22 Hwy 28
PO Box 307
Crystal Bay, NV 89402

T (775) 313-6903
F (775) 833-3378
bhelm@boulderbayresort.com

www.boulderbayresort.com

BOULDER BAY
TOTAL MAXIMUM DAILY LOAD
POLLUTANT LOAD REDUCTION PLAN

ATTACHMENTS

Boulder Bay BMP Plan
Boulder Bay TMDL Strategies
JBR Storm Water Quality Preliminary Report

OVERVIEW

Water clarity at Lake Tahoe is primarily impacted by the quality of storm water and snow melt run-off within the basin discharging to the lake. The condition of this water quality is a direct result of the condition of the built environment surrounding the lake such as pavement, eroding slopes, forested uplands, etc. Traditionally, the use of Best Management Practices (BMPs) have been employed to control the conveyance and treatment of storm water and snow melt around the lake. Recently, the debate has shifted to a Total Maximum Daily Load (TMDL) approach in order to more effectively remove harmful elements, including sediment and fine sediment (particle size less than 20-micron), nitrogen and phosphorus. It is believed that traditional BMP have not been as effective in removing these constituents that are most closely linked with the loss in lake clarity.

Since the project will be built on a site that is 100% previously disturbed the use of a network of interrelated storm water conveyance and treatment strategies appropriate for urban infill regions will be employed. These strategies fall into four distinct categories:

1. Pollutant Source Control (PSC)
2. Hydrologic Source Control (HSC)
3. Strom Water Treatment (SWT)
4. Airborne Source Control (ASC)

Within the Boulder Bay TMDL Reduction Plan PSCs, HSCs, SWT and ASC work together to reduce pollutant loads. These strategies are implemented in an integrated network to reduce runoff volumes and improve effluent water quality.

MONITORING

The storm water program was based a monitoring and analysis plan developed and implemented by JBR Environmental Consultants, Inc. out of Reno, NV. During each storm event, JBR sampled surface runoff from between 9 and 13 sites within the current project area. The storm water samples were analyzed for nitrate (NO3-N), nitrite (NO2-N), ammonia (NH3), total nitrogen (TN), total kjeldahl nitrogen (TKN), total phosphorous (TP), dissolved phosphorous (DP-P), total suspended solids (TSS), turbidity (nephelometric) and oil & grease (gravimetric). Storm water from two events was also analyzed for TSS less than 20-micron. This data collected represents baseline storm water quality for the site.

Based upon an estimate of flow rates, total precipitation, uphill area and % impervious, total annual sediment, nitrogen and phosphorus loads passing through the site were estimated to provide an understanding of the baseline conditions (see March 4, 2009: JBR Storm Water Quality Preliminary Report).

FORECASTED BENEFITS

Based on an understanding of existing conditions, proposed site layout, impervious coverage, BMP and TMDL strategies and the associated performance specifications, the Boulder Bay design objectives include:

1. Total Effective Site Coverage: 254,000 sq. ft. (35.8%)
2. Storm water runoff volume capture capacity (TRPA/TMDL)[1]:
   a. 20 yr/1 hr – 125% / 150%;
   b. 50 yr/1 hr – 100% / 125%
   c. 100 yr/1 hr – 75% / 100%
3. Total Sediment Annual Load Reduction: 90%
4. Fine Sediment (<20 micron) Annual Load Reduction: 90%

POLLUTANT SOURCE CONTROL

PSCs reduce the mobilization and transport of pollutants of concern at their sources. This includes sources that could be widely distributed in a catchment (e.g., land surface erosion) and those that are more concentrated (e.g., steep slope erosion).

REDUCED COVERAGE

Impervious coverage within the North Stateline Community Plan Area will be reduced by 64,429 sq ft. Total coverage of the 16.3-acre site will be 49.9%. The "effective" coverage of the site will be further reduced through the implementation of the HSC strategies detailed on page 3.

1. **Total Impervious Coverage**: 353,400 sq. ft. (49.9%)
2. **"Effective" Coverage Replaced (TMDL)**: 99,400 sq. ft.
3. **Total Effective Site Coverage**: 254,000 sq. ft. (35.8%)

[1] Note: The notation "(TRPA/TMDL)" refers to the use of either the TRPA definition of coverage (no credit given for technologies that reduce storm water runoff such as pervious pavers, storm water catchment and green roofs) or a TMDL coverage that includes a credit for these technologies when completing project area hydrology calculations.

IMPROVED ROADWAYS

All roadways through and adjacent to the project area will be improved to include curb and gutter design as well as storm water conveyance.

1. **Improved Roadway**: 149,000 sq. ft.

STABILIZED ERODING SLOPES

The existing conditions currently include significant areas of steep eroding slopes often adjacent to large paved areas. All of these eroding slopes will be stabilized and restored with retaining walls and vegetation to eliminate this condition:

1. **Location**: Above Biltmore rear parking lot; above Tahoe Mariner parcel.
2. **Repaired Eroding Slopes**: 60,000 sq. ft.

SNOW-MELTED ROADWAYS

All project roads and pedestrian paths interior to the site will be heated to facilitate snow melting and eliminate the need for the application of sand and chemicals during winter months. Research shows that traction control material applied to paved roadways is a major source of fine sediments and suggests the volume of vehicular traffic is responsible for the generation of those fine particles (USEPA 2007). Wintertime road dust emissions factors average four times higher than summer time emissions factors due to the seasonal application of traction materials:

1. **Location**: Interior Boulder Way and Wellness Way.
2. **Snow-melted Area**: 56,000 sq. ft.

HYDROLOGIC SOURCE CONTROL

HSCs reduce runoff volumes and rates through runoff interception, infiltration, and disconnection of impervious surfaces. HSCs primarily function to increase infiltration, which routes precipitation, runon and surface runoff to groundwater. The design specifications associated with each of the HSC will be based upon *The Truckee Meadows Low Impact Development Handbook: Regional Stormwater Quality Management Program; August 2007* and the referenced *Low Impact Development: Technical Guidance Manual for the Puget Sound; January 2005*.

STORM WATER INFILTRATION

Through the implementation of an integrated network of above and below ground storage and infiltration galleries, the project will capture and infiltrate storm water runoff from the project area as well as NDOT and Washoe County right of ways. For the project area Boulder Bay proposes to achieve:

1. **Minimum Capacity (TRPA Coverage)**: 100% of 50yr/1hr storm
2. **Minimum Capacity (incld. TMDL Coverage Reduction)**: 100% of 100 yr/1 hr storm.
3. **Systems**: Storm Tank Underground retention galleries; traditional above ground retention galleries; Trenches

PERVIOUS PAVEMENT

Boulder Bay will utilize pervious pavers through out the site to significantly increase the area available for storm water infiltration:

1. **Pervious Pavers – Pedestrian**: 14,800 sq ft
2. **Pervious Pavers – Driveway**: 41,500 sq ft
3. **Total Increase Area for Infiltration**: 28,000 sq ft (50% area)
4. **Modeled Performance**: 50% landscaped/50% impervious.[2] No reduction in performance was assumed during cold weather months.[3]
5. **Maintenance Plan**: Surfaces will be swept with a high-efficiency or vacuum sweeper twice per year; once in the autumn and again in early spring.

STORM WATER CATCHMENT

Boulder Bay will utilize storm water catchment systems on selected building roofs. The system will be designed to capture rainwater from the roofs of buildings and transport it through gutters and other pipes into storage facilities until it is needed for irrigation and hygiene uses.

1. **Location**: Primary roof tops of Buildings B, C, D, E
2. **Storm Water Catchment Area**: 61,300 sq. ft.
3. **Modeled Performance**: 100% of drainage area excluded from impervious surface.[4]

GREEN ROOFS

Boulder Bay will install extensive (3-8 inch soil growing medium) green roofs on selected buildings. Planted roofs absorb excess rainwater and can reduce runoff and thus reduce the impact of each building on the surrounding watershed.

1. **Location**: Retail buildings G & H, covered pedestrian walkways; Building A, interior roofs.
2. **Area Planted/Catchment**: 16,200 sq ft / 34,500 sq ft
3. **Benefits**: Infiltration of rainwater from buildings A, G & H, reduced heat island effect, and improved aesthetics.
4. **Modeled Performance**: 20% landscaped.[5]

STORM WATER TREATMENT

SWT removes pollutants after runoff has entered concentrated flow paths. This will include treatment of flows to be infiltrated to groundwater.

BIO RETENTION

Bio Retention systems such as bio swales and modular wetlands are used on the perimeter of the project area in-line with storm water conveyance and retention systems. Runoff flows into landscaped systems, where it ponds and infiltrates the soil. The engineered soil mix

---

[2] Hinman, C (2005). *Low Impact Development: Technical Guidance Manual for the Puget Sound*, (p. 142), Puget Sound Action Team • Washington State University Pierce County Extension.
[3] T. Ballestero (2009) *Performance of Stormwater Practices in Cold Climates,* PHRC 17th Annual Pennsylvania Housing Conference.
[4] Hinman, C (2005). *Low Impact Development: Technical Guidance Manual for the Puget Sound*, (p. 150), Puget Sound Action Team • Washington State University Pierce County Extension.
[5] D. Beyerlein (2005). *Western Washington Hydrology Model v.3 Eco-Roof Documentation*, (p. 15), Clear Creek Solutions.

(36-inch depth) and vegetation provide water quality treatment and infiltration similar to undeveloped areas.

1. **Installations**: Along Stateline Road; Along SR 28 in front of A building; CB Motel/Overflow parking lot site.
2. **Performance Specifications (Reported Removal %)**[6]:
    a. TSS Removal: 90%
    b. Phosphorus: 81%
    c. Total Kjeldahl Nitrogen: 68%
    d. Total Nitrogen: 43%
    e. Nitrate: 23%
    f. Oil & Grease: 95%
3. **Modeled Performance**: 100% landscaped

AIRBORNE SOURCE CONTROL

ASC's reduce the amount of pollutants entering Lake Tahoe via atmospheric sources (more than half of the nitrogen reaching the Lake is delivered through the air). This might include the use of mass-transit, VMT reduction, street sweeping and removal of above ground parking lots.

REGENERATIVE AIR STREET SWEEPER

Boulder Bay will implement a regenerative air sweeper program as a first line of defense in pollutant controls. A rigorous road-sweeping program has the potential to remove much of the wintertime traction materials before they undergo pulverization and become tiny particles. Sweeping removes the fine particles (and associated phosphorous) from the roadway before they are transported as re-entrained dust or in storm water runoff. The sweeper program is also used to maintain the ongoing effectiveness of the pervious pavers and pavement.

1. **Sweeper Specifications**: 70% of particulate matter collected by the dustless regenerative air sweeper.
2. **Particle Size Limits**: Sweeper collects road material that has a D50 of 20µm by mass.

UNDERGROUND PARKING

Boulder Bay proposes to remove all existing surface parking lots. 98% of all parking spaces in the proposed project are located in underground structures.

1. **Underground Parking Spaces**: ~600; final TBD from EIS
2. **Surface Parking Spaces**: 12

ALTERNATIVE TRANSPORTATION

Boulder Bay is committed to supporting the long-term success of public transportation within the Lake Tahoe Basin (see Boulder Bay Alternative Transportation Plan).

1. **Vehicle Trip Reduction**: 38,500/yr
2. **Vehicle Miles Traveled Reduction**: 229,800 miles/year

[6] Hinman, C (2005). *Low Impact Development: Technical Guidance Manual for the Puget Sound*, (p. 86), Puget Sound Action Team • Washington State University Pierce County Extension.

TMDL Reduction Parameters		
POLLUTANT SOURCE CONTROLS		
Impervious Coverage	Reduced by 15%. Additional "effective reduction" resulting from pervious pavement, green roofs and storm water catchment systems.	TRPA Coverage: 353,400 sq ft HSC Reduction: 99,400 sq ft Effective Coverage: 254,000 sq ft (35.8%)
Road Design	Curb & gutter design throughout to aid in controlled surface conveyance	149,000 sq ft of road area improved.
Stabilized Slope Conditions	All eroding slope conditions are stabilized	60,000 sq ft of slope area repaired.
Snow-melted Roadways	Eliminate the need for the application of sand to roadways.	56,000 sq ft of hard-scape snow melted.
HYDROLOGIC SOURCE CONTROLS		
Storm Water Capture	BMP's designed to greater than 125 % of 20yr/1 hr storm; 100% of 50yr/1 hr storm; 75% of 100yr/1 hr storm.	Including HSC strategies, the system is designed to greater than 150 % of 20yr/1 hr storm; 125% of 50yr/1 hr storm; 100% of 100yr/1 hr storm.
Storm Water Storage	Replace above ground retention basins with subterranean storage and infiltration systems	Total Capacity: 58,152 cubic ft
Porous Pavement	Utilized in pedestrian streets and walkways internal to the site. Porous paving systems allow infiltration of storm water while providing a stable load-bearing surface for walking and driving.	56,300 sq ft of total area; 50% effective area for infiltration – 28,000 sq ft. Not included in official TRPA coverage reduction.
Storm Water Catchment Systems	Rainwater catchment systems are used to reduce sites water needs and provide storm water management benefits.	61,300 sq ft of roof area intercepted. 100% of area removed from impervious coverage. Toilet flush and on site irrigation
Green roofs	Used along retail buildings to provide small-scale decentralized controls that collect, absorb, and increase the evapo-transpiration rates of rainfall.	34,500 sq ft of roof area intercepted. 16,200 sq ft of planted roof surface. 20% of roof area removed from impervious coverage.
STORM WATER TREATMENT		
Bio retention Systems	Used along the perimeter of pedestrian and park areas in-line with storm water storage and infiltration galleries.	Removal efficiencies: a. TSS: 90%; P: 81%; TKN: 68%; TN: 43%; NO3: 23%; Oil & Grease: 95%
AIRBORNE SOURCE CONTROLS		
Regenerative Air Street Sweepers	Dustless sweeper removes dirt, dust and debris from the sweeping surface, and cleans the exhausted air to 99.999% of 0.5 Micron size particles.	Dustless technology is equally efficient in wet or dry conditions and can be used during winter conditions.