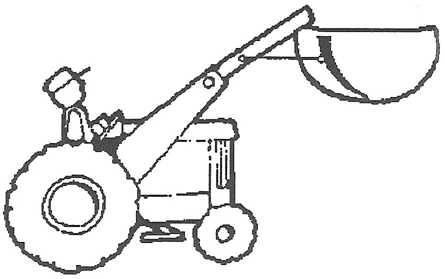


Flanigan Excavation

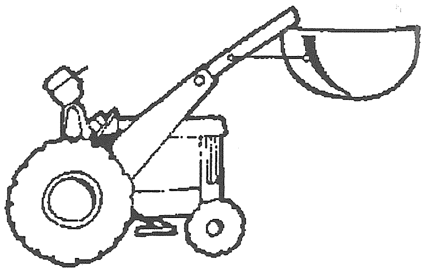
Haddam, Connecticut

Eastern Connecticut Environmental Review Team Report

Eastern Connecticut Resource Conservation & Development Area, Inc.

Flanigan Excavation

Haddam, Connecticut



Environmental Review Team Report

Prepared by the
Eastern Connecticut Environmental Review Team
of the Eastern Connecticut
Resource Conservation and Development Area, Inc.

for the
Inland Wetlands Commission
Haddam, Connecticut

November 1996

CT Environmental Review Teams
1066 Saybrook Road, P.O. Box 70
Haddam, CT 06438
(860) 345-3977

Acknowledgments

This report is an outgrowth of a request from the Haddam Inland Wetlands Commission to the Middlesex County Soil and Water Conservation District (SWCD). The SWCD referred this request to the Eastern Connecticut Resource Conservation and Development Area (RC&D) Executive Council for their consideration and approval. The request was approved and the measure reviewed by the Eastern Connecticut Environmental Review Team (ERT).

The Eastern Connecticut Environmental Review Team Coordinator, Elaine Sych, would like to thank and gratefully acknowledge the following Team members whose professionalism and expertise were invaluable to the completion of this report.

The field review took place on Wednesday, September 25, 1996.

Nicholas Bellantoni	State Archaeologist UCONN - CT Museum of Natural History (860) 486-5248
Norman Gray	Geologist UCONN - Dept. Of Geology and Geophysics (860) 486-4434
Ann Hadley	Executive Director/Geologist Middlesex County Soil & Water Conservation District (860) 345-3219
Doug Hoskins	Wetland Specialist/Environmental Analyst III DEP - Inland Water Resources Division (860) 424-3903
Ann Kilpatrick	Wildlife Biologist DEP - Wildlife Division (860) 295-9523

Dawn McKay	Biologist/Environmental Analyst III DEP - Natural Resources Center (860) 424-3592
Brian Murphy	Fisheries Biologist DEP - Fisheries Division (860) 295-9523
J. Eric Scherer	Resource Conservationist USDA - Natural Resources Conservation Service (860) 688-7725

I would also like to thank Roger Alsbaugh, Haddam wetland enforcement officer, Leslie Starr, inland wetlands commission member, William Flanigan, the property owner and Terrance Lomme, the attorney for the property owner for their cooperation and assistance during this environmental review.

Prior to the review day, each Team member received a summary of the proposed project with a general location and soils map. During the field review Team members were able to view updated plans and were given additional information, Following the review, reports from each Team member were submitted to the ERT coordinator for compilation and editing into this final report.

This report represents the Team's findings. It is not meant to compete with private consultants by providing site plans or detailed solutions to development problems. The Team does not recommend what final action should be taken on a proposed project - all final decisions rest with the Town. This report identifies the existing resource base and evaluates its significance to the proposed development, and also suggests considerations that should be of concern to the Town. The results of this Team action are oriented toward the development of better environmental quality and the long term economics of land use.

The Eastern Connecticut RC&D Executive Council hopes you will find this report of value and assistance in making your decision concerning this proposed sand and gravel excavation.

If you require additional information please contact:

Elaine Sych, ERT Coordinator
CT ERT Program
P.O. Box 70
Haddam, CT 06438
(860) 345-3977

Table of Contents

Page

Introduction

Introduction

The Haddam Inland Wetlands Commission (IWC) has requested an environmental review of the Flanigan Gravel Excavation and proposed enlargements to existing pits.

The 32.9 acre parcel is located between Cedar Lake Road and Route 9. Access to the site is from Cedar Lake Road via a 55 foot access strip. The site is currently being excavated under a permit issued earlier in the year, and the site has a long history of excavation possibly dating to pre-1950.

A new plan has been submitted to enlarge the excavation areas of Pit #1 and Pit #2 in areas close to Turkey Hill Brook, wetlands and a pond.

Objectives of the ERT Study

The Haddam IWC has asked for assistance with the review of the proposed expansion areas with regard to their potential impacts on the brook, wetlands, water quality, fisheries habitats and wildlife, as well as long term impacts to the entire site.

The ERT Process

Through the efforts of the town this environmental review and report was prepared for the Haddam IWC.

This report provides an information base and a series of recommendations and guidelines which cover the topics requested by the commission. Team members were able to review plans and supporting documentation provided by the applicant. A preliminary report highlighting erosion and sediment controls was given to the commission in mid-October (a copy may be found in the appendix).

The review process consisted of four phases:

1. Inventory of the site's natural resources;
2. Assessment of these resources;
3. Identification of resource problem areas and review of plans; and
4. Presentation of management and land use guidelines.

The data collection phase involved both literature and field research. The field review was conducted on September 25,1996. The emphasis of the field review was on the exchange of ideas, concerns and recommendations. Being on site allowed Team members to verify information and to identify other resources.

Once Team members had assimilated an adequate data base, they were able to analyze and interpret their findings. Individual Team members then prepared and submitted their reports to the ERT coordinator for compilation into this final ERT report.

Location and Topography

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N

Scale 1″ = 2000′

——— Approximate Site

Geology

Bedrock Geology

Although bedrock is not exposed on the site itself, roadcuts on Route 9 just west of the site consist of interbedded rusty weathering crystalline schists and gneisses belonging to the Upper member of the Middletown Formation (Bedrock Geologic map of Connecticut, Rodgers, 1985). One 100 foot thick sulfide rich layer exposed there is especially rusty suggesting the local groundwater might be unusually iron and sulfur rich.

Surficial Geology

The Flanigan Gravel pit is situated on a kame terrace - delta complex on the western side of the Turkey Hill Brook Valley. This and other sand and gravel deposits along Turkey Hill Brook, and Filley and Jericho Roads, all of which lie at approximately 400 foot elevation, seem to have deposited at the edge of a temporarily ice dammed lake as remnants of the last major continental ice sheet were retreating northward 14,000 years ago. Although spectacular 30 foot high crossbeds and climbing ripples suggest most of the sand in the Flanigan pit was deposited underwater at the leading edge of a delta, coarse-grained gravel channels cut into the sands near the base of the deposit suggest the lake was frequently drained. Well defined minor faults, some with more than 10 feet of vertical displacement document the collapse of the steep eastern slope of the deposit whenever the lake emptied. When ice-dams broke the lake must have drained almost catastrophically, waters rushing through the low point on the north-south ridge just west of the site appear to have cut several, steep sided ravines 10 to 20 feet or more into the deposit.

The source of most of the sand in the pits appears to have been the local crystalline metamorphic rocks. However, the deposit does contain several 1 to 3 feet thick layers of red hematite colored sand that is characteristic of the red sandstones of the Connecticut Valley lowlands. The nearest source for this material is at least 10 miles northwest of the site. This suggests that sand was carried to the Flanigan deposit by a rapidly changing network of meltwater streams on the surface of the retreating ice sheet.

Sand and Gravel Resources

The Flanigan pit has substantial reserves of high quality sand and gravel. Like most kame delta complexes the sediments coarsen upwards. Gravel channels are thicker and more common at the top of the deposit. However, unlike many kame deltas the foreset beds, those deposited underwater, are not dominated by fine-grained sands and silts, material that is generally of little commercial value. The proposed pit expansion is certainly commercially viable and justified. For the most part the proposed excavations seem to be well above the local water table and thus should have minimal impact on the regional ground water system. Although water in Turkey Hill Brook which runs along the base of the site seems to have recently become enriched in iron, the lack of any rust or manganese precipitates in the coarse gravel lenses in the pits suggest that the iron is not coming from the deposit itself. However, because of the sulfide-rich zones in the Middletown Formation groundwater discharging to Turkey Hill Brook from the bedrock aquifer may be the cause for the iron bacteria in the stream. (Please also refer to the Water Resources section and Fisheries section for more discussion of the iron bacteria.)

Terminology

- **Climbing ripples** - a wave-like sedimentary bed formed by very rapid sedimentation.
- **Crossbeds** - sedimentary beds that are inclined with respect to the horizontal.
- **Kame terrace** - a terrace consisting of stratified sands and gravels along a valley side which was directly in contact with glacier ice when deposited.

- **Gneiss** - a high grade metamorphic rock, always coarse grained and foliated, with marked compositional layering, but with imperfect cleavage.
- **Schist** - a well-foliated metamorphic rock in which the component platy minerals are clearly visible.

Soil Resources

The landscape of this site is dominated by glacial outwash and glacial till soils (see Soils Map).This parcel is bisected northeast to southwest by a perennial stream. Along this stream lie glacial till soils (Soil Map Units Lg, Wzc, PbB, and CcB) while steeper soils of glacial outwash make up the surrounding areas (Soil Map Units HmE, HkC, and Pr).

The glacial till soils are represented by the Woodbridge extremely stony fine sand loam, soil map unit (WkC) which is nearly level to sloping and is a moderately well drained soil, while the Paxton and Montauk fine sandy loam, soil map unit (PbB) and Canton and Charlton very stony fine sandy loam, soil map unit (CcB) represent somewhat level to sloping, well drained soils. The Leicester, Ridgebury and Whitman extremely stony fine sandy loam, soil map unit (Lg) is found along the stream corridor and is a poorly drained and nearly level soil.

The glacial outwash soil map units Hinkley gravelly sand loam (HkC), Hinckley and Manchester soils (HmE) and Pits, gravel (Pr) represent over 60% of the sites' soils. The Hinckley and Manchester map units, like the pits and gravels, are sloping to steep, excessively to well drained soils.

Undisturbed soils at this site are in woodland, which is the predominant land use of these soils for the surrounding area. More detailed non-technical soil descriptions for each map unit can be found in the **Nontechnical Soils Description Report** in the appendix. *The Soil Survey of Middlesex County, Connecticut* indicates that only one soil map unit (Lg) located on the parcel is identified as a State of Connecticut regulated wetland soil. State regulated inland wetlands have been mapped and delineated in drawings entitled "Closure Plan for the Property of William F. Flanigan, Cedar Lake, Haddam, Connecticut" , sheet 1 and 2 of 2, dated February 1989 and revised 9/3/96. Additional plans submitted for review included Sheets 1 through 4 of 4, entitled "Closure Plan for the Property of William F. Flanigan, Cedar Lake Road, Haddam, Connecticut", dated February 1989 and revised 4-13-90.

The dominant soil features of this site are depth to bedrock (commonly greater than 60 inches) and the excessively drained to well drained nature of the non-wetland soils (see appendix, **Soil Features Reports**). Dominant water features of these non-wetland soils are depth to high water table (greater than 6.0 feet) and a perched water table on the soil map units of Lg, PbB and WzC (see appendix, **Water Features Report**). The sandy and gravely soils found on this site are currently being extracted for use off-site. The report **Construction**, found in the appendix offers general site information on these soils and their suitability for construction materials. The report **Physical and Chemical Properties of the Soil**, also found in appendix, offers additional information about the soils of this site.

Soils Map

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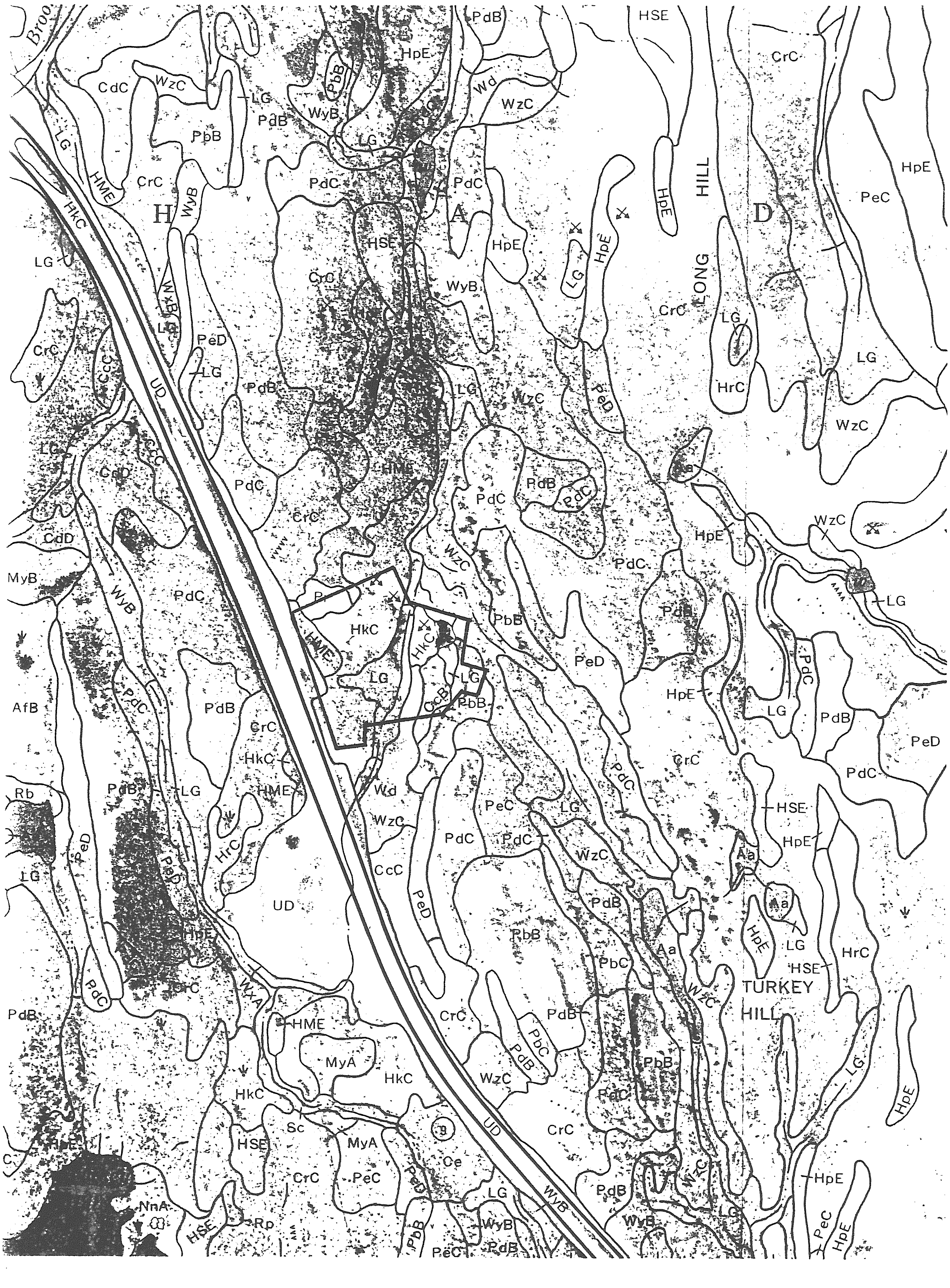
Scale 1" =1320'



Erosion and Sediment Control

Closure plans submitted do not indicate a final land use cover for this site, once extraction operations are completed. Restoration of the site will be dependent upon the expected final land use of the site. Final closure plans indicate that all final side slopes will be 2:1 or 2 feet (horizontal) to 1 foot (vertical). These steep slopes can be difficult to establish and maintain, particularly if ground water seepage is encountered.

Closure plans call for 4" of topsoil to be used in establishing a final vegetative cover. Due to the droughty nature of the soils found on the site where extraction will be taking place, it is recommended a more detailed plan be developed. This detailed plan should include a more suitable depth of topsoil that will provide seed material with an appropriate seed bed. It is recommended that the applicant develop a plan to replicate existing topsoil conditions to help ensure success of plantings.

The seed mixture suggested on sheet 4 of 4 is more adapted to finer textured soils (silts and loams) and not to coarser textured soils (sands and gravels). It is recommended that all slopes 3:1 or steeper be mulched with 2 ton/acre (or greater) straw mulch. This mulch should be anchored to ensure coverage and stability. Anchored mulch can be applied as a pre-manufactured blanket or by the use of a liquid tackifier with other appropriate mulch materials. A more detailed and site appropriate vegetative/seeding plan is needed for this site.

Due to the steepness of the proposed cut slopes, it is anticipated that the site will be hydroseeded and possibly hydromulched. Experience with hydromulching has shown varied success due to use of inappropriate mulch materials, application rates and the absence of a tackifier.

It appears that the extraction process for this site will be conducted on an irregular schedule, i.e., moving from one area of material to another, depending upon the demand of materials needed for construction projects. Consequently, a very proactive plan for stabilization, both temporary and permanent, of the site is needed. The current use of haybales as sediment barrier on this site are ineffective and do not follow standards set in *The Connecticut Guidelines for Soil Erosion and Sediment Control*. It is strongly recommended that geotextile sediment barriers with reinforcement be used along all perimeter areas, (i.e., wetlands). A preliminary report provided to the town, described in detail more specific recommendations on use of sediment barriers and stone check dams. (Please refer to the appendix for a copy of the preliminary report.)

On sheet 4 of 4 of the drawings dated 4/13/90, under **"Sedimentation and Erosion Control Measures"**, item I.4., it states that "the bottom of slope is to (be) cleared of all debris and deposited sediment "hydroseeded". It appears that the toe of slope adjacent to wetlands south of Pit #2 has tree tops and logs lined along the edge. As an erosion and sediment control measure, this is not an effective practice and the cleaning of any sediment from this area will be difficult. This material should be removed and disposed of appropriately.

The over-all erosion and sediment control plan is a good start in protecting both on- and off-site resources but needs to be more detailed, especially on the phasing and sequencing of the site and installation of measures. Additionally, the location of soil erosion and sediment control measures need to be located appropriately on plan so as to be effective.

The plans need additional details on the construction entrance pad and the sediment basins. These basins need to be appropriately sized and constructed. An operation and maintenance plan should be developed for the site to ensure each of the control measures are installed, operated and maintained appropriately.

A detailed sub-watershed flow/drainage way analysis needs to be completed for the site. This analysis should take into account the phasing of the site, ensuring all runoff and associated sediments are accounted for, and that storm runoff leaving the site is treated. Stabilized storm outlets are needed for the site to ensure that runoff from the site will not erode or pollute receiving waters.

The road access across the perennial stream should be upgraded and armored to prevent washing of road fines into the stream channel. There is a great deal of erosion to each side of the main travel road for the operation, and a lot of material washes down and across this sand road. It is recommended that several water diversion bars be installed across the road, directing water and sediment to settling areas at various intervals. Gravel check dams may also be placed in the side ditches to slow down the water and settle sediment.

In addition, a gravel tracking pad, like a construction entrance, should be added on the travel road across the stream culvert. This should also extend for at least 50 feet or so in either direction. This will help keep sediment from being easily washed off of this area and into the stream. (This should be installed similar to a standard construction entrance with filter fabric under the stone.)

Water diversions should be created on either side of the stream culvert to prevent sediment laden water from traveling down the travel road to the crossing and into the stream.

Several sites have been noted on the plans to act as equipment storage areas. There is no information on the plans detailing depth to bedrock or depth to ground water, and care should be taken to prevent ground water contamination from equipment and machine fluids. Contaminants will travel rapidly downward in this very permeable sandy material. To help prevent contamination, equipment should be stored on an impermeable surface, such as a concrete pad, which is designed to contain any material that may drip from the equipment.

A detailed inspection schedule should be developed for this site that will allow the Land Use Enforcement Officer to anticipate site condition needs, and ensure that changes to the approved plan are effective.

Wetland Resources

Included in this section are observations of the wetland resources, the impacts that the proposed activities may have on those resources and recommendations for future development of this parcel given these possible impacts.

The existing and proposed gravel excavation areas are situated next to Turkey Hill Brook which runs from south to north through the property. The brook has been impounded in the middle of the property to create a pond. Currently, most of the excavation activity has been kept approximately 50 feet from the wetland areas. During the site visit, a thin, even layer of orange-brown sediment was observed covering the stream bottom. Further inspection of the gravel pit and stream corridor on the property did not reveal any obvious source or pathways for this material to enter the brook, however, high concentrations of what appears to be an iron-feeding type of bacteria were observed between the access road culvert and the impoundment. Where water velocities were low, an orange gelatinous material was suspended throughout the water column. Orange stains were also observed on the gravel pit side of the stream where groundwater was flowing out of the bank and into the stream.

According to water quality experts within the DEP Inland Water Resources Division, the presence of oxidized iron precipitates in surface waters is often the result of land disturbing activities such as excavation in, or filling with iron-rich earth material. The bedrock and surficial materials in this area commonly contain high amounts of iron. In this case, it is very likely that rainwater infiltrating down through the disturbed surface of the gravel pits and flowing into the stream as groundwater or base flow is carrying with it high concentrations of iron, which combines with the oxygen rich waters cascading through the impoundment, basically causing the iron to "rust" and display an orange color. (The Team Geologist believes that the source of the iron is not coming directly from the pits.)

Iron is the favored food of several different types of bacteria which exploit an abundant food source and multiply, forming the gelatinous material observed in the stiller sections of the stream. In addition, this bacteria and its iron food source could attach to the fine sediment particles present in the stream during storm events and give them more mass, causing it to sink to the bottom of the stream to coat the substrate.

The area between the access road culvert and the impoundment where the highest concentrations of iron bacteria were found is also the area where disturbed soils encroach closet to the stream (approximately 10 feet). Keeping a sufficient, undisturbed buffer between the stream and excavation activities may reduce or eliminate this phenomenon. For excess sediment and nutrient removal, a buffer width of at least 100 feet is often prescribed. However, this figure is only an average and can vary according to slope, soil type and vegetative cover. Since much of the area between the stream and the excavations contain steep slopes and highly permeable soils, this preferred buffer width could arguably be increased.
The location of the proposed "sedimentation basin" for Pit 1, an area where surface water will be concentrated and left to infiltrate to groundwater, is approximately 60 feet from the wetland boundary. This activity, as well as other excavation or stockpiling activities that are proposed as close as 50 feet from the wetland boundary may worsen the iron bacteria phenomenon currently occurring in Turkey Brook.

Other concerns include:

- The lack of emergency spillways and riser outlets indicates that the proposed sedimentation basins have not been designed according to Connecticut's Guidelines for Soil Erosion and Sedimentation Control (1988). These guidelines also have standards to be used when determining the required storage volume needed for a particular drainage area and should be adhered to.

- Rills and small gullies observed on the access road as it nears Turkey Brook indicated that additional diversion of stormwater off of the access road to stable outlets is recommended.
- Jute matting is specified for slope stabilization within the narrative on sheet 4 of 4. The use of some type of erosion control blanket will be critical to adequately stabilize the 2:1 slopes as proposed on the plan. It is important that the proper "grade" of matting be chosen and installed proper}y.
- This proposed activity will most likely require a NPDES Stormwater General Permit from the DEP Water Management Bureau. It is recommended that the applicant contact Chris Stone of this bureau's Permitting Enforcement and Remediation Division at (860) 424-3850 for further information.

Fisheries Resources

Stream Resources

The existing gravel excavation is situated adjacent to Turkey Hill Brook, a small headwater tributary of Mill Creek. The field review indicated that the stream has been degraded due to sediment input from unknown upstream location(s). It is not known if sediment emanates from active erosion sites or is caused by stormwater runoff from Route 9. Instream substrates were observed to be covered with a layer of fine sediment that appears to be of a clay, sandy origin. The stream also shows signs of lateral expansion. This is a condition where the stream gradually widens causing a high width-depth ratio. Streams with high width-depth ratios are characterized by very shallow macro habitats which lack a well-defined low flow channel. These conditions collectively cause instream fish habitats to become less suitable for habitation by fish populations.

Turkey Hill Brook has not been surveyed for fish populations by the CT DEP Fisheries Division. Despite its degraded state, it does appear to support a coldwater fishery since one native adult brook trout was observed the day of the field review near an undercut streambank. Poor instream habitat would indicate population abundance to be low.

Impacts

The following impacts to aquatic resources can be expected if proper mitigation measures are not implemented:

1. **Site soil erosion and sedimentation of Turkey Hill Brook from mining areas.** At present, sediment runoff has been properly contained from areas of active

disturbance and there is no evidence of stream degradation due to on-site mining activities. Expansion of Pit # 1 will encroach into the riparian zone of Turkey Hill Brook. The creation of a berm should help to mitigate runoff; however land disturbance in close proximity to any watercourse increases the potential for possible sediment runoff events. As previously discussed, Turkey Hill Brook has already been damaged due to sediment runoff. Additional sediment deposition from sand/gravel mining could further damage the aquatic ecosystem in the following ways:

(1) Sediment reduces the survival of resident fish eggs and hinders the emergence of newly hatched fry. Adequate water flow, free of excess sediment particles is required for fish egg respiration and successful hatching.

(2) Sediment reduces the survival of aquatic macro-invertebrates. Since aquatic insects are important food items in fish diets, reduced insect populations levels in turn will adversely affect fish growth and survival. Fish require an excessive output of energy to locate preferred prey when aquatic insect levels decrease.

(3) Sediment reduces the amount of usable habitat required for spawning purposes. Excessive fines can clog and even cement gravels and other desirable substrate together. Resident fish may be forced to disperse to other areas not impacted by siltation.

(4) Sediment reduces stream pool depth. Pools are invaluable stream components since they provide necessary cover, shelter, and resting areas for resident fish. A reduction of usable fish habitat can effectively limit fish population levels.

(5) Turbid waters impair gill functions of fish and normal feeding activities of fish. High concentrations of sediment can cause mortality in adult fish by clogging the opercular cavity and gill filaments.

(6) Sediment encourages the growth of filamentous algae and nuisance proportions of aquatic macrophytes. Eroded soils contain plant nutrients such as phosphorous and nitrogen. Once introduced into aquatic habitats, these nutrients function as fertilizers resulting in accelerated plant growth.

(7) Sediment contributes to the depletion of dissolved oxygen. Organic matter associated with soil particles is readily decomposed by microorganisms thereby effectively reducing oxygen levels.

Recommended Mitigation Measures

The following mitigation measures should be considered by the Town of Haddam to mitigate impacts to aquatic resources.

1. **Upstream sources of erosion and sedimentation should be identified in Turkey Hill Brook.** The town's inland wetland officer should investigate possible sources of erosion and stormwater runoff in the upper watershed. Appropriate mitigation measures should be undertaken in areas of active erosion so as to reduce instream sedimentation. The team's fisheries biologist is available for further technical guidance relative to the assessment of erosion sites.
2. **It is highly recommended that at a 100 foot riparian buffer zone be maintained along Turkey Hill Brook.** This buffer can be an effective mitigation measure at this development location. See DEP Fisheries Division policy on riparian corridor protection for specifics (in the appendix).

The Natural Diversity Data Base

The Natural Diversity Data Base maps and files regarding the Flanigan property have been reviewed. According to our information, there are no known extant populations of Federal or State Endangered, Threatened or Special Concern Species that occur at the site in question.

Natural Diversity Data Base information includes all information regarding critical biologic resources available to us at the time of the request. This information is a compilation of data collected over the years by the Natural Resources Center's Geological and Natural History Survey and cooperating units of DEP, private conservation groups and the scientific community. This information is not necessarily the result of comprehensive or site-specific field investigations. Consultations with the Data Base should not be substituted for on-site surveys required for environmental assessments. Current research projects and new contributors continue to identify additional populations of species and locations of habitats of concern, as well as, enhance existing data. Such new information is incorporated into the Data Base as it becomes available.

Please be advised that this is a preliminary review and not a final determination. A more detailed review may be conducted as part of any subsequent environmental permit applications submitted to DEP for the proposed site.

Wildlife Resources

A site visit was to evaluate existing wildlife habitats on the 33-acre property with emphasis on the effects of expanding Pit #1 through the removal of 6,100 cubic yards of sand and gravel. A variety of habitat types were identified: northern hardwood forest, mixed hardwood forest, hardwood swamp and riparian. The variety of habitat types provide wildlife with a diverse mix of foods, nesting and escape cover. Wildlife species observed or identified by their sign are identified by an asterisk (*) in this section of the report.

Wildlife Habitats and Impact Assessment

Northern Hardwood Forest

At the time of inspection, the proposed expansion area (with exception of the berm) was cleared of all vegetation with the exception of the larger, mature oaks which were to be harvested for saw timber. This area was comprised of mature hardwood forest containing northern red oak, white oak, red maple and American beech with an understory of primarily mountain laurel and witch hazel. Mast produced by oaks and beeches provide excellent forage for a wide variety of mammals and birds including white-tailed deer*, gray squirrel*, southern flying squirrel, eastern chipmunk*, white-footed mouse, eastern wild turkey and blue jay. Other wildlife found in this habitat type include scarlet tanager, ovenbird, white-breasted nuthatch, black and white warbler, worm-eating warbler, hairy woodpecker, pileated woodpecker, American redstart, barred owl, broad-winged hawk, redback salamander and northern ringneck snake. There will be some loss of wildlife from the area given the direct loss of food and cover.

Evidence of bank swallows, i.e., holes near top of excavated bank, was found in pit #2. Bank swallows require sandbanks and sloughed off embankments on woodland edges for nesting. Sand pits have become one of the principle nest sites for this species in Connecticut. Bank swallows nest from May through July typically in dense colonies where 10 to as many as 300 borrows may be constructed.

Wetlands

The excavation site and access road are located within 50 feet of Turkey Hill Brook, a narrow, slow-moving perennial stream. South and east of Pits #1 and #2 is a large active beaver impoundment surrounded by mixed hardwood forest and hardwood swamp dominated by red maple. Also present are tulip poplar, yellow birch, shagbark hickory, pignut hickory, white ash and eastern hemlock. A relatively open understory of greenbriar, Christmas fern, cinnamon fern and skunk cabbage transitions into a dense shrub layer of sweet pepperbush, spicebush and swamp azalea and herbaceous layer of sphagnum moss in the lower elevations. Vegetation found within and around the pond edge include cattail, rushes, pickerelweed, speckled alder, highbush blueberry and American holly. The standing dead and dying trees and fallen, rotted logs found here provide nest and den sites for a variety of birds, small mammals and herpetofauna. The abundance of flying insects found in wetlands are a valuable food source for swallows, flycatchers and bats. Wildlife likely found here include great-crested flycatcher, willow flycatcher, tree swallow, bank swallow*, black-capped chickadee*, tufted titmouse*, Louisiana waterthrush, great-blue heron, green-backed heron, wood duck*, American black duck, mallard, Virginia opossum, short-tailed shrew, little brown myotis, gray tree frog*, wood frog, wood turtle, red-spotted newt, spotted salamander, northern water snake and eastern garter snake*.

The forested riparian zone between the proposed excavation site and Turkey Hill Brook contains yellow birch, red maple, swamp azalea, sweet pepperbush and cinnamon fern. Forested riparian buffers aid in the survival of aquatic invertebrates and plants by removing excess nutrients and sediment, provide shade for optimum light and temperature conditions necessary for the survival of fish, and serve as travel corridors for wildlife. Wildlife likely utilizing these areas for food and cover include eastern cottontail, white-tailed deer, raccoon, river otter, mink, short-tailed weasel, star-nosed mole, green frog, pickerel frog and spotted turtle. Birds commonly found nesting in these areas include common yellowthroat, eastern phoebe, gray catbird*, blue-gray gnatcatcher and wood thrush. Potential impacts to wildlife is primarily that of disturbance due to heavy equipment operation. Birds may be discouraged from nesting adjacent to the excavation site during operations from May through July. To minimize impacts to the wetland/riparian zone, erosion control measures and a 100 foot buffer of natural vegetation should be maintained to help filter and trap silt and sediment and provide travel corridors for wildlife moving between the fragmented habitats on the property.

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Archaeological Sensitivity

A review of the State of Connecticut Archaeological Site Files and Maps shows no known archaeological sites on the project area. However, four archaeological components are located in immediate proximity of the property and represent occupations by Native Americans as early as 4,000 years ago. These sites occur in different environmental areas in the lower Connecticut River Valley during different time periods and provide important information on settlement and subsistence patterns of these people adapting to the natural riverine and upland resources prior to European Contact during the 17th century.

In addition, environmental and topographic features suggest a high probability for undiscovered archaeological sites existing on the project area. The elevated, well-drained soils adjacent to Turkey Hill Brook provide ideal situations for encampments and are similar to the locations of the four mentioned sites.

The Office of State Archaeology recommends an archaeological survey for any areas proposed for earth-moving activities that are situated on elevated well-drained soils adjacent to the brook and other wetland systems. These topographic and environmental features are highly sensitive for the discovery of unrecorded archaeological sites. The Office of State Archaeology is prepared to offer any technical assistance to Flanigan Gravel and the Town of Haddam in completing the recommended survey which would test for site locations and remove them prior to any construction activities.

Please feel free to contact the state archaeologist at UCONN should you have any questions and to expedite the archaeological survey.

Appendix

NONTECHNICAL SOILS DESCRIPTION REPORT
FOR DESCRIPTION CATEGORY - SOI

Survey Area- MIDDLESEX COUNTY, CONNECTICUT

Map Symbol	Description
CcB	CANTON AND CHARLTON VERY STONY FINE SANDY LOAMS, 3 TO 8 PERCENT SLOPES This unit consists of gently sloping, well drained soils. The Canton soil formed in sandy deposits over friable sandy gravelly till and the Charlton soil formed in friable loamy till. It is on the side slopes and crests of upland hills and ridges. Stones and boulders cover 2 to 10 percent of the surface. Bedrock is commonly more than 60 inches below the surface. The water table is commonly below a depth of six feet. The permeability of the Canton soils is moderately rapid in the surface layer and subsoil, and rapid in the substratum. The permeability of the Charlton soils is moderate or moderately rapid throughout. The surface runoff is medium and the available water capacity is moderate.
HkC	HINCKLEY GRAVELLY SANDY LOAM, 3 TO 15 PERCENT SLOPES This rolling, excessively drained soil formed in sandy and gravelly water-sorted materials. It is on terraces of stream valleys, outwash plains, kames and eskers. Bedrock is commonly more than 60 inches below the surface. The water table is commonly below a depth of six feet. Permeability is rapid in the surface layer and subsoil, and very rapid in the substratum. Surface runoff is slow and the available water capacity is low.
HmE	HINCKLEY AND MANCHESTER SOILS, 15 TO 45 PERCENT SLOPES This moderately steep to very steep, excessively drained soil formed in glaciofluvial material. It is on the sideslopes of outwash terraces, plains, deltas, kames, and eskers. Depth to bedrock is commonly greater than 60 inches below the surface. The water table is commonly below a depth of 6 feet. Permeability is rapid in the surface layer and subsoil, and very rapid in the substratum. Surface runoff is slow to very slow and the available water capacity is low.
Lg	LEICESTER,RIDGEBURY, AND WHITMAN EXTREMELY STONY FINE SANDY LOAMS These nearly level, poorly drained and very poorly

NONTECHNICAL SOILS DESCRIPTION REPORT
FOR DESCRIPTION CATEGORY - SOI

Survey Area- MIDDLESEX COUNTY, CONNECTICUT

Map Symbol	Description
	drained soils formed in compact and friable loamy glacial till. They are in depressions and drainageways of glacial till uplands. Depth to bedrock is commonly more than 60 inches below the surface. From 8 to 25 percent of the surface of these soils are covered with stones and boulders. The soils were mapped together because they have no significant differences in use and management. These soils have a seasonal high water table at or near the surface from fall through spring. Permeability is moderate or moderately rapid in the surface layer and subsoil of these soils. The permeability is slow to very slow in the substratum of the Ridgebury and Whitman soils and moderately rapid in the substratum of the Leicester soils. Runoff is slow. The available water capacity is moderate in these soils.
PbB	PAXTON AND MONTAUK FINE SANDY LOAMS, 3 TO 8 PERCENT SLOPES
	These gently sloping, well drained soils formed in compact glacial till. They are on the tops and side slopes of drumlins and hills of glacial till uplands. Depth to bedrock is commonly more than 60 inches below the surface. These soils have a seasonal high water table perched at a depth of about 2 feet for several weeks in the spring. Permeability in the Paxton soil is moderate in the surface layer and subsoil and slow to very slow in the substratum. Permeability in the Montauk soil is moderate or moderately rapid in the surface layer and subsoil and moderately slow or slow in the substratum. Surface runoff is medium and the available water capacity is moderate.
Pr	PITS, GRAVEL
	These areas consists of nearly level to sloping, excessively drained to moderately well drained soils. They are mostly on outwash plains and terraces of stream valleys and have been altered by excavating or filling. They are mostly irregular in shape but may be rectangular or long and narrow. Depth to bedrock is commonly more than 60 inches below the surface. The water table is commonly below a depth of 6 feet but in a few places it is near the surface. A few areas

NONTECHNICAL SOILS DESCRIPTION REPORT
FOR DESCRIPTION CATEGORY - SOI

Survey Area- MIDDLESEX COUNTY, CONNECTICUT

Map Symbol	Description
	adjacent to streams are subject to flooding. Permeability is rapid or very rapid. Surface runoff is slow and the available water capacity is low. These areas require on-site investigation and evaluation to determine the suitability for most uses.
WzC	WOODBRIDGE EXTREMELY STONY FINE SANDY LOAM, 3 TO 15 PERCENT SLOPES This nearly level to sloping, moderately well drained soil formed in compact glacial till. It is on the top and side slopes of large drumlins and hills on glacial till uplands. Depth to bedrock is commonly more than 60 inches below the surface. From 1 to 8 percent of the soil surface is covered with stones and boulders. The soil has a seasonal high water table at a depth of about 20 inches from fall to spring. Permeability is moderate in the surface layer and subsoil and slow to very slow in the substratum. Surface runoff is medium to rapid and the available water capacity is moderate.

NONTECHNICAL SOILS DESCRIPTION REPORT
FOR DESCRIPTION CATEGORY - URB

Survey Area- MIDDLESEX COUNTY, CONNECTICUT

Map Symbol	Description
CcB	CANTON AND CHARLTON VERY STONY FINE SANDY LOAMS, 3 TO 8 PERCENT SLOPES These soils are well suited to community development.
HkC	HINCKLEY GRAVELLY SANDY LOAM, 3 TO 15 PERCENT SLOPES These soils are well suited to community development. However, the rapid permeability of the subsoil may cause groundwater pollution in areas used for onsite septic systems. Steep slopes of excavations are unstable.
HmE	HINCKLEY AND MANCHESTER SOILS, 15 TO 45 PERCENT SLOPES These soils are well suited to community development. However, in areas where slope exceeds 25 percent, they are not suited to community development. The rapid permeability of the subsoil may cause groundwater pollution in areas used for onsite septic systems. Steep slopes of excavations are unstable.
Lg	LEICESTER,RIDGEBURY, AND WHITMAN EXTREMELY STONY FINE SANDY LOAMS These soils are poorly suited to community development. The major limitation is the high water table.
PbB	PAXTON AND MONTAUK FINE SANDY LOAMS, 3 TO 8 PERCENT SLOPES These soils are well suited to community development.
Pr	PITS, GRAVEL This unit requires onsite investigation and evaluation for community development uses.
WzC	WOODBRIDGE EXTREMELY STONY FINE SANDY LOAM, 3 TO 15 PERCENT SLOPES These soils are fairly suited to community development. The primary limitation is the seasonal high water table.

SOIL FEATURES

Survey Area- MIDDLESEX COUNTY, CONNECTICUT

Map symbol and soil name		Bedrock		Cemented pan		Subsidence		Potential frost action	Risk of corrosion	
		Depth	Hardness	Depth	Hardness	Initial	Total		Uncoated steel	Concrete
		In		In		In	In			
CcB	CANTON	60- 60		-		-	-	LOW	LOW	HIGH
	CHARLTON	60- 60		-		-	-	LOW	LOW	HIGH
HkC	HINCKLEY	60- 60		-		-	-	LOW	LOW	HIGH
HmE	HINCKLEY	60- 60		-		-	-	LOW	LOW	HIGH
	MANCHESTER	60- 60		-		-	-	LOW	LOW	HIGH
Lg	LEICESTER	60- 60		-		-	-	HIGH	LOW	HIGH
	RIDGEBURY	60- 60		-		-	-	HIGH	HIGH	HIGH
	WHITMAN	60- 60		-		-	-	HIGH	HIGH	HIGH
PbB	PAXTON	60- 60		-		-	-	MODERATE	LOW	MODERA
	MONTAUK	60- 60		-		-	-	MODERATE	LOW	HIGH
Pr	PITS	-		-		-	-			
WzC	WOODBRIDGE	60- 60		-		-	-	HIGH	LOW	MODERA

WATER FEATURES

Survey Area- MIDDLESEX COUNTY, CONNECTICUT

Map symbol and soil name		Hydrologic group	Flooding: Freq	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months
						(Ft)		
CcB	CANTON	B	NONE		-	6.0- 6.0		-
	CHARLTON	B	NONE		-	6.0- 6.0		-
HkC	HINCKLEY	A	NONE		-	6.0- 6.0		-
HmE	HINCKLEY	A	NONE		-	6.0- 6.0		-
	MANCHESTER	A	NONE		-	6.0- 6.0		-
Lg	LEICESTER	C	NONE		-	0- 1.5	APPAR	NOV-MAY
	RIDGEBURY	C	NONE		-	0- 1.5	PERCH	NOV-MAY
	WHITMAN	D	NONE		-	-	PERCH	-
PbB	PAXTON	C	NONE		-	1.5- 2.5	PERCH	FEB-APR
	MONTAUK	C	NONE		-	2.0- 2.5	PERCH	FEB-MAY
Pr	PITS				-	-		-
WzC	WOODBRIDGE	C	NONE		-	1.5- 2.5	PERCH	NOV-MAY

CONSTRUCTION MATERIALS REPORT

Survey Area- MIDDLESEX COUNTY, CONNECTICUT

Map symbol, soil name		Roadfill	Sand	Gravel	Topsoil
CcB	CANTON	Good	Improbable excess fines	Improbable excess fines	Poor small stones area reclaim
	CHARLTON	Good	Improbable excess fines	Improbable excess fines	Fair small stones
HkC	HINCKLEY	Good	Probable	Probable	Poor too sandy small stones area reclaim
HmE	HINCKLEY	Poor slope	Probable	Probable	Poor too sandy small stones slope
	MANCHESTER	Poor slope	Probable	Probable	Poor too sandy small stones area reclaim
Lg	LEICESTER	Poor wetness	Improbable excess fines	Improbable excess fines	Poor wetness
	RIDGEBURY	Poor wetness	Improbable excess fines	Improbable excess fines	Poor wetness small stones area reclaim
	WHITMAN	Poor wetness	Improbable excess fines	Improbable excess fines	Poor wetness large stones area reclaim
PbB	PAXTON	Good	Improbable excess fines	Improbable excess fines	Fair area reclaim small stones
	MONTAUK	Fair wetness	Improbable excess fines	Improbable excess fines	Poor small stones
WzC	WOODBRIDGE	Fair wetness	Improbable excess fines	Improbable excess fines	Fair area reclaim small stones slope

PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

Survey Area- MIDDLESEX COUNTY, CONNECTICUT

Map Symbol	Soil Name	Depth (In)	Clay (pct)	Moist Blk Density (g/cm3)	Permeab-ility (In/hr)	Available water cap (In/in)	Soil React (ph)	Salin-ity (mmhos/cm)	Shrink Swell Pot.	Erosion Factor K	T	Wind Erod. Group	Org Matt (pct
CcB	CANTON	0- 2	1- 8	0.90-1.20	2.0- 6.0	0.13-0.20	3.6-6.0	-	LOW	.20	3		0.-
		2-19	1- 8	1.20-1.50	2.0- 6.0	0.09-0.17	3.6-6.0	-	LOW	.28			-
		19-60	0- 5	1.30-1.60	6.0- 20	0.04-0.08	3.6-6.0	-	LOW	.17			-
	CHARLTON	0- 2	3- 8	1.00-1.25	0.6- 6.0	0.08-0.23	4.5-6.0	-	LOW	.20	3		0.-
		2-32	3- 8	1.40-1.65	0.6- 6.0	0.07-0.20	4.5-6.0	-	LOW	.24			-
		32-65	1- 8	1.45-1.70	0.6- 6.0	0.05-0.16	4.5-6.0	-	LOW	.24			-
HkC	HINCKLEY	0- 8	4- 8	0.90-1.10	6.0- 20	0.08-0.14	3.6-6.0	-	LOW	.20	3		2.-
		8-20	1- 5	1.20-1.40	6.0- 20	0.01-0.10	3.6-6.0	-	LOW	.17			-
		20-60	0- 3	1.30-1.50	20- 20.0	0.01-0.06	3.6-6.0	-	LOW	.10			-
HmE	HINCKLEY	0- 8	4- 8	0.90-1.10	6.0- 20	0.08-0.14	3.6-6.0	-	LOW	.20	3		2.-
		8-20	1- 5	1.20-1.40	6.0- 20	0.01-0.10	3.6-6.0	-	LOW	.17			-
		20-60	0- 3	1.30-1.50	20- 20.0	0.01-0.06	3.6-6.0	-	LOW	.10			-
	MANCHESTER	0- 9	3- 7	1.10-1.30	6.0- 20.0	0.04-0.12	4.5-6.0	-	LOW	.17	3		2.-
		9-18	1- 4	1.25-1.50	6.0- 20.0	0.02-0.08	4.5-6.0	-	LOW	.17			-
		18-65	0- 1	1.35-1.60	20.0- 20.0	0.01-0.06	4.5-6.0	-	LOW	.10			-
Lg	LEICESTER	0- 7	3-10	1.00-1.25	0.6- 6.0	0.12-0.18	4.5-5.5	-	LOW	.24	3		0.-
		7-33	3-10	1.35-1.60	0.6- 6.0	0.10-0.20	4.5-5.5	-	LOW	.28			-
		33-65	2- 7	1.45-1.70	0.6- 20.0	0.06-0.16	4.5-6.0	-	LOW	.24			-
	RIDGEBURY	0- 7	3-10	1.00-1.30	0.6- 6.0	0.06-0.21	4.5-6.5	-	LOW	.20	3		0.-
		7-24	2- 8	1.60-1.90	0.6- 6.0	0.04-0.20	4.5-6.5	-	LOW	.32			-
		24-60	2- 8	1.80-2.00	0.0- 0.2	0.01-0.05	4.5-6.5	-	LOW	.24			-
	WHITMAN	0- 5	5- 8	1.10-1.30	0.6- 6.0	0.12-0.26	4.5-6.5	-	LOW	.20	3		0.-
		5-22	2- 4	1.60-1.85	0.6- 6.0	0.10-0.17	4.5-6.5	-	LOW	.32			-
		22-60	1- 3	1.85-2.00	0.0- 0.2	0.03-0.04	4.5-6.5	-	LOW	.24			-
PbB	PAXTON	0-10	3-12	1.00-1.25	0.6- 2.0	0.10-0.20	4.5-6.0	-	LOW	.24	3		2.-
		10-32	3-12	1.35-1.60	0.6- 2.0	0.08-0.18	4.5-6.0	-	LOW	.32			-
		32-65	3-12	1.70-2.00	0.0- 0.2	0.05-0.10	4.5-6.0	-	LOW	.24			-
	MONTAUK	0- 7	6-18	1.30-1.60	0.6- 6.0	0.10-0.16	3.6-6.0	-	LOW	.24			-
		7-25	1-18	1.70-1.90	0.6- 0.6	0.02-0.08	3.6-6.0	-	LOW	.24			-
		25-60	-	-	0.06-	-	-	-					-
WzC	WOODBRIDGE	0- 3	3-12	1.00-1.25	0.6- 2.0	0.08-0.18	4.5-6.0	-	LOW	.20	3		0.-
		3-28	3-12	1.35-1.60	0.6- 2.0	0.08-0.18	4.5-6.0	-	LOW	.32			-
		28-65	3-12	1.70-2.00	0.0- 0.2	0.05-0.10	4.5-6.0	-	LOW	.24			-

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
CONNECTICUT

CONSERVATION INFORMATION SHEET
JANUARY 1981

CRACK SEEDING OR FROST CRACK SEEDING

Frost crack seeding is an effective way to plant grass seed during late winter or early spring.

This method uses the freezing and thawing action of frost in the soil to work the seed into the soil for good contact. It is most effective on areas that have a seedbed prepared, or areas that have been disturbed but where topsoil exists and vegetation has not been established.

A good seeding day is one where the temperature was below freezing the night before and the temperature is predicted to reach 35°F or higher during the day. A sunny day is best to help with radiant warming of the soil. The seed should be broadcast early in the morning, before any thawing occurs. As the soil warms and ice crystals melt, the soil compacts and the seed works into it. At night, the soil freezes, expands, and the cycle repeats itself. A period of 3-5 days of good maple sap days would be good frost cracking days. This method should be used in late winter so that the seed does not germinate and then freeze, killing the plant. Late February or March is best.

Advantages to this method include:

1. A reasonable assurance of soil moisture when it is needed for germination and growth.

2. Taking advantage of the longest possible growing season.

3. Less hand or mechnanical labor to rake in seed than would be needed later in the seeding period of April to June.

4. The ability to successfully seed difficult slopes where machinery could not work, and/or where existing roots make raking the seed into the soil difficult.

Frost crack seeding can be used to reseed or overseed an area already seeded, but where the catch was poor. The existing plants can remain undamaged by mechanical raking, while the frost works the seed into the soil on bare areas.

This method works particularly well with legumes, such as crownvetch and flatpea, which have a hard seed coat. The natural freezing action breaks down the seedcoat to allow for germination.

Seeding rates should be increased 10 percent when using the frost crack method.

Lime and fertilizer are necessary to establish a high quality grass or legume. Ideally, lime should be applied the previous fall to allow time for reaction with the soil. Apply according to a soil test. In lieu of a soil test, apply lime at a rate of 2 tons per acre and 10-10-10 fertilizer at 600 lbs. per acre. Lime and fertilizer should not be applied when the ground is frozen.

The Connecticut Environmental Review Teams

Eastern Connecticut and King's Mark
1066 Saybrook Road
Mailing Address: P.O. Box 70
Haddam, CT 06438
(203) 345-3977

Eastern Connecticut

King's Mark

Preliminary Report on the Site Review for "Closure Plan for the Property of William F. Flanigan" Cedar Lake Road - Haddam, CT.

This is a preliminary report for the proposed expansion of Pit #1 as shown on the drawings "Closure Plan for the Property of William F. Flanigan - Cedar Lake Road - Haddam, CT.", dated February 1989 and revised 9/3/96, sheets 1 and 2 of 2. This information on erosion and sediment control is offered as per request for use by the Town of Haddam in an upcoming meeting. Additional information will be forthcoming on the whole site in the ERT report.This preliminary report does not contain the concerns or recommendations from the wetland specialist, wildlife biologist, geologist or planner.

An extension of the gravel/sand extraction operation of Pit #1 is being proposed that will extend the current top of slope 160'± to the north, regrade the western (east facing) slope to a 2:1 slope and excavate the pits bottom to an elevation of 254 and reface the southern (north facing) slope to a slope of 2:1.

Of primary concern to the Town of Haddam are potential impacts to existing wetlands and off-site resources. The final limit of excavation will approach within 25'± of existing wetland limits. The cross section A-A' (on sheet 2 of 2) shows a final grade with a slope of 6 foot vertical to 1 foot horizontal, sloping towards the wetland.

- Plans indicated that the primary measure to be used for erosion control is the placement of a sediment barrier using hay bales. Hay bales are a useful measure if installed and maintained correctly. Unfortunately, current hay bale sediment barriers on the site are not installed and/or maintained correctly and therefore emphasis on their use is discouraged. The CT

Guidelines on Soil Erosion and Sedimentation Control specify the installation of this measure and limits their life span to 60 days. If this proposed extraction operation is to exceed 60 days (and considering the cost of removing and installing hay barriers every 60 days), it is recommended that an alternative sediment barrier be installed. The attached standard and specifications for a geotextile, reinforced **"silt fence"** would be a recommended alternative, especially with the close proximity of the proposed top of slope to the wetland.

- It is also recommended that the broad drainage swale located where the "New Top Slope" delineation is proposed (see sheet 1 of 2) be addressed. This swale outlets directly into the wetlands where the bank of the existing channel is currently being undermined by the stream. It is recommended that surface flow in this swale be redirected to a safe outlet. This area has been cleared recently (within the last year) and there is evidence of minor soil erosion occurring within the swale.

- It is recommended that stone check dams be installed in this swale using the attached guidelines for the **Standards and Specifications for Check Dams** attached. These stone check dams could be constructed with equipment and materials on-site. They would remain in effect until the "New Top Slope" limit is established.

- A tracking pad for the trucks should be installed on the access road before the stream culvert.

STANDARD AND SPECIFICATIONS FOR SILT FENCE

Definition

A temporary barrier of geotextile fabric (filter cloth) used to intercept sediment laden runoff from small drainage areas of disturbed soil.

Purpose

The purpose of a silt fence is to reduce runoff velocity and effect deposition of transported sediment load. Limits imposed by ultraviolet stability of the fabric will dictate the maximum period the silt fence may be used.

Conditions Where Practice Applies

A silt fence may be used subject to the following conditions:

1. Maximum allowable slope lengths contributing runoff to a silt fence are:

Slope Steepness	Maximum Slope Length (Ft)
2:1	50
3:1	75
4:1	125
5:1	175
Flatter than 5:1	200

2. Maximum drainage area for overland flow to a silt fence shall not exceed 1/2 acre per 100 feet of fence; and
3. Erosion would occur in the form of sheet erosion; and
4. There is no concentration of water flowing to the barrier.

Design Criteria

Design computations are not required. All silt fences shall be placed as close to the area as possible, and the area below the fence must be undisturbed or stabilized.

A detail of the silt fence shall be shown on the plan, and contain the following minimum requirements:

1. The type, size, and spacing of fence posts.
2. The size of woven wire support fences.
3. The type of filter cloth used.
4. The method of anchoring the filter cloth.
5. The method of fastening the filter cloth to the fencing support.

Where ends of filter cloth come together, they shall be overlapped, folded and stapled to prevent sediment bypass. See Figure 5A.9 on page 5A.20 for details.

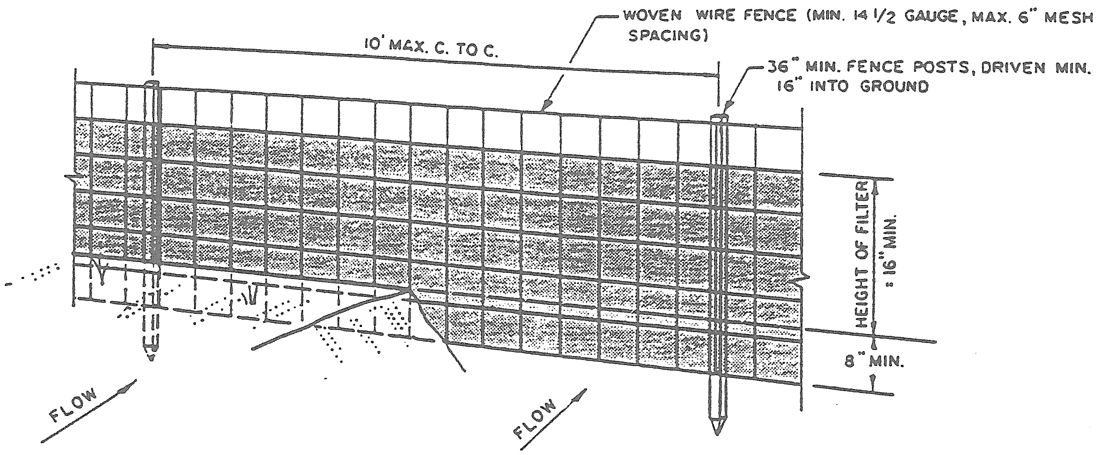
Criteria for Silt Fence Materials

1. Silt Fence Fabric: The fabric shall meet the following specifications unless otherwise approved by the appropriate erosion and sediment control plan approval authority. Such approval shall not constitute statewide acceptance. Statewide acceptability shall depend on in field and/or laboratory observations and evaluations.

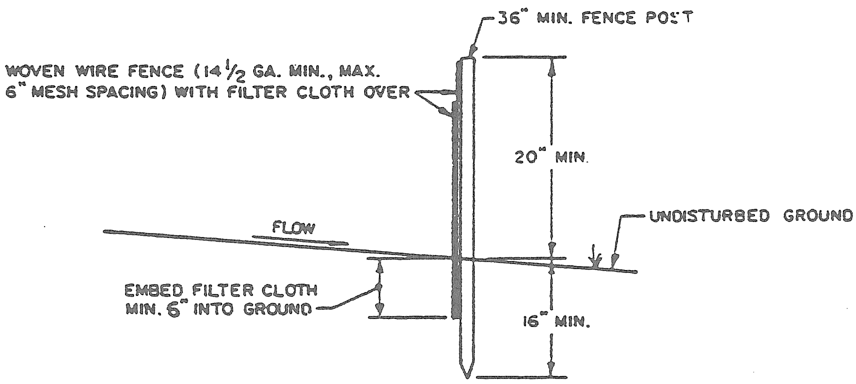
Fabric Properties	Minimum Acceptable Value	Test Method
Grab Tensile Strength (lbs)	90	ASTM D1682
Elongation at Failure (%)	50	ASTM D1682
Mullen Burst Strength (PSI)	190	ASTM D3786
Puncture Strength (lbs)	40	ASTM D751 (modified)
Slurry Flow Rate (gal/min/sf)	0.3	
Equivalent Opening Size	40-80	US Std Sieve CW-02215
Ultraviolet Radiation Stability (%)	90	ASTM G-26

2. Fence Posts (for fabricated units): The length shall be a minimum of 36 inches long. Wood posts will be of sound quality hardwood with a minimum cross sectional area of 3.0 square inches. Steel posts will be standard T and U section weighing not less than 1.00 pound per linear foot.
3. Wire Fence (for fabricated units): Wire fencing shall be a minimum 14-1/2 gage with a maximum 6 in. mesh opening, or as approved.
4. Prefabricated Units: Envirofence or approved equal may be used in lieu of the above method providing the unit is installed per details shown in Figure 5A.9.

Figure 5A.9
Silt Fence Details



PERSPECTIVE VIEW



SECTION

CONSTRUCTION NOTES FOR FABRICATED SILT FENCE

1. WOVEN WIRE FENCE TO BE FASTENED SECURELY TO FENCE POSTS WITH WIRE TIES OR STAPLES.

2. FILTER CLOTH TO BE TO BE FASTENED SECURELY TO WOVEN WIRE FENCE WITH TIES SPACED EVERY 24" AT TOP AND MID SECTION.

3. WHEN TWO SECTIONS OF FILTER CLOTH ADJOIN EACH OTHER THEY SHALL BE OVERLAPPED BY SIX INCHES AND FOLDED.

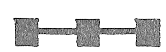
4. MAINTENANCE SHALL BE PERFORMED AS NEEDED AND MATERIAL REMOVED WHEN "BULGES" DEVELOP IN THE SILT FENCE

POSTS: STEEL EITHER "T" OR "U" TYPE OR 2" HARDWOOD

FENCE: WOVEN WIRE, 14 1/2 GA. 6" MAX. MESH OPENING

FILTER CLOTH: FILTER X, MIRAFI 100X, STABILINKA T140N OR APPROVED EQUAL.

PREFABRICATED UNIT: GEOFAB, ENVIROFENCE, OR APPROVED EQUAL.

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE SYRACUSE, NEW YORK	SILT FENCE	STANDARD SYMBOL 

STANDARD AND SPECIFICATIONS FOR CHECK DAM

Definition

Small temporary stone dams constructed across a drainageway.

Purpose

To reduce erosion in a drainage channel by restricting the velocity of flow in the channel.

Condition Where Practice Applies

This practice is used as a temporary or emergency measure to limit erosion by reducing flow in small open channels that are degrading or subject to erosion; and where permanent stabilization is impractical due to short period of usefulness and time constraints of construction.

Design Criteria

Drainage Area: Maximum drainage area above the check dam shall not exceed two (2) acres.

Height: Not greater than 2 feet. Center shall be maintained 9 inches lower than abutments at natural ground elevation.

Side Slopes: Shall be 2:1 or flatter

Spacing: The check dams shall be spaced as necessary in the channel so that the crest of the downstream dam is at the elevation of the toe of the upstream dam.

Stone Size: Use graded stone 2 to 15 inches in size (NYS - DOT Light Stone Fill meets these requirements).

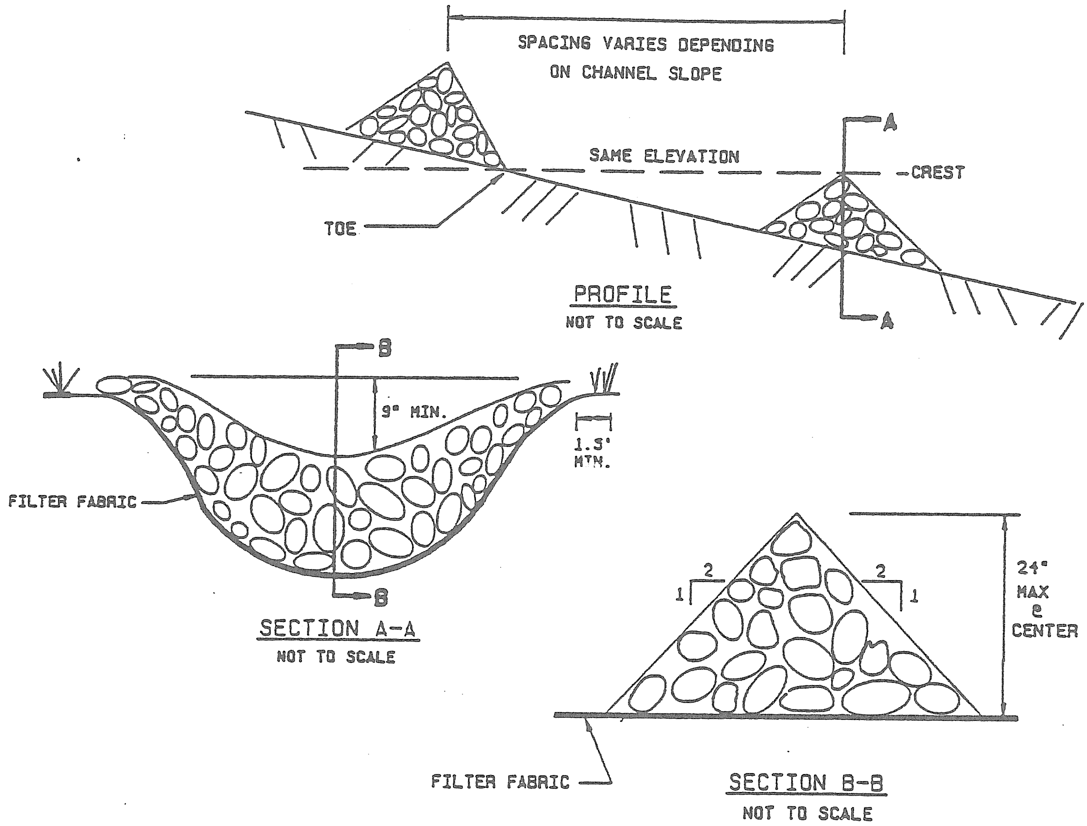
The overflow of the check dams will be stabilized to resist erosion that might be caused by the check dam. See Figure 5A.10 on page 5A.22 for details.

Maintenance

The check dams should be inspected after each runoff event. Correct all damage immediately. If significant erosion has occurred between structures a liner of stone or other suitable material should be installed in that portion of the channel.

Remove sediment accumulated behind the dam as needed to allow channel to drain through the stone check dam and prevent large flows from carrying sediment over the dam. Replace stones as needed to maintain the design cross section of the structures.

Figure 5A.10
Check Dam Details



CONSTRUCTION SPECIFICATIONS

1. STONE WILL BE PLACED ON A FILTER FABRIC FOUNDATION TO THE LINES, GRADES AND LOCATIONS SHOWN IN THE PLAN.
2. SET SPACING OF CHECK DAMS TO ASSUME THAT THE ELEVATIONS OF THE CREST OF THE DOWNSTREAM DAM IS AT THE SAME ELEVATION OF THE TOE OF THE UPSTREAM DAM.
3. EXTEND THE STONE A MINIMUM OF 1.5 FEET BEYOND THE DITCH BANKS TO PREVENT CUTTING AROUND THE DAM.
4. PROTECT THE CHANNEL DOWNSTREAM OF THE LOWEST CHECK DAM FROM SCOUR AND EROSION WITH STONE OR LINER AS APPROPRIATE.
5. ENSURE THAT CHANNEL APPURTENANCES SUCH AS CULVERT ENTRANCES BELOW CHECK DAMS ARE NOT SUBJECT TO DAMAGE OR BLOCKAGE FROM DISPLACED STONES.

MAXIMUM DRAINAGE AREA 2 ACRES.

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE SYRACUSE, NEW YORK	CHECK DAM	STANDARD SYMBOL

DEPARTMENT OF ENVIRONMENTAL PROTECTION
INLAND FISHERIES DIVISION

POLICY STATEMENT
RIPARIAN CORRIDOR PROTECTION

I. INTRODUCTION, GOALS, AND OBJECTIVE

Alteration and exploitation of riparian corridors in Connecticut is a common event that significantly degrades stream water quality and quantity. Inasmuch as riparian ecosystems play a critical role in maintaining aquatic resource productivity and diversity, the Inland Fisheries Division (Division) recognizes that rigorous efforts are required to preserve, protect, and restore these valuable resources. Consequently, a riparian corridor protection policy has been developed to achieve the following goals and objective:

Goals

Maintain Biologically Diverse Stream and Riparian Ecosystems, and

Maintain and Improve Stream Water Quality and Water Quantity.

Objective

Establish Uniform Riparian Corridor Buffer Zone Guidelines.

II. DEFINITIONS

For the purpose of implementing a statewide riparian corridor protection policy, the following definitions are established:

Riparian Corridor: A land area contiguous with and parallel to an intermittent or perennial stream.

Buffer Zone: An undisturbed, naturally vegetated area adjacent to or contained within a riparian corridor that serves to attenuate the effects of development.

Perennial Stream: A stream that maintains a constant perceptible flow of water within its channel throughout the year.

Intermittent Stream: A stream that flows only in direct response to precipitation or which is seasonally dry.

III. RIPARIAN FUNCTION

Naturally vegetated riparian ecosystems perform a variety of unique functions essential to a healthy instream aquatic environment. The delineation and importance of riparian functions are herein described. Vegetated riparian ecosystems:

* Naturally filter sediments, nutrients, fertilizers, and other nonpoint source pollutants from overland runoff.

* Maintain stream water temperatures suitable for spawning, egg and fry incubation, and rearing of resident finfish.

* Stabilize stream banks and stream channels thereby reducing instream erosion and aquatic habitat degradation.

* Supply large woody debris to streams providing critical instream habitat features for aquatic organisms.

* Provide a substantial food source for aquatic insects which represent a significant proportion of food for resident finfish.

* Serve as a reservoir, storing surplus runoff for gradual release into streams during summer and early fall base flow periods.

IV. RIPARIAN CORRIDOR BUFFER ZONE GUIDELINES

Recognizing the critical roles of riparian corridors, the Division provides buffer zone guidelines that are designed to bring uniformity and consistency to environmental review. The guidelines are simple, effective, and easy to administer. The following standard setting procedure should be used to calculate buffer zone widths.

Perennial Stream: A buffer zone 100 feet in width should be maintained along each side.

Intermittent Stream: A buffer zone 50 feet in width should be maintained along each side.

Buffer zone boundaries should be measured from either, (1) edge of riparian inland wetland as determined by Connecticut inland wetland soil delineation methods or (2) in the absence of a riparian wetland, the edge of the stream bank based on bank–full flow conditions.

The riparian corridor buffer zone should be retained in a naturally vegetated and undisturbed condition. All activities that pose a significant pollution threat to the stream ecosystem should be prohibited.

Where the Division policy is not in consonance with local regulations and policies regarding riparian corridor buffer zone widths and allowable development uses within these areas, local authorities should be encouraged to adopt the more restrictive regulations and policies.

12/13/91
Date

James C. Moulton
Acting Director

POSITION STATEMENT
UTILIZATION OF 100 FOOT BUFFER ZONES TO PROTECT RIPARIAN AREAS IN CONNECTICUT

BY

BRIAN D. MURPHY
TECHNICAL ASSISTANCE BIOLOGIST
INLAND FISHERIES DIVISION

I. INTRODUCTION

One tenet of the Inland Fisheries Division Policy on Riparian Corridor Protection is the utilization of a 100 foot buffer zone as a minimum setback along perennial streams. The adoption of such a policy is sure to be controversial. Laymen, developers and natural resource professionals alike will ask questions such as: Why was a standard setting method adopted? What's magical about 100 feet? Will 100 feet be sufficiently protective, or will it be overly protective? In response, this paper outlines the ramifications of adopting a riparian corridor policy including the use of a 100 foot buffer zone.

II. STANDARD SETTING VERSUS SITE SPECIFIC BUFFER ZONES

There are two approaches for determining buffer zone width; standard setting and site specific. Standard setting methods define an area extending from the streambank edge or highwater mark to some landward fixed point boundary. Site specific methods utilize formulas that incorporate and consider special site specific land characteristics, hence, the calculation of a variable width buffer zone. In both case, buffers are employed to define an area in which development is prohibited or limited.

A major advantage of standard setting methods is that they are easy to delineate and administer, thereby improving the consistency and quality of environmental assessments. Furthermore, valuable staff time would not be required to determine site specific buffer zones along each and every watercourse of concern.

The exact width of a buffer zone required for riparian corridor protection is widely disputed (Bottom et al. 1985 and Brinson et al. 1981). Buffer width recommendations found in the literature vary from as little as 25 feet to as great as 300 feet (Palfrey et al. 1982). The 100 foot buffer is widely accepted in Connecticut having been adopted by numerous inland wetland and conservation commissions as an appropriate minimum setback regulation for streambelts. In addition, Division staff have been recommending the utilization of the 100 foot buffer zone to protect streambelts since the early 1980's. Scientific research has not been generated to dispute the adequacy of utilizing 100 foot buffer zones to protect Connecticut's riparian corridors. In fact, to ensure that riparian functions are not significantly altered, recent scientific information points towards maintaining buffer zones that would be at a minimum, 100 feet in width (see section III).

Site specific methods define buffer widths according to the character and sensitivity of adjacent streamside lands. These buffer widths, also referred to as "floating buffers," consider physical site characteristics such as slope, soil type, and vegetative cover. The advantage of site specific methods is that buffer widths are designed using site characteristics and not an arbitrary predetermined width. Unfortunately, there is no "one" universally accepted formula or model and none have been developed for use in Connecticut. Most formulas are based on the degree to which sediment can be removed or filtered by natural vegetation, thus, the primary useage is sediment control. Other weaknesses of site specific techniques are (1) all areas must be evaluated on a case-by case basis and, (2) the subjectivity of different techniques (i.e. if the evaluation technique is inadequate, the buffer width will also be inadequate).

Additionally, these formulas only concentrate on one specific riparian function at a time and do not take into account multiple riparian functions, especially those of inland fisheries values as discussed in Section III. Consequently, site specific formulas approach riparian function on a single dimension rather than taking a more realistic, holistic approach.

In the absence of a scientific model to determine buffer widths suitable to protect Connecticut's riparian corridors, the utilization of a standard setting method is environmentally and politically prudent.

III. RIPARIAN FUNCTION

To assess the efficacy of a 100 foot buffer zone, the literature was searched to identify studies which have applied a quantitative approach to buffer width determination. Literature was searched for studies which both support and dispute the 100 foot zone. The following is a summary "by riparian function" of quantitative studies which assess buffer widths.

Sediment Control

Width, slope and vegetation have been cited as important factors in determining effectiveness of buffer zones as sediment filters (Karr and Schlosser 1977). Wong and McCuen (1981), who developed and applied a mathematical model to a 47 acre watershed, found that a 150 foot zone along a 3% slope reduced sediment transport to streams by 90%. Mannering and Johnson (1974) passed sediment laden water through a 49.2 foot strip of bluegrass and found that 54% of sediment was removed from the water. Trimble and Sartz (1957) developed recommendations as to width of buffer areas between logging roads and streams to reduce sediment load. They determined a minimum strip of 50 feet was required on level land with the width increasing 4 feet for each 1% slope increase. Buffer widths as determined by Trimble and Sartz (1957) have been characterized as evaluated guesses rather than empirically defined widths (Karr and Schlosser 1977). Rodgers et al. (1976) state that slopes greater than 10% are too steep to allow any significant detention of runoff and sediment regardless of buffer width. After a critical review of the literature, Karr and Schlosser (1977) determined that the size and type of vegetative buffer strip needed to remove a given fraction of the overland sediment load cannot be universally quantified. Existing literature does suggest that 100 foot riparian buffers will assist with sediment entrapment, although efficacy will vary according to site conditions.

Temperature Control

Brown and Brazier (1973) evaluated the efficacy of buffer widths required to ameliorate stream water temperature change. They concluded that angular canopy density (ACD), a measure of the ability of vegetation to provide shading, is the only buffer area parameter correlated with temperature control. Results show that maximum angular canopy density or maximum shading ability is reached within a width of 80 feet. Study sites were 9 small mountain streams in Oregon that contained a conifer riparian vegetative complex. Whether or not maximum angular canopy density is reached within 80 feet in a typical Connecticut deciduous forest riparian zone is doubtful. Tree height in Connecticut riparian zones is smaller than in Oregon (Scarpino, personal communication), therefore buffers greater than 80 feet in width would be required for temperature maintenance in Connecticut.

Nutrient Removal

Nutrient enrichment is caused by phosphorous and nitrogen transport from, among other things, fertilized lands and underground septic systems. Most research on nutrient enrichment has focused on overland surface flow. Karr and Schlosser (1977) report that 88% of all nitrogen and 96% of all phosphorous reaching watercourses in "agricultural watersheds" were found to be attached to sediment particles; thus, successful nutrient removal can be accomplished through successful sediment removal. There are conflicting reports on the ability of buffer widths to remove nutrients with most research being tested on grass plots. Butler et al. (1974) as cited by Karr and Schlosser (1977) found that a 150 foot buffer width of reed canary grass with a 6% slope caused reductions in phosphate and nitrate concentrations of between 0–20%. Wilson and Lehman (1966) as cited by Karr and Schlosser (1977) in a study of effluent applied to 300 m grass plots found that nitrogen and phosphorous concentrations were reduced 4 and 6%, respectively. Studies on subsurface runoff as cited in Clark (1977) found high concentrations of nitrates at 100 feet from septic systems with unacceptable levels at 150 feet. Clark (1977) recommended that a 300 foot setback be used whenever possible, with a 150 setback considered adequate to avoid nitrate pollution. Environmental Perspective Newsletter (1991) states that experts who commonly work with the 100 foot buffer zone set by the Massachusetts Wetlands Protection Act are increasingly finding that it is insufficient since many pollutants routinely travel distances far greater than 100 feet with nitrate-nitrogen derived from septic systems moving distances of greater than 1000 feet. Research indicates that the adoption of 100 foot buffer widths for Connecticut riparian zones will assist with the nutrient assimilation; albeit, complete removal of all nutrients may not be achieved.

Large Woody Debris

The input of large woody debris (LWD) to streams from riparian zones, defined as fallen trees greater than 3 m in length and 10 cm in diameter has been recently heralded as extremely critical to stream habitat diversity as well as stream channel maintenance. Research on large woody debris input has mainly been accomplished in the Pacific Northwest in relation to timber harvests. Murphy and Koski (1989) in a study of seven Alaskan watersheds determined that almost all (99%) identified sources of LWD were within 100 feet of the streambank. Bottom et al. 1983 as cited by Budd et al. (1987) confirm that in Oregon most woody structure in streams is derived from within 100 feet of the bank. Based on research done within old-growth forests, the Alaska region of the National Marine Fisheries Service, recognizing the importance of LWD to salmonid habitat, issued a policy statement in 1988 advocating the protection of riparian habitat through the retention of buffer strips not less than 100 feet in width (Murphy and Koski 1989). All research findings support the use of a 100 foot buffer zone in Connecticut for large woody debris input.

Food Supply

Erman et al. (1977) conducted an evaluation of logging impacts and subsequent sediment input to 62 streams in California. Benthic invertebrate populations (the primary food source of stream fishes) in streams with no riparian buffer strips were compared to populations in streams with buffer widths of up to 100 feet. Results showed that buffer strips less than 100 feet in width were ineffective as protective measures for invertebrate populations since sediment input reduced overall diversity of benthic invertebrates. Buffer strips greater than 100 feet in width afforded protection equivalent to conditions observed in unlogged streams. The ultimate significance of these findings is that fish growth and survival may be directly impacted along streams with inadequate sized riparian buffer zones. All research supports the feasibility of implementing a 100 foot buffer zone in Connecticut to maintain aquatic food supplies.

Streamflow Maintenance

The importance of riparian ecosystems in terms of streamflow maintenance has been widely recognized (Bottom et al. 1985). In Connecticut, riparian zones comprised of wetlands are of major importance in the hydrologic regime. Riparian wetlands store surplus flood waters thus dampening stream discharge fluctuations. Peak flood flows are then gradually released reducing the severity of downstream flooding. Some riparian wetlands also act as important groundwater discharge or recharge areas. Groundwater discharge to streams during drier seasonal conditions is termed low flow augmentation. The survival of fish communities, especially coldwater salmonid populations is highly dependent upon low flow augmentation (Bottom et al. 1985). Research, although documenting the importance of riparian zones as areas critical to streamflow maintenance, has not investigated specific riparian buffer widths required to provide the most effective storage and release of stream flows.

IV. OTHER POLICY CONSIDERATIONS

Measurement Determination

The proposed policy states that buffer zone boundaries should be measured from either the edge of the riparian inland wetland as determined by Connecticut inland wetland soil delineation methods or in the absence of a riparian wetland, the edge of the streambank based on bank–full flow conditions. This boundary demarcation is absolutely necessary to ensure that all riparian wetlands are protected. For example, if all measurements were to start from the perennial stream edge and extend landward for a distance of 100 feet, many riparian zones that contain expansive wetlands greater than 100 feet in width would be left unprotected.

Also, since boundary demarcation includes wetland delineation, the ultimate width of the buffer will vary according to site specific features. Consequently, buffer width determination as stated by Division policy is a "hybridization" of both standard setting and site specific methods. This hybridization of methods is advantageous since it acknowledges the sensitivity of streamside wetlands.

Home Rule

Where the Division policy is not in consonance with local regulations and policies regarding riparian corridor buffer zone widths, local authorities would be encouraged to adopt the more restrictive regulations and policies. This feature incorporates flexibility to acknowledge the importance of local "home rule" regulations or policies already in accepted practice. Conversely, towns and cities without accepted policies and regulations could choose to enact the Division policy.

Allowable Uses in Buffer Zones

The Division policy states that "the riparian corridor buffer zone should be retained in a naturally vegetated and undisturbed condition and that all activities that pose a significant pollution threat to the stream ecosystem should be prohibited." In essence, the buffer zone becomes an area where no development should be allowed. For this policy to be effective, there should be no exceptions, a blanket restriction of all uses would be recommended. Further clarification and more precise definitions of allowable uses will, however, be required in the future if the policy evolves into a departmental regulation.

Recently, the Connecticut Supreme Court has ruled that local agencies can prohibit specific development within buffer zones. The *Lizotte v. Conservation Commission of the Town of Somers, 216 Conn.320 (1990)* decision ruled that the construction or maintenance of any septic system, tank, leach field, dry well, chemical waste disposal system, manure storage area or other pollution source within 150 feet of the nearest edge of a watercourse or inland wetland's seasonal high water level can be prohibited (Wetlands Watch 1990). If this decision is a precursor of the future, Connecticut courts will continue to the support the use of buffers, especially those which restrict or prohibit detrimental activities.

V. CONCLUSIONS

The following actions are required to preserve, protect, and restore Connecticut's riparian corridors:

1. The Inland Fisheries Division needs to adopt and implement the proposed policy so that staff can use it as a guideline to assist cities, towns, developers and private landowners with making sound land use decisions. This policy will act to solidify a collective position concerning riparian corridor protection.

2. While the proposed policy in its "current form," represents a recommendation from the CTDEP Inland Fisheries Division, the ultimate goal of the Division should be to progressively implement this policy as either a CTDEP regulation or State of Connecticut statute.

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ABOUT THE TEAM

The Eastern Connecticut Environmental Review Team (ERT) is a group of professionals in environmental fields drawn together from a varety of federal, state and regional agencies. Specialists on the Team include geologists, biologists, foresters, soil specialists, engineers and planners. The ERT operates with state funding under the supervision of the Eastern Connecticut Resource Conservation and Development (RC&D) Area — an 86 town region.

The services of the Team are available as a public service at no cost to Connecticut towns.

PURPOSE OF THE TEAM

The Environmental Review Team is available to help towns and developers in the review of sites proposed for major land use activities. To date, the ERT has been involved in reviewing a wide range of projects including subdivisions, landfills, commercial and industrial developments, sand and gravel excavations, elderly housing, recreation/open space projects, watershed studies and resource inventories.

Reviews are conducted in the interest of providing information and analysis that will assist towns and developers in environmentally sound decision-making. This is done through identifying the natural resource base of the project site and highlighting opportunities and limitations for the proposed land use.

REQUESTING A REVIEW

Environmental reviews may be requested by the chief elected official of a municipality or the chairman of town commissions such as planning and zoning, conservation, inland wetlands, parks and recreation or economic development. Requests should be directed to the chairman of your local Soil and Water Conservation District and the ERT Coordinator. A request form should be completely filled out and should include the required materials. When this request is approved by the local Soil and Water Conservation District and the Eastern Connecticut RC&D Executive Council, the Team will undertake the review on a priority basis.

For additional information and request forms regarding the Environmental Review Team please contact the ERT Coordinator: 860-345-3977, Eastern Connecticut RC&D Area, P.O. Box 70, Haddam, Connecticut 06438.