Agronomic Report
for
XYZ Golf Course

Prepared for: Superintendent
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The Brookside philosophy of the soils chemical balance, physical condition, and biological environment are given top consideration when utilizing the analytical reports to give recommendations for each laboratory audit and analysis. The turfgrass manager can then implement these recommendations by applying additional materials to the soil and enhancing the present grooming practices in order to achieve the desired soil improvements. Balancing the elements will improve the soil's physical condition. Opening the soil to air, water and nutrient movement and increasing the microbial activity will result in a healthier root mass and a higher quality turfgrass.
The objective of the recommendations is to maintain the desired levels of cations, keep the soil open, and assure that the plant is receiving the available nutrients. The soils nutrient reserve (blue sheet) indicates the soil pH, exchange capacities, organic matter, and excess or deficit amounts of calcium, magnesium, sulfur, potassium, phosphorous, sodium and all minor elements plus their base saturation percentages. The percentages represent the amount of each element on the colloid and in solution. Excess or deficient amounts of these elements can be found in the following report. Following the recommendations will bring the soils to the desired elemental values. When balancing most soils there should be:

Greens Summary:

Greens 1, 4, 5, 10, 13, 18, and the Practice Green were sampled. The standard soil analysis (blue sheet) tells us what nutrient levels are in reserve on the soil colloid and in soil solution. The Saturated Soil Analysis gives us a picture of what nutrients are available in soil solution only, and this test was run on 4 and 18.

The Standard soil reports indicate that there are nutrient deficiencies in Magnesium, Potassium, Boron, and Manganese while the Sodium levels are much higher than desired. Greens 4 and 18 contain a Calcareous sand root-zone and the organic matter levels on these greens are lower than desired. I recommend utilizing an organic based product for half of the Nitrogen applied to these greens. The nutrients need to be maintained at sufficient levels rather than trying to balance the percentages like the soil based greens. The Manganese levels are slightly lower than desired on most of the greens sampled. I recommend utilizing the Magnesium and Manganese applications to maintain/improve turf color and apply Nitrogen when additional growth is desired and for the dormant feed.

The Sulfur level is the highest on the PG which indicates poor water movement/drainage. This green was highly compacted at the six inch depth while the rest were not highly compacted until the 9 inch depth. Vary the depth of the deep-tine aerating on this green between 7-10

inches for optimal fracturing of the root-zone. Continue to deep-tine aerate the other greens at the 10-12 inch depth due to most of the compaction being between 9-12 inches.

The Saturated soil reports indicate that there are low soluble levels of Calcium, Magnesium, and Potassium while the soluble Chloride, Nitrate, and Sodium levels are higher than desired. The Sodium level is three times higher than the Potassium and this will result in weaker turf that is unable to regulate the water as well. I highly recommend increasing the Calcium, Magnesium, and Potassium levels to combat this. The higher Nitrate levels will result in weaker turf especially during the summer heat, and I recommend rechecking a few areas to make sure this is the case during the summer months.

I also highly recommend venting the greens monthly (solid tine 1/4", bayonet tines, etc...) to increase soil oxygen levels, increase soil microbial activity, and reduce the organic layers in the root-zone. Vent the greens following sand top-dressing to increase sand incorporation. Also utilize a bio-stimulant to increase microbial activity and organic matter/thatch decomposition. If there is more than enough turf growth while using the bio-stimulant, then reduce or eliminate the Nitrogen applications.

Aerification Displacement Chart			
Tine Size	**1.25" x 1.25"**	**2.5" x 2.5"**	**5" x 5"**
1/4" Hollow Tines	3.14%	0.79%	
3/8" Hollow Tines	7.07%	1.77%	
1/2" Hollow Tines	12.75%	3.14%	
5/8" Hollow Tines		4.91%	1.23%
3/4" Hollow Tines			1.77%
1" Hollow Tines		7.07%	3.14%
7/8" Drill & Fill (7" Centers)			1.23%
Graden (15 blades at 1" spacing)	3.93% (1 mm)	7.87% (2mm)	11.81% (3mm)

The profile on the left is from green #4 and there is a slight concern with the organic layer in the upper 0.75” of root-zone. No more organic matter should be allowed to accumulate and ideally this would be no greater than 0.5”.

The soil based greens contain an excellent sand profile with a little more organic matter in the upper .75” than desired. They all (except PG) are highly compacted at the 9 inch depth which decreases water movement and increases Sodium accumulation.

There is also an excellent amount of fracturing in the sand/soil interface to improve water movement and reduce salt accumulation. It may be possible to deep water these greens more regularly.

This picture from #5 green is showing the affects of the variation in depth of greens mix and poor environment for turf. The back-left portion of the green seems to contain 18-20 inches of root-zone. The knob on the right contains 22 inches of root-zone. The rest of the green seems to contain 10-15 inches of root-zone mix. The areas containing more than 12 inches of toot-zone will tend to be very droughty due reduced ability to utilize capillary action. Between the extra sand and poor sunlight, this green is going to continue to struggle even with the best maintenance programs. More than 60 minutes of water will be needed to flush the deeper root-zone mix on this green. I highly recommend improving morning sunlight on this green through tree thinning or removal.

Fairway Summary:

Fairways 1, 4, 5, 10, 13, and 18 were sampled. The standard soil reports for the fairways indicate that there are nutrient deficiencies in Phosphorus, Magnesium, Potassium, Boron, Manganese, and Zinc. The biggest concern is the low levels of Potassium and very high levels of Sodium. I highly recommend making the blend applications along with the supplemental Potassium applications where needed. The Sulfur level is higher than desired on 13 which indicates there is poor water movement/drainage on this fairway compared to the others. This is most likely due to the water table being just below the surface and not allowing the water to move out of the root-zone as fast.

Continue to improve water movement through the soil by reducing the compaction and organic matter content through deep tine aerification (Soil Reliever, Vertidrain, Weidenmann, Aerway, Bannerman, etc...), deep verti-cutting (Sisis, Graden, Locke, Weidenmann, First Products, etc...), and sand top-dressing. Also consider the use of a bio-stimulant to decrease the organic matter in the upper 1-2 inches of root-zone.

Tee Summary:

Tees 1, 4, 5(Blue and White), 10(White), 13(Black and Blue), and 18(Black and Blue) were sampled. The Standard soil reports indicate that there are nutrient deficiencies in Phosphorus, Magnesium, Potassium, Boron, Manganese, Copper, and Zinc while the Sodium levels are much higher than desired. The sand based tees (4, 13-BB) also contain low organic

matter levels and an organic based product should be utilized for at least half of the Nitrogen applied to them. There is a slight sod layer left in these tees and I recommend venting them monthly to prevent this layer from sealing off the root-zone. This can be accomplished with slicing, solid tine aerification (1/4", bayonet, star tines, etc...). The Saturated soil report for 10-W indicates that there are deficient soluble levels of Calcium, Magnesium, and Potassium while the Chloride and Sodium levels are higher than desired. Utilize the gypsum to correct the soluble levels of Calcium and combat the Sodium on the sand based tees.

Nutrient Information:

Calcium: In the plant Calcium is essential for strengthening the cell wall structure and is needed for cell division. Plant deficiencies will occur in low exchange soils when the calcium levels are low in solution. In higher exchange soils, Calcium is needed to make the soil flocculate, to keep the pores open for air, water and nutrient movement, which will prevent the build-up of excess Sodium and Magnesium in the soil. Soluble Calcium displaces the excess Sodium and Magnesium ions from the soil colloid for percolation down through the soil. Calcium can be lost or leached through the soil by:

1. Irrigation water bicarbonates or high pHc values
2. Sulfate fertilizers that dissolve the Calcium
3. Leaching from heavy or acidic rainfall

Magnesium: Magnesium is a part of chlorophyll that is needed for photosynthesis. It is essential for plant respiration and the metabolism of carbohydrates. In high exchange soils excess magnesium can be detrimental to the plant since it will tighten and bind the soil pores reducing air, water and nutrient movement which will cause poor drainage and a deficient root mass.

Potassium: Potassium helps the plant thicken its cell walls in order to build a resistance to pathogens. Potassium also aids in respiration, is essential to water movement, supplies carbohydrates, helps maintain sugar, and reduces water loss and wilting.

Phosphorus: Plant available Phosphorous will help the turfgrass tighten, tack down and enhance root mass. Plant unavailable Phosphorous reduces the uptake of other elements. Phosphorous can become unavailable because of a high or low pH, high soil Calcium or Zinc, imbalance of irrigation Bicarbonates, and temperatures below 55 degrees.

Sodium: Although Sodium is needed for plant growth, the soils should contain no more than 60-100# per acre or <1% base saturation. If the Sodium levels are equal to or more than the Potassium levels, the plant could take-up the Sodium ions, which hinders the uptake of water and nutrients. Stress along with excessive traffic and adverse weather conditions will make the plant more susceptible to disease and insect damage. Applying additional Nitrogen is NOT the correct response to this condition. Increasing and maintaining the soil Potassium at higher percentages will reduce Sodium plant uptake. The soluble Calcium will displace the Sodium off the soil colloid and allow it to leach through the soil. This is the solution to the excess soil Sodium levels.

The **pH** levels should be close to 6.5 or at least acidic so that there is hydrogen available for nutrient uptake by the turf. Increasing the soluble levels of Calcium with the gypsum (Calcium Sulfate) should not increase the pH levels here while the use of lime (Calcium Carbonate) would.

Organic Matter should be 2-4%. When there is less than 2%, there is typically less microbial population, diversity, and activity in those soils. When there is greater than 5% organic matter in the soil, there is typically too much moisture retention. The location of the organic matter in the soil profile (thatch, subsoil, layers, etc…) is important to consider as well. Ideally the organic matter would be evenly distributed with 2-4%.

Sulfur: Sulfur in the form of sulfate is very important in the break down of nutrients from insoluble to soluble. It is also important as a microbial food source and has numerous functions in plant growth and production.

Bicarbonates: High Bicarbonates can decrease Calcium and Magnesium availability and lead to hydrophobic conditions (Localized Dry Spots). The negative RSC value found on the irrigation water test tells us that some Calcium and Magnesium is being supplied to the soil solution when irrigating. When concentrated enough, Bicarbonates surround the sand particles and bind together forming a seal in the profile which becomes hydrophobic.

The **Soluble Salts** levels on the Saturated Soil Analysis should below 640 ppm. When the Soluble Salts level approaches 640 ppm, then a flushing irrigation cycle is needed. Again, venting the greens regularly and continuing with the deep and infrequent irrigation cycle will help to ensure that these salts do not cause an added stress on the turf.