ML- Morris County Fair Housing Council v. Boonton

Feb 8, 1980

Transcript of Deposition of Arthur Johnson

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ML0009335

SUPERIOR COURT OF NEW JERSEY
LAW DIVISION - MORRIS COUNTY
Docket No. L-6001-78PW

ML000933G

MORRIS COUNTY FAIR HOUSING COUNCIL,

Plaintiff,

vs.

TOWNSHIP OF BOONTON, et als.,

Defendants.

CIVIL ACTION

Deposition of:
ARTHUR JOHNSON

T R A N S C R I P T of the stenographic notes of the proceedings in the above-entitled matter, taken by and before JACQUELINE WASKO, a Certified Shorthand Reporter and Notary Public of the State of New Jersey, held at the DEPARTMENT OF THE PUBLIC ADVOCATE, 428 East State Street, Trenton, New Jersey, on Friday, February 8, 1980, commencing at approximately ten o'clock in the forenoon.

A p p e a r a n c e s:

DEPARTMENT OF THE PUBLIC ADVOCATE,
By: KENNETH E. MEISER, ESQ.,
Attorney for the Plaintiff.

MESSRS. SACHAR, BERNSTEIN, ROTHBERG, SIKORA & MONGELLO,
By: DANIEL S. BERNSTEIN, ESQ.,
Attorneys for the Townships of Chatham and Mendham.

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Appearances: (continued)

MESSRS. WILEY, MALEHORN & SIROTA,
By: JAMES P. WYSE, ESQ.,
Attorneys for the Township of Rockaway.

MESSRS. YOUNG, DORSEY & FISHER,
By: PETER LEE, ESQ.,
Attorneys for the Township of Hanover.

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A R T H U R J O H N S O N, sworn.

DIRECT EXAMINATION BY MR. BERNSTEIN:

Q Mr. Johnson, you're testifying on behalf of the Public Advocate as an environmentalist, is that correct?

A I don't think so, no.

Q Would you tell us the area of your expertise?

A Soils and the relationship between soils and water such as runoff, runoff chemistry.

I am also, I think, an expert in geology having had two degrees in geology, and can speak on relationships between geology and soils, geology and water, geology and water quality.

Q And what do you understand that you will be doing for the Public Advocate?

A I'm going to review all the documents that are prepared by other consultants related to the individual townships, and to try to assess whether or not I think those are accurate given an understanding of the landscape in Morris County.

Q I assume you haven't done any of that to date?

A That's essentially correct. I've briefly reviewed one report which I haven't a recollection of who wrote

with soil properties.

MR. MEISER: For the record, the only one he looked at was the report on soil borings for East Hanover.

MR. LEE: East Hanover or Hanover?

MR. MEISER: Hanover Township.

And the purpose of doing that was to suggest questions that Keith Orsdorff might add at the deposition. That was the only document that he looked at.

MR. BERNSTEIN: I would ask, Mr. Meiser, the same request that I had with Mr. Sinton that if I could depose Mr. Johnson on a second occasion, hopefully on the 22nd when I'll be seeing Mr. Sinton, when he would be more familiar with the Mendham Township documents.

MR. MEISER: The 22nd is a Friday and he has classes on a Friday.

MR. BERNSTEIN: I'll be happy to come back at a mutually convenient time.

Off the record.

(Discussion off the record.)

MR. BERNSTEIN: What we agreed off the record was to tentatively schedule

Mr. Johnson for 10:00 for subsequent depositions when he's reviewed the Mendham Township and Chatham Township reports so that he can speak with some authority as to what he's seen.

MR. MEISER: I'm not sure that he will have revlewed those reports by that time.

MR. BERNSTEIN: What I would request is if I could have a date subsequent to today when he has looked at it so I'll know his thinking as to Mendham Township. I have no problem with setting up a date after the 26th. In fact, I told Carl Bisgaier if he wanted to depose Al Gershen after the 26th, it's not sacrosanct as far as I'm concerned.

Q Mr. Johnson, aside from reviewing the reports that will be submitted to the Public Advocate by the defense counsel, are there any other documents that you will be reviewing for this case?

A Yes. The thing I would like to do would certainly be to read the Soil Survey and to get a sense of the landscape in Morris County from a soil's

and those patterns are recognizable and distinctive of certain kinds of subsurface conditions and so on. That would be one document that I would certainly need to make use of.

Q When you say "the Soil Survey," you're speaking of the Soil Conservation Service documentation?

A Yes, it's called Soil Survey for Morris County, U. S. Department of Agriculture, Soil Conservation Service. They're white with a photograph on the cover and so on.

In addition to Soil Survey, any geologic reports that are pertinent, and there are some, I understand, that have been prepared by Rutgers.

There is also in our geology library a fairly detailed assortment of publications done on various areas in the northern U. S. And through a system of indexing and so on, I can find pertinent reports for certain areas.

And I would say that those two documents would be important as well as any 208 Studies that had been prepared by the area. I'm not sure if it's necessary or important to digest all of those which tend to be rather substantial in size, but certainly pertinent portions of that that relate to streams in question or water bodies in question.

MR. MEISER: For the record, he's obviously given those that he's aware of now. This is not meant to preclude him using other sources if they come to his attention.

Q Do you know the names of any of the soils studies that were prepared by Rutgers University or the authors?

A No, I don't.

Q You just have heard of that through studies that you may wish to use?

A They were geologic studies, I believe, subsurface geology. That's my understanding of what information they contained.

Q You don't know when they were prepared or by whom or which department?

A No.

Q Sir, have you studied and been aware of the Lord's Report?

A No.

Q You're not aware of the Lord's Report?

A No.

Q Would you consider yourself an expert on the cost of constructing sanitary sewer facilities and package plant facilities?

A On the cost of, no.

Q Would you consider yourself an expert on any aspects of sanitary sewer or package plant facilities?

A I think I can speak on the level of treatment that can be obtained under conditions which would be specified to me by a sanitary engineer.

Q What does the term "headwaters" mean to you?

A First of all to me it's a very vague term. It simply means -- it refers to the area, or the small streams in an area which feed a larger river system, but it's a vague term. I think it's not readily definable in scientific language.

Q As a soils expert, do you feel that any special precautions should be taken when one is constructing structures in close proximity to headwater regions?

MR. MEISER: Do you have any specific concern for that?

MR. BERNSTEIN: Yes, but since the gentleman hasn't studied the specific rivers and streams in Morris County in general, Mendham Township in particular, asking specifics really wouldn't lead

anywhere. So I think I'm better off with the general.

MR. MEISER: You're concerned about the soils on the headwaters, is that it?

MR. BERNSTEIN: I'm concerned with construction in close proximity to headwaters since he's also an expert in water runoff.

MR. MEISER: So your concern is with respect to water runoff?

MR. BERNSTEIN: All environmental considerations.

A That's a very large question, but I'll try to deal with it in parts.

I don't like the word "special" in your question when you referred to any special considerations. I think that considerations for environmental quality and control of degradation of streams should be applied wherever there are streams which constitute a useful resource and which are governed by legislation and so on. So I would not say that there are special things that one should do. I would say that there are a number of good practices which can be adopted and, I believe, should be adopted.

Q Without using the word "special," -- I've

no problem with deleting that from my question -- what do you consider to be good practices when one is constructing in the vicinity of headwaters?

A I think that control of runoffs, surface runoffs is certainly one aspect that is very important. If one can control surface runoffs, I also think that erosion of soils can be controlled concommitantly. I would say that's another aspect that people should -- or designers and people who construct these things should attend to.

I also believe that there should be the number of individuals. The type of sewerage treatment that is selected ought to be compatible with the size of the water body into which any effluent is discharged.

Q Would you explain that to me?

A I wouldn't want to discharge ten million gallons per day into a stream that was four feet wide and a foot deep.

Q Is there any formula that you can give us or is it a more subjective type of test as to the amount of additional water that you'd be comfortable with discharging into a small stream?

A Well, I can rely on rules of thumb that have been [illegible] for Pennsylvania streams in an environment which is very similar to Morris County.

Q Could you give those?

A Yes, that would be the seven day, ten year low flow should not be augmented by more than 20 percent.

Q Would you explain that? I think I know what it means.

A The seven day dry period that occurs once every ten years should not be augmented dramatically.

Q By more than 20 percent?

A I would like to strike that because I don't have an absolutely firm feeling for that, but certainly there is wisdom on this which I can find out about.

Q Can you give us for the next deposition the percentage increase in that rule of thumb?

A Yes.

Q Given an area where one does not have sanitary sewers and where one does not have public water, is there a relationship between the environment and the maximum number of dwelling units which can be constructed?

A I'd like to try to rephrase your question. I think I know what you mean, but I don't think I can answer it the way you ask it. You mean a density limitation rather than just a total number?

Q Yes.

A Yes, but dependent on the method of sewerage

treatment selected.

Q Well, my first given is let's suppose we have no public sanitary sewer facilities, we have no public water supplies so that --

A Do you mean by "public" a municipality or do you mean --

Q Any public sanitary sewers. And the question is given this set of facts, and assuming that there will be no sanitary sewer constructed, are there any limitation as to the density of development which could occur?

A Under certain conditions yes. Under other conditions, I would say -- well, you've asked me a question that is difficult to answer. I would like to define on what basis should we consider a limitation. A limitation because of water quantity, because of water quality, a limitation because of erosion, a limitation because of slopes?

Q And because of effluent disposal. All of the above.

A All of the above and effluent disposal?

Q Right.

A We better take it one at a time.

Q Fine.

A Effluent disposal, I think that under certain conditions using certain types of effluent disposal

that there is a rational and reasonable limit to density.

Q And could you explain to me what that relationship might be?

A If septic tanks are utilized as the sole means of dispersing sewerage effluent into the ground, then I would say that a gross density of one DU per acre is what I would recommend as a maximum. Now, what I mean by gross density is that the total number of dwelling units divided by the size of the drainage basin above the point into which the effluent might be expected to flow.

Q And you mean by gross density the aggregate area?

A The total area of the drainage basin above the point. When it's determined where in the stream particular effluent might eventually run as it's treated, as it flows through the soil, the drainage basin above that particular area can be calculated, and based on that total drainage area, then I think an upper density of one DU per acre is what I would recommend as a maximum if sewerage treatment is solely by septic tanks.

Q And would there be instances where you would recommend a lower density than one dwelling

unit per acre where all the dwelling units would be on septic systems?

A I would recommend?

Q A density of less than one unit per acre because of soil conditions.

A Soil conditions and effluent relationship?

Q Yes.

A I can't think of any at the present time. I won't preclude the possibility that it might be wise, but I can't think of a situation.

Q Let me rephrase the question.

You would indicate that where septic systems were to be used, the maximum density that you would recommend would be one dwelling unit per acre on a gross basis, correct?

A That's not what I said. If septic tanks are the sole means of dispersing effluent, not if they are to be used.

Q Let's assume that septic tanks are the sole means of septic disposal, effluent disposal. Given that situation, was your testimony that the maximum density which you would recommend would be one dwelling unit per acre on a gross basis?

A On a gross basis calculated on the area of the watershed above the point in the stream into which

this effluent would be expected to flow.

Q Are there any situations where given dwelling units being constructed where the sole means of effluent disposal would be septic systems where you would recommend a density of less than one unit per acre?

A I cannot think of any at the present time.

Q And would this one unit per acre hold true regardless of the type of soil and regardless of the type of bedrock which would underline the area that you were examining?

A No, it wouldn't. There certainly could be a condition where certain of the areas where the soils were exceedingly thin, where people might wish to install septic tanks which are of marginal effectiveness, and I think that it might be possible then to recommend a lower density. It's not likely, however, because if a septic tank will function properly, then the soil probably is deep enough in order to treat the effluent substantially so that I would again retreat to the one DU per acre maximum.

Q Well, isn't it a fact that on the Soil Surveys that soil is categorized in some instances [illegible] slight, moderate, and severe limitations with respect to septic effluent disposal?

A I didn't understand what your question was asking.

Q You're familiar with the Soil Surveys which are prepared by the U. S. Department of Agriculture?

A Yes.

Q In those Soil Surveys they make various classifications of soil for different purposes.

A Right.

Q They have one classification with regards to the limitations of soil for effluent disposal purposes?

A Yes.

Q And I believe the three categories that are used are slight, moderate, and severe?

A That's correct.

Q What do those categories mean?

A They mean that under conditions where they list the limitations as severe, that septic tanks probably will not function properly and renovate effluent in the way that they should for a variety of reasons. There's one specific reason why they might rate it to be severe. That's an example.

Moderate means that there are certain conditions under certain of these soils that probably one should exercise care in selecting a particular area or in the design of the system for, again, one of a variety of

reasons.

Slight limitations generally mean that there are -- to me -- that there are no particular problems, that so long as the system is designed carefully and within standard guidelines, that the system should work reasonably well.

Q Is it your testimony that regardless of whether the soils have slight, moderate, or severe limitations with regard to a septic disposal, that in each of these situations one would generally require an acre per dwelling unit?

A I would not recommend septic tanks in the areas which are designated as being severely limited. So that I would say that the appropriate density for dwellings on soils which have severe limitations for septic tanks is zero. You don't build houses with septic tanks on severely restricted soils.

Q How about with regard to moderate or slight limitations?

A I would say that it's okay to install septic tanks on soils which have slight limitations, and probably okay in most instances with careful on-site inspection, careful instruction to install septic tanks in moderate soils.

Q But you would agree that there are certain

soils where one would require more than one acre for the construction of a home on a septic system where you had certain limitations with regards to the soil?

A That's correct.

Q Could you tell us some of the soil types which you've run into in your experience as a soils expert where a larger unit of land than an acre is required for each dwelling unit?

A On the basis of the treatment of effluent?

Q Yes, sir.

A So as to meet appropriate water quality standards, shall we say?

Q All right.

A Soils and selected soils in the Pine Barrens require large amounts of land because of the fact that they are extremely sandy. They are virtually inert chemically. The only means of treating effluent in those soils is by dilution. Therefore -- and that's dilution from the precipitation which then means that a sizable area is probably necessary for a house operating with a septic tank.

Q Would there be any limitations with regards to effluent disposal through septic systems where one was in the area of high water tables?

A Depending on the height of the water table, the

answer is yes.

Q So let's assume that one has an acre of ground where one wishes to construct a single dwelling unit on a septic system, but there is a water table of two feet. Would this constitute in your opinion a limitation to the construction of the dwelling unit and the septic system?

A Are you referring to a permanent water table as two feet or a seasonable high water table?

Q Seasonable.

A I would say that this is a limitation.

Q Why would that be a limitation, sir?

A When the leverage fields in the septic tank are submerged, and where the ground is rated within that zone, then the normal aerobic processes do not function very well.

Q Could one construct a septic system for a single dwelling unit on ground that has a seasonable high water table of two feet?

A Can one construct a septic system? Do you mean a septic tank system?

Q That will probably function.

A It has certainly been done. We call them [illegible].

Q Would it be fair to say that you would not

a mound if the depth of the water table was four feet or less? Is there any cut-off point where you feel that a mound is required?

A I don't have an opinion on that, not in the way the question was phrased.

Q Well, if you have a depth to water table of three feet or less, could one install a properly functioning septic system without a mound?

A I wouldn't want to answer that because I think it might be important to know in that particular locality is there a rapidly and greatly fluctuating water table or is there a water table which is more or less permanently between three and four feet. I would say that a mound at three feet -- I could conceive of septic tanks being constructed if it would be demonstrated that the water is really only at that level very infrequently, perhaps not in all the years. I think that more site specific information is needed, but I'm more comfortable at a depth of four feet or greater or seasonal high water table.

Q When you say you're more comfortable, did you mean when constructing the septic systems, you prefer to have the depth to water table of four feet [illegible]?

A That's correct.

Q Now, if the depth to water table is four feet or less, as a general rule would you recommend what you referred to as a turkey mound without looking at other attributes of the soil?

A I'm not sure that I would recommend turkey mounds. I think that if the water table is at a depth of two or three feet, then the Soil Survey will probably have identified that and considered that to be either a moderate or moderate to severe or perhaps severe limitation, and I would say on the basis of that, that my recommendation is that septic tanks probably are not appropriate, but I'm not sure. I would just simply recommend turkey mounds where you can't put in a septic tank because you're afraid of seasonal high water table.

Q Isn't the so-called turkey mound one of the alternate methods of disposal which has been permitted by chapter 199 of the Laws of New Jersey?

A I don't have any idea of what those laws say.

Q So you're not familiar with the restrictions which New Jersey places on construction of septic systems, the aerobic system, the spray systems, the lagoons, and the other types of alternative disposal [illegible]?

A I'm not specifically acquainted with New Jersey

laws and what they say about those systems.

Q Are there any disadvantages to the mounds which you mentioned as a possible method of overcoming a high depth to water table problems?

A Inherent problems or problems that can arise?

Q Inherent problems, and then problems that can arise.

A I don't necessarily see any inherent problems with them.

Q Are there problems that can arise with these systems?

A If they're poorly constructed, problems can arise with any system.

Q Do you have any idea of the cost of these mounds?

A No, I don't.

Q How many of those mounds have you personally seen in operation?

A I lived with one for three years.

Q Other than that one, how many of the mounds are you personally familiar with?

A Now, have I seen and stepped on or have I sampled?

Q Seen.

A So I would say several, but I don't know whether

it's ten or twenty or fifteen.

Q And how many are you familiar with, that is, that you're aware were constructed?

A That I am aware were constructed, watched being constructed?

Q You didn't have to watch. That you were aware of.

A I don't understand what you mean.

Q If I were to ask you to mention all the properties where you either knew or heard that a mound was constructed without physically having seen it, how many would that entail?

A I have no idea.

Q Would it be a fair statement that of all the septic systems constructed, only a very small percentage, less than five percent, is constructed on mounds?

A My sense is that would be correct of all the ones that have been constructed.

Q Why would there be such a small percentage on mounds?

A I would guess, and I'm simply guessing, that prudent planning precludes the use of septic tanks on land where the water table is questionable and where people might select this as an alternative.

Q So that you're saying that the mounds can't be used in every area where there are high water tables?

A I decline to answer that question. I don't really feel that you're asking a very general question about a never or always or sometimes. I mean sometimes, but I mean the situation, the nature of the geology, the underlying geology, all those factors need to be taken into consideration before one could answer that question. I wouldn't want to give a blanket answer based -- I would not give a specific answer based on the lack of site-specific in this.

Q In determining whether or not a mound was to be used, could you tell me what you would consider to be essential information that you would have to have before you could make a determination?

A The nature of the soils, the cation-exchange capacity of soils, the depth of seasonal high water tables, the depth of the soils, the nature of the underlying geology particularly with respect to its permeability, it's hydraulic conductivity. I'd like to know about the degree of fluctuation of the water table. I'd like to know into what type of area did this particular -- would this effluent drain. I'd like to know what the down slope essentially considerations would be. I'd like to know the content

in which it was being used such that is this a single family dwelling on ten acres or five acres? Is this a high density development in the center of a city?

I would say that there are at least eight, and probably more, general environmental factors that I would consider before recommending that one of these be built or recommend that it not be built.

Q In order to determine all the factors that you just enumerated, you would have to make an on-site inspection of the site in question or could you do it from your living room by looking at various documents?

A It depends on how complete and how accurate the documents happen to be.

Q I'm asking in your opinion as the expert on soils, could one make a proper determination for a specific site without visiting the site, merely by reviewing pertinent documents?

A For planning purposes or design purposes?

Q For planning purposes.

A I believe that the documents would suffice for planning purposes, but not for design purposes.

Q For planning purposes, what might those documents be which you feel would be necessary in order to determine if mounds could be used?

A The Soil Survey would be the main document that I would rely on first of all. Secondly, topography; thirdly, land use; fourth, the best geologic information that is available which may be simply what the Soil Survey says the substratum happens to be. I'd like to look at what a land use map -- I guess I probably mentioned that. I would like to know surrounding population densities, receiving waters. I would like to know whatever legal restrictions there were on the water quality in the streams.

Those would be the documents with which I would begin an analysis.

Q Now, if you were to determine if land could be utilized with septic systems, what information would you need before making an educated opinion?

MR. MEISER: Do you understand that question?

THE WITNESS: I would like him to repeat it.

MR. BERNSTEIN: I'll have the reporter read it back.

(Previous question read back by reporter.)

A Utilized in the sense for planning purposes or

for design purposes?

Q Planning purposes.

A I would say that my first approach would be to see whether the Soil Survey suggests that there are slight, moderate, or severe limitations. If I were pressed to come up with better evidence than that --

Q Would that suffice in your opinion for planning purposes? Is the Soil Survey sufficient?

A For township comprehensive plan level analysis, I think yes.

Q Would I be right in assuming that you would be opposed to septic systems being used on soils which had been classified as having severe limitations?

A That's correct on a planning basis, yes.

Q With regard to soils having moderate or slight limitations, what would be your recommendation on a planning basis?

A I would simply allow them to be considered as a possibility if they were listed to be moderate. I would consider them to be a high possibility if listed slight.

Q Have you had any experience, sir, with systems for effluent disposal other than septic [illegible]?

A Yes, I have.

Q And can you explain first what other types of disposal systems you're familiar with?

A I spent roughly three years under EPA contracts to first, draw up a training program for engineers, to educate them into the appropriate properties that soils should have in order to successfully treat effluent by four or five or six different types of alternative sewerage treatment methods.

I spent roughly two years under EPA contract designing guidelines for the disposal of municipal and industrial waste for alternative treatment for the state of Idaho.

The types of alternative treatment measures that I'm familiar with through these studies and also to a certain extent by personal visits to areas where these are operating are spray irrigation --

Q If you'd just go slowly.

A Spray irrigation, trickle and flood irrigation, overland flow treatment systems, marsh-pond treatment systems, sludge disposal alternatives. Those are the main ones that I'm largely familiar with.

Q How about the mounds? Wouldn't it be a sixth category?

A I don't claim to have studied mounds in a scientific content.

Q Could you explain to me what the spray irrigation method entails?

A For what?

Q For construction first.

A It depends on the type of land use that you wish to make spray compatible with. Exactly what materials and equipment are required, but generally there would be some level of pretreatment which may be specified by state statute, and maybe be dictated by common sense, may also be the effect of what is available in terms of materials. There is generally some sort of a holding device, a tank or a pond or whatnot, and then a system of pipes which extend into a spray field area which deliver effluent at rates which are calculated on the basis of soil geologic environmental conditions. That is the guts of the system.

There are a number of accoutrements which are necessary such as buffer zones and so on, to insure some sort of reasonable level of safety.

Q When you talk about buffering, can you tell me what you mean by that with respect to a spray irrigation system?

A It's generally considered wise to use some sort of system between the edge of the spray field and other contiguous land uses in order to reduce the

potential hazard of aerosols and aerosol drift downwind facilities.

Q And is there a rule of thumb as to the type of buffering that would be considered minimally acceptable?

A There is no general rule of thumb. It would depend again on state regulations. It depends on the velocity of spray if spray is the chosen method of distributing the effluent. The height and the type of lands in which the spray is taking place. If it's into a forest, then that's more difficult than if it's in a field. And if it's into opened areas which are subject to substantial winds, then I would say that one could make a case. It would be difficult if it was enclosed forest land.

Q What would be the minimum buffer which would be acceptable given the most favorable conditions?

A I couldn't tell you that offhand.

Q Could you use a spray system with all types of soils?

A No.

Q What types of soils are those types which could accept the spray system?

A Now, it's important to define the use of the word "type." Soil type has a very specific connotation

to a soil scientist. You mean soil texture, soil conditions, do you really mean soil type?

Q When I use the term "soil type," I mean the different types of soils. I'm not using it in the scientific, but in the layman's, and I'm asking are there soils which cannot accept the spray irrigation system?

A The answer to that is yes.

Q Would you say that most soils could accept spray irrigations?

A Most soils in all of the world?

Q In Morris County?

A I haven't a first-hand familiarity with Morris County so I don't feel that I can answer that at this point.

Q I'm going to use the word "type" from a layman's standpoint rather than from an expert's standpoint.

Can you tell me what type of soils which would be found in the Morris County region would accept spray irrigation, and what types of soils would not accept spray irrigation?

A In order to treat the effluent appropriately soil which are suitable for septic tanks would accept spray irrigation.

Q Do you have an opinion as to the maximum density which one could construct dwelling units with respect to a system which utilized spray irrigation?

A The maximum density is dependent on the means and the effectiveness by which nitrogen would be removed from the effluent. It would also be dependent on the total number of people, the total number of land required for the spray field with an appropriate buffer area. So that I think there is no inherent density limit for the number of units that people could put in one particular space, that the constraints are on the basis of the size of the spray fields and the effectiveness with which nitrogen is removed, and that can vary dramatically depending on the type of systems selected.

Q Do you know of any studies that would tell us the maximum density by which residential dwelling units could be constructed with spray irrigation?

A You have to define maximum density, as density to a developed site like?

Q Units per acre.

A Gross units per acre?

Q Gross units.

A I cannot give you that. I think that it could be calculated if we knew the exact details of the proposal

development. We would need to know the total area owned, the total area that could be leased. We would need to know several factors before we could calculate that, but I think a very reasonable estimate could be made.

Q Do you have an density figures on any -- the density of any projects which are constructed using spray irrigation?

A Yes, I definitely knew of those. I don't know them off the top of my head. I will tell you that there are high density development communities. I guess they might be called PUD. I could be mistaken because my definition of PUD may not be perfect.

There is a retirement community which I would judge the density to be 12 per acre and that has been operative for several years using spray irrigation.

Q Is that on a gross or density basis, 12 units per acre?

A That is the area which is developed.

Q What would that be on,a gross unit basis?

A I don't know exactly the size of the spray field. I could not guess without further information.

Q In order to make an estimate as to the maximum density by which you could construct dwelling units given a system using spray irrigation, what factors would you have to know and what studies would

you have to make before giving an opinion?

A I think those were enumerated previously on the record. I'll do them again if you wish.

Q Fine.

A First, we would need to know the total area that could be used, the total area that is owned and could be leased. We need to know several soil properties. I need to know the depth of seasonal high water table. You need to know texture. You need to know permeability of the various horizons. You need to know something about the geology substratum. You need to know the moisture retention capacity of soils. You need to know the cation capacity of soils that are being utilized. You need to know the nature of the effluent and the particular compounds and components that it might contain. We certainly need to know any legal restrictions which govern buffer zone's pretreatment. We need to know the number of people in order to calculate the size of the field which goes along with knowing about the soil properties.

I'm sure there are other factors which don't leap to mind, but that I can easily find out and can produce documents which I have once produced.

Q And what documents would you have to study before determining all the factors that you just

enumerated?

A Certainly one would begin with the Soil Survey as being the supplier of information which will relate to the effectiveness with which the soil will treat the effluent, and that will also allow us to calculate the size.

Other geologic and topographic information should be consulted again to try to understand in which direction this will move.

We would need to know which type of vegetation that people would want to select to put onto this site in order to be able to judge the effectiveness with which nitrogen would be removed.

Those are the documents that I would first consult.

Q Would it be fair to say when estimating densities that could be used and when determining whether or not various systems would work in a particular area, that you would have to go through the processes that you've just discussed when making a proper analysis for planning purposes?

A That's correct.

Q I would modify that slightly by saying that for planning purposes I believe a check of the Soil Survey and the information that it provides with respect

to each of those properties I named would be very good for planning purposes. I might like to refine that by checking out topography in areas that were designated as being appropriate. It would also be useful to consult landscape maps certainly.

Q Would that be able to tell you the densities that you could provide, or merely how the system could function?

A It would tell whether the system can function or not. Densities are site-specific and location-specific.

Q Is it also true that spray irrigation as a general rule requires a substantial land area in order to make it work properly?

A Spray irrigation could conceivably be used for a single dwelling unit if the owner so chooses. It would probably not be functionally useful, but would not require a particularly large area. He could spray his garden if he wished or his back yard. If one is considering spray irrigation -- from your reaction I can tell you have very little first-hand familiarity with spray systems.

Q I'm not the expert.

A But if one is planning for a substantial number of people, the amount of land required is in general

large, probably larger, certainly larger than one would need for the septic tanks.

Q Would you explain the trickle and flood system?

A The flood system is generally -- at least with what I'm familiar with and would say that are possible alternatives require land which is relatively level. There is often embankments or dikes along the edges. There is generally a pipe, a system of pipes and a large pipe which has gates in it which will distribute the effluent at selected intervals which will then flood the area that is surrounded by dikes or relatively flat areas. That is allowed to soak in. And the dosing rate, we depend on the soil properties, but probably they had been dosed once a week or something like that with one or two inches of effluent. That's a very general statement as to how these might operate.

Q I assume that not all soils could accept this type of treatment?

A That's right.

Q I assume this would require a relatively larger area as well?

A For a larger number of people and a large amount of effluent it requires in general a substantial area. The area could be roughly calculated by figuring as a

first estimate two inches of effluent per week.

Q How would that determine the area? In other words, assuming I had one dwelling unit --

A If you can multiply the number of people by the appropriate number of gallons of water per day that they use, this will give you a volume. If you know the area -- if you select an area and you can divide that into the volume and determine how many inches.

Q Let's assume that I have a family of four living in a single-dwelling unit and that family produces -- we'll be conservative -- three hundred gallons a day of effluent. What do you estimate would be the area that would be required for the trickle and flood method, and I'm interested in the area that you would require for the effluent disposal.

A You would have to tell me what soil conditions you're dealing with.

Q I'd be assuming moderate soil limitations, and aside from that, I'd be assuming optimal conditions.

A Moderate soil limitations? I'm not sure I would recommend this particular system for areas where there are moderate limitations. Also it would be a question of what caused the moderate limitations.

Now, if the soil said that the limitations were moderate because the area was very stony and it was

hard to put a septic tank in, that might not preclude using this particular type of system.

I will crank out a number for you if you wish to know based on soil properties alone and not a specified limitation of what the amount of area would be.

Q I'm looking for a ballpark figure.

A I've got to get a calculator.

MR. MEISER: I don't know if we have one here.

A I cannot do it for you then.

Q We'll save it for the next set of depositions. If you could put that on your list.

And if you could explain to me the overland flow system.

A At this time you would like me to do that?

Q Yes, sir.

A The overland flow system is again a method of land treatment whereby we have a gently sloping surface which is generally impermeable or waterlogged. They work best if we have relatively impermeable soils. The effluent is allowed to flow over the surface of this slope deferred again by a large pipe with gates or a system of pipes. As the water flows downhill, the soil acts to remove phosphorus. Bacteria are

engrained and ultimately destroyed. There is an aerobic portion of the process by which nitrogen is nitrofied in the waterlogged zones of the particular fields where the treatment is taking place. There is denitrofication which allows for the removal of excessive nitrogen.

At the bottom of the field, depending on the nature of the effluent, there may be a recollection system which will collect the runoff and recycle it, perhaps spray it if additional treatment is expected or desired. Or there may be suitable effluent to deliver to an irrigation way, a stream or whatever.

Q I assume you can't give me any general statement as to density that would be permitted with this system?

A I cannot give you a general statement.

Q With regards to the marsh-pond?

A The marsh-pond systems are still in the experimental stage but have been shown experimentally to be quite effective. There's some -- and this is the case also with the other land treatment systems -- there is some pretreatment which might be comminution to something like that of solids and perhaps a chance for some BOD removal by aerobic decomposition aerated tank. That effluent tank flows through an artificial, or perhaps in some cases,

a natural marsh, and it has been shown that certain types of plants are particularly effective at accomplishing a number of important characteristics. Bacteria and other pathogens are engrained and destroyed. Heavy metal are scavenged by the sediments in the bottom of this marsh. Nitrogen is first nitrofied and then denitrofied in the sediments of the marsh if it presses readily fixed by the sediments and along with the nitrogen that's taken up by the plants in the marsh.

The outlet of the marsh then is introduced into a pond, which we might think of as a polishing, which would contain a food chain which would be specified as to the components that exist there, and the food chain would remove additional nutrients from the water which then would be distributed into a tributary stream. It would be put into infiltration basins.

The experimental results indicate that the water quality and the outlet of the lake is very good.

Q And I assume you couldn't give me any general statement as to densities that would be permitted with the marsh-pond system?

A The densities are a function again of how much land is required. We have designed a marsh-pond

system for a development in Bucks County, Pennsylvania, and it has been approved -- my understanding is it has been approved by all the appropriate authorities, and that the developer is interested in obtaining EPA project funding in order to implement this.

Q Do you know what the proposed density will be for this project on a gross basis?

A The developer has a substantial tract of land which he wishes to develop in stages. The design of the system was for ten units which were on approximately two-acre parcels plus or minus.

Q Are all ten dwelling units on two acres or is each dwelling unit on a two-acre plot?

A I don't recall the size of the plots, but it's not ten dwelling units on two acres. It wouldn't matter if it were, but I can say that they could all be on two acres and they could use exactly the same system if they wished.

Q So you don't really know the densities other than the fact that they're ten dwelling units?

A The density is irrelevant to the nature and the size of the treatment system. It's simply the number of units which determines the size of the system.

Q Well, how large will be the area where

the marsh-pond will be constructed?

A I don't recall the exact figure since this was about two years distant, but I would judge that there is no more than a couple acres tied up in the entire marshing pond for ten units.

Q If you had more units, would that require a larger marshing pond?

A It would require a larger marsh, yes, and it may not require a larger pond in that the rate of flow through the pond just might be increased.

Q The last method you speak of, polishing disposal --

A Right.

Q -- can you explain that for the record?

A There is a substantial number of ways in which municipal sludge is disposed of. Some which are on-going are illegal.

One method for disposing of sludge is to apply it to land in any number of different types of situations, the goals being: one, to get rid of the sludge from the area where it accumulates; two, to recycle the nutrients in some way that we might at least convince ourselves that we are getting some benefit from the three to dispose of it in such a way so as to reduce the nuance aspects of sludge,

that being the possibility of pathogens, excess nutrients, heavy metals, odors, to name some.

Q I assume that you couldn't give me any general statements as to the densities, what the maximum densities are that one could build dwelling units using the sludge disposal system?

A The two are absolutely unconnected. Sludge is often disposed of away from the site where it's accumulated. A for instance is a very high density, and they are wishing to and maybe successful at disposing of their sludge in the coal mining region in central Pennsylvania 400 miles distant.

Q I assume that would be expensive?

A I would say that's absolutely correct.

Q Now, do you have any general figures as to the cost per dwelling unit which is associated with using any of the five systems that you just discussed?

A I believe that our calculations for the marsh-pond system indicated it was competitive to the sewerage treatment conventional septic tank systems. I believe it's $1200 per dwelling unit as we calculated. That's an estimate, and I would have to refer to the specific documents.

Q That was for a single marsh-pond system

given a single set of facts, isn't that right?

A That's correct.

Q And you couldn't say that based on your one experience that it would generally cost $1200 per unit per marsh-pond whenever it's constructed?

A I would not wish to generalize across the U.S.A. The state of Pennsylvania--but I would say in similar circumstances with similar types of geology soils, similar hydrologic conditions, that I would not expect the cost to vary dramatically from that figure, but I would not say in general all will cost that.

Q Do you have any idea of the cost for any of the other systems besides the marsh-pond?

A I don't have a cost figure which I could give you based on DU's per acre or per individual household. Costs are generally calculated on the basis of gallons of effluent per day, and such figures I would suspect could be found. In general, I would say that the smaller the number of units and the smaller amount of effluent one is going to dispose of, the greater the unit cost will be. There is efficiency and there is cost benefits to substantial systems.

Q Is there a smell associated with any of these systems?

A If these are operated properly, the answer is no. If they are operated and designed improperly, the answer is in some cases there certainly might be. When you say "Is there a smell," we say there is an inoffensive smell.

Q Offensive?

A I don't believe so. I believe I can convince you of that too if I took you to some of them.

Q Are there any disadvantages in using any of the systems that you discussed over installing septic tank systems?

A Are there any disadvantages?

Q Yes.

A I don't believe we could categorically say that, and I don't believe there are any inherent disadvantages except that they might require more land if one considers that to be a disadvantage. It may be an advantage if someone is seeking to preserve space or open space.

Q Why would these five systems require more land than septic systems?

A Buffer zones are probably a major factor there.

Q Let me see if I understand you correctly.

I believe it was your testimony that the maximum gross density that one could build, assuming

one were to use septic systems exclusively for effluent disposal, would be one unit per acre, is that correct?

A On a basis of the whole watershed?

Q Gross density we're talking about.

A Yes.

Q Can one increase this gross density above the one unit per acre if one were to use the five alternative systems that you just discussed for me?

A Yes.

Q And can you tell me up to what point could you increase the gross density?

A Now, when you say "increase the gross density" that means more than one DU per acre?

Q That's correct.

A The limit depends, in my opinion, upon the efficiency of any flow, general removal in any of the systems which are selected.

Q And would this have to be done on a site-specific basis?

A Now your question doesn't follow from the information that I just gave you.

Q Now, how would you determine what the maximum densities one could use these alternative systems were? How would you determine it?

A You would select a system and then I would or

you would select -- you would find out the nitrogen removal efficiency of these various systems, and from that then you would be able to estimate what the nitrogen renovation capacity is, and that would then allow you to determine what density or the number of units you could have on this system. It would determine -- you could determine the number of units you could have on the system given available land, and that would tell you whether or not you could do this based on nitrogen alone.

Now, that is the density limiting, or the number limiting factor that you're concerned with given the answer that I gave you.

Q Is it the sole limiting factor or are there other limitations with the systems?

A I would suggest that the actual amount of water that's going to be displaced over this land is something that one should consider. The actual amount of land that is owned or can be leased is another potential limiting factor in this system.

Q So in order to determine maximum density using each of those five systems, wouldn't you really have to be site-specific and project-specific rather than speaking in general terms speaking about densities?

A If you were going to design a system, you would need site-specific information. If you wished to determine the general feasibility as to whether or not the landscape has the appropriate properties, then I think you are warranted in doing this without on-site investigation.

Q What I'm interested in, though, are estimates as to maximum densities.

A Then you have to do it. There isn't necessarily a connection between density and the systems. These systems, I think, do not imply density at all.

Q Well, these systems, don't each have an infinite capacity for additional dwelling units?

A You're talking about numbers, and not density. That's different.

Q Well, there are limitations that each of these systems have, is that true?

A Limitations as far as what?

Q Amount.

A If you have a very, very large parcel of land available, then you can hold a very, very large number of people, or you can supply sewerage treatment to a very large number of people.

Q Each of these systems has maximums that are inherent because of the characteristics of the

land?

A That's not correct.

Q You're saying that some of these systems can take an infinite amount of effluent?

A If you have an infinite amount of land?

Q I'm saying given a specific piece of land.

A Okay. You never gave me that before.

Q Unfortunately neither we nor the Public Advocate has an infinite amount of land.

Given a specific piece of property, that property can only take a certain amount of effluent?

A That's correct.

Q And do you have any formulas or do you know of any studies or have you had any conversations with any experts in the field that would give you the basis for a formula so that you can say piece of land--

A There's no rule of thumb that can be constructed given the site-specific information. I could do it. It can be done by a large number of qualified people.

Q Now, let's assume that I owned a hundred acres and I want to see the maximum of dwelling units I can construct on it to maximize my profits.

What would you have to do in order to

determine the maximum number of units I could create using any of these five systems?

A I would have to start by targeting a number of the DU's that you might like to have, and then you could ask the question, "Is it more cost effective perhaps to distribute them in two-acre lots or one-acre lots on this hundred acres, or is it perhaps better to cluster them and then to consider using the remaining land as a land treatment system?"

And then when you have that general number and you figure out how many acres you might have left over, you could identify the soil properties, and you can make a first estimate as to how many people -- the waste from how many people could be treated on the available land. You could then adjust the number of dwelling units based on whether or not the land could take more or should, in fact, not take as much as you would hope.

Obviously there's a feedback process that one would go through in determining this. There's no sort of rule of thumb.

Q Wouldn't one have to, preliminarily at least, design a system and see if it would work given the total number of units the developer wanted to construct?

A Design a system, no. I don't think so, because the nature of the design might be fitted to the landscape. It's simply judging the inherent capability of the system to deal with the required amount of effluent with a specified amount of land available.

Q And I assume each piece of property would have different capacities?

A That is only true if their landscape properties are different.

Q You would agree that --

A Each piece of property --

Q -- land is unique?

A Each piece of property is unique, but that doesn't mean that two pieces of property cannot have virtually the same characteristics and would allow then virtually the same density or the same number of units.

Q When you were to advise a developer, you couldn't give that developer general rules as to maximum densities, could you?

A On the basis of what?

Q On the basis of merely looking at the soils maps and assuming that he were to use one of the alternative systems.

A I can give him the maximum number of units that

he could treat by going through the soil properties I have enumerated previously, and then I could give him an estimate.

Q Well, are there any soils anywhere that you've studied in your years as a soils expert where you can tell me, given certain soil properties a hundred acres of land could take, the effluent produced from "X" dwelling units?

A I have never designed land treatment systems for an individual, for a municipality, so I cannot speak from experience.

Q Is this beyond the purview of your expertise?

A No, I believe I could calculate for a man the number of units that he could put on a particular piece of property given the appropriate information with which to assess the ability of the property to assimilate effluent in any of the scenarios.

Q But you'd have to look at the specific site?

A I would have to look, at least, at the data for a specific site.

Q And it's your testimony that you've never [illegible] any of the systems that you designed

A I guided and participated in the design of a

marsh-pond system. I certainly have put together all of the guidelines and all the considerations that a person needs to know about to design virtually any of those systems. And I have run -- we have run tests problems, you know, test cases, given this other thing was the appropriate density. The calculations of such a number of units is really not very difficult to do given the appropriate information. I'm very qualified to do it.

Q But you've never done it before?

A I've never been paid to do it by a developer.

Q Have you ever made a calculation as to the number of units that a specific parcel of land could hold for any purpose?

A The number of units?

Q The number of units.

A I've calculated how much effluent is appropriate to apply to a certain parcel of land.

Q Have you ever calculated the total number of units that could be constructed on a given parcel of land given the limitations for septic purposes.

A Well, I don't know the answer to that question, but it's so simple to get from the total number of gallons of effluent divided by the number of people

and their water use per day so that that number is positively trivial to obtain that number given the kind of calculations that I've got.

Q And you've made these calculations as to the amount of effluent that land could hold in what specific geographic areas, New Jersey, New York, Pennsylvania?

A I'm not sure whether the soil properties and so on that we used were site-specific or whether they were simply general soil characteristics that we have specified for the purpose of an example to show other people how it's done. I don't have a specific recollection, although I believe it was done in conjunction with the work I did at Cornell as a Post Doc on this course designed for engineers, and it may in fact be reflected or may have been done again in the Idaho study.

Q Other than your two studies, have you ever --

A There are three studies, one was the marsh-pond system, one was Post Doc at Cornell in designing a course to educate people as to what they need to know about land systems. This is a course that the EPA is putting on or has put on, a short course around the country that was designed on the proble...

we were working with. It wasn't a course for students at Cornell. It was a general educational-type course. And the third study was designing guidelines for use in the state of Idaho, all over the state of Idaho, virtually all over the state of Idaho, with the exception of a few areas for treating a variety of effluent including municipal effluent.

Q Well, the only study that you did which was relevant to actual construction was with regard to a single marsh-pond, is that correct?

A That's correct.

Q Now, with regard to all these studies, can you tell us the results of any study with regard to the amount of effluent that could be held by a single unit of land such as an acre, ten acres, a hundred acres? Do you remember any of those statistics?

A I can give you a general guide for the eastern U.S. as to how much effluent a parcel of land can hold.

Q Right.

A Assuming suitable conditions was specified, two inches per week of effluent.

Q And how would we make the computation? I realize you don't have a computer, but assuming we

have a family of four in a single dwelling unit that produces 300 gallons of effluent and water a day, what would be the computation so that I can find out how much land area is needed to treat this waste?

A I would say that we might, as a first cut at this, assume that we will not put on more than two inches per acre. So there is two inches times some area -- we'll call it "X" which is the volume of water that we can put onto this particular parcel of land. 300 gallons per day can be multiplied by the appropriate number of days in the week, which is seven, to come up with a total number of gallons. That's the volume which would then be converted to acre inches, and that volume can take as much as two inches of effluent per week.

Q And this would be using any of the alternative systems that we discussed?

A Two inches per week is strictly applicable to irrigation systems, trickle-flood or spray irrigations systems.

I think we would have to adjust the overland flow system rates by some appropriate factor, which I cannot specify now. It may be different than two inches per week.

Q Do you know of any spray irrigation system

that is working in New Jersey at the present time?

A Campbell Soup has spray irrigation facilities. I'm not first-handedly familiar with those in New Jersey.

Q I assume that would be industrial rather than residential?

A Yes, but the general concerns are very similar in the case of canning wastes.

Q How big is the site at Campbell Soup?

A I don't know.

Q Other than the Campbell Soup facility, do you know of any other spray irrigation systems that are operating in New Jersey?

A First-handedly, no, but I do believe -- I recall that there is at least a model spray system operating in the Pine Barrens. If it's not an operating system, the operating data has been drawn up.

Q Do you know of any trickle and flood irrigation methods operating in New Jersey?

A No.

Q Any overland flow methods?

A No.

Q Any marsh-pond methods?

A No.

Q Any sludge disposal methods that are used

in New Jersey?

A Not first-hand.

Q Could you tell us if you consider yourself to be familiar with the situation in New Jersey with regard to effluent disposal or whether or not your actual knowledge has been directed towards other geographical areas?

A My knowledge is not site-specific. I believe I could apply it very readily to New Jersey when I know what the legal standing of the system is and what the legal implications are.

Q Well, in the past you worked in New Jersey?

A Not with a treatment system.

Q Have you worked with any of your areas of expertise in New Jersey?

A Oh, yes. I've worked for two years as a research soils scientist in the Pine Barrens.

Q Anywhere else in New Jersey have you worked?

A I've been a consultant to a project that was conducted in Bedminster Township. I was simply a one-day consultant asked to give an explanation of the landscape and why it was the way it was.

Q I assume this was on behalf of Allen Gerchen?

A I don't know. I was a sub-consultant hired by

a consultant to Wallace, McHarg, Roberts & Todd.

Q You were involved with John Sinton on that project?

A That's where I met John Sinton.

Q Did you prepare a written report?

A No.

Q What was your task with regard to Bedminster?

A To fly over the area in an aircraft, to observe what the landscape looked like number one. Number two, to read the Soil Survey report and to interpret from that what kind of soils in general are found in what types of landscape settings, what type of landscape positions. Third, to drive through the township to visit sites that might have been of specific interest to, in my understanding, the landscape.

Q And did you make a written report to anyone?

A No written report.

Q Oral report?

A Yes.

Q To whom?

A To Ian McHarg.

Q Did you talk to anyone else?

A There was a group of people in this little gathering. It was done on the wing of an airplane.

And John Sinton may have been present. I don't recall. There may or may not have been lawyers who were involved in this particular township present at the time. There was no more than four or five people, perhaps as few as three or four.

Q Was John Kerwin one of the people that you reported to in the Bedminster case?

A I have no recollection of names except for Ian McHarg and John Sinton.

Q And other than your work in the Pine Lands and your work in the Bedminster case, was there anything else you had done in New Jersey in a professional capacity?

A I have to think a minute. I believe that's it.

Q And what did you dor for the Pine Lands study?

A Well, I've dug along with my students 50 or 60 holes, looking at the soils, measured a wide variety of soil properties. We have kept very careful track of a nutrient budget and a trace metal budget and an experimental watershed that we have in the Pine Lands.

[illegible] I've given a course on the Pine Barrens and a wide

variety of the different ecosystem types that exist in the Pine Barrens.

I've cored 300 trees in the Pine Barrens and recorded how the trees have grown over the past 120 years.

I have in my laboratory under my direction analyzed several hundred water samples from the Pines. At least several tins of soil samples have been analyzed for a wide variety, or for a variety of different constituents.

We have tried to trace historic changes of pH in the soils, historic changes of pH in the streams.

It's a very wide approach to it by geochemistry of the Pine Barren's ecosystem that we are still engaged in.

Q Would you recommend that for certain areas in the Pine Barrens that there be a residential density of more than or less than one unit per acre?

A A gross density?

Q Yes.

A Within what bounds? Within the bounds of a watershed, shall we say?

Q You can pick the dimensions.

A I will venture an opinion at this point that, yes -- did you ask whether we could have less than

or more than a DU per acre?

Q Less than.

A Less than DU per acre can I justify in the Pine Barrens?

Q Yes.

A Under some circumstances, yes.

Q Would you explain what these circumstances might be?

A Where there are soils which do not have substantial capacity to renovate effluent.

Q And what do you believe would be the smallest density which you feel land in the Pine Barrens would reasonably be expected to take, yet consistent with good planning and good environmental design?

A I'd like to confer with counsel, if I may.

I would say that for certain areas in the Pine Lands that a density of one dwelling unit per seven acres probably would be an appropriate density.

Q You wanted time to give an explanation. This is it. Give the explanation.

A My feeling is based on the fact that the Pine Lands are a very unique ecosystem, and that I would like to see applied to the Pine Lands very strict controls of water quality and land uses that stems

from an understanding of the soils and their properties and a feeling that unique resources should be preserved and protected.

Q Can you tell us what's unique in the Pine Barrens that you as a soils expert feels should be preserved and protected?

A The water chemistry in the Pine Barrens is unique probably in North America. The water which is there is as soft as any water which I have studied or have seen any record of studies. By soft I mean it contains a porosity of dissolved constituents. Because it is unique, it is, in my view, appropriate to preserve it in order to study and to understand it.

This particular type of water system which is very soft may be very simple, which would give us some insights into naturally occurring biogeochemical processes which would not be observed elsewhere in more complex types of water.

In addition to the water chemistry, the biogeography of the Pine Lands is unique. It's an area where the southern-most range of certain plant and animal species is observed, and it's also the northern-most range of other species of plants and animals, and therefore there is a mixture of plants and animals which are at one extreme or another of

their nature range which generally tends to suggest this is a fragile environment or fragile ecosystem.

Additionally, the soil properties in the Pine Barrens may not be unique in all of North America, but they are certainly very limited to an area of the outer coastal plains. And the properties which we see in the Pine Barrens, in the Pine Barrens' soil have never been reported upon in the literature. And I would say that therefore I think that careful study is warranted. I would like to see these particular soils not disturbed or destroyed until we know more about their particular chemical aspects.

Another reason why I think that I would like to see the Pine Lands protected is that there are a number of rare and/or endangered plant species which exist in habitats which may depend upon the continuation of the current water quality with no disruption.

We ought to know at least whether or not these things will be altered dramatically by changes in water quality, and we cannot assess that yet.

To summarize why I think stringent requirements are required, I think that at this point in time we know less about the way Pine Barrens' soils in the Pine Barrens' ecosystem operates than most other ecosystems in the United States. And therefore we

should proceed with great caution.

Q How would you recommend that the Pine Barrens be protected?

A I have no recommendation on how it should be protected.

Q What steps could be taken in order to protect the Pine Lands and its unique systems that you've just described?

A I believe that they have instituted -- they, meaning the State of New Jersey -- has instituted sufficient water quality standards for the Pine Land region which are more stringent than the water quality standards for most of the rest of the State of New Jersey, which, I believe, is an appropriate move. And that also has led to my general characterization of one DU per seven acres on appropriate development. That's based on repetitively strict water quality standards, particularly with respect to nitrogen.

The actual social structure and infrastructure necessary to effectively preserve the Pine Lands, I don't feel qualified to make an expert judgment on, but I believe I understand what the federal and state governments have in mind. I'd be glad to explain that [illegible]

Q I'm interested more in your opinions than

in the federal and state government, since you will be testifying. If you are going to support the federal or state positions, then I'd like to hear it if it's a position that you're at one with, but I'm not interested if it's just an explanation you're going to give.

A I don't really have a well-formed opinion as to how is the best way to go ahead and protect the Pines. The reason I don't is that my feeling is that the greatest threat to the integrity to the Pine Lands does not come from within the Pines, but from outside, and that is the effect of acid, rain, and the additional constituents that are blown into New Jersey from outside.

Q How would one protect the Pines from the effects of developments outside of the Pine Lands region?

MR. MEISER: You're talking about --

MR. BERNSTEIN: All of the negative effects from development outside of the Pine Lands region.

Q What are the methods that you as an soils expert would recommend in order to protect the integrity of the Pine Lands?

A Desulphurization of phosphorus gasses.

Q Which entails what?

A The use of any one of a variety of, shall we call them, sulphur scrubbers.

Q For homes, for cars, for industry?

A Principally for large industries scattered from Philadelphia to Chicago and south to Tennessee and Virginia.

Q How about development adjoining the Pine Lands? Would you recommend any restrictions on that?

A Yes and no. I need now to say that your question has prompted me to recall a one-evening discussion with a consultant named Michael Clark about a specific area adjacent to the Pine Lands.

My feeling about the development next to the Pine Lands is that, again, we don't have all the facts that we need to confidently assess what the effects might be, and therefore we should proceed with the reasonable degree of caution. We don't know what the effects would be on the Pine Lands. Therefore, we should proceed with a reasonable degree caution.

Q Would that suggest low densities for development within the area close to the Pine Lands?

A Low densities based on what? If you're asking me to say does that preclude high density development the answer is no. But low overall densities, I would say at this time would be a prudent action.

Q So what you're saying, I believe, is that you would support gross densities within the area adjoining the Great Swamp?

A I don't have any particular first-hand knowledge of the Great Swamp.

Q I meant the Pine Lands. I assume you'd recommend low gross density within the area surrounding the Pine Lands?

A I would not make such a recommendation to the State of New Jersey. I would simply stay out of it.

If they asked me for my opinion, I would say that would be a prudent way to proceed, but I would not say my experience as a consultant entitles me to say that.

Q I'm asking for your opinion.

A Low densities would be prudent under the current situation.

Q How far might these low densities extend beyond the actual perimeter?

A That is a question which probably cannot be answered since we don't understand perfectly the hydrology of the region.

Q What is your opinion since you're the expert and I'm the attorney?

A My opinion would be that I would not give an

opinion until confronted with the appropriate information. I would --

MR. MEISER: You don't have to guess.

A I would not advise you. If you came to me for a recommendation as to what is a safe distance, I would decline to advise you.

Q And you've studied the Pine Lands for at least two years?

A That's correct.

Q And you have no idea what would be a safe distance where low densities would be required?

A I've studied the heart of the Pine Lands. I've not studied the contiguous areas that I thought we were discussing. I am not familiar with those fringe areas, and would therefore decline to give you a distance.

Q Could you give me a range? Could you say that you would worry beyond a distance of ten miles from the Pine Lands, or could you not even make that statement?

MR. MEISER: Again, you don't have to guess. If you have an opinion, okay.

A I'll give an opinion. If I could find the appropriate kind of soil for a house with a septic

tank, I would say that you could develop as adjacent to the central Pine Barrens as anyone would allow with the appropriate kind of soil. I can't give you a broad range. Site-specific information would need to be brought to bear.

Q Would you be concerned with high density development ten miles from the perimeter of the Pine Lands?

A It depends entirely on what would happen to the subsurface distribution of water from that development.

Q Can you think of situations where you would be worried about development of high density dwelling units occurring ten miles from the Pine Lands?

A I can't answer that question because the specific boundaries of the Pine Barrens would definitely be at issue.

Now, there are legally defined boundaries which may or may not coincide with the natural boundaries other investigators might choose. No one has the same boundaries for the Pine Lands. So that the ten-mile distance may have absolutely no real bearing on what happens to the Pine Lands.

Q Ten miles from any legal boundary?

A I simply cannot say without site-specific

evidence. In general, I will say that I'm not too worried about things that happen ten miles away, but I won't preclude that something adverse could happen.

Q Could you conceive of a situation where you would be concerned about high density development occurring five miles from the legal boundary, from any legal boundary of the Pine Lands?

A I cannot conceive of one, but I will not preclude that there could be a situation which would make me inclined to say that maybe this should not happen here.

Q Could you conceive a situation where you'd be concerned about high density development occurring within two miles of the legal boundaries of the Pine Lands?

A I would answer that exactly the same as the five-mile distance.

Q How about 50 feet? Could you conceive of a situation --

A Yes, I can.

Q How about a thousand feet?

A Maybe.

Q What's the definition of non-point pollution?

A What is the definition of non-point pollution?

Q Your definition.

A My definition of non-point pollution are the naturally occurring substances which are considered to be pollutants, which are derived from a diffuse area that do not come out, for instance, a pipe, that are transported to a stream. I think of non-point source pollution in the context of a stream. It has pollutants in it and these are derived from a diffuse area, not a single place.

Q Are you concerned about the effect of non-point pollution on the Pine Lands?

A Pollution by what type of substances?

Q Any kind of pollution. You're the expert, aren't you?

A Yes, I'm concerned to a certain extent.

Q Well, didn't you tell us just a little while ago that the greatest danger to the Pine Land area was from outside the Pine Lands and not within?

A I told you that the type of pollution I'm referring to is, in fact, non-point source pollution, first of all, and secondly, the fact that I considered that to be the greatest, that really doesn't mean I'm not concerned by other things that would happen

Q Now, what are the pollutants that you're

concerned with that come from non-point sources with respect to the Pine Lands?

A I would say that nitrogen is one that is a possibility. Our work has suggested that lead may be another potential problem in the Pine Lands under certain types of development pressure. I am, to a certain extent, wary of a potential threat from phosphorus, from non-point source pollution. I believe there is a possibility of other chemical fertilizers or other constituents used in chemical fertilizers which might constitute non-point source derived pollutants in certain streams of the Pines.

Q And what creates all those pollutants that you're concerned with? What's the source of those pollutants that you envision as a danger to the Pine Lands?

A Human activities with respect to the things I mentioned. I'm thinking of human activities, primarily agriculture, secondly, agricultural uses of the land.

Q You said, "Primarily agricultural uses." What are the other causes?

A Housing, and housing certainly is an appropriate type of a source for non-point pollutions such as nitrogen and perhaps phosphorus.

Q How could one reduce the effect of

non-point pollution on the Pine Barrens or any other sensitive area?

A Control of the source is the way to do it.

Q With regard to a house, how do you control pollution at a house?

A By what particular type of a mechanism?

Q What I'm concerned with is you are concerned with pollutants that affect the Pine Lands.

A Right.

Q What steps can be taken to control the non-point sources of pollution so that it will have less of an effect on the Pine Lands?

A Then I've got to deal with them in categories.

Q Okay, residential.

A To prevent additional discharge of surface runoff into streams, that means that I would not particularly advocate the use of extensive sewer systems which would come together and drain into a particular water body. But that's not a problem in the Pine Lands. So that some mechanism in design or capturing excess runoff from these developments would be a useful first step. I would advocate sewerage treatment systems which were as effective as possible at removing nitrogen from sewerage effluent, and I would also want

to be a little bit more informed, but I could see that it's possible that I might advocate acceptable sewerage treatment so as to remove phosphorus as well.

As far as the problem with lead is concerned, I can speak only from our experimental work which I consider that to be more or less private property, and that is that we found that disturbing soils tends to release substantial quantities of lead. Therefore, if that turns out to be generally true, then I might recommend that development occur in the context of not disturbing the soils as much as possible.

Q Would one method of reducing non-point pollution be to reduce the density of a residential development occurring adjacent to sensitive areas?

A Certainly effective non-point source control can be affected by reducing densities.

Q What was the basis for your recommendation that certain areas of the Pine Barrens should be developed on the basis of one DU per seven acres?

A A substantial investigation was carried out by two workers at Rutgers named Trella and Douglas. Their conclusions were from studying the soil properties taking into account the special water quality standards with respect to nitrate that seven acres was an appropriate size.

Q And you subscribe to that view?

A In the Pine Lands, I do.

Q What's the relationship, if any, between density and storm water runoff?

A In general, the greater the density, the greater the impervious surface, and the greater the increase in surface runoff that occurs.

Q And what is the effect between density and storm water quality?

A I have no specific figures to enlighten me, but I would suspect that higher densities which, if they are accompanied by greater impervious surface, may lead to an increase in the concentrations of undesirable elements in that runoff water. That doesn't necessarily mean that that water has to impact streams in that particular condition.

Q Are you stating, sir, that the impervious ground cover is the critical factor, and increased ground coverage leads to increased storm water runoff and increased pollutants in that storm water runoff?

A I would say that is the first consideration, the first line consideration that I think of in the context of that, but I could also imagine that the type of sewerage treatment, the extent of sewerage treatment and potentially other variables would be

important as well, perhaps more important in certain situations. It's difficult to generalize.

Q Do you have an opinion as to whether or not residential development should occur in areas which are designated as flood plains?

A I have an opinion, yes. I think that in general residential development does not belong in flood plains.

Q And your reason?

A It is a potential hazard to life and health and property.

Q How would you define the term "steep slopes"?

A That should be defined with respect to the region. I would say for the Piedmont of Pennsylvania that steep slopes are greater than 15 percent.

Q What would be the definition of steep slopes in Morris County?

A I am at least vaguely familiar with the topography of Morris County. I would say that 15 percent or greater is a steep slope.

Q Would you recommend residential construction on steep slopes?

A If it conformed to certain prescribed performance standards

Q What would those performance standards be?

A That the erosion, excess runoff, and the general lay of the land not be disturbed beyond its original state. In other words, I don't personally like to see a lot of cut and fill take place in order to develop on steep slopes. But there are certain designs which I personally find very attractive which can be built into hillsides which are much steeper than 15 percent. But I would say that one should strive to preserve topsoil, limit erosion, and prevent excess runoff.

Q Would you say that it's more expensive to construct on steep slopes?

A I would guess the answer is yes.

Q Would you say that high density development should not occur on steep slopes?

A I couldn't say that categorically because I'm familiar with what I think are very attractive, very well-designed high density developments on slopes that are as much as 35 percent.

Q And what densities might there be on these substantial slopes?

A 12 DU's, 15 DU's per acre, perhaps even greater than that.

Q Is that a net basis or a gross basis?

A That is the land that is built.

Q But on a gross basis, what would the density be?

A You have to give me what your definition of gross is.

Q Gross is the entire parcel, is that part where development has occurred.

A I have no idea what the total land owned is in the cases I'm thinking of. I'll be more specific. Resorts in the ski areas in the Green Mountains of Vermont are the ones that I have in mind that I believe function very nicely.

Q These are cottages or what?

A They are condominium-type developments. There are also apartment-type developments. In the distinction between them, they sometimes pass from one to the other.

Q Do you have any knowledge about the Great Swamp?

A Virtually none.

Q Do you know where it is located?

A In Morris County.

Q Which communities?

A I don't know.

Q Do you know if it's at all significant?

A I don't know. What do you mean "significant"?

Q From an environmental and ecological standpoint.

A I really have no first-hand knowledge. I am sympathetic with the preservation of wetlands which is normally, or in many areas that is, mandated by statute.

Q First, would you tell us what you mean by the term "wetlands"?

A There are a wide variety of definitions. My own definition involves areas where the ground is saturated virtually all of the time or most of the year. There are botanical categorizations of wetlands, but for my viewpoint saturated ground constitutes a wetland, saturated year round.

Q That would be a swamp or marsh?

A That depends on the depth of water as to whether you want to call it a swamp or marsh.

Q But swamps or marshes would be considered forms of wetlands?

A That's correct.

Q I assume flood plains would be forms of wetlands?

A They may or may not be.

Q What would your position be with regard to construction of wetlands?

A I am in a position that I could say in general one should never construct or in general it's okay to construct. I believe -- I know of areas which have very attractive communities. In fact, relatively high density communities have been built in coastal wetland areas, and they are built on stilts to keep them above the flooding induced by hurricanes and so forth. So I don't have an overall opinion.

Q Aside from stilts, do you know of any areas of wetlands where you would recommend residential construction?

A Aside from constructing houses on stilts could I imagine a way in which houses could be constructed in wetlands?

Q Right.

A Not really. It would be a very specialized act by a person who was very interested in living in a wetland.

Q Now, have you done any work, sir, in the area of ground water availability?

A Yes.

Q And have you done any studies with regard to Morris County?

A No.

Q Is there a limit on the amount of potable

water which is available, presupposing the use of wells exclusively, as it relates to residential development?

A Let me see if I understand your question. Is there a limit to the amount of water that you can obtain from the ground if you are only using water from the ground?

Q That's right.

A I would suspect that the answer is yes.

Q And do you know of any studies or any papers or any theories which set up parameters for limitations on ground water availability?

A I do not know of them first-hand, but I know that the concept of safe yield has been discussed in a number of concepts, largely by engineers, and that information is available to me if I should need it.

Q You haven't studied that information?

A That's correct.

Q It has been relevant to your work in the past?

A It has been relevant to my work in the past except that the answer was obvious given the natural features of the landscape and the subsurface geology, and therefore I never need to delve into theories about safe yield was obviated.

Q Are you familiar with the term "precambrian gneiss"?

A Yes, I'm familiar with it.

Q Can you tell us what that means?

A A gneiss is a type of rock which is characterized as a metamorphic rock, it being of a variety of specific mineral compositions. In general, it appears to be relatively banded in that it has light and dark zones, and it's comprised of minerals which may include feldspars, it may include quartz, it may include micas to a certain extent.

Q Precambrian means that it was formed a long time ago?

A Yes.

Q Can you tell us what the water-bearing qualities are of precambrian gneiss?

A That depends on factors which are not strictly a property of the rock as I described it. It may have substantial water-bearing tendencies in certain areas where it's heavily faulted or jointed.

In areas where it's not heavily faulted or jointed, the gneiss itself does not contain very readily assessible water, although it may be -- the [illegible] with other materials which are better aquifers and have a greater water-bearing

tendency.

Q Isn't it a fair statement that where the precambrian gneiss is not shattered, it has limited water-bearing capacities?

A I would agree with that. Where it's not shattered, assuming that you mean shattered in the context of jointed or faulted.

Q Would you agree that it would be important to protect FB-1 and FB-2 streams from non-point pollution?

A I need to review the definition of FB-1 and FB-2 streams. I presume those are New Jersey designations?

Q That's right, and they go along with particular water quality standards.

A In general, I am in sympathy with protecting streams from water quality problems and non-point source pollution.

Q And could you tell us the methods that could be used to protect streams from non-point pollution?

A I'll give you a variety of methods which I'm familiar with. Some of these methods involve planning, some involve design. I would say that the retention of runoff in the [illegible]. Runoff could be retained in a number of ways which are pleasing in design. There are

such things as porous pavement which would allow the infiltration of water through the pavement. This is partially experimental, but it has been utilized in other areas. I believe, in fact, there are communities which have ordinances specifying the nature of the paving to be used.

There are such things as Dutch drains or French drains which are holes in the ground filled with rocks into which runoff percolates. Water can be made to run off of roofs onto very permeable areas below which would be perhaps trenches that are lined with gravel or sand or something to allow infiltration of the water.

There is the potential of holding retention basins which might be necessary in very large instances which are functional and could be made to be useful depending on the types of soils that are present.

There is the opportunity to withhold water on built surfaces or surfaces in the man-made landscape which would encourage evaporation of that water. That could be employed to reduce the amount of runoff and to reduce the pollutants that are associated with the runoff.

Planning strategies that would be appropriate would be to limit development in areas where surface runoff was apt to be a problem, and by "limit," I mean

to make developments in those areas conform to performance requirements, performance standards which would allow no excess runoff over what normally occurs under the natural situations.

Q I assume with these planning standards what you're really mandating is a limited amount of impervious coverage?

A Not necessarily. That is one way to achieve it, but relatively high coverage can still -- the water can still be collected and prevented from entering stream courses.

Q I assume that would be an expensive method?

A Not necessarily, because as it's typically done or has been done in the past 15 or 20 years, expensive sewer systems have been revised to collect the water and to get it off the site absolutely as quickly as possible. I would say that that's relatively expensive because you need to put in pipes and so forth.

Although I cannot speak on the cost effectiveness of soft mechanisms I just explained to you, I know that there are test data on some of them. In concept

[illegible]

MR. BERNHARDT: Thank you very much

CROSS-EXAMINATION BY MR. LEE:

Q Right in the beginning of the deposition you mentioned what documents you reviewed.

A I mentioned I had reviewed one report.

Q Could you specify what report that was?

A No, I don't recall, but it's on the record.

MR. MEISER: If I could clarify for the record, the report, it was the Soil Borings Report.

Off the record.

(Discussion off the record.)

MR. MEISER: On the record. It was the Convers--Ward--Dixon Soil Borings Report. That's the one he's looked at.

Q On the basis of your review of that report, do you have any comments to make.

THE WITNESS: Off the record.

(Discussion off the record.)

A Could you be more specific, please?

Q On the basis of information provided by Mr. Salzman in his report, were you able to come to any conclusions about the matters within the report where specifically he addressed soil conditions in the Township of Hanover?

A I came to no conclusions. I would not wish to

come to any conclusions based on what I read in his report alone.

Q I take it, therefore, that you have not made any report based on Mr. Salzman's study?

A I've made no formal report.

Q Neither written nor oral?

A I'd like to confer with counsel on that.

MR. MEISTR: Off the record.

(Discussion off the record.)

A On the record, the only thing he did was to suggest questions to Keith. He spent a half hour on that, and that was his purpose, to give the attorney assistance on the type of questions to ask. It was not for the purpose of drawing conclusions about the validity of the report.

Q Have you made any on-site inspections in the Township of Hanover?

A No, I have not.

Q Have you examined any of the reports prepared by the experts in this case for the Township of Hanover?

A No, I believe that -- I believe not. The other material which I have looked at are general maps of

Environmental Protection.

Q Could you be more specific?

A There was a roll of maps that were provided to me by Michael Clark who was at one time involved in this, and I simply looked at the title of each map, saw where the boundaries of Morris County were, and ascertained a very gross overview of the nature of that landscape. There were maps with respect to geology. There were stream and watershed maps. There were land use maps. There were a variety of sewerage treatment district maps, public water maps I believe were there topographic maps, maps of roadways and so on. That is the basis of my recollection. I spent maybe an hour or a half hour doing that.

MR. LEE: I have no further questions than that.

CROSS-EXAMINATION BY MR. WYSE:

Q Mr. Johnson, have you any familiarity with Rockaway Township?

A No.

Q Have you ever driven through or walked

the topography of Rockaway Township?

A Since I could not pick out Rockaway Township on a map, I'm not -- I don't think that I would categorically know. My experience in driving through that area has been limited to a couple trips on Route 202. To my knowledge, I haven't been there.

Q When you examined the maps you just referred to from the, I believe, the Department of Environmental Protection, did you take any particular notice of Rockaway Township, or was your review --

A No, I was simply looking at the whole of Morris County.

Q Did you come to any generalized conclusions regarding Morris County as a result of those maps?

A I formed a preliminary method in my mind of what I should expect upon further examination.

Q And what was the substance of that method?

A Faulted precambrian, relatively steep topography, linear features in the western portion of the county. In the eastern portion of the county, triassic low areas with some general -- some specific inclusions of [illegible]. I think it might not be exactly accurate, but [illegible] the possibility of [illegible]

of landscape being covered with glacial material, a variety of different types of glacial materials, but in general it's not unlike portions of southern Pennsylvania. They are geologically connected, geologically the same units, and I suspect that the nature of the landscape would be -- I suspect that it would be relatively similar.

That was my initial impression. More detailed work will obviously modify and alter the preliminary impressions.

Q Now, of course, I'm an attorney and I don't have expertise in soils, but you've named several factors or things you noticed. Does that include an opinion as to what types, what soil types are present in Morris County?

A I have a reasonably good comprehension of general soils geography throughout most of the United States, and it's a little bit better in areas that I'm close to, so that I am in general familiar with the types of soils I expect to find there on the basis of their official nomenclature names. They are designated by town names or locality names like Lawrenceville soils or something that's very specific. But in general there will be [illegible] soils in this particular region because they're characteristic of

the eastern seaboard and the triassic lowlands of New Jersey and other portions of the Piedmont as well.

Q Do you have professional experience dealing with the soil types that you expect to find in Morris County?

A I can't answer that question from the soil science point of view because soil types to a soil scientist mean something very specific, and I have probably dealt with some of the soil types and defined by soil scientists. I have dealt with the general kinds of soil, the general categories and classifications to a fairly significant extent in the context of planning in the Piedmonts of Pennsylvania.

Q If I may draw an analogy just to see if you would agree with it. I get the impression from your testimony that soil can be classified almost as the way plant and animal life is classified? They are general categories going down to more specific categories?

A That's correct.

Q And you are familiar with the general categories of the soils in Morris County, but you can't go too much more specifically than general

categories, is that correct?

A There are seven levels that we might wish to categorize soils at, seven or eight, and I would say that I'm familiar with these things on the basis of second or third most detailed category. You can go way beyond the very general properties, and I can get down to rather specific properties. I'm not familiar with each soil theories, that is, the official name that exists in the township.

Q This familiarity is based on your review of the maps that you previously discussed from DEP?

A No, my familiarity is based on work that I have done with the soils in Pennsylvania which has very, very, similar types of landscapes and soils which would be the same down to the second or third level of specificity.

Q And you say that those types of soils are present here from viewing those maps and from your general knowledge?

A My general impressions of the eastern coast, the examination of triassic lowlands, faulted metamorphic rocks in the western portion.

Q Is there a name in your branch of science given to that level, that second or third level from the most detailed that you're referring to?

A Yes, I would say that I could deal with these soils and could probably list a number of great groups and subgroups that would exist based on my cursory review of the area and my general familiarity with the region. I might even -- if I was very lucky -- be able to name some soil theories which I have looked at in other places which could occur in Morris County.

Q You mentioned great groups and subgroups. Is that a technical terminology in your profession?

A Yes it is.

Q We've discussed generally in this deposition what you might have to know in order to establish reasonable densities of land use, residential land use, and certain types of soils.

Can you tell me what, of these seven levels, what knowledge would you have to have in order to arrive at the calculations you are referring to?

A In other words, at which level could I make reasonable inferences as to the density?

Q Yes.

A The accuracies of the inference decreases as you move to more and more general categories. At the level which it is appropriate for comprehensive [illegible] soil series or perhaps even [illegible] soils phase can be easily and readily [illegible]

that is more specific than any of the categories to which I have referred.

However, as far as beginning to construct a method of that this landscape is like, subgroup level familiarity with soils will go a long way towards telling one about the soil properties, and then inferences can be made based on that as to sensitivity.

I would not as a planner say that we should use subgroup level information. I would say we use the most detailed level of information that we can map at a reasonable expense and can reasonably be interpreted and that is soils series or soils phase information.

Q We discussed five different types of alternative effluent treatment systems. Would you say that you could make any specific recommendations with respect to those five types based upon this subgroup level of knowledge about the soils?

A No, that requires soils series level information. In my opinion, a recommendation could be made, a general recommendation, but that may prove to be erroneous in a specific case, so I would say that you want the soils series and soils phase information to

Q I believe you testified that on [illegible]

kind of information you have to examine the specific site, is that correct?

A No, for general planning purposes the Soil Survey, I believe, is adequate for design of the systems, but site-specific information is required.

Now, the site-specific information includes not just the soil property, but the size of the development, the number of units planned, the surrounding land use topography, and so on.

Q Do you have any opinion with regard to the suitability of these five types of alternative systems in areas that are predominantly steep slopes?

A Their effectiveness is probably modified by steep slopes. I would say that their suitability as a treatment mechanism probably is reduced under conditions of steep slopes, but not necessarily because the slope is steep, but because of other things that are correlative to steep sloping areas, particularly with respect to the Piedmont. I am not in favor of putting these things on very steep slopes.

However, it's possibly useful to say that they had been used for treating effluent in ski areas in the wintertime on relatively steep slopes.

Q What kind of a system?

A Spray irrigation is a mode that has been used

at Sunapee Mountain or Lake Sunapee, whatever it's called in New Hampshire.

Q Could you, for instance, use the marsh-pond method on an area predominated by a steep slope?

A I would not choose to, but I wouldn't say that it's impossible, but I wouldn't choose to. It depends -- given my definition of steep slopes, greater than 15 percent, I would not choose to use that.

Q Are there periodic maintenance costs connected with the use of this alternative effluent disposal system?

A There are maintenance costs associated with them. I don't know that I would want to characterize them as periodic, but they certainly -- there are maintenance requirements and maintenance costs.

Q Well, can you describe for each of these systems what sort of maintenance has to occur? Do they, for example, require periodically that the entire system be replaced or any kind of major renovation of the system over a period of years for each of the different systems you were talking about?

A That's very difficult to answer because anything which is managed improperly stands a chance of breaking down. In which case major modifications may be needed

Q Let's limit ourselves to assuming proper maintenance.

A If it's operated appropriately and managed appropriately, there will be maintenance costs such as cleaning or replacing perhaps plugs, spray nozzles, if spray irrigation happens to be the type that's used.

I believe that if these systems are going to be operated, they should be done in conjunction with vegetation. I like to see treatment systems which produce a vegetative product such as pulp wood, for instance, or in some cases, hay. So that there is a maintenance cost associated with harvesting, but there may also be a return that can be generated by harvesting.

So no one will claim that they are free of maintenance costs. However, it's possible that some of the cost of the treatment can be offset by marketing a product.

Q Are you aware of any studies that investigate this area of maintenance costs and return on harvesting vegetable products?

A Yes, the foremost study probably has been done

entire city has been used to grow corn, and its quality

of the corn has been tested, and the corn has been marketed, and they know how many dollars went in and how much dollars came back, and so on.

So that kind of information does exist, and I'm familiar with the fact that it does exist.

Q And which type are they using?

A I believe it's the spray irrigation in Muskegon, but I don't know absolutely for sure. It's an irrigation procedure, and I suspect it's spray.

Q In marsh-pond method, after a period of years, is there any requirements for dredging either the marsh or the pond?

A As these are experimental, I would say that the general indications, that the general rule of thumb, the general management procedures are not probably completely understood. But, in general, it's wise to plant these things so that the marsh can be taken out and replanted. The way that this is designed -- in general, the way I would design them is with a series of connected trenches that you could walk between rows of marsh vegetation. They generally require gravel and sand in the bottom as a growing medium so that it's relatively easy to harvest or cut them.

But experimental data can be gathered on this and fairly definitive statements made about that. I cannot make them in the absence of something more significant in front of me.

Q Is it fair to say that no one really knows what the long term maintenance cost of some of these systems are?

A I don't know if anybody knows or not. There are systems which have been in operation in other countries for very long periods of time, for 60, 70, or 80 years, so that information could be gained on the costs of those systems. Whether or not that's directly applicable, I don't know. I'm not really a cost person, but I would say that we could give fair judgment as to the field in general. There is information that would give fair judgment as to the long term operating costs of these things. They are not so experimental and so new.

I want to clarify this if I may. Did you mean the marsh-pond or did you mean all the alternative systems?

Q All the alternative systems.

A That's what my answer was with respect to, that these have existed for long periods of time in other places, and presumably information could be obtained

Q Now, I was referring to all the systems. Are you saying that examples of each of these systems has been in existence in other countries for a long period of time?

A Certainly. The irrigation system has been in existence for some period of time.

Q That's the five types of irrigation systems that you discussed?

A Yes.

Q Is it fair to say that the maintenance costs of these alternative systems would be higher than the cost of operating a septic tank system on an individual lot?

A I don't know the answer to that. I don't feel qualified as an expert on costs.

Q You don't know? That's fine.

Do you know if there are any studies which would show the incidence of malfunctioning or breakdown in any of these systems we've discussed?

A Are there any studies? Certainly these systems have failed for a variety of reasons in a variety of places. I believe that it's possible that someone could generate a catalog of failures and why they [illegible] none of them have anything to [illegible]

or an effluent development.

One was a milk processing factory that did not seem to be working very well. I'm familiar with production outset using land treatments, which I wasn't satisfied with the performance of the site tests, but I believe the information probably could be found on that. Although that is generally less well documented than systems that do work. People like to bury failures rather than to expose them.

Q Do you know offhand what particular type of system these examples you were just referring to used?

A Spray was in one case, flood irrigation in another case. I want to point out though, if I may, that is not a function of the land. It's simply a function of poor management. My feeling has been, and I can say this with conviction, that it's very possible to find a site suitable for land treatments, that the weakest link right now is in the management aspect of it.

Q Do you have any opinion why management has been a problem using these techniques?

A I suspect that they may have been improperly designed in order to conserve the amount of land that's necessary. Perhaps economics. In some cases

it's a question of rotating schedules, when to rotate the fields. You don't spray every field all the time. You don't set off all the nozzles at all times. A person who is trained to do this properly shouldn't have any trouble in deciding that you turn these off today and these on today. But in cases where there are mixups or misunderstandings, that may account for substantial failures. Some of the failures probably were sort of trial-and-error experiments, for instance, harvesting. It's difficult to harvest on wet soil in general. This has been circumvented by the use of very low pressure tires, oversized tires, and so on, but we had to learn that by experience.

So that unknowns contributed perhaps to failures in the past. Poor management due to misunderstanding or shortcuts may still contribute to malfunctions.

Q Taking the five systems, alternative systems you discussed and the conventional on-site septic system, do either you have an opinion or have you seen any opinions of others which would rank them in terms of long term reliability, long term effectiveness?

A No, I don't think -- well, I can only answer this question in the context of what I think you're thinking about, and that is the disposal of effluent

from developed areas and residential effluent, be it low density or high density.

Q Yes.

A Not in terms like municipal sewerage treatment plants with ten million gallons whereby you couldn't use septic tanks or something like that. So that in the context of development and developed areas, I don't feel I would want to make a judgment on long term reliability based on simply a statement of these five things. Different soil conditions, different climatic conditions, different geologic conditions in different areas will determine which is best. There are some which may not be appropriate for New Jersey at all because of climatic conditions. It may be that appropriate soils don't exist.

So that to simply rank them on the basis of general operating parameters, I could not do that.

Q Can you rank them based upon the level of knowledge that you now have of the soil conditions in Morris County --

A No.

Q -- or the topography of Morris County?

A No. I would say that we would have to have the [illegible] information consistent with those interrelated soil theories, soil phase information.

Q Is it fair to say that you're saying that you need more site-specific information in order to determine what the best system would be?

A I need to look at the characteristics of soil theories and soil phases. That's not necessarily site-specific information. I could read in a book about this soil series has these properties and could make, I think, a very educated inference based on available information as to whether or not they are suitable for any of those systems, particularly the land-based ones, not necessarily the marsh-pond ones, but that follows from written information, topographic information.

Q Would it be possible for you to say just on a very average basis the average type of soil, the type of soil in Morris County, whether any one or more of these systems would be better than the others?

A I don't think the concept of an average soil applies, so I can't answer that.

MR. WYSE: I have no more questions. Thank you.

(Witness excused.)

(Deposition concluded.)

MORRIS COUNTY FAIR HOUSING COUNCIL,

Plaintiff,

vs.

TOWNSHIP OF BOONTON, et als.,

Defendants.

CERTIFICATE

I, JACQUELINE WASKO, a Certified Shorthand Reporter and Notary Public of the State of New Jersey, do hereby certify the foregoing to be a true and accurate transcript of the deposition of ARTHUR JOHNSON, who was first duly sworn by me at the place and on the date hereinbefore set forth.

I further certify that I am neither attorney nor counsel for, nor related to or employed by, any of the parties to the action in which this deposition was taken, and further that I am not a relative or employee of any attorney or counsel employed in this case, nor am I financially interested in this action.

Jacqueline Wasko

Certified Shorthand Reporter