# ENVIRONMENTAL GUIDELINES

# FOR THE

# DESIGN AND MAINTENANCE

# OF GOLF COURSES

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## ABSTRACT

Studies conducted to determine the recreational needs of Baltimore County, Maryland indicate that there is presently a severe shortage of golf course facilities. It is anticipated that future demand will be even greater. The reality of this demand has been evidenced by the number of plans for private golf courses submitted for County review within the last two years.

In an effort to minimize the impacts of these golf courses on the County's natural resources, the Baltimore County Department of Environmental Protection and Resource Management developed Environmental Guidelines for the Design and Maintenance of Golf Courses. The guidelines outlined in this paper include: 1) requirements for conducting an environmental assessment prior to site design; 2) standards for the maintenance of undisturbed vegetated buffers adjacent to streams, wetlands, and other water bodies; 3) design criteria for the layout of the golf course relative to siting of buildings, path crossings of watercourses and wetlands; 4) design criteria for ponds; 5) strategies for controlling the quality of stormwater runoff; 6) requirements for the protection of forests and significant habitat areas; 7) requirements for evaluating the impacts of irrigation wells on in-stream flows, and minimum standards for the maintenance of in-stream flows; 8) requirements for developing and implementing an Integrated Pest Management Program; 9) requirements for developing and implementing a water quality monitoring program; 10) general requirements for conducting assessments to determine impacts on ground water quantity and quality; and 11) specific design standards for the protection of ground water quality.

These guidelines have been applied successfully to a number of private golf courses and are currently being used to assist in site selection for future public golf courses.


Addendum 11/15/90

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## SECTION I. STREAM, WETLAND, AND HABITAT PROTECTION

### I. ENVIRONMENTAL CONSTRAINTS ANALYSIS

#### A. Existing Conditions Survey

The applicant will conduct a survey to determine the existing environmental conditions on the site. The applicant will prepare and submit to the Department of Environmental Protection and Resource Management (DEPRM) and report with accompanying plans which provides the following information:

1. Field located streams, ponds, or other water bodies;

2. Name of watershed and subwatershed, Stream Use Class designation;

3. Field located wetlands including documentation of vegetation, soils, and hydrology;

4. Wetlands classifications (Cowardin);

5. Calculated 100-year floodplain;

6. Topography with slopes differentiated as <10%, 11-19%, and >20%;

7. Existing land cover (e.g., forest, meadow, old field, etc.);

8. Location of significant plant and/or animal habitat including: documentation of species, date of last known siting, status, and source of documentation.

#### B. Application of Regulations and Policies

After verification of the existing environmental conditions by DEPRM, the applicant will identify on the plan those areas of the site that would be restricted from development by: 1) application of the forest buffer standards outlined in the Executive Order, June 4, 1989, Regulations for the Protection of Streams, Wetlands, and floodplains, 2) denoting those areas of significant habitat determined to exist on site that will be preserved, and 3) denoting those existing forest areas that will be preserved to meet the forest clearing limits outlined in these guidelines.

## II. DESIGN STANDARDS

### A. Preliminary Plan

After the applicant has determined those areas restricted from development, a plan should be prepared for submission to DEPRM that shows the proposed lay-out of the golf course. This plan should include the following:

1. Tees, greens, fairways, and practice range;

2. Building (e.g., clubhouse, maintenance facilities, etc.);

3. Roads and parking lots;

4. Conceptual design for the management of stormwater runoff and water quality including locations and methods and documentation that these locations and methods are practical; and

5. Location of irrigation wells and/or ponds.

The objective is to design the golf course so that there are no encroachments on the areas restricted from development and to minimize the impact of the overall site development on the natural resources of the area.

### B. Variances to Forest Buffer Standards

If any of the above facilities would require encroachment on forest buffer, streams, wetlands or floodplains, a variance of the standards must be granted by DEPRM. Any variance must meet the following conditions:

1. Fairways Crossings

   a) Fairways should be sited to reduce the number of crossings. Crossings should be limited to a maximum of two (2) for each 1,000 feet of stream length.

   b) Fairways should be sited to eliminate or minimize the need to clear forest on steep or erodible slopes (Figure 1).

c) Fairways should be cross perpendicular to the stream, wetland, etc. (Figure 2). The objective is to minimize the clearing of forest canopy over the stream and limit the conversation of forested wetlands to shrub-scrub or emergent wetlands.

d) Fairways will not require filling or grading in buffers, wetlands, or floodplains.

e) In cases where lack of topographic relief requires clear cutting of trees, this may be permitted; however, that portion of the fairway in the buffer, wetlands, or floodplains must be maintained as an unplayable rough (Figure 3). The vegetation will be maintained as shrub-scrub or herbaceous with a concentration of shrubs and small trees along the stream banks to provide shading and stream bank stability.

f) Cart paths will be timber, on timber pilings, (no wider than 6 to 8 feet in width) where they cross wetlands. Cart paths will not be located along steep or erodible slopes. Minimal clearing will be allowed, the design should weave around trees (Figure 4).

2. Buildings and parking lots will not be located in stream buffers, wetlands or floodplains.

3. Storm water and water quality management facilities will not be located in stream buffers, wetlands or floodplains.

C. Ponds

1. Ponds constructed for irrigation water supply or as hazards will not be located in streams or wetlands on Class III trout waters. If ponds are proposed in streams or wetlands of Class I or IV waters, the following impacts must be addressed:

(1) Changes in organic materials transport;

(2) Invertebrate drift;

(3) Fish passage; and

(4) Loss of wetland function.

2. Ponds constructed in upland areas of Class III watersheds must be designed to avoid thermal impacts. This may be addressed by a pond designed to store up to and including a two-year storm with no discharge.

D. Forest Cover and Significant Habitats

1. The applicant should determine the percentage of the total site acreage that is forest cover. The design of the golf course should limit clearing of forest to 25% of the total forest acreage. If the design requires that more than 25% of the existing forest be cleared, an afforestation program must be implemented to replace any acreage over the 25% clearing limit. Afforestation in other parts of the watershed may be accepted to meet the percent forest cover requirements. A conceptual plan for how this requirement will be met is a condition of golf course approval.

2. Where significant plant and/or animal habitat are determined to exist on site, the applicant will design the golf course to preserve these areas.

E. Stormwater Management and Water Quality Management

1. The applicant will prepare concept plans for managing of stormwater runoff. Major consideration will be given to the control of stream bank erosion and control of pollutants (Nutrients and pesticides from fairways, tees and greens; and nutrients, metals and organic materials from roads and parking lots).

2. Emphasis should be placed on the use of a combination of methods, such as infiltration, grassed swales, shallow marsh, vegetated filter strips and forest buffers to provide water quality management. (Figures 5,6 and 7.)

3. The current criteria for water quality is control of the first -half inch of runoff from impervious areas. Management of a two-year storm is required to control for streambank erosion.
4.

F. Stream Baseline Depletion

1. Where irrigation wells are proposed, a stream depletion analysis may be required.

2. In the event that a depletion analysis is required, an assessment of the impacts of stream base flow reduction on in stream habitat will also be required. There are a number of methods used to determine the effects of stream flow reductions on in stream habitat (i.e., Montana Method, In stream Flow Incremental Methodology, etc.).

3. The current criteria is maintenance of a base flow that is $\geq$50% of the Mean Annual Flow (MAF).

## III. SURFACE WATER MONITORING PROGRAM

A. The applicant will be required to conduct surface water monitoring for one (1) year prior release of grading permits and for three (3) years after the start-up of golf course operations.

B. This monitoring program will be developed in coordination with DEPRM and will include monitoring of: water quality, stream morphology, benthic macro-invertebrates and fisheries (Appendix A).

## IV. INTEGRATED PEST MANAGEMENT PROGRAM (IPM)

The golf course applicant will develop in coordination with DEPRM an IPM program. Emphasis will be given to: 1) selection of drought and disease resistant grass species for fairways, tees and greens; 2) the use of biological controls instead of chemicals; 3) where pesticides are used, selection of those chemicals that are less toxic, less mobile and have a shorter half-life; 4) strict control over those pesticides in terms of location of application; and 5) identification of areas on a site that are particularly susceptible to ground water contamination.

## SECTION 2. GROUND WATER PROTECTION

I. GENERAL REQUIREMENTS

A. Ground Water Quantity Issues

1. Aquifer Testing: A pump test should be established that ensures a sufficient water supply is available, and so that necessary values for transmissivity and storativity can be determined. The test should be coordinated through the Maryland Department of Natural Resources, Water Resources Administration. A minimum of two observation wells around the pumping well are required for drawdown measurements. Flow field characteristics for both pre- and post-golf course conditions should be evaluated. Note that pump tests must be conducted on all proposed wells.

2. Water Balanced Assessment: A water balance assessment should be conducted. The assessment should evaluate all gains and losses to the ground water system. Surface runoff estimations should factor in soils, slope, vegetative cover and impervious surface. All plans for irrigation needs and domestic uses (club house, homesites, etc.) must be included.

3. Impact Analysis for Adjacent Well Supplies: The potential impact golf course ground water withdrawals will have on adjacent ground water supplies must be evaluated.

4. Stream Depletion Analysis: The potential impact of irrigation withdrawals on surface water base flows must be evaluated.

B. Ground Water Quality Issues

1. Permeability Analyses: In situ permeabilities should be determined. Since nutrient and pesticide applications will likely be heaviest on greens and tees, testing should focus on those areas initially. In selecting depth and internal sampling, post-construction conditions should be considered.

2. Total Organic Carbon: Total organic carbon (TOC) is a significant factor with regard to attentuation of some pesticide compounds. TOC content should be evaluated in conjunction with the permeability determination.

3. Baseline Water Quality: Baseline water quality should be evaluated to determine the impacts of the golf course on the ground water resource of the area. The number and location of sampling points is site specific; however, sample points should be representative of prior land use. On-site test wells should be sampled and analyzed quarterly for a minimum one year period to establish background water quality. Sample parameters should include inorganic chemistry, major ions, volatile priority pollutants, and pesticides. The number and type of pesticide parameter is also site specific and depends on prior land use.

4. Lakes and Ponds: Since lakes and ponds can function as open conduits to ground water, mitigative measures geared at preventing ground water contamination must be established. Mitigative measures include pond berming or synthetic liners.

5. Integrated Pest Management (IPM): An IPM plan is required as part of the standard operating procedure for the golf course operation.

6. Operational Ground Water Monitoring: Operational ground water monitoring is required to ensure the efficiency of the IPM plan and to permit sufficient remedial response time in the event ground water contamination occurs. Sampling locations may include monitoring wells and/or lysimeters. Parameters are the same as those used for baseline water quality definition. The only difference relates to pesticide monitoring. Pesticide parameters includes only those that have actually been used on the golf course. The number, location, and type of ground water sample points is site dependent and will be influenced by the DRASTIC index.

## II. DESIGN STANDARDS

A. Greens and tees should be located in areas where the maximum high water table or bedrock is greater than four feet below the surface. Field determination of high bedrock and/or ground water should be conducted with respect to the final grading of those location

B. Underdrain systems for greens and tees must also maintain four feet of soil separation between the subsurface leaching system and high bedrock and/or ground water. Field verification is required.

# APPENDIX I

# STREAM MONITORING PROGRAM

**BALTIMORE COUNTY, MARYLAND**

**STREAM MONITORING PROGRAM**

I. GENERAL

A. The sampling stations will be selected by the consultant in coordination with DEPRM, and should be shown on a plan for submission to the Department.

B. The baseline monitoring phase will be for one year prior to grading permit release (provides samples representative of each season).

C. The follow-up monitoring phase will include a period of three (3) years from the start up of golf course operations.

D. Sampling for both the baseline and follow-up phases must be conducted for the parameters outlined below and according to the sampling frequencies noted.

E. A minimum of three (3) storm events (storm event approximately 2x base flow) must be sampled annually for all of the water quality parameters outlined below.

II. WATER QUALITY

A. Monthly Samples

The following parameters will be sampled on a monthly basis throughout the baseline and follow-up phases at all sampling stations: pH (S.U.); DO (mg/l); conductivity (umhos/cm); flow (cu ft/sec); and velocity (ft/sec).

B. Quarterly Samples

The following parameters will be sampled on a quarterly basis throughout the baseline and follow-up phase at all sampling stations: total phosphorus (mg/l); total nitrogen (mg/l); alkalinity (mg CaC03/1); total suspended solids (mg/l); turbidity (N.T.U.'s); and pesticides (see note below).

C. Temperature

Continuous recording thermographs will monitor in-stream temperature from July to September during the baseline and follow-up monitoring at all sampling stations. Instantaneous in-stream temperatures will be recorded for each station during each sample collection period.

D. Pesticides

Those pesticides to be monitored will be determined by DEPRM in cooperation with the golf course superintendent, and the developers' environmental consultants. Consideration will be given to the characteristics of the pesticides used (toxicity, mobility, degradation rates, application rates, application location, etc.). No baseline monitoring is required for pesticides; however, the developer may want to consider conducting a scan to determine current levels. Pesticides will be sampled on a quarterly basis at all sampling stations during the follow-up phases.

E. Stormwater Samples

To the extend possible, stormwater samples collected during the follow-up phase should coordinate with golf course operations. It is desirable to select storm events that occur within a week of fertilizer and/or pesticide applications.

III. BENTHIC MACROINVERTEBRATES

A. The assessment will include the following: taxonomic composition (at least to genus); abundance (mean density); taxa richness; a diversity index (e.g., Shannon-Weaver); a biotic index; and a functional group analysis.

B. Sampling will be conducted in the Fall (late October/early November) and in the Spring (late February) at each of the sampling stations during baseline and follow-up phases.

IV. FISHERIES

A. Sampling will be conducted for a minimum distance of 100 meters at each station (or the length necessary to include all habitat types: riffle, run, pool). Multiple sampling runs will be made through

stations with the first and second runs collecting trout and subsequent runs collecting forage fish.

B. This assessment will include data on:

Non-trout species:

- Relative abundance.

Trout species:

- Young-of-year length measured.
- Adults length and weight measured with a condition factor calculated.

An index of biotic integrity for the community will be determined.

C. Sampling will be conducted in September at each of the stations during the baseline and follow-up phases.

## V. STREAM MORPHOLOGY

A. A detailed assessment will provide data on substrate composition; substrate embeddedness; bankful width and depth; wetted width and depth; stream bank conditions, pool class and shading.

B. Sampling will be conducted annually at each of the stations during the baseline and follow-up phases.

## VI. REPORTING REQUIREMENTS

All data will be compiled in a report which will be submitted to Baltimore County DEPRM and Maryland Department of Natural Resources at the end of each monitoring period (annually). All field notes and lab records should be available upon request.

# APPENDIX II

# GROUND WATER MONITORING PROTOCOL

## GROUND WATER MONITORING PROTOCOL

Ground water quality and quantity monitoring is included in the protection strategy. The objective of the quality monitoring effort is to provide an early warning system for the detection of pesticides into the ground water system. The objective of the quantity effort is to ensure that the theoretical ground water drawdown calculations are accurate and that no adverse impacts with respect to quantity will occur. The monitoring program is designed to protect the aquifer system that exists beneath the golf course site and any adjacent domestic well supplies. Data generated is necessary for the stream depletion analysis and is also essential to the effective operation of the integrated pest management (IPM) plan.

The monitoring plan should provide for perimeter and interior golf course monitoring. Interior monitoring wells sites are selected on t he basis of soil permeability and organic carbon content analyses determined from on-site testing. Monitoring wells and lysimeters are chosen for those locations with the highest permeability, while at the same time showing the least amount of organic carbon. Perimeter monitoring wells are based upon ground water drainage and flow field characteristics.

Although data generated from all of the quality monitoring wells is of value to the golf course superintendent in the operation of the IPM plan, the interior monitoring wells are of critical importance. The interior monitoring wells are to be developed in conjunction with lysimeters that will aid the golf course superintendent in the selection of the type and amounts of pesticides to be used, both during the “grow-in” period and for normal golf course operations.

The details to the ground water quality and quantity monitoring program presented here are treated independently. The discussion begins with the ground water quality monitoring program.

### GROUND WATER QUALITY MONITORING

Ground water quality monitoring can be divided into two phases: (1) baseline water quality definition, and (2) operational ground water monitoring.

#### Baseline Ground Water Quality

Background water quality samples should be collected quarterly for a full year in order to develop adequate comparison standards. It is essential that

complete background water quality parameters be established. Incomplete baseline water quality definition provides poor comparison standards and ultimately has the potential to create future problems for the community residents, as well as golf course developers and owners.

All wells should be sampled quarterly for a period of one year. Sample parameters should include general inorganic chemistry (such as: nitrate-N, alkalinity, hardness, pH, temperature, and conductivity), volatile priority pollutants, and pesticides. The exact list of pesticides selected for screening should be representative of prior land use. Agricultural Extension Services are good references for prior pesticide usage.

Operational Ground Water Quality

Operational ground water monitoring will begin after the establishment of background water quality. Operational monitoring will consist of perimeter and interior well sampling protocol exists for each.

Perimeter Wells:

Perimeter wells will not be sampled during the first year of the grow-in period, tri-annually during the second year, and once yearly thereafter. The annual monitoring should occur after fall recharge has been verified by a noted increase in ground water elevations in associated monitoring wells.

Interior Wells:

Interior wells are to be sampled on a tri-annual basis. Monitoring parameters are to include general inorganic chemistry, as well as all pesticides used on the course the previous year. Some pesticides may be excluded from the analysis if analytic techniques for any particular pesticide(s) is not well developed. Volatile organic compounds may be included in the sampling protocol if significant amounts of solvents are used as chemical intermediates in the production of any of the pesticides used. The determination will be made after the selection of golf course pesticides has been made and their chemical compositions reviewed.

A copy of all water quality monitoring results will be submitted to this office for review as soon as they are available.

GROUND WATER QUALITY MONITORING

To provide an additional degree of protection to adjacent well supplies, water quantity wells should be identified and maximum drawdown levels established for each.

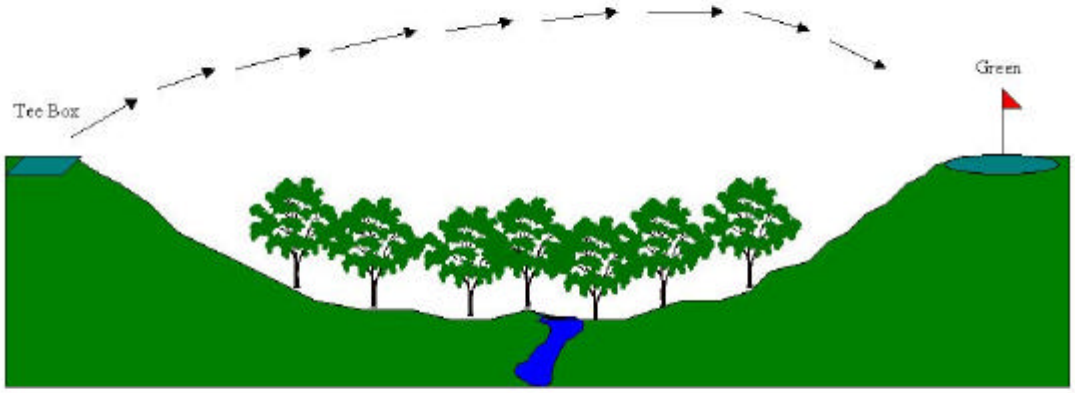
Maximum drawdown values should be selected by use of the Theis equation and the selection of a drawdown figure over and above the predicted value to account for natural ground water elevation fluctuations. If drawdowns are significantly higher than predicted values, the impact to adjacent supplies should be re-evaluated.

Natural water table fluctuations should be determined prior to golf course development and initiation of the irrigation process. Ground water elevations should be recorded for pre-determined monitoring wells.

# APPENDIX III

# FIGURES

**Fig. 1 STREAM AND WETLAND CROSSINGS**

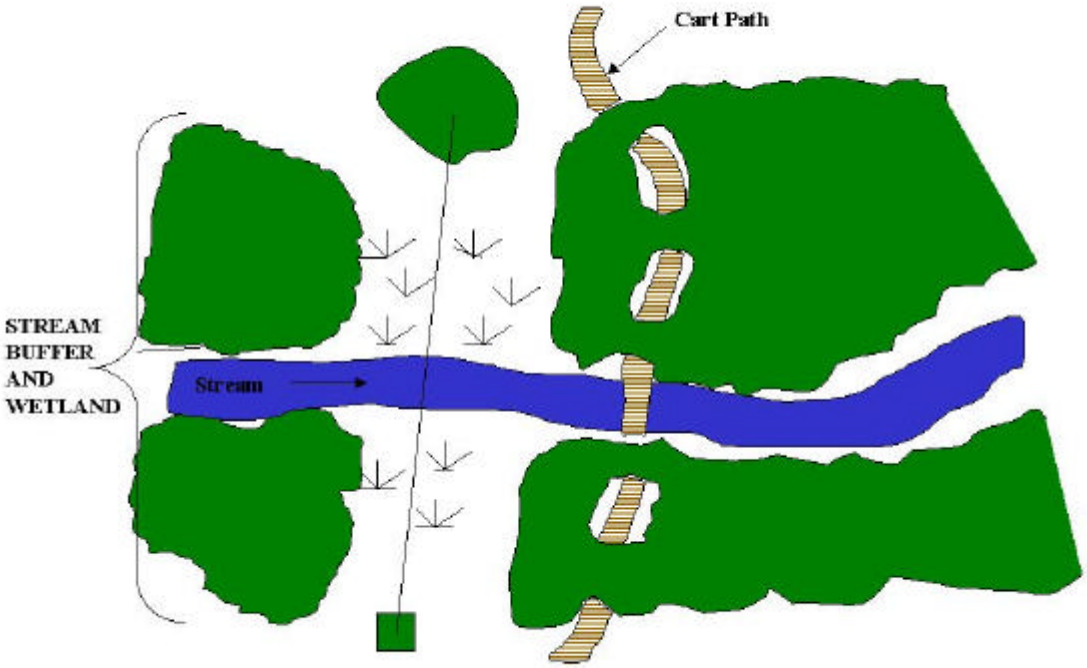



Appropriate siting of Tees and Greens will allow for crossings with little or no disturbance of the forest buffer.

Fig. 2 STREAM & WETLAND CROSSINGS

**Crossings should be perpendicular to the stream and wetlands, thereby minimizing the removal of the tree canopy along the stream and conversion of forested wetlands to shrub-scrub or emergent wetlands.**

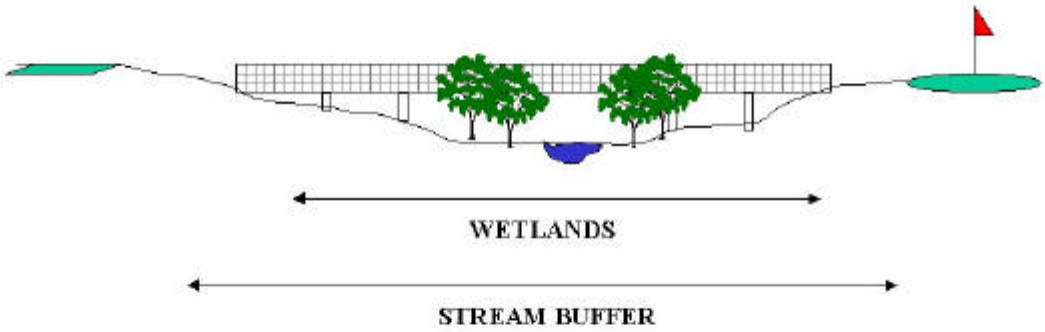
Fig. 3 STREAM AND WETLAND CROSSINGS




1. Stream buffer and wetlands remain undisturbed except for the minimum needed for the crossing.

2. Stream buffer and wetlands in crossing are maintained as unplayable rough.

Fig. 4 STREAM AND WETLAND CROSSINGS




1. Wetlands crossing should be accomplished with raised cart paths.
2. No Filling or grading.
3. Vegetation is maintained in early successional stages.

Fig. 5 WATER QUALITY MANAGEMENT

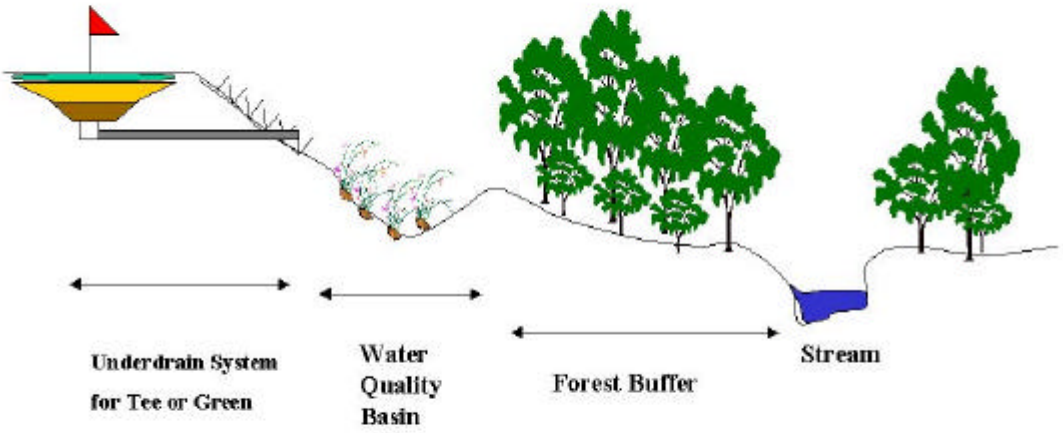


Fig. 6 WATER QUALITY MANAGEMENT

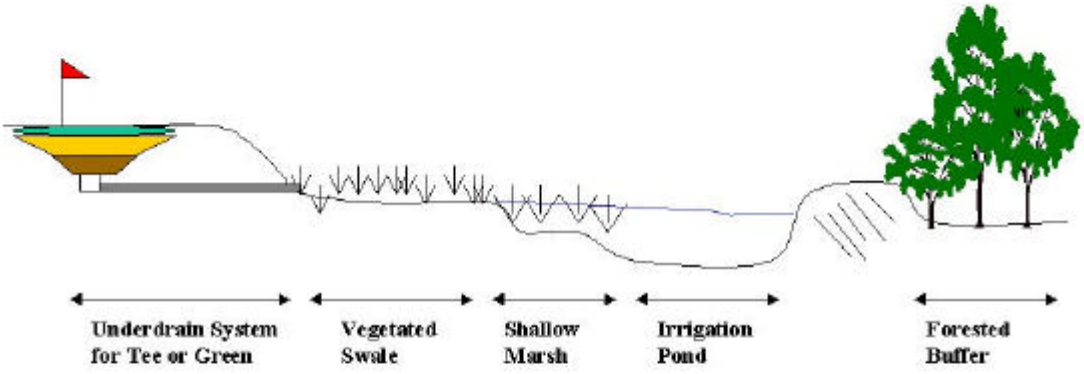
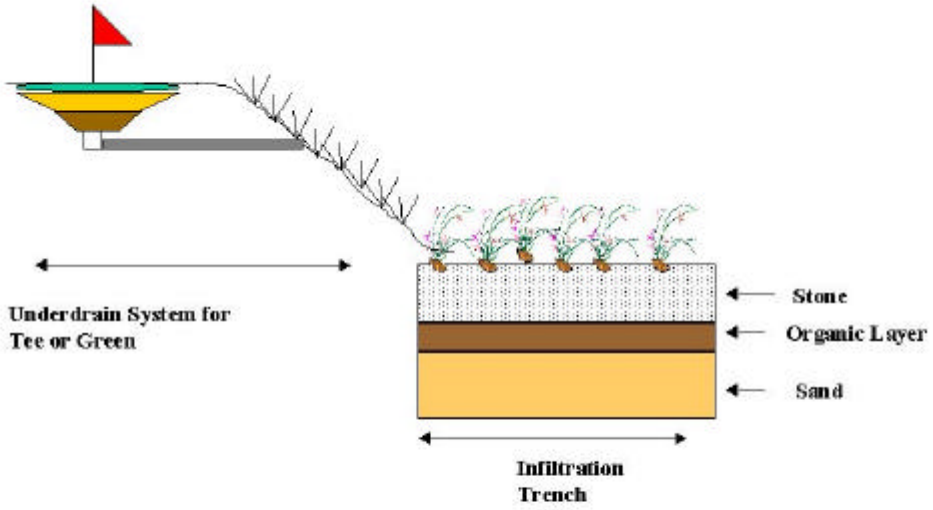



Fig. 7 WATER QUALITY MANAGEMENT