LA 222 Hydrology for Planners

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Term Project

Best Management Practices for the Los Angeles River:

Taylor Yard Case Study

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Abstract

Implementing Best Management Practices (BMP) as a way of controlling stormwater runoff is becoming a common practice encouraged by cities across the United States. The City of Los Angeles is no exception and has an active stormwater management program.

On December 13, 2001, the Regional Water Quality Control Board issued a Municipal Storm Water National Pollutant Discharge Elimination System Permit (NPDES Permit No. CAS004001) that requires new development and redevelopment projects to incorporate storm water mitigation measure, effective September 2, 2002. Depending on the type of project, either a Standard Urban Stormwater Mitigation Plan (SUSMP) or a Site Specific Mitigation Plan is required to reduce the quantity and improve the quality of stormwater runoff that leaves the site. Developers are encouraged to begin work on complying with these regulations by visiting the Watershed Protection Division (WPD) in the design phase of their projects[i].

This study focuses on using a BMP to detain stormwater runoff from two tributaries to the Los Angeles River, the capture volume required at a specific site, and to foresee the effect the same techniques would have if applied across the entire Los Angeles River watershed.

Problem Statement

The Los Angeles River is one of the largest urbanized "rivers" in the world. In fact, most people who call Los Angeles home don't even know it's a river at all. They simply know it as the concrete ditch they pass over while navigating the city in their automobiles. Channelized by the U.S. Army Corps of Engineers in the 1950s to alleviate property damage caused by flooding, it was by far the largest civil engineering project at the time. The river originates at the confluence of two other channelized rivers, Bell Creek and Arroyo Calabasas in the San Fernando Valley before flowing fifty-one miles to its eventual end, draining into the Port of Los Angeles and the Pacific Ocean. In total, the Los Angeles River drains a watershed 827 mi^2 (529,280 acres) in size.

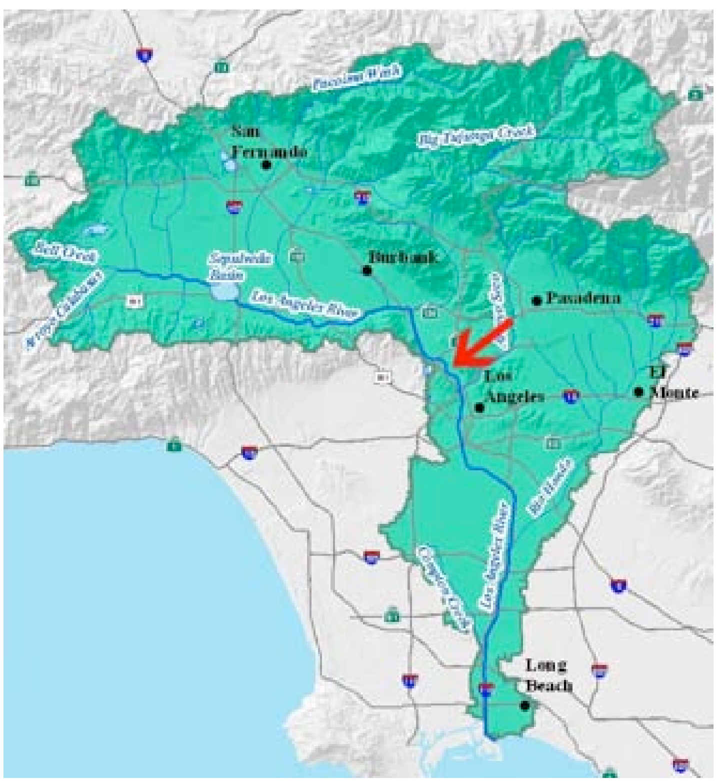


Figure 1: Taylor Yard site within the LA River watershed (Indicated by arrow). See full size image: Appendix A.

The dense urban development of the Los Angeles River watershed has increased runoff and consequently, flood hazards. With the possibility of even more flashy storm events occurring in the future due to climate change, decision makers are considering alternative ways

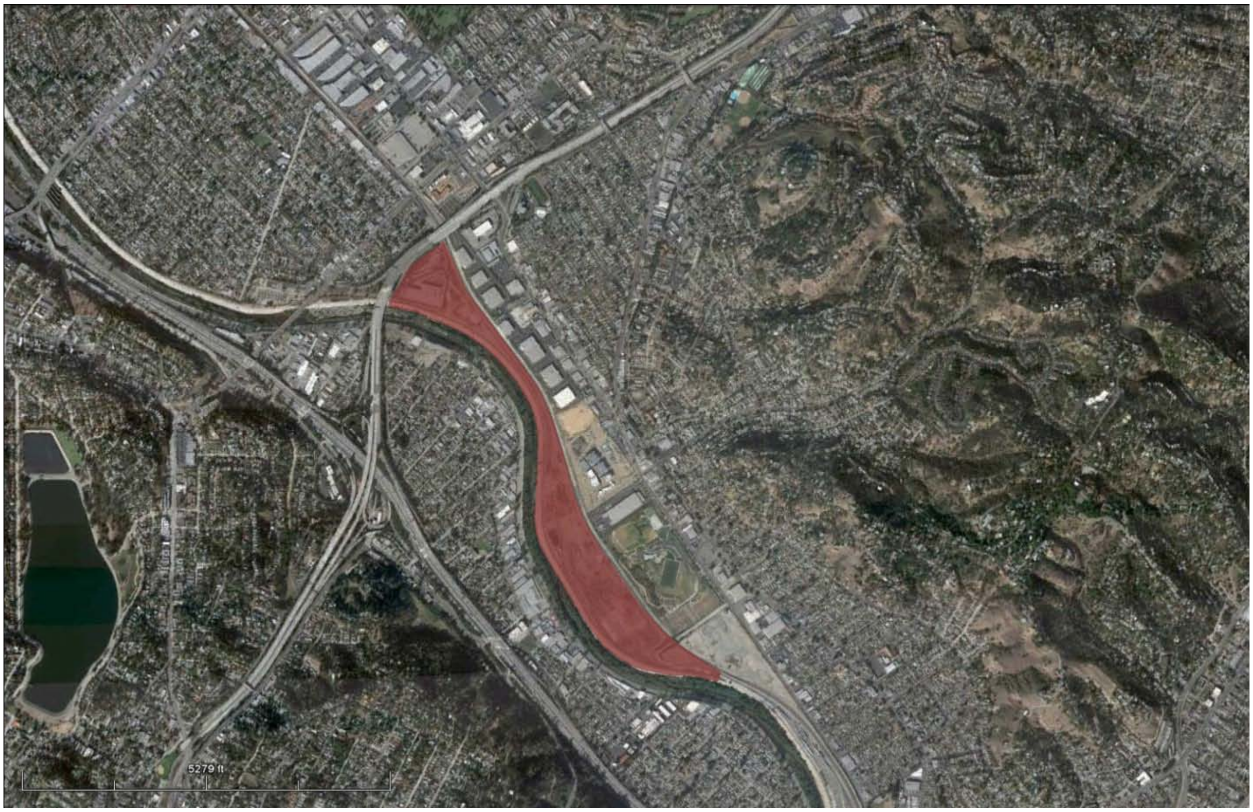


Figure 2: Taylor Yard (shown in red)

to convey the water and, pressured by environmental groups, studying the removal of the concrete and restoring ecological habitats and natural cycles.

As a follow up to the LA205 studio project at the now abandoned Taylor Yard railway site, we're proposing alternative designs to capture and detain stormwater runoff at the Taylor Yard site, therefore alleviating pressure put on the Los Angeles River channel.

There are two main sub-watersheds that drain into the LA River at the Taylor Yard site; Sycamore Creek draining an area of 0.3 mi^2 and Eagle Rock Creek draining 7.9 mi^2, together totaling an area of 8.2 mi^2.

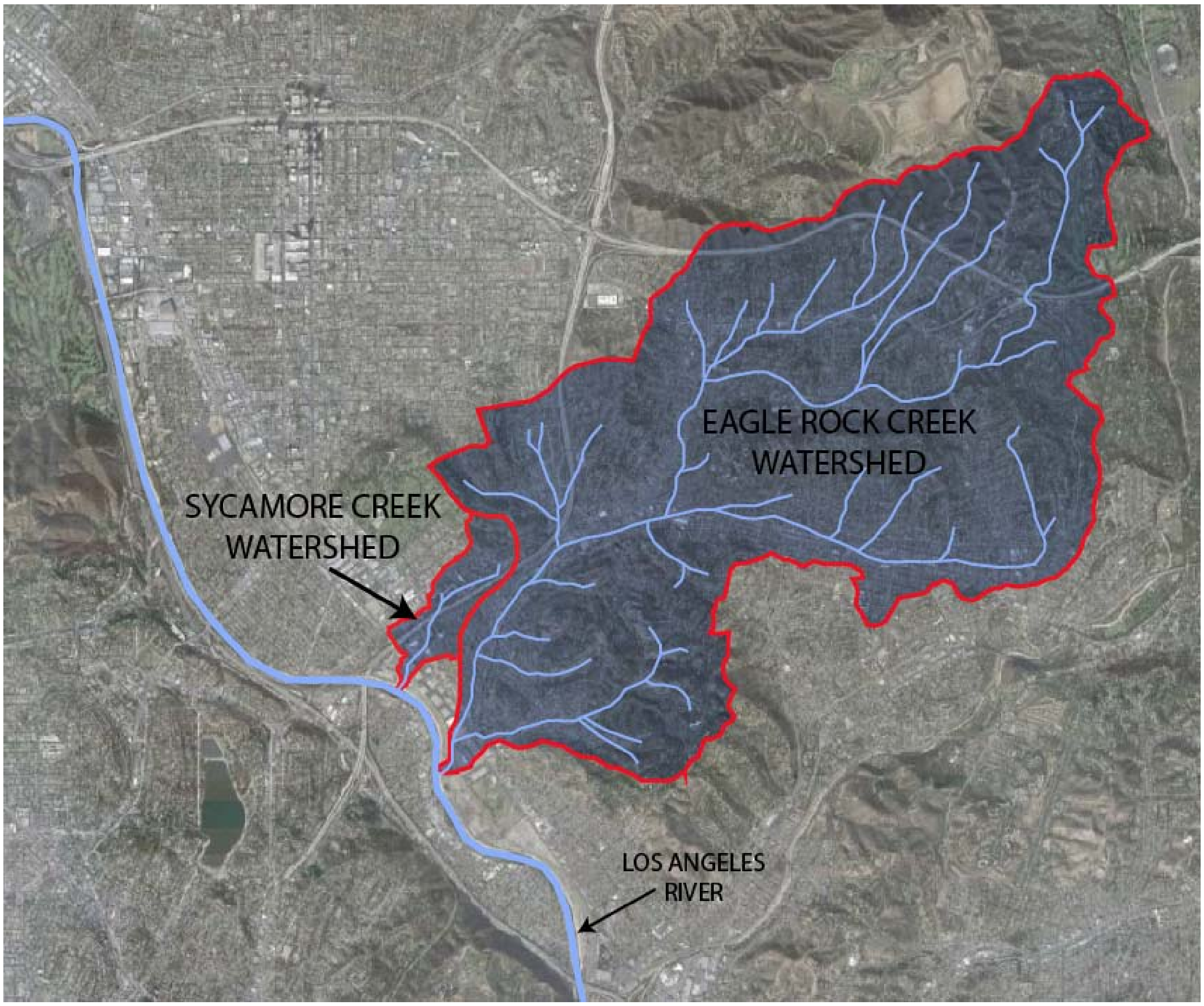


Figure 3: The two sub-watersheds, Eagle Rock Creek and Sycamore Creek, that drain into the LA River at Taylor Yard.

Research Questions

- How much runoff reaches the LA River from both sub-watersheds?
- How much runoff could be captured at Taylor Yard using BMP?
- What would be the impact on the LA River channel on site?

Methods

We used Geographic Information Systems (GIS) data gathered from the City and County of Los Angeles and from the United States Geological Survey (USGS) to map the LA River sub-watersheds.

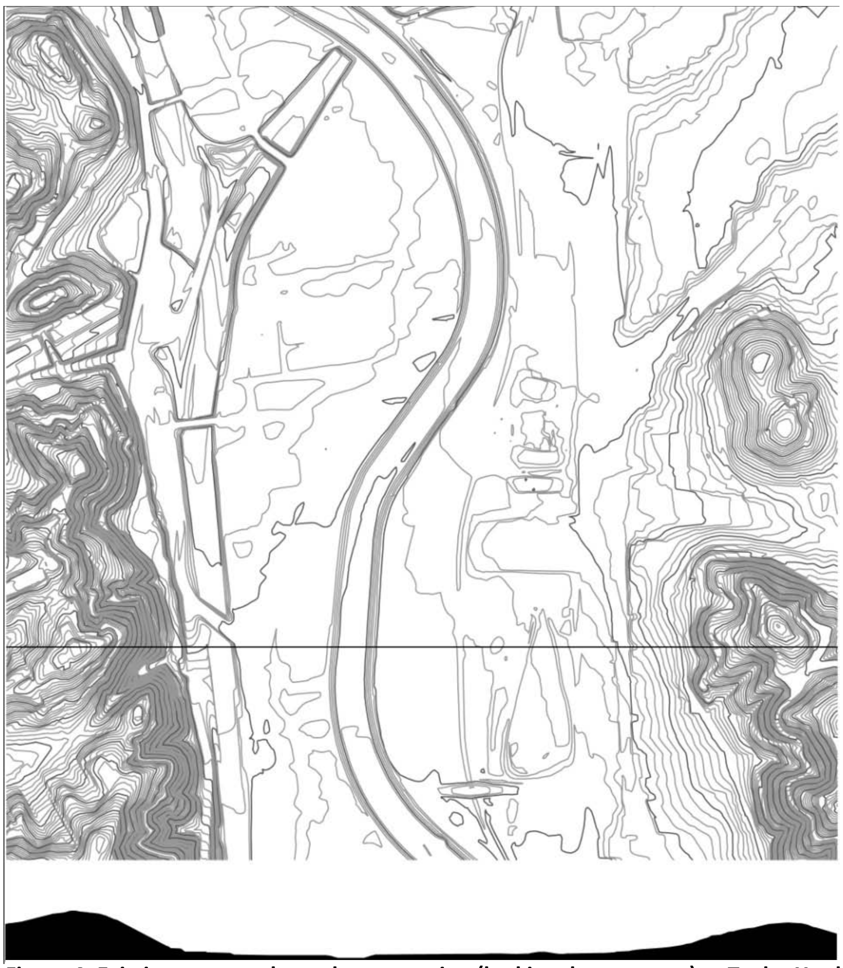


Figure 4: Existing topography and cross section (looking downstream) at Taylor Yard

The existing topography shows the historical floodplain the Los Angeles River was allowed to meander through and flood prior to channelization. Because the river is no longer allowed to jump its banks, urban development has encroached all the way up to the banks of the channel.

To calculate discharge of each sub-watershed we used the *Rational Method* (Q = CIA)[ii], where Q is discharge, C is the rational coefficient of cover factor, I is rainfall intensity (inches/hour), and A is the total drainage area of both sub-watersheds (acres).

To estimate the cover factor, we used the matrix provided by the U.S. Federal Highway Administration *Design of Roadside Channels* manual. Using aerial photography and on-site analysis we determined the watershed to be mainly sloping residential, about 50% impervious. According to the information provided in the manual, this cover condition has a coefficient of **0.7.**

The objective is to calculate the volume of stormwater we can detain at Taylor Yard based on the rainfall within the County of Los Angeles, which varies spatially. The Los Angeles Regional Water Quality Control Board (RWQCB) agreed to use a spatially distributed statistical rainfall distribution report for water quality studies. The RWQCB allows the use of 85th percentile 24-hour rainfall event or the 0.75-inch event for Standard Urban Storm Water Mitigation Plan (SUSMP) and BMP design hydrologic studies. The 85th percentile 24-hour rainfall amounts vary from 0.30 to 1.50 inches within the County of Los Angeles. This report provides the analysis used to determine the spatial distribution of the 85th percentile 24-hour rainfall within the

Figure 5: The 85th percentile isohyets for Los Angeles County. Two sub-watersheds (shown in blue) fall around an average rainfall of 1.00" per 24 hours.

County of Los Angeles[iii]. We decided to use this reference because we could determine from their mapping a more precise number for our site. The two sub-watershed being studied fall near the 1.00" of rainfall per 24 hour period isohyet (see figure 5). To get the rainfall intensity per hour, we divided this number by 24 to get **0.04"** per hour.

As mentioned above, the total area of both sub-watersheds is 8.2 mi^2, **or 5,248 ac**.

Previous studies of Taylor Yard conducted by the US Army Corp of Engineers, estimate flows for the LA River channel during 25 year and 100 years storm events to be:

Q_{25} = 69,600 cfs and **Q_{100} = 93,800 cfs**[iv].

The reach of the Los Angeles River at Taylor Yard has a bed width of 220' with 90' wide banks totaling 400' from top of bank to top of bank. On average, it is 22' deep from bed to top of bank.

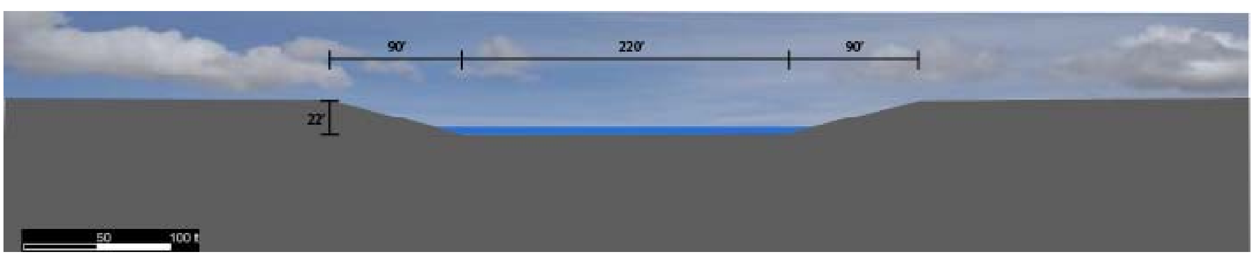


Figure 6: Cross section of the Los Angeles River channel at Taylor Yard

Using the 1-inch of rainfall event as a reference, we can conceive a BMP at Taylor Yard. To estimate the capture volume of the BMP, we used the formula $V = CA_{tot}R$, where V is the volume (ft^3), C is the weighted average runoff coefficient, given by $C = (\sum c_i A_i)/A_{tot}$, where c_i is runoff coefficient for each area of contributing drainage and A_i is the area. R is the design rainfall (ft).

Results

Q = CIA, where C is 0.7, I is 0.04 inches (1 inch divided by 24 hours), and A is the total area of both sub-watersheds, totaling 5,248 ac.

Q = 147 cfs at peak runoff discharged into the La River at Taylor Yard.

V = CAR, where C is 0.7, A is 5,248 ac or 228,602,880 ft^2, and R is 1-inch or 0.08 ft, the design rainfall.

V = 12,801,761 ft^3 or 293 acre-feet of control volume.

Therefore, in order to capture the runoff coming off these two sub-watersheds, a detention basin with a capacity of 293 acre-feet would be required to detain rain from a 1" storm event. Using the standard detention basin depth of four feet[v], this volume could be captured in an area of 73 acres, equivalent to the entire area of Taylor Yard. A detention basin with a depth of 4 feet allows for wetland vegetation species to establish, providing water quality, ecologic, and aesthetic improvements. This detention basin would barely be noticeable juxtaposed to the 22 feet of depth found in a typical reach of the LA River.

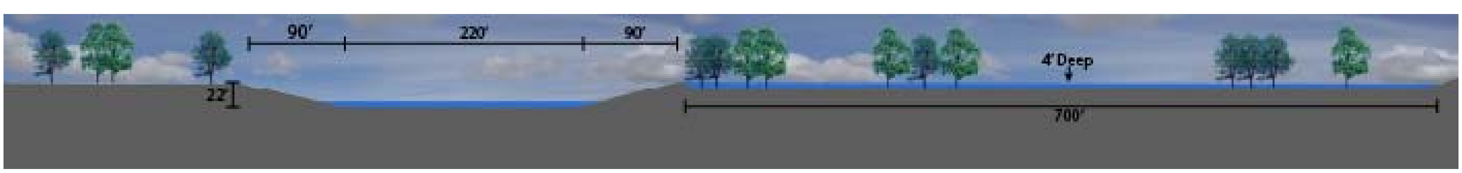


Figure 7: 4 ft. deep detention basin barely noticeable next to the 22 ft. deep river channel

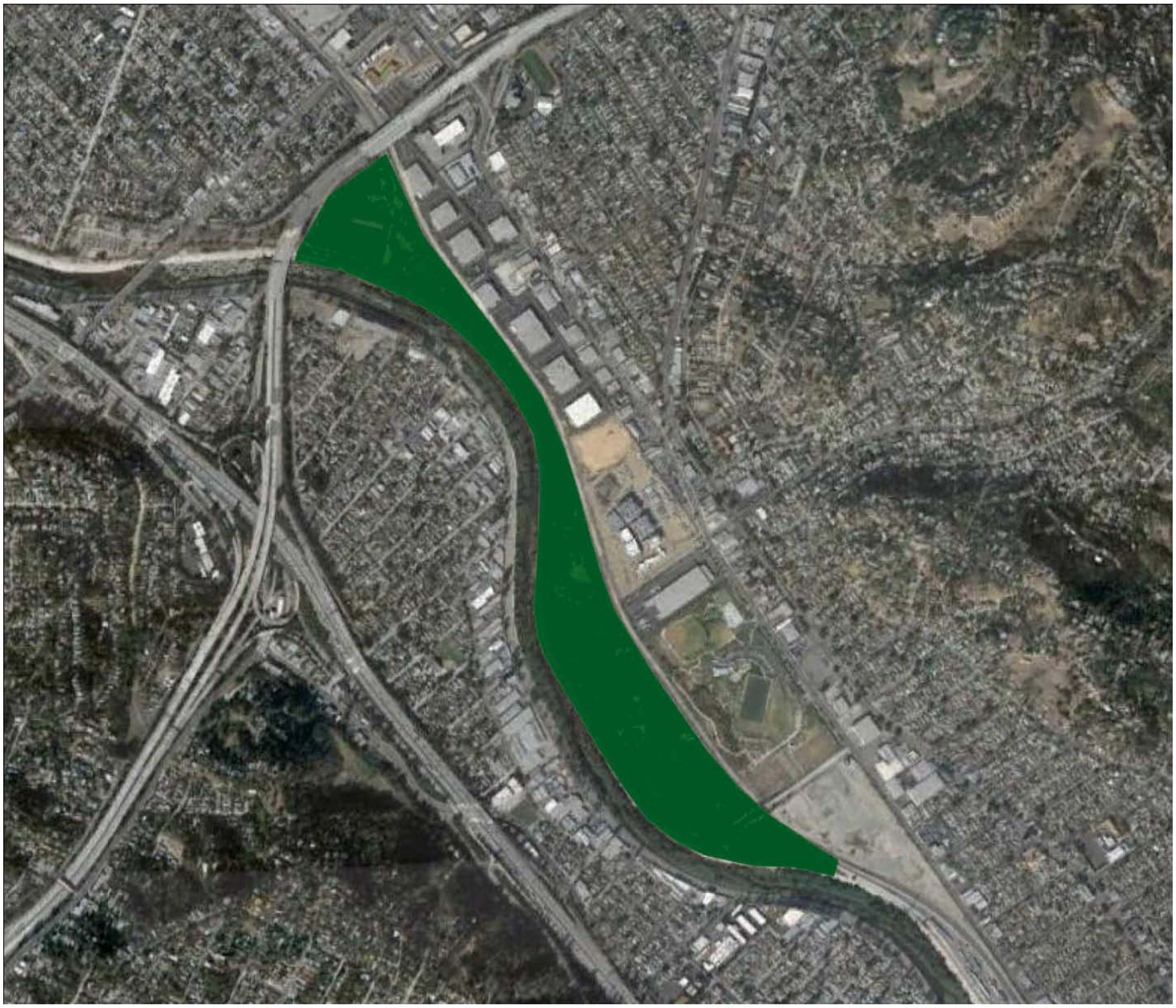


Figure 8: Plan view of detention basin at Taylor Yard

Discussion

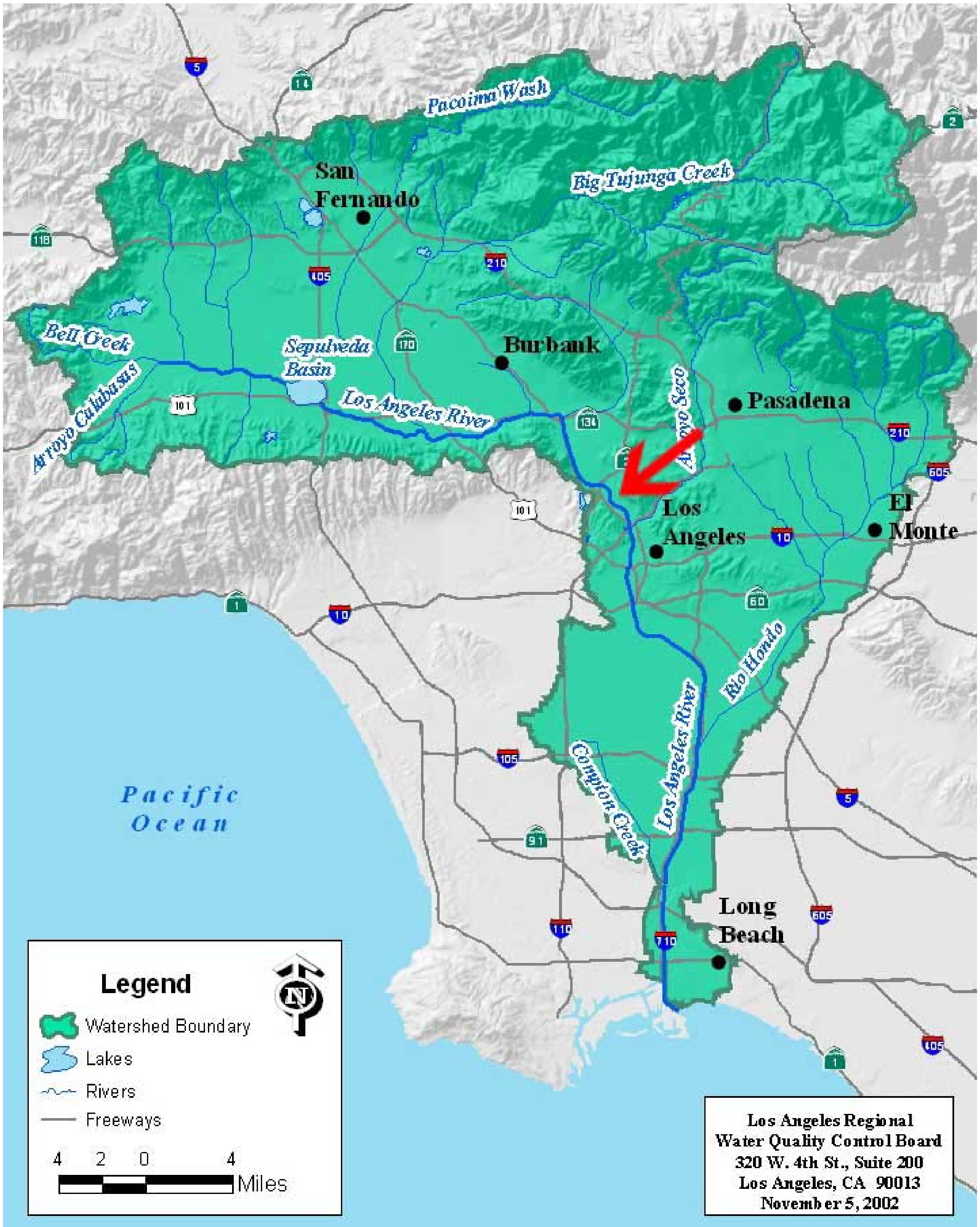
Detention basins, because dry most of the time, can serve many purposes besides storing stormwater during large rainfall events. A large detention facility, Sepulveda Basin, currently exist upstream from the Taylor Yard site. This basin provides large storage capacity when needed but also plays host to other diverse uses including athletic fields, agriculture, golf courses, a fishing lake, parklands, a sewage treatment facility, and a wildlife reserve.

Conclusions

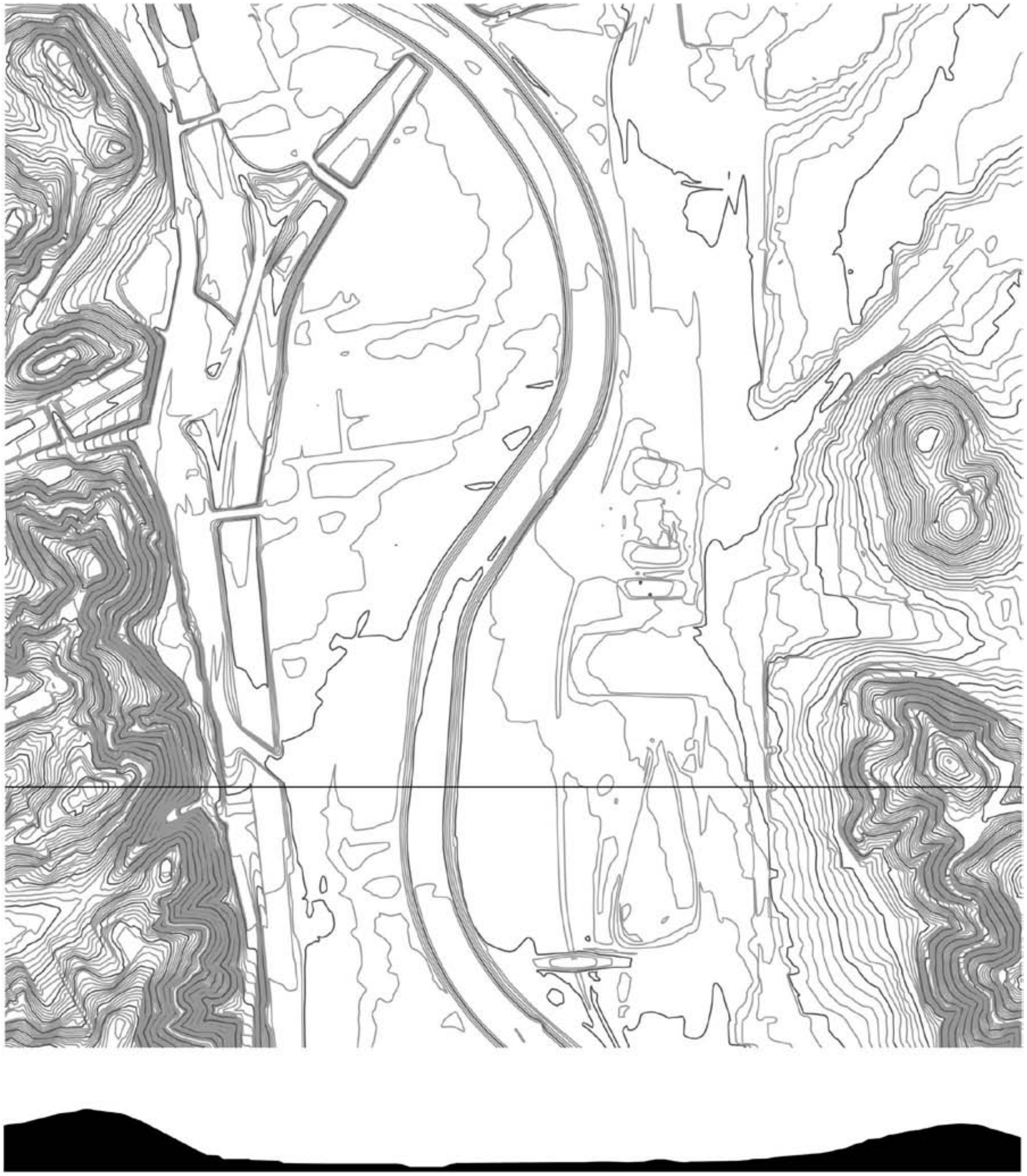
Since the LA River watershed is located in a subtropical-Mediterranean climate[vi]; receiving only 15.14" of rainfall in an average year, the extreme water conveyance infrastructure that is the Los Angeles River is rarely used to full capacity and is often seen with hardly any water in it at all. Additionally, when the watershed does receive substantial amounts of rainfall those few times a year; large volumes of water move at swift velocities down the river channel, creating a concern for public safety. For these reasons, there has been much recent discussion about restoring the urbanized LA River channel to a more natural state, providing greater hydrologic and ecologic value.

Even though the impact capturing the runoff from these two sub-watersheds made on the total discharge of the LA River was minimal, what if these strategies such as this were applied across the entire 827 mi^2 of the Los Angeles River watershed? More of an impact could be made if other post-industrial brownfield sites across the entire basin were evaluated for their stormwater storage capabilities.

Appendices



Appendix A: Taylor Yard site within the LA River watershed (Indicated by arrow)



Appendix B: Cross section of the Los Angele River channel at Taylor Yard

References

[i] City of Los Angeles Stormwater Program. Standard Urban Stormwater Mitigation Plans. 2002.

[ii] Dunne, T. and A. Leopold. Water in Environmental Planning. 1978.

[iii] County of Los Angeles Department of Public Works. Analysis of 85th Percentile 24-hour Rainfall Depth Analysis Within the County of Los Angeles. 2004.

[iv] Everest International Consultants, Inc. Taylor Yard Multiple Objective Feasibility Study-Final Report. 2002.

[v] California Stormwater Quality Association. California Stormwater BMP Handbook. 2003.

[vi] National Oceanic and Atmospheric Administration. Climatology of the United States No. 20. 2010.