TRAN

TESTIMONY OF DR. J. P. LAWLER
BEFORE THE NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION
AUGUST 4, 1971

move up that slope?

A. Yes, probably yes.

Q. And again, you didn't make any specific studies to see whether those velocities would create scouring of the river bottom in this area or not?

A. No, no specific studies.

MR. NITZEL: That's all, Your Honor.

DR. BUND: Any questions of Mr.-- Professor Neale, please? Anybody?

(No response.)

MR. BERGEN: No redirect, Your Honor.

(Witness excused.)

MR. HONELMAN: Your Honor, call Dr. John Lawler.

DR. JOHN P. LAWLER,

called as a witness in rebuttal for and in behalf of the applicant, having been duly sworn, was examined and testified as follows:

DR. BUND: Give your full name, please, and residence.

THE WITNESS: John P. Lawler, 14 Westerly Drive, New City, New York.

DIRECT EXAMINATION

BY MR. HOEHLEIN:

Q. Dr. Lawler, what's your occupation?

A. I'm a consulting sanitary engineer and a partner in the consulting engineering firm of Quirk, Lawler & Matusky Engineers, 505 Fifth Avenue, New York, New York.

Q. What is your educational background?

A. I received a Bachelor of Civil Engineering degree with a major in Sanitary Engineering from Manhattan College in 1955. I received a Master's degree in Civil Engineering, again with a major in Sanitary Engineering from New York University in 1958, and I was awarded a Ph.D. degree in Civil Engineering, again with a major in Sanitary Engineering from the University of Wisconsin in 1960.

Q. Please briefly describe your professional experience.

A. From graduation in 1955 to early 1956 I was an engineer with E. G. Davidson Incorporated, a consulting civil engineer in Rockland County, New York. From 1956 through 1958 or mid-1958 I was an instructor in the Civil Engineering Department at Manhattan College. From 1958 through 1960 I was a university

research fellow at the University of Wisconsin. From 1950 through 1965 I was assistant professor of Civil Engineering at Rutgers University, New Brunswick, New Jersey. From 1962 through 1967 I was visiting associate professor of Civil Engineering at Manhattan College in Manhattan's graduate program of Sanitary Engineering. From 1965 to the present I have been a partner in the Civil Engineering firm of Quirk, Lawler & Matusky. All my teaching and research experience in the colleges and universities mentioned has been in the field of water supply, waste water disposal and river and estuarine water quality evaluations.

Q. What is the nature of your consulting activities with Quirk, Lawler & Matusky?

A. Quirk, Lawler & Matusky's activities are heavily oriented toward the analysis and design of waste water treatment and disposal systems, and the analysis of the influence of waste water discharges on the water quality parameters of natural bodies of water. I am partner in charge of all projects relating to the effect of waste water discharges on the water quality of receiving water bodies.

Q. Are you a member of any professional societies relating to the disciplines included within sanitary engineering?

A. Yes, I'm a member of the American Academy of Environmental Engineers and the Water Pollution Control Federation.

Q. Are you a licensed professional engineer?

A. Yes, I am licensed to practice engineering in several states including New York, New Jersey, Connecticut, Michigan and Virginia.

Q. In the course of your work with Quirk, Lawler & Matusky have you become familiar with the existing conditions in the Hudson River?

A. Yes, our work over the past six years has involved a large number of projects relating to the discharge of various effluents to the Hudson River and the resulting effect on the Hudson River quality. These include a comprehensive three-year study carried out for the Division of Pure Waters, now of the Department of Environmental Conservation but during the course of the study a Division of the New York State [illegible] in which we related the response [illegible] quality parameters including

biochemical oxygen demand, dissolved oxygen and temperature and various other water quality characteristics to the discharge of waste organic material. This included the investigation of the river from its first recognized source of pollution at Corinth, some 220 miles north of the Battery down to the Battery and into the New York Harbor. This study also involved a careful evaluation of the relationship between river flow and salt intrusion since salt intrusion has a significant positive influence on the flushing of waste organic material from the river. In addition to this study, we have investigated the effect of thermal discharges on the temperature distribution in the river from virtually every existing and proposed electrical generating facility on the river.

Q. You stated that you have investigated the effect of salinity in the river with reference to its influence in connection with the assimilative capacity of wastes discharged into the river. In the course of your investigations have you investigated the behavior of salt and salinity concentrations in the river?

A. Yes, I have made an extensive study of the natural behavior of salt in the estuary. This behavior is a very important factor in determining the balance between waste water pollution and river water quality. This investigation of salt behavior has been directed toward relating fresh water runoff in the estuary to the longitudinal distribution of salt. To develop this relationship, these studies included extensive sampling of river salt as well as examination of salinity data previously collected on the river.

Q. Are you also generally familiar with the company's plans for the Cornwall Project?

A. Yes. I have discussed the plans for the project with company officials and engineers and with representatives of Ebl, Hall & Rich. I have also examined the company's application to the Federal Power Commission, and, of course, its application to this Department. In addition, I have attended each of the hearings in this proceeding.

Q. I take it then that you have heard the testimony of Dr. Harman and Dr. Alexander and of Dr. Rehnborg.

A. Yes.

DR. BURD: By -- excuse me, by "the company" you're referring to Con Edison, in that previous question?

THE WITNESS: Yes, by company, I mean Con Edison.

DR. BURD: O.K. I'm sorry, proceed.

BY MR. HOBELMAN:

Q. Based on your knowledge of the Hudson River and your familiarity with the project, do you have an opinion with respect to the probable effect of the operation of the Cornwall Project upon salt concentrations in the Hudson?

A. Yes.

Q. Well, please state your opinion and the basis for it.

A. My review of this question suggests there is no reason why increased upstream movement of salt should occur as a result of Cornwall operation. This opinion is the result of the following considerations:

1. Significant upstream movement of salt can only occur by bringing more salt into the estuary from the ocean. This means that Cornwall would have to change the balance of factors that control salt

movement from the ocean through the Battery in order to have a significant upstream effect.

2. These factors are river fresh water flow leaving the estuary through the Battery, tidal motion at the Battery, and the ocean salt concentration.

3. Cornwall operation is cyclic or oscillatory; that is, whatever volume of water the project removes from the river below Cornwall is very shortly returned. This perturbation, or disturbance, of the normal river flow system, has little chance of being felt at the Battery because neither release nor withdrawal is sufficiently sustained to permit the flow balance at the Battery to be altered. On the other hand, were the river flow one-way, the effect would eventually be felt at the Battery, just as the salt intrusion is changed by sustained changes in the river's natural fresh water runoff.

Take, for example, the effect of a sustained rainfall of several days on the basin. Several days after introduction of such an increased runoff to the estuary, at Troy and through the lower river tributaries, salt will be pushed down the river.

Shortly after this impulse leaves the river, salt will move back up to the position it held before the introduction of this higher flow to the river. Cornwall flows, on the other hand, are reversed each day, so that any tendency to move salt down the river upon release of Cornwall water is offset roughly 12 hours later by subsequent withdrawal.

Some numbers may be used to illustrate the foregoing. The estuary contains some 800 billion gallons of water between Troy and the Narrows. Cornwall can store 8 billion gallons. Summertime operation of Cornwall involves one to three turnovers per week; that is to say, some 8 to 24 billion gallons are withdrawn and released each week. This means that the weekly operation of Cornwall, involving five oscillatory motions, perturbs only 1% to 3% of the total water available for damping these oscillations before their effect is felt at the estuary's entrance. This alone suggests that the Cornwall effect has little chance of being felt at the Battery.

Q. Now, Mr. Lawler, may I interrupt you for a moment? Would you turn back to Page 6 of your prepared

testimony? Now, I may be wrong there but I'd like you to confirm whether or not the sentence reading under paragraph numbered 3, the last sentence, "On the other hand, were the river flow one-way, the effect would eventually be felt at the Battery", is that to be river flow or project flow?

A. I take it as either one actually. All right, if the river flow or if the project flow were one-way. All right, leave it the project flow. The river flow obviously is one way.

Q. All right.

A. I'll amend that to read, "On the other hand, were the project flow one-way -- "

Q. Would you submit to your --

MR. HUND: How do you want that now?

THE WITNESS: That's -- I'll amend that.

MR. HUND: To read how?

THE WITNESS: Yeah, it makes more sense stated that way, the river flow is obviously one-way.

MR. HUND: So I still don't have it.

MR. HOLLIMAN: "On the other hand, were the project flow one-way" is the way the sentence still stand.

DR. KUHN: Were the project flow one-way?

THE WITNESS: Then the remainder of the sentence is the same.

DR. KUHN: Yeah.

BY MR. HOFFMAN:

Q. Please continue with your prepared testimony on Page 7.

A. I'm in the second paragraph on Page 7. One turnover per week can be represented by a continuous withdrawal of about 3,500 cfs. for 12 hours of each day, followed by 3,500 cfs. release for the next 12 hours. Compare this to the average tidal flow of about 150,000 cfs. past Cornwall, and it can be seen that the Cornwall disturbance is relatively very small. Furthermore, as the Cornwall flow moves down the estuary, it is damped by the increasing volume of the estuary. The tidal flow, on the other hand, becomes progressively larger as one moves toward its source. At the Battery, average tidal flow is about 400,000 cfs. By comparison to a Cornwall oscillation, if it is there at all, of substantially less than 3,500 cfs. Then the Cornwall oscillatory effect, at the Battery, is substantially less than 1% of the [illegible] motion at that point. This may

be compared to natural tidal variations during the lunar month of some 10 to 20% above and below the average tide. These natural variations have only a small effect on Hudson River salt intrusion.

Observation of natural river behavior supports these statements. River salt and fresh water runoff data for a typical spring period were analyzed to determine the response of river salt to large changes in runoff.

These data show that salt movement lags fresh water input at Troy by some six days, and that short term flow reversals donot cause reversals in salinity movement and that is to say, one to three days of increased flow, sandwiched between a gradually increasing runoff pattern, does not cause the gradually increasing salt front to reverse its direction. Furthermore, salt tends to return to an equilibrium position for any given sustained fresh water runoff, regardless of whether the departure from this position is occasioned by an increase or decrease in runoff.

The lag time of six days represents the time it takes the tenth chloride to respond to pur-

turbation to the system at Troy. Since the river volume between Cornwall and the Battery is about one-half the total volume between Troy and the Battery, the probable response time of salt to a Cornwall perturbation is three days.

Since the Cornwall period of oscillation is one day, Cornwall flow is not sufficiently sustained to permit the perturbation to be felt at the Battery. Therefore, the introduction of additional salt is not expected.

Q. In the Federal Power Commission proceedings, Mr. Quigley of the Interior Department testified to Interior's concern that Cornwall operation might move salt upriver. Are you familiar with his testimony?

A. Yes.

Q. Could you comment on the question he raised?

A. Mr. Quigley's concern was directed to the situation in which water is withdrawn during the flood phase, bringing relatively high content salt into the reservoir, and subsequently released during the ebb phase, displacing water of high salt content [illegible] with relatively low salt content. He

supposed that this water, now of a higher salt content than under natural conditions, would move upstream on the next cycle, thus increasing salt concentrations upstream.

Mr. Quigley's analysis, and Mr. Ferrara's similar analysis, do not appear to me to be complete. What is missing is the fact that on the flood phase the withdrawal of a fraction of this flood flow, say 20,000 cfs. will reduce the tendency of the tide to move salt upstream above Cornwall. Therefore, upstream salt concentrations would be less than those which would be expected if Cornwall were not operating.

Furthermore, during release on ebb, the addition of treated water to the river will increase ebb flow, again increasing the tendency of downstream directed river flow to move salt downstream. Thus the tendency to increase upstream salt movement according to Mr. Quigley's and Mr. Ferrara's reasoning about salt concentration would be offset by a tendency to increase flows downstream and therefore, decrease upstream salt movement.

Therefore, we should not expect a

net movement in either direction as a result of project operation.

Q. During the course of your firm's activities on the Hudson, you stated that you had studied the BOD and the dissolved oxygen content of the river. Could you briefly describe the nature of those sampling studies?

A. We established sampling stations every three miles over a 150-mile stretch of the Hudson and took samples of and measured dissolved oxygen and BOD in mid-channel at each of those stations during the low flow summer months in the year 1967. We have also made extensive surveys of the DO content of the river in connection with other studies of plants along the river.

Q. What is the dissolved oxygen level in the vicinity of the Cornwall Project?

A. The DO level in the vicinity of the Cornwall Project during the low flow summer months ranges from 5.5 parts per million to 6.5 parts per million. From Bear Mountain Bridge south, the DO level varies due to the addition of organic waste discharges, from approximately 5.0 parts per million at Dam

Mountain Bridge, to approximately 2.0 parts per million at the Battery.

Q. Dr. Alexander has expressed some concern about the effects of possible silt movement or algal growth with respect to dissolved oxygen. In your opinion, would the operation of the Cornwall Project have any significant effect on the dissolved oxygen in the river in the vicinity of the project?

A. No. There are very few possible factors which might affect DO content of the river as a result of the construction and operation of the project. First, the addition of approximately 240 acres of upper reservoir surface into the river system will add some small amount of oxygen to that system. Another factor entering into consideration of river DO levels resulting from project operation is the argument which has been advanced by some intervenors in this proceeding concerning the growth and die-off of algae. Dr. Lauer has already testified that in his opinion there will be no dramatic increase in algae populations in the upper reservoir. Even if we were to suppose a massive proliferation of algae in the upper reservoir and their subsequent

death, the magnitude of this dead organic material would not be sufficient to cause anything more than a negligible influence on the river's dissolved oxygen content. The effect would be in the order of 0.1 parts per million or less.

Q. In connection with your study for the Health Department, did you also sample the pH content of the Hudson River at various locations and times?

A. Yes. The pH content of the river was sampled continuously during the extensive surveys of 1967 described previously.

Q. What is the pH content of the Hudson in the vicinity of the Cornwall Project?

A. During the surveys of 1967 we observed the pH in the vicinity of the Cornwall project to range from 7.0 to 8.0.

Q. In your opinion, would the operation of the project have any effect on the pH content of the river at Cornwall?

A. It is inconceivable to me that the operation of this project would affect any measurable change in the pH content of the river.

Q. [illegible], various intervenors

have expressed concern regarding the question of whether pumping from and discharge into the project tailrace would result in erosion or scouring of the Hudson River bed. Here I'm referring to scouring beyond the screens. I take it that you have been present at the hearings and are aware of these contentions. Is that correct?

A. Yes.

Q. Do you have an opinion as to whether the alleged scouring effect will occur?

A. Yes, I do.

Q. Please state your opinion and the reasons for it.

A. Examination of Exhibit H of the application shows that in the immediate vicinity of the tailrace [illegible] in the river will increase, particularly on release, over the naturally occurring velocities in this vicinity. Qualitatively, this means that provided heavier and/or larger particles exist on the bottom than those that now occur, some of the particles will tend to rise. However, the area over which these increased velocities will occur is relatively small by comparison to the river as a whole, and, secondly, the increase in these

velocities, in terms of practical scour considerations, is negligible. Those velocity increases are on the order of .1 to .3 feet per second. For example, natural river velocities on the order of 1.9 feet per second at points close to the station discharge will increase to about 2.1 feet per second. Practically speaking, significant changes in scour velocities would normally be talked of in terms of, let us say, 0.5 feet per second increments. For example, in designing sewer systems, we are concerned with velocities of 1.0 foot per second, 2.0 feet per second, or perhaps 2-1/2 feet per second, and then when we get into storm sewer design, 3.0 feet per second and what I am suggesting here is that the small changes from 1.9 to 2.1 feet per second or changes of that order are insignificant in terms of describing scour in the Hudson River.

It will be difficult to see measurable differences in turbidity resulting from scour in front of the project. This is especially true because the area in the immediate vicinity of the tailrace caisson will be dredged during construction. Expand a little from your prepared testimony for a moment,

Dr. Lawler, I take it you're familiar with the Class "B" standards which are set forth in an exhibit to this proceeding and, of course, have been discussed at length here, is that correct?

A. That is correct.

Q. One of those standards reads as follows: "Floating solids: Settleable solids, sludge deposits, scum which are readily visible and attributable to sewage, industrial wastes or other wastes or which deleteriously increase the amounts of these constituents in receiving waters after opportunity for reasonable dilution and mixture with the waste discharged thereto." In your opinion, would the theoretical pickup or even if there were any minimal actual pickup and deposit of solids in front of the tailrace violate that standard?

A. In my opinion, I would not think so. The reason for this is that even if I do pick up some material in the area immediately in front of the tailrace or in that area that the Alden studies, Exhibit H, show slight changes in velocity, I'm looking at an area that's [illegible] of, let's say, the river [illegible] Dalton dam to Deer Mountain Bridge,

the section designated Class "B" waters, and I'm using that as an example. Secondly, I -- I don't think we'll see significant effects there.

Q. In connection with your work on the Hudson and other waters, have you been involved with consultation and the preparation of applications to the State Department of Environmental Conservation for permits to discharge heated liquids into the waters of the State?

A. Yes.

Q. Is it the practice of the Department in reviewing applications for thermal discharge permits to assume in evaluating the effects of those discharges that the generating plant in question is operating at its maximum capacity continuously?

A. Yes. The rules and regulations of the Department in connection with applications for permits to construct facilities to discharge heated water to waters of the State require that an engineer's report be submitted with the application before formal review on the part of the State Department of Environmental Conservation takes place, and we have been told by the State Department of Environmental Conservation in connection with all these thermal applications for

new generating facilities on the Hudson River, as well as for other sites through the State for that matter, that the engineer's evaluation of the effect of any thermal generating facility must be based upon operation of the proposed facilities at their maximum output on a continuous basis; that is, 24 hours a day, 365 days of the year.

Q. Dr. Alexander's testimony has suggested that an oxygen decrease might result due to the stirring up of organic sediments, with the resultant oxygen demand impressed on the river. This testimony suggests that it is impossible to predict the extent of the decrease at this time. Do you agree with these statements?

A. No. Qualitatively, it is true that stirring up of organic sediments can impress an oxygen demand on the river. I believe that the maximum conceivable extent of this effect can be estimated and I believe it's negligible.

For example, consider the river bottom in the immediate vicinity of the station's discharge. Examination of Exhibit H of the application shows that some 40% acres of the river's bottom may be

velocities on the order of 5 to 20% higher than are seen in that vicinity at present.

Now, I then suppose that this bottom was covered with actively decaying sewage and industrial waste sludges which I really have no reason to suppose, with an oxygen demand of 5 grams per square meter per day. Now, this oxygen demand represents not the -- about the maximum one would see in a decaying river sludge. Presuming coverage over the entire 200 acres, this sludge would represent a daily oxygen demand of about 0.15 parts per million on the river system.

This estimate presumes a continuous, day after day, impression of this demand; that is, an infinite source of sludge, and also it presumes no regeneration by atmospheric action. Neither of those conditions, however, would exist and there is no evidence of significant amounts of this type of oxygen-demanding sludge at Cornwall. Velocities are too great. Studies show where it does exist, for example, below Albany, it is scoured naturally at least each spring, if not more often. Existing tidal velocities in the Cornwall area are more

than sufficient to scour organics. Finally, dredging in the area of the discharge will remove any putrescible material currently existing there.

Therefore, in my opinion, the effect on dissolved oxygen depletion, if any, must be significantly less than 0.1 ppm, and cannot be sustained over time.

Q. Would similar considerations apply to Dr. Alexander's suggestions that reservoir organic content, algae decay, or reduced photosynthetic effect will reduce dissolved oxygen resources, but cannot be estimated?

A. Yes. For example, proliferation of a massive algal bloom in the upper reservoir, and subsequent death and decay can also be shown to depress a deficit of about 0.13 ppm on the river. Calculation of this massive [illegible] growth over the entire reservoir surface of 240 acres, a maximum decay rate of 5 grams per square meter per day of oxygen, a continuous, day by day source of dead algae cells, no replenishment by atmospheric reaeration, and no credit for DO generation during the photosynthetic cycle. [illegible] these factors into account, the maximum [illegible] is significantly less than

0.1 ppm and will not be sustained over time.

DR. EUND: Will not be sustained over time?

THE WITNESS: Will not be sustained over time.

DR. EUND: I emphasize that because you have it, your paper reads "will be sustained", my copy.

THE WITNESS: That's an error. I -- I had "cannot" and I changed it to "will not".

DR. EUND: Will not be sustained over time.

THE WITNESS: Correct.

At this juncture, it should also be mentioned that the provision of an additional exposure of 2'0 pounds of silver mass to the atmosphere will add on the order of 0.1 parts per million DO to the silver. It is significant that this addition will be a continuous, day by day contribution, since the exposure to the atmosphere will always take place.

Q. A couple other questions, Your Honor, with reference to Dr. -- Mr. Ferrara's testimony, Dr. Lawler. Was the year 1954 the year of longest sustained drought on record in the Lakes Area?

A. Yes, to the best of my knowledge, it was.

Q. How far back in time are you aware of such records?

A. Well, records with respect to what?

Q. To drought flows.

A. The flows go back well into the early 1900's. Salt would go not quite as far back. I'm -- we have used salt data back as far as 1929.

Q. Dr. Lawler, in your professional opinion as a sanitary engineer and based upon your knowledge of the Hudson and of the Cornwall project, are you reasonably assured that the construction and operation of the project will not violate applicable water quality standards in the Hudson River?

MR. [illegible]: I object, Your Honor.

MR. [illegible]: Overruled. Answer the question if you can.

A. Yes, I am. I am satisfied and reasonably certain that the water quality standards of the State of New York for these waters will be -- will not be violated by this project.

MR. [illegible]: That completes my direct examination of Dr. Lawler, Your Honor.

DR. [illegible]: I have one or two questions.

Dr. Lawler, do you know -- do you know whether or not the -- and we've had an answer to this from somebody else in these proceedings. Do you know whether or not the river at the point in question and at about the point in question now meets the Class "B" quality standards?

THE WITNESS: Well, it would depend --

DR. EUND: If you know.

THE WITNESS: It would depend on what particular standard you're referring to.

DR. EUND: All right, standards, we have to meet the water quality standards.

THE WITNESS: Well, I know we're meeting DO, I know we're meeting pH, I know we're meeting temperature. I would generally say we are meeting settleable solids although there are a number of raw and primary sewage discharges that are currently being upgraded to secondary. Now, depending on the stage of that upgrading, we may have some settleable solids emanating from some of the plants on both sides of the river, either plants or raw sewage [illegible]

[illegible]: Well, I'm glad I asked the

question now because it could be argued that the question is immaterial. I can entertain such an argument too because the point is that it should meet Class "B" standards so there is no point in my asking, but I think it was Mr. Kwiatkowski that was -- that mentioned that. I don't remember whether it was in response to a question specifically put like that, but whether in talking he mentioned it, he said that he didn't think it does. Of course, that's not an argument, that doesn't mean, but he didn't give an argument, but I'm glad that you seem to talk about that more specifically and I hesitated to ask that question but it only makes Mr. Butzel's case a little stronger, it would seem to me, since if we meet the standards now there's no argument to say well, it doesn't meet it now. That's why I asked the question. I don't think that that's a good argument but some people would say, "Well, it doesn't meet it now, why fuss with all this." But if your opinion is that it does meet it, then, of course, then it should -- then we shouldn't defend it. That's the purpose of my question.

THE WITNESS: Well, as I said, on an

overall basis I would think it does but you certainly may find local response where it doesn't.

DR. BUND: Well, now, Mr. Butzel, deferring to your suggestion, how much time would you like so the record will show that the hearing officer is prepared to stay until 7:00 a.m. -- well, approximately 5:00 a.m. because I've got to get down to the ferry in the morning.

MR. BUTZEL: With all respect, Your Honor, I think that if I had an hour and 45 minutes or two hours for dinner I could shorten the cross examination rather than extend it.

DR. BUND: Got a lot to do.

MR. [illegible]: How about 7:30?

MR. [illegible]: Fine.

DR. BUND: All right, 7:30.

(Thereupon at 6:00 p.m. a recess was taken until 7:30 p.m.)

EVENING SESSION

DR. BUND: All right, the hearing is resumed. The witness is recalled. This witness having been sworn need not be resworn.

I might say on the record we took a little more time than we should have but that's the way dinner runs into these intangible situations. That's what I tried to avoid.

MR. BUTZEL: I appreciate it, Your Honor. It made me feel better.

DR. BUND: But anyhow, it means we get home a little later. The good Lord will be with us on and off the record, I hope we don't run into fog.

MR. BUTZEL: Your Honor, I presume I can proceed with cross examination of Dr. Lawler?

DR. BUND: Yes, please do.

(The witness, John P. Lawler, returned to the witness stand.)

CROSS EXAMINATION

BY MR. BUTZEL:

Q. Dr. Lawler, your firm does a good deal of work with Gen Motors, does it not?

A. [illegible]

Q. All right, and you've your firm has done work for them in connection with not only this plant but the Indian Point plants and the like?

A. Yes, we've worked on the Indian Point plant.

Q. And you're being paid by Con Edison?

A. We certainly are.

DR. EUND: Only it's not clear as for what.

BY MR. RUTZEL:

Q. You're being paid by Con Edison to appear at this proceeding, are you not, sir?

A. Yes, we are.

DR. LAMB: Very difficult to hear back here.

DR. EUND: Yes, try to speak up. Thank you.

BY MR. RUTZEL:

Q. Have you ever in any public hearing ever delivered a negative report in terms of Con Edison's plants?

DR. EUND: The form is certainly objectionable.

A. Well, I'm --

DR. EUND: Negative.

THE WITNESS: I'm just trying to think of the language, negative, I would say no.

MR. HOEHLMAN: I think I brought these on myself.

BY MR. LUSKEL:

Q. We're all feeling good right now. Dr. Lawler, your testimony on here, have you performed any model studies in connection with this testimony?

A. No, I have not.

Q. You mentioned in your testimony the statement of Mr. Quigley. You understand that that was given in 1966?

A. That's correct.

Q. -- do you, sir?

A. Right.

Q. Have you done nothing since then in terms of specific studies on this question of safe water?

A. Well, the -- the responses that I gave represent thinking or considerations or whatever words you want to use with respect to this particular question.

Q. I understand that, and I presume that you developed your thinking in connection with this proceeding, is that correct, sir?

A. That's correct.

Q. But in this five-year period since 1965, have you

conducted any studies specifically with the view to testing Mr. Quigley's -- the concern that he expressed?

A. I was aware of Mr. Quigley's concern at the time he expressed it and I would say at times over that period of five years, the -- the concern that he expressed has occurred to me and I looked at it in various ways and the testimony that I've given a few hours ago is a result of these considerations.

Q. But isn't it the case, sir, that it would have been and indeed is possible now to run model studies in terms of salt water penetration?

A. Well, what kind of model studies are you referring to?

Q. I mean reproducing some of the flows in the river.

A. Well, you're still not telling me what kind of model studies.

Q. Well, let me put it a different way: When we were here the first day, Mr. Mobelman stated that no studies in -- specific studies in terms of salt water intrusion had been conducted. He further stated that the Bureau was attempting to develop now a basis for such studies but that such studies

themselves had not been conducted. Now, that's what he said on the record. Basically, I'm asking you whether or not that is the case.

A. O.K. That is the case.

Q. So that there have been no such studies done?

A. Right.

Q. Now, in the City's testimony, Mr. Egan's testimony this morning, he indicated that Mr. Lawler had said that such studies should be run.

MR. HOBELMAN: Lauer.

MR. HUTZEL: Mr. Lauer, I'm sorry.

Q. Mr. Lauer said that such studies should be run to determine the effects of the -- potential effects of the salt water, and no such studies have been run as yet, is that true, sir?

A. That is correct.

Q. I see that you're a licensed engineer in the State of Michigan. That's my home state, so why don't you tell me what you've done in Michigan?

A. I have done -- I have been in charge of no projects to my recollection in Michigan. The reason for carrying a P.E. in Michigan, our firm has done some work in Michigan. One of my partners has been

responsible for that work but the Michigan professional engineers law, as is the case here in New York, requires that all principals of a partnership be registered in the state.

Q. I see, I see. Now --

MR. BUND: Would you try to raise your voice. Some of the people are motioning to me. Thank you.

BY MR. BUTZEL:

Q. Dr. Lawler, what's your understanding of how the project would operate in terms of the hours that it would be pumping and the hours that it would be generating?

A. Generally, the project will pump during the late evening hours or the very early morning hours and generally, it would release or generate during the hours of the work day that electrical demand throughout the system tends to be greater.

Q. And how long would it -- how long do you understand that it would likely be pumping on a typical week day night?

A. Well, this -- this is a variable kind of thing but it can pump on a typical week day night anywhere,

I suppose, from five to seven hours or so.

Q. How about on a peak night?

A. On a peak night it probably would go eight hours, possibly a bit more.

Q. What rate would it be pumping at on a peak night?

A. Well, it would depend on how peak is peak.

Q. For the purposes of your testimony, what have you assumed?

A. Well, we testified that the -- the volume displaced from the river to and from the river over a week would range from one to three turnovers in this -- and this would range from 8 to 24 billion gallons.

MR. LAIB: He's just talking to the front row and it's awfully hard to hear.

MR. DUNN: Speak up. He doesn't mean to do that. Try to raise your voice.

MR. LAIB: But he's doing it and it's very hard for us to hear the conversation.

MR. DUNN: All right, try to raise your voice, Dr. Lawler.

THE WITNESS: Well, the peak, as I recall, the three [illegible] week which corresponds to

24 billion gallons displacement involves peak operation most of the week. The one turnover per week involves typical day operation most of the week and the -- and the -- anything in between those two represents some combination of peak requirements and typical day requirements.

Q. Well, I'm just anxious to test your knowledge since you gave a good deal of testimony on how the project is going to operate and that seems to underlie your -- some of your conclusions, how you understand this project is going to operate in terms of pumping and generation. I'm trying to understand.

A. All right. Well, what I'm saying is that the capacity of the units, all units running, the reservoir full to the 1150 level or thereabouts, on generation you will run 27,000 cfs. through the turbines. Again, on pumping, all units running and the reservoir empty or virtually empty down to this 1,000-foot level or thereabouts, you'll pump at the rate of 21,000 plus cfs. Now, maximum day's operation and typical day's operation are not at those rates for sustained periods of time and they would drop down from that level. You

might be pumping at 12 -- at 12,000 cfs., 8,000 cfs., 7,000 cfs. or -- or numbers of that order. That's what we're talking about.

Q. Well, I think you've fairly described the manner in which the project would operate in the sense of pumping velocities and discharge velocities. What I'm more interested in is how you understand this project would operate over the cycle of, say, a week.

A. Over a week?

Q. Yeah.

A. As -- I think in the same manner that I've just described. Over a given week, one might have a combination of what, for simplicity's sake, has been termed a typical day as opposed to a maximum day and you'd have a combination of these things in any given week may be different than another. That's why these things range.

Q. But your understanding is that it would operate on these principles?

A. That's correct and it's the reason for using the range of one to three turnovers per week.

Q. And it's a daily circulation of pumping up and discharge, is that correct?

A. That is correct.

Q. Were you aware, sir, that the project may be pumping only for periods as long as from Friday evening through Sunday?

A. Yes.

Q. You didn't describe that just now. That would mean then, would it not, sir, that for periods of two and a half days perhaps you would have merely and solely an intake?

A. That's correct, if you were pumping for that period.

Q. Would you expect that to occur very often?

A. You can pump over the weekend for periods of a weekend. My understanding is thatyou would not be pumping continuously through the same X hours from Friday evening at 6:00 p.m. to Monday morning at 9:00 a.m.

Q. But is it your understanding that you would only be pumping during that period, you might not be doing anything at all?

A. I would say that it's conceivable that you could be pumping during the weekend although it's unlikely [illegible] be.

Q. Now, in your testimony on Pages 5 through 9, you discuss some of the factors of salt water movement and at one point you say at the bottom of Page 6, Conwall flows on the other hand are reversed each day. Now, tide is at the bottom of Page 6. Now, you obviously didn't mean that in light of the testimony you just gave, did you, sir?

A. No, I meant that --

Q. You did, but even though on the weekends it wouldn't be reversed each day?

A. That's correct, I did not consider the weekends to be too terribly significant in this operation.

Q. You didn't make any studies, I think we've agreed on that, in terms of model studies on that, did you?

A. On the weekend, no.

Q. All right. Now, on the next page, you start talking about the amount of water between Troy and the Narrows and the percentages of total water in the estuary versus the amount of water that would be pumped in by Conwall. Is it your understanding, Dr. Lawler, that the salt concentrations in the riverare -- are constant?

A. Are constant.

Q. Yeah, I mean they --

A. No, certainly not.

Q. Well, why did you select the area from the Battery to Troy as the area of comparison in your particular case?

A. Well, comparison to what?

Q. Well, you're giving us a whole series of percentage figures in terms of the estuary as a whole and the amount of water in the estuary as a whole. Why did you use the amount of water in the estuary as a whole as your basis for conclusion?

A. Well, what I'm trying to say is that we know that fresh water movement does have a key relation to the movement of salt from the estuary and what I'm trying to determine is whether or not the movement at Cornwall can be related to a fresh water flow and, therefore, have a similar effect on the salt. Now, the -- I mentioned the oscillatory motion. I consider this to be very important because what you're saying, this is a -- this is a system, a physical system. It could be analogous to a spring and a damping system. There are many ways you can look at it. The point is when you perturb

any system of this nature the perturbation is not felt instantaneously throughout the entire system. Let me finish now.

Q. That --

A. Now, my point is to bring salt into the estuary, Cornwall, to have an effect on salt, must bring additional salt into the estuary and I somehow or other have to see that effect. I've said the Battery, actually the Narrows is a better description of where the effect has to be seen. Now, I will see that effect eventually if my movement or my perturbation is all in one direction and is sustained because eventually I have to feel that effect but I don't feel it instantaneously and --

Q. You don't?

A. -- if I reverse my perturbation, in other words, if I withdrew water as opposed to releasing the water, I -- during the reverse of what I did 12 hours before or sometime during the period before.

Q. You have limited your vision to the Battery or the Narrows?

A. That's correct.

Q. You've also at the same time recognized, and there

can be no question about that, that the salt water concentrations vary and not just straight up and down. When you withdraw water at Cornwall, you've geared your vision to the Narrows or to the Battery. What about the water at West Point?

A. I have to gear my vision to the ocean entrance because my point is that, or my concern is with a sustained upstream movement of salt and the only way I can support that is to account for more salt in the estuary than I had previously.

Q. That's your definition, sustained upstream movement of salt, but if the salt content were high at West Point and if, as a consequence of Cornwall pumping that salt content were drawn further up, what would the consequence be on the water in that particular area?

A. I -- I'd like you to repeat the question.

Q. Well, I'll repeat it. If you were pumping, if there were a high salt content at West Point and if, as a consequence of Cornwall operation, that saline water were drawn further up, what would be the consequence on the water in that particular area as distinct from your distance down at the Battery?

A. Well, before I can answer that question, you have to give me an idea of whether you're considering this pumping to a place during ebb or during flood.

Q. Well, it's -- let's take the most advantageous condition for me, the flood.

A. All right, if you're pumping on flood, O.K. Now, the way I would look at this is as follows: During flood tide and moving upstream, my hydraulic gradient is in the upstream direction, heading upstream, with something in the order of let's say 150,000 cfs. because that would be roughly the average flood movement in the Cornwall area. Now, if I withdraw 10,000 or 15 or any number that Cornwall is capable of running, I am reducing the ability of the tide to carry that salt farther upstream.

Q. Well, that's, in effect, what you say.

A. That's the point I was driving at here.

Q. At the bottom of Page 8, is it not?

A. That's correct.

Q. What makesyou assume that that water that's withdrawn and, in effect, creates a hole, is going to reduce the upstream movement when, because of the tidal

effect, the elevations behind the tide are higher than the water you're drawing and when the fresh water flow itself is constant in the river?

A. I didn't say I was drawing the water from the upstream. I said that --

Q. I said --

A. Look at it this way: I have 150,000 cfs. moving down a channel and I divert 20,000 or 10,000 of it. Now, I have 140,000 left moving upstream, O.K.? Under a natural set of conditions for a constant fresh water flow, O.K., I haven't changed fresh water flow at all. I have a balance and that balance is the net effect of tidal motion and river geometry and fresh water flow. Now, if I reduce my tidal motion in the upstream diversion, I reduce the tendency to carry salt upstream.

Q. I may be wrong about this but I have been advised that when you draw that water out you may increase that movement.

A. Well, I can't agree with that, not on the movement.

Q. Well, why wouldn't that be the case, sir? What is the effect that is in it that you're drawing out of that water and why shouldn't the -- the upstream --

when I say the upstream water, I'm really using the wrong term, the water that's higher, why shouldn't the water from the sea be the water that's going to move into that void?

A. It will into Cornwall. It will be, I don't suggest that in the least. What I'm saying is that the water above Cornwall, not up high above Cornwall but upstream above Cornwall, will now see less of a tendency to move up and, therefore, for that period of time that the pumping is taking place during flood, the tendency for the flood tide to carry salt upstream beyond Cornwall is not as great. It simply -- you're just taking 10,000 cfs. away from it.

Q. You're saying you're taking the water from the upstream -- from the downstream movement. I'm suggesting to you that when you're pumping, you're taking the water from the upstream area causing the water to flow in behind it with that much -- that much factor, I do not see how given the principles of gravity and given the fact that you have a constant fresh water flow in the Indian downstream even on the ebb tide there's fresh water flow, you know,

the net may be up but it's still moving into the reservoir, how it could be any other way.

A. All right, let me ask you this question --

Q. Don't ask me anything. I'd like to get on that stand.

MR. DUNN: Put it in a statement, put it in a statement.

THE WITNESS: Well, then let me try --

MR. DUNN: Don't forget us lawyers invented this procedure.

THE WITNESS: Let me try to describe it this way: I have a pipe and I'm moving in a given direction in that pipe at a rate of 15 units, O.K.? And now I put a "T" in that pipe and I draw water out of that pipe at the rate of one unit. I am saying that the new balance of flow in that pipe will be 15 units up in the section of the pipe upstream of the "T" and 14 units in the section of the pipe downstream of the "T". I just -- you know, that's hydraulics.

Q. Well, it isn't necessarily hydraulics if the water that's behind it has a greater force sufficient to fill in that -- you know, that "T" that you're taking. You've taken a pipe situation, you know, which is

a bounded situation and tried to analogize it to a river which --

MR. HOBELMAN: Your Honor, I object.

THE WITNESS: Then the river would be identical. Then let it be an open channel.

MR. HOBELMAN: I object, the question is getting argumentative.

MR. REID: All right, let it be, we have no question right now.

THE WITNESS: The only way the water can move is under a -- under a pressure gradient, pressure either being gravity or pressure in a pipe system.

BY MR. BUZZEL:

Q. Or tidal?

A. Or tidal, sure, but you still have a hydraulic gradient on the ebb tide and it's going to move in the direction of the decreasing gradient and you're not going to pull it up above.

Q. And on a flood tide, what is the decreasing gradient?

A. From down below upstream.

Q. So why shouldn't it move in from down below upstream?

A. That's why what I said it was going to do.

Q. Well, then I guess we don't disagree.

DR. BUND: Mr. Butzel, may I interrupt you for a moment before I forget this question?

MR. BUTZEL: Yes.

DR. BUND: Dr. Lawler, at certain times of the year or certain seasons of the year it's possible that there be more fresh water in the area of the intake than there would be salt water, am I correct? I'm only thinking out loud.

THE WITNESS: Yes, that's correct.

DR. BUND: So take the fresh -- the water that would be taken in would be fresh water only?

THE WITNESS: That's correct.

DR. BUND: And then at certain times of the year it would be the other way around. It would be more, depending upon what the situation is with the water in the river there might be more salt water at the given area where the depth, the intake, is and it would be taken up in -- taking up salt water?

THE WITNESS: That is correct.

DR. BUND: So when the water is -- the water that, as Dr. or as Mr. Ferrara put it for our lay people, when the water, this chunk of water, is taken out of the area, you know, whereby this intake

is, we don't know what it's going to be, sometimes it's going to be mostly salt, sometimes it's going to be mixed, sometimes it might be fresh or almost fresh, is that correct? That's what we just said.

THE WITNESS: That's correct, that's right.

MR. BUND: So the same answer comes with respect to what type of water is going to rush in. You're saying it's going to rush in from both sides.

THE WITNESS: No, I'm saying that the direction from which the water will come will depend on what the tide is doing at that time. The example Mr. Batzel questioned me on was where will the water be coming from when the river is flooding.

MR. BUND: There are a lot of conjectures.

THE WITNESS: And the answer is downstream.

MR. BUND: Lot of conjectures to it.

THE WITNESS: No conjectural answer.

MR. BUND: I don't mean your answer, but a lot of conjecture, depends on the tides at the given moment and so forth.

THE WITNESS: Right, it can come from upstream and it can come from both directions and the release can be the same.

MR. DUTZEL: O.K.

THE WITNESS: The release could be upstream or go downstream or it could go in both directions.

DR. DUND: Assuming the water were evenly distributed at the point of intake, in other words, there was just as much salt water at the time of the intake as there was fresh water, in other words, the drafting area was in the middle, then what would be the proposition you think with respect to the water flowing into the void?

THE WITNESS: You have a draft tube in the center of the river in your example.

DR. DUND: Yeah, make it a draft tube.

THE WITNESS: And it's a big hole in the bottom of the river.

DR. DUND: Yeah, I'm using lay terms.

THE WITNESS: Roaring water in, and you're asking me --

DR. DUND: That's right, is it possible that salt water would come in to a greater extent than [illegible] because it's got salt in it?

THE WITNESS: Because it's on the bottom?

DR. DUND: No, not really, is the salt water going to rush in any faster?

THE WITNESS: No, absolutely not. The answer, I don't care if the hole is on the bottom of the river or if it's on the side of the river. It's going to --

DR. DUND: Yeah, all right.

THE WITNESS: The force of the water, i.e., whether it comes from upstream or downstream, has to depend on what the tide is doing at that time.

DR. DUND: Your conclusion here anyhow, according to this testimony if I recall, is that it wouldn't make -- it's a negligible consequence.

THE WITNESS: Yes, my conclusion, yes, that's correct.

DR. DUND: I'm just saying what I thought he said, that's all.

MR. DUTZEL: I hope you're just saying that, Your Honor.

BY MR. DUTZEL:

Q. Dr. Lawler, I'm trying to recapture the word, tidal something, I think is the word in the Hudson River.

A. Right.

Q. The tides force the water upriver a distance and then it comes back with the ebb tide and there's a net downstream flow, as I understand it, based on the amount ultimately of fresh water that's put into the river, is that correct?

A. That's correct.

Q. Now, what is the -- the distance of the tidal excursion in the area of the Cornwall Project if you know?

A. Probably on the order of six miles. It would be between four and eight miles.

Q. Between four and eight?

A. I can compute it for you if you want me to.

Q. There was, I think, some dye studies which indicated that it was on that -- I had heard six to ten miles.

A. Well, no, that -- I would say it's not as much as ten miles. That's too much. It would be difficult --

Q. We've lost him.

MR. EUND: I'm sorry.

A. It would be difficult to support ten miles as to tidal flow.

Q. But four to eight miles?

A. Yes, of that order.

Q. Now, did you testify that the project had pumped up

in an area of -- in a time of flood tide and for various reasons, the saline content of the water was higher as it moved up from the sea and it discharged on the flood tide -- I'm sorry, it discharged on the ebb tide just at the very end of the ebb tide that morning, the saline water, that means, does it not, sir, that that more saline water could at least be moved back upstream from four to eight miles depending on the distance of the tidal excursion?

A. I would -- I could sit down and figure it out but I would generally agree that if you -- if you withdrew salt from Cornwall or from the intake at a period of flood and high tide and maximum salt for that particular cycle and kept it up there at that concentration and then released it at a point of, say, slack before the next flood which would be the end of ebb which would be the point where the concentration would be lowest and you release salt of a higher concentration, you would have an increase in the salt concentration at that point.

Q. As it moved back up the river?

A. In time?

Q. And if on the next ebb moved in, on the new flood

tide moved in, that would move it back up the river?

A. Right.

Q. From four to eight miles depending on the flow?

A. Right, provided you recognize the offsetting factors that I suggested in my testimony would occur.

Q. Dr. Lawler, moving on to Page 10 of your testimony, I'm -- what is BOD? It's biochemical oxygen demand?

A. That's correct.

Q. Now, you say, "We established sampling stations every three miles over a 150-mile stretch of the Hudson." These sampling stations were established in 1967?

A. Yes, the surveys I'm referring to were in 1967.

Q. And when you say "we", do you mean your firm?

A. Yes.

Q. How many -- how many boats did you make?

A. Well, these -- these, this sampling program in 1967 represented three separate surveys of the entire length of the tidal Hudson from the Battery to Troy, one one during a week-long period in August of '67, one during a three week-long period in September of '67 and the third during a week to possibly week and a half long period in October of '67. Now, when you ask me the number of samples that we took, I'm going

to have to describe how the surveys took place. They are --

Q. I think you've answered what I wanted to know anyway. Please feel free to go on but --

A. Well, it is -- all right, well, I will establish one point.

Q. Please do, I didn't mean to interrupt you.

A. The samples, I noted here that the sampling was done in mid-channel. Those samples, the surveys done in August and October of '67 were done by helicopter for the specific reason that we can follow a single phase of the tide all the way up the river via helicopter. Now, they weren't only taken at mid-channel but they were always taken at mid-channel those we had at times we took samples on the side as well and those surveys took a week and what we did on each day, we took a different phase of the tide, high water slack, low water slack, strength of flood and strength of ebb.

DR. ZUND: A little louder, please.

THE WITNESS: I got -- I said that during the helicopter surveys of October and September -- and August of '67 we made or we looked on or looked

at the four -- what we considered to be the four most significant points on the tidal cycle, the two slacks and the two strengths on each day, we did one of those four. The survey in September of '67, sampling stations were located roughly every 15 miles and those surveys were done by both -- one station or one mile point a day and what we did there was sample over the entire tidal cycle and over the entire cross section. We took at least nine samples for cross section and at least ten samples per tidal cycle so you had at least 90 samples per -- per station. The reason for this was to be able to correlate the lateral and vertical behavior to the helicopter samples that were generally taken in mid-channel run.

Q. But the sampling was limited to these three months, September -- August, September and October, is that correct?

A. The particular surveys that I'm describing here, yes, were limited to those three months.

Q. Yes, O.K. Now, in terms of runoff and the like, was -- what's [illegible] a relatively wet year?

A. I [illegible] recall. I could look it up. It

-- it was certainly wetter than '64 and '65, I agree to that.

Q. Well, that I agree from your earlier testimony.

A. I agree to that readily. Those were generally -- the flows were generally low during the summer but not abnormally low.

Q. What was the flow in August?

A. I would guess that it was on the order of 7,000 cfs. but I'd have to check it.

Q. Do you know? I appreciate your guess and I'll accept that if it's the best you can do right now.

A. It's certainly of that order, I mean it's very readily checked but we didn't really care what the flow was during that sampling program.

Q. Now, in this -- in this, in your sampling, you were sampling the water, is that correct?

A. Yes, the water of the Hudson River.

Q. You weren't sampling the stream bed?

A. No, not in these surveys.

Q. All right. On Page 11, speaking about dissolved oxygen, you say first the addition of approximately 240 acres of upper reservoir surface into the reservoir system will add some small amount of oxygen to

that system. What are the grounds that you say that on?

A. One of the major sources of oxygen to a river, any river, is the surface contact of the river with the -- with the atmosphere and so the more surface area of river you have available to you, the more potential you have for absorbing dissolved oxygen. All I'm saying here is we're increasing the river surface area or the surface area available for water that is part of the river system to take on oxygen.

Q. M-m h-m-m, all right. Now, have you given any thought to the -- either the possibility or the likelihood of oxygen being forced out of the water as it moves through the two-mile power tunnel between the reservoir and the turbines and as it moves through the turbines which themselves are depressed to minus 50 feet below sea level all at rather substantial pressure?

A. Well, if -- the higher the pressure the greater the tendency to maintain oxygen in the water.

Q. And why is that true?

A. Well, that's known as Henry's Law but --

Q. I want to get a lecture on biology.

A. It's very simple, it just simply says that the concentration of oxygen that you can hold in a water is proportional to the pressure that you can hold on that water. That's why -- well --

Q. All right.

MR. EUND: To a certain extent, I'm bound by 'Henry's Law".

MR. BUTZEL: Of course, you are, Your Honor. Never disputs that except I would say it's hearsay.

BY MR. BUTZEL:

Q. Then that would indicate to the extent that a vacuum might be created that it would have the opposite effect, is that correct?

A. That is correct.

Q. Have you given any thought to the possible creation of vacuums in connection with the operation of those turbines, the condition I think sometimes known as cavitation?

A. Yes, the Henry's Law does apply, true, but Henry's Law only applies to equilibrium and you can show that the -- there is insufficient time to either strip out oxygen from the system due to a vacuum or less than atmospheric pressure in the environment

or to add oxygen to increase the pressure on the system. So I really don't think that -- that there will be any significant change in the dissolved oxygen as it moves through the system.

Q. Might I suggest no more significant than the increase as a result of the increased surface in the upper reservoir?

A. Well, I -- I haven't -- well, no, I would say that the increase of all -- what I tried to do is look at as many possible oxygen sources and samples as I could come up with and of them all, I would say this is the most significant if you want to call .1 part per million or less significant. You can measure that but you'd be very hard pressed to tell that the reason for a difference of .1 part per million was thus or this.

Q. All right. Now, down toward the bottom of Page 11, you say, "Even if we were to suppose a massive proliferation of algae, et cetera" and you go on to say the effect would be in the order of .1 part per million or less. What is your basis for that, sir?

A. [illegible] in a computation that recognizes

the biochemical oxygen demand of -- on, or oxygen demand of dead algal cells, the area of the reservoir and the potential of the river to consume this kind of material. I -- it's -- I could give you a calculation if you'd like to see it.

Q. Well, I guess the calculations I ought to look at but what did you assume in terms of dead algal cells?

A. Well, we took what is generally considered to be a -- a rather extensive amount of dead cells. We took an oxygen uptake rate of 5 grams per square meter per day and this is considered to be a -- something that is -- would be very unusual, particularly if applied to the entire surface area reservoir.

Q. Now, 5 grams per square meter per day, is that --

A. Yes, and I also presume that that happened day after day after day after day.

Q. What does that assume in terms of the amount of the algal growth, the depth of it, the consequence in terms of other organisms within the reservoir? Is it -- does it just assume the death of the algae at the top of the reservoir or anything else beyond that?

A. It pretty much assumes the death of the algae in the surface layers of the reservoir.

Q. Doesn't take any account -- doesn't take into account other organisms below that?

A. Well, I couldn't tell you how thick it was or what other organisms were there.

Q. You're not a biologist, I assume?

A. No, I'm not a biologist.

Q. Not even a marine biologist?

A. Not even a marine biologist.

Q. I have a note here from Dr. Alexander that says he's -- that this is the part, this is the type of approach that's led to the present mess on the river.

A. I object to that, in -- the statement that the river is a mess.

Q. You react to that?

A. Very much so. I think it's a pretty terrific river to say the least.

Q. Well, you and I would not disagree on that. The question is whether we can keep it that way. Now, at Page 12, you're asked your opinion on the pH content of the river and you say it's inconceivable to you that the operation of the project would

effect any measurable change in the pH content of the river. Now, in your answer, what are you referring to when you say the river?

A. When I say the river?

Q. H-m-m.

A. The -- well, the river.

Q. Well, if there were --

MR. NOBELMAN: The Hudson River.

BY MR. NUTZEL:

Q. If there were highly acid substances in the reservoir area that were drawn down as a consequence of leaching, that might effect a measurable change on the river right at the tailrace, I should imagine, wouldn't it?

A. Well, it would depend on -- on how highly acid these substances were and what the leaching rate was and what surface area of substances were exposed for leaching.

Q. Have you made any measurements of the acid content in the soil in the upper reservoir area?

A. No.

Q. Do you know how much of the upper reservoir area is going to be left in soil?

A. I -- in listening to the testimony presented at

this hearing I can only use, I think, the number expressed is 50%.

DR. BUHD: A lot of it.

THE WITNESS: I think the number that's been expressed in previous testimony has been 50%.

BY MR. BUTZEL:

Q. Now, I'm glad you were here. In your answer at the bottom of Page 13, you talk about the scouring and heavier or larger particles that exist on the bottom. Now, have you -- what is the composition of the river, the bottom, at this particular location, do you know, sir?

A. Well -- well, all I can report is what the borings show, the type of testimony that Professor Neale mentioned earlier.

Q. I think Professor Neale said that he didn't know what the nature of the bottom was at this particular point.

A. Well, he said that it was silty and that --

DR. BUHD: I beg your pardon, Doctor.

THE WITNESS: He said it was silty at the -- or maybe he didn't say that. Well, anyway, it's a -- it has a rather sandy silty nature and as one goes down deeper into the [illegible] into the earth, at least locally

at the borings that have been taken, you get into a denser material, a sandier material.

Q. And how deep is the silt there?

A. I can't tell you offhand.

Q. Do you know what the micron sizes are in that silt?

A. No.

Q. Do you know whether that's organic silt or not?

A. There would certainly be some organic material in there.

Q. Are you aware that it's described in the report that is appended as Exhibit K to this application as -- if I can get it out -- soft organic silty clay?

A. Yes, I said I am aware there's organic silt.

Q. Well, do you know whether any of that soft organic silty clay would be entered?

A. I would presume that the -- some of that organic material would be entered right now. I would be surprised if it isn't.

Q. And would you -- if the velocities were to increase as the operation -- as a result of the operation of the project, wouldn't you presume that some more of it would be entered?

A. I do. I don't I said that in my testimony that

more of it could be scoured.

Q. Now, you use an example on Page 14 of your testimony of 1.9 feet per second as compared to 2.1 feet per second as an increase in velocity. You are aware, are you not, that there are other -- other circumstances under the model studies where the velocity increases are substantially greater than that?

A. Certainly, I would agree that if the -- if the river isn't slack and you're releasing, you're going to see velocities in the vicinity of the plant that you don't normally see.

Q. Now, you say up towards the middle of Page 14, it would be extremely difficult to see measurable differences in turbidity resulting from scour in front of the project. At the same time you acknowledge that there may be additional scouring now. Is this simply a qualitative judgment? Have you made any specific studies to determine what that increase might be?

A. No, I have not made specific studies.

Q. Now, you noted -- you note that the area in the vicinity of the tailrace screens will be dredged during construction. That's the effect of dredging

going to be on turbidity?

A. Well, my -- my presumption here is that as one moves down into the deeper soils, you will see a more consolidated material and generally denser particles than you see at the surface. This would be typical of most situations.

Q. But I mean in terms of turbidity, what is the consequence of dredging going to be, the dredging operation itself? Isn't the dredging operation in short --

A. During the dredging --

Q. -- going to increase the turbidity of the water?

A. For the period of dredging? Of course.

Q. And those particles that are brought up into the water are going to remain suspended for a greater or lesser period of time depending on their specific gravity?

A. That's correct. I mean --

Q. On Page 15 you talk about applications, thermal discharge applications to the Department of Environmental Conservation. You refer to at least three applications for new generating facilities. What [illegible] you referring to there?

A. Arthur Kill, Astoria and Indian Point.

Q. What Indian Point?

A. Indian Point 3.

Q. O.K. Has a certificate been granted on Roseton?

A. Yes.

Q. On Bowline?

A. Yes.

Q. On Indian Point 3?

A. I -- there is a certificate on Indian Point 2 that I know of.

Q. But not on 3?

A. The situation on 3 is that there's a stipulation on 3.

Q. There's no certificate been issued yet, is there?

A. I don't think so.

Q. And how about Verplank?

A. There's no application on Verplank.

Q. How about Ravenswood?

A. I don't know the situation in Ravenswood.

Q. Astoria?

A. That's an old plant. Astoria, there's -- there's a thermal discharge permit. I would suspect there is a certificate but I can't guarantee that.

Q. Did you -- were you involved at all in Astoria?

A. Yes.

Q. But you don't know whether there's a permit or not?

A. I know there's a permit, I don't know whether the certificate has been issued. They're two separate animals.

MR. BUTZEL: Can counsel help us?

MR. HOBELMAN: Can't help. I have not been involved in that. Certificate of what?

THE WITNESS: Reasonable assurance.

MR. HOBELMAN: Excuse me, Astoria 6?

MR. BUTZEL: Astoria 6.

MR. HOBELMAN: No, the application has been filed, it has not been issued.

MR. EUND: Let that be counsel's response.

MR. BUTZEL: I stipulate to it. If they say so, I agree to it.

MR. EUND: I just want the record to show the speakers.

BY MR. BUTZEL:

Q. On Page 16, I think we're getting to the end. You refer to Dr. -- the questioner referred to Dr. Alexander's testimony. You acknowledge that stirring up of sediments can increase an oxygen demand on the

river but you believe the maximum conceivable extent of this effect can be estimated and is negligible. Now, have you yourself -- you have not, I gather -- made a specific investigation of the nature of the sediments in front of the Cornwall plant, in front of the location?

A. We have made an investigation of the sediments in the Hudson River, in the Hudson River. Whether we took samples immediately in front of Cornwall, I can't say.

Q. So at this point, you could not tell me what the nature or composition of those sediments happens to be?

A. I can assume you it's not of the nature that I'm describing here as a maximum case.

Q. But my question was rather can you tell me what the nature of it is?

A. Well, I will answer it this way: Whatever its nature, it has an oxygen uptake substantially less than the numbers I'm using here.

Q. Well, that kind of trace elements are they, do you know?

A. No, I don't.

Q. What kind of -- are there soil deposits there?

A. I would imagine that there are, there are in most parts on the river.

Q. M-m h-m-m. Other kinds of solid waste deposits possibly even if not in this magnitude that you --

A. I'm -- you can find, I'm sure you could find this kind of sludge at some point but what I'm saying is I doubt that you would find 200 acres of it at Cornwall immediately in front of the plant.

Q. Well, how deep is the sedimentary layer in front of the Cornwall location?

A. I don't follow your question. How deep is what layer?

Q. The depth, the depth. An acreage is usually a surface area as far as I'm concerned or as far as I've ever learned but what I'm now asking is what is the depth of the sedimentary deposits in the area of that project either at Site 1 or at Site 2, if you know?

A. I don't know, but it's not going to have an influence on the rate that I'm using because it's at the bottom that's exposed to the dissolved oxygen surface.

Q. But it might have an effect on the time duration,

might it not?

A. That is true, yes.

Q. Do you have any idea whether there is anaerobic -- that's spelled a-n-a-e-r-o-b-i-c --

A. O.K.

Q. -- materials in the area?

A. I would imagine you -- if you searched, you could find some anaerobic materials in any of these organic sludges that we're talking about. The surface layer would be aerobic and the subsurface layer would be -- normally be anaerobic.

MR. BUTZEL: If you'll excuse me one second, I'll consult.

DR. LUND: Recess.

BY MR. BUTZEL:

Q. Isn't it the case that anaerobic materials create a greater oxygen demand?

A. Create a greater oxygen demand?

Q. A relatively great oxygen demand.

A. When they're anaerobic, their oxygen demand in terms of rate is far less than --

Q. What is anaerobic material? Have to find out what you mean.

A. Anaerobic simply means that your bacteria are breaking down the organic sludges in the absence of molecular oxygen. They use oxygen but from other sources.

Q. I'm advised by my consultant that when anaerobic materials are moved back into the water column they then create a substantial demand for oxygen.

A. Yeah, that would be true.

Q. Wouldn't it be possible relatively easily to measure the -- and test the materials that -- the surface, the channel bottom materials in this area?

A. I -- I suppose it would but I don't really see the necessity for doing it.

DR. REID: Speak up, please.

THE WITNESS: I said I suppose it would be relatively easy to determine the channel bottom materials in the area but I said I don't see the necessity, --

Q. Well, wouldn't --

A. -- of doing it.

Q. Well, if you had the more specific knowledge of the materials --

A. Well, let me describe it this way: When we did

this oxygen study for the State, we had to address ourselves to this question and the question was simply do we have a concern with organic sludges on the dissolved oxygen balance in the river, and we went out and made a survey to determine whether -- whether we did have a problem and the places where we actually looked for sludges were those places where we would expect them to be, particularly in the area of the Albany pool and we didn't even find them there to the extent that we thought we would. We thought we'd have sludge over the entire bottom from Troy down to Hudson. There wasn't anything even close to that and the long and short of it was the effect of organic sludges was negligible on the dissolved oxygen balance that we created, relating organic waste discharges to the oxygen tension in the river, and if it's negligible up there it's certainly negligible down here.

Q. All right. Then that means that some other factor is not negligible, does it not, sir?

A. That's true.

MR. BOEHLERT: I object to that. That's speculation and hypothetical.

DR. BUND: Wait a minute, wait a minute, I'll allow the question.

MR. BUTZEL: You'll allow the question?

DR. BUND: It's kind of technical.

MR. BUTZEL: He answered it anyway. I think he said yes because I think you answered it at one point, I think you said the DO contents are much lower at Albany and Troy than they are at the Cornwall area.

THE WITNESS: That's correct.

BY MR. BUTZEL:

Q. All right. Now, what is it that causes those DO levels to be so much less, if you know?

A. I do know. It's the discharge of industrial and sewage -- of sewage and industrial wastes untreated from Albany and the Capital District.

Q. And --

A. In balance with the physical characteristics of the river at that point and it's not a good balance.

Q. And that I gather is something different from sludges or decaying sewerage?

A. Absolutely. The -- when you're talking sewage discharges or industrial waste discharges, you have

to characterize them as to whether they're settleable solids, suspended solids or soluble solids and soluble and suspended solids do not settle in the waterway but they do exert an oxygen demand on the waterway. Now, generally, the first thing that goes when you provide any degree of treatment at all are the heavy sludges, the settleable material, and what the river is saddled with today is soluble and suspended solids. You still have sludges in the -- in the Albany pool but what I'm saying is the effect of those is not as great as you -- as we thought it would be when we first looked at it.

Q. O.K.

A. Far more significant are the -- are the suspended and soluble wastes.

Q. I wish I had more knowledge. At the bottom of Page 16 you say, 'Presuming coverage over the entire 200 acres', and you're referring to sludge here?

A. Right.

Q. "This sludge would represent a daily oxygen demand of about .15 parts per million on the river system."

A. Correct.

Q. Now what would it represent in the immediate vicinity

of the Cornwall Project?

A. That was computed in the immediate vicinity of the Cornwall Project.

Q. This .15 parts per million is --

A. Right.

Q. -- for what area?

A. Right in the -- in the immediate vicinity of Cornwall.

Q. I'm not sure what you have in mind when --

A. Well --

Q. I seem we may have two different things in mind. I'd just like to get an understanding of what --

A. Well, what I'm saying is I impress a demand for oxygen on the system at Cornwall in accordance with [illegible] per specific meter per day for 200 acres and convert that to so many pounds per day. O.K. The river at Cornwall has a certain potential for providing that oxygen, its flow, its dispersion, its mixing characteristics. Put that together and compare it to this 10,000 pounds per day load and I end up with the numbers I've given you.

Q. [illegible] -- just let me --

[illegible]: A few seconds, would you like

a few seconds?

MR. RUCKELSHAUS: No, no.

Q. Let me put another question to you: You've related all of your calculations to sludges on the bottom which you regard as a maximum addition. Just to clarify for the record, you do not know what the particular situation is in terms of the bottom of the river in that area right now?

A. I think I testified to that previously.

MR. BUND: A little louder, Dr. Lawler.

THE WITNESS: I said I think I answered that question previously.

MR. BUND: That was about the silt and possible sand and --

THE WITNESS: Correct.

MR. RUCKELSHAUS: And that being so --

MR. BUND: And Professor Neale --

BY MR. RUCKELSHAUS:

Q. Now, can you predict the precise effect of the stirring up of that material, what it might be, organic or otherwise?

A. That is correct, and I'm not trying to predict the precise effect. I'm trying to predict the maximum

effect that I could conceive occurring, and whatever the precise effect is, it's going to be less than the numbers I'm talking about.

MR. BUTZEL: Your Honor, I think that's all the questions I have for Dr. Lawler.

MISS JUNGE: Your Honor, I'd like to ask a few questions. I'm Miss -- I was interrupting you?

DR. EBND: No, no, go right ahead. I was looking for another page.

BY MISS JUNGE:

Q. Dr. Lawler, I hope you'll bear with me because I'm not an engineer and I have had some difficulty in conceptualizing your testimony. So on Page 5 you made the statement that a significant upstream movement of salt can only occur by bringing more salt into the estuary from the ocean. It's my understanding that you could have a significant movement of salt without bringing -- without increasing the volume of salt water but by changing the distribution of that salt water. Do you understand my point?

A. Yes, I understand.

Q. Could you agree with that?

A. I don't agree. I agree that locally, you could have some -- create some change but I don't agree that you can sustain an upstream movement without bringing additional salt in. It just physically, you have so many pounds of salt in the estuary and if you're going to have a significant upstream movement, you're going to have more pounds in there. You can't play with that salt distribution curve that much.

Q. Well, what do you mean by "significant"?

A. Well, significant primarily in terms of sustained.

Q. Well, what do you mean by "sustained"?

A. Sustained means you'll get something up there and it will stay up there by comparison to the situation you would have if this situation weren't operating. In other words, given its natural situation -- O.K.? -- whether it's constant flow, variable flow or constant flow, I don't care what. What I'm saying is, the thing I'm concerning myself with is if I run the station, will I have a salt distribution or a salt profile that's different and different [illegible] upstream under all sequences [illegible] than I would otherwise have.

That's what I mean by sustained.

Q. O.K. Let me ask another question: On Page 6 of your testimony on the last sentence, you said "Cornwall flows, on the other hand, are reversed each day so that any tendency to move the salt down the river upon release of Cornwall water is offset roughly 12 hours later by subsequent withdrawal." My question is supposing you have a situation in the late summer when salt front is naturally upstream and let's say for these purposes it's definitely beyond Cornwall. Supposing you release the water from the plant on a flood tide, what effect would that have on a salt water that's already upstream?

A. If I release water on a flood, what effect will [illegible] would tend to push it forward, upward, and to be consistent with what I've said previously.

Q. O.K. Well, as I say, I have some difficulty understanding your testimony so I would just want to make sure I understand these things. Can I just take a second? I have one more question that is not in your prepared testimony. At the end of your testimony, your direct testimony, you made a statement to

Mr. Hobelman in response to a question by Mr. Hobelman which I don't have the exact wording of, but you said that basically that in your opinion the project would not affect the applicable water standards. Could you tell me precisely what you had in mind? Were you more specifically -- were you limiting that statement to the Class "B" classification?

A. I was but I -- I know what the Class "A" standards are and I -- I don't see that -- I think my opinion would be the same for Class "A" standards. In other words, I look at the pH, DO, temperature, the whole bit, and I don't see where anything that we talked about in the past several days will contravene the water quality standards.

Q. Just one more second. My final question, Dr. Lawler, is --

DR. LUND: I advise you not to limit yourself.

BY MRS. JUNGE:

Q. You are aware that the City has a pumping station at Clarkson?

A. Yes, I am.

Q. Could you say that under the following conditions -- well, let me give you the conditions that the City is most concerned about. You have, say, a late summer when the salt water is at the -- the salt water front is naturally at its highest and Con Edison would be using the plant to meet its peak load needs. Could you say definitely that the operation of the plant would not have a significant effect on the quality of water that is taken from the river at Chelsea?

A. I'm saying -- well, let me comment on your question first of all.

Q. All right.

A. You've used the word "definitely". You've suggested that the water is naturally highest in late summer in terms of salinity and you're suggesting that the plant is operating at peak load conditions. First of all, I can't answer anything definitely. Nothing is certain in this world, O.K.?

Q. All right.

A. But to the best of my opinion, I don't think there [illegible] Furthermore, I don't think your [illegible] salt occurs at late summer.

It -- if it's going to occur, it's going to occur after the -- after as long a drought as you can get after the spring runoff. That's why Mr. Ferrara's testimony earlier, he noted that in November you had severe situations. In the 1964 data which was mentioned in August where salt at Poughkeepsie was in the order of 130 parts, in November of 1964 after three more months of sustained drought, the salt at Poughkeepsie was closer to 700 parts so I'm just not arguing with you. I'm trying to suggest that -- that I don't think late summer is necessarily the worst -- the worst time. However, it is a period of low flows and you might possibly have salt up in that area but, in any event, what I'm saying is I don't think this situation will have a significant effect on the Chelsea's -- the water quality available to the Chelsea pump station.

MISS JUDGE: I'm just deciding whether that was my final question. It's a woman's prerogative to change her mind.

BY MISS JUDGE:

Q. My new final question is, as to your last statement, have you made any specific studies?

A. On what, on Chelsea?

Q. On Chelsea.

A. Not in connection with this particular question that you asked me.

Q. O.K.

A. Do you want -- well --

DR. BUND: On what, studies on what?

THE WITNESS: On Chelsea. We've -- Chelsea has been a concern from a number of standpoints. The City --

DR. BUND: That's what? She hasn't said what it's --

THE WITNESS: Well, she said with respect to her previous question, i.e., the salt at Cornwall.

DR. BUND: The salt problem.

THE WITNESS: And Chelsea has been --

DR. BUND: Speak up, please.

THE WITNESS: Chelsea, the question of Chelsea has come up on a number of occasions in various things we've been involved with, for instance, the Roseton plant is immediately across the river from Chelsea and various questions have been asked by Mr. [illegible] and others with respect to the influence,

possible influence, of Roseton on Chelsea. But my comments basically -- well, no, I haven't, really.

MISS JUNGE: O.K. That was my final question.

DR. REID: All right, anybody have any questions of Dr. Lawler?

BY MR. BUTZEL:

Q. I want to ask one further question: Mr. Hobelman indicated the other day that studies were in the works, that in trying to collect data as a basis to set out to study this problem, I believe that's what he said, are you going to be involved in these studies?

A. Yes.

Q. Is your firm going to be involved in these studies?

A. Yes, yes.

MR. [illegible]: Speak up.

Q. And some kind of study is expected to be made?

A. That is correct.

Q. And none has been made yet?

A. I -- as Mr. Hobelman said the other day, a preliminary or program of studies has been or is in the process of being developed.

Q. Well, how much does that program cover?

A. How [illegible] program cover?

Q. I mean what is the -- what period of time are these studies going to take; do you have any idea when they're going to be finished or anything of that sort?

A. That's pretty hard to say.

Q. At this time?

A. Right.

Q. But it's of serious enough concern to you to make the studies or to Con Edison, is that correct?

A. Well, it's -- I wouldn't -- well --

MR. LUND: Speak up, please.

THE WITNESS: The studies are being considered in response to the number of questions that have arisen with respect to --

BY MR. [illegible]:

Q. Right.

A. -- this question of suit.

MR. DUNNE: O.K. That's all.

MR. ROBILLIARD: We have no redirect, Your Honor.

MR. LUND: Thank you, Dr. Lawler.

(Witness excused.)

MR. [illegible]: We want to put Mr. Ferrara on

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(K)