

## **How a LEED Platinum Building is Cleaning up Inland Empire Urban Runoff**

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### **ABSTRACT**

In 2002, the Inland Empire Utility Agency (IEUA) – a municipal water agency in western San Bernardino County - designed and constructed its new Headquarters with the goal of attaining the first 2.0 platinum level “LEED” - Leadership in Energy and Environmental Design - rating established by the U. S. Green Building Council.”

IEUA has implemented a BMP project that truly showcases the beauty of “going back to the basics” in their creative stormwater management program. By integrating site design, source control, and treatment BMP’s into the headquarters facility, pollutants in the project have resulted in runoff reduction and treatment, and removal of stormwater runoff, particularly 85% to 99% of the total coliform that would traditionally contribute to the pathogen contaminants loading in Chino Creek which is currently listed on the 303d list for pathogens.

Chino Creek is an important tributary to the Prado wetlands, located only a few miles away. From Prado wetlands, the water either infiltrates or discharges into the Santa Ana River, which continues down to the Pacific Ocean. This project illustrates how and why it is critical to encourage stormwater treatment BMPs, including wetlands and riparian habitat, further up in the watersheds, and that these projects have direct impacts in protecting coastal resources.

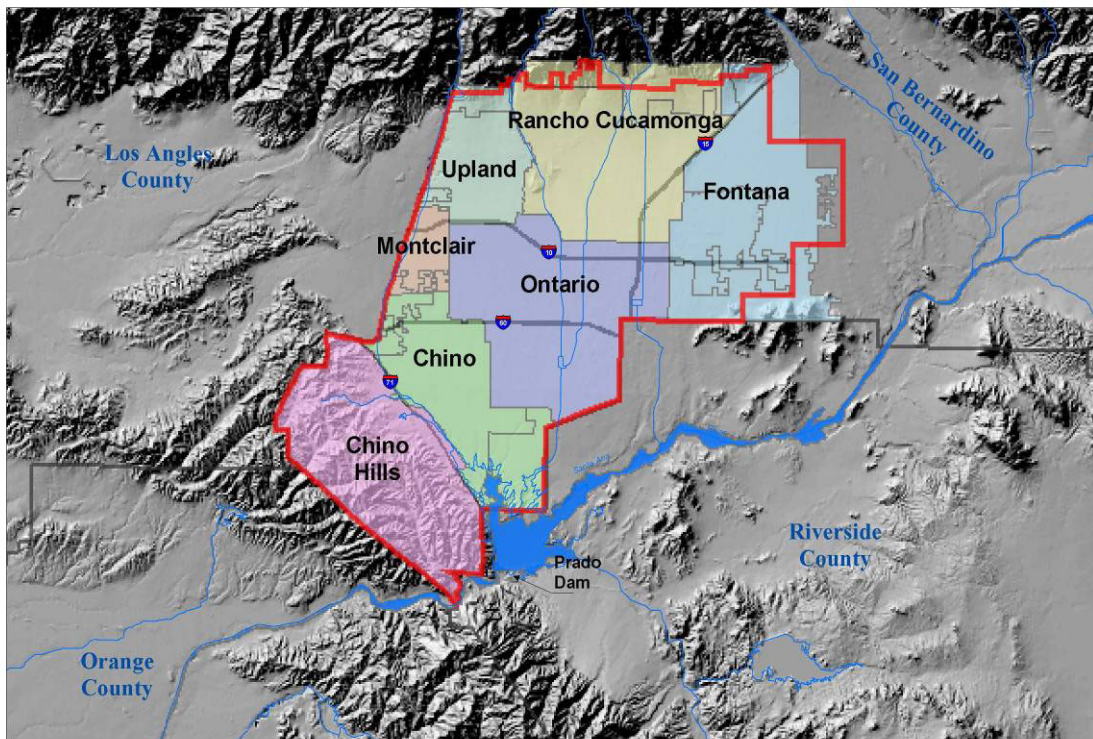
### **KEYWORDS**

Stormwater BMPs, Pervious pavements, Bioswales, LEED.

## INTRODUCTION

The Inland Empire Utilities Agency (IEUA/Agency), former Chino Basin Municipal District (CBMWD), was formed in 1950 to supply supplemental water to the Inland Empire. The IEUA's 242 square mile service area is located in the southwest corner of San Bernardino County, approximately 35 miles east of Los Angeles (See **Figure 1**), and provides regional wastewater service and imported water deliveries to eight contracting agencies which include the City of Chino, City of Chino Hills, Cucamonga Valley Water District, City of Rancho Cucamonga, City of Fontana, City of Upland, City of Montclair and City of Ontario.

**Figure 1: IEUA's Service Area**



IEUA's service area is one of the fastest growing areas in the US. With approximately 750,000 residents and is expected to double by 2030. Much of the growth is spurred by the selling of dairy and agricultural land for residential, commercial and industrial development.

With all of the development comes impervious landscapes, increased stormwater flows, and water quality degradation. IEUA is providing leadership in the region for stormwater BMPs through the design and construction of its unique Headquarters (HQ) site.

In 2004, IEUA's New HQ facility received the US Green Building Council's highest ranking for a green building: Leadership in Energy and Environmental Design (L.E.E.D.) Platinum. IEUA was the first public utility in the world and at the time the building was the largest LEED Platinum facility. The specific economic and environmental benefits from the stormwater BMPs that this facility has on site is just beginning to be realized. Capital costs alone have saved local taxpayers over \$1.4 million associated with stormwater facilities.

IEUA's commitment is to promote and educate water conservation, water recycling, groundwater management, renewable energy, energy conservation, and overall environmental stewardship in partnership with the communities we serve. Leading by example, the Board approved the use of the LEED design criteria for this facility to showcase how an integrated, sustainably-designed building can create a better environment, conserve energy, improve productivity, and contribute to the restoration of historic landscapes.

With over eight site and source BMPs, the grounds and parking lot serve as a regional BMP demonstration site where local cities send their developers, contractors, and consultants to walk around, take notes, and observe. It is a site with multiple stormwater BMPs and is an example that can be replicated in other places. Regional Cities have found that if developers say they cannot cost-effectively implement their stormwater BMPs, they tell them to visit the IEUA HQ.

This paper presents how public and private entities save money on projects as it relates to stormwater design elements on both capital and O& M costs. In addition, this paper will present cost-effective educational, technical, and scientific initiatives that advance stormwater quality management.

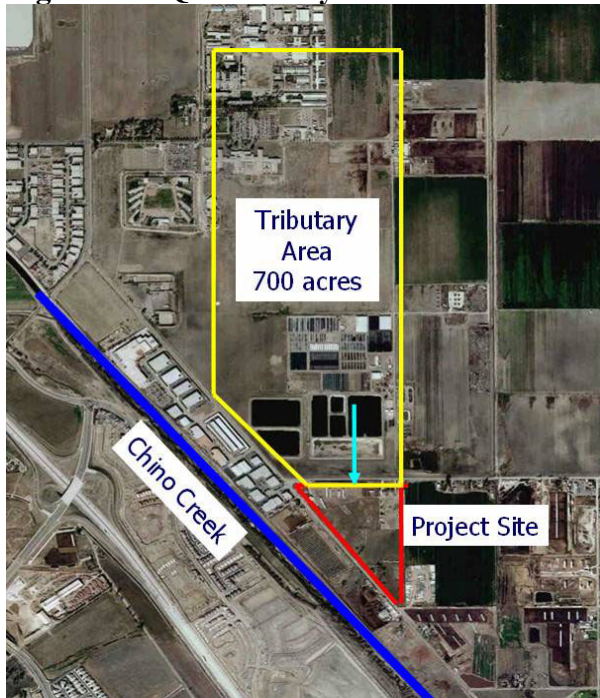
Situated in the middle of Chino's dairies the new IEUA Headquarters building was envisioned to "promote water conservation, water recycling, groundwater management, organic composting, renewable energy, and overall environmental stewardship in partnership with the communities they serve."

## DESIGN

In 2002, engineers, landscape architects, biologists, and hydrologists attended a stormwater charrette to determine if there were alternatives to a one mile 10 ft by 10 ft box culvert that was required by the *City of Chino's Stormwater Master Plan*. According to the master plan, the site would see over 760 cfs during a 100-year storm event. Using the recommendations from the participants, the Agency developed final design drawings and built a building completed in 2003 that included a parking lot and grounds that are unconventional and the first of its type (**Figure 2**).

**Figure 2: IEUA's Headquarters**

The tributary area to the Headquarters complex consists of 700 acres north of Kimball (See **Figure 3**). In a given storm event, off site storm flows will runoff from this area through IEUA's site. A portion of these flows will be routed through the site, between the two headquarter buildings and in a large detention basin.

**Figure 3: HQ Tributary Area**

The project design challenged the conventional. It was difficult not only for the City plan checkers, but for the design team as well. In the end, the lead civil engineer stated “I have designed 1000’s of parking lots during my career, but this is the first one that challenged me and I learned in the process.”

The design objectives included the following:

- Minimize costs
- Build a demonstration BMP parking lot and implement what has been discussed in Southern California for years
- Minimize stormwater runoff
- Increase on-site infiltration and reduce contaminants flowing to Chino Creek
- Meet U.S. Green Building Council 2.0 LEED™ manual’s criteria for post project conditions:
  - Reduce the “C” value by 25%, capture 85% of the total runoff
  - Removal of 80% TSS and 40% TP of the post-project’s annual nutrient loading

The 14-acre site is characterized as unique and unconventional containing the following features:

- Over five paving materials- three porous,
- Over eight stormwater site and source BMPs for water quality, infiltration, and storm flows,
- No curb and gutters

- Recycled materials
- Over 10,000 *California friendly* plants - over 100 different types of plants
- Ultimately 80 percent shade on the hardscape and
- Detains the 25-year storm event.

In addition, IEUA’s Headquarters is considered as an integrative BMP Project in which the following stormwater site and source BMPs are present:

- Pervious Pavement
- No Curb and Gutter
- Swales and Roof Runoff Controls
- Natural Drainage Systems/Detention Basin
- Perforated Drain Pipes

Below each BMP is discussed.

**Pervious Pavement:** The Agency utilized over 65,000 square feet of pervious paving materials (i.e. pavers, porous concrete, and decomposed granite) on-site to promote infiltration (See **Figure 4**).

**Figure 4: Pervious Pavement used at Headquarters**



**No Curb and Gutter:** The removal of curb and gutter was one of the most difficult elements to remove from the design, yet resulted in one of the largest cost savings (\$252,000). By removing curb and gutter (See **Figure 5**), water sheet flows across the site, which allows for ample time for detention, infiltration, and retention. Also, by eliminating curb and gutter, drainage becomes a design element. Textures and colors were used to delineate walkways, landscaping, parking aisles, and driveways. Subsequently, the ‘clean’ look desired by the civil engineer was achieved.

**Figure 5: No curb and gutter**



**Swales:** Swales were easily integrated into the site to treat on-site and off-site urban runoff (See **Figure 6**). The vegetation within the swales reduces the flow velocity to allow runoff to naturally infiltrate. Not only do the swales provide treatment, but they also enhance the aesthetics of the overall project. In addition, all **Roof Runoff Controls** were not hidden and drains into pipes below grade, as with conventional designs, but were visible to ensure that all roof drains were directed to surface flow to the swales.

**Figure 6: Bioswales**



**Natural Drainage/Retention Basin:** The site contains a historical drainage channel, which has been degraded by development. The site is a low spot, which receives stormwater runoff from the region. The Agency introduced an engineering drainage system that restores the natural drainage. The natural drainage redirects untreated off-site flows from Chino Creek on-site for treatment. A 25 MG detention basin is used to detain up to a 25-year storm event on-site (See **Figure 7**). The detention of these flows on-site assist in the prevention of flooding in

downstream areas and encourages detention, infiltration, and retention. In addition, the use of a detention basin on-site promotes natural resources and ecosystems to improve water quality. The first seasonal storm event resulted in immediate improvement to water quality in Chino Creek.

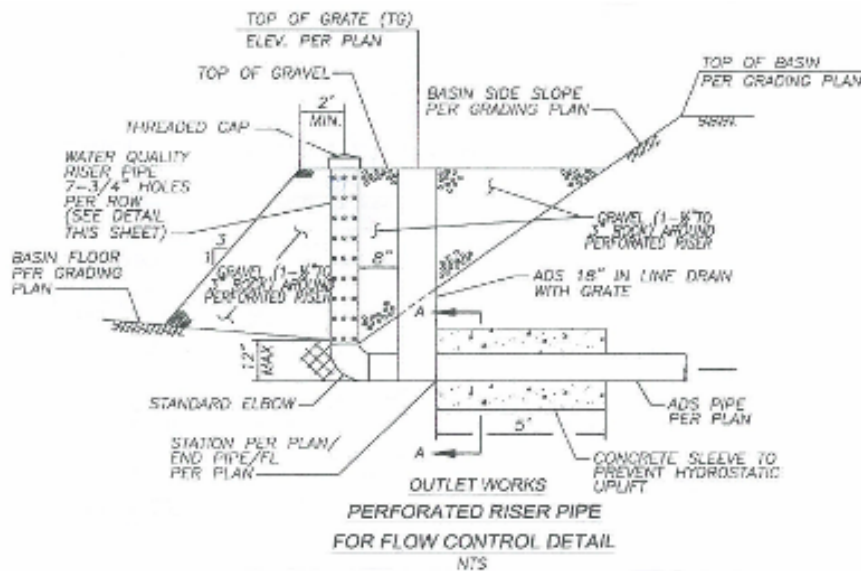
**Figure 7: Channel and Detention Basin**



**Perforated Drain Pipes:** Stormwater generated on-site, including from the roof drains, is filtered and treated before entering the storm drain system to the detention basin. This design has never been used for this purpose and improves water quality (See **Figure 8**).

**Figure 8: Stormdrain Collection System**





## METHODOLOGY

Samples are taken during the first flush to best understand the impacts of urban and agricultural non point source contamination to local stream channels. Metal, organic, and bacterial indicators were sampled using developed techniques from the EPA and methodologies outlined below.

Samples for trace metals, organics, conventional constituents, and toxicity testing are collected using methods described in Section 2 of the State Water Resources Control Board's (SWRCB) Surface Water Ambient Monitoring Program (SWAMP) Quality Assurance Management Plan (QAMP). Using the clean techniques that conform to the EPA "clean" sampling methodology described in *Method 1669: Sampling Ambient Water for Trace Metals* (USEPA 1995a). Samples are taken from shore or within streams and ponds, by safely wading to a common location at each monitoring point and bottled using a near surface grab sample technique. After collection, field samples are stored at approximately 4°C until dropped off at a local contract laboratory, typically within an hour.

Bacteria samples are also collected using Section 2 of the QAMP. Clean samples are taken in sterile 100ml containers with a small amount of sodium thiosulfate to protect from bactericides. They are then bagged and stored in a dark container at 4°C and taken to the Orange County Health Labs in Newport Beach within 3 hours. Samples are taken to the Orange County Public Health Lab and are tested using a membrane filtration technique approved by the EPA and recommended by the SWRCB for testing Total, Fecal, E. Coli, and Enterococcus bacteria (See **Table 1**). When sampled in this manner, results can be given within 24 hours and are significantly more accurate and reliable than the multiple tube methods used at other laboratories. Note that the unit of measurement in **Table 1** is 'coliform forming unit' (cfu), and not the more common 'most probable number' (mpn).

**Table 1. Orange County Health Laboratories Test Information**

TEST	SAMPLE TYPE	DESCRIPTION	ORGANISM(S)	TURNAROUND TIME	MEDIA	REPORTED UNITS
<b>Membrane Filtration (MF)</b>	Recreational & Wastewater	Standard Methods 9222B	Total Coliforms	24 hours	Les	CFU/100ml*
		Standard Methods 9222D	Fecal Coliforms		m-Endo	
		EPA Method 1600	<i>Enterococcus spp.</i>		m-FC	
		Modified <i>E. coli</i> Method (EPA)	<i>Escherichia coli</i>		m-EI	
					m-TEC	

Appendix D and H of the QAMP describes strategies and protocol in greater detail. (<http://www.waterboards.ca.gov/swamp/qamp.html>).

Samples were collected during 14 storm events during the 2004 – 2006 wet periods at seven different locations as show in **Figure 10**.

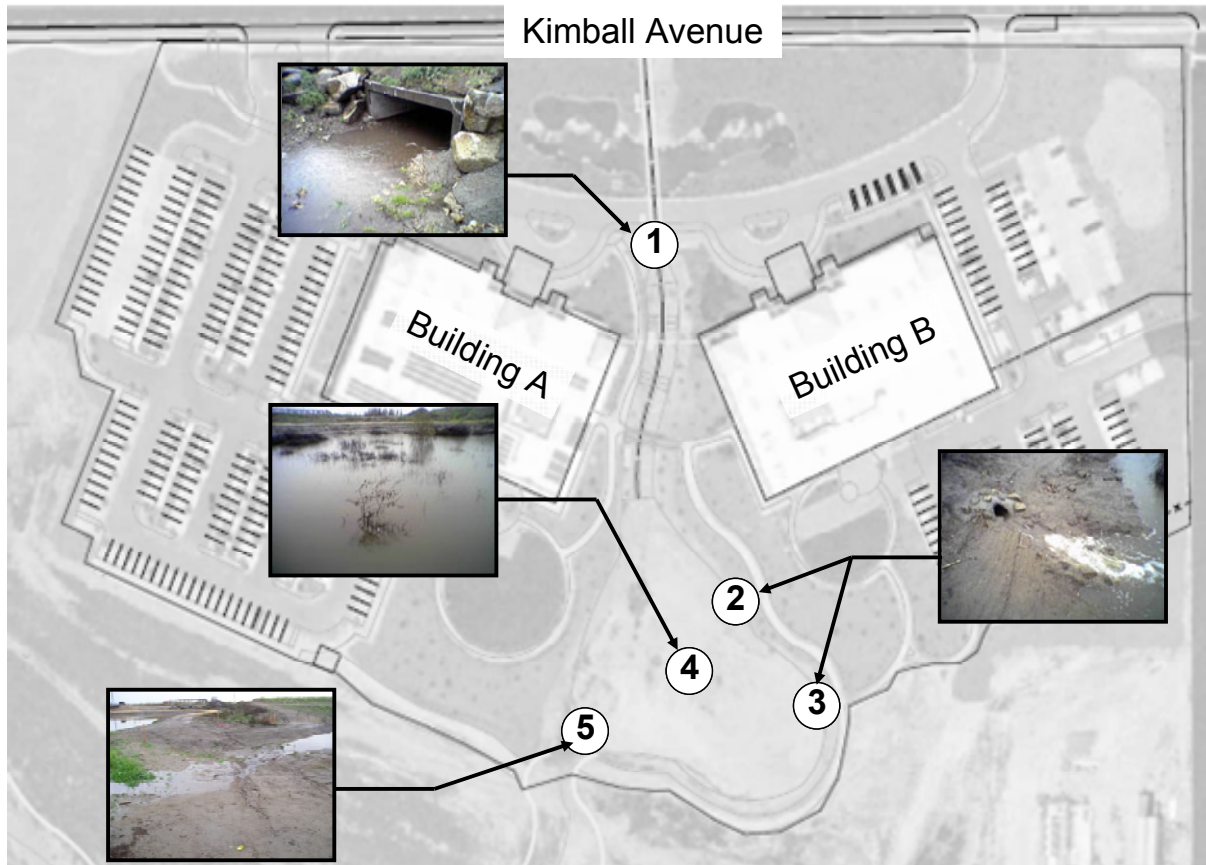
Location 1: The quality of these samples will reflect the quality of off-site stormwater prior to going through BMPs.

Location 2 and 3: The quality of these samples will reflect the quality of on-site stormwater entering the detention basin after going through swales/biostrrips/other BMPs.

Location 4: The quality of these samples will reflect the combined quality of on-site and off-site stormwater after going through swales/biostrrips/other BMPs.

Location 5: Samples were taken at this location in the event that the detention capacity of the basin was exceeded. These samples will reflect quality of combined samples from locations 1, 3 and 4 after being retained at the basin.

Figure 10: Sampling Locations



Because we did not measure flows during the storm events, weight average reductions can't be calculated. However, we were able to calculate the mass loading for all tested constituents.

Mass loading for all constituents, except for bacteria, were calculated as follows:

$$Q = C \cdot I \cdot A = .4 \cdot \frac{10in}{year} \cdot \left( \frac{ft}{12in} \right) \cdot 700acre \cdot \left( \frac{43560ft^2}{acre} \right) \cdot \frac{year}{3.15 \cdot 10^7 s} = .322cfs$$

Where,

Q = stormwater run-off tributary to IEUA's site

C = 0.4 (assumed based on existing land use)

I = 10-inches (average annual rainfall obtained from San Bernardino Flood Control

District)

$$Q = .322 \text{ cfs} \cdot \left( \frac{1 \text{ MGD}}{1.55 \text{ cfs}} \right) = .206 \text{ MGD}$$

$$\frac{\text{lb}}{\text{yr}} = .206 \text{ MGD} \cdot \left( \frac{8.34 \text{ lb}}{\text{gal}} \right) \cdot \left( \text{constituent} \frac{\text{mg}}{\text{L}} \right) \cdot \left( 365 \frac{\text{days}}{\text{year}} \right)$$

$$\frac{\text{lb}}{\text{yr}} = \left( \text{constituent} \frac{\text{mg}}{\text{L}} \right) \cdot 627$$

**RESULTS**

Stormwater quality improvements have been significant at this site. **Table 2 and 3** present the stormwater quality improvements that occurred.

**Table 2. Stormwater Quality Analysis**

<b>Bacteria (CFU/100ml)</b>	<b>Box Culvert</b>		<b>Parking Lot 1</b>		<b>Parking Lot 2</b>		<b>Pond Middle</b>	
	<b>Max</b>	<b>Min</b>	<b>Max</b>	<b>Min</b>	<b>Max</b>	<b>Min</b>	<b>Max</b>	<b>Min</b>
Total Coliforms	160,000	1,600	10,700,000	1,600	810,000	1,600	145,000	900
Fecal Coliforms	41,000	1,600	4,500,000	140	16,500	90	50,000	90
Ecoli	6,400	400	430,000	90	90	90	1,400	90
Enterococcus	54,000	9,000	3,900,000	1,200	1,700	1,700	18,000	2,600

**Figures 11 through 14** show the mean, maximum and minimum concentrations of all constituents, except bacteria, per location.

**Table 3. Stormwater Quality Analysis**

Constituents (mg/L)	Box Culvert		Parking Lot 1		Parking Lot 2		Pond Middle	
	Max	Min	Max	Min	Max	Min	Max	Min
Ammonia	1.50	0.03	0.70	0.03	0.60	0.20	0.62	0.20
Antimony	0.03	0.01	0.03	0.01	0.01	0.01	0.03	0.01
Arsenic	0.05	0.01	0.05	0.01	0.01	0.01	0.05	0.01
Barium	0.21	0.03	0.14	0.01	0.08	0.04	0.05	0.03
Beryllium	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Boron	0.69	0.01	0.65	0.01	0.11	0.07	0.65	0.02
Cadmium	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Calcium	102.00	3.00	41.90	5.00	35.00	27.00	38.00	16.70
Chloride	71.00	1.00	61.00	1.00	20.00	5.00	15.00	1.00
Chromium (total)	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Cobalt	0.01	0.01	0.03	0.01	0.01	0.01	0.01	0.01
Copper	0.10	0.02	0.05	0.01	0.02	0.02	0.02	0.01
Iron	12.50	1.94	11.30	0.76	10.50	3.46	2.84	0.19
Lead	0.05	0.02	0.05	0.02	0.02	0.02	0.05	0.02
Magnesium	22.20	3.12	13.00	0.90	8.50	5.90	6.10	2.93
Manganese	0.35	0.02	0.37	0.02	0.16	0.06	0.09	0.02
Nickel	0.04	0.01	0.02	0.01	0.01	0.01	0.04	0.01
Nitrate (N)	9.90	0.40	20.50	0.20	5.00	0.60	17.60	0.10
Nitrite (N)	0.65	0.01	0.09	0.01	0.09	0.01	0.02	0.01
Oil & Grease	21.00	1.00	25.00	2.00	2.00	2.00	33.00	1.00
Potassium	30.00	4.00	44.50	0.10	9.00	6.00	9.19	2.30
Selenium	0.08	0.01	0.08	0.01	0.01	0.01	0.08	0.01
Silver	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Sodium	156.00	5.00	134.00	4.89	11.00	9.00	135.00	7.00
Sulfate	136.00	4.00	60.00	2.00	31.00	9.00	11.00	7.00
Suspended Solids	420.00	28.00	546.00	8.00	143.00	35.00	38.00	3.00
Titanium	0.30	0.05	0.30	0.05	0.05	0.05	0.16	0.05
Total Dissolved Solids	684.00	60.00	570.00	26.00	198.00	69.00	188.00	90.00
Total Hardness	346.00	52.00	210.00	15.00	121.00	92.00	119.00	50.00
Total Organic Carbon	74.00	5.00	136.00	4.00	16.00	9.00	15.00	7.00
Zinc	0.24	0.02	0.20	0.02	0.04	0.02	0.04	0.01

All stormwater generated on-site, from roof drains and onsite surfaces, are filtered and treated before entering the storm drain system and eventually discharge into a channel and then into a detention basin where the contaminants settle out. Based on the existing detention capacity of the basin most of the flows infiltrate at this location. **Table 4** presents the total mass in the next 20 years, per constituents, that will be detained and treated on-site instead of being discharged into Chino Creek.

**Table 4. Chino Creek Mass Reduction in the next 20 years**

Constituents (mg/L)	Constituents Mass Reduction (lb/20yr) From Chino Creek			
	Box Culvert	Parking Lot 1	Parking Lot 2	Pond Middle
Silver	0.00	125.40	125.4	125.40
Arsenic	256.42	280.40	125.4	249.95
Boron	1,016.68	685.64	1149.373319	1,424.63
Barium	1,062.01	297.67	680.7759382	421.66
Beryllium	125.40	125.40	125.4	125.40
Calcium	252,188.04	167,330.87	373675.0917	294,528.74
Cadmium	125.40	125.40	125.4	125.40
Chloride	84,035.50	31,346.99	143547.166	71,020.41
Cobalt	125.40	143.86	125.4	125.40
Chromium (total)	153.02	125.40	125.4	125.40
Copper	354.46	236.49	250.8	186.34
Iron	61,593.25	26,092.32	65150.1026	10,548.83
Total Hardness	1,178,879.68	628,425.65	1290913.951	865,052.91
Potassium	86,893.38	28,019.06	90669.55198	58,803.12
Magnesium	81,210.09	26,109.50	87179.18069	45,071.44
Manganese	1,181.84	581.27	1148.377328	535.57
Sodium	147,890.13	122,959.79	129014.987	182,152.76
Ammonia (N)	4,644.77	2,782.16	5216.850228	4,275.61
Nickel	215.00	177.34	125.4	186.34
Nitrite (N)	571.17	326.43	260.8425114	138.45
Nitrate (N)	20,069.97	11,865.21	30508.32521	5,096.04
Lead	376.87	396.55	250.8	371.43
Antimony	292.79	301.99	125.4	285.85
Selenium	341.29	354.68	125.4	305.73
Sulfate	164,980.61	67,899.14	236357.4803	119,405.74
Total Dissolved Solids	1,709,087.93	1,268,327.40	1717334.573	1,748,286.73
Titanium	1,363.15	1,592.21	627	1,185.96
Total Organic Carbon	264,570.06	144,627.08	136720.1534	148,029.18
Suspended Solids	1,408,942.17	497,309.95	1002225.898	166,821.14
Zinc	1,103.28	560.81	315.9881993	250.80
Oil & Grease	62,516.31	47,613.82	25080	68,249.03

Figure 11: Box Culvert Results

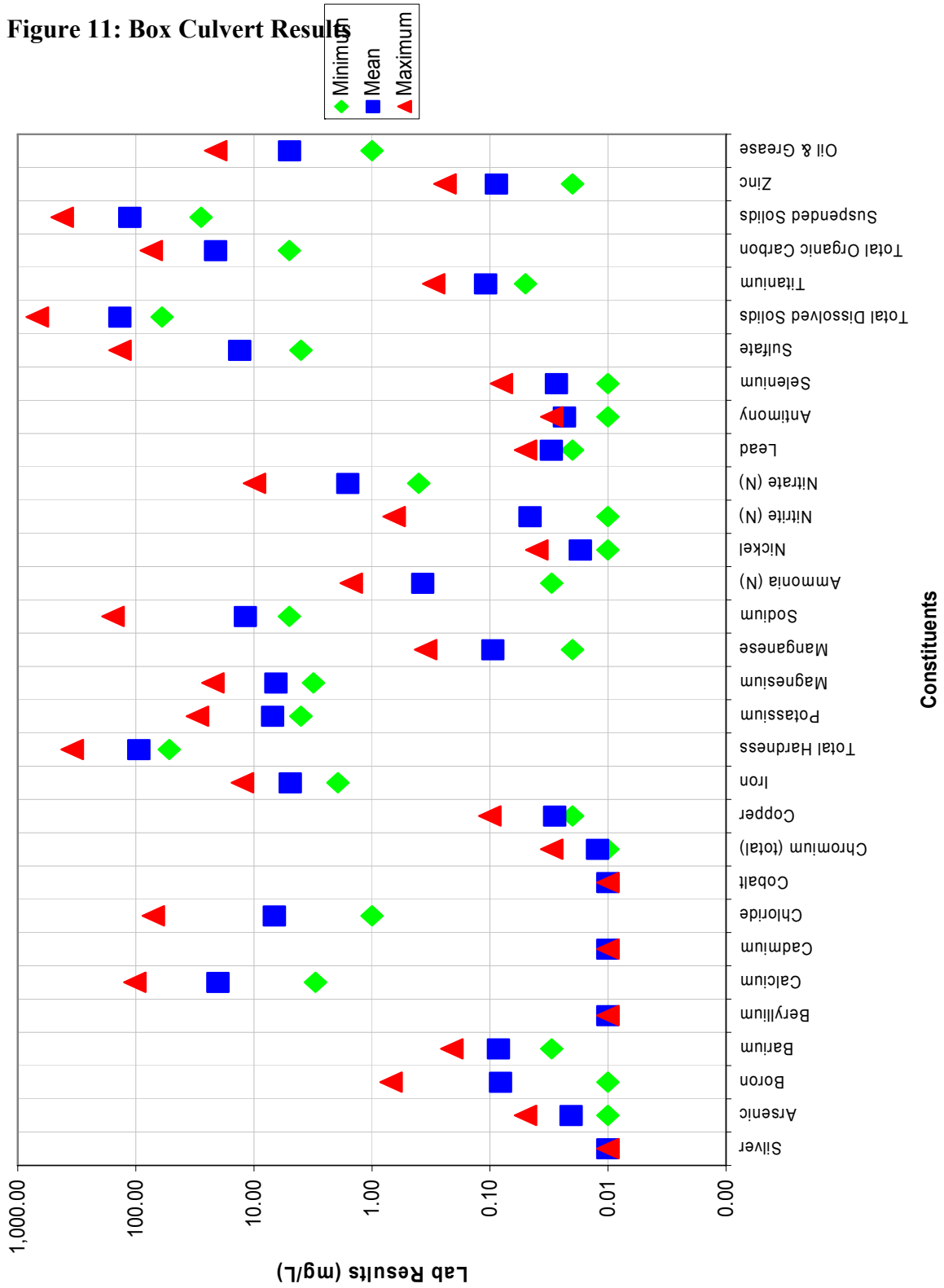


Figure 12: Parking Lot 1 Results

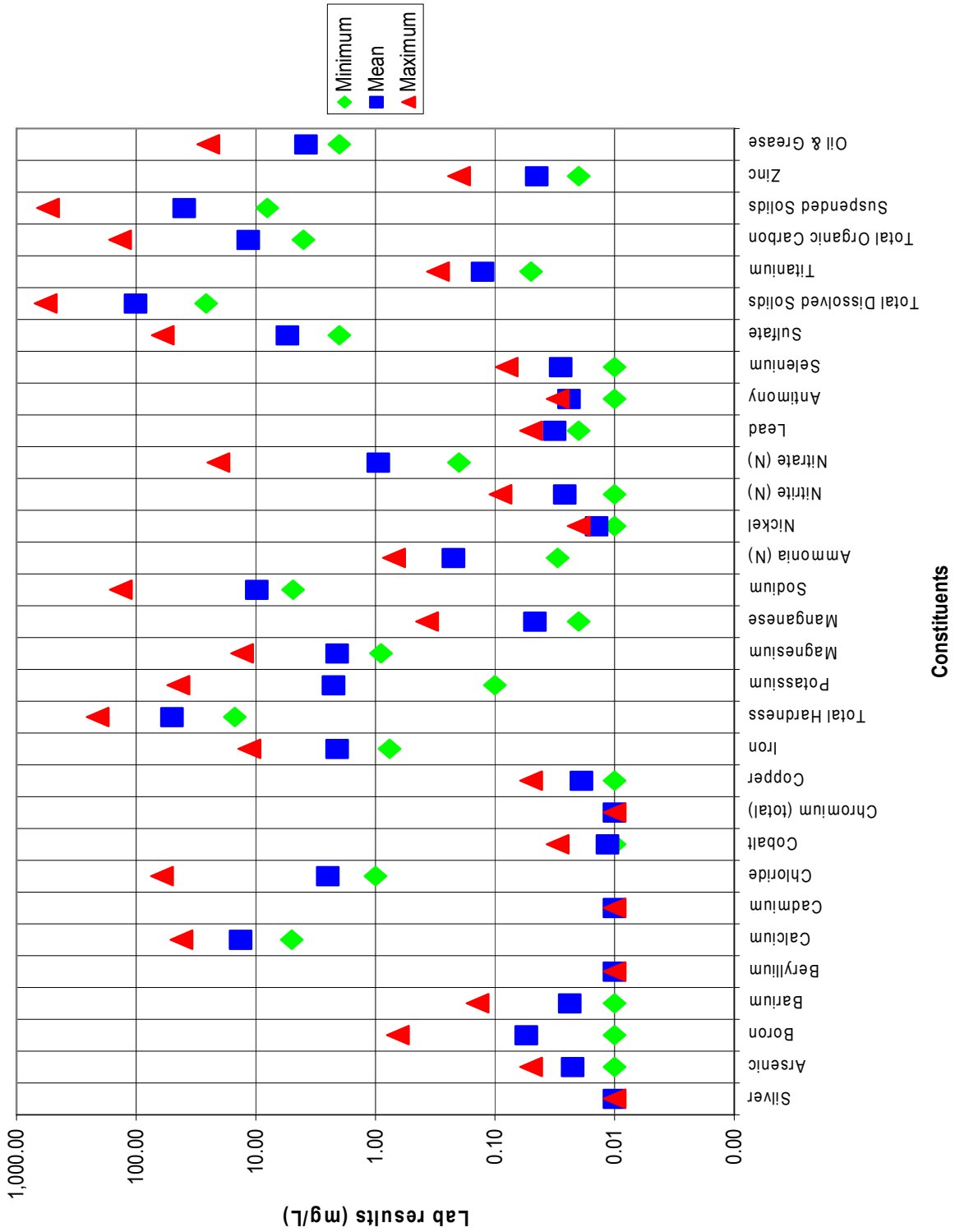


Figure 13: Parking Lot 2 Results

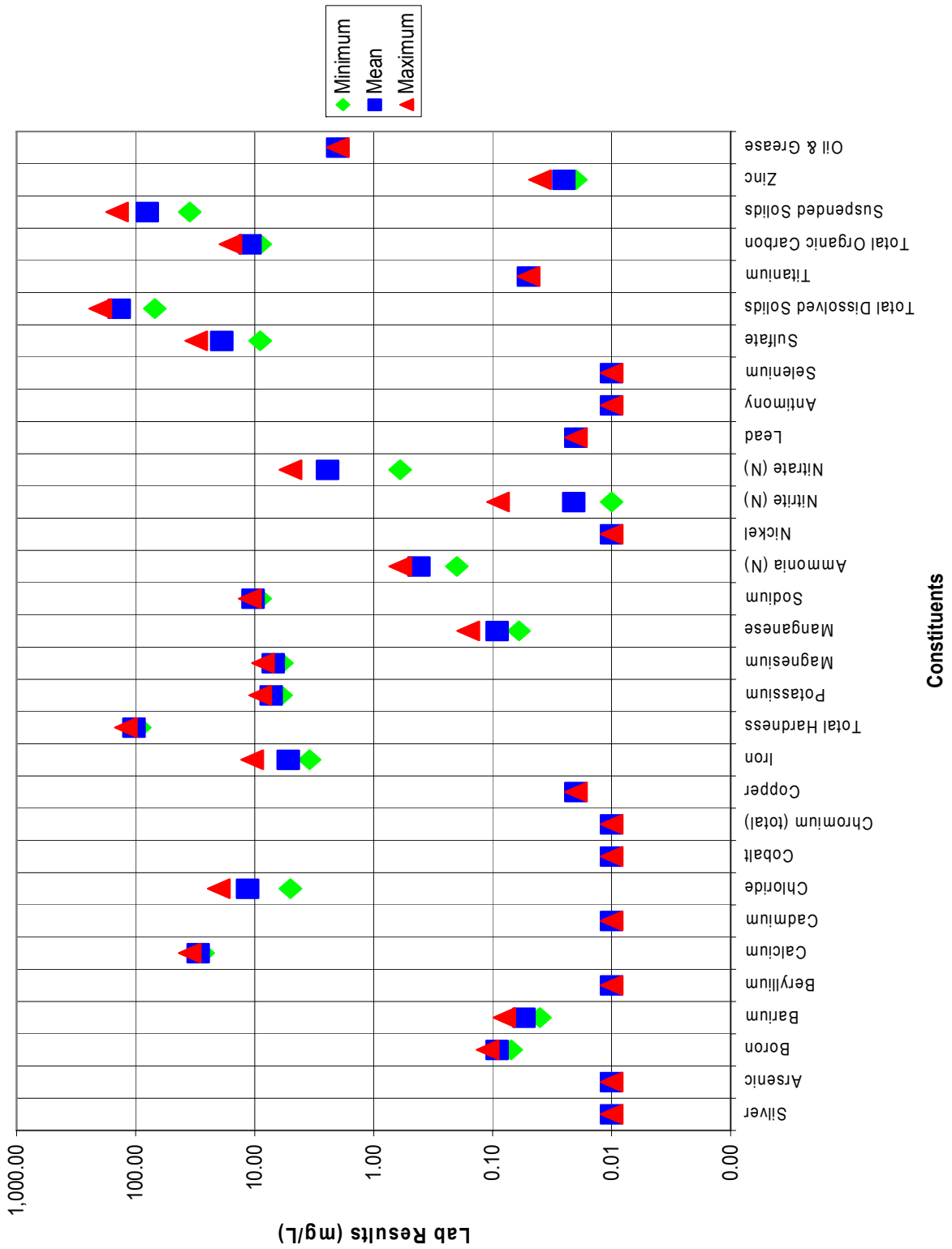
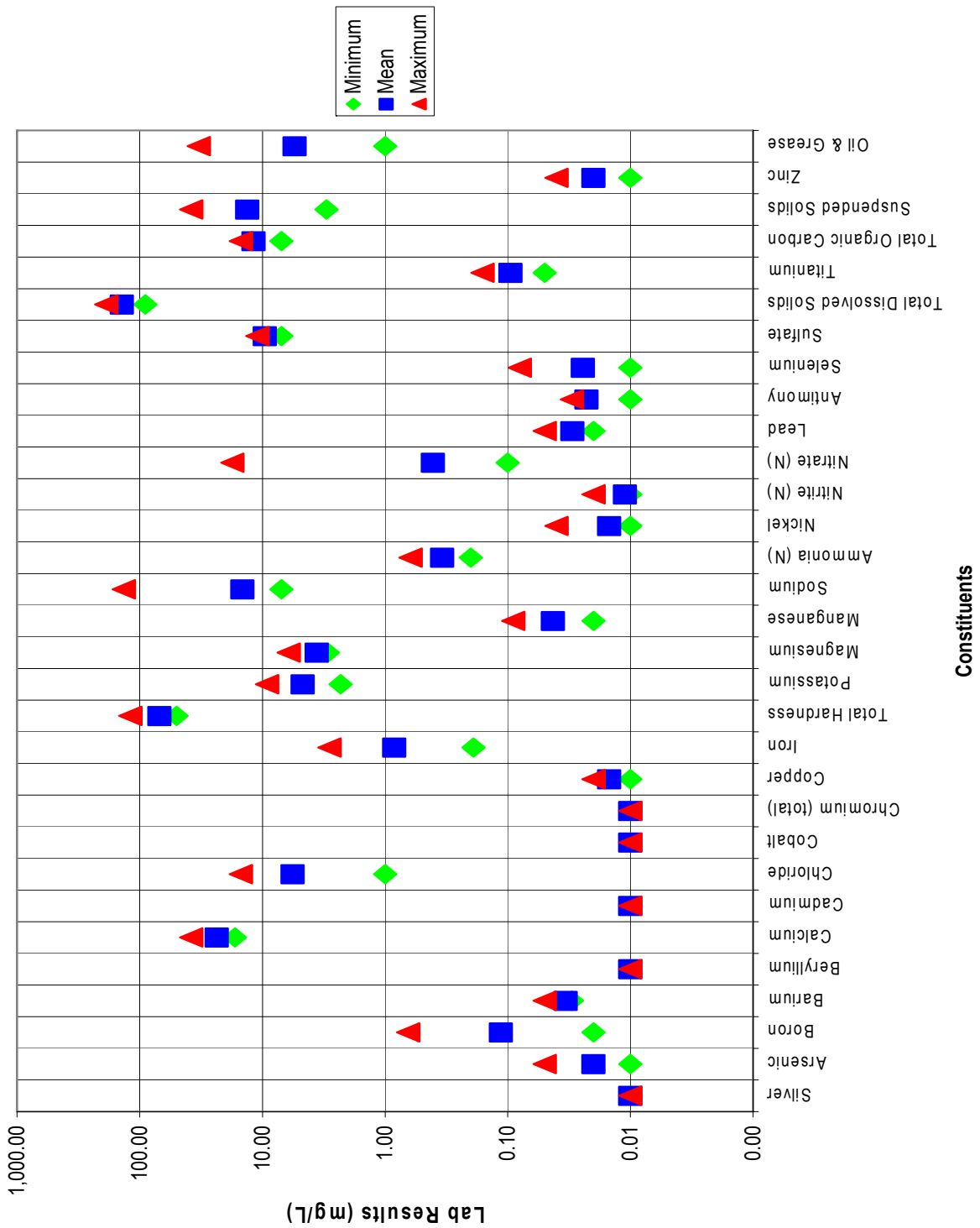


Figure 14: Pond Middle Results



On-site infiltration occurred during all 14 storm events that have been captured over the last three storm seasons. Even though the soils report indicated that this site was not a site that would infiltrate very well, the site has performed quite well. Below presents photos taken during a storm event and then five hours later.

**Before**  
February 28, 2006  
11:00 a.m.



**After**  
February 28, 2006  
4:00 p.m.



**Before**  
February 28, 2006  
11:00 a.m.



**After**  
February 28, 2006  
4:00 p.m.



The project met U.S. Green Building Council 2.0 LEED™ manual's criteria for post project conditions. With the implementation all BMPs the "C" value was reduced by 25%, capturing 85% of total runoff. In addition, the site was designed to remove 80% TSS and 40% Total phosphorus of the post-project's annual nutrient loading. Appendix A has the results and a summary of the calculations completed for LEED.

## DISCUSSION

True economic savings were realized when the Agency was willing to challenge the stormwater master plan that called for a 1 mile 10ft by 10ft box culvert. It was not until after a design charrette that Agency management was willing to ask for a modification to the City's requirements. With many experts participating and with the City engineers willing to try something different, there was confidence that this could work.

The initial savings were capital costs from the 10ft by 10ft box culvert that was eliminated. In its place were two 3ft by 5 ft box culverts 225 ft and 169 ft long. Both discharged into channels and swales, leading into detention ponds.

Because this was a demonstration project, the construction costs associated with the parking lot was carefully tracked. **Table 5** presents the actual costs of the BMPs constructed at the HQ facility compared to construction costs of a conventional site of equal size. Table 2 summarizes the \$1.4M construction cost savings.

**Table 5. Hardscape / Stormwater Infrastructure Construction Costs**

<b>Description</b>	<b>Headquarters</b>	<b>Conventional<sup>1</sup></b>
Off-Site Stormwater Management	\$621,879	\$2,000,000
<b>Hardscape</b>		
Pavers	\$139,993	N/A
Asphalt	\$205,457	\$434,774
Pervious Concrete	\$90,000	N/A
Decomposed Granite	\$89,280	N/A
Natural Gray Concrete	\$262,320	\$168,000
<b>Base</b>		
14" Class II (Vehicular Pavers)	\$18,496	N/A
6"&4" Class II (Vehicular Asphalt)	\$79,404	\$168,028
10" ¾" Rock (Pervious Concrete)	\$20,000	N/A
4" Class II (Concrete/Decomposed Granite)	\$237,081	\$134,400
Storm Drain	\$42,289	\$87,070
Boulders	\$20,953	N/A
Curb & Gutter	N/A	\$252,200
<b>TOTAL:</b>	<b>\$1,827,150</b>	<b>\$3,244,472</b>
<b>IEUA SAVINGS</b>	<b>\$1,417,322</b>	

1. Costs were calculated based upon costs in 2002. The same unit costs were used to calculate the Headquarters and Conventional costs.

In addition to the construction costs, the Agency has also realized O&M savings. A portion of the current savings are attributed to the implementation of a program to wash Agency cars on-site (all runoff detained on site, not increasing off-site surface runoff). In the future, the Agency anticipates the current savings of \$18,000 to increase to over \$140,000 annually. In comparison to the conventional parking lot identified in Table 2, the Agency has saved annually approximately \$5,000 in parking lot maintenance.

The savings due to the implementation of the BMPs on-site are not only beneficial to the Agency, but also to the region. Since the development in the City of Chino is growing rapidly, developers do not have to educate the City on these cost-effective new BMPs for reducing stormwater runoff and improving water quality. The region will benefit economically from the future savings associated with the improved water quality of storm water runoff to Chino Creek. Since the storm water runoff in Chino Creek is tributary to the Santa Ana River, which provides a portion of the drinking water to the 2.3 million downstream residents in Orange County. It is anticipated that with the reduction of nitrates there are significant savings due to reduced treatment costs of drinking water and stormwater treatment cost.

If the traditional stormwater master plan was implemented, over 6 pounds of microbial bacteria, 1,600 pounds of oil & grease and 2,400 pounds of Nitrogen would have already been discharged into Chino Creek. A total of 2 million pounds of organic and inorganic constituents would have been discharged over the next 20 years.

## **CONCLUSIONS**

Resistance to building projects with stormwater BMPs usually is due to concerns regarding capital, operation, and maintenance costs. IEUA has demonstrated that there is tremendous value in both the construction and O&M costs associated with this project. The Agency was able to present the costs associated with the construction of the parking lot to be equivalent to a conventional design. In fact the overall value to the Agency, the region, OCWD, and the City of Chino is much greater when future stormwater and drinking water treatment costs are considered. This project is playing a key role in furthering the educational, technical and policy initiatives that advance stormwater quality management, science, and regulation.

**APPENDIX A**

**C = Runoff Coefficient -  $C = 0.9 (A_i + (I - F_p)A_p I^{-1})$**

**I= Rainfall Intensity. Based on 85th percentile, where I = 0.87**

**F<sub>p</sub>= Infiltration Rate for Pervious Area**

**A<sub>p</sub> = Pervious Area**

**A<sub>i</sub> = Impervious Area**

**Prior to project**

Surface Type	Area (Sq. ft)	C	I	F <sub>p</sub>	A <sub>p</sub>	A <sub>i</sub>	CN	K
Barren/Graded Soil	554,516.70	0.7	0.9	0.02	0.9	0.2	91	409,233.32
Dairy Wet Ponds	11,151.20	0.9	0.9	0.18	0.2	0.8	91	9,611.02
Buildings	36,118.10	0.9	0.9	0.18	0	1	91	32,506.29
<b>Total Area (Sq. ft)</b>	<b>601,786</b>						<b>Total</b>	<b>451,350.63</b>
							<b>Weighted "C" Value</b>	<b>0.75</b>

**After project**

Surface Type	Area (Sq. ft)	C	I	F <sub>p</sub>	A <sub>p</sub>	A <sub>i</sub>	CN	K
AC Pavement	91,251	0.8	0.9	0.59	0.2	0.9	69	73,546.12
Stabilized Decomposed Granite	24,335	0.8	0.9	0.59	0.2	0.9	69	19,621.17
Non-stabilized Decomposed Granite/Commercial Landscape	40,071	0.5	0.9	0.59	0.7	0.3	69	18,541.09
Landscaped Areas	266,263	0.3	0.9	0.59	1	0	69	73,300.64
Precast Pavers	33,060	0.8	0.9	0.59	0.2	0.8	69	25,623.44
Water Features	16,809	0.9	0.9	0.59	0	1	69	15,123.10
Buildings	68,040	0.9	0.9	0.59	0	1	69	61,236.00
Non-Porous Concrete	34,361	0.9	0.9	0.59	0	1	69	30,924.90
Porous Concrete	27,632	0.7	0.9	0.59	0.3	0.7	69	19,690.24
<b>Total Area (Sq. ft)</b>	<b>601,786</b>						<b>Total</b>	<b>337,611.69</b>
							<b>Weighted "C" Value</b>	<b>0.56</b>