# Stormwater Treatment: Best Practices for the Indian River Lagoon

**(http://www.brevardfl.gov/SaveOurLagoon/project-plan, pp 54-58)**

*Stormwater runoff contributes 33.6% of the external TN loading and 43.4% of the external TP loading to the lagoon annually.*

Stormwater runoff from urban areas carries pollutants that affect surface waters and groundwater. These pollutants include nutrients, pesticides, oil and grease, debris and litter, and sediments. In Brevard County, there are more than 1,500 stormwater outfalls to the IRL.

There are a variety of best management practices that can be used to capture and treat stormwater to remove or reduce these pollutants before the stormwater runoff reaches a waterbody or infiltrates to the groundwater. Potential stormwater best management practices that could help restore the IRL system include:

- Traditional best management practices – These best management practices are the typical practices that are used to treat stormwater runoff and include wet detention ponds, retention, swales, dry detention, baffle boxes, stormwater reuse, alum injection, street sweeping, catch basin inserts/inlet filters, floating islands/managed aquatic plant systems. Descriptions of these traditional best management practices and expected TN and TP efficiencies are shown in **Table 4-25**.

- Low impact development/green infrastructure – These types of best management practices use natural stormwater management techniques to minimize runoff and help prevent pollutants from getting into stormwater runoff. These best management practices address the pollutants at the source so implementing them can help decrease the size of traditional retention and detention basins and can be less costly than traditional best management practices. Descriptions of low impact development and green infrastructure best management practices and estimated efficiencies are shown in **Table 4-26.**

Table 4-25: Traditional Stormwater Best Management Practices with TN and TP Removal Efficiencies

| Best Management Practice | Definition | TN Removal Efficiency | TP Removal Efficiency | Source |
|---|---|---|---|---|
| Wet detention ponds | Permanently wet ponds that are designed to slowly release a portion of the collected stormwater runoff through an outlet structure. Recommended for sites with moderate to high water table conditions. Provide removal of both dissolved and suspended pollutants through physical, chemical, and biological processes. | 8%-44% | 45%-75% | Florida Department of Environmental Protection et al. 2010 |
| Off-line retention | Recessed area that is designed to store and retain a defined quantity of runoff, allowing it to percolate through permeable soils into the groundwater aquifer. Runoff in excess of the specified volume of stormwater does not flow into the retention system storing the initial volume of stormwater. | 40%-84% | 40%-84% | Harper et al. 2007 |
| On-line retention and swales | Recessed area that is designed to store and retain a defined quantity of runoff, allowing it to percolate through permeable soils into the groundwater aquifer. Runoff in excess of the specified volume of stormwater does flow through the retention system that stores the initial volume of stormwater. | 30%-74% | 30%-74% | Harper et al. 2007 |
| Dry detention | Designed to store a defined quantity of runoff and slowly release it through an outlet structure to adjacent surface waters. After drawdown of the stored runoff is completed, the storage basin does not hold any water. Used in areas where the soil infiltration properties or seasonal high-water table elevation will not allow the use of a retention basin. | 10% | 10% | Harper et al. 2007 |
| 2nd generation baffle box | Box chambers with partitions connected to a storm drain. Water flows into the first section of the box where most pollutants settle out. Overflows into the next section to allow further settling. Water ultimately overflows to the stormwater pipe. Floating trays capture leaves, grass clippings, and litter to prevent them from dissolving in the stormwater. | 19.05% | 15.5% | GPI 2010 |
| Stormwater reuse | Reuse of stormwater from wet ponds for irrigation. Compare volume going to reuse to total volume of annual runoff to pond. | Amount of water not discharged annually | Amount of water not discharged annually | Not applicable |
| Alum injection | Chemical treatment systems that inject aluminum sulfate into stormwater systems to cause coagulation of pollutants. | 50% | 90% | Harper et al. 2007 |
| Street sweeping | Cleaning of pavement surfaces to remove sediments, debris, and trash deposited by vehicle traffic. Prevents these materials from being introduced into the stormwater system. | TN content in dry weight of material collected annually | TP content in dry weight of material collected annually | University of Florida 2011 |
| Catch basin inserts/inlet filters | Devices installed in storm drain inlets to provide water quality treatment through filtration of organic debris and litter, settling of sediment, and adsorption of hydrocarbon by replaceable filters. | TN content in dry weight of material collected annually | TP content in dry weight of material collected annually | University of Florida 2011 |

| Best Management Practice | Definition | TN Removal Efficiency | TP Removal Efficiency | Source |
|---|---|---|---|---|
| Managed Aquatic Plant System | Aquatic plant-based best management practices that remove nutrients through a variety of processes related to nutrient uptake, transformation, and microbial activities. | 10% with 5% pond coverage | 10% with 5% pond coverage | Florida Department of Environmental Protection 2018 |

Table 4-26: Low Impact Development and Green Infrastructure Best Management Practices and TN and TP Removal Efficiencies

| Best Management Practice | Definition | TN Removal Efficiency | TP Removal Efficiency | Source |
|---|---|---|---|---|
| Permeable pavement | Hard, yet penetrable, surfaces reduce runoff by allowing water to move through them into groundwater below (Institute of Food and Agricultural Sciences 2016). | 30%-74% | 30%-74% | Harper et al. 2007 |
| Bioswales | An alternative to curb and gutter systems, bioswales convey water, slow runoff, and promote infiltration. Swales may be installed along residential streets, highways, or parking lot medians (Institute of Food and Agricultural Sciences 2016). Must be designed for conveyance, greater in length than width, have shallow slopes, and include proper landscaping. | 38%-89% | 9%-80% | Florida Department of Environmental Protection 2014 |
| Green roofs | These systems can significantly reduce the rate and quantity of runoff from a roof and provide buildings with thermal insulation and improved aesthetics (Institute of Food and Agricultural Sciences 2016). Retention best management practice covered with growing media and vegetation that enables rainfall infiltration and evapotranspiration of stored water. Including a cistern capture, retain, and reuse water adds to effectiveness. | 45% (without cistern)<br>60%-85% (with cistern) | Not applicable | Florida Department of Environmental Protection 2014 |
| Bioretention basins/rain gardens | Small vegetated depressions in the landscape collect and filter stormwater into the soil (Institute of Food and Agricultural Sciences 2016). Constructed adjacent to roof runoff and impervious areas. | 30%-50% | 30%-90% | Florida Department of Environmental Protection 2014 |
| Tree boxes | Bioretention systems with vertical concrete walls designed to collect/retain specified volume of stormwater runoff from sidewalks, parking lots and/or streets. Consists of a container filled with a soil mixture, a mulch layer, under-drain system, and shrub or tree (Florida Department of Environmental Protection 2014). | 38%-65% | 50%-80% | Florida Department of Environmental Protection 2014 |

- Denitrification best management practices/Biosorption – These best management practices use a soil media, known as biosorption activated media to increase the amount of denitrification that occurs, which increases the amount of TN and TP removed. Biosorption activated media includes mixes of soil, sawdust, zeolites, tire crumb, vegetation, sulfur, and spodosols. Additional details about denitrification best management practices are included below.

- Best management practices to reduce baseflow intrusion – These projects are modifications to existing best management practices which help reduce intrusion of captured groundwater baseflow into stormwater drainage systems. These best management practices include backfilling canals so that they do not cut through the baseflow, modifying canal cross-sections to maintain the same storage capacity while limiting the depth, installing weirs to control the water levels in the best management practice, or adding a cutoff wall to prevent movement into the baseflow.

- Re-diversion to the St. Johns River – Portions of the current IRL Basin historically flowed towards the St. Johns River. By re-diverting these flows back to the St. Johns River, the excess stormwater runoff, as well as the additional freshwater inputs, to the IRL have been removed. The re-diversion projects include a treatment component so that the runoff is treated before being discharged to the St. Johns River. The St. Johns River Water Management District has taken the lead on large-scale projects while the County has re-diverted more than 400 acres in the Crane Creek basin and partnered with the St. Johns River Water Management District to increase re-diversion from the Melbourne-Tillman Water Control District canal system. See: https://www.facebook.com/BrevardCountySaveOurLagoon/videos/284153042868113

Due to the importance of treating dry season baseflow to the lagoon, Brevard County has found that ditch denitrification is the most cost-effective best management practice. Biosorption activated media can be added in existing best management practices or to new best management practices to improve the nutrient removal efficiency. The removal efficiencies of using biosorption activated media in various stormwater treatment projects (Wanielista 2015) are summarized in **Table 4-27**. While the efficiencies in **Table 4-27** are only for Bold & Gold, other types of biosorption activated media may be used in a project, if there is Florida-specific information available on the removal efficiencies for that media.

The County's proposed total maximum daily loads include two components: (1) a total maximum daily load for the five-month period (January – May) that is critical for seagrass growth, and (2) a total maximum daily load for the remaining seven months of the year to avoid algal blooms and protect healthy dissolved oxygen levels. In 2019, Brevard County updated the estimates for nutrient loading entering the lagoon through each stormwater ditch and outfall. The update incorporated more recent land use data, more recent rainfall and evapotranspiration data, and improved stormwater infrastructure mapping and topography. There are more than 2,000 hydrologically distinct catchment basin areas within the lagoon watershed countywide. These connect to the lagoon through more than 1,500 stormwater ditches and structural outfalls. For the purpose of maximizing seagrass response to stormwater treatment, these new loading estimates for catchment basins were prioritized based on the amount of nutrients migrating into the stormwater system as groundwater baseflow during a five-month season found to be most critical to annual seagrass expansion or loss.

Table 4-27: TN and TP Removal Efficiencies for Biosorption Activated Media

| Location in Best Management Practice Treatment Train | Material | TN Removal Efficiency | TP Removal Efficiency |
|---|---|---|---|
| Bold & Gold as a first best management practice, example up-flow filter in baffle box and a constructed wetland | Expanded Clay<br>Tire Chips | 55% | 65% |
| Bold & Gold in up-flow filter at wet pond and dry basin outflow | Organics<br>Tire Chips<br>Expanded Clay | 45% | 45% |
| Bold & Gold in inter-event flow using up-flow filter at wet pond and down-flow filter at dry basin | Expanded Clay<br>Tire Chips | 25% | 25% |
| Bold & Gold down-flow filters 12-inch depth at wet pond or dry basin pervious pavement, tree well, rain garden, swale, and strips | Clay<br>Tire Crumb<br>Sand and Topsoil | 60% | 90% |

The stormwater project benefits were estimated, as follows, to ensure both components of the total maximum daily load are adequately addressed. The five-month total maximum daily load covers the dry season in this area when there is minimal rainfall and stormwater runoff; therefore, the benefits of stormwater biosorption activated media projects during this period were based only on January – May baseflow loading estimates from the Spatial Watershed Iterative Loading model. The estimated project treatment efficiencies used for January to May baseflow only are 55% for TN and 65% for TP. These projects also reduce nutrient loads during the remaining seven months of the year. To estimate annual load reduction benefits, the annual baseflow and stormwater loading estimates from the Spatial Watershed Iterative Loading model were used with a project efficiency of 45% for TN and 45% for TP. The estimated TN and TP reductions accomplished by using biosorption activated media upstream of these priority outfalls are summarized in **Table 4-28**, as well as the estimated cost per pound of TN or TP removed.

Table 4-28: Estimated TN and TP Reductions and Costs for Biosorption Activated Media Projects

| Sub-lagoon | Number of Basins | Estimated Total Project Cost | TN Reductions (lbs/yr) | Cost per Pound Per Year of TN | TP Reductions (lbs/yr) | Cost per Pound per Year of TP |
|---|---|---|---|---|---|---|
| Banana River Lagoon* | 67 | $14,403,300 | 63,737 | $226 | 8,421 | $1,710 |
| North IRL* | 98 | $23,584,400 | 121,815 | $194 | 16,152 | $1,460 |
| Central IRL* | 10 | $3,995,300 | 24,166 | $165 | 3,182 | $1,256 |
| ***Total*** | ***175*** | ***$41,983,000*** | ***209,718*** | ***$200*** | ***27,755*** | ***$1,512*** |

(See: **(**[http://www.brevardfl.gov/SaveOurLagoon/project-plan](http://www.brevardfl.gov/SaveOurLagoon/project-plan) Appendix E for or a detailed list of stormwater projects revised as part of this 2019 Update. The locations of the basins to be treated are shown in **Figure 4-21**, **Figure 4-22**, and **Figure 4-23**.)