Chronological History of the Standards for Soil Erosion and Sediment Control in New Jersey to 1999 & The Early Years of the Soil Erosion and Sediment Control Program in New Jersey

February 2024

(available on the New Jersey Association for Floodplain Management webpage at https://www.njafm.org/archive.html)

Acid Soil Supplements (1836-1999)

By
William Minervini
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Acid Soil Supplement A

Excerpts from 1836 and 1868 Reports by the New Jersey State Geologist, and the 1880 Annual Report of the New Jersey State Agricultural Experiment Station

Acid Soil Supplement B

Excerpts from 1965 Water Control Guide for Suburban and Rural-Residential New Jersey and 1971 Soil Survey of Burlington County

Acid Soil Supplement C

Examples of 1975-1983 project documents and correspondence

Acid Soil Supplement D

Soil Conservation Service (SCS): 1980-1982 Technical Notes and recommendation

Acid Soil Supplement E

New Jersey Department of Environmental Protection (NJDEP): 1983 SCS letter to NJDEP; 1984-1985 NJDEP rules, Technical Notes, and strategy; 1995-1996 NJDEP rules and general permit fact sheet

Acid Soil Supplement F

Selected pages with acid soil language in the 1974, 1982, 1987, and 1999 Standards for Soil Erosion and Sediment Control in New Jersey

William Minervini created this searchable PDF file in 2020, applying for most of the file the text recognition feature of basic PDF software. The searchable text layer has not been proofread, and has text recognition errors.

Acid Soil Supplement A

Excerpts from 1836 and 1868 Reports by the New Jersey State Geologist, and 1880 Annual Report of the New Jersey State Agricultural Experiment Station

The following pages with these excerpts were extracted from these PDF files:

- PDFs of the 1836 and 1868 State Geologist reports are available at https://www.state.nj.us/dep/njgs/enviroed/oldpubs/Survey1836.pdf and https://www.nj.gov/dep/njgs/enviroed/oldpubs/SG-GEOLOGY-NJ-1868.PDF, respectively.

- A PDF of the 1880 Agricultural Experiment Station report was downloaded from the Google Books website in October 2019.

EXCERPTS

REPORT

ON THE

GEOLOGICAL SURVEY

OF THE

STATE OF NEW JERSEY.

BY HENRY D. ROGERS,

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PHILADELPHIA:
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1836.

NEW JERSEY GEOLOGICAL SURVEY

REPORT.

To His Excellency Peter D. Vroom,

SIR,—In compliance with the appointment which I had the honour to receive from you under the date of April the 24th, 1835, to make a Geological and Mineralogical Survey of the State of New Jersey, as ordered by act of the Legislature, I beg leave to submit the following Report:

Bearing in mind your instructions as to the scope and object of the survey, namely, to bring to light the native mineral productions of the State, in a manner to make the examination as serviceable as possible to the interests of its agriculture and other branches of industry, I beg permission to state that I have directed my more especial attention to those points in the Geology of each district, immediately connected with the developement of these resources. The various tracts of *Marl*, *Limestone*, and other mineral substances useful as agents for fertilizing the land, the numerous *ores*, *sands*, *clays*, *building materials*, and substances of value in the arts have been explored and examined, while no pains were spared to trace them in their range across the State, as minutely as was consistent with the design of a general survey, and the time allotted to the duty.

It being impracticable, with the means at command, to investigate in detail, every portion of so large a territory, a plan of survey was adopted, intended to unite a considerable share of research, respecting those points of chief utility alluded to, with a general study of the Geology of the State at large.

This plan consisted in laying down upon the Map of the State, (Gordon's) a series of straight lines, five in number, so drawn as to cross, nearly at the same angle, all the various formations. The

regions adjacent to these lines, embracing a width of several miles on both sides of each, were then selected for more particular and detailed examination, and the extent and boundaries of the several formations as far as determinable, were delineated upon these portions of the map.

The five geological sections or profiles thus surveyed embrace all the strata, and afford a general insight into the principal features of the stratification, of the State.

During this examination, specimens of the materials susceptible of useful application, have been gathered from the districts adjoining these profiles, and likewise from much of the intervening country, all the most important localities throughout which were visited for that purpose.

Such of these substances, as seemed to require a minute investigation, have been submitted to *Chemical analysis* in the hope that the precise information, thus procured of the composition and properties, of the several mineral productions of each region, may tend to incite a spirit of wholesome enterprise to their developement in the useful arts: such enterprise will extend itself, in proportion as the latent resources of the State, are made known to its citizens, and it will be sound, just in proportion to the degree of care and accuracy employed in the development.

In accordance with this plan, I have explored more minutely than in other parts of the State, the Geology of the five following tracts, the structure of which will be better understood by referring to the profiles constructed to elucidate them.

First, a line of country extending across Bergen and Sussex counties, from the vicinity of Fort Lee, on the Hudson river, to near Dingman's Ferry, on the Delaware.

Secondly, a tract stretching from the sea-shore, in Monmouth, to the Water Gap of the Delaware, in Warren.

Thirdly, a tract extending from the bend of the Delaware, at Easton, parallel with the general course of the river to Trenton, and thence prolonged to the sea-shore, south of Barnagat.

Fourthly, a section across Gloucester county, reaching from the Delaware river, at Camden, to the sea-shore, near Leed's Point.

Fifthly, a tract traversing Salem, Cumberland, and Cape May counties, from the Delaware to the sea-coast.

Besides exploring systematically the regions lying within several miles of the profile lines here laid down, various other examinations were made by tracing the formations in the longitudinal direction, or in other words, along the boundaries which separate each two contiguous strata.

This was done more especially in the survey made of the *green sand or marl formation*, passing through Monmouth, Burlington, Gloucester, and Salem counties. The country lying both upon the N. W. and S. E. of this tract, was in many places carefully explored, in order to trace the prolongation of the marl, beneath the surface, and ascertain its existence over wider limits than were before supposed to exist. Nearly all the important localities, moreover, in the green sand district, were visited with a view to make selections for analysis of the several varieties of this substance, which, from its rare powers as a fertilizing agent, seems to claim especial and minute investigation. On both sides of the tract where the green sand marl is found naturally exposed, I have in part succeeded in following the stratum to where there was but little previous confidence that it extended.

The utility of these researches to the agriculture of the districts interested, may hereafter be considerable, especially should the depth at which the marl spreads itself below the soil, be determined with any approach to accuracy. The chemical investigation of the several qualities of the marl, will, it is believed, result in some useful information, tending not only to direct a proper selection of the material, but to guide the agriculturist in the manner of applying all the several varieties of it to the soil.

INTRODUCTION.

General View of the Formations comprised in the State.

IT is apparent to even a casual observer, looking at the surface of New Jersey, that its area is pretty equally divided into two very dissimilar regions, whether we refer to their physical geography, their mineral strata, or overlying soils. The boundary line which separates the whole territory of the State into these two districts, which both in geological structure and agricultural character may be regarded as so strongly contrasted, will, it is believed, be found, when more accurately determined at some future day, to be a somewhat undulating line, extending from the Delaware river, at Bloomsbury, below Trenton, across to the river Raritan, below the mouth of Lawrence's Brook. To the south and east of this division line, the strata of the rocky or consolidated sort are extremely few, the deposits being chiefly loose sands and soft clays of various composition, while the prevailing soil is sandy and the surface flat. To the north and west of the same limit, the strata are all, on the contrary, of the stony character, or what in ordinary phrase is meant by rocky, and each set or formation is covered by its peculiar class of soils in which the predominant character is less sandy than in the other section of the State. These differences result from and point to a wide natural disparity in the materials composing the two regions, in the period when their component strata were brought together, or in other words, their geological age. They are likewise significant of a no less important difference in some of the causes that have operated in impressing so strong a contrast in their external features upon the two sections.

The rocks to the north-west of the limit alluded to, belong in part to the stratified primary class, in part to the lower groups of the secondary series, or that which embraces the non-fossiliferous and fossiliferous strata, lower in the list of our formations than the anthracite coal of this country.

The district in question embraces likewise numerous ridges and outbursts of rocks of the Trap class, more recent, in all proba-

bility than the rocks above-mentioned, though still of an obviously remote age.

The section of the state lying south and east of the same line, comprises formations of a much more recent period, inasmuch as the strata of that tract belong to the upper or later portions of our secondary series, and to the still newer tertiary.

Some of the strata in this region contain a sufficiently copious supply of organic remains to enable the geologist to determine, with some approximation to accuracy, the position which these beds should occupy in the series of North American secondary and tertiary formations. On the other hand, the rocks in the northern division of the state, with the exception of a single stratum, enclose very few fossils, and it becomes, therefore, a task of considerable difficulty to decide with confidence, whereabouts we should place them in the system of the American secondary strata and to what equivalents among the European rocks we should refer them. These difficulties, time and laborious research alone can dissipate, and I am, therefore, more solicitous to express myself in this report with caution upon these the higher generalizations of the science, than to commit myself to decided opinions at a time when systematic geological investigations among us may be said to be only in their infancy.

The order which I design to pursue in describing the several tracts of the state, is to treat each formation, that is, each group of strata produced at about the same period, separately; and I shall commence with the latest formed deposits first, and pass to the next older in regular succession. The little that admits of being said in this place respecting the soils of each district, will be given in the sections referring to the respective strata upon which they repose, because soils in the great majority of instances are derived from the rocks which lie beneath them.

In conformity, therefore, with the course proposed, the lower or southern half of the state will be described first.

NEW JERSEY GEOLOGICAL SURVEY

CHAPTER I.

Geology of the counties of Middlesex, Monmouth, Burlington, Gloucester, Salem, Cumberland and Cape May.

GENERAL DESCRIPTION.

This section, which embraces the greater part of Middlesex, the whole of Monmouth, Burlington, Gloucester, Salem, Cumberland and Cape May counties, includes strata belonging to two separate geological eras—the *Tertiary*, and the *Upper Secondary* periods of modern geology.

The deposits of both classes are very nearly horizontal. This and the usual level outline of the surface itself have caused the several strata of the region to be almost every where concealed by an extensive though not deep layer of sand and gravel, which has been strewed over them at some period subsequent to their original deposition. As it is a fact very generally true, more especially in widely expanded level countries, that the soil and superficial layer of loose earth is, in most part, derived from the subjacent strata, whether rocky or unconsolidated, we see whence it happens that the surface matter of this portion of the state is in general so remarkably sandy; for sea-shore or ocean sand has been a large ingredient in the original formation of most of the deposits of the district.

The obscurity arising from this cause, together with the absence of any deep valleys or high vertical banks, such as in many regions, exhibit the edges of the numerous strata in their order of superposition, renders it extremely difficult, in the present stage of research, to lay down, at least with precision, the exact relations of the beds which occupy some sections of this extensive level district. The following may be assumed to represent with sufficient accuracy for present purposes, the order in which the strata of this region would succeed each other in the descending series, were they all to occur together.

A. Sand and gravel lying beneath the vegetable soil to a variable depth, but generally many feet thick. This usually overlies all the other deposits indiscriminately.

B. A bed consisting of bluish or lead-coloured clay, with sand in variable proportions, embedding, in the few localities where

alone the formation has hitherto been discovered, a profusion of fossil shells in a state of decomposition, which give to the more clayey portions of the mass the properties of *a calcareous marl.* This stratum is of the *Tertiary* class, and reposes upon the succeeding.

C. A blue, somewhat plastic clay, often sandy and micaceous, and interstratified with variegated ferruginous sands. It frequently contains leaves, parts of trees, lignite, amber, and other vegetable products, and rests very generally upon the green sand or granular marl, with which material it is very often confounded. It sometimes contains a quantity of free sulphate of iron (copperas) and sulphate of alumine, and is consequently deleterious to the soil. Whether this deposit is of secondary or tertiary date has not thus far been fully ascertained, though little doubt remains that it is *secondary.*

D. A group of beds of the *upper secondary series,* bearing a certain degree of analogy to the green sand formation of Europe. The principal members of this group are—

1. A brown coarse ferruginous sand-stone, and conglomerate, made up of transparent quartz sand, fragments of felspar and quartz pebbles, cemented by a dark brown ferruginous paste. This sandstone often contains grains of the green sand so abundant in the strata lower down. It crowns the tops of the hills. It is doubtful to what group it belongs, though probably to the secondary. It is also uncertain whether these beds or the stratum C. are lowest in the series.

2. A yellow ferruginous sand, being analogous in composition to the sandstone ; containing often a sensible proportion of the green grains. Sometimes thirty feet thick. This, which is a very extensive bed, is believed to be the same which in one or two localities, as in the Nevesink hills for example, exists as a soft sandstone stratum, containing the secondary fossils usually in the state of *casts.* If so, it is of the secondary group, and is connected immediately with the green sand bed upon which it very generally rests. In some of the central parts of the marl region this stratum is a loose sand, but full of organic remains in the state of solid casts formed in the interior of numerous bivalve and univalve shells.

3. A yellowish granular limestone, sometimes siliceous. It occurs in thin detached layers, a few inches thick, divided by a

loose calcareous earth. It abounds in organic remains of upper secondary origin. This, like the former stratum, overlies directly, in some parts of the region, the green sand or "*marl*" stratum, and seems intimately related to it. It contains often a considerable proportion of the green grains which constitute the material here called marl.

4. Lastly, the green sand or "marl" stratum, consisting of the peculiar *green sand* mineral, mixed, in greater or less proportion, with clay and ordinary quartz sand. This is the lowest bed of the series, and forms the basis of the formations at present known in this section of New Jersey.

The area embracing the strata here enumerated, comprises the whole southern half of the state, bounded by the lower edge of the rocky strata which lie between Trenton and Perth Amboy. If we trace a slightly undulating line from a little below Trenton to the western side of the Sand-hills, and prolong it from thence to Perth Amboy, we shall have a pretty near approximation to the limit separating the two portions of the state. This southern area may be conveniently divided, for our present purpose, into three parallel sections, by two nearly straight lines, which I consider to be, as yet, only approximately ascertained. These lines enclose the "marl tract" of the state. That upon the north-western side we may venture to delineate as commencing near Middletown Point, and passing in the neighbourhood of Mount's Mills, Allentown, Crosswicks, Burlington, Moorestown, Woodbury, and Sculltown to Salem. The south-eastern line is not so well determined, but we shall trace it from the Atlantic coast, near Deal, towards Squankum, and from thence cast of New Egypt and Vincentown, past Blackwoodtown and Woodstown, to join the first line near Salem. The most western of the three divisions thus designated forms a narrow belt of scarcely more than six miles breadth, extending from the Raritan river and bay, through the centre of Middlesex, to the bend of the Delaware at Bordentown, and thence parallel to the river, as far as Lower Penn's Neck, in Salem county. The strata of this narrow belt of territory are those described in the previous summary under the heads (A.) (C.) and (D 1.) The south-eastern division, by far the most extensive of the three, is bounded by the south-eastern line of the Delaware, from Salem to Cape May, and the Atlantic coast from Deal to

the same point, and is composed of the strata (A.) (B.) (C.) and (D 1.) The middle section, or that included between the two lines, and designated as the "marl tract," will be found, I believe, to embrace the *whole series.* Let it be here distinctly understood, however, that we do not mean that the whole series in the order laid down, are assembled together in any *one place*, for one or several of the middle beds are frequently absent.

In general features, the whole of this southern region of the state is an extensive and nearly horizontal plain, the mean elevation of which above the sea is probably not greater than forty or sixty feet. It is highest in the north-east of Monmouth, where the Middletown and Nevesink hills are between 250 and 300 feet above the sea, and it seems to descend gently from this quarter and from the central division or the marl tract, on both sides, towards the ocean on the south-east, and towards the Delaware and the Millstone on the north-west. Rising above this slightly undulating plain are a number of low insulated hills of which the Nevesinks are the highest. These hills are, many of them, single detached conical eminences of regular rounded outline, sometimes having a circular base, but more usually showing an oval outline, the longer dimension of the hill, in the greater number of cases, being directed north-east and south-west, or parallel to the length of the "marl tract," and also to the strata in the upper half of the state. In other parts of the region, especially in Monmouth, these hills have the form of short ranges, with a waving outline, as if shaped by the same actions which gave form to the single conical ones. These eminences are not confined to the limits of the "marl tract," but rise indiscriminately from the general surface in all parts of the low country. One striking and invariable feature about them is, that towards their summits we meet with the brown ferruginous sandstone and conglomerate described in (D 1.), generally in solid beds, and horizontally stratified. The presence of this rock is indicated by the large quantity of fragments, most commonly rounded and water-worn, produced during the destruction and washing away of a large portion of the same stratum.

That nearly the whole surface of the region was at some former period upon a level with the tops of these hills must be inferred from our finding this sandstone stratum always at about the

same elevation, and in the horizontal position in which it was deposited, implying that the bed in question had been prolonged over all the intermediate area. We are strengthened in this inference upon observing the prodigious mass of small fragments and gravel, evidently traceable to this rock, which strews the general surface of the plains between these detached and often widely distant hills, which seem thus to be remnants or outstanding portions of a once much more extensive stratum. In geological language they are denominated hills of *denudation,* that is to say, formed by the washing away, or laying *naked,* of the strata which formed the surface of the region around them. From what quarter the mighty rush of waters proceeded which swept off so extensive a part of the upper rocks of this large section of the state, and what course it took, are questions upon which we arc unprepared to speculate, though from the prevalence of a north-cast and south-west direction in the longer dimensions of the hills, we may see a probability of one day arriving at more definite conclusions. I may enumerate as among the more conspicuous of these detached hills, the Nevesinks, the range south-east and south of Middletown Point, the two hills near Red Bank, those near Colt's Neck, the Forked river mountains near Barnagat, Mount Holly, also Arney's Mount near Juliustown, the mount at Evesham, and the Sand-hills between Princeton and New Brunswick. Many more might be specified, and in a detailed geological map of the region it would be desirable to include them all, from their being the chief repositories of a stratum furnishing the only building stone of the country.

It is not intended to assert that this brown sandstone does not occur except near the tops of the hills, for I am aware that in many neighbourhoods it may be found beneath the soil where no positive eminences or knolls exist; yet even here the rule will hold true, that the rock occurs only near the highest places. The streams of this region are very numerous, and the valleys through which they empty themselves all give evidence that they neither acquired their chief outlines or their present size from the insufficient waters which meander through them. It is on the contrary obvious to every observer, that the valleys were scooped out and shaped by the same sudden drainage which has given to the hills the configuration before described.

To have a correct conception of the relations and distribution of all these strata which occupy the three sections specified, let us imagine the materials of all except the two uppermost beds, to have been deposited or brought together in succession, *horizontally* or nearly so; and suppose that in the subsequent emergence of the whole from beneath the water, the central region including that here marked out as the "marl tract," was raised to a rather greater elevation, and exposed then or subsequently in a greater degree than the rest of the territory, to the destruction and removal of wide portions of the upper beds of the series. Such an idea is in accordance with the practically important fact, that there is a gentle dip of the lower strata *both ways*, from the centre of the marl belt. This supposed washing away of a part of the upper strata, likewise accounts for the immensely extensive superficial bed of transported sand and gravel, covering the surface in an almost uninterruped sheet over all the three sections. The middle one differs from the other two in features and resources, chiefly because the lower stratum or marl bed is occasionally *laid bare*. This slight declining of the strata from the marl tract in opposite directions; on one side towards the ocean or south-east, on the other towards the valley of the Delaware river or to the North-west, must give of course a gently convex outline to the surface of the lower beds, and must lead to the important conclusion that these inferior strata so valuable for their fertilizing contents, spread away unseen in those directions over perhaps a very extensive area. The "marl tract" might therefore on fair geological grounds, have been made to embrace a far wider area than I have thought fit for the present to assign to it; but it was deemed wiser to restrict the name to the belt of country, where in the low grounds the inferior bed—the marl stratum—is believed to be every where accessible within the moderate depth of a few feet. If what is here said of the dip of the lower beds be correct, and it is supported by the examination of a great number of localities, it becomes at once apparent, that the further we retire on either side, from the region in which the marl stratum is exposed, the less probability we have of reaching it, except by sinking to a considerable depth; and we see why, in the two districts outside of it, we have within our view only the upper beds of the series.

is again renewed after the lapse of a series of years. In some places, the requisite period does not exceed twenty years. It is essential to the continual deposition of the ore, that the soil in which it is precipitated should not be drained, but that it should be incessantly washed by the ferruginous springs. Where the water from these is enabled readily to escape, while the surface of the ore is laid bare and exposed to the rains, the oxide of iron vanishes almost as rapidly as it before accumulated. The lumps retain, it is true, the cellular structure of bog ore, but the matter left in them consists almost entirely of the more earthly portions, owing to the decidedly solvent power of rain water for the oxide of iron in the loosely cohering state in which it exists in the ore. The rain water seems to owe its capacity of dissolving the iron in the ore to the small quantity of carbonic acid which it collects in its passage through the atmosphere.

We derive one important hint from these facts; it is that those who are making use of this variety of ore, should avoid keeping large accumulations of it exposed to the weather as we so frequently witness at the furnaces in the sections of the state where the bog ore abounds. It should be dug, in fact, only as it is needed.

Tertiary Calcareous Marls.—These are highly interesting in a two-fold point of view: first, in reference to our agriculture, as occurring in the midst of a region of sandy soils where the green sand marl, lime, and other like sources of fertility are remote; and secondly, in reference to the progress of our scientific geology, from being the only *tertiary formations* yet discovered in the state, and at the same time the extreme north-eastern limit of the very extensive range of the tertiary deposits of the Atlantic border of the Middle and Southern States.

The geology of these beds is at present somewhat obscure, though the small list of fossil collections from them proves that they belong to one of the oldest periods of our tertiary class of formations. Their range is very circumscribed, the only locality of much importance being near the western corner of Cumberland county. Nevertheless, the deposit demands a brief description from its present economical value to the neighbourhood where it occurs, and the clew which description may furnish to finding a corresponding stratum in other sections of the seaboard region of

the State. The principal deposit of these tertiary marls occurs in Cumberland county, upon the upper part of Stow creek and its tributaries, but whether it extends farther through the country concealed by the superficial sands, or, what is rather more likely, occupies what was originally a *cove* or *bay* in the midst of the adjacent *secondary* strata, are points too obscure to be so soon determined. At Elwell's pits, about two miles north-west of Roadstown, the deposit shows the following features. The superficial stratum of the neighbourhood is rather coarse yellow sand, which is five or six feet thick in the bank where the marl is excavated. Beneath this, there is a layer four or five feet thick, of a reddish yellow clay, abounding in traces more or less obscure of fossil shells in an extremely rotten and decayed condition. Beneath this there is a bluish green clay containing a multitude of the same fossils in a somewhat less decomposed state, though very soft and tender. These two fossiliferous beds are in some places twelve feet thick, and rest upon a dark greenish blue adhesive sand, bearing a close resemblance in all points to the tenacious sandy clay deposit described in the summary as the stratum (C). In the bed of the adjacent bank it has the very prevailing deep brown colour of this bed, and strongly arrests our notice, from the large quantity of the *astringent* substances (copperas, &c.) which it so generally contains. The mass of loose friable clay, both yellow and green, exhibits a very considerable proportion of *carbonate of lime* derived from the decomposition of the shells: enclosing also the calcareous matter of these fossils themselves. It is a greenish marl calculated to be especially beneficial upon the very sandy land of the vicinity. It will be found valuable as a fertilizer in proportion to the percentage of lime which it contains, the crumbling state of the shells, and its freedom from sand. The description here given of Elwell's marl, will apply pretty well to the other marls, excavated upon the same streams, with this reservation however, that the shells in some localities are less rotten and in their nature less destructible. This is the case when they are oyster shells. These occur in one part of the deposit at Davis's bank ; and also in the greater number of the openings higher up the stream, where also the clay seems to possess a rather large share of sand. The important question as to which is the best marl of the neighbourhood, will be best determined for the pre-

sent by the agriculturist himself, on testing the various specimens with dilute muriatic acid.

I have accompanied this account with the following analysis of these marls carefully made, for the purpose of ascertaining for the inhabitants of the quarter interested, the relative efficacy of different marls from several localities.

In excavating marl in this neighbourhood, it is all important to avoid mixing with the calcareous stratum any of the *astringent* matter which lies immediately beneath. This is, as I shall presently show, noxious to the crop and seriously detrimental to the land. It will be known by its *taste*, and its never containing any fossils.

Another neighbourhood of nearly the same nature and geological age, occurs about a mile and a half south-east of Fairton, and near the Rattlesnake run. It is a very thin stratum of a similar bluish clay, containing a small proportion of decomposed shells, and resting, like the Stow creek marl, upon the same astringent argillaceous sand. It also is of two varieties, one containing only oyster shells and much sand ; the other being more clayey, and possessing a larger amount of calcareous matter (lime), with the fossils in a very decayed state. The deposit here being but newly brought to light, it has not been much developed, though it obviously deserves to be zealously explored.

Much of the value of a marl of this description seems to depend upon the kind of fossil shells which furnish the lime. These may be very indestructible, the case most generally with the oyster; or on the contrary so easily decomposed, as to be found generally in a chalky and decayed state, such as is necessary to constitute a good marl. The largest, and at the same time one of the most abundant fossils in the Stow creek marl, is the *Perna maxillata*, a thick, flat, pearly shell, dividing into numerous thin scales, and valuable in any marl bed from the readiness with which it decays and distributes its calcareous particles.

1. A specimen of average richness from the marl pits of Mr. Elwell, yielded

Lime,	25.5	} Carbonate of lime 45.5 per cent.
Carbonic acid,	20.0	
Greenish residue chiefly clay with some oxide of iron,	54.0	
Loss,	00.5	
	100.0	

The shells in a very rotten chalky state, principally *Pernas*, and a good many small turrited univalves.

corresponding dark bed and white clay do at South Amboy. To determine with certainty that the white clay holds invariably a position *beneath* the other, would be a generalization of some practical value in assisting us in further discoveries respecting this valuable material.

But we must leave this and many more such questions undetermined for the present.

SECTION 3.—*Geology of the "Marl Tract," embracing portions of Middlesex, Monmouth, Burlington, Gloucester, and Salem counties.*

This must be regarded as one of the most important regions of the State, from its being the depository of a material endowed with the rarest powers as a fertilizing agent, spread under the soil in a quantity which must altogether defy the wants of the community to exhaust. The marl bed, though but one of several strata which occur within the territory, so much surpasses all the others in usefulness, that I have directed my examinations in the district now before us, almost exclusively to the development of that deposit. It will be understood that the lines which I have marked out as limiting the area of the marl bed or lower stratum, are not intended to designate the positive boundary of that stratum, but rather to mark the space, outside of which, I imagine, from my *present data*, that the surface of the marl descends too deep to be readily accessible to the agriculturist.

From the nature of the case, the precise depth of the deposit below the soil, must of course be imperfectly known in many portions of the tract, and I therefore wish the lines in question to be considered as only conventionally adopted to meet the existing state of our information.

It will be seen from profiles No. 3, 4, and 5, and from what has before been stated, that these two lines, loosely defining the limits of the marl tract, mark pretty nearly the division between the *true* or lower marl, and the overlying *spurious marl*, or *dark astringent clay*. As, however, the latter bed abounds over much of the area containing the true marl, and as its properties, moreover, are of great importance, I shall treat of it in this place, and shall enter upon the description of it first.

Dark astringent clay stratum. Wherever this bed is seen, and it may be examined almost any where upon the Camden and Am-

boy rail-road, or a few miles above the mouths of all the creeks which empty into the Delaware river below Trenton,—we find it invariably exhibiting certain very distinctive features. Usually it is a blue, deep lead-coloured, or black clay, somewhat tough and plastic when moist, and apt to bake into a rather hard mass upon drying, and to assume a light lead colour, or bluish grey. It is rarely free from a considerable quantity of common sand, often in a very finely divided state, and has also occasionally more or less mica in a state of minute division. In Maryland, a stratum in all respects analogous in composition, if not in relative position, to the green sand, or marl stratum, has been examined by Professor Ducatel, and called by him in his last Report, "Black Micaceous Sand." Its dark colour seems mainly due to a small share of carbonaceous matter, and it is not unfrequently seen to contain remains of vegetation, as carbonized wood, amber, &c. Its odour is that of marsh mud, or the ooze of the ocean. This smell is often overruled, however, by the strong odour of sulphur which it emits, in consequence, it is presumed, of the decomposition of the *sulphuret of iron*, with which it is largely charged. To the sulphuret of iron, reacting with the argillaceous matter, or the clay, we must attribute the copious quantity of sulphate of iron, (*copperas*,) and sulphate of alumine, (*alum earth*,) with which it is oftentimes impregnated, imparting to it, its characteristic astringent taste and hurtful properties. Sometimes it is of a brown colour and is then always highly astringent.

These astringent matters make themselves obvious upon the surface of the clay where it is partially dry, in the form of a light yellowish incrustation of the well known appearance of efflorescing copperas. This may easily be recognized by its strong, styptic, inky, taste. The tongue indeed furnishes a good means of telling whether the moist clay itself contains much of the astringent principle.

The bed has occasionally other colours and aspects than those here mentioned, but enough has been said to enable any one to recognize it. In many places, especially from Middletown point across to Bordentown, and thence on to the S. W. parallel to the Delaware, the stratum contains, besides the ordinary siliceous (flinty) sand, a sensible admixture of the green grains characteristic of the marl bed beneath it. These exist sometimes in a suffi-

ciently large proportion to impart a fertilizing action to the whole material; and it has been in repeated instances dug and applied as a marl, most generally through a misconception of its true nature. One result generally attends every such experiment. If employed in a very limited quantity, a temporary injury arises, though its ultimate effects on the soil are beneficial; but if used incautiously, a serious and long continued *sterility* is the consequence.

Whether or not any part of the stratum is sufficiently impregnated with the sulphates of iron and alumine, to hold out encouragement to the chemical manufacturer that copperas and alum may be procured from it in quantity, is a problem, for the solution of which, there must be instituted a number of preliminary inquiries, as well geological, as chemical. In the present state of information, I consider it to be premature to express a decided opinion, though thus far, I do not think that I have met with the astringent matter in sufficient concentration to justify any present anticipations. What a more detailed investigation might develope we cannot say.

With a view to exhibit more definitely the composition of this earth, I have submitted samples of it to chemical analysis. The following results from a specimen procured from the base of the Nevesink hills, on the Raritan bay, will show the average composition of a very abundant variety of the stratum.

Analysis of the blue Astringent Micaceous Clay:

Silica,	35.75
Alumina,	39.25
Protoxide of Iron,	12.10
Sulphuric acid,	1.95
Carbonaceous matter,	1.00
Potash,	0.30
Magnesia,	0.25
Muriate of Soda ,	*a trace.*
Oxide of Magnesia,	*a trace.*
Water and Volatile Matter,	7.00
	97.70

That certain portions of this bed may be rendered available in enriching the soil, I entertain a strong hope. The statement already made, that there sometimes exists in it a considerable share of the *green sand*, or in other words, the fertilizing material of the marl, is enough to encourage those who may possess it, and not the genuine marl, to give it their attention. Notwithstanding the

very frequent, we may say, almost invariable occurrence, of the astringent matters, which are, in themselves, so unequivocally deleterious to the vegetation; precautions may be adopted and means used, which very possibly may make it a valuable auxiliary to the farmer, in places where the genuine marl lies remote. The recommendations respecting the mode of using it will be found in the short section of this chapter, which treats of marling.

Other details, as to the aspect which it assumes in various localities, will appear when speaking of the several places where it lies, in connexion with the true marl, in the neighbourhoods more minutely examined by me.

THE MARL STRATUM.

Description.—The essential, predominant, and often sole ingredient in this bed, is a peculiar mineral always in the form of small dark grains, about the size of grains of gunpowder. Their form is roundish, and they are very often composed of two or three smaller ones united together, a distinctive feature by which they may at once be recognized from other dark kinds of sand. Though they contain on the average about fifty per cent. of Silica, (the basis of flint,) they are not gritty but can be readily bruised between the teeth, or upon the nail, and some varieties, when moistened, admit of being kneaded into a half plastic mass, like impure clay. The prevailing colour of the grains is a *deep green*, though sometimes the tint is as bright as that of Verditer. It is often a dull greenish blue, and not unfrequently a dark chocolate colour.

Though I believe that this mineral is not invariable in its composition, or in its shade of colour, yet I conceive the green to be its essential hue, and the other tints to arise frequently from a minute coating over each grain, of the clayey matters from which the bed is rarely altogether free. I am induced so to think, by finding that the action of acid for a short time upon the grains, almost invariably brings out the green, which is also produced in all cases when we *bruise* a grain of whatever external colour, upon the nail, or on a sheet of white paper. The bright green streak given, whenever a granule of this substance is thus crushed, affords us perhaps the readiest and most unerring test by which to recognize it from all other varieties of sand.

Though upon the most carefully conducted experiments I find

important variations in the relative proportions of the several component substances which unite to form this green granular mineral, yet the following analyses may be considered as presenting a fair average of its composition.

An analysis made some years ago, by Mr. Seybert, gives silica 49.83, alumina 6.00, protoxide of iron 21.53, potash 10.12, magnesia 1.83, water 9.80, in the 100 grains.

The same mineral, from a stratum at Havre, in France, has been examined by M. Berthier, an able French chemist, who reports the following proportions: silica 50, protoxide of iron 21, alumina 7, potash 10, water 11, in the hundred parts.

My own analyses of the same substance from several of the most important marl localities in the state, will be presented in a tabular shape with my other analyses at the end of this report. It will be seen that some of these marls exhibit as much as 14.5 per cent. of *potash*, and 10.4 per cent. of lime, and it must cease, therefore, to be a mystery why this substance possesses a power of fertilizing the soil, surpassing that of any material, whether mineral or animal, hitherto discovered.

Though the green granular substance here described makes up the essential and far largest portion of the marl stratum, it must not be supposed that it exists always alone. There is sometimes a very considerable quantity of clay mixed intimately among the grains, and as this is of different colours in different localities, it becomes, when it is abundant, the chief source of that variety in external aspect which the mass (called *marl*) assumes. This clay composes occasionally as much as fifty per cent. of the whole bed. Its ordinary tint is a dull blue or lead colour; it is sometimes yellowish, from the presence of oxide of iron, and again has a chocolate colour, a brown, or even a white when dry. Though it influences greatly the general appearance of the marl, it is in reality, a very inert portion of it, and must be considered rather as usurping the place of a material (the green grains) of much more active and beneficial properties.

Too large a portion of this clay will be known, by the marl being very sticky. It is to the clay in the marl, that I trace the strong *sulphureous odour* so very generally observed in it, and in this and other respects the intermingled clay seems to be identical with that which often constitutes a stratum by itself, overlying the marl and described in the previous section. It resembles it in co-

lour, exhibits not unfrequently the same astringent yellow *efflorescence of copperas*, contains a sensible share of mica and often a good deal of common siliceous (flinty) sand. Indeed this latter material white sand, is no uncommon substitute in whole or in part for the clay itself, and of course, when largely present, it has some share in determining the suitableness of the marl to certain soils.

The astringent ingredient, when present, has a much more powerful interfering influence than the mere clay upon the fertilizing agency of the marl. If copious in quantity, it not only abates greatly, by its poisonous properties, the benefits that would naturally result from the green mineral with which it is associated, but it too often has arrested or destroyed entirely, the whole crop for one or several seasons. Certain marls, otherwise excellent, have grown into disrepute in consequence, and the indiscreet use of it and of the overlying astringent clay before mentioned, has had in several neighbourhoods a seriously mischievous effect in retarding the growing spirit of experiment and enterprise in regard to the use of marl, which is, nevertheless, fast effecting a happy change in the agriculture of all this region. A specific, and it is hoped, effectual antidote will be suggested, which will render marls thus contaminated nearly equal in efficacy to the purest.

Besides the foreign matters here specified as often present with the green granular substance, there are other materials now and then associated with it whose agency is highly beneficial, cooperating to the same fertilizing purposes with the other portion.

These substances are the *carbonate of lime* and the sulphate of lime (*gypsum*) derived directly and indirectly from the numerous beds of fossil shells and other organic remains which largely abound in certain portions of the stratum. Various fossil shells and other marine remains, to the number of considerably more than one hundred species, are scattered through the marl bed. They do not occur everywhere, but are collected together in groups or *colonies*, extending in layers of a few feet thickness over pretty extensive areas. It is an error, and a prevailing one, that supposes these organic relics to be the essential cause of the highly fertilizing powers of the marl. Their presence or absence seems to have *little or no effect* upon the efficacious action of that

any hitherto seen. It consists of hardly anything but shells in a fragmentary condition, very friable and purely calcareous, and contains but a very small share of the green particles; its colour is yellowish owing to a small portion of sand. The shells are in a very broken condition, but we may recognize them to belong to the well known secondary fossils of the marl. The large shell called *Terebratula Harlani* seems to constitute a large portion of the mass. Something similar is seen farther to the south, on the farm of Mr. Field, about one and a half miles from Eatontown. This deposit deserves to be traced more minutely, as it is probably a new variety of marl fit for the agriculture of the neighbourhood, containing much more lime than the green sand of the same formation elsewhere.

Red Bank.—Here the dark green sand marl has a top layer of the large round consolidated masses, an indication of a superabundance of oxide of iron. The marl itself is rather copiously charged with the sulphate of iron or copperas. The predominant portion of the material is the green sand.

At Judge Paterson's we have a convincing proof of the hurtful influence of the copperas, in a marl otherwise excellent; his being extremely rich in the fertilizing green grains. The bank from the level of the water for a few feet up, is composed of the marl stratum, but abounding in the yellow astringent efflorescence. Tried upon the land it has been found injurious to the crops for at least the first year or two, unless when applied in great moderation.

Where the poisonous impurity is abundant, it is not safe to employ more than five loads of the marl upon an acre; nor do I see any good reason why five loads of a rich marl is not enough in nearly all cases for a single dressing.

The entire material of the beach beneath the bank, consists of the dark green sand or marl grains, from which nearly the whole of the astringent matter appears to be removed by the washing of the waves, as the caving of the bank from time to time, brings down the matter upon the beach, and within the dissolving action of the water.

This washed marl is pure, and may be used, as some experiments made by Judge Paterson have fairly proved, in any degree of abundance, even at the rate of one or two hundred loads to the acre, without showing any caustic effects upon the vegetation.

This among other facts induces me to recommend to the farmers, to expose their *caustic* or astringent marls to the rain for a season, before attempting to employ them.

Long Branch.—Along the low sea-cliff facing the ocean in front of the boarding-houses at Long Branch, appearances in several places show that the true marl stratum meets the sea-coast in this quarter, and that it cannot lie at any considerable depth below the beach. About half a mile north of Renshaw's, at apparently the highest point in the cliff, the astringent clay bed which so generally accompanies the marl as an overlying stratum is exposed, rising four or five feet above the average level of the beach. This itself is strongly indicative of the existence of the marl bed at no great distance beneath. The probability of the fact is manifested however in another way. The sand of the beach contains a very notable proportion, often *five per cent.* or more, of the green granules of the marl, which examination assures me cannot be derived from any of the strata in this part of the bank, and which therefore can only come from a bed extending into the sea below the ocean level, or at least lying as low as the base of the cliff. This mixture of the green granules among the sand of the beach is observable along the whole bay shore, from near *Chapel* to the Telegraph hill, and thence along the ocean side from the mouth of the Shrewsbury river past Long Branch to Deal, and somewhat further. It has been discovered somewhat recently that the beach sand throughout this line where it has been tried, is endowed with active fertilizing powers, attributed heretofore to salt and other supposed ingredients in the beach. But the well known properties of the marl grains, coupled with the fact that in every place along the shore further south than Deal, at which place the marl region departs from the coast, the sand of the beach contains none of the dark granules, is a sufficiently convincing proof that the benefits so distinctly perceived, are attributable to the source which I suppose. The good effects of the beach sand are strikingly exhibited upon Wardell's farm, a little north of Long Branch. Surprising results are also witnessed on the farm of Jacob Curlis, at Deal. The most sterile patches of sandy soil are made to sustain very admirable crops of corn by the use of this powerful agent. The quantity of the beach sand applied is often as great

beneficial to potatoes. The stratum is the blue sandy clay usually so astringent.

At Crosswick's, Gideon Middleton has a marl pit near the mill, in which the layers are as follows:

1. A micaceous tough clay on top.

2. A rather greenish grey marl, somewhat micaceous, but pretty rich. Beneath this, one foot of ferruginous manly concretions, each about the size of a man's head.

3. A dark blue marl.

4. A black sand and marl.

In sinking a well at his house, many years ago, the beds traversed were ten feet of yellow sand, then twenty-seven feet of marl strata, and below all a white sand. Low down in the pit just spoken of, shells, belemnites, &c. occur. Fossil wood, with much pyrites attached, is sometimes seen in the marl pit near the bottom.

This marl is highly fertilizing, as Mr. Middleton's fields show. Mr. M. has *mixed it with lime with very beneficial results.* In the upper stratum, yellow incrustations of efflorescent sulphate of iron abound.

The marl is very good one mile lower down upon Crossrick's creek at David Killey's. It lies in a bank on the side of the meadows of the creek, and has a top layer of the black astringent clayey or spurious marl. There is good marl on Crosswick's creek, half a mile above Hogsback landing, and I am told it extends still lower down. This proximity to the railroad is a matter of deep importance to the state.

Near the Sand hills, and in places between these and Bordentown, the upper or spurious marl stratum is visible in the sections of the rail-road, and I am now firmly of the opinion, that the clay with lignite at Bordentown landing and below, is but the upper bed of the marl formation, and is identical with the astringent blue clay bed above the true marl or greensand bed on the Nevesink river and elsewhere in Monmouth county, and throughout a great portion of the whole marl region.

Shelltown.—Howard's marl is near this place on the south side of Crosswick's creek, and presents both the true marl stratum and the overlying astringent clay. The marl is dark, friable, smells of sulphur, and is found to be very efficacious. The overlying

lead-coloured clay is somewhat micaceous, and contains a trivial quantity of the greensand, being in all respects like the bed which shows itself at Wall's mill near Burlington. It resembles very much the character of the bed where it caps the marl at Crosswicks and in the neighbourhood.

On the road from Shelltown to James S. Lawrence's, which is one mile south-west from Varmintown, the same overlying bed is exposed in numerous places in the banks of the meadows.

All these cases are adduced to show the high degree of probability before expressed, that the true marl underlies the dark clay along nearly the whole north-western edge of the marl tract, as, for example, near Burlington and Camden.

Fine exposures of the marl deposit offer themselves to view in the vicinity of the residence of Mr. Lawrence. The soil itself is a brown ferruginous loam, being a portion of a narrow tract of red clayey soil, which extends a considerable distance north-east and south-west, passing by Arneystown, and exhibiting whenever it is seen, every evidence, from its texture and the minute waterworn grains of quartz in it, that it has resulted from the breaking up of a once overlying stratum of brown sandstone. In some of Mr. Lawrence's fields, it contains a very sensible quantity of the green granules. The upper part of the marl stratum here differs materially in aspect from the lower. For a thickness of several feet, it is little else than a mass of decomposed shells almost invariably in the state of casts, or replaced by oxide of iron. An inconsiderable proportion of the green grains is mingled with a yellowish white pasty matter, which is a mixture principally of sulphate and carbonate of lime, derived no doubt from the shells, and tending to impart many valuable qualities to the marl.

The lower stratum is a mass of dark greensand in which we witness few traces of the changes noticed in the materials of the mass above. The quantity of oxide of iron in the free state mixed with the marl causes it to be rather hard in the digging; this is the case with nearly all the more ferruginous kinds, but a short exposure to the air renders it friable, when it is found to be a very powerfully fertilizing marl. Striking benefits result from the use of this stratum when it is applied in the ratio of about ten loads to the acre. In this bed have been found teeth

of the *mososaurus* and several bones apparently of the fossil crocodile. Mr. Lawrence states that his lower or dark green marl, which is very full of the astringent matter or sulphate of iron, will not admit of being lavishly employed, for it then invariably *poisons the crop*. If as much as twenty-five loads be used, the growth of the corn is seriously checked; nor does it recruit until late in the season, after which the vegetation is wonderfully quickened. The upper stratum, on the other hand, will admit of being applied in any excess, one hundred loads or even more, manifesting no deleterious effects upon the crop. Where the banks of the meadows are high, a different stratum from either of the previous two is seen, and to all appearance occupying a higher place in the series. This is the calcareous sandy stratum which in another part of this report I alluded to as being in all probability a deposit of the same date with the limestone of Vincentown and Mannington. It is here a yellow calcareous sand with scattered grains of marl in it and with a multitude of solid casts of various fossils, some of which do not show themselves in the green marl beneath. Out of this bed I have procured *coprolites*,* the first time they have been found in this country. All the casts in question consist chiefly of carbonate of lime in an earthy state mixed with a little clay and sand.

The stratum in some places is more than twenty feet in thickness. Being the upper bed, it is in some instances the only accessible one, in which case I think it deserves to be employed as a substitute for marl, not merely for the amount of calcareous matter in it, but for the quantity of the greensand grains distributed throughout it. Bones of some reptile, the *crocodile* apparently, are found in this stratum, and we may hence form a conjecture of the source to which the coprolites belong. From the same bed we may procure solid internal casts of *claws* of a *fossil crab*, two species of *baculites*, teeth of the crocodile, and many interesting species of bivalve and univalve shells.

In a deep ravine on the opposite or west side of Crosswick's creek, and a little lower down than where the previous beds are seen, and very near the line of an ancient Indian path, we have

* *Coprolites*, are the fossilized dung of extinct animals.

doubt that it spreads itself in the south-west direction to the Delaware. At Joseph Bassett's, about four miles from Salem, the marl may be seen at a small depth beneath the surface. It resembles in all respects that which is generally the lower stratum; containing the same mixture of clay, the same shells, and having the same white efflorescence. The principal fossils are *gryphea convexa*, *exogyra costata*, *ostrea falcata*, and several spiral univalves in the state of casts, finely preserved, from which we may justly infer that the stratum is not very wet. Teeth and bones also occur.

The marl stratum may be no doubt probed in places still nearer to Salem, for at the new dam across the creek, about one mile north of the town, the piles when driven down reached a stratum below the mud of the creek, which exactly corresponded, from the description I received, with the marl. The creek here is twenty-five feet deep, so that the marl stratum must lie at a depth of at least thirty feet below the surface of the country.

I have thus brought my observations as far to the south-west as any traces of the marl stratum show themselves. The chief object of the numerous details here given is to furnish hints, possibly of some future advantage to the several neighbourhoods specified, and moreover to awaken in each district a spirit of *inquiry* and *experiment*, which, should it ever be aroused to a vigorous activity, must sooner or later be productive of the greatest benefits to the whole marl region and to the state at large.

On the proper mode of correcting the noxious effects of the spurious marl, or astringent clay, and of employing it as a substitute for the true marl.

From the descriptions of this stratum already presented, it appears that the action of this astringent mass upon the crop is decidedly pernicious, when the material is employed in any amount beyond the most stinted doses; and the cause of its poisonous property would seem, judging from the chemical analyses made, and from other evidence, to be attributable to the acid reaction of the astringent ingredients which it possesses, namely, the *copperas* and *alum earth*.

Copperas, though a neutral salt, is well known to chemists to exert an *acid reaction*, and hence we are not to be amazed that

a clay having it in such obvious quantities, should act in a way to burn, or more strictly, to *poison* the vegetation. Knowing, as we now do, the source of the deleterious properties of the clay, a few simple correctives suggest themselves, and such as any one wishing to use this substance as a substitute for marl may adopt.

My first recommendation to the farmer who is about to make use of this clay upon his soil, is, that he be careful to select, when he has the choice, that variety which contains the green granular material of the true marl, and to avoid altogether, unless indeed good marl be very remote from him, the kind which is wholly destitute of this substance. When the green grains are numerous enough in the mass, as they are near Spotswood, Burlington, Camden, and generally upon the north-west side of the marl tract, I would then advise its use, but guarded by the following precautions. Let the clay be dug several months before it is to be scattered on the land, and let it be spread out in broad, *shallow*, flat heaps, where the rains may soak through it and carry away the copperas and alum earth, which it is presumed from their well known solubility will be easily dissolved and washed off. The green mineral does not dissolve in water, and hence, while the rains will purify the mass, no loss of its more active portions can happen. Numerous attempts at using this clay as a marl have shown, that though noxious at first, it is often permanently beneficial to the land, after the second, third, or fourth year; a fact which I attribute to the gradual escape of the astringent matter by the rain. Though I do not think that the exposure of even an entire winter will always suffice to rob the clay of all the sulphates (copperas, &c.) which it may contain, yet it bids fair to do much good and therefore deserves a careful trial.

I have to offer another, and I think, far more promising suggestion, for making the better portions of this stratum beneficial in their effects upon the soil. Chemists are aware that both the sulphate of iron and the sulphate of alumine, are decomposed by *caustic lime*; and the antidote I propose is founded upon this fact. My recommendation is, to add to every heap of this spurious astringent marl, a small quantity of *freshly burnt lime*, and to mingle

them thoroughly together. The sulphuric acid of the copperas or alum earth, or of both if present, will pass over to the lime and form sulphate of lime, (*gypsum* or *plaster*,) the value of which, as a stimulant to vegetation, is well understood; the other ingredients, the oxide of iron and clay, will on being liberated contribute also towards improving the texture of the soil should it be sandy. A bushel of lime to every hundred bushels or five tons of the mass, will in most cases be sufficient to neutralize all the astringent matter present, and to convert it into, or rather replace it by, *gypsum*. The dressing of an acre of such a mixture will contain of the green marl, of gypsum, and of uncombined lime, or more truly lime now in a state of carbonate, in all probability fully enough to impart to the soil a most decided improvement in its fertility.

Lastly, I would recommend, for this astringent marly clay, the same course so long pursued in Europe in regard to lime; I mean the practice of making *a compost* of the substance with the common *manure of the farm*.

It would be justified, like the former suggestion, by good chemical reasons. In the fermentation of animal manure, *ammonia* always escapes in greater or less quantity, and ammonia, like lime, has the power of decomposing the sulphates of iron and alumina. In this case, however, gypsum is not a product.

From what I have here said, it will be obvious, that when a field has been made *sterile* by the indiscreet use of this caustic clay, a ready and certain remedy will be found by spreading upon every acre a few bushels of newly made lime.

Should these hints, which are designed to bring into use, as a marl, certain portions of this upper stratum, receive their final corroboration from experience, we may consider that the area of the region susceptible of improvement by marling without the expense of hauling the material from a distance, has been in many districts doubled or tripled in extent. To ascertain whether the clay possesses a sufficient share of the green granules to warrant a trial of it upon the land, it may be necessary to employ the aid of a small *magnifying-glass*, which will be found by every farmer to be of indispensable use in the discrimination of all greensand marls.

DIRECTIONS FOR TIME SELECTION AND PROPER MODE OF APPLYING THE GREENSAND MARL.

In seeking for the marl stratum in neighbourhoods where it is supposed to occur, but where a covering of any of the superficial deposits obscures it, the primary point to be remembered is, that the true marl is the lowest deposit of the region. We should find out, therefore, the *deepest depressions* of the land, as the meadows and natural ravines, and by the use of an auger or other instrument for probing the ground, several feet in length, we may very frequently ascertain whether the stratum lies sufficiently near the surface to be easily and economically uncovered. A pretty sure guide to the marl may be found in some places from the aspect and composition of the earth upon and near the surface. Should it be at all *greenish*, or contain, on close inspection, any of the green granules, the probability is pretty strong that the marl lies beneath, at a very moderate depth, and the likelihood of this is augmented when we find our borings bring up an increasing proportion of this mineral as we descend deeper. I have repeatedly found the position of the marl stratum indicated by the trickling forth of the water from the foot of a bank, for the water is almost invariably seen to issue along the top of either the dark clay or the true marl.

For judging of the quality of a marl by observation, some familiarity with the multiform aspects which it puts on is indispensable. The leading rule, however, is, to bear in mind that the fertilizing efficacy of the compound, resides in the minute round greenish grains which compose more or less of it, or sometimes all of it, and that it seems, moreover, to be dependant upon the proportion which these green grains contain of those powerful alkaline stimulants to vegetation, *potash* and *lime*, but more especially potash. The first thing then, is to approximate to the relative quantity of the green grains in the whole mass, and this may be effected, to a greater or less degree of accuracy, in several ways. The simplest and surest method is to employ a small pocket magnifying-glass (a common burning-glass will answer), and to make the eye familiar as soon as possible with the dark green grains, so as to distinguish them at

once from other dark varieties of sand which sometimes occur associated with them. A little practice will very soon enable one to use the glass expertly, and to arrive at a pretty true estimate of the probable percentage in which the green grains may exist. But as these granules cannot sometimes be distinguished from the grains of ordinary white flinty sand, or from other kinds, in consequence of the particles being *all alike coated* with a thin film of the dark cementing clay, it will be useful to devise some method of bringing out under the magnifier their different characteristic traits of colour and form. Let the mass be washed in a large glass tumbler, and repeatedly agitated with the water, until as much of the clay as possible has been detached from the grains. After pouring off the turbid water by repeated rinsings, and permitting it to settle until clear, we may estimate the comparative quantity of clay in different marls by the relative amount of sediment which subsides. If we wish to be more accurate, we can weigh out a given quantity of the marl, then pursue the above plan, and decant the clear water from the clay, and after thoroughly drying the clay, weigh it to ascertain its amount. Having got away most of the clay, we should spread out the granular matter upon a sheet of paper and dry it, when there will be no farther difficulty in distinguishing, by their colour and lustre, the foreign impurities, from the grains of the true marl, and also of estimating the relative abundance of each. When the marl to be examined contains much clay, I would recommend the experiments to be made upon a regularly weighed quantity, weighing both the clayey and the granular portions. A delicate apothecary's balance will commonly be found accurate enough. Another more expeditious, though less accurate method, is merely to dry the marl, and spread it extremely thin upon a sheet of white paper, and then to hold it near a window or in the light, and to examine it carefully by the magnifier. The flinty sand, though stained with clay, may then be clearly discerned, in consequence of its transparency, whereas when we inspect a solid lump, all the particles upon the surface are nearly alike dark.

A good suggestion is, to place a portion of the marl upon a hot shovel or on the top of a stove, when all the marl grains will change from their ordinary green to a light red or brick colour, while the other materials of the mass sustain little alteration. This

will often make it obvious to the naked eye in what proportion the green grains are present.

When there is a yellowish or whitish incrustation upon the marl in a bank, after the *moist* surface has remained for some time exposed to the weather, it is indicative of the existence of a portion of copperas or alum earth, the hurtful nature of which has already been explained.

An astringent inky *taste* will very often detect the presence of these noxious substances at times when no such efflorescence shows itself. If the quantity be too small to betray itself distinctly to the palate, and we are still in doubt as to their presence, other more rigorous tests are within our reach, and as these astringent matters are so unquestionably pernicious in their action, it must be of importance to have the means of determining in what proportions they abound in different marls. This can be effected with precision only by a systematic chemical analysis, but their existence can be made to appear by the following test. Put a small portion of the marl in a flask or other thin glass vessel, pour upon it some pure water, and heat it moderately. After causing the water to dissolve in this way as much as possible, remove the heat, and let it settle, then decant the *clear* fluid into some glass vessel, such as a wine-glass. If there has been any copperas present, it will be proved by adding to the fluid a little lime-water, which will produce a milky turbidness, that after a little while will become stained of a yellowish-brown colour. The milkiness is owing to the formation of gypsum, and the brown colour to oxide of iron from the copperas. Or in lieu of this, add a solution of oak bark, and if copperas be present, we shall have a dark inky colour at once produced.

A good marl will, upon being squeezed in the hand, fall asunder again rather than bake into a tough doughey mass, and upon being left in heaps to dry will retain a light grayish green colour and be extremely *crumbly*. It seems to be a very general characteristic of the better class of marls, that they throw out a white efflorescence or crust, upon those grains which are most exposed to the air. Hence the very light colour externally, which some heaps of marl possess. This crust I have already shown to consist of the sulphate of lime (gypsum) and carbonate of lime, but much more usually of the former. A drop or two of

EXCERPTS

GEOLOGY

OF

NEW JERSEY.

BY AUTHORITY OF THE LEGISLATURE.

GEORGE H. COOK,
STATE GEOLOGIST.



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NEW JERSEY GEOLOGICAL SURVEY

CHAPTER III.

GREENSAND MARL.

SECTION I.

CLAY MARLS.

These marls consist of greensand mixed with clay. These are used as fertilizers to some extent, which makes it important to examine their chemical constituents*, and the following are presented as average samples from the strata which contain the most greensand, and which have been most used in agriculture, and are probably of highest value.

1. Analysis of a sample from the stratum near Ten Eyck Brothers, at Matavan, Middlesex County:

*Chemical Analyses.—On account of the great economical importance of the marls, this branch of the subject has been taken up at greater length than the other parts of the work. The analyses which are here given are not equally distributed among the marl openings in different parts of the state. Nearly all those in the county of Monmouth were made in 1855 and 1856, during the former geological survey, when it was proposed to finish the work by counties, and Monmouth County was the first in the marl region that was to be published. The preparation for this was well advanced when the survey was suspended. With the resumption of the work the plan was changed, so as to present all the results relating to the same geological formation together. The basis for comparison and study having been furnished by these marls, it was not necessary to carry the analyses out with the same fulness in all the counties. Enough have been given to show the different varieties. The analyses of 1855 and 1856 were chiefly made by Julius Koch, a competent German chemist, then employed in the survey. His method was to decompose the marls by hydrochloric acid, to separate the iron and alumina by potash, the potash and magnesia by sulphuric acid and acetate of baryta, and the phosphoric acid in a separate quantity by molybdate of ammonia. The analyses made during the present survey are by John C. Smock, the Assistant Geologist. In these the marls have been decomposed by hydrochloric acid, the iron determined by Penny's method of volumetric analysis, the potash by phosphate of soda and bichloride of platinum, and the phosphoric acid by molybdate of ammonia. The other constituents were obtained by the ordinary routine methods.

The chief fertilizing value of the marls being in the lime and phosphoric acid which they contain, these substances have been carefully estimated in all the samples; while the potash which is almost uniform in quantity in all of them has not been estimated in many of them; and for the same reason the iron and alumina, which are always present have not, in many cases, been separated from each other. This has left many of analyses incomplete, in appearance, though in fact all the valuable constituents have been determined.

NEW JERSEY GEOLOGICAL SURVEY

Phosphoric acid	1.15
Sulphuric acid	1.28
Silicic acid and sand	34.50
Potash	1.54
Lime	2.52
Magnesian	2.15
Alumina	6.00
Oxide of iron	31.50
Water	18.80
	99.43

This specimen was carefully washed to separate the grains of greensand from the clay, and was found to contain twenty-seven per cent. of greensand grains. The mass is somewhat like clay in consistency, though when exposed in piles it falls into sandy powder. It is greenish in color, and changes to a rusty red on exposure to the atmosphere.

2. Analysis of a sample from the farm of J. B Johnson, on the Matchaponix Creek, three miles south of Spotswood, Middlesex County:

Phosphoric acid	0.58
Silicic acid	45.40
Potash	3.79
Lime	1.51
Magnesia	2.20
Alumina	5.80
Oxide of iron	24.50
Water	15.40

3. Analysis of a sample from the land of Miller Howard, Shelltown, Burlington County:

Phosphoric acid	0.18
Sulphuric acid	3.42
Silica	67.26
Potash	5.16
Lime	0.62
Magnesia	1.94
Alumina	4.36
Oxide of iron	10.27
Water	5·70
	98.91

4. Analysis of a sample from the land of Benjamin Tatem, below Woodbury, Gloucester County:

NEW JERSEY GEOLOGICAL SURVEY

Phosphoric acid	0.24
Sulphuric acid	2.22
Silica	65.00
Potash	2.49
Lime	0.39
Magnesia	0.85
Alumina	6.76
Oxide of iron	10.86
Water	5.80
Organic matter	5.35
	99.96

5. Analysis of a black clay of this formation:

Phosphoric acid	0.18
Sulphuric acid	0.36
Silicic acid and quartz	64.70
Potash	2.52
Lime	1.40
Magnesia	0.90
Alumina	6.20
Oxide of iron	12.35
Water	10.66
	99.27

6. Analysis of material from the land of John E. Hopkins, Haddonfield, Camden County:

Phosphoric acid	1.28
Silicic acid and quartz	74.10
Potash	1.19
Lime	1.34
Magnesia	1.72
Alumina	6.61
Oxide of iron	6.49
Water	8.25
	100.98

Nos. 1, 2, 3 and 4, are clay marls, and have been used as fertilizers. They are slightly acid from the sulphate of iron in them, and need care in applying them to the soil They contain much less phosphoric acid than the genuine greensand marls. Wherever applied they have been found beneficial. The Messrs. Ten Eyck and many of their neighbors near Matavan, have used them satisfactorily. Enoch Hardy, near Jacksonville, showed a remarkable growth of clover from the application of clay marl. Mr. Craig, near Englishtown, has dug and used it with good results. It has been used by Mr. Waln, at Waln's mills; by Mr. Howard, at Shelltown. In Burlington County, along the Rancocus, it has been used in many places; also in Camden and Gloucester Counties, and with profit. When found upon the farm, so that the hauling is short, it is better economy to use it than to purchase the richer but more expensive marls found at a dis-

NEW JERSEY GEOLOGICAL SURVEY

tance. With these marls and lime to alternate, land can be kept in first-rate condition; and they deserve to be much better known than they now are.

No. 5 is a specimen of the dark clay which is very common in the formation.

No. 6 is called a marl, and has been used as a fertilizer with good success. Some portions of it contain a good deal of white carbonate of lime from decaying shells. With the exception of the phosphoric acid, this is an average of the laminated sands.

In addition to the uses for agricultural improvement of these marls, they, in their clayey portions, have been used in making brick. There are large kilns at Keyport, near Matavan on Matavan Creek, and at Kincora. The present capacity of these works (1866) is twenty-six millions a year; and their product for the year is from fifteen to eighteen millions. The bricks are of good color, and are durable. They are somewhat more fusible than those made from the plastic-clays.

SECTION II.

ANALYSES OF MARLS.

For convenient reference among those who use marl, the analyses are presented in groups, as follows:

1. Marls of Eastern Monmouth County.
2. Marls of Western Monmouth and Ocean Counties.
3. Burlington County marls.
4. Camden and part of Gloucester County marls.
5. Salem and part of Gloucester County marls.

1.—MARLS OF EASTERN MONMOUTH.

FROM THE LOWER MARL BED.

Samples from the Navesink Highlands, shore of Sandy-Hook Bay.

	1	2	3	4
Phosphoric acid	1.51	1.77	.41	1.04
Sulphuric acid	2.40	....	.35	2.31
Silicic acid (soluble)	36.89	52.70	75.76	49.02
Silicic acid (insoluble)	18.80			
Potash	5.27	4.30	....	....
Lime	0.65	1.51	1.66	0.89
Magnesia	0.79	2.10	....	...
Alumina	6.61	6.20	....	....
Oxide of iron	21.63	23.27	....	....
Water	8.85	7.26	....	....
53	102.40	99.11		

NEW JERSEY GEOLOGICAL SURVEY

No. 1 is a black marl; No. 2 is a marl rich in phosphoric acid; No. 3 is not acid in its reaction, containing 2–5 per cent. of carbonate of lime; No. 4 is a black marl, and acid in properties, containing sulphate of iron. Taken together these analyses will probably give an average of the quality of marls which can be obtained from this finely exposed section of the bed.

Partial analysis of a sample from the Marl-pits on Clay-pit Creek.

Phosphoric acid	0.91
Sulphuric acid	0.08
Silicic acid	53.31
Lime	0.20

This marl is slightly acid.

Partial analysis of Marl from J. B. Story's pits at Middletown.

Phosphoric acid	1.29
Sulphuric acid	0.70
Silicic acid	60.74
Lime	1.30

This is locally called grey-marl, being slightly changed by atmospheric agencies. It effervesces with acids, and contains about one and a half per cent. of carbonate of lime.

Partial analysis of Marl from the south side of the Navesink River, at Red Bank.

Phosphoric acid	0.35
Sulphuric acid	1.49
Silicic acid	64.60
Lime	0.44

This marl is too much mixed with the overlying clay; it is slightly acid.

Samples of marl from the bank of Wm. V. Conover, north bank of the Navesink River, at Red Bank.

	1	2	3	4	5
Phosphoric acid	1.14	1.53	0.66	0.45	2.75
Sulphuric acid	0 14	0.78	2.03	0.21	....
Silicic acid	38.70	49.62	78.14	61.89	49.70
Potash	3.65	....	....	....	....
Lime	9.07	1.22	0.35	trace.	....
Magnesia	1.50	....	....	....	....
Alumina	10.20	....	....	....	....
Protoxide of iron	18.63	....	....	....	....
Water	10.00	....	....	....	....
Carbonic acid	6.14	....	....	....	....
	99.16				

No. 1 is a sample of the best marl of this bed. It contains about fifteen

NEW JERSEY GEOLOGICAL SURVEY

per cent. of carbonate of lime. No. 2 is a good sample from a different part of the bed, and though not acid, contains but about one per cent. of carbonate of lime. No. 3 is a very acid marl from near the top of the bed. No. 4 is marl grains which are found washed in the bed of the river, and is used as a fertilizer. It called *river sand*, but is almost all greensand granules. No. 5 was a selected sample, examined on account of the unusual amount of phosphate of lime which could be seen in it.

From the Marl-pits of the late J. B. Crawford, Nut Swamp.

	1	2
Phosphoric acid	1.12	0.96
Sulphuric acid	0.70	0.04
Silicic acid	40.61	38.95
Lime	....	1.54
Carbonate of lime	20.17	....

No. 1 is a good sample of the best of the Nut Swamp marls. No. 2 is too much mixed with clay.

From the Marl-bank of Peter R. Smock of Holmdel.

Phosphoric acid	1.23
Silicic acid	36.03
Lime	15.19
Carbonate of lime	23.05

A marl of the first quality, and a fair sample of those in the neighborhood.

Samples from the Marl of Rev. Garret C. Schenck, on Hop Brook, near Marlboro.

Phosphoric acid	2.18	2.08
Sulphuric acid	....	0.76
Silicic acid	43.70	56.30
Potash	....	4.92
Lime	8.85	tracc.
Magnesian	2.33	1.70
Oxide of iron	25.00	17.38
Alumina		8.20
Water	9.21	8.05
Carbonic acid	5.40	....
		99·39

No 1 is a carefully selected and averaged sample of the whole bed as dug, twenty-one feet. No. 2 is a black marl; it has evidently been changed by sulphate of iron, and all carbonate of lime dissolved out.

NEW JERSEY GEOLOGICAL SURVEY

From the Marls of J. H. Morgan, on the northwest slope of the Mt. Pleasant Hills.

	1	2
Phosphoric acid	1.42	0.84
Sulphuric acid	.10	0.12
Silicic acid	50.86	52.07
Potash	....	6.46
Lime	1.31	1.01
Magnesia	....	1.53
Alumina	....	6.96
Oxide of lime	....	21.55
Water	....	9.31
		99.85

These are fair samples of hill marls. Surface water has penetrated them to some extent and then drains out, taking the carbonate of lime and changing the protoxide of lime to a peroxide. No. 1 is acid in properties; No. 2 is neutral.

From the bank of W. H. Sickles, on the south slope of the Mount Pleasant Hills.

Phosphoric acid	1.47
Sulphuric acid	0.59
Silicic acid	37.21
Carbonate of lime	19.22

This is a dry bank marl, but has not been leached, or its iron reddened; it is not acid.

Marl from the pits of James Johnson, on the south slope of the Mount Pleasant Hills.

Phosphoric acid	0.88
Sulphuric acid	0.83
Silicic acid	35.81
Carbonate of lime	21.77

This is a sample of unchanged blue marl, of good quality.

From the farm of D. Abeel Statesir, of Marlboro.

Phosphoric acid	0.51
Sulphuric acid	trace.
Silicic acid	51.18
Lime	0.99

This is a dry bank marl; and has been subjected to change from atmospheric agencies.

From the Marl-pits of Elisha Holmes, deceased, Hillsdale.

	1	2
Phosphoric acid	.97	1.09
Sulphuric acid	3.26	1.20
Silicic acid	48.25	37.81
Lime	1.33	....
Carbonate of lime	....	19.65

NEW JERSEY GEOLOGICAL SURVEY

No. 1 is very acid; No. 2 is an unchanged blue shell-marl.

Marls from the late John R. Schenck's farm, Marlboro.

	1	2	3
Phosphoric acid	0.55	0.97	1.37
Sulphuric acid	0.92	1.93	0.45
Silicic acid	55.40	49.28	40.40
Lime	0.12	1.62	....
Carbonate of lime	....	....	19.054

Nos. 1 and 2 are black marls and are acid; No. 3 is a blue shell-marl, and such are never acid.

From the Marl-pits of John Carson, Marlboro.

	1	2
Phosphoric acid	1.14	0.85
Sulphuric acid	0.31	2.25
Silicic acid	38.70	68.50
Potash	4.47	....
Lime	....	1.70
Magnesia	1.21	....
Oxide of iron and alumina	30.67	....
Carbonate of lime	13.91	0.26
Water	11.22	....
	99.63	

No. 1 is a good sample of the blue marl; No. 2 is a sand marl, and though largely mixed with sand, has some value on account of its phosphoric acid.

Marl from the pits of Obadiah Herbert, Marlboro.

Phosphoric acid	1.60
Silicic acid	41.50
Magnesia	2.37
Oxides of iron and alumina	30.12
Water	9.91
Carbonate of lime	11.47

This is a carefully averaged sample, for a depth of eighteen feet of marl.

Marl from Jos. I. Van Derveer, Marlboro.

Phosphoric acid	1.39
Sulphuric acid	0.28
Silicic acid	36.96
Carbonate of lime	22.53

A good blue marl.

Sample from David I. Van Derveer's pits, Marlboro.

Phosphoric acid	0.99
Sulphuric acid	4.87
Silicic acid	35.75
Carbonate of lime	13.63

A blue marl of average quality.

NEW JERSEY GEOLOGICAL SURVEY

Samples of Marl from Wm. Hartshorne's diggings, north of Freehold.

	1	2	3	4
Phosphoric acid	0.94	0.83	1.52	0.38
Sulphuric acid	4.22	0.23	0.17	0.20
Silicic acid	68.66	51.71	47.69	53.10
Potash	....	....	....	3.78
Lime	....	....	2.63	....
Magnesia	....	....	.....	0.70
Alumina	....	....	....	6.30
Protoxide of iron	....	....	....	15.39
Water	....	....	....	8.04
Carbonate of lime	1.73	14.52	1.98	12.10
				100.59

No. 1 Is a sand marl.

2 and 4 are good blue marls.

3 Is from near the top of the bed.

Marl from Enoch Cowart's pits, north of Freehold.

	1	2
Phosphoric acid	0.33	0.72
Sulphuric acid	1.90	0.89
Silicic acid	63.72	48.66
Lime	1.40	2.45
Carbonate of lime	....	3.25

1 This sample is from the upper part of the bed, and contains a good deal of clay.

2 Is from lower down, but is scarcely an average sample.

Marl from Dr. J. Conover Thompson's pit, north of Freehold.

Phosphoric acid	1.89
Sulphuric acid	0.18
Silicic acid	53.91
Lime	2.62

This is a changed marl, but rich in phosphoric acid.

Marl from the pits of Jacob Herbert, near Monmouth Battle-Ground.

	1	2	3	4	5	6
Phosphoric acid	0.76	0.63	1.12	1.19	.98	.41
Sulphuric acid	0.35	0.34	1.54	1.90	1.48	.67
Silicic acid	67.40	49.70	48.86	63.73	67.44	57.66
Potash	2.90	4.42	6.24	....	....	....
Lime	0.95	1.40	1.81	1.53	1.41	1.19
Magnesia	1.70	2.40	2.13	....	....	....
Alumina	7.10	6.50	7.16	....	....	....
Protoxide of iron	9.37	24.03	17.78	....	....	....
Water	9.08	11.00	12.03	....	....	....
	99.61	100.42	98.67		....	....

No. 1 Is from near the bottom of the bed.

2 Is from the middle of the bed; it is acid.

3 Is a black marl, of average quality.

NEW JERSEY GEOLOGICAL SURVEY

4 Is of average richness in phosphoric acid; it is slightly acid.

5 Is like No. 1, approaching the sand-marl.

6 Is the material under the marl.

Marl from Geo. C. Gordon's, near Monmouth Battle-Ground.

Phosphoric acid	0.77
Sulphuric acid	.88
Silicic acid	53.48
Lime	1.31

This marl was slightly acid.

Marl from William T. Sutphen's, near Monmouth Battle-Ground.

Phosporic acid	2.45
Sulphuric acid	1.11
Silicic acid	46.67
Lime	1.17

This specimen is unusually rich in phosphoric acid; it is not certain that it is an average.

INDURATED GREEN EARTH.

Analysis of a sample from the deep cut on the Holmdel and Keyport turnpike.

Phosphoric acid	1.15
Sulphuric acid	0.34
Silicic acid	28.35
Potash	3.93
Lime	1.17
Magnesia	1.83
Alumina	8.27
Oxide of iron	40.37
Water	17.38
	102.79

There is a great deal of phosphate of iron in this earth; so much that it can be seen by the naked eye. It cannot but become valuable, as a fertilizer.

Analyses of two specimens from Tinton Falls.

	1	2
Phosphoric acid	.76	1.20
Sulphuric acid	.07	....
Silicic acid	36.20	36.70
Potash	4.41	3.10
Lime	1.12	1.56
Magnesia	2.40	2.60
Alumina	9.30	43.58
Oxide of iron	32.04	
Water	12.78	10.62
	99.44	99.36

NEW JERSEY GEOLOGICAL SURVEY

1 Is from the farm of John S. Cooke; and

2 From that of Mr. Polhemus. Both have been used to some extent as fertilizers, and with good effect.

MIDDLE MARL BED.

Analysis of Marl from between Eatontown and Tinton Falls.

Phosphoric acid	0.19
Sulphuric acid	0.41
Silicic acid (soluble)	46.93
Silicic acid (quartz)	4.22
Potash	7.08
Lime	0.49
Magnasia	2.02
Alumina	8.23
Oxide of iron	23.13
Water	6.67
	99.37

This is a pure greensand, but rather poor, containing much less than common of phosphoric acid.

Analysis of Green Marl, from John S. Cooke's, Tinton Falls.

Phosphoric acid	2.43
Silicic acid	45.40
Lime	1.29
Magnesia	2.16
Oxides of iron and alumina	36.31
Water	6.89

This was an average taken from a pile of the marl, and is probably a fair sample.

Marl from the farm of J. P. Conover, deceased, Colt's Neck.

Phosphoric acid	1.15
Silicic acid	48.90
Lime	2.20
Sesquioxide of iron	32.10

This is a sample sent to the laboratory, and is probably an average of this variety.

Sample of marl from near the top of Mount Pleasant Hills on Holmdel and Keyport turnpike.

Phosphoric acid	0.64
Sulphuric acid	0.38
Silicic acid	42.50
Potash	5.71
Lime	0.78
Magnesia	1.47
Oxides of iron	33.06
Alumina	7.00
Water	9.91
	101.45

NEW JERSEY GEOLOGICAL SURVEY

This marl has been long exposed to the weather and is much altered. It was taken from near the top of the cut.

Marl from the farm of J. B. Forman, near Freehold.

Phosphoric acid	0.50
Sulphuric acid	0.34
Silicic acid	47.50
Potash	5.29
Lime	0.56
Magnesia	2.70
Oxides of iron	20.52
Alumina	8.60
Water	13.57
	99.58

This is a nearly pure greensand, but is not very active as a fertilizer.

From the Marl-pits of Henry C. Brinkerhoff, below Blue-Ball.

	1	2
Phosphoric acid	0.42	0.24
Sulphuric acid	0.04	0.09
Silicic acid	45.70	46.10
Potash	3.15	2.90
Carbonate of lime	28.00	20.50
Magnesia	1.00	0.70
Alumina	7.70	7.20
Oxides of iron	10.69	17.38
Water	3.11	4.98
	99.81	100.09

These marls are valuable for the large amount of carbonate of lime which they contain.

Marls from the pits of Geo. Shepherd, south of Blue-Ball.

	1	2
Phosphoric acid	1.04	0.75
Sulphuric acid	1.44	....
Silicic acid	54.11	65.70
Potash	6.98	3.78
Lime	0.48	....
Alumina	23.39	8.40
Oxides of iron		14.43
Magnesia	3.79	1.80
Water	8.11	4.60
	99.34	99.46

These marls are quite pure greensand grains, and are good samples of the green marls of this vicinity.

NEW JERSEY GEOLOGICAL SURVEY

Marls from Charles Bennet's pits, below Blue-Ball.

	1	2
Phosphoric acid	1.28	....
Silicic acid	48.30	58.10
Lime	1.68	trace.
Magnesia	2.84	1.97
Oxide of iron and alumina	31.00	28.30
Water	8.18	8.65
	93.28	97.02

1 is a fair specimen of the green marl.

2 is remarkable for having all the lime removed and replaced by oxide of iron.

From Abraham Havens' land on the Squan River, southeast of Blue-Ball.

Phosphoric acid	1.26
Silicic acid	52.30
Potash	6.51
Lime	0.10
Maguesia	0.70
Alumina	6.80
Oxides of iron	25.43
Water	6.28

This specimen effervesces with acids, and is the changed limesand.

From a mass of corals picked up on the shore at Long Branch.

Silicic acid	17.1
Sesquioxide of iron and alumina	5.0
Carbonate of lime	75.0

This is a good specimen of the limesand.

UPPER MARL BED.

Marls from the pits of Rulief Smith, Deal.

Phosphoric acid	2.73	1.32
Sulphuric acid	0.48	....
Silicic acid	44.56	51.00
Potash	....	1.95
Lime	1.41	1.79
Magnesia	....	0.70
Alumina	....	10.60
Sesquioxide of iron	....	23.70
Water	....	8.60
		99.66

These marls are of fair quality, though somewhat dry.

NEW JERSEY GEOLOGICAL SURVEY

From the Marl-pits of Wm. P. West, at Deal.

Phosphoric acid	2.05
Sulphuric acid	0.48
Silicic acid	49.15

This marl is from the very bottom of the Upper Marl Bed, and is a good specimen, though somewhat inert from having been dried and wet repeatedly.

From the pits of J. Gardner, of Deal.

Phosphoric acid	3.16	1.70
Sulphuric acid	1.64	....
Silicic acid	46.73	51.20
Potash	....	2.96
Lime	5.88	1.51
Magnesia	....	1.50
Alumina	....	11.90
Oxides of iron	....	23.67
Water	....	5.53
		99.97

These marls are from the green layer, and are good average specimens.

An ash Marl from Garret Hendrickson's, Deal.

Phosphoric acid	1.08
Sulphuric acid	2.13
Silicic acid	66.91
Lime	1.39

Though not a greensand this substance has everywhere proved a valuable fertilizer.

Two samples of blue Marl from the pits of Jacob White, of Deal.

	1	2
Phosphoric acid	1.28	4.16
Sulphuric acid	1.47	0.04
Silicic acid	55.50	55.50
Potash	3.99	3.50
Lime	2.80	4.20
Magnesia	1.68	1.80
Oxides of iron	18.20	19.41
Alumina	6.70	3.70
Water	9.25	8.39
	100.87	100.70

No. 1 is a changed marl.

2 Is unchanged, and is a little acid.

These samples are from the same pit, on the same level, and but a feet from each other. They illustrate the change which air and moisture can make in the composition.

NEW JERSEY GEOLOGICAL SURVEY

Marl from the blue layer at Amos White's pits, in Deal.

Phosphoric acid	2.76
Sulphuric acid	1.86
Silicic acid	57.34
Lime	3.09

This is a good sample of the blue marl layer.

Marl from the pits of Rulief Van Derveer, at Poplar.

Phosphoric acid	1.58
Silicic acid	56.10
Potash	3.71
Lime	1.12
Magnesia	2.60
Alumina	8.00
Oxides of iron	20.32
Water	6.61
	100.04

Green marl from near the bottom of the layer.

Marl from the pits of Wm. Taylor, of Poplar.

Phosphoric acid	1.98
Sulphuric acid	1.80
Silicic acid (soluble)	35.42
Silicic acid (insoluble)	23.45
Potash	3.96
Lime	1.78
Magnesia	0.27
Iron and alumina	24.66
Water	6.52
	99.84

This specimen is from near the bottom of the green marl.

Marls from the heaps of Mr. Howland, of Poplar.

	1	2	3
Phosphoric acid	1.42	4.11	6.87
Sulphuric acid	6.33	....	3.12
Silicic acid (soluble) / Silicic acid (insoluble)	41.89	44.70	35.36 / 9.32
Potash	....	2.39	3.97
Lime	2.26	2.74	4.97
Magnesia	....	1.90	2.97
Alumina	....	13.20	6.04
Oxides of iron	....	23.27	18.97
Water	....	7.36	8.63
		99.67	99.32

No 1 is scarcely an average marl, but is very acid.

2 Is strongly acid, but is rich in phosphoric acid.

3 Is extraordinary, containing more phosphoric acid than any other marl that has been examined during the survey. It was taken from a heap, but is above the average richness.

NEW JERSEY GEOLOGICAL SURVEY

From the Marl heap of J. King, of Poplar.

Phosphoric acid	1.03
Sulphuric acid	4.99
Silicic acid	56.19
Lime	0.60

This marl was remarkable for containing a considerable amount of alum. The sample taken is hardly of average richness. The green marl from here is, however, equal to any other.

An ash Marl from W. Van Benthuysen's marl opening, at Poplar.

Phosphoric acid	0.98
Sulphuric acid	1.57
Silicic acid	68.12
Lime	1.10

This marl has not been much used.

Green Marl from Dewitt C. Shafto, of Shark River.

Phosphoric acid	3.16
Sulphuric acid	3.18
Silicic acid	49.30
Lime	2.92

This marl is an excellent fertilizer, but is very acid.

Marls from Hugh Hurley's pits, at Shark River.

	1	2
Phosphoric acid	3.73	2.58
Sulphuric acid	2.44	
Silicic acid (soluble)	37.90	56.70
Silicic acid (insoluble)	11.78	
Potash	4.98	2.39
Lime	4.14	2.91
Magnesia	0.47	1.30
Alumina	28.71	9.70
Oxides of iron		17.29
Water	5.54	6.16
	99.69	99.03

These are green marls of good quality, and very extensively used.

Marl from Buckalew's pits, Farmingdale.

Phosphoric acid	2.56
Sulphuric acid	1.06
Silicic acid	56.00
Lime	4.09
Oxide of iron and alumina	23.97
Water	7.47

A green marl, sent as an average of that dug at the pits.

NEW JERSEY GEOLOGICAL SURVEY

Marl from Thomas Longstreet's at Squankum.

Phosphoric acid	1.38
Sulphuric acid	0.14
Silicic acid	64.40
Potash	3.46
Lime	1.70
Magnesia	1.80
Alumina	7.70
Oxides of iron	10.59
Water	8.34
	99.51

This a green marl, taken from very near the bottom of the layer. It is somewhat sandy.

From the pits of Thomas Windsor, Squankum.

Phosphoric acid	3.23
Silicic acid	50.70
Potash	3.02
Lime	2.63
Magnesia	1.20
Alumina	10.50
Oxides of iron	22.77
Water	5.51
	99.56

A green marl, extensively used in agriculture.

Marls from the pits of J. B. Williams, Squankum.

Phosphoric acid	4.54	3.97
Sulphuric acid	0.43	....
Silicic acid	51.16	56.50
Potash	4.27	3.97
Lime	3.48	3.08
Magnesia	2.04	2.00
Alumina	6.10	10.30
Oxides of iron	17.67	11.68
Water	9.13	7.92
	98.82	99.42

Fine green marls. These are, probably, more used than any others in the eastern part of the state.

Marl from E. K. Johnson, Squankum.

Phosphoric acid	3.59
Sulphuric acid	1.41
Silicic acid	51.40
Lime	3.08
Alumina and oxide of iron	28.32
Water	7.19

This a good Squankum marl, which is largely used.

NEW JERSEY GEOLOGICAL SURVEY

Marl from the pits of the Squankum Marl Company.

	1	2	3
Phosphoric acid	4.48	2.08	1.20
Sulphuric acid	1.58	1.93	2.16
Silicic acid	52.60	53.70	73.10
Lime	3.47	3.83	1.62
Oxide of iron and alumina	20.85	24.16	12.60
Water	6.17	6.86	8.26

No. 1 is the best of the green marl.
2 Is near the top of the green marl, and a litle intermixed with the ash marl.
3 is the ash marl.

Analysis of the white Marl or Fullers' earth, which is found in the bottom of the Upper Marl Bed, from the Squankum Marl Company's pits.

Phosphoric acid	2.18
Sulphuric acid	0.75
Silicic acid	61.00
Potash	2.54
Lime	1.85
Magnesia	1.62
Oxide of iron and Alumina	19.67
Water	11.20
	100.81

Though not containing as much phosphoric acid as the marl over it, it must be of value for a fertilizer.

Marl from J. S. Forman's Marl-pits on southwest bank of Squan River near Lower Squankum

	1	2
Phosphoric acid	2.58	0.88
Silicic acid	61.60	73.70
Potash	2.58	2.39
Lime	0.87	0.61
Magnesia	2.20	1.00
Alumina	7.70	5.20
Oxides of iron	14.24	5.89
Water	8.53	9.31

These marls are from the upper part of the bed. No. 1 is a blue marl and No. 2 an ash marl.

NEW JERSEY GEOLOGICAL SURVEY

2.—WESTERN MONMOUTH AND OCEAN COUNTY GROUP.

LOWER MARL BED.

Marls from John Rue Perrine's farm, Black's mills.

	1	2
Phosphoric acid	2.37	2.75
Silicic acid	47.10	44.70
Lime	2.52	2.69
Magnesia	2.44	....
Oxide of iron and alumina	32.93	29.40
Water	8.90	....

These were sent to the laboratory by Mr. Perrine. They are rich marls

Marl from the pits of M. P. Rue, Millstone township.

Phosphoric acid	0.42
Sulphuric acid	0.51
Silicic acid	60.14
Lime	10.26
Carbonate of lime	17.51

Marls from the pits of William H. Mount, Perrineville.

	1	2
Phosphoric acid	2.38	2.33
Sulphuric acid	....	0.64
Silicic acid	50.40	54.70
Potash	....	4.15
Lime	2.52	1.40
Magnesia	1.76	2.00
Oxide of iron	30.34	20.36
Alumina		8.70
Water	8.07	6.41
Carbonic acid	1.50	....
	96.97	100.69

1 Is an average of eleven feet depth of marl.
2 Was taken from a pile of the marl.

Marl from the pits of James Giberson, near Imlaystown.

Phosphoric acid	0.77
Silicic acid	44.20
Lime	8.57
Oxide of iron and alumina	25.31

This marl is not rich in phosphoric acid, but from containing fifteen per cent. of carbonate of lime, it is a valuable fertilizer.

NEW JERSEY GEOLOGICAL SURVEY

MIDDLE MARL BED.

Marl from Benj. Dubois' bank, near Smithville, Manalapan township.

Phosphoric acid	.54
Sulphuric acid	.37
Silicic acid	51.85
Potash	6.38
Lime	.392
Magnesia	3.10
Alumina	6.88
Oxides of iron	19.27
Water	11.31
	100.099

This marl is nearly pure greensand granules. It is considered of but little value as a fertilizer.

Marl from Samuel Horner's, New Egypt.

Phosphoric acid	1 58
Sulphuric acid	2.27
Silicic acid	49.77
Potash	5.78
Lime	2.56
Magnesia	2.79
Oxide of iron and alumina	24.49
Water	10.49
	99.73

This marl is of the green layer, from near the top. It is not acid.

Limesand from Samuel E. Emley's, near New Egypt.

Silica	7.05
Magnesia	1.15
Oxide of iron and alumina	4.90
Carbonate of lime	80.40

This is a good calcareous marl, though but little used.

UPPER MARL BED.

Marl from John Irons', southeast of New Egypt.

Phosphoric acid	2.53
Sulphuric acid	2.26
Silicic acid	63.15
Potash	5.04
Lime	2.63
Magnesia	1.00
Alumina	4.15
Oxides of iron	9.97
Water	9.27

This is from the green layer, and is a good fertilizer.

NEW JERSEY GEOLOGICAL SURVEY

Marl from Samuel E. Emley's, Pike Hill, Burlington Co.

Phosphoric acid	2.05
Silicic acid	55.10
Lime	2.20
Magnesia	2.66
Alumina and oxide of iron	22.38
Water	7.76

This marl is an excellent one, and the analysis an average one for eleven feet. It is extensively used.

3.—BURLINGTON COUNTY MARLS.

MIDDLE MARL BED.

Marl from S. R. Gaskill's pits, at Pemberton.

Phosphoric acid	2.39
Sulphuric acid	0.13
Silicicacid	49.34
Potash	6.92
Lime	1.22
Magnesia	4.21
Oxides of iron and alumina	27.07
Water	7.87
	99.16

This is a fair sample from Mr. Gaskill's marl, and of the quality of the large quantity which he sells.

Marl from the Pemberton Marl Company, sent by J. C. Gaskill, as an average.

Phosphoric acid	1.02
Sulphuric acid	.27
Silicic acid	50.23
Potash	6.32
Lime	1.40
Magnesia	3.45
Alumina	7.04
Oxide of iron	20.14
Water	9.00
	99.77

This marl is well known from its extensive use.

Marl from Lawrence W. Jones', near Medford, along Sharp's Run.

Phosphoric acid	1.79
Silicic acid	47.00
Lime	1.90
Magnesia	3.05
Alumina and oxide of iron	30.11
Water	8.44
	00.00

This is an averaged sample in a digging of nine feet. It is extensively used, and is much liked.

NEW JERSEY GEOLOGICAL SURVEY

Marl from Inskip's Bridge.

Phosphoric acid	2.16
Sulphuric acid	4.00
Silicic acid	49.20
Lime	2.80
Magnesia	3.66
Alumina and oxides of iron	26.64

This is an acid marl, but of good quality, and much used.

Chocolate Marl from John Brown's, at Belly Bridge, near Lumberton.

Phosphoric acid	1.60
Silicic acid	51.50
Potash	5.59
Lime	1.01
Magnesia	2.74
Alumina and oxides of iron	29.26
Water	9.13
	100.83

This is a specimen of the chocolate-colored earth which is found everywhere in West Jersey, under the Middle Bed.

UPPER MARL BED.

From Joshua Forsyth's, near Pemberton.

Phosphoric acid	1.68
Sulphuric acid	0.96
Silicic acid	55.93
Potash	5.80
Lime	1.64
Magnesia	1.01
Oxide of iron and alumina	24.41
Water	8.84
	100.27

This is green marl, and an average specimen.

Marl from Messrs. J. & S. Butterworth, Stop-the-Jade Creek, near Vincentown.

Phosphoric acid	3.52
Silicic acid	56.40
Lime	3.25
Magnesia	1.72
Oxide of iron and alumina	21.98
Water	8.60

This is a carefully averaged specimen of the green marl, and is a superior marl.

NEW JERSEY GEOLOGICAL SURVEY

4.—CAMDEN AND GLOUCESTER COUNTY MARLS.

LOWER MARL BED.

Marl from John C. Hopkin's farm, on Little Timber Creek, one and a half miles southwest of Haddonfield.

Phosphoric acid	0.41
Sulpuric acid	....
Silicic acid	70.30
Potash	2.24
Lime	.98
Magnesia	1.42
Alumina and oxide of iron	16.32
Water	6 25
	99.74

This marl is not used to any extent, and is not specially valuable.

Marl from pits west of and near Carpenter's Landing.

Phosphoric acid	1.28
Sulphuric acid	.73
Silicic acid	74.60
Potash	1.41
Lime	0.84
Magnesia	0.14
Alumina and oxide of iron	13.69
Water	7.13
	99.82

This is not much used as a fertilizer, though it is well exposed.

MIDDLE MARL BED.

Marl from Minor Rogers', near White-house.

Phosphoric acid	2.24
Sulphuric acid	0.39
Silicic acid	50.80
Potash	5.18
Lime	2.13
Magnesia	3.59
Alumina	8.77
Oxide of iron	18.83
Water	8.46
	101.39

This is an average for fourteen feet. This marl is extensively distributed along the line of the Camden and Atlantic Railroad, and is a good one.

NEW JERSEY GEOLOGICAL SURVEY

Marls from the pits of David E. Marshall, Blackwoodtown.

	1	2	3
Phosphoric acid	3.66	3.62	1.02
Sulphuric acid	0.62	.. .	....
Silicic acid	49.94	49.10	54.70
Potash	6.31	....	....
Lime	2.37	2.25	0.45
Magnesia	2.71	3.48	1.70
Oxide of iron Alumina	24.54	27.54	28.52
Water	9.43	9.16	....
	99.58		

The above marl, No. 1, is an excellent fertilizer, and is largely used.
No. 2 is an average of 13 feet of green marl.
3 is quite inferior to the others.

Marls from the pits of the West Jersey Marl and Transportation Company, near Barnsboro, Gloucester County.

	1	2
Phosphoric acid	1.47	2.69
Sulphuric acid	1.30	0.26
Silicic acid	48.00	49.40
Potash	4.70	6.31
Lime	1.68	2.52
Magnesia	3.77	3.25
Alumina	10.60	8.90
Oxides of iron	20.34	18.66
Water	9.41	7.55
	101.47	99.54

No. 1 is a chocolate marl. It is acid.
2 is like that which is so extensively sold for a fertilizer. The analysis was made from an average of the whole of the bed which is dug.

Marls from pits of Thomas J. Heritage, Hurfsville, Camden County.

Phosphoric acid	2.50
Silicic acid	47.30
Lime	2.97
Magnesia	2.69
Oxide of iron and alumina	29.91
Water	8.96

This is an average of the whole green marl. It is an excellent marl.

Marls from Nathan T. Stratton, two miles east of Mullica Hill.

	1	2
Phosphoric acid	3.60	3.48
Sulphuric acid	.98	....
Silicic acid	46.66	49.80
Potash	6.82	....
Lime	2.86	1.68
Magnesia	3.09	3.50
Oxides of iron and alumina	26.61	28.22
Water	8.57	....
	99.19	

NEW JERSEY GEOLOGICAL SURVEY

No. 1 is a good sample of the green layer
2 is from a carefully averaged sample of the whole bed. They are good marls and much used.

UPPER MARL BED.

Marl from the pit of Hamilton Adams, Clementon.

Phosphoric acid	2.64
Sulphuric acid	0.44
Silicic acid	56.20
Potash	5.37
Lime	1.98
Magnesia	1.61
Alumina	6.00
Oxide of iron	16.29
Water	9.28
	99.81

This is good-looking marl, and should be valuable.

A Marl from the farm of John P. Craig, Glendale, Camden County.

Phosphoric acid	2.58
Silicic acid	44.30
Lime	2.85
Magnesia	2.59
Oxide of iron and alumina	33.24
Water	9.88

It is dug from under the Middle Marl Bed, and is probably the representative of the indurated green earth. It is a good fertilizer.

5.—SALEM COUNTY MARLS.

LOWER MARL BED.

Marl from Samuel Humphrey's, Sculltown.

Phosphoric acid	1.34
Silicic acid	65.60
Lime	4.54
Magnesia	1.47
Protoxide of iron and alumina	13.89
Water	7.11

This marl is used to a large extent. Its phosphoric acid and seven per cent. of carbonate of lime make it valuable.

NEW JERSEY GEOLOGICAL SURVEY

Marl from William Slape's, Marshallville.

Phosphoric acid	1.39
Sulphuric acid	.87
Silicic acid (soluble)	20.20
Silicic acid (insoluble)	49.92
Potash	2.46
Lime	2.36
Magnesia	0.42
Alumina	6.10
Protoxide of iron	8.32
Water	7.08
	99.12

This is a very good fertilizer. It is not acid in its reaction, but contains carbonic acid enough to effervesce with acids.

Marls from Joseph Bassett's, Marshallville.

	1	2
Phosphoric acid	1.85	.77
Silicic acid	65.50	62.40
Potash	....	4.41
Lime	1.70	....
Magnesia	....	2.00
Alumina	16.55	2.15
Protoxide of iron	....	12.73
Water	....	...

These marls are good samples of the Lower Bed at the southwest part of the cretaceous formation.

Marl from farm of Jesse Lippincott, near Oldman's Creek, Gloucester Co.

Phosphoric acid	2.34
Sulphuric acid	0.21
Silicic acid	50.00
Potash	6.18
Lime	1.57
Magnesia	0.60
Oxides of iron	24.32
Alumina	6.15
Water	6.88
	98.25

This is an average of the green marl of this neighborhood.

Marl taken from pile, dug near Salem Creek, at Woodstown.

Phosphoric acid	3.20
Sulphuric acid	0.25
Silicic acid	48.20
Potash	6.31
Lime	1.51
Magnesia	1.00
Oxides of iron	7.25
Alumina	22.05
Water	9.00
	98.77

NEW JERSEY GEOLOGICAL SURVEY

This is a very good marl; the shells in it have the carbonate of lime replaced by oxide of iron.

Marls from pits of I. V. Dickinson and Brothers, banks of Nikomus Run, west of Woodstown.

	1	2
Phosphoric acid	2.65	2.56
Sulphuric acid	0 11	0.22
Silicic acid	49.73	51.50
Potash	6.81	4.62
Lime	1.05	1.26
Magnesia	1.81	3.95
Alumina	8.04	6.01
Oxides of iron	21.60	21.04
Water	7.04	7.39
	98.84	98.55

No. 1 is the analysis of a sample taken from a wagon.

2 Is an average of fifteen feet; the whole thickness of the green layer as here worked. It is a marl of high reputation and extensive use.

Chocolate Marl from farm of Samuel Prior, near Major's Run, southwest of Sharptown.

Phosphoric acid	1.28
Sulphuric acid	.61
Silicic acid	47.90
Potash	6.20
Lime	1.34
Magnesia	3.65
Alumina	9.40
Oxides of iron	20.54
Water	9.11
	100.05

This marl is acid in its reaction, but when carefully used, is a valuable fertilizer, and much liked by farmers.

Joseph Robinson's Marl, from banks of Major's Run, near Sharptown.

Phosphoric acid	2.30
Sulphuric acid	1.47
Silicic acid	53.60
Lime	2.46
Magnesia	2.28
Oxide of iron and alumina	25.01
Water	9.81

This marl is a good fertilizer, as shown by the analysis, and verified by experience.

NEW JERSEY GEOLOGICAL SURVEY

Marls from pits of David Petit, Mannington township.

	1	2	3	4
Phosphoric acid	1.30	2.53	3.10	1.26
Sulphuric acid	....	....	....	....
Silicic acid	45.10	51.80	46.00	49.70
Potash	4.48	6.37	5.80	7.63
Lime	trace.	0.70	0.80	trace.
Magnesia	0.90	1.20	1.00	1.70
Alumina	5.15	4.15	4.30	4.65
Oxides of iron	35.21	25.00	31.02	30.21
Water	5.37	6.32	7.22	4.99
	97.51	98.07	99.24	100.14

These marls are from different levels in the marl bank, 1 being the highest, and the others lower in succession, according to their numbers. The carbonate of lime formerly in them has been replaced by oxide of iron.

Marl from banks of Mannington Creek, pits of J. Petit.

Phosphoric acid	1.26
Silicic acid	52.30
Potash	6.51
Lime	0.10
Magnesia	0.70
Alumina	6.80
Oxides of iron	25.43
Water	6.28
	99.38

This marl has been found of inferior quality, on trial, and the analysis shows the same.

Limestone, selected as a fair sample of the Yellow Limestone in Mannington township, Salem County.

Phosphoric acid	0.04
Sulphuric acid	0.06
Silicic acid	23.31
Magnesia	1.81
Alumina	0.91
Oxide of iron	3.07
Carbonate of lime	69.61
Water	0.24
	99.05

This limestone makes a lime almost free from magnesia, and in that respect is quite different from that made from most of our blue limestones.

Limesand from pits of John Fowler, Swede's Bridge, Mannington township.

Phosphoric acid	0.20
Sulphuric acid	0.23
Silicic acid	8.11
Carbonate of lime	84.73
Magnesia	1.40
Alumina	0.86
Oxide of iron	3.56
Water	0.45
	99.54

NEW JERSEY GEOLOGICAL SURVEY

This is a sample of the loose variety of the limesand; it is gray in color, and contains many greensand grains.

Limesand from Wm. Barber's pits, along a branch of Mannington Creek, Mannington township.

Silicic acid	43.40
Carbonate of lime	44.45
Magnesia	1.95
Oxides of iron and alumina	6.20

This limesand is extensively used as a fertilizer. The stony layers are burned into lime, which has an extensive use and gives good satisfaction.

SECTION III.

GENERAL STATEMENTS REGARDING THE USE OF MARL.

The marl which has been described in the preceding pages has been of incalculable value to the country in which it is found. It has raised it from the lowest stage of agricultural exhaustion to a high state of improvement. Found in places where no capital and but little labor were needed to get it, the poorest have been able to avail themselves of its benefits. Lands which, in the old style of cultivation, had to lie fallow, by the use of marl produce heavy crops of clover, and grow rich while resting. Thousands of acres of land, which had been worn out and left in commons, are now, by the use of this fertilizer, yielding crops of the finest quality. Instances are pointed out everywhere in the marl district of farms which, in former times would not support a family, but are now making their owners rich from their productiveness. Bare sands by the application of marl are made to grow clover, and then crops of corn, potatoes and wheat. What are supposed to be pine barrens, by the use of marl are made into fruitful land. The price of land in this region was considerably below that in the northern part of the State forty years ago; now that the lands are improved their prices are higher than those in the northern part of the State, though even there they are higher than any where else in the United States. In 1830 Thomas Gordon said of these lands:

"It would be difficult to calculate the advantages which the state has gained, and will yet derive from the use of marl. It has already saved some districts from depopulation, and increased the inhabitants of others, and may, one day, contribute to convert the sandy and pine deserts into

NEW JERSEY GEOLOGICAL SURVEY

regions of agricultural wealth."—*Gordon's History and Gazeteer of New Jersey, Part 2, p. 5.*

This prediction is fast being fulfilled. The following table, in which the prices of land in the purely agricultural counties are given, will prove this statement. The counties are about equally convenient to market.

The reputation of New Jersey soils forty-seven years ago is strongly stated in Morse's American Universal Geography, edition of 1819:

"*Soil and Agriculture.*—The mountainous parts of the state have generally a strong soil, and form a fine grazing country. The farmers there raise great numbers of cattle for the markets of New York and Philadelphia. They also raise wheat, rye, maize, buckwheat, potatoes, oats and barley, enough for their own consumption. They keep large dairies, and make great quantities of butter and cheese. In the counties that are uneven and hilly the soil is likewise generally rich, and very productive of the various kinds of grain, particularly wheat and maize. Near New York and Philadelphia great attention has been paid to the cultivation of fruit and vegetables; and the finest apples, pears, peaches, plums, cherries, strawberries, raspberries and melons, are constantly carried to these markets. Fine orchards abound in all the northern half of the state; and the cider of New Jersey, particularly that of Newark, is of proverbial excellence. Maple sugar is made in considerable quantities in the county of Sussex. A narrow tract of country on the Delaware, in Burlington and Gloucester counties, is rich and fertile; as are various similar tracts in the southern half of the state, on the small rivers and creeks. In Salem, Cumberland and Cape May, there are also very extensive tracts of salt meadow on the river and bay. In Gloucester and Burlington similar tracts have been recovered by sluices and mounds from the inroads of the sea, and are now rendered rich fresh meadow. With these exceptions, the greater part, at least four-fifths of the six southern counties, or two-fifths of the whole state, are barren. They produce little else but shrub-oaks and yellow pines. They yield, however, an immense amount of bog iron ore, which is worked up in these counties. The inhabitants raise a little maize, rye and potatoes; but subsist chiefly by feeding cattle on the salt meadows, and by fishing on the shores and in the creeks and rivers."

The six southern counties alluded to are: Monmouth (which then included Ocean), Burlington, Gloucester (which then included Camden and Atlantic), Salem, Cumberland and Cape May. In contrast with the above, we insert the following table prepared from the census report of 1860. In this it will be seen that the highest price of land and the largest amount of agricultural products is from the six southern counties, and from those where marl is found:

NEW JERSEY GEOLOGICAL SURVEY

—	Cash value of farms.	Price per acre of land in farms.	Farming implements and mach'y, value of.	Live stock, value of.	Wheat, bushels of.	Rye, bushels of.	Indian Corn bushels of.	Oats, bushels of.	Irish potatoes, bushels of.	Sweet potatoes, bushels of.	Buckwheat, bushels of.	Orchard products, value of.	Market-garden products, value of.	Butter, pounds of.	Hay, tons of.	Animals slaughtered, value of.
Bergen	$11,834,925	$96	$340,845	$733,476	6,530	90,669	182,127	93,732	229,902	.....	867	$31,632	$295,540	440,488	22,269	$106,795
Passaic	3,769,895	42	83,805	875,596	6,688	45,145	113,880	57,911	95,055	2	33,403	2,434	42,040	295,152	13,302	59,076
Hudson	5,106,350	581	66,815	84,205	1,692	3,005	23,542	9,924	19,389	515	220	12,063	210,765	14,826	3,017	1,220
Essex	5,332,075	106	148,218	519,745	11,731	26,740	153,818	54,565	73,688	167	16,042	15,104	140,669	292,933	16,885	275,656
Union	4,770,150	70	138,556	309,958	10,631	15,010	194,580	100,576	54,660	12	15,709	9,323	5,545	228,235	12,258	41,703
Morris	10,462,026	41	307,646	1,090,484	53,653	73,103	633,394	354,920	139,208	101	121,548	21,243	8,600	706,637	38,196	210,856
Sussex	11,135,233	42	296,290	1,396,472	25,176	238,232	503,841	274,915	113,098	10	142,552	18,396	66,720	2,042,987	48,078	308,819
Warren	12,685,074	55	378,906	1,115,719	176,808	217,123	633,807	312,900	93,970	50	102,501	14,104	1,614	1,079,343	24,843	216,833
Hunterdon	15,824,190	63	713,850	1,602,383	241,805	130,741	1,055,711	530,053	92,935	480	91,835	60,227	2,401	1,010,674	31,403	291,961
Mercer	10,714,244	84	366,543	859,625	136,554	36,049	594,807	475,963	140,991	8,133	43,950	54,491	37,857	475,860	21,199	227,216
Somerset	11,922,419	63	428,124	1,001,906	131,166	93,927	748,730	741,228	62,065	350	41,249	20,243	3,059	892,845	31,069	240,685
Middlesex	9,916,005	68	298,142	868,691	103,613	55,795	467,115	350,592	156,102	12,151	57,825	21,046	43,029	451,644	27,760	168,307
Monmouth	16,295,970	80	510,735	1,897,445	143,256	97,224	859,877	293,014	1,051,525	42,029	25,337	25,450	133,264	609,899	34,613	312,853
Ocean	2,318,800	20	78,748	257,085	10,001	34,598	104,548	12,519	61,962	6,501	10,220	1,488	5,116	111,895	10,862	103,143
Burlington	17,552,530	62	556,411	1,727,480	182,212	172,872	1,031,224	239,603	485,260	117,819	36,841	53,097	257,217	694,475	60,505	669,126
Camden	5,992,105	81	158,005	351,303	69,476	35,530	291,522	24,830	351,585	87,149	8,360	10,188	193,738	418,217	14,574	136,399
Gloucester	7,962,445	65	289,636	663,306	69,997	42,139	425,033	19,419	300,847	585,756	13,501	15,522	44,500	298,500	21,220	237,623
Atlantic	686,250	10	14,709	79,002	6,889	6,391	46,217	2,302	16,857	6,491	4,267	494	4,134	85,625	6,703	24,522
Salem	10,241,468	69	341,493	952,591	233,494	15,343	748,731	211,132	425,272	100,805	23,150	27,738	13,340	373,863	35,698	280,021
Cumberland	4,295,575	39	162,230	482,665	114,343	12,083	472,747	118,405	162,941	44,548	25,117	6,172	17,222	241,079	26,947	150,603
Cape May	1,462,400	22	66,750	174,903	21,303	2,411	120,445	19,969	36,528	21,700	4,013	1,837	10,595	59,670	11,165	53,649
	$150,258,338		$5,746,567	$16,134,603	1,763,218	1,439,497	9,733,336	4,539,132	4,171,690	1,034,852	577,386	$429,402	$1,541,995	10,714,447	508,736	$4,120,276

NEW JERSEY GEOLOGICAL SURVEY

SECTION IV.

MODES OF APPLYING MARL, AND ITS EFFECTS.

The marl is in the form of an earth, and is dug with spades, or, if very compact, is loosened by grubbing hoes; and, when fairly crumbled, as it soon is by the sun and air, it is as easily handled as sand. It can then be spread evenly over the surface of the ground. The quantity used varies with the quality of the marl, and the crop to which it is applied. In Eastern Monmouth, where the Lower Marl Bed is largely developed, and is rich in powdered carbonate of lime and poor in phosphoric acid, it is used in enormous quantities, and never injures crops, but on the contrary is of the greatest utility. From one hundred to two hundred tons to the acre are not uncommon. Marls of any kind, which are acid from containing sulphate of iron or sulphate of alumina, are applied sparingly and with care. If put on potatoes in the hill, the sprouts are killed by them, and a dressing of fifty tons to an acre has sometimes destroyed all vegetation. The safe way of using such marls is found to be upon well limed lands, or else in dressings of from ten to twenty tons per acre, or else composted with lime. Those marls which contain no carbonate of lime, but are rich in phosphoric acid, are used in quantities of from five to twenty tons per acre.

In some places the marl is so strongly acid that it is not used, the labor of composting it with lime being more than it is thought worth. It cannot, however, be too strongly insisted upon, that lime will certainly correct the injurious effects of such marls, and no cases can probably be found but what one bushel of slaked lime to ten bushels of marl will be sufficient for the purpose, and generally a half, or even a quarter of that amount will be enough. The effect of the lime is to decompose the sulphate of iron or alumina and form sulphate of lime (plaster), which is a valuable fertilizer, and would greatly improve the quality and effects of the marls, so that these *poison* or *black* marls, when properly corrected, are more valuable than those which are not poisonous. This is abundantly verified by the experience of good farmers.

It should be remarked that the *poison* marls do not generally make up the whole bed, but only a portion of it near the top or bottom; the causes which have formed it having operated from the upper or under side of the bed, and only gradually penetrated and changed it from its original condition. That which produces this effect, is in all cases sulphuric acid. A number have been analyzed and their acid properties mentioned in the

NEW JERSEY GEOLOGICAL SURVEY

remarks, and the amount of acid given in the analysis. It can always be detected in the marl by its astringent and inky taste; and if further tests are desired, they can be made by soaking the marl in water, and then pouring into it the purple infusion of red cabbage, when, if acid, the cabbage-water will turn of a bright red; or if strong tea is poured into it, the color will change to dark-purple or black.*

A bare inspection of a pile of poisonous marl is generally sufficient to tell its nature. After a rain it will remain wet, when the pure marls have quite dried out, and when dry, it is covered with a yellowish-white efflorescence or coating of copperas or alum.

A number of persons using the marl from the northwest slope of the Mount Pleasant hills, mention that it is poisonous, that it contains sulphate of iron, but by exposure for several years, loses this property. They, however, use it at once, and compost with lime, using one bushel of slaked lime to twenty bushels of the marl. Prepared in this way, it is quick in its effects, and safe. Along the north shore of the Navesink River much black or poisonous marl is dug, and is used with good effects by composting with lime; thirty to forty tons to the acre is a medium amount.

About Holmdel, Marlborough, and Nut Swamp, in Monmouth, it is not uncommon for farmers to use two hundred and fifty cart loads of the unchanged blue marl of the Lower Bed on an acre of ground. The practice at present, however, is to use less than formerly. In Western Monmouth, a much smaller quantity has always been used; from fifteen to twenty tons on an acre of the Cream Ridge marl is thought to be sufficient. This marl is very durable. The late J. B. Crawford, of Nut Swamp, said he had been able to see the effects of a single marling for forty-four years; and it is said that the marl from this bed, which was put on a field near Marlboro in 1768, still shows its good effects. This marl always does good to the soil; it may be applied over and over again in successive years, and each one shows itself beneficial.

In fact there is scarcely a limit to the amount of such marl applied except the expense of excavation and distribution over the surface. In the districts where the marl outcrops on every farm more is used than in those neighborhoods where it is not found, and to which it must be hauled—perhaps several miles. Transportation influences to a great degree the amount used. The blue-shell marl of the Lower Bed, on account of its mildness, admits of the enormous doses that are given the soil. This is not the case with those of the Middle and Upper Beds. These require more caution in

*The infusion of cabbage is made by taking common red cabbage, cutting it fine and soaking it for a few minutes in warm water, when a beautiful purple-colored liquid will be produced.

NEW JERSEY GEOLOGICAL SURVEY

their use, otherwise the crop is injured or even killed by the excess. While the latter produce good results in small quantities, they are not so durable or lasting in their effects as the blue marl of the Lower Bed, and, consequently call for more frequent applications. This is the unanimous testimony of the best farmers of the state who have tried both. The former produces general results—is amendatory of the soil; the latter are more specific in their actions —benefiting for a short time certain crops. In treating of the use and effects of marls, several points must be constantly borne in mind, viz., the physical condition of the soil, the physical and chemical character of the marl, and the crops to be grown. These modify almost every general statement, because it is only in a proper conjunction of these several points that we can expect the best results. A marl adapted to one soil is unsuited to another, not because of any lack of the necessary chemical constituents, but because of its individual peculiarities, physically considered. And the same marl so apparently inert when applied on soils of different character, may yield most striking results. Instances of this are to be seen in the whole marl region of the state. In order to convey a correct idea of the use of this fertilizer in different parts of the state, a number of localities are presented with their modes of application, results, etc. About Eatontown and Tinton Falls, Monmouth County, the marl (of the middle bed) is deemed specially adapted to the growth of potatoes, and it is used at the rate of twenty to thirty tons per acre. For other crops it is inferior to the Poplar marl which is much used in that vicinity. Lime is found to be of great service with these green marls. By inspecting the analyses it will be seen that they are deficient in that constituent when compared with the blue marl of the Lower Bed. The lime probably hastens their action as well as supplies a needed element to the soil and crop. The yellow, calcareous marl which outcrops south of Eatontown and thence eastward to Turtle Mill, is but little used at present. Wherever this marl has been applied lime fails to show any striking effect. It is valuable for the general improvement of the soil and is worthy of more extended use.

The marls of Deal and Poplar deservedly enjoy a high reputation. They are carted several miles into the adjoining country. For grass and grain they are especially liked. The ash marl of the above-named localities, although destitute of greensand, and hence not properly a greensand marl, gives very satisfactory results. It is commonly applied in larger quantities than the green marl which underlies it, having been used to the amount of one hundred tons per acre. It is said to be a lasting fertilizer. Much of it and the overlying blue marl go to the clay lands of Squan, where it is highly esteemed. At Shark River, from ten to forty tons are applied per acre. Here the ash marl, or, as it is better known in this locality, the *clay* marl

NEW JERSEY GEOLOGICAL SURVEY

is preferred for sandy soils; while the green only is used upon the heavier lands. The same is true at Squankum. The ash marl is mostly taken south to the more sandy districts. To show the value in which it is held, it is deemed profitable to haul it in wagons twenty-five miles and further, occupying two or three days in making a trip for one ton of marl. The green marl of Squankum has long enjoyed a wonderful celebrity as a model fertilizer. The prosperity of the country about Blue-Ball, Freehold, Englishtown, and Jamesburg, and that bordering the Camden and Amboy Railroad, is largely due to this marl. Railroad facilities have of late extended the scope of country wherein it is used. The amounts used per acre vary exceedingly. Instances are frequently cited where it has been sowed as plaster, or applied in the hill sparingly as guano, and produced good crops on lands previously barren. It seems to be better adapted to heavy soils than to those quite sandy. The latter need a change in their physical condition before marl can be made to show its usual effects. Under the auspices of the State Agricultural Society, Hon. J. G. J. Campbell, N. S. Rue, Esq., and the State Geologist, were authorized to send out a circular letter with questions, asking information in relation to the source of supply, character of soils upon which it was used, mode of applying, amount used per acre, nature of crop, adaptation to particular crops, its cost and value compared with barnyard manure. Some very interesting replies to these questions were received. Wm. Updyke, of Dutch Neck, Mercer County, who has used about twenty-five thousand bushels of Squankum marl during the last ten years, says the lands in his vicinity have been doubled in price by the use of this marl. He considers it specially adapted to buckwheat and potatoes. Uses from thirty to one hundred bushels per acre—mostly on surface. Main object is the production of clover, which is afterwards turned under as a green manure. In this way fine crops are obtained. In wheat it is generally composted with barnyard manure. Thos. S. Snedeker, of Jamesburg, has used from two thousand to seven thousand bushels of Squankum marl annually during the last twenty-five years. Considers marl more valuable than barnyard manure. He uses from sixty to one hundred bushels per acre; applied raw, except a small quantity composted for wheat. He thinks it specially adapted for grass. Price, sixteen cents per bushel at the railroad depot. John G. Shultz, also of Jamesburg, has made use of Squankum marl for twenty-one years. Best for grass. He uses about one hundred bushels to the acre on grass; seventy-five on potatoes and wheat; fifty on rye; and thirty on buckwheat. Judge Wm. P. Forman, of Millstone township, Monmouth County, after thirty years' experience with marl, says: "I look upon it as the foundation of my improvement in renovating a tract of worn-out land." He considers the marl

NEW JERSEY GEOLOGICAL SURVEY.

worth one hundred and fifty per cent. more than barnyard manure, the quantities being equal, but the value of each is enhanced by composting. He uses about two hundred bushels per acre for wheat, corn, rye and grass; about fifty per cent. more for potatoes, and same amount for buckwheat. Particularly good for grass, potatoes and buckwheat. The general experience with Squankum green marl shows that it gives greatest results when applied as a top-dressing upon grass. In Freehold, Manalapan and Millstone townships, it is used upon soils underlaid by marl of the Lower Bed. For light soils the latter is preferred, but many farmers haul marl from Squankum, fifteen to twenty miles, in preference to their own—so much smaller quantity producing the same effects. The sand marl of that district is much liked. This is probably due to its physical rather than chemical constitution. For immediate results, especially for potatoes, their *red* and *grey* marls are largely used. This is the case in Eastern Monmouth also. The top or changed marls seem to be specially beneficial to potatoes, and for this they are mostly used. Their effects are quick rather than lasting. The Middle Bed, as opened at Smithville and Burnt Tavern, shows a nearly pure greensand, but it is characterized by the owners as worthless. It is an example showing the value of marl to depend upon the phosphate and carbonate lime rather than upon the potash, or more properly, the greensand. An analysis of this green marl, as found on Benjamin Dubois' farm, is given on a preceding page. At Cream Ridge the blue marl, similar to that of Holmdel and Marlboro, is used at the rate of three hundred to four hundred bushels to an acre, with the best of results. The grey, calcareous marl of New Egypt is esteemed for sandy land, but for heavy, clay soil the green and black, grain marls are preferred. The stony layers were formerly burned for lime, but the work has been abandoned. The lime-sand also is seldom used. Of the Upper Bed marl at this point from six to fifteen tons is the usual quantity per acre; generally as a top-dressing upon grass, or spread on corn-land in the fall or winter previous to the crop. Always does good on grass. For potatoes it is put in the hill. It increases the yield of corn and clover, and helps wheat. The improved state of the land around New Egypt is owing to the liberal use of marl. At Poke Hill, Burlington County, the green marl is employed to great advantage on their lands at the rate of ten to twenty tons per acre. In Springfield township there is not much marl dug, although the bed can be very conveniently worked. Its place is now supplied by barnyard manure, which is probably an indirect result of former use of their marl. From ten to twenty-five loads of marl are applied per acre; generally with lime, which with the marl shows striking effects. About Pemberton a great deal of marl is used. The lime-sand of this vicinity has been tried with very great benefit—espe-

NEW JERSEY GEOLOGICAL SURVEY

cially upon light soils; but the green marls of both the Middle and Upper Beds are most largely employed. S. R. Gaskill, in reply to a circular, says that he has used marl for thirty-five years from pits on his farm, upon all kinds of soils; generally applied raw, except on wheat, where it is composted with barnyard manure. About two hundred bushels used to an acre, but one-half that quantity does well. For potatoes it is applied in the hill. Benefits corn, grass, potatoes, and all kinds of garden-truck. Especially adapted to grass and potatoes. Cost of digging about ten cents a ton. He considers it equal in value to barnyard manure, and for clover and potatoes worth twice as much. Jas. A. Fenwick, near Pemberton, replies that he has used several hundred tons of marl (of Upper Bed) annually for many years. Used upon sandy and loamy soils, and upon drained swamp lands. Generally applied in a raw state—some composted—and mostly on the surface. Formerly used twelve tons per acre; now eight tons, and with best results for the outlay. The young grass is marled annually. Its best effects are upon grass. Its application to young clover more than doubles the crop. Potatoes more than doubled by application in the hill. Used in conjunction with barnyard manure, it is equal with the latter alone, ton for ton, and more lasting in its effects. Lime has a good effect upon fields which have been marled, but plaster and sulphate of soda do not show the least benefit. Same is true of phosphate of lime which is not ammoniated. Mr. Fenwick says he knows of a farm that was too poor to grow rye long enough to be gathered by a cradle, which now is very rich, producing good crops of clover, wheat, corn, etc.; and this change has been wrought by marling and growing clover in the rotation practiced. About Pemberton, Vincentown and Medford, both the Middle and Upper Beds are worked. The marl of the latter bed is, in the opinion of those who have carefully experimented with both, superior, particularly for top-dressing grass, and also for grain. Upon root crops the difference is not so manifest. Average amount applied ranges from ten to thirty tons on an acre. The limesand and limestone of these localities are not much used. Formerly lime was made from it at Vincentown, but the cost of fuel and difficulties in burning, with the cheapness of Pennsylvania lime, has caused the abandonment of the work. Where the limesand is applied, it is beneficial, and with some farmers is a substitute for lime. Along a branch of Big Timber Creek, near Brownsville, Camden County, the yellow limestone has been burned for lime within the last year. For agriculture said to be equal to Schuykill lime.

In regard to the *chocolate* marl of West Jersey there is a diversity of opinion. Generally it needs cautious application, as most of it is injurious, if put on the land in too heavy dressings. Two and three tons per

NEW JERSEY GEOLOGICAL SURVEY

acre have proved valuable, particularly upon potatoes. For grass also it has appeared beneficial as a top-dressing. In Salem County, in some neighborhoods where it contains a large percentage of greensand, it is much esteemed; but throughout nearly the whole extent of country where it is found it is discarded. This is, however, partly due to the fact that it is reached most generally at the bottom of pits after passing through several feet of green marl. Further and careful experiments with it are desirable. The analyses show a fair proportion of phosphoric acid, lime and potash, and where it is easily accessible its merits should be clearly settled, before using other marls at greater expense and inconvenience.

The marl of the Lower Bed is opened at a few points only in Burlington and Camden Counties. It is much more sandy than in Monmouth County, and is quite inferior in quality. By some it is thought to be equal to the marls of the beds lying east of it. Lime is needed with most of it to correct its acidity.

In many parts of West Jersey the green layer of the Middle Bed is of a yellowish-green color, and altogether inert. Its outcrop forms what is commonly known as *greensand*, which is deemed worthless as a soil basis. With proper drainage and liming such lands are certainly capable of much improvement, and careful experiments with them are very desirable.

The marls of Whitehorse, Blackwoodtown and Hurfsville have attained a high reputation as fertilizers, not only in their immediate neighborhoods, but also over a vast extent of country south and east, to which they are distributed by railroad. A glance at the analyses of these marls show that they are rich in phosphoric acid, containing from two to three and a half per cent. of that most valuable constituent. To this is attributable their excellence. The amount used everywhere about these localities varies from ten to twenty-five tons per acre. At Blackwoodtown it is used as a top-dressing upon wheat in winter. For corn or potatoes applied in hill with great benefit. Sometimes put on sward previous to corn crop. The use of marl has been very much increased in the southern part of the state through the operations of the West Jersey Marl and Transportation Company. It is distributed along the various connecting railroad lines to a wide scope of country. Its effects are such as to create a constantly increasing demand for it. In Salem and Cumberland Counties it has been known to increase the amount of grass fourfold. The yield of potatoes and corn is also largely increased by its use. Its greatest benefit is upon grass or clover and potatoes. The annually increasing amount sent to the districts bordering the railroad lines is changing the whole face of a once comparatively barren country.

NEW JERSEY GEOLOGICAL SURVEY

The marl of the Lower Bed, as worked in Gloucester and Salem Counties, is generally employed as a fertilizer in the district of its outcrop with successful results. Although quite sandy, containing as much as forty per cent. of quartz sand, it has a large percentage of carbonate of lime and to this is due its beneficial effects. In comparison with the green marl of the Middle Bed, it is not so active in its properties but more durable. For improving the soil it is probably equal to the marl of the Middle Bed. Where immediate results are desired it is quite inferior. Most generally it is applied upon clover sward in dressings of from ten to twenty-five loads per acre. Here are seen its best effects. For potatoes it is a good manure when spread on the field previous to planting.

In the Middle Bed the openings in Gloucester and Salem Counties offer to the farmers a most excellent and cheap fertilizer. Its use has not been confined to the marl localities; in all directions it is carted for miles. Eastward in Pittsgrove its use has been persevered in, until a land once too poor to sustain its sparse population, has become as productive as any other in Salem. Here its most striking effects were to be seen upon buckwheat. But the improvement of the country has been brought about by promoting the growth of grasses and thereby increasing the manures of the farm. In Mannington township the marl is used more liberally, to the extent of from twenty-five to fifty tons per acre. Here also the limestone of this bed is burnt by Wm. Barber, and during the year '64–'65, twenty thousand bushels of slaked lime were made at this place. This lime is considered superior to that from Pennsylvania for agricultural purposes, and fully equal to it for mortar. The cost of fuel is about two cents per bushel of slaked lime. Price is fifteen cents per bushel. Farmers of the vicinity agree in the statement that the calcareous marl or limesand is a permanent fertilizer and that where applied there is less need of lime. David Petit, of Mannington township, has used it in heavy doses with great benefit. Along Major's Run, underneath the green and chocolate marls, the indurated earth or its equivalent is worked. An analysis of a sample from J. Robinson's farms shows that it is quite rich in phosphoric acid and lime. Many prefer it to the green marls found along the same stream.

From these observations some practical conclusions may be drawn:

1. That the most valuable marls, and those which will best pay the cost of long transportation, are those which contain the largest percentage of phosphoric acid.

2. That the most durable marls are those containing carbonate of lime, the more the better.

NEW JERSEY GEOLOGICAL SURVEY

3. That greensands containing but little of either phosphoric acid or carbonate of lime, become active fertilizers when composted with quick-lime.

4. That marls which are acid and burning from containing sulphate of iron, can be rendered mild in properties and useful as fertilizers by composting with lime.

5. That crops particularly improved by it are all forage crops, grass, clover, etc.; for these the green marl may be spread upon the surface to the amount of from one hundred to four hundred bushels per acre. The crop is generally doubled, and in some cases quadrupled, by this application. Other marls must be used in larger quantities, but will produce good results.

Potatoes. For this crop marl seems to be a specific. It does not materially increase the growth of vines, and the yield is not much greater, but the potatoes are smoother and fairer in the skin and dryer and of better quality when boiled. The marl is put on the potatoes in the hill at planting; if not acid, it is thrown directly on the tuber; if acid, the potatoe is first covered by earth and the marl thrown on or beside that. From five to thirty tons may be used on an acre.

Buckwheat. Most remarkable effects upon this crop are produced by marl. Two and a half tons or fifty bushels to the acre, spread on after sowing, have caused an equal amount of buckwheat to grow on land which otherwise was not worth cultivating.

Wheat, rye, oats and corn, are improved by the use of marl, though not with the striking results seen on the crops before mentioned. It is applied as a top-dressing on the prepared ground, is spread on the surface before plowing, is worked in the hill or drill, or is composted with barnyard manure and spread on the ground according to the farmer's judgment. From five to thirty tons and even more may be used upon an acre.

With any kind of garden or field-crop it may be used, and will be beneficial both to the crop and soil. It is free from the seeds of weeds, is dry, and convenient to handle—all of which recommend it to any snug farmer.

SECTION V.

CAUSES OF THE FERTILIZING ACTION OF MARL, AND ITS COMMERCIAL VALUE.

How does marl act in increasing the fertility of the soil is a question which presents itself to every inquiring mind? The answer is in part easy, but the precise effects which each of the constituents has in the whole action is not yet explained. *Phosphoric acid* is the most valuable con-

NEW JERSEY GEOLOGICAL SURVEY

stituent of the whole. Indeed, it may be asserted as a general truth, that the greensand marls may be valued just in proportion to the percentage of this acid they contain. An inspection of the preceding analyses and the general reputation of the marls will fully sustain this proposition. That this is in accordance with the experience of agriculturists in other countries is well shown by this extract from Morton's Encyclopedia of Agriculture, art. Marl:

"Practical men have long been acquainted with the fact, that some marls exercise a much more beneficial action than others, particularly when applied to corn crops; but the true explanation in accounting for these facts has not been given until lately, when analyses pointed out the presence of a large amount of phosphoric acid in these marls, as the principal cause of their superior fertilizing effects.

"Generally speaking, indeed, the best marls are those which are richest in phosphoric acid—an acid which is used largely by cereals for the perfection of their seed. But as the proportion of phosphoric acid in some marls amounts to a fraction of a per cent., whereas others contain two, three, four, five per cent., or a still larger quantity, we can readily explain the differences in the effects which must follow the application of different kinds of marl to the same land. Some, as the greensand marls of the south of England, in particular, are very rich in phosphoric acid, and have long been remarkable for great productiveness in corn."

Beds of calcareous marl occur both in the upper and lower strata of the greensand formation, which lies immediately below the chalk; and Mr. Paine and Prof. Way, who have carefully described in the *Journal of the Royal Agricultural Society of England, vol.* 9, the position of these beds, and pointed out their exact chemical composition, have discovered in many specimens, large quantities of phosphate of lime or bone-earth. An examination of the various pits in the neighborhood of Farnham, has further led these gentlemen to the discovery of several layers of phosphatic nodules, some of which furnished, on analysis, as much as forty to sixty per cent. of bone-earth, or a quantity equal to that contained in bones. In the neighborhood of Göttingen, in Hanover, phosphatic marl-beds, rich in fossilized organic remains, have also been discovered, several years ago, by Dr. Volcker and Dr. Merkelin; and it is likely that similar beds occur in other continental localities situated on the greensand formation. In examining a marl intended to be used for agricultural purposes, particular care should be bestowed upon the determination of the phosphoric acid which it may contain; because its fitness and value, as a manure, in a great degree is dependent on this valuable fertilizer."

NEW JERSEY GEOLOGICAL SURVEY

One of the English marls analysed by Prof. Way, and referred to in the preceding extract, has the following composition:

"*Fossiliferous Green Marl.*

	Soluble in dilute acids.	Insoluble in dilute acids.	Sum.
Silicic acid	31.88	22.06	53.94
Carbonic acid	undetermined.	....	....
Sulphuric acid	.45	....	.45
Phosphoric acid	3.76	....	3.76
Chlorine	trace.	....	....
Lime	5.61	1.52	7.13
Magnesia	.85	1.09	1.94
Potash	3.21	.45	3.66
Soda	1.20	.31	1.51
Peroxide of iron	18.45	6.14	24.99
Alumina	.74		
Combined water and a little organic matter	....	3.82	2.62
			100.00

The phosphoric acid is in most cases combined with lime, and the little particles of it are plainly to be seen, but some of the acid is combined with iron, and it is not uncommon to meet with it, crystallized as vivianite and uncrystallized as blue earth. The grains of phosphate of lime are usually as small as the grains of greensand; of a greenish-white color, and easily pulverized.

Sulphuric Acid. This constituent is found combined with lime forming plaster, with iron forming copperas, and with alumina forming alum. The plaster is very common. Almost any pile of marl that has been exposed to the weather, and is nearly dry, if looked at closely, will be seen to have a great number of fibrous-like white or transparent particles which are crystals of sulphate of lime. Sulphates of iron and alumina are not so common, but are frequently seen. They give to the marl an acid reaction, a black color, and when laid on growing plants destroy them if applied in large quantities. These latter sulphates are made into plaster by adding equivalent quantities of lime. In the analyses given the sulphuric acid is set down by itself, for though combined with either lime, iron, or alumina, it is difficult to tell exactly the amount combined with each; and in estimating its value it is safe to consider it as representing twice its weight of plaster. The efficiency of this substance as a fertillizer is well known, though the cause of its action is not satisfactorily explained. It seems specially adapted to clover, causing it to grow upon even the poorest of soils, and a very moderate application of this substance in fine powder, not more than one or two cwt. to the acre, is sufficient to bring forward a heavy growth of clover, which can be plowed in and used for enriching the soil so

NEW JERSEY GEOLOGICAL SURVEY

as to produce a crop of corn or wheat, and render further improvement of the same kind easier. It should be remarked in regard to gypsum that experience is not uniform in relation to its value as a manure. In some districts of country it produces the most wonderful effects, while in others it is thought to be of no value. Near the seashore it is said not to do any good; in wet seasons its effects are not seen. It shows the best results in dry seasons.

Soluble Silica is thought by many to be of great importance in soils, by furnishing silica to the straw and stems of plants, and thus stiffening them, so that they will not fall or lodge. The marl has from thirty to fifty per cent. of soluble silica; enough to answer every purpose required.

Potash always constitutes from four to six per cent. of the greensand. The fertilizing properties of wood-ashes have long been known; and their action has as long been ascribed to the potash in them. At an early stage in the use of the marls it was thought their beneficial effects were due to their potash. The discovery of other fertilizing constituents in them has changed this opinion; and it has also been observed that some marls containing the proper proportion of potash are altogether worthless as fertilizers. The part played by potash in the marl is not understood. As the inert marls are rendered active by composting with lime, it is probable that potash when liberated by the lime, shows its good effects. A comparison of the ash of potatoes and potato tops with those of other plants, shows them to contain an unusually large percentage of potash, and the peculiarly beneficial effect of the greensand on this crop has strengthened the opinion that this substance is of high value in the marl.

Oxide of iron, which constitutes about a fifth of the weight of the marl, has usually been considered as of no special value. It is generally observed, however, that the marls which have been changed by exposure or by drainage so as to become red in color, and to have lost nearly the whole of their lime and phosphoric acid, are still as valuable for manuring potatoes as the unchanged marls. This is everywhere noticed, and the only objection to them is that their effects are limited to a single year. That the oxide of iron is the cause of this effect, is rendered probable by the observed effects of red earth and loams which are used for fertilizers in other parts of the state. At Shiloh in Cumberland County, a red earth, which is called *marl*, is dug from beneath the surface and applied as a fertilizer, with excellent effect. It contains no shells nor greensand, and gives no test for ammonia; its only observed peculiarity is the large per centage of oxide of iron. At Vineland the subsoil is in many places a very red gravelly loam. When this is brought to the surface it is observed to increase the growth of vegetation,

NEW JERSEY GEOLOGICAL SURVEY

and especially to benefit fruit trees. The oxide of iron of this subsoil is the most noticeable substance in it. The red soils of the Red Sandstone region as well as those of the Red Sand Bed of the Cretaceous Formation, when neglected are perhaps the poorest in the state; but with skillful cultivation they yield most extraordinary crops.

The protoxide of iron of the marl, by exposure slowly changes to a peroxide; cultivation of the soil in its various agencies hastens this change.

"Iron when covered with a thin layer of water and exposed to the air, is converted into the hydrated peroxide, by taking up the oxygen which the water absorbs from the air, and combining as oxide with a portion of the water. In this reaction there is likewise produced a portion of ammonia, which partly escapes and partly remains in combination with the hydrated peroxide; the formation of the ammonia is due to the decomposition of a portion of the water, and the combination of its hydrogen with the nitrogen of the air which has been absorbed by the water."—*Guelin.*

If this process goes on, as seems reasonable, in the peroxidation of the protoxide in the greensand it gives a cause for the fertilizing action in the ammonia formed. The oxide of iron may be important in the growth of potatoes by supplying a constituent needed peculiarly for that vegetable. The ash of potatoes and potato tops is quite as large as of any other of our cultivated crops, and the percentage of oxide of iron in this ash is more than ten times as great as in any of our grain crops.

Magnesia is not usually considered as an important constituent of a fertilizer. It is found, however, in the ashes of grain, and may be of some value.

Alumina is the base of clay. It is not found in the ashes of plants at all, but is an essential part of all fertile soils.

It is a difficult matter to estimate the value of marl from the commercial value of its constituents, but it is worth the attempt. Prof. S. W. Johnson, of the Sheffield Scientific School, has made estimates of the money-value of different fertilizers, which have been very generally adopted. They were, however, prepared before the war, and should now be advanced about fifty per cent. to make them correspond with present rates. He estimates as follows:

Phosphoric acid, soluble variety	12½	cents per pound.
Phosphoric acid, insoluble variety	4½	" " "
Potash	4	" " "

With the advance of prices, this would give—

Phosphoric acid, soluble variety	18¾	cents per pound.
Phosphoric acid, insoluble variety	6¾	" " "
Potash	6	" " "

NEW JERSEY GEOLOGICAL SURVEY

The phosphate of lime in the marl belongs to the insoluble variety, but it is so very soft and finely divided that its action is almost as quick as the soluble varieties usually are. In a marl containing three per cent. of phosphoric acid, if the price of insoluble phosphoric acid is taken, the sixty pounds of phosphoric acid in a ton would be worth $4.05, or twenty cents a bushel; and if the soluble variety is taken, it would be worth $11.25 a ton, or fifty-six cents a bushel. The last estimate is probably nearest the true value, as there are prosperous farmers who, from their experience, think such marls worth from thirty-five to forty cents a bushel. The worth of the potash is hard to estimate. It is almost insoluble in the soil, being slowly liberated by the action of carbonic acid and water, and somewhat more rapidly by the action of quicklime. It is certainly not worth more than two cents a pound in the marl, and probably less. At that price five per cent. would add two dollars a ton to the value of the marl, and would influence the value of high-priced marl. Two and a half per cent. of sulphuric acid, or five per cent. of plaster, may increase the value of marl to the amount of forty or fifty cents a ton. The fine carbonate of lime found in many of the marls may be worth half as much as plaster, so that ten per cent. of carbonate of lime in a marl would be worth forty or fifty cents a ton. The other constituents cannot be estimated.

As a basis for safe calculation I would put the prices as follows:

Phosphoric acid	12½ cents per pound.
Sulphuric acid	½ " " "
Potash	1 " " "
Carbonate of lime	⅖ " " "

With these prices the calculated value of the marl (p. 421) from Obadiah C. Herbert's pits at Marlboro, and which was a carefully selected average, is $5.79 a ton, or twenty-nine cents a bushel. That of the West Jersey Marl Company (p. 437) which is also an average, is $7.99 a ton or forty-cents a bushel. The Squankum marl, from the pits of E. K. Johnson (p. 430) is worth $10.05 a ton, or fifty cents a bushel. These prices represent the value of the marl, not upon the pit-bank, but when it has been carted and delivered upon the field where it is to be used. They are as near the true value as they can be made; and it is thought that experience will show that it is a safe estimate for the buyer.

NEW JERSEY GEOLOGICAL SURVEY

SECTION VI.

STATISTICS OF MARL—QUANTITIES AND PRICES.

It is impossible to make an *accurate* estimate of the amount of marl dug in the state. But from data collected at many of the larger workings it is possible to give an approximate estimate of the quantity. The following statistics and prices were obtained during the progress of the survey. It must be remarked that they are incomplete, since in the majority of cases no records are kept.

The Squankum Marl Company sold in two months of year '64–'65 fifty thousand bushels to go south towards Tom's River. They sell at four cents per bushel at pits, or eight cents delivered along line of Raritan and Delaware Bay Railroad. It is probable that thirty thousand tons are taken annually from the several pits at Squankum. The price varies with the thickness of the bed as it is worked at the different points. In the ground it ranges from four to eleven cents per square foot.

From the pits about Marlboro an immense amount is yearly carted. It is estimated that thirty thousand tons are sold from the neighborhood at prices ranging from two cents to six cents per square foot in ground, or forty cents a ton dug out. One dealer has realized one thousand dollars from sales of marl in a single year. At Blue Ball Chas. Bennett sold in 1864 about six thousand tons; price three dollars per pit, averaging one hundred tons each.

At Perrineville probably five thousand tons are taken from the more extensive openings of Messrs. Mount, Perrine and Laird.

From Poke Hill, Burlington County, a considerable amount is carted to the adjoining county. Price five cents a square foot, or seven dollars per pit seven by fourteen feet.

Near Pemberton S. R. Gaskill sells large amounts—about fifteen thousand tons annually. Price forty cents a ton at pits.

Along Ash Run, Vincentown, about ten thousand tons of marl are dug each year. Chas. Austin sold in 1865 five thousand tons. Price forty cents a ton, or ten cents in ground.

West of Medford on Sharp's Run, Lawrence W. Jones sold in 1865 five thousand tons. Probably ten thousand tons are sold from all the pits along this stream. Price thirty-five cents a ton, or thirty-five dollars per square rod, dug out.

Near Marlton a very large amount of marl is dug by Messrs Brick, Sharp and others. It is said that twenty acres have been worked over on Samuel

NEW JERSEY GEOLOGICAL SURVEY

Brick's lands. He has sold one hundred and fifty square rods in one year, equivalent to fifteen thousand tons. Price ten dollars per square rod in ground, or from thirty-two to forty-four dollars pitted.

At White Horse about ten thousand tons are dug annually by Minor Rogers. Price fifty cents a ton at diggings.

Along Mantua creek an enormous amount of marl has been dug on lands of the Heritage family. It is estimated that at least five hundred thousand tons have been dug from borders of this stream. Thomas J. Heritage has sold four thousand tons in a year, not including that dug by the buyers. It sells at forty cents a ton:

During seven months of 1865 the West Jersey Marl and Transportation Company sold twenty-six thousand one hundred and eighty-seven tons at prices varying from six and a half cents to thirteen and a half cents per bushel, along railroad lines of West Jersey.

At Blackwoodtown, David E. Marshall sells annually about five thousand tons. Price fifty cents per ton. Top marls thirty-eight cents a ton.

Along Raccoon Creek, near Mullica Hill Gloucester County, Hon. N. T. Stratton's marl sales amount to from six hundred to one thousand dollars per annum. Price forty cents per ton. Near Harrisonville a great deal is dug. Alfred Lippincott has sold ten thousand tons in one winter season. Price twelve to thirteen dollars per square foot. Calcareous marl sells at forty cents per ton. In the Lower Bed John E. Turner has sold two thousand tons in one year. Price ten dollars per square rod. No statistics are at hand of that dug about Woodstown, Salem County. An idea of the amount may be got from the fact that at least twenty-five acres have been dug out along the several streams in that neighborhood. Average price is seventy-five cents a ton. Along Major's Run, Messrs. Atkinson and Lippincott dug two thousand tons in 1864, and sold at seventy cents a ton. At Marshallville Joseph Bassett sells about three thousand tons per annum.

Along a branch of Mannington Creek, the limestone of the Middle Bed has been extensively worked by Wm. Barber. Twenty thousand bushels of slaked lime was made in 1864. Putting together all the several estimates it is probable that the aggregate amount of marl dug in Monmouth County for transportation to the lands adjoining the region of marl outcrop, ranges from one hundred thousand to one hundred and fifty thousand tons per annum. Then there is used by farmers, who dig for their own farms, about five hundred thousand tons—making a sum total of over six hundred thousand tons in that county. In the other marl counties about two hundred thousand tons are sold for lands outside of marl districts, and probably two hundred thousand tons used at home—making four hundred thousand tons

NEW JERSEY GEOLOGICAL SURVEY

for these counties. For the whole State the aggregate is very near one million tons as the annual amount used.

The following article on the transportation and sale of marl by railroads, which mainly supply the country outside the marl region, was published at the close of 1867:

	BUSHELS.	TONS.
By the Squankum Marl Company	400,000	20,000
" Freehold and Jamesburg Agricultural R. R.	366,805	18,340
" Pemberton Marl Company	500,000	25,000
" Camden and Atlantic Railroad.	220,000	11,000
" West Jersey Marl Company	1,048,000	52,400

Prices of Marl.—The Squankum Marl Company deliver marl on the line of the Delaware and Raritan Bay Railroad, between Eatontown and Manchester, for 7½ cents a bushel, or $1.50 a ton; and at all other points on that road, as well as on board boats at Port Monmouth, for 8 cents a bushel, or $1.60 a ton. William E. Barrett, Farmingdale, Agent.

The price of Squankum Marl on board of cars at Freehold is 12 cents a bushel, or $2.40 a ton; and the Freehold and Jamesburg Agricultural Railroad Company deliver it at Bordentown, Trenton, and Millstone, at 5 cents a bushel advance; at New Brunswick, 4½ cents; Rocky Hill and South Amboy at 4¼ cents; and at all intermediate points along the railroads for lower prices, corresponding with the distances. I. S. Buckalew, Jamesburg, Superintendent.

The Pemberton Marl Company sells marl from the Middle Marl Bed, digging it near Birmingham, Burlington County. Their advertised prices, delivered by railroad, are: At Birmingham 80 cents a ton, of twenty bushels; at Mount Holly 95 cents; at Burlington $1 25; at Camden $1.70; Bordentown $1.90; South Amboy $3.00; Trenton $2.10; New Brunswick $2.90; Flemington $2.95; and at Belvidere $3.95 a ton. John S. Cook, Mount Holly, General Agent.

The White Horse marl is delivered along the line of the Camden and Atlantic Railroad for prices varying from about four cents a bushel upwards, according to distance. This marl is dug near White Horse Postoffice, Camden County.

The West Jersey Marl Company deliver marl by railroad at South Amboy for $3.50 a ton, of 20 bushels; New Brunswick $3.40; Trenton $2.65; Bordentown $2.45; Camden $1.70; Marlboro 90 cents; Bridgeton $1.85; Salem $2.00, and for corresponding prices at intermediate points, and on the road to Cape May. On the Delaware and Raritan Canal the freights are less than by railroad, and the prices are lower by from 30 to 50 cents a ton. I. C. Voorhees, of Woodbury, Agent.

During the present year, 1868, a marl company has been organized, and is now in operation for supplying marl along the line of the Pemberton and Hightstown Railroad, from pits near Hornerstown. And the Freehold and Squankum Marl Company has been organized for the transportation and sale of Squankum marl through all the northern portion of the state, and parts of the adjoining states. This company will be in full operation by the close of the year.

NEW JERSEY GEOLOGICAL SURVEY

A marl company, called the Burlington County Marl Company, to supply marl from the Upper Marl Bed, at Vincentown, is also preparing to work.

The Auburn Marl Company, in Salem County, is organized to dig marl from the Lower Marl Bed, on Oldman's Creek. They are not yet in operation, but expect to send out the marl in boats and sell at points along the Delaware Bay and river which are accessible.

There is a reasonable prospect that the marl trade of 1869 will be double that of 1867.

SECTION VII.

MARL DIGGING.

The Extraction of Marl from its Bed.

On account of the marl occurring in an earthy and not in a rocky form, and being overlaid by earth, it has not been, and probably will not be for a long time, obtained by any process like mining. Every method yet practiced requires that the overlying earth, *top-dirt*, should first be removed before the marl can be dug out. Where it occurs on hill-sides, the process is perfectly simple. The top-dirt is thrown off and the marl is then extracted just like earth or gravel. But the largest portion of marl is dug along brooks, in meadow-flats, and generally in broken ground, where the least damage will be done to farming land by the holes which are dug. In such cases, most of the work has to be done below the level of the water, and though the marl is so solid that water does not run through it, there is an abundance in the open strata immediately beneath, so that whenever the marl is dug to the bottom, water immediately comes in, and in the course of one night, will fill the hole to the top, and cause it to cave on the sides. The practice in all such cases is to have help enough to dig out a pit in one day. The top-dirt from over another pit is then thrown into this and the new one dug so as to leave a wall of solid marl about a foot thick between the old and new pits, so that water from the old one may not leak into the new while digging. In carrying on operations on a larger scale, it is necessary, in most places, to make special provision for removing the water as it accumulates, so that a single large pit may be kept open continually and worked from a perpendicular face, or by plowing and digging off the upper surface of the marl over the whole pit, and so working

NEW JERSEY GEOLOGICAL SURVEY

downwards gradually. Pumps worked by horse-power have been tried in a good many places and with tolerable success. Steam pumps for draining marl-pits are in use at Blue Ball, Monmouth County, and on Major's Run, in Salem County, and answer the purpose. The West Jersey Marl Company have a branch railroad connecting with the West Jersey railroad, near Barnsboro. Their track runs down into the bottom of their pit. The layer of green marl is fourteen or fifteen feet thick, and where they work it is almost entirely below the level of the stream. The marl is dug with a perpendicular breast, and the track being movable, is shifted so as to bring it within convenient distance for loading the marl directly into the cars. The loaded cars are moved by a locomotive, and everything is as conveniently arranged as possible. To remove the water from the pit, the company have a horse engine in operation, and many gallons of water are pumped out daily.

At the marl-bank of S. R. Gaskill & Sons, near Pemberton, the bed is worked in a thickness of twenty-two feet, and a drain carries off the water within five feet of the bottom. Their railroad connects with the Pemberton branch, and the track is laid five feet above the bottom of the bed. They uncover a strip of marl wide enough to work conveniently on the surface, and then shovel off the top into the cars, and gradually lower the whole strip. When they get too low for convenient shoveling into the cars, they hoist the marl by horse-power. There has been twenty thousand tons of marl taken out in this way during the past year, and if proper facilities for transportation had been ready, it might have been much increased. Fourteen thousand tons of this was sold on the line of the Burlington County Railroad.

On the Camden and Atlantic Railroad, at White Horse, Minor Rogers works his marl by an arrangement almost identical with that of Messrs. Gaskill. His pit was to be drained by a deep ditch running to the creek.

Quite a unique plan is undertaken by the Squankum Marl Company. Their marl is in the valley of a stream which runs into the Squan River. They own the Old Manassee mill, and use the dam and water to carry out their plan of operations. The whole of the ground they operate upon is laid under water. They have a large steam dredging machine which will float in two feet of water, and will excavate to a depth of twenty-six feet beneath the surface, and to a breadth of forty feet at the surface of the water, and will discharge the material excavated at a height of twelve feet above the water. A branch railroad connects with the Delaware and

NEW JERSEY GEOLOGICAL SURVEY

Raritan Bay Railroad at Lower Squankum. The track from this branch is laid along the margin of the pond, and the cars are brought up to be loaded directly from the excavator. In this way the water is to be made useful, instead of being a hindrance. The machine is floated to the place where it is required; it is then set to work removing the top-dirt, in the present working six feet deep, which is deposited in a bank along the margin of the pond. The track can then be brought up and the marl dug and dumped in the cars to be carried away. The work is very rapid; a ton of marl can be dug in a minute, and so powerful is the excavator that it gouges out the marl and deposits it in the cars as solid and almost as dry as when in the marl bed. Should this plan in its working equal the expectations of its projectors, it will be a great success. The machine, which costs about ten thousand dollars, is driven by a sixteen-horse engine, is operated by four men, and burns a cord of wood a day. When all is arranged it digs about a ton per minute, and can probably do half that for the day through, which would be three hundred tons deposited in the cars in ten hours. An allowance must be made from this for the stripping, which may amount to from a quarter to a third as much as the extraction of the marl.

The new companies all propose to run their railroad tracks directly into the pits, and to load from the banks by shoveling.

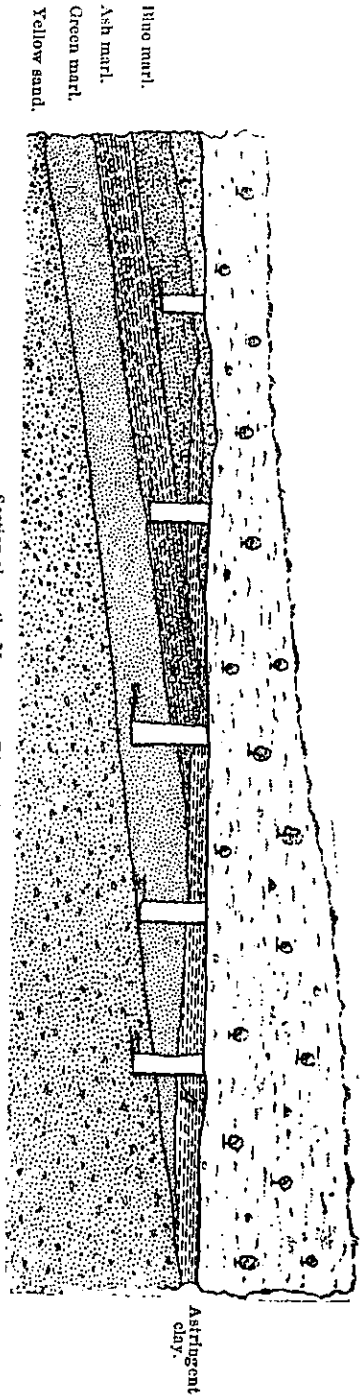
At Woodstown the Messrs. Dickinson Brothers dig marl very successfully by a floating dredging machine, operating under water like that of the Squankum Marl Company. They can take out a little more than a ton a minute, and by the day, from two hundred to two hundred and fifty tons, and require eight men to manage the machine and take the marl out of the way.

Every improvement by which these wet marls can be obtained more cheaply is a public benefit. The best marls will always be found below the natural drainage of the country, or at least where they have never drained out to dryness. There are inexhaustible quantities of marl in this condition in the State. The water in which they are immersed, and the earth by which they are covered, are the difficulties to be met in extracting them cheaply.

The opening of marl-pits for the purpose of getting large supplies of the best quality of marl, is a matter of much interest. The structure of the marl beds, including their thickness, dip and strike, and their remarkable uniformity all across the state, has been fully described in the detailed geology of the marl beds in Part I.

The following drawings of marl diggings (Figs. 90–93) along valleys which

NEW JERSEY GEOLOGICAL SURVEY

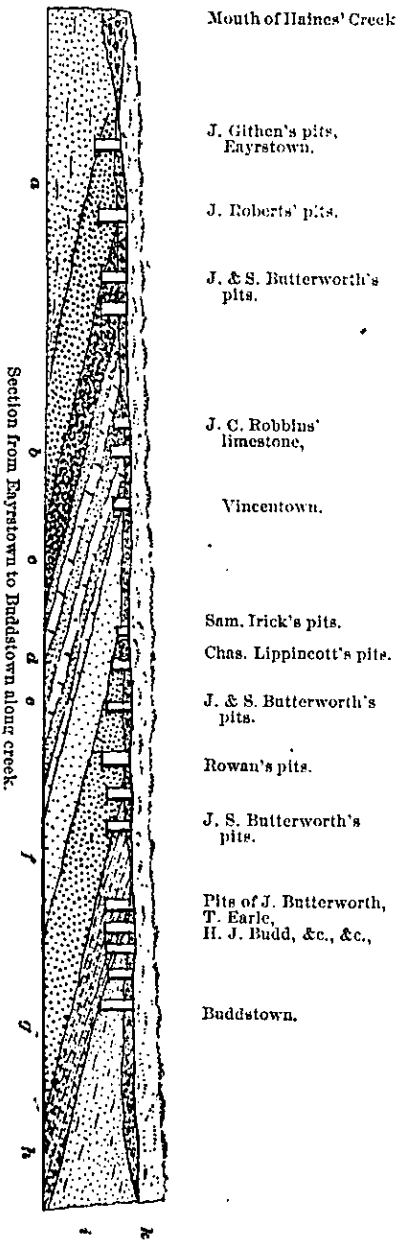


Section along the Manasquan River; looking South.

FIG. 90.

have a northwest and southeastern direction, were prepared to show the varieties of marl which are found in a series of marl-pits only a short distance from each other. For example, the section along Manasquan River is represented as looking southwest; and while the surface of the ground is nearly level, the dip of the marl beds causes them to descend rapidly beneath the surface. The right-hand opening passes through the astringent clay and the thin stratum of green marl into the yellow sand. The next pit, which is on the same level and of the same depth, passes through the same layer of astringent clay, and then almost through the green marl, but does not reach the yellow sand. The third pit, still on the same level and equally deep, passes through the astringent clay and a portion of the ash marl and then for a few feet into the green marl. The fourth pit is through the gravel, astringent clay, a little blue marl, and the remainder in ash marl; no green marl being met. The fifth pit passes through the top-earth, and then enters but does not go through the blue marl. The reason for finding such a variety in the different pits is apparent at a glance. This series of pits is found within a distance of two miles.

NEW JERSEY GEOLOGICAL SURVEY



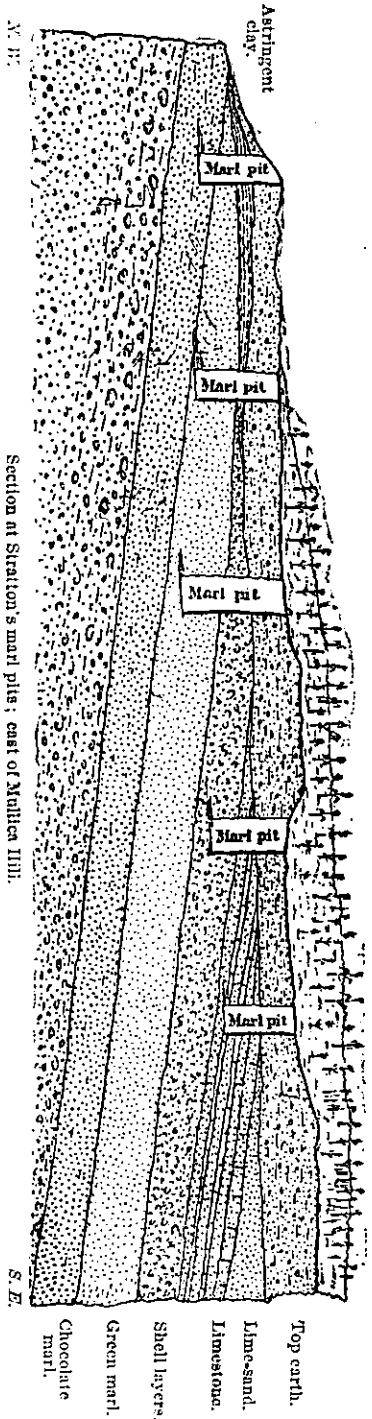
Section from Eayrstown to Buddstown along creek.

FIG. 91.

The section (Figure 91) along the creek from Eayrstown to Buddstown in Burlington County, passes across the Middle and Upper Marl Beds. The view is taken looking northeast. *a* is the red-sand; *b* is the green layer of the Middle Bed; *c* is the shell-layers; *d* and *e* the limestone and limesand of the same bed; *f* is the yellow sand; *g* the green marl of the Upper Bed; *h* the ash marl; *i* the overlying earth; and *k* the astringent, miocene clay. In this section, which represents a distance of nearly four miles, every variety of marl belonging to the Middle and Upper Marl Beds, is to be found; some of the pits being in the green marl of the Middle Bed; others in the shell-layers; others still entirely in the limestone and limesand of the same bed; while several others are in the green marl of the Upper Bed, and a few in the ash marl.

The section (Figure 92 on the page following), in Stratton's marl-pits, near Mullica Hill, Gloucester County, illustrates the same regularity of structure in the Middle Marl Bed. The view is taken looking northeast, and includes a distance of less than half a mile. Of the five pits selected, the left-hand one is in the green and chocolate marls; the second in the green marl above; the third in the shell-layers of the green marl; the fourth in the limestone, limesand, and shell-layers; and the fifth altogether in the limestone and limesand. The unconformable layers of astringent, miocene clay, and top-earth are cut through

NEW JERSEY GEOLOGICAL SURVEY



Section at Stratton's marl pits; east of Mullica Hill.

FIG. 92.

to reach the marls. From an examination of any of these sections it is plain that an abundance of any one of the varieties of marl can always be found if those searching for it choose to incur the trouble and expense of getting it out. It is apparent, too, that after knowing the position, dip and strike of the marl at any place, it is possible, by proper surveys with a compass and level, to determine how far the marl bed is beneath the surface at any other place, and to construct topographical maps which shall show exactly how much earth overlies the marl in any plot which is the subject of inquiry. The Cretaceous Map of the survey shows the location of marl beds in general, and furnishes the basis from which such detailed maps may be carried out; and will enable property-owners to satisfy themselves as to where available supplies of marl are to be had. And it is believed that information furnished in answer to inquiries made relating to this practical branch of the subject has already been of large pecuniary benefit to the new marl enterprises, and of saving to the whole farming community.

NEW JERSEY GEOLOGICAL SURVEY

SECTION VIII.

HISTORICAL NOTICE OF THE GREENSAND MARL AS A FERTILIZER.

The greensand marl was first used as a fertilizer in Monmouth County. The earliest use of it was in 1768, when an Irishman, employed in ditching a meadow on the farm of Peter Schenck (now of Obadiah C. Herbert), near Marlboro', threw out a substance which he called *marl*. It was spread over one and a half acres of a field, where its good effects were to be seen for many years afterwards. But this circumstance attracted no particular notice until 1811, when the farm came into the possession of John H. Smock. Then the superior fertility of the marled field led to another trial, and the proper commencement of the use of marl in that neighborhood. Previous to the latter date, however, marl was used on the farm of Cyrenius Van Mater (now Morford Taylor), in 1795. It was applied on a field east of the Holmdel road, and in the following year west of the same road on lands now owned by Lafayette Schenck. Mr. Van Mater's attention was called to it by his brother Hendrick, who had seen it used in England. It was dug along Hop Brook, on the farm of Hendrick Smock, a year or two afterwards, and came into quite general use in that neighborhood at the beginning of the present century. In Pleasant Valley it was discovered in digging a well on the farm of Phillip Holmes (now Wm. H. Sickles), and used on the land as a manure in 1802. Marl was first used by John B. Crawford, Holmdel township, in 1814; did not come into general use until 1817. Near Mount Pleasant marl was first used about the year 1816, by John Whitlock.

In Upper Freehold the Lower Marl Bed was first opened and the first marl dug in 1805, by Benjamin Woodward, on farm now owned by Nimrod Woodward. Near Jacobstown, Burlington County, the marl was dug in 1809 by — Rogers.

The American Journal of Science, Vol. 6, p. 237, contains an article from James Pierce, Esq., on the "Alluvial District of New Jersey, with remarks on the application of the rich marl of that region to agriculture." It was written in 1823, and he says that "six years since but one or two small beds of this valuable manure were known in this region (about Middletown), and but few experiments of its utility had been made. . . . . Marl is now extensively used and highly esteemed."

The above notes all refer to the Lower Marl Bed. At no point was it generally used previous to the beginning of this century. At that date, however, it began to be extensively worked.

NEW JERSEY GEOLOGICAL SURVEY

In the Upper Marl Bed the discoveries are of a more recent date, although there is considerable diversity of opinion respecting dates at particular localities. None go beyond 1820. Some pits are known to have been opened at Deal thirty years ago, and it is said that marl was dug on Jacob White's lands in 1827. The bed at Poplar was certainly worked in 1833, possibly a few years earlier than that time.

In vicinity of Shark River marl was first dug on farm of J. T. L. Tilton, according to one authority, nearly fifty years ago. The first notice of Squankum marl being used was in 1827. It was taken from pits of John B. Thorp (now of Thomas Windsor), by Aaron Chamberlain, of Blue Ball. It soon afterwards came into general use.

At Long Branch it is said that the yellow marl of the Middle Bed was used as long ago as 1819. In 1833 this bed was worked along Parker's Creek, Branchport.

About Eatontown marl has been used for thirty years. Geo. A. Corlies dug it on his farm in 1834. It is reported that marl was dug by Joseph Lafetra in 1830, and that it was the first dug about Eatontown. The same bed in Atlantic township was discovered on lands of Daniel Polhemus in 1832, in digging a ditch, wherein the greensand was found.

At Colt's Neck the marl of this bed has not been used longer than about fifteen years.

About Smithville and Burnt Tavern marl has been dug about twenty years.

In Millstone township marl of the Lower Bed came into notice in 1822. Having been unskillfully applied, its further use was abandoned, and it was not until 1842–3, that it was again tried from Wm. H. Mount's pits, Perrineville.

In Burlington County the Poke Hill marl has been used about thirty years; that of New Egypt, Ocean County, about the same length of time.

In the neighborhood of Pemberton it was discovered in digging a well. The material thrown out proved so valuable as a fertilizer, that it attracted attention, and soon began to be extensively used. This was in 1805, and on farm now owned by Wm. Budd, and in the Upper Marl Bed.

Near Vincentown the first use of marl was made in 1806–7, on farms of Daniel Peacock, John Butterworth, Asa Rogers, Joseph Hilliard and William Irick. This also in the Upper Bed. It came into general use about 1810.

First lime made from the yellow limestone of this formation was by Elijah B. Woolston, of Vincentown, in 1824.

In Salem County the Lower Bed was first opened on the lands of Joseph Bassett, Marshallsville, about thirty years ago. It was discovered in dig-

NEW JERSEY GEOLOGICAL SURVEY

ging a well. In the same county the Middle Bed has been worked for a longer period.

In vicinity of Woodstown first marl dug was on farm of Jonathan Riley, about 1826. He was induced to try it from reports received by him of its value and benefits in Monmouth County. This was earliest used in the county. About 1828 it began to be generally used. The above statements were obtained in the course of the survey from a number of individuals throughout the marl region.

NEW JERSEY GEOLOGICAL SURVEY

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FIRST ANNUAL REPORT

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OF THE

NEW JERSEY STATE

Agricultural Experiment Station

FOR THE YEAR

1880.

TRENTON, N. J.:
JOHN L. MURPHY, BOOK AND JOB PRINTER.
1880.

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EXCERPT

advanced to report on. The cows are fed nothing but ensilage and cotton seed meal, and yet there is no falling off in their flesh, and the flow of milk is fully kept up. With the conclusion of the experiment, and completion of the analyses and inquiries, some facts and figures may be presented which will help to show whether any and what advantages are to be derived from its use.

CRANBERRY SCALD OR ROT.

The first bulletin of the Station was upon the cranberry scald or rot. It is a subject which excited a great deal of interest among those engaged in growing this fruit. There are cranberry bogs in this State sufficient to produce an annual crop of 200,000 bushels or more. On account of this scald there is probably less than one-half that amount of good fruit gathered. Hence the importance of some inquiry into the cause and possible cure of this trouble. The bulletin was as follows:

On a recent visit to the farm of the late Chalkley Albertson, near Haddonfield, attention was called to a deposit of "poison marl." This marl destroyed all vegetation when applied in the ordinary way as a top dressing for crops. Yet piles of the marl which had been lying out and exposed to the weather for some years, were now covered with a luxuriant growth of cranberries. A visit to the locality showed the cranberry plants with the fruit still on them in April, and the plants healthy and vigorous. On digging into the earth on which they grew, it was found to be of a rusty red color for four or five inches down, and from that on downwards to be dark colored and almost black. It was composed mainly of sand with a very little loam in it. It had a strong inky taste, and was decidedly acid to the tongue as well as to chemical tests. Two samples of the earth were taken for analysis, one from near the surface in which the roots of the cranberry were growing, and the other from about thirteen inches beneath the surface, and below where any roots were seen. The analyses which were made only to find the amount of sulphate of iron in the earth, resulted as follows, viz.: Surface earth contains 0.038 per cent. sulphuric acid. Earth thirteen inches down contains 0.028 per cent. sulphuric acid. This acid is combined with iron, forming the common crystallized green vitriol, or copperas; what is known to chemists as proto-sulphate of iron and as ferrous-sulphate. The surface layer on an acre contains, in the first six inches of depth, 1875 pounds of this ferrous-sulphate, and the lower layer for the same area and thickness contains 1381 pounds of the same substance. It is quite certain that many of the bogs in which

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EXCERPT

cranberries thrive contain sulphate of iron, and it will be an interesting question, for this season, to ascertain whether all the good cranberry bogs are acid from the presence of that substance or from some organic acid. And also to ascertain whether those bogs where the cranberry fails most completely, are not lacking in this acid property.

A soil containing the smallest trace of acid will cause blue litmus paper, if moistened, to turn red the moment the paper touches it. [To those who wish to try the experiment, some of the litmus paper will be sent from the Station.] For the purpose of testing the fact as to whether sulphate of iron will cause the cranberry plants to grow more vigorously, it is recommended to make experiments. Take five pounds of sulphate of iron and dissolve it in one hundred gallons of water, and use this in repeated sprinklings on a square rod of cranberry bog. It may be that less than this will be sufficient, and one pound in twenty gallons of water may be used on a square rod, and this be repeated as often as it appears to be needed.

Several of the owners of cranberry bogs tried the copperas in the course of the Summer. In some cases it was applied in solution, as suggested, and in others it was simply pulverized and then sown in powder on the ground. The latter method was the least troublesome, and was thought to answer as well as the other. It did no harm to the growing vines, though in one case ten pounds were put upon a square rod, which is 1600 pounds to an acre. Its effect was very soon seen in the improved color and vigor of the vines, and it seemed to retard the appearance of the scald upon the fruit. In bogs where there were portions to which it was applied and others where it was not used, the comparison was easily seen and the conclusion verified. At the end of the season, however, the scald was found to be bad enough upon those plots where the copperas had been used. The experiments are not conclusive, though encouraging. They were not begun early, and this may be a cause for their partial failure, and it may be that repeated light applications may be needed.

Mr. N. L. Britton visited more than thirty different bogs from August 21st to August 28th. The few experiments made with copperas were then in progress and promised well. He tested the bogs and found that those free from scald were decidedly acid to test paper, and where the scald was worst the earth was very little acid—in some cases entirely neutral. He found very few places where there was any sulphate of iron in the bogs, and his conclusion was that the acidity was due to some organic acid in the muck. The reports were uniform that the copperas did destroy all the worms that infested the bogs, and destroyed the fruit.

Dr. T. F. Pruden, of Toms River, Sheriff Charles Holman, of Toms

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River, and E. W. Crane, Esq., of Caldwell, have all tried the copperas on their bogs in Ocean county, and their experience is well expressed in the following extract from a letter written by Dr. Pruden on the 27th of last December: "I do not think that copperas dissolved did any good, but where I sowed it I could see that the vines had a better color, deep green like myrtle leaves, and the fruit was in better condition in those spots than immediately surrounding it, in each of four places tried. I ordered a barrel each for five bogs, and intended to put some on each this Fall, but owing to the delay of its arrival have not as yet used it, but shall in the Spring immediately after the water is off. I have some spots sowed with it late in the Summer from which I could perceive no effect, but shall watch the next year. I intend to sow it about from 600 to 800 pounds to the acre, in sizes not larger than a cranberry, breaking up the large lumps."

A RASPBERRY DISEASE.

The second bulletin was upon this subject, and was as follows:

The Station has received from E. Williams, Esq., of Montclair, Essex county, specimens of raspberry canes which have been killed by some cause. He writes that the disease prevails over a wide extent of country; that it has entirely ruined some plantations, and its injurious effects are experienced in many others. The specimens were submitted to examination by the Camden Microscopical Society, and the following report has been received from them:

To the New Jersey Agricultural Experiment Station:

The following report gives the result of the examination of the raspberry canes, received from the director.

JOSEPH L. DELACOUR,
Secretary C. M. Society,

To the Microscopic Society of Camden:

The Committee on Botany, to whom was referred for examination the stems of Rubus, submits this report, as the result of the investigation:

The canes were found to have their epidermis ruptured in many places, the result of a growth of a fungus which had attacked them either during the Winter or in the early Spring months. In order to determine the species, one of the canes was submitted to J. B. Ellis, Newfield, N. J., a reliable authority on microscopic fungi. I have his reply as follows:

MAY 8th, 1880.

On receiving the stems of Rubus, I went and looked at my red raspberries, which were all killed to the ground last Winter, and I found the canes near the ground had the bark ruptured like your specimens. The trouble with my canes was the red rust (Uredo), which took the leaves off the middle of last Summer, thus enfeebling them so that they died before the middle of January. There was a fungus on one of your

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Acid Soil Supplement B

Excerpts from 1965 Water Control Guide for Suburban and Rural-Residential New Jersey and 1971 Soil Survey of Burlington County

EXCERPT

Circular 605

WATER CONTROL GUIDE for Suburban and Rural-Residential New Jersey

HUNTERDON COUNTY EXTENSION SERVICE
Extension Center - Route 31
R. D. 6. Box 48
Flemington, New Jersey 08822

New Jersey Agricultural Experiment Station
College of Agriculture and Environmental Science
Rutgers - The State University
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EXCERPT

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CONTENTS

Water and the Community 3
Methods of Control 4
Surface Control 4
Vegetal Cover 4
Detention Reservoirs 5
Grassed Waterways 5
Diversion Ditches 6
Open Ditches 6
Storm Sewers 6
Subsurface Control 6
Soils 7
Permeability 7
Water Table 8
Topography 9
Soil Properties Affecting System Design and Performance 10
Erodibility 10
Permeability 10
Chemical Properties 10
Influence of Soil Drainage on Plant Growth 10
Other Soil-Plant Relationships 10
National Cooperative Soil Survey Information 11
Determination of Runoff 12
Surface Water Hydrology 12
Cook's Method 12
The Rational Method 15
Drainage Runoff Curves 16
Design of Water Control Facilities 17
Detention Reservoirs 17
Grassed Waterways 17
Diversion Ditches 22
Open Ditches 22
Tile Drains 22
Storm Sewers 24
Culverts 24
Construction Specifications 24
Maintenance 24
Legal Aspects and Requirements 25
Statutory Law 25
Municipal Governing Bodies 26
Local and General Improvements 26
Sewers and Drains 26
Review of Plats and Official Maps 26
Waters and Watercourses 27
Municipal Zoning Powers 27
Municipal Planning Boards 27
County Boards of Chosen Freeholders 28
County Mosquito Extermination Commissions 28
County Planning Boards 28
State Division of Water Policy and Supply 28
Other State Agencies 29
Federal Government 29
Common Law 29
Water in Channels 29
Surface Waters 30
Additional Help and Information 30
References 31

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EXCERPT

Soil Properties Affecting System Design and Performance

Erodibility. Basically, the erodibility of a soil is determined by the ease with which the particles can be detached from the mass and be carried away by water or wind. The coarser the soil particles are, the easier they are to detach but the more difficult they are to transport. The finer the soil particles are, the more difficult they are to detach but the more easily they are transported. Consequently, medium textured soils with large amounts of fine sand and silt are the most susceptible to erosion.

This relationship holds true for a kind of subsurface erosion called piping. Piping is the washing out of fine materials along cracks or crevices and from spaces between coarser particles, leaving pipe-like channels. Piping can seriously affect the stability of a water-retaining structure.

Saturated fine sands are prone to sloughing in open cuts and to clogging tile lines underground.

The erodibility of the soil as well as its stability must be considered in designing all earth structures. Some control measures protect the soil from impact of raindrops or blasting by wind by providing a good cover. Other measures are designed to intercept the water or wind by barriers such as terraces or windbreaks. Still others lead the water away slowly to protected outlets. A good protective cover may consist of a tight vegetation, mulch for temporary protection, or paving. The latter of course increases rate and amount of runoff, whereas the other two measures reduce runoff.

Permeability. The choice of alternative drainage systems is dictated by the ability of the soil to transmit water to the tile or ditch. Slowly permeable soils, such as some silty clay loams, are drained best by providing for rapid removal of surface water. Water moves too slowly through such soils for tile drains to work properly. Tile drainage is feasible in moderately or rapidly permeable soils.

Conversely, the most suitable soils for reservoir pool areas are those with very slow permeability. Areas underlain by cavernous limestone are generally poorly suited as reservoir sites. It is difficult to find and plug all the leaks at such locations.

Chemical Properties. There are some wet, poorly drained soil layers and underlying geological strata that contain large amounts of sulphide and soluble iron. When exposed to air the sulphide-bearing material becomes very acid, rendering it corrosive to metal, destructive to concrete, and injurious to plants. Soluble iron in water can quickly plug drainage tile with a gel-like precipitate.

Influence of Soil Drainage on Plant Growth

The chief purpose of draining excess water out of the soil is to provide for adequate aeration; that is, to empty enough pores of water to allow for free circulation of air into and out of the soil. Movement of oxygen through any soil layer in which the pores are water-filled is too slow to satisfy the oxygen needs of the roots of most plants for satisfactory growth. Uptake of nutrients and water by plant roots and microorganisms is influenced by soil aeration. Poor aeration can result in the production of toxic amounts of certain substances in the soil. Thus, adequate drainage will increase the rooting depth of a soil and in turn will increase the amount of water and nutrients available for plant growth. Removing excess water will also allow the soil to warm up earlier in the spring.

Other Soil-Plant Relationships

In addition to drainage there are, of course, many other soil-plant relationships that are as important to suburban and rural residents as they are to the farmer.

As stated previously, a good vegetative cover is necessary to reduce erosion and siltation. Soil texture, structure, organic content, permeability, moisture-holding capacity, drainage or wetness, acidity, and fertility strongly affect the quality and density of cover. Topsoil usually has the best of these characteristics. The sale of topsoil and its removal from the site can result in poor lawns, reduced effectiveness of septic systems, unsightly erosion, and silting of drainageways and culverts. The last item can easily result in the backing up of storm water and flooding of basements.

It is possible to make a suitable plant-growing medium from some kinds of raw subsoil with proper liming, fertilization, and possibly the use of organic matter such as peat. This could be a long and costly procedure. In the meantime, much damage can occur because most subsoils are less fertile, less permeable, and more erodible than topsoils.

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SOIL SURVEY

Burlington County New Jersey



UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
NEW JERSEY AGRICULTURAL EXPERIMENT STATION
Issued October 1971

EXCERPTS

moderate glauconite content; some sandy loam layers are iron cemented.

The solum ranges from 20 to 40 inches in thickness. Rounded quartzose pebbles occur in some places, but normally they are not abundant.

In places the Ap horizon is black or very dark brown loam. In some areas the B horizon is sandy clay loam. Mottling is commonly distinct or prominent.

The C horizon normally consists of stratified sandy layers, but in places there are thin iron-cemented layers, and small areas are underlain by clay beds.

Keansburg soils are associated mostly with Shrewsbury, Adelphia, and Holmdel soils. Keansburg soils have a darker surface layer than Shrewsbury soils and are more gray than Adelphia and Holmdel soils. Keansburg soils resemble Pocomoke soils, except for the olive-gray B horizon and the glauconite that occur in the Keansburg soils.

Keansburg fine sandy loam (Ka).—Included with this soil in mapping are areas of loam or mucky loam, and small areas of loamy sand that are not extensive enough to map separately. The loam cannot be worked so quickly after a rain as the sandier soil. It is also subject to frost heave and possible surface ponding.

In considerable areas of this soil the ironstone has formed at a depth of 10 to 20 inches. Ironstone occurs in less than half of this soil. Where more than half of the area contains ironstone, it is mapped as Shrewsbury, ironstone variant. Where the cemented iron occurs at a depth of 24 inches, it does not affect farming so much as where it occurs at 10 inches. (Capability unit IIIw–25; woodland suitability group 3w2)

Keyport Series

The Keyport series consists of moderately well drained brownish soils that have a moderately fine or fine textured subsoil and that formed on clay beds. The clay beds are thick marine deposits containing variable amounts of glauconite. In many places the material has been redeposited. Slopes are as much as 25 percent in some places, but the nearly level to gently sloping soils in high positions are most extensive.

In a typical profile the surface layer is a dark grayish-brown loam about 10 inches thick. The dark yellowish-brown subsoil extends to a depth of about 38 inches. It is loam in the upper 6 inches and clay loam below, and there is mottling below a depth of 24 inches. The substratum is gray clay loam (fig. 12).

Keyport soils have a high available water capacity and are slowly permeable. When rainfall is heavy and not much water is used, excess water occurs in the surface layer and subsoil and in the sandy loam layers of the substratum where they are present. The water perches over the clayey material but does not saturate the soil. These soils crack widely when they dry, and they crust enough to reduce seed germination.

These soils are moderate in organic-matter content and in fertility. They warm slowly in spring and dry slowly after heavy rains. Because of the high available water capacity and slow permeability, few crops are irrigated. Except where lime has been added in large amounts, these soils are very strongly acid.

The native vegetation is a hardwood forest consisting of yellow-poplar, red oak, white oak, ash, beech, and hickory. The only native stands of rhododendron in the Coastal Plain grow on the abrupt, north-facing slopes of Keyport soils. A small area of Keyport loamy sand in the outer Coastal Plain supports a mixture of pines and oaks.



Figure 12.—**Profile of Keyport loam.**

In most places Keyport soils have been cleared for crops. The most common crops are small grains, corn, soybeans, hay, pasture, and tomatoes. Drainage is generally not good enough for fruit.

Typical profile of Keyport loam, 0 to 2 percent slopes, in a cultivated field a half mile northwest of Jacksonville:

Ap—0 to 10 inches, dark grayish-brown (10YR 4/2) loam; moderate, fine, granular structure; friable; glauconite content low; clear, smooth boundary; horizon 8 to 12 inches thick.

B1—10 to 16 inches, dark yellowish-brown (10YR 4/4) heavy loam; moderate, medium, subangular blocky structure; firm when moist, hard when dry, sticky and plastic when wet; thin discontinuous clay films on ped faces; glauconite content low; gradual, smooth boundary; horizon 2 to 8 inches thick.

B2t—16 to 24 inches, dark yellowish-brown (10YR 4/4) heavy clay loam, yellowish brown (10YR 5/8) when crushed; moderate, medium, subangular blocky structure; very firm when moist, very hard when dry, sticky and plastic when wet; thin clay films on ped faces; glauconite content low; gradual, smooth boundary; horizon 8 to 20 inches thick.

EXCERPTS

B3—24 to 38 inches, dark yellowish-brown (10YR 4/4) clay loam; common, medium, distinct mottles of gray (10YR 5/1); weak, medium, subangular blocky structure; firm when moist, hard when dry, sticky and plastic when wet; thin clay films on ped faces; glauconite content low; gradual, smooth boundary; horizon 8 to 18 inches thick.

C—38 to 60 inches, gray (10YR 5/1) clay loam, dark yellowish brown (10YR 4/4) when crushed; massive; firm when moist, sticky and plastic when wet; glauconite content low; abrupt, smooth boundary.

Keyport soils contain rounded quartzose pebbles and cobblestones in places. They are concentrated in the surface layer, but normally a few are in the horizons below. The solum ranges from 30 to 50 inches in thickness, but plant roots extend into the clayey underlying material.

Unplowed Keyport soils normally have a very dark A1 horizon about 4 inches thick and an A2 horizon of about the same thickness. When the soils are plowed, these horizons are destroyed and mixed with the upper part of the B1 horizon to make an Ap horizon. The Ap horizon is 2 or 3 in chroma.

The B horizon ranges from 10YR to 7.5YR in hue, is 4 or 5 in value, and ranges from 4 to 8 in chroma. It is yellowish brown or strong brown when crushed. In places mottling is more abundant, more prominent, and closer to the surface than in the typical profile. The B2t horizon ranges from heavy clay loam to clay. It has angular blocky structure where texture is fine (heavy) and subangular blocky structure where texture is coarser (light).

In places the C horizon contains 6 to 12 inches of sandy loam over underlying clay loam, silty clay, or clay beds. Water normally is transmitted laterally over the clayey substratum. Thin iron sheets form in the cracks in the clay beds in places. The clay beds also contain numerous nodules of iron pyrite that form sulphuric acid in solution.

Keyport soils are associated mostly with Donlonton, Holmdel, Freehold, Collington, and Sassafras soils. Keyport soils are not so gray as Donlonton soils. They are finer textured in the B horizon than the Holmdel, Freehold, Collington, and Sassafras soils.

Keyport loamy sand, 0 to 5 percent slopes (KeB).—This soil has a light yellowish-brown surface layer 16 inches thick. It is underlain by brownish-yellow (10YR 6/6) sandy clay and light-gray (2.5Y 7/2) clay that extends to a depth of about 5 feet. The upper few inches of the surface layer are bleached gray, as is common in the pine barrens. In other respects the profile of this soil is similar to that described as typical for the series.

This soil is in the outer Coastal Plain. It contains no glauconite, and all areas are forested with pitch pine and oak, as are the adjacent sandy soils. (Capability unit IIe–3; woodland suitability group 2w1)

Keyport fine sandy loam, 2 to 5 percent slopes (KfB).—This soil warms a little earlier in spring than Keyport loam, 0 to 2 percent slopes, and is more easily worked. It has a fine sandy loam surface layer but otherwise has a profile similar to that described as typical for the series.

This soil is suited to late planted vegetables such as tomatoes. On the longer slopes, the use of cover crops and stripcropping may be necessary to control erosion. Drainage is needed only on the ponded, more nearly level areas. Underdrains are satisfactory for draining local sandy pockets. Because the subsoil is so slowly permeable, underdrains generally work too slowly to be effective. (Capability unit IIe–2; woodland suitability group 2w1)

Keyport loam, 0 to 2 percent slopes (KlA).—This soil has the profile described as typical for the series. Included with this soil in mapping are small areas of Holmdel, Collington, and Sassafras soils. Also included are small areas of sandy loam.

Water is ponded in rounded depressions and on extensive flats. Well-spaced, shallow ditches can be used for draining these depressions if they are not too deep. The flats also need a bedding system to help dispose of perched surface water. Except where sandy pockets occur, underdrains generally are ineffective.

Alfalfa, small grains, and other crops that are on the soil through winter may be damaged by frost heave. Alfalfa is not easily grown on this soil; some spots are too wet, and others are severely damaged by frost heave. (Capability unit IIw–1; woodland suitability group 2w1)

Keyport loam, 2 to 5 percent slopes (KlB).—Runoff is moderate on this soil, and erosion is a hazard. This soil has a profile similar to that described as typical for the series. Included with this soil in mapping are small areas of Freehold, Collington, and Sassafras soils.

Stripcropping, contour farming, and cover crops are used to reduce the hazard of erosion. Drainage generally is needed only in small areas. Interceptor drains may be satisfactory in the sandier areas. Diversion terraces may be needed to collect surface runoff and divert it to grassed waterways. (Capability unit IIe–1; woodland suitability group 2w1)

Keyport loam, 5 to 10 percent slopes (KlC).—Runoff is moderately rapid on this soil, and erosion is a severe hazard. In some fields erosion has thinned the surface soil so much that normal plowing exposes the more yellow and more sticky subsoil. Except for the thinner surface layer, this soil has a profile similar to that described as typical for the series. Seeps occur on the lower part of long slopes.

Stripcropping, diversion terraces, and contour farming are used to reduce erosion in fields. Interceptor underdrains may be used to collect ground water in places. (Capability unit IIIe–1; woodland suitability group 2w1)

Keyport loam, 10 to 15 percent slopes (KlD).—Runoff is rapid, and erosion is a severe hazard on this soil. Eroded spots are common in fields. Except in the eroded spots, the profile of this soil is similar to that described as typical for the series. Included with this soil in mapping are some severely eroded areas of Keyport loam, 5 to 10 percent slopes.

Keyport loam, 10 to 15 percent slopes, is suited to small grain, hay, and pasture. Germination of seeds and growth of crops are slower on the eroded areas than on the uneroded areas. (Capability unit VIe–1; woodland suitability group 2w1)

Keyport loam, 15 to 25 percent slopes (KlE).—The surface layer of this soil is thinner than that in the profile described as typical for the Keyport series. Seeps occur on the lower parts of long slopes. Included with this soil in mapping are small areas of severely eroded soil that have slopes of 10 to 15 percent.

Because of the erosion hazard, a permanent cover is needed to keep erosion at a minimum. The cover may be pasture, trees, or plantings that provide food and

Wooded Pemberton soils normally have a very dark A1 horizon about 4 inches thick. In some places this is underlain by a bleached gray horizon 3 inches or less thick. When the soil is plowed, these two horizons are destroyed and mixed with some of the A2 horizon to make up the Ap layer.

The Ap horizon normally is 3 or 4 in value, but it ranges to 5 where there has been active soil blowing. It is 1 or 2 in chroma. The A2 horizon is 10YR or 2.5Y in hue, 5 or 6 in value, and ranges from 2 to 6 in chroma. The A2 horizon is mottled in the lower part in places. The A horizon has a minimum thickness of 20 inches.

The B horizon ranges from 10YR to 2.5Y in hue, is 4 or 5 in value, and ranges from 4 to 6 in chroma. Mottles vary widely in this horizon. They range from 10YR to 5Y in hue, from 4 to 6 in value, and from 2 to 8 in chroma.

The C horizon ranges from 1 to 4 in chroma and is mottled in places. It is stratified sand and loamy sand in most places, but sand is dominant.

Pemberton soils occur with Tinton soils on long narrow terraces on the south side of the major streams, such as Rancocas and Assiscunk Creeks. They also are associated with Freehold and Holmdel soils. Mottling in Pemberton soils distinguishes them from the Tinton soils. Pemberton soils have a thicker surface layer than the Freehold and Holmdel soils.

Pemberton sand, 0 to 5 percent slopes (PbA).—This soil is subject to soil blowing because much of the sand is fine. It has the profile described as typical for the series. Included with this soil in mapping are areas of Pemberton soil that have a thick surface layer and of Tinton, Holmdel, and Freehold soils. Also included are areas of loamy sand.

Where it has been drained, this soil is suited to irrigated vegetables. Extensive exposed areas need to be protected against soil blowing by the use of windbreaks, cover crops, or windstrips. (Capability unit IIIw–15; woodland suitability group 3s1)

Pemberton sand, thick surface, 0 to 5 percent slopes (PcA).—The surface layer of this soil is at least 30 inches thick. Average thickness is 35 inches. The subsoil is about 14 inches thick. Except for the thickness of the surface layer, this soil has a profile similar to that described as typical for the series. Included with this soil in mapping are areas of Pemberton sand and of Tinton, Holmdel, and Freehold soils.

This soil is not suited to crops, even when irrigated. Fertility is very low and cannot easily be improved. This soil needs very frequent irrigation when used for crops, and it is subject to soil blowing.

This soil is suitable for use as woodland and for growing food and cover for wildlife. It is especially suited to the deep-rooted perennial plants. (Capability unit IIIw–16; woodland suitability group 3s1)

Pits

This land type consists of pits opened to excavate sand and gravel or clay and marl.

Pits, sand and gravel (Pt).—These pits, ranging from 4 to 20 feet in depth, were opened to excavate sand, gravel, and borrow material. Both sand and gravel have been taken from some of them. Most pits are at the tops of knolls, and the material is taken from them by loaders and trucks. Where the pits are in low places and extend below the water table, the material is taken by hydraulic pumps. After excavation was completed, some pits were converted to swimming areas. Olympia Lakes and Pemberton Lakes are examples.

A number of pits adjacent to the New Jersey Turnpike and Garden State Parkway were opened to obtain fill material for constructing the two roadways. Since sandy areas generally were selected, the borrow areas are similar to the sand and gravel pits. They are, however, more likely to be underlain by clay beds.

Sand is more abundant than gravel in this mapping unit. It has many uses in building, industry, and the making of soil-cement. Gravel is most abundant where the material has been deposited by glacial melt waters. Along the Delaware River a deposit of pebbles, cobblestones, and boulders below the soil at about sea level is called stratified drift. Much of this material consists of shale, sandstone, gneiss, and diabase.

Permeability is rapid, and available water capacity and fertility are very low. Organic-matter content is low, and added fertilizers leach readily. This land is extremely acid. Large exposed areas are subject to soil blowing.

Areas in the higher positions are suited to pine trees, though growth is slow at first. They are also suitable for wildlife habitats. (Capability and woodland suitability unclassified)

Pits, clay and marl (Pu).—This land consists of pits excavated for clay and marl. The clay was excavated primarily to make bricks, and the marl was used as a fertilizer. The source of the material was the Merchantville, Woodbury, and Hornerstown Formations. These formations contain iron pyrite, which can form sulfuric acid. In places ponds in these clay pits are so acid that fish cannot reproduce (fig. 20).

Abandoned clay pits normally have abrupt vertical side slopes, but some have been smoothed. Revegetation of these slopes is slow, partly because extreme acidity and severe frost heaving prevent most plants from living through the first winter.



Figure 20.—**In places, ponds in abandoned clay pits are extremely acid.**

EXCERPTS

The marl pits were excavated between 1850 and 1900 and are now all abandoned. Nearly all areas are overgrown with sweetgum, yellow-poplar, hickory, and many other trees and shrubs. The walls of the pits have become gently sloping, and only a few areas still contain water. The underlying beds are almost neutral and are very productive when stocked with fish.

Neither clay nor marl pits are suited to crops or pasture. They are suitable as sites for dug ponds and have moderate limitations as woodland and as wildlife habitats. The pits receive much runoff from the slopes above, and they are slowly permeable. Where they are smoothed and graded for paving, a frost-free surface application is needed to prevent frost heaving. (Capability and woodland suitability unclassified)

Pocomoke Series

The Pocomoke series consists of very poorly drained soils that have a very dark fine sandy loam surface layer. These soils formed in very low positions where they receive much runoff from the slopes above, or they are on extensive flats that lack deep natural drainage. In Burlington County they are formed in water-laid materials that were mostly redeposited by glacial melt waters.

In a typical profile, the surface layer is black fine sandy loam about 10 inches thick and the subsurface layer is light-gray fine sandy loam about 5 inches thick. The subsoil, about 13 inches thick, is gray fine sandy loam mottled with yellowish brown. It overlies a layer of light-gray stratified sand and gravelly sand that extends to a depth of 5 or more feet.

In their natural state, Pocomoke soils are saturated 8 to 10 months of the year, and they have a high water table. Late in winter the water is at the surface, or it is ponded. In summer it drops to a depth of about 2 feet. Where they are drained, these soils have a moderately high available water capacity. The subsoil is moderately permeable. Because they are gently sloping and occur in low positions, Pocomoke soils drain slowly. These soils are high in organic-matter content.

The native vegetation is a hardwood forest consisting of pin oak, willow oak, southern red oak, swamp white oak, sweetgum, blackgum, holly, and red maple. The dense understory consists of sweet pepperbush, highbush blueberry, sheep laurel, bayberry, and greenbrier.

If adequately drained, Pocomoke soils are suited to soybeans, corn, small grains, late vegetables, blueberries, hay, and pasture. They are not suited to fruit, alfalfa, or asparagus.

These soils are moderately fertile, and added fertilizers do not leach readily. Because they are very strongly acid, they require frequent additions of lime. They warm late in spring and become wet early in fall, even where drainage is provided. Heavy rains are likely to cause ponding. In places Pocomoke soils occur in frost pockets. The water table can be lowered by open ditches or underdrains. In places. however, drainage outlets are difficult to find or expensive to install and maintain. These soils are well suited as sites of dug ponds.

Typical profile of Pocomoke fine sandy loam in a cultivated field about a half mile southwest of Tabernacle School:

Ap—0 to 10 inches, black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) when dry; weak, medium, granular structure; very friable, nonsticky when wet; abrupt, smooth boundary; horizon 8 to 12 inches thick.

A2g—10 to 15 inches, light-gray (10YR 6/1) fine sandy loam; common, medium, faint mottles of yellowish brown (10YR 5/4) and white (10YR 8/2); weak, medium, granular structure; very friable; sand grains clean; gradual, wavy boundary; horizon 0 to 6 inches thick.

B2tg—15 to 28 inches, gray (5Y 5/1) heavy fine sandy loam, light gray (5Y 7/1) when dry; many medium to coarse, prominent mottles of yellowish brown (10YR 5/6) diminishing in number and size with increased depth; moderate, medium and coarse, subangular blocky structure that tends to be thick and platy; friable, slightly sticky and slightly plastic when wet; few fine pores; sand grains weakly bridged, thin discontinuous clay films in root channels; about 5 percent is rounded quartzose pebbles; abrupt, wavy boundary; horizon 10 to 24 inches thick.

IICg—28 to 60 inches, alternating layers of light-gray (10YR 7/1) sand and gravelly sand and yellowish-brown (10YR 5/4) sandy loam; single grain or massive; loose or very friable.

The solum ranges from 20 to 40 inches in thickness. Rounded quartzose pebbles generally are not abundant in any horizon. They are most abundant in the C horizon, but they occur in the A and B horizons in places.

In places the Ap horizon is sandy loam. The Ap horizon is 2 or 3 in value and 1 or 2 in chroma. The dark surface layer generally is less than 10 inches thick, but it is as much as 14 inches thick in places.

The B horizon is sandy clay loam in places in the inner Coastal Plain. The C horizon generally includes strata of more than one texture, and the finest of these materials controls permeability.

Pocomoke soils are associated mostly with Fallsington, Pasquotank, and Woodstown soils. Pocomoke soils have a darker A horizon than any of these associated soils, and they are grayer than the Woodstown soils. Sands in the Pocomoke soils are not so consistently fine as in the Pasquotank soils. Pocomoke soils resemble Keansburg soils but generally do not occur with them. Pocomoke soils lack the olive-gray colors and the glauconite common in the Keansburg soils.

Pocomoke fine sandy loam (Pv).—This soil has the profile described as typical for the series. Included with this soil in mapping are areas of Fallsington and Pasquotank soils and small areas of Woodstown soils. Also included, along the north side of North Branch Rancocas Creek east of Pemberton, is a large area that is subject to flooding.

Deep drainage, carefully installed and maintained, is needed if this soil is to be farmed successfully. Open ditches or underdrains can be used to lower the water table. (Capability unit IIIw–24; woodland suitability group 3w2)

Sandy Land, Ironstone

Sandy land, ironstone (Se) consists of about 2 feet of sand over discontinuous ironstone layers ½ to 2 feet thick. Slopes generally are 5 to 15 percent, but in some places are more than 15 percent. The ironstone occurs in about 60 to 70 percent of the area. Because the ironstone formerly was quarried extensively, the soil ma-

EXCERPTS

Acid Soil Supplement C

Examples of 1975-1983 project documents and correspondence

The list of these examples below is followed by their text.

(U.S. Army Engineer New York District, 1975)

> The November 1975 Draft Environmental Statement (excerpts) prepared by the U.S. Army Engineer New York District about its proposed flood control project for Pine Brook (widening and deepening of approximately 6000 feet) in Manalapan Township.

(Bellard, 1975)

> November 16, 1976 letter from Chester F. Bellard, Soil Conservation Service (SCS, now NRCS) State Conservationist, to F. Howard Zahn, Chief, Bureau of Environmental Analysis, New Jersey Department of Transportation (NJDOT) about proposed completion of Route I-295 in Gloucester County.

(Decter, 1977)

> March 30, 1977 letter to Lawrence Schmidt, Office of Environmental Review, NJDEP from Stephen A. Decter, Assistant Research Professor, Rutgers University about proposed NJDOT Route I-195 crossings of the Manasquan River at Squankum in Monmouth County.

(Toth, 1978)

> February 27, 1978 letter from Stephen J. Toth, Professor of Soil Colloids, Rutgers University to Donald J. Kroeck, Supervising Engineer, Bureau of Water Supply Planning and Management, NJDEP about NJDOT and acid soils.

(Schmidt, 1978)

> June 14, 1978 letter (excerpts) from Lawrence Schmidt, Chief, Office of Environmental Review, NJDEP to Colonel Clark H. Benn, District Engineer, Corps of Engineers about the Corps' proposed flood control project for Pine Brook.

(Miller, 1978)

> October 20, 1978 letter from Judith H. Miller, Review Coordinator, NJDEP to A. J. Weiss, Chief, Engineering Division, New York District, U.S. Army Corps of Engineers about the Corps' proposed Pine Brook dredging and channelization project.

(Descenza, 1979)

February 6, 1979 letter about this Pine Brook project from P. A. Descenza, Chief, Engineering Division, New York District, U.S. Army Corps of Engineers to Charles H. Parkell, Review Coordinator, Division of Water Resources, NJDEP.

(Hofman, 1979a)

April 2, 1979 letter about this Pine Brook project from Dirk C. Hofman, Acting Director, Division of Water Resources, NJDEP to Richard Maraldo, Chief, Civil Projects Management Branch, New York District, U.S. Army Corps of Engineers.

(Hofman, 1979b)

May 8, 1979 letter about this Pine Brook project from Acting Director Hofman to the Honorable James J. Howard, Congressman.

(Sonnenblick, 1979; Toth, 1979)

July 17, 1979 letter about this Pine Brook project from Gerald N. Sonnenblick, Manalapan Township Attorney to Charles Rooney, U.S. Army Corps of Engineers forwarding a July 11, 1979 letter to Mr. Sonnenblick from Stephen J. Toth, Professor of Soils, Rutgers University.

(Descenza, 1980)

January 8, 1980 letter about this Pine Brook project from P. A. Descenza, Chief, Engineering Division, New York District, U.S. Army Corps of Engineers to Charles H. Parkell, Division of Water Resources, NJDEP.

(Hofman, 1980)

July 23, 1980 letter about this Pine Brook project to Chief Descenza from Dirk C. Hofman, Deputy Director, Division of Water Resources, NJDEP.

(Campbell, 1980)

September 2, 1980 letter from Plater T. Campbell, State Conservationist, SCS, to the Bureau of Environmental Analysis, NJDOT about the NJDOT I-295 highway widening project in Gloucester County.

(Descenza, 1981?)

Letter about the proposed Pine Brook dredging and channelization project sent sometime after September 1981 (the date on the examined copy of the letter is unclear) from P. A. Descenza, Chief, Engineering Division, New York District, U.S. Army Corps of Engineers to Dirk C. Hofman, Deputy Director, Division of Water Resources, NJDEP.

(Farry, 1983)

October 27, 1983 letter from James E. Farry, P.E., Schoor, De Palma & Gillen, Inc. to Rick Reilly, Division of Water Resources, NJDEP about a Western Monmouth Utilities Authority (WMUA)

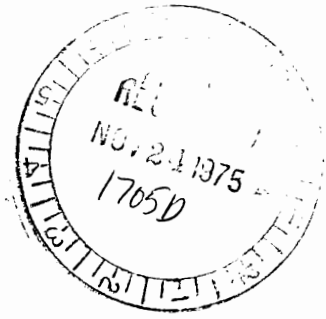
application for an NJDEP stream encroachment permit for slope stabilization of the same Pine Brook.

The U.S. Army Engineer New York District (1975) excerpts were extracted from a PDF downloaded from the Google Books website in November 2019.

The Bellard (1975) and Campbell (1980) correspondence was extracted from a PDF, downloaded from the Google Books website in November 2019, of a 1982 Draft Environmental Impact Statement, prepared by the Federal Highway Administration and NJDOT, for upgrading Interstate 295 in Gloucester County (from Hessian Avenue to Repaupo Road).

All other correspondence listed above was scanned by William Minervini from photocopies provided by NJDEP in response to his request under the Open Public Records Act. (This correspondence was part of a file he created while working with others at NJDEP on acid soil matters in the early 1980s.)

DRAFT ENVIRONMENTAL STATEMENT



FLOOD CONTROL PROJECT
FOR
PINE BROOK, MANALAPAN TOWNSHIP
BOROUGH OF ENGLISHTOWN
NEW JERSEY

NEPA COLLECTION
Transportation Library
Northwestern University Library
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U.S. ARMY ENGINEER DISTRICT, NEW YORK, NEW YORK
November 1975

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ACID RELATED EXCERPTS

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SUMMARY

FLOOD CONTROL PROJECT
PINE BROOK - MANALAPAN TOWNSHIP
ENGLISHTOWN, NEW JERSEY

(x) Draft Environmental Statement ( ) Final Environmental Statement

Responsible Office: U.S. Army Engineer District
26 Federal Plaza
New York, New York 10007
Tel. (212) 264-4663

1. Name of Action: ( ) Administrative (x) Legislative

2. Description of Action: The recommended plan of flood protection is channel modification consisting of widening and deepening of approximately 6000 ft. of the Pine Brook. The newly straightened channel would extend from the vicinity of the Pension Rd. Bridge to 700 ft. upstream of Winthrop Drive Bridge. The channel, after project completion, would have an average bottom width of 15ft. and a depth of 7ft. The channel would be designed to handle the discharge from a storm that would occur with a frequency of once in 100 years. The discharge from such a storm would be 1,575 cubic ft/second. The project life would be 50 years.

3a. Environmental Impacts: The proposed plan would alter the natural environment by affecting the natural stream, wildlife, aesthetic values, and land and materials utilization. The protective works would produce monetary benefits by reducing flood damages and property losses and enhancing land values. There would also be a reduction of hazards to life and health.

3b. Adverse Environmental Impacts: Temporary adverse impacts associated with construction include increased noise, dust and fumes, traffic disruptions and increased sedimentation and turbidity. Impacts of a more permanent nature include removal of vegetation, some loss of wildlife and wildlife habitat and the change of aesthetics to a modified appearance of the stream and land due to the presence of structural works.

4. Alternatives: Other plans considered by themselves or in combination include non-struuctural methods such as evacuation of the floodplain, floodproofing and floodplain management regulations. Structural solutions included levees and floodwalls along with a "no action" alternative.

5. Comments Requested:

a. Federal Agencies

Environmental Protection Agency, Region II
Department of Interior
Department of Agriculture
Federal Power Commission
Department of Transportation
Department of Health, Education and Welfare

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from the Winthrop Drive bridge to a point approximately 600' upstream. Sand and gravel bars have developed upstream of the Winthrop Drive bridge. The stream banks are stabilized.

e. Winthrop Drive to Pension Road.

The above mentioned channel with stabilized banks continues for an additional 300'. At this point a new channel has been constructed recently through another development. The banks of the new channel are raw and silt and gravel bars have developed in the channel. The brook is then left undisturbed to a point approximately 300' east of the Pension Road bridge. At this point channelization has recently taken place. Here again the banks are somewhat barren.

f. Pension Road to Matchaponix Brook.

The major portion of the channel and its banks through this area have been disturbed. Accelerated erosion is evident along the banks and the adjacent area. Trash and litter from the Englishtown Market creates an extremely ugly appearance along the brook. The Pine Brook Sewage Plant, opposite the Englishtown Market, dumps its effluent into Pine Brook near the confluence of the Matchaponix Brook. A trunk sewer line runs parallel and south of Pine Brook through this section. The water in this area is an opaque grayish-green with a putrid odor emanating from it. In addition, some of the rocks are coated with a black material.

2.03. Soil Conditions. The soil types found immediately adjacent to the Pine Brook are classifed by the Engineering Soils Survey of New Jersey (Rutgers Univ., 1955) as AR/Z, which are recent alluvium deposits essentially horizontally stratified. Adjacent and outside the immediate stream channel area, the soils are classifed as MV-47 which are composed of silty sands, sandy silts, silt and clay sands. These soils all have poor drainage characteristics because of their low permeability properties (See Table 2).

Mineral acid clay formations, which are high in iron and aluminum are found at various depths throughout northern and western Monmouth County. The acidity is generally caused by a pyrite content. This material forms sulphuric acid when exposed to air. Pyrite has been reported in the following formations: Woodbury, Englishtown, Wenonah, and Marshalltown.

At present, Pine Brook waters have a pH of about 4.0. This acid condition may be aggraviated as a result of acid soil exposure in the watershed. Where extreme amounts of acid material has been exposed pH readings have been less than 2.5 (Dept. of Agriculture, 1974).

With regard to this acid condition, site inspections were made by the Corps of Engineers during January and March of 1975. The water was observed to be clear, however the stream bed was composed of a rust colored material. In many areas, the stream bed contained shoals of rust colored deposits. These are thought to contain iron. Six bottom soil samples were taken by probe at various points along the stream between the Winthop Drive Bridge and the Pine Brook Municipal Sewage Treatment facility (Fig. 5). The pH of the water-soil mixture was taken and the results are shown in Table 3.

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TABLE 3

Sample No.	Depth (ft.)	pH, 10% Slurry	pH of Wet Solids	Acid (mg/kg)
1	0-1.5	5.39		
2	0-2.0	5.54	5.0	550 Sulfuric
3	2.5-4.0	6.32		
4	0-1.5	5.35		
5	0-3.0	4.03	3.4	710 Sulfuric
6	0-3.5	4.52		

As can be seen all samples taken indicate an acid condition (pH 7.0) ranging from 6.32 to 4.03. At the time that these samples were taken with calm wind conditions prevailed and a sulphurous odor in the air could easily be detected near the stream.

2.04. Vegetation. Although the Pine Brook area shown in figure 2 is lightly to moderately developed, much natural parkland still remains, particularly upstream of the Pease Road Bridge. In the western section, (Pension Road Bridge to the beginning of the housing development) just north of the Brook, heavy, deciduous woods of great density are present. Upstream however, through the housing development, much of the area is lawned over, leaving only a narrow strip of trees and brush along the stream itself (Ryan, R., 1974).

The predominant tree species found in the Pine Brook area include the following: sweetgum, sassafras, red maple, black sherry, pin oak, river birch, shagbark hickory, and black locust. The predominant shrubs and vines of the area include the following: Virginia creeper, pepperbush, grape, blackberries, blueberries, milkweed, swamp azalea, catbriar, winterberry, and elderberry. In addition to the trees, shrubs, and vines mentioned above, several varieties of ferns, mosses and grasses are found in this area. A more complete listing of plant species is included in Appendix A.

2.05. Wildlife. Over 100 species of Amphibians, Reptiles, Birds and Mammals, are believed to inhabit the Pine Brook project area. Much of the wildlife in the area utilizes the woodland found between Pension Road and the housing development, as most species originally present further upstream have been eliminated due to the housing. A brief listing of the predominant species is presented below. The listing contained here, and the more extensive listing which appears in Appendix A, was prepared with the assistance of Mr. R. Ryan, Director of the Turtle Back Zoo of W. Orange, New Jersey.

2.06. Amphibians. The predominant amphibians which probably inhabit the proposed project area include the following: American Toad, Wood Frog, Green Frog, and Spring Peeper. (See Appendix A).

2.07. Reptiles. The predominant reptiles which probably inhabit the proposed project area include the following: Eastern Box Turtle, Common Snapping Turtle, Eastern Painted Turtle, Eastern Garter Snake, Northern Black Racer, Smooth Green Snake, and Northern Water Snake (See Appendix A).

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2.08. Birds. There are a large number of birds, including waterfowl, which inhabit Monmouth County. Although developmental pressures have resulted in losses of suitable habitat and food supply within the proposed project area, sufficient parkland still remains in areas adjacent to Pine Brook and in the upstream portion, to support many resident species, as well as provide attractive resting spots for migrating or wintering species. Many of these species are heavily dependent on woodland habitat and/or vegetative resources adjacent to the stream. A brief listing of the species present is provided below:

Green Heron, Mallard, Redtailed Hawk, American Kestrel, Bobwhite, Rock Dove, Yellow-billed Cuckoo, Screech Owl, Barred Owl, Whip-poor-will, Common Nighthawk, Belted Kingfisher, Downy Woodpecker, Wood Thrush, Veery, Solitary Vireo, Yellow Warbler, Ovenbird, House Sparrow, Northern Oriole, Rusty Blackbird, Cardinal, Purple Finch, Field Sparrow, and Song Sparrow (See Appendix A).

2.09. Mammals. Approximately 36 different species of large as well as small mammals inhabit the proposed Pine Brook project area and vicinity. A partial listing follows:

Oppossum, Masked Shrew, Smoky Shrew, Eastern Mole, Starnose Mole, Keen Bat, Little Brown Bat, Silver-haired Bat, Eastern Pipistrel, Red Bat, and Raccoon. (See Appendix A).

2.10. Fish. Due to the acidic condition found in the waters of Pine Brook (pH 4.0-4.5), it is deemed unlikely, under present conditions, that any significant amount of aquatic life could exist in the stream (U.S. Dept. of Interior). The only possible exception, may be the presence of the mud minnow (N.J. Dept. of Env. Protection), which could tolerate these low pH conditions. In addition, during site visits made by the U.S. Army Corps of Engineers during January, March and June 1975, no aquatic life was observed (See Fig. 6).

Downstream of the Pine Brook there is significant aquatic life present (N.J.D. E.P.). In Matchaponix Brook, for example, Mud Minnow, Grass Pickerel and American Eel exist. Also, Dubernal Lake located approximately 6 miles north of the Matchaponix-Pine Brook junction in Old Bridge, Middlesex County, is an important recreational area and contains the following species of fish: Largemouth Bass, Smallmouth Bass, Yellow Perch, Pumpkinseed Sunfish, Black Crappie, Eastern Pickerel and Grass Pickerel.

2.11. Historical and Archeological Sites. Consultation with the National Register of Historic Places and coordination with the U.S. Department of the Interior, National Park Service and the N.J. Department of Environmental Protection, Historic Sites Section has indicated that presently there are no existing, proposed, or known potential units of the National Park System, or any known historic, natural or environmental education sites eligible for the National Landmark Program within the proposed project site. However, there is the General David Foreman House located off Pine Brook Road, between Route 9 and Englishtown at approximately 4,000 feet distant from the Brook itself. This building is listed in the State Historic Preservation Plan, Inventory, June, 1973 and is a potential candidate for the National Landmarks Program. This property will be avoided should the proposed project be implemented. In addition, an inquiry was made of Dr. Lorraine E. Williams of the Bureau of Archaeology, N. J. State Museum as to the presence of archaeological sites in the area. She indicated that there are no known records of existing archaeological resources in the area.

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A loss to the tax base of the community would occur as a result of the maintenance easements that are to be removed from the tax rolls for the 50 year life of the project. This loss of revenue to the community may be partialy offset by land enhancement benefits.

Damages that would normally occur as a result of flooding would be reduced for the 50 year life of the project. These savings could be used by individuals, business interests and government agencies for improvement of their respective properties and facilities instead of for flood fighting and restoring normal conditions after each damaging flood. The estimated non-Federal average annual charges for maintenance would be about $2,600.

4.06. Geology. The proposed project would not affect major topographic features in the area. During the detailed design of the project, subsurface explorations would be made and these data will be used for a more adequate determination of the projects impact on geology. Construction would naturally have temporary adverse effects associated with it during the channelization process. Most construction scars, however, should heal in a year or two as regrowth of vegetation takes place. A long-term change would be that the natural aspect of the meandering stream is to be exchanged for a straightened channel in order to efficiently move water away from the affected area.

4.07. Soils. There is a possibility that the proposed project may expose acid-laden clay deposits during construction and thereby further lower the pH of Pine Brook and of waters downstream of the project site. While this occurrence does not seem likely, the Corps will implement protective measures to insure that these effects are minimized (See paragraph 4.10).

4.08. Sedimentation. The question of sedimentation is, of course, related to the geology of the basin and stream characteristics. However, certain generalities can be stated about the changes in sedimentation induced by channel modifications. When the slope of a channel is increased during the channelization process, a change is induced in the stream's capacity for carrying sediments if the width remains constant. However, channel modifications usually involve widening in addition to increasing the side slopes. This enables storm runoff and sediments to be carried downstream at a faster rate and therefore flooding at any one point is less likely to occur. The stream velocity could be reduced somewhat if the channel was also deepened. However, increases in bottom velocity of the stream permits scouring to take place. If the channel is designed so that this scouring does not occur, then at some critically low velocity downstream a deposit of silt would accumulate and begin to build upstream from its initial point of occurrence. Such a siltation problem would make it mandatory that maintenance be carried out on a regular basis. A stream channel in its natural state seeks to achieve a minimum expenditure of energy but a newly modified channel cannot adjust rapidly to a change in sediment load and changes in both depth and velocity can occur.

At the present stage of investigation on the Pine Brook, it is not possible to accurately predict the degree of siltation following construction. However, as a precautionary measure to limit siltation downstream of the construction site (Matchaponix Brook, South River), a silt screen barrier will be utilized during the channelization process that will confine 80 to 90 percent of suspended materials. In addition, following cessation of construction activities, side slopes will be vegetatively stabilized to further reduce project siltation.

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Although the present bottom found in many portions of the steambed would be disturbed and removed by channel modifications it is likely that the same process which brought the existing bottom into being in the past will continue to operate in the future.

4.09. Maintenance. By a local cooperation agreement made with the Corps of Engineers, the Town will perform periodic maintenance excavation whenever it is deemed necessary. Normally maintenance is required after several years, however, should a major runoff occur because of heavy rains or snows, the increased rate of sedimentation may require the performance of this task to be accomplished sooner. According to a report prepared for the Council on Environmental Quality, the recovery of a stream after initial channelization will be largely determined by the degree and amount of channel maintenance required. Continuous and frequent maintenance could have almost as severe effects as initial construction if vegetation along the side slopes is destroyed each time. Maintenance operations would, in addition, make it difficult for any aquatic life, originally present, to reestablish itself.

4.10. Water Quality. As previously mentioned, the waters of the Pine Brook have been found to be acidic due primairily to natural mineral acid soils within the watershed. The question of whether excavation from the proposed project will increase the stream acidity by uncovering these acid deposits has been raised by the U.S. Dept. of Interior and the Dept. of Agriculture. Field investigations of the Pine Brook watershed made by the U.S. Army Corps of Engineers and U.S. Dept. of Interior (See 2.12), indicated that the acidic condition of the waters in Pine Brook is in evidence above the study area as well as in the Matchaponix Brook (below the study area). It seems therefore likely that this condition is regional and not limited to a source only in the study area. Furthermore, from the soil samples taken eariler (see 2.03), the pH readings of the stream bed materials show less acidity than those of the water sample. Therefore it would appear that the proposed excavation should have little effect, if any, on decreasing the pH of the waters downstream of the study area.

As on added precaution in preventing downstream transport of any disturbed acid-laden silt during construction, the follwoing mitigation methods will be adhered to:

1. A silt screen will be utilized during channelization to confine suspended materials.

2. Stream bank and spoil areas will be vegetatively stabilized immediately following construction to reduce project silitation and acid drainage.

Other precautionary measures recommended by the U.S. Department of the Interior and the New Jersey Department of Environmental Protection include:

1. Performance of construction activities during the fall and/or winter months when water temperatures are low and impact on downstream fishery resources in the Matachaponix and South Rivers is minimal.

2. The addition of lime during channelization to neutralize the acid.

These suggestions will be investigated and implemented if possible.

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Besides the acid problem, during the construction phase of the project, a temporary degradation of the water is anticipated due to turbidity, pollution from spillage, and disposal of materials. These effects can be reduced by the use of dikes and settling basins to retain pollutants at the site for proper disposal. Erosion of land caused by changes in drainage patterns and vegetation would increase the sediment load in the stream further reducing the quality of water and the capacity of the channel. This could be minimized by measures such as sediment basins, drainage ditches, catch basins and timely surface treatment of graded areas such as roads and embankments to hold materials in place. Erosion control will further be improved by immediate planting along the banks as has already been discussed.

4.11. Vegetation, Fish and Wildlife. During construction it would be necessary to remove approximately 6.8 acres of woodland and vegetation along the banks of the stream. This would eliminate some of the habitat for those wildlife resources that are present in the area such as birds, mammals and amphibians. These effects, however, would partially be mitigated by seeding and eventual growth of new vegetation upon completion of the project. Clearing, grubbing, borrowing or other operations could disturb or destroy feeding and nesting areas, and noise from the construction machinery may frighten away land animals and birds. Again, these effects would only be temporary and short-lived. With respect to aquatic life, because of the high acidity of the stream it is unlikely that any significant fish resources exist in the Pine Brook, consequently no effect is anticipated by the project.

A beneficial result of the project would be that it would prevent inundation by flood waters on animal habitats if and when repopulation occurs. Coorodination with Federal and State Agencies have indicated that there are no known endangered species in the area.

4.12. Mosquitos. A mosquito problem exists within the region of Monmouth County that includes the Pine Brook Study Area and is considered quite severe during late spring to early fall (Monmouth Co. Exterminating Commission). This is mostly attributed to poor drainage into the Pine Brook and other streams following rainstorms. Residual stagnated pools and ephemeral streams of fresh water act as suitable breeding grounds for several species of mosquito larvae from late winter through early summer.

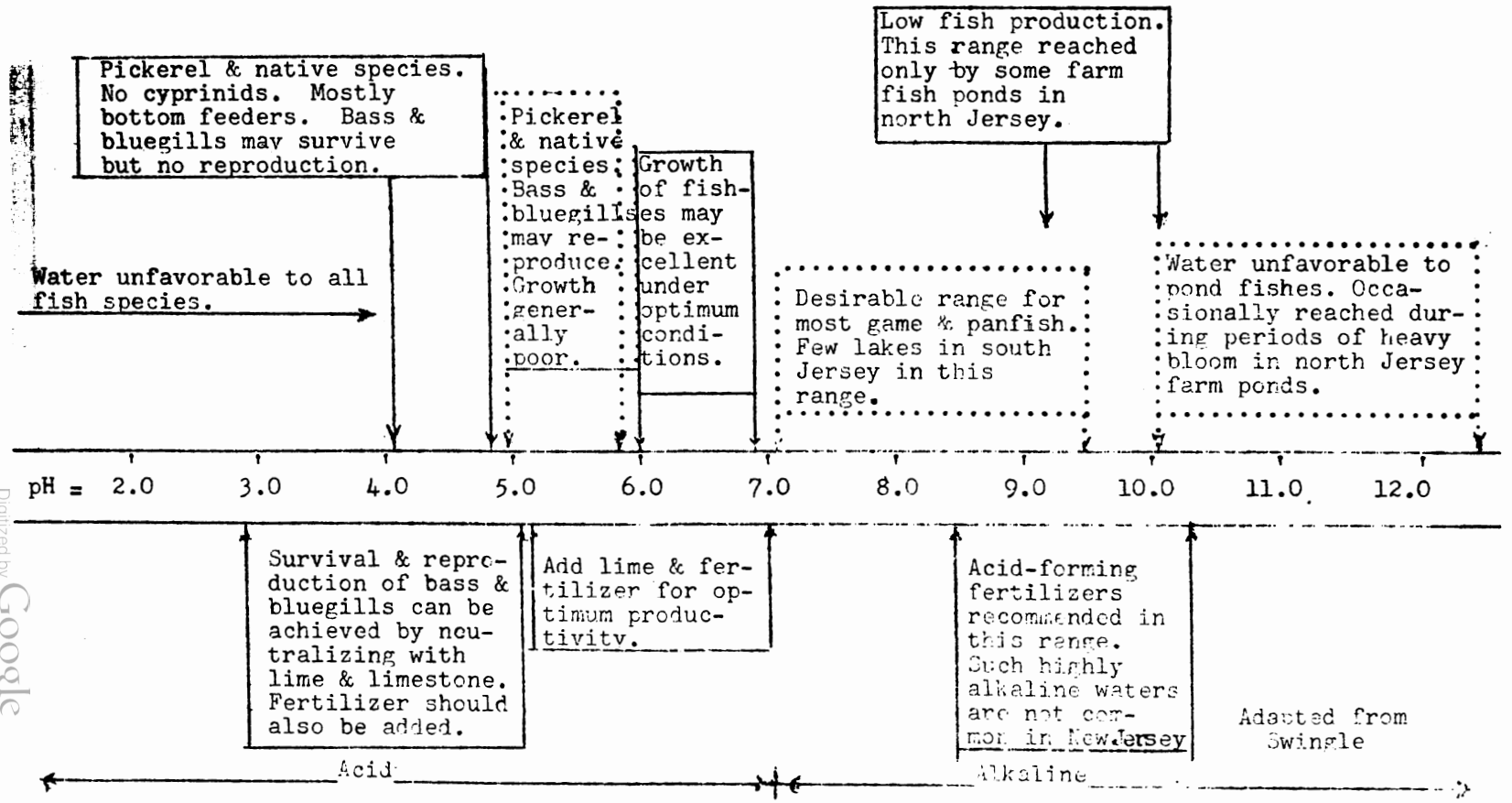
The proposed Federal project, however, should have no effect on increasing mosquito populations, as the Pine Brook within the project limits flows rapidly enough to preclude its use as a mosquito breeding area. In addition, the likelihood of mosquito hatching in the mainstream of the Pine Brook is further reduced by the acidity of the waters itself.

4.13. Aesthetics. During the construction of the proposed project, there will be an adverse effect upon the appearance of the area due to the presence of equipment and temporary disruption of the natural environment. However, after the construction phase is completed and plant growth has reestablished itself along the banks, the area should once again become aesthetically pleasing to most persons. It is doubtful however, that the stream will ever return to its original state because of the necessary removal of trees approximately 10 feet deep on each side of the stream. An additional 20 feet may also be required on both sides for the temporary maintenance easements. An attempt will be made to save any particularly large or beautiful trees within the easement path

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Relationship of pH of Lake & Pond Waters in New Jersey
and
Their Suitability for Game & Panfishes

State Fisheries Laboratory
Division of Fish & Game
New Jersey Dept. of Conservation & Economic Development



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Figure 2

14. U.S. Army Corps of Engineers, April 1975: Expanded Reconnaissance Report for Flood Control on Pine Brook, Manalapan Township, New Jersey, under authority of Section 205 of 1948 Flood Control Act, as amended.

15. U.S. Dept. of Agriculture, 1974: Field investigation of Pine Brook Watershed.

16. U.S. Department of Commerce, Bureau of the Census (1970), Number of Inhabitants, New Jersey, pp. 32-6, 32-11, 32-22.

17. _____, National Weather Service Records (1931-1973), obtained from hydrology branch, Corps of Engineers.

18. U.S. Dept. of Interior: Letters from the National Park Service dated 8 July 1974 and 7 February 1975 persuant to request by the Corps for information related to Historic Sites and National Landmarks.

19. _____, Letter from Fish and Wildlife Service dated 20 April 1975 subsequent to field trip made by Mr. Jerry Bady.

20. U.S. Geological Survey, 1969: Chemical analysis of the Pine Brook made on 24 Sept, 1969 by the Water Resources Division, 420 Federal Building, P.O. Box 1238, Trenton, N.J. 08607.

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1370 Hamilton Street, PO Box 219, Somerset, N.J. 08873

November 16, 1976

Mr. F. Howard Zahn, Chief
Bureau of Environmental Analysis
N.J. Dept. of Transportation
1035 Parkway Avenue
Trenton, N.J. 08625

Re: Route I-295, Sections IX and IW

Dear Mr. Zahn:

We have reviewed the information and maps provided by Mr. Kaminsky pursuant to the completion of Route I-295, Sections IX and IW in Gloucester County.

The primary concern of the Soil Conservation Service is that adequate provision is made for the control of sediment and erosion during and after the construction work both along the highway right-of-way and in any borrow or spoil areas. We would suggest that the Standards for Soil Erosion and Sediment Control as published by the New Jersey State Soil Conservation Committee be utilized in the preparation of a sediment and erosion control plan.

Of particular concern on this project is the underlying Woodbury and Merchantville geologic formations which become extremely acid when excavated due to oxidation. The acidity of these formations results from the content of iron pyrite (FeS_2). On exposure, the iron pyrite decomposes readily, especially in a moist atmosphere, to various sulfates and sulfuric acid producing soils with a pH as low as 2 or 3, so low that revegetation is an extremely difficult and costly undertaking. These compounds also prove to be highly corrosive to unproperly treated metal pipe and concrete structures incorporated into the highway drainage system.

Our concern is that you address this geologic condition and make adequate provisions to protect drainage appurtenances and to properly treat or bury this material both along the right of way and on any borrow areas such that adequate revegetation is accomplished.

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Mr. Joseph Voschin, of our Williamstown Office, Route 42, Black Horse Pike, P.O. Box L, Williamstown, N.J. 08094, will be glad to assist you in developing solutions to the problems you may encounter along these lines.

We have appreciated the opportunity to make an input into the planning of your project at this early stage.

Sincerely,

Walter T. Campbell Acting

CHESTER F. BELLARD
State Conservationist

cc: J. Voschin
A. C. Addison

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RUTGERS
THE STATE UNIVERSITY
OF NEW JERSEY

COOK COLLEGE • NEW JERSEY AGRICULTURAL EXPERIMENT STATION • MANASQUAN RESERVOIR SYSTEM PROJECT
10 /DERS LANE • EAST BRUNSWICK • NEW JERSEY 08816 • (201) 932-9259/9265

March 30, 1977

Mr. Lawrence Schmidt
Office of Environmental Review
Department of Environmental Protection
John Fitch Plaza
Trenton, N.J. 08625

Dear Mr. Schmidt:

The attached proposal presents our technical approach and budget for the work to be done with regard to the I-195 crossings of the Manasquan River at Squankum.

BACKGROUND INFORMATION AND SCOPE OF WORK

The N.J. Department of Transportation (DOT) filed an Environmental Statement (ES), with the Department of Transportation Federal Highway Administration (dated October 26, 1971) for the proposed extension of the I-195 in Ocean and Monmouth counties, New Jersey. The ES was submitted to both state and federal agencies for review. The N.J. Division of Fish, Game and Shellfisheries has recommended that the DOT reinspect the proposed design and construction methods at the Manasquan River crossings. The underlying rational is presented in Attachment C (in memoranda from Fish and Game to DOT and DEP).

Mr. Larry Schmidt acting on behalf of Commissioner Bardin contacted Mr. Seve Decter at the Manasquan Reservoir Systems Project (conducted by Rutgers University for N.J. DEP) and requested a meeting. On March 14, 1977 Messrs. Decter and Dan Rabinowitz met with Mr. H. Zahn of DOT and Mr. Schmidt of DEP in Trenton. At the end of the meeting Mr. Schmidt requested that we submit a proposal to cover the following three tasks.

1. Review and evaluation of technical reports and engineering design of the I-195 crossings. The engineering design will be provided by DOT and the evaluation will be conducted with respect to impacts on water quality.

2. Field and laboratory investigations of possible water quality changes (pH and metals) due to newly exposed soil surfaces;

3. Preparation of report which will include an evaluation of the proposed action by DOT, recommendation for the construction technique which will least affect the present equilibrium of the Manasquan River environment and recommend procedures for an environmentally sound construction monitoring of the I-195 crossing at the Manasquan River.

TECHNICAL APPROACH

Five Rutgers University faculty and staff members (two civil engineers, two soil scientists, and a hydrologist) reviewed the available material listed in Attachment C. It is our consensus that the information which we have been able to review does not provide sufficient data to critically evaluate the potential impact of the proposed I-195 crossings on the Manasquan River.

Of particular concern here are the potential increased acidity due to the exposure of various marls underlying the Manasquan River flood plain, the change in the hydraulic characteristics of some 1700 feet of channelized river and the increased erosion due to construction and channelization.

Determination of the formation or absence of acidic conditions and other potential changes in water quality parameters will be possible only after fresh soil samples have been obtained and specialized laboratory testing procedures carried to completion. Considerable care shall be taken regarding sampling and analytical techniques. This task will be conducted in its entirety by Dr. S. J. Toth and his staff. Prof. J. C. Tedrow will be task reviewer.

The information necessary for engineering and channel hydraulics evaluation will be provided by DOT. The Rutgers University project team will not attempt to conduct field investigation or modify existing DOT engineering design but rather critically evaluate them. Engineering and/or design modifications when deemed necessary will be offered in concepts only. This task will be conducted by Dr. Y. S. Chae. Dr. M. L. Granstrom will be task reviewer.

The overall project coordination between Rutgers University and the State of New Jersey as well as between the various Colleges of the University will be conducted by Prof. S. Decter.

Resumes for principal investigators and reviews are presented in Attachment B.

The actual work will be conducted in three tasks.

Task-1 Engineering and Hydraulic Evaluation

(1) Objectives

The objectives of Task-1 are:

(1) To critically review the design alternatives of the proposed Route I-195 interchange with respect to possible effects on water quality by erosion, possible loss of water due to soil permeability and erosion control during construction;

(2) To analyze and study the channel modifications with respect to hydraulics, erosion and sediment with an aim to assessing possible effects on downstream biota.

(2) Description of Work

Engineering and hydraulic evaluation will be conducted based on soils data, engineering design, and construction specifications provided to us by the DOT. Data deficiencies, when identified, will be requested from DOT or their engineering consultants.

Subtask 1-1: Critical Review of Design Alternatives

(a) Design - Review of engineering design and its potential affects on the Manasquan River will be initiated upon receiving the alternate designs of the I-195 interchange. This should include soil properties and characteristics (physical and chemical); flow characteristics including climate data; and design of relocated channels. It should also include data on the physical and chemical properties of borrow and spoil banks material. Soil stabilization characteristics will also be investigated.

(b) Permeability - The permeabilities of the soils in the area will be utilized to assess the possibility of water loss through modified stream and channel beds and to study leaching and other infiltration effects. The permeability characteristics of the existing soils and of the proposed lining material will be closely investigated.

(c) Soil Chemistry - The chemical properties of the soils in the area are to be investigated to assess the possible detrimental effects on water quality (Task 2 below). The pH values, metal concentration and organic matters will be closely investigated.

Subtask 1-2: Channelization

(a) Erosion and Sediment Control - The first step in the study of erosion and sediment control is to identify the sources of erosion and sediment such as areas being cleared, grubbed and scalped for construction, haul and access roadways, excavations and other activities disruptive of natural drainage. The second step is to identify the factors influencing erosion and sediment including climate (precipitation, temperature, wind), vegetation cover, soil characteristics, and topography. Erosion control measures will be evaluated with respect to runoff control, soil stabilization and vegetation establishment. Sediment control evaluation is to be made with respect to the flow characteristics of water and the nature of particles transported.

(b) Channel Hydraulic Evaluation - This evaluation includes channel dimensions, geometry, roughness and flow characteristics and the bank soil characteristics. The effect of channelization on downstream hydraulics in terms of flow volume and velocity; timing, magnitude and duration of downstream flood peaks; and stream turbidity, will also be evaluated. This study will commence upon receiving the designs of relocated channels and relevant data on climate, flow and soils.

Task-2 Soils Chemistry

(1) Objectives

The objectives of Task 2 are:

(a) To determine if soil cores collected from the proposed construction areas on the Manasquan River contain "black or poison greensand marls";

(b) To determine the "potential acidity" that might develop in these marls once they are exposed;

(c) To determine the release of heavy metals from these marls and to note if possible deleterious effects may effect the ecology of the areas involved;

(d) Suggest possible methods for mitigating these effects.

(2) Description of Work

Soil cores collected from the proposed construction area will be examined for the presence of "black marl". Depth as well as thickness of the beds will be noted. Locations for soil cores will be determined by Professor Toth who will personally handle their collection, storage and transportation to New Brunswick. DOT will provide the equipment and field crew for the actual coring operation. Samples will be taken of the beds and examined for pH, "potential acidity" (incubation test) and release of heavy metals during incubation (water and 0.05N HCl extracts).

In addition water samples will be collected and analyzed from the various streams involved to establish baseline water quality. Task 2 will be conducted in three parts:

Subtask 2-1:

(a) Collection and classification of soil borings. Preparation of soil samples for analysis.

(b) Collection and analysis of water samples from the Manasquan River, Mingamahone Brook and Bear Swamp Brook prior to construction. (This could form the baseline information for periodic sampling during the construction cycle).

Subtask 2-2:

(a) Determination of pH and "potential acidity" of samples suspected to contain FeS, using the incubation method.

(b) Determine the release of heavy metals from incubated samples.

Subtask 2-3:

(a) Bimonthly reports on progress of the study and preliminary results, once cores are obtained, will be submitted to the DEP and DOT.

(b) Final report containing possible amerolation techniques for preventing heavy metals from reaching the waters of the three streams mentioned above will be prepared.

Task-3 Preparation of Report

It will take four to six months from the time the DOT drilling equipment is on site and we receive at least two design alternatives from the DOT to complete the aforementioned tasks. However, we will provide the State with bi-weekly reports on the progress and findings of the soil analysis studies (subtask 2-3).

There are a number of important points, with regard to the final report of this study, which we would like to clarify in closing. The role of the University will be to critically evaluate design alternatives provided by DOT with respect to soil chemistry, water quality and engineering design. In so doing, the University will provide analysis and render judgments by the best scientists available. It can not guarantee to the State that any single alternative will not adversely impact the Manasquan River System. At most, we will suggest mitigating measures and provide a ranking matrix of alternatives.

ESTIMATED BUDGET

The total estimated cost of the proposed work is $26,100 to $32,600. Detail breakdown of the proposed budget is given in Attachment A.

Rutgers University is pleased to have this opportunity to work with you. If you have any questions please call me or Dan Rabinowitz at (201) 932-9265.

Sincerely Yours,

Stephen A. Decter /by P.C.

Stephen A. Decter
Assistant Research
Professor

DDR/pc
cc: file

RUTGERS
THE STATE UNIVERSITY
OF NEW JERSEY

COOK COLLEGE • DEPARTMENT OF SOILS AND CROPS
P.O. BOX 231 • NEW BRUNSWICK • NEW JERSEY 08903

February 27, 1978

Mr. Donald J. Kroeck
Supervising Engineer
Bureau of Water Supply Planning and
Management
N.J. Department of Environmental Protection
Trenton, New Jersey

Dear Mr. Kroeck:

I am replying to the criticisms of Mr. Zahn concerning acid soils, greensand marls and a review of the use of the "Freehold Soil Conservation District Standards", for acid soils.

Upon checking with the Freehold Soil Conservation District and the offices of the Soil Conservation Service in New Brunswick, I found that no one was aware of such standards being used and in fact they pointed out they used amelioration procedures for these soils as outlined in a paper entitled, "Acid Soils" which I presented to a joint meeting of the two groups several years ago.

I would like to know where and from whom the D.O.T. obtained these so-called standards and if detailed field tests were conducted to justify their use.

Apparently, the writer of the letter is not a soil expert since he considers material in geologic formations as "soils" rather than "soil material". Further all acid soils in South Jersey would have a pH value 4.0 or below when dried, and therefore, would have a "potential for extremely acidic conditions". This statement is of course, incorrect since we have soils with "potential acidities" ranging from 1.0-7.0 me/100 gms.

The statement that, "the bacteria require hydrogen ions" is of course, false. No proof has ever been advanced that bacteria require hydrogen ions to complete their life cycle.

The incubation technique to determine the potential acidity of soils or soil materials does not differentiate between the chemical and biological oxidation of Fe S but rather represents a total or sum of the two processes operating during incubation. It is, at the present, the best method for differentiating between normal and highly acid soils (potential).

The amount of acidity developed during incubation can be expressed in a number of ways including:

1. Amount of H_2SO_4 produced per acre of soil.
2. Amount of $CaCO_3$ or other bases required to neutralize H_2SO_4 produced.

It has been our experience that values for acidity obtained by a six week incubation when neutralized by bases or carbonates will not require additional treatments to maintain pH values.

The acidity developed during incubation increases the solubility of heavy metals such as Fe, Al, Mn, Cu, Zn, Ni, Cr, Cd and Pb. We believe that the increased solubility of these metals is responsible for plant death rather than the production of acids. I would also like to emphasize that Al ions at low concentrations (1-5 ppm) are extremely toxic to trout and other fish.

The drying of a soil sample and the determination of pH will not differentiate between soils of low and high potential acidities. This fact has been well documented in soil literature many times, and is simply stated as follows: "there is no relation between soil pH and base unsaturation".

The use of one foot of non-acid soil plus 6 inches of topsoil to ameliorate conditions produced by the presence of acid soils is not sufficient. At least 3 feet of a non-acid soil will be required plus at least 1 foot of topsoil to do an adequate job.

I would also like to raise the question as to the source of non-acid soil that the D.O.T. would use for this purpose, especially since all South Jersey soils are acid.

Sincerely,

Stephen J. Toth

Stephen J. Toth
Professor of Soil Colloids

SJT/bh
cc: Dan Rabinowitz

State of New Jersey

DEPARTMENT OF ENVIRONMENTAL PROTECTION

TRENTON 08625

OFFICE OF THE COMMISSIONER

June 14, 1978

Colonel Clark H. Benn
District Engineer
Corps of Engineers
26 Federal Plaza
New York, New York 10007

Dear Colonel Benn:

We are in receipt of the Corps' Public Notice #9423 regarding the proposed Flood Control Project for Pine Brook, Manalapan Township, Borough of Englishtown, New Jersey. As stated in our comments on the Final EIS, the Department agrees with the need for flood control measures but disagrees with the rationale by which the project has been justified.

The benefit-cost ratio was not documented; and it is open to question since some of the damages which the Corps associates with flooding may be attributed to inferior construction practices. Foundation failures and landscape losses may be related to the observed use of organic and acid bearing soils as fill material. The acid soils cannot be expected to be productive and organic soils offer inadequate bearing strength.

The homes which have experienced legitimate flood damage, including structural damage, and the existing deteriorated and unstable state of Pine Brook are the premise upon which the Corps should base its determination for the project. The Final EIS made numerous unsubstantiated assumptions including the unanswered question of future channel stability. These assumptions should have been documented or eliminated and the Final EIS amended accordingly.

The Final EIS failed to note that presently a private developer has a proposal for the widening and deepening of approximately 2000 feet of Pine Brook before the Department's Water Policy and Supply Council. The area covered by this application is within the 6000 foot section proposed for channel improvement by the Corps. The design of the channel before the Council will have a typical bottom width of 30 feet and a depth of 4 feet. The Corps channel is to be 15 feet wide and 7 feet deep. If the Council approves the proposed channel modification and the project is completed prior to any action by the Corps, additional work, at public expense, will be necessary in this 2000 foot section to meet the Corps' design. If these projects were coordinated, the benefit-cost ratio of the Corps project might be more favorable.

JUN 16 1978

With regard to the adequacy of the cultural resources analysis, we reiterate that we cannot evaluate the proposed project's effects until a Cultural Resources Survey has been undertaken. The results from such a survey should be presented as an addendum to the Final EIS. We concur with the comment by EPA (p. 52) that the Final EIS should include a discussion of how the project will avoid the historic site identified as the General David Foreman House. This information should be incorporated into the survey report. We would like to repeat our earlier request that prior to the initiation of a Cultural Resources Survey, this office has an opportunity to review the proposed scope-of-work.

In addition to these general comments, the Department's Division of Water Resources had the following detailed comments on the Final EIS.

1.03 Flood Problem

"including in excess of 90 residential structures would be affected under conditions of a Standard Project Flood." This has little bearing. The Standard Project Flood exceeds the 100 year flood, and the proposed channel is only designed for a fifty year flood. Figure 5 shows that the present 100 year storm will impact approximately 40 homes.

"a row of 21 residential structures, most of which were subject to serious damage during the 1971 flood." A reference to this same event is included in paragraph 2.18 which indicates that "Water levels reached the main floors of 6 bi-level homes, and entered the lower levels of 3 split-level homes." The other homes suffered basement and grounds damage. Of the 21 affected homes, we consider that nine experienced serious damage, not "most."

Much of the total damage appears to have been to landscaping.

1.04 Project Description

The indication is that a six-inch layer of well-graded stone is to be used as a medium for stabilization. In a later section (4.07) it is stated that crushed stone will be used. We are concerned with the stability of this material with respect to the anticipated velocities of the design flood.

A design procedure for selecting the rock size for channel protection (recognized by the USDA) is recommended in the National Cooperative Highway Research Program Report No. 108. The Final EIS does not describe the size adequately. Without this analysis it is impossible to evaluate the stability of the lining, a very important environmental and B/C consideration.

1.07 Benefit-Cost Ratio

The B/C ratio determination should be expanded without requiring one to peruse the "Expanded Reconnaisance Report." Actual Flood damage costs (separately) should be shown. Also, what figure has been assigned to "employment benefits derived from an increased

labor force?" (1.06). What benefits were used to offset the cost of the channel lining so as to increase the B/C ratio from 1.36 to 1.57 to 1?

2.03 Soil Conditions

The soil sampling analysis as exhibited may not be a true indicator of the potential range of pH. The comment that "this material forms sulphuric acid when exposed to air" is too simplified and does not address the associated impact of introducing heavy metals into the system. When FeS_2 is exposed to the atmosphere in the presence of an acid media, H_2S is the resulting formation. The resulting oxidation of S_2 produces the sulfuric acid.

Perhaps the most important aspect of this process, which was neglected in the Final EIS, is the potential for "an increase in concentration of heavy metals by acid solubilization." The FW-2 classification certainly requires that this aspect be addressed. Furthermore, the sampling and testing procedures should be reexamined. The soils should be taken to the depth of the deepest excavation at that sample site (which may or may not have been the case) and the samples should undergo an incubation period of at least two weeks (see Dr. Stephen J. Toth, 1970).

2.11 Water Quality

The use of the Hydrion pH Test Paper for the determination of pH is a rough analysis.

2.18 Flood Damage

Much of the claimed project benefits appear to be for 1971 flood damage to new landscaping. Cracked basement walls, seepage and failed attempts at revegetation are cited. When this project was constructed, organic and acid-bearing soils were observed being used for fill. How much of the "flood damage" to foundations and landscaping is in fact a result of consolidation, oxidation (and subsequent settling) and acid soil conditions?

4.08 Sedimentation

Mention was made of the utilization of a "silt screen" during construction. We would like to see details of said structure.

4.12 Disposal Site

Would the runoff from this site enter Milford Brook, and if so what are the potential impacts (i.e., pH and heavy metals)?

We are disturbed that our comments on the Draft EIS, which were not fully answered in the Final EIS, may not be considered. It is hoped that these comments will assist the Corps' future evaluation of this project and that they will respond accordingly.

Sincerely,

Lawrence Schmidt, Chief
Office of Environmental Review

WQC 78-8-14 (same as WQC 78-7-1
Rec'd 8/15/78 Rec'd 7/6/78)

10/20/78

A. J. Weiss, Chief
Engineering Division
Department of the Army
New York District, Corps of Engineers
26 Federal Plaza
New York, New York 10007

Re: WQC 78-8-14
Army Corps of Engineers
Proposed dredging and channelization Pine Brook
Pension Road and proceeding upstream to Winthrop Drive
Block 10, Lot 15
Manalapan Township, Monouth County

Water Quality Certification
More Information Needed

This Division has determined that prior to our issuance of Water Quality certification under the provisions of Section 401 (a) (1), "Federal Water Pollution Control Act Amendments of 1972", it will be necessary for you to submit the following additional material:

Since the Corps of Engineers proposes to remove virtually all of the surrounding vegetation, precisely with what do they intend to replace it? The use of conventional perrenial laron grasses would not be advisable since these will not thrive in such acid soil, requiring the expenditure of large quantities of lime and fertilizer annually in order to maintain soil cover and retard erosion. If so, the runoff from the stream banks would contribute significant amounts of calcium, phosphorus and nitrogen to the brook which could have an adverse effect on the water quality downstream. Additional information is needed from the Corps of Engineers on this subject before a full evaluation can be made.

With the removal of all shading vegetation an increase in water temperature can be expected, an effect already mentioned in the E.I.S. This coupled with a less turbulent stream due to channelizing (lower reaeration constant) would lower the Dissolved oxygen levels.

What effect will the acid-water run-off from the disposal site have upon Milford Brook as well as the surrounding vegetation; is Milford Brook also acidic and if not what are the pH tolerance of the dominant aquatic species?

Although the low pH does inhibit most aquatic species there are those which are low pH tolerant such as some members of the Limnephilidae family, therefore, a better survey should be made of the aquatic biota in order to ascertain the full effects of this project.

Some flood control measures are indicated for Pine Brook in order to avert continued property damage but an alternative to the complete de-vegetation and channelizing of this stream should be exersized in order to preserve its FW-2 water quality.

Failure to respond or submit the requested information within 90 days of the date of this letter may result in a disapproval of your request for certification.

Very truly yours,

Judith H. Miller
Review Coordinator

JHM:295400:M:B10-11:SD7

DEPARTMENT OF THE ARMY
NEW YORK DISTRICT, CORPS OF ENGINEERS
26 FEDERAL PLAZA
NEW YORK, N. Y. 10007

NANEN-E

6 February 1979

Mr. Charles H. Parkell
Review Coordinator
Division of Water Resources
P.O. Box 2809
Trenton, NJ 08625

Dear Mr. Parkell:

Reference is made to a recent telephone conversation regarding WQC 78-8-14, Army Corps of Engineers proposed dredging and channelization of Pine Brook, Manalapan Township, Monmouth County.

Inclosed for your information are the following items:

1. Map of the project site showing points used in subsurface explorations.

2. Data gathered from subsurface explorations.

3. Additional general soils data for the project area.

Area geology and the Englishtown Aquifer are discussed in the Final Environmental Impact Statement for the Pine Brook Flood Control Project. As pointed out in the EIS, the relatively shallow depth of the proposed excavation is not expected to have any significant impacts on the aquifer. The soil samplings taken for the project did not indicate the presence of the aquifer.

As stated before, limestone riprap will be used as a mitigating measure to counter any harmful effect of the project on the pH of Pine Brook. A full planting program will be conducted to stabilize the channelized banks of the stream, and prevent further acid run-off.

NANEN-E 6 February 1979

Mr. Charles H. Parkell

If you have any further questions, please contact Mr. Robert Dieterich of the Environmental and Economics Branch at (212) 264-4662.

Sincerely yours,

3 Incl
As stated

P. A. DESCENZA
Chief, Engineering Division

State of New Jersey
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES
P. O. BOX [redacted] CN-029
TRENTON, NEW JERSEY 08625

Mr. Richard Maraldo
Chief, Civil Projects
Management Branch
New York District
U.S. Army Corps of Engineers
26 Federal Plaza
New York, New York 10007

APR 2 1979

Re: WQC 78-8-14
Army Corps of Engineers
Proposed dredging and channelization - Pine Brook
Pension Road and proceeding upstream to Winthrop Drive
Block 10, Lot 15
Manalapan Township, Monmouth County

Water Quality Certification
More Information Needed

In accordance with your instructions at a meeting held on March 14, 1979, with my staff, the following minimum quantitative data is required by this Division for review of the above referenced project in order to make a final determination on your application:

A. Quantification of the Effects of Acid Soil

1. The lower 2 feet of each of the 8 cores sampled along the proposed project area should be used for the pH-incubation lime requirement test, phosphorus test and extractable heavy metals tests.

2. The procedure for the pH-incubation test is:

   a. Record initial pH in 0.1 N KCl with a pH meter.

   b. Twenty-five grams of duplicate soil samples are brought to optimum moisture (60% of field capacity) and put into 250 ml flasks and stoppered with cotton plugs.

   c. The flasks are weighed and their weights recorded.

d. Distilled water is added each Monday, Wednesday and Friday in an amount to restore each flask to its original weight.

e. The flasks are maintained at 37°C by storage in an incubator.

f. Duplicate samples are titrated with 0.04 N $Ca(OH)_2$ before incubation and at 2, 4 and 6 weeks of incubation time. To prepare each sample for titration, 50 ml of 0.5 M $CaCl_2$ is added to the 25 grams of soil. After 5 minutes, the pH is taken and $Ca(OH)_2$ is added with frequent stirring, in amounts sufficient to bring the pH to 7.0.

g. A plot of $Ca(OH)_2$ (ml added) vs. pH is then constructed.

h. The results are given in tons of limestone ($CaCO_3$) per acre (6.6 inches in depth) necessary.

3. A second set of 25 grams, duplicate samples for the extractable metals should be leached with dilute acid (0.1 N HCl) at the same time intervals as the titrations above. These soil samples should also be subjected to incubation, and the amounts of total extractable Copper, Zinc, Mercury, Cadmium and Phosphorus should be reported in mg/kg of soil (ppm).

B. Characterization of Hydrologic Gradient Between Stream and Aquifer

1. Install 4 wells, 2 inches in diameter, with 5 feet of screen into the first water-bearing sands of the Englishtown Formation.

2. The top of each casing should be surveyed to establish its elevation (M.S.L.).

3. One pair of wells should be located along Winthrop Drive. One of the pair should be located just outside the southern limit of the project, adjacent to Winthrop Road. The second well should be located just south of the junction of Tarrytown and Winthrop Roads, approximately 200 feet away from the first well.

   A second pair of wells should be located between the terminus of Oxford Road and the project limit. One of the pair should be located adjacent to the southern project limit, in the vicinity of bore hole #5. The second well should be located near the terminus of Oxford Road.

4. Water levels in the stream (M.S.L.) and in each of the 4 wells should be recorded at 1 week and at 2 weeks after well installation.

C. Required Data to be Submitted to Quantify Effects of Acid Soils at the Disposal Site

1. Plot plan
2. Topographic map and drainage
3. Soil borings and ground-water levels
4. Finished grade (topographic map)

D. Quantification of the Chemical Effects on Water Quality and Aquatic Life

1. Calculation of the change in nutrient (N&PO4) loading to Pine Brook and downstream waters (Matchaponix and Duhernal Lake), as a result of both substrate disruption and the application of fertilizers for vegetation stabilization, is to be done. The methodology used and the data base generated are to be forwarded with results.

2. The type, efficiency and actual location of the silt screen to be installed during project construction is to be specified. The expected maximum turbidity, expressed as Jackson Turbidity Units, below the silt screen at any time during the project is to be specified. The method and schedule in which the sediment is going to be removed from the stream bed and the measures taken to prevent any further degradation of the stream water while it is dewatered are to be specified. Based upon the results of the calculations specified above the expected increase in Pine Brook water temperature due to increased insolation, as a factor of increased turbidity, is to be calculated for the time period during which the project is expected to be constructed. A revised mean Dissolved Oxygen concentration can then be calculated based upon the revised mean water temperature.

For all conclusions supportive data and calculations are to be provided.

3. Based upon the results of the core sample pH incubation tests and the mean stream flows the following questions are to be addressed:

   a. Will the Brook's water pH be depressed by the exposure of the iron pyrite bearing soil and to what mean value will it drop?

   b. How long will any pH depression be observed after the completion of the project?

c. Taking into account the buffering capability of Matchaponix Brook and the mean flows of both the Matchaponix and Pine Brook, how much depression of pH in the Matchaponix can be expected both during and after the project.

4. So that a better evaluation of the effect this project will have upon the indigenous aquatic biota can be made the following surveys shall be performed:

a. A qualitative sampling for the periphyton community as outlined by the EPA in their "Biological Field and Laboratory Methods", manual (EPA-670/4-73-001) shall be performed.

b. A quantitative sampling of the benthic macro invertebrate community shall be performed (methodology as outlined in above referenced manual).

c. The indigenous fish population shall be sampled for species present, dominant species and condition. Methodologies shall conform to the above referenced manual.

E. Quantitative Data on Proposed Erosion Control

1. Please submit the basic hydrology and hydraulic calculations used in sizing the crushed stone and riprap which have been included in the channel design to control erosion and turbidity.

2. State the specific type of crushed stone and riprap to be used.

F. Quantitative Data on Proposed Limestone Riprap

You have proposed using limestone riprap as a mitigating measure to counter any harmful effects of the project on the pH of the Pine Brook due to the disturbance of acid soils.

1. What is the specific type of limestone to be used and in what locations?

2. What is the quantity and the size?

3. What is the life expectancy?

Please include all calculations.

It is noted that in the past, stream encroachment applications have been submitted for all Corps of Engineers flood control projects in New Jersey. Your objection to filing an application is understood, since the 90 day bill enacted in December 1975 would require a considerable application fee for the subject project. However, in continuing the past excellent cooperation between the Corps of Engineers and our Division, it is requested that two sets of the latest drawings for the project be submitted to our office so that our records may be kept current. Your efforts for flood control in New Jersey are appreciated, however, we feel that all projects should be coordinated between our two agencies.

If you have any questions, please contact Mr. Charles H. Parkell at 609-292-5913. Thank you for your cooperation.

Very truly yours,

Dirk C. Hofman, P.E.
Acting Director

cc: Mr. Arnold Grill, Manalapan Township Administrator
Assemblyman Water Kozloski

State of New Jersey
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES
P. O. BOX CN-029
TRENTON, NEW JERSEY 08625

MAY 8 1979

The Honorable James J. Howard
Rayburn House Office Building
Long 2245
Washington, D.C. 20515

Re: Manalapan Township - Pine Brook Flood Control Project

Dear Congressman Howard:

Commissioner O'Hern has referred your March 27, 1979 letter regarding the U.S. Army Corps Pine Brook Flood Control Project to me for reply. The Department of Environmental Protection shares your concern and that of the residents in the affected area regarding the periodic flooding and the resultant damages that occur.

When the Clean Water Act Amendments of 1977 (P.L. 95-217) were passed in December 1977, Section 401 (a)(6), was deleted. This change meant that federal agencies must now also obtain Water Quality Certificates from the states to accompany their applications for federal licenses or permits. There was no "Grandfather" clause and this Army Corps project was one of those that was caught in this transition period.

During the Division of Water Resources' review of the project, we found that there were both technical and informational problems that needed to be resolved. Questions have been raised by our geologists and biologists and more quantitative technical information is needed (see attached letter for details). We are particularly concerned about a potential drop in the dissolved oxygen level, increases in nitrogen and in phosphorous levels and the potential drop in pH due to the proposed project activity that would severely impact the Lower Pine Brook, Matchaponix and Duhernal Lake. This Lake is the recharge point for industrial water supply wells used by Dupont, Hercules Powder and National Lead. While the eutrophic effect might not be observed in Pine Brook, the increase in phosphorous loading to the Matchaponix could stimulate further eutrophication in the Brook as well as Duhernal Lake, which is currently phosphorous limited.

We have always maintained a cooperative effort between agencies. In the past, Stream Encroachment applications have been submitted for all Corps Flood Control projects in New Jersey. In this case, because of recent changes in our law, we are only asking that the Corps submit two sets of the latest plans to our office for our records.

If you have any further questions, please do not hesitate to contact me. Thank you for your cooperation.

Very truly yours,

Dirk C. Hofman, P.E.
Acting Director

CHP:DCH:sg
Attachment is letter to Marello dated 4/5/79

363

LAW OFFICES

SONNENBLICK, PARKER & SELVERS
A PROFESSIONAL CORPORATION

100 CRAIG ROAD
FREEHOLD, N.J. 07728

(201) 431 1234

GERALD N. SONNENBLICK
CHARLES R. PARKER
JEROME M. SELVERS+
RENEE L. FERRETTI

+ N.J. & N.Y. BAR

July 17, 1979

RECEIVED
JUL 20 1979
State of New Jersey
Dept. Environmental Protection
Division Water Resources

Mr. Charles Rooney
Department of the Army
Corps of Engineers
26 Federal Plaza
New York, N.Y. 10007

re: Pine Brook Flood Control Project
Manalapan Township

Dear Mr. Rooney:

Enclosed is a copy of the pH values of recently collected soil cores for the Pine Brook Flood Control Project.

Dr. Toth was kind enough to test these samples without charge. Unfortunately it appears that additional testing is now necessary, and I assume the Corps will immediately commence same. If I am incorrect in my assumption, kindly advise. Otherwise, I would appreciate your advice as to the anticipated date that the tests will have been completed.

Thank you.

Very truly yours,

GERALD N. SONNENBLICK
Manalapan Township Attorney

/rd
cc: Mayor and Township Committee
Mr. Arnold Grill - Administrator
Mr. Timothy Gillen
Western Monmouth Utilities Authority
Mr. John Trela

RUTGERS
THE STATE UNIVERSITY
OF NEW JERSEY

COOK COLLEGE • DEPARTMENT OF SOILS AND CROPS • P.O. BOX 231 • NEW BRUNSWICK • NEW JERSEY 08903 • 201/932 9771

JUL 16 1979

July 11, 1979

Sonnenbleck, Parker and Silvers
100 Craig Road
Freehold, NJ 07728

Dear Mr. Sonnenbleck:

Enclosed find a table listing the pH values of soil cores which were recently collected.

Thirteen of the 22 samples collected have the potential for developing acid soil conditions upon exposure to air. However, this point should be verified by conducting "incubation tests" on the samples.

Sincerely,

S. J. Toth
Professor of Soils

/vcl

Encl.

pH Values of Soil Cores

Pine Brook Flood Control Project

Code	pH
B-1, S-1, 0'-2' (2-2-3-3)	3.9*
S-2, 2'-4' (5-7-7-8)	3.7*
S-3, 4'-6' (2-2-3-5)	5.4
S-4, 6'-8' (2-2-3-5)	5.9
B-4, S-1, 0'-2'	3.8*
S-2, 2'-4'	4.1*
S-3, 4'-6'	4.1*
B-5, S-1, 0'-2'	3.9*
S-3, 4'-6'	4.1*
B-6, S-1, 0'-2' (1-2-1-1)	3.9*
S-2, 2'-4' (1-0-0-1)	4.1*
S-3, 4'-6' (5-5-3-4)	4.5
S-4, 6'-8'	5.0
DH-2, S-1, 0'-2'	3.8*
S-2, 2'-4'	4.7
DH-3, S-1, 0'-2'	4.1*
S-2, 2'-4'	4.1*
S-3, 4'-6'	3.5*
DH-7, S-2, 2'-4'	5.4
6'-8'	5.6
DH-8, S-2, 3'-5A	5.6
S-2B, 3'-5'	5.1

* May contain iron sulfide, which may upon exposure to oxygen oxide to H_2SO_4. To verify, incubation tests are required.

WQC 78-7-1
PINE BROOK FLOOD CONT
PROJECT - U.S. ARMY COR

DEPARTMENT OF THE ARMY
NEW YORK DISTRICT, CORPS OF ENGINEERS
26 FEDERAL PLAZA
NEW YORK, N. Y. 10007

NANEN-G

8 January 1980

Mr. Charles Parkell
Division of Water Resources
Department of Environmental Protection
Trenton, New Jersey 08625

Dear Mr. Parkell:

Reference is made to your letter, dated 2 April 1979, in which pH incubation tests on the soil samples from the Pine Brook Flood Control Project were requested by your office to determine the project's eligibility for a Water Quality Certificate.

Inclosed for your comment and review are two copies of the test results. Upon completion of your review and receipt by this office of your comments in writing, in the interest to all parties concerned, it is recommended that a meeting be held. The purpose of the meeting will be to discuss the need for additional testing and/or the modification of the project as proposed. An assessment as to the eligibility of the project for a Water Quality Certificate will also be discussed.

Please contact Mr. Charles J. Rooney, Project Manager, at (212) 264-9080 to make arrangements for this meeting.

Sincerely,

Stanley Fo

P. A. DESCENZA
Chief, Engineering Division

Incl
As stated

United States Testing Company, Inc.
Chemical Services Division
1415 PARK AVENUE • HOBOKEN, NEW JERSEY 07030 • 201-792 2400

REPORT OF TEST

December 18, 1979

NUMBER 68137

CLIENT: U. S. Army Engineer District, NY
Foundation and Materials Branch
26 Federal Plaza
New York, NY 10007
Attn: Mr. Kevin Mabon

SUBJECT: Thirteen soil samples

Authorization: Contract #DACWS1-79-M-1613

PURPOSE:

Quantification of the Effects of Acid Soil.

PROCEDURE:

Per method A supplied by client. In addition, there was substantial information provided by Dr. S. J. Toth of Rutgers University (201-932-9810).

SIGNED FOR THE COMPANY

BY Richard Posner

jiw

Richard Posner

Laboratories in: New York • Chicago • Los Angeles • Tulsa • Memphis • Reading • Richland

UNITED STATES TESTING COMPANY, INC. REPORTS AND LETTERS ARE FOR THE EXCLUSIVE USE OF THE CLIENT TO WHOM THEY ARE ADDRESSED AND THEY AND THE NAME OF THE UNITED STATES TESTING COMPANY, INC., OR ITS SEALS OR INSIGNIA ARE NOT TO BE USED UNDER ANY CIRCUMSTANCES IN ADVERTISING TO THE GENERAL PUBLIC AND THEIR COMMUNICATION TO ANY OTHERS OR THE USE OF THE NAME OF UNITED STATES TESTING COMPANY, INC. MUST RECEIVE OUR PRIOR WRITTEN APPROVAL. OUR REPORTS APPLY ONLY TO THE STANDARDS OR PROCEDURES IDENTIFIED AND TO THE SAMPLE(S) TESTED AND/OR INSPECTIONS MADE. UNLESS OTHERWISE SPECIFIED. THE TEST AND/OR INSPECTION RESULTS ARE NOT INDICATIVE OR REPRESENTATIVE OF THE QUALITIES OF THE LOT FROM WHICH THE SAMPLE WAS TAKEN OR OF APPARENTLY IDENTICAL OR SIMILAR PRODUCTS AND NOTHING CONTAINED IN OUR REPORTS SHALL BE DEEMED TO IMPLY OR MEAN THAT UNITED STATES TESTING COMPANY, INC. CONDUCTS ANY QUALITY CONTROL PROGRAM FOR THE CLIENT TO WHOM THE REPORT IS ISSUED. SAMPLES NOT DESTROYED IN TESTING ARE RETAINED A MAXIMUM OF THIRTY DAYS.

Sample	Initial pH	0-weeks pH	0-weeks meq added $Ca(OH)_2$	2-weeks pH	2-weeks meq added $Ca(OH)_2$	4-weeks pH	4-weeks meq added $Ca(OH)_2$	6-weeks pH	6-weeks meq added $Ca(OH)_2$	$\Delta pH_{t_1-t_2}$
D-H-8	1.95	1.95	7.3	2.45	5.7	2.05	5.9	1.90	6.4	-.05
B-5	3.50	3.50	1.5	3.55	3.0	3.45	2.9	3.55	1.7	+.05
3	3.55	3.55	3.0	3.40	2.6	3.25	1.4	3.15	1.4	-.40
4	3.45	3.45	0.66	3.60	1.6	3.45	1.4	3.45	1.4	.0
13	3.95	3.95	0.84	3.80	0.84	3.90	1.6	3.50	1.4	-.45
14	3.70	3.70	0.62	3.70	0.89	3.60	1.4	3.55	1.6	-.15
15	3.65	3.65	0.79	3.70	1.5	3.45	1.8	3.25	1.6	-.40
16	4.00	4.00	0.48	4.15	1.2	4.00	1.6	3.85	1.4	-.15
17	3.25	3.25	0.88	3.15	1.5	3.15	2.1	2.75	1.9	-.50
19	3.25	3.25	2.1	3.35	3.4	3.40	3.2	3.10	2.8	-.15
23	3.10	3.10	0.48	3.20	0.97	2.95	1.7	3.15	1.2	-.05
24	3.70	3.70	1.2	4.10	3.6	3.75	3.1	3.65	2.5	-.05
25	3.50	3.50	0.62	3.15	1.1	3.25	1.2	3.20	1.0	-.30

1 ml of 0.044-N $Ca(OH)_2$ = 0.044 meq

Plots of $Ca(OH)_2$ added vs. pH have not been constructed since based on the values obtained there is no slope. This was discussed with Dr. Toth.

United States Testing Company, Inc.
Number
Page

State of New Jersey
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES
P. O. BOX CN-029
TRENTON, NEW JERSEY 03625

Mr. Patrick A. Descenza
Chief, Engineering Division
Corps of Engineers
26 Federal Plaza
New York, New York 10278

JUL 23 1980

RE: Pine Brook Flood Control Project
WQC application #78-7-1

Dear Mr. Descenza:

Thank you for sending us the additional information regarding the pH soil incubation tests on the core samples from the above referenced project site. As we have stated before, we are in agreement that some type of relief from periodic flooding must be provided to the area residents. The proposed project is unique, however, in that it involves the disruption of pyritic/marlitic (acid) soils that are unstable, and have the peculiar property of both bacteriologically and chemically producing an extremely acid condition upon exposure to air.

This property has caused considerable damage to the aquatic environment both downstream from the project site and in other locations in New Jersey (e.g. Matawan Lake, which is now at a pH of 2.0 and considered "dead" in that even algae will not grow in it). The exposure of these soils is the primary reason that both the Western Monmouth Utilities Authority and the Englishtown Auction acreage at the lower end of Pine Brook will not support vegetative re-growth. Under normal weathering, it may take decades for the soil to return to the original pH level.

The pH incubation tests showed that, in addition to releasing heavy metals, none of the 13 soil samples showed any significant increase in pH, and 11 of the 13 samples showed a decrease in pH. These results indicate that, even after 6 weeks the samples had not reached the equilibrium necessary to compute the total amount of lime that would be required to bring these soils to circumneutral if they were exposed. One of our Soils Scientists has estimated, based on our experience with Matawan Lake, that such exposure of

the acid producing clay lenses in the Pine Brook area would reduce the pH in the Brook to 2.0-2.5. This drop would have an additional impact not only on the lower Matchaponix but also on Duhurnal Lake which is used as both a process and drinking water source.

In the last few months after receiving the test data, we have attempted to define the impacts and quantify their effects. We also wanted to take a close look at your proposal to use limestone riprap as a mitigating measure and to investigate other potential measures. We collected and assembled all the available water quality and biological data from our Division and others within the Department of Environmental Protection and found we still lacked proportional flow data for the Pine Brook and the Matchaponix. U.S.G.S. agreed to develop that data, and there was a delay in completing our analysis while they worked our request into their schedule.

I have attached a copy of two reports summarizing the results of our analysis. Limestone riprap was ruled out as it would cause a precipitation of iron oxide and become coated fairly swiftly. The coating would effectively seal it off and prevent any further dissolving. The most startling information came from the Bureau of Mines who stated that the speed of the bacterial growth is such that any exposed soil must be covered within a short period of time or an irreversible acidic condition would prevail which would require Herculean efforts to alleviate.

At the last Quarterly Coordination meeting on June 18, 1980, Dennis Suszkowski asked the name of the bacteria that causes this acidic formation. They are chemoautotrophic organisms such as:

Ferrobacillus ferrooxidans
Ferrobacillus sulfooxidans
Thiobacillus thiooxidans
Thiobacillus ferrooxidans

The Water Pollution Control Research Series, published by the U.S. Department of Interior, Federal Water Quality Administration covers this topic in "Microbial Factor in Acid Mine Drainage Formation", 14010 DKN 11/70, dated July, 1970, and others.

After your engineers have had time to review the reports, we would like to set up a meeting to discuss the project. Please contact Chuck Parkell at (609) 984-6860, who is coordinating our efforts on this matter. If you have any questions, he would also be able to put you in touch with our technical staff.

Very truly yours,

Dirk C. Hofman
Deputy Director

cc: Larry Schmidt
Paul Arbesman
Arnold Schiffman
George Tyler

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
1370 Hamilton Street, P.O. Box 219, Somerset, New Jersey 08873

September 2, 1980

N.J. Dept. of Transportation
Bureau of Environmental Analysis
1035 Parkway Avenue
Trenton, New Jersey 08625

Re: FP No. I-295-1(43, 52)

Dear Sir:

We reviewed the I-295 Highway widing project in Gloucester County in 1976. Attached is a copy of our comments: Our position on this project has not changed, however, implementation of the Soil Erosion and Sediment Control list, Chapter 459, P.L. 1980 may require additional assistance from our local personnel who will help you with technical guidance in developing the erosion and sediment control plan.

We appreciate having had the opportunity to review the project.

Sincerely,

PLATER T. CAMPBELL
State Conservationist

cc: Joseph Voschin, SCS, Williamstown, NJ

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DEPARTMENT OF THE ARMY
NEW YORK DISTRICT, CORPS OF ENGINEERS
26 FEDERAL PLAZA
NEW YORK, N. Y. 10278

REPLY TO
ATTENTION OF: NANEN-G

RECEIVED
State of New Jersey
Dept. Environmental Protection
Division Water Resources

Mr. Dirk C. Hofman
Deputy Director
Division of Water Resources
Department of Environmental Protection
Trenton, New Jersey 08625

Dear Mr. Hofman:

Reference is made to the Corps' application for a Water Quality Certificate for the Pine Brook Flood Control Project, Manalapan Township, New Jersey.

Pursuant to the State's request to mitigate against acid soil conditions in the project area, the subject project has been modified to include a bentonite layer to protect the waters of the Pine Brook. As recommended in NJDEP Memo, dated 4 May 1981, soil samples were sent to the American Colloid Company to test the durability of the bentonite layer and to determine the required application rate of the bentonite. Attached is a copy of the test results (Incl. 1).

Based on the recommended application rates of the bentonite, a revised total construction cost estimate was prepared (Incl. 2). The total construction cost including 10% contingency, engineering and design, and supervision and administration is $1,398,389 (September 1981). This represents an annual cost of $109,402 using an interest rate of 7 5/8% for a 50 year project life. The updated annual benefits for the project are estimated to be $72,690 (October 1981 price level). The current Benefit to Cost Ratio (BCR) is .66.

Since the BCR is less than one (1.0), the Corps cannot participate in the project as currently designed.

Prior to informing Manalapan Township, the local sponsor, of this decision kindly inform my office of NJDEP's recommendation. Should you wish to meet to discuss the project, please call Mr. Charles J. Rooney, Project Manager, (212) 264-9080.

Sincerely,

for P. A. DESCENZA
Chief, Engineering Division

Incl as
stated

schoor, de palma & gillen inc.

a member of the schoor engineering group

Consulting and Municipal Engineers
356 Main Street (Route 79), P.O. Box 508
Matawan, New Jersey 07747 (201) 566-0100

WAD267-III-3

October 27, 1983

ward M. Schoor, P.E., L.S., P.P.
ephen P. DePalma, P.E., P.P.
nothy W. Gillen, P.E., P.P.
mes V. DeMuro, P.E., L.S., P.P.
ank L. Trafford, L.S.
thony C. Canger, L.S., P.P.
eodore D. Cassera, P.E., P.P.
mes A. Murray, B.B.A.
bert Lawrence, P.E.
ter Chmiel, P.E., P.P.
niel McSweeney, P.P.

IGINEERS:

ough of Sayreville
ough of Keyport
ough of Roosevelt
ough of Matawan
ough of Sea Bright
ough of Spotswood
ough of Bound Brook
ough of Millstone
ough of Raritan
nship of Millstone
nship of Little Egg Harbor
nship of Stafford
nship of Shrewsbury
tern Monmouth Utilities Auth
e Egg Harbor M.U.A.
ford M.U.A.
let Township Sewerage Auth.
an Township Sewerage Auth.

ONSULTING ENGINEERS:

ough of Union Beach
ough of Freehold
nship of Hazlet
nship of Manalapan
nship of North Brunswick
nship of Mount Olive
nship of Wayne
nship of Jackson
nship of Howell
nship of East Hanover
nship of Parsippany
eley Township Sewerage Auth.
nty of Monmouth
nty of Union
Dept. of Transportation
Dept. of Energy

N.J. Department of
Environmental Protection
Division of Water Resources
P.O. Box CN-029
Trenton, NJ 08625

Attention: Mr. Rick Reilly

Re: WMUA - Pine Brook Slope Stabilization
Stream Encroachment Permit #10844

Dear Mr. Reilly:

As per your verbal request, we have estimated the cost for excavating an additional (1') foot of acidic material and replacing same with non-acidic material. The additional work is required in all areas where excavation of the existing material is necessary in order to grade the slopes to the proposed contours. The additional work includes the excavation and offsite disposal of the acid soil and importing, placing and compacting non-acidic soil on the slopes. We estimate the cost of this additional work will be in excess of $120,000. Enclosed is a copy of our estimate.

If you have any questions, please do not hesitate to contact us.

Very truly yours,

SCHOOR, DE PALMA & GILLEN, INC.

James E. Farry

James E. Farry, P.E.

JEF:ejs
Enc.

C: WMUA-Attn: Mr. Russell E. Nerlick, P.E. (w/enc.)
Timothy W. Gillen, P.E. (w/enc.)

10-27-03
WA0267
JEI

WMUA PINE BROOK SLOPE STABILIZATION

COST ESTIMATE FOR EXCAVATION OF 1' OF ADDITIONAL ACIDIC SOIL AND REPLACEMENT WITH 1' OF NON ACIDIC SOIL IN ALL EXCAVATION AREAS

① VOLUME OF MATERIAL

VOL OF EXC = VOL OF FILL

STEEP SLOPES $\frac{720' \times 55' \times 1'}{27 ft^3/yd^3} = 1467\ yd^3$

OTHER AREAS $\frac{155' \times 100' \times 1'}{27 ft^3/yd^3} = 574\ yd^3$

2041

SAY 2100 yd^3

VOL OF EXCAVATION = VOL OF FILL = 2100 yd^3

(2) EXCAVATION OF 1' OF ACIDIC SOIL

A. GRADALL 30" BUCKET $3.57/C.Y. , 240 yd³/D (FROM MEANS)

∴ 2100 yd³ X 3.57 = $7,500 (9 DAYS OF EXCAVATING)

B. LOAD ONTO TRUCKS

FRONT END LOADER 9 DAYS X $750/D = $6,750

C. TRUCK TO LANDFILL

6 TRUCKS X 9 DAYS X $340/D = $18,360

TIPPING FEE AT LANDFILL $10.60/C.Y.

2100 cy X 12.48 = $26,208

MON. CTY. RECLAMATION CENTER $8.32/TON ACID SOIL

∴ 3000 lb/cy / 2000 lb/T = 1.5 T/C.Y. X 8.32 = $12.48/C.Y.

D. ADDITIONAL LABOR & MAN POWER

3 LAB X 9 D X 8 HRS/D X $21/HR = $4536

$63,354

(3) IMPORT NON ACID FILL

A. BORROW MATL (DELIVERED TO SITE)

2100 yd^3 x $7/$yd^3 = $14,700

B. COMPACT ON SCOPE

2100 yd^3 x $3.50 = $7,350 (FROM MEANS INFLATED FOR WORK ON SCOPE)

C. COSTS TO PLACE MATL ON SCOPE (USING GRADALL) (FROM MEANS)

2100 yd^3 x $3.57/$yd^3$ = $7500

D. ADDITIONAL LABOR & MAN POWER

3 LAB x 9 DAY x 8 HR/D x $21/HR = $4,536

34,086

TOTAL = 63,354 + 34,086 = 97,440

10% O.H. 9,744

107,184

10% PROFIT 10,718

117,902

SAY $120,000 or $57/$yd^3$

Acid Soil Supplement D

Soil Conservation Service (SCS): 1980-1982 Technical Notes and recommendation

New Jersey Technical Note 28 (issued January 17, 1980) concerning establishment of vegetation on extremely acid soils

Technical Note Plant Materials No. 9 - Use Of Lime And Soil Cover To Provide Vegetation On Extremely Acid Soils issued May 15, 1981

April 9, 1982 memorandum from SCS State Conservationist Plater T. Campbell forwarding a March 1982 recommendation on acid soils developed by Cluster R. Belcher, Manager, SCS Cape May Plant Material Center

The three documents listed above and provided below were scanned by William Minervini from photocopies provided by NJDEP in response to his request under the Open Public Records Act. (These documents were part of a file he created while working with others at NJDEP on acid soil matters in the early 1980s.)

New Jersey Technical Note 28 January 17, 1980

U.S.D.A.
Soil Conservation Service
1370 Hamilton Street
Somerset, New Jersey 08873

CORRECTED COPY

RE: PLANT MATERIALS - VEGETATION OF ACID SOILS

The purpose of this note is to distribute current information on establishment of vegetation on extremely acid soils.

Frank H. Webb, Plant Materials Specialist in Somerset, New Jersey developed the information.

Raymond N. Brown, Jr.

RAYMOND N. BROWN, JR.
State Resource Conservationist

Attachment

AO

TECHNICAL NOTES

Technical Note

VEGETATION OF ACID SOILS

Purpose

The Purpose of this notice is to distribute current information on establishment of vegetation on extremely acid soils. The information was developed by Frank H. Webb, Plant Materials Specialist in Somerset, New Jersey.

Scope

Many situations exist in central New Jersey and surrounding states where exposed soil is extremely acidic. With pH readings in some cases as low as 2.3 absolutely no plant species will survive. However, there is an urgent need to establish vegetation on these sites, some of which are extensive.

In recent years several trials have been conducted by SCS Plant Materials and university personnel to find answers to this problem.

Traditionally the application of lime (calcareous or dolomitic) has worked well where acidifying factors were organic in nature and initial pH was 5.0 or higher. Below that figure the quantities required are not usually practical.

With the situations to be dealt with in this technical note the involved soils contain iron sulfide and buffering factors. When such soils are exposed to the air iron sulfide ultimately forms sulfuric acid.

The involved chemical reactions are as follows:

1. $FeS_2 + H + \longrightarrow H_2S$
2. $2H_2S + 0_2 \longrightarrow 2H_20 + S_2$
3. $S_2 + 30_2 + 2H_20 \longrightarrow 2H_2S0_4$

When the sulfur (step 3) is oxidized the following things occur.

1. Increased acidity in the soil
2. Increased quantity of sulfates
3. Increased concentration of toxic heavy metals made soluble by the acid.

Depending on the concentration of available sulfur and resultant acid, involved soils may require application of up to 150 tons of lime per acre. Such application is obviously not practical.

Trials have been conducted to determine how much soil "lift" material must be applied over the acidic soil to permit establishment of lasting vegatative cover.

Using the "incubation type of lime requirement procedure" Toth tested and treated soils over a period of weeks. In the example shown below an initial need of 4.3 tons of lime was indicated. After a six-week incubation period and four treatments, it was apparent that the actual requirement was almost 80 tons.

Weeks Incubation	Lime (tons C_aCO_s/acre Requirement
0	4.3
2	16.9
4	27.8
6	30.3
Total	79.3

Obviously any extensive area of this soil could not be adequately limed under efficient management. Covering it with a 6" to 12" lift of suitable material would seem more practical.

As previously indicated other soils containing acid of organic origin and not high in sulfates can be satisfactorily limed. However, some of these may require as much as 10-25 tons/acre. The existing situation must be understood before the most appropriate treatment can be determined.

When heavy metals are excessive they must be made insoluble by rigid maintenance of pH. Alternatives to this involve the use of phosphates and gypsum to permanently tie up such metals.

This technical note is aimed at facilitating the establishment of vegetation on critical areas.

Any potential use of these acid areas for growing crops would require even more individually specific measures.

Maintenance of pH, or rendering insoluble any heavy metals initially present become essential. It is unlikely that areas as critical as those dealt with here would be considered potential cropland.

United States
Department of
Agriculture

Soil
Conservation
Service

Northeast Technical
Service Center
Broomall, Pennsylvania

TECHNICAL NOTE

PLANT MATERIALS NO. 9

USE OF LIME AND SOIL COVER TO PROVIDE VEGETATION ON EXTREMELY ACID SOILS

ABSTRACT

When extremely acid spoil is encountered in earth moving operations, how best to deal with it and stabilize the site must be resolved. Two procedures are discussed. One involves treating the spoil with lime and the other involves covering the spoil. This technical note discusses how to select the most appropriate procedure and two studies where spoil was covered with different depths of soil.

DIST: NE-S, T, W

Prepared by: W. Curtis Sharp
Plant Materials Specialist
May 15, 1981

What Causes the Problem?

Soil pH is a measure of the hydrogen (H+) ion concentration of the soil in relation to the hydroxal (OH-) ion concentration. As the concentration of H+ ions increase, the pH goes down, or the soil is considered more acid. The pH values are logarithmic; therefore a pH of 5.0 is ten times more acid than a pH of 6.0. At pH 7.0, there is a equilibrium in the hydrogen and hydroxal ions concentration.

Acid soils are common place in the humid parts of the U.S. There are several reasons for this. The principal one relates to the production of carbonic acid from the decomposition of organic matter. The H+ ion in the carbonic acid replaces the carbonate ion of calcium, magnesium, etc. in the soil solution and on the soil particle. The latter is leached from the soil profile, thus causing an increase in the H+ ion concentration. To correct this condition, calcium carbonate is applied to replace or drive off the H+ ions. The amount required is influenced primarily by the amount of H+ ions held by the soil particle. Soils with high amounts of clay particles generally have a higher capacity to hold ions (exchange capacity) and require more lime to raise the pH the same amount.

Another natural condition, also producing acid soils, results from the presence of iron sulfides in the soil. This condition is frequently encountered in surface coal mining operations. Earth movement for mining, construction, etc., occasionally uncovers such material. When exposed to the air, the iron sulfide ultimately forms sulfuric acid as follows:

Iron sulfide (FeS_2) + Hydrogen(H) = Hydrogen sulfide(H_2S)

Hydrogen sulfide (H_2S) + Oxygen(O_2) = Water(H_2O) + Sulphur(S_2)

Sulphur(S_2) + Oxygen($3O_2$) + Water($2H_2O$) = Sulfuric acid(H_2SO_4)

When these reactions take place, there is a rapid increase in surface acidity and increased aluminum and

manganese availability which is brought into solution by the free acid. Both conditions can prohibit plant growth. Usually the pH will be in the range of 2.0-3.5. As the bare spoil erodes, additional spoil is exposed and the iron sulfide in it is oxidized and the toxic conditions are maintained. Until the site is stabilized either with vegetation or some other protective cover, the process will continue.

How Can the Problem be Corrected?

The first of these two conditions is easily corrected through the periodic use of agricultural lime. However, depending on the amount of iron sulfide in the spoil, the latter conditions may defy such a straight forward approach. As much as 150 tons may be required to neutralize the potential acid producing capabilities of the spoil. Such applications are obviously not practical. Lime can be applied to temporarily raise the pH to adequate levels, but as more sulfur oxidizes, the pH will drop to preliming levels. Consequently, the amount of sulfides, or more importantly the amount of lime to neutralize all of the acid which can be produced by the sulfides, is important to know.

One approach to make this determination is the 'incubation method'. Soils samples are taken from the depth to which lime might be incorporated in actual field conditions. This should be about 8 inches. The samples are then treated to raise the pH to a predetermined level, usually 6.0. They are then incubated for several weeks to allow additional sulfuric acid to be produced. Lime is again applied and the process repeated until the pH remains stable. At that point, the total lime requirements can be determined.

If the amount of lime required is in excess of 20 to 30 tons per acre, as determined by the incubation method, its use may not be practical for the following reasons: 1. The uniform incorporation of this much lime into the top 6-8 inches of reclaimed surface mine land is nearly impossible. 2. This much lime applied at one time, will initially push the pH well above 7.0, and years may be required for all the sulfides to oxidize and the pH stabilizes within a desirable range. In other words, it is impractical to overload with lime to allow for anticipated acidity.

Once the determination is made of the lime requirements and a decision is reached that liming is not a practical solution, the next most logical approach is to cover the affected area with adequate soil cover to reduce or eliminate additional oxidation and provide a medium in which vegetation can grow. Two obvious questions then arise:

1. How deep must the soil cover be to adequately support vegetation and restrict oxidation?

2. Will the acid in the subsoil move up into the cover material and if so, how far and how fast?

Recent unpublished studies shed some light on this.

Study #1

This was conducted in Ocean County, New Jersey, by the SCS Plant Materials Center at Cape May, New Jersey, on a subsoil with a silty clay loam texture and a pH range of 2.2 to 3.3. Liming treatments used on this site were 0, 5,10,15 and 20 tons per acre applied on the surface of the acid spoil without incorporation. Cover material was a loamy sand coastal plain subsoil with a pH of 5.5. The cover material was applied at either 6 or 12 inch depths. It was then fertilized with 1,000 pounds per acre of 10-10-10 and seeded with either deertongue, tall fescue, switchgrass, or weeping lovegrass-sericea lespedeza mixture. The species were planted across each lime-cover variable.

After three growing seasons, all species were producing satisfactory cover for erosion control on all lime treatments and soil cover depths. Table 1 shows the pH of the cover and spoil material after three growing seasons.

Table 1 - pH of spoil and cover material as affected by lime treatment and depth of cover material placed on the spoil.

Tons lime per acre	6" fill Sampling Depths[1]				12" fill Sampling Depths[1]			
	3"	6"	7"	10"	6"	12"	13"	16"
0	4.9	4.3	3.2	3.2	5.0	4.0	2.8	2.5
5	4.6	4.6	3.3	3.0	5.6	4.7	3.0	2.8
10	5.1	4.9	3.0	2.9	6.0	5.2	2.9	2.4
15	5.2	4.6	3.2	3.1	4.6	4.3	3.0	2.5
20	4.9	5.1	2.9	2.4	5.7	5.2	2.6	2.4

[1] On the plots with 6 inch fill the sampling depth of 6 inches was immediately above the spoil and the 7 inch sampling depth was just into the spoil. The 12 inch sampling depth in the plots covered with 12 inches of fill was just above the spoil and the 13 inch sampling depth was just into the spoil.

Five years after planting, the tall fescue was thinning due to drought and lack of fertilizer. Weeping lovegrass had mostly winter killed. The switchgrass, deertongue, and lespedeza has remained stable or is improving. A perceivable benefit is evident in the growth of vegetation on the 12 inch versus then 6 inch depth of cover material. Both are providing ground cover in excess of 50 percent.

Root penetration in all plots went to the surface of the spoil and stopped.

Study #2[1]

This study was conducted in Macoupin County, Illinois. The site was a coal mine gob pile with a generally course texture but containing pockets of finer material. The pH of the gob was approximately 3.8 at the start of the study in 1977. The gob was limed at 2 rates, 50 or 100 tons per acre and disked into a depth of 6 inches.

The gob was covered with 0,6,12, or 24 inches of subsoil material with a clay loam-silt texture. Where cover was used, five tons per acre of lime was applied and disked in 6 inches.

By 1978, the seeded species, consisting of several grasses and birdsfoot trefoil, accounted for most of the plant cover and production on the areas which received cover material. The plot without cover produced no vegetation regardless of liming treatment and was dropped from the study. In 1979, the birdsfoot trefoil remained only in the 24 inch plots. Growth of perennial grasses, including, Blackwell switchgrass, smooth brome, and little bluestem were performing satisfactory on all plots. Growth in 1980 was less on the plots receiving the lower lime treatments, but has not been influenced by the depths of cover. Roots are not penetrating the gob which may account for the lack of trace elements being found in the vegetation. Table 2 shows pH ranges for 1977-79.

Table 2-Range in Mean pH over 6 Depth Lime Treatments

Depth Increment	1977	1978	1979
Surface: (0-3 inches)	5.7-6.8	5.8-7.0	6.4-6.9
Interface: (3 inches above gob)	4.8-5.3	4.0-5.8	4.7-5.9
Gob: (3 inches below gob)	3.8-7.2	3.5-5.7	3.1-4.1

[1] This study was conducted by Anthony J. Dvorak, Mark L. Knight, Barbara K. Mueller, and Julie D. Jastrow of Argonne Laboratories, 9200 Caste Ave, Argonne, Illinois. It is continuing and the results will be published upon completion of the study. The use of this unpublished data is through the courtesy of the investigators.

The surface pH in Table 2 reflects the limed cover material and the interface probably reflects the pH of the unlimed cover material. Note the higher pH ranges of the gob in 1977 and the general drop in their values

thru 1979. The 1977 values may reflect the initial lime treatment and suggests the initial affect of the lime is being neutralized as acid is being produced in the gob. The pH of the surface has gone up, suggesting the ground limestone which was used in 1977 is becoming effective. The pH of the interface (3 inches above the gob) has not changed in three growing seasons.

Summary of The Use of Lime and Soil Cover to Produce Protective Vegetation on Acid Spoil

Adequate data is not available at this time to develop firm recommendations for the treatment of extremely acid spoil. Data available suggests the following to assist in reaching the most practical solution. They apply when spoil is encountered containing sulfides sufficient to produce a pH below 4.0.

1. Determine the amount of lime needed to neutralize the acid potential in the surface 6-8 inches.

2. If it exceeds 20-30 tons, it may not be practical to effectively stabilize the pH at a level where vegetation can be sustained. Covering the spoil becomes the best solution.

3. The spoil must be graded to provide adequate drainage and avoid ponding areas.

4. The value of liming the spoil prior to applying the cover material is unclear at this time, but limited evidence suggests it is worthwhile. Amounts in excess of 20 tons per acre is questionable.

5. Apply cover material. The depths will be somewhat influenced by the texture of the spoil, the quality of the cover material and the type vegetation one wishes to grow on it. If plants requiring considerable moisture are to be used and the texture of the cover material is coarse, then a greater depth will be needed. If a drought tolerant species like Blackwell switchgrass is used, and the texture of the cover is medium or fine, the depth needed may not be as great. Under any circumstances, the depth of fill should not be less than 6 inches and little justification exists for it to be in access of 12 inches if the purpose is only to stabilize the site against erosion.

6. Following the cover application, lime and fertilize to meet the requirements of the species being used, and make the planting using the best agronomic practices available.

Kirkham

United States Department of Agriculture

Soil Conservation Service

1370 Hamilton Street
Somerset, NJ 08873

Subject: 330-MGT - STC Advisory Committee Recommendation on Acid Soils

Date: April 9, 1982

To: Don W. Hamer, Asst. Manager, PMC, Cape May, NJ
Foy D. Hendrix, Agronomist, Raleigh, NC
Sherman L. Lewis, State Conservationist, Amherst, MA
George C. Norris, Deputy State Conservationist, Raleigh, NC
Thornton H. Secor, SRC, College Park, MD
Frank H. Webb, PMS, Somerset, NJ
Henry J. Ritzer, SRC, Amherst, MA
Cluster R. Belcher, Manager, PMC, Cape May, NJ
Norman O. Wilson, Forester, Richmond, VA
Obie D. Ashford, SRC, Somerset, NJ
Everett C. Stuart, SRC, West Warwick, RI
Francis L. Zaik, SRC, Storrs, CT
Arthur B. Holland, Director, NTC, Broomall, PA
Plater T. Campbell, State Conservationist, Somerset, NJ

The attached material, developed by Cluster Belcher, is provided relevant to recommendation #2 by the Cape May Advisory Committee at the October 7, 1981 meeting.

This information refers specifically to recommended testing procedures and supplements existing data on stabilization of acid soils.

Plater T. Campbell

PLATER T. CAMPBELL
State Conservationist

attachment

Soil?

Acid Soil Treatment

This is in response to Recommendation No. 2 from the Cape May State Conservationist's Advisory Committee that met October 7, 1981. The recommendation is to determine the analyses required on acid soils before suggesting vegetative treatments.

Two technical notes prepared during the past two years address this problem. They are NE Technical Note PM No. 9 Use of Lime and Soil Cover to Provide Vegetation on Extremely Acid Soils and New Jersey Technical Note 28 Vegetation of Acid Soils. The following statements supplement the contents of these references.

I discussed analyses and treatments for acid soils, especially those with low pH values and having high residual sulphur contents with Professor Roy Flannery, Cook College, Rutgers. He has conducted research on extremely acid soils and is in charge of the Soil Laboratory.

Dr. Flannery suggested that the Incubated lime requirements procedure be conducted on extremely acid soils rather than a simple pH test. This is more expensive and may require up to 8 weeks but the results are much more dependable than the regular pH test. In an analyses of a low pH soil sample by Steven Toth, the regular pH test indicated the lime requirement to be 4 tons/acre. Subsequent analyses over a period of several weeks resulted in a lime requirement of 80 tons/acre. Soil texture is determined as a matter of routine for each sample.

Based on the discussion with Dr. Flannery, an incubated lime requirement analyses is the only one that is essential for recommending soil amendments in the vegetation of acid soils.

I did some calculations on rates of limestone application. These calcultations indicate that limestone broadcast at a rate of 100 tons/acre would be less than one inch thick and maybe as thin as one-half of an inch. Dr. Flannery did not see any problem with working this rate of limestone into the soil with a rotary tiller or disc harrow.

Since the question of incorporation has been resolved, let's look at costs of lime vs. topsoil. Price quotations were from construction companies in Cape May County. These are price quotes and my be slightly more expensive than an actual bid. The limestone quote was from a Pennsylvania firm that supplies Cape May County. The Notes infer that no less than four inches of topsoil should be used and six inches may not be sufficient. A comparison is made between 100 tons of limestone per acre delivered and spread and six inches of low quality topsoil dumped but not leveled.

Treatment (1 acre)		
1. 100 tons lime	(within 5 miles of quarry)	$1,455.
	(Cape May County)	$2,380.
2. Topsoil 500 cubic yards (6 inches deep)	(within 5 miles of site)	$4,000.
	(within 20 miles of site)	$4,500.

The cost of one-half acre foot of topsoil is clearly more expensive than 100 tons of limestone. Spreading and leveling of the topsoil would be an extra expense but would cost more than the incorporation of the lime. However, the cost of the topsoil would be somewhat less than stated if it was on site and would be moved only a short distance.

The 100 tons of limestone per acre and 6 inches of topsoil were selected as likely extremes. Most acid soils will probably have an incubated lime requirement of less than 100 tons while some might exceed this value. In our work, six inches of good quality topsoil over acid soil on level sites seems to be sufficient. However, six inches of topsoil or maybe one and one-half feet may not be sufficiently thick to prevent acid seeps from surfacting on unlevel sites.

CAPE MAY PMC STAFF
March 1982

Acid Soil Supplement E

New Jersey Department of Environmental Protection (NJDEP): 1983 SCS letter to NJDEP; 1984-1985 NJDEP rules, technical notes, and strategy; 1995-1996 NJDEP rules and general permit fact sheet

December 8, 1983 Soil Conservation Service (SCS) letter endorsing NJDEP Mitigation Procedures for Acid Producing Deposits

Excerpts from NJDEP adoption notice for the Flood Hazard Area Regulations, N.J.A.C. 7:13, effective May 21, 1984

See N.J.A.C. 7:13-5.10 (Projects exposing acid-producing deposits) and N.J.A.C. 7: 13-5.2(d)

Excerpts from NJDEP Flood Plain Management Technical Manual, Stream Encroachments (August 1984)

See Section 3.6, “Technical Notes Concerning Acid-Producing Deposits”

Excerpts from NJDEP Statewide Water Quality Management Program Plan (December 1985)

See the “Acid-Producing Deposits” strategy (pages II-24 through II-27)

Excerpts from NJDEP adoption notice for the Flood Hazard Area Control Rules, N.J.A.C. 7:13, effective March 20, 1995

See N.J.A.C. 7:13-3.7 (Projects exposing deposits of acid-producing soils), N.J.A.C. 7: 13-1.3(a) and 4.1(j), and Comments-Responses 247, 248, and 249

Excerpts from February 5, 1996 NJDEP Fact Sheet for Revocation and Reissuance of NJPDES General Permit No. NJ0088323 (the "construction activity" general NJPDES stormwater permit)

See “E. Acid-Producing Deposits” (Section III.E) on page 19, closely related Section IV.A.2 paragraph on pages 38-39, and last paragraph on page 37

3:11

United States Department of Agriculture
Soil Conservation Service
1370 Hamilton Street
Somerset, NJ 08873

December 8, 1983

Mr. George Horzepa, Chief
Bureau of Planning and Standards
NJ Department of Environmental Protection
Division of Water Resources
P.O. BOX CN 029
Trenton, NJ 08625

Dear Mr. Horzepa:

As requested by your letter of November 7, 1983, we have reviewed the copy you provided of Mitigation Procedures for Acid Producing Deposits.

An excellent job was done in the preparation of this document. We have no suggestions for changes or additions.

Sincerely,

CARL J. MONTANA, P.E.
State Conservation Engineer

cc: Wendell Kirkham

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(a)

DIVISION OF WATER RESOURCES

Flood Hazard Area Regulations

Adopted New Rule: N.J.A.C. 7:13
Adopted Recodification: N.J.A.C. 7:13-1.11 to N.J.A.C. 7:13-7

Proposed: December 19, 1983 at 15 N.J.R. 2104(a).
Adopted: May 4, 1984 by Robert E. Hughey, Commissioner, Department of Environmental Protection.

Filed: May 7, 1984 as R.1984 d. 201, **with substantive and technical changes** not requiring additional public notice and comment (see N.J.A.C. 1:30-3.5).

Authority: N.J.S.A. 58:16A-50 et seq., N.J.S.A. 58:10A-1 et seq. and N.J.S.A. 13:1D-1 et seq.

Effective Date: May 21, 1984.
Expiration Date pursuant to Executive Order No. 66 (1978): May 4, 1989.
DEP Docket No. 068-83-11.

Summary of Public Comments and Agency Responses and Reasons for changes:

The Department has undertaken a substantial public participation process to insure that consideration is given to all concerns of the State's citizens and industries, potentially impacted by these rules. These rules were informally pre-proposed in June of 1983 and three regional public hearings were held. Numerous comments were received by the Department both at the hearings and in writing. These comments were discussed in the New Jersey Register Notice, formally proposing these rules on December 19, 1983 (15 N.J.R. 2104). As the preamble to the proposal indicated, various changes in the rules were made in response to these comments.

As part of the public participation process associated with proposal of the rules, two additional public hearings were held and written comments were received. Most of these comments were similar to those received during the pre-proposal phase of the rule-making process.

NET FILL

As with earlier comment, the largest single issue raised in the public comment process relates to the Department's insistence that flood plain development be governed by a firm standard. The Department staff has determined that only steadfast restrictions on the amount of "net fill" allowed in flood hazard areas will result in effective flood hazard protection, as required by the Flood Hazard Area Control Act, N.J.S.A. 58:16A-50 et seq. This means that areas which may be flooded at some time in the future, can only be filled-in up to the amount of fill (net fill) allowed by these rules. Net fill in flood hazard areas, except in the Central Passaic River Basin where no net fill is allowed, is limited to filling up to 20 percent of the space now available to flood waters. It is this "20 percent net fill" rule that has caused the greatest concern in the adoption of these rules. The rule states: "**N.J.A.C. 7:13-4.7(d)1.** Within the flood fringe area of delineated streams or within the 100-year flood plain but outside of encroachment lines of non-delineated streams, the volume of net fill and structures to be placed on an applicant's site shall be limited to occupying 20 percent of the total volume between the natural ground surface of the applicant's property and the level of the flood hazard design elevation along delineated streams or the 100-year storm elevation along non-delineated streams." Contrary to the conclusion suggested by certain commentors, this rule does not mean that only 20 percent of the land surface in flood hazard areas may be developed. Proper planning of the grading and filling of a property will usually permit the use of much more than 20 percent. This is especially true when one considers that such things as roads, lawns and parking areas do not usually contribute to the net fill quantity.

Numerous commentors expressed strong support for the position of Department staff to propose a clear and unambiguous standard for regulatory control. Several of these citizens and public interest groups stated that a "no-net-fill" standard for the entire State was their desire, but that any firm standard is better than the situation without such a rule.

Commentors representing landowners and developers objected to the net-fill standards as being arbitrary. They asserted that there is inadequate technical support to justify the setting of a strict standard. Though the Department does not concede that the net-fill limits lack any needed technical support, several comments revealed an apparent misunderstanding of what categories of facts are proper to be considered by a regulatory agency when it sets control standards. Misunderstanding is also revealed by criticism of the Department's position that it is appropriate to consider environmental impact factors in the review of major stream encroachment applications. Clearly, technical data is an important part of the foundation for rule-making. However, several other criteria must be considered if the Department is to adequately fulfill its legislative mandates.

Among the factors to be considered is historical experience. The literature of flood history in New Jersey and elsewhere reveals that no effective control of flooding has occurred or will occur until development in flood hazard areas is brought under effective control. A variety of control systems have been implemented by State and Federal governments. Their inadequacy is evident in the statistics of continual increase in flood damage and loss of life. These programs all contain the uncertainty of application which developers seek to retain, under the name of flexibility. The results can be witnessed virtually every Spring and Fall. Experts in the Department have examined the records of experience of many government efforts to control flooding. They are convinced that a strict standard must be set, or the continual increase in flood damages will result.

A second factor must be considered when evaluating the reasonableness of a strict, net-fill requirement. Critics of this approach appear to perceive the Department as a group of autonomous programs with totally separate legal objectives. According to this logic, the flood hazard area regulations may only concern themselves with flooding. The Department constantly attempts to overcome this tunnel-vision by looking to the many laws which describe what this Department is to do. The Legislature has instructed the Department to protect the environment by controlling discharges of sediments and other pollutants into the streams and rivers of the State, by protect-

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sites of any excavated materials except material recovered from stream cleaning.

(i) Retention and detention basins for storm water management: Retention and detention basins for storm water management within the flood fringe area along delineated streams or between encroachment lines and the 100-year floodplain along non-delineated streams shall be constructed in accordance with criteria of the State Storm Water Management Regulations (N.J.A.C. 7:8).

(j) Manhole requirements under regulated uses: If manholes are to be located within the flood fringe area along delineated streams or between encroachment lines and the 100-year floodplain along non-delineated streams, they shall be flush with ground level and provided with watertight manhole covers.

(k) Minimization of environmental damage:

1. Consideration shall be given to short and long term primary environmental effects of any stream encroachment whether or not it is classified or handled as a Project of Special Concern.

2. Stream encroachment projects shall be carried out in such a manner that the pollution, impairment, or destruction of the environment as related to the flood hazard area, is minimized to the extent practicable. Federal, State, and local statutes, regulations, and ordinances designed to minimize or prevent such damage shall be complied with.

(l) Sewage disposal requirements under regulated uses: Individual sewage disposal systems within the 100-year floodplain but outside of encroachment lines or within the flood fringe area shall be constructed in accordance with the Department's Standards for the Construction of Individual Subsurface Sewage Disposal Systems, N.J.A.C. 7:9-2.

SUBCHAPTER 5. SPECIAL CASES

7:13-5.1 General provisions

(a) To help assure adequate protection of the State's aquatic life and water resources from the adverse impacts of some kinds of stream encroachments, special procedures and standards have been prepared to supplement the general standards. These special requirements include the following:

1. The classification of some kinds of stream encroachments as "Projects of Special Concern"; and

2. The establishment of special standards for various kinds of stream encroachments affecting selected geographic areas.

3. The general standards in subchapter 3 and 4 remain applicable to any stream encroachment to which this subchapter is applicable, except insofar as the requirements of this subchapter are more stringent.

(b) As described in N.J.A.C. 7:13-5.2, Projects of Special Concern are stream encroachment projects which, because of their potentially serious adverse effects, will not be approved unless denial of the application would damage the public interest, cause hardship to the applicant, or produce costs disproportionately large relative to the adverse effects of the project.

1. Some kinds of stream encroachment projects are always classified as Projects of Special Concern.

2. Other kinds of stream encroachment projects may be classified as Projects of Special Concern depending on geographic location or on the characteristics of the individual projects.

3. Projects of Special Concern are subject to special requirements for public notice and fact-finding meetings.

(c) Dams built for any purpose are subject to special requirements for public notice and fact-finding meetings described in N.J.A.C. 7:13-5.3.

7:13-5.2 Projects of Special Concern, defined

(a) A Project of Special Concern shall be any stream encroachment project in perennial streams with over 50 acres of drainage area, which involves either or both of the following:

1. Channelization or relocation of a stream for a distance over 100 feet (except for low-flow channels constructed as part of a detention basin) or for a distance over 300 feet on either side of a bridge or culvert; or

2. Loss of more than 6,000 square feet of the existing woodland within 25 feet of the banks.

(b) Where a project is performed in phases and two or more applications are submitted, the total length of the affected stream segment shall be used in applying the criteria in (a) above.

(c) In addition, stream encroachment projects which the Department determines would be likely to produce serious adverse effects on the water resources of the State *[may]* ***shall*** also be handled as Projects of Special Concern. Such effects *[may]* ***shall*** include, but are not limited to, the following:

1 Potential serious adverse effects on the biota of the stream, the adjoining wetlands, or on the sites where dredge spoils are to be disposed of including, but not limited to, rare or endangered species.

2. Potential serious degradation of water quality below the Department's Surface Water Quality Standards or Ground-Water Quality Standards.

3. Potential serious adverse effects on water resources including, but not limited to, adverse effects on potable water supplies, flooding, drainage, channel stability, navigation, energy production, municipal, industrial, or agricultural water supplies, fisheries or recreation. Such adverse effects include damage to potential as well as existing water uses.

(d) Projects affecting the following are always Projects of Special Concern in the indicated geographic areas:

1. Trout-associated streams:

i. Stream encroachment applications requiring loss of more than 6,000 square feet of the existing woodland within 50 feet of the banks of perennial trout-associated streams; or

ii. Construction of low dams across perennial, trout-associated streams, except for the reconstruction or repair of existing dams.

2. Acid-producting deposits: Stream encroachment projects causing exposure of acid-producing deposits along more than 50 feet of stream channel, if the drainage area of the stream is over 50 acres. However, this applies to smaller streams if the stream is trout-associated and if the stream is perennial.

7:13-5.3 Procedural requirements

(a) The Department shall *[not]* ***neither:***

1. *Delegate to any other agency its power to approve or disapprove any stream encroachment application that is classified or handled as a Project of Special Concern *[or]* ***nor***

2. *Process any such application on an over-the-counter basis.

(b) Concurrent with submitting any application for a Project of Special Concern, the applicant shall publish a public notice in a local newspaper stating the name of the applicant and the location, reference number, and description of the

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Department's Coastal Resource and Development Policies (N.J.A.C. 7:7E), including policies concerning shellfish beds (N.J.A.C. 7:7E-3.2), maintenance dredging, new dredging, and dredge spoil disposal (N.J.A.C. 7:7E-4.10), and potentially productive shellfish area (N.J.A.C. 7:7E-8.3).

***7:13-5.9 Projects involving bridges which traverse a floodway**

Bridge approaches for bridges which traverse a floodway shall be considered as part of the permit application submitted to the Department for the bridge.*

[7:13-5.9] ***7:13-5.10*** Projects exposing acid-producing deposits

(a) Applicability of this section follows:

1. The requirements of this section apply only to acid-producing deposits that are sometimes found in the following Coastal Plain geologic formations:

i. Raritan Formation;
ii. Magothy Formation;
iii. Merchantville Formation;
iv. Woodbury Clay;
v. Englishtown Sand;
vi. Marshalltown Formation;
vii. Navesink Formation;
viii. Red Bank Sand; and
ix. Kirkwood Formation.

2. These formations are mapped on the "Geologic Overlay" maps published by the Department for the Department's topographic atlas sheets. A map showing the general location of these deposits can be found in the Manual.

(b) Except where otherwise provided in this section, the requirements of this section apply only to stream encroachments which result in:

1. Exposure of acid-producing deposits (to air or surface waters) within the stream channel or among the stream bank(s); or

2. Exposure of more than 1,000 square feet of acid-producing deposits within the floodway or encroachment lines.

(c) The requirements of this section are applicable to such stream encroachment projects whether or not such stream encroachments are classified as "major" or "minor" in the 90-day construction permit rules (N.J.A.C. 7:1C) or are classified or handled as Projects of Special Concern.

(d) Where it is known in advance that acid-producing deposits would be exposed by the proposed stream encroachment, the stream encroachment application shall include a written site evaluation prepared by a properly qualified person approved by the Department, that identifies the extent of exposure, a plan to mitigate the impacts of such exposure, and the result of the special laboratory analysis, if required by (h) below.

(e) If a stream encroachment application submitted directly to the Department does not include a site evaluation and mitigation plan and if the Department knows or has reason to believe that acid-producing deposits would be exposed by the proposed stream encroachment, the Department shall, within a maximum of 20 working days of receipt of the application, notify the applicant in writing that the application shall not be considered complete until a site evaluation and mitigation plan deemed acceptable for review is received by the Department.

(f) If the Department accepts as complete a stream encroachment application that does not include a site evaluation and mitigation plan, but subsequently determines that acid-producing deposits would be or have been exposed by the stream encroachment, the Department shall:

1. Request the applicant to submit a site evaluation and mitigation plan within an allotted time period; or

2. Disapprove the application if the application has not yet been approved and if a site evaluation and mitigation plan is not received; or

3. Order the applicant to desist from further exposure of acid-producing deposits and to apply mitigation procedures to deposits already exposed, pending submission to and approval by the Department of a site evaluation and a mitigation plan.

(g) The Department may specify the use of simple chemical tests for use in the field or laboratory to identify the presence of acid-producing deposits.

(h) Speical laboratory analysis:

1. If a stream encroachment application has been submitted and the Department determines that a proposed stream encroachment would expose acid-producing deposits along more than 100 feet of stream channel or stream bank and if the Department determines that information about characteristics of such deposits is needed for the Department's decision to approve or disapprove the stream encroachment application, the department may require the site evaluation (see (d) above) to include the results of the following chemical analysis, performed using methods specified in the Manual by a certified lab, on samples of such deposits taken from preconstruction borings along such stream channel or bank:

i .pH;
ii. Cation exchange capacity;
iii. Exchangeable cation content;
iv. Potential acidity; and
v. Extractable metals (Fe, Al, Mn, Cu, Zn, Ni, Cr, Cd, Pb) and sulfate.

2. The department may also require laboratory analyses of physical characteristics. These chemical and physical tests shall be performed by the applicant in accordance with procedures specified by the Department. Pending submission of the results of the tests to the Department, the application shall be considered incomplete or disapproved in accordance with the provisions of N.J.A.C. 7:13-2.8.

(i) When acid-producing deposits are to be exposed as the result of a stream encroachment, mitigation measures shall be taken to:

1. Minimize the extent and period of exposure of acid-producing deposits;

2. Minimize the spreading or mixing of acid-producing deposits onto or into soil free of such deposits and control the disposal of such deposits inside or outside the flood hazard area or the 100-year floodplain.

3. Cover acid-producing deposits with a sufficient quantity of limestone and of non-acid-producing soil to permit the establishment of vegetation; and

4. Provide for prompt, temporary and permanent stabilization of areas where acid-producing deposits were exposed.

(j) When acid-producing deposits are exposed within a stream channel or along stream banks as the result of a stream encroachment, mitigation procedures shall be applied in order to:

1. Minimize the period of exposure;

2. Keep post-construction oxidation rates from exceeding preexposure oxidation rates; and

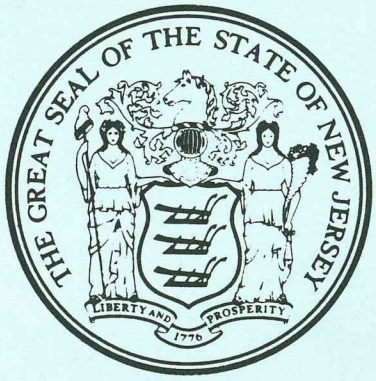
3. Neutralize acid generated in the brief period of exposure.

Flood Plain Management

TECHNICAL MANUAL

FOR

STREAM ENCROACHMENT



AUGUST, 1984

Prepared by:

Bureau of Flood Plain Management

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Department of Environmental Protection · Division of Water Resources

EXCERPT

This excerpt from the NJDEP "Flood Plain Management Technical Manual for Stream Encroachment" (August 1984) is limited to:

- Section 1

- The Section 3 cover page, and the full text of Section 3.6, “Technical Notes Concerning Acid-Producing Deposits”

This searchable version was processed with text recognition software, and has text recognition errors.

SECTION 1: INTRODUCTION AND PURPOSE OF THE MANUAL

The purpose of this Manual is to facilitate the preparation and processing of stream encroachment permit applications. The Manual has been prepared in looseleaf form to allow for convenient revisions at later dates.

Section 2 of the Manual contains the directly applicable regulations whereas the Law (Flood Hazard Area Control Act) governing the program and necessary forms are provided in the Appendix. Section 3 is technical in nature, dealing with design and construction methodology, and the prevention or mitigation of adverse environmental impacts. The technical details in this section explain how to make engineering computations required in certain cases, and specify the required engineering practice for construction in and near channels. The section also provides engineering standards for safe and durable structures which will not be unduly vulnerable to erosion and will help applicants meet the requirements of the Flood Hazard Area Regulations (hereafter Regulations).

The Law and Regulations are of course controlling, and no provisions of the technical or procedural material should be understood to modify in any way the provisions of the Law or Regulations. The technical material is provided for general guidance; but circumstances may arise in which deviations may be allowed as a matter of engineering judgment or when a balance among conflicting objectives is necessary.

The Bureau of Flood Plain Management within the Division of Water Resources administers the Stream Encroachment Program but not all stream encroachments require approval of the Bureau. On stream locations with a drainage area less than 320 acres and for general stream cleaning and maintenance projects, certain approval authority is vested in local or county authorities, as defined in the Regulations. Also certain farming practices which would otherwise constitute stream encroachments may be reviewed by the local Soil Conservation Districts. For the Flood Fringe Areas of delineated streams the Regulations make specific provisions for delegation of the regulatory authority to municipal governments. In these cases, the general criteria for protecting the environment are still applicable; but the procedures and requirements of information may be varied by the local authorities. The Regulations should be consulted for specific details.

In any case of proposed construction which may involve a stream encroachment, the applicant should first consult the Regulations (and, if necessary, appropriate references cited in the Regulations), to determine whether the project site is near a non-delineated or delineated stream, and, if the latter case, whether it is in the floodway or the flood fringe area. In each case different requirements apply, and these are stated in the Regulations. There are also special requirements stated in the Regulations for projects in or along trout streams, for projects affecting shellfish areas, and for projects exposing acid producing deposits.

The applicant should also check the Regulations to determine the classification of the project itself, since the scope and magnitude of work proposed also affect some of the criteria and technology applicable. The criteria applicable to the class of the proposed project, in the class of flood plain in which it is located, may be determined from the Regulations. The definitions of "major and "minor" stream encroachment projects, applicable fee schedules, and procedures for over the counter processing of stream encroachment projects are given in the Ninety-Day Construction Permit Rules.

Enforcement procedures for monitoring, reporting and processing of stream encroachment violations of the Law are covered in Section 4 of the Manual.

The provisions of this Manual apply to fluvial rivers and streams and not to coastal waters or off stream lakes or ponds. The Regulations should be consulted for more exact limitations and for a list of coastal waters that are excluded from the Scope of the Regulations.

SECTION 3

TECHNICAL NOTES

3.6 TECHNICAL NOTES CONCERNING ACID-PRODUCING DEPOSITS

3.6-1 Introduction

Upon exposure to oxygen from the air or from surface waters, iron sulfide minerals (pyrite or marcasite) oxidize and produce sulfuric acid. For this reason, geologic deposits which contain such minerals are called "acid-producing deposits". The sulfuric acid increases the solubility of metals to the extent that the metals can become toxic to aquatic life or land vegetation, or can reach concentrations undesirable in sources of potable water supply. This section describes how acid-producing deposits can be identified and provides guidelines to prevent or minimize the problem of water pollution and soil contamination that may otherwise be caused by exposure of these acid-producing deposits.

The following geologic formations in the Coastal Plain physiographic province in New Jersey sometimes contain substantial acid-producing deposits:

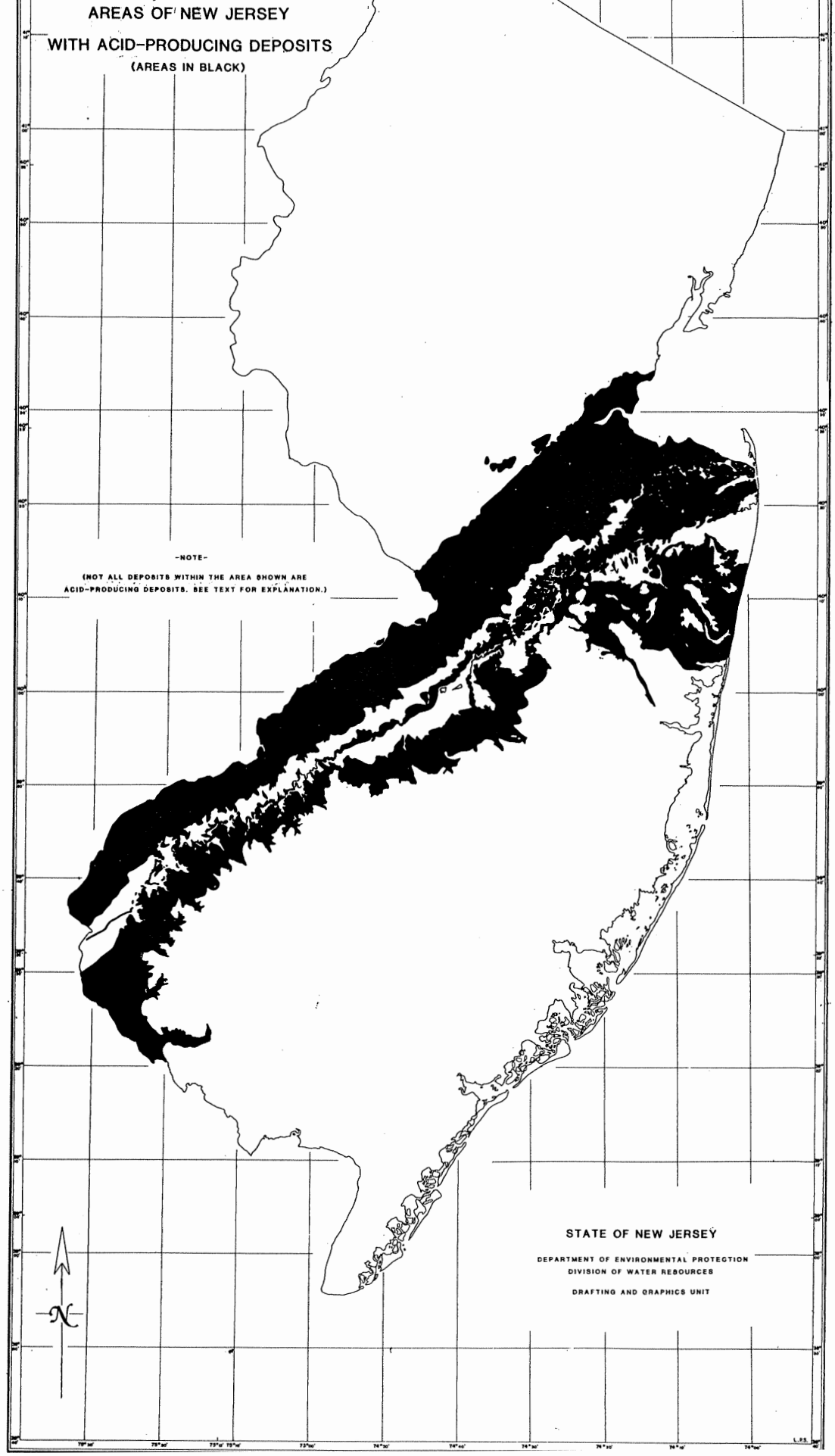
Raritan Formation
Magothy Formation
Merchantville Formation
Woodbury Clay
Englishtown Sand
Marshalltown Formation
Navesink Formation
Red Bank Sand
Kirkwood Formation

These formations are mapped on the "Geologic Overlay" maps published by the Department for its topographic atlas sheets. Figure 3.6-1(A-1) provides the general location of these formations. Not all deposits within these formations are acid-producing deposits, and only selected members of the Englishtown Sand, Red Bank Sand, and Kirkwood Formation contain acid-producing deposits.

As discussed in the following subsections, one principal method of preventing or minimizing these problems is to minimize the rate at which acid is produced, by minimizing the time during which acid-producing deposists are exposed. The prompt burial of acid-producing deposits under one foot of soil reduces the availability of oxygen and therefore the rate at which acid is produced. The establishment of vegetation on extremely acid soils resulting from exposure of acid-producing deposits is discussed in two recent U.S. Department of Agriculture, Soil Conservation Service Technical Notes: NE Technical Note PM No. 9 Use of Lime and Soil Cover to Provide Vegetation on Extremely Acid Soils (May, 1981) and New Jersey Technical Note 28 Vegetation of Acid Soils. (January, 1980). The current Standards for Soil Erosion and Sediment Control in New Jersey require that "soils having a

AREAS OF NEW JERSEY WITH ACID-PRODUCING DEPOSITS

(AREAS IN BLACK)



-NOTE-

(NOT ALL DEPOSITS WITHIN THE AREA SHOWN ARE ACID-PRODUCING DEPOSITS. SEE TEXT FOR EXPLANATION.)

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DIVISION OF WATER RESOURCES

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pH of four (4) or less or containing iron sulfide shall be covered with a minimum of twelve (12) inches of soil having a pH of five (5) or more before seedbed preparation" (page 3.21).

3.6-2 Site Evaluation:

When excavation in any of these nine geologic formations is being considered, preconstruction borings should be taken to a depth one foot greater than the proposed depth of excavation. The entire length of such borings should be examined for the possible presence of acid-producing deposits. Acid-producing deposits are typically found in gray, dark brown, or black materials (sometimes with a greenish tinge) which have a clay-plus-silt content exceeding thrity (30) percent on a dry weight basis.* (Not all such materials, however, are acid-producing deposits.) Sandier materials, or reddish, yellowish, or light to medium brown materials, are basically free of acid-producing deposits. Acid-producing deposits may be dominant in a particular profile, or may be confined to specific layers or lenses in the profile. Crystals of pyrite or marcasite are positive evidence of acid-producing deposits, but sometimes the crystals are too small for recognition by ordinary means in the field. Simple chemical tests, described in the following section, are useful for identifying acid-producing deposits that contain these very small crystals. Detailed logs of preconstruction borings and the location and results of chemical tests should be submitted for review. The simple chemical tests should be performed on gray, dark brown, or black (sometimes greenish) materials which have a clay-plus-silt content exceeding thirty (30) percent on a dry weight basis*, or which are suspected of being acid-producing.

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*In the ASTM Soil Classification System (Unified), a clay-plus-silt content exceeding thirty (30) percent on a dry weight basis corresponds to the SC, CH, CL, and ML classifications. In the USDA system, the approximately equivalent textural classes are:

Clay, silty clay, sandy clay, clay loam
Silty clay loam, sandy clay loam
Loam, silt loam, silt.

The nine geologic formations listed above can be divided into two classes, as follows:

Class I	Class II
Raritan Formation	Merchantville Formation
Magothy Formation	Woodbury Clay
Englishtown Sand	Marshalltown Formation
	Navesink Formation
	Red Bank Sand
	Kirkwood Formation

In Class I formations, clayey deposits (some of which contain acid-producing deposits) are (in general) distributed irregularly throughout the formation in beds, lenses, and pods of highly variable thickness. In Class II formations, the entire formation consists of clayey deposits (Merchantville Formation, Woodbury Clay, Marshalltown Formation, Navesink Formation), or the clayey deposits are restricted to a thick bed in one part of the formation (Red Bank Sand, Kirkwood Formation). As a general guideline, preconstruction borings should be spaced 200 feet apart in Class I formations and 500 feet apart in Class II formations. These spacings may be modified as local geological conditions warrant. The applicant should seek prior approval of the Division of Water Resources.

3.6-3 Chemical Tests for Acid-Producing Deposits

Two simple tests for pH and sulfate should be performed in the field or laboratory during preconstruction investigations and during construction to identify the presence of acid-producing deposits. (These tests are especially useful for identifying deposits containing very small crystals of pyrite or marcasiste that cannot be recognized by ordinary means in the field). Strictly speaking, these tests give positive results only when the samples from an acid-producing deposit have oxidized or have begun to oxidize. When the results of both tests are positive, the presence of acid-producing deposits is confirmed. However, negative results in field tests do not prove the absence of acid-producing deposits since the samples may not have undergone appreciable oxidation before the field tests were performed. When results are positive in one of the two field tests, or when for other reasons deposits are suspected to be acid-producing, additional samples should be brought to the laboratory so that the tests may be repeated on laboratory-oxidized samples (see Section 3.6-3(c)). This applies particularly when in a field test the pH value in calcium chloride solution is between 3.0 and 4.0

Exact same soil samples should not be used for both tests. Instead, soil samples should be mixed and divided into two parts, one part to be tested for pH and the other to be tested for sulfate.

3.6-3(a) pH Value in Calcium Chloride Solution

1. General Discussion

The pH value of a suspension of soil material in distilled water measures only the activity of the dissociated hydrogen ions. Many more hydrogen ions remain adsorbed on the cation exchange surfaces of the soil material particles. When soil material is instead suspended in a moderately strong solution of calcium chloride, calcium ions displace hydrogen ions from the cation exchange surfaces. The displaced hydrogen ions go into solution, whose pH is then measured (Reference No. 23). So long as calcium ions are present in excess, the exact concentration of calcium ions in the suspension is not critical (this concentration will vary somewhat with the moisture content, bulk density, cation exchange capacity, and base saturation of the soil material sample).

Solutions of calcium chloride in distilled water are generally alkaline or acidic because of impurities in the dry calcium chloride reagent. The calcium chloride solution is made neutral by the addition of hydrochloric acid or sodium hydroxide before the solution is mixed with the soil material sample.

2. Apparatus

i. pH meter - Consisting of potentiometer, glass electrode, reference electrode, and a temperature compensating device. Standardize according to manufacturer's instructions. When only occasional pH measurements are made, standardize the pH meter before each measurement. When frequent measurements are made and meter readings are stable, standardize less frequently but at least daily.

ii. Beakers - Preferably use polyethylene or TFE (Teflon or equivalent) beakers. The beaker which will hold the sample of soil material should have a capacity equal to or exceeding 250 mL.

iii. Buret - Borosilicate glass.

iv. Titration vessel - Borosilicate glass.

v. Stirrer - For neutralization of calcium chloride reagent, use either a magnetic, TFE-coated stirring bar or a mechanical stirrer with inert, plastic-coated impeller.

vi. Stirring rod - For mixing soil material with neutralized calcium chloride reagent, preferably use an inert plastic stirring rod.

3. Reagents

The following reagents are to be prepared in the laboratory:

i. Hydrochloric acid, 1.0N (approximate) - Add 83 mL of ACS-grade (36-37%) hydrochloric acid to 500 mL of distilled water. Dilute to 1,000 mL with distilled water and mix thoroughly.

ii. Hydrochloric acid 0.1N (approximate) - Dilute 100 mL of 1.0N (approximate) hydrochloric acid to 1,000 mL with distilled water and mix thoroughly.

iii. Sodium hydroxide solution, 1.0N (approximate) - Add 40 g ACS grade solid NaOH to 500 mL distilled water.

iv. Sodium hydroxide solution, 0.1N (approximate) - Dilute 100 mL of 1.0N (approximate) sodium hydroxide solution to 1,000 mL with distilled water and mix thoroughly.

Store 1.0N and 0.1N sodium hydroxide solutions in polyethylene (rigid, heavy type) bottles with polyethylene screw caps, paraffin-coated bottles with rubber or neoprene stoppers, or borosilicate glass bottles with rubber or neoprene stoppers.

v. Neutralized calcium chloride reagent, 0.5M (approximate) - Add 73.5 g ACS-grade $CaCl_2 \cdot 2H_2O$ to 500 mL distilled water. Dissolve and mix thoroughly. Adjust pH to 7.0 using a buret, titration vessel, stirrer, pH meter, and 1.0N and 0.1N solutions of hydrochloric acid or sodium hydroxide. (If the initial pH exceeds 7.0, use 1.0N and 0.1N solutions of hydrochloric acid. If the initial pH is less than 7.0, use 1.0N and 0.1N solutions of sodium hydroxide. Add 1.0N hydrochloric acid or sodium hydroxide solution dropwise; mix thoroughly and measure pH after the addition of each drop. When pH approaches 7.0, complete the neutralization by dropwise addition of 0.1N solutions of hydrochloric acid or sodium hydroxide.) Dilute to 1,000 mL with distilled water and mix thoroughly.

4. Procedure

i. Rinse a clean polyethylene or TFE beaker (250 mL or larger capacity) and a plastic stirring

rod thoroughly with tap water and then distilled water. Fill the beaker to a depth of approximately one (1) inch with the sample of soil material (at field moisture content if the test is performed in the field).

ii. Add neutralized calcium chloride reagent to the beaker until the total depth of soil material plus reagent is approximately two (2) inches.

iii. Stir the contents of the beaker thoroughly with a plastic stirring rod. Allow the contents to stand at least fifteen (15) minutes. Stir the contents thoroughly again, allow the contents to stand at least five (5) minutes, and measure the pH of the supernatant liquid.

5. Interpretation of results

pH values below 3.0 indicate the presence of ferrous sulfate, and the presence of acid-producing deposits should be strongly suspected (Reference No. 23). pH values between 3.0 and 4.0 are also of concern if they occur in field tests; in such cases the test should be repeated in the laboratory on a replicate soil material sample that has been oxidized in the laboratory (see Section 3.6-3(c)).

6. Alternate methods of pH measurement

pH paper or indicator solutions may be used in the field instead of pH meters if these alternative methods are accurate to 0.2 pH units in the pH range of 2.5 to 4.5 and if color or turbidity in the calcium chloride extract of the soil material sample does not interfere with the test. (In some cases interfering color or turbidity can be removed by filtering the extract.) Use only pH meters in the laboratory.

3.6-3(b) Qualitative Test for Sulfate Ion

1. General discussion

Sulfate is precipitated as barium sulfate by the addition of barium chloride. The formation of obvious turbidity when barium chloride is added to a distilled water extract of the soil material sample confirms the presence of appreciable quantities of sulfate ions. Barium carbonate or barium phosphate should not precipitate so long as the pH of the distilled water extract is 5.0 or less (see American Public Health Association et al., 1981, pp. 437-438).

2. Apparatus

i. Beakers and flasks - Preferably use borosilicate glassware. The beaker which will hold the sample of soil material shall have a capacity between 250 mL and 500 mL, inclusive.

ii. Stirring rod - For mixing soil material with distilled water, preferably use an inert plastic stirring rod.

3. Reagents

i. Barium chloride solution, 10% (approximate) - Add 66.6 g ACS-grade $BaCl_2 \cdot 2H_2O$ to 500 mL distilled water; dissolve and mix thoroughly. Solution should be free from obvious turbidity; if there is no alternative, obvious turbidity should be removed by filtration through a membrane filter or hard-finish filter paper.

4. Procedure

i. Rinse a clean glass beaker (250-500 mL capacity) and a plastic stirring rod thoroughly with tap water and then distilled water. Fill the beaker to a depth of approximately one (1) inch with the sample of soil material (at field moisture content if the test is performed in the field).

ii. Add sulphate-free distilled water to the beaker until the total depth of soil material plus water is approximately two (2) inches.

iii. Stir the contents of the beaker thoroughly with a plastic stirring rod. Allow the contents to stand at least fifteen (15) minutes. Stir the contents thoroughly again, and allow the contents to stand at least five (5) minutes.

iv. Add one (1) drop of barium chloride solution. Voluminous flocs of barium sulfate will form immediately if appreciable quantities of sulfate ions are present.

3.6-3(c) Laboratory Oxidation of Soil Material

1. General discussion

As noted in the beginning of Section 3.6-3, field tests on samples of acid-producing deposits may be negative if the samples have not sufficiently oxidized, and it may be necessary to repeat either or both tests on laboratory-oxidized samples. The simplest way of oxidizing the samples is to dry them for several hours at an elevated temperature.

2. Apparatus

i. Evaporating dish, porcelain.

ii. Drying oven, for operation at 110°C.

3. Procedure

i. Fill a 250 mL capacity beaker that will be used for the pH test [Section 3.6-3(a)] or the qualitative test for sulfate ion [Section 3.6-3(b)] to a depth of approximately one (1) inch with the sample of soil material to be oxidized. Transfer the soil material from the beaker to the evaporating dish.

ii. Place the evaporating dish in the drying oven and dry the sample for at least 8 h at 110°C. Cool to room temperature.

iii. Transfer the soil material sample back to the beaker and, as appropriate, test for pH value or sulfate in accordance with section 3.6-3(a) or section 3.6-3(b) above.

3.6-4 General Mitigation Standards

1. The area of acid-producing deposits exposed should be no larger than that which is absolutely necessary for the conduct of the project.

2. Construction schedules should be formulated to provide minimum practicable exposure of acid-producing deposits.

3. Where the top layer of soil (remaining after clearance of vegetation) is free from acid-producing deposits, such soil should be stripped and stockpiled separately from the deeper, acid-producing deposits to be exposed. No acid-producing deposits shall be included in this stockpile.

4. Acid-producing deposits (including soil contaminated with such deposits and contaminated soil washed from construction equipment) should not be exposed for more than eight hours except where absolutely necessary for the conduct of the project. If such deposits must be exposed for more than eight hours, such deposits should be covered with pulverized limestone at the rate of 30 tons per acre (1375 pounds per 1,000 square feet) and then covered with a minimum of one foot of compacted topsoil (free of acid-producing deposits) within one week after exposure, or before the pH of a well-mixed sample from the uppermost two inches of the exposed deposit drops to 3.0, whichever occurs first.

5. Equipment used for excavating or backfilling acid-producing deposits should be cleaned at the end of each day's operation in such a way that will not cause the spreading of acid-producing deposits onto uncontaminated soil or into the stream.

6. Every effort should be made to minimize the spreading or mixing of acid-producing deposits (including soil contaminated with such deposits) onto or into soil free of such deposits (on or off the construction site). No construction should take place during rainstorms or while the ground is saturated, if such construction is likely to smear or spread acid-producing deposits over uncontaminated soil or into waterways. If acid-producing deposits must be stockpiled on top of soil heretofore free of such deposits, the area used for stockpiling should be minimized. Erosion and sediment control measures should be applied where acid-producing deposits are exposed or stockpiled, to prevent or reduce the movement of acid-producing material into streams or onto contaminated soil.

7. Excavated material should be returned to trenches or pits in the order of its removal, i.e, lower material first, followed by upper material. (However, if acid-producing deposits are found only in the upper material, then the upper material should be returned first. This exception also applies to the following sentences). Where acid-producing deposits are stockpiled on soil heretofore uncontaminated with such deposits, the top two inches of such soil should be scraped off and buried along with the "lower material." The surplus material resulting due to permanent grade reduction, placement of pipes or other structures, and soil scraped from areas under temporary stockpiles of acid-producing deposits, should be substituted for an equal quantity of deeper material which in turn should be removed to a suitable disposal site (see Section 3.6-4). After backfilling the deeper material, pulverized limestone should be spread over the top of the material, at the rate of ten (10) tons per acre (460 pounds per 1000 square feet), before the application of the surface layer of soil. This lining procedure is applicable only in well-drained areas. The top layer of soil, free of acid-producing deposits, stripped and stockpiled in item 3 above, should then be replaced. If necessary, additional quantities of topsoil should be imported so as to ensure at least one (1) foot deep cover of soil, free of acid-producing deposits. Restrictions established in the Regulations concerning the amount of net fill that may be placed in flood plains must also be complied with.

8. Temporary vegetative cover should not be used for stabilization of acid-producing deposits unless the liming and topsoil application requirements of item 7, and the surface soil pH requirements of item 9, are first met. Otherwise, temporary stabilization of acid-producing deposits should be accomplished with "mulch only", in accordance with the "Standards for Soil Erosion and Sediment Control in New Jersey." No more than eight hours should elapse before the application of mulch. (Mulching for temporary stabilization is not a substitute for the limestone and topsoil application requirements of items 4 and 7. Mulch should not be directly applied to the exposed surface of acid-producing deposits, but rather to the topsoil applied to cover such deposits.)

9. Permanent vegetation should be established as soon as possible taking into account the six weeks that may be needed for the "incubation test" discussed below. Revegetation must be performed under the direction of a soils specialist or agronomist, who by training or experience is famililar with the problems of revegetating acid-producing deposits. The soils specialist or agronomist should perform pH tests on the surface layer of soil where the vegetation will root (allowing for root expansion due to plant growth). If the pH is below 4.0, the soils specialist or agronomist should also perform incubation lime requirement tests (soil sample allowed to oxidize for six (6) weeks) to determine lime application rates. The pH of the surface layer of soil must be raised to at least 5.0 before seeding or planting. Seeding should always be accompanied by mulching.

10. In addition to the above requirements, the "Standards for Soil Erosion and Sediment Control" should be met.

3.6-5 Mitigation Procedures Along Stream Channels

If construction would expose acid-producing deposits (to air or surface waters) within stream channels or along stream banks, the period of exposure should be held to a minimum and measures should be taken to cover such deposits so as to prevent the accelerated oxidation of such deposits. This requirement applies whether or not the length of exposure exceeds 50 feet.

To prepare the plan for covering the acid-producing deposits, the applicant should consider the use of the following procedure:

1. Spread one (1) foot of soil free of acid-producing deposits over the exposed deposit surface. The pH of such soil should be 5.0 or greater. The texture of the soil should fall within the following textural classes (U.S. Department of Agriculture, Soil Conservation Service classification):

   Clay, silty clay, sandy clay, clay loam
   Silty clay loam, sandy clay loam
   Loam, silt loam, silt

   No more than ten (10) per cent of the soil (by mass) may consist of coarse fragments (particles above 2mm diameter or long-axis length) and no fragments may exceed three (3) inches diameter or long-axis length.

2. Compact the soil that has been spread pursuant to item 1 above. If vegetation is to be used to stabilize the stream banks (see Item 3 below), the soil shall not be compacted to a bulk density exceeding 1.7 grams per cubic centimeter, and the liming and pH requirements of items 7 and 9 of the General Mitigation Procedures shall be met.

3. Prepare a stable channel in a manner consistent with the "Standards for Soil Erosion and Sediment Control." The cover of soil free of acid-producing deposits shall not be susceptible to appreciable erosion and washout. Where acid conditions may prevent the establishment of sufficient vegetation, acid-resistant riprap shall be used instead of vegetation. The channel shall be restored to the physical condition existing prior to construction, unless changes to that condition are an integral part of the project.

4. Since the oxidation of sulfide minerals and resulting generations of acid commences as the acid-producing deposits are exposed, the soil layer should be applied promptly to the newly exposed deposits within or along the channel. To accomplish this, channel excavation should proceed (where necessary) in stages along the successive reach lengths of the channel, scheduled in such a way that no newly exposed acid-producing deposits remain exposed longer than one week, or the time required for the pH of a well-mixed sample from the uppermost two inches of the deposit to drop to 3.0, whichever is less.

In some places it may not be practical to cover the acid-producing deposits with a soil-limestone mixture in the manner described above because of steep slopes or because of running water that cannot be diverted during construction. In such cases, plastic liners may be utilized, placing them over the newly exposed acid-

producing deposit with suitable protection. Any fill material placed over the plastic liner should be free of acid-producing deposits. (The fill would be held in place over the liner by riprap, concrete walls, or other permanent design features.)

Whenever it is proposed to seal acid-producing deposits with artificial liners (e.g., plastic or specially prepared bentonite), the applicant must illustrate that the liner:

1) would be suitably acid-resistant and durable;
2) would be protected from erosion and washout;
3) would be protected from puncture or tearing due to vehicular or foot traffic, plant growth, riprap, sharp objects, vandalism, or other causes; and
4) would be impermeable or very slowly permeable to water movement; and
5) would not release to ground or surface waters appreciable quantities of toxic substances leached from the liner or resulting from the chemical or physical deterioration of the liner.

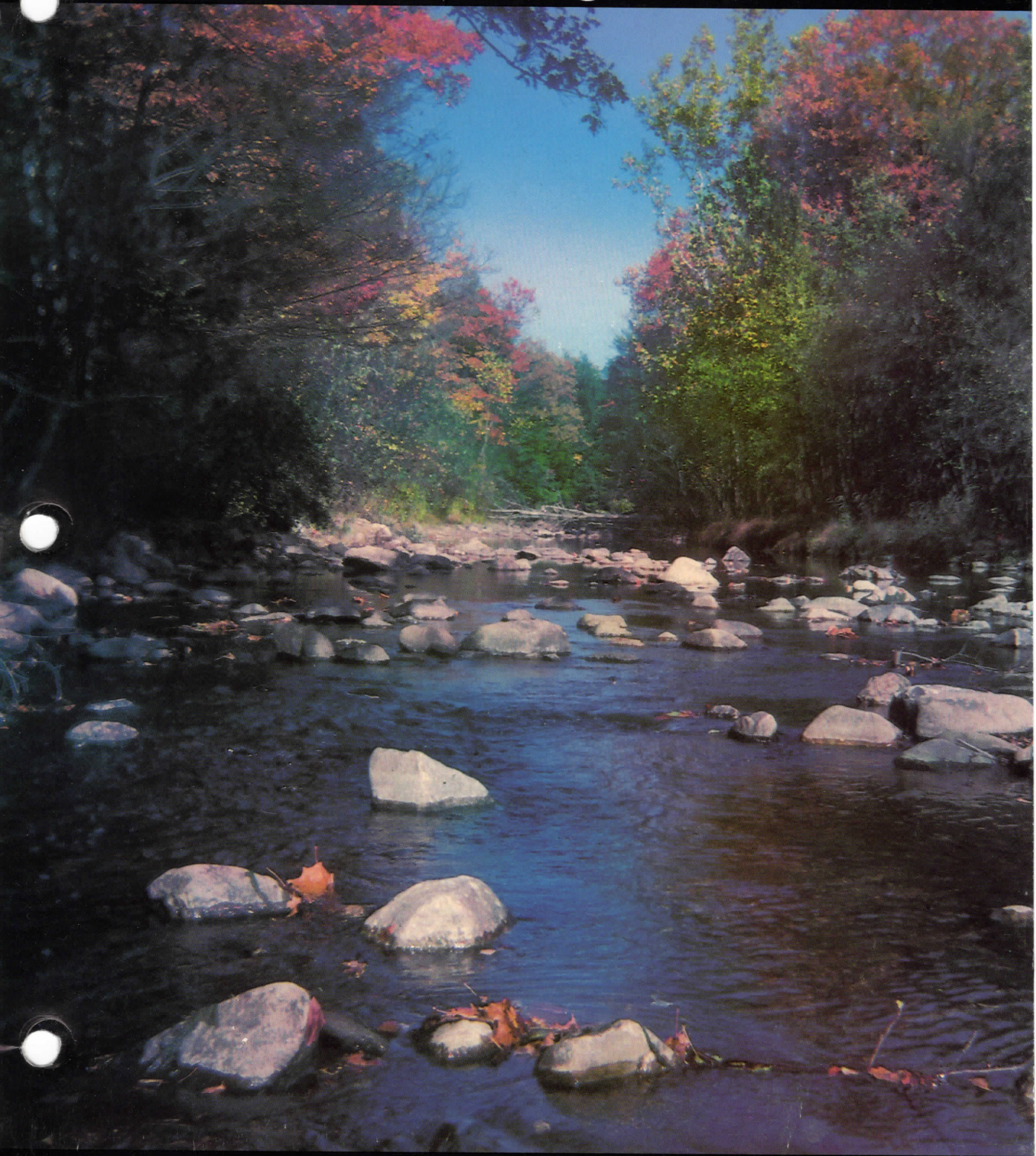
Concrete and asphalt are not suitable liners. However, use of concrete protected by liners from corrosion due to acid-producing deposits may be given consideration.

3.6-6 Disposal of Acid-Producing Deposits

Acid-producing deposits (including earth contaminated with such deposits) that are not backfilled and covered pursuant to sections 3.6-1 or 3.6-2 above should be disposed of on or off the construction site in a suitable manner and location. Acid-producing deposits should not be discharged into streams, indiscriminately spread over uncontaminated soil, or sold or distributed as topsoil or topsoil amendments suitable for plant growth. Instead, such deposits should be buried at least two feet beneath the land surface, in such a manner that the cover material is not subject to accelerated erosion. Stockpiles of acid-producing deposits awaiting burial should be covered with pulverized limestone at the rate of 30 tons per acre (1375 pounds per 1000 square feet) and then covered with a minimum of 12 inches of compacted soil, free of acid-producing-deposits within one week after exposure, or before the pH of a well-mixed sample from the uppermost two inches of the deposit drops to 3.0, whichever occurs first. Whenever practicable, the deposit should be buried the same day it is excavated.

New Jersey

Statewide Water Quality Management Program Plan



N.J. Department of Environmental Protection • Division of Water Resources

Statewide Water Quality Management Program Plan

December 1985

Thomas H. Kean
Governor

Robert E. Hughey
Commissioner

EXCERPT

This excerpt from the New Jersey Statewide Water Quality Management Plan (December 1985) is limited to the following pages in Chapter II:

- Page II-1 and the "Acid-Producing Deposits" strategy (pages II-24 through II-27)

This searchable version was processed with text recognition software, and may have text recognition errors.

Chapter II

WATER QUALITY AND WASTEWATER MANAGEMENT PLANNING STRATEGIES

Introduction

The "strategies", "policies", and "procedures" of the Statewide WQM Plan are concise statements of preventive or corrective courses of action, which were developed to address various water resource-related needs and issues. The strategies are methodologies that outline suggested future actions to be taken by the Division or other agencies. The policies and procedures, included in a subsequent section of the document, concisely describe present methods by which the Division is addressing certain issues or problems. Policies and procedures are important as they provide a clearly defined and uniform mechanism to be applied in protecting mechanism to be applied in protecting the water resources. It is important to note that policies and procedures are binding as operational requirements in the implementation of the appropriate permit programs. In addition, while strategies may be changed or revised without following a formal process, policies and procedures can only be changed through the WQM Plan amendment procedure (N.J.A.C. 7:15-3.4).

This section consists of the Statewide WQM Plan's strategies. The strategies are divided into four subgroups: Water Quality Management Strategies, Wastewater Management Strategies, Planning Strategies, and Program Strategies.

A. WATER QUALITY MANAGEMENT STRATEGIES

These strategies seek to address certain technical issues, factors or problems which are related to water quality. They include technical methodologies for addressing certain issues through the water quality standards, protecting especially vulnerable water bodies, as well as other technical considerations. The strategies included in this subsection are:

1. Surface Water Quality Standards Review.
2. Shellfish Waters Restoration and Protection.
3. Trout Waters Protection.
4. Lakes Restoration and Management.
5. Acid Producing Deposits.
6. Water Quality/Water Supply Integration.

Acid-Producing Deposits

- Background

Several geologic formations in the Coastal Plain physiographic province in New Jersey sometimes contain deposits with iron sulfide minerals (pyrite or marcasite). Upon exposure to oxygen from the air or from surface waters, these deposits produce sulfuric acid. This acid increases the solubility of metals to the extent that the metals can become toxic to aquatic life or land vegetation, or can reach concentrations undesirable in sources of potable water supply. With pH readings in some cases as low as 2.3 in soils and surface waters, no plant species will survive on land, and no fish will survive in water, until remedial measures are applied and take effect.

Because considerable environmental damage can occur in the time between the development of extremely acid conditions and the application of remedial measures, and because remedial measures may sometimes not be practicable or successful, preventive as well as remedial measures should be considered to control the exposure of acid-producing deposits for stream encroachments and other purposes. Preventive measures can also reduce the expense of remedial measures in some cases. Inconsistencies have developed in recent years between the preventive and remedial measures required by the Department and the more limited remedial measures included in the current "Standards for Soil Erosion and Sediment Control in New Jersey."

The current "Standards for Soil Erosion and Sediment Control in New Jersey" include "Standards for Permanent Vegetative Cover for Soil Stabilization" which state that "soils having a pH of 4 or less or containing iron sulfide shall be covered with a minimum of 12 inches of soil having a pH of 5 or more before seedbed preparation." Two U.S. Department of Agriculture, Soil Conservation Service publications (NE Technical Note PM No. 9 "Use of Lime and Soil Cover to Provide Vegetation on Extremely Acid Soils" and New Jersey Technical Note 28 "Vegetation of Acid Soils") provide additional technical recommendations concerning lift material, lime requirement tests, lime application, and plant species. These publications partially address the problem of acid-producing deposits but do not, in the Department's present judgement, give sufficient attention to preventive appproaches that could minimize the rate and geographic extent of acid production. For example, where it is known from pre-construction investigation that acid-producing deposits would be encountered on a particular construction site, steps could be taken to prevent the prolonged exposure of acid-producing deposits (where practicable) and to prevent the indiscriminate spreading of acid-producing material onto uncontaminated soil. Preventive measures could be particularly important where high water tables would permit the movement of extremely acid ground water into lift material.

In recent years, the Division has become concerned about acid-producing deposits in its review of proposals for construction of sewerage facilities, interstate highways, State-owned reservoirs, and stream

channelization projects. For example, the "acid soils" problem was discussed at length in the "Environmental Impact Analysis for the Proposed Manasquan Reservoir System Project" (June 1978) prepared for the Division by Rutgers University, and the "disruption of pyritic/marlitic (acid) soils" was a major issue in the Division's review of a proposed Corps of Engineers Flood Control Project along Pine Brook in Monmouth County. Division staff prepared and distributed guidelines entitled "Specifications for Construction in Acid Soils" and "Acid Soil Mitigation Procedures."

On May 21, 1984, comprehensive Department Flood Hazard Area Regulations became effective (N.J.A.C. 7:13-1.1 et seq.). These regulations list nine Coastal Plain geologic formations in which acid-producing deposits are sometimes found, and include special provisions to control the exposure of acid-producing deposits resulting from construction within floodway or encroachment lines. Included are provisions for site evaluation and mitigation plans, chemical and physical analysis of soil material samples, and the application of preventive and remedial mitigative measures to minimize the production of acid and to promote the establishment of vegetation. Projects which would expose acid-producing deposits along more than 50 feet of stream channel are classified as "Projects of Special Concern" which will not be approved except in special circumstances.

Specific mitigation measures are described in the "Technical Notes Concerning Acid-Producing Deposits" included in the Division of Water Resources "Flood Plain Management Technical Manual, Stream Encroachments" (August 1984). Figure 4, which is included in these "Technical Notes," identifies the general location of the nine geologic formations listed in the adopted regulations (Raritan Formation, Magothy Formation, Merchantville Formation, Woodbury Clay, Englishtown Sand, Marshalltown Formation, Navesink Formation, Red Bank Sand, and Kirkwood Formation).

This report includes guidance for site evaluation and descriptions of simple chemical tests for acid-producing deposits. The mitigation procedures described in this report can be applied where land is disturbed for stream encroachment or other purposes.

- Objective

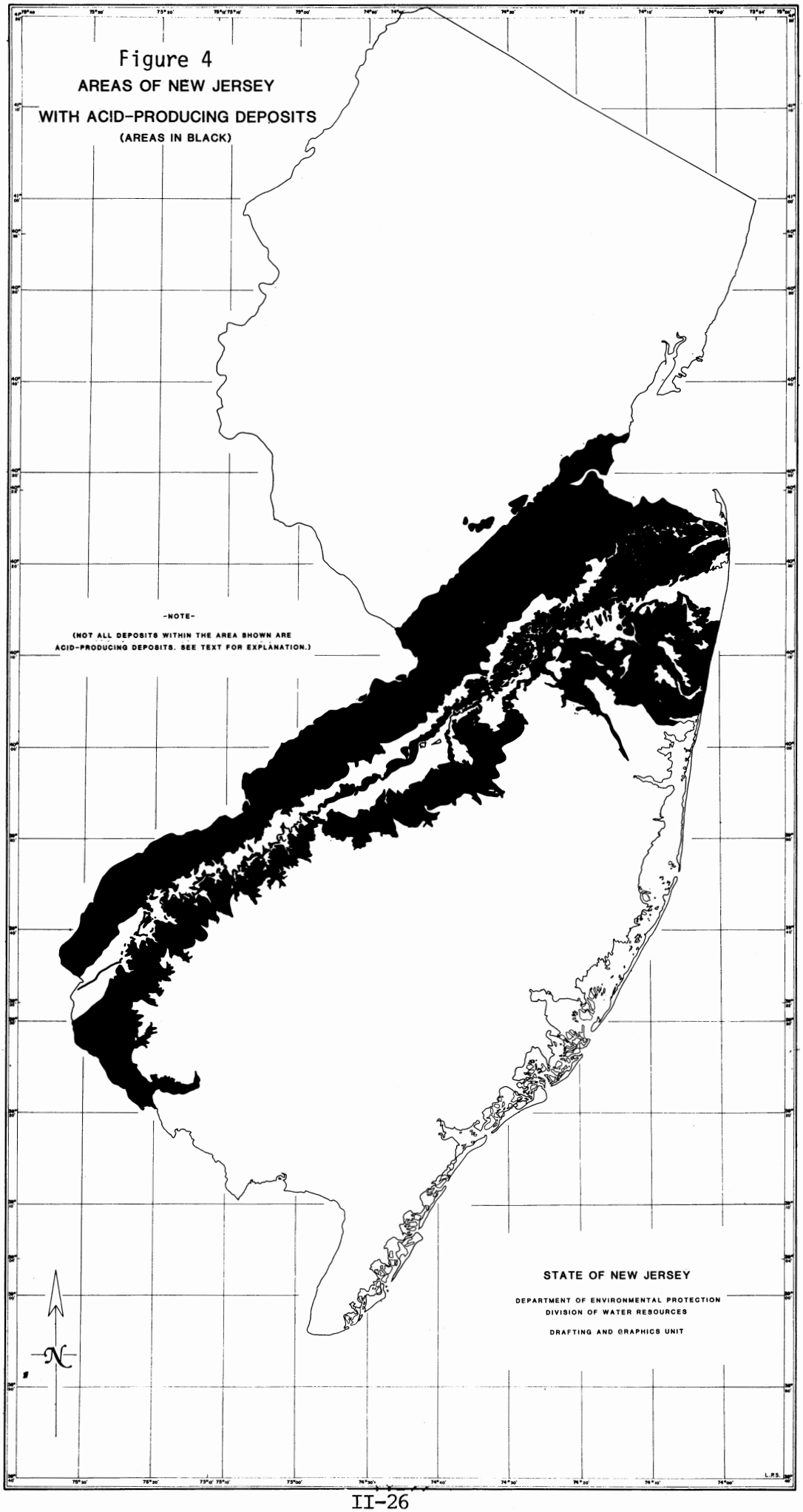
The Department's present objectives regarding acid-producing deposits are as follows:

a. Flood Hazard Area Regulations

The implementation of comprehensive Flood Hazard Area Regulations to control the exposure of acid-producing deposits resulting from construction of stream encroachments.

b. Soil Erosion and Sediment Control Act

The achievement, if possible, of greater consistency between provisions for acid-producing deposits required by the Department


Figure 4
AREAS OF NEW JERSEY
WITH ACID-PRODUCING DEPOSITS
(AREAS IN BLACK)
-NOTE-
(NOT ALL DEPOSITS WITHIN THE AREA SHOWN ARE
ACID-PRODUCING DEPOSITS. SEE TEXT FOR EXPLANATION.)
N
STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES
DRAFTING AND GRAPHICS UNIT

and provisions for acid-producing deposits in the "Standards for Soil Erosion and Sediment Control in New Jersey."

- Strategy

By themselves, the Flood Hazard Areaa Regulations only partly address the problem of acid-producing deposits. In particular, these regulations do not control the exposure of such deposits outside floodway or encroachment lines, or control their exposure for "non-regulated uses" such as residential lawns and gardens. As described below, the problem of acid-producing deposits may warrant additional attention in the "Standards for Soil Erosion and Sediment Control in New Jersey."

Acid-producing deposits are exposed in uplands and lowlands by land disturbance which, except for agriculture and horticulture, is generally subject to regulation pursuant to the Soil Erosion and Sediment Control Act. The exposure of acid producing deposits creates erosion hazards, among other problems. Preventive mitigation procedures for acid-producing deposits include the on-site identification of such deposits and the on-site management of such activities as the excavation, stockpiling, backfilling, and liming of soil material. There is an obvious, close relationship between the management of acid-producing deposits (a special type of soil material) and activities addressed administratively and technically by the Soil Erosion and Sediment Control Act and the "Standards for Soil Erosion and Sediment Control in New Jersey."

Because the Division has perceived a need to supplement the provisions for acid-producing deposits in the current "Standards for Soil Erosion and Sediment Control in New Jersey," the Division has, in recent years, proposed or identified additional management practices for projects within its purview (see "Background" section above). However, in the future, it would be desirable to achieve, by mutual agreement between the Department and the State Soil Conservation Committee, greater consistency between DEP requirements and the "Standards for Soil Erosion and Sediment Control in New Jersey." The Department, through its representation on the State Soil Conservation Committee, will endeavor to persuade the Committee to review the provisions for acid-producing deposits in Department documents and the current "Standards for Soil Erosion and Sediment Control in New Jersey," and to make recommendations for modifications to achieve greater consistency.

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the trail and its facilities in a manner consistent with the designated classification of the trail during the period of construction or permanently thereafter; or

2. If the Commissioner determines that the proposed Department-funded construction project will permanently interfere with the trail right-of-way or its uses, thereby rendering the trail unsuitable for its designated purposes, and that no satisfactory remediation or mitigation is possible, the Commissioner may disapprove use of the trail for the proposed project. Remediation for permanent interference with the trail right-of-way may include relocation of the trail right-of-way in a manner consistent with N.J.A.C. 7:5D-5.1 and 5.2.

(f) Emergency measures to protect public health, safety and welfare may be undertaken in the trail right-of-way without prior review by the Department. However, persons or organizations undertaking such measures must notify the Division in writing within 24 hours of commencing such measures.

SUBCHAPTER 8. STATE TRAILS SYSTEM

7:5D-8.1 State Trails System

(a) The following trails are designated as components of the State Trails System:

1. (Reserved)

7:5D-8.2 Public information

Interested persons may obtain information on the State Trails System by contacting:

Office of Natural Lands Management
Department of Environmental Protection
CN 404
Trenton, New Jersey 08625-0404
(609) 984-1339

(a)

ENVIRONMENTAL REGULATION—LAND USE REGULATION PROGRAM

Flood Hazard Area Control Rules

Adopted Repeal and New Rules: N.J.A.C. 7:13

Proposed: February 22, 1994 at 26 N.J.R. 1009(a).
Adopted: February 22, 1995 by Robert C. Shinn, Jr., Commissioner, Department of Environmental Protection.
Filed: February 22, 1995 as R.1995 d.149, **with substantive and technical changes** not requiring additional public notice and comment (see N.J.A.C. 1:30-4.3).

Authority: N.J.S.A. 58:16A-50 et seq., 58:10A-1 et seq., and 13:1D-1 et seq.
DEP Docket Number: 06-94-01/123.

Effective Date: March 20, 1995.
Expiration Date: March 20, 2000.

On February 22, 1994, the Department of Environmental Protection (Department) proposed to repeal and repromulgate N.J.A.C. 7:13. The Department revised the rules to make them easier to understand, to reflect organizational changes within the Department and to bring the rules into compliance with relevant court decisions and actual agency procedure which has evolved since the original adoption in 1984.

Summary of Hearing Officer's Recommendations and Agency Response:

The Department held a public hearing concerning the proposal on March 28, 1994 in Trenton, New Jersey. Ernest P. Hahn, Administrator of the Department's Land Use Regulation Program, served as the hearing officer. The Department accepted written comments through April 25, 1994. After reviewing the testimony given at the hearing and the written comments received Administrator Hahn recommended that the proposed rules be adopted with the changes described in the Summary of Public Comments and Agency Responses and the Summary of Agency-Initiated Changes below. The Department accepted the recommendation.

Interested parties may inspect the public hearing record, or obtain a copy upon payment of the Department's normal copying charges, by contacting:

Janis Hoagland, Esq.
Administrative Practice Officer
New Jersey Department of Environmental Protection
CN 402
Trenton, New Jersey 08625-0402

Summary of Public Comments and Agency Response

The following is a list of the individuals who testified at the hearing and/or timely submitted written comments on the proposal:

1. Perry Boynton, Jersey Central Power and Light Company
2. Bob Harsell, Arthur Kill Watershed Association
3. Anthony Dilodovico, Schoor, Depalma and Canger Consulting Engineers
4. Joseph Skupien, Somerset County Engineers Office
5. Michael Amorosa, Somerset County Engineer
6. Robert Anastasia, Taylor, Wiseman & Taylor
7. Michael Baker, Jr., Michael Baker, Jr. Inc.
8. William Brash, Jr., Mercer County Soil Conservation District
9. James Byrne, Intech Engineering Corporation
10. Richard Candeletti, Associated Executives of Mosquito Control Work in New Jersey
11. Florence Caporaso
12. Joseph Caruso, Board of Chosen Freeholders of the County of Burlington
13. Lou Cattuna
14. Martin Chomski, Board of Chosen Freeholders of the County of Monmouth and Monmouth County Mosquito Extermination Commission
15. Leo Coakley, Killam Associates
16. Abigail Fair, Association of New Jersey Environmental Commissions
17. Michael Fink, New Jersey Builders Association
18. Guliet Hirsch, Heritage Minerals, Inc.
19. Jeffrey Horn, The Association for Commercial Real Estate
20. Bruce Johnson, Hunterdon County Engineer's Office
21. Stephen Kinsey, New Jersey Society of Municipal Engineers
22. Albert Knoll, Township of Dennis
23. John Lehman
24. Tony Sabidussi, New Jersey Department of Transportation—Bureau of Environmental Analysis—Permits/Ecology Section
25. James Shissias, Public Service Electric and Gas Company

The following is a summary of the oral and written comments timely submitted and the Department's responses. The number(s) in parentheses after each comment identifies the commenter(s) listed above.

General

1. COMMENT: This subchapter extends the jurisdiction of the program far beyond the current regulations by encompassing drainage basins of less than 50 acres. The regulated community is thus faced with increased costs for design applications and consultants and time delays for a limited environmental benefit. When every minor watercourse that cannot be proved man-made comes under the jurisdiction of this chapter, the resources of both the construction industry and the Department will be strained. The Department must exercise better judgment in identifying areas for decreasing, rather than increasing, regulation. (7)(12)(18)(19)

RESPONSE: The new rules reflect the policy and procedures which have evolved over the 10 years since the Flood Hazard Area Control Rules were first implemented and which are currently used to review of stream encroachment permit applications. The rules do not include any item of review or area that is not currently regulated under this program by the Department. The clarification of jurisdiction and the restatement of regulated activities actually reduce the areas and types of projects for which a permit is required under these regulations.

The rules being repealed regulated Projects of Special Concern (PSC) regardless of drainage area. For non-PSC projects the 50 acre drainage area threshold was established under those rules as a limit below which there was no need to apply the engineering standards, since flooding problems below this limit are minimal. The 50 acre drainage area threshold is retained in the new rules for the engineering standards. The new rules eliminate the classification of Projects of Special Concern but retain the environmental standards to be applied to projects regardless of drainage area.

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RESPONSE: As noted in the response to Comment 238, above, the Department has long recognized the importance of upstream areas in maintaining water quality downstream in the trout production and maintenance areas. While the inclusion of tributaries in the definition of trout associated watercourses is new in this rule, the Department has been applying these standards to these areas for several years. The definition was modified on adoption to remove the arbitrary distinction between "unnamed" and "named" streams, and to clarify that the tributaries of concern are those that flow into the trout production and trout maintenance waters. Timing restrictions are imposed on a case-by-case basis depending on the specifics of the site. Thus the Department does not anticipate any changes in existing review procedures and requirements as a result of the new rule.

242. COMMENT: The timing restrictions in N.J.A.C. 7:13-3.5(d)1 and 3.6 are confusing and inconsistent because the first paragraph in N.J.A.C. 7:13-3.5(d) together with N.J.A.C. 7:13-3.5(d)1 states that regulated activities which could cause sediment or turbidity are prohibited within 50 feet of the top of bank, whereas subparagraph (d)1iv states that all construction activity should be suspended from March 15 through June 15 along trout-stocked waters. The commenter considers the prohibition of all construction activity during certain times to be unnecessary, and suggests that this be revised to allow construction work to occur as along as there is no impact upon the water body. With adequate soil erosion and sediment control measures, construction can occur adjacent to trout streams without affecting water quality. Most bridge projects require at least one full construction season (10 months) to complete, and these timing restrictions will require the work to extend over another year. This will add to the expense of completing the project, delay the completion of necessary public safety improvements, and greatly inconvenience the public if detours are involved. In addition, if the work is already underway and has to stop because of these restrictions, the disturbed construction area could be subject to increased erosion during the period when no work can be performed. It would be preferable to allow the work to be completed and stabilized as expeditiously as possible. Structural steel, guide rail installation, electrical, and so on can be done without affecting the waterbody. (24)

RESPONSE: These requirements are not new and have been in effect since before the repealed rules were adopted. This section does not prohibit all construction, only construction which, as indicated in N.J.A.C. 7:13-3.5(d) will introduce sediment or increase the turbidity in the watercourse. The Department allows construction to continue as long as an applicant can show that no sediment will be introduced into the watercourse, or that the disturbance is minimal, or that timing of construction cannot be shifted in certain circumstances.

243. COMMENT: Tidal portions of Rancocas Creek could be liberally construed to include tributaries in N.J.A.C. 7:13-3.6(a)1ii. The commenter suggests a definable limit along Rancocas Creek, that is, Turnpike Bridge. Also, liberal interpretation of time limits on work will produce an extreme hardship on Burlington County as it will essentially limit bridge reconstruction projects to July and August. Construction from December 1st to March 31st is extremely difficult and expensive. Finally there should be a provision permitting construction within 50 feet of the banks during the prohibited period if certain protective measures are employed. (12)

RESPONSE: The Department did not intend at N.J.A.C. 7:13-3.6 to totally prohibit construction but to only prohibit the introduction of sediment into the specified watercourses during the specified periods, similar to the restrictions at N.J.A.C. 7:13-3.5 for trout watercourses. N.J.A.C. 7:13-3.6(a) and (b) above has been revised to prohibit only the introduction of sediment or to prohibit any other activity that will increase the turbidity of the watercourse and interfere with fish passage. This would include allowing work within 50 feet of the top of bank if it could be shown that the work would not introduce sediment into the stream. Along tidal and tidally influenced areas this concern will be addressed under the Waterfront Development Program and not these rules.

244. COMMENT: N.J.A.C. 7:13 3.6(c)1 requires that watercourse cleaning projects are to be constructed so that low-flow water depth is at least as deep as in the existing channel or 10 inches deep, whichever is less. This appears to mean that any stream cleaned in the State that is more than 10 inches deep will have to be filled in! The commenter assumes this is a misstatement. It may help to include the rationale behind the proposed rules. Then the language may become self-evident. (14)

RESPONSE: The intent of N.J.A.C. 7:13-3.6(c)1 was to provide for low-flow fish passage. The rule has been revised on adoption to require that the depth of water in the new or modified watercourse channel be at least as deep as the existing channel.

245. COMMENT: N.J.A.C. 7:13-3.6(c)2 states that no delegated agency may grant exceptions for the minimum depths of flow through bridges and culverts or in modified channels. Why not? (14)

RESPONSE: Due to the serious potential for damage to the State's fisheries resources, the Department retains sole authority to grant exceptions for deviations from the minimum depths of flow through bridges and culverts or modified channels. The public interest in preserving the State's fisheries is best served by allowing the Department to determine the impacts of proposed exceptions on the fisheries resources based upon its long-standing expertise in these matters.

246. COMMENT: Does the Department intend to impose 25 foot setback requirements around ponds and lakes containing the fish species listed in N.J.A.C. 7:13-3.6(b)? These setbacks are beyond the Department's jurisdiction. (17)

RESPONSE: The 25 foot setback would apply around ponds or lakes which contain the fish species listed in the rule because the sediment will have the same affect on the fish in the pond or lake as it would in any other watercourse. The Water Pollution Control Act grants the Department ample authority to protect the water quality and fisheries resources in ponds and lakes as provided in this rule.

247. COMMENT: Although N.J.A.C. 7:13-3.7(d) requires mitigation of acid soils exposed by proposed regulated activity, the practice has always been handled by the Soil Conservation Districts (SCDs), rarely by the Department. The Memorandum of Agreement between DEP and the Department of Agriculture stipulates that the SCDs will oversee the mitigation of acid soils since SCDs are the only entity that can realistically mitigate acid soil. (8)

RESPONSE: The Memorandum of Agreement stipulates that the SCDs will, as necessary, monitor all acid soil mitigation for stream encroachment permits and report non-compliance to the Department. While, the SCDs are better equipped to performing this activity, the authority to require the mitigation is still under the authority of the stream encroachment regulations. It is beyond the scope of this revision to transfer the regulation of acid soils to the Soil Conservation Districts. Therefore, this section will remain in the rule. The Department is open to discussions regarding the transfer of the responsibility for the regulation of acid soils.

248. COMMENT: The Department should delete the requirement in N.J.A.C. 7:13-3.7(g) for special laboratory analysis of potential acid soils in order to determine more information about its characteristics because this requirement is very expensive and unnecessary. If an applicant can determine in advance where these soils are (and there are maps available) and takes the precautions that are outlined in the Technical Manual, then there is no need to perform these expensive tests. (17)

RESPONSE: This requirement is carried over from the now-repealed rule and has not resulted in excessive costs to permittees, to the Department's knowledge. While there are maps available showing the approximate areas of acid producing soils, these maps are not highly accurate. The only sure way of telling whether or not a soil is acid-producing is by testing.

249. COMMENT: N.J.A.C. 7:13-3.7(d) (projects exposing deposits of acid-producing soils) states that the exposure of acid-producing soils will require a site evaluation by a "professional" and, perhaps a special laboratory analysis of the soils. Although the qualifications for this "professional" are not specified, a specialized consultant should not be needed for all projects located in the large geographic area where acid-producing soils could be found. Similarly the special laboratory tests should not be required for all projects located within this geographic area. The commenter is concerned that a "professional" consultant report and the laboratory analysis will become a standard requirement for all applications located within the listing geological formations, and suggests that the criteria for requiring the professional report and laboratory tests be explicitly defined. (24)

RESPONSE: This provision has been in the regulations since 1984. The Department has never required that testing be done if the applicant is already aware that the site contains acid soils. Engineers and consultants working in such areas are clearly aware of their responsibility for mitigating the effects of acid leaching, and this rule does not change that responsibility. However, an applicant with a project in an area that is known to have such soils that does not provide information with the application regarding acid soils will be required to perform appropriate testing to establish whether such soils exist on-site and how the exposure of such soil will be mitigated.

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"Retention basin" means an impoundment area with a permanent pool made by constructing an embankment, or excavating a pit, or both for the purpose of temporarily storing storm water.

"Soil Conservation District" means a political subdivision of the State of New Jersey authorized under N.J.S.A. 4:24-1 et seq.

"Solid waste" means garbage, sludge, refuse, trash, rubbish, debris or other discarded materials.

"State Soil Conservation Committee" means the agency created pursuant to N.J.S.A. 4:24-1 et seq.

"Stream encroachment" means any manmade alteration, construction, development or other activity within the areas within the jurisdiction of this chapter.

"Stream Encroachment Permit" means a permit issued by the Department, or delegated agency under the provisions of the Acts.

"Structure" means any assembly of materials above or below the surface of land or water including, but not limited to, buildings, fences, dams, fills, levees, bulkheads, dikes, jetties, embankments, causeways, culverts, roads, railroads, bridges and the facilities of any utility or governmental agency. Trees and vegetation are not structures.

"Threatened or endangered species" means those species of animals listed pursuant to "The Endangered and Nongame Species Conservation Act," N.J.S.A. 23:2A-1 et seq., identified in N.J.A.C. 7:25-4.13, ***and 7:25-4.17,*** and those species of plants identified in the Endangered Plant Species List, N.J.A.C. 7:5C-5.1.

"Tidal flood" means a flood caused by the tide backing up a channel.

"Trout-associated watercourses" means watercourses that are:

1. Trout production waters;
2. Trout maintenance waters;
3. Non-trout waters upstream from trout production waters (with or without intervening trout maintenance waters);
4. Non-trout waters less than one mile upstream from trout maintenance waters that are not upstream from trout production waters; or
5. *[Unnamed tributaries]* ***Tributaries*** flowing into *["Trout Associated"]* ***trout production or trout maintenance*** waters which will take the classification of the waters they flow into.

"Trout maintenance waters" means the trout maintenance waters identified in the Department's Surface Water Quality Standards (N.J.A.C. *[7:9-4]* ***7:9B***).

"Trout production waters" means the trout production waters identified in the Department's Surface Water Quality Standards (N.J.A.C. *[7:9-4]* ***7:9B***).

"Trout stocked waters" means waters that are stocked with trout by the Department's Division of Fish, Game and Wildlife, as listed in N.J.A.C. 7:25-6 and amendments thereto as adopted by the New Jersey Fish and Game Council.

"Upstream/downstream" refers to direction with respect to a fixed point in a waterway.

"Watercourse" means a path which conveys surface water runoff. Flow paths with a total contributory drainage area less than 50 acres must have definable bed and banks to be considered a watercourse.

7:13-1.3 Applicability

(a) All development within the larger of the following areas shall require a permit under this chapter unless specifically exempted as provided in this chapter:

1. The flood plain, as defined at N.J.A.C. 7:13-1.2;
2. Twenty-five feet back from the top of the channel bank; or
3. Fifty feet back from the top of the channel bank along waters

i. Containing deposits of acid-producing soils as defined in N.J.A.C. 7:13-5.10;

ii. Classified as Category One, FW-1 ***trout-associated, or****, FW-2*[, or]* trout-associated;

iii. Which are a critical part of the habitat supporting a threatened or endangered species of plant or a current population of any species of threatened or endangered animal on a permanent or temporary basis, for any purpose such as resting, breeding or feeding, during any portion of its life-cycle; or

iv. Located within documented, historic habitat for threatened or endangered species of animals, which habitat remains suitable for breeding, resting or feeding by those species of animal during any portion of its life-cycle.

(b) New Jersey's geography and location along the Atlantic coastline subjects the State to both tidal and fluvial flooding. The effects of development on flood elevations vary depending on the type of flooding and the area in which it occurs. For the purpose of this chapter, three areas of concern have been identified based on the type of flooding and the impact of development in that particular area. These areas are as follows:

1. Tidal: Tidal flooding is the result of higher than normal tides which in turn inundate low lying coastal areas. The 100-year tidal flood elevation will not be affected by development. Therefore, certain areas in which the regulatory flood is the 100-year tidal flood will not be regulated under this chapter. The elevation of the 100-year tidal flood, which varies along the coast, can be obtained from the Department.

i. Tidal water bodies not regulated under this chapter shall include, but not be limited to, the Atlantic Ocean and all water bodies named on the U.S. Geological Survey 7½ inch topographic maps as "bays," "canals," "coves," "guts," "harbors," "inlets," "sounds," "thorofares," and "channels," except for: the portion of the Delaware River near Camden called "Back Channel," all man-made lagoons and canals and all sections of the "Intracoastal Waterway."

ii. The lower reach of a watercourse that flows into a tidal water body will be subject to the same flooding characteristics as the tidal water body. Subparagraph (b)1ii(1) through (16) below identifies reaches along specific watercourses that will be considered tidal for the purposes of this chapter and, therefore, not regulated under this chapter. Along those watercourses not specifically identified in (b)1ii(1) through (16) below that flow into tidal waterbodies listed in (b)1 above, the reach between the mouth of the watercourse and the closer of either the first bridge or culvert upstream or the point upstream where the regulatory flood exceeds the 100-year tidal elevation will be considered a tidal water body for the purposes of this chapter and, therefore, not regulated under this chapter.

(1) Arthur Kill (Middlesex Co./Union Co.): entire reach;

(2) Comptons Creek (Monmouth Co.) Raritan Bay to Campbell Avenue;

(3) Deal Lake (Monmouth Co.) Atlantic Ocean to Wickapecko Drive;

(4) Hackensack River (Hudson Co.) Newark Bay to the Pulaski Skyway;

(5) Hudson River (Bergen Co./Hudson Co.);

(6) Manasquan River (Monmouth Co./Ocean Co.): Atlantic Ocean to Route 70;

(7) Metedeconk River (Ocean Co.): Barnegat Bay to Route 70;

(8) Navesink River (Monmouth Co.): Shrewsbury River to Coopers Bridge;

(9) Passaic River (Essex Co./Hudson Co.) Newark Bay to the Pulaski Skyway;

(10) Raritan River (Middlesex Co.): Raritan Bay to The New Jersey Turnpike;

(11) Shark River (Monmouth Co.): Atlantic Ocean to confluence with Laurel Gully Brook;

(12) Shrewsbury River (Monmouth Co.): Sandy Hook Bay to Seven Bridge Bay;

(13) Waretown Creek (Ocean Co.) Atlantic Ocean to Route 9;

(14) Whale Brook (Middlesex Co./Monmouth Co.): Raritan Bay to Route 35;

(15) Wreck Pond (Monmouth Co.) Atlantic Ocean to Route 71; and

(16) All tidal watercourses flowing into Raritan Bay, north of Route 36 in Monmouth County.

2. Tidally influenced: Tidally influenced areas are subject to both tidal flooding and flooding caused by the tidal wave traveling up a watercourse. Since the Department is concerned with environmental impacts in the flood plain and obstructions to flow in the floodway produced by development in these areas the engineering standards for the flood fringe will not apply in these areas.

3. Fluvial: Fluvial flooding is the result of storm water runoff which exceeds the capacity of the watercourse to carry the flow

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***(j) Channel modifications at bridges and culverts (including the upstream and downstream transition zones), channelization projects, watercourse cleaning projects, and other channel modifications (excluding dams) shall comply with the following fish passage requirement;**

1. Any new or modified channel of a watercourse shall be designed and constructed so that, during low-flow conditions, the water depth is at least as deep as in the pre-construction channel unless the Department allows an exception to this requirement pursuant to (j)2 below.

2. No exception to (j)1 above shall be allowed by any delegated agency. The Department will allow an exception to (j)1 above if:

i. The pre-construction channel does not allow for the upstream passage of fish during low-flow conditions;

ii. Conditions upstream or downstream of the channel modification are unfavorable to fish passage; or

iii. The Department determines that other circumstances, such as public need for the project or exceptional and undue hardship for the applicant, warrant such an exception.*

7:13-3.6 Projects affecting other fish resources

(a) Construction *[activity]* ***activities that would introduce sediment into the watercourse or otherwise increase the turbidity in the watercourse*** within 50 feet of the banks of watercourses which support anadromous fish are prohibited during the following *[dates]* ***periods***:

1. For projects on waters identified as anadromous migratory pathways (watercourses): April 1 to June 30, inclusive; and

2. For projects on waters used by American Shad for migrations on the Delaware River System:

i. Mouth of bay to Delaware Memorial Bridge and tidal Maurice River: March 1 through June 30 and October 1 through November 30;

ii. Delaware Memorial Bridge to New York State line and the tidal portions of Rancocas and Raccoon Creeks: April 1 through June 30 and September 1 through November 30;

iii. Timing restrictions for formerly-native or introduced fish species, such as, but not limited to, the Atlantic Salmon, Chinook Salmon, or Coho Salmon which may or will in the future be reintroduced to State waters, will be developed as those species become established.

(b) Construction *[activity]* ***activities which would introduce sediment into the watercourse or otherwise increase the turbidity in the watercourse,*** within 25 feet of the banks of waterbodies identified as supporting warm-water fish including but not limited to smallmouth bass, largemouth bass, pickerel, walleye and yellow perch shall be prohibited during the following *[dates]* ***periods***:

1. Waterbodies supporting general game fish: May 1 to June 30 inclusive;

2. Waterbodies supporting pickerel: Ice Out to April 30 inclusive; and

3. Waterbodies supporting walleye: March 1 to May 30 inclusive.

(c) Channel modifications at bridges and culverts (including their upstream and downstream transition zones), channelization projects, watercourse cleaning projects, and other channel modifications (excluding dams) shall comply with the following fish passage requirements:

1. Any new or modified channel of a watercourse shall be designed and constructed *[in such a manner]* so that, during low-flow conditions, the water depth is at least as deep as in the *[existing]* ***pre-construction*** channel *[or 10 inches deep, whichever is less,]* unless the Department *[determines in writing that the project cannot be constructed or redesigned to fulfill its intended use without modification of this requirement]* ***allows an exception to this requirement pursuant to (c)2 below***.

2. *[Exceptions to the requirement i]* ***No exception to*** (c)1 above shall not be *[granted]* ***allowed*** by any delegated agency ***.****[, but may be considered by the Department]* ***The Department will allow an exception to (c)1 above*** if:

i. The pre-construction channel does not allow for the upstream passage of fish during low-flow conditions;

ii. *[Fish passage in the particular channel segment in its pre-construction condition is irrelevant because of upstream or downstream conditions]* ***Conditions upstream or downstream of the channel modification are*** unfavorable to fish passage; or

iii. The Department determines that other circumstances such as public need for the project or exceptional and undue hardship *[compel waiver of this requirement]* ***for the applicant warrant such an exception***.

(d) Channelization of watercourses supporting the fisheries resources described in this section is prohibited unless the Department determines that:

1. There is a compelling public need for the proposed project greater than the need to preserve the natural condition of the channels of such watercourses and that need cannot be met by essentially similar projects in the region which are under construction or expansion or which have already received the necessary governmental permits and approvals and the project cannot be accomplished in a less-destructive manner; and

2. The requirements of (e) and (f) below are met.

(e) Any application for channelization of a watercourse which supports the fisheries resources described in this section shall include a map of the existing watercourse channel that identifies the location, dimensions and area of cascades, riffles, flats and pools, except as follows:

1. Channel modification directly and inextricably linked to the construction or maintenance of bridges or culverts, including transition zones up to 100 feet upstream or downstream from such bridges or culverts;

2. Minor bank re-establishment or bank protection projects limited to 100 feet of channel length; or

3. Other projects which require 100 feet or less of channel modification including, but not limited to sewer headwalls, sewer outlet works, sewer outlet diffusers, minor water intake facilities and channel crossings of utilities.

(f) The new or modified channel of a watercourse shall be designed and constructed in such a manner as to duplicate or preserve the pre-construction character of the channel including proportion of shading, pools, flats, riffles and cascades and areas for fish cover and shelter.

7:13-3.7 Projects exposing deposits of acid-producing soils

(a) The requirements of this section apply only to deposits of acid-producing soils that are sometimes found in the following Coastal Plain geologic formations:

1. Raritan Formation;
2. Magothy Formation;
3. Merchantville Formation;
4. Woodbury Clay;
5. Englishtown Sand;
6. Marshalltown Formation;
7. Navesink Formation;
8. Red Bank Sand; and
9. Kirkwood Formation.

(b) The map showing the general location of these deposits can be found in the Technical Manual.

(c) The requirements of the section are applicable to projects under the jurisdiction of this chapter which shall affect deposits of acid-producing soil, whether or not encroachments are classified as "major" or "minor" in the 90-Day Construction Permit Rules (N.J.A.C. 7:1C).

(d) Where it is known in advance that deposits of acid-producing soils would be exposed by the proposed regulated activity, the application for a permit under this chapter shall include a written site evaluation prepared by a professional which identifies the extent of exposure, the applicant's plan to mitigate the impacts of such exposure, and the result of the special laboratory analysis of the soils, if required by (g) below.

(e) If, after the Department determines an application under this chapter complete for review, the Department or the applicant determines that deposits of acid-producing soils would be or have been exposed by the regulated activity, the Department may, time permitting, permit the applicant to amend the application by submitting

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a site evaluation and mitigation plan as described above within a time stipulated in writing by the Department, or deny the application on its merits. Ammended applications may be submitted in accordance with N.J.A.C. 7:13-4.7(g).

(f) If construction activity (pursuant to a permit issued under this chapter or otherwise) reveals deposits of acid-producing soils not described to the Department in an application for a permit to conduct regulated activities at the location containing such soils, the Department shall order the permittee, or other person as the case may be, to desist from further exposure of acid-producing deposits and to apply Department-specified mitigation measures to deposits already exposed, pending the Department's review and approval of a site mitigation and evaluation plan, and an application for a permit under this chapter, as the case may be.

(g) Special laboratory analysis requirements are as follows:

1. If the Department determines that deposits of acid-producing soils have been or will likely be exposed as a result of regulated activities proposed by an applicant, or as a result of activities undertaken by a permittee or undertaken illegally by a person who has not yet applied for a permit under this chapter, and the Department determines that it requires more information about characteristics of such deposits to approve or disapprove an application to conduct such regulated activities, the Department may require the permittee, or applicant as the case may be, to include in its site evaluation and mitigation plan the following chemical analysis of samples of deposits taken from pre-construction borings along the relevant sections of the watercourse channel or flood plain as stipulated by the Department. The following tests shall be performed by a State-certified Laboratory, using methods specified in the Technical Manual:

i. pH;

ii. Cation exchange capacity;

iii. Exchangeable cation content;

iv. Potential acidity; and

v. Extractable metals (Fe, Al, Mn, Cu, Zn, Ni, Cr, Cd, Pb) and sulfate.

2. The Department may also require laboratory analysis of physical characteristics of the soil. These chemical and physical tests shall be performed by a State-certified laboratory employed by the permittee or the applicant, as the case may be, in accordance with procedures specified by the Department in the Technical Manual. In the event an order has been issued stopping activities regulated pursuant to this chapter, no such activity may commence until the Department reviews the test results required under this section and approves an application under this section including the site evaluation and mitigation plan.

(h) When acid-producing deposits are to be or have been exposed, mitigation measures shall be taken by the person engaging in the regulated activity, including:

1. Minimizing the area and time of exposure of acid-producing soils;

2. Minimizing the spread or mixing of acid-producing soils onto or into soil free of such deposits and controlling the disposal of such deposits inside or outside the flood plain;

3. Covering deposits of acid-producing soils with limestone and non-acid-producing soil to permit the establishment of vegetation; and

4. Providing prompt, temporary and permanent stabilization of areas where acid-producing soils are exposed.

(i) When acid-producing soils are exposed within a watercourse channel or along watercourse banks within the jurisdiction of this chapter as the result of activities regulated under this chapter, the person engaging in such activities shall undertake mitigation measures in order to:

1. Minimize the area and time of exposure;

2. Neutralize acid generated in the brief period of exposure; and

3. Keep post-construction oxidation rates from exceeding pre-exposure oxidation rates.

7:13-3.8 Freshwater wetlands

(a) Any disturbance of the vegetation or soil of more than one-quarter acre of freshwater wetlands located within the jurisdiction of this chapter *[and]* contiguous to the watercourse constitutes a significant and adverse impact on the biota of the watercourse. A permit application which proposes such a disturbance shall not be approved by the Department unless the applicant demonstrates to the Department's satisfaction that:

1. The disturbance is absolutely necessary to construct the project or that the project cannot be redesigned to reduce or eliminate the disturbance and still meet the objective and purpose of the project; and

2. That effective measures shall be taken by the applicant to mitigate or replace wetlands to be disturbed or destroyed with wetlands of the same or higher quality.

(b) This section shall apply only to those areas located within the Hackensack Meadowlands Development Area.

7:13-3.9 Threatened and endangered species

(a) In addition to the other requirements set forth in this chapter, the Department shall issue a permit for an activity regulated under this chapter only if the activity will not adversely affect populations of species of threatened or endangered plants or animals *[living]* ***documented*** in the areas under the jurisdiction of this *[capter]* ***chapter which are critically dependent on the watercourse to survive,*** and will not adversely affect their habitats located within the jurisdiction of this chapter, which habitats are either currently occupied by species of threatened or endangered plants or animals, or which are documented, historic habitat for threatened or endangered species of plants or animals and which remain suitable for breeding, resting, or feeding by those species of animal during any portion of their life-cycle. ***A survey for threatened and endangered species may be required if the proposed project will disturb an area documented to contain a threatened and endangered species, or nearby areas in which the habitat that can support these species is present. Persons seeking information pertaining to threatened and endangered species occurrences on or near a project site may contact the "Natural Heritage Program", CN 404, Trenton, N.J. 08625-0404 (fee required).***

(b) Those persons undertaking threatened and endangered plant or animal surveys/assessments on behalf of an applicant for a permit under this chapter shall possess the education and experience in wildlife biology, zoology or botany necessary to perform the required surveys/assessments. The Department may request additional information and/or surveys/assessments if it finds the surveys/assessments inadequate or that the minimum data have not been supplied. Threatened and endangered species surveys/assessments shall include the following data:

1. The name and address of all persons participating in the survey, the date and time of the investigation including total number of hours spent by each individual specifically for species observation, and the number of observers present on the site at any one time, including their location on the site relative to one another;

2. The site conditions during the survey and observation, that is, precipitation, wind speed and direction, and temperature, artificial or natural noises, nearest human activity or development to site, aside from the observers listed in (b)1 above;

3. The method and specifics of species sightings, indicating whether the subject was sighted directly or identified by call, track, scat, remains or other indirect evidence of presence, the date and time of each such sighting or discovery of evidence, and the relative age and condition of any indirect evidence observed and its location on the property. If the species is observed directly, note the number of individuals, activity of each when observed, each individual's sex and age, location of each individual observed on or near the project site, as the case may be, and the distance between the animals and the observer at each sighting;

4. A description of the techniques and methodology(s) employed by the observer during the site investigation;

5. The acreage of the surveyed area and breakdown of acreage as per habitat/cover type shown on the USGS *[Quad]* ***Quadrangle*** map and NWI maps with site boundaries delineated;

6. A description of each habitat and cover type on site including vegetation, hydrology, soils and natural communities. These habitats shall be assessed for suitability and compatibility to the life history

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of the target species. If no target species are observed, a discussion of the site's suitability for the species shall be provided.

(c) If, while reviewing the merits of an application deemed complete for review without a threatened and endangered species survey/assessment, the Department determines that the project or its construction would significantly damage or destroy threatened and endangered plants or animals or their current or historic habitats the Department shall, time permitting, either request the applicant to submit a threatened and endangered species survey to the Department within the time stipulated by the Department in accordance with the criteria outlined in (b) above or deny the application on its merits. Amended applications may be submitted pursuant to N.J.A.C. 7:13-4.7(g).

SUBCHAPTER 4. APPLICATION PROCEDURE FOR STREAM ENCROACHMENT PERMITS

7:13-4.1 Required information for all applications submitted to the Department

(a) The standard application form, CP-1, shall be completed by the applicant or the applicant's authorized agent including all signatures and seals. Notarization is not necessary.

(b) The Engineering Data Sheet shall be completed and all required information for the type of project shall be supplied along with a copy of the completion check list and, where applicable, a copy of any pre-application conference minutes.

(c) The fee as required by the 90-Day Construction Permit Rules (N.J.A.C. 7:1C) shall be included with all applications for permits.

(d) Certification of notification required by N.J.A.C. 7:13-4.2 shall be submitted.

(e) Six sets of plans prepared in accordance with the requirements of this chapter outlined on the Engineering Data Sheet shall be submitted.

(f) A Soil Erosion and Sediment Control Plan shall be submitted.

(g) Two sets of color photographs showing the work area shall be submitted.

(h) Except for applications by public entities which have asserted the right of eminent domain, the applicant shall provide evidence of easements or other property owner's permission for any work outside the applicant's property or which will physically affect properties not owned or controlled by the applicant.

(i) Any application made pursuant to this chapter affecting any land within the Pinelands Area as defined in N.J.S.A. 13:18A-11 is not complete for review until the applicant submits to the Department a Certificate of Filing, a Certificate of Compliance or an Resolution of Approval from the Pinelands Commission for the proposed development and proposed activities on that land.

(j) Three copies of an environmental report bound or in loose-leaf form, on 8½ by 11 inch paper shall be submitted to the Department. All maps, plans and aerial photographs shall contain a north arrow, graphic scale, date of preparation, name of author, and source of information. The report shall contain a detailed environmental inventory and assessment which describes and documents in narrative and map form (including Soil Conservation Service soil maps) possible short and long term effects of each proposed activity upon the site as well as upon adjacent areas upstream and downstream. To the extent required to meet the requirements of this chapter, the report shall include:

1. A description of the scope and nature of the proposed activity including reasons why the proposed structures and their location are the most appropriate for the site and why they minimize to the greatest extent possible any adverse affects upon the pre-construction character of the site ***located within the jurisdiction of this chapter***. The report shall also describe and analyze alternatives to the proposed activity, including the no-build option;

2. Temporary and permanent physical changes to the site which would result from the proposed activity and the impact of these changes on the *[project site]* ***areas within the jurisdiction of this chapter*** and the adjacent properties, including details regarding:

i. The effect of the project on public health, safety, and welfare; water quality and quantity; flood storage; existing and potential water uses; parks and/or preserves; vegetation, wildlife, and fisheries, including threatened and endangered species;

ii. All measures to be taken during construction and thereafter to reduce detrimental on-site and off-site effects of both construction and use of the structure in question; and

iii. Adverse environmental impacts which cannot be avoided or mitigated;

3. Project location using the State plane coordinate system;

4. For encroachments along trout-associated watercourses, the environmental report shall identify:

i. The method for disposing of sediment-laden pumpage from dewatering operations;

ii. Channel segments along which trees or shrubs shall be removed; and

iii. Places where construction vehicles shall operate on the banks of trout-associated watercourses and the physical character of the watercourse bed at such places;

5. For all proposed detention and retention basins ***under the jurisdiction of this chapter***, the applicant's environmental report shall address the effects of the basin on the watercourse habitat (that is, what plants and animals will be disturbed or displaced, the degree of destruction or disturbance and how these effects shall be mitigated or remedied by the applicant), and whether or not the basin will contribute to or constitute a breeding habitat for mosquitoes;

6. A site evaluation and mitigation plan for acid-producing soils, where applicable;

7. A threatened and endangered animal and plant survey or habitat suitability assessment; and

8. An Environmental Report, prepared using an interdisciplinary approach, containing the identity and qualifications of the persons who prepared each element of the report. References to data, reports or treatises not contained completely in the Environmental Report shall be cited throughout the text as appropriate, and in a consistent manner. Complete copies of all documents cited in the report shall be made available to Department personnel, at the applicant's expense, upon reasonable advance notice.

(k) If applicable, the application shall include the date on which the proposed application was preconferenced with the Department pursuant to N.J.A.C. 7:13-4.3, and the name of the Department personnel who preconferenced the application.

(l) Any application which does not contain the information required in this section fshall be considered incomplete and ineligible for review, or alternatively, shall be denied.

7:13-4.2 Notice

(a) The applicant shall provide notice to those persons described in (a)1 to 5 below, of the filing of an application for a permit under this chapter for projects considered a major project under the 90-Day Construction Permit Rules (N.J.A.C. 7:1C), for projects along trout associated watercourses, for projects exposing acid-producing soils, for projects requesting a hardship exemption and for an appeal of the Department's decision on an application deemed complete for review. The notice shall include a description of the nature and location of the proposed project, data on the application (a copy of the CP-1 form will be acceptable to fulfill these requirements) and a request that written comments be sent to the Department at the address stipulated in N.J.A.C. 7:13-1.5. The notice shall be sent to the following agencies and individuals:

1. The municipal planning board, engineer, construction official, environmental commission and clerk's office of the municipality in which the project is located. Also the municipality across the watercourse and the municipality next downstream on both sides of the waterway, if within one mile of the project must be notified;

2. All property owners within 200 feet of the legal boundary of the property or properties on which the project shall be constructed;

3. The county planning board, county engineer, county environmental commission and county mosquito control commission;

4. The local county Soil Conservation District; and

5. Any other agencies or bodies as requested by the Department or the county.

(b) If the proposed project is a linear facility such as a pipeline or road of more than one-half mile ***within the jurisdiction of this**

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newspapers and a list of all persons who have requested notice of the decision.

(c) Pending appeal of the Department decision and the Commissioner's final decision on the appeal, a person may apply to the Commissioner for a stay of the issuance of a permit by written request and for good cause shown therein. The Commissioner may stay the issuance of the permit upon such terms and conditions as the Commissioner may deem proper in his or her sole discretion. The request for stay of issuance of the permit shall be made within 21 days of the issuance of the Department approval of the permit application.

(d) Where a request for a hearing concerning a Department decision on a permit application has been granted by the Department, the request shall be referred to the Office of Administrative Law for a fact-finding hearing if required pursuant to the Administrative Procedure Act (N.J.S.A. 52:14B-1 et seq.), after which, the Commissioner shall issue a final decision adopting, rejecting or modifying the findings of fact and conclusions of law of the administrative law judge, within the time frame specified in N.J.S.A. 52:14B-10.

(e) Nothing in this section shall be construed to provide a right to an adjudicatory hearing in contravention of N.J.S.A. 52:14-3.1 through 3.3 (P.L. 1993, c.359).

7:13-4.11 Permit application review by delegated agencies

When authority to approve certain types of regulated activities is delegated in writing by the Department to another agency under provisions of this chapter and the Acts, that agency shall apply the standards and criteria of this chapter to all matters arising under the jurisdiction of this chapter which have been delegated to that agency.

SUBCHAPTER 5. IMPLEMENTATION

7:13-5.1 Consistency with other requirements in permit review

(a) A permit under this chapter is expressly conditioned upon the permittee complying with all other applicable Federal, State and local statutes, rules and regulations, orders, standards, plans, and ordinances which may apply to the work necessary to accomplish the proposed project, and obtaining all other permits, licenses or approvals required for the work which is a part of the proposed project. The issuance of a permit pursuant to this chapter shall not obligate the Department to grant or deny an application by the permittee for any other license, permit or approval issued by the Department.

(b) In cases where the Department has not delegated authority under N.J.A.C. 7:13-5.3, no local agency or employee thereof shall grant any application for development as defined in the "Municipal Land Use Law" (N.J.S.A. 40:55D-1 et seq.) for an activity regulated under this chapter until an application for a permit under this chapter has been approved by the Department. ***The Department will consider this provision satisfied if the local approval is conditioned upon obtaining a permit under this chapter.***

7:13-5.2 Creation of a county water resources association

The governing body of any county may, by ordinance or resolution, as the law may provide, create a county water resources association to discuss and coordinate county flood control and water management programs, to advise the county governing body on these issues and to undertake any other such duties concerning water management as the county governing body may legally delegate to it by ordinance or resolution. Members of this Association shall be appointed by the county governing body and may include the chief administrative officer or executive of any county planning agency, county engineer's office, county utility authority, county health department, county mosquito commission, county soil conservation district, county parks agency and any other person with relevant experience or training.

7:13-5.3 Delegation of power to counties

(a) Except as otherwise expressly provided in this chapter, the Department may delegate its authority to review and decide any application made to it pursuant to this chapter as well as its power to enforce any aspect of its legal obligations arising under the Acts to a county governing body which shall expressly agree to accept such designation, and follow the rules stated herein, and which, in the Department's judgment, retains those employees with professional training and education capable of properly administering the provisions of this chapter.

1. A county wishing to apply for authority to issue permits pursuant to the provisions of this chapter or to undertake enforcement of any of the provisions of this chapter shall submit a written request to the Department and specifically describe those aspects of the permitting and enforcement authority of the Department under this chapter which it wishes to assume. The county shall also submit evidence of a formal approval by the county governing body agreeing to apply for delegation of the authority or obligations described in the application and agreeing to adopt, in the event the request is granted, an ordinance or resolution containing all provisions of this chapter relevant to the duties and obligations to be assumed by the county. The request shall also describe in detail the personnel, physical resources and source and amount of funding by which the county shall fulfill the obligations the county wishes to assume.

2. A county to which permitting authority or enforcement obligations have been delegated pursuant to this subsection shall preserve, for the Department review, all documents, plans, maps, memoranda and notes as necessary which document that it has discharged its delegated duties in accordance with the applicable provisions of this chapter.

3. The Department shall review the county records pertaining to all duties delegated to the county under this subsection at least once every 365 days after the date of the formal delegation of duties to the county, and may at any time revoke such delegation if, in the judgment of the Department, the county has failed to properly administer powers delegated to it, which may include a failure to maintain the records stipulated in (a)2 above.

4. The county governing body to which permitting functions under this chapter have been delegated shall not charge fees in excess of those promulgated by the Commissioner pursuant to N.J.S.A. 13:1D-33.

(b) The Department shall not delegate the powers to review or decide any application for a permit pursuant to this chapter filed by a State agency.

7:13-5.4 Penalties

Any person who violates a provision of this chapter shall be subject to penalty and injunctive relief, as applicable, pursuant to N.J.S.A. 58:16A-63 and 58:10A-1 et seq.

SUBCHAPTER 6. (RESERVED)

SUBCHAPTER 7. DELINEATED FLOODWAYS

(OAL NOTE: The text of adopted N.J.A.C. 7:13-7.1 includes no changes from N.J.A.C. 7:13-7.1 currently in the New Jersey Administrative Code. Given the extensive text of these rules, its text is not reproduced as part of this adoption, but may be found in the New Jersey Administrative Code.)

FACT SHEET FOR REVOCATION AND REISSUANCE OF NJPDES GENERAL PERMIT NO. NJ0088323

EXISTING N.J.A.C. 7:14A-3 APPENDIX B
PROPOSED N.J.A.C. 7:14A-11 APPENDIX B

State of New Jersey
Department of Environmental Protection
February 5, 1996

EXCERPTS

FACT SHEET FOR REVOCATION AND REISSUANCE OF NJPDES GENERAL PERMIT NO. NJ0088323

EXISTING N.J.A.C. 7:14A-3 APPENDIX B
PROPOSED N.J.A.C. 7:14A-11 APPENDIX B

I. BACKGROUND

In order to comply with Section 402(p) of the Federal Clean Water Act (Federal Clean Water Act), 33 U.S.C. §1251 et seq., the U.S. Environmental Protection Agency (USEPA) issued rules on November 16, 1990 establishing National Pollutant Discharge Elimination System (NPDES) permit application requirements for certain stormwater discharges, including stormwater discharges associated with industrial activity (see 55 Fed. Reg. 47990, amending 40 CFR 122, 123 and 124). The federal rules define the term "storm water discharge associated with industrial activity," and establish requirements for submitting individual permit applications and group applications for such discharges. The federal rules also allow such discharges to obtain authorization under a promulgated general permit. These rules were later amended to establish minimum notification requirements for general permits, and revised requirements for stormwater permits. A background discussion explaining the origin and basis of these federal rules is provided in the preamble to the November 16, 1990 rules, and also in the preambles to subsequent draft and final amendments to 40 CFR 122 (see 55 Fed. Reg. 47990, 56 Fed. Reg. 12098, 56 Fed. Reg. 56548, 57 Fed. Reg. 11394, 57 Fed. Reg. 60444, 60 Fed. Reg. 17950, 60 Fed. Reg. 40230).

The New Jersey Department of Environmental Protection (Department) is the issuing authority for NPDES permits in the State of New Jersey, and issues those permits as part of the New Jersey Pollutant Discharge Elimination System (NJPDES). In 1992, as part of its initial response to the USEPA stormwater discharge rules, the Department proposed and adopted amendments to the NJPDES rules, N.J.A.C. 7:14A. On October 1, 1992, as part of those rule amendments, the Department issued two general permits for stormwater discharges associated with industrial activity: General Permit No. NJ0088323 (the "construction" general permit, existing N.J.A.C. 7:14A-3 Appendix B), which is for stormwater discharges from certain construction, mining, and quarrying activities, and General Permit No. NJ0088315 (the "basic industrial" general permit, existing N.J.A.C. 7:14A-3 Appendix A), which is for stormwater discharges associated with a broad range of industrial activities. Both general permits are cited in existing N.J.A.C. 7:14A-3.9(c).

Both general permits are for discharges to surface water (DSW), and became effective on November 2, 1992. Background discussions explaining the origin and basis of those general permits and other NJPDES rule amendments are provided in the Department's fact sheets for the draft general permits (dated June 5, 1992), and in the New Jersey Register

EXCERPTS

notices for the proposal and adoption of those amendments and subsequent administrative corrections and changes (see 24 N.J.R. 2352(a), 4088(a), 4364(a), 4522(a), and 25 N.J.R. 687(a)). Both general permits are currently scheduled to expire on November 1, 1997.

On May 15, 1995, the Department proposed a second set of NJPDES rule amendments (DEP Docket Number 19-95-04/539), including but not limited to modification of both general permits. (The Department issued those draft permit modifications on April 12, 1995.) The Department has not yet adopted any of those proposed amendments, and has not yet issued a final permit decision on the general permit modifications that are part of those proposed amendments. Background discussions explaining the origin and basis of those draft permit modifications and other proposed NJPDES rule amendments are provided in the Department's fact sheets for those draft permit modifications (dated 12 April 1995), and in the May 15, 1995 New Jersey Register notice for those proposed amendments (see 27 N.J.R. 1857(a)).

The Department is now proposing to restructure the NJPDES program by repealing most of the existing NJPDES rules and replacing them with new NJPDES rules (DEP Docket Number 54-95-12/205, 28 N.J.R. 380(a)). As part of that proposal, the Department is proposing to revoke and reissue both general permits. This fact sheet is for revocation and reissuance of General Permit No. NJ0088323, which would be reissued at N.J.A.C. 7:14A-11 Appendix B (which is cited in proposed N.J.A.C. 7:14A-11.5(j)). A more specific description of the discharges authorized under that permit is provided under Section II of this fact sheet. (The Department has prepared a separate fact sheet for revocation and reissuance of General Permit No. NJ0088315.)

The proposed new NJPDES rules incorporate USEPA stormwater discharge rules with certain qualifications and exceptions (see, e.g., proposed N.J.A.C. 7:14A-11.5 and the definition of "stormwater discharge associated with industrial activity" at proposed N.J.A.C. 7:14A-1.2). The proposed NJPDES rules also authorize the Department to issue general permits for stormwater and other discharges (see proposed N.J.A.C. 7:14A-6.13).

The number of New Jersey businesses (including some government establishments) that may need a DSW permit for a "stormwater discharge associated with industrial activity" is very large. For example, the New Jersey Department of Labor has identified approximately 20,000 establishments under Standard Industrial Classification (SIC) codes listed in the 40 CFR 122.26(b)(14) and proposed N.J.A.C. 7:14A-1.2 definitions of "storm water discharge associated with industrial activity." (Moreover, these approximately 20,000 establishments do not include most of the construction activity that falls under category (x) of those definitions, which is not based on SIC codes.) The large number of facilities that potentially fall under the regulatory definition of "stormwater discharge associated with industrial activity" places correspondingly large administrative burdens on the Department. The Department is recognized by USEPA as authorized to administer the

EXCERPTS

water from landscape irrigation, groundwater infiltration, etc.). Therefore, the Department believes that it is not reasonable or practicable to exclude from this permit all stormwater discharges that are combined with non-stormwater discharges.

Non-stormwater discharges in stormwater conveyances must still, where required, obtain authorization under a NJPDES permit with conditions appropriate for such discharges. Stormwater discharges other than stormwater from eligible construction, mining, or quarrying activities are excluded from this permit because the SPPP required by the reissued permit consists solely of a soil erosion and sediment control plan (or municipal ordinance requirements) that may not adequately control such discharges.

III. POLLUTANTS IN DISCHARGES AUTHORIZED UNDER GENERAL PERMIT NO. NJ0088323

A. Introduction

As noted in fact sheets and notices for USEPA draft and final baseline and Multi-Sector Storm Water General Permits (56 Fed. Reg. 40948; 57 Fed. Reg. 41237, 58 Fed. Reg. 61146, 60 Fed. Reg. 50811), the volume and quality of stormwater discharges associated with industrial activity will depend on a variety of factors, including the industrial activities occurring at the facility, the nature of precipitation, and the degree of surface imperviousness. Stormwater may pick up pollutants from structures and other surfaces as it drains from the land. In addition, sources of pollutants other than stormwater, such as illicit connections, spills, and other improperly disposed materials may increase the pollutant loads discharged from separate storm sewers. The sources which contribute pollutants to stormwater discharges vary with the type of industry operation (including construction, mining, and quarrying) and facility-specific features.

B. Construction

Construction activities are characterized by high production of suspended solids caused by erosion of unprotected exposed soils and soil piles. Extremely high pollutant loads are produced from construction sites if no erosion control practices are implemented. Of all land uses, construction site erosion is one of the activities that results in the highest rates of erosion. Sediment yields from developing urban areas can be extremely high, sometimes reaching values up to 50,000 tonnes per square kilometer per year. Construction erosion is one of the most significant sources of pollution in suburban areas. Highway erosion is associated with stripping of large areas of their vegetative protection during road construction. Uncompacted or unsettled fills may be subject to intensive rill erosion and, eventually, to landslides. The magnitudes of sediment yields from these areas are similar to those from urban areas under construction (Novotny and Olem, 1994).

EXCERPTS

and sediment control practices. The Standards for Soil Erosion and Sediment Control in New Jersey note that while erosion and sediment control are important for all sites, particular attention should be given to areas of steep topography and highly erodible soils. Also, the larger the disturbed area and the longer it is left unstabilized, the more serious the problem becomes.

E. Acid-Producing Deposits

EPA's above mentioned March 1995 report to Congress noted that acidity in stormwater may be caused by air pollutants and certain land uses, and that mining is the land use with the most well known acidic stormwater discharges. The report noted that in the eastern United States, mining of coal high in sulfur is historically associated with some of the most dramatic water quality impacts caused by acidity. Elsewhere, USEPA identified pyrite (an iron sulfide mineral) in coal and overburden as the precursor for acid mine drainage from coal mines (60 Fed. Reg. 50904). In addition, USEPA's 1993 CZARA Section 6217(g) Guidance mentioned, as one of the potential pollutants associated with construction activities, "acid ... solutions from exposed soil."

New Jersey does not have coal mines. However, several geologic formations in the Coastal Plain physiographic province in New Jersey sometimes contain iron sulfide minerals (pyrite or marcasite) that, upon exposure to oxygen from the air or from surface waters, oxidize and produce sulfuric acid. The Department's Flood Hazard Area Control rules refer to geologic deposits containing such minerals as "deposits of acid-producing soils" (N.J.A.C. 7:13-3.7), and list the following nine Coastal Plain geologic formations that sometimes contain substantial quantities of these deposits: the Raritan, Magothy, and Merchantville Formations; Woodbury Clay; Englishtown Sand; Marshalltown and Navesink Formations; Red Bank Sand; and Kirkwood Formation. Acid-producing deposits in these geologic formations are sometimes exposed by construction and mining activities. Such exposure decreases the pH of stormwater (which, in turn, increases the concentration of dissolved metals in stormwater), and can also increase the discharge of sediment in stormwater by creating soil conditions toxic to vegetation used for erosion and sediment control.

N.J.A.C. 7:13-3.7 also refers to a Technical Manual (last revised by the Department in September 1995), which contains "Technical Notes Concerning Acid-Producing Deposits." Those "Technical Notes" provide additional background information, describe how acid-producing deposits can be identified, and provide guidelines to prevent or minimize the problem of water pollution and soil contamination that may otherwise be caused by exposure of these deposits.

EXCERPTS

Toy, T.J. and Osterkamp, W.R. (1995) The applicability of RUSLE to geomorphic studies. *J. Soil Water Conserv.*, **50**, 498.

Yoder, Daniel and Lown, Joel. (1995) The future of RUSLE: Inside the new Revised Universal Soil Loss Equation. *J. Soil Water Conserv.*, **50**, 484.

U.S. Department of Agriculture, Soil Conservation Service (1978). Sediment pollution and erosion control guide for resource conservation. *New Jersey Technical Guide, Section III-B.*

U.S. Department of Agriculture, Soil Conservation Service (1986). *Sediment pollution and erosion control guide for New Jersey.*

U.S. Environmental Protection Agency (1993). *Guidance Specifying Management Measures For Sources of Nonpoint Pollution In Coastal Waters.* USEPA-840-B-92-002, U.S. USEPA, Office of Water, Washington, D.C.

U.S. Environmental Protection Agency (1995). *Storm Water Discharges Potentially Addressed By Phase II Of The National Pollutant Discharge Elimination System Storm Water Program: Report to Congress.* USEPA 833-K-94-002, U.S. USEPA, Office of Water, Washington, D.C.

IV. BASIS AND DESCRIPTION OF DRAFT REVOKED AND REISSUED PERMIT

The objective of this permit action is to REVOKE AND REISSUE General Permit No. NJ0088323 pursuant to existing N.J.A.C. 7:14A-7.5. (See Section I of this fact sheet for background information about the existing permit and related federal and NJPDES stormwater permitting rules.)

The Department noted in 1992 that the initial NJPDES rule amendments were only a first step in the Department's Statewide Stormwater Permitting Strategy. On May 15, 1995, the Department proposed a second set of NJPDES rule amendments (27 N.J.R. 1857(a)), including but not limited to modification of General Permit No NJ0088323 (The Department issued those draft permit modifications on April 12, 1995.) The Department has not yet adopted any of those proposed amendments. The Department is now proposing to restructure the NJPDES program by repealing most of the existing NJPDES rules and replacing them with new NJPDES rules (DEP Docket Number 54-95-12/205, 28 N.J.R. 380(a)). As part of that proposal, the Department is proposing to revoke and reissue General Permit No. NJ0088323.

EXCERPTS

A. Fundamental Character of the Permit

The draft reissued General Permit No. NJ0088323 incorporates a number of proposed revisions to the existing General Permit No. NJ0088323. These revisions do not alter the fundamental character of that permit.

1. Authorization Under This Permit; Request for Authorization (RFA) Requirements

Like existing General Permit No. NJ0088323, draft reissued General Permit No. NJ0088323 has a "permit area" (the area where the discharge must be located in order to be eligible for authorization) that is the entire State of New Jersey. The permit specifies this large "permit area" in order to maximize the number of otherwise eligible facilities that potentially can be authorized under this permit. (As noted below, however, facilities in the "Pinelands Area" continue to be subject to additional authorization requirements.) Also like existing General Permit No. NJ0088323, draft reissued General Permit No. NJ0088323 is intended to authorize and control stormwater discharges from certain construction, mining, and quarrying activities. Further background information about the draft reissued permit is contained in Section I of this fact sheet.

The types of discharges that can be authorized under the draft reissued permit are discussed in Section II of this fact sheet. As discussed there, the draft revisions to the opening clause of Part I.B.1 of the permit ("Eligibility") are essentially equivalent to the draft modifications to that clause that the Department issued in April 1995. Also, as discussed in Section II, the Department deleted the existing language in Part I.B.1.a that excludes construction activities disturbing less than five acres from eligibility for the permit.

USEPA regulations at 40 CFR 122.28(b)(2) require that all general permits for stormwater discharges associated with industrial activity include requirements for "notices of intent" to be prepared and submitted by the discharger seeking authorization under the general permit. This draft reissued permit contains such requirements, but as in the existing permit and proposed N.J.A.C. 7:14A-6.13(d), uses the term "request for authorization" (RFA) rather than "notice of intent" (NOI). (The term "request for authorization" more completely and accurately describes this document.)

The RFA content requirements in the draft reissued permit are intended to satisfy 40 CFR 122.28(b) and proposed N.J.A.C. 7:14A-6.13(d), and to establish a mechanism that will provide a clear accounting of the number, identity, and location of facilities and permittees authorized under the general permit, and a brief description of those facilities and their proposed uses. (The name of the receiving surface water is not required in the RFA, because this information can be obtained, with as much or more reliability, from documents prepared under the Soil Erosion and Sediment Control Act.) The RFA can also be used as a screening tool to identify dischargers for whom individual permits or

EXCERPTS

permit only, and does not retroactively affect the authorization of projects under the existing permit.)

2. Non-Numeric Effluent Limitations: Stormwater Pollution Prevention Plan

a. General Requirements

Like existing General Permit No. NJ0088323, draft reissued General Permit No. NJ0088323 does not include numerical effluent limitations. Instead, this draft reissued permit contains, as non-numeric effluent limitations, requirements for implementation and retention of a stormwater pollution prevention plan (SPPP). As discussed below, this SPPP consists of requirements established under the Soil Erosion and Sediment Control Act, N.J.S.A. 4:24-39 et seq. In this and other respects, the draft reissued permit continues to integrate the requirements of that permit with the requirements of that Act. (See Section IV.A.1 of this fact sheet for discussion of the statutory basis for such integration.)

The term "pollution prevention" in this context emphasizes that the requirements in these SPPPs provide a flexible basis for developing site-specific measures (including erosion controls where appropriate) to reduce sediment loadings in stormwater discharges regulated under this permit. The term "pollution prevention" distinguishes this approach from traditional pollution control approaches that typically rely on end-of-pipe treatment to reduce pollutants in the discharges. USEPA regulations (40 CFR 122.44(i)(4)) and proposed N.J.A.C. 7:14A-11.2(a) expressly identify stormwater pollution prevention plans as a primary means for controlling stormwater discharges associated with industrial activity to reduce pollutant loadings.

In USEPA documents outlined below, USEPA summarizes options for controlling pollutants in stormwater discharges from construction sites and from mineral mining and processing facilities. Most of these options are erosion and sediment controls, which generally address pollutants in stormwater generated from the construction site during the time when construction activities are occurring, and in stormwater generated from mining and quarrying activities. Erosion controls provide the first line of defense in preventing offsite sediment movement and are designed to prevent erosion through protection and preservation of soils. Sediment controls are designed to remove sediment from runoff before the runoff is discharged from the site. As noted in preceding sections of this fact sheet, sediment is generally the most significant pollutant in stormwater discharged from construction, mining, and quarrying activities eligible for this permit. Thus, erosion and sediment controls address the most significant sources of pollutants in stormwater discharges from those activities.

Erosion and sediment controls for these activities are already established under the Soil Erosion and Sediment Control Act. Under that Act, the New Jersey Department of Agriculture, its State Soil Conservation Committee, the soil conservation districts, the

EXCERPTS

outlined below. (The State Soil Conservation Committee and NJDOT may change those standards at any time in accordance with the Soil Erosion and Sediment Control Act and the Administrative Procedure Act. For example, those standards may be changed while the draft revocation and reissuance of General Permit No. NJ0088323 is pending, or after that permit is reissued.)

The Department believes that end-of-pipe treatment requirements are not necessarily appropriate for many regulated industrial stormwater discharges from construction, mining, and quarrying activities. The end-of-pipe treatment approach (which is typically associated with numerical effluent limitations) may be prohibitively expensive for many dischargers with such activities. This approach is also not consistent with the Department's goal of moving from end-of-pipe treatment as its primary pollution control strategy to source reduction and pollution prevention (including erosion control) as a more cost-effective and environmentally sound regulatory strategy. While pollution prevention may not be appropriate or attainable in all cases, the Department believes that efforts should generally be made to encourage a pollution prevention approach wherever feasible.

(Although sediment basins and other sediment controls may in some contexts be considered a form of "end of pipe treatment," the Department does not consider sediment controls that are required under the Soil Erosion and Sediment Control Act, but that are not accompanied by requirements for stormwater sampling and numerical effluent limitations, to be "end-of-pipe treatment" for purposes of the preceding and following paragraphs. As noted below, USEPA makes a similar distinction between end-of-pipe treatment and BMPs, including "treatment BMPs." Also, for discharges authorized under this permit, the agency reviewing the project under the Soil Erosion and Sediment Control Act is responsible for approving or rejecting the proposed use of erosion controls, sediment controls, or a combination of both.)

Since the Soil Erosion and Sediment Control Act already provides a basis for controlling sediment in stormwater discharges from construction, mining, and quarrying activities, the Department believes that it would be inappropriate to establish, on a Statewide basis, different technical requirements for erosion and sediment control in General Permit No. NJ0088323. Therefore, draft reissued General Permit No. NJ0088323 requires a SPPP that consists of the project's certified soil erosion and sediment control plan (or, where applicable, requirements for soil erosion and sediment control established in or pursuant to the ordinance of an "exempt municipality") under the Soil Erosion and Sediment Control Act (except for any provisions in the soil erosion and sediment control plan or municipal requirements that are not relevant to the authorized stormwater discharge). Compliance with that Act will reduce soil erosion and, to the extent practicable, retain sediment onsite during construction, mining, and quarrying activities. Also, compliance with "Vegetative Standards" promulgated under that Act will help to ensure that where vegetation is used for erosion and sediment control, fertilizer and limestone are applied using appropriate quantities and methods. The SPPP must be retained by the permittee.

For construction, mining, and quarrying activities, the Department believes that permits requiring such an SPPP should generally not require additional end-of-pipe treatment or numeric effluent limitations for stormwater discharges. (Among the exceptions, however, are stormwater discharges that require numeric effluent limitations to comply with USEPA effluent limitation guidelines for stormwater in 40 CFR Subchapter N. Discharges subject to such guidelines are ineligible for this general permit, and may require end-of-pipe treatment or additional best management practices to achieve those numerical effluent limitations.)

The SPPP provision in this permit reduces bureaucracy, makes efficient use of available resources to protect water quality, and allows the Department of Environmental Protection to concentrate on programmatic issues rather than on technical evaluation of erosion and sediment controls for individual construction, mining, and quarrying activities. This permit makes extensive use of the soil conservation districts, which currently regulate most of these activities under the Soil Erosion and Sediment Control Act, and which have the local presence and currently have the most expertise to determine, on a site-specific basis, which erosion and sediment controls are appropriate for these activities. However, this permit also recognizes authority that NJDOT and "exempt municipalities" have under the Soil Erosion and Sediment Control Act.

All of the selected erosion and sediment controls in the SPPP required by this permit qualify as "best management practices" under 40 CFR 122.44(k), proposed N.J.A.C. 7:14A-6.2(b)1, and the definitions of "best management practices" (BMPs) in 40 CFR 122.2 and proposed N.J.A.C. 7:14A-1.2. BMPs are defined in proposed N.J.A.C. 7:14A-1.2 as "schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of waters of the State. BMPs also include treatment requirements, operating procedures, and practices to control site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage." (The definition at 40 CFR 122.2 is similar.) As discussed below in Section IV.C of this fact sheet, the SPPP requirements in the draft reissued permit include some revisions to the SPPP requirements in the existing permit.

Section III.E of this fact sheet discusses the problem of "acid-producing deposits." Because exposure of such deposits creates soil conditions toxic to vegetation used for erosion and sediment control, this problem often can be addressed under the Soil Erosion and Sediment Control Act. The Department generally prefers that this problem be addressed under that Act and under Department rules at N.J.A.C. 7:13-3.7, where applicable, and has not included specific provisions concerning acid-producing deposits in draft reissued General Permit No. NJ0088323. However, if the Department determines (more likely at a location where N.J.A.C. 7:13-3.7 does not apply) that problems caused by acid-producing deposits are not being adequately addressed under the Soil Erosion and Sediment Control Act and General Permit No. NJ0088323, the Department may take

action under proposed N.J.A.C. 7:14A-6.13 to revoke the facility's authorization under that permit.

Draft reissued General Permit No NJ0088323 also does not include specific requirements for housekeeping BMPs. As noted above in Section III.F of this fact sheet, however, the draft reissued permit provides that this permit does not authorize any infringement of State or local law or regulation. Such law and regulation includes, but is not limited to, the Spill Act, the Pesticide Control Act of 1971, the Solid Waste Management Act, and statutes pertaining to local and county health agencies. Compliance with such laws and regulations would help limit discharges in stormwater of toxic substances and other pollutants besides sediment. Hazardous substances discharges from onsite spills (as distinguished from hazardous substances typically found in normal stormwater runoff) are not authorized by this permit, and are therefore still subject to the Spill Act. Again, the Department may take action in appropriate cases under proposed N.J.A.C. 7:14A-6.13 to revoke the facility's authorization under General Permit No NJ0088323, in order to limit discharges in stormwater of pollutants besides sediment. (In the future, the Department may propose to revise this permit to include specific requirements for housekeeping BMPs.)

Like existing General Permit No. NJ0088323, draft reissued General Permit No. NJ0088323 does not require, for construction sites, stormwater management measures that are installed prior to completion of the construction process, but primarily result in reductions of pollutants in stormwater discharged from the site after the construction has been completed (except to the extent, if any, that such measures are required at a particular project under the Soil Erosion and Sediment Control Act). Instead, the Department intends to require such stormwater management measures under other programs including the Storm Water Management rules (N.J.A.C. 7:8), the Sewage Infrastructure Improvement Act (N.J.S.A. 58:25-23 et seq.), and, possibly, NJPDES-DSW permits for some municipal separate storm sewer systems. However, the Department may reconsider this matter in the future, and may propose to revise this permit to require such stormwater management measures, or to control stormwater discharges after construction is complete.

Options for Controlling Pollutants (Outline of USEPA Summaries)

In USEPA's notice for its final NPDES general permits for stormwater discharges from construction sites (57 Fed. Reg. 41176), USEPA summarizes options for controlling pollutants in such stormwater discharges. Following is a brief outline of that summary. Most controls for construction activities can be categorized into two groups: (1) sediment and erosion controls; and (2) stormwater management measures. Additional measures include housekeeping best management practices. (The Department considers all of these options, including sediment and erosion controls and stormwater management measures, to fall under the broad 40 CFR 122.2 definition of "best management practices" (BMPs).)

EXCERPTS

Acid Soil Supplement F

Selected pages with acid soil language in the 1974, 1982, 1987, and 1999 Standards for Soil Erosion and Sediment Control in New Jersey

(Unlike the other material in this Supplement, the Appendix A3 "Guide for Construction Specifications" in the 1974, 1982, and 1987 Standards was never adopted as part of the State Soil Conservation Committee rules for the Soil Erosion and Sediment Control Act, N.J.A.C. 2:90-1.)

September 1974

Standards for Soil Erosion and Sediment Control in New Jersey

First pages of “Standards for Permanent Vegetative Cover” and “Standards for Topsoiling”; and first and last pages of “Standard for Subsurface Drainage”

First page of Appendix A3 “Guide for Construction Specifications”

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STANDARDS FOR PERMANENT VEGETATIVE COVER

Definition

Establishment of permanent vegetative cover on exposed soils where perennial vegetation is needed for long term protection.

Purpose

To permanently stabilize the soil, assuring conservation of soil and water and to enhance the environment.

Where Applicable

On exposed soils that have a potential for causing off-site environmental damage.

Methods and Materials

I. Site Preparation

A. Grade as needed and feasible to permit the use of conventional equipment for seedbed preparation, seeding, mulch application and anchoring, and maintenance. All grading should be done in accordance with Standard 4.1.

B. Install needed erosion control practices and facilities such as diversions, grade stabilization structures, berms, channel stabilization measures, desilting basins and waterways. See Standards 4.2 through 4.7.

II. Seedbed Preparation

A. Apply limestone and fertilizer according to soil tests such as those offered by Rutgers University Soil Testing Laboratory. Contact your county agricultural agent at your county office. If soil testing is not feasible on small or variable sites, or where timing is critical, fertilizer may be applied at the rate of 600 pounds per acre or 14 pounds per 1,000 square feet using 10-20-10 or equivalent. In addition, 300 pounds 38-0-0 per acre of slow release nitrogen may be used in lieu of topdressing (see page 3.25 Section IV). Apply limestone (equivalent to 50 percent calcium plus magnesium oxides) as follows: 1/

Soil Textures	T/Ac.	Lbs./1,000 Sq. Ft.
Clay, clay loams and high organic soil	4	180
Sandy loams, loams, silt loams	3	135
Loamy sand, sands	2	90

Pulverized dolomitic limestone is preferred for most soils south of the New Brunswick-Trenton line.

B. Work lime and fertilizer into the soil as nearly as practical to a depth of 4 inches with a disc, springtooth harrow or other suitable equipment. The final harrowing or discing operation should be on the general contour. Continue tillage until a reasonably uniform, fine seedbed is prepared. All but clay or silty soils and coarse sands should be rolled to firm the seedbed wherever feasible.

1/ Acid soil conditions:

Soils having a pH of 4 or less shall be covered with a minimum of 12 inches of soil having a pH of 5 or more before seedbed preparation.

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STANDARDS FOR TOPSOILING

Definition

Topsoiling entails the distribution of suitable quality soil on areas to be vegetated.

Purpose

To improve the soil medium for plant establishment and maintenance.

Where Applicable

Topsoil should be used where soils are: sands, gravelly soils, loamy sands, clays, silty clays, very shallow or where they are extremely acid (less than pH 4.0) or salty (content greater than 1,000 ppm); or where topsoil is available on site and assurance of improved vegetative growth is desired.

Methods and Materials

I. Materials

Topsoil should be friable and loamy, free of debris, objectionable weeds and stones and contain no toxic substance that may be harmful to plant growth. A pH range of 5.0-7.5 is acceptable. Soluble salts should not exceed 500 ppm.

II. Stripping and stockpiling

A. Field exploration should be made to determine whether quantity and or quality of surface soil justifies stripping.

B. Stripping should be confined to the immediate construction area.

C. Where feasible, lime may be applied before stripping at a rate determined by soil tests to bring the soil pH to 6.5. In lieu of soil tests, see lime rate guide in seedbed preparation for permanent vegetative cover, 3.21.

D. A 4 to 6 inch stripping depth is common, but may vary depending on the particular soil.

E. Stockpiles of topsoil should be situated so as not to obstruct natural drainage or cause off-site environmental damage.

F. Stockpiles should be vegetated in accordance with standards previously described herein, see 3.1 or 3.2.

III. Site Preparation

A. Grade as needed and feasible to permit the use of conventional equipment for seedbed preparation. Seeding, mulch application and anchoring, and maintenance. See Standard 4.1.

B. Subsoil should be tested for lime requirement and limestone, if needed, should be applied to bring soil pH to 6.5 and incorporated into the soil as nearly as practical to a depth of 4 inches.

C. Immediately prior to topsoil distribution, the surface should be scarified to provide a good bond with the topsoil.

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STANDARDS FOR SUBSURFACE DRAINAGE

Definition

Removal of water through the soil by conduit, such as tile, pipe, or tubing, installed beneath the ground surface to collect and convey drainage water.

Purpose

A drain may serve one or more of the following purposes:

1. Improve vegetation by lowering the water table.
2. Intercept and prevent water movement into a potentially wet area.
3. Relieve artesian pressures.
4. Reduce surface runoff.
5. Serve as an outlet for other drains.
6. Replace natural subsurface drainage patterns which are interrupted by construction operations.

Conditions Where Practice Applies

Drains are used in areas having a high water table where benefits of lowering groundwater or controlling surface runoff justify the installation of such a system.

The soil shall have enough depth and permeability to permit installation of an effective system. On site investigations are required.

An outlet for the drainage system shall be available, either by gravity flow or by pumping. The outlet shall be adequate for the quantity and quality of effluent to be disposed of with consideration of possible damages above or below the point of discharge.

Design Criteria

The design and installation shall be based on adequate surveys and investigations.

Design Inflow

The design inflow can be determined by the use of the method described in reference (9), the use of table 4.8-1 or by other accepted methods.

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Installation Requirements

All drains shall be laid to line and grade and covered with not less than three inches of approved hand placed backfill and /or filter material. The upper end of all drain lines shall be closed with concrete or other durable material unless connected to a structure.

Earth backfill material shall be placed in the trench in such a manner that displacement of the drain will not occur, and so that the filter material, after backfilling, will meet the requirements of the design.

The gap between drain pipe joints shall not exceed one-fourth inch for mineral soils or one-half inch for organic soils. Openings wider than these shall be covered with fiber glass or other suitable material.

If the conduit is to be placed in a rock-trench, or where rock is exposed in the bottom of the trench, the rock shall be removed below grade deep enough so that the trench may be backfilled, compacted, and bedded so that the conduit is not less than two inches from rock.

When iron sulfide chemical reaction causes sealing of joints or perforations, the drain shall be enclosed in a clean sand-gravel filter. Riser pipes for flushing the line shall be provided at intervals not to exceed 500 feet.

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GUIDE FOR CONSTRUCTION SPECIFICATIONS

The contractor shall perform all work, furnish all materials and install all measures required to reasonably control soil erosion resulting from construction operations and prevent excessive flow of sediment from the construction site. Such work may include the installation of water diversion structures, diversion ditches, and sediment basin, and seeding, mulching or sodding critical areas to provide temporary protection. The contractor shall submit a plan showing the methods to be used for controlling erosion during construction along with the schedule of construction operations. When no work will be performed on critical areas for more than 30 days, they shall be protected by temporary seeding, mulching, or sodding, or the slope lengths shall be reduced by the installation of diversions or other means. When topography permits, debris basins shall be constructed at points of water concentration from critical area that will remain unprotected longer than 30 days. Earth berms or diversions shall be constructed to intercept and divert runoff water away from critical areas. Diversion outlets shall be stable or shall be stabilized by paving or other means acceptable to the engineer.

Critical areas shall be those areas subject to excessive erosion due to highly erodible soils, slope length and steepness or water concentrations. Concentrations of runoff water, or other reasons, may cause the area to be critical. All areas that may become critical when the vegetation or other soil surface protection is removed as shown or noted on the drawings or otherwise identified.

The permanent restoration of vegetative cover such as seeding or sodding on all areas shall be accomplished within 10 days after final grading operations have been completed. Time extensions beyond the 10 days requirement may be requested in writing and are subject to written approval by the engineer.

Structural measures for erosion shall be designed and constructed in accordance with the attached Engineering Practice Standards for diversions, waterways and debris basins.

Seeding, mulching and sodding of critical area shall be in accordance with the attached vegetative standards.

Exposed soil having a pH value of less than 4 shall be covered with a minimum of 12 inches of soil material no coarser than a sandy loam or SM and that can be corrected to a minimum pH of 6.5.

Unless otherwise approved in writing by the engineer, construction operations in rivers, streams, ponds and reserviors shall be restricted to those areas of work shown on the drawings and to those areas which must be entered for the construction of temporary or permanent structures. Rivers, streams, ponds or reservoirs shall be promptly cleared of all temporary false work, piling, debris or other obstructions placed therein or caused by the construction operations.

Excavated soil material shall not be placed adjacent to rivers, streams or bodies of water in a manner that will cause it to be washed away by high water or runoff.

Frequent fording of streams with construction equipment will not be permitted, therefore, temporary bridges, culverts or other structures shall be used wherever stream crossings are necessary. Unless otherwise approved in writing by the engineer, mechanized equipment shall not be operated in streams except as may be required to construct channel work and temporary or permanent structures.

Pollutants such as chemicals, fuels, lubricants, bituminous, raw sewage and other harmful waste shall not be discharged into or alongside of rivers, streams, impoundments or into natural or man-made channels leading thereto.

November 1982[1]

Standards for Soil Erosion and Sediment Control in New Jersey

First pages of "Standard for Temporary Vegetative Cover for Soil Stabilization" and "Standard for Permanent Vegetative Cover for Soil Stabilization"; full "Standard for Topsoiling"; and first and last pages of "Standard for Subsurface Drainage"

Appendix A3 "Guide for Construction Specifications"

[1] The fourth edition of the Standards for Soil Erosion and Sediment Control in New Jersey, which is dated November 1982 (with a January 1983 Foreword), has individual components associated with multiple dates. In regard to components listed on this page, the standards for topsoiling, and for temporary and permanent vegetative cover for soil stabilization, were last revised, and the new standard for subsurface drainage was adopted, in September 1979. These revisions and new standard were incorporated in the SSCC Chapter 251 rules at N.J.A.C. 2:90-1.3 effective July 3, 1980. See 12 N.J.R. 301(b) and 451(a). The Appendix A3 "Guide for Construction Specifications," which was not in those rules, was last revised in November 1982.

STANDARD
FOR
TEMPORARY VEGETATIVE COVER
FOR SOIL STABILIZATION

Definition

Establishment of temporary vegetative cover on soils exposed for periods of two to 12 months.

Purpose

To temporarily stabilize the soil and reduce damage from wind and water erosion until permanent stabilization is accomplished.

Where Applicable

On exposed soils that have the potential for causing off-site environmental damage.

Methods and Materials

I. Site Preparation

A. Grade as needed and feasible to permit the use of conventional equipment for seedbed preparation, seeding, mulch application, and mulch anchoring. All grading should be done in accordance with Standards for Land Grading, page 4.11.

B. Install needed erosion control practices or facilities such as diversions, grade stabilization structures, channel stabilization measures, sediment basins and waterways. See Standards 4.2 through 4.16.

II. Seedbed Preparation

A. Apply limestone and fertilizer according to soil test recommendations such as those offered by Rutgers University Soil Testing Laboratory. Soil sample mailers are available from the local Cooperative Extension Service office. If soil testing is not feasible on small or variable sites, or where timing is critical, fertilizer may be applied at the rate of 500 pounds per acre or 11 pounds per 1,000 square feet of 10-20-10 or equivalent. If seed is drilled over banded fertilizer, the rate of fertilizer is reduced 50 percent. Apply limestone (equivalent to 50 percent calcium plus magnesium oxides) as follows:

Soil Texture	Tons/Ac.	Lbs/1000 sq. ft.
Clay, clay loam and high organic soil	3	135
Sandy loam, loam, silt loam	2	90
Loamy sand, sand	1	45

Pulverized dolomitic limestone is preferred for most soils south of the New Brunswick-Trenton line.

B. Work lime and fertilizer into the soil as nearly as practical to a depth of 4 inches with a disc, springtooth harrow or other suitable equipment. The final harrowing or discing operation should be on the general contour. Continue tillage until a reasonably uniform seedbed is prepared.

C. Inspect seedbed just before seeding. If traffic has left the soil compacted, the area must be retilled as above.

D. Soils high in sulfides or having a pH of 4 or less should be mulched only. See Standards for Stabilization with Mulch Only, page 3.31.

STANDARD
FOR
PERMANENT VEGETATIVE COVER
FOR SOIL STABILIZATION

Definition

Establishment of permanent vegetative cover on exposed soils where perennial vegetation is needed for long term protection.

Purpose

To permanently stabilize the soil, assuring conservation of soil and water and to enhance the environment.

Where Applicable

On exposed soils that have a potential for causing off-site environmental damage.

Methods and Materials

I. Site Preparation

A. Grade as needed and feasible to permit the use of convential equipment for seedbed preparation, seeding, mulch application and anchoring, and maintenance. All grading should be done in accordance with Standards for Land Grading, page 4.11.

B. Install needed erosion control practices and facilities such as diversions, grade stabilization structures, channel stabilization measures, sediment basins and waterways. See Standards 4.2 through 4.16.

II. Seedbed Preparation

A. Apply limestone and fertilizer according to soil tests such as those offered by Rutgers University Soil Testing Laboratory. Soil sample mailers are available from the local Cooperative Extension Service office. If soil testing is not feasible on small or variable sites, or where timing is critical, fertilizer may be applied at the rate of 500 pounds per acre or 11 pounds per 1,000 square feet using 10-20-10 or equivalent. In addition, 300 pounds 38-0-0 per acre or equivalent of slow release nitrogen may be used in lieu of topdressing (see page 3.27 Section IV). Apply limestone (equivalent to 50 percent calcium plus magnesium oxides) as follows: 1/

Soil Textures	T/Ac.	Lbs./1,000 Sq. Ft.
Clay, clay loam and high organic soil	4	180
Sandy loam, loam, silt loam	3	135
Loamy sand, sand	2	90

Pulverized dolomitic limestone is preferred for most soils south of the New Brunswick-Trenton line.

B. Work lime and fertilizer into the soil as nearly as practical to a depth of 4 inches with a disc, springtooth harrow or other suitable equipment. The final harrowing or discing operation should be on the general contour. Continue tillage until a reasonably uniform, fine seedbed is prepared. All but clay or silty soils and coarse sands should be rolled to firm the seedbed wherever feasible.

1/ Acid soil conditions:

Soils having a pH of 4 or less or containing iron sulfide shall be covered with a minimum of 12 inches of soil having a pH of 5 or more before seedbed preparation. The added soil shall be limed as above.

STANDARD
FOR
TOPSOILING

Definition

Topsoiling entails the distribution of suitable quality soil on areas to be vegetated.

Purpose

To improve the soil medium for plant establishment and maintenance.

Where Applicable

Topsoil should be used where soils are: sands, gravelly soils, clays, silty clays, very shallow or where they are extremely acid (less than p.H 4.0) or salty (conductivity greater than 1.0 millimhos per centimeter); or where topsoil is available on site and assurance of improved vegetative growth is desired.

Methods and Materials

I. Materials

Topsoil should be friable and loamy, free of debris, objectionable weeds and stones and contain no toxic substance that may be harmful to plant growth. A pH range of 5.0-7.5 is acceptable. Soluble salts should not be excessive (conductivity less than 0.5 millimhos per centimeter). Topsoil hauled in from off-site should have a minimum organic matter content of 2.75%. Organic matter content may be raised by additives.

II. Stripping and stockpiling

A. Field exploration should be made to determine whether quantity and or quality of surface soil justifies stripping.

B. Stripping should be confined to the immediate construction area.

C. Where feasible, lime may be applied before stripping at a rate determined by soil tests to bring the soil pH to 6.5. In lieu of soil tests, see lime rate guide in seedbed preparation for permanent vegetative cover, page 3.21.

D. A 4 to 6 inch stripping depth is common, but may vary depending on the particular soil.

E. Stockpiles of topsoil should be situated so as not to obstruct natural drainage or cause off-site environmental damage.

F. Stockpiles should be vegetated in accordance with standards previously described herein, see 3.1 or 3.2. Weeds should not be allowed to grow on stockpiles.

III. Site Preparation

A. Grade as needed and feasible to permit the use of conventional equipment for seedbed preparation, seeding, mulch application and anchoring, and maintenance. See page 4.1.

B. Subsoil should be tested for lime requirement and limestone, if needed, should be applied to bring soil pH to 6.5 and incorporated into the soil as nearly as practical to a depth of 4 inches.

C. Immediately prior to topsoil distribution, the surface should be scarified to provide a good bond with the topsoil.

D. Employ needed erosion control practices such as diversions, grade stabilizabtion structures, channel stabilization measures, sedimentation basins and waterways. See Standards 4.2 through 4.16.

IV. Applying Topsoil

A. Topsoil should be handled only when it is dry enough to work without damaging soil structure; i.e., less than field capacity (see glossary).

B. A uniform application to a depth of 5 inches (unsettled) is recommended. Soils with a pH of 4.0 or less or containing iron sulfide shall be covered with a minimum depth of 12 inches of soil having a pH of 5.0 or more.

STANDARD
FOR
SUBSURFACE DRAINAGE

Definition

Removal of water through the soil by conduit, such as tile, pipe, or tubing, installed beneath the ground surface to collect and convey drainage water.

Purpose

A drain may serve one or more of the following purposes:

1. Improve vegetation by lowering the water table.
2. Intercept and prevent water movement into a potentially wet area.
3. Relieve artesian pressures.
4. Reduce surface runoff.
5. Serve as an outlet for other drains.
6. Replace natural subsurface drainage patterns which are interrupted by construction operations.

Conditions Where Practice Applies

Drains are used in areas having a high water table where benefits of lowering groundwater or controlling surface runoff justify the installation of such a system.

The soil shall have enough depth and permeability to permit installation of an effective system. On site investigations are required.

An outlet for the drainage system shall be available, either by gravity flow or by pumping. The outlet shall be adequate for the quantity and quality of effluent to be disposed of with consideration of possible damages above or below the point of discharge.

Design Criteria

The design and installation shall be based on adequate surveys and investigations.

Design Inflow

The design inflow can be determined by the use of the method described in reference (9), the use of table 4.8-1 or by other accepted methods.

Installation Requirements

All drains shall be laid to line and grade and covered with not less than three inches of approved hand placed backfill and /or filter material. The upper end of all drain lines shall be closed with concrete or other durable material unless connected to a structure.

Earth backfill material shall be placed in the trench in such a manner that displacement of the drain will not occur, and so that the filter material, after backfilling, will meet the requirements of the design.

The gap between drain pipe joints shall not exceed one-fourth inch for mineral soils or one-half inch for organic soils. Openings wider than these shall be covered with fiber glass or other suitable material.

If the conduit is to be placed in a rock-trench, or where rock is exposed in the bottom of the trench, the rock shall be removed below grade deep enough so that the trench may be backfilled, compacted, and bedded so that the conduit is not less than two inches from rock.

When iron sulfide chemical reaction causes sealing of joints or perforations, the drain shall be enclosed in a clean sand-gravel filter. Riser pipes for flushing the line shall be provided at intervals not to exceed 500 feet.

APPENDIX A3

GUIDE FOR CONSTRUCTION SPECIFICATIONS

The following are examples of requirements that may be used for preparing construction specifications. Incorporation of such requirements will help assure protection of disturbed areas especially where critical soil erosion problems may exist.

The contractor shall perform all work, furnish all materials and install all measures required to reasonably control soil erosion resulting from construction operations and minimize the flow of sediment from the construction site. Such work may include the installation of water diversion structures, diversion ditches, and sediment basin, and seeding, mulching or sodding critical areas to provide temporary protection. The contractor shall adhere to the plan showing the methods to be used for controlling erosion during construction along with the schedule of construction operations. When no work will be performed on critical areas for more than 60 days, they shall be protected by temporary seeding, mulching, or sodding, or the slope lengths shall be reduced by the installation of diversions or other means. When topography permits, debris basins shall be constructed at points of water concentration from critical area that will remain unprotected longer than 60 days. Earth berms or diversions shall be constructed to intercept and divert runoff water away from critical areas. Diversion outlets shall be stable or shall be stabilized by paving or other means.

Critical areas shall be those areas subject to excessive erosion due to highly erodible soils, slope length and steepness or water concentrations. Concentrations of runoff water, or other reasons, may cause the area to be critical. All areas that may become critical when the vegetation or other soil surface protection is removed as shown or noted on the drawings or otherwise identified.

The permanent restoration of vegetative cover such as seeding or sodding on all areas shall be accomplished within 10 days after final grading operations have been completed. Time extensions beyond the 10 day requirement may be requested in writing and are subject to written approval.

Structural measures for erosion shall be designed and constructed in accordance with the attached Engineering Practice Standards for diversions, waterways and debris basins.

Seeding, mulching and sodding of critical areas shall be in accordance with the attached vegetative standards.

Exposed soil having a pH value of less than 4 shall be covered with a minimum of 12 inches of soil material no coarser than a sandy loam or SM and that can be corrected to a minimum pH of 6.5.

Unless otherwise approved in writing construction operations in rivers, streams, ponds and reserviors shall be restricted to those areas of work shown on the drawings and to those areas which must be entered for the construction of temporary or permanent structures. Pivers, streams, ponds or reservoirs shall be promptly cleared of all temporary false work, piling, debris or other obstructions placed therein or caused by the construction operations.

Excavated soil material shall not be placed adjacent to rivers, streams or bodies of water in a manner that will cause it to be washed away by high water or runoff.

Frequent fording of streams with construction equipment will not be permitted, therefore, temporary bridges, culverts or other structures shall be used wherever stream crossings are necessary. Unless otherwise approved in writing, mechanized equipment shall not be operated in streams except as may be required to construct channel work and temporary or permanent structures.

Pollutants such as chemicals, fuels, lubricants, bituminous, raw sewage and other harmful waste shall not be discharged into or alongside of rivers, streams, impoundments or into natural or man-made channels leading thereto.

The contractor shall comply with applicable State and local regulations relating to the prevention and abatement of pollution.

April 1987

Standards for Soil Erosion and Sediment Control in New Jersey

First pages of "Standard for Temporary Vegetative Cover for Soil Stabilization" and "Standard for Permanent Vegetative Cover"; full "Standard for Topsoiling"; and first and last pages of "Standard for Subsurface Drainage"

Appendix A3 "Guide for Construction Specifications"

STANDARD
FOR
TEMPORARY VEGETATIVE COVER FOR SOIL STABILIZATION

Definition

Establishment of temporary vegetative cover on soils exposed for periods of two to 12 months.

Purpose

To temporarily stabilize the soil and reduce damage from wind and water erosion until permanent stabilization is accomplished.

Where Applicable

On exposed soils that have the potential for causing off-site environmental damage.

Methods and Materials

I. Site Preparation

A. Grade as needed and feasible to permit the use of conventional equipment for seedbed preparation, seeding, mulch application, and mulch anchoring. All grading should be done in accordance with Standards for Land Grading, p. 4.11.

B. Install needed erosion control practices or facilities such as diversions, grade stabilization structures, channel stabilization measures, sediment basins, and waterways. See Standards 4.2 through 4.16.

II. Seedbed Preparation

A. Apply limestone and fertilizer according to soil test recommendations such as those offered by Rutgers University Soil Testing Laboratory. Soil sample mailers are available from the local Cooperative Extension Service office. If soil testing is not feasible on small or variable sites, or where timing is critical, fertilizer may be applied at the rate of 500 pounds per acre or 11 pounds per 1,000 square feet of 10-20-10 or equivalent. If seed is drilled over banded fertilizer, the rate of fertilizer is reduced 50 percent. Apply limestone (equivalent to 50 percent calcium plus magnesium oxides) as follows:

SOIL TEXTURE	TONS/ACRE	LBS./1,000 SQ. FT.
Clay, clay loam, and high organic soil	3	135
Sandy loam, loam, silt loam	2	90
Loamy sand, sand	1	45

Pulverized dolomitic limestone is preferred for most soils south of the New Brunswick-Trenton line.

B. Work lime and fertilizer into the soil as nearly as practical to a depth of 4 inches with a disc, springtooth harrow, or other suitable equipment. The final harrowing or discing operation should be on the general contour. Continue tillage until a reasonably uniform seedbed is prepared.

C. Inspect seedbed just before seeding. If traffic has left the soil compacted, the area must be retilled as above.

D. Soils high on sulfides or having a pH of 4 or less should be mulched only. See Standards for Stabilization with Mulch Only, p. 3.3.1.

III. Seeding

A. Select seed from recommendations in Table 3.1-1.

STANDARD
FOR
PERMANENT VEGETATIVE COVER FOR SOIL STABILIZATION

Definition

Establishment of permanent vegetative cover on exposed soils where perennial vegetation is needed for long term protection.

Purpose

To permanently stabilize the soil, assuring conservation of soil and water, and to enhance the environment.

Where Applicable

On exposed soils that have a potential for causing off-site environmental damage.

Methods and Materials

I. Site Preparation

A. Grade as needed and feasible to permit the use of conventional equipment for seedbed preparation, seeding, mulch application and anchoring, and maintenance. All grading should be done in accordance with Standards for Land Grading, p. 4.11.

B. Install needed erosion control practices and facilities such as diversions, grade stabilization structures, channel stabilization measures, sediment basins, and waterways. See Standards 4.2 through 4.16.

II. Seedbed Preparation

A. Apply limestone and fertilizer according to soil test recommendations such as those offered by Rutgers University Soil Testing Laboratory. Soil sample mailers are available from the local Cooperative Extension Service office. If soil testing is not feasible on small or variable sites, or where timing is critical, fertilizer may be applied at the rate of 500 pounds per acre or 11 pounds per 1,000 square feet of 10-20-10 or equivalent. In addition, 300 pounds 38-0-0 per acre or equivalent of slow release nitrogen may be used in lieu of topdressing (see page 3.2.7, Section IV). Apply limestone (equivalent to 50 percent calcium plus magnesium oxides) as follows: 1/

SOIL TEXTURE	TONS/ACRE	LBS./1,000 SQ. FT.
Clay, clay loam, and high organic soil	4	180
Sandy loam, loam, silt loam	3	135
Loamy sand, sand	2	90

Pulverized dolomitic limestone is preferred for most soils south of the New Brunswick-Trenton line.

B. Work lime and fertilizer into the soil as nearly as practical to a depth of 4 inches with a disc, springtooth harrow, or other suitable equipment. The final harrowing or discing operation should be on the general contour. Continue tillage until a reasonably uniform, fine seedbed is prepared. All but clay or silty soils and coarse sands should be rolled to firm the seedbed wherever feasible.

C. Remove from the surface all stones two inches or larger in any dimension. Remove all other debris, such as wire, cable, tree roots, pieces of concrete, clods, lumps, or other unsuitable material.

D. Inspect seedbed just before seeding. If traffic has left the soil compacted, the area must be refilled and firmed as above.

1/ Acid soil conditions:

Soils having a pH of 4 or less or containing iron sulfide shall be covered with a minimum of 12 inches of soil having a pH of 5 or more before seedbed preparation. The added soil shall be limed as above.

STANDARD FOR TOPSOILING

Definition

Topsoiling entails the distribution of suitable quality soil on areas to be vegetated.

Purpose

To improve the soil medium for plant establishment and maintenance.

Where Applicable

Topsoil should be used where soils are: sands, gravelly soils, clays, silty clays, very shallow, or where they are extremely acid (less than pH 4.0) or salty (conductivity greater than 1.0 millimhos per centimeter); or where topsoil is available on site and assurance of improved vegetative growth is desired.

Methods and Materials

I. Materials

Topsoil should be friable and loamy, free of debris, objectionable weeds and stones, and contain no toxic substance that may be harmful to plant growth. A pH range of 5.0-7.5 is acceptable. Soluble salts should not be excessive (conductivity less than 0.5 millimhos per centimeter). Topsoil hauled in from off site should have a minimum organic matter content of 2.75 percent. Organic matter content may be raised by additives.

II. Stripping and Stockpiling

A. Field exploration should be made to determine whether quantity and or quality of surface soil justifies stripping.

B. Stripping should be confined to the immediate construction area.

C. Where feasible, lime may be applied before stripping at a rate determined by soil tests to bring the soil pH to 6.5. In lieu of soil tests, see lime rate guide in seedbed preparation for permanent vegetative cover, page 3.2.1.

D. A 4-6 inch stripping depth is common, but may vary depending on the particular soil.

E. Stockpiles of topsoil should be situated so as not to obstruct natural drainage or cause off-site environmental damage.

F. Stockpiles should be vegetated in accordance with standards previously described herein; see 3.1 or 3.2. Weeds should not be allowed to grow on stockpiles.

III. Site Preparation

A. Grade as needed and feasible to permit the use of conventional equipment for seedbed preparation, seeding, mulch application and anchoring, and maintenance. See page 4.1.

B. Subsoil should be tested for lime requirement and limestone, if needed, should be applied to bring soil pH to 6.5 and incorporated into the soil as nearly as practical to a depth of 4 inches.

C. Immediately prior to topsoil distribution, the surface should be scarified to provide a good bond with the topsoil.

D. Employ needed erosion control practices such as diversions, grade stabilization structures, channel stabilization measures, sedimentation basins, and waterways. See Standards 4.2 through 4.16.

IV. Applying Topsoil

A. Topsoil should be handled only when it is dry enough to work without damaging soil structure; i.e., less than field capacity (see glossary).

B. A uniform application to a depth of 5 inches (unsettled) is recommended. Soils with a pH of 4.0 or less or containing iron sulfide shall be covered with a minimum depth of 12 inches of soil having a pH of 5.0 or more.

STANDARD
FOR
SUBSURFACE DRAINAGE

Definition

Removal of water through the soil by conduit, such as tile, pipe, or tubing, installed beneath the ground surface to collect and convey drainage water.

Purpose

A drain may serve one or more of the following purposes:

1. Improve vegetation by lowering the water table.
2. Intercept and prevent water movement into a potentially wet area.
3. Relieve artesian pressures.
4. Reduce surface runoff.
5. Serve as an outlet for other drains.
6. Replace natural subsurface drainage patterns which are interrupted by construction operations.

Conditions Where Practice Applies

Drains are used in areas having a high water table where benefits of lowering groundwater or controlling surface runoff justify the installation of such a system.

The soil shall have enough depth and permeability to permit installation of an effective system. On-site investigations are required.

An outlet for the drainage system shall be available, either by gravity flow or by pumping. The outlet shall be adequate for the quantity and quality of effluent to be disposed of with consideration of possible damages above or below the point of discharge.

Design Criteria

The design and installation shall be based on adequate surveys and investigations.

Design Inflow

The design inflow can be determined by the use of the method described in reference (9), the use of Table 4.8-1, or by other accepted methods.

TABLE 4.8-1

INFLOW RATES FROM DIFFERENT SOIL TEXTURES 1/ 2/

SOIL TEXTURE	UNIFIED SOIL CLASSIFICATION	INFLOW RATE PER 1000 FT. OF LINE IN CFS
Coarse sand and gravel	GP, GW, SP, SW	0.15 to 1.00
Sandy or gravelly loam	SM, SC, GM, GC	0.07 to 0.25
Silt loam	[illegible], ML	0.04 to 0.10
Clay and clay loam	CL, CH, MH	0.02 to 0.20

1/ Required inflow rates for interceptor lines on sloping land should be increased by 10% for slopes 2% to 5%; 20% for slopes 5% to 12%; and 30% for slopes over 12%.

2/ For complete drainage systems, use the lower value in the above table for the given soil texture.

Filters and Filter Material

Suitable filters shall be used, where required by site conditions, to prevent sediment accumulation in the conduit. The need for a filter shall be determined by the characteristics of the soil materials at drain depth and the velocity of flow in the conduit.

Not less than three inches of filter material shall be used for sand-gravel filters.[1] Filters of organic material such as salt hay, straw, or wood chips shall provide a six-inch thickness.

Where fiber glass material is used, it shall be manufactured from borosilicate type glass and the manufacturer of the material shall certify that it is suitable for underground use. The material shall cover all open joints and perforations.

Envelopes shall be used around drains where necessary to improve flow characteristics of groundwater into the conduit.

Installation Requirements

All drains shall be laid to line and grade and covered with not less than three inches of approved hand placed backfill and/or filter material. The upper end of all drain lines shall be closed with concrete or other durable material unless connected to a structure.

Earth backfill material shall be placed in the trench in such a manner that displacement of the drain will not occur, and so that the filter material, after backfilling, will meet the requirements of the design.

The gap between drain pipe joints shall not exceed one-fourth inch for mineral soils or one-half inch for organic soils. Openings wider than these shall be covered with fiber glass or other suitable material.

If the conduit is to be placed in a rock-trench, or where rock is exposed in the bottom of the trench, the rock shall be removed below grade deep enough so that the trench may be backfilled, compacted, and bedded so that the conduit is not less than two inches from rock.

When iron sulfide chemical reaction causes sealing of joints or perforations, the drain shall be enclosed in a clean sand-gravel filter. Riser pipes for flushing the line shall be provided at intervals not to exceed 500 feet.

[1] A recommended method of installation is to place filter material to a depth of three inches under the drain, and cover the drain and filter with a sheet of plastic. The filter shall be designed to prevent the material in which the installation is made from entering the drain. Not more than 10% of the filter shall pass the No. 60 sieve.

APPENDIX A3

GUIDE FOR CONSTRUCTION SPECIFICATIONS

The following are examples of requirements that may be used for preparing construction specifications. Incorporation of such requirements will help assure protection of disturbed areas especially where critical soil erosion problems may exist.

The contractor shall perform all work, furnish all materials and install all measures required to reasonably control soil erosion resulting from construction operations and minimize loss of sediment from the construction site. The contractor shall adhere to the certified soil erosion and sediment control plan showing the methods to be used for controlling erosion during construction which includes sequence of construction operations. When no work will be performed on critical areas for more than 60 days, they shall be protected by temporary seeding, mulching, or sodding, or the slope lengths shall be reduced by the installation of diversions or other means.

The contractor shall install erosion controls on all disturbed critical areas or disturbances adjacent to critical areas.

Critical areas are any area subject to excessive erosion due to highly erodible soils, slope length, steepness, water concentration or other factors. Areas may become critical when the vegetation or other soil surface protection is removed.

The permanent vegetative cover such as seeding or sodding on all areas shall be accomplished within 10 days after final grading operations have been completed. Time extensions beyond the 10 day requirement may be requested in writing and are subject to written approval.

Exposed soil having a pH value of less than 4 shall be covered with a minimum of 12 inches of soil material no coarser than a sandy loam or SM and that can be corrected to a minimum pH of 6.5.

Excavated soil material shall not be placed adjacent to rivers, streams or bodies of water in a manner that will cause it to be washed away by high water or runoff. Excess borrow material removed from the construction site shall be stabilized at the site of placement.

The contractor shall comply with applicable State and local regulations for prevention and abatement of pollution.

July 1999

Standards for Soil Erosion and Sediment Control in New Jersey

Full "Standard for Management of High Acid Producing Soils"

(Figure 1-1 on page 1-3 is shown here on two pages because Figure 1-1 is too large to fit on the scanner used in preparing this Supplement)

First and last pages of "Standard for Subsurface Drainage"

Appendix A3 "Guide for Construction Specifications"

STANDARD FOR MANAGEMENT OF HIGH ACID PRODUCING SOILS

Definition

Identifying high acid producing soil which may be exposed during excavation and land grading activities and practices for its burial. High acid producing soils are soils with a pH of 4 or less or contain iron sulfide.

Purpose

To prevent or limit exposure, exposure time and spreading by equipment or rainfall on and off site and minimize erosion, sedimentation and acid leachate related damages.

By its exposure to air, soils containing iron sulfide, characterized by pyrite or marcasite nuggets or green sands, causes chemical oxidation to occur producing sulfuric acid and results in soil pH levels falling to pH 3 and lower. Most vegetation is incapable of growth at this pH level. Adjacent land and receiving waters will be negatively impacted by the acid leachate. Calcium containing materials such as sidewalks, culverts and other structures and some metallic materials are also susceptible to degradation. Agricultural limestone materials applied at rates of 8 tons per acre have resulted in only a temporary buffering effect and "liming-only" is therefore not considered an acceptable mitigation practice.

Water Quality Enhancement

Protects on site soils and offsite streams and lakes from sulfuric acid leachate which creates soil pH conditions unsuitable for growth of vegetation.

Where Applicable

This practice is applicable to any high acid producing soil materials. Such materials have been found in the Coastal Plain areas of Burlington, Camden, Gloucester, Mercer, Middlesex, Monmouth, Ocean and Salem Counties.

Planning Criteria

Early recognition and burial, removal or disposal of high acid producing soils is essential for limiting the amount of acidic material produced.

Review a surface geology map for the proposed site to investigate the presence of geologic formations which commonly contain high acid producing deposits. The geologic formations are as follows:

Englishtown Sand	Navesink Formation
Kirkwood Formation	Raritan Formation
Magothy Formation	Red Bank Sand
Marshalltown Formation	Woodbury Clay
Merchantville Formation	

Figure 1-1 on page 1-3 shows areas where these deposits may be present.

Contact the local Soil Conservation District to determine the historical presence of high acid producing soils in the

vicinity of the proposed development site.

High acid producing soils may be present in undisturbed soils at varying depths including near the soil surface to excavations or deep disturbances. Its presence on a site may be significant or limited in the soil profile. High acid producing soils are commonly black, dark brown, gray or greenish with silvery pyrite or marcasite nuggets or flaked. Alternatively, sandy soils or reddish, yellowish or light to medium brown soil materials are usually free of high acid producing deposits.

Methods and Materials

1. Limit the excavation area and exposure time when high acid producing soils are encountered.

2. Topsoil stripped from the site shall be stored separately from temporarily stockpiled high acid producing soils.

3. Stockpiles of high acid producing soil should be located on level land to minimize its movement, especially when this material has a high clay content.

4. Temporarily stockpiled high acid producing soil material to be exposed more than 30 days should be covered with properly anchored, heavy grade sheets of polyethylene where possible. If not possible, stockpiles shall be covered with a minimum of 3 to 6 inches of wood chips to minimize erosion of the stockpile. Silt fence shall be installed at the toe of slope to contain movement of the stockpiled material. Topsoil shall not be applied to the stockpiles to prevent topsoil contamination with high acid producing soil.

5. High acid producing soils with a pH of 4 or less, or containing iron sulfide, (including borrow from cuts) shall be ultimately placed or buried with limestone applied at the rate of 6 tons per acre (or 275 pounds per 1,000 square feet of surface area) and covered with a minimum of 12 inches of settled soil with a pH of 5 or more except as follows:

a. Areas where trees or shrubs are to be planted shall be covered with a minimum of 24 inches of soil with a pH or 5 or more.
b. Disposal areas shall not be located within 24 inches of any surface of a slope or bank, such as berms, stream banks, ditches and others to prevent potential lateral leaching damages.

6. Equipment used for movement of high acid producing soils should be cleaned at the end of each day to prevent spreading of high acid soil materials to other parts of the site, into streams or stormwater conveyances and to protect machinery from accelerated rusting.

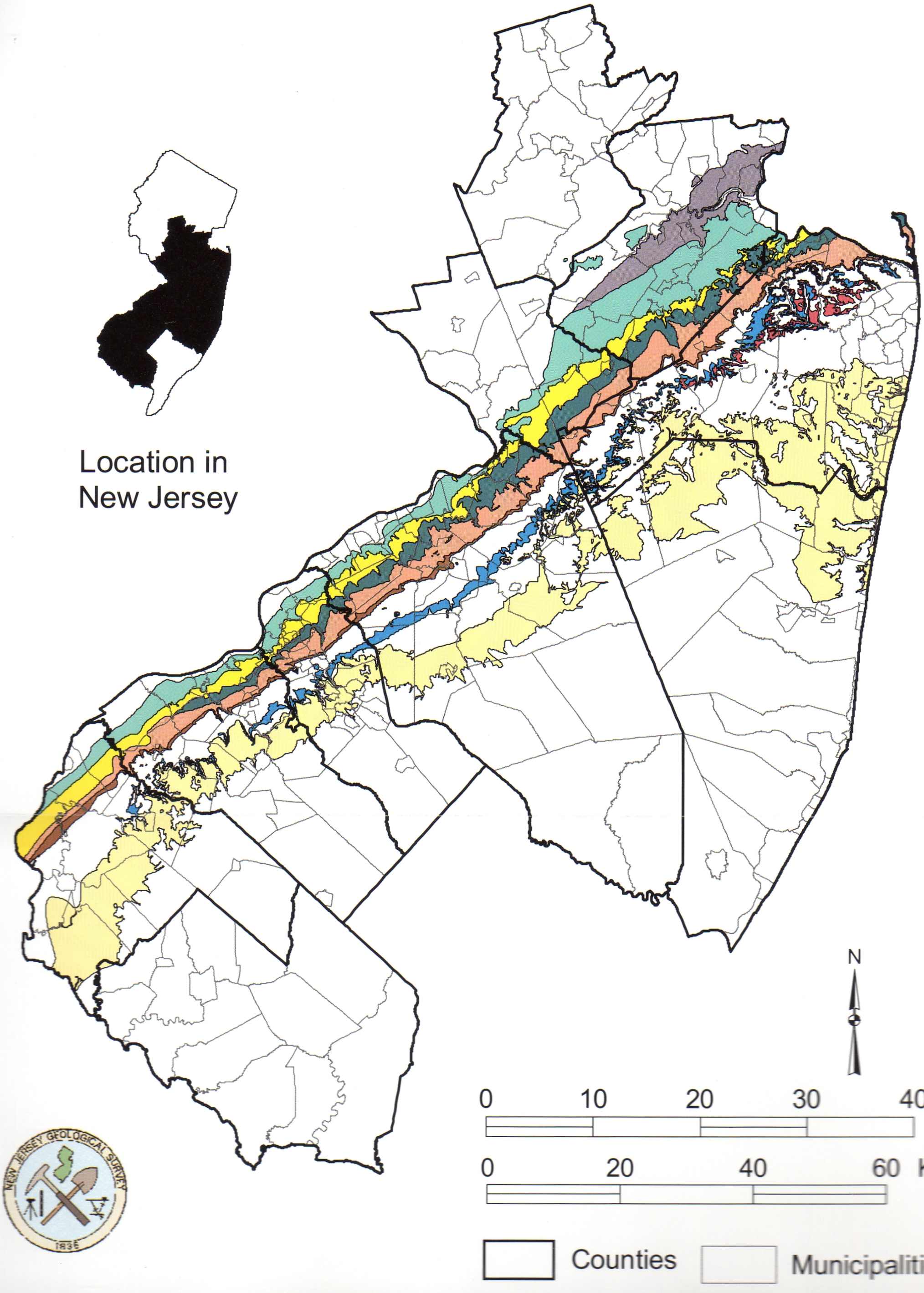
7. Non vegetative erosion control practices (stone tracking pads, strategically placed limestone check dam, silt fence, wood chips) should be installed to limit the movement of high acid producing soils from, around or off the site.

8. Following burial or removal of high acid producing soil, topsoiling and seeding of the site, (see Temporary Vegetative Cover for Soil Stabilization, pg. 7-1, Permanent Vegetative Cover for Soil Stabilization , pg. 4-1 and Topsoiling, pg. 8-1) monitoring should continue for approximately 6 to 12 months to assure there is adequate stabilization and that no high acid soil problems emerge. If problems still exist the affected area must be treated as indicated above to correct the problem.

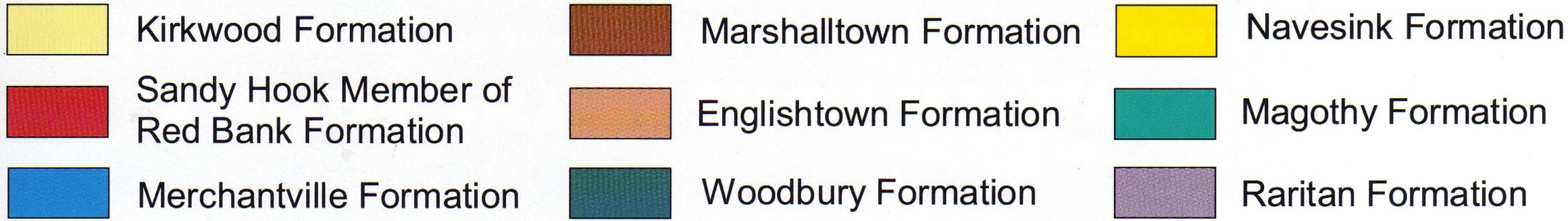
9. Monitoring of areas where high acid producing soil has been placed or buried should be performed for at least 2 years or longer if problems occur, to assure there is no migration of potential acid leachate.

Figure 1-1
Coastal Plain Formations of New Jersey Associated with Acid-Producing Soils

Location in New Jersey



NEW JERSEY GEOLOGICAL SURVEY 1836



This map shows the location of geologic formations in the Coastal Plain that are the source of acid-producing soils. These formations are organic-rich silts and clays containing the iron sulfide mineral pyrite (FeS2). When exposed to the atmosphere the sulfides often become oxidized to produce sulfuric acid in the soil.

STANDARD FOR SUBSURFACE DRAINAGE

Definition

Removal of water through the soil by conduit, such as tile, pipe, or tubing, installed beneath the ground surface to collect and convey drainage water.

Purpose

A drain may serve one or more of the following purposes:

1. Improve vegetation by lowering the water table.
2. Intercept and prevent water movement into a potentially wet area.
3. Relieve artesian pressures.
4. Reduce surface runoff.
5. Serve as an outlet for other drains.
6. Replace natural subsurface drainage patterns which are interrupted by construction operations.

Conditions Where Practice Applies

Drains are used in areas having a high water table where benefits of lowering groundwater or controlling surface runoff justify the installation of such a system.

The soil shall have enough depth and permeability to permit installation of an effective system. On-site investigations are required.

An outlet for the drainage system shall be available, either by gravity flow or by pumping. The outlet shall be adequate for the quantity and quality of effluent to be disposed of with consideration of possible damages above or below the point of discharge.

Water Quality Enhancement

The use of subsurface drainage will prevent surface ponding of runoff, which can kill stabilizing vegetation. Loss of this vegetation can result in increased erosion and an increase in discharge of nutrients and fertilizers without the aid of filtration and adsorption from vegetative cover.

type of conduit.

Filters and Filter Material

Suitable filters shall be used, where required by site conditions, to prevent sediment accumulation in the conduit. The need for a filter shall be determined by the characteristics of the soil materials at drain depth and the velocity of flow in the conduit.

Not less than three inches of filter material shall be used for sand-gravel filters.[1]

Envelopes shall be used around drains where necessary to improve flow characteristics of groundwater into the conduit.

Installation Requirements

All drains shall be laid to line and grade, and covered with not less than three inches of approved hand placed backfill and/or filter material. The upper end of all drain lines shall be closed with concrete or other durable material unless connected to a structure.

Earth backfill material shall be placed in the trench in such a manner that displacement of the drain will not occur, and so that the filter material, after backfilling, will meet the requirements of the design.

The gap between drain pipe joints shall not exceed one-fourth inch for mineral soils or one-half inch for organic soils. Openings wider than these shall be covered with geotextile filter or other suitable material.

If the conduit is to be placed in a rock-trench, or where rock is exposed in the bottom of the trench, the rock shall be removed below grade deep enough so that the trench may be backfilled, compacted, and bedded so that the conduit is not less than two inches from rock.

When iron sulfide chemical reaction causes sealing of joints or perforations, the drain shall be enclosed in a clean sand-gravel filter. Riser pipes for flushing the line shall be provided at intervals not to exceed 500 feet.

[1] A recommended method of installation is to place filter material to a depth of three inches under the drain, and cover the drain and filter with a sheet of plastic. The filter shall be designed to prevent the material in which the installation is made from entering the drain. Not more than 10% of the filter shall pass the No. 60 sieve.

APPENDIX A3

GUIDE FOR CONSTRUCTION SPECIFICATIONS

The following are examples of requirements that may be used for preparing construction specifications. Incorporation of such requirements will help assure protection of disturbed areas especially where critical soil erosion problems may exist.

The contractor shall perform all work, furnish all materials and install all measures required to reasonably control soil erosion resulting from construction operations and minimize loss of sediment from the construction site. The contractor shall adhere to the certified soil erosion and sediment control plan showing the methods to be used for controlling erosion during construction which includes sequence of construction operations. When no work will be performed on critical areas for more than 60 days, they shall be protected by temporary seeding, mulching, or sodding, or the slope lengths shall be reduced by the installation of diversions or other means.

The contractor shall install erosion controls on all disturbed critical areas or disturbances adjacent to critical areas.

Critical areas are any area subject to excessive erosion due to highly erodible soils, slope length, steepness, water concentration or other factors. Areas may become critical when the vegetation or other soil surface protection is removed.

The permanent vegetative cover such as seeding or sodding on all areas shall be accomplished within 10 days after final grading operations have been completed. Time extensions beyond the 10 day requirement may be requested in writing and are subject to written approval.

Exposed soil having a pH value of less than 4 shall be treated in accordance with the standard for Management of Highly Acid Soil, pg. 1-1.

Excavated soil material shall not be placed adjacent to rivers, streams or bodies of water in a manner that will cause it to be washed away by high water or runoff. Excess borrow material removed from the construction site shall be stabilized at the site of placement.

The contractor shall comply with applicable State and local regulations for prevention and abatement of pollution.