

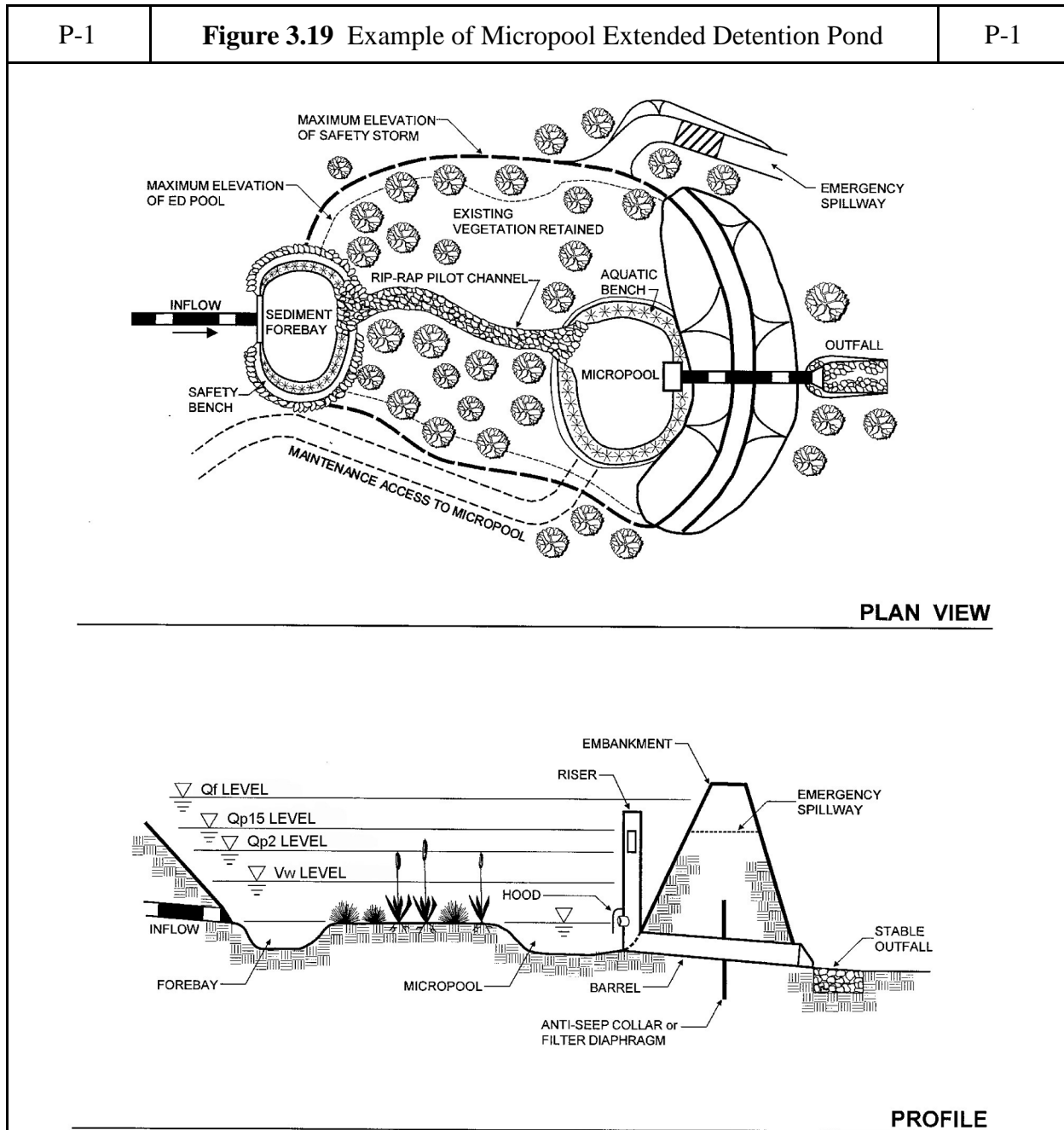
### Section 3.4 Storm Water Ponds

**Definition:** Practices that have a combination of a permanent pool, extended detention or shallow marsh that provide storage equivalent to the entire  $V_w$ . Design variants include:

- P-1 micropool extended detention pond
- P-2 wet pond
- P-3 wet extended detention pond
- P-4 pocket pond

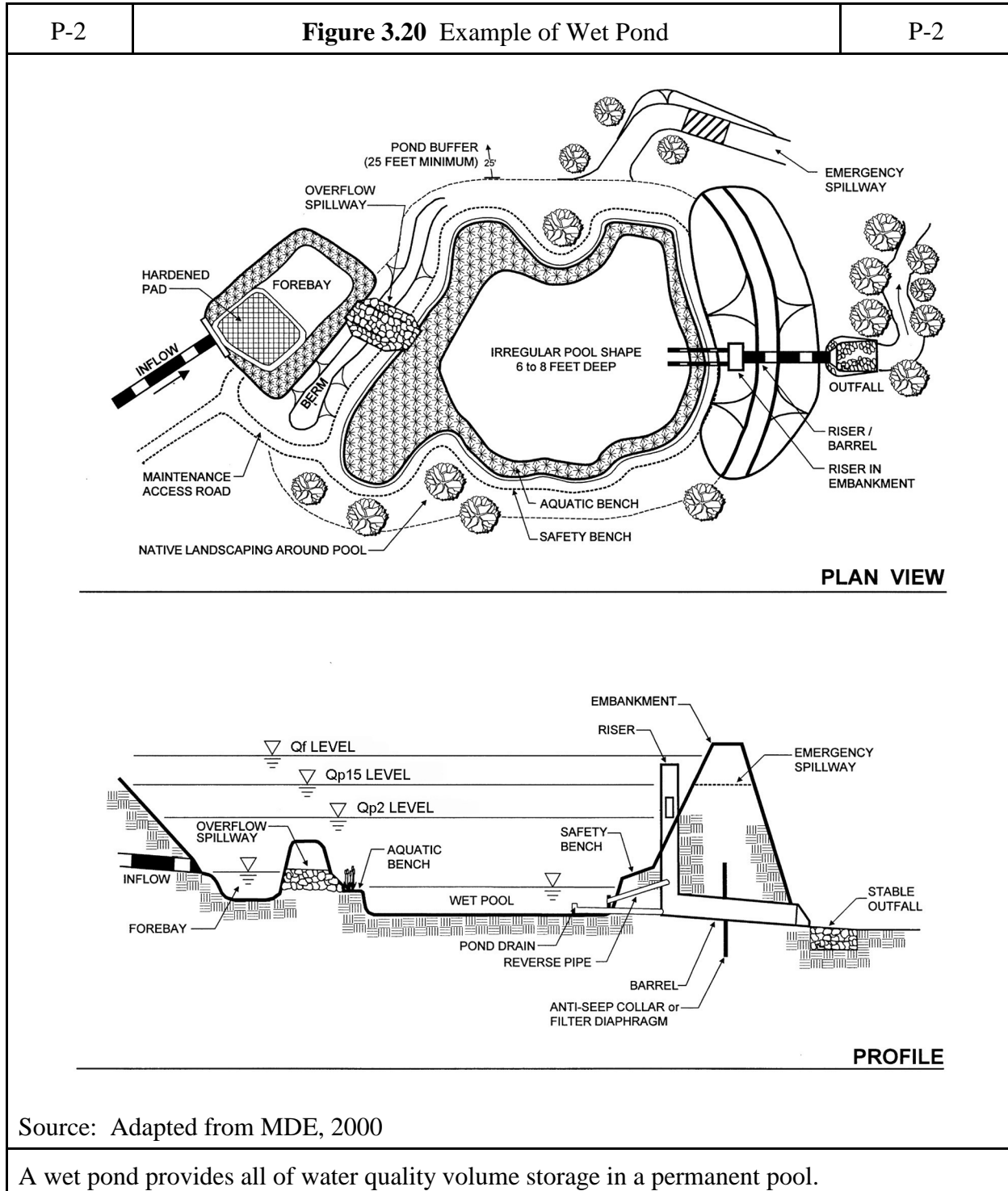
Storm water ponds may also provide storm water detention storage ( $Q_{p2}$ ,  $Q_{p15}$ , and / or  $Q_f$ ) above the  $V_w$  storage.

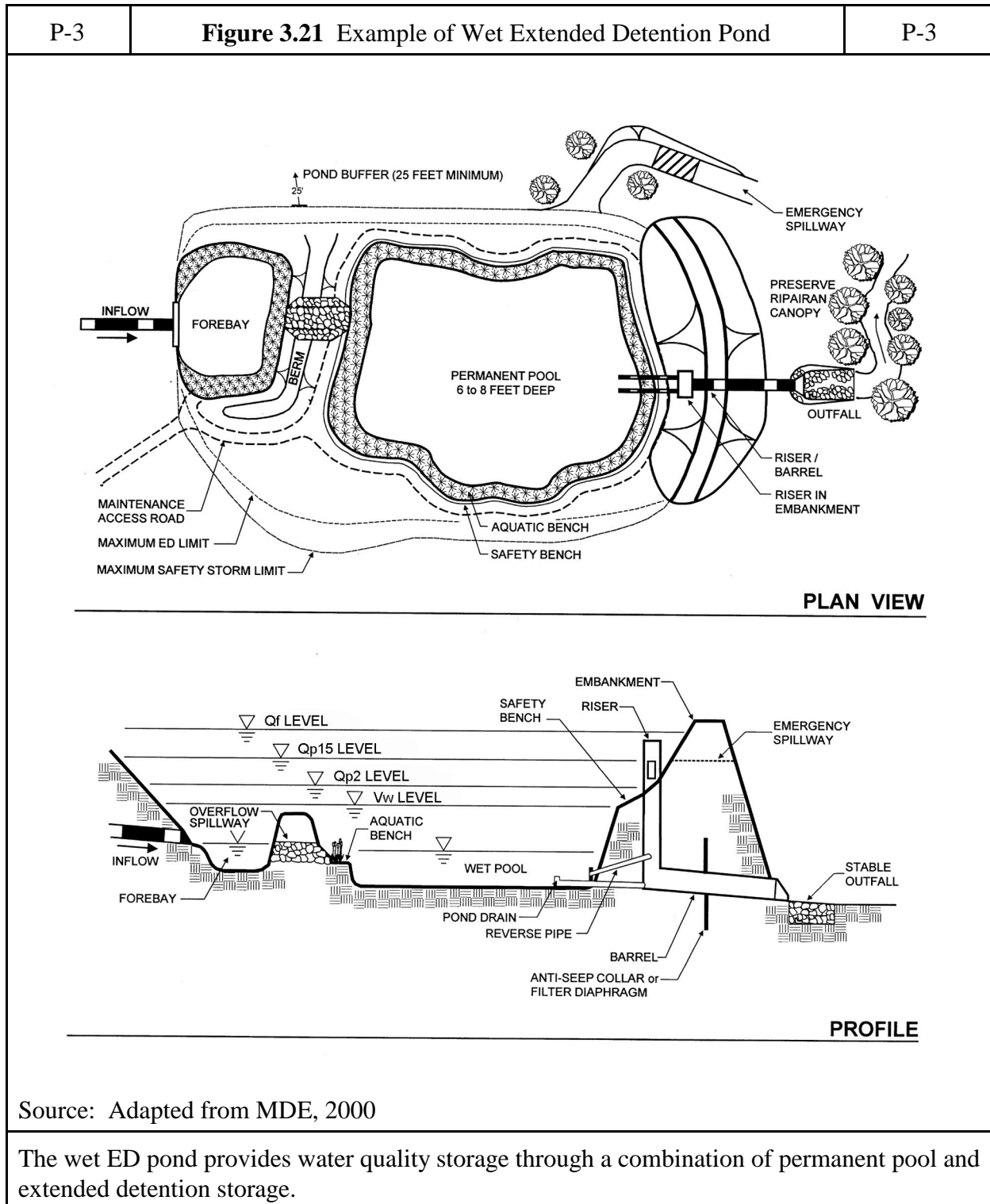
The term "pocket" refers to a pond or wetland that has such a small contributing drainage area that little or no baseflow is available to sustain water elevations during dry weather. Instead, water elevations are heavily influenced and, in some cases, maintained by a locally shallow water table.

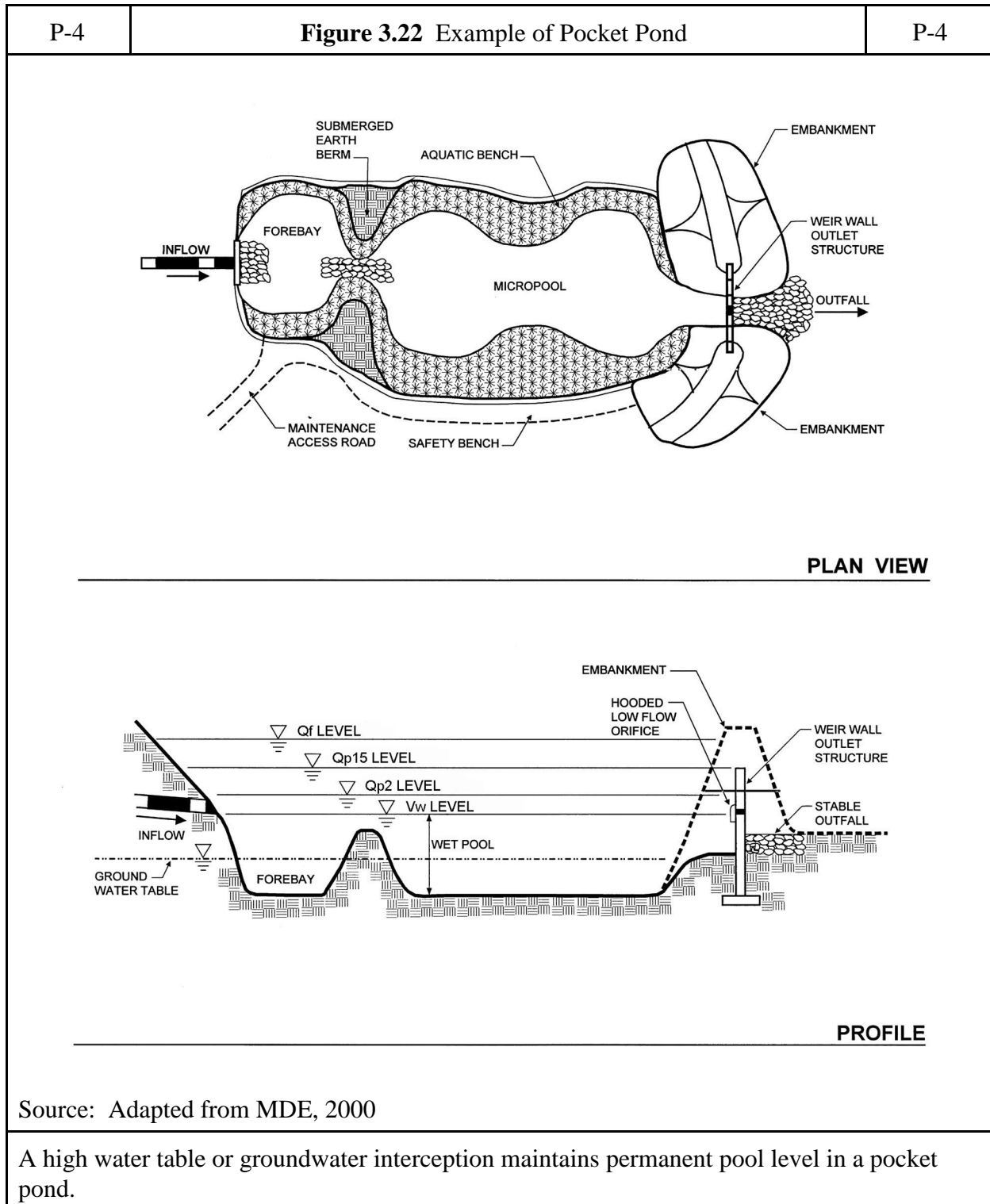


Source: Adapted from MDE, 2000

A micropool is provided in an extended detention pond to prevent resuspension of previously settled sediments and prevent clogging of the low flow orifice.







### **3.4.1 Pond Feasibility Criteria**

Storm water ponds should have a minimum contributing drainage area of ten acres or more (25 or more are preferred), unless groundwater is confirmed as the primary water source (i.e., pocket pond).

*Storm water ponds cannot be located within jurisdictional waters, including wetlands, without obtaining a Section 404 permit under the Clean Water Act.*

*For an open pond system, no utility lines shall be permitted to cross any part of the embankment where the design water depth is greater than 2 feet.*

*Sediment control ponds that are to be converted into permanent storm water management facilities must be designed according to all specifications stated in this book. Approval must be obtained before any such pond can be used for storm water management control.*

### **3.4.2 Pond Conveyance Criteria**

When reinforced concrete pipe is used for the principal spillway to increase its longevity, “O-ring” gaskets (ASTM C361) shall be used to create watertight joints.

*To prevent scouring of the pond bottom, stone pilot channels are required in all ponds or portions of ponds above the permanent pool. In no case should a pond have a bottom slope less than 1% in the pilot channel and a 0.5% slope towards the outlet or pilot.*

### **Inlet Protection**

Inlet pipes to the pond can be partially submerged.

*A forebay shall be provided at each inflow location, unless the inflow provides less than 10% of the total design storm inflow to the pond.*

### **Adequate Outfall Protection**

*Velocity dissipation devices shall be placed at the outfall of all detention or retention structures and along the length of any outfall channel as necessary to provide a non-erosive velocity of flow from the structure to a water course. An outfall analysis should be included in the storm water management plan showing discharge velocities down to the nearest downstream water course. Where indicated, the developer / contractor must secure an off-site drainage easement for any improvements to the downstream channel.*

*Ponds must have an earthen emergency spillway cut in natural ground unless waived by the*

*Department. Emergency spillways cut in fill must be lined with filter cloth beneath PVC-coated gabion baskets.*

*The final release rate of the facility shall be modified if any increase in flooding or stream channel erosion would result at a downstream structure, highway, or natural point of restricted streamflow (see section 2.4 Additional Storm Water Management Requirements).*

Flared pipe sections that discharge at or near the stream invert or into a step-pool arrangement should be used at the spillway outlet.

If a pond daylights to a channel with dry weather flow, care should be taken to minimize tree clearing along the downstream channel, and to reestablish a forested riparian zone in the shortest possible distance. Excessive use of rip-rap should be avoided.

### **3.4.3 Pond Pretreatment Criteria**

#### **Sediment Forebay**

*Each pond shall have a sediment forebay or equivalent upstream pretreatment. The forebay shall consist of a separate cell, formed by an acceptable barrier (e.g. concrete, gabions, earthen embankment).*

*The forebay shall be sized to contain 0.1 inches per impervious acre of contributing drainage, and should be between 4 and 6 feet deep. The forebay storage volume counts toward the total  $V_w$  requirement. Exit velocities from the forebay shall be non-erosive. Non-erosive velocities are 4 feet per second for the two-year event, and 6 feet per second for the 15-year event.*

*Direct maintenance access for appropriate equipment shall be provided to the forebay.*

The bottom of the forebay may be hardened to make sediment removal easier.

A fixed vertical sediment depth marker should be installed in the forebay to measure sediment deposition over time.

### **3.4.4 Pond Treatment Criteria**

#### **Minimum Water Quality Volume ( $V_w$ )**

*Provide water quality treatment storage to capture the computed  $V_w$  from the contributing drainage area through any combination of permanent pool, extended detention ( $V_w$ -ED) or marsh.*

It is generally desirable to provide water quality treatment off-line when topography, head and space permit (i.e., apart from storm water quantity storage).

Water quality storage may be provided in multiple cells. Performance is enhanced when multiple treatment pathways are provided by using multiple cells, longer flowpaths, high surface area to volume ratios, complex microtopography, and/or redundant treatment methods (combinations of pool, ED, and marsh).

### **Minimum Pond Geometry**

*The minimum length to width ratio (i.e., length relative to width) for ponds is 1.5:1. Greater flowpaths and irregular shapes are recommended.*

Maximum depth of the permanent pool should not generally exceed eight feet unless the pond is designed for multiple uses. Ponds should be wedge-shaped, narrowest at the inlet and widest at the outlet.

### **3.4.5 Pond Landscaping Criteria**

#### **Pond Benches**

The perimeter of all deep pool areas (four feet or greater in depth) should be surrounded by two benches:

- A safety bench that extends 15 feet outward from the normal water edge to the toe of the pond side slope. The maximum slope of the safety bench shall be 6%.
- An aquatic bench that extends up to 15 feet inward from the normal shoreline and has a maximum depth of 18" below the normal pool water surface elevation.

#### **Landscaping Plan**

*A landscaping plan for a storm water pond and its buffer shall be prepared to indicate how aquatic and terrestrial areas will be vegetatively stabilized and established.*

Wherever possible, wetland plants should be encouraged in a pond design, either along the aquatic bench (fringe wetlands), the safety bench and side slopes (ED wetlands) or within shallow areas of the pool itself.

The best elevations for establishing wetland plants, either through transplantation or volunteer colonization, are within 6" (plus or minus) of the normal pool.



The soils of a pond buffer are often severely compacted during the construction process to ensure stability. The density of these compacted soils is so great that it effectively prevents root penetration, and therefore, may lead to premature mortality or loss of vigor. Consequently, it is advisable to excavate large and deep holes around the proposed planting sites, and backfill these with uncompacted topsoil.

As a rule of thumb, planting holes should be 3 times deeper and wider than the diameter of the rootball (for balled and burlap stock), and 5 times deeper and wider for container grown stock. This practice should enable the stock to develop unconfined root systems. Avoid species that require full shade, are susceptible to winterkill, or are prone to wind damage. Extra mulching around the base of the tree or shrub is strongly recommended as a means of conserving moisture and suppressing weeds.

### **Pond Buffers and Setbacks**

A pond buffer should be provided that extends 25 feet outward from the maximum water surface elevation of the pond. The pond buffer should be contiguous with other buffer areas. An additional setback may be provided to permanent structures.

Existing trees should be preserved in the buffer area during construction. It is desirable to locate forest conservation areas adjacent to ponds. To discourage resident geese populations, the buffer can be planted with trees, shrubs and native ground covers.

*Woody vegetation shall not be planted or allowed to grow within 15 feet of the toe of the embankment and 25 feet from the principal spillway structure.*

Annual mowing of the pond buffer is only required along maintenance rights-of-way and the embankment. The remaining buffer can be managed as a meadow (mowing every other year) or forest.

### **3.4.6 Pond Maintenance Criteria**

#### **Maintenance Measures**

*Trash racks shall be provided for low-flow pipes and for riser openings not having anti-vortex devices.*

*Maintenance responsibility for a pond and its buffer shall be vested with a responsible authority by means of a legally binding and enforceable maintenance agreement that is executed as a condition of plan approval.*

Sediment removal in the forebay should occur every 5 to 7 years or after 50% of total forebay capacity has been lost.

### **Maintenance Access**

*All ponds must be designed so as to be accessible to annual maintenance. Unless waived by the Department, a 5:1 and 15 foot wide entrance ramp shall be required for maintenance access.*

*A maintenance right of way or easement shall extend to a pond from a public or private road.*

The maintenance access should extend to the forebay, safety bench, riser, and outlet and be designed to allow vehicles to turn around.

### **Non-clogging Low Flow Orifice**

*The low flow orifice shall have a minimum diameter of 3", and shall be adequately protected from clogging by an acceptable external trash rack. The low flow orifice diameter may be reduced to 1" if internal orifice protection is used (i.e., a perforated vertical stand pipe with holes or slots that are protected by wire-cloth and a stone filtering jacket).*

The preferred method is a submerged reverse-slope pipe that extends downward from the riser to an inflow point one foot below the normal pool elevation.

Alternative methods are to employ a broad crested rectangular, V-notch, or proportional weir, protected by a half-round CMP that extends at least 12" below the normal pool.

The use of horizontal perforated pipe protected by geotextile and gravel is not recommended.

### **Riser in Embankment**

The riser should be located within the embankment for maintenance access, safety and aesthetics.

Access to the riser is to be provided by lockable manhole covers, and manhole steps within easy reach of valves and other controls. The principal spillway opening can be "fenced" with pipe or rebar at 8" intervals for safety purposes.

### **Pond Drain**

*Each pond shall have a drain pipe that can completely or partially drain the pond. The drain pipe shall have an elbow within the pond to prevent sediment deposition, and a diameter capable of draining the pond within 24 hours.*

Care should be exercised during pond drawdowns to prevent downstream discharge of sediments or anoxic water and rapid drawdown. The approving authority shall be notified before draining a pond.

#### **Adjustable Gate Valve**

Both the  $V_w$  outlet pipe and the pond drain should be equipped with an adjustable gate valve (typically a handwheel activated knife gate valve).

Both the  $V_w$  outlet pipe and the pond drain should be sized one pipe size greater than the calculated design diameter.

Valves should be located inside of the riser at a point where they (a) will not normally be inundated and (b) can be operated in a safe manner.

To prevent vandalism, the handwheel should be chained to a ringbolt, manhole step or other fixed object.

#### **Safety Features**

Fencing of ponds is not generally desirable, but may be required in some cases. A preferred method is to manage the contours of the pond to eliminate dropoffs and other safety hazards.

*Side slopes to the pond shall not exceed 3:1 (h:v), and shall terminate on a 15 ft wide safety bench. Both the safety bench and the aquatic bench may be landscaped to prevent access to the pool. The bench requirement may be waived if slopes are 4:1 or gentler.*

*The principal spillway opening shall not permit access by small children, and endwalls above pipe outfalls greater than 48" in diameter shall be fenced to prevent a hazard.*

