What Wetlands Boards Expect from Engineers

by

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Course 415
4 PDH (4 Hours)

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INTRODUCTION

Wetlands Boards or Commissions or Panels can consist of community volunteers, paid staff or a combination of both. Sometimes they are known as Conservation Committees. They may be combined with Planning and Zoning Boards too. Some states and their Departments of Environmental Conservation (or Protection, etc.) handle Wetlands issues for both large and for small scale Wetlands impacts, depending on acreage and features. Some parts of our country may have no local Wetlands and Watercourses regulations at all. Large water bodies including navigable waters are under the jurisdiction of the Army Corps of Engineers, which just claimed more territory in the author's town the month of this initial writing. Rural and farmland regulations differ greatly, under the US Department of Agriculture, and are not covered specifically in this course. Neither are certain Coastal regulations.

To facilitate reading of this course, a Board or Commission or Panel is hereby referred to as the "**Board**", and Inland Wetlands and Watercourses are "**Wetlands**".

Since Board activity will vary from state to state and even town to town, the frequent use of the words "may" and "might" invite the reader to check the specific nature of your own local situation before proceeding. But note the similarities in how Wetlands are protected throughout America.

Like almost all engineering today, procedures must follow existing codes, bylaws, rules and regulations passed by statute or law from the legislating body. Commonly, each state delegates local permitting and enforcement to the county, city, or town, which legally delegates power to the Board.

The topic of this SUNCAM course is to describe what Boards, (who serve the local community) expect from the engineers who submit design work and may appear before them at a Board meeting. These engineers are authorized in writing by the property owner (who has applied for a Wetlands permit) to represent that owner and work toward a mutually agreeable project result. Where sealed drawings are required the engineer must be a state Licensed Professional Engineer.

WETLANDS REGULATIONS

Municipalities adopt their own Inland Wetland and Watercourse Regulations conforming to state laws allowing such, by having their governing bodies vote these regulations and amendments in place as in Virginia, shown here: https://vacode.org/28.2-1302/ *(Web site references beyond this SUNCAM course are not part of the test questions.)*

Almost all of these regulations are now available for review online. Following them is the first thing an engineer should attempt, when seeking to receive permission to begin the construction project. Assuming that regulations in Elmville will apply to Oakdale is a big mistake.

Under the "Definitions" section are three important wordings shown below but superseded of course by whatever the regulations say for the geographic community in which the work will occur.

Wetlands *means land, including submerged land as defined in this section, not regulated pursuant to sections … inclusive, of the (state) General Statutes, which consists of any of the soil types designated as poorly drained, very poorly drained, alluvial and floodplain by the National Cooperative Soils Survey, as it may be amended from time to time, of the Natural Resources Conservation Service of the U.S. Department of Agriculture (USDA). Such areas may include filled, graded, or excavated sites which possess an aquic (saturated) soil moisture regime as defined by the USDA Cooperative Soil Survey.*

Watercourses *means rivers, streams, brooks, waterways, lakes, ponds, marshes, swamps, bogs, and all other bodies of water, natural or artificial, vernal or intermittent, public or private, which are contained within, flow through or border upon the Town or any portion thereof not regulated pursuant to sections …, inclusive, of the (state) General Statutes. Intermittent watercourses shall be delineated by a defined permanent channel and bank and the occurrence of two or more of the following characteristics:*

(a) evidence of scour or deposits of recent alluvium or detritus,

(b) the presence of standing or flowing water for a duration longer than a particular storm incident, and

(c) the presence of hydrophytic vegetation.

An obvious watercourse. Intermittent watercourses are more difficult to define.

Regulated activity *means any operation or use of a wetland or watercourse involving removal or deposition of material, or any obstruction, construction, alteration or pollution, of such wetlands or watercourses, and any earth-moving, filling, construction or clear-cutting of trees within 75 feet of wetlands or 75 feet of watercourses but shall not include activities specified in Section 4 of these regulations.*

A strict interpretation of this is that even a single shovelful turned over is not allowed, just as trespassing by one inch is prohibited on another person's private property. Reasonable soil sampling by a non-destructive soil auger or spade is perhaps an exception.

The above referenced 75 foot "Upland Review Area" or "Buffer" zone rationale is explained here in the *Planner's Guide to Wetland Buffers for Local Governments* http://www.eli.org/sites/default/files/eli-pubs/d18_01.pdf

If the property does not have Wetlands or adjacent areas that can be impacted, then building and zoning permits are expedited for approval without a wetlands permit. Usually just a signoff from the Board's representative may be required.

For jobs that could impact a Wetland, some Boards delegate minor activities such as a house back yard deck 75 feet from a wetland to its Wetland enforcement officer, who can issue the permit for no fee, or a modest fee. For larger scale earth grading activity, or an impervious surface or change in storm water runoff condition, etc. the full Board usually reviews your plan and presentation. They might also refer the plan to their engineering consultant for review comments before they vote to approve or deny the plan application.

The Board conducts its meetings fairly by Robert's Rules of Order, using Parliamentary Procedure. Final votes on Motions required for permit approval must be by a majority with a chairperson presiding. Boards follow Freedom of Information policies and nighttime meeting volunteers might be mostly without scientific or engineering backgrounds. They avoid conflict of interest by recusing themselves from any project application with which they have personal connection. Examples include being related to the applicant owner, or team member, having a business interest directly with the application, etc. If a fellow Professional Engineer is also a volunteer Board member at night, expect that engineer to so declare these qualifications at the beginning of the meeting so that their vote is not prejudiced. Boards hold extraordinary power, backed up by state law, to issue cease work orders, etc.

These three and the other dozens or so of definitions within the regulations that they administer, have evolved over the years since their beginnings, in the middle of the last century. The 1948 Federal Water Pollution Control Act began the process. A famous documentary narrated by actress Katherine Hepburn in 1965 entitled "*The Long Tidal River*" helped lead to 1972 passage of the Clean Water Act, and subsequent local regulations.

RATIONALE FOR WETLANDS REGULATIONS

The unregulated polluting, filling and building at or near wetlands had unintended consequences on the *"indispensable and irreplaceable but fragile natural resource with which the citizens of the state have been endowed"* as described in the "Purpose and Authority" sections at the beginning of official regulations documents. Of course, each state differs in regulations, so specific geographies must be addressed. What is prohibited there might be

permissible here, but certain Best Management Practices can be used by engineers to protect Wetlands wherever they may be.

In a philosophical conversation with our State's then Commissioner of the Department of Environmental Protection, (whose wife was the author's district federal congresswoman at the time this course was originally written) the author asked if the purpose of Wetlands regulations today is the same as it was a half a century ago. Is the resulting limitation on development growth still the same goal? Are the uses of wetlands and upland review areas to treat minor pollutants a bad thing? Wetlands can be helpful in removing limited pollutants, yet septic systems must be distant by law, unless exempted, usually for repair only. Regulations indirectly warn of problems that can occur by building in Wetlands. But today the Internet shows developers these problems that they can encounter, by building on poorly drained soils, such as the not funny image below.

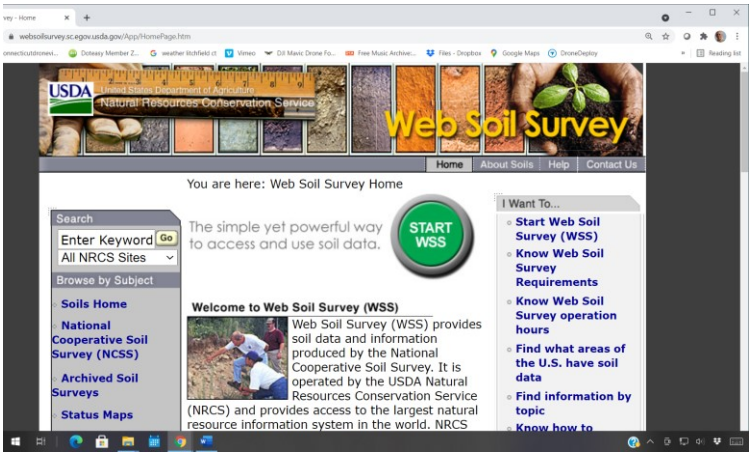
Saving trees in upland seems similar to saving trees in Wetlands soils, if stumping operations and haul road do not impact. Is habitat for Wetland wildlife more important than habitat for Upland wildlife? Land clearing away from wetlands has impact too, but with different regulations. See image below. Note however, that application time is not the time to challenge whether saving wetlands trees is important, while awaiting the vote on your pending project application.

These issues are addressed and updated as regulations change from time to time. Model wording from statutes to localities may or may not be implemented. The latest changes or amendments added at the end of a regulatory Wetlands document should be checked for relevance to your application.

Tree cutting and chipping operation on the author's company's approved housing site.

DETERMINING WETLANDS MAPPING BORDERS

Sometimes Wetlands soils follow delineation of the US Department of Agriculture (USDA) soils maps that are available at http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm.

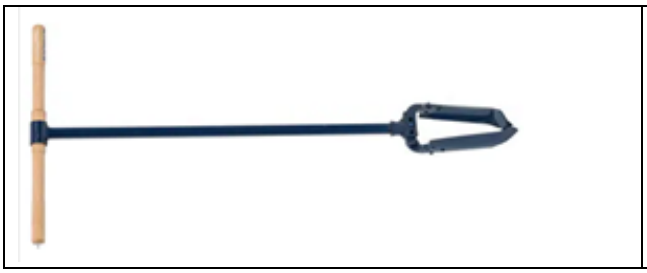


Poorly drained, alluvial or floodplain soils as mapped on the Web Soil Survey might be the locale's Wetlands by regulations definition. These mapped soils may be transferred to the government's Geographic Information System (GIS) mapping.

City Wetlands per the Web Soil Survey

Where the exact boundary that is more specific than the Web Soil Survey boundary is required, then the soil scientist flagging will supersede the Web Soil Survey, and the more precise soil boundaries will be accepted by the Board.

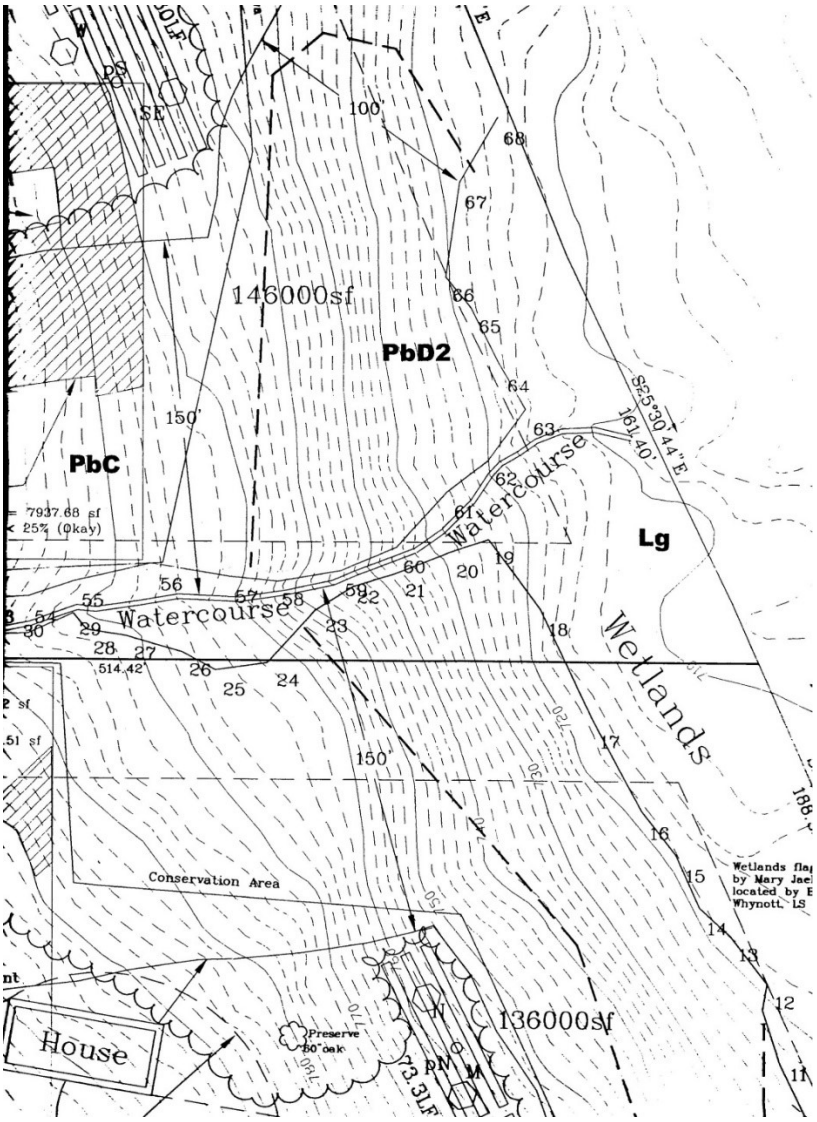
A qualified soil scientist, possibly certified by the Soil Science Society of America, will flag out Wetland boundaries, by probing a soil auger or spade into the earth.



Sometimes, eight-inch depth to soil mottling is the guideline criteria. Mottling refers to colors in soils that are secondary to the compositional colors. When water saturates soil long enough for a chemical reaction to occur, it may leave rusty colored "redoximorphic" colored spots within the sample examined. This indicates that the soil retains water and is a Wetland. The soil scientist will place colored flags along the line where the soil goes from more than 8 inches to less than 8 inches depth to mottling. These flags are commonly pink for wetlands or blue for water courses, to distinguish them from orange colors used often by Licensed Land Surveyors at monuments, property corner rebar pins, or controls spikes.

Pink Wetland boundary is very close to the Watercourse boundary or centerline.

The soil scientist also numbers the flags with permanent marker in the order placed. Wire flags can be used if branch canopy is unavailable. The licensed land surveyor then field locates each flag with instrument and plots the Wetlands and Watercourse boundaries on a map for the engineer to use in design. With map in hand, and standing at a Wetlands flag as numbered, one will know exactly where they are located on the subject property. In the design plan example below, Wetlands flags are numbered, and soil types from the web soil survey are labeled. Lg is Leicester-Ridgebury- Whitman very stony complex, poorly to somewhat poorly drained, and a regulated Wetland.



Pb = Paxton Soils are not Wetlands Soils. The Watercourse shown above was not numbered because it is close to the Wetland boundary. Note that Wetlands acreages (disturbed and not) can be computed by area command on AutoCAD to report to an inquisitive Board that might ask for the acreage of wetlands nearby on their Application Form.

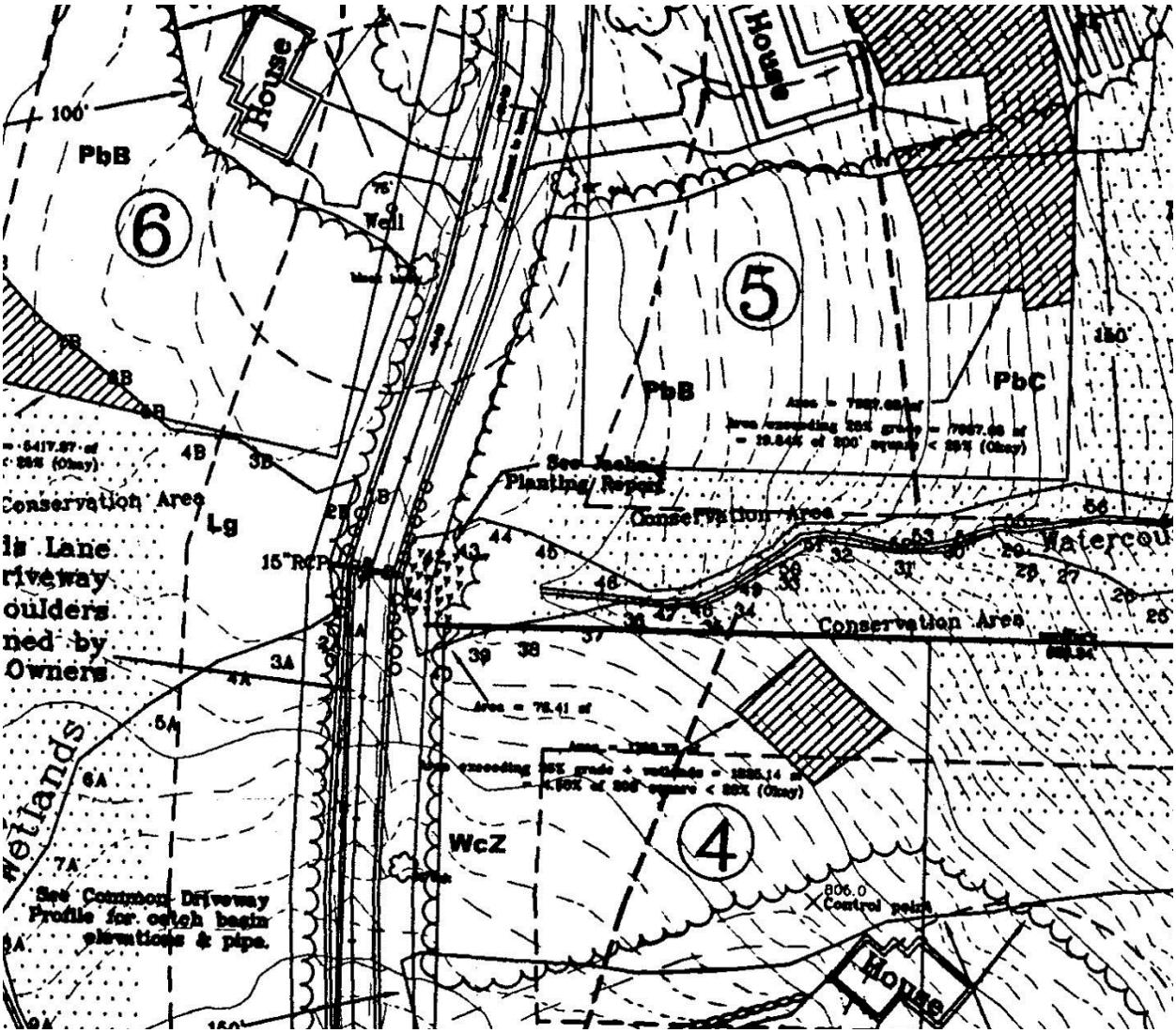
LOCATING NEW FEATURES ON A SITE PLAN

The easiest design is to keep disturbance as far away from these flags as possible. If the definition of upland review area extends one hundred feet from a Wetland, and soil disturbance can be kept there, perhaps no permit is required. If disturbance must be one hundred and fifty feet from a watercourse and that can be achieved, the permit might similarly not be required. Note in the proposed subdivision drawing above, that new lot homes and septic system leaching trenches are shown at least one hundred feet from the soil scientist wetlands borders and one hundred and fifty feet away from the soil scientist mapped intermittent watercourse.

If the proposed facilities cannot be located distant for the landowner's preference to develop, then the engineer applicant must convince the Board why there is no prudent and feasible alternative, if the regulations so require. Note that construction on existing building lots that were approved prior to Wetlands regulations or under previous permits, will have more flexibility then subdividing land and requiring great impact on Wetlands to do so. Building an addition within thirty feet might be approved, whereas subdividing new lots which will have houses thirty feet from Wetlands is likely to be denied, if there is already good existing use for the parcel.

Experienced engineers attempt to help their clients, while minimizing impact from features, like temporary construction earth disturbance, or permanent features such as fertilized lawns. Fertilizer can leach out phosphorus and nitrogen or other growth accelerators into a wetland. If surface or sub surface drainage patterns must be altered, the Board will want to know why. Even allowing heated rainwater runoff from an asphalt parking area to drain immediately into a wetland can have impact. If a house was proposed on a building lot and required filling in hundreds of square feet of wetlands it would be denied, if that house could be built elsewhere on the lot within the zoning setback lines in upland areas that would not affect the Wetlands. But that same few hundred square feet of fill might be allowed, if by doing so a shared driveway could be built over that wetland to access much more acreage on the other side

that would otherwise be land locked. In the figure below, subdivision lots 5 and 6 were thus allowed, plus access to an existing house beyond.



Of course, an existing driveway filled over wetlands would take preference for expansion over a new driveway that would require vast land tree clearing and filling in previously undisturbed areas. And shared driveways like this are Board preferred to individual driveways, even though homeowners might prefer their own private driveway to use and maintain.

While non disturbance is a prominent Wetlands Board goal, certain regulated activities may be permitted when a proper design is submitted. Here is a brook at an outfall turned into a larger pond, with much soil disturbance, but eventually a stable pond.

A dredged pond designed by the author for the Audubon Society and permitted by the Wetlands Board.

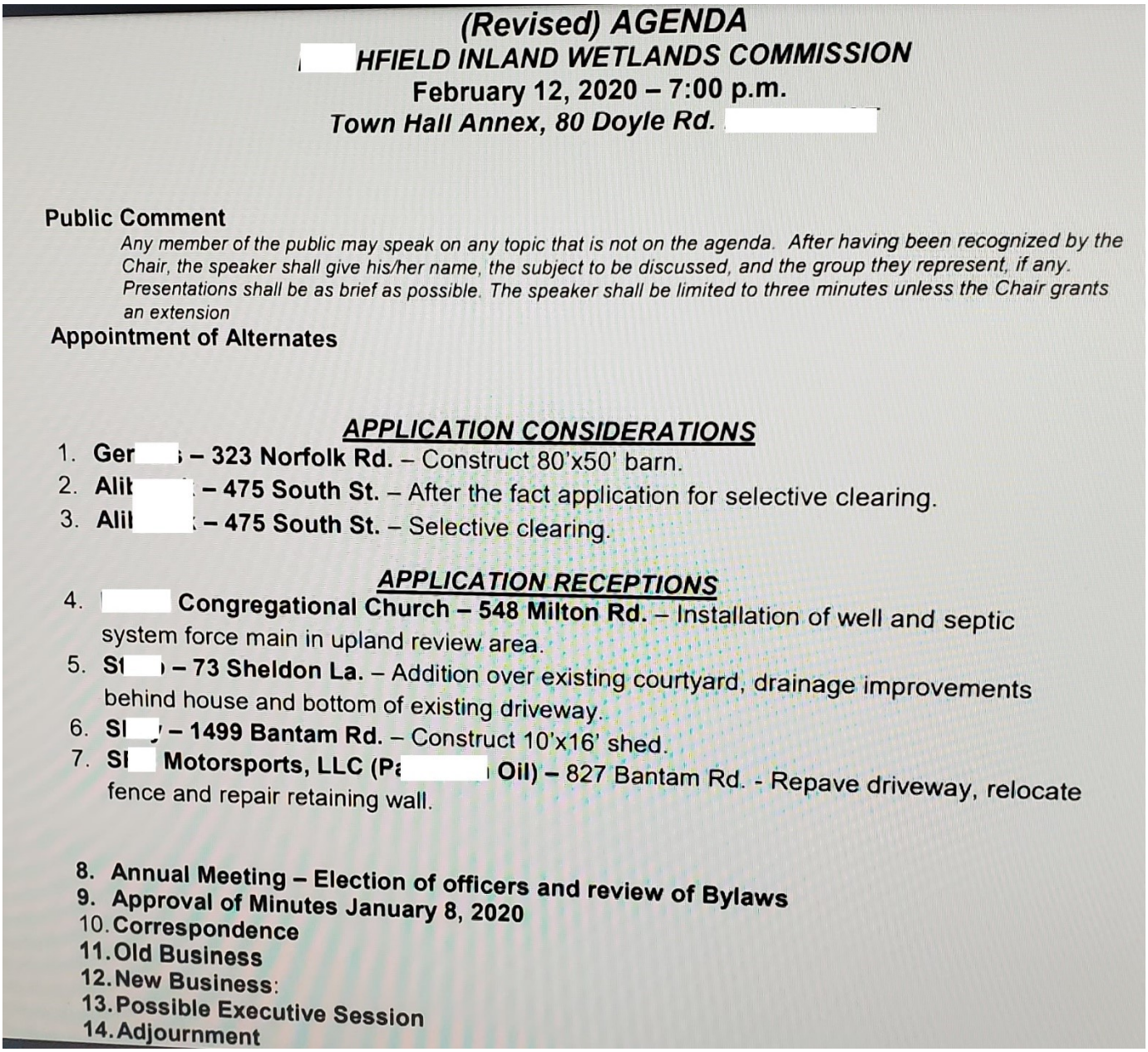
Detention and retention basins normally are constructed closer to but not within wetlands where more watershed can be captured, treated and retained to pre-existing runoff discharge levels. Engineers must site these at or near upland review areas, as the Board must so agree. More discussion on engineered features and a simple detention facility design will follow.

Winter Scene of a Detention Basin

APPLICATION PROCEDURE

An application form and application fee, depending on the intensity of activity is usually the first step of the process. Meeting with the Board's staff or other representative can be helpful, and all that is said off the record is not indicative of how a Board will later vote. Some boards require a mandatory pre-hearing meeting, to clarify what will be needed. In addition, if a project is located near (sometimes five hundred feet from) another municipality, that town, county or city might also have to be informed by the applicant of the proposed activity.

Often, the Application Form requires the owner and applicant's signatures, a site plan, a soil scientist report, surveyor stamp on flag location mapping, and a professional engineer's stamp or seal on drainage calculations and site plan. It is not uncommon for the Form to request that nine copies be submitted of all materials. One will be for the official public records file, and one for each of eight Wetlands Board members. These submissions are often due weeks before a meeting, so that Board members can review paperwork before official meetings. Usually, the paid staff Wetlands Enforcement Officer will receive your package with drawing and report copies, and mail them individually to the volunteer board members' homes or places of business. Digital .pdf drawings may or may not be utilized. A sample meeting agenda is next.



(Revised) AGENDA

HFIELD INLAND WETLANDS COMMISSION

February 12, 2020 – 7:00 p.m.

Town Hall Annex, 80 Doyle Rd.

Public Comment

Any member of the public may speak on any topic that is not on the agenda. After having been recognized by the Chair, the speaker shall give his/her name, the subject to be discussed, and the group they represent, if any. Presentations shall be as brief as possible. The speaker shall be limited to three minutes unless the Chair grants an extension

Appointment of Alternates

APPLICATION CONSIDERATIONS

1. **Ger – 323 Norfolk Rd.** – Construct 80'x50' barn.
2. **Alit – 475 South St.** – After the fact application for selective clearing.
3. **Alil – 475 South St.** – Selective clearing.

APPLICATION RECEPTIONS

4. **Congregational Church – 548 Milton Rd.** – Installation of well and septic system force main in upland review area.
5. **Sl – 73 Sheldon La.** – Addition over existing courtyard, drainage improvements behind house and bottom of existing driveway.
6. **Sl – 1499 Bantam Rd.** – Construct 10'x16' shed.
7. **Sl Motorsports, LLC (Pa Oil) –** 827 Bantam Rd. - Repave driveway, relocate fence and repair retaining wall.

8. **Annual Meeting – Election of officers and review of Bylaws**
9. **Approval of Minutes January 8, 2020**
10. **Correspondence**
11. **Old Business**
12. **New Business:**
13. **Possible Executive Session**
14. **Adjournment**

Actual Board Agenda showing three items for voting approval & four projects to be received.

Wetlands Board meeting in session

A permit on a complicated application will not usually come up for a vote until the following meeting, so that Board members can absorb the information, and not make a hasty decision. For regularly scheduled monthly meetings, this could involve a minimum 30-day process, so schedule accordingly.

If a meeting is held as properly noticed by posted agenda, the applicant is given the opportunity to present the project to the Board. The days of flipchart 24 by 36-inch prints on tripod easels are giving way to PowerPoint presentations with AutoCAD PDF files shown on screen for all to see. A color-coding showing Wetlands Areas and Buffer Area Limits is not unusual. Blue can be for Watercourse, green for Wetland, and yellow for the limit of the Upland review Buffer area. At the meeting, the Chairperson presides. There are commonly past Meeting Minutes and business items for their attention, as well as a list of projects before them. Some courteous Boards have been kind to audience and owners (paying professionals by the hour) by handling housekeeping items at the end of the agenda, giving audience members the option to listen to business not pertaining to their specific application, or to leave. When it is your turn, it is probably best not to address Madame Chairwoman (too formally) nor by their first name, (too informally), unless you must, or are a routine, familiar applicant.

If the Board consists of experienced volunteers, they will be familiar with your typical issues. They anticipate a brief summary and description of the site plan and report, which you previously submitted to them. Expect interruption questions as you go from any Board member and give them the courtesy to answer immediately when asked.

At this time, you may wish to indicate alternatives that were found to be infeasible by your Alternatives Analysis. Conclude by summarizing why your application package before them meets all of their regulations and should be approved. This is their real goal, not to stop or promote various projects. If upon presentation, the Board finds that it meets their standard definition as a complicated, significant activity, -enough to go before a future public hearing, they will decide so without your opinion. Do not urge them to skip a Public Hearing. Public Hearings will be similar to Zoning Board of Appeals Variance requests, or Planning and Zoning or School Board public hearings, with which you may be familiar. Hearings must be properly advertised by registered mail to abutting landowners, by email, by newspaper notice declaration, etc. This is usually done after the initial Wetlands meeting and prior to the public hearing meeting date set 30 or 60 days later. The earliest a public hearing can begin is at a future scheduled meeting, after this adequate notice time is given. More meeting time could be required for the Board to study public comments, and your replies; so, four to six months of time until the vote to approve is not unusual.

FIELD VISITS

Between the time of the submission and meeting or after the meeting and before the vote the Board may decide to make a field visit to your site.

On site

Field trip visits have evolved through the years. Sometimes only the Wetlands Enforcement Officer will tour the property, with or without the owner's representatives. At other times the entire Board decides to visit "*on Saturday morning at 11 a.m. after the tour of the Smith Wetlands application property*" to see conditions for themselves. If unauthorized work has proceeded without permit, "after the fact" processes are held to a higher standard, so expect a visit from the full contingent of Board members and note that application fees for after the fact activities can be several hundred dollars more. Usually, the engaged Professional Engineer makes apologies for ignorant owners, who tried to proceed under the radar.

Field visits in our time of open Freedom of Information follow certain fairness protocols. Now gone are the days where a few Board members may gather in private at a junk spare tire in a skunk cabbage patch and decide amongst themselves that the project should not be approved.

The Chairperson if there, usually leads discussion that may be limited to observing only where they are on site and no other talking. The Field Visit can be documented in writing or recording minutes or notes to be added to the Project Record for vote consideration at a future meeting. The owner and/or owner's engineering applicant representative may listen to spoken concerns by Board members, and may be invited to answer questions, mostly to orient the Board as to their location on the property. All numbered wetlands flags should be visible and replaced if torn off by deer or wind, so that those with site plan in hand know exactly where they are on the property. Having stakes and ribboning at proposed building locations can also help the Board understand what the final development will be like.

Proposed house location.

PUBLIC HEARINGS

After any field visit and before a formal meeting to vote on approval or not, a public hearing may be held. Usually, the public is not allowed on field visits, but may be, depending on many factors, including necessity, owner permission or denial. The public may listen at regularly scheduled meetings but usually are not allowed to provide testimony.

Board members may have seen a property so they can be knowledgeable for the public, who will be commenting before the Board at the later, evening public hearing meeting. Public hearing procedures are legally defined. The hearing usually starts with the engineer repeating the presentation given at a previous meeting but in more depth, for the public to see and hear. Public comments or questions may be answered by the engineer, as the Chairperson so desires. If the applicant is asked to wait until all public comments are delivered, the wise engineer takes notes on relevant issues and attempts to respond accordingly, so the public and Board can hear. Do not waste note time on irrelevant issues such as traffic or school impact. If issues are important or unexpected, and the public hearing is held open by the Chairperson and Board until a future meeting, the engineer can submit written testimony in the interim, showing why public comments of concern have been or will be addressed.

Presentation to the public

Engineers must keep cool during public hearings. Real stories are explained now to better prepare you for anything that could happen. A professional engineer in another state described how a citizen stood up at his project's Wetlands Public Hearing, holding a flower on the endangered species list, to be destroyed by the proposed construction. After the shock and awe, a mistake in flower classification was confirmed in time for the next meeting, where the permit was then issued.

Another Wetlands Public Hearing had a neighbor on a Lake show frustration for submerged geothermal pond loops proposed at only six-foot depth as a swimming hazard. The engineer's reply was that the neighbor was mistaken because the loops were to be submerged fifteen feet deep as the owner reported such depth to be. How embarrassing it was, when the owner admitted for all to hear that the fifteen-foot depth was actually out further in the lake than was reported, and the 6-foot depth drawings presented to the engineer earlier was incorrect. This embarrassment forced a withdrawal of being the formal applicant and motivated the engineer next time to insist that a licensed land surveyor provide soundings of pond bottom topography. Or that the engineer insists on taking those depth soundings for a fair fee.

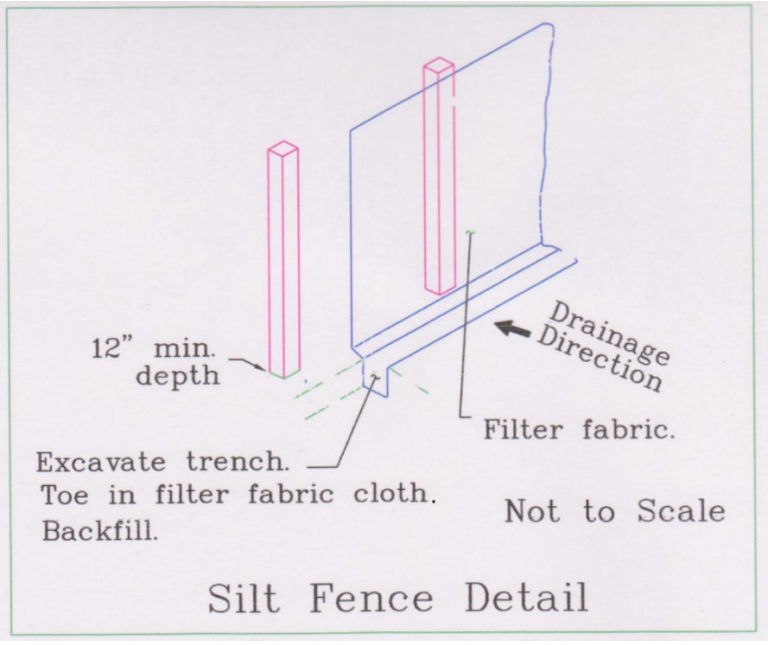
Public hearings must be managed by the Engineer, Owner, Soil Scientist and Attorney to stick to regulation type issues. It is a good opportunity to strengthen the Record, should the motion ever be appealed at the judicial level. With Wetlands Boards reportedly winning ninety five percent of the cases before a judge, avoidance of going to court by the applicant at almost all cost is prudent. Applicants will also want to avoid court appeal of a voted Board Approval by a neighbor who claims to be harmed. Often, a Board rejected application that cannot be modified according to negative comments received may simply be resubmitted in a new application with alternatives used instead. And acceptance of a Motion to Approve with a list of Board "Conditions" is common.

TECHNICAL ISSUES

The Board will expect professional engineers to be expert in the typical issues that appear before them, and especially the most common control on all soil disturbance projects, the **Soil Erosion and Sedimentation Controls.**

Erosion and sedimentation control silt fencing becomes the de facto Limit of Disturbance relative to the Wetlands. A typical fence at an existing meadow is shown below.

200 linear feet of filter fabric or "silt fence" protect the pond at the bottom of the hill before excavation starts in wintertime.



Typical Silt Fence Detail.

Wood posts are supposed to be located on the downhill side to resist flow.

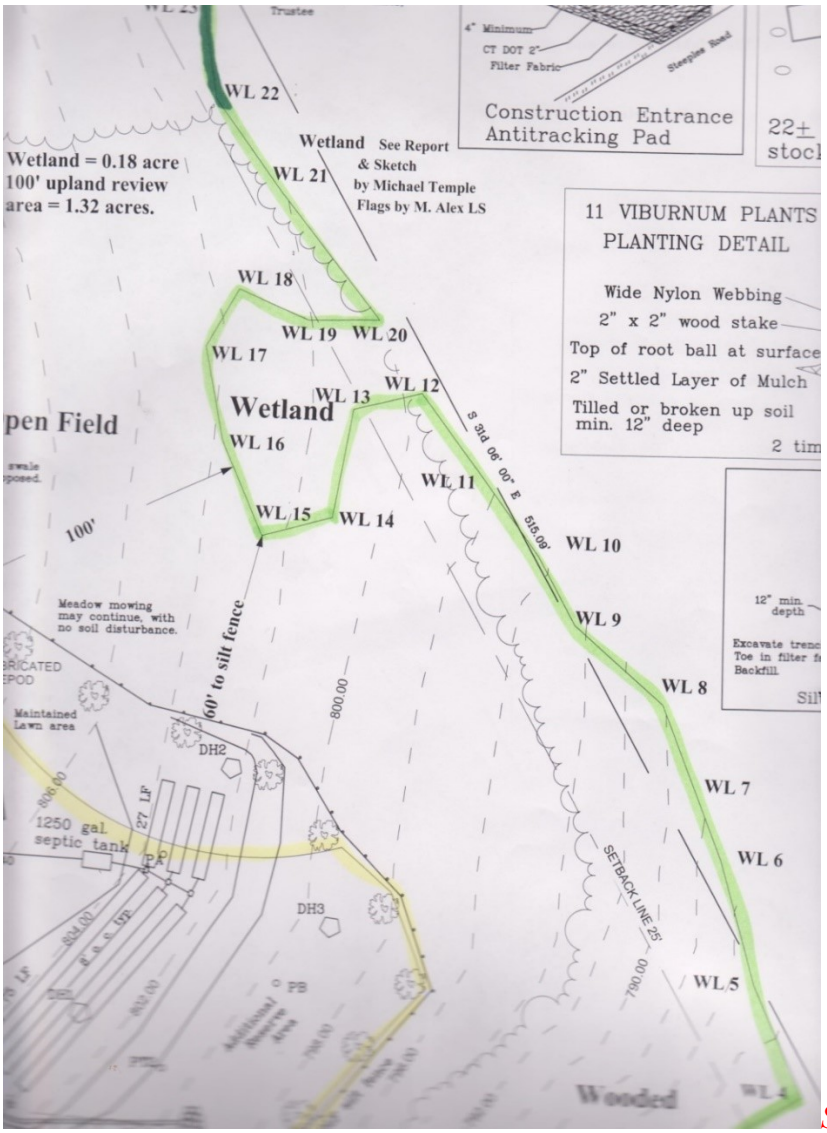
But posts are sometimes on the uphill side stressing the staples!

If soil disturbance constitutes a regulated activity and the upland review area definition extends one hundred feet from each pink Wetlands flag, the Board will expect to see a silt fence line one hundred and one feet (or further) away from those flags on your site plan.

This allows track hoe movement and digging beyond their jurisdiction and prevents soil from washing into the one-hundred-foot buffer area, and possibly into a Wetland itself.

Track Hoe Excavator stays uphill of the silt fence limit of disturbance.

If proposed work activity requires more area and you set the silt fence sixty feet from pink flags, Board members may ask why it cannot be seventy-five feet away. They know that distance allows runoff filtering, especially downhill. Perhaps in order to meet septic system construction guidelines (that might require minimum leaching system spread to engage a wide swath of absorption soil) leaching trenches must be constructed to within 80 feet of an adjacent side wetlands, with twenty feet of room for select sand fill and track hoe movement. The silt fence barrier must be sixty feet away for a feasible construction, and would usually be so approved, as it was here. The attached sketch shows this. Note green wetlands flags and yellow one hundred foot buffer, from this 24" x 36" print submitted to the Board.

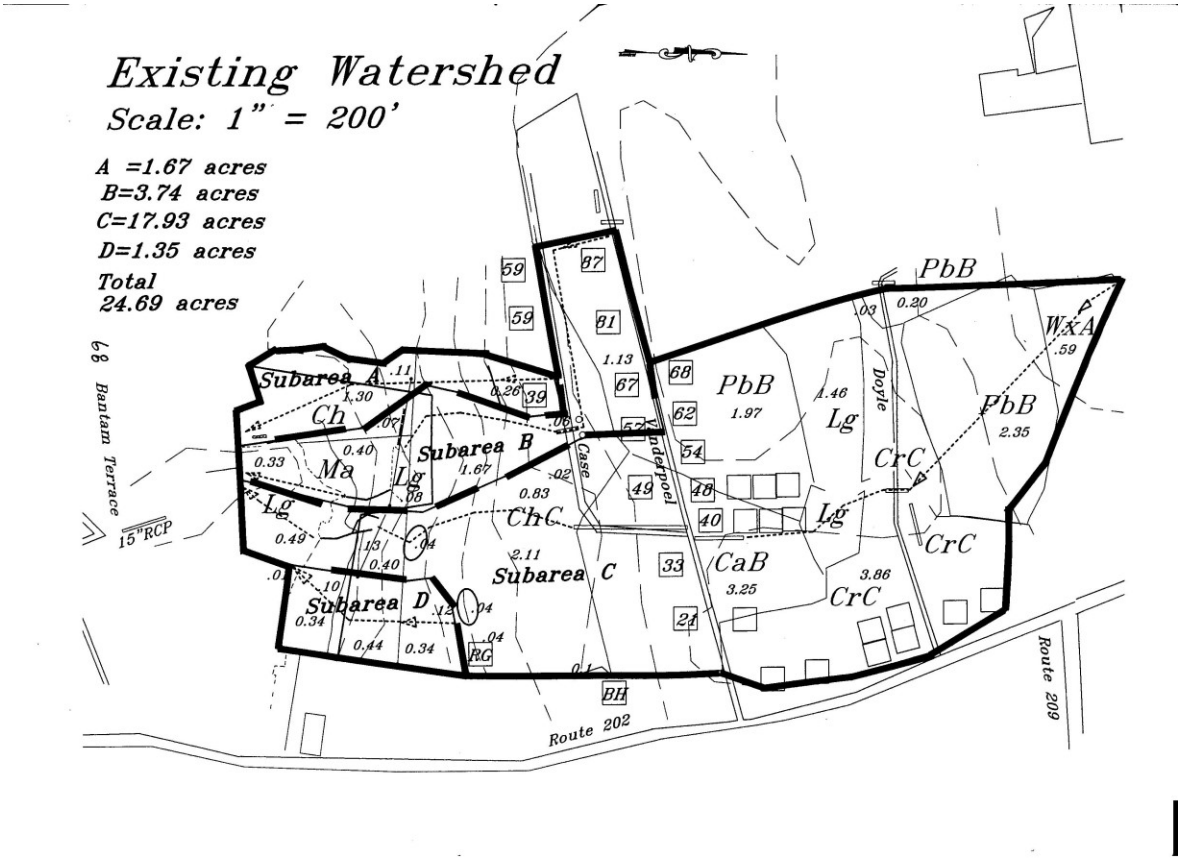


Septic system approved laterally.

The days where Boards would ask why not build a three-bedroom house alternative, instead of a four-bedroom house, appear over, after the 2008 building construction economic decline. Single family residential proposals are now less frequent and seem to be better received.

Also, activity sixty feet from the side of a wetland running down a hill is voted more permissible than sixty feet directly uphill, which will tend to drain contaminants straight into a Wetland directly down gradient. While engineers understand that surface runoff proceeds perpendicular to level contour line topography, novice Board members may not easily realize this, and can be shown the watershed diagram, draining to the Wetland if necessary. Boards will

expect design engineers to delineate watersheds and shed border sub drainage basins with ridge lines, shown below as heavy solid and dashed lines to assist them in judging potential impact from soil disturbance to Wetlands they protect.



Most experienced Board members can also envision sheet flow pattern impact perpendicular to the two-foot contours shown on site and grading plans, where the watershed is significant or very steep. They will expect proper slope stabilization techniques (as shown below) to be specified.

Straw mat is stapled into the steep hillside. Grass seed can germinate through it.

The typical detail of a silt fence located at the toe of a steep hill, or containing a large watershed acreage above, might require beefing up, with either a second parallel silt fence or an additional staked hay bale barrier. State Erosion and Sedimentation Control Manual Guidelines provide ready-made drawing details. They have Notes and Specifications, which towns and counties and Boards accept, along with their own publications.

SEQUENCING

Sequences of Operation for the Wetlands enforcement officer to follow during construction are usually not boilerplate and must be specifically written by the Engineer/ Designer. Here is one example sequence:

HOUSE CONSTRUCTION SEQUENCE:

1. Layout house corner & field locations.
2. Install silt fences & anti-tracking pad.
3. Notify XXX Town to inspect Erosion & Sedimentation (E & S) Control measures at least 48 hrs. (2 business days) in advance of next steps.
4. Excavate and install sewage fields.
5. Excavate and fine grade driveway.
6. Mulch all embankments.
7. Excavate and build foundation.
8. Set house with crane.
9. Drill well and geothermal boreholes.
10. Maintain erosion control measures.
11. Backfill, place topsoil and seed.
12. Plant buffer plants as shown.
13. Mulch as required until stable.
14. Once stable, remove fence & mulch.

The typical Wetland submission plan will have the lot lines, contours, wetlands flags as numbered, existing and proposed structures and facilities, plus Notes, Details, Specifications and Sequence of Operations. Be sure the contractor does not use a separate grading or sewage disposal design plan or other plan, instead of the approved Wetlands site plan. If unavoidable, always place a note on that plan referring to the existence of a separate Wetland submission plan for adherence. Whether a blueprint paper or PDF accessed by the site superintendent's handheld mobile device, the Wetlands plan approved should always be available in the field. Sometimes

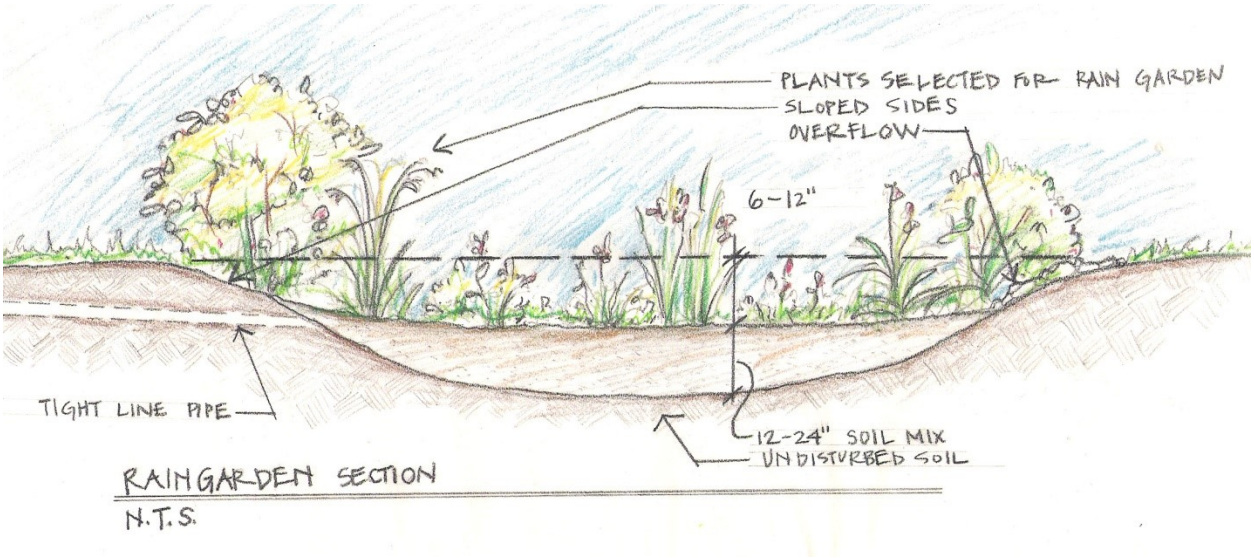
some Boards will require that their Wetlands Enforcement Officer be notified 24 or 48 hours prior to initiation of any construction activity, so that E&S controls can be inspected for proper toe in.

COMMON WETLANDS FEATURES

Other common Wetlands features to be designed by engineers are:

Rain Gardens.

Modern state health codes now allow rain gardens immediately down gradient of septic systems, (as the only allowed intrusion into those soils) showing how widely promoted their use is becoming. Plants selected are usually native to the geographic location.



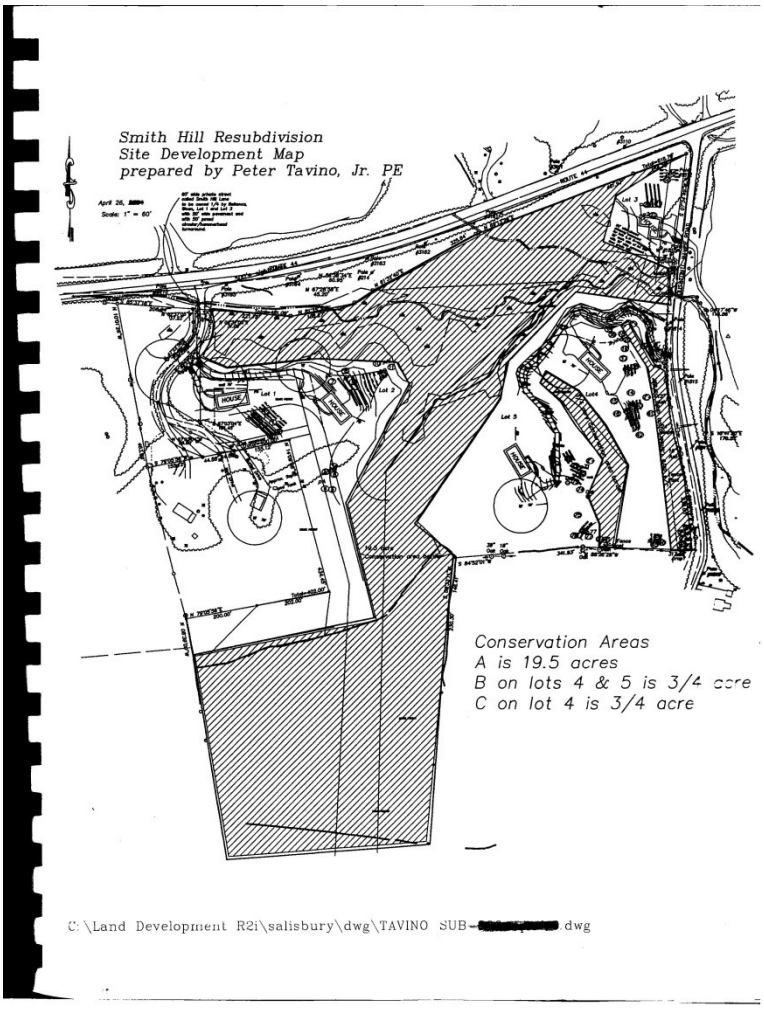
Operational Rain Garden

Sometimes a Rain Garden can be used as a mitigation feature to filter storm water and enhance landscaping. Select the native plantings carefully depending on soil moisture you anticipate. Some common plants that have been used include: Viburnum, Winterberry, Pussy Willow, Dogwood, Marsh Marigold, Blue Iris, Cardinal Flower, etc.
https://www.thespruce.com/plants-that-can-live-in-wet-areas-4767394

A Rain Garden that is also a butterfly pollinator habitat. The riprap outlet channels from the house moisten the low-level Giant Milk Weed and native flowering butterfly-friendly bushes and trees. Everything drains to sandy soils. Ground cover treatment is from local pine needles produced by mighty "Slash Pine Grand Trees" in the back yard for sustainability.

Conservation Easements

If Wetlands must be filled, with no suitable alternative, remediation or trade off should be proposed. Constructing new Wetland elsewhere is addressed below. Another popular tradeoff is to preserve conservation lands in perpetuity by deed restriction or easement in favor of a local land trust, or other entity. Wooded land that would not otherwise be needed for construction or ornamental landscaping can be mapped out, left in its natural state, and placed in permanent conservation, per conditions filed on the municipal land records, as part of the Wetlands application process.



INVASIVE PLANTS

Another popular remediation is the promised removal (to root surface at least) of invasive plants on the uplands site. These tend to radically change Wetlands health and should be properly identified in the field by an expert, mapped, and shown to be mechanically removed by hand or excavator brush hog for example, and not sprayed by Round Up or other herbicide.

Conservation District Expert inspects and classifies invasive herbaceous perennials on site.

Note that the Barberry invasive plants bloom before the native plants in the early Spring image below:

Light green invasive barberry bushes

Alternately, where invasive plants are undesirable, endangered species are highly desirable. Consult state maps with certain confidential settings of secretive natural resources mapping.

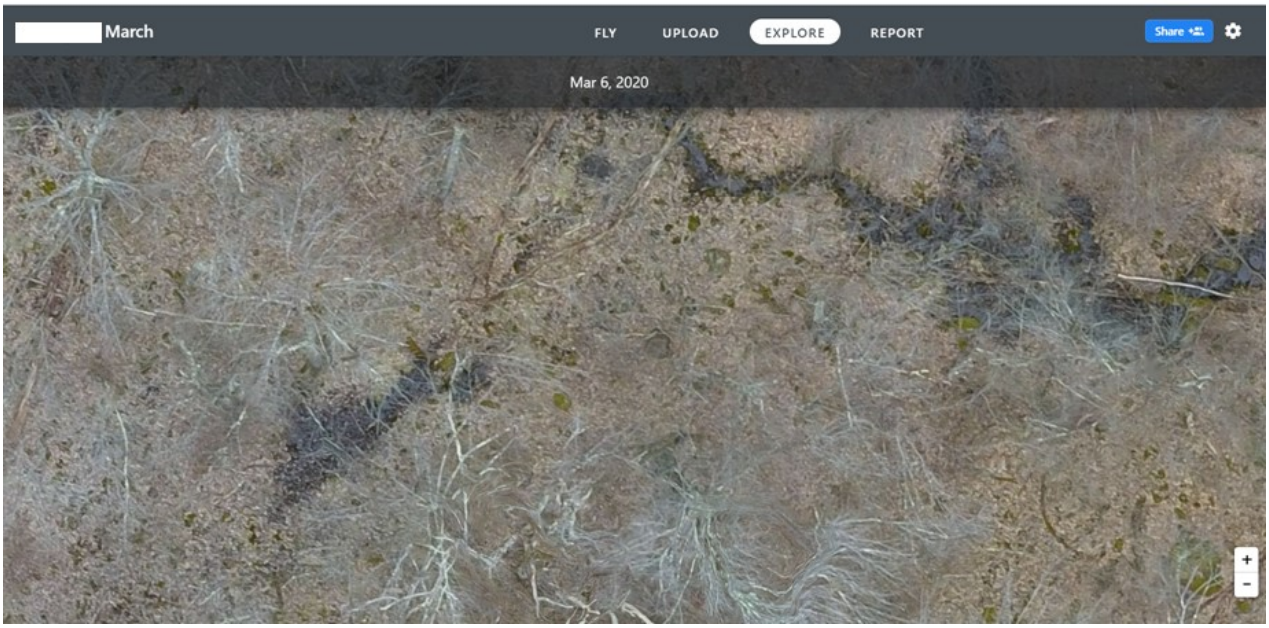
VERNAL POOLS

Vernal pools are another important issue for Wetlands Boards because they may be a breeding habitat for salamanders and amphibians in the Spring only and disappear in summer or fall. These and turtle habitat will be considered for protection by most Boards. Drones might be used to easily locate vernal pools with the landowner's permission, allowing a ground tour to proceed more efficiently over large acreage parcels.

Should a Wetlands Board or neighbor have the right to view land from Federal Aviation Administration controlled air that does allow for such view? A neighbor who understands that a

developer might begin the application process in the summer, might try to find vernal pools on a site in March for the Wetlands Board to examine in depth when they are allowed on the property after application is made. A Michigan court order in 2021 on zoning suggests that a search warrant might be warranted first.
https://www.detroitnews.com/story/news/local/michigan/2021/03/19/appellate-court-says-township-violated-michigan-couple-privacy-drone-photos/4764083001/

Perhaps the dark area in the lower left portion of the image below is a vernal pool draining to the intermittent watercourse in the upper right side of that image. It should be ascertained with a close-up inspection by a qualified professional.



Continuing with drone usage to enhance a wetlands application, healthy plant health concentration in a water body is easily depicted if the application involves dredging dock installation or weed harvesting in a lake or pond. (from Drone Deploy software)

Green colored areas have good plant health while red areas do not. So lake algae can be so mapped.

OTHER BEST MANAGEMENT PRACTICES

The engineer applicant should be familiar with all available Best Management Practices, (BMPs) beyond these sampled, such as Energy Dissipater riprap channels at culvert outfalls, bioremediation, permeable paver blocks, phosphorous removal techniques, fertilizer management programs, arch bridge span advantages over pipe culverts in fill, and wall construction replacing side slopes to reduce Wetland fill area.

Major Facility Best Management Practices such as Retention and Detention Basins and Ponds can be designed following advice in these listed SUNCAM courses by author David E. Fantina, PE:

169-Design of Drywells

171-Design of Sand Filters & Bioretention Systems

172-Design of Constructed Stormwater Wetlands

174-Design of Infiltration & Extended Detention Basins

189-A Guide to Low Impact Development

212-A Comparison of Runoff Estimation Techniques

The engineer's use of a full "toolbox" of design options will lead to a smoother process avoiding costly redesign.

A simplified minor **Detention Facility Design Example** is shown next. It is from the author's past job using hand calculation of the Rational Method for Peak Runoff and Storage. See the resulting Professionally Engineered and sealed design plan below.

This Engineering Site Plan will be used to demonstrate how to store the runoff increase from a 25-year frequency storm, so that there is a zero increase in offsite runoff due to development. The 20-minute per inch percolation rate can be considered to dissipate storms at 25- and 50-year frequency. A 10-year storm is stored with no reliance on soil absorption. Half of such a storm (and all smaller storms) will be stored in the plastic underground chambers. The remainder will be stored in the rain garden and berm down gradient, which shall contain even greater storage volume.

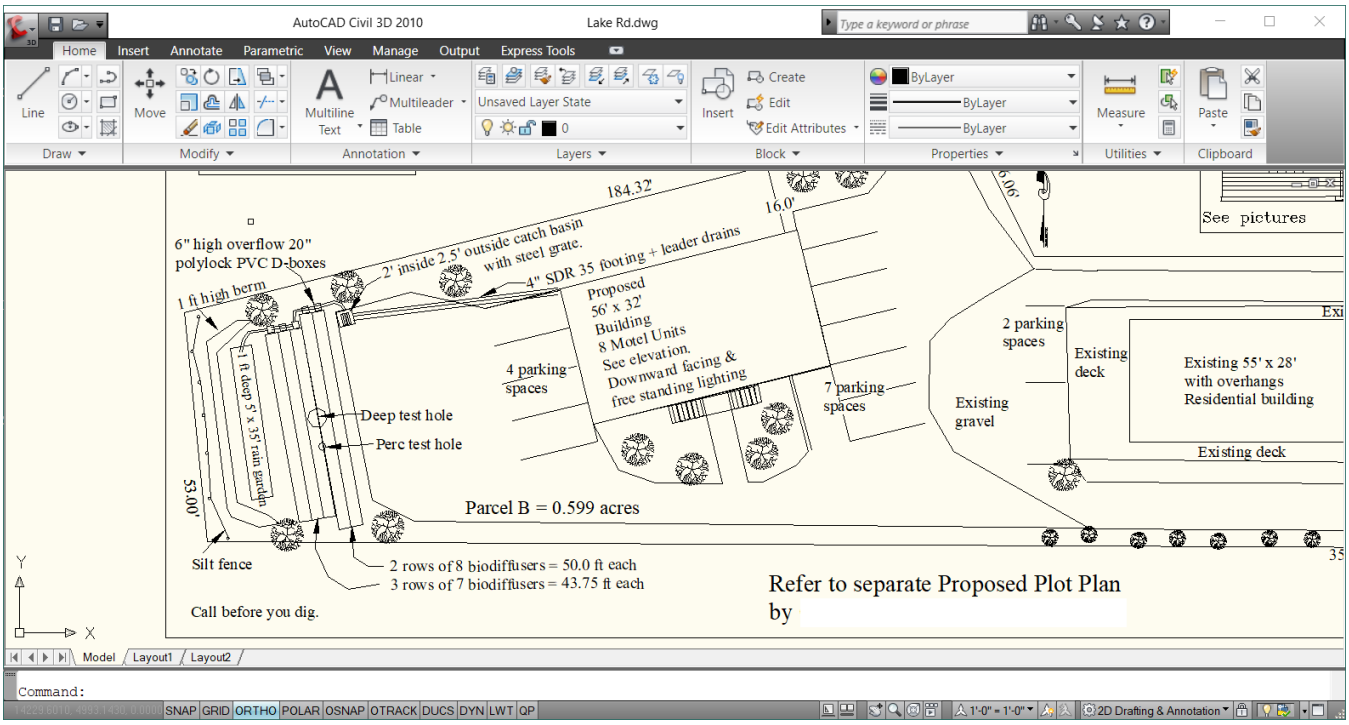
For the existing meadow changing to a 56 ft x 32 ft building plus gravel driveway and parking with less pervious surface, Runoff Coefficient increases from 0.3 for meadow to 0.85 for building and 0.5 for gravel.

Storage volume Q = C x I x A. (runoff Coefficient x Inches x Area)
I = Inches of runoff for a 10 year storm in Connecticut =
170/(23+20minutes)/12 = 0.329 ft

For the building, C increase = 0.85 - 0.3 = 0.55 Area = 1792 sq. ft.
Q = 0.55 x 0.329 x 1792 = 324 cu ft. to be stored.

For gravel, C increase = 0.5 - 0.3 = 0.2 Area = 5452 sq. ft.
Q = 0.2 x 0.329 x 5452 = 358 cu ft. to be stored.

Total stored in Bio diffusers and Rain Garden = 324 + 358 = 682 cu ft
Each Bio diffuser stores 9.21 cu. ft = 37 required for half = 682/2 = 341 c.f.
Rain garden and berm at 2' depth must have a footprint area > 171 sq ft.
341 cu ft in Bio diffuser chambers + 341 cu ft in rain garden = 682 (OK)



WETLANDS BOARD TRAINING

States usually have training programs and continuing education available, especially for their new Board members. Much of this is now by video online, such as this one.

http://www.ct.gov/deep/cwp/view.asp?a=2720&Q=434010&deepNAV_GID=1907

This training is presented by State Engineers, Attorneys, successful veteran Chairpersons and Wetlands Enforcement Officers.

In the past, perspectives from the Home Builders Association used to be presented. One year the author's Home Builders Association - Developers Council was asked to present information during the new Board member Training. The author showed them a sand filter design beneath a detention pond, situated just above an important city reservoir. The state Dept of Environmental Protection gave rave reviews of the detailed design. This was during the early days of the Maryland Center for Watershed Protection, which featured success in Austin, Texas with pollutant removal from sand filters. During the demonstration, showing how clean the water sample was from the outlet pipe, yours truly drank a portion of it in front of the audience to show its purity. But the next day he became mildly sick and learned the hard way, the difference in bacteria count, between deep groundwater well sourced potable water, and filtered water at grade! Don't make this same mistake! Less drama is better!

These meetings also familiarize Board members with legal do's and don'ts, and perhaps a relevant court case review. When they begin their duties, Board members are given a large manual to read with typical wetlands images, plans, details and text to which they may refer. This manual will be used in the course of their oversight work, and it would behoove the design engineer to know of its content as well. But mostly the Board knows its own regulations cold and will instantly recognized instances where they are not being met. These regulations booklets are almost always present at the regularly scheduled meetings. In addition to initial training, state associations of Wetlands Boards provide continuing education conferences with topics ranging from the latest court case findings to technology use, to presentations of successful mitigation procedures, etc. If meeting attendance is open, the practicing applicant engineer is welcomed to participate.

IMPLEMENTATION IN THE FIELD

Successful soil stabilization and completion of the permitted work is guaranteed if the engineer oversees the approved design. After notifying the Wetlands Enforcement Officer that the erosion control silt fence and hay bales are in place and may be inspected (because excavation work is planned to start in about 2 days) the Engineer should be prepared to show the enforcement officer how the approved site plan as designed will be installed and implemented. Any changes to the approved plan that are major might have to go back before the entire Board at their next meeting. Minor adjustments can usually be approved by the Wetlands Enforcement Officer. At the conclusion of the project, when all disturbed soil areas have been mulched and seeded or plantings have been complete, an optional As Built drawing for the owner may or may not be required.

Be sure that contract work prior to design that includes field inspection work is determined in writing before proceeding. If the Board does not take a monetary performance bond to ensure that the project is built as designed, the owner might opt to not install expensive plantings and such as promised for a rain garden for instance. And work anticipated by the engineer or Soil Scientist will not be performed. This is unfortunate.

But most projects will go smoothly when the engineer works with the Wetlands Board and enforcement officer to implement a project that has been carefully planned, reviewed and approved. After the first project is designed, constructed and inspected, your future projects will flow smoothly.

Thank you for taking this SUNCAM course. May the knowledge you have gained lead to better projects near Wetlands that are under your influence. Good Luck!