Stormwater Detention Compound Evaluation For Laymen

By

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January, 2012

Proof Draft

OBSERVATION NOTES

By Franklin Buie

This packet is a personal essay on the elements of retention/detention compounds based on several years of contemplation. Professional engineers may find it simplistic.

This paper deals with detention areas, usually defined as normally dry basins. Some of the comments will apply to retention ponds, usually holding a permanent pool of water that supports many spices of aquatic life, but with an intentional design for the water level to fluctuate significantly, providing a measure of flood control for the sites downstream. Some residential ponds may serve this purpose, but most of them have no flood control facility.

There is no attempt here to define the mathematical points of water flow. Instead, I approach the concern as a matter of common sense. Non-engineers should be able to evaluate the general effectiveness of an installation. If problems are detected, then the engineers should be informed, so that proper corrections may be completed.

The owner of property with a detention pond may find these pages useful to evaluate the facility. One that is not working properly constitutes wasted space that may be seen as useful for other purposes. If the detention pond is required to protect neighbors and public interests, then the owner would want it to work properly.

Problems result in silt and serious erosion-related problems downhill from the compound, usually well beyond the point where the cause and effect may be linked by sight. Also, we become so used to a site that we no longer see it; a problem may grow so slowly that we become accustomed to the changes and miss the deterioration of function.

Compounds require little, but some maintenance. Outlet ports and inlet culverts get blocked, outflow culverts break, brush grows wonderfully well under the excellent moisture conditions often found in compounds. Grounds-keepers and well-meaning citizens “correct” problems they see and thwart excellent design, or complicate problems with poor design. Engineers, contractors and inspectors make mistakes, too.

A 10,000 sqft hole in the ground designed to hold rainwater for three days after a moderate rain that never holds water for more than ten hours is a bad investment of land and the cost of engineering, not to mention taxes. The water that runs off (an interesting synonym for *delinquent*) could have contributed to the overall health of the surrounding environment. Instead, a little too much outflow here and there quickly transforms a gentle creek into a dangerously flooded stream that threatens land, buildings and people. Silt passing through the excavation contributes to the destruction of every pond and lake downstream in the watershed; the silt, usually the best of the world's topsoil, ultimately ends in the ocean. Often the excessive flows pick up roadside litter which they deposit with silt in the first deep water encountered.

Every compound should work at maximum efficiency, therefore, for the good of the landowner and everyone down the hill.

A General Description

Outlet structures and detention excavations seldom take the same shape. The design is determined by the shape and size of the area served, the area available for the facility, and the creativity of the designer. Some compounds are beautifully done. Some are not so attractive. Appearance, however, is as deceiving in this discipline as any other. The most attractive compounds may be virtually useless. A very large facility, which could be the best, could rank among the worst. The least attractive "industrial" compound may surprise even its creators with engineering beauty.

The **outflow culvert** from a detention compound may be designed to carry the maximum amount of water expected in a 100 year rain. The culvert is usually placed at the bottom of the back of the outlet structure to carry water under the dam. It may or may not be seen within the compound. If visible, it should appear sound, with no erosion nearby. If broken and visible inside the compound, water will by-pass outlet structure to exit.

The **outlet structure**, whether of metal, masonry, or concrete, should rise above the outflow culvert to a height no more than two feet below the rim of the excavation and have an inside flow capacity at least equal to the flow capacity of the outflow culvert. Ports for water to enter the structure should begin above the floor of the excavation to allow as much water to soak into the soil as soil conditions, compound area, and atmospheric drying conditions allow. Additional ports between the lowest and the top may be provided to increase the flow as more water enters the compound in a heavier rain. The size and spacing of the ports should be coordinated to allow increased flow for increased rainfall at regular intervals. If before development no runoff occurred from the area served by the facility after a 2" rainfall, then the first two inches of runoff should be retained to soak into the ground. (If the compound cannot handle this amount, then it should be enlarged or supplemented by another compound .) The top of the structure should be open to a flow of water equal to the outflow capacity of the structure in the event that the ports become blocked. A protective cover may be placed over the top to prevent large objects from entering, including people, where that may be a concern.

Inlet devices to direct stormwater into the compound may be buried culverts opening into the sides of the compound or surface ramps. The point of contact for incoming stormwater and the soil should be protected with riprap, gravel or concrete pads to prevent erosion within the compound. In some cases, water may flow randomly down the banks of the retention compound; if so, the slopes must be protected from erosion and maintained as necessary.

The **detention compound**, built up or excavated, serves a dual function: to capture silt as well as controlling flooding. Excessive silt collections should be cleared as necessary to provide space to retain an amount of water equal to the "no-run-off before development" level, and should have capacity sufficient to handle all the runoff expected from the area it serves in a government-specified event, holding the water until the outlet structure meters the outflow at a volume and rate not to exceed the outflow before development for whatever amount of rain actually falls in a given 24-hour period. The outflow should take up to three days to complete.

The permeability of the soil should be considered in all computations. In dry sandhills, no outlet structure at all may be needed; in hard clay soils, or in swampy areas already near saturation, special consideration must be made to accommodate the stormwater. One design does not fit all applications.

The compound may be fenced, walled, bordered with traffic guard rails or open, depending on the safety requirements of the area. If strong currents may occur, fences may be needed to exclude people and animals. If unfenced, at least one escape ramp should be provided to allow people and animals a way to exit the compound.

The excavation or construct (compound) may be a large hole in the ground, a ravine-like area with level dam-like barrier to hold the water (with a protected spillway), an enclosure built for the specific purpose, or a combination of any of these. Sloped earthen banks, concrete or masonry walls, sloping or vertical, may be used as conditions, space and esthetics require. The floor may be the local soil, gravel or riprap or covered with vegetation. Vegetation may or may not be luxuriant; wetland plants may or may not be present. Extremes of vegetation or the lack thereof may be an indication of a problem. The compound should be maintained in good repair. The size and capacity will vary according to the need. Multiple compounds may be required for a large development, depending on the hills, size and layout of the development, with particular regard for the impervious areas. They may be incorporated into the overall development plan to provide scenic vistas, or they may be hidden on back lots. They may be linked together in chains. They may serve several properties in a cooperative agreement for maintenance.

The interior space may be a single tank or it may be divided with dikes. Input devices may be placed behind a dike to control turbulence and prevent silt from entering the main area and to facilitate silt removal as needed. The dike may be semi-porous, have a wide spillway, or one or more outlet structures to allow water into the main compound. The compound may or may not have an outlet structure, depending on the capacity of the soil (area and permeability) to absorb water.

Maintenance should include silt removal as necessary and control of vegetation. Cuttings should be removed from the compound. The outlet structure should be repaired as necessary and the openings checked periodically for proper operation.

THE BASIC ELEMENT OF POOR DESIGN: "BATHTUB" DRAIN

In the design, construction and maintenance of a compound, the single most important factor is the placement of outlet ports. The most common mistake is the use of what I call a "bathtub drain," which will render an otherwise perfect design useless.

A bathtub drain is placed at the bottom of a bathtub and is connected to an overflow drain a few inches from the rim of the tub. Ideally, either outflow opening should be able to accommodate whatever inflow may occur. The plug must be in the bottom outlet for the tub to retain any water, and the overflow drain should be impossible to close, to prevent overfilling and to protect the house from flooding. Modern water supply systems make it possible for water to enter a tub faster than it drains, but that is beside the point. If the drain is left unstopped, it will take a long time for the tub to fill, if ever. In the meantime, a lot of water will have run off, wasted.

In a detention compound, a very small bottom drain may be useful where the soil is barely permeable and the water must be gone in three days to prevent mosquito infestation. But the opening should be designed only as large/small as necessary to accommodate the need. Indeed, in highly permeable soils, such as pure sand, given adequate space, outlet structures and drains may be totally unnecessary. Practical applications usually come somewhere between the extremes.

A retention/detention facility is intended to hold excessive water temporarily and retain silt permanently. While restrained, any silt should fall out of the water, hopefully evenly over the bottom of the excavation. A bathtub drain allows silt-laden water to drain quickly, carrying the silt with it and perhaps eroding the compound itself. If the bathtub drain current draws a few large items, it may become clogged and perhaps cease to function altogether.

Exit ports for stormwater raised above the floor of the compound provide for detention of average rainfall amounts, control of silt; additional ports above gradually increase flow as the amount of rainfall increases. This also provides the outflow area downstream to recover after a normal rain, instead of enduring a flood with every event, no matter how small. If the lowest exit port is properly raised, riprap dams around them are unnecessary.

Eight Signs of a Bathtub Drain

1. A crude dam of riprap around the outlet structure. A "bathtub" drain allows the water out too fast. Caretakers, realizing that something is wrong, build the dams to improve the function and control silt, usually in vain. Even if their innovation works, the retained water will reach only the depth provided by the makeshift "repair" and the silt makes its way through the riprap.

2. Very dry, thin grasses struggling to live. Unless drought conditions prevail in the area, a "bathtub" drain may be entirely too large.

3. An irrigation system serves the excavation. Unless the area is a desert, water passing though the excavation should be sufficient to water the plants.

4. A very clean, manicured, evenly grassed and colored appearance makes the retention area a beautiful lawn. A working retention area will probably not be so neat, as repeated flooding causes irregular things to happen. If there is no irrigation system, look for a swamp nearby that processes the stormwater instead of the compound.

5. The absence of water lines or marks, absences of changes in grass color or density. Signs of water flow, such as flattened grass and concrete troughs may indicate a significant flow of water in the detention area and may indicate that no water is collected by the facility.

6. Ditches dug through the excavation that lead to the outlet structure. Ask, “Why?”

7. A build-up of silt below the dam. (Or worse, build-ups of silt that are flushed away after a heavy rain event.

8. Absence of a fence around the excavation. If the caretakers for the property, especially at a school with a large parking lots and playing fields, find a fence unnecessary, the outlet structure may be allowing the water out too fast.

POOR MAINTENANCE AND POOR DESIGN:

1. Outlet structure tower other than two feet lower than rim of compound.
2. Outlet structure top closed
3. Broken parts of the outlet structure
4. Silt –filled excavation
5. Silt-laden outflow
6. Rim of compound not level (other than spillway); washed out dam
7. Erosion anywhere associated with compound
8. Brush allowed to grow wild in and around excavation. Non-wetland plants obviously thriving may indicate that the excavation is not retaining water . Look for breeched dams, blocked inlets, inadequate capacity.
9. Excessive growth of wetland plants may mean the excavation is retaining water too long!
10. Trash and flood debris on cover grate or inside structure. The excavation may not be large enough, or a drain is blocked.

Bathtub drain in useless compound at BCBS facility on Alpine Road. Depends on the swamp to care for stormwater.

100% infiltration; no outlet structure. Located east of Grace Way between Sparkleberry and Valhalla Drive.

DETENTION AREA FIELD OBSERVATION REPORT

By Franklin Buie

If you are inspecting a detention area on private property, please contact the owner, explain what you are doing and why and get permission to proceed. Invite to owner to share the inspection. Leave a copy with the owner when done. Allow the owner to add comments.

This is not a casual matter; a proper observation may take up to 30 minutes or more. Please study the detention area carefully; if you see something that you do not understand about the design, please make a note about your question or questions.

The answers should be circled. Where several answers apply, mark as many as do apply. For estimates of size, etc., mark the nearest if the exact number is not available. If the answer is a guess, also mark (Approx). Comments are welcome and may be written on the back of the page opposite or after the question. Simply mark the question with "see comment" and where the comment appears, identify the question to which the comment refers.

The form provides answers to many questions. The preferred answer comes first in the choices. Please READ the answers before marking! Following the **15 Most Important Questions**, a box appears. If the preferred answer is the answer to the question, shade, check, or somehow mark the plus + section. If another answer is better — that is the answer denotes something short of ideal, mark the minus – section. Then score the MIQs somewhere on the top sheet. 15 / 0 would indicate a very good report 0 / 15 would not be so good.

Problems may still exist on a 15 / 0 report, however. Other matters that may require attention may be marked by circling the question number, or any mark of your choice.

If signs of petroleum or other toxic contamination are present, report this directly to DHEC, immediately.

One report form should be used for each installation inspected. If the compound is one of several on the same property, be sure to mark the Multiple Compounds on the last page and if possible, prepare individual reports on all the compounds in the series.

When complete, give the report to anyone on the Technical Committee of the Gills Creek Watershed Association.

IF the county stormwater manager is amenable to receiving the reports, completed forms may be presented to the county office.

Interested persons may duplicate these pages as desired.

STORMWATER DETENTION AREA FIELD OBSERVATION REPORT

By Franklin B. Buie

1. Street Address ____
2. City, State, Zip ____
3. Name of Business or Development ______________________________
4. Visible from street? Yes No

OBSERVER AND CURRENT WEATHER

1. Observer's Name____
2. Address____
3. Date ____
4. Is it raining now? No Yes
5. Has it rained in recent three days? Yes No Estimate how much: _______

DETENTION/RETENTION COMPOUND

1. Size: Large 5 Acres Medium 1 Acre Small ½ acre or less (Approx)
2. Access: Fenced Walled Guard rail Open
3. Esthetically Attractive? Yes No Could Be Strictly Utilitarian
4. Type: Normally dry Normally very low water Permanent pool
5. **Maintained? Yes (+) Some (–) No (–)** . . . . + | −
6. Serves: Parking Lot Parking Garage Streets Buildings All of Above
7. **Is there any Odor? No (+) Yes (–) Describe** _________________________ . . . . + | −

OIL/WATER SEPARATOR

1. Is an automotive service facility located in the served area? Yes No
2. Is the automotive service area isolated from this compound? Yes No
3. Is an oil separator included in this system? Yes No
4. Is it maintained regularly? Yes No
5. Is there any sign of petroleum contamination in the retention compound? No (+) Yes (–) + | −

OUTFLOW CULVERT OUTSIDE COMPOUND

1. **General condition: OK (+) Needs attention (–) Not observed (–)** . . . . . . + | −
2. Opening: Observed Not Observed Could not locate
3. Approx size: _________
4. Mouth: Open Partially blocked Mostly blocked Blocked
5. Erosion at mouth: None Mild Severe
6. Erosion protection: Riprap Concrete Other

OUTFLOW CULVERT INSIDE COMPOUND

1. Visible inside compound? No Yes Comments ______________________________
2. **Does it appear sound? Yes (+) No (–)** Comments ______________________________ + | −
3. Other observations ______________________________________

OUTLET STRUCTURE

1. Constructed of: Metal Masonry Concrete Wood Combination
2. General condition: New Good Needs repairs

3. Height 1' 2' 3' 4' 5' 6' 7' 8' 9' 10' 12'+ 20' (Approx)

4. **Height relative to dam or spillway** -2 feet **(+)** Other______ **(–)** Interior size (Approx) ___________ + | −

5. **"Bathtub Drain": No(+) Yes (–)** → Buried under silt Large Small Approx size _________ . + | −

6. "Baththb Drain" protection: Riprap dike Screen Metal Arc None

7. Ports: Single Multiple Approx size and number ________________

8. Array of ports: Vertical Spiral Continuous slot __________________

9. **Water accessible top: Yes (+) No (–)** ||| **Type:** Open Raised concrete lid Metal grate + | −

10. Debris Protection: Ports Top Grate Raised Concrete

11. Manhole and ladder: Yes No

12. Water marks: No Yes Where? _____________

13. Inside structure: Moisture Moss Standing water Unknown

14. Flotsam: None On top Inside Other

15. Other Comments ____

INLET DEVICES

1. How many: Buried culverts _____ Surface ramps _____ Other______________

2. Size of culverts: 12" 24" 32" 36" 48" 72" (Approx)

3. Inflow erosion protection: Riprap Gravel Concrete Pad None

4. Signs of Erosion: None At contact with soil Around pipe

5. Signs of maintenance: Yes No Not needed Needed

6. Ramps: Concrete Other

7. Signs of erosion for ramps: None Along sides Down the middle At contact with soil

INDIVIDUAL COMPOUND (ONE OUTLET STRUCTURE)

1. Type: Excavation with Natural Sides Blocked Ravine Hillside Excavation w/ Dam

2. Construction: Sloped Earth Sides Masonry/Concrete Walls Both Other

3. What type of soil prevails in the compound? Clay Sand Mix: Clay _____% Sand _____%

4. Is this compound: Single Double Triple Other ___

5. If double or more, how are the sections connected? Open Ditches Large Culverts

6. Is this compound divided with dikes? Yes (see Dikes Section) No

7. Do **you see any problems: No (+) Yes (–) Erosion Breeched dam Broken pipes Blocked ports Damages to outlet structure Missing grate or cover** _________________________________ + | −

8. Is water standing in compound? No Yes

9. Is water permanent? No Yes (See Permanent Retentions)

10. How much water is standing? Dry Damp 6"or less ±15" 36"or more Full Overflowing

11. Does the amount of water standing in compound seem normal? Yes No

12. If dry: Plants stained with silt Grass matted by waterflow Silt everywhere No Plants All Dead

13. Type of vegetation on floor of compound: None Wetland Other Trees Grass Weeds and vines

14. Primary vegetation: Lawn grass Love Grass Cattail Willows _____________________

15. Is vegetation maintained in any way? Yes How? ______________________________ No

16. Are pruned limbs or other cut debris left to decay in the retention area? No Yes

17. Is litter present? None Some Much

18. Type of litter: Paper Plastic Foam Glass Metal

19. Are animals other than fish using the compound? Species ______
20. Are dead animals present? No Yes
21. **Mosquitoes? No (+) Yes (–)** . . . . + | −

MULTIPLE COMPOUNDS

1. How many compounds in development? 1 2 3 4 5 6 or more
2. How many chains _____
3. How many in each chain ___
4. How many feed last compound? _____
5. How many feed this compound? _____

SILT AND WATER RETENTIONS (PERMANENT POND)

1. Is water clear? Yes No
2. Is it aerated (fountain, waterfall) ? Yes No
3. Does it have fish? Yes No Unknown
4. **Is the outlet structure clear and maintained? Yes (+) No (–)** . . . . + | −
5. **Do you see water marks on the banks to indicate fluctuations in water level? Yes (+) No (–)** + | −
6. Do you see silting at the inlet culverts? **No Yes**
7. **Is the silt taking over the pond? No (+) Yes (–)** . . . . + | −
8. Is the silted area accessible to removal equipment? Yes No
9. **Other problems: None (+) Yes (–) Mosquitoes Odor Other _____________________** . . + | −

DIKES

1. How many dikes 1 2 3 4
2. Any comment on dikes? ____
3. Dike material: Earth Gravel Riprap Concrete Combination
4. Porous? Yes No
5. Outlet structure for water to pass? Yes No
6. Spillway for water to pass? Yes No
7. Height 1’ 2’ 3’ 4’ 5’ 6’ 7’ 8’ 10’
8. Silt trapped behind dike? Yes No
9. Is silt removed as needed? Yes No Unknown
10. Does silt need removal now? No Yes
11. **Is silt oily? No (+) Yes (–) Unknown** . . . . + | −

NOTE ANYTHING UNUSUAL OR REMARKABLE

1.
2.
3.

This report form is a first draft. Please add questions or comments on questions for author’s consideration.