Characterization of Urban Runoff Water Treatment Ponds in San Dieguito River Park

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Introduction

- Natural lagoon and wetland area east of Del Mar Racetrack has been restored under the San Dieguito River Park
- Urban runoff threatens to damage lagoon with flood of pollutants
- Four sequential treatment ponds were installed to trap and filter this runoff before it enters the lagoon
- This study aims to quantify the effectiveness of these treatment ponds based on water quality and soil pollutants

Hypothesis

Treatment pond four will have lower water and soil pollution levels than treatment pond one. Figure one represents a diagram of the four treatment ponds located at SDRP.

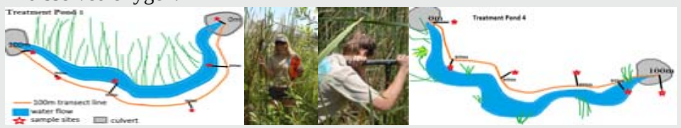
Figure 1. Letter A represents where the urban runoff enters into the treatment pond one. It is then diverted under a constructed berm by a culvert to direct flow into treatment pond two. It is then filtered through and underneath the trail through a culvert into treatment pond three, where it filters through again and under a berm through a culvert into treatment pond four where it is filtered for a fourth time before being released into the salt water marsh, letter B.

Methods

Sample Collection

At each pond one 100m Transect line is set up following the gradient flow of water. A total of 24 (six samples collected per pond in both summer and winter), 10 cm soil samples were collected every 20meters along each transect. These samples were analyzed for nitrogen and carbon content.

Water quality samples were taken using the SD Coast Keeper procedures on a monthly basis between May 2012 to May 2013 to characterize the water quality during both summer and winter. Water samples are analyzed for nitrogen and carbon levels, conductivity, temperature, pH, and dissolved oxygen.



Soil Core Sampler

Processing Samples

Soil samples were dried for one week at 70°C. Samples were ground into a fine powder and 5-10mg were weighed and placed into small aluminum tins. The soil samples were run in an auto analyzer and recorded for carbon and nitrogen content. Water quality samples were processed by the San Diego Coast Keeper and forwarded to us for further statistical analysis.

Farthest left shows samples wrapped in small tins for analysis. Each row includes soil samples from treatment pond one and four. The center picture shows how samples are loaded into the auto analyzer . On the right samples are loaded into place to be analyzed.

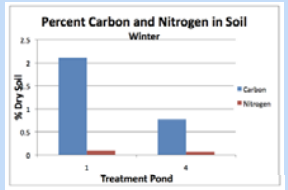


Figure 2. Mean percent carbon and nitrogen in treatment ponds one and four. Error bars show standard deviations. No significant difference in carbon ($p= 0.119$) and nitrogen ($p= 0.246$) levels found between ponds one and four.

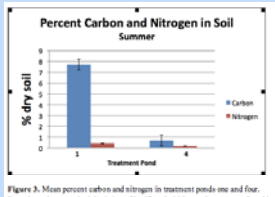


Figure 3. Mean percent carbon and nitrogen in treatment ponds one and four. Error bars show standard deviations. Significantly higher carbon content found in treatment pond one over pond four ($p= 0.0389$). No significant difference in nitrogen levels found between ponds one and four ($p= 0.067$).

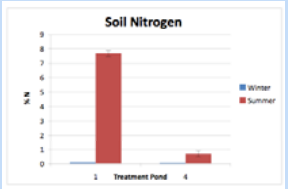


Figure 4. Mean percent nitrogen in treatment ponds one and four. Error bars show standard deviations. There is a significant difference in nitrogen levels found in pond one during the summer and winter data collection ($p= 0.029$).

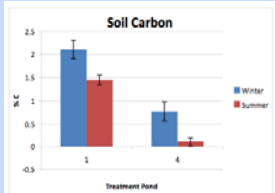


Figure 5. Mean percent carbon in treatment ponds one and four. Error bars show standard deviations. No significant difference indicated ($p= 0.067$).

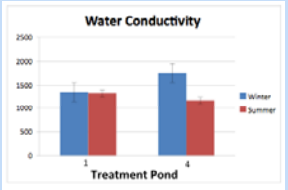


Figure 6. Mean comparison of measured conductivity levels in ponds one and four compared between summer and winter. Error bars show standard deviations. No significant difference indicated winter ($p= 0.45$), summer ($p= 0.80$).

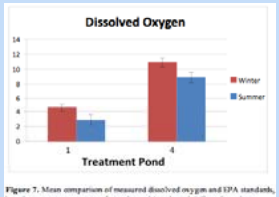


Figure 7. Mean comparison of measured dissolved oxygen and EPA standards, based on water temperature, for each pond 1 and pond 4. Error bars show standard deviations. Winter ($p= 0.004$) and summer ($p= 0.004$) dissolved oxygen levels show significant differences between levels found in ponds one and four.

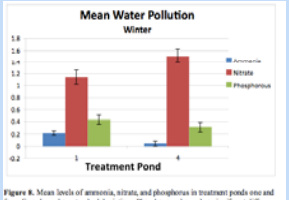


Figure 8. Mean levels of ammonia, nitrate, and phosphorus in treatment ponds one and four. Error bars show standard deviations. Phosphorus showed no significant difference between ponds one and four ($p= 0.068$). Nitrate showed no significant difference between ponds one and four ($p= 0.363$). Ammonia showed a significant difference between ponds one and four ($p= 0.034$).

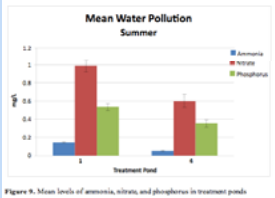


Figure 9. Mean levels of ammonia, nitrate, and phosphorus in treatment ponds one and four. Error bars show standard deviations. Phosphorus showed no significant difference between ponds one and four ($p= 0.040$). Nitrate showed a significant difference between ponds one and four ($p= 0.009$). Ammonia showed a significant difference between ponds one and four ($p= 0.036$).

Statistical Analysis

A series of indicators such as carbon, nitrogen, dissolved oxygen, conductivity, and pH were compared to determine if these levels declined from treatment pond one to treatment pond four. Results were compared between both ponds in winter and summer months. Results were also compared to Environmental Protection Agency (EPA) environmental standards. Statistical t-tests determined if there was a significant difference in pollutant levels between ponds.

Results

Results indicate that the treatment ponds effectively filter pollutants before water and sediment are released into the salt water marsh.

Soil

- Significantly higher carbon levels ($p= 0.0389$) found in treatment pond one during dry summer months (figure 3).
- Pond one has a significantly higher nitrogen level ($p= 0.029$) during summer months (figure 4).

Water

- Conductivity did not show a significant change from treatment pond one to four in both summer and winter months (figure 6).
- Dissolved oxygen levels were significantly different between ponds one and four in both winter and summer months ($p< 0.05$, figure 7). Treatment pond four expressed an acceptable dissolved oxygen range according to EPA.
- Significant difference from treatment pond one to four in pH ($p=0.002$) and ammonia ($p=0.019$, figure 8) during winter months.
- Significant difference from treatment pond one to four in pH ($p=0.005$), ammonia ($p=0.036$), and nitrate ($p= 0.009$, figure 9).

Treatment pond one water collection and filtration technique

Conclusion

- EPA has set standards on water quality and all of this data was compared to these standards and ranges (http://water.epa.gov/type/rsl/monitoring/)
- Optimal pH for brackish water ranges from 7.5-8.5 and although the runoff is not considered brackish water, it will eventually empty into a brackish lagoon water column. Without maintaining a pH within this range, pollutants can become more readily absorbed my marine organisms and can cause stress to plant life as well.
- Safe nitrate, ammonia and phosphorus levels were found in both ponds
- Dissolved oxygen is dependent on several factors such as phosphorus, nitrogen and temperature. It was found there was a significant improvement in dissolved oxygen levels from pond one to four; pond four fell within a safe range and pond one did not.
- Although there was no significant difference in conductivity levels between pond one to four both ponds fail to fall within the safe range of 150-500µmhos/cm.

Acknowledgements

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