Pass Not on-site, in collection system.	Cost includes adding heat exchangers, sewer modifications, and modifications to end-user HVAC systems.	Fail Added complexity	Yes Reduction in heat usage, which will also reduce GHG emissions	**FAIL** Does not meet the limits This is a concept used where heat can be harvested from the sewer in cold environments. Not suitable for warm climates.
	Public outreach and residential rebate programs.	Unknown Focus on residential sector which is the source of most heat load.	Fail Home-based heat recovery devices but difficult to implement.	Pass Not on-site. In residential homes.	Cost to establish outreach and rebate/incentive program to retrofit all existing homes.	Pass Belong to homeowners.	Yes Cities may provide residential rebates to customers.	**FAIL** Does not meet the limits Unknown applications, cost-effectiveness unknown. Difficult to implement. Depends on the depth of the sewer from the ground.
	Industrial source control through local limit or site specific limit.	Fail Given comparatively small industrial flows, unlikely to meet either limit. Local limit is important in managing the influent temperatures to the WRP	Pass Local limit is established way to control industrial discharges.	Pass Not on-site.	Relatively low cost.	Pass No operations	No	**FAIL** Does not meet the limits May provide some reduction, but will not meet limits. May impact industries. Also depends on the depth of the sewer from the ground.

Classification	Examples	Screening						Justification Notes for Screening
		Ability to Meet Limits	Technology Implementation	Site Constraints	Cost	Operations	Provides Other Benefits	
In-Plant Process Changes	Identifying processes that increase wastewater temperature, Using alternatives processes/technology for wastewater treatment, Using energy-efficient mechanical equipment to minimize losses due to friction.	Fail Typical temperature rises through treatment by 2 to 3 degrees F.	Fail No known implementation for in-process cooling.	Pass Control on-site WWTP.	Unknown	Fail Changes would impact operations.	Yes Reduction in energy usage, which will also reduce GHG emissions.	**FAIL** Does not meet the limits The ability to control temperature increases through biological treatment is unlikely. Equipment temperature rises may not be controllable.

1.6 Conclusions

As shown in the tables above, few options have the potential to reduce effluent temperatures at the three WRPs, and none can meet the limits. To meet the 80-degree F Effluent Limit, effluent temperatures at the three WRPs need to be reduced by up to 7 to 9 degrees F, while meeting the Delta 5-degree requirement in the receiving water would require reductions of effluent temperatures by to 32 to 37 degrees F. The large temperature reduction for Delta 5 compliance eliminates any of these non-traditional (non-mechanical cooling) solutions. The options identified as having potential for temperature reduction are those options that appear to have the most likely benefit and may be implementable. However, given that there are few installations or examples of where these concepts have been applied, it is not clear that an effluent of 80 degrees F could be achieved year-round in all conditions.

Implementing the potential options may be contingent on regulatory approval(s), such as those related to discharge permitting and basin planning. Moving to a land disposal scheme through hyporheic zone injection/infiltration trenches could both reduce temperature and eliminate the permit requirement for DCTWRP; however, it is unlikely 100 percent of the effluent could be removed from the stream due to the expectations of providing beneficial flows. Modifications to effluent discharge structures at all three WRPs is a lower investment option to be considered in conjunction with other traditional options for the 80 degree F limit, but will not meet Delta 5 compliance.

Source control is unable to meet the Delta 5 limit, and it is unclear how much temperature reduction could be achieved for the 80-degree F limit. Local limits may be beneficial in managing the influent temperatures at the WRPs, but will not be able to provide significant temperature reduction or meet the limits.

In summary, none of the options evaluated can be relied on to meet the limits. For reliable compliance with the objectives, a mechanical solution (cooling towers or chillers) or elimination of flow from the discharge location would be needed (See TM2).