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GOLF COURSE DESIGN, CONSTRUCTION AND MAINTENANCE: BEST MANAGEMENT PRACTICES

GOLD RUSH RANCH
SUTTER CREEK, CA

April 19, 2007

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1 PURPOSE AND SCOPE

An outstanding golf course is the result of excellent design, responsible construction, proper vegetative measures, and well thought-out course operations and maintenance.

Following proper course design and construction practices will result in significant dividends in the future through reduced maintenance. Proper water management, preservation of good soil quality, and wise tee and green siting will reduce stresses on plants such as disease and negative moisture balance.

To achieve this, best management practices (BMPs) for the course design, construction and maintenance are recommended. The intent of BMPs is to provide a set of guidelines specific for the site that include well accepted practices that will ensure (1) that the golf course design and construction will result in a very playable course and (2) that the cultural and chemical practices used in the construction and maintenance phases will not have a deleterious effect on the surrounding environment that typically includes wildlife, wetlands, soil and surface water and groundwater quality.

It is the intent of this document to outline the guidelines required for the proposed development at the Gold Rush LLC Ranch. These guidelines will be considered and implemented prior to construction and amended based on changing site conditions.

2 SITE SELECTION

2.1 Site Selection & Design

The first step toward establishing an environmentally compatible golf course is site selection. Normally, a full length golf course will transform between 160-200 acres of what is existing cropland, meadow, water, wetland, and woodland. This land in its existing state usually provides a great many natural resource benefits including wildlife habitat, stormwater infiltration, and scenic vistas. A thorough analysis of all natural, social, and archaeological resources of potential golf course sites will be performed at the Gold Rush site. The presence and extent of some types of ecosystems may render portions or entire sites unsuitable for development. Examples include:

- Sensitive aquatic regimes
- Threatened and endangered plants or animals
- Wetlands or high water table
- Steep slopes

There may be opportunities to restore or enhance environmentally sensitive ecosystems in the golf course development process through widening of riparian buffers and establishing 'no-impact' zones of existing native vegetation. If the course is designed properly, these sensitive areas often provide some of the most distinctive integral features and scenery on a site.

The concept of having the golf course 'lay lightly on the land' is one that has been in use in Scotland and England for centuries. Simply put, the course designer finds a socially and environmentally suitable site and then fits the golf course to the existing terrain as much as possible. The course then is constructed in an efficient manner and proper relationships with site resources are established. Extra sensitivity is afforded the zones associated with watercourses, wetlands, and steep terrain. Much native vegetation is preserved in large sections of rough and out of play areas, with intensively managed turf kept to the minimum.

In the United States, the contrary idea has been used for much of this century. That is, sculpting the golf course from the land through extensive earth moving, without sufficient regard for natural features and limitations. In this way, greater risk for environmental degradation can result, and greater management measures are necessary. This type of development can also increase costs for permitting, construction, and maintenance. At the Gold Rush site, the more site-sensitive design will be implemented.

A team of experienced professionals has been assembled to carry out the design, construction, and operations phases at the Gold Rush site. An experienced golf course architect is employed along with a course supervisor and various engineering, contracting, and environmental consultants.

Communication with local residents and government officials has occurred since the inception of the project. The course will be sited and designed employing a spirit of partnership with owner, operator, designer, and local people. This is an important facet of all phases of golf course development: design, construction, and operations. Each potential site will possess both unique natural and social characteristics and should be addressed that way.

The following design features and factors will be typically identified and mapped as appropriate. These are under consideration at the Gold Rush project and include:

- Property boundaries
- Topography with areas of steep slopes emphasized
- Natural runoff patterns
- Existing vegetation
- The existing ecosystems must be identified
- Water resources, both surface and ground, including wetlands
- Soil map units from USDA Cooperative Soil Survey
- Climatic: sun, wind orientation
- Location of underground utilities and any rights-of-way
- Scenic views for preservation
- Historical and archaeological resources
- Location and extent of threatened and endangered plant & wildlife habitats
- All existing roads and structures on and adjacent to the site
- Adjacent land uses

2.2 Summary of BMPs Relevant to the Design and Site Selection at the Gold Rush Site

- The Gold Rush project involves golf course layout and design that is compatible with the existing landscape.

- The BMPs for the project have been developed to ensure minimal environmental impact and disturbance to the land. For example, course layout avoids impact to existing watercourses and wetlands and involves identification of numerous site conditions that could be impacted by the course.

- The BMPs outlined in the project will consider:

    - Property boundaries

    - Topography with areas of steep slopes emphasized

    - Natural runoff patterns

    - Existing vegetation

    - The existing ecosystems must be identified.

    - Water resources, both surface and ground, including wetlands

    - Soil map units from USDA Cooperative Soil Survey

    - Climatic: sun, wind orientation

    - Location of underground utilities and any rights-of-way

    - Scenic views for preservation

    - Historical and archaeological resources

    - Location and extent of threatened and endangered plant & wildlife habitats

    - All existing roads and structures on and adjacent to the site

    - Adjacent land uses

3 TERRAIN AND WATER CONSIDERATIONS

A careful study of areas such as streams, wetland, fragile ecosystems, and unique habitats will determine their effect on the golf course. The natural drainage patterns are reviewed in conjunction with the topography. The layout must be done with respect to existing runoff patterns to provide reduced pollution risk and efficient operation and maintenance.

If the course is being constructed on existing cropland, runoff may be slightly less once the course is established; if built in woods, runoff will increase. The proposed Gold Rush project is likely intermediate between these two extremes. Whenever possible, existing water features should not be altered, riparian buffers should be preserved or enhanced, and stream crossings kept at a minimum. When stream crossings do occur, they should traverse the riparian zone at a perpendicular to the stream. Existing surface water features can be utilized in the strategy of the golf course and provide for some of the most challenging and scenic golf holes.

Water features are usually added in order to improve the course and to provide improved stormwater management and water quality benefits. Stormwater retention structures such as ponds, wetlands, and enhanced grass swales or shallow ditches with 'pocket' wetlands can improve the quality of the runoff leaving the golf course. These features will be used to filter stormwater runoff from the golf course and to prevent fertilizer and pesticides form entering adjacent water resources. These types of features are being considered at the Gold Rush project.

3.1 Summary of BMPs Relevant to Terrain and Water Considerations at the Gold Rush Site

- The BMPs for terrain and water impacts are crucial for minimizing environmental impacts at the site.

- The BMPs for the site that are expected to be implemented to address terrain and water considerations include :

    - Examination of soil mapping units, soil distribution and soil depth such that erosion and runoff can be determined.

    - Identification of natural drainage and runoff patterns will be identified to ensure that construction activities and the course layout minimally impact water quality, changes in flow patterns and potential changes to water volumes and flows that may alter the existing drainage and flow patterns.

- Slope changes via cut and fill, will be examined thoroughly as part of the BMP process which will not negatively impact course, surrounding land and habitat.

4 STORMWATER MANAGEMENT

Basically, three different approaches exist for stormwater management on golf courses. They are detention, filtration, and infiltration. Usually, the best approach employs a combination of these three, which are all being considered for the Gold Rush project stormwater management scheme.

Detention on a golf course would be accomplished through constructed detention basins, ponds and pond wetland systems. Detention mostly controls water *quantity*, with water quality improvement usually an ancillary benefit.

Filtration would be done using constructed wetlands, biofiltration areas, sand filters, riparian forest buffers, and vegetative filter strips.

Infiltration may be accomplished with infiltration trenches, infiltration wetland basins, and biofiltration areas.

All of these stormwater management structures will need to be maintained on a regular basis in order to function properly. Accumulated debris in basins, erosion on shorelines or in swales must be addressed promptly or the structures can become offsite pollutant *exporters*.

Stormwater runoff from the course should be directed through constructed pond/wetland filtration systems, filter strips, or riparian forest buffers before flowing into existing off site water bodies.

When a course is part of a residential development, stormwater management ponds that are part of the course can be used to collect and treat runoff from impervious areas. In many cases, stormwater management features are used to collect and recycle water for irrigation and equipment washdown use, which can greatly reduce the need for other water sources.

4.1 Summary of BMPs Relevant to Stormwater Management at the Gold Rush Site

- The BMPs for he course and residential development include the collection and control of stormwater during construction and as part of the course maintenance plan.

- Stormwater is proposed to be directed to a stormwater collection pond. Since underlying soil is relatively impermeable, the site is ideal for collection of stormwater.

- Stormwater will be released to local water bodies under controlled conditions to ensure that water quality is not impacted.

- During construction, stormwater will be collected and sediment load reduced or eliminated using silt fences and significant retention time within the collection pond prior to release.

- Since the course is part of a residential development, stormwater management ponds will be used to collect and treat runoff from impervious areas.

5 IRRIGATION WATER CONSIDERATIONS

The issue of irrigation water is a critical one. The availability of water, irrigation requirements of the golf course, and methods of application will influence the location and design of the golf course. In some areas where water supply is strictly controlled, the course design should allow for reduced irrigation requirements through use of native warm season grasses and drought-tolerant grasses in rough areas.

Irrigation issues are addressed in the design phase. Research can be done to determine if the withdrawal of groundwater for irrigation will affect the water supply of an area. Based on this research, irrigation requirements can be altered if necessary to prevent depletion of the aquifer. All alternatives to ground water, such as recycling of effluent or stored stormwater should be thoroughly investigated and used, if feasible. For the Gold Rush project recycle water is being evaluated for the bulk of irrigation.

5.1 Summary of BMPs Relevant to Irrigation Water at the Gold Rush Site

- BMPs for irrigation water primarily focus on the use of recycle water for the course which will greatly reduce the need for other water sources and provide a safe means of disposing of treated water.

- The BMPs will include an analysis of recycle water impact on soils, vegetation and local water ways to ensure that no significant change occurs due to use of recycle water. This analysis has been performed in the Geochemistry section of the EIR.

6 GREEN AND TEE CONSIDERATIONS

Green and tee locations and construction pose another set of considerations. Both greens and tees should be located in areas where the depth to seasonal high water table or bedrock is greater than four feet. Underdrain systems for greens and tees must also maintain four feet of soil separation between the subsurface drainage system and the water table or bedrock. Part of tee and green construction should include provisions for leachate collection and filtration.

Poorly located tees and greens can present a great environmental liability. Excessive shading and reduced airflow will decrease turfgrass vigor and increase disease pressure. This then means greater chemical use to sustain turfgrass quality.

6.1 Summary of BMPs Relevant to Greens and Tees at the Gold Rush Site

- BMPs for greens and tees will include placement in areas where the depth to seasonal high water table or bedrock is greater than four feet.

- BMPs will include underdrain systems for greens and tees that will maintain four feet of soil separation between the subsurface drainage system and the water table or bedrock.

- BMPs will ensure that excessive shade and reduced airflow will not occur. This will lead to minimal chemical use necessary to sustain turfgrass quality.

7 VEGETATION CONSIDERATIONS

The natural vegetation of the Gold Rush site is being assessed for habitat and water quality benefits. Evaluation is made for the extent of clearing necessary and areas for potential revegetation with native plant materials. Trees especially can be incorporated into the characteristics of the course, affecting shot making strategy and enhancing aesthetics.

Areas providing vegetative habitat for desired or protected wildlife are worked around and incorporated into the flavor of the layout. For example, roughs can provide foraging habitat for raptors feeding on small rodents. These areas should be allowed to grow to a height of 12-18 inches and kept as old field habitat. If rough is planted, utilize grass species that are relatively deep rooted and climate tolerant.

7.1 Other Course Planning Considerations

The orientation of sun and wind is another consideration. Longer holes can be situated to take advantage of wind direction and are not adversely impacted with rising or setting sun.

The existing road system should be evaluated to determine points of access to provide the most efficient ingress, egress, and local circulation for golf course operations.

7.2 Buildings and Parking Considerations

The construction of clubhouses, pro shops, food & beverage facilities, parking lots, and maintenance areas causes water quality impacts similar to traditional commercial development. Runoff from these areas can contribute sediment, heavy metals, fecal bacteria, organic and inorganic debris, household chemicals, oils & greases, and floatables to the adjacent surface waters. Since most of these facilities require extensive impervious surfaces, stormwater runoff volumes are much heavier than pre-development conditions. The impacts of higher pollutant export are felt not only in adjacent water bodies, but also far downstream.

Impervious areas should always be kept to a minimum. Parking lots, especially, can be installed so that paved parking exists for only the year round daily ‘average’ number of vehicles rather than the maximum possible. Overflow parking for weekends and other busy times should be on porous gravel, to reduce runoff. Runoff management practices such as infiltration trenches, sand filters, and/or catch basins enhanced with filtration or settling capability should be planned and installed in the most advantageous locations.

7.3 Summary

It is in the planning and design phase that responsible solutions are found for the environmental issues. Impacts during construction and management of the course can best be avoided by identifying and addressing all potential environmental issues beforehand. To provide the proper environmental protection during construction, the location of erosion and stormwater management controls must be included as part of the original plan. Inclusion and consideration of all of these factors will result in a plan that can be passed and permitted more readily.

7.4 Summary of BMPs Relevant to Vegetation and Course Planning at the Gold Rush Site

- The BMPs addressing the natural vegetation of the Gold Rush site are being assessed for habitat and water quality benefits. Evaluation is made for the extent of clearing necessary and areas for potential revegetation with native plant materials. Trees especially can be incorporated into the characteristics of the course, affecting shot making strategy and enhancing aesthetics.

- The BMPs for the site will provide vegetative habitat for desired or protected wildlife and incorporated into the course layout. For example, roughs can provide foraging habitat for raptors feeding on small rodents. These areas should be allowed to grow to a height of 12-18 inches and kept as old field habitat. If rough is planted, utilize grass species that are relatively deep rooted and climate tolerant.

- The BMPs will also address the site access to minimize entrances and exits. The BMPs will address the amount of impervious area in order to minimize areas of excessive runoff, erosion and stormwater control.

8 CONSTRUCTION PHASE

Once the planning and design process has been completed and a satisfactory plan has been reviewed and permitted, the construction phase at the Gold Rush site will be initiated. The construction BMP requirements that will be implemented at the Gold Rush site will typically include:

- Soil Erosion and Sediment Control Plan: The Plan is required for the project to be approved for construction. The Plan shows the location and methods of controls for stormwater and erosion on disturbed areas of the site during construction.

- Grading and Drainage Plan: This shows the overall plan for construction of the golf course and the terrain alteration necessary to create course features and produce proper drainage. Both pre and post construction contours should be shown.

- Clearing Plan: Indicates the limits of clearing necessary for construction of the golf course. Specimen trees to be saved or areas of natural vegetation to be preserved will be shown here and staked in the field.

- Staking Plan: Locates the key points (greens, tees, fairways) and no-disturbance areas in the field for review and construction.

- Vegetation Plan: Indicates the areas where specific turfgrasses and in some cases, ornamental grasses and trees are to be planted. Species for fairways, tees, and greens should be consistent with regional turf recommendations. As a part of this plan, the conservation and natural areas are included.

- Irrigation Plan: This provides all information for the type of irrigation system, pump locations, and conduit network to be installed.

- Construction Details: Shows how the golf course features (greens, tees, bunkers, ponds) are to be constructed in detail.

- Specification and Bid Documents: Outlines the methods, materials, and details of construction for course completion.

As mentioned earlier, the golf course superintendent should be hired prior to the start of construction. The superintendent will serve as the onsite representative for the owner and be responsible for checking on the site on a daily basis.

During construction, site visits will also made by the course architect and the consultant team to ensure that the goals of the course will be met. Inspections are also commonly made by

local officials to monitor the erosion control and other environmental quality measures implemented at he Gold Rush site.

8.1 Construction Process

The construction process starts with the stakeout of the golf course by the consulting engineer. After the key points and center lines of each golf hole have been staked in the field, the golf course architect reviews their relationship to the site's characteristics. Minor field adjustments are made at the time to best fit the course features into the landscape and preserve unique natural features such as rock outcrops or large trees.

The soil erosion and sediment control features are then installed and checked to ensure proper placement and installation prior to the clearing and grading of the site. Sediment loading from large construction sites may be as much as *100 times* greater per acre than farmed fields. Suspended solids represent not only an important pollutant, but are also a principal transport vector for other surface water pollutants such as phosphorous fertilizer, pesticides, and heavy metals. Golf course construction often involves the disturbance of an unusually large amount of land. Unless runoff is properly managed during construction, increased erosion and sedimentation, increased water turbidity, decreased aquatic productivity, and reduced water quality will result.

The Standards for Soil Erosion and Sediment Control for the Gold Rush site will provide descriptions and design criteria for the most effective soil conservation. Practices such as staged sequence of construction, silt fence, sediment basin, diversion, mulching, conduit outlet protection, temporary stabilization, and others will be needed throughout the course. These controls are placed to control erosion during clearing and grading with extra emphasis on sensitive slopes, habitats, and especially all ponds, streams, and wetlands. The measures are in place throughout construction until all disturbed areas are vegetated and stabilized. Some will remain as permanent water management features of the course.

Clearing of the site then begins, with special care given to areas containing trees. All tree removal is done in phases to prevent damage to preserved trees and integrate tree communities into the fabric of the course. Trees are one of the best ways to create compatibility between the golf course and the site, incorporating a natural setting into the golfing strategy.

8.2 Addressing Soil Compaction

Parking lots, cart paths and maintenance roads are laid down with subbase and then used as the primary staging and pathway for construction equipment in order to reduce soil compaction and damage to vegetation.

The issue of preventing soil compaction is a critical one. The natural infiltration capacity of the soil before disturbance is started is an important stormwater management component.

Post-construction soil quality should be managed so as to stay as close as possible to the pre-construction condition.

If good soil quality is preserved in the construction process, future dividends of reduced maintenance will be realized. Specifically, there will be a reduction of plant stress from poor drainage and root restrictions. This in turn will mean less disease risk. A healthy plant is a lower maintenance plant.

Some soil quality concepts that will be considered at the Gold Rush site are:

- Preserve and stay off of as much of the site as possible, especially woods
- Use the lightest-weight construction and maintenance equipment possible
- Avoid doing grading and earthmoving when the soil is saturated
- Loosen the top 6-12 inches of soil after grading, before seeding
- Incorporate organic matter like leaf compost in the top 6-12 inches if possible
- Avoid rolling established greens when saturated.

After primary path establishment, the golf course is then cleared and graded as efficiently as possible to avoid excessive disturbance, minimize soil compaction, provide proper drainage, and set up the course features. First, the site is rough graded to accomplish the major earthwork necessary for the essential earth and water features. Fine grading is then done to smoothly blend features together. As a part of this operation, the topsoil is removed, stockpiled and stabilized for replacement after final grading.

8.3 Summary of of BMPs Relevant to Construction at the Gold Rush Site

- BMPs pertaining to construction will include the following strategies:
    - Preserve and stay off of as much of the site as possible, especially woods
    - Use the lightest-weight construction and maintenance equipment possible
    - Avoid doing grading and earthmoving when the soil is saturated
    - Loosen the top 6 inches of soil after grading, before seeding
    - Incorporate organic matter like leaf compost in the top 6 inches if possible
    - Avoid rolling established greens when saturated.

- The golf course is will be cleared and graded as efficiently as possible to avoid excessive disturbance, minimize soil compaction, provide proper drainage, and set up the course features.

- The site will be rough graded to accomplish the major earthwork necessary for the essential earth and water features.

- Fine grading is then done to smoothly blend features together. As a part of this operation, the topsoil is removed, stockpiled and stabilized for replacement after final grading.

9 FINAL STEPS IN CONSTRUCTION

After grading, the irrigation system is installed. The system must be up and running in order to support the seeding of the Gold Rush course.

Next, all disturbed areas are prepared and planted with the specific types of turf grass or other grasses specified in the vegetation plan. All areas will need mulching for protection during germination and seedling stage.

The landscaping of the course will be done at this point, with trees, shrubs, and ornamentals placed to enhance the sporting, aesthetic, and environmental qualities of the course. Conservation areas can be enhanced with native grasses for improved habitat and visually interesting rough areas. Nest boxes, birdhouses, and bat houses can be installed in this phase.

Prior to the completion of construction, the maintenance and management of the golf course will start. During the vegetative establishment period, responsible management practices are monitored and maintained and the golf course is prepared for opening. After all disturbed areas are completely stable and vegetated, the temporary erosion controls will be removed. Permanent structures will be cleaned out and enhanced vegetatively to fill the role of permanent course stormwater features.

9.1 Summary of BMPs Relevant to Final Construction Steps at the Gold Rush Site

- BMPs for the course final construction will include installation of irrigation system.

- Landscaping will be done following BMPs for establishing turf while minimizing erosion and runoff. This will require establishment of both permanent and temporary erosion control devices.

10 OPERATIONS & MAINTENANCE

BEST MANAGEMENT PRACTICES

Once the turfgrass has been established, a maintenance program has been implemented, and buildings, roads and parking lots are completed, the golf course will be opened for play. If the design and construction of the course was done properly, the job of the superintendent will be made easier and the operations more efficient.

A complete management plan and pollution prevention plan will be developed before course operations begin at the Gold Rush site. This plan is developed under the concept of *Integrated Course Management* or ICM. The plan will include best management practices (BMP's) to ensure that any adverse impacts to the environment are minimized. The procedure to develop the ICM Plan is as follows:

1. Schedule to periodically perform an 'Environmental Audit' of operations that will include:
    - Stormwater management
    - Irrigation management
    - Integrated pest management
    - Soil fertility management
    - Maintenance area management
2. Prepare record keeping forms and procedures.

11 IRRIGATION MANAGEMENT

Careful water use is not only environmentally and fiscally sound, but also is essential to promote healthy turfgrass that is better able to tolerate environmental stress and resist insect pests, weeds, and disease. Healthy turfgrass subsequently requires less water, fertilizer, and pesticides. More efficient water use reduces the amount of water removed from streams, resulting in less disturbance to aquatic systems. Less water taken from wells reduces impacts on the ground water levels and wells in that locality.

A water conservation scheme depends on several factors: soils, terrain, course layout, grass selection and acreage, irrigation system design and control, and whether or not treated effluent is available. Operational considerations affecting irrigation water management will include irrigation quantity and frequency, fertilization program, pest management, and mowing. Most new golf courses are designed with water conservation in mind.

11.1 Course Layout

Golf course layout has a large impact on water use. Most courses are between 160-200 acres in size. At the Gold Rush project about 100 acres will be irrigated. Narrowing fairways and incorporating warm season native vegetation such as switchgrass, bluestem, and indiangrass in roughs can lower this amount. Therefore, the Gold Rush consultants will prioritize areas for irrigation:

1. Greens
2. Tees
3. Fairways
4. Maintained rough areas

This priority system is similar to the golf of earlier days, where fairways, greens, and tees represented the only high maintenance areas of the course, and the majority of acreage was in a more natural state. This concept saves water and has little or no effect on the playability of the course.

11.2 Turf Selection

Significant water savings are possible with the appropriate selection of locally adapted turfgrasses for greens, fairways, and planted rough. Grass species cultivars can differ significantly in water uptake rate.

Water use is only one factor in turfgrass choice. The best approach is to identify species and cultivars that perform best under the intended use in terms of pest resistance and vigor. Then compare desired species within water use data to make the final selection. This combined approach will result in grasses that require less fertilizer, pesticide, and water. The Golf Course architect and superintendent will make this selection with these guidelines in mind. Some turf characteristics are noted below that may be considered in this process.

Fine leaf fescues:

- Use the least water and suffer the least permanent drought damage
- Low wear tolerance
- Good for some rough and other low wear areas

Perennial ryegrasses:

- Medium – high water requirements
- Moderate drought sensitivity. Can be improved with optimum fertility conditions.
- Low cold tolerance
- Widely used on fairways, tees, and roughs
- High disease susceptibility
- Good wear tolerance

Creeping bentgrass:

- High water use
- Used primarily on greens
- Variable disease tolerance
- Moderate drought tolerance

Kentucky bluegrass:

- High water requirements
- High summer dormancy mechanism

Tall fescue:

- Extremely drought tolerant
- Very high water use rate
- New dwarf varieties maintain acceptable quality with less fertilizer and pesticide

- More saturation tolerant than fine fescues
- Less desirable playing surface

11.3 Fertility and Water Use

Nitrogen and potassium can be applied at rates that provide adequate nutrition while minimizing water use. In general, lower nitrogen applications rates reduce water use. Heavily fertilized plants have greater growth rates, have wider leaves, are often denser, and often have shallower root systems. These factors lead to greater water demand. Potassium can improve Turfgrass resistance to drought injury, and effect on water use is insignificant. Higher potassium rates may be advisable if 'deficit irrigation' (irrigating at *less* than the minimum rate) is practiced.

11.4 Infiltration

Low infiltration rates reduce irrigation efficiency and increase runoff of water and potential pollutants. Turfgrass cultivation and aeration promote higher infiltration rates and a deep, vigorous root zone, which uses soil moisture more effectively.

Traditional hollow-tine core cultivation of greens and tees should occur twice a year to control compaction and reduce thatch. Water injection, solid tine cultivation and spiking are other methods which can be used throughout the summer to maintain good infiltration rates on greens and tees.

12 IRRIGATION SUPPLY

12.1 Water sourcing

If irrigation water is to be taken from natural surface water, a surface or ground water withdrawal permit will be required. Water sources for irrigation supply should be evaluated and prioritized in order to reduce impacts on natural water sources.

A prudent priority of sources might be:

1. Stored stormwater in ponds or detention basins onsite
2. Treated effluent
3. Public or municipal water supplies
4. Existing natural surface waters
5. Private wells

This prioritization results in best use of available low-impact water sources. At present, treated effluent is the proposed source of long term irrigation water at the Gold Rush project. Initially, "raw" water will be used until delivery of treated effluent is operational.

12.2 Irrigation BMP's

The primary goal of irrigation BMPs is to fine tune irrigation practice to maintain peak irrigation system efficiency. Careful use of the irrigation system will result in a better quality turf. Avoid over irrigation in the spring. A continually saturated condition in the springtime root zone prevents the development of a deep, fibrous root system, which means trouble for summer survival. Critical irrigation BMPs include for the Gold Rush site will include:

- Using a soil probe before irrigating to determine existing soil conditions.
- Applying irrigation water as uniformly as possible (variability of soils and turf types will require customized application in some instances).
- Applying water only as fast as the soil can accept it. To avoid puddling and runoff, use short duration cycles.

- Irrigating when there is little wind and avoid mid-day irrigation during peak evaporation periods.

- Utilizing drip irrigation for tree and shrub areas.

A well designed, properly installed, maintained and managed *automatic* irrigation system usually provides the best means of conserving water. Water savings of 40% to 75% have been documented on golf courses that have converted from manual to automatic.

BMP principles for efficient irrigation operation at the Gold Rush site will include:

- The repair of all leaks,

- The checking of nozzle size as it relates to available pressure and resulting coverage,

- Checking for nozzle wear and replacement as needed,

- The use of part-circle sprinklers where applicable,

- Checking pump performance and other pumphouse systems, and

- Frequent testing of sprinkler application rate and evenness.

12.3 Summary of Irrigation BMPs for the Gold Rush Site

The primary goal of irrigation BMPs is to fine tune irrigation practice to maintain peak irrigation system efficiency. The following BMPs will be considered and implemented:

- Careful use of the irrigation system will result in a better quality turf. The BMP will avoid over irrigation in the spring. A continually saturated condition in the springtime root zone prevents the development of a deep, fibrous root system, which means trouble for summer survival. Other critical irrigation BMPs include for the Gold Rush site will include:

    - Using a soil probe before irrigating to determine existing soil conditions

    - Applying irrigation water as uniformly as possible (variability of soils and turf types will require customized application in some instances)

    - Applying water only as fast as the soil can accept it. To avoid puddling and runoff, use short duration cycles

    - Irrigating when there is little wind and avoid mid-day irrigation during peak evaporation periods

    - Utilizing drip irrigation for tree and shrub

- A well designed, properly installed, maintained and managed *automatic* irrigation system will be used. BMP principles for efficient irrigation operation at the Gold Rush site will include:

    - The repair all leaks

    - The checking of nozzle size as it relates to available pressure and resulting coverage

    - Checking for nozzle wear and replacement as needed

    - The use of half-circle sprinklers where applicable

    - Checking pump performance and other pumphouse systems

    - Frequent testing of sprinkler application rate and evenness.

13 CULTURAL TURF MANAGEMENT

Healthy turf is the goal of cultural management practices. Turf that is healthy and vigorous is better able to propagate and resist weeds, insects, and disease. A good cultural management program recognizes that cultivar selection, soil improvement, mowing, irrigation, and fertilization are all interdependent and synergistically produce a result. This section describes general management techniques to prevent or mitigate diseases, weeds, insects, animals, and aquatic pests. At the Gold Rush project the following BMPs are recommended.

13.1 Cultivar Selection

Cultivar selection should be based on the following principles and processes:

- Select turfgrass cultivars adapted to the local climate and growing conditions. Poorly adapted species have higher maintenance requirements, are more stress prone and may require more fertilizer and pesticides. Information on cultivars may be obtained form UC Davis Cooperative Extension, trade journals, and seed companies.

- Conserve native grass species and establish diverse grass communities whenever practical. Native or diverse grass communities are generally more resistant to pest outbreaks. However, these types are less adapted to high traffic, so they should be used out of play areas.

13.2 Soil Improvement

Soil improvement and maintenance at the Gold Rush site should be based on the following BMPs:

- Prevent soil compaction

- Conduct soil testing early in the construction process. Early evaluation allows time to review results and plan amendment strategies. Also, soil acidity and phosphorous adjustments are more effective if lime or phosphate can be worked into the root zone. Sample soil every other year once turfgrass is established.

- In areas of compacted soil, use core cultivation or similar soil aerators. Opening the compacted surface improves infiltration, reduces runoff, improves fertilizer uptake and enhances root zone development.

13.3 Mowing

Common Mowing BMPs are listed below. These may be adjusted or amended based on established turf behavior at the Gold Rush site:

- Raise fairway mowing height and reduce mowing frequency. Slightly higher turf improves infiltration, decreases runoff, improves soil moisture retention, encourages deeper root systems, reduces mowing frequency, and discourages weeds. Ideally, no more than one-third of the grass blade is removed at one mowing.

- Ensure blades are sharp. Mowing with dull or pitted blades tears and sheds the grass leaves. This can slow growth, encourage disease and make for a ragged appearance. Additionally, mowing with sharp blades increases the decomposition rate of the grass clippings.

- 'Cut it and leave it' on fairways. Grass clippings that remain on the surface provide a natural source of organic matter and nutrients. However, clippings should be removed during disease outbreaks to contain the disease. If grass clippings must be removed, they should be spread lightly in the rough or other unmanaged areas away from surface waters, outside of buffer zones.

- Improve drainage in poorly drained areas.

13.4 Summary of BMPs Relevant to Cultural Management at the Gold Rush Site

- The BMPs will include the selection of turf cultivars that are well adapted to site conditions and will allow reasonable water, nutrient and pest practices to be implemented.

- The BMPs will be designed to prevent soil compaction in designated areas where practical.

- BMPs for mowing practices will include maximizing height adjustment and frequency. As with other BMPs, these may be modified as the course matures.

14 FERTILITY MANAGEMENT

Fertilizers are necessary to maintain healthy turfgrass that is under heavy use. The primary necessary turfgrass fertilizer nutrients are nitrogen (N), phosphorus (P), and potassium (K). Excessive applications of N and P can encourage weed growth, turf disease, and cause pollution of both ground and surface waters.

Surface runoff from established, healthy turf does not usually carry harmful amounts of N and P. The potential for nutrient polluted runoff increases in newly seeded areas, on steep slopes, when application is done at improper times, and during rehabilitation of depleted or damaged turfgrass.

The proper objective of a fertilizer management program is to supply plant nutrients at the proper time and in the proper amount to supply sufficient food for the turf with no excess. Recommended BMPs for the Gold Rush project include:

- Develop and document fertilizer programs for each area of the golf course. Nutrient needs vary by cultivar, soil conditions, and use pressure. A fertilizer plan should address the different needs of each area of the course. Application frequency, timing, formulation, and amount should be documented each time.

- Manage fertilizer applications according to weather and soil conditions. Never exceed fertility recommendations.

- Avoid fertilizer applications during dry soil conditions just prior to significant rainfall events. Do not apply high N fertilizers on wet turf. Always avoid heavy applications of soluble nitrogen fertilizers. Instead, use light foliar feedings of soluble N concentrations.

- On coastal plain or similar course textured soils, use lower amounts applied more frequently in order to meet the turf nutrient requirements.

- Slow release temperature sensitive nitrogen fertilizers should be used for applications done late in the season. These fertilizers remain insoluble in cold temperatures, which reduces leaching to ground water. Slow release fertilizers should supply 50% of the nitrogen requirements.

- Maintain a fertilizer free transition zone around all surface waters, including stormwater detention facilities. Transition zone around all surface waters, including stormwater detention facilities. Transition zone grasses that receive no fertilizer act as buffers or filter strips. This zone should be considered the upper area of the riparian buffer.

- Be moderate with fertilizer on newly seeded areas. Grasses lacking a fully developed root system are unable to assimilate high levels of nutrients. Use several light applications in the critical establishment phase.

Periodically the superintendent will conduct a soil-sampling program for each area of the course. The soil test program should include phosphorous, potassium, organic matter, micronutrients, and pH. On intensively managed areas such as greens and tees, plant tissue analysis will be of more value.

14.1 Summary of BMPs Relevant to Fertility Management at the Gold Rush project include:

- Develop and document fertilizer programs for each area of the golf course. Nutrient needs vary by cultivar, soil conditions, and use pressure. A fertilizer plan should address the different needs of each area of the course. Application frequency, timing, formulation, and amount will be documented each time.

- Manage fertilizer applications according to weather and soil conditions. In this way, fertility recommendations will not be exceeded.

- Fertilizer applications will be avoided during dry soil conditions just prior to significant rainfall events. High N fertilizers will not be applied on wet turf. Heavy applications of soluble nitrogen fertilizers will be avoided.

- Slow release temperature sensitive nitrogen fertilizers should be used for applications done late in the season. These fertilizers remain insoluble in cold temperatures which reduces leaching to ground water. Slow release fertilizers should supply 50% of the nitrogen requirements.

- Maintain a fertilizer free transition zone around all surface waters, including stormwater detention facilities. Transition zone around all surface waters, including stormwater detention facilities. Transition zone grasses that receive no fertilizer act as buffers or filter strips. This zone should be considered the upper area of the riparian buffer.

- Use fertilizer on newly seeded areas. Grasses lacking a fully developed root system are unable to assimilate high levels of nutrients. Use several light applications in the critical establishment phase.

- Periodically the superintendent will conduct a soil-sampling program for each area of the course. The soil test program should include phosphorous, potassium, organic matter, micronutrients, and pH. On intensively managed areas such as greens and tees, plant tissue analysis will be of more value.

15 INTEGRATED PEST MANAGEMENT

Integrated Pest Management (IPM) ranks right with irrigation and fertility management in environment priority. The overall goal of golf course IPM is to promote healthy turfgrass that can withstand higher levels of pest pressure without significant damage. IPM prevents economically significant weed, insect, and disease levels through cost effective means and with the least possible hazard to humans, wildlife, non target organisms and water resources. IPM can be challenging because the very nature of desirable golf course conditions (low cutting heights and heavy traffic during the hottest time of year) create significant turf stresses.

The best place to start formulating an IPM plan is with an understanding of turfgrass growth, pest biology, and the factors that encourage pest infestation. The next issue to ascertain is the definition of treatment thresholds for determining when corrective action should be taken and the development of a pest scouting strategy and monitoring program to determine the effectiveness of control methods. Pest management methods and their success will vary by geographic region and even among differing areas within the same golf course.

Appropriate pest control methods can be both cultural and non-cultural in nature. Cultural management offers pest-specific methods for blocking or reducing the extent of a pest problem. Non cultural management employs biological controls or pesticides to control pests posing an economic threat to turfgrass resources. The IPM guidelines recommended for the Gold Rush project are detailed below.

15.1 Problem Identification: Pest Biology

Pests, in the IPM context, include those weeds, insects, diseases, and animals that reduce golf course quality. The correct selection and effective implementation of IPM techniques relies upon a thorough knowledge of pest biology, including pest identification, life cycle, and conditions favoring population growth.

A successful IPM program relies on effective scouting and diagnosis. Scouting is the process of identifying pest types, populations, and field locations. Scouted populations are compared to known population levels which can then be compared with established threshold levels to determine appropriate treatment measures. Walking the course often is a critical facet of the scouting process.

- Base the scouting program on the common pests known locally to affect the turf, trees, and surface waters. Don't go 'looking for zebras in a field of horses.'

- Perform regular, systematic inspections to identify pest problems. Standardized methods for survey patterns, sample numbers and sizes, and turf type descriptions

will permit effective comparisons of recorded information. Initial scouting should entail a detailed hole-by-hole survey, with any problems noted on a map. In case of disease outbreaks, weather conditions should also be recorded.

- Base scouting frequency on pest occurrence. Scouting frequency depends on the type and extent of the pest problem. Regular scouting may be done weekly, but daily checks may be required during outbreaks or periods that favor pest establishment. Pay particular attention to areas that historically experienced pest outbreaks.

- Accurately identify pests. Damage caused by different pest is often similar in appearance. If in doubt, submit samples of the pest, turf, or soil to a specialist for analysis.

- Properly diagnose the stage and severity of the pest program. Treatment decisions rely on accurate diagnoses. Once damage has occurred, it is often appropriate to facilitate turfgrass recovery and prevent recurrence of a particular pest rather than target the pest itself.

- Monitor pest problems to determine effectiveness of treatment regime. Use a standard, replicable method to evaluate IPM management decisions and treatments.

- Keep accurate and complete records. Record scouting observations, weather conditions, management decisions, control methods and strategy effectiveness.

15.2 IPM Treatment Thresholds

IPM treatment thresholds take into account population, damage, and economic thresholds. It may not be economical to treat a pest problem where the damage is minimal and the problem is not expected to intensify to the point of causing economic impacts.

Input and agreement is essential between course owners and operators for successful implementation of treatment thresholds. When determining treatment thresholds, course managers must define:

- Population thresholds for each potential pest.

- Damage thresholds for each area of the golf course, especially greens, tees, fairways, and rough. This is especially important to establish because there are some portions of the course (greens) where practically NO pest damage is acceptable, while others (rough, some fairway) where a moderate level is tolerated.

- Unit costs of standard cultural and non cultural control methods.

15.3 Disease Control

Biological or parasitic turfgrass diseases are a result of bacteria, viruses, fungi, and nematodes. Diseases may be caused by environmental conditions such as excessive moisture, optimum temperatures, or damage from foot and vehicular traffic. Cultural controls should be the first and primary defense against turfgrass disease.

The following cultural practices should be followed to reduce the threat posed by a range of fungal diseases.

- Implement an area-specific scouting program.
- Use improved, disease resistant turfgrass varieties.
- Manage soil fertility, weed control, and soil moisture level to maintain a vigorous turf stand and increase disease resistance.
- Avoid early evening irrigation, which extends leaf surface wetness. Early morning irrigation removes dew, helping turfgrass to dry faster and reducing the potential for disease outbreaks.
- Facilitate proper turf surface aeration. Turf aeration practices include spiking and coring. Aeration increases oxygen in the root zone, lowering moisture and reducing the conditions favorable for some diseases.
- Improve sunlight penetration and air movement across turf surfaces, especially tees and greens.

15.4 Weed Control

Weed control is based on recognizing the biological and morphological differences between weeds and turfgrass and focusing control measures at the more susceptible phase of the weed life cycle. Below are recommended cultural weed control practices:

- Always use the highest quality seed stock available.
- Prevent the spread of weeds by equipment.
- Schedule control operations before weeds begin to produce seed. Such control measures vary with the type of weed. For example, timely mowing of certain weeds will help prevent seed production and can starve plant roots. This is ineffective for low growing, prostrate weeds that flower below the cutting height.

15.5 Insect Control

Insect pests can occasionally pose a significant risk to turfgrasses in California. Insecticides should be used as little as possible, since they pose a greater risk to fish and wildlife than most herbicides and fungicides. There are a number of cultural insect management practices that can reduce the need for insecticides:

- Select native or insect resistant trees, shrubs, and ornamentals.

- Avoid the use of insecticides on non-turf areas. Use instead non chemical alternatives such as insecticidal soaps. *Bacillus thuringiensis*, which is a bacterium that infects the larvae of some moth species; and diatomaceous earth are good alternatives.

- Avoid insecticide based mosquito control. Maintain a level of flow in water bodies whenever possible to reduce mosquito habitat. Create optimum conditions for mosquito predators.

16 PESTICIDES ON THE GOLF COURSE

Pesticides will usually reduce pest damage to turfgrasses but can also have serious environmental effects. To protect water resources, careful consideration must be given to pesticide selection and application. Integrated pest management programs should always incorporate the following principles which will be employed at the Gold Rush site:

- Minimize chemical use through cultural control measures, if possible.
- Select the least toxic, least persistent, least mobile and most pest specific California registered pesticide.
- Apply the pesticide at the pest's most vulnerable life cycle stage.
- Apply the pesticide at the minimum required rates to the minimum area necessary.
- Use the pesticide in strict accordance with the product label directions and guidelines.
- Avoid continually using pesticides of the same chemistry or active ingredient mode of action to avoid buildup of pest resistance.
- Be aware of the 36-48 hour weather forecast.
- Adopt a notification program for neighbors when pesticides are to be applied near course boundaries.

16.1 Pesticide Selection

There will always be more than one type of pesticide that is effective and registered for a specific use. Pesticide selection must consider environmental factors, as well as the pesticide toxicity, persistence, tendency to accumulate in living tissues, solubility, and soil adsorptive characteristics. These factors all play an important role in the movement of pesticide surface runoff and leaching to ground water.

Environmental criteria for profiling and selecting pesticides are listed below.

- Profile the important physical environmental factors affecting chemical mobility for each area of the golf course. Several factors are: soil organic matter, clay content, texture, permeability, subsoil texture, and drainage, which can affect pesticide movement and should be factored in chemical management plans. For example, the higher the percentage of organic matter and clay content in the soil, greater is the soil ability to adsorb chemicals and decrease leaching. In contrast, sites featuring coarse

textured soils offer high permeability, which makes it easier for mobile chemicals to leach down to the water table. Golf courses built over karst, fluvial or alluvial sandy-gravelly complexes also run higher risk of leaching and runoff.

- Eliminate pesticides which are persistent and can bioaccumulate. Such substances, which may include pesticides and pesticide metabolites, pose the greatest environmental risk. Pesticides with a soil persistence of greater than 21 days, a soil absorption (Loc) value of less than 30 mg/L should be used with extreme caution. These general guidelines are especially important in areas with coarse textured soils, soils with low organic matter, and steep slopes near surface waters.

- Avoid applying pesticides in late fall and winter in flood prone or ponded areas. Some waterfowl species, both resident and migratory, are attracted to flooded fields. They can be poisoned through ingestion of persistent pesticides, particularly granular formulations.

16.2 Pesticide Application

It is the applicator's responsibility to take appropriate precautions to protect non-target organisms from exposure. All pesticide applicators and supervisors must be trained and be California licensed. Pesticide application BMPs include:

- Read product labels carefully and completely. Apply chemicals only according to the manufacturer's recommended usage and only for registered uses. Pay particularly close attention to the delivery rate and spray volume per unit area.

- Minimize drift. There are a number of techniques that can be employed:

  – Closely monitor weather conditions and forecasts to comply with application guidelines. Avoid application when wind speeds exceed 5 miles per hour or when winds are blowing toward adjacent non target sensitive areas. Avoid conditions of temperature inversions – they can lead to vapor cloud formation.

  – Use low pressures and large droplet nozzles if practical. Large droplet nozzles *can* adversely affect weed control.

  – Consider use of drift inhibitor or retardant additives.

  – Mix a spray pattern indicator with pesticide when spraying near a pesticide free buffer area.

  – Use wind skirts, guards, and shrouds on all sprayers.

- Do not fill pesticide sprayers near water courses and drains.

- Do not leave sprayers unattended while filling.

- Maintain nozzles, hoses, tanks, pumps and all other application-related equipment.

16.3 Pesticide-Free Buffer Zones

Use of pesticide free zones reduces the chance of pesticide drift, runoff or leaching into sensitive areas. Surface waters to be protected by pesticide free zones include all water courses (including stormwater ditches), ponds, lakes, and wetlands.

It is common to maintain a minimum 25 foot pesticide-free buffer zone adjacent to watercourses or water bodies. No pesticide or application equipment may enter the zone.

16.4 Aquatic Pest Control

Golf course developments use ponds and wetlands as part of landscape design, stormwater management, and for irrigation water. Excessive growth of algae and weeds can reduce dissolved oxygen levels, produce noxious smells and discolor the water as the vegetation decays. Some simple practices at the Gold Rush site can be used to reduce this hazard:

- Aerate ponds. Fountains or compressors with underwater bubbling lines will maintain dissolved oxygen to levels that sustain fish and macroinvertebrates. Algae will also be reduced. Small ponds may use a solar-powered unit.

- Use mechanical methods for removing vegetation and decayed debris.

- Utilize aquatic bio controls with caution. Introducing grass carp for weed control, or snails, weevils, or midges can have implications for non target organisms.

16.5 Summary of BMPs Regarding Pesticide Use

Integrated pest management programs should always incorporate the following principles which will be employed at the Gold Rush site:

- Select the least toxic, least persistent, least mobile and most pest specific California registered pesticide.

- Apply the pesticide at the pest's most vulnerable life cycle stage.

- Apply the pesticide at the minimum required rates to the minimum area necessary.
- Use the pesticide in strict accordance with the product label directions and guidelines.
- Avoid continually using pesticides of the same chemistry or active ingredient mode of action to avoid buildup of pest resistance.
- Be aware of the 36-48 hour weather forecast.
- Adopt a notification program for neighbors when pesticides are to be applied near course boundaries.

17 NEW CONSTRUCTION

17.1 Clearing Land for Construction

Clearing land involves the removal of vegetation and existing structures to prepare a site for construction. Clearing land can impact the environment by:

- Reducing the structural safety of land (e.g., making it more susceptible to landslides or floods).
- Impacting aquatic resources (particularly wetlands) and endangered species.
- Increasing soil erosion and sedimentation caused by the removal of vegetation.
- Increasing the flow to storm sewer systems leading to increased potential for downstream flooding and increased stream bank erosion in receiving waters.

Additional impacts of construction include dust/odors from construction traffic, air emissions, noise, and vibration from construction equipment.

New construction may directly affect wetlands through the placement of fill for grading purposes.

> Sediment from construction sites may also affect the hydrologic capacity of wetlands. Wetland losses may increase downstream flooding and may impact a wide variety of aquatic and upland species. If impacting aquatic areas, such as wetlands, and endangered species habitat (see below), local governments must obtain a special permit before beginning a construction project. Any dredging and general construction in , over, and under navigable waters of the United States are regulated by the U.S. Army Corps of Engineers (Corps) under Section 10 of the Rivers and Harbors Act. The Corps also regulates the discharge of dredged and fill material into waters of the United States, which include wetlands. These wetland activities are regulated under Section 404 of the CWA and may require a Section 404 permit. In addition, controlling construction site discharges is regulated under EPA's National Pollutant Discharge Elimination System (NPDES) permitting program, and local erosion and sediment control programs.

Endangered species are plants and animals that, without special protection and management, are in danger of becoming extinct. Threatened species are likely to become endangered in the foreseeable future.

Protection of federally-listed threatened and endangered species of plants, animals, and the habitats upon which they depend is provided by the ESA. Local government responsibilities under the ESA depend upon whether or not proposed activities occur with federal government involvement. Federal government involvement is triggered when a project seeks to cross public lands, receive public funds, or requires a federal permit (e.g., Section 404 wetland permit).

Any activities by local governments that involve new construction may be regulated under the NEPA (if they involve federal funds) or other state laws that require the preparation of an environmental impact statement. Construction impacts on receiving waters may be regulated under the NPDES storm water section of the CWA, and may require the local government to obtain a permit and implement certain controls. Air and noise impacts may be regulated under the CAA and state and local ordinances.

17.2 Construction Waste Disposal

Most of the waste generated through construction activities is non-hazardous solid waste. Typical wastes generated at construction sites may include concrete, steel, wood, rubber, asphalt, soil, and organic matter, such as stumps.

The disposal of these wastes may be regulated under a variety of federal, state, and local laws. If generated, hazardous construction wastes are regulated under the federal RCRA hazardous waste regulations. Many states and local governments have regulations regarding the disposal of non-hazardous construction and demolition debris at special construction waste landfills. Many states allow debris such as uncontaminated concrete and asphalt to be used as fill material.

18 MAINTENANCE AND RENOVATION

Maintenance and renovation of roads, bridges or tunnels may include street sweeping, maintenance of storm sewers, snow removal, and lead-based paint removal and disposal. Street sweeping involves using mechanical sweepers to remove dirt, grit, and solids from road surfaces. Snow removal includes plowing streets and sanding and salting roads. Lead-based paint removal and disposal occurs due to bridge and tunnel maintenance. Maintenance and renovation activities may impact the environment by removing materials that can enter storm sewers (sweeping), adding materials that end up in storm sewers and are discharged to water ways (salting, sanding, sandblasting), or emitting contaminated dust to the air (paint removal). Aspects of these activities may be regulated under the CWA, TSCA, RCRA, local water protection ordinances, and local solid waste disposal requirements.

18.1 Street Sweeping

Local governments may be required to conduct street sweeping and related practices as conditions of their NPDES storm water or combined sewer overflow (CSO) permit. Street sweeping is conducted to reduce the concentration of pollutants in storm water runoff and to improve street appearance. Considered a best management practice (BMP) and an integral part of a storm water pollution control plan, street sweeping also ensures the continued structural effectiveness of storm sewers.

18.2 Maintenance of Storm Sewers

Local governments may be required to maintain storm sewers as part of their NPDES storm water or CSO permit. Maintenance of storm sewers may include activities such as catch basin cleaning, litter removal from storm channels, and maintenance of storm water detention facilities. Catch basin cleaning and litter removal from channels protect against street flooding, and remove potential pollutants from storm water. Publicly owned storm water detention facilities and other pollutant removal structures, such as sand filters and oil and grit separators, also require frequent maintenance. Disposal of materials generated during cleaning may be regulated under local solid waste disposal requirements.