BEFORE THE CONTRACT REVIEW BOARD

FOR THE PURPOSE OF REJECTING AN APPEAL BY JAMES LUZIER OF THE AWARD OF A CONTRACT TO PORTLAND STATE UNIVERSITY FOR GROUNDWATER MODELING AT THE ST. JOHNS LANDFILL AND AUTHORIZING THE EXECUTIVE OFFICER TO EXECUTE THE AGREEMENT	)))))))	RESOLUTION NO. 94-1897 Introduced by Rena Cusma, Executive Officer

WHEREAS, In September of 1993, the Metro Solid Waste Department (Department) issued a request for proposals for groundwater modeling services for St. Johns Landfill; and

WHEREAS, Five proposals were received, and were evaluated by the Department; and

WHEREAS, Following evaluation of all proposals, the Department determined that a proposal from Portland State University (PSU) was the best proposal received; and

WHEREAS, James Luzier, of Luzier Hydrosciences, objected to the award of the contract to PSU and filed an appeal to the Executive Officer within the timeframe specified in the Metro Code; and

WHEREAS, The Executive Officer, by letter to Mr. Luzier dated December 15, 1993, rejected Mr. Luzier's appeal; and

WHEREAS, Mr. Luzier appealed the Executive Officer's decision to the Metro Contract Review Board (Board) in the timeframe specified in the Metro Code; and

WHEREAS, After reviewing all relevant material and providing Mr. Luzier an opportunity to be heard, the Board has concluded that the appeal should be rejected and the contract awarded to PSU as requested by the Solid Waste Department; now, therefore,

BE IT RESOLVED,

That the Metro Contract Review Board hereby rejects the appeal of James Luzier of the award to Portland State University of the contract for groundwater modeling at the St. Johns Landfill, and authorizes the Executive Officer to execute the agreement.

ADOPTED by the Metro Contract Review Board this 13th day of January, 1994.

Judy Wyers, Presiding Officer

ds
1147

SOLID WASTE COMMITTEE REPORT

CONSIDERATION OF RESOLUTION NO. 94-1897, FOR THE PURPOSE OF REJECTING AN APPEAL BY JAMES LUZIER OF THE AWARD OF A CONTRACT TO PORTLAND STATE UNIVERSITY FOR GROUNDWATER MODELING AT THE ST. JOHNS LANDFILL AND AUTHORIZING THE EXECUTIVE OFFICER TO EXECUTE THE AGREEMENT

Date: January 6, 1993 Presented by: Councilor Washington

Committee Recommendation: At the January 4 meeting, the Committee voted unanimously to recommend Council adoption of Resolution 94-1890. Voting in favor: Councilors Buchanan, McFarland, McLain, Washington and Wyers.

Committee Issues/Discussion: The Solid Waste Department conducted an RFP process to award a contract for groundwater modeling services at the St. Johns Landfill. This work is necessary to meet closure-related environmental requirements that have been imposed by DEQ. Following a preliminary review, the evaluation committee interviewed the two highest ranked candidates, Portland State University (PSU) and Luzier Hydrosciences. The committee then conditionally awarded the contract to PSU. Following receipt of notification of the awarding of the contract, Mr. Luzier formally appealed to the Executive Officer. This appeal was rejected. Mr. Luzier then exercised his rights under the Metro Code to appeal the award decision to the Council, acting as the Contract Review Board.

Mr. Luzier presented written testimony (see attached) and made an oral argument of his case before the committee. His oral comments focused on the qualifications of his firm and his concern about publically funded agencies competing with the private sector for public contract work. He offered to work with Portland State in some type of joint venture to complete the work of the contract, arguing that PSU and his firm would complement each other.

Joanna Karl, Project Manager for the contract, noted that PSU had indicated that they carefully select those public contracts upon which they bid and that they bid on only those projects that can offer an educational experience for some of their students.

Todd Sadlo, Assistant Legal Counsel, noted that the Council was free to tailor any solution, but that he was concerned that an unsuccessful bidder could use the appeal process to delay final award in an effort to have themselves included in the proposed work. He further noted that PSU won the contract in a fair and competitive process and that there might be a perception problem if PSU is forced to give an unsuccesful bidder a portion of the work.

Bob Martin indicated that it is not clear that PSU would welcome a joint venture with Luzier. He noted that the modelling work was critical to complete a required monitoring program that is already behind schedule.

PLEASE NOTE: At the time the resolution was considered by the committee, it had been incorrectly numbered 1890. This number had already been given to another resolution. The resolution was renumbered 1897 and the error has been corrected on all documents related to the resolution.

7.5

LUZIER HYDROSCIENCES
Two Gershwin Court, Lake Oswego, Oregon 97035
Fax (503) 636-7664 *(503) 636-1012*

January 4, 1994

Judy Wyers, Presiding Officer
Metro Contract Review Board
600 N.E. Grand Avenue
Portland, Oregon 97232-2736

Re:
- Pending Award of Groundwater Modeling Contract to PSU.
- Alternative Proposal for Joint Modeling Effort by LHS and PSU.

Ladies and Gentlemen:

My name is Jim Luzier of Luzier Hydrosciences and sitting next to me is Rick Thrall of Foundation Engineering. We wish to thank you for taking the time to hear our viewpoint, after which we will propose an alternative solution for your consideration.

Rick and I have worked together on a number of projects and technical proposals. We have a close working relationship with Portland State University. On several occasions, we have given technical seminars to groundwater and engineering classes at PSU. We have also teamed up and worked together on consulting projects with PSU's faculty members and graduate students.

Case in point: the attached Penn Mine Reservoir graphic (which is also in your packet), utilizes a watershed/reservoir response model developed by Professor Roy Koch, P.E., of the PSU Civil Engineering Department, and several PSU engineering graduate students. The modeling work was accomplished on time and within budget (at standard consulting pay rates), by subcontract to Luzier Hydrosciences in 1992 and 1993. EPA incidentally, in a proposed Consent Decree, has recognized the value of this unique reservoir model, by ordering its use in engineering predesign of water control and remediation schemes at Penn Copper Mine.

Our point is this: we have a proven track record of working with the University and supporting its programs -- we each benefit from the arrangement, and we will continue working with the University in future years. Unfair competition from public supported institutions however, is a business matter and is the primary basis for the Appeal of the Contract Award. All other issues are secondary.

THE ISSUE: UNFAIR COMPETITION

We have been on the losing side of proposals many times, but never before have we appealed a contract award. After all, the competitive selection process in the private sector works very well most of the time, and the process is fair - and we enjoy it.

If you read our original Appeal submittal of Dec. 2, you will see that the primary reason for this Appeal is the inherent unfairness of University competition with private sector firms. We will concede that Metro has little control over any entity such as PSU, who wants to respond to an advertised solicitation to private sector firms.

Notably, Oregon Graduate Institute and other qualified Universities in Oregon and Washington, did not respond to the RFP, nor did many highly qualified consulting firms. Understandably, the PSU team has a special relationship to Metro through ongoing Intergovernmental Agreements or contracts for work at St. Johns Landfill.

However, once Metro made the formal decision to go outside to private sector firms with an RFP, rather than a direct noncompetitive award to PSU for the modeling services, then Metro incurred a special public responsibility and commitment to the private sector firms who responded in good faith and trust.

While Metro's motivation to encourage PSU is understandable, the effect is to drive a wedge into a long term working relationship between local consulting firms and the University. The engineering faculty at PSU has expressed discomfort with PSU's intrusion into private sector competition, and for many years, PSU has strictly avoided this arena.

PSU will be the first to acknowledge the inherent advantage in time and material costs available to publicly funded institutions. Private consulting firms including Luzier Hydrosciences, also contribute support to PSU's support in the form of seminar time, teaching, and funds for software packages such as visualization graphics and Lahey fortran compilers. These software packages are available for use in the St. Johns groundwater modeling effort. This is unfair competition and that is the issue we are discussing tonight.

Proposed Alternative Solution

We would like to propose an alternative solution that we think is fair to all parties, resolves the issue of unfair competition, resolves the professional registration issue, and enhances regulatory acceptance of the modeling results.

Dr. Franz Rad, PSU Chairman of Civil Engineering, was the first to suggest that perhaps the LHS team and PSU could jointly perform the groundwater modeling services project for Metro. We have met with Dr. Li and Dr. Rad, and we know we have mutual interests in doing good work and getting the job done. We would welcome the opportunity to work with PSU and Metro because a joint work effort could jump start the modeling program and accomplish the goals of the project in a timely manner. The primary advantages of a joint LHS - PSU working arrangement are as follows:

1. Metro will get a superior product because the skills of the two top ranked teams are complimentary:

   ☒ LHS Team -- hands-on, field based experience with a proven track-record in groundwater modeling reports acceptable to DEQ and EPA.

   ☒ PSU Team -- strong theoretical and research oriented modeling approach, state-of-the-art chemical transport understanding and methodology.

2. A traditional joint working arrangement between the University and private sector firms, will eliminate issues of unfair competition and registered practice.

3. We would propose a change in the project deliverables to include up to two interpretative technical reports, stamped and signed. The independent reports will enhance acceptance of the modeling results by DEQ and EPA.

We appreciate your patience in this matter and will answer any questions.

Sincerely,

Luzier Hydrosciences,

James E. Luzier, P.G., Geohydrologist
President

Foundation Engineering, Inc.

Frederick G. Thrall, PhD., P.E.
Senior Consultant

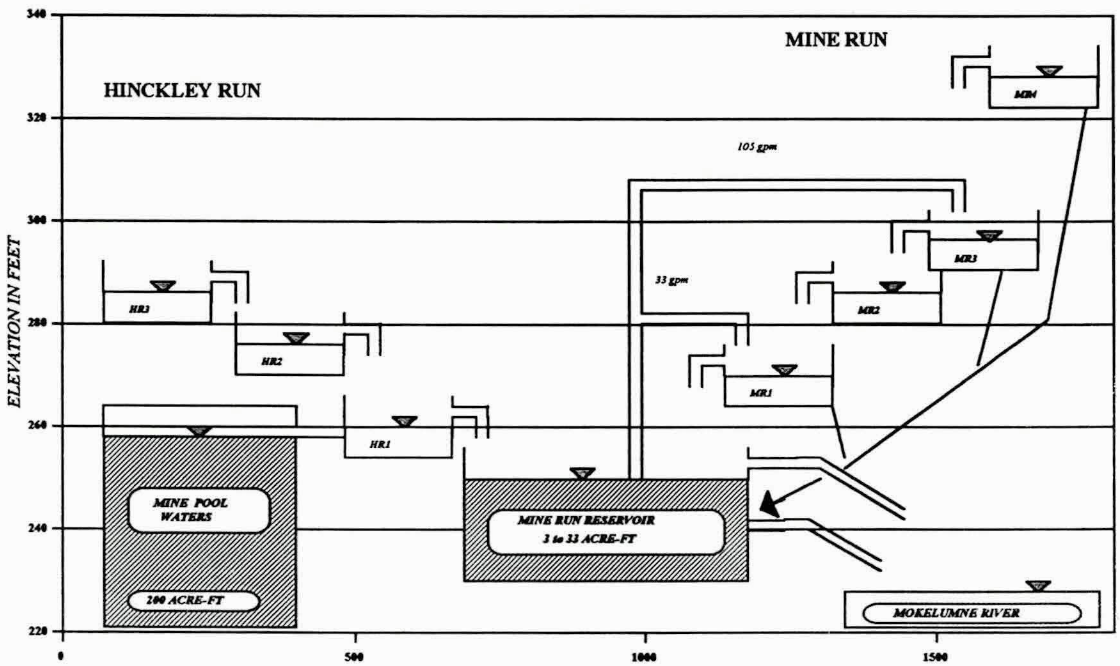
Attachments: LHS Penn Mine graphic.
Registration case history documents regarding Geologic Practice.

James E. Luzier, P.G. **LUZIER HYDROSCIENCES**
Roy W. Koch, P.E., James Patrick Moore

RESERVOIR RESPONSE MODELING USING *LHS Proprietary Code MINERUN*
CASE HISTORY: PENN COPPER MINE, SIERRA NEVADA FOOTHILLS

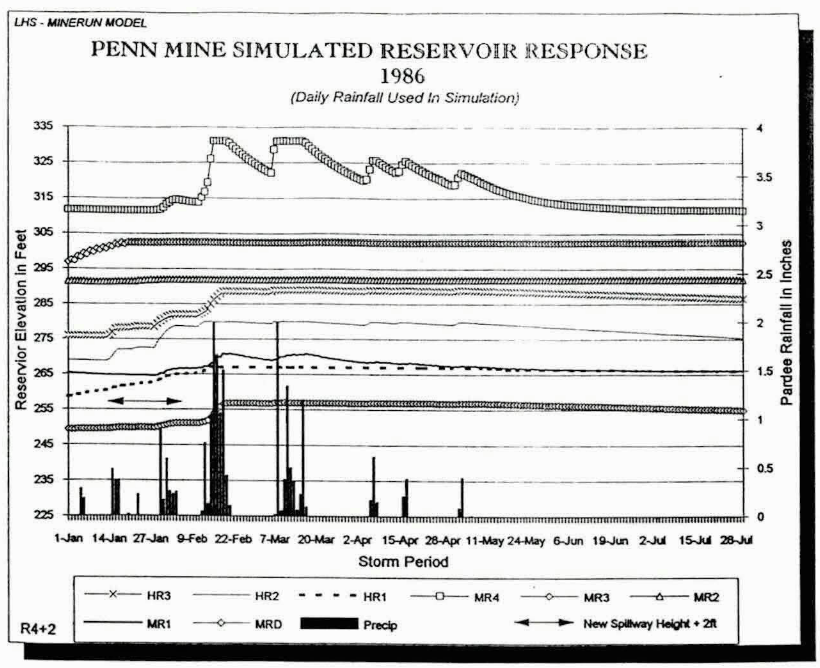
Luzier Hydrosciences was retained in 1992-93 by the California Regional Water Quality Control Board and East Bay Municipal Utility District (EBMUD), to perform reservoir response modeling of the 464 acre Penn Mine watershed, an abandoned underground mine site next to Mokelumne River and Camanche Reservoir. Seven reservoirs containing toxic metals (Cu, Zn, and Cd) and acid mine waters with pH of 2.5, are subject to floods and overtopping in the lower reaches of Mine Run and Hinckley Run. Typical large winter storms dump rain at about 1

SCHEMATIC OF PENN MINE RESERVOIR SYSTEM



——— **PRIMARY LEAKAGE AND GROUNDWATER PATHWAYS**

inch per day for 3 to 9 days, thereby exceeding the 65 acre-ft of reservoir storage and causing downstream fish kills. The flooded mine tunnels act as a giant groundwater collector with 200 acre-ft of storage to depths of 3,400 feet. Unfortunately, the only outlet from the mine pool is a mine shaft in lower Hinckley Run, flow from which helps overload the main reservoir even during the dry season.



MINERUN, a custom multi-reservoir response model was used by LHS to simulate major storm events, and to evaluate various scenarios including raising MRD dam and spillway 2, 4, and 5 feet. The response analysis suggests spillage will be reduced for peak events from 24 acre-ft at the existing dam height, to 6 acre-ft with the dam raised 5 feet.

THE ISSUE OF GEOLOGIC PRACTICE AND REGISTRATION

We have attached several self explanatory documents from the Board of Geologist Examiners, including minutes of meetings. These selected documents from 1984 and 1985 address some of the issues of registration and geologic practice raised in the Appeal.

Our team has not contacted the Board of Geology Registration, nor have we released any docments whatsoever to any entity. We also have decided that it is Metro's responsibility to contact the Geology Board and we therefore retract our decision (item 6., LHS letter of Dec. 22, 1993), to seek guidence from the Board of Registration.

James E. Luzier, P.G., Geohydrologist
President

Frederick G. Thrall, PhD., P.E.
Senior Consultant

VICTOR ATIYEH
GOVERNOR

Department of Commerce

403 LABOR & INDUSTRIES BLDG., SALEM, OREGON 97310 PHONE 378-4458

March 25, 1985

James E. Luzier
Luzier Hydrosciences
2 Gershwin Court
Lake Oswego, OR 97034

Dear Mr. Luzier:

The Board appreciates your efforts to comply with the geologist registration law. Because (1) ORS 672.545 allows the practice of geology by nonregistered individuals through the medium of a business (partnership or corporation) having a partner or corporate officer who is registered; and (2) you have entered into a formal partnership as of October 10, 1984 with registered engineering geologist Leonard Palmer, E434, your business, Luzier Hydrosciences, may as of that date legally offer to perform geologic services to the public. You, as a partner in this firm, may practice geology in the name of the firm as a subordinate to Mr. Palmer [ORS 672.535(3)].

However, as an individual, Mr. Luzier, until you are registered, you may not practice in your own right or call yourself a "geologist" or or hold yourself out as one who offers to provide geologic services [ORS 672.505(9)].

The Board is fully aware that you do not consider hydrology to be part of the field of geology; therefore, you do not recognize the Board's position that hydrology, hydrogeology, or geohydrology are disciplines within the field of geology and require registration as a geologist with certification in the specialty of engineering geology. Be that as it may, the official position of the Board is that the practice of hydrology requires registration with the Board of Geologist Examiners in the State of Oregon.

Sincerely,

BOARD OF GEOLOGIST EXAMINERS

Elaine Day
Administrator

ED:cf

VICTOR ATIYEH
GOVERNOR

Department of Commerce

403 LABOR & INDUSTRIES BLDG., SALEM, OREGON 97310 PHONE 378-4458

October 9, 1984

James E. Luzier
2 Gershwin Court
Lake Oswego, OR 97034

Dear Mr. Luzier:

The Oregon Board of Geologist Examiners received a formal request to review their instructions to you that you could practice geology in the state as long as you had a registered geologist or engineer as an employe or subcontractor to stamp your work.

Since the question involved the legality of the Board's instructions, I was obligated to pose the question to the Board's legal advisor, Assistant Attorney General Mike Weirich. After review of the geologist registration statutes, notably ORS 672.535-545, Mr. Weirich discussed the question with Board Chairman Dick Thoms and me. In his opinion, there is no authority in the law to permit you to practice unless

(1) You are a <u>subordinate</u> to a registered geologist, or
(2) You are a partner, or associate in a corporation, with a principal who is registered as a geologist.

I apologize for the inconvenience this may cause you. Although the Board offered you an alternative in good faith, it must now withdraw the alternative. You may not engage in the public practice of geology except under the two conditions listed above or until you become registered.

Again, we apologize for the confusion.

Sincerely,

BOARD OF GEOLOGIST EXAMINERS

Elaine Day
Elaine Day
Administrator

ED:jh

AN EQUAL OPPORTUNITY EMPLOYER

VICTOR ATIYEH
GOVERNOR

Department of Commerce

403 LABOR & INDUSTRIES BLDG., SALEM, OREGON 97310 PHONE 378-4458

February 11, 1985

Edward K. Neubauer, Chief Engineer
Oregon Department of Fish & Wildlife
506 S.W. Mill Street
P. O. Box 3503
Portland, OR 97208

Dear Mr. Neubauer:

It has come to our attention that your agency has requested a proposal for geotechnical engineering services for a groundwater study at Lookingglass Hatchery Auxiliary Groundwater Supply.

Because ORS 672.695 requires governmental bodies to contract for geologic services, only with individuals registered under ORS 672.505 - 672.705, I am requesting copies of the proposals submitted to you. I assume these are available under the public records law. If there are any charges for the copies, please let me know.

Thank you for your cooperation.

Sincerely,

STATE BOARD OF GEOLOGIST EXAMINERS

Elaine Day

Elaine Day, Administrator

ED:dsj

cc: John Donaldson, Director

AN EQUAL OPPORTUNITY EMPLOYER

COMPLIANCE

Status of Rohleder Hearing

Day reported that the hearing took place as scheduled beginning on Monday, October 21, continuing through Wednesday, October 23. It was again continued and is scheduled to begin Wednesday, November 13. It is anticipated to continue another three days.

Status of Komar Stipulated Agreement

Day reported to the Board that Komar signed the Board approved stipulated agreement. In addition, a directive is going to be sent, not just to Oregon State University, but to all higher education; that if a person is practicing in a field that requires a license, that person must observe that licensing law. The Department of Higher Education will be sending the Board a copy of the directive when it is finished. Day added that Higher Education is looking at the related issue of public service competing with private enterprise and may establish guidelines as to what is or is not public service. Staff will send copies of the stipulated agreement to the Board.

CBEI ADVERTISEMENT

Fleming reported the office had received an anonymous complaint in the form of a copy of the CBEI flyer, setting forth the availability to do "geologic assessments". The standard followup letter, which outlined the law and asked what the term meant, was sent to CBEI. Carolyn Browne responded, explaining her plan to act as a referral agent and that she has changed the flyer, deleting the term 'geologic assessments'. After acknowledging the statement in Ms. Browne's letter that she would delete this term, the motion was made by Gisler to take no further action if the phrase was deleted. The motion passed unanimously. Hull suggested staff do a followup letter accepting Ms. Browne's offer to remove the phrase, and also extend an invitation to Ms. Browne to take the geologist exam as soon as she qualifies.

FINANCIAL REPORT

Day told the Board that as a result of its compliance activities, it is in financial trouble. The Board has $6,000 budgeted for compliance activities for 1985-87 and has already spent $4,000 for the investigator, $2,900 for legal services through September, and is incurring debts for October Attorney General services as well as the hearings officer. She will submit a request to the State Emergency Board for authority to expend additional moneys to (1) continue normal operation to the end of the biennium, (2) to pay outstanding, hearing-related bills; and (3) set aside contingency money for court of appeals expenses, if necessary.

REPORT ON FALL EXAMINATION

Fleming reported that, since the time in which to appeal had not ended, the Board would be given a complete report on statistics and review appeals at the next meeting. She stated that some information has been gathered from the control group -- and is expecting more in the near future. It was Fleming's recommendation that control people continue to take the exam, even though there had been suggestions that the volunteers be allowed to critique the exam without actually taking it. However, she suggested allowing the volunteers to

The findings of fact consist of evidentiary matters. Evidentiary matters can mean concrete or abstract facts. (Example: this building is located on a certain street which is a concrete fact). Abstract things can also be entered as findings of fact. These are things that the hearings officer can actually make a factual finding on. The Board will have to do this in its final order. In an administrative hearing, even a letter is admissible evidence. Letters gathered by a claimant stating facts as to the condition of a lawn prior to treatment, for example, will be accepted as evidence. The person's testimony is evidence. One thing that is done in the hearings officer's proposed order that is not done in the final order, is that the hearings officer rules on the credibility of witnesses, and whether or not she believes a witness. She also determines her facts when conflicting facts are presented. There are many clues as to whether that witness is telling the truth or not, including body language. (These findings are not subject to change by the Board.) The findings of fact are very important. If the case reaches the court of appeals, the findings of fact are the first thing the judge will look at.

Contained in the proposed order will be an opinion. Although not required by statute, it is required by case law. There is also the ultimate finding of fact, which is also required under case law. These are just the facts that are necessary to come up with the conclusions of law. Every fact in the ultimate finding is pertinent.

Finally, there is the conclusion of law. By this point, the conclusion should be evident. It has to be based on facts. The statutes strictly say there must be a conclusion of law, and the court of Appeals and the Supreme Court have required it be spelled out.

Day further explained the process step-by-step with the Board as follows: The hearings officer makes his/her findings which are called a proposed order. The hearings officer's findings can be appealed directly to the Board. The appeal to the Board is where the Board makes its findings. From those findings, the Board makes a final order. The next stop in the appeal process is the Court of Appeals.

The discussion was then opened for questions. After answering the Board's questions, Myzak was excused.

Following review of a staff prepared draft outlining the conduct of hearing, a consensus of the Board was that staff had summarized Board "agreed upon" procedure accurately but asked that a few wording changes be made and a second draft be submitted to the Board. Day stated that it would be redrafted and distributed in advance of the next meeting.

UPDATE ON CIVIL PENALTY AND REVOCATION ACTIONS

Komar

Day reported that she had attended several meetings between attorneys representing the Board, Department of Higher Education, the Attorney General, and the Governor and as a result, rescheduled the hearing for September 12, 1985. The Director of Commerce also became involved at the request of the

RECEIVED
FEB 5 1985
DEPT. OF COMMERCE

February 5, 1985

Department of Commerce
Board of Geologist Examiners
4th Floor, Labor & Industries Building
Salem, Oregon 97310

Attn: Ms. Elaine Day, Administrator

Dear Ms. Day:

It has come to my attention that contracting practices of the Oregon Department of Fish and Wildlife (ODFW) may be in violation of state laws. Specifically, the violation pertains to Section 672.695 of the Oregon Revised Statutes concerning public agencies contracting only registered geologists.

Consultant services were recently solicited by ODFW for a geohydrologic evaluation and ground water supply development project at the Lookingglass Hatchery in Union County, Oregon (see attached advertisement). Following ODFW review of letters of interest, a "short list" consisting of four firms were requested to submit detailed proposals and interview for the contract. Two of the four firms included in the short list are, to my knowledge, operated by persons who are not registered by the Board to perform the "Public Practice of Geology". The non-registered individuals (and their firms) who interviewed for this consulting contract included: Jim Luzier, Luzier Hydrosciences, and Dave Brown, Pinnacle Geotechnical Ltd. Further, I understand that Pinnacle Geotechnical is now being awarded the contract.

I feel it is my professional responsibility to bring this matter to the attention of the Board. ODFW, a state agency, may be acting in ignorance of the state law in violation of ORS 672.695. Further, it appears that the two above named individuals are in violation of ORS 672.525, Subsection 2, by offering to publicly practice geology for ODFW. I feel the Board has a responsibility to investigate this situation, and bring it to the attention of ODFW. The above mentioned contract is now in the process of being negotiated. A timely inquiry by the Board into this matter may result in a fair settlement of the matter. I request that the Board investigate this situation immediately.

If you have any questions regarding this matter, I may be contacted at my office telephone, 635-4419.

Very truly yours,

[signature]

by Gary Peterson, C.E.G

GP/es
Enclosure

M E M O R A N D U M

METRO

John H.

Date: December 28, 1993

To: Judy Wyers, Presiding Officer
Metro Contract Review Board

From: Todd Sadlo, Senior Assistant Counsel

Regarding: LUZIER APPEAL OF AWARD OF GROUNDWATER MODELING CONTRACT TO PSU
Our file: 9.§11

Basis for Appeal of Award

Mr. James Luzier of Luzier Hydrosciences has appealed the award of a contract to Portland State University (PSU) for groundwater modeling at the St. Johns Landfill. The contract was awarded through a Request for Proposals (RFP) in which the review panel determined that the PSU proposal was superior.

Mr. Luzier's appeal is brought under Metro Code Section 2.04.031, a copy of which is included in the attachments to this memo. Section 2.04.031 allows an unsuccessful proposer to appeal for relief first to the Executive Officer, and then to the Contract Review Board. In a letter issued to Mr. Luzier dated December 15, 1993, the Executive Officer rejected Mr. Luzier's appeal, and he has now appealed to the Contract Review Board.

Metro Code Section 2.04.031 requires that an appellant "describe the specific citation of law, rule, regulation, or procedure upon which the appeal is based." It also states that "In the case of Requests for Proposals, disagreement with the judgment exercised in scoring by evaluators is not a basis for appeal."

The Metro Council Presiding Officer, who also presides over the Contract Review Board, can either schedule this matter for a hearing before the full Council (sitting as the Contract Review Board) or refer it to the Solid Waste Committee, which can then make its recommendation to the full Board. Mr. Luzier is not entitled to a contested case hearing, but he is entitled to be heard either before the Solid Waste Committee or the full Board. The project is being delayed pending the outcome of these proceedings.

Attachments

1. Metro Code Section 2.04.031
2. Copy of Advertised Notice, RFP #93R-43-SW
3. Request for Proposals #93R-43-SW

4. Addendum No. 1 to RFP #93R-43-SW
5. Proposal submitted by Mr. Luzier
6. Proposal submitted by PSU
7. Notice of Award issued to PSU
8. Notice of Award issued to Michael Pottinger, Geraghty & Miller, Inc.
9. Notice of Award issued to Jim Luzier
10. Letter of appeal submitted by Mr. Luzier dated December 2, 1993
11. Memo from Joanna Karl to Neil Saling dated December 6, 1993, describing the groundwater modeling RFP review process, and attachments
12. Executive Officer rejection of appeal dated December 15, 1993
13. Letter from James Luzier to Rena Cusma, appealing to Contract Review Board, dated December 22, 1993

Recommendation to Contract Review Board

It is the opinion of this Office that the appeal is without merit and should be rejected. This memo addresses Mr. Luzier's letter of December 22, 1993, to the extent that it raises new objections to the contract award to PSU. In all other respects, the Council should refer to Mr. Luzier's letters of appeal dated December 2 and December 22, 1993, and the response from the Executive Officer dated December 15, 1993.

Analysis

Mr. Luzier has claimed that there were procedural flaws in the RFP process, that PSU may not be qualified to perform the work requested, and that Metro "may be in violation" of a state statute (ORS 672.695) that requires political subdivisions of the state to contract for geological services only with a registered geologist or a firm employing one. He has also stated that it is unfair for Metro to accept a proposal from another governmental entity. The fairness claim was addressed at some length in the Executive Officer's response dated December 15, 1993. Because the fairness claim does not include an allegation that Metro's action was illegal or violated Metro policy or procedures, it is not addressed further here.

Mr. Luzier has submitted no additional information to support his original claim that the work in question is the "practice of geology" and that PSU is not qualified to do the work because it is not registered. This claim was addressed in the Executive Officer's letter of December 15, 1993. The review panel concluded that the PSU team was most qualified of all proposers to perform the work in question. As stated, under the Metro Code the judgment of the evaluators is not subject to appeal. Mr. Luzier is, of course, free to pursue his claim against PSU before the State Board of Geologist Examiners.

Mr. Luzier's claim that Metro may be in violation of state law regarding the hiring of registered geologists was also fully rebutted by the Executive Officer's letter of

December 15, 1993. Mr. Luzier has provided no additional information to challenge the conclusion of this Office that the statute in question would not be violated by this award. The work in question is primarily mathematical modeling, not geological services, and the team that Metro proposes to hire includes a registered geologist.

Mr. Luzier's December 22, 1993, letter alleged one additional procedural error in this RFP process. He states that the Notice of Award was "conditional," and that therefore the actual Notice of Award has yet to be issued. He is apparently asking that the word "conditional" be deleted from the notice, that the notice be reissued, and that the appeal process begin again. Mr. Luzier also claims that the Notice of Award that he received was not the same Notice of Award that was provided to PSU, and is defective for that reason.

"Notice of Award" is defined in Metro Code Section 2.04.010(g) as:

> "written communication to a responsive, responsible bidder or proposer stating that their bid or proposal has been <u>conditionally</u> determined to be the lowest, responsive, responsible bid or most responsive proposal and that the District intends to enter into a contract upon completion by the bidder/proposer of all required <u>conditions</u>." (Emphasis added.)

The main purpose of the "Notice of Award" is to start the clock for appeal of the award. It also notifies the successful bidder of the need to submit any required certificates of insurance or bonds required by the contract specifications. By definition, the notice is of <u>conditional</u> award of the contract; if the successful proposer cannot meet the conditions for signing the contract, or the award is overturned on appeal, the contract will not be awarded. It was not improper for the Notice of Award to be written in terms of "conditional" award.

Mr. Luzier also objects to the fact that the notice that he received was different from the one that the successful proposer received. Other than objecting to the fact that the letter was not the same as the one sent to the successful proposer, he does not state why it was inadequate.

It is clear, in fact, that the letter that Mr. Luzier received far exceeded what is required by the Metro Code, and served its purpose. The letter notified him of the award of the contract to PSU, fully described the process for appeal of the award and included a copy of the Metro Code section on appeals. Mr. Luzier proved the effectiveness of this notice by appealing the award within the timeframe allotted by the Code.

Mr. Luzier appears to object mainly to the short timeframes for appeal provided in the Code. The timeframes specified are short because delay in the award of a contract is potentially costly. In this instance, Mr. Luzier's appeal has delayed the work specified in the contract. Mr. Luzier would like to delay that work further by restarting the appeal process. However, 27 days elapsed between his receipt of the Notice of Award and the last day for filing of his appeal to the Contract Review Board. He will have additional time prior to being heard before the Board. Mr. Luzier has stated no legal basis for further extending the appeal process, and no practical purpose would be served. On the contrary, the delay in executing the contract only causes inconvenience and uncertainty for the successful proposer and the Solid Waste Department.

Mr. Luzier's letter of appeal dated December 22, 1993, raises no other claims of substantive or procedural irregularities in the award of the groundwater modeling contract to PSU. Mr. Luzier has been notified by this Office by telephone that his late demand for confidentiality cannot be honored under the Oregon Public Records Law (ORS Chapter 192). He has stated no reason why any of the information regarding his appeal is exempt from disclosure under the Public Records Law. In addition, as a matter of basic fairness, PSU should have an opportunity to address Mr. Luzier's claims that the University is not qualified to carry out the work in question and should be disqualified from the award.

It is recommended that the Contract Review Board reject the appeal of award of contract #93R-43-SW to PSU, and that the contract be executed as soon thereafter as possible. Solid Waste staff involved in this project and I will be available to answer questions at the time set for Mr. Luzier to address the Board.

ds
1298

Attachments

cc: Metro Council
Rena Cusma
Bob Martin
John Houser
Rich Wiley
Joanna Karl
James Luzier
Shu-Guang Li (PSU)

2.04.031 Notice of Award and Appeals:

(a) At least five (5) days prior to the execution of any Public Contract over $15,000 or a Personal Services Contract over $10,000 the District shall provide a Notice of Award to the contractor selected and to all contractors who submitted unsuccessful bids or proposals. This requirement may be waived by the Executive Officer for any emergency contract entered into pursuant to this Code.

(b) Bid/Request for Proposals Appeal Procedures: The following procedure applies to aggrieved bidders and proposers who wish to appeal an award of a Public Contract above $15,000 and a Personal Services Contract above $10,000. The appeal process for bids is the same as for Requests for Proposals. In the case of Requests for Proposals, disagreement with the judgment exercised in scoring by evaluators is not a basis for appeal.

(1) All appeals shall be made in writing and shall be delivered to the Contracts Administrator at Metro's main office within five (5) working days of the postmarked date on the Notice of Award. The written appeal must describe the specific citation of law, rule, regulation, or procedure upon which the appeal is based.

(2) The Contracts Administrator shall forthwith notify the appropriate department head and the Executive Officer of the appeal. Within ten (10) working days of the receipt of notice of appeal, the Executive Officer shall send a notice of rejection of the appeal or a notice of acceptance of the appeal as applicable to the appellant. The appellant may appeal the Executive Officer's decision to reject the appeal in writing to the Contract Review Board within five (5) working days from the postmarked date on the Notice of Rejection.

(3) The Contract Review Board will review the grounds for appeal, all pertinent information, and the Executive Officer's recommendation, and make a decision. The decision of the Contract Review Board is final.

(4) No contract which is the subject of a pending appeal may be executed unless the Contract Review Board shall have given its approval at the request of the Executive Officer. The Executive Officer may request the Contract Review Board to determine a matter without waiting for the expiration of the time periods provided for herein.

2

METRO
REQUEST FOR PROPOSALS

Proposals due October 19, 1993

Metro is soliciting proposals to develop a groundwater model of the St. Johns Landfill area in Portland, Oregon (RFP #93R-43-SW). The work involves selecting, constructing, and calibrating a three-dimensional, steady-state numerical groundwater model that will simulate groundwater flow patterns and contaminant transport in the landfill area using existing data. The model shall be capable of calculating reasonable estimates of mass loading of pollutants to surface water surrounding St. Johns Landfill. The term of the contract shall be through June 30, 1994.

Sealed proposals must be delivered to the Solid Waste Department, Metro, 600 NE Grand Avenue, Portland, OR 97232, to the attention of Joanna Karl, PE, Senior Engineer, no later than 3:00 p.m., PDT, Tuesday, October 19, 1993.

Potential proposers may obtain proposal documents by contacting the Solid Waste Department at 797-1650. Metro may reject any proposal not in compliance with all prescribed public procedures and requirements and may reject for good cause any or all proposals upon a finding of the agency that it is in the public interest to do so.

3

Request for Proposals for Groundwater Modeling Services for St. Johns Landfill

RFP #93R-43-SW

September 1993

METRO

Solid Waste Department
600 NE Grand Ave
Portland, OR 97232-2736
(503) 797-1650
Fax (503) 797-1795

REQUEST FOR PROPOSALS

FOR

GROUNDWATER MODELING SERVICES FOR ST. JOHNS LANDFILL

RFP #93R-43-SW

September 1993

Metro
Solid Waste Department
600 NE Grand Avenue
Portland, OR 97232
797-1650

REQUEST FOR PROPOSALS

FOR

GROUNDWATER MODELING SERVICES
FOR ST. JOHNS LANDFILL

I. INTRODUCTION

The Solid Waste Department of Metro, a metropolitan service district organized under the laws of the State of Oregon and the 1992 Metro Charter, located at 600 NE Grand Avenue, Portland, OR 97232-2736, is requesting proposals for groundwater modeling services for St. Johns Landfill (RFP #93R-43-SW). Proposals are due and must be received no later than 3:00 p.m., Tuesday, October 19, 1993, at Metro's Solid Waste Department, 600 NE Grand Avenue, Portland, Oregon 97232-2736. All proposals must clearly identify the subject matter of the RFP and be directed to the attention of Joanna Karl, PE.

Interviews, if required, will be held Monday, October 25, 1993, or Tuesday, October 26, 1993.

II. BACKGROUND/HISTORY OF PROJECT

The half-century-old St. Johns Landfill, which served nearly all of the Portland metropolitan region, is currently being closed. Metro, which is responsible for managing all aspects of solid waste disposal in the Portland metropolitan area, owns the St. Johns Landfill, and has operated it since 1980. Metro is currently in the second year of the five-year closure.

To monitor its environmental impact and meet permit requirements from the Department of Environmental Quality (DEQ), Metro has historically performed groundwater, and surface water sampling at St. Johns Landfill. Over the past few years, water level data has been continuously collected from some of the wells. In July 1993 Metro also began collecting data at 6 new piezometer clusters in preparation for modeling the groundwater flow.

III. PROPOSED SCOPE OF WORK/SCHEDULE

Metro is seeking proposals from firms qualified to perform the services and deliver the products described in the attached Scope of Work (Attachment 3).

IV. QUALIFICATIONS/EXPERIENCE

Each proposal must include a description of: (1) the firm's or individual's experience and qualifications which directly relate to the activities identified in the Scope of Work; and (2) the project team's or individual's experience and qualifications for each specific task specified.

V. PROJECT ADMINISTRATION

Metro's project manager is Joanna Karl, PE, Senior Solid Waste Engineer.

Proposers must identify a single person as project manager to work with Metro. The Contractor must assure responsibility for any subcontractor work and shall be responsible for the day-to-day direction and internal management of the project. The prime contractor shall have, or be capable of obtaining, professional liability insurance, general liability insurance, business automobile insurance, and workers compensation insurance covering the services to be performed, as shown in Attachment 2 (Personal Services Agreement). Metro shall be named as an additional insured.

VI. PROPOSAL INSTRUCTIONS

A. Submission of Proposals

Three (3) copies of the proposal shall be furnished to Metro, addressed to:

Joanna Karl, PE
Metro
600 NE Grand Avenue
Portland, OR 97232-2736

B. Deadline

Proposals must be received by <u>3:00 p.m., Tuesday, October 19, 1993</u>.

C. RFP as Basis for Proposals:

This Request for Proposals represents the most definitive statement Metro will make concerning the information upon which Proposals are to be based. Any verbal information which is not contained in this RFP will not be considered by Metro in evaluating the Proposal. All questions relating to this RFP should be addressed to Joanna Karl, PE, Senior Engineer at (503) 797-1650. Any questions, which in the opinion of Metro, warrant a written reply or RFP amendment will be furnished to all parties recorded as in receipt of this RFP. Metro will not respond to questions received after Tuesday, October 12, 1993.

D. Contract Type

Metro intends to award a Personal Services Agreement with the selected Contractor. A copy of the standard contract form approved by Metro General Counsel is attached (Attachment 2). Any proposed changes in the language, construction or requirements of these documents must be raised and resolved as a part of the RFP process.

E. Information Release

All proposers are hereby advised that Metro may solicit and secure background information based upon the information, including references, provided in response to this RFP. By submission of a proposal all proposers agree to such activity and release Metro from all claims arising from such activity.

F. Minority and Women-Owned Business Program

In the event that any subcontracts are to be utilized in the performance of this agreement, the proposer's attention is directed to Metro Code Sections 2.04.100 and 200.

Copies of that document are available from the Procurement and Contracts Division of Regional Facilities, Metro, 600 NE Grand Avenue, Portland, Or 97232-2736 or call Mr. Amha Hazen at (503) 797-1713.

VII. PROPOSAL CONTENTS

The text of the proposal should include no more than fifteen (15) pages of written material (excluding biographies and brochures which may be included in an appendix), and specifically describe the ability of the consultant to perform the work requested, as outlined below:

A. Transmittal Letter: Indicate who will be assigned to the project, who will be Project Manager, and verify that the proposal will be valid for ninety (90) days.

B. Approach/Project Work Plan: Describe how the work will be done within the given timeframe and budget. Include a proposed work plan and schedule.

C. Staffing/Project Manager Designation: Identify specific personnel assigned to major project tasks, their roles in relation to the work required, percent of their time on the project, and special qualifications they may bring to the project.

Metro intends to award this contract to a single firm or individual. Proposals must identify a single person as Project Manager to work with Metro. The consultant shall be responsible for any subconsultant work as well as the day-to-day direction and internal management of the consultant effort.

Designate which tasks will be done by subcontractors.

D. Experience: List specific projects conducted by the firm and/or Project Manager over the past five years which are clearly relevant to the work proposed. For each project, include the name of the contact person, his/her title, role on the project, and telephone number. Identify persons on the proposed team who worked on each project, and their respective roles. Include complete resumes of individuals proposed for this contract.

E. Cost/Budget: Present all incremental costs and rates proposed and applicable to this project. List hourly rates for personnel assigned to the project, total personnel expenditures, support services, and subconsultant fees (if any). Requested expenses should also be listed. A totally inclusive budget not-to-exceed $100,000 (including the contingency discussed below) has been established for all groundwater modeling work at St. Johns Landfill.

The Cost Proposal Form (Attachment 1, Form 2), to be filled out, separately breaks out the required and optional tasks. Optional costs shall not exceed a $50,000 contingency. Optional tasks or subtasks will only be pursued upon prior request by Metro, and when a not-to-exceed budget is satisfactorily negotiated between Metro and the Contractor.

Indicate the following on the form: (1) not-to-exceed cost for Tasks I and II, (2) subtotal of required tasks (I and II), and (3) total contract costs to complete all tasks (including $50,000 contingency). Include a cost per hour table which lists all persons who may work on any of the tasks (either required or optional).

F. Technical Information

Model Choice:

(1) Indicate model(s) which is (are) appropriate to this project and your expertise in its (their) use.

(2) Indicate the task(s) or subtask(s) for which the model is appropriate.

(3) Indicate how the model(s) could be adapted, if needed, for this project.

G. Exceptions and Comments: To facilitate evaluation of proposals, Metro requests that all respondents adhere to the specific RFP format outlined.

Firms wishing to take exception to, or comment on, any specified criteria within this RFP are encouraged to document their concerns in this part of their proposal. Exceptions or comments should be succinct, thorough and organized.

VIII. GENERAL PROPOSAL/CONTRACT CONDITIONS

A. Limitation and Award: This RFP does not commit Metro to the award of a contract, nor to pay any costs incurred in the preparation and submission of proposals in anticipation of a contract. Metro reserves the right to waive minor irregularities, accept or reject any or all proposals received as the result of this request, negotiate with all qualified sources, or to cancel all or part of this RFP.

B. Contract Type: Metro intends to award a personal services contract with the selected firm for this project. A copy of the standard form contract which the successful consultant will be required to execute is attached.

C. Billing Procedures: Proposers are informed that the billing procedures of the selected firm are subject to the review and prior approval of Metro before reimbursement of services can occur. A monthly billing, accompanied by a progress report, will be prepared for review and approval.

D. Validity Period and Authority: The proposal shall be considered valid for a period of at least ninety (90) days and shall contain a statement to that effect. The proposal shall contain the name, title, address, and telephone number of an individual or individuals with authority to bind any company contacted during the period in which Metro is evaluating the proposal.

IX. EVALUATION OF PROPOSALS

A. Evaluation Procedure: Only proposals that conform to the RFP instructions will be evaluated. The evaluation will take place using the evaluation criteria identified in the following section. The evaluation process will result in Metro developing a short list of the firms who, in its opinion, are best suited to this project. Interviews with these firms may be requested prior to final selection of one firm.

B. Evaluation Criteria: Metro shall utilize the following criteria the evaluation of the proposals.

PROPOSED PROJECT WORK PLAN/APPROACH (35%)

- Clarity, understandability, and completeness of proposal
- Demonstrated understanding of the project objectives.
- Responsiveness to project objectives
- Commitment to the projects timely completion

PROPOSED PROJECT STAFFING (35%)

- Project organization: specific identification of the Project Manager, all technical and support staff, and subconsultants; their qualifications and references.
- Specific demonstrated knowledge of the strengths and weaknesses of modeling techniques
- Documented compliance with similar work schedule deadlines.

BUDGET/COST PROPOSAL (30%)

- Documented commitment to complete the project within budget
- Balanced and comprehensive cost proposal with pricing most advantageous to Metro.

X. NOTICE TO ALL PROPOSERS -- STANDARD AGREEMENT

The personal services agreement (Attachment 2) included herein is a standard agreement approved for use by Metro's General Counsel. As such, it is included for your review prior to submitting a proposal.

Any changes in the included standard agreement must be requested and resolved as part of the proposal process or as a condition attached to the proposal.

Consider the language carefully. Conditioned proposals may be considered nonresponsive. Subsequent requests for modification may not only be rejected, but interpreted as a request to modify and withdraw the original proposal.

S:\SHARE\KARL\GWMODEL.RFP

Form 1. TECHNICAL INFORMATION

Model Choice:

(1) Indicate model(s) which is (are) appropriate to this project and your expertise in its (their) use.

(2) Specify the task(s) or subtask(s) for which each model is appropriate.

(3) Indicate how the model(s) could be adapted, if needed, for this project.

Form 2. COST PROPOSAL FORM

REQUIRED TASKS:

I. Model Construction ____________

II. Steady-state Flow Conditions ____________

SUBTOTAL ____________

OPTIONAL TASKS: $50,000

III. Seasonal Transient Flow Conditions
IV. Model Applications
(1) Contaminant Transport
(2) Leachate Collection System
(3) Drawdown in the Lakes
(4) Intertidal Habitat in Bybee Lake

TOTAL CONTRACT COST ____________

(Attach Cost/Hour table)

Project:
Contract No:

PERSONAL SERVICES AGREEMENT

THIS AGREEMENT is between Metro, a metropolitan service district organized under the laws of the State of Oregon and the 1992 Metro Charter, located at 2000 S.W. First Avenue, Portland, OR 97201-5398, and ______________________________, referred to herein as "Contractor," located at ____.

In exchange for the promises and other consideration set forth below, the parties agree as follows:

1. Duration. This personal services agreement shall be effective ___________ 1993, and shall remain in effect until and including ______________________ 1993, unless terminated or extended as provided in this Agreement.

2. Scope of Work. Contractor shall provide all services and materials specified in the Attachment A -- Scope of Work," which is incorporated into this Agreement by reference. All services and materials shall be provided by Contractor in accordance with the Scope of Work, in a competent and professional manner. To the extent that the Scope of Work contains additional contract provisions or waives any provision in the body of this Agreement, the Scope of Work shall control.

3. Payment. Metro shall pay Contractor for services performed and materials delivered in the amount(s), manner and at the time(s) specified in the Scope of Work for a maximum sum not to exceed ____ ($_____________).

4. Insurance.

a. Contractor shall purchase and maintain at the Contractor's expense, the following types of insurance, covering the Contractor, its employees, and agents:

(1) Broad form comprehensive general liability insurance covering bodily injury and property damage, with automatic coverage for premises, operations, and product liability. The policy must be endorsed with contractual liability coverage; and

(2) Automobile bodily injury and property damage liability insurance.

b. Insurance coverage shall be a minimum of $500,000 per occurrence. If coverage is written with an annual aggregate limit, the aggregate limit shall not be less than $1,000,000.

c. Metro, its elected officials, departments, employees, and agents shall be named as ADDITIONAL INSUREDS. Notice of any material change or policy cancellation shall be provided to Metro 30 days prior to the change or cancellation.

d. Contractor, its subcontractors, if any, and all employers working under this Agreement that are subject employers under the Oregon Workers' Compensation Law shall comply with ORS 656.017, which requires them to provide Workers' Compensation coverage for all their subject workers. Contractor shall provide Metro with certification of Workers' Compensation insurance including employer's liability. If Contractor has no employees and will perform the work without the assistance of others, a certificate to that effect may be attached, as Exhibit B, in lieu of the certificate showing current Workers' Compensation.

e. If required by the Scope of Work, Contractor shall maintain for the duration of this Agreement professional liability insurance covering personal injury and property damage arising from errors, omissions, or malpractice. Coverage shall be in the minimum amount of $500,000. Contractor shall provide to Metro a certificate of this insurance, and 30 days' advance notice of material change or cancellation.

5. Indemnification. Contractor shall indemnify and hold Metro, its agents, employees and elected officials harmless from any and all claims, demands, damages, actions, losses and expenses, including attorney's fees, arising out of or in any way connected with its performance of this Agreement, or with any patent infringement or copyright claims arising out of the use of Contractor's designs or other materials by Metro and for any claims or disputes involving subcontractors.

6. Maintenance of Records. Contractor shall maintain all of its records relating to the Scope of Work on a generally recognized accounting basis and allow Metro the opportunity to inspect and/or copy such records at a convenient place during normal business hours. All required records shall be maintained by Contractor for three years after Metro makes final payment and all other pending matters are closed.

7. Ownership of Documents. All documents of any nature including, but not limited to, reports, drawings, works of art and photographs, produced by Contractor pursuant to this Agreement are the property of Metro, and it is agreed by the parties that such documents are works made for hire. Contractor hereby conveys, transfers, and grants to Metro all rights of reproduction and the copyright to all such documents.

8. Project Information. Contractor shall share all project information and fully cooperate with Metro, informing Metro of all aspects of the project including actual or potential problems or defects. Contractor shall abstain from releasing any information or project news without the prior and specific written approval of Metro.

9. Independent Contractor Status. Contractor shall be an independent contractor for all purposes and shall be entitled only to the compensation provided for in this Agreement. Under no circumstances shall Contractor be considered an employee of Metro. Contractor shall provide all tools or equipment necessary to carry out this Agreement, and shall exercise complete control in achieving the results specified in the Scope of Work. Contractor is solely responsible for its performance under this Agreement and the quality of its work; for obtaining and maintaining all licenses and certifications necessary to carry out this Agreement; for payment of any fees, taxes, royalties, or other expenses necessary to complete the work except as otherwise specified in the Scope of Work; and for meeting all other requirements of law in carrying out this Agreement. Contractor shall identify and certify tax status

and identification number through execution of IRS form W-9 prior to submitting any request for payment to Metro.

10. Right to Withhold Payments. Metro shall have the right to withhold from payments due to Contractor such sums as necessary, in Metro's sole opinion, to protect Metro against any loss, damage, or claim which may result from Contractor's performance or failure to perform under this Agreement or the failure of Contractor to make proper payment to any suppliers or subcontractors.

11. State and Federal Law Constraints. Both parties shall comply with the public contracting provisions of ORS chapter 279, and the recycling provisions of ORS 279.545 - 279.650, to the extent those provisions apply to this Agreement. All such provisions required to be included in this Agreement are incorporated herein by reference. Contractor shall comply with all applicable requirements of federal and state civil rights and rehabilitation statutes, rules and regulations including those of the Americans with Disabilities Act.

12. Situs. The situs of this Agreement is Portland, Oregon. Any litigation over this agreement shall be governed by the laws of the state of Oregon and shall be conducted in the circuit court of the state of Oregon, for Multnomah County, or, if jurisdiction is proper, in the U.S. District Court for the District of Oregon.

13. Assignment. This Agreement is binding on each party, its successors, assigns, and legal representatives and may not, under any circumstance, be assigned or transferred by either party.

14. Termination. This Agreement may be terminated by mutual consent of the parties. In addition, Metro may terminate this Agreement by giving Contractor five days prior written notice of intent to terminate, without waiving any claims or remedies it may have against Contractor. Termination shall not excuse payment for expenses properly incurred prior to notice of termination, but neither party shall be liable for indirect or consequential damages arising from termination under this section.

15. No Waiver of Claims. The failure to enforce any provision of this Agreement shall not constitute a waiver by Metro of that or any other provision.

16. Modification. Notwithstanding and succeeding any and all prior agreement(s) or practice(s), this Agreement constitutes the entire Agreement between the parties, and may only be expressly modified in writing(s), signed by both parties.

____________________	METRO
By: ____________________	By: ____________________
____________________ Print name and title	____________________ Print name and title
Date: ____________________	Date: ____________________

KARL\GWATER.PSA

SCOPE OF WORK

GROUNDWATER MODEL OF THE ST. JOHNS LANDFILL

PROJECT OBJECTIVE

To select, construct, and calibrate a three-dimensional, steady-state numerical ground water model that will simulate groundwater flow patterns and contaminant transport in the St. Johns Landfill area using existing data. The model shall be capable of calculating reasonable estimates of mass loading of pollutants to surface water surrounding St. Johns Landfill. All work shall be completed no later than June 30, 1994.

EXISTING DATA

Metro's data has been gathered from a number of different sources, including the following:

(1) Water quality monitoring (required by Metro's permit with DEQ) was performed by CH2M Hill from 1985.

(2) Permeability data was gathered by Sweet-Edwards/EMCON when they drilled the G-wells, and by Cornforth Consultants when drilling the J-borings to verify the results of a geophysical study at the perimeter of the landfill. Permeability data for soil under the solid waste was gathered by Cornforth Consultants when drilling the H-wells.

(3) Continuous water level data at selected wells and points in the slough was collected by Portland State University (PSU) researchers.

(4) Continuous water level data at newly constructed piezometer clusters (P-series) is being gathered by Metro.

A matrix of the data Metro will provide is shown in Tables 1 and 2 appended to this scope of work. Table 3 shows the vertical depths of each well. Table 4 is a list of related reports, providing information and data for the area. Figures 1, 2, and 3 show the general area and well locations. Additional information, such as the well logs, is available at Metro.

Metro will also provide mapped contours of the subsurface, which will be digitized data in the state plane coordinate system. Metro will provide the Contractor both the maps and the electronic data from which the maps were produced.

The regional boundaries to which the digitized contours extend are shown in Figure 1. The digitized maps use ArcInfo, a Geographic Information System. The following digitized maps will be provided: top of Pleistocene gravel, top of Columbia River Sand, top of recent overbank silt deposits, and existing ground surface, as well as the bottom of the dredged sand fill in the area northeast of the landfill (Ramsey Lake).

Figures 4, 5, and 6 show the digitized contours within the landfill, and the locations of wells and borings from which they were developed. These are drafts developed for the RFP, while the final versions are being completed. The top of the silt deposits will reflect the silt levees and engineered silt dikes around the perminter of the landfill. Figures 7 and 8 are cross-sections based on the underlying geology.

It is the responsibility of the Contractor to determine and use additional available data sources, as needed.

BACKGROUND/RELATED PROJECTS

Metro has operated the St. Johns Landfill - located adjacent to the Columbia and North Sloughs and the Smith and Bybee Lakes - since 1980. In 1991, Metro began final closure of the landfill.

As part of both operations and closure, Metro has historically performed groundwater and surface water sampling at St. Johns Landfill (see Tables 1 and 2). The City of Portland performed groundwater and surface water monitoring since the early 1970's. Historical data is available as part of a Paradox database.

Some related projects, which either provide data for the model or which model results will effect, include:

Hydrodynamic Computer Modeling of the Columbia Slough for the City of Portland by PSU: The City of Portland contracted with Portland State University (PSU) to develop a hydrodynamic computer model of the Columbia Slough to study flow augmentation. Development of this model included some monitoring of the surface water near the landfill. Metro contracted with PSU to do additional monitoring with the intent of "piggy-backing" the monitoring and modeling efforts of the City of Portland as they studied flow augmentation in the Columbia Slough. This provides the opportunity to interactively relate the surface water and groundwater to each other.

Smith and Bybee Lakes Management Plan. The Smith and Bybee Lakes Management Area occupies more than 2,000 acres along the Columbia Slough near the confluence of the Willamette and Columbia Rivers. The Smith and Bybee Lakes wetlands area includes St. Johns Landfill and the surface waters which surround it.

The Plan indicates that groundwater mounding (of contaminated leachate) and resulting groundwater flow from the landfill may produce major impacts on groundwater recharge and discharge functions, habitat for fish, and active recreation functions of surrounding sloughs and wetlands. Further, the hydrology of the area is controlled by human development such as the landfilling activity and water control structures. The future environment of the wetlands complex will depend on hydrologic management practices such as altering lake elevations.

Landfill impacts on the surrounding surface waters may be altered by some of the potential environmental projects discussed in the Plan.

Total Maximum Daily Loads (TMDLs): The Oregon Department of Environmental Quality (DEQ) is currently in the process of setting and allocating Total Maximum Daily Loads (TMDLs) for the Columbia and North Sloughs, which are adjacent to St. Johns Landfill. Metro can help to establish the landfill's TMDL allocation by determining seepage and pollutant loading.

Feasibility Study for Treatment of Combined Sewer Overflows through Constructed Wetlands: This July 1992 study by Black and Veatch addresses the feasibility of implementing a constructed wetlands treatment system at the Ramsey Lake site (in the Rivergate Industrial District) for the treatment of up to four combined sewer overflow (CSO) outfalls and some localized stormwater flows. The geotechnical study included some borings and monitoring wells with permeability tests.

REQUIRED TASKS - The required tasks shall be completed no later than March 1, 1994.

I. MODEL CONSTRUCTION

The completed model shall utilize existing Metro data, as well as other existing data sources, to provide Metro with a tool capable of simulating the scenarios in Task IV of this Scope of Work. To ensure the Contractor's product will meet the needs of Metro, the Contractor shall obtain approval of the conceptual approach and the model selection from Metro prior to construction of the model. The constructed model shall also be presented to Metro at the completion of Task I of this scope. Metro approval shall be obtained before proceeding to Task II. Contractor shall provide to Metro short written summaries of all presentations, explaining assumptions.

1. Conceptual Approach - Contractor shall propose and justify Contractor's conceptual approach to modeling the St. Johns Landfill region. Contractor shall consider any physical, chemical, and biological processes which may affect the problem.

2. Select Appropriate Model - Contractor shall propose a mathematical computer model that can simulate steady-state groundwater flow patterns in three dimensions under various conditions (including variation of groundwater surface elevations and surface water elevations across seasonal highs and lows). The model may employ finite difference or finite element methods. Contractor shall justify Contractor's model selection.

3. Grid Design - Contractor shall design a model grid or mesh that is capable of simulating the scenarios described in Task IV of this scope, including both existing (leachate collection system under about one-fourth of the landfill) and possible future leachate collection schemes.

4. Aquifer Framework - Contractor shall construct the aquifer framework using existing data provided by Metro or from available sources, and anticipating future data as described in Tables 1 and 2. The Contractor is required to complete a review of all pertinent available data prior to constructing the aquifer framework.

5. Boundary Conditions - Boundary conditions must be set to include characteristics that are important in determining flow and transport in the landfill region (they may be beyond the immediate vicinity of the landfill).

6. Inputs/Outputs. The model or a pre-processor will be adapted to accept input from Metro's electronic data loggers. (Metro has two different types of data loggers currently in the field -- Unidata and Geo Group.) Metro will assist in developing an interface, as needed, to manipulate the output data from its data loggers.

   Model outputs shall facilitate the production of graphic displays.

II. STEADY-STATE FLOW CONDITIONS

1. Approximate Calibration - Contractor shall roughly calibrate steady-state flow model to known conditions using existing data. No aquifer pumping or slug tests shall be performed. Approximate calibration model results shall be within ± 5 feet of groundwater surface elevations observed in the existing groundwater wells and piezometers.

2. Output - The complete model at this step should simulate 3-D, steady-state groundwater flow with the capabilities for particle tracking and time-of-travel estimation. Results should be observable in plane and cross-sectional view.

3. Documentation - Contractor shall provide to Metro a short written summary of Contractor's inputs and assumptions.

OPTIONAL TASKS

The following tasks will be completed only if requested by Metro. A not-to-exceed cost must be negotiated for any task or subtask which Metro requests. A $50,000 contingency is available for the optional tasks. The optional tasks shall be completed no later than June 30, 1994.

III. SEASONAL TRANSIENT FLOW CONDITIONS

1. Model - The steady-state model will be converted to transient flow conditions and particle transport with a calibration process that uses existing data.

2. Output - Particle tracking capabilities should be included in addition to time-of-2travel capabilities, and results should be observable in plane and cross-sectional view.

3. Documentation - Contractor shall provide to Metro a short written summary of Contractor's inputs and assumptions.

IV. MODEL APPLICATIONS

1. Contaminant Transport. Utilize groundwater model to simulate potential contaminant transport, and determine the magnitude of groundwater flow and associated contaminants (expressed in lb/day or kg/day) moving from the St. Johns Landfill and entering surface waters and groundwater adjacent to the landfill. Concentration shall be illustrated in both plane and cross-section view.

   Contractor shall discuss contaminants to be modeled and assumptions with Metro staff before simulating contaminant transport.

2. Leachate Collection System. Determine the effect of an added perimeter leachate collection system (based on a conceptual design to be provided by Metro) in abating movement of contaminants from St. Johns Landfill into surrounding ground and surface waters.

3. Drawdown in the Lakes. Determine the effect of drawdown in Smith and Bybee Lakes on the rate of movement of contaminants away from the St. Johns Landfill.

4. Intertidal Habitat in Bybee Lake. Assess the effect on groundwater flow in the region if Bybee Lake or a portion of the lake were to be returned to intertidal habitat (i.e., Bybee Lake directly connected to Columbia Slough and its associated daily/seasonal surface water elevation changes).

DELIVERABLES

1. Contractor shall complete tasks in a timely manner, based on the timetable delivered with Contractor's proposal.

2. All documentation, as required in Tasks I through IV above.

3. Contractor shall deliver all groundwater models developed for this project to Metro in a working form compatible with Metro's computer systems. This includes an executable electronic copy of the computer model, with all calibration data, on computer disks and an operation manual.

4. The Contractor shall provide Metro technical staff hands-on training not-to-exceed sixteen (16) hours at Metro's office on running the model.

Payment Provisions

Contractor shall invoice Metro for time and materials in the amounts not-to-exceed those indicated by Contractor in the Cost Schedule Proposal Form included in Metro's RFP and in Contractor's proposal, all of which are incorporated into this Agreement by this reference.

Metro shall pay Contractor for services performed and materials delivered in the maximum sum of __________ AND NO/100THS DOLLARS ($___). This maximum sum includes all fees, costs, and expenses of whatever nature to which Contractor is entitled under this agreement. Contractor's billing statements shall include an itemized statement of the work done during the billing period, and will not be submitted more frequently than once per month. Metro shall pay Contractor within 30 days of receipt of an approved invoice/billing statement.

Invoices shall be sent to: Joanna Karl, PE, Metro, 600 NE Grand Ave., Portland, OR 97232-2736

jk: c:\wp51\gwmodel\gwater.sop or s:\share\karl\gwater.sop

TABLE 1
METRO DATA - FLOW MODELING

	ON-GOING MONITORING AND EXISTING DATA					ADDITIONAL PROPOSED DATA	
LEACHATE MOUND	**WELL**	**WATER LEVEL**		**SOURCE**		**WELL**	**WATER LEVEL**
	H-1 thru H-5	Monthly (5/91-5/92); 8/92		CH2M Hill		H-1 through H-5	Continuous
SHALLOW AQUIFER	**WELL**	**WATER LEVEL** (PSU - File name: "W 'Well name' ASCII.ZIP, or "WELL .DAT")		**K*** (cm/sec)	**K**** (cm/sec)	**PIEZOMETERS/ BAROMETERS**	**WATER LEVEL**
	G-1	Continuous	2/91-4/92; 6-9/92	2.1×10^{-4}	5×10^{-7}	P-1a,b P-2a,b P-3a,b,BAR P-4a,b,BAR P-5a,b P-6a,b P-7a,b P-8c P-9a,b,c	Continuous
	G-2	Continuous	1/91-4/92; 6-9/92	1.5×10^{-4}	2×10^{-7}		
	G-3	Continuous	5/91-4/92; 6-9/92	8.7×10^{-4}			
	G-5a	Continuous	10/90-4/91; 5/91-4/92; 6-9/92	2.8×10^{-4} 3.1×10^{-4}	2×10^{-4}?		
	G-7	Continuous	1-4/92; 6-9/92	5.1×10^{-4}	$6\text{-}8\times10^{-7}$		
	G-8a	Continuous	1/91-2/91; 4/91-4/92; 6-11/92				
	D-1a D-1b	Continuous	12/90-4/91; 5/91-7/91; 9/91-4/92; 6-9/92				
	D-2b,D-6b	Monthly	1/91-12/91				
	CONSTANT HEAD TEST (Parametrix, 7/90)						
	BORING/ K(cm/sec)	**BORING/ K (cm/sec)**	**BORING/ K (cm/sec)**	**BORING/ K (cm/sec)**			
	J-1 6×10^{-4} J-2 2×10^{-7} J-3 6×10^{-4} J-4 1×10^{-4} J-5 4×10^{-4}	J-6 5×10^{-4} J-7 3×10^{-4} J-8 3×10^{-4} J-9 4×10^{-7} J-10 1×10^{-7}	J-11 1×10^{-4} J-12 1×10^{-4} J-13 2×10^{-4} J-14 1×10^{-4} J-15 7×10^{-7}	J-16 $<5\times10^{-7}$ J-17 3×10^{-7} J-18 5×10^{-7} J-19 1×10^{-4} J-20 $<5\times10^{-7}$			
DEEP AQUIFER	**WELL**	**WATER LEVEL**		**K***** (cm/sec)		**PIEZOMETERS**	**WATER LEVEL**
	G-5b	Continuous	10/90-4/92; 6-9/92	0.14/0.53		P-1c,d,e P-2c,d P-3c P-4c P-5c P-6c P-7c,d P-8c P-9d	Continuous
	G-6	Continuous	2/91-4/92	.010/.020			
	Familian	Continuous	5/91-4/92				
	G-8b,G-8c	Continuous	1-4/91; 5/91-4/92; 6-11/92				
	D-6c,D-8a D-7a,E-2D	Monthly	1/91-12/91				
SLOUGHS	**SAMPLE PT**	**WATER LEVEL** (from: "Gaging" table in Metro database)					
	BY1 ENS SJB	Continuous	6/91-5-92 6-91-11/91 6/91-5/92				

*Sweet-Edwards/EMCON (1989) From rising head permeability tests
**Sweet-Edwards/EMCON (1989, Appendix H). G-1, G-2, and G-5a from shelby tube samples; G-7 from triaxial setup
***Sweet-Edwards/EMCON (1989) From pump test/recovery test

TABLE 2
METRO DATA - QUALITY MODELING

Note: Metro also has an historical database with all water quality data from the early 70's.

	ON-GOING MONITORING AND EXISTING DATA				ADDITIONAL PROPOSED WORK
LEACHATE MOUND	WELL	PARAMETERS	PERIOD	SAMPLER	
	H-1 H-2 H-3 H-4 H-5	Priority Pollutants	12/90-1/91	Parametrix	
		Chloride, conductivity, temperature	Monthly (5/91-5/92)	CH2M Hill	
SHALLOW AQUIFER	WELL	PARAMETERS	PERIOD	SAMPLER	Semi-annual sampling (proposed monitoring plan to DEQ) - includes new K-series shallow monitoring wells.
	G-1 G-2 G-3 G-5a G-7 G-8a D-1a,D-1b D-1c D-6a,D-6b D-2b	Chloride, conductivity, temperature	Monthly (approx. 1/91-4/92)	PSU	
	B-3 B-5 C-1 C-2 C-3 C-5 D-1a,b,c D-2,b D-3a,b D-4a,b D-5a,b D-6a,b E-1s,d E-2s F-1	Temp, pH, conductivity, color, alkalinity, hardness, TOC, chloride, sulfate, ammonia nitrogen, nitrate nitrogen, nitrite nitrogen, dissolved iron, dissolved calcium, dissolved magnesium, COD	Semi-annually (1985-present)	CH2M Hill	
	B, C, D, F wells	Various (all in Metro's historical database)	1970's on	Various	
DEEP AQUIFER	WELL	PARAMETERS	PERIOD	SAMPLER	Semi-annual sampling (proposed monitoring plan to DEQ)
	G-5b G-6 Familian G-8b,G-8c D-6c D-8a D-7a E-2d	Chloride, conductivity, temperature	Monthly (approx. 1/91-4/92)	PSU	
	B-6 D-6c D-7a D-8a D-2d	Temp, pH, conductivity, color, alkalinity, hardness, TOC, chloride, sulfate, ammonia nitrogen, nitrate nitrogen, nitrite nitrogen, dissolved iron, dissolved calcium, dissolved magnesium, COD	Semi-annually (1985-present)	CH2M Hill Metro	
SLOUGHS	Longitudinal surveys: CNS ENS SJB	Chloride, conductivity, temperature	Monthly (approx. 6/91-11/91)	PSU	

TABLE 3. MONITORING WELL AND PIEZOMETER SUMMARY

Well	Status	Construct Date	Coordinate Location	Approx Ref. Elev.[1] (ft MSL)	Approx Bottom Elev.[2] (ft MSL)	Total Depth (ft)	Screen Location Depth (ft)	Material at bottom of boring	Well Casing Dia.	Well Casing Mat'l
A-1	Abandn'd (11/92)	1971	E12,370, N1,510							
A-2			E11,885, N1,892							
A-3			E12,790, N1,910							
A-4	Lost		E12,790, N1,910							
B-1	Lost	1971								
B-2	Abandn'd (11/92)		E11,090, N1,840							
B-3	Abandn'd (10/91)									
B-4	Abandn'd (11/92)		E11,035, N2,639							
B-5			E13,347, N1,980							
B-6	Lost									
C-1	Abandn'd (11/92)	1971	E12,424, N1,238							
C-2			E11,115, N1,245							
C-3	Abandn'd (5/92)		E10,859, N3,445							
C-4	Lost									
C-5	Abandn'd (11/92)		E12,290, N3,550							
D-1a	IN USE	10/9/84	E9,301, N3,239	27.3	-12	39	28-38	Clay	3"[3]	PVC
D-1b			E9,298, N3,232	27.7	-41.5	69	58-68			
D-1c			E9,295, N3,225	27.5	-83	110	88-108	Silt		
D-2a		9/29/84	E10,224, N2,453	27	-15	42	31-41	Clay		
D-2b	Abandn'd (11/92)	10/5/84	E10,227, N2,445	27.7	-44.5	72	61-71	Silt		
D-3a	IN USE	10/3/84	E10,070, N1,308	38.3	-12.5	50	39-49	Clay		
D-3b			E10,068, N1,305	37.8	-42	80	70-80	Clay, silt		
D-4a		10/5/84	E11,588, N1,202	23.4	-7	30	21-31			
D-4b			E11,583, N1,202	23.2	-39	62	51-61			
D-5a	Abandn'd (11/92)	10/17/84	E13,226, N1,335	31.7	-10.5	42	31-41			
D-5b			E13,217, N1,330	32.0	-40.5	72	61-71			
D-6a	IN USE	10/24/84	E14,248, N3,062	30.4	-2	41	30-40	Clay		
D-6b			E14,250, N3,054	29.8	-22.5	61	51-61			
D-6c			E14,252, N3,046	30.7	-80.5	111	90-110	Sand, gravel		
D-7a	Abandn'd (11/92)	10/16/84	E12,712, N3,587	28.9	-31.5	61	47-57			
D-8a	Abandn'd (5/92)		E10,928, N3,328	33.8	-37	71	66-71			

E-1	Abandn'd (11/92)	1979	E12,300, N3,420							
E-2			E13,280, N3,740							
EPA-B	Abandn'd (11/91)	1985	E10,253, N2,840							
EPA-O	Abandn'd (11/92)		E12,440, N2,040							
EPA-P			E11,632, N2,553							
EPA-Q			E11,286 N1,591							
EPA-R			E10,928, N3,328							
Familian	IN USE	?	E10,392, N733							
Port		1988	E9,439, N1,358							
SEA-B4		1987	E9,409, E1,253							
F-1	IN USE	1979		16.7	-11.5	28	23-28	Sandy silt?	3"	PVC
G-1	IN USE	8/30/88	E12,367, N1,200	24.1	-34.5	58.5	43-53	Silty sand	2"	PVC
G-2		8/31/88	E11,018, N1,244	24.0	-36	60	48-58	Silt, sand		
G-3		9/1/88	E13,550, N3,829	29.7	-28.5	58	46-56	Silt		
G-4a		10/6/88	E11,238, N3,781	17.6	-2	19.5	8.5-17.5			
G-4b		9/11/88	E11,236, N3,779	17.3	-40	57	46-55	Sand, gravel	4"	
G-5a		10/6/88	E13,387, N4,050	13.9	-7	21	9-18	Silty sand	2"	
G-5b		9/21/88	E13,387, N4,055	13.6	-44.5	58	46-56	Sand, gravel	4"	
G-6		10/12/88	E9,232, N2,663	17.3	-168.5	186	175-185			
G-7		10/5/88	E10,713, N3,491	16.7	-25	41.5	26-36		2"	
G-8a		10/7/88	E14,562, N1,146	45.4	-6	51.5	38.5-47.5	Sand		
G-8b		10/22/88	E14,564, N1,140	45.4?	-40.5	86	81-86	Sand, gravel		
G-8c					-79	124	117-122			
H-1	IN USE	7/30/90	E10,232, N3,037	60.5	-8.5	69[4]	48-58	Sandy clayey silt	2"	stain-less steel
H-2		8/16/90	E11,409, N3,046	75	-9	80[4]	57.5-67.5			
H-3		8/21/90	E11,710, N1,619	69	-5	74	49-59			
H-4		8/24/90	E12,740, N2,950	71	-7.5	66.5	40-50			
H-5		8/13/90	E13,865, N3,031	87	-5	92[4]	54-64	Silty clay/ clayey silt to fine sandy clayey silt		

K-1	IN USE	12/7/92	E10,999, N1,216	24.1	-0.4	21.3	4-19	Clayey silt	2"	PVC
K-2		12/17/92	E10,183, N2,426	27.5	-1.4	28.9	12-27	Clayey fine sandy silt		
K-3		12/8/92	E10,674, N3,494[5]	18.9	.9	17.3	5-15	Clayey silt		
K-4		12/8/92	E14,262, N3,129[5]	21.7	-3.3	22.6	10-20	Sandy clayey silt		
K-5		12/3/92	E13,407, N1,855	32.2	-3.5	35.3	18-33	Clayey silt		
K-6a		12/1/92	E13,255, N1,310[5]	31.9	-3.4	33.3	16-31	Sandy clayey silt		
K-6b		12/10/92	E13,265, N1,311[5]	30.8	-41.2	-42.2	27-37	Silty sand		

Piezometer	Status	Date Constructed	Coordinate Location	Approx Ref. Elev.[1] (ft MSL)	Approx Bottom Elev.[2] (ft MSL)	Total Depth (ft)	Piezometer location depths (ft)	Material at piezometer location	Piezometer Casing Dia.	Piezometer Casing Mat'l
P-1a P-1b P-1c P-1d P-1e	IN USE	10/13/92-10/19/93	E10,989, N1,216	22.4	-129.0	148.3	18.5 56.3 86.2 126.0 146.0	silt/sand silt/sand sand gravel gravel	2"	PVC
P-2a P-2b P-2c P-2d	IN USE	11/23/92-12/2/92	E10,184, N2,438	26.2	-145.0	167	21.0 80.9 148.1 165.0	clayey silt sandy silt sand sand	2"	PVC
P-3a P-3b P-3c	IN USE	11/17/92-11/18/92	E10,666, N3,497	17.5	-42.0	58.5	13.0 26.4 56.4	Sa/cl/silt Cl/silt sand Sa/gravel	2"	PVC
P-4a P-4b P-4c	IN USE	10/5/92-10/6/92	E14,258, N3,122	18.7	-50.8	68.2	14.0 49.9 64.9	Silt/sand Silt/sand Gravel/sa	2"	PVC
P-5a P-5b P-5c	IN USE	11/9/92-11/12/92	E13,411, N1,850	31.5	-69.4	100.5	34.5 74.0 98.0	Clayey silt Silt Gravel	2"	PVC
P-6a P-6b P-6c	IN USE	10/28/92-10/29/92	E13,263, N1,316	30.3[5]	-61.2	89.7	26.9 47.9 87.4	Si/cl, sand Silt/clay Gravel	2"	PVC
P-7a P-7b P-7c P-7d	IN USE	9/10/92-9/11/92	E11,417, N3,476	27.9	-53.4	80.7	23.2 40.1 55.0 77.0	Clayey silt Sand, silt Gravel Gravel	2"	PVC
P-8a P-8b P-8c	IN USE	9/29/92	E11,454, N4,085	15.2	-34.6	48.9	12.9 24.9 45.4	Silt Silt Sa/gravel	2"	PVC
P-9a P-9b P-9c P-9d	IN USE	9/23/92	E14,776, N3,419	13.3	-67.5	78.9	11.1 25.1 45.0 75.4	Clayey silt Silty sand Silty sand Gravel	2"	PVC

[1]D-wells: Reference elevation from SE/E, 5/89, p.19. Don't know whether surface or top of casing.

G-wells: Reference elevation from drill logs (SE/E, 5/89, App.B). Not outrightly stated, but appears to be ground surface elevation. Survey in App. K is approximately the same elevation, but doesn't state the point of measurement, either.

H-wells: Reference elevation at ground surface at time of drilling (CCI, 10/90, drill logs)
K-wells: Reference elevation at top of casing (CCI, 1/93, drill logs)
P-wells: Reference elevation at ground surface

[2]D-wells, G-wells: Approximate bottom elevation from SE/E, 5/89, pp.19-21, based on drill logs
H-wells: Approximate bottom elevation from drill logs (CCI, 10/90)
K-wells: Calculated from drill logs (CCI, 1/93)

[3]2" inserts placed in all the D-wells (D-3b: SE/E, 1988; remaining wells: Jensen Drilling, 1992)

[4]H-1: Backfilled to depth 64'
H-2: Backfilled to depth 80'
H-5: Backfilled to depth 80'

[5]Coordinates are very approximate. P-3, K-3, P-6 and K-6a and b are all based on only one control point.

TABLE 4
RELATED REPORTS

Assessment of Management Alternatives for Water Quality Improvement in the Columbia Slough System, February 1, 1992, Portland State University (Vol. 1 and 2)

Feasibility Study for Treatment of Combined Sewer Overflows through Constructed Wetlands, July 1992, Black & Veatch.

Lower Columbia Slough System Field Data Summaries - August 1990 through June 1991, March 15, 1992, Portland State University.

Natural Resources Management Plan for Smith/Bybee Lakes, May 1990, Portland Bureau of Parks & Recreation, Port of Portland.

Smith and Bybee Lakes Environmental Studies, November 1987, Fishman Environmental Services, et al. (Technical Appendices).

St. Johns Landfill - Water Quality Impact Investigation, May 31, 1989, Sweet-Edwards/EMCON (Volume I-Text, Volume 2-Appendix).

St. Johns Landfill Closure - Leachate Migration, Perimeter Dike, October 1990, Cornforth Consultants (Technical Memorandum).

St. Johns Landfill - Water Monitoring Plan, August 1993, Metro.

C:\WP51\GWATER.SCP or S:\share\karl\gwater.scp

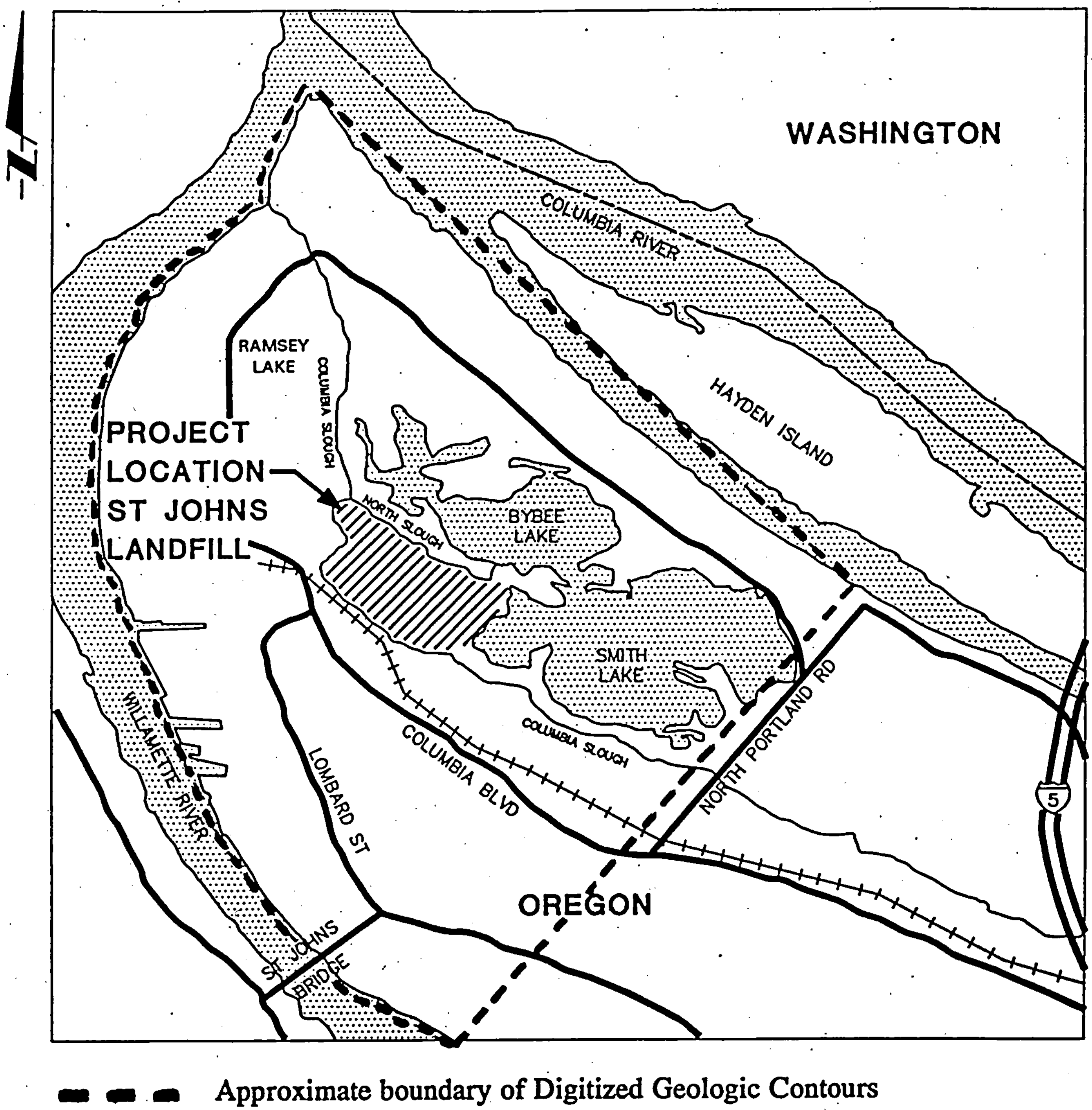
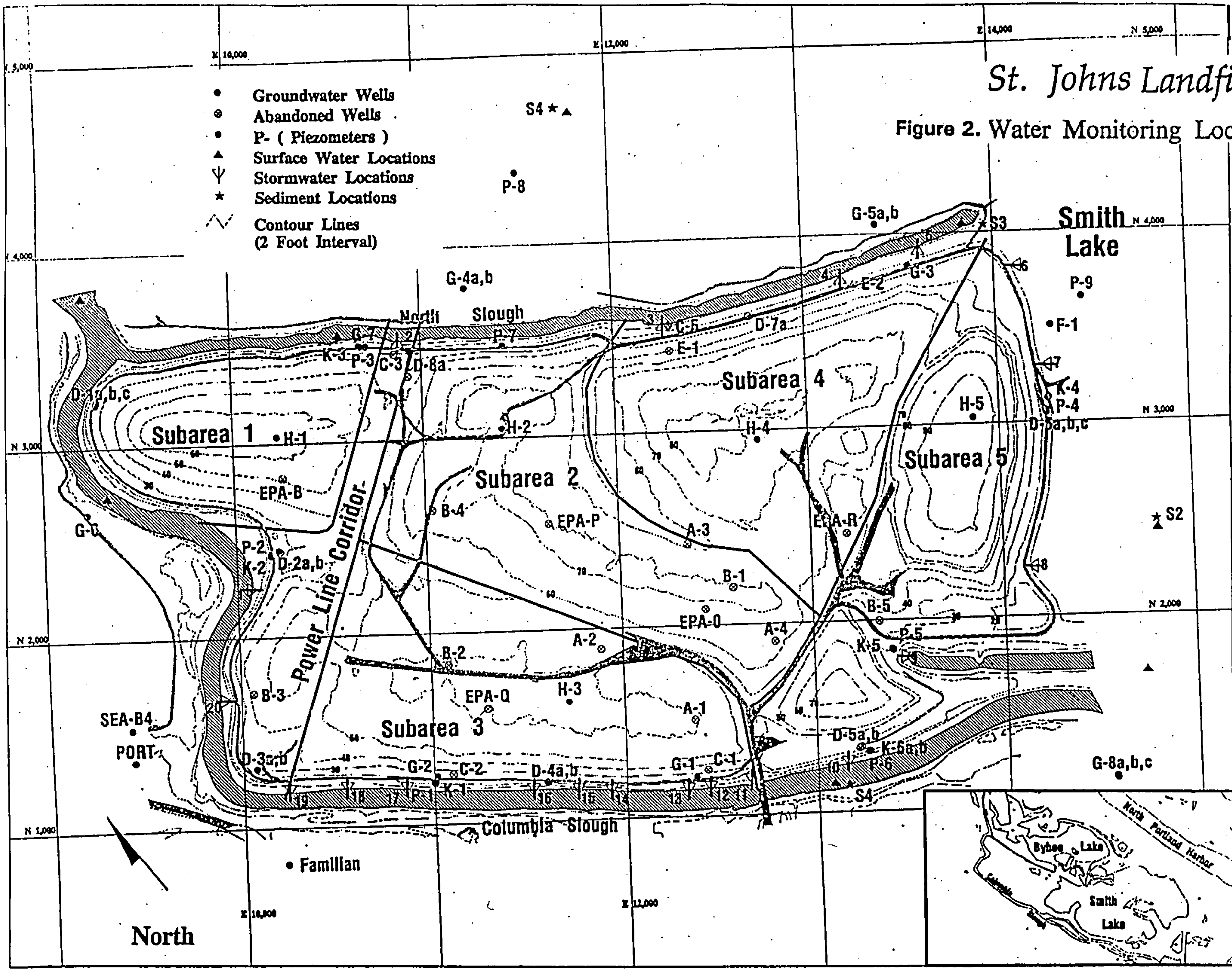


Figure 1. VICINITY MAP



St. Johns Landfill

Figure 2. Water Monitoring Locations

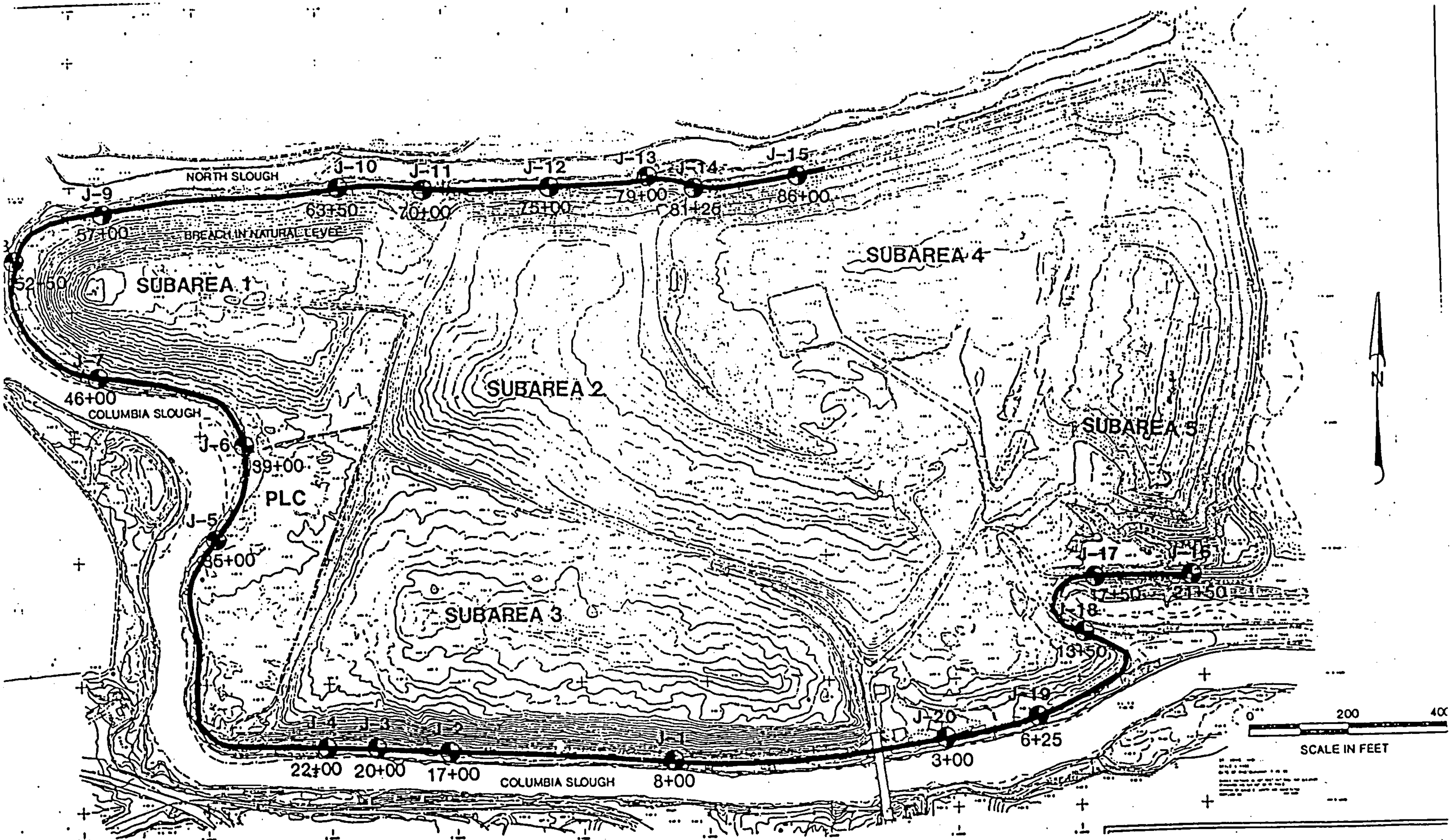


Figure 3. ST. JOHNS LANDFILL PERIMETER DIKE

Title: SITE PLAN

Cornforth Consultants, Inc.
7440 S.W. Hunziker Rd.
Portland, Oregon 97223

Date: SEPT. 1990
Job No. 0485

LEGEND

J-1 / 8+00 — EXPLORATORY BORING LOCATION AND DESIGNATION.

GEOPHYSICAL SURVEY LINE (LIMITS OF DIKE CHARACTERIZATION)

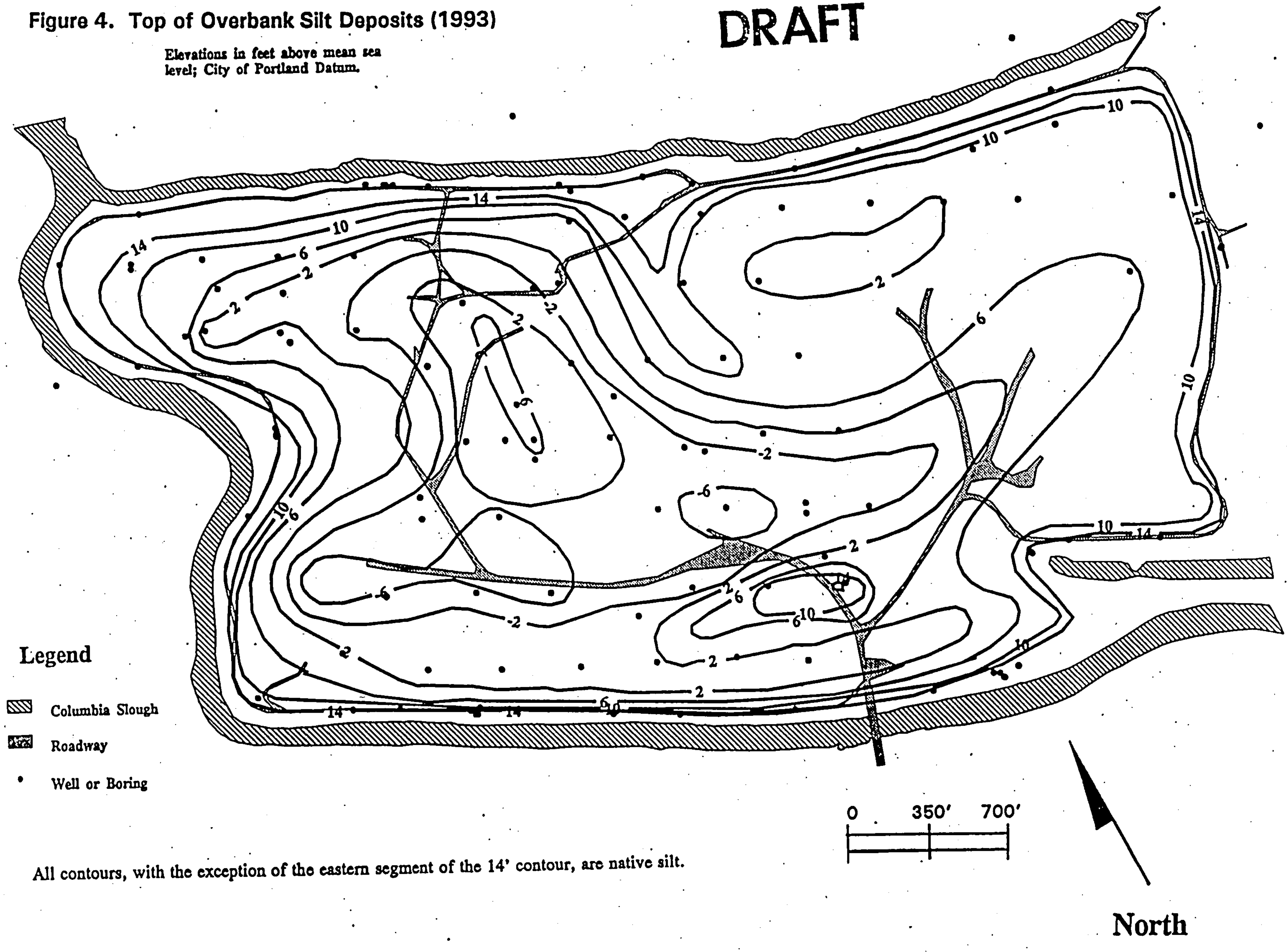
NOTES: STATIONING FROM "GEOPHYSICAL SURVEY FOR PERIMETER DIKE CHARACTERIZATION, ST. JOHNS LANDFILL, PORTLAND, OREGON." REPORT PREPARED BY NORTHWEST GEOPHYSICAL ASSOCIATES, INC., SEPTEMBER 1990. (APPENDIX A).

BASE MAP PROVIDED BY METRO DATED JULY 20, 1990.

Figure 4. Top of Overbank Silt Deposits (1993)

Elevations in feet above mean sea level; City of Portland Datum.

DRAFT



All contours, with the exception of the eastern segment of the 14' contour, are native silt.

Figure 5. Top of Columbia River Sand Formation

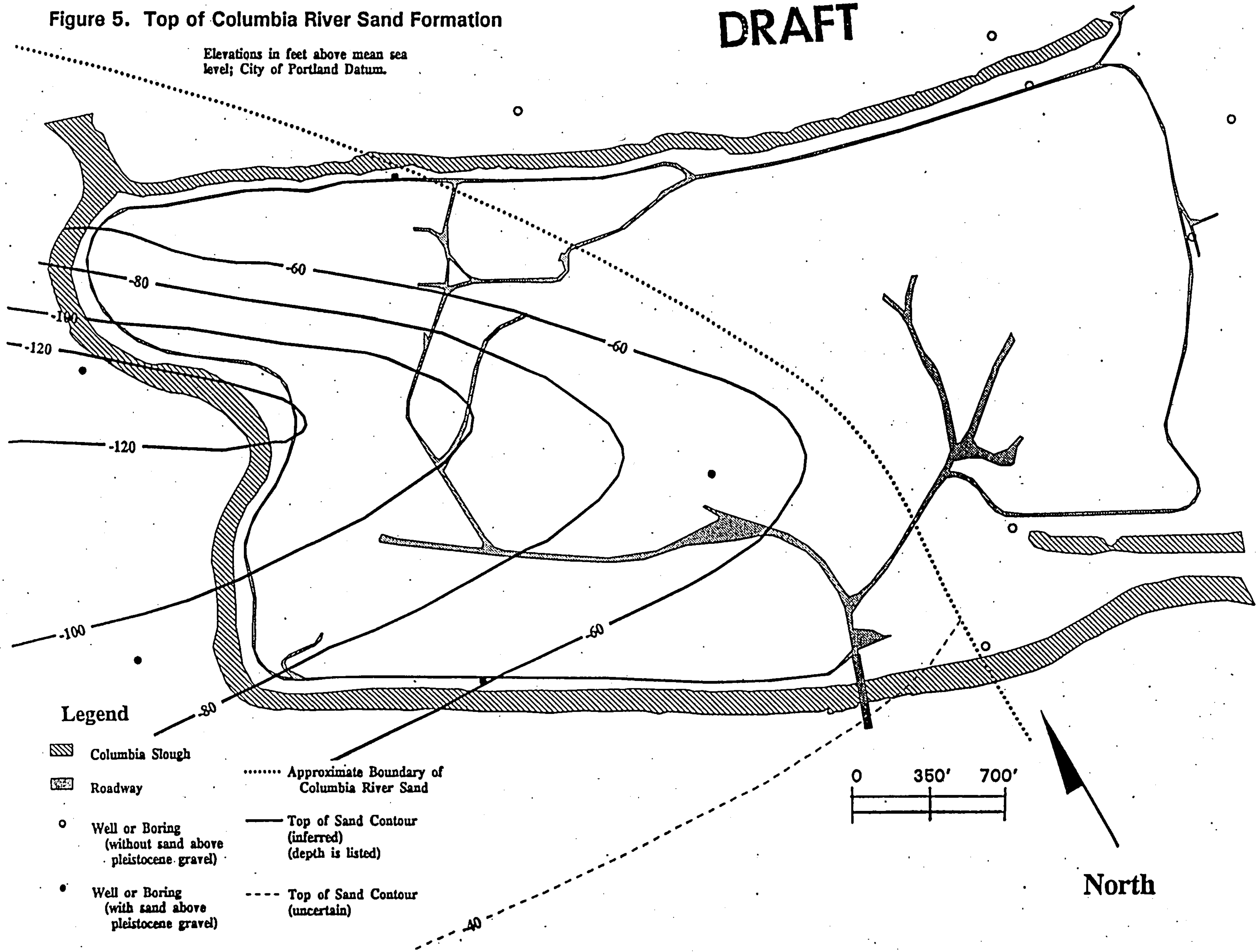


Figure 6. Top of Pleistocene Gravel Formation

Elevations in feet above mean sea level; City of Portland Datum.

DRAFT

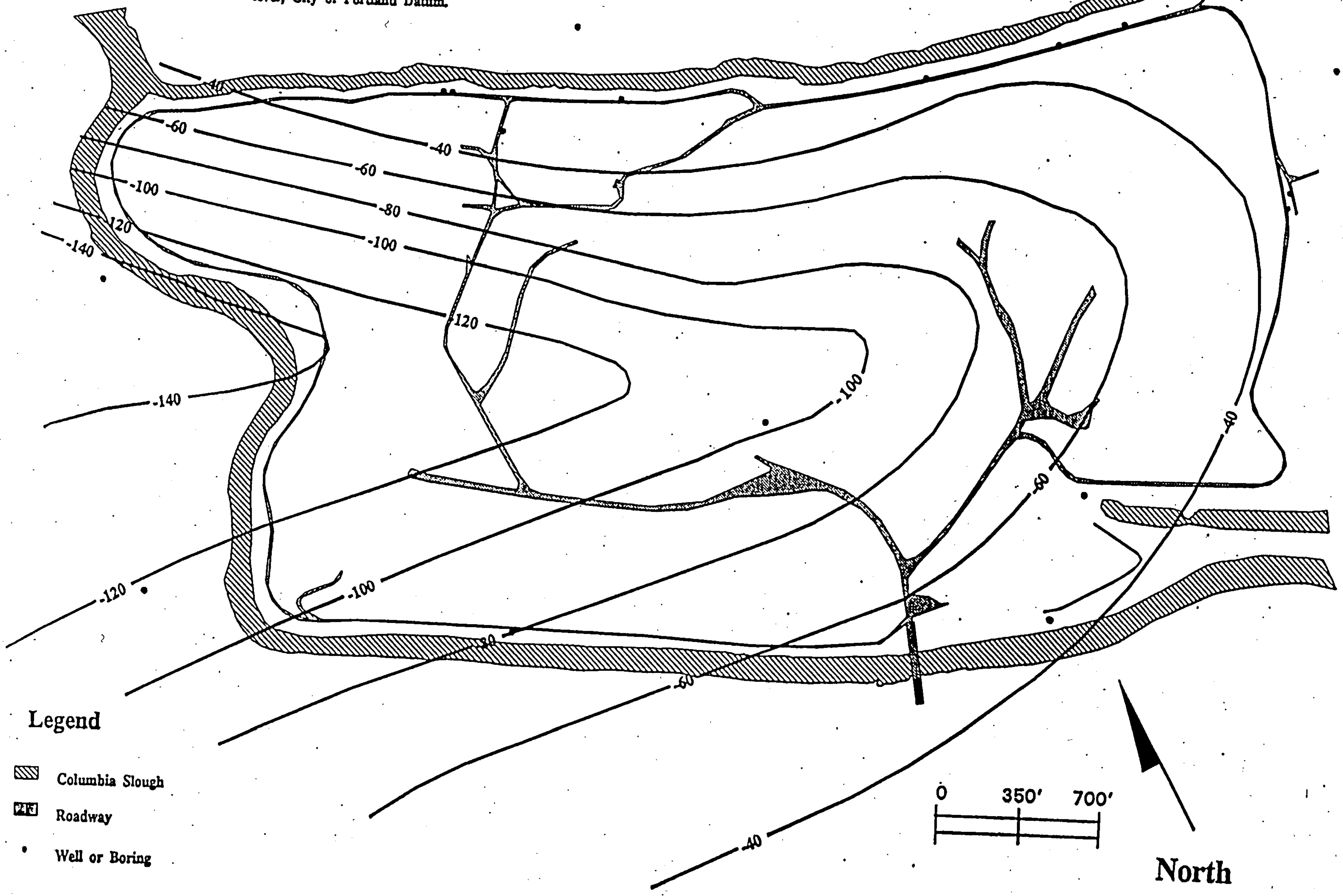
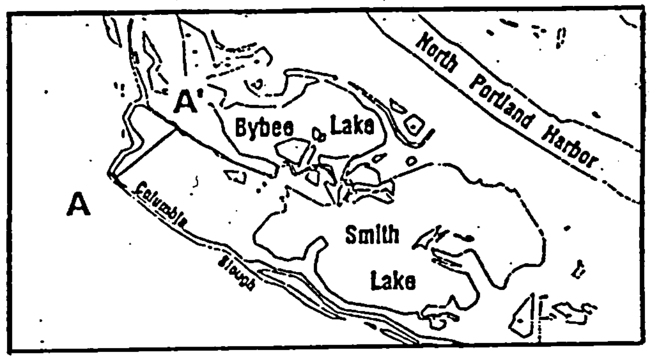


Figure 7. Cross-section A-A′



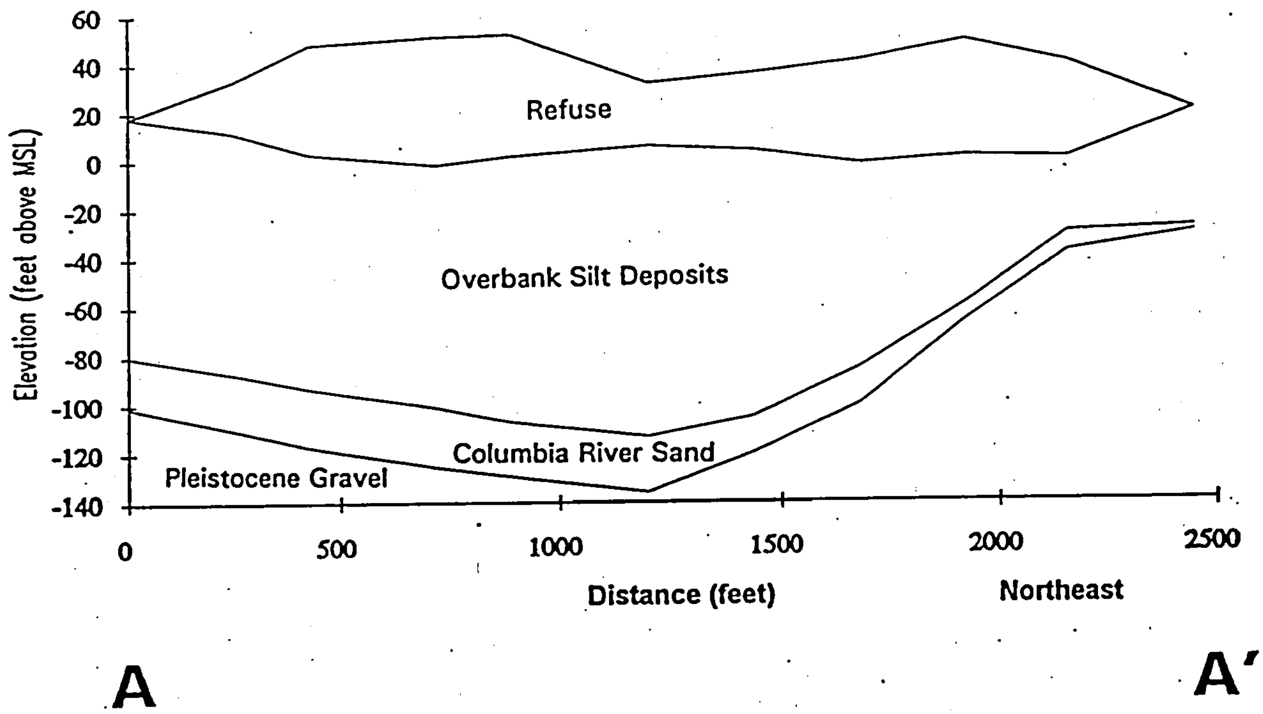
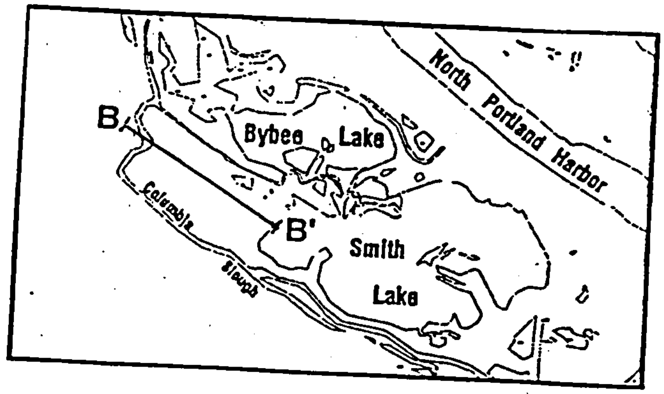
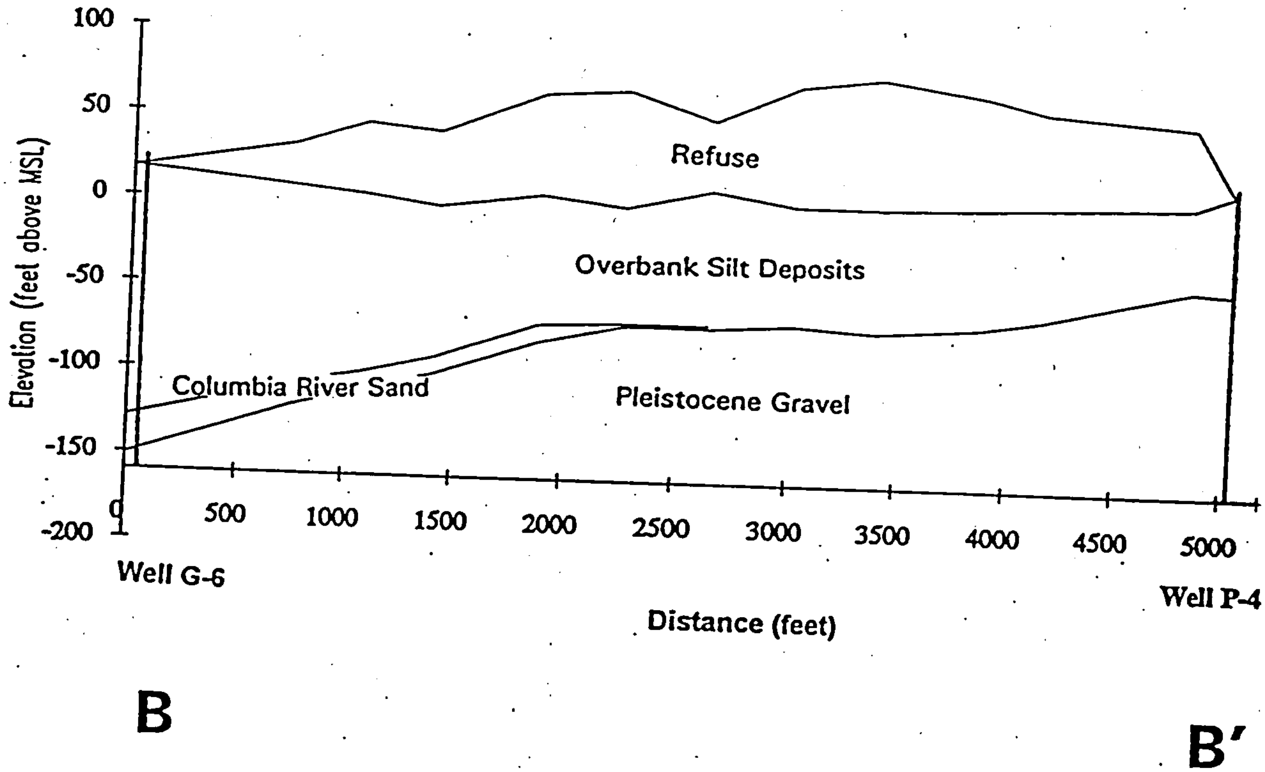


Figure 8. Cross-section B-B′





ADDENDUM NO. 1
TO THE REQUEST FOR PROPOSALS
FOR GROUNDWATER MODELING FOR THE ST. JOHNS LANDFILL

The following additions and deletions to RFP #93R-43-SW, dated September 1993, hereby become part of the RFP document. It is essential that all potential proposers note the contents of Addendum No. 1 and that Metro be made aware that each proposer received this addendum. Therefore, please state in the proposal that you received this addendum.

1. Page 1, paragraph 1, I. Introduction, and
   Page 2, second-to-last paragraph, VIB. Proposal Instructions, Deadline

   Proposal due date changed from Tuesday, October 19, 1993, at 3:00 p.m. to Monday, October 25, 1993, at 12:00 Noon.

2. Page 1, paragraph 2, I. Introduction

   Dates of interviews, if required, changed from Monday and Tuesday, October 18 and 19 to Monday and Tuesday, November 1 and 2.

3. Page 2, paragraph 3, VIA. Proposal Instructions, Submission of Proposals

   Provide Metro six (6) copies of the proposal, rather than three (3) copies.

4. Page 4, last two paragraphs, VIIE. Proposal Contents, Cost/Budget

   Contingency amount changed from $50,000 to $30,000.

5. Page 5, first paragraph, VIIF. Proposal Contents, Technical Information

   ADD the following:

   "Model Approach:

   (4) Describe modeling approach to develop: (a) transient flow model; and (b) non-conservative solute transport model.

   Calibration:

   (5) Indicate how close you will calibrate the model results: (a) to the groundwater surface elevations observed in the existing groundwater wells/piezometers (±feet) for the transient flow model, and (b) to the contaminant concentrations for the nonconservative solute transport model.

   Pre- and Post-processing Modeling Interfaces:

   (6) Describe pre- and post-processing modeling interfaces to be used and form of output to be attained: (a) with transient flow model, and (b) with non-conservative solute transport model.

6. Changes in Form 1. Technical Information (see attached for additions/deletions; additions are shaded and deletions are struck through).

7. Changes in Form 2. Cost Proposal Form (see attached for additions/deletions; additions are shaded and deletions are struck through).

8. Changes in Scope of Work (see attached for additions/deletions; additions are shaded and deletions are struck through).

9. Additional permeability test data for H-wells to be added to Table 1 (see attached).

Joanna R. Karl

Joanna Karl, P.E., Senior Engineer

10/13/93

Date

S:\SHARE\KARL\GWATER.AD1

Form 1. TECHNICAL INFORMATION

Model Choice:

(1) Indicate model(s) which is (are) appropriate to this project and your expertise in its (their) use.

(2) Specify the task(s) or subtask(s) for which each model is appropriate.

(3) Indicate how the model(s) could be adapted, if needed, for this project.

Model Approach:

(4) Describe modeling approach to develop: (a) transient flow model; and (b) non-conservative solute transport model.

Calibration:

(5) Indicate how close you will calibrate the model results: (a) to the groundwater surface elevations observed in the existing groundwater wells/piezometers (±feet) for the transient flow model, and (b) to the contaminant concentrations for the nonconservative solute transport model.

Pre- and Post-processing Modeling Interfaces:

(6) Describe pre- and post-processing modeling interfaces to be used and form of output to be attained: (a) with transient flow model, and (b) with non-conservative solute transport model.

(7)

Form 2. COST PROPOSAL FORM

REQUIRED TASKS:

I. Model Construction ____________

II. ~~Steady-state~~ Transient Flow Conditions ____________

SUBTOTAL (not-to-exceed): ____________

OPTIONAL TASKS (not-to-exceed): ~~$50,000~~ $30,000

~~III. Seasonal Transient Flow Conditions~~
III. Non-Conservative Transport Solute Model

IV. Model Applications
(1) Contaminant Transport
(2) Leachate Collection System
(3) Drawdown in the Lakes
(4) Intertidal Habitat in Bybee Lake

TOTAL CONTRACT COST ____________

(Attach Cost/Hour table)

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(8)

SCOPE OF WORK

GROUNDWATER MODEL OF THE ST. JOHNS LANDFILL

PROJECT OBJECTIVE

To select, construct, and calibrate a three-dimensional, ~~steady-state~~ numerical ground water model that will simulate groundwater flow patterns and contaminant transport in the St. Johns Landfill area using existing data. The model shall be capable of calculating reasonable estimates of mass loading of pollutants to surface water surrounding St. Johns Landfill. All work shall be completed no later than June 30, 1994.

EXISTING DATA

Metro's data has been gathered from a number of different sources, including the following:

(1) Water quality monitoring (required by Metro's permit with DEQ) was performed by CH2M Hill from 1985.

(2) Permeability data was gathered by Sweet-Edwards/EMCON when they drilled the G-wells, and by Cornforth Consultants when drilling the J-borings to verify the results of a geophysical study at the perimeter of the landfill. Permeability data for soil under the solid waste was gathered by Cornforth Consultants when drilling the H-wells.

(3) Continuous water level data at selected wells and points in the slough was collected by Portland State University (PSU) researchers.

(4) Continuous water level data at newly constructed piezometer clusters (P-series) is being gathered by Metro.

A matrix of the data Metro will provide is shown in Tables 1 and 2 appended to this scope of work. Table 3 shows the vertical depths of each well. Table 4 is a list of related reports, providing information and data for the area. Figures 1, 2, and 3 show the general area and well locations. Additional information, such as the well logs, is available at Metro.

Metro will also provide mapped contours of the subsurface, which will be digitized data in the state plane coordinate system. Metro will provide the Contractor both the maps and the electronic data from which the maps were produced.

The regional boundaries to which the digitized contours extend are shown in Figure 1. The digitized maps use ArcInfo, a Geographic Information System. The following digitized maps will be provided: top of Pleistocene gravel, top of Columbia River Sand, top of recent overbank silt deposits, and existing ground surface, as well as the bottom of the dredged sand fill in the area northeast of the landfill (Ramsey Lake).

Total Maximum Daily Loads (TMDLs): The Oregon Department of Environmental Quality (DEQ) is currently in the process of setting and allocating Total Maximum Daily Loads (TMDLs) for the Columbia and North Sloughs, which are adjacent to St. Johns Landfill. Metro can help to establish the landfill's TMDL allocation by determining seepage and pollutant loading.

Feasibility Study for Treatment of Combined Sewer Overflows through Constructed Wetlands: This July 1992 study by Black and Veatch addresses the feasibility of implementing a constructed wetlands treatment system at the Ramsey Lake site (in the Rivergate Industrial District) for the treatment of up to four combined sewer overflow (CSO) outfalls and some localized stormwater flows. The geotechnical study included some borings and monitoring wells with permeability tests.

REQUIRED TASKS - All required tasks for model development shall be accomplished in order to develop the non-conservative solute transport model in Task III and apply models as listed in Task IV. The required tasks shall be completed no later than March ~~1~~ 15, 1994.

I. MODEL CONSTRUCTION

The completed model shall utilize existing Metro data, as well as other existing data sources, to provide Metro with a tool capable of simulating the scenarios in Task IV of this Scope of Work. To ensure the Contractor's product will meet the needs of Metro, the Contractor shall obtain approval of the conceptual approach and the model selection from Metro prior to construction of the model. The constructed model shall also be presented to Metro at the completion of Task I of this scope. Metro approval shall be obtained before proceeding to Task II. Contractor shall provide to Metro short written summaries of all presentations, explaining assumptions.

1. Conceptual Approach - Contractor shall propose and justify Contractor's conceptual approach to modeling the St. Johns Landfill region. Contractor shall consider any physical, chemical, and biological processes which may affect the problem.

2. Select Appropriate Model - Contractor shall propose a mathematical computer model that can simulate steady-state groundwater flow patterns in three dimensions under various conditions (including variation of groundwater surface elevations and surface water elevations across seasonal highs and lows). The model may employ finite difference or finite element methods. Contractor shall justify Contractor's model selection.

3. Grid Design - Contractor shall design a model grid or mesh that is capable of simulating the scenarios described in Task IV of this scope, including both existing (leachate collection system under about one-fourth of the landfill) and possible future leachate collection schemes.

3. <u>Documentation</u> - Contractor shall provide to Metro a short written summary of Contractor's inputs and assumptions, as well as a sensitivity analysis to all inputs/assumptions.

4. <u>Steady-state Simulation</u> - Determine the number of years to reach steady-state condition, and the size of the leachate mound based on Metro's closure sequence (i.e., Subareas 1 and 2 are currently closed, Subarea 3 will be closed in 1994, and Subareas 4 and 5 will be closed by the end of the 1996 construction season).

3. <u>Drawdown in the Lakes</u>. Determine the effect of drawdown in Smith and Bybee Lakes on the rate of movement of contaminants away from the St. Johns Landfill.

4. <u>Intertidal Habitat in Bybee Lake</u>. Assess the effect on groundwater flow in the region if Bybee Lake or a portion of the lake were to be returned to intertidal habitat (i.e., Bybee Lake directly connected to Columbia Slough and its associated daily/seasonal surface water elevation changes).

Permeability Test Data

Sample Designation	Cell Pressure (psi)	Head Pressure (psi)	Backpressure (psi)	Final B	k (cm/sec)
H-1, S-18	80.9	58.0	55.0	0.82	$1x10^{-6}$
H-1, S-18	81.8	60.0	55.0	0.86	$9x10^{-7}$
H-1, S-18	82.8	62.0	55.0	0.84	$9x10^{-7}$
H-2, S-12	80.8	58.0	55.0	0.68	$3x10^{-7}$
H-2, S-12	81.8	60.0	55.0	0.84	$2x10^{-7}$
H-2, S-12	82.8	62.0	55.0	0.90	$2x10^{-7}$
H-2, S-12	89.1	58.0	55.0	0.74	$2x10^{-7}$
H-2, S-12	90.1	60.0	55.0	0.94	$2x10^{-7}$
H-2, S-12	91.1	62.0	55.0	0.94	$2x10^{-7}$
H-3, S-14	80.8	58.0	55.0	0.72	$3x10^{-7}$
H-3, S-14	81.8	60.0	55.0	1.0	$3x10^{-7}$
H-3, S-14	82.8	62.0	55.0	--	$3x10^{-7}$
H-3, S-14	89.1	58.0	55.0	0.94	$3x10^{-7}$
H-3, S-14	90.1	60.0	55.0	1.0	$2x10^{-7}$
H-3, S-14	91.1	62.0	55.0	1.0	$2x10^{-7}$
H-5, S-16	80.8	58.0	55.0	0.76	$4x10^{-6}$
H-5, S-16	81.8	60.0	55.0	0.82	$4x10^{-6}$
H-5, S-16	82.8	62.0	55.0	0.82	$4x10^{-6}$
H-5, S-16	89.1	58.0	55.0	0.86	$3x10^{-6}$
H-5, S-16	90.1	60.0	55.0	0.86	$3x10^{-6}$
H-5, S-16	91.1	62.0	55.0	0.86	$3x10^{-6}$

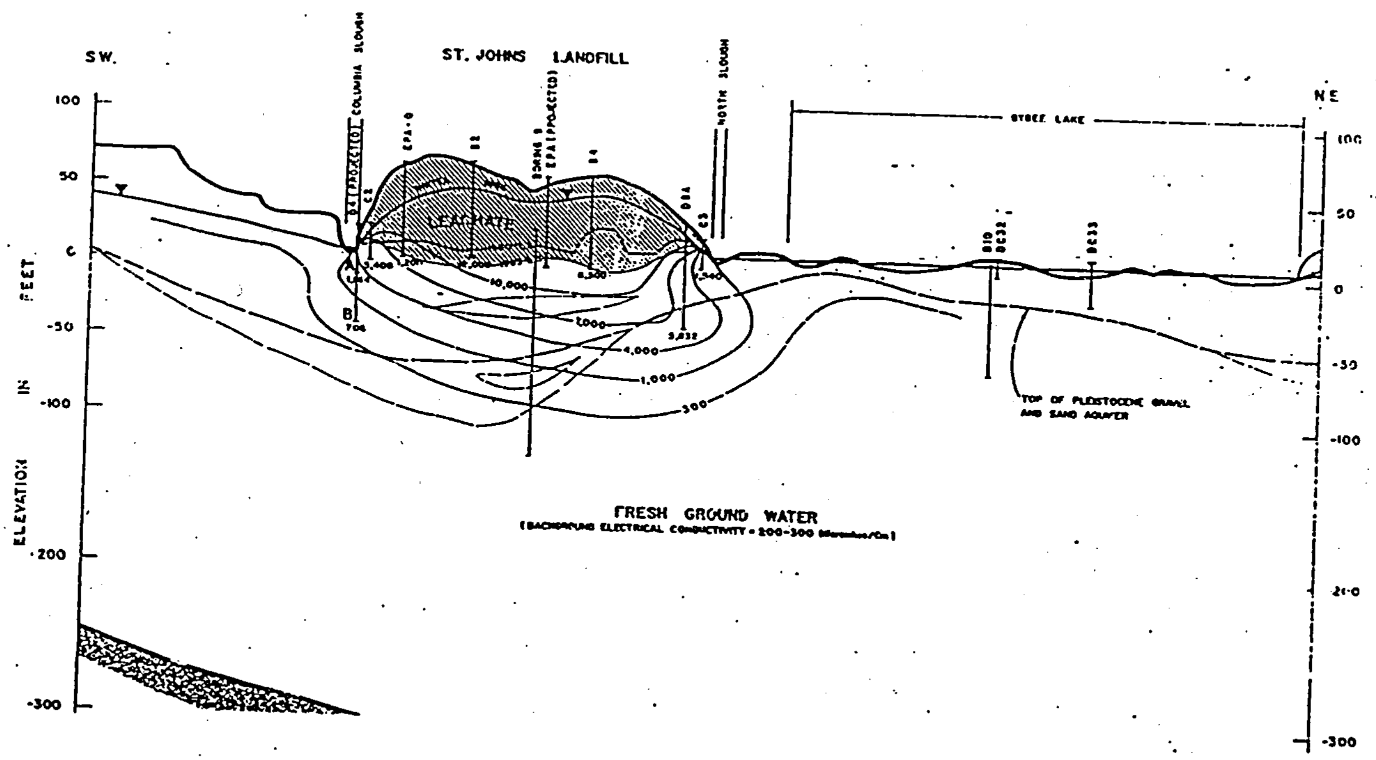
5

METRO

Solid Waste Department (RFP #93R-43-SW)

Joanna Karl, P.E., Project Manager

GROUNDWATER MODELING SERVICES FOR
ST. JOHNS LANDFILL, PORTLAND, OREGON



October 25, 1993

LHS Proposal

In Association with
Foundation Engineering

Luzier Hydrosciences

LUZIER HYDROSCIENCES
Two Gershwin Court, Lake Oswego, Oregon 97035
Fax (503) 636-7664 *(503) 636-1012*

October 25, 1993

Joanna Karl, P.E., Project Manager
METRO Solid Waste Department
600 NE Grand Avenue
Portland, Oregon 97232-2736

Re: **Request for Proposals (RFP#93R-43-SW):**
Groundwater Modeling Services for St. Johns Landfill

Dear Ms. Karl:

Luzier Hydrosciences is pleased to submit this proposal to conduct groundwater modeling services for Metro. Jim Luzier, P. G. (Geohydrologist with 31 years experience in groundwater hydrology modeling applications), Joe Gonthier, P.G., and A. Scott Yankey (LHS experienced Hydrogeologists), and Rick Thrall, P.E. of Foundation Engineering (Geotechnical Engineer with 12 years experience), will work closely with you to accomplish the activities defined in the scope of work.

Jim Luzier, Project Manager for the St.John's modeling effort, and Rick Thrall, have worked together on many projects of above average complexity, including on-site experience with subsurface investigations and waste/sediment consolidation issues at St. Johns Landfill. First hand experience and understanding "how things work" (such as consolidation impacts on leakage and permeability within and beneath the landfill), will ensure full consideration in the critical early stages of model selection, design, and calibration.

More than 50 years of field investigations and monitoring have produced a large amount of scientific and engineering information on groundwater and surface water interaction in the vicinity of St. Johns Landfill. In essence, most of the field investigations required for designing and testing a reliable groundwater/surface water interaction model are available, but extraction of usable data will require considerable effort and experience.

Previous studies in the landfill area generally were focused to solve specific local area problems at different times of the year, over a period of decades under highly variable environmental and constantly changing site conditions. Unlike a natural groundwater flow system, the internal structure of the St. Johns Landfill is constantly and nonuniformly deforming, with continuous variation in leachate levels, output, quality, recharge, and tidal/flood response in the natural system surrounding the landfill.

The "live" and complex nature of the landfill/groundwater flow system must be recognized and considered in the interpretative process of formulating a reliable groundwater modeling approach. Some of the factors that could have a significant impact on flow and transport in the immediate area of the landfill are as follows:

- St. Johns Landfill has grown steadily in size and mass until recently. Its massive weight has deformed and is compressing the soft floodplain sediments on which it rests,
- Permeability reductions probably have taken place within the underlying protective layer due to loading, along with soil shearing in the perimeter regions of the landfill,
- Leachate hydrostatic levels within the landfill can be misleadingly elevated in parts of the landfill during the most gaseous production phase of waste decomposition,
- Waste loading and capping of the landfill, and installation of vacuum and leachate collection systems, also affect the degree of gas entrainment and hydrostatic fluctuations in the saturated portions of the waste,
- The driving force for leachate leakage, and the composition of the leachate, have been highly irregular during the filling period, but the variability in these two parameters should decrease during the closure period.

The LHS team has hands-on experience and a record of accomplishment at St. Johns Landfill unmatched by most other firms. Our special blend of professional specialties in groundwater modeling, contaminant geochemistry, geotechnology, and on-site experience, will expedite the front end review effort and jump-start the goundwater modeling effort. We offer a customized personal approach and senior level of experience not usually applied by large firms, while retaining the flexibility, direct availability, and affordability of smaller firms.

Luzier Hydrosciences and Foundation Engineering (a fully qualified minority small business), look forward to working with you on the St. Johns groundwater modeling project, and we promise our best efforts to complete the project on time and within budget to the satisfaction of METRO.

This proposal for groundwater modeling services continues on the following pages and it is valid for a period of ninety (90) days.

If you have any questions or need additional information, please contact me.

Sincerely,

LUZIER HYDROSCIENCES

James E. Luzier, P.G., Geohydrologist

Attachments: Proposal Continuation: Groundwater Modeling Services for St. Johns Landfill
Appendix: Luzier Hydrosciences key resumes and selected project graphics.
Foundation Engineering key resumes and qualifications.

Proposal: Groundwater Modeling Services, St. Johns Landfill, Portland, Oregon

Luzier Hydrosciences has prepared a concise proposal and scope of work on the following pages for the proposed groundwater modeling services. Our technical proposal starting with the cover letter, encompasses all elements of the METRO'S Request For Proposal and Addendum NO.1 *(RFP#93-43-SW)*. The elements of the proposal are discussed below in the sequence and letter designation as presented by METRO.

B. APPROACH AND PROJECT WORK PLAN

We propose to conduct a one-half day project initiation workshop as a kick-off approach which would involve interested parties invited by METRO. We have found by experience that early involvement by interested parties, can help focus the modeling effort and set the stage for a successful project.

We are prepared to begin work immediately upon your Notice to Proceed. We anticipate the following time schedule:

- Month 1 - Start Tasks I and II, review, hydro-mapping updates, select/setup model.
- Month 2 - Finalize field response tests, initial layer parameters, start calibration runs.
- Month 3 - Flow calibration and matching to field conditions.
- Month 4 - Complete transient model calibration, training, documentation memo.
- Month 5 - Start Tasks III and IV, calibrate contaminant parameters and assumptions.
- Month 6 - Continue with transport calibration and scenario tests.
- Month 7 - Complete transport applications, training, documentation memo.

Tasks I and II will be completed by March 15, 1994, and we will finish the project by June 30, 1994, provided we receive timely notice to proceed after award of the project.

C. STAFFING AND PROJECT MANAGER DESIGNATION

Jim Luzier (estimated project time 42 percent) will be the Project Manager responsible for day to day contact with Metro. He will be responsible for contractual and budget issues, scheduling, subcontractors, and the timely submission of deliverable items. Jim Luzier will be in charge of the modeling and directly perform a substantial portion of the groundwater modeling with assistance from Scott Yankey. He will maintain direct responsibility for the quality of the technical product.

A. Scott Yankey (project time 40 percent), will assist Jim Luzier in review and developing the model, and will perform a substantial role in calibration phases of the groundwater modeling.

Joe Gonthier, P.G. (estimated project time 5 percent) will help review existing information, update the physical aquifer framework with new data, and assist in conceptual analysis of the flow system.

Rick Thrall (Foundation Engineering, estimated project time 13 percent) will be responsible for evaluating the consolidation effects on hydraulic conductivity, porosity, potentiometric head, and the chemical effects on hydraulic conductivity. Rick is also familiar with recent work at the site including the new wells and piezometer installations, and will assist in evaluating leachate levels and properties of the perimeter landfill dike.

D. EXPERIENCE

Jim Luzier was responsible for a previous study of contamination potential from the St. Johns Landfill *(Smith and Bybee Lakes Environmental Studies, September 1987)*. Geohydrologic framework information presented in the report included a series of structural contour maps for layers throughout the landfill region and beneath the landfill. Depths to pleistocene gravels and sand were used to develop the drilling quantity estimates for the METRO groundwater monitoring well improvements and piezometer installation work completed in late 1992. The contour maps which were compiled from widely spaced boring information from old files, were proven to be remarkably accurate, resulting in a successful drilling and testing project *(As-Built Information, Groundwater Monitoring Well Improvements and Piezometer Installation, January, 1993)*.

Jim Luzier has personally performed many groundwater/surface water modeling calibration projects of above average complexity. Selected written and graphic examples of relevant projects are included in the Appendix, and briefly discussed in the resume.

A. Scott Yankey who will assist Jim Luzier in the groundwater modeling, has worked closely with Jim for 3 years on the Illinois Low Radioactive Waste Project in analyzing buried valley aquifer tests, hydrogeologic mapping, and review of multilayer modeling of buried valley deposits.
Joe Gonthier, former colleague of Jim Luzier in the USGS, has exceptional experience in hydrogeology of the Portland Basin and Oregon in general, as shown by his list of publications and his resume.

Rick Thrall from 1990 to 1993, was the project geotechnical manager in charge of geotechnical design and construction work during the $30 million St. Johns Landfill closure project. Technical work for which he was directly responsible includes the following:

- Design and installation of a comprehensive network of monitoring wells and automated multilevel piezometers. Over 30 wells were abandoned, improved, or installed. Nine clusters with up to five electrical pressure sensors each were installed into Columbia River Alluvium and underlying gravels to depths of up to 170 feet.
- Design, preparation of construction documents, and CQA monitoring for earthwork construction of several phases of the landfill cover. This work included evaluation of the existing clay for reuse in the new landfill cover.
- Explorations and qualitative evaluation of leachate migration through perimeter dikes.
- Permeability testing of sediments taken from directly beneath the refuse during installation of the H-wells. Foundation Engineering performed the flexible wall laboratory permeability tests.
- Four monitoring wells at the landfill were evaluated by Luzier Hydrosciences using a proprietary method for evaluating leakage and settlement damage.
- Evaluation of long-term settlement of Columbia River Alluvium and refuse and design, preparation of construction documents, and CQA of a preload program to minimize future distress to the liner system.

Rick was also the project engineer for feasibility studies for constructed wetlands at the Ramsey Lake site located adjacent to the St. Johns Landfill.

E. Costs and Budget

FORM 2. -- COST PROPOSAL FORM

REQUIRED TASKS:

Task I - Model Construction	$14,000.00
Task II - Transient Flow Conditions	$36,000.00
SUBTOTAL (not-to-exceed)	$50,000.00

OPTIONAL TASKS (not-to-exceed):

Task III - Non-Conservative Transport Model Task IV - Model Applications (1) Contaminant Transport (2) Leachate Collection System (3) Drawdown in the Lakes (4) Intertidal Habitat in Bybee Lake	$30,000.00
TOTAL CONTRACT COST	$80,000.00

COSTS PER HOUR BY TEAM MEMBER:

Jim Luzier, P.G., Project Manager/Groundwater Modeling	$ 96.50
Rick Thrall, P.E., Consolidation Mechanics/Permeability	$ 76.50
Joe Gonthier, P.G, General Hydrogeology	$ 72.50
A. Scott Yankey, Hydrogeology/Groundwater Modeling	$ 72.50
Janet Bane, Technical Typist/Data Processing, Admin.	$ 34.50

Additional Cost Breakdowns:	Task I, II	Task III,IV
Est. Computer Time/Software Costs	$2,000.00	$1,800.00
Travel, Reproduction, Misc. Expenses	$ 200.00	$ 200.00
Foundation Engineering Subcontract Portion	$8,200.00	$2,200.00

F. TECHNICAL INFORMATION

FORM 1. TECHNICAL INFORMATION

Model Choice:

(1) Models appropriate to this project: Groundwater modeling at St. Johns Landfill will require a multilayer analysis with capability for solute transport in 4 to 6 layers. Several fully integrated multilayer transport models such as HST3D, are available and used by LHS for injection/recovery experiments and seawater intrusion simulation. However, fully integrated transport models (with temperature, density, flow, and concentration), such as HST3D or equivalent models, are cumbersome and not appropriate or flexible enough for handling the complicated, time varying boundary conditions at St. Johns Landfill. Such models require extensive training and experience, and they have a voracious appetite for data which is rarely available.

We propose two optional modeling strategies for METRO to consider. Each option permits a high degree of interactive, hands-on modeling (on-screen watch it happen and save it), that will enhance the usefulness of the model to METRO staff, and speedup the modeling effort by LHS.

Modeling Option 1: MODFLOW (3D FLOW) AND RAND3D OR INTERTRANS (3D TRANSPORT)

Modflow is the most widely used groundwater flow model in the U.S., and it is perfectly suited to the Tasks I and II transient and steady-state flow analysis of the St. Johns Landfill region.

Rand3D and Intertrans are fully interactive on-screen multilayer transport models which read the Modflow run output (in effect, Modflow is used as the number cruncher for heads, flows, and water budgets). Rand3d and Intertrans models would be applicable to Tasks III and IV, and produce concentration subarea maps and cross-sections interactively on-screen, with output concentrations in lbs/day. The user may observe the subsurface movement of thousands of contaminant particles in color, for any user specified time period (time of travel), or model area. Input variables include retardation, radioactive decay, 3D dispersion coefficients, porosity, and contaminant concentration (continuous or one time sources by subarea), for every aquifer and each confining layer.

Luzier Hydrosciences has used Modflow on more than 30 groundwater multilayer modeling projects, and has used Rand3d, HST3D, and the Konikow-Bredehoef MOC transport models on about 14 projects *(see graphic examples of selected projects in Appendix)*.

Modeling Option 2: INTERSAT (3D FLOW) AND INTERTRANS (3D TRANSPORT)

This modeling option basically replaces Modflow (which is not interactive), with the fully interactive Intersat flow model for use in Tasks I and II. Intertrans is then used in the same way as described above for Rand3d in Tasks III and IV, with output also in lbs/day. Option 2 provides a fully interactive, graphics based modeling program from start to finish, which may be desirable for calibration efficiency, and ease of use and understanding by METRO staff. Luzier Hydrosciences has not used the new commercial versions of Intersat or Intertrans, but the two programs have interesting features and internal modules not available elsewhere that could expedite the modeling program and ensure usability by METRO. We recommend consideration of both Options 1 and 2 early in the project, and have included time material costs for software purchase and brief demonstration tests for METRO.

(2) **Applicability of models to the assigned tasks:** The flow models Modflow and Intersat are each applicable and to Tasks 1 and II, and either model can provide the necessary flow and physical framework parameters for modeling solute transport interactively in Tasks III and IV, using either Rand3d or Intertrans.

(3) **Model Adaptations for the project:** Luzier Hydrosciences uses large memory Lahey F77 compilers and has the capabilty to recompile source code for improved output, execution time, and memory management on the Intel 486 Workstations. We do not anticipate a need for code changes or additions to any models discussed above and have not included costs for such effort.

Modeling Approach:

(4a) Transient flow modeling Approach: The METRO monitoring files and previous studies will be searched for large scale events with suitable information on aquifer response, that can serve as a check on transient performance of the flow model. Field response events need to be of large scale to be recognized within the background noise, and very well controlled as in the case of several unpublished aquifer tests on the floodplain. Possibly a flood event can be reconstructed as a test of calibration providing groundwater data is available for matching.

We anticipate that the flow/transport modeling framework grid will consist of a minimum of 4 layers and possibly 5 layers, at a minimum resolution or cell dimension of about 20 to 100 feet extending over much of the immediate area of the landfill, and extending outward to natural flow boundaries of the groundwater flow system (Columbia and Willammette Rivers). The fine grid is needed for local area evaluations in which the resolution accuracy is needed to define local area features such as leachate drains, dikes, sloughs, lakes, channels, leakage parameters, and layer thickness.

The St. Johns Landfill region has been mapped extensively by METRO and its consultants. These maps in digital format from METRO, will serve as the primary basis for model layering. The uppermost layer consists of low permeability overbank deposits, lakes, sloughs, and the landfill mass. A second layer may consist of a deeper subdivision of the overbank deposits, underlain by the Columbia River sand, which is in turn underlain by the Pleistocene Gravels. A possible 5 th layer, may consist of the Troutdale Formation or in part, a deep subdivision of the Pleistocene Gravel.

The widely used Modflow groundwater flow model, or the Intersat flow model, will be used to model the aquifer. These models have simulation capability unmatched by other models such as:

- complicated and variable timed stress periods for any number of field situations,
- groundwater/lake/slough/river water interactions, recharge, and bottom leakage calculations,
- evapotranspiration and variable distribution and timing of recharge by subarea,
- groundwater drains such as infiltration galleries, or excess groundwater flow to or from ditches.

The regional modflow model grid will be fine enough vertically and horizontally to define all lakes and drainage features, so that leakages and local area drawown/recovery influences can be quantified and hydrographed as need to answer the RFP study conclusions. The results of the PSU Lower Columbia Slough system study will be used in the calibration process. The modeling calibration scenarios may be transient, seasonally averaged runs with recharge distribution, perhaps as a variable percentage of rainfall by subarea.

Our modeling goal is to produce a reasonably good degree of model matching to field data and general field observations, sufficient to answer the study conclusions with confidence. The matching process must be commensurate with the quality of representative field data, and the magnitude of the stress induced variations being simulated.

Consolidation Effects on Hydraulic Conductivity: Loading of the soft alluvium has been occurring since filling began in the mid 1930's. Rick Thrall, in his previous engineering work on the landfill, has charted the progress of filling and estimated consolidation with time for three points in each of the subareas and the power line corridor. This technical analysis was performed in order to estimate of settlement in the floodplain alluvium for the closure and preload areas. The details of this settlement analysis are unpublished but are available from METRO's engineering consultant files.

The significance of settlement within the alluvial sediments is as follows:

- Settlement results from the reduction of pore space between the sediment grains,
- As the sediment pore space is reduced, the hyraulic conductivity is reduced,
- The stress causing the sediment settlement is highest just below the refuse load, and decreases with depth beneath the refuse,
- Two critical parameters to contaminant transport, effective porosity and hydraulic conductivity, are thereby impacted and these effects must be approximated in the modeling analysis.

We propose to estimate the reduction in hydraulic conductivity within the protective bottom layer of the landfill based on loading versus hydraulic conductivity measurements on existing tests at the landfill and adjacent Ramsey Lake site. Theoretical estimates of hydraulic conductivity estimates will also be made based on void ratio reductions .

Consolidation Effects on Potentiometric Head: Consolidation causes an increase in porewater pressure in the saturated zone beneath and within the landfill. The depth of influence of pressure increase is approximately twice the width of the landfill, which is well below the bottom of the soft overbank sediment layers. This increase in porewater pressure will influence readings in piezometers and wells surrounding and within the landfill. Therefore, the calibration of a reliable groundwater model will need to recognize and account for the effects of increased potentiometric pressures due to the consolidation effects.

This special knowledge will assist the team in evaluating the overall physical condition and long term behavior of the overbank sediments beneath and adjacent to St. Johns Landfill.

Chemical Effects of Leachate on Soft Alluvium: Rick Thrall, in previous engineering landfill design work has studied the long term effects of leachate chemistry on naturally occuring fine grained materials. Rick would carry out evaluations for leachate/soft alluvium contact at the St. John's Landfill.

Condition of Perimeter Dike: The landfill is surrounded by a perimeter dike consisting of approximately 10,000 lineal feet of uncontrolled fill on the south, west, and north portions of the site. The northeast, east, and southeast portion of the landfill is surrounded by a controlled fill dike.

The condition of the uncontrolled fill portion of the perimeter dike is critical to the modeling effort. Studies pertinent to the perimeter dike are summarized in the following two technical memoranda which were submitted to METRO in the early part of the closure studies: i) Drilling and geophysical studies of the soil profile of the perimeter dike entitled "St. Johns Landfill Closure, Leachate Migration, Perimeter Dike", October 1990; and ii) Survey of location and estimated quantity of visible leachate seeps (reference not immediately available).

The study results show that the uncontrolled fill dike consists of varying thickness of soil fill mixed with refuse overlying soft alluvium. Two large pockets of refuse were encountered in the explorations. In-situ permeability tests were run within the mixed soil/refuse fill and underlying alluvium.

The soft alluvium is a natural levee formed adjacent to the sloughs. Examination of historic photos and topographic information indicated that several natural and man-made breaches were present in the natural levee. These were buried during construction of the dike.

The study concludes that the dike fill is presently acting as a partial hydraulic barrier between the slough(s) and the landfill. However, lateral migration of the leachate is occurring as evidenced by the seeps coming out of the dike.

(4b) Solute Transport Modeling Approach:

Once a mutually satisfactory flow model is calibrated, we can proceed to scenario tests interactively for various levels of contamination using leachate as the source. Several of the constituents that could be evaluated during calibration include chloride, ammonia, and hardness. Other constituents may be suitable based on a review of more recent data. Using Rand3D or Intertrans, we can experiment with several contaminants of interest and achieve the best possible match to field measurements.

Calibration:

(5a) Calibration matching to existing groundwater surface elevations for the transient flow model:

and

(5b) Calibration matching of contaminant concentrations for the solute transport model:

Luzier Hydrosciences will attempt to achieve the best possible match to head elevations in the flow system using potentiometric maps of observed versus computed head distribution patterns, and point by point comparisons, vertically and in plan view. The matching goal will be a goodness of fit commensurate with the limitations of the original field data, and the resolution or ability of the model to simulate the observed data points. This section is equally applicable to the transport modeling calibration process as well.

For example, if the gravel aquifer in the vicinity of the landfill has vertical head gradients of 2 feet per hundred feet of depth (or concentration gradients), but the only observed data point is a partially penetrating shallow well screen, an attempt to force a model match may look good but may be and probably is incorrect, particularly if the gravel layer (in model form), is very feet thick and has variable parameter properties. Tidal and atmospheric influences and sources also generate background interference noise near St. Johns Landfill, as well as the "snapshot" timing of the measurement period or periods.

Luzier Hydrosciences therefore cannot guarantee a precise level of matching to field groundwater elevations or to contaminant concentrations at this time. To do so would ignore the often forgotten warning of C.V. Theis *"Every model in every field contains simplifications that lead to results somewhat erroneous when applied to the prototype data. Errors may or may not be significant. Recall Mellor's statement -- Danger of the model imposing its concept on thinking about the real system." (Theis personal communication, USGS in-house San Mateo Groundwater Seminar, Aug. 19, 1966).*

Luzier Hydrosciences however, will work out a mutually agreed understanding with METRO staff in early phases of the modeling tasks to define reasonable and achievable calibration matching goals, based on a review and mapping of the observed data, the degree of control within the observed database, and a mutually agreed physical modeling framework.

Pre- and Post-Processing Modeling Interfaces:

(6a) Description and form of output with transient flow model: Modflow input and output is normally processed using Premod and Postmod, or one of the Modelcad or GIS systems. We are comfortable with any efficient system, but we prefer Golden Software for producing contour maps, with Postmod as the front end. The means of inputing the METRO supplied data surfaces and monitoring data will depend on model selection.

If Intersat is used, contouring and graphic displays are instantly available on screen, as well as file output for contouring packages. Data input and modeling is entirely interactive.

(6b) Description and form of output with non-conservative solute transport model: Both Rand3D and Intertrans are completely interactive transport models with results instantly available on screen in plan view or in cross-section, with output files for contouring.

G. EXCEPTIONS AND COMMENTS None.

APPENDIX

Luzier Hydrosciences

Frederick (Rick) G. Thrall, Ph.D., P.E.

Senior Consultant

Foundation Engineering

Rick Thrall directs the Portland Office operations and provides technical oversight and project management services for all Portland area projects. He also provides company-wide consultation for projects with difficult or unusual soil conditions.

Professional Career

Foundation Engineering, Inc., Portland, Senior Consultant. 1993 to Present.
Cornforth Consultants, Inc., Portland, Oregon, Associate. 1984 to 1993.
Golder Associates, Inc., Denver, Colorado, Geotechnical Engineer. 1981 to 1984.

Experience

Dr. Thrall has 12 years experience as a geotechnical engineer, including nine years based in Portland, Oregon. He has completed work on major Portland area projects including the West Side Light Rail Feasibility Studies, Bonneville Lock design and construction, Mt. St. Helens Sediment Retention Structure, and closure of the St. Johns Landfill.

Evaluation, design, preparation of construction documents, and CQA monitoring for geotechnical elements of the closure of the St. Johns Landfill, **METRO**, Portland.

Project Manager responsible for the monitoring and evaluation of 20 pumping tests involving up to eight observation wells each, **Corps of Engineers**, Fort Lewis.

Feasibility studies for constructed wetlands, combined sewer outfalls, and FERC safety studies of Bull Run Dam No. 2, Mount Tabor embankments and Washington Park Slide, **City of Portland**.

Design and construction of a contaminated groundwater barrier, collection, and treatment system, **City of Denver**.

Geotechnical and hydrologic investigations for burial impoundment of uranium mill tailings in Colorado and South Dakota; burial of refinery wastes in Kansas and Utah.

Stabilization of both the Faraday Canal Slide and Frog Lake Dam, **Portland General Electric**, Estacada, Oregon.

Mt. St. Helens Sediment Retention Structure and Bonneville Lock design and construction, several projects, and stability evaluations for the Elk Creek Dam, **Corps of Engineers**, Oregon.

Education

B.S., Civil Engineering, Oregon State University, Corvallis, Oregon, 1976.
Ph.D., Geotechnical Engineering, Oregon State University, Corvallis, Oregon, 1981.

Foundation Engineering

Professional Geotechnical Services

7460 SW Hunziker Road, Suite D
Portland, OR 97223-8252
Phone: (503) 684-9514
Fax: (503) 598-9343

Foundation Engineering is an Oregon based geotechnical consulting firm with offices in Portland and Corvallis. Our professional staff of five geotechnical engineers provide a full range of services including:

- Foundation investigations
- Feasibility studies
- Field explorations
- Engineering consultation
- Forensic investigations
- Instrumentation/monitoring
- Design services
- Computer analysis

Foundation Engineering's ICBO certified laboratory is fully staffed and well equipped, offering a complete range of testing services for soils, aggregate, concrete and asphalt. Specialized laboratory services include triaxial strength and permeability testing.

Foundation Engineering has been delivering quality geotechnical services since 1982. With an extensive list of projects completed throughout Oregon, Washington and California, Foundation Engineering has experience in all types of construction, shallow and deep foundations, and sites with troublesome soil conditions. We pride ourselves on the ability to meet urgent time schedules when required. Project experience includes:

- Civil and Industrial Projects
- Landslide and Slope Repair
- Water Supply, Treatment Facilities and Reservoirs
- Bridges
- Treatment Lagoons and Storage Ponds
- Warehouses, Silos and Storage Facilities
- Parking Structures
- Office Buildings
- Waste Water Treatment Facilities
- Roads and Airport Pavements
- Medical Facilities
- Schools
- Restaurants, Banks and Churches
- Communication Towers
- Housing, Motels and Apartments
- Retail Shopping Centers

Examples of specific projects as well as references are available upon request.

Certified MBE/DBE, Oregon Number 2282

LHS REFERENCES

East Bay Municipal Utility District (EBMUD) Watershed Balance/Reservoir Hydrology
P.O. Box 24055
Oakland, California 94623
Contact: Richard Sykes, P.E, Remediation Manager (510) 287-1629

Manke Lumber Company, Inc. Oregon WRC ClosureHearings, Deep Basalt Drilling
1717 Marine View Drive
Tacoma, Washington 98422
Contact: Holly Manke-White, Property Manager (206) 842-4954

Coos Bay North-Bend Water Board Coastal Dunes Wellfield Hydrology/Geochemistry
P.o. Box 539
2305 Ocean Boulevard
Coos Bay, Oregon 97420
Contact: Phil A. Matson, General Manager (503) 269-5370

City of Gold Beach Beach Aquifer Modeling for Seawater Impacts/Wastewater
510 S. Ellensburg Ave.
Gold Beach, Oregon 97444
Contact: Bill Curtis, City Administrator (503) 247-7029

City of Port Orford Dunes Aquifer Modeling/Subsurface Wastewater Disposal
555 W. 20th St.
P.O. Box 310
Port Orford, Oregon 97465
Contact: Dean Madison, City Manager (503) 332-3681

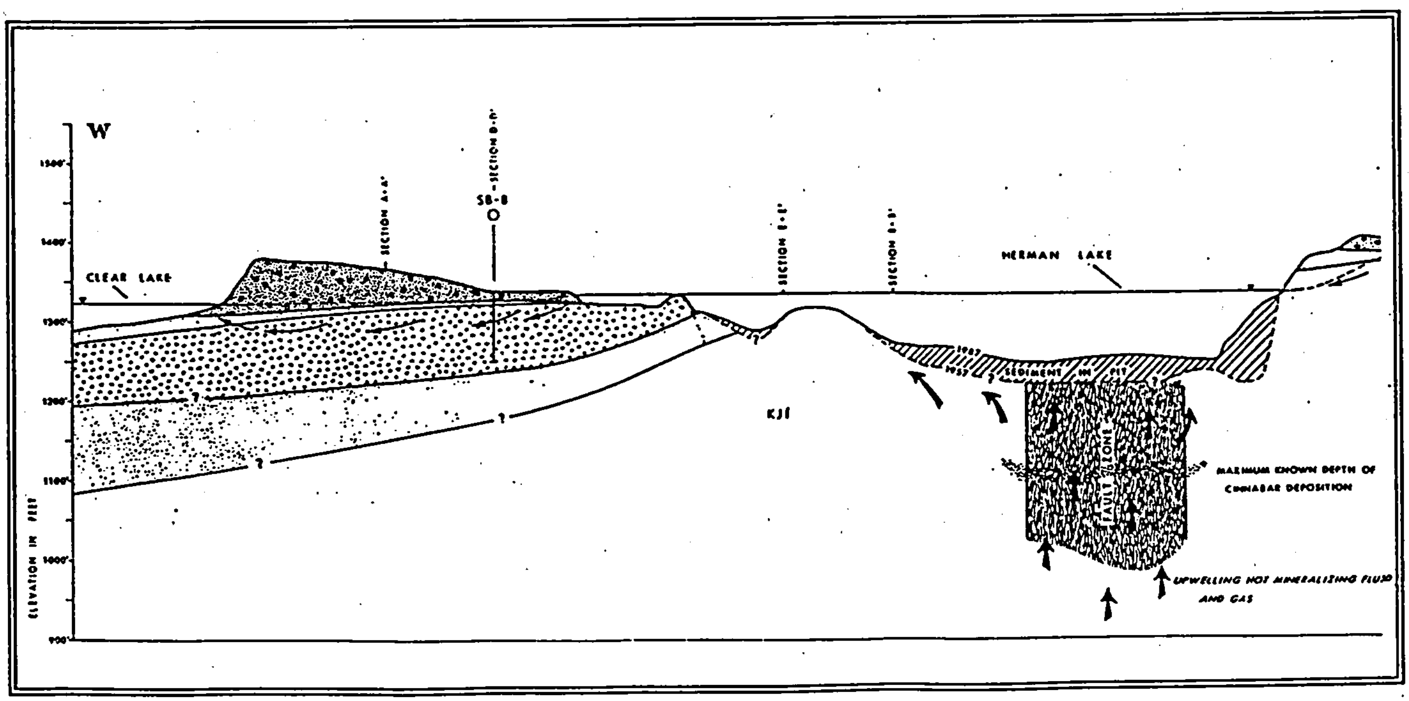
Shannon & Wilson, Inc. Wellfield Dewatering Models Tunnels & Landslides
11500 Olive Blvd., Suite 276
St. Louis, MO 63141
Contact: Rich Frueh, P.E. (314) 872-8170

City of Portland Water Bureau Wellfield Modeling for 100 MGD, Hydrogeochemistry
Bureau of Water Works
1120 SW 5th Ave.
Portland, Oregon 97204
Contact: Robert F. Willis, P.E., Deputy Chief Engineer (503) 823-7482

MINE ABATEMENT EXPERIENCE
SULPHUR BANK MERCURY MINE:
Geohydrology & Remediation, Clear Lake, CA.

Sulphur Bank Mine is an EPA Superfund Site and it constitutes one of the richest hydrothermal mercury sulphide deposits in the world. Deep-seated geothermal springs and gases deposited cinnabar ore containing about 7,000 tons of mercury during the past 40,000 years. The main ore body occupies a major fault zone cutting basalt, lake sediments, and metamorphic rocks. About 5,000 tons of mercury have produced during the past 100 years from mine adits, shafts, and open pits. A large ammonia-rich acid lake about 90 feet deep and 23 acres in size (a Toxic Pit), has formed in the mine workings. Jim Luzier, Al Waibel, and Roy Koch performed mine abatement studies for Bradley Mining Company of San Francisco, under the California Toxic Pits Classification Act, and a comprehensive Hydrogeological Assessment Report (HAR) in 1988-89.

Subsurface acid lake profile sampling and bottom cores have shown that the lake sediments contain toxic levels of mercury. However, Luzier and Waibel have shown by analysis of trace element ratios, geochemical equilibrium/reaction studies, and direct findings of freshly deposited cinnabar, that mercury sulphide is still being transported into the mine workings and the lake by thermal waters and gas. Prevailing winds were found to maintain lake circulation and oxygen levels at 50 percent of saturation, thereby permitting the lake to act as a natural treatment system and forcing dissolved mercury to precipitate and accumulate in bottom sediments. Ground-water monitoring has shown that dissolved mercury and arsenic levels remain low and are not a significant threat to public waters. The primary path of offsite mercury transport is probably due to wave erosion of wasterock piles at the Clear Lake shoreline. Site remediation by Luzier Hydrosciences and Cornforth Consultants will be anchored by a 1,300 foot shoreline rockfill-buttress, backslope drainage diversion into the mine workings, and vegetation enhancement. Innovative remediation concepts include use of a low cost rockfill armored by premium quality rip-rap, incorporation of a road bench atop the rockfill for maintaince and sediment removal, maintainance of existing steep but resistant wasterock slopes (rather than regrading), and use of cinder fill in gullies to suppress runoff intensity.



NITRATE CONTAMINATION OF GROUNDWATER NEAR DEER PARK, WA.

Turner, Stoeve, Gagliardi & Goss, P.S., Spokane, Washington

Broad scale nitrate contamination of a sandy aquifer is present throughout the Deer Park area. In one particular area where nitrate levels in domestic well water exceeded drinking water standards, a multimillion dollar lawsuit was filed by 8 property owners against two corporations. Jim Luzier, as special consultant initially to Shannon & Wilson Portland, and later as principal of Luzier Hydrosciences, was retained during the period 1987-89 by the legal defense team, to evaluate and track local sources of nitrate contamination. A comprehensive surface sampling and testing program of soils, ground water, and runoff, and drilling six on-site multilevel monitoring wells, was used to establish flow directions, and the vertical and areal distribution of contaminants in a sandy aquifer about 80 feet thick. During the final stages of case preparation, farmsteads and domestic wells of 8 plaintiffs in the surrounding area were examined, photographed, and sampled in the presence of attorneys for both sides. The field investigations and analysis of ground-water flow directions generally showed the following:

1. plaintiff properties had actively operating nitrate sources from septic drainfields constructed in sand trenches above the water table, less than 150 feet from actively pumping and contaminated domesticwells,
2. poultry, livestock, and fertilizer sources of nitrate were present and visible on most farmsteads,
3. analysis of ground-water flow direction showed that most of the litigant properties were bordered on the upgradient ground-water slope by other potential nitrate sources from nonlitigant farmsteads or fertilized farm fields,
4. flow direction analysis largely precluded the possibility that a majority of the wells owned by the litigants, could have been contaminated by ground-water transport of nitrate from the client's facility.

This lawsuit was settled out of court in 1989 prior to trial.

METHANE GAS AND GROUNDWATER CONTAMINANTION, MIDWAY & KENT LANDFILLS,

Seattle Law Department, City Of Seattle, Washington

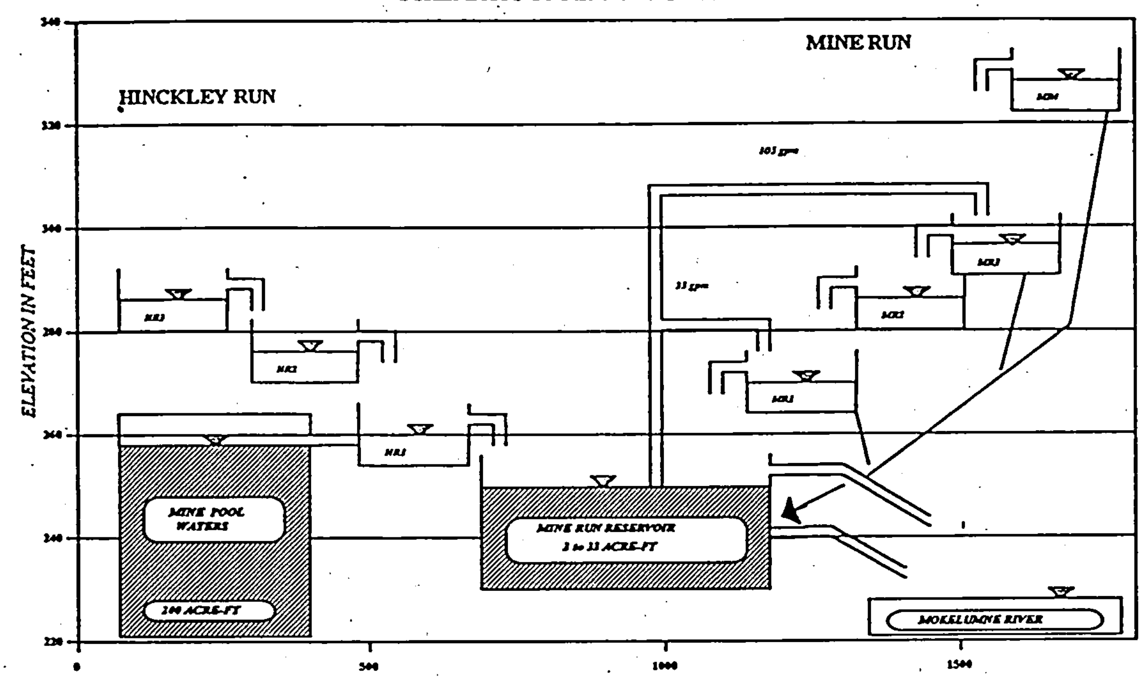
Jim Luzier as geohydrology consultant to Shannon & Wilson, Seattle, provided second opinions to the head of the Seattle Law Department in 1987, as part of a review of field investigations by a major environmental consulting firm. Two City owned landfills, both EPA Superfund sites in glacial deposits near SEA-TAC Airport, were under active investigation, and remediation for explosive gas in nearby residential areas. The work involved preparation of an independent analysis of site conditions, outlining probable pathways for methane and groundwater migration, directions of groundwater flow, and depth of leachate penetration. Findings and recommendations on the progress and focus of ongoing consultant investigations were formally presented to the City's Legal Defense Team.

James E. Luzier, P.G.
Roy W. Koch, P.E., James Patrick Moore

RESERVOIR RESPONSE MODELING USING *LHS Proprietary Code MINERUN*
CASE HISTORY: PENN COPPER MINE, SIERRA NEVADA FOOTHILLS

Luzier Hydrosciences was retained in 1992-93 by the California Regional Water Quality Control Board and East Bay Municipal Utility District (EBMUD), to perform reservoir response modeling of the 464 acre Penn Mine watershed, an abandoned underground mine site next to Mokelumne River and Camanche Reservoir. Seven reservoirs containing toxic metals (Cu, Zn, and Cd) and acid mine waters with pH of 2.5, are subject to floods and overtopping in the lower reaches of Mine Run and Hinckley Run. Typical large winter storms dump rain at about 1

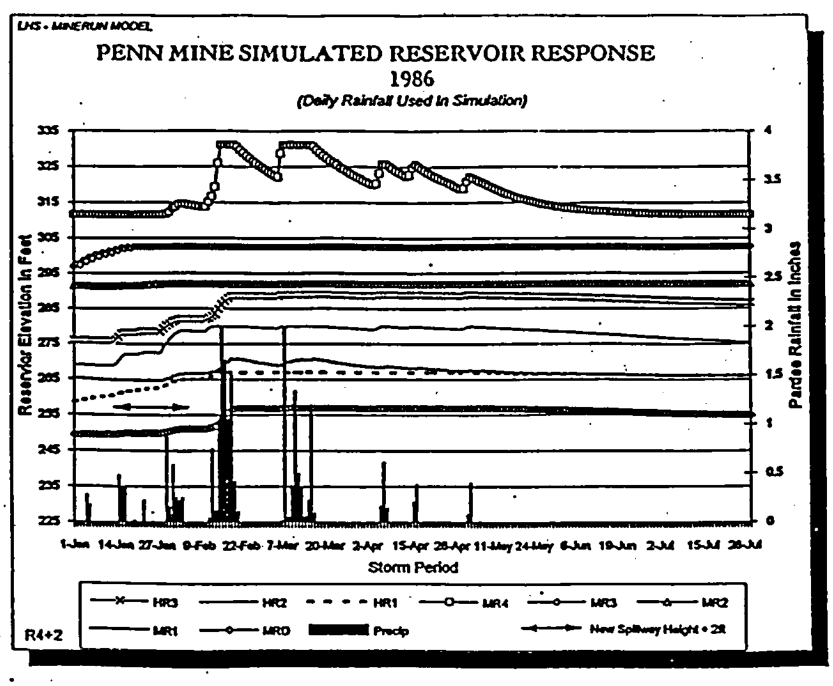
SCHEMATIC OF PENN MINE RESERVOIR SYSTEM



——— PRIMARY LEAKAGE AND GROUNDWATER PATHWAYS

inch per day for 3 to 9 days, thereby exceeding the 65 acre-ft of reservoir storage and causing downstream fish kills. The flooded mine tunnels act as a giant groundwater collector with 200 acre-ft of storage to depths of 3,400 feet. Unfortunately, the only outlet from the mine pool is a mine shaft in lower Hinckley Run, flow from which helps overload the main reservoir even during the dry season.

MINERUN, a custom multi-reservoir response model was used by LHS to simulate major storm events, and to evaluate various scenarios including raising MRD dam and spillway 2, 4, and 5 feet. The response analysis suggests spillage will be reduced for peak events from 24 acre-ft at the existing dam height, to 6 acre-ft with the dam raised 5 feet.



SUBSURFACE WASTEWATER DISPOSAL
PORT ORFORD & GOLD BEACH, OREGON
Hydrogeology, Modeling & Drainfield Design.

The Cities of Port Orford and Gold Beach retained Luzier Hydrosciences in 1990 to perform siting and characterization studies for high capacity wastewater disposal systems along the south Oregon Coast. Geologic studies, drilling and aquifer testing were used by LHS to site large capacity aquifer drainfields in permeable coastal beach and dune deposits near each City. Ground-water modeling and pathline flow analysis demonstrated that large average daily wastewater loads of 350,000 to 500,000 gpd can be readily absorbed without mounding and increased residence times, and without causing nitrate-nitrogen concentrations to exceed 5 mg/l. Natural filtration and treatment coupled with long travel times through unsaturated materials and the aquifer, are expected to result in treatment levels superior to advanced wastewater treatment, prior to reaching the surf discharge zone. Both community drainfields have been approved by State regulatory agencies and have strong public support because subsurface disposal is environmentally more sound and much less costly than Ocean outfalls.

The Gold Beach disposal simulation below demonstrates that high tide intrusion of the aquifer for a 6 hour period, invades only the coastal fringe of the aquifer. Saturated thicknesses beneath the drainfields are essentially unaffected, as are ground-water flow directions and travel times.

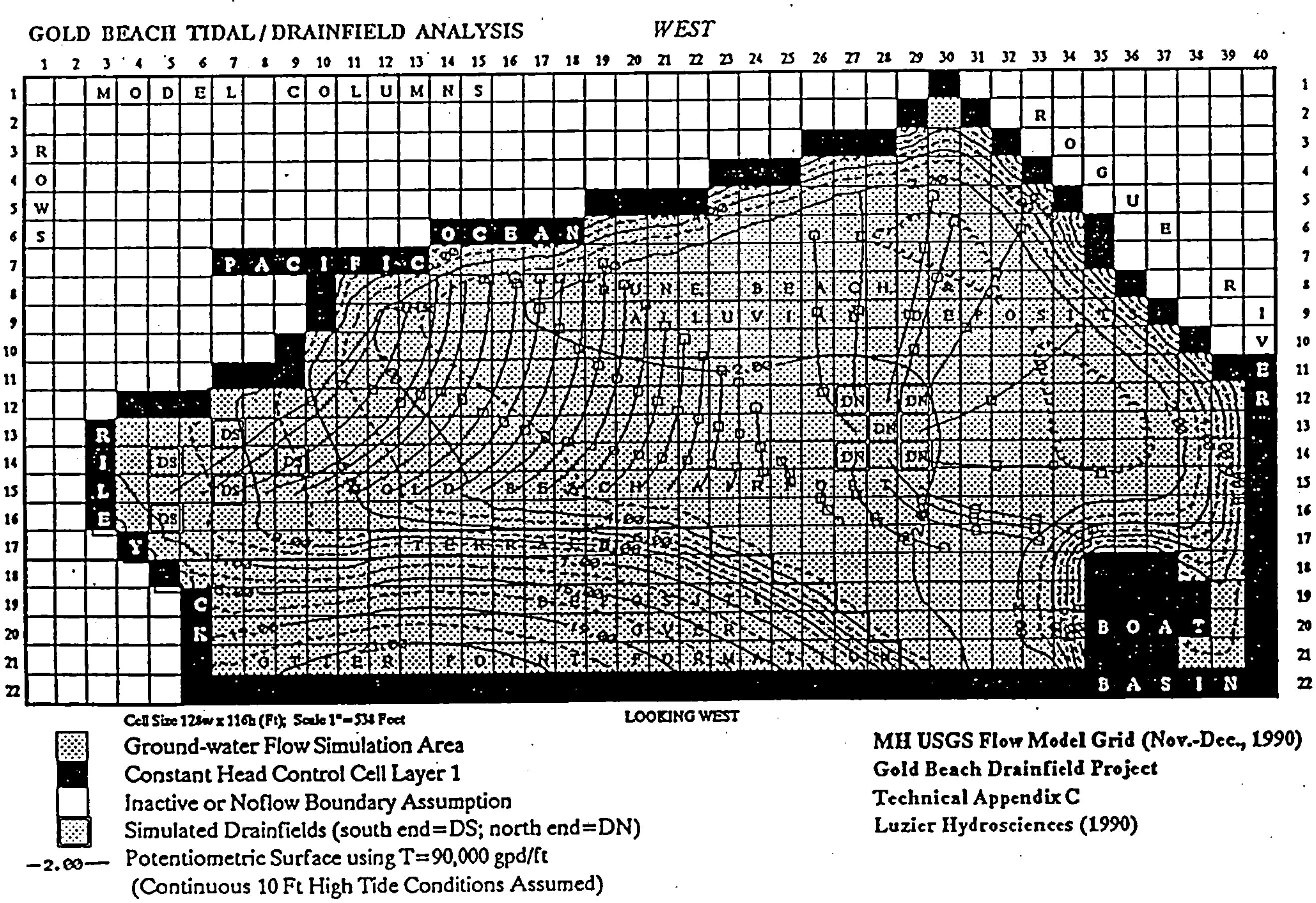


FIGURE 11--Forward one year pathline analysis (blue) showing movement of ground water and wastewater in 120 day increments (squares).

REGIONAL AQUIFER PROTECTION MEASURES NEW JERSEY COASTAL PLAIN

Jim Luzier and USGS colleague Arlen Harbaugh (MODFLOW author), conducted hands-on hydrogeology and modeling of the largest ground-water supply system in New Jersey (1973-80). More than 600 production wells in the modeled region produce 218 mgd (151,000gpm) continuously from lower Cretaceous sands up to 4,000 feet thick in a 2,000 mi² area of the Coastal Plain. Ground-water depletion since 1900 has produced a regional cone of depression with groundwater elevations as much as 100 feet below sea level. The primary issue was protection of the regional ground-water supply from (1) non-specific industrial pollutants in the Delaware River outcrop area, (2) seawater in lower reaches of the Delaware Estuary, and (3) old seawater in seaward dipping reaches of the aquifer. Regional and fine grid modeling was used to simulate 18 years of pumping history, and to produce estimated ground-water migration speeds. Luzier and Harbaugh used the calibrated model to design and predict deep-well injection rates needed to maintain a protective freshwater head barrier 35 miles long, under several optional recharge and pumping modification scenarios. The modeling analysis showed that 19 deep wells would be required with initial injection rates of 1,400 gpm, but normal growth in pumping demand would require gradual increases in injection rates to 2,300 gpm within 16 years following construction of the freshwater barrier.

Client: New Jersey Department of Environmental Protection

USGS Publications Available on Request: Luzier (1980), Harbaugh, Luzier, and Stellerine (1980)

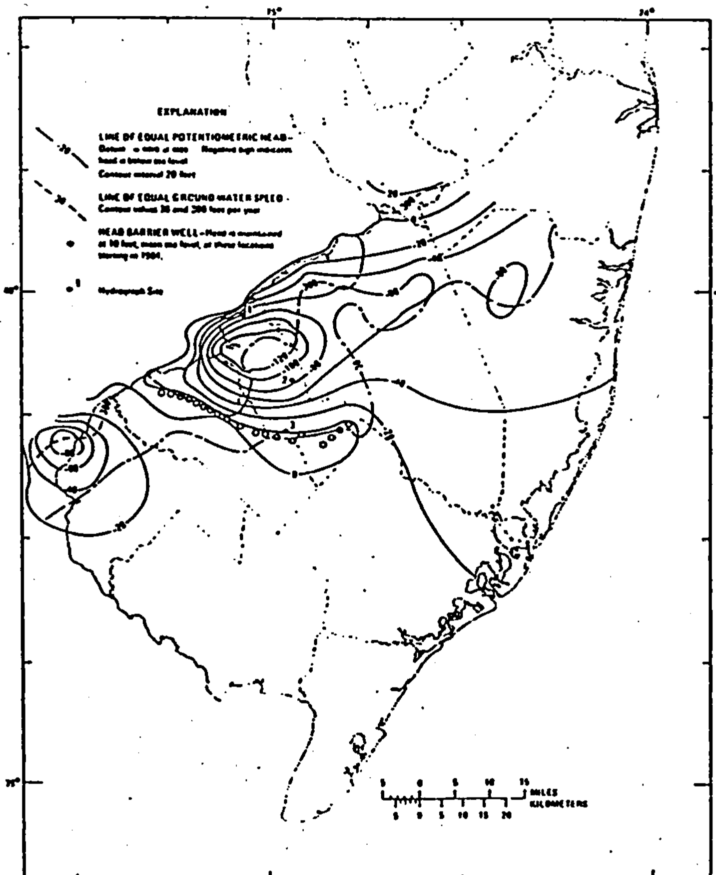


Figure 10.--Heads at the end of 1999 for simulation B without conjunctive use scheme.

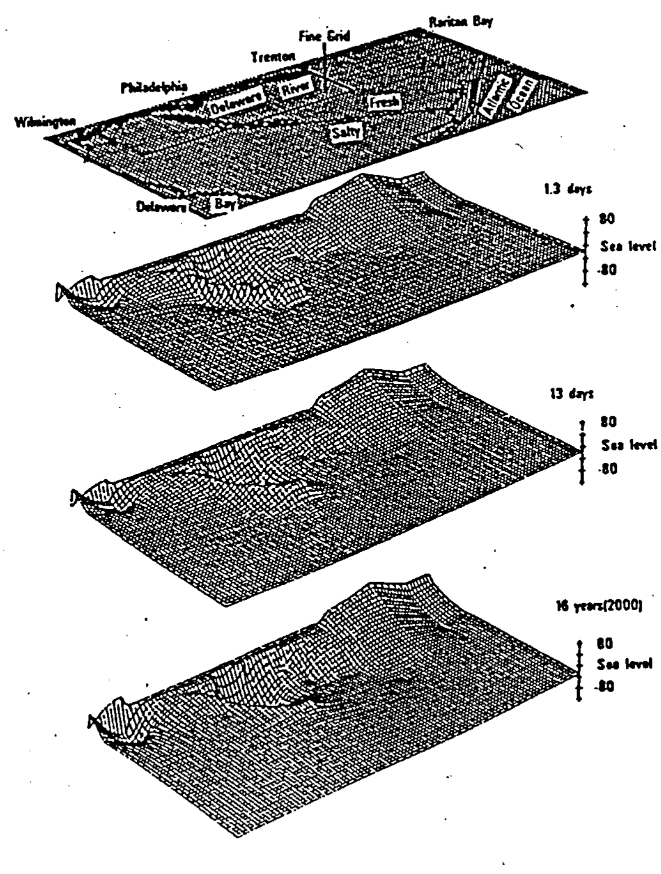


Figure 31.--Perspective potentiometric surfaces of the Potomac-Raritan-Magothy aquifer system computed by model at various time periods after activation of freshwater head barrier in 1984.

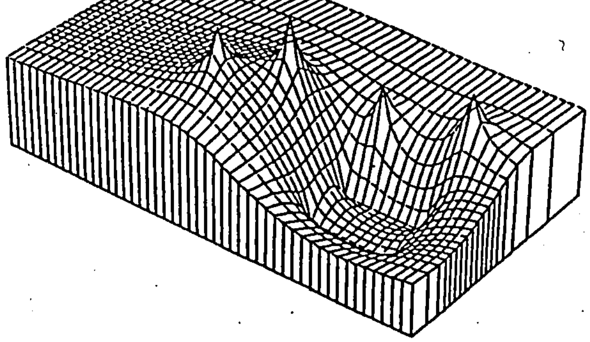
PROJECT EXPERIENCE

Seattle Metro Transit Tunnels and Stations

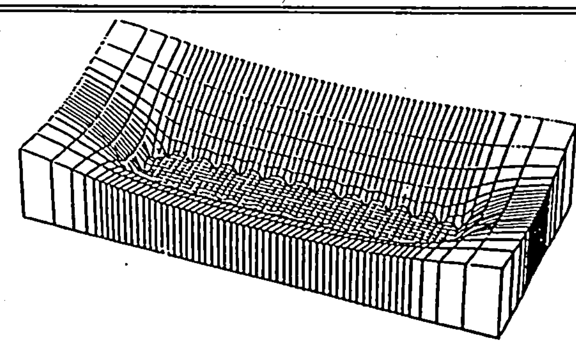
In 1985 and 1986, Jim Luzier as a consultant to the Shannon & Wilson tunnel project team, provided the dewatering design analysis for the Metro Project. The major areas of dewatering concern included:

(a) high groundwater levels and hazardous fluid wastes at the south portal which is immediately adjacent to old historical buildings near Union Depot and other structures subject to dewatering induced settlements
(b) the dual 20-foot diameter tunnels beneath downtown city streets left little room for installation and regular spacing of dewatering facilities
(c) the tunnels had to descend below sea level to avoid an existing railroad tunnel, thereby forcing more severe dewatering requirements and increasing the potential for settlement at remote sites.

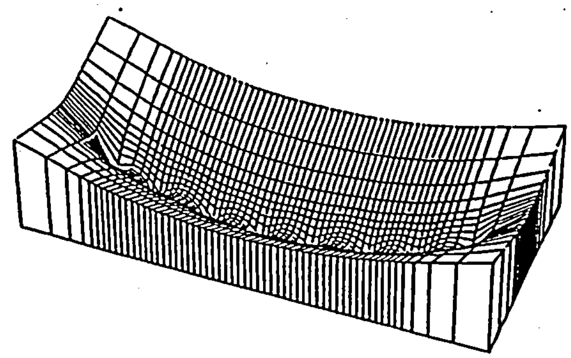
A regional flow system analysis and aquifer tests were used by Luzier in conjunction with three site specific multilayer dewatering models, to successfully predict well spacing, lead time, and pumping rate requirements for various construction stages ranging from 90 days to 365 days in length *(see below)*. The tunnel project as of January 1988, had successfully penetrated about 80 percent of the alignment including the principal areas of concern cited above. Flow rates during construction from a combination of deep pumping wells, shallow well points, and deep recharge injection wells, were found to agree fairly well with rate requirements predicted by the dewatering model analysis.



METRO TUNNEL SOUTH PORTAL DEWATERING WITH RECHARGE
STAGE 2 DRAWDOWN AFTER 365 DAYS



PIONEER SQUARE STATION DEWATERING
SUGGESTED SYSTEM - SMALL CAPACITY WELLS AT 40-FT SPACING

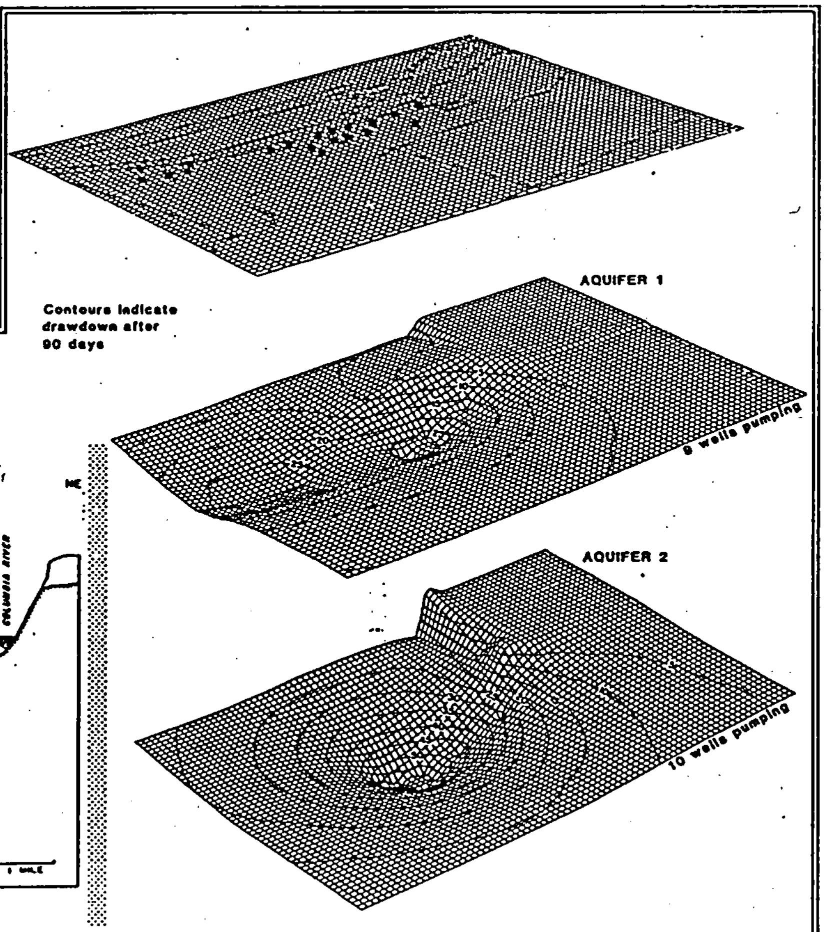


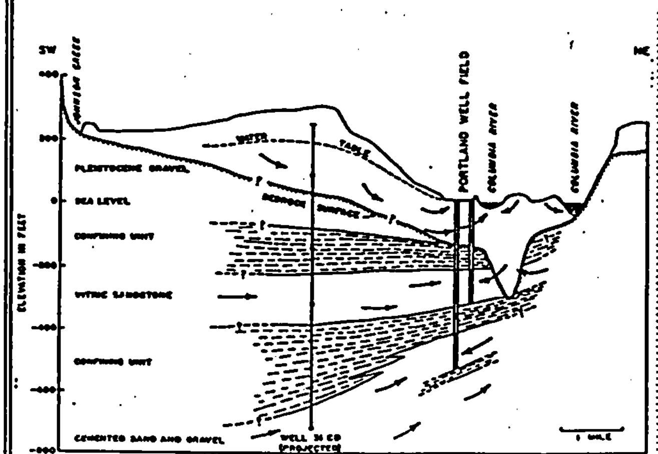
PIONEER SQUARE STATION DEWATERING
CONTRACTOR'S SYSTEM - 100 GPM WELLS AT 100-FT SPACING

CITY OF PORTLAND WELLFIELD HYDROGEOLOGY AND COMPUTER MODELING

A supplemental and emergency ground-water supply system with a design capacity of 70,000 gpm was constructed from 1979-85, by the Portland Water Bureau under the direction of Bob Willis, utilizing aquifers beneath the flood plain of the Columbia River east of Portland. Two wellfields containing 33 deep wells with pumping rates of 1,100 to 7,000 gpm, were designed for 3-month emergency operating periods. Two multilayer finite-difference groundwater flow models were developed by Jim Luzier concurrently during wellfield construction, and were calibrated using data from aquifer tests and hydrogeological mapping. In the Blue Lake Wellfield, a surficial aquifer consisting of high permeability, Pleistocene flood gravels (transmissivity about 500,000 gpd/ft), occupies deep channels carved into the bedrock of the Troutdale Formation. Drilling and marine seismic profiling revealed that the Pleistocene flood deposits range from 200 to more than 300 ft in thickness for at least 15 km along the axis of a previously undetected buried channel of the Columbia River. Most drilling and aquifer testing was conducted in two confined bedrock aquifers with average aquifer transmissivities of about 33,000 and 56,000 gpd/ft. The uppermost bedrock aquifer, a black vitric sandstone about 100 ft thick, and the deeper aquifer, a sequence of lightly cemented sands and gravels also about 100 ft thick, are in contact with buried Pleistocene channel deposits under the Columbia River. Pre-operational model predicted head changes in the bedrock aquifer system using a 90 day pumping period and a rateof 33,000 gpm from 19 wells indicated that drawdowns within a 19 mi^2 area near the wellfield, would range from 25-80 ft in the vitric sandstone, and 80-160 ft in the cemented sand and gravel aquifer *(below)*. Interactive groundwater modeling during wellfield construction helped define targets and testing needs, and directly contributed to the optimization of well spacing and layer allocation. After the wellfield was brought online and operated for the first time in 1985, individual pumping rates, power-loss shutdowns, and startups were simulated, and the model results closely matched actual field response, thereby validating the predictive ability of the wellfield groundwater flow model. (p1u719)

Owner: City of Portland, Bureau of Water Works





JOSEPH B. GONTHIER, P.G.
Senior Project Hydrogeologist

EDUCATION

U. S. Geological Survey National Training Center, 1970-82 (Short Courses: hydrogeology/10 weeks).
U. S. Geological Survey/ University of Arizona, 1969 Hydrology Short Course, 7 weeks.
M. S. in Geology, University of Massachusetts, 1964
B. A. in Geology, University of Connecticut, 1959

PROFESSIONAL SOCIETIES

Association of Ground Water Scientists and Engineers
American Geophysical Union
Geological Society of America

REGISTRATION

Professional Geologist Oregon #643

PROFESSIONAL BACKGROUND

Joe Gonthier has 30 years experience in the professional practice of groundwater hydrology with the USGS. He was Project Chief of numerous hydrogeological investigations throughout the United States, including 5 years in the Eastern U.S., 5 years in the Midwest, and 17 years in the Western U.S., mostly Oregon and California. Joe worked with Robison on the Coastal Dunes aquifer modeling, and conducted extensive drilling and testing in the coastal deflation plain to identify areas of high iron water for the Coos Bay-North Bend Water Board in the late 70's. In the early 1980's, Joe worked extensively with Luzier in designing and conducting the NTW shallow zone aquifer tests opposite Saunders Lake. The unpublished test results were plotted and analyzed for aquifer parameters by Joe Gonthier.

EXPERT TESTIMONY AND OPINION

1993 Ball, Janik & Novack OWRC (Oregon Water Resources Commission hearing, Mt. Hood Meadows Ski Area request for supplemental water rights.
1992 Deschutes County Planning Dept., Unbiased technical review of conclusions and recommendations made in a ground-water report performed for Eagle Crest Phase II Destination Resort.

TYPICAL GROUNDWATER HYDROLOGY PROJECTS

1990	Hydrogeologic maps for Bear Creek Valley, Jackson County, Oregon.
1989	Water resources of the Umatilla Indian Reservation (Update)
1988-89	Technical advisor to U. S. Bureau of Reclamation Oregon ground-water recharge projects.
1987-88	Part of team defining hydrogeologic units in the Portland Basin, Oregon and Washington.
1983-87	Oregon project chief Columbia Plateau Regional Aquifer System Analysis (RASA).
1983	Oregon ground-water quality and its' relationships to hydrogeologic factors.
1983	Description of aquifer units in eastern Oregon.
1982	Summer detail to Leviathan Sulfur mine eastern Calif., test drilling and sampling on-site.
1979-80	Ground-water resources of the Rogue River Basin Jackson and Josephine counties, OR.
1978-79	Ground-water resources of the Bend-Redmond area Deschutes Co., OR.
1975-77	Ground-water resources of the Dallas-Monmouth area, OR.
1974-75	Water-resources of the Umatilla Indian Res., OR.
1972	Ground-water resources of Waukesha Co., WI.
1971	Electric analog model of the Sandstone Aquifer Dane Co., WI.
1969-70	Ground-water resources of the Milwaukee River Basin, WI.

A. Scott Yankey
Project Hydrogeologist

Luzier Hydrosciences
Two Gershwin Court
Lake Oswego, OR 97035
(503) 636-1012

EDUCATION

B.S. in Geology, University of Kentucky, 1983
M.S. Candidate in Geology, University of Georgia, (Coursework completed, Thesis pending)

Continuing Education

University of Wisconsin at Madison, 1989, Environmental Drilling Technology
National Water Well Association, 1990, MODFLOW for Simulation of Groundwater Flow/Advective Transport
National Ground Water Association, 1992, Solving Groundwater Problems with Models

PROFESSIONAL SOCIETIES

National Ground Water Association
Illinois Ground Water Association

HEALTH AND SAFETY TRAINING

Completed the hazardous waste operations and emergency response 40-hour health and safety training program required by OSHA and trained to Level B protection.

PROFESSIONAL BACKGROUND

Scott has 9 years of professional experience with two midwest and southeast engineering consulting firms. His recent assignments in Illinois have included groundwater modeling using flow simulation and solute transport models (i.e., MODFLOW, MODPATH, PLASM, RANDOM WALK). He has conducted extensive subsurface field investigations involving deep well aquifer testing on a radioactive characterization study in Illinois, and performed computer modeling analysis of the test results. One of his specialtities includes geophysical techniques using seismic reflection, seismic refraction, electrical resistivity, electromagnetic, and very low frequency methodologies to define subsurface geology and contaminant migration pathways. Scott has travel extensively in the U.S. as project manager of numerous leaking underground storage sites for a national communications company. These projects frequently involved independent hydrogeologic characterization of local areas, risk assessment, and recommendation of remedial alternatives. Scott has developed technical procedures for field hydrogeologic and geophysical operations with job specific Quality Assurance/Quality Control Plans.

In the southeast U.S., Scott designed and managed geophysical investigations using electrical resistivity, electromagnetic and magnetic instruments to delineate subsurface stratigraphy, site boundaries, hydrogeologic fracture features, and contaminant spills. His southeast experience included aquifer tests and analysis of field data.

RELEVANT PROJECT EXPERIENCE

- Phase 1 Remedial Investigation. Project manager at an 800 acre site containing radioactive and mixed waste petroleum hydrocarbons at retired coal gasification plants, Illinois. Assisted in modeling of groundwater flow and containment movement using solute transport and ground water flow simulation programs.
- Manufacturing facility, South Carolina. Designed and supervised the installation of a recovery and monitoring well network for the recovery and treatment of volatile organic compounds.
- Aquifer characterization of Low Level Radioactive Waste Site in Illinois. Performed field oversite and analysis of aquifer tests and slug tests of a multilayered, buried bedrock valley aquifer system.
- Manufacturing facility, Ohio. Performed a critical review of existing remedial investigative data collected at the facility. Defined specific weaknesses in the existing site hydrogeologic model and recommended future investigative options.
- Siting of a low-level radioactive waste disposal facility Illinois. Collected and analyzed geophysical data utilizing seismic refraction/reflection, electrical resistivity, electromagnetic, and very low frequency methodologies to define subsurface stratigraphy.
- United States Air Force, California, Georgia, and Illinois. Provided supervision of drilling and monitoring well installation as part of the Installation Restoration Program. Performed geophysical surveys utilizing electrical resistivity, electromagnetics, and magnetic methodologies to aid in the location and extent of hazardous waste sites and associated plumes.

MAJOR CONSULTING PROJECT REPORTS:

Luzier, J.E., 1992, Hydrogeology and Aquifer Testing Program, Parrett Mountain Critical Groundwater Area: Public Hearings and Testimony before the Oregon Water Resources Commission: LHS area findings on behalf of Manke Lumber, Inc. accepted and put into law.

Luzier, J.E., Koch, Roy W., and Moore, J. Patrick, 1992, Penn Copper Mine California: Hydrologic Response Modeling Estimates and Data Collection Recommendations, Technical Memorandums 1,2,& 3: for California Reg. Water Quality Board and East Bay M.U.D.

Luzier, J.E., 1993, 1992, 1991, Geohydrology and Distribution of Phosphorus in Groundwater, Jackson Bottom Wastewater Wetlands, Tualatin River Basin, Oregon: for SRI, Inc., and United Sewerage Agency, Washintonton County, Oregon.

Luzier, J.E. (key technical role): for Battelle Memorial Institute and Hanson Engineers, Inc., Illinois Low Level Radioactive Waste Siting Project, reports with Shannon & Wilson for Hanson Engineers: Client, Illinois Dept. of Nuclear Safety, Springfield, Illinois

1990, Aquifer Test Reports on Sand Facies and Basal Sand Aquifers, Martinsville Alternative Site, Clark County, Illinois.

1989, Geological, Hydrological, and Geotechnical Characterization Report, Martinsville Site, Clark County, Illinois.

1988, Geff Alternative Site Characterization Plan, Wayne County, Illinois, 188p.

1988, Martinsville Alternative Site Characterization Plan, Clark County, Illinois, 181p.

1988, General Site Characterization Plan, 98p.

Luzier, James E., 1988, Multilevel Groundwater Sampling System, United States Patent Number 4,745,801, 5/88, U.S. Dept. of Commerce, Patent & Trademark Office, Wash. D.C., 8p.

Luzier, J.E. and Waibel, A.F., 1988, Hydrogeological Assessment Report, Sulphur Bank Mercury Mine, Clearlake, California: Columbia Geoscience for Bradley Mining Co., San Francisco, 62p.

Waibel, A.F., and J.E. Luzier, 1987, Herman Lake Toxic Pits Classification Act Assessment, Sulphur Bank Mercury Mine, Lake County, California: Columbia Geoscience for Bradley Mining Co., San Francisco, 45p.

Luzier, J.E., and Livermore, D.G., 1987, Site Evaluation and Monitoring Detection Program for Chromic Acid Wastes in Soils and Groundwater, private industrial site, Clark Co., WA: Shannon & Wilson, Inc.

Luzier, J.E., and Livermore, D.G., 1987, Design, Drilling, and Testing of a Deep Basalt Well 1, Boeing Aerospace Range, Boardman, OR: Shannon & Wilson, Inc., for Horton, Dennis & Associates, Inc., Kirkland, WA.

Luzier, J.E., Balmer, D.K., & Druebert, H.H., 1986, Geohydrology & Spill Migration/Recovery Analysis, Hazardous Waste Storage Facility, Fort Lewis, WA: Shannon & Wilson for U.S. Army Corps of Eng., Seattle Dist., 21p.

Gurtowski, T.M. and Boirum, R.N., 1986, Geotechnical Report on Downtown Seattle Metro Tunnels Transit Project: Shannon & Wilson for Parsons Brinckerhoff Quade & Douglas, Inc., Seattle, WA, 146p.

Boirum, R.N. and Parker, H.W., 1986, Geotechnical Report on Aquifer Testing and Dewatering requirements, Seattle Metro South Tunnel Portal & International District Station: Shannon & Wilson for Parsons Brinckerhoff Quade & Douglas, Inc., Seattle, WA 33p.

Luzier, J.E. and Livermore, D.G., 1986, Groundwater Hydrology of the Smith and Bybee Lakes Region, with emphasis on St. Johns Landfill, Portland, OR: Shannon & Wilson and Fishman Environmental Service for Port of Portland and City of Portland, 27p.

Luzier, J.E., Deacon, R.J., & Livermore, D.G., 1986 Municipal Landfill Siting Studies, Portland Metropolitan Area: Evaluation of Groundwater Hydrology and Geotechnical Siting Criteria: Hillsboro Sites, Wilsonville, and West Linn, OR; Shannon & Wilson, Inc.

Luzier, J.E., 1986, Testing & Deep Well Rehabilitation, City of The Dalles, OR: Shannon & Wilson, Inc., 13p.

Luzier, J.E., Fujitani, K.F., and Wright, W.L., 1985, Aquifer tests and Landslide Dewatering Design, Kelly Avenue Landslide, The Dalles, OR: Shannon & Wilson, Inc., 22p.

Luzier Hydrosciences, 1985, Environmental Consequences of Groundwater Contamination near the Portland Wellfield: Dec. 1984: 24p.

PUBLICATIONS:

Magaritz, Mordeckai, and Luzier, J.E., 1985, Water-rock Interactions in the Seawater-Freshwater Mixing Zone, Coastal Dunes Aquifer, Coos Bay, OR: Geochimica et Cosmochimica Acta, Vol. 49, 0. 2515-2525.

MacFarland, W.D., Luzier, J.E., & Willis, R.F., 1982, Hydrogeology & Simulation Modeling of the Portland Well Field, Portland, OR: American Geophysical Union Poster Session, SF. CS: EOS abs., Vol. 63, No. 45, p433.

Luzier, J.E., 1982, Iron Geochemistry & Distribution in a Coastal Dunes Aquifer, Coos Bay, OR: American Geophysical Union Poster Session, San Francisco, CA: EOS Abs., Vol. 63, No. 45, p.932.

Harbaugh, Arlen H., Luzier, J.E., Stellerine, Flavian, Modeling Analysis of use of Delaware River Water to Supplement Groundwater Supplies from the Potomac-Raritan-Magothy Aquifer System in Southern New Jersey: USGS Water Resources Investigation 80-31, 41 p.

Luzier, J.E., 1980, Digital-Simulation & Projection of Head Changes in the Potomac-Raritan-Magothy Aquifer System, Coastal Plain, New Jersey: USGS Water Resources Investigations 80-11, 72p.

Luzier, J.E., & Burt, R.J., 1974, Hydrology of Basalt Aquifers & Depletion of Groundwater in East-Central Washington: Washington: USGS/WDOE Water Supply Bull. #33, 53p.

Luzier, J.E., 1969, Geology & Groundwater Resources of Southwestern King Co., Washington: USGS/WDOE Water-Supply Bull. #28, 260p.

Luzier, J.E., 1969, Groundwater Occurrence in the Goldendale Area, Klickitat Co., WA: USGS Hydrologic Atlas, HA-313.

Luzier, J.E., 1964, Groundwater Supply for Mount Rainier Nat. Park Headquarters, WA; USGS Open-File Rept.26p.

Luzier, J.E., & others, 1968, Groundwater Survey, Odessa-Lind Area, WA: USGS/WDOE Water-Supply Bull. 36, 31p.

Luzier, J.E., & Willis, Robert F. (In Prep.) Intertactive Geohydrology and Simulation Modeling of the Portland Emergency Wellfield, 1978-84.

Luzier, J.E., (In Prep.) Control of Iron-Rich Groundwater by Siderite Precipitation, Coastal Dunes Wellfield, Coos Bay, OR.

JAMES E. LUZIER, P.G.
Principal Geohydrologist

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EDUCATION

U.S. Geological Survey National Training Center, 1962-64 *(Short Courses: hydrogeology/modeling/geochemistry,18 weeks).*
M.S. in Geology, West Virginia University, 1961
B.S. in Geology, West Virginia University, 1960

PROFESSIONAL SOCIETIES

Association of Ground Water Scientists and Engineers
American Water Works Association
National Water Well Association
National Federation of Independent Business

REGISTRATION

Professional Geologist	• Idaho #570
Professional Geologist	• Oregon #909
Professional Geologist	• California #4063
Professional Hydrogeologist	• American Institute of Hydrology #583

PROFESSIONAL BACKGROUND

Jim Luzier has 31 years of experience in professional practice. He has been principal of Luzier Hydrosciences since 1984, and consultant to Shannon & Wilson Geotechnical Consultants, Inc. (Seattle/St. Louis), 1985-91. Prior to private practice, Jim served 22 years with the USGS as Project Chief and Research Scientist in charge of geohydrology and groundwater modeling investigations in Washington, New Jersey, and Oregon. Professional practice nationally includes 6 years in the Eastern U.S., 3 years in the Midwest, and 22 years in the Western U.S. From 1978-84, Jim Luzier directed the USGS interactive modeling design study during construction of Portland's 100 mgd, $40 million emergency wellfield. During the same period, he conducted sea water interface modeling and iron geochemistry studies at the coastal dunes wellfield at Coos Bay, using an 18-layer, 3D transport code HST3D.

Based on Mr. Luzier's 1992 testimony before the Oregon Water Resources Commission, the Commision has adopted new regulations and new approaches in regional groundwater management of basalt aquifers in the Parrett Mountain region southwest of Portland. Recent consulting projects include assistance to METRO staff in modeling of the St. Johns Landfill, Mine Hydrology and Reservoir Response Modeling at a Sierra Foothills Copper Mine, and Toxic Pit Evaluations, Hydrogeological Assessments, and Mine Abatement Remediation at Sulphur Bank Mercury Mine, Clear Lake, CA. From 1988-90, Jim Luzier was Shannon & Wilson/Hanson Engineers Group Leader for groundwater hydrology and geochemistry on the Illinois Low Level Radioactive Waste Project. Consulting specialties include second opinion, modeling, and contaminant hydrology of groundwater flow systems, basalt borehole short-circuiting impacts on flow system analysis, design of well fields, underground aquifer storage and recovery, and dewatering systems, mine hydrology and hydrochemistry, and expert testimony. Mr. Luzier was awarded a 1988 U.S. Patent on a multilevel groundwater sampling system.

EXPERT TESTIMONY EXPERIENCE AND CASE PREPARATION

1991-91	Lukins & Annis, Spokane, WA (Pollution Control Board Hearing, Streamflow Depletion, Sinking Creek).
1987-91	Landels, Ripley and Diamond, San Francisco, CA (Sulphur Bank Mercury Mine, EPA Superfund Site)
1987-89	Turner, Stoeve, Gagliardi & Goss, Spokane,WA (Nitrate Contamination of Groundwater,Deer Park Area)
1987-88	Seattle Law Department (Methane Migration/GW Contamination, Midway Landfill, EPA Superfund)
1984-87	Esler, Stephens & Buckley, Portland, OR (Landfill Contamination, Tillamook Co. Landfill -- RCRA suit)

TYPICAL GROUND-WATER, HYDROLOGY, AND GEOTECHNICAL PROJECTS

1992-93	East Bay MUD & California Water Quality Control Board • Penn Copper Mine Runoff/Reservoir Model.
1991-92	Manke Lumber Co., Seattle • Basalt Hydrology, Production Well Drilling, Critical Area Closure Hearings.
1987-91	Bradley Mining Co., San Francisco • Toxic Pit and Mine Abatement, Sulphur Bank Mercury Mine.
1990-91	Cities of Gold Beach & Port Orford • Coastal Siting/MODFLOW/MOC Modeling of WW Drainfields.
1986-87	Seattle Metro Dual Subway Tunnels • MODFLOW Dewatering Design, Injection/Contamination Control.
1984-85	Portland Wellfield • Contamination Potential and Groundwater Flowpath Travel Time Estimates.
1985-89	City of The Dalles • Design Model and Construction of Kelly Ave. Landslide Dewatering Wellfield.

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Luzier Hydrosciences specializes in groundwater and surface water hydrology projects of above average complexity. We provide a wide range of groundwater protection and resource evaluation services including aquifer delineation and testing, groundwater modeling & wellfield design, aquifer protection measures, contaminant transport, geochemistry and identification, and legal case preparation. One of our specialties is the design and spacing of wells for municipal production and underground storage, and dewatering design for tunnel, landslide, and excavation dewatering.

Over the years, we have provided site specific practical ideas including (1) use of deep screened production wells in the coastal wellfield at Coos Bay to induce iron-rich groundwater to pass through shell rich marine sands, thereby forcing iron to precipitate as the carbonate cementing mineral siderite — a natural aquifer treatment mechanism that takes advantage of contaminant transport and flow directions, and pH/redox driven geochemical equilibrium processes that produce nearly iron free groundwater, (2) the use of multi-screened gravity well-drains in landslide dewatering at the PGE Faraday Canal — an advantageous use of permeability differences to avoid or reduce pumping costs, (3) the use of south coastal dune and beach deposits for pressurized drainfield disposal of municipal wastewater in lieu of environmentally sensitive and costly Ocean outfalls — an application of sea water-freshwater interface mechanics, natural filtration and treatment in the unsaturated zone, and long travel times to the Ocean surf, and (4) interactive groundwater modeling and simulation of many aquifer tests at the City of Portland Wellfield prior to and during construction to evaluate well spacing requirements, depth, capacity, interference, and aquifer boundaries — a rare example and practical application of groundwater modeling to assess groundwater resources based on full field-scale data from a multi-layered aquifer system. Field geohydrology studies conducted by LHS are complimented where necessary, by a full suite of quantitative tools and resources including:

- *Multi-layer groundwater flow-transport modeling capability and Experience*
- *Transport & forward/reverse pathline travel time analysis*
- *In-house 32-bit Big Memory Models & Fortran Compiler*
- *486-33 Modeling workstation, MODFLOW, RAND3D, KB-MOC, HST3D*
- *Proprietary Storm/Runoff/Reservoir Response Models STORMFLO & MINERUN*
- *Portable CPU and ISI data loggers, self-contained RV fieldOffice*
- *LHS designed packer system for borehole/casing tests*
- *LHS proprietary GW multi-tube screen sampling system (1988 U.S. Patent)*
- *Project Video documentation for Client review*

Portland State University

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600 Northeast Grand Ave.
Portland, OR 97232-2736
Solid Waste Department, Metro

Dear Joanna,

Enclosed please find six copies of a proposal in response to your RFP #93R-43-SW and Addendum No.1 to the RFP.

The PSU groundwater team will consist of myself, four other graduate assistants as well as a subconsultant service team - Portland Office of Parametrix Inc. I will be the project manager responsible for over all technical direction, management and communication with Metro.

We have have recently significantly enhance our computational and visualization capabilities to meet our rapidly growing groundwater research needs. We have added three more top-of-the-line workstations (Sun Sparc 10/41), one color postscript graphics printer, the ARCO/INFO GIS and two advanced visualization softwares, PVWave and SitePlanner. PVwave is a generic package that can be used to visualize any three-dimensional data set along any areal or vertical cross-sections. SitePlanner is a specialized software especially designed for groundwater site investigation. SitePlanner can be used to visualize groundwater flow, contaminant plumes together with site features, topography, stratigraphy, and sampling configurations such as montoring wells and piezometers, etc ..

The issues addressed in the RFP fits exactly our expertise and areas of research. I am confident, with our modeling expertise as well as the excellent computational capabilities, that we can make an unique contribution helping Metro assess the environmental impact of St Johns Landfill and design cost effective management plans for the landfill and surrounding surface and groundwater systems. Also, our new visualization capabilities will dramatically improve our result presentation to Metro.

I will be looking forward to working with you on modeling St. Johns Landfill. If you have any question about the proposal please feel free to call me at 725-5543.

Sincerely yours,

Shu-Guang Li
Assistant Professor

Three-Dimensional Modeling of Groundwater Flow and Contaminant Transport at the St. Johns Landfill Region

A Proposal Submitted to
Solid Waste Department, Metro

Submitted by
Professor Shu-Guang Li, Project Manager
Portland State University

A. Transmittal Letter

B. Approach and Project Work Plan

Site Description

St. Johns Landfill is situated on the Columbia floodplain bounded by the North Slough and Bybee Lake to the north, by the Columbia slough to the south and southwest and by Smith Lake to the east. The landfill sits on a layer of fine grained silty/clayey floodplain sediments with many randomly embedded sand lens/channels. Underlying the floodplain sediments is the productive Pleistocene gravel aquifer hydraulically connected to the Columbia River to the north and the Willamette River to the south and southwest.

Project Objective

The objective of the proposed project is to develop a three-dimensional groundwater model for simulating groundwater flow and contaminant transport at the St. John's landfill region. Model results will be used to assess the environmental impact of St. Johns Landfill on surrounding surface and groundwater systems and to evaluate different management strategies for St. Johns Landfill and Bybee Lake.

Specifically, model results will be used to address the following typical issues facing Metro site planners and managers:

1. Is St. Johns Landfill a major contributor to pollution in the Columbia and North sloughs? What is the leachate seepage and contaminant flux into the sloughs and how do they vary seasonally and annually?

2. How effective are the floodplain sediments under the landfill protecting the deep Pleistocene gravel aquifer from leachate contamination? How long does it take for landfill contaminants to penetrate the "buffer layer"? What is the extent of offsite leachate contamination now and what will it be 20 years later?

3. How effective are the floodplain sediments protecting possible upward leakage of contaminated groundwater to Bybee Lake? How does leachate upwelling vary seasonally? How can we control the water level in the lake to avoid/minimize leachate induced pollution? How will water quality in Bybee Lake change if the lake were to open to the Columbia slough and returned to intertidal habitat?

4. How fast will leachate loading from the landfill to surrounding surface water and groundwater systems decrease with time after the landfill is completely capped? When will the magnitude of leachate loading decrease to one half of the current level? What will be the additional impact of installing a perimeter leachate collection system?

Existing field data, though valuable, are too limited to provide adequate answers to these questions. The proposed project address these issues by developing physically-based groundwater models combined with existing site specific information. The proposed model will provide a systematic approach for characterizing the complex groundwater flow system and contaminant transport at the St. Johns Landfill region. The model will be particularly useful for Metro site planners and managers to experiment with different management scenarios and alternatives and design cost effective plans for managing St. Johns Landfill and surrounding surface water and groundwater systems.

Proposed Tasks

The proposed project will be divided into two phases. The first phase includes model construction and flow modeling and will be completed by March 15, 1994. The second phase is optional and will be completed only if requested by Metro. This phase consists of transport modeling and model applications, and will be completed by June 30, 1994. The specific tasks and subtasks in each phase are discussed below.

Phase I - Flow Modeling

1 Model Construction

1.1 Conceptual Approach

A conceptual model is a pictorial representation of groundwater flow system and it should always be the first step in the complete modeling process. In a conceptual model we specify the model area, the aquifer framework and identify the key flow processes that must be captured in order to achieve specific modeling objectives.

Key Flow Processes at the St. Johns Landfill Region

Leachate Mounding in the Landfill: Existing water level data clearly suggest that leachate saturation level in St. Johns Landfill has risen well above the original level (Steven, Thompson & Runyan, 1974). A leachate mound has formed and the annual mean leachate level increases roughly 2 feet every year with a seasonal fluctuation of approximately 5 to 10 feet (Fishman Environmental Services, 1986). Rising leachate mound in the landfill increases the leachate flux to the surrounding sloughs and the deep aquifer. This in turn reduces net leachate accumulation in the landfill and slows down the rate of increase in leachate mounding. If annual mean recharge is constant, the leachate mound will stabilize asymptotically and reach a dynamic equilibrium state when the mean influx from recharge is balanced by the mean seepage to the surrounding sloughs and the deep aquifer.

Leachate mounding is also affected importantly by the on-going five year landfill closure project. Infiltration to the landfill will be essentially cut off when the landfill is completely capped by 1996. Leachate mound will then start to decline until an equilibrium condition is reached when leachate level in the landfill becomes approximately the same as the surrounding surface water level. The rate of leachate mound decline will be limited by the low permeability of the underlying silty/clayey floodplain sediments. Use of an additional leachate collection system may significantly accelerate the decline of leachate mound in the landfill.

The transient process of leachate mounding (seasonal variation and annual net increase or decline) is an important feature of groundwater flow at St. Johns Landfill. This process must be captured in order to evaluate the maximum leachate loading to the sloughs and the extent of offsite leachate migration and to evaluate the effect of landfill capping and use of leachate collection system in abating leachate induced environmental pollution.

Leachate Upwelling Below Bybee Lake: The Pleistocene deep gravel aquifer is highly transmissive and characterized by significant diurnal and seasonal variations in response to the fluctuating river stage in the Columbia and Willamette Rivers (Fishman Environmental Services, 1986). Such head variation in the deep aquifer lead to significant head difference between the deep aquifer and the surface water bodies because of their vastly different retention times. Hydraulic head in the deep aquifer may become significantly higher than that in the overlying floodplain sediments and lake system after surface water recedes following a major storm event or after a long wet season. The opposite may happen during a wet season when surface water level is high.

The two way transient interactions between surface water and groundwater at the St. Johns Landfill region has important environmental implications. When hydraulic head in the deep aquifer is low, landfill leachates move downward and given enough time they may penetrate the silty/clayey sediments, especially in the northeast area of the landfill where the sediment layer thins to as low as a few feet (Sweet-Edwards/EMCON, Inc. 1989). These leachate contaminants, once entering the deep aquifer, move laterally with regional groundwater flow in the general direction of Bybee Lake and the Columbia River. When hydraulic head in the deep aquifer goes up, however, leachate contaminants will move upward, leachate upwelling may occur below Bybee Lake and even the landfill. Upwelling below landfill will block (or reduce) downward leachate loading to the deep aquifer and increase lateral loading to the slough system (Sweet-Edwards, Inc. 1983; Ecology and Environment, Inc. 1986). Upwelling in Bybee Lake may lead to leachate pollution in the lake especially in the northwest area where the lake bottom sediments may thin to less than 5 feet creating a window into the underlying Pleistocene gravel aquifer (Fishman Environmental Services, 1986).

– Leachate upwelling is the direct consequence of dynamic groundwater-surfacewater interaction. The transient nature of the interaction is crucial and must be properly represented in the model to be able to assess the landfill impact on Bybee Lake and to estimate reliably maximum daily pollutant loads to the sloughs.

Conceptual Representation

Conceptual model representation is dictated by modeling objectives. Based on the above analysis we will select the model area to include the landfill, the adjacent sloughs, Smith/Bybee Lake as well as the underlying deep aquifer since we are interested in the landfill-slough-aquifer-lake interactions. We will also include the Columbia River to the north and the Willamette River to the south and southwest since the two large rivers dictates the fluctuating head in the deep aquifer and thus affects importantly the aquifer-lake-landfill interactions.

The selection of bottom and east boundaries of the model domain is somewhat arbitrary. No physical boundaries are obvious in the immediate neighborhood of the domain of interest. Artificial hydraulic boundaries have to be specified. We assume that bottom boundary is flat and located at many leachate plume thickness below the bottom of the floodplain sediments. The assumption is considered reasonable since flow in the deep aquifer is essentially horizontal. The east boundary will be another hydraulic boundary to be located in the neighborhood of the North Portland Road. The exact location will depend on the regional groundwater flow pattern in that area. The regional groundwater information needed can be obtained from another related regional groundwater modeling project conducted by the Portland Office of USGS and will be available to the project team. The regional model results may also be used in specifying boundary conditions in the deep gravel aquifer on the other three-sides of the model boundaries. We will discuss this in more detail when we address boundary conditions.

The aquifer framework consists of landfill refuse and four other major geological units including silty/clayey floodplain sediments, dredged sandfill (not present in the landfill proper), the Columbia River Sands and the deep Pleistocene Gravels. Actual data will be used to construct the framework. We will discuss more on this in a separate section.

We will assume that groundwater is homogeneous, isothermal, incompressible and the aquifer matrix is rigid. Flow induced by variable density and temperature are considered to be secondary and will be ignored since groundwater dynamics at the St. Johns Landfill region is predominantly driven by gravitional, tidal and seasonal forcing.

Conceptual representation of transport processes will be presented when we discuss transport modeling in Phase II.

1.2 Model Selection

We will use the following groundwater models to simulate flow and contaminant transport at the St. Johns Landfill region:

- MODFLOW for simulating three-dimensional transient flow
- PATH3D for three-dimensional transient particle tracking
- MT3D for simulating three-dimensional transient contaminant transport

These models are selected based on their solution algorithm, capabilities, reliability, extendibility, source availability and the project manager and his team's familiarity in using the models.

MODFLOW:

The USGS MODFLOW (McDonald and Harbaugh, 1988) is by far the most well tested, documented and accepted groundwater flow model available. It is a transient three-dimensional finite difference model suitable for simulating the groundwater flow system at the St. Johns Landfill region. MODFLOW contains many special packages. The RIVER Package can be used to treat the sloughs, the Columbia River, the Willamette River and Bybee/Smith Lakes; the DRAIN Package can be used to model a leachate collection system (LCS). The newly added BCF2 package can be used to deal with groundwater mounding in the landfill. MODFLOW also provides the capability of calculating seepage fluxes across different geological boundaries and into different compartments such as streams, lakes and drains. This is important since estimation of seepage and leachate fluxes from landfill to adjacent streams, lakes and aquifer is the very motivation of this project.

One potential pitfall in using MODFLOW lies in its numerical difficulty in simulating water table aquifer with significant vertical flow (like groundwater mounding). Water table boundary conditions can be highly nonlinear and an iterative solution algorithm is necessary. The new BCF2 package in MODFLOW is specially designed to address this type boundary condition. Our experience, however, shows that one may encounter extremely slow iterative convergence or even divergence when the groundwater mound is high and the rate of increase is fast. Different remedies and methods are available to circumvent the potential problem and the project manager has personal experience with these different fixes and knows their relative effectiveness. This is an important issue and must be realized since groundwater mounding is an essential feature we need to capture.

PATH3D

Particle tracking model PATH3D developed by Zheng (1990) will be used as a postprocessor to MODFLOW for calculating groundwater flow path and contaminant travel time. PATH3D is compatible with MODFLOW and suitable for modeling the St. Johns Landfill site. One should note that the current version of the commonly used particle tracking model MODPATH (Pollock, 1989) is only good for steady state problems.

MT3D

Selection of transport code is trickier and requires knowledge in-depth of modeling techniques. In addition to model compatibility and capability, etc., an important issue we have to consider is numerical accuracy/stability in the transport solver used in the model. Numerical solution of the contaminant transport equation is far more difficult than its counterpart flow equation. It is well known to almost every numerical modeler of general transport processes that conventional Eulerian finite difference or finite element based transport models are often plagued with either excessive false diffusion or spurious nonphysical oscillations. The class of random walk based transport models [e.g. RNDWALK (Prickett et al., 1981), INTERTRANS (distributed by Scientific Software Group), etc.] are free of these numerical problems but generally have difficulties in simulating chemically active contaminants. Further more these random walk based models may become prohibitively expensive when contaminant source size is large as is the case at St. Johns Landfill.

In this project we will use transport model MT3D developed by Zheng (1990). MT3D is fully compatible with MODFLOW. It is designed to simulate contaminant transport of chemically active contaminants in three dimensional time dependent velocity field. The transport solver is based on the Lagrangian-Eulerian algorithm which is essentially free of artificial dispersion or nonphysical oscillations and represents the state of art in solving the contaminant transport equation. The project manager has special expertise in the numerical solution of the contaminant transport equation and has published extensively on this topic in respected refereed journals (Li, 1988; Li and Venkataraman, 1991; Li and McLaughlin 1991, Li et al. 1992).

1.3 Grid Design

Spatial Grids:

Generally speaking, the St. Johns Landfill region can be roughly visualized as an aquitard-aquifer system. The landfill refuse, floodplain sediments and dredged sandfill can be considered as aquitards while the Pleistocene Gravels can be considered as an aquifer. Hydraulic head varies fast vertically in the aquitards and flow is predominantly vertical. Vertical grid spacing should be so designed that the fast varying vertical head distribution can be adequately resolved. A vertical spacing of approximately 5 to 20 feet may be adequate. Lower limit should be used in the immediate neighborhood of sloughs and right below Smith/Bybee Lakes.

Lateral flow may be important within the landfill because of groundwater mounding. As a result, head within the landfill may vary significantly in all directions and especially near the landfill perimeter. A reasonably fine areal (horizontal) grid spacing has to be used within the landfill in order to adequately estimate lateral flow into the sloughs. An areal grid spacing on the order of approximately 50 to 250 feet may be adequate. Again lower limit should be used in the neighborhood of the sloughs. Outside the landfill, a progressively increasing areal grid spacing from 250 feet to as large as necessary can be used to cover the entirely model area. Lower limit should be used in the neighborhood of Bybee Lake to resolve offsite leachate plume migration in the deep aquifer.

The Pleistocene Gravel aquifer is highly transmissive. Flow in this aquifer is essentially horizontal and head variation in the vertical direction is small. In fact, head data in the deep aquifer seem to show that horizontal gradient is also extremely flat (Sweet-Edwards, 1989; Schock, 1993). Grid spacing in this case is dictated by transport simulation. The leachate plume originating from the large landfill volume source is expected to be flat and thin since permeability in the field is almost always strongly anisotropic (water tend to move more easily in the horizontal direction than in the vertical direction) and vertical dispersivity is always orders of magnitude smaller than the horizontal dispersivities. Therefore, vertical spacing over the vertical plume extent should be so designed that the expected sharp vertical concentration distribution in the deep aquifer can be properly resolved.

It is important to point out that the proposed vertical discretization is different from that in typical MODFLOW simulations where vertical discretizations are often made to conform with geological layers. This means that in effect vertical grid varies spatially within a layer. This procedure allows greater flexibility in fitting hydrostratigraphic units into a finite difference grid. This type of vertical discretization, however, applies only when flow moves essentially along the geological layers. This is clearly not the case at the St. Johns Landfill region. Multiple computational layers must be used within a single geological unit to capture the converging flow into the sloughs and vertical upwelling into Smith/Bybee Lakes.

Time Steps

Flow and leachate concentration at the St. Johns Landfill region are characterized by cyclic diurnal and seasonal variations as well as a systematic net annual trend. Selection of time steps depends on what level of temporal details we want to resolve and what level of temporal details we can afford to resolve. For a shorter term simulation on the order of years, we may be able to afford to resolve the detailed diurnal head variation. The time step used in this case should be on the order of hours. For a longer term simulation over a time span of 20-100 years it is probably more realistic to predict only seasonal variation and the annual trend. The time step used in this case should be on the order of months. If we are only interested in the net annual trend, the time step used can be on the order of years. To calculate an asymptotic steady state, a even larger time steps can be used. In this project we will try a range of time steps and explore the environmental implications of diurnal and seasonal forcing as well as the long term influence of St. Johns Landfill on the surrounding surface and groundwater systems.

Overall, we expect a discretized system on the order of 100,000 to 500,000 computational nodes with approximately 50 to 500 time steps is necessary to adequately resolve the flow and transport at the St. Johns Landfill region. Computations involved are formidable and not suitable for implementation on personal computers. We will perform all computations on workstations at Portland State University. Personal computers will be used for small scale simulations for explorative purpose.

1.4 Aquifer Framework

As discussed earlier, the aquifer framework at the St. Johns Landfill region is made of the landfill refuse, floodplain sediments, dredged sandfill, the Columbia Sands and the Pleistocene Gravels. Accuracy of aquifer characterization dictates how faithfully we can reproduce the flow and transport at the site and affect our decisions as to how we should optimally manage the system. For example, estimated thickness of floodplain sediments and its hydraulic conductivity dictates how long it takes for contaminants to penetrate this "buffer layer" and the extent of offsite aquifer pollution. In particular, floodplain sediments in the northeastern area of the landfill and the northwestern area of Bybee Lake are reportedly very thin (Fishman Environmental Services, 1989; Sweet-Edwards/EMCON, 1986). Adequate characterization of sediment thickness in these areas is crucial since it dictates aquifer-landfill and aquifer-lake interactions as well as the role of temporal forcing at different time scales. The influence of diurnal variation or a major individual storm may become a lot more important when the sediment layer thins to only a few feet.

We will carefully review all data and maps available on elevations of each geological layer and construct to the best we can an aquifer framework that reflects the actual field conditions especially at critical areas. We will discuss with Metro about the constructed aquifer framework before proceeding to full scale flow and transport modeling.

1.5 Boundary and Initial Conditions

Boundary condition

Boundary conditions at the St. Johns Landfill region is crucial. Unlike in most groundwater modeling problems, flow dynamics at this site is completely dictated by boundary forcing. This is why we propose to extend model boundaries to the Columbia River and Willamette River even though we are not directly interested in the flow conditions outside the landfill affected slough-aquifer-lake area.

Three dimensional groundwater modeling requires that boundary conditions be specified on both lateral boundaries and top/bottom boundaries. Specification of lateral boundary conditions requires information on flow condition in the Columbia and Willamette Rivers as well as knowledge of regional groundwater flow pattern in the deep aquifer in the neighorhood of the lateral model boundaries.

We will assume that bottom boundary in the deep aquifer is flat and no flux boudary conditions will be used since flow in the deep aquifer is essentially horizontal. The exact location of the bottom boundary will be inconsequential as long as it is located sufficiently removed from the bottom of the floodplain sediments.

As we have discussed earlier, iterative treatment of water table boundary condition can be tricky and sometimes problematic. Special fixes may be necessary. Many existing groundwater models get around specifying water table boundary condition by using Dupuit approximation. This applies only when flow is essentially horizontal and is clearly inapplicable for modeling St. Johns Landfill.

Also deserve a special mention on the top boundary is the treatment of sloughs and lake system. These surface water bodies will be treated as head dependent flux boundary condition (Anderson and Woessner, 1991). Specification of such boundary condition requires information on how water level in the sloughs as well as Smith/Bybee Lakes varies in time in response to tidal and seasonal forcing at the Columbia River. Such information can be obtained from another related project directed by Professor Scott Wells on simulating surface water hydrodynamics in the St. Johns Landfill region. In particular, the two key members of the proposed PSU groundwater modeling team, Christopher Berger and Marko Boyko, were responsible for the development of the hydrodynamics models for simulating the sloughs and Smith/Bybee Lakes. These models will be used to generate boundary conditions for the proposed groundwater models. The resulting simulated boundary conditions will be consistent with diurnal and seasonal fluctuations in the Columbia River. Development of such a set of consistent boundary conditions is particularly important when Bybee Lake were open to the Columbia slough and returned to intertidal habitat.

Initial Condition

Flow at St. Johns Landfill is inherently time dependent. An initial head condition has to be specified when simulating the transient process of groundwater mounding since what happen in the past clearly affect the transient flow condition and extent of contamination today and what they will be in the future.

The existing flow condition at the St. Johns landfill region can be treated as a transition from a pre-landfilling equilibrium flow condition toward a new asymptotic equilibrium. The pre-landfilling flow condition may serve as an obvious initial condition for transient flow simulation. This initial equilibrium condition can be generated by running the transient groundwater model for a sufficiently long time under pre-landfill site condition with an arbitrary initial condition until a "steady state" is achieved. Setup of such an initial condition requires historical information about the St. Johns Landfill site. We will work closely with Metro and our subconsultant, Portland office of Parametrix Inc. in collecting/organizing site-specific historical information and converting it to model required inputs.

1.6 Inputs/Outputs

It can never be emphasized too much that model predictions can only be as good as model inputs. Before moving on to full scale modeling, we will systematically summarize all existing data provided by Metro as well as from other sources. In particular, we will start by asking ourselves the following questions:

- What data are needed by the proposed groundwater model ?
- What data are available from Metro and other sources ?
- What parameters/inputs have to be assumed (based on typical values) ?

We will work closely with Parametrix Inc. and Metro in collecting and analyzing existing data and convert them to model required inputs. In particular we will search from various sources for offsite data on hydraulic head and water quality parameters especially in the area of Bybee Lake. These offsite data are crucial to the success of simulating offsite plume migration and aquifer-Bybee Lake interactions.

We will discuss outputs and model postprocessing in a separate section.

2 Transient Flow Conditions

2.1 Model Calibration

Model parameters and inputs based on limited field data are always uncertain. As a result, model predictions based on these parameters may often do not reproduce existing known flow conditions. These model parameters and inputs must be further adjusted or "calibrated" before the model can be used for predictive purpose.

Parameters and inputs that need to be calibrated are those that are not observed or not directly observable. These include hydraulic conductivity between measurement locations, hydraulic conductivity anisotropy, specific storage coefficient, specific yield, recharge, river and lake leakage, drain conductance, initial condition and boundary conditions, etc..

Calibration can be done either manually or automatically using an existing computer package such as MODFLOWP (Hill, 1990) and MODINV (distributed by Scientific Software Group). In this project we will perform the calibration manually. Manual calibration allows us to make use of our physical insight in groundwater physics and our knowledge on how each parameter affects groundwater flow in estimating model parameters.

We will first calibrate the model by comparing visually the predicted spatial head distribution with observed head distribution at a given time. We will then compare the predicted and observed temporal head distribution at given wells/piezometers. Matching spatial head distribution helps, for example, tune the spatial distribution of hydraulic conductivity. Matching temporal distribution (e.g. fitting amplitude of head fluctuation and minimizing phase lag) helps tune the mean level of hydraulic conductivity, storage coefficient and specific yield. Our final quantitative criterion will be to minimize the root mean square (RMS) error in head prediction, or the average of the squared differences in measured and simulated heads. The maximum acceptable error of the calibration criterion depends on the magnitude of the change in heads over the problem domain. At the St. Johns Landfill region maximum head loss is equal to the difference between water level in the landfill and water level in the deep aquifer. A reasonable maximum acceptable error will be 10% of the total head loss.

2.2 Steady-State Simulation

As we discussed earlier, when boundary forcing is cyclic, there should exist an asymptotic dynamic equilibrium flow condition. This "steady state" flow condition can be obtained by running the calibrated transient flow model for a sufficiently long time until the initial condition is "forgotten".

One should be aware, however, that two different steady state flow conditions will result with and without landfill capping as we discussed ealier. Without landfill closure, mean water level in the landfill will increase steadily until it approaches maximum limit. At the steady state, the total mean leachate flux into the surrounding surface water and groundwater system will be equal to the mean influx from recharge. Under existing Metro landfill closing plan, infiltration to the landfill will be gradually reduced to essentially zero by 1996 when the landfill is completely capped. Mean water level in the landfill will then decline steadily until an equilibrium is established when water level in he landfill becomes approximately equal to that in the surrounding surface water system. The asymptotic steady state flow condition under existing Metro landfill closure plan will reduce essentially to the initial known pre-landfilling flow conditions. What is unknown and needs to be determined is the time it takes to reach the steady state.

We will perform a long term simulation for calculating the asymptotic steady state flow condition for the no-closure scenario and under the existing Metro landfill closure sequence. In particular, we will determine the associated asymptotic maximum and minimum leachate flux into surrounding surface and groundwater systems and the time it takes to reach the steady state conditions.

2.3 Postprocessing and Visualization

Flow visualization plays an important role in three-dimensional flow simulation. Visualization will significantly facilitate visual flow calibration and can reveal new insight into the groundwater flow process. Portland State University has just purchased an advanced graphics package called "SitePlanner" specially designed for three dimensional subsurface investigations. The software is interactive and user friendly can be used to visualize any four-dimensional data sets (property value as a function x,y,z) along any areal or vertical cross-sections together with topography, surface site features, stratigraphy, aquifer framework and sampling configurations such as piezometers and monitoring wells.

We will apply SitePlanner to visualize groundwater flow and contaminant transport at the St. Johns landfill region. We believe our advanced graphics and visualization capabilities will dramatically improves our result presentation to Metro.

2.4 Documentation

We shall provide to Metro a short written summary of all flow model inputs and assumptions.

Phase II - Transport Modeling and Model Applications

3 Non-Conservative Solute Transport Model

3.1 Model

We will develop a transport model using MT3D (Zheng, 1990) for simulating migration of chemically active contaminants in three-dimensional transient flow field at the St. Johns Landfill region. We will incorporate chemical reactions such as sorption described by a retardation factor and hydrolysis and decay described by a first order decay constant. The sorptive process will be assumed rapid compared with the flow velocity and the contaminants will reach an equilibrium condition with the sorbed phase that can be described by an equilibrium sorption isotherm.

Source Representation, Boundary and Initial Conditions:

Leachate plume from St. Johns Landfill are characterized by elevated concentration of total dissolved solids, alkalinity, chloride and other organic and inorganic constituents. Different contaminants in the leachate plume behaves differently both physically and chemically. Soluble conservative contaminants are mobile and move as fast as groundwater. A conservative solute plume defines the outer edge of the leachate plume and represent a conservative description of the actual leachate plume. Chemically active contaminants tend to move slower than groundwater due to the so called "retardation" effect. The associated concentration is usually smaller than an otherwise conservative contaminant due to chemical transformation and/or biodegration. The selection of a contaminant indicator for modeling purpose depends on the objective of transport modeling. For general characterization of the space-time leachate plume distribution, we should track a constituent that is representative and can be modeled reliably. Reliability of transport prediction strongly depends on how much data we have and how well we understand the physical and chemical processes involved for the contaminant we select. We will carefully review all the water quality data available and discuss with Metro staff before we decide on the contaminant(s) to be modeled.

We will treat refuse within St. Johns Landfill as a continuous volume source releasing contaminant at a rate determined from flow modeling results. Model domain for transport simulation does not necessarily have to be the same as that used for flow modeling since the overall plume scale is expected to be significantly smaller than that of flow domain. The transport model domain depends on the overall plume size and will be selected such that it is just large enough to contain the entire leachate plume and allow us to specify zero or background concentration on the boundaries. The initial condition will be assumed as zero or background concentration corresponding to pre-landfilling condition.

Grid Design:

We will use the same computational grid network for both flow and transport simulation. We should emphasize again that leachate plume is expected to be fat in the horizontal direction but very thin in the vertical direction in the deep aquifer. Vertical grid spacing will be limited by transport modeling and it should be so designed that the sharp concentration distribution in the vertical direction can be adequately resolved.

Calibration:

The proposed transport model involves additional parameters. These include dispersivities in all three directions, chemical partition coefficient(s), and the first order decay constant. The magnitude of these parameters is dictated by the type of aquifer material and the type of contaminant. Dispersivities generally increase with soil grain size and the degree of heterogeneity. Dispersivities in the floodplain sediments should be orders of magnitude smaller than those in the Pleistocene Gravels. Sorption increases with the fraction of organic carbon content for organic contaminants. The chemical distribution coefficient in the silty/clayey floodplain sediments should be significantly larger than that in the Pleistocene Gravels. We will obtain a rough estimate of these parameters from existing formulas and further calibrate these parameters by comparing predicted concentration with existing known concentration values at scattered monitoring wells. The maximum acceptable value of root mean square error of concentration prediction will be set as of 5%-10% of the source concentration.

3.2 Documentation

We shall provide to Metro a short written summary of all transport model inputs and assumptions.

4 Model Applications

4.1 Contaminant Transport

The calibrated groundwater flow and transport models will be used to predict contaminant transport from St. Johns Landfill to surrounding surface and groundwater systems. In particular we will determine

- groundwater flow and contaminant flux to the Columbia and North Slough as a function of time
- groundwater flow and contaminant flux to the deep Pleistocene gravel aquifer as a function of time
- groundwater flow and contaminant flux to Smith/Bybee Lakes as a function of time
- spatial concentration distribution of leachate plume at different times

We will discuss contaminants to be modeled and assumptions with Metro staff before simulating contaminant transport.

4.2 Leachate Collection System

Flow and transport simulations performed in Section 4.1 will be repeated with an added perimeter leachate collection system (LCS) (based on a conceptual design to be provided by Metro). The results will be compared with those obtained in 4.1 to assess the effect of LCS in abating movement of contaminants from St. Johns Landfill into surrounding ground and surface waters.

4.3 Drawdown in the Lakes

Flow and transport simulations performed in Section 4.1 will be repeated for different water levels in Smith/Bybee Lakes. The results will be compared with those obtained in 4.1 to assess the effect of drawdown in Smith/Bybee Lakes on the rate of movement of contaminants away from the St. Johns Landfill.

4.4 Intertidal Habitat in Bybee Lake

Flow and transport simulations performed in Section 4.1 will be repeated with Bybee Lake directly connected to the Columbia slough. The results will be compared with those obtained in 4.1 to assess the effect on groundwater flow in the region if Bybee Lake or a portion of the lake were to be returned to intertidal habitat.

Deliverables

We have proposed a comprehensive model for simulating groundwater flow and contanminant transport at the St. Johns Landfill region. We have made a special effort to assure that the proposed model will achieve the specific modeling objectives and can address the issues that concern Metro site planner and managers. If the proposed project is approved we shall

1. complete the proposed tasks in a timely manner, based on the timetable delivered with the proposal.
2. deliver all groundwater models developed for this project to Metro in a working form compatible with Metro's computer model, with all calibration data, on computer disks and an operation manual.
3. provide a complete documentation of all model inputs assumptions used in the model.
4. provide Metro technical staff hands-on training on runing the model at Metro's office.

C. Staffing and Project Manager Designation

The Portland State University Groundwater Modeling Services Team members are listed below:

Shu-Guang Li (70% effort), Ph.D., Project Manager
Christopher Berger (49%), Graduate Assistant
Mark Boyko (49%), Graduate Assistant
We Li (49%), Graduate Assistant
Qing Zhou (49%), Graduate Assistant
John Harris (10%), CAD Computer Lab Technician

Parametrix Subconsultant Services Team (150 hours):

Dave Morton, R.G. - Geologist
Rick Malin - Hydrogeologist
Vicki Martinez - Hydrochemist
Susan Harrington - Geographic Information System Specialist
Linda Logan - Ecological Risk Assessment
Rick Cardwell, Ph.D - Toxicology Group Manager

Task Designation

Shu-Guang Li
Overall project direction and management
Communication with Metro

Christopher Berger, We Li and Shu-Guang Li
Model construction
Model calibration/execution
Model applications
Model documentation

Mark Boyko, Qing Zhou, Shu-Guang Li
Model input preprocessing
Model output postprocessing and visualization
Boundary condition simulations
Smith/Bybee Lakes simulation
Columbia and North Sloughs simulation

Parametrix, Shu-Guang Li
Existing data analysis
Offsite data collection
Site information
Historical information
Regional groundwater information
Columbia/Willamette Rivers hydrological data collection

John Harris
Computer software and system support

D. Experience

The Project Manager, Shu-Guang Li, specializes in hydrogeology and contaminant hydrogeology. His research area includes contaminant fate and transport modeling, groundwater simulation techniques, effect of heterogeneity and field scale transport, model uncertainty and stochastic modeling, parameter estimation and monitoring network design.

Over the years, the project manager has been actively involved in groundwater research. His contributions include theoretical innovations and site specific model study. Listed below are some of the major research projects the project manager has been involved in:

Stochastic Modeling of Groundwater Flow in Heterogeneous Aquifers, funded by EPA, see Li and McLaughlin, Water Resources Research, submitted

Two-Dimensional Site Characterization and Monitoring of Groundwater Flow and Contaminant Transport at a Coal Tar Waste Disposal Site in Upstate New York, Funded by EPRI; see McLaughlin, Reid, Li and Hyman, 1993, Journal of Groundwater

Three-Dimensional Modeling of Groundwater Flow and Contaminant Transport at a Coal Tar Waste Disposal Site in Upstate New York, Funded by EPA, see Li, 1992, Ph.D thesis

Improved Methods for Three-Dimensional Stochastic Contaminant Transport Modeling, Funded by EPA, see Li, 1992, Ph.D thesis

Two-Dimensional Simulation of Groundwater Flow and Contaminant Capture Zone at a Superfund Site in Woburn, Massachusetts Using MODFLOW/MODPATH/MODPATH-PLOT, Unfunded. Case study in Groundwater Modeling class taught by the project manager at Portland State University, 1992

Improved Methods For Solving the Contaminant Transport Equation, Funded in part by MIT and EPA; see Li et al. 1992, Water Resources Research; Li and Venkataraman, 1992, Journal of Hydraulic Research

Development of a Hazardous Waste Design Package, funded by MIT, 1991

Improved Methods for Solving Groundwater Flow Equation, see Li, 1988, Numerical Heat Transfer

These projects were all joint research projects with Professor Dennis McLaughlin at Massachusetts Institute of Technology. Professor McLaughlin was the Principal Investigator. He can be reached at (617) 253-7176 for further information.

The project manager is also actively involved in teaching at Portland State University since 1992. The following is a list of groundwater related courses the project manager has taught:

CE569/669 *Introduction to Subsurface Flow and Contaminant Transport*, 1992 Winter, 1993 Fall
CE570/670 *Numerical Modeling to Subsurface Flow and Contaminant Transport*, 1992 Spring
CE510/610 *Groundwater Remediation*, 1992 Spring
CE510/610 *Management of Hazardous Substances*, 1993 Fall
CE571/671 *Advanced Topics in Subsurface Flow and Transport*, to be offered 1993 Spring

E. Cost/Budget

Phase I: Required Tasks

Salaries and Wages		Total Budget
Li, Shu-Guang; Project Manager 12/1/93-3/15/94 @ 0.7 FTE	45,324 / 9 mos.	12,338.00
Harris, John A.; CAD Computer Lab Technician 12/1/93-3/15/94 @ 0.10 FTE	39,291 / 12 mos.	1,146.00
Berger, Christopher; Graduate Research Assistant 12/1/93-3/15/94 @ 0.49 FTE	21,720 / 9 mos.	4,139.00
Boyko, Mark; Graduate Research Assistant 12/1/93-3/15/94 @ 0.49 FTE	19,620 / 9 mos.	3,739.00
Li, Wei; Graduate Research Assistant 12/1/3-3/15/94 @ 0.49 FTE	17,460 / 9 mos.	3,327.00
Zhou, Qing; Graduate Research Assistant 12/1/3-3/15/94 @ 0.49 FTE	17,460 / 9 mos.	3,327.00
Student Clerical Support 12/1/93-3/15/94 @ 15hr/wk× 15 wk @ $8/hr		1,800.00
Total Salaries & Wages		29,816.00
Fringe Benefits		
Faculty: 35 % of Total Salaries & Wages		4,045
Students: 7% of Total Salaries of Wages		1017.00
Student Tuition Remission: 1 Terms $1,140/term		4,560.00
Total Fringe Benefits		9,622.00
Total Personnel Costs		39,438
Subconsultant/Parametrix 12/1/93-3/15/94 150 hours $60.00/hour		9000.00
Computer Softwares and Supplies		2,000.00
Office Support, Telephone, Postage		200.00
Printing and Copying of Report		250.00
Total Direct Costs		50,888.00
Indirect Costs - 15% of (TDC Excluding Tuition Remission)		6949.00
Total Costs -		57,837.00

Phase II: Optional Tasks

Salaries and Wages		Total Budget
Li, Shu-Guang; Project Manager		
3/16/94-6/15/94 @ 0.4 FTE	45,000 / 9 mos.	6,043.00
6/16/94-6/30/94 @ 1.0 FTE	45,000 / 9 mos.	2,518.00
Berger, Christopher; Graduate Research Assistant		
3/16/94-6/30/94 @ 0.49 FTE	21,720 / 9 mos.	4,139.00
Boyko, Mark; Graduate Research Assistant		
3/16/94-6/30/94 @ 0.30 FTE	19,620 / 9 mos.	2,289.00
Li, Wei; Graduate Research Assistant		
3/16/94-6/30/94 @ 0.30 FTE	17,460 / 9 mos.	2,037.00
Total Salaries & Wages		17,026.00
Fringe Benefits		
Faculty: 35 % of Total Salaries & Wages		1,813.00
Students: 7% of Total Salaries of Wages		290.00
Student Tuition Remission: 1 Terms $1,140/term		3,624.00
Total Fringe Benefits		5,727.00
Total Personnel Costs		22,753.00
Total Direct Costs		22,753.00
Indirect Costs - 15% of (TDC Excluding Tuition Remission)		2,869.00
Total Costs		25,622.00

Curriculum Vitae

Name, Addrress and Present Position

Shu-Guang Li, Assistant Professor of Civil and Environmental Engineering
Portland State University, Portland, OR 97207-0751
Phone: (503) 725-5543, Fax: (503) 725-4298, Email: shuguang@eas.pdx.edu

Education

- Ph.D., 1992, **Massachusetts Institute of Technology**
  Water Resources and Environmental Engineering, specializing in groundwater hydrology.
  Thesis: *A nonstationary spectral method for solving stochastic groundwater problems.*
- M.S., 1988, **University of Iowa**
  Fluid Mechanics, specializing in computational fluid dynamics.
  Research project: *New methods for solving the Navier-Stokes fluid flow equations.*
- M.S., 1985, Chengdu University of Science and Technology, China
  Hydraulics, specializing in supercritical flow hydraulics, cavitation and energy dissipation.
  Thesis: *An improved method for solving rapidly varying flows past spillways.*
- B.S., 1982, Chengdu University of Science and Technology, China
  Hydraulic Engineering.
  Thesis: *Hydraulic modeling of Red Rock irrigation works*

Research Interests

- Modeling groundwater flow and contaminant transport: field-scale behavior; effect of natural heterogeneities; model-data interactions; site characterization and monitoring.
- Large-scale parallel computation and numerical simulation techniques.
- Distributed-parameter system theory and environmental applications; stochastic partial differential equations.
- Modeling flow and mixing processes in natural rivers.

Research Experience

Assistant Professor, Portland State University, 1992 December - present

- Characterization of groundwater contamination at a coal tar waste site in upstate New York.
- Simulation of groundwater flow and contaminant transport at Superfund Site Wells G and H, Woburn, Massachusetts.

Research Assistant, Massachusetts Institute of Technology, 1988-1992

- Three-dimensional stochastic modeling of solute transport in heterogeneous porous media.
- Development of improved methods for solving the convection-dominated dispersion equation.
- Prediction of flow resistance in irregular natural streams.
- Development of a hazardous waste cleanup design package.
- Symbolic *Mathematica* calculation of stochastic groundwater flows.
- Development of improved methods for stochastic estimation of distributed parameter systems.
- Development of improved methods for nonstationary stochastic groundwater prediction.
- Prediction of contaminant dispersion in irregular natural streams.

Research Assistant, University of Iowa, 1986-1988

- Development of improved numerical methods for solving parabolic partial differential equations.
- Development of an expert system for teaching engineering core curriculum.

Research Assistant, Chengdu University of Science and Technology, 1982-1985

- Calculation of rapidly-varying supercritical flows past spillways.
- Hydraulic modeling of *Red Rock* irrigation works.

Consulting: Aquifer pump test analyses, Cornforth Consultants, Portland, 1993.

Courses Taught (at Portland State University)

- CE569 *Introduction to Subsurface Flow and Contaminant Transport*, Fall 1992.
- CE570 *Numerical Modeling of Subsurface Flow and Contaminant Transport*, Spring 1993.

Professional Societies

- Member of the American Geophysical Union (AGU)
- Member of the Association of Groundwater Scientists and Engineers

Professional Activities

- Reviewer for *Water Resources Research* (WRR)
- Reviewer for *Advances in Water Resources* (AWR)
- Reviewer for *Journal of Hydraulic Engineering* (JHY)

Honors and Awards

- Distinguished Young Investigator's Award: The Li Foundation Fellowship for two years of advanced study in the United States, among the twelve selected in China for academic excellence.

Publications

1. D.B. McLaughlin, L.B. Reid, S.G. Li and J.A. Hyman, *A Stochastic Method for Characterizing Groundwater Contamination*, Journal of Groundwater, Vol. 31, No. 3, 237-249, 1993
2. S.G. Li, F. Ruan and D.B. McLaughlin, *A Space-Time Accurate Method for Solving Solute Transport Problems*, Water Resources Research, Vol. 28, No.9, 2297-2305, 1992.
3. S.G. Li, L. Venkataraman and D.B. McLaughlin, *A Stochastic Theory for Irregular Stream Modeling, Part 1: Flow Resistance*, Journal of Hydraulic Engineering, ASCE, Vol. 118, No. 8, 1079-1090, 1992.
4. S.G. Li and D.B. McLaughlin, *A Nonstationary Spectral Method for Solving Stochastic Groundwater Problems, Part 1: Unconditional Analysis*, Water Resources Research, 27(7), 1589-1605, 1991
5. S.G. Li and L. Venkataraman, Discussion on *Time-Line Interpolation for the Solution of the Dispersion Equation*, Journal of Hydraulic Research, Vol. 29, No. 4, 568-571, 1991.
6. L.B. Reid, D.B. McLaughlin, S.G. Li and J.A. Hyman, *A New Stochastic Method for Characterizing Groundwater Contamination: Application to a Coal Tar Waste Disposal Site*, Proceedings of International Hydrology and Water Resources Symposium, 435-439, 1991.
7. S.G. Li, *Theoretical Longitudinal Dispersion Coefficient in Natural Rivers - A Stochastic Approach*, Proceedings of XXIII IAHR Congress, Session D: Environmental Hydraulics, 1989.
8. S.G. Li, *An Optimal Exponential Difference Scheme for Solving Parabolic Partial Differential Equations*, International Journal of Computation and Methodology: Numerical Heat Transfer, Vol. 14, No. 3, 357-371, 1988.
9. S.G. Li and Z.X. Liang, *Gravity-Affected Potential Flows Past Spillway Flip Buckets*, Journal of Hydraulic Engineering, ASCE, Vol. 114, No. 4, 409-427, 1988.

Conference Presentations

1. S.G. Li and D.B. McLaughlin, *A Nonstationary Spectral Method for Three-Dimensional Stochastic Groundwater Transport Modeling*, presented at the AGU Spring Meeting, Baltimore, 1993.
2. S.G. Li and D.B. McLaughlin, *A Nonstationary Groundwater Analysis*, presented at the AGU Spring Meeting, Montreal, Canada, 1992.
3. S.G. Li and D.B. McLaughlin, *New Methods for Characterizing Groundwater Contamination at Hazardous Waste Sites*, presented at EPA Science Advisory Meeting, NJIT, New Jersy, 1992.
4. S.G. Li, F. Ruan, and D.B. McLaughlin, *A Laplace-Transform/Finite-Analytic Method for Solving the Transient Groundwater Transport Equation*, presented at the AGU Fall Meeting, San Francisco, 1991.
5. S.G. Li and D.B. McLaughlin, *A New Filtering Formulation for Spatially-Distributed Groundwater Systems*, presented at the First International Conference on Stochastic Computational Mechanics held in Corfu, Greece, 1991.
6. D.B. McLaughlin and S.G. Li, *Real-Time Prediction and Monitoring of Groundwater Contamination*, presented at ModelCARE 90: Calibration and Reliability in Groundwater Modeling, The Hague, The Netherlands, 1990.
7. S.G. Li and D.B. McLaughlin, *A Nonstationary Spectral Method for Solving Stochastic Groundwater Problems*, presented at the AGU Fall Meeting, San Francisco, 1989.
8. S.G. Li, *Theoretical Longitudinal Dispersion Coefficient in Natural Rivers - A Stochastic Approach*, presented at the XXIII IAHR Congress, Ottawa, Canada, 1989.

Christopher Berger
11462 S.E. 90TH AVE. #512
Portland, Oregon 97266
(503) 653-1270

Education:

Master of Science in Civil Engineering, Portland State University, in progress. Expected graduation date, fall, 1993. Thesis topic: "Water Quality Modeling of the Tualatin River".

Bachelor of Science in Civil Engineering, Portland State University, 1991.

Bachelor of Science in Physics, Oregon State University, 1987.

Work Experience:

Research Assistant to Scott Wells, Columbia Slough Project, Portland State University. August, 1992 to present. Currently participating in the development of Upper and Lower Columbia Slough receiving water model. Responsibilities include computer programming, model calibration, water quality sampling, and analysis of management alternatives.

Research Assistant to Scott Wells, Tualatin River Project, Portland State University. January, 1992 to present. Participated in the development, calibration, and implementation of in-stream Tualatin River water quality and hydrodynamic model. Responsibilities included: preparation of channel geometry, inflow, and withdrawal information; development of a diversion dam algorithm; surveying of the river channel and gaging sites; model calibration and verification; analysis of management alternatives.

Engineer. Mackenzie Engineering Incorporated, Portland. June, 1991 to December, 1991. Site development work including the design of storm sewers, sanitary sewers, roads, parking lots, and water utilities.

Assistant Watermaster. Tualatin River District, Washington County. June, 1990 to September, 1990. Measured stream flows, maintained stream gaging stations, helped regulate water rights, surveyed stream gaging sites, and inspected wells in the Tualatin River basin.

Student Worker for Scott Wells, Portland State University. October, 1990 to June, 1991. Helped maintain monitoring stations and collected water quality and hydraulics data in the Columbia slough (Portland, OR) and the South Slough (Coos Bay, OR). Participated in dye studies to estimate pollutant transport characteristics of these systems.

MARK BOYKO

4525 S.E. 60th
Portland, OR 97206
(503) 775-5350

CAREER OBJECTIVE: Environmental/Water Resources Engineering

EDUCATION: B.S.M.E. Lehigh University, Bethlehem, PA. 1983.

Currently finishing *M.S.C.E.; Environmental/Water Resources Engineering*; Portland State University, Portland, OR.

WORK EXPERIENCE:

▸ 7/92 - present: Portland State University, Portland, OR.

Research Assistant: Create a hydraulic model of Smith/Bybee Lakes, the existing flow control structure, and a proposed flow augmentation structure. Design and model the flow augmentation structure. Monitor water quality in Smith and Bybee Lakes. Install and retrieve data loggers and piezometers from monitoring wells at the St. John's Landfill as part of closure plan. Collect groundwater elevation data from remote sensors and reduce data. Collect samples and water quality and elevation data from the Columbia Slough. Assist in the drawdown test of the Upper Columbia Slough to be performed September 1 - October 31, 1993.

Teaching Assistant: Grade papers and tabulate results. Lab Instructor.

▸ 9/92 - present: Woodward-Clyde Consultants, Portland, OR.

Field Technician: Install flow monitoring and water sampling equipment. Assist in storm sampling. Delineate catchment basins.

▸ 1/85 - 6/91: U.S. Army Information Systems Engineering Command, Quality Assurance Directorate, Ft. Huachuca, AZ.

Test Engineer (GS-12): Test Director, Assistant Test Engineer, and Data Collector for the acceptance testing and evaluation of satellite and terrestrial communications systems/equipments. Write and submit Technical Acceptance Recommendations. Write Quality Assurance segments of System Design Plan and Engineering Installation Packages. Review and editing of Statements of Work, test plans, etc.

Resume

Name: Wei Li
Major: Civil Engineering & Geography
Education Background:

1985-1989	Geography Department of Zhongshan University, Guangzhou, P.R. of China (B.S. Degree)
1992--	Portland State University (Seeking M.S.)

Working Experience:

1989.7-1992.2	Guangdong Scientific Research Institute of Lands and Surveying & Mapping, Lands Development Department of Guangdong Province

Research Experience:

1986.2-4	Data collection and analysis in Shunde Stream for wastewater drainage works of a local printing and dying mill
1987.6-9	Data collection and analysis in affection on Humen Estuary by hot water drain of Shajiao Electric Power
1988.12-1989.3	Guangzhou City Plan:1985-2020
1989.3-7	Water & soil loss research for subtropical region in Guangdong Province
1989.8-1990.12	Research for lands value-used reformation system
1990.5-1992.2	Found data base system of lands resources in Guangdong Province
1991.1-1992.2	Lands utilization overall plan in Guangdong Province
1991.5-12	Ecological development strategies in the Pearl River Delta: 1990-2020
1991.10-1992.2	Lands plan of Zhuhai Economic Special Zone
1992.7-	DMS reducing test and oder analysis

Publish:

1. "Water & soil research for subtropical region in Guangdong Province" Zhongshan University Scientific Research Report 1989 vol 2
2. "Analysis on lands transfer issue of Panda Automobile City" Guangdong Lands 1990 vol 5
3. "Analysis on lands value-used system in the Pearl River Delta" Youth Geographist 1991 vol 4
4. Ecological development strategies in the Pearl River Delta: 1990-2020 pulb by Environmental Protection Department of Guangdong Province
5. Draft of Lands plan of Zhuhai Economic Special Zone pulb by Lands Development Department of Zhuhai City

Award:

Excellent Student Zhongshan University 1987, 1988
Scholarship of 1992-1993 Portland State University
Research Assistnat of CE Department, PSU 1993

Specific in modeling:

1. Application Sacramento Model in Wuha (Subtropical region)
2. Application HEC-1 in Sandy River
3. Application QUAL2E/QUAL2EU in Tualatin River
4. Application MODFLOW/MODPATH for a case study at Boston.

Xueqing Zhou

1630 SW Clay St., #4-c
Portland, OR 97201
(503) 228-5199

Education:

M.S. student, Civil Engineering,
Department of Civil Engineering, Portland State University,
Portland, Oregon (9/92--).
B.S., Geography, Central China Normal University, Wuhan, PRC
(9/82-- 7/86).

Experience:

Graduate Research Assistant, Department of Civil Engineering, Portland State University, working on varied water resource modeling projects as follows (3/93 --):

1. **MODFLOW AND MODPATH,** Applying the modflow and modpath software in ground water modeling.

2. **FINITE-ANALYTIC/LAPLACE TRANSFORM METHOD,** Using this method to solve the transient transport equation.

3. **IRREGULAR STREAM MODELING,** Solute ransport in natural rivers, develop a probabilistic method for predicting contaminant transport in irregular natural streams.

4. **QUAL2E/QUAL2EU,** and its applications in Modeling Tualaitn River water quality.

5. **P V WAVE** applications in water quality modeling and graph demonstration.

References available upon request.

Portland State University — Civil Engineering

CE 569/669 Introduction to Subsurface Flow and Contaminant Transport
Fall Quarter 1992

Course Description: CE 569/659 Introduction to Subsurface Flow and Contaminant Transport (3)
Principles of flow and contaminant transport in porous media and application to problems of water supply and contaminant transport. Topics include: Properties of porous media; Darcy's law and aquifer equations; solution for steady and unsteady flow problems; flow net analysis; regional vertical circulation; unsaturated flow; well dynamics and pump test analysis; surface-groundwater interactions; water quality and contaminant transport; transport models; transport in heterogeneous porous media and tracer test. Prerequisite: graduate standing in civil engineering. (This course has been modified in 93-94 Catalog).

Textbook: R.A. Freeze and J.A. Cherry, Groundwater, Prentice-Hall, 1979.

References: P.A. Domenico and F.W. Schwartz, Physical and Chemical Hydrogeology, John Wiley & Sons, 1990.
C.W. Fetter, Contaminant Hydrogeology, MacMillan, 1992.

Coordinator: S.G. Li, Assistant Professor of CE

Goals: To introduce fundamentals of flow and contaminant transport in porous media and prepare students for more advanced groundwater related courses.

Prerequisites by Topic:

1. Fundamentals of fluid dynamics
2. Pipe flow
3. Differential equations

Topics (1½ hour classes):

1. Properties of porous media (1 class)
2. Darcy's experiment and generalized Darcy's law (1 class)
3. Head map and flow net analysis (1 class)
4. Two-dimensional aquifer flow and governing equations (2 classes)
5. Three-dimensional flow equation and regional vertical circulation (1 class)

6. Unsaturated flow (2 classes)
7. Well dynamics (1.5 classes)
8. Pump test design and analysis (1.5 classes)
9. Stream-aquifer interaction (1 class)
10. Water balance and water quality models (1 class)
11. Contaminant transport in porous media (2 classes)
12. Transport models (2 classes)
13. Transport in heterogeneous media and tracer test (1 class)
14. Mid-term and final exam (2 classes)

Computer Usage:

Students are encouraged to use computers to assist homework solution and term project

Estimated Content:

Engineering Science: 2.5 credits or 83%
Engineering Design: 0.5 credits or 17%

Prepared by: S.G. Li Date: May 1993

Portland State University | Civil Engineering

CE 510/610 Numerical Modeling of Subsurface Flow and Contaminant Transport
Winter Quarter 1993

Course Description: CE 510/610 Numerical Modeling of Subsurface Flow and Contaminant Transport (3)
Review of physical principles of flow and contaminant transport in porous media; finite difference and finite element methods for solving groundwater flow and contaminant transport equations; method of characteristics and finite-analytic method for solving advection-dominated transport problems; numerical modeling of flow and contaminant transport in saturated, unsaturated and multiple fluid porous systems; introduction to industrial groundwater models; case study. Prerequisite: CE 569

References:
J. Bear, **Hydraulics of Groundwater**, McGraw-Hill, 1979.
J. Bear, **Fluid Dynamics in Porous Media**, Dover, 1988.
P.S. Huyakorn and G. Pinder, **Computational Methods in Subsurface Flow**, Academic Press, 1983.

Coordinator: S.G. Li, Assistant Professor of CE

Goals: To present classical and improved numerical methods for solving the groundwater flow and transport equations and give students the ability to develop computer models using appropriate solution methods for realistic groundwater problems related to water supply and contaminant transport

Prerequisites by Topic:

1. Fundamentals of fluid dynamics
2. Numerical analysis
3. Fortran language
4. Differential equations

Topics (1½ hour classes):

1. Review of basic concepts (2 weeks)
   - A. Flow through porous media
     1. General balance equations
     2. Saturated groundwater flow equation
     3. Transport of miscible contaminants
     4. Boundary conditions
     5. Source/sink terms

6. Vertical averaging

B. Analytical solutions for selected equations

C. Introduction to numerical solutions

II. Numerical solutions for single phase systems (3.5 weeks)

A. Flow equation
1. Finite difference, finite element, and collocation methods
2. Treatment of leakage; multiple aquifer systems
3. Implementation of singularities; mass balance

B. Transport equation
1. First-order hyperbolic equations and characteristics
2. Finite difference and finite element approximations
3. Fourier analysis: stability, numerical dissipation and dispersion
4. Improved interior methods: Petrov-Galerkin, High-order upwinding, Optimal test function methods, Finite-analytic methods
5. Method of characteristics, Eulerian-Lagrangian methods

III. Multiple fluid porous media systems (3.5 weeks)

A. Two fluid systems
1. Interfacial physics and fluid movements
2. Constitutive equations
3. Numerical treatment of nonlinearities
4. Unsaturated groundwater flow
   a. Finite difference, finite element, and collocation approximations.
   b. Comparison of methods

B. Three fluid systems
1. Physics of fluid movement
2. Constitutive equations

IV. Introduction to the USGS models: MODFLOW/MODPATH, case study (1 week)

Final exam and term project

Computer Usage:

All homework, case study and term project are computer oriented. Students are required to do their assignments with the use of computers.

Estimated Content:

Engineering Science: 3.0 credits or 100%

Prepared by: S.G. Li Date: May 1993 Portland State University

Portland State University — Civil Engineering

CE 510/610 Advanced Topics in Subsurface Flow and Contaminant Transport
Spring Quarter 1993

Course Description: CE 510/610 Advanced Topics in Subsurface Flow and Contaminant Transport (3)
Probablistic approach for analyzing the effects of complex heterogeneity of subsurface environment on field-scale groundwater flow and contaminant transport. Classical transport processes; heterogeneity/uncertainty and probablistic representations; temporally variable subsurface flow and lumped parameter water quality models; spatial variability in subsurface flow; contaminant transport processes in heterogeneous media; geostatistical methods, measurement conditioning and parameter estimation; field applications of stochastic methods. Prerequisite: CE 569.

Textbook: L.W. Gelhar, Stochastic Subsurface Hydrology, Prentice-Hall, 1993.

References: J. Bear, Fluid Dynamics in Porous Media, Dover, 1988.
de Marsily, Quantitative Hydrogeology, Academic Press, 1986.

Coordinator: S.G. Li, Assistant Professor of CE

Goals: To provide a probablistic approach for analyzing uncertainty and accuracy of groundwater models and the profound effect of complex heterogeneity of subsurface environment on field-scale groundwater flow and contaminant transport

Prerequisites by Topic:

1. Fundamentals of fluid dynamics
2. Fundamentals of fluid dynamics in porous media
3. Statistics
4. Differential equations

Topics (1½ hour classes):

I. General Concepts and Classical Transport Processes (1.5 weeks)
   A. Natural Variability and Scales in Groundwater Problems
   B. Continuum Description and Mass Balances
   C. Physical Description of Subsurface Flow and Transport

D. Stochastic Approach and Concepts

II. Stochastic Description (1 week)
  A. Probability and Random Variables
  B. Random Functions and Time Series
  C. Spatial Variability and Random Fields
  D. Stochastic Differential Equations

III. Temporally Variable Subsurface Flow (1.5 weeks)
  A. Lumped Parameter Water Balance Models
  B. Dynamic Functions and Time Series
  C. Dynamic Response to Groundwater Quality Models
  D. Other Applications and Approaches

IV. Spatial Variability in Subsurface Flow (2 weeks)
  A. Effects of Hydraulic Conductivity Variations in Steady Saturated Flow
  B. Nonstationary and Boundary Effects
  C. Water Table Aquifers and Unsteady Saturated Flow
  D. Unsaturated Flow in Heterogeneous Soils
  E. Flow in Fractured Rocks

V. Transport Processes in Heterogeneous Media (2 weeks)
  A. Simplified Models of Mixing in Saturated Flow
  B. Macrodispersion in Three-Dimensional Statistically Anisotropic Media
  C. Concentration Variability
  D. Solute Transport in Fractured Rocks
  E. Other Effects in Dispersive Transport Processes

VI. Geostatistical Methods and Parameter Estimation (1 week)
  A. Introduction to Geostatistics
  B. Some Parameter Estimation Methods
  C. Geostatistical Approach to Parameter Estimation
  D. Model Data Interactions and Measurement Conditioning

VII. Field Applications of Stochastic Methods (1 week)
  A. Kriging of Two-Dimensional Aquifer Data: Tucson Basin, AZ
  B. Three-Dimensional Macrodispersion Prediction: Borden Site, Canada
  C. Three-dimensional characterization of a coal tar waste disposal site

Term project

Computer Usage:

Students are encouraged to use computer to assist homework solution and term project.

ST. JOHNS LANDFILL
GROUNDWATER MODELING SUBCONSULTANT SERVICES
PORTLAND STATE UNIVERSITY GROUNDWATER MODELING SERVICES TEAM

INTRODUCTION

Parametrix, Inc., as a subconsultant with project experience at and in the vicinity of St. Johns Landfill, will be providing technical assistance to the Portland State University (PSU) St. Johns Landfill Groundwater Modeling Services team lead by Shu-Guang Li, Ph.D of the Civil Engineering Department. An overview of the integrated engineering and environmental services provided by Parametrix is presented in an attached technical fact sheet. Included with the Parametrix overview is a Parametrix' comprehensive services brochure for Environmental Waste Management. Parametrix is conducting or has completed several environmental and engineering projects in the St Johns Landfill and adjoining Columbia River/Slough area. These projects include:

- St. Johns Landfill Closure
- Ramsey Lake Constructed Wetlands Treatment System Feasibility Study
- NuWay Oil Company Remedial Investigation/Removal Assessment
- Tidewater Moorage 5 Property

Discussion of these Parametrix projects, relevant computer modeling projects, and environmental hydrogeologic investigations in the greater Portland Metropolitan area is provided in the attachments to this proposal.

The Portland office of Parametrix will be providing the PSU Groundwater Modeling Service team support on the St. Johns Groundwater Modeling project. Key Parametrix staff identified for this modeling project include:

Dave Morton, R.G.	-	Geologist
Rick Malin	-	Hydrogeologist
Vicki Martinez	-	Hydrochemist
Susan Harrington	-	Geographic Information System Specialist
Linda Logan	-	Ecological Risk Assessment
Rick Cardwell, Ph.D.	-	Toxicology Group Manager

Key Parametrix staff resumes are presented in the attachments to this proposal. Parametrix also has an established relationship with Cornforth Consultants, Inc., a well-known geotechnical engineering firm headquartered in Portland, that provides technical assistance to Parametrix on geotechnical issues. Cornforth Consultants installed multi-level groundwater piezometers with data loggers at the St. Johns Landfill and is familiar with geologic and hydrogeologic conditions and issues associated with the site. Cornforth Consultants will be able to provide technical assistance and support as needed to the PSU Groundwater Modeling Services team.

Additional resources that Parametrix is able to provide the PSU Groundwater Modeling Services team is a multi-discipline staff with strong physical resources and extensive experience in solid waste issues. Parametrix staff includes 70 registered professionals licensed to practice in the scientific and engineering fields throughout the United States and Canada. Parametrix has doctorate staff in the disciplines of water quality, fisheries biology, toxicology, and economics. Parametrix physical resources include computer-aided design and drafting (CADD) systems and Geographic Information Systems (GIS; ARCINFO) which are fully compatible with Metro's CADD and ARC/INFO system. Parametrix is also able to offer fully equipped laboratory facilities for toxicology, sediment analysis, bioassay and water quality assessments. Parametrix, through its solid waste services to clients in the State of Oregon, has established relations with the state's regulatory community.

Parametrix has the ability to provide design drawings in various forms including; large scale hard copy drawings (Raster Color Station), eight millimeter 2.3 GB cartridge tape, or high density computer disks. A list of Parametrix' available CADD equipment is attached. Parametrix has used its CADD system extensively on a wide range of projects including site, civil, road design, and landfill development. Drawing files in MicroStation format have been provided to the Oregon Department of Transportation (ODOT); the City of Seattle, Washington; Washington State Department of Transportation; and Puget Power. If Metro has any specific questions regarding Parametrix's CADD or equipment related compatibility, please feel free to contact Ron Ricks at (503) 256-5444.

Parametrix CADD Equipment List

- 3 - Intergraph MicroStation PC 486/50 workstations with dual screens
- 1 - 8 mm cartridge tape backup drive
- 20 - IBM PC compatibles with AutoCAD design software Version 12C2
- 13 - IBM PC compatibles with Ethernet network to a plot server
- 2 - IBM PC with DCA modules including Advanced Design and AutoCAD software
- 1 - Raster Graphics color plotter networked to 13 AutoCAD and MicroStation PCs
- 1 - HP Design Jet plotter (36")
- 2 - Tektronix color printers networked to AutoCAD stations
- 2 - HP 7585 B drafting plotters (36x48)
- 3 - Macintosh computers networked to plotters and printers
- 12 - Summagraphics microgrid digitizers (18x24)
- 2 - Summagraphics microgrid digitizers (42x60)
- AutoCAD drawings are transferred through 19.2 BAUD modems

PARAMETRIX EXPERIENCE

PROJECTS AT OR IN THE VICINITY OF ST. JOHNS LANDFILL

St. Johns Landfill Closure, Portland, OR

Client: METRO

Contact: Dennis O'Neil (503) 797-1700
Joanna Karl, P.E. (503) 797-1690

Parametrix was selected by METRO - Portland to prepare plans and specifications for the closure of the 238 acre St. Johns Landfill in Portland, Oregon. The project included the design of a final cover system, surface water management, and a landfill gas collection and permanent flare system. The final cover system will use existing onsite clay materials as part of the interim cover in conjunction with a 40 mil flexible membrane liner. To protect the cover system and to control odors, gas collection will include installation of approximately 100 wells. A vacuum condensate collection system will also be installed to separate water out of the gas collection system. To control the gas, a permanent motor blower and flare system will be installed. Parametrix is providing services during construction and administration of the construction contracts. Parametrix is also assisting METRO to evaluate proposals and negotiate a contract to develop and sell the methane gas. Parametrix has provided project management services on the installation of interior leachate monitoring wells, perimeter groundwater monitoring wells, and piezometers. Parametrix collected initial groundwater quality samples from the interior leachate monitoring wells for analytical testing and provided an water quality assessment of the test results.

Portland/Vancouver Area Environmental Site Assessment and Site Investigation Projects

Client: Black & Veatch (B&V) City of Portland Bureau of Environmental Services (BES)

Contacts: Randy Krueger (B&V) - Project Manager (503) 624-0175
Joan Oshner (BES) - Project Manager (503) 823-7192

Parametrix, Inc. provided environmental and engineering consulting services to Black & Veatch on the Ramsey Lake project. Parametrix performed environmental site assessment (ESA), site investigation, groundwater quality impact investigations and conveyance pre-design engineering services. The project area consists of three proposed sites located in the Rivergate Industrial District near the St. Johns Landfill. The ESA scope of work included performing a historical background review; regulatory agency file review, site reconnaissance, and a review of soil/groundwater conditions in the project study area. The site investigation program included developing a Sampling and Analysis Plan (SAP) and implementing the SAP at specific sites to assess the environmental conditions, site geology and hydrogeology, and the groundwater quality impacts of the Wetlands Treatment System on surface water and groundwater.

NuWay Oil Company Remedial Investigation and Feasibility Study (RI/FS), Portland, OR.

Client: DEQ-Environmental Cleanup Division (ECD)

Contact: Bill Dana - Project Manager (503) 229-6662

Parametrix conducted an RI/FS at a former oil recycling facility which is adjacent to the Columbia Slough near N.E. 46th Avenue in Portland, Oregon. The project site is a State of Oregon Superfund site with cleanup costs provided from the Orphan Fund account. The remedial investigation included surface soil, subsurface soil, groundwater, surface water, and sediment data collection and analysis. Unique characteristics of this site included floating product, multiple waste types, and groundwater/slough interactions. In addition to the RI/FS, our staff developed recommendations for short-term site management. To date, a detailed RI/FS work plan and a site security report have been developed and approved. Remedial actions conducted in early 1993 include abandonment and installation of new groundwater monitoring wells, site explorations (hard augers and soil borings), environmental sampling and analysis, and petroleum sludge treatability studies.

Tidewater Moorage 5 Property
Environmental Site Assessment and Site Investigation
Vancouver, WA

Client: Tidewater, 6 Beach Drive, Vancouver, WA 98661

Contact: James Weisgerber (503) 281-0081

Parametrix performed an environmental site investigation on this proposed 50-acre marine terminal property. The site is located along the Columbia River in Vancouver, Washington. Properties surrounding this site have confirmed petroleum hydrocarbon, volatile organic compounds, and priority pollutant metals contaminants in the soil and groundwater. Parametrix' scope of work included performing a historical background search, reviewing regulatory agency files, collecting environmental samples for analytical testing, evaluating historical soil and groundwater analytical test results, and developing a site investigation program. The site investigation program included drilling soil borings and collecting soil samples for analytical testing, installing groundwater monitoring wells in areas of suspected contamination; collecting groundwater quality samples for analytical testing; and preparing a final report with our findings and recommendations. Parametrix prepared groundwater level contour maps to determine the interaction of the upper-most groundwater zone with deeper aquifers. Contaminant concentration maps were prepared to assess the limits of known contaminants in the project area.

East Multnomah County Database and Model Study; Multnomah Co., Oregon

Client: State of Oregon Department of Environmental Quality (DEQ), Environmental Cleanup Division (ECD)

Contact: Bruce Gilles (503) 229-6662

The primary focus of this project is to protect the City of Portland's Columbia Southshore Wellfield and other water users in East Multnomah County. The objective of the project is to access strategies for the safe use of groundwater in the area. Groundwater flow and contaminant transport modeling are to be used to predict safe pumping scenarios.

Parametrix developed an extensive geologic database which contains key information including: water supply and monitoring well log records; well construction and design data; surface water and groundwater level data; water chemistry data; and water use and pump test data. An extensive water supply well inventory was conducted in the area of high groundwater use. Parametrix assisted in developing the conceptual model and workplan for use in three dimensional MODFLOW groundwater modeling. Project area base maps are geologic map were prepared with Parametrix SunStation workstation using ARC/INFO Geographic Information System (GIS).

Monthly water wells measurements were collected by Parametrix and others, and were plotted to determine groundwater glow directions for each aquifer unit. Parametrix provided the project management for a geophysical survey where data gaps and complex geologic conditions limited the understanding of the geologic framework in the project area. Parametrix provided the project management, specification document preparation, and geologic inspection of three groundwater monitoring wells that were drilled and installed in data gap areas.

This project has demonstrated Parametrix' ability to perform technically complex hydrogeologic investigations on highly visible projects and to develop realistic, cost effective solutions to groundwater contamination problems.

GROUNDWATER MODELING PROJECTS

Lake Union Contaminated Sediment Capping, Seattle, WA

Client: Seattle City Light

Contact: Terry Kakida (206) 625-3862

Parametrix was responsible for performing groundwater modeling of contaminant flux through sediments and potential contamination of capping materials. The computer model used was SUTRA, a two-dimensional finite element flow and contaminate transport model. Contaminants of concern were polynuclear aromatic hydrocarbons (PAHS), metals, and polychlorinated biphenyls (PCBs).

Washington State University, Pullman, WA

Client: Washington State University

Parametrix, Inc. was responsible for evaluating major ion chemistry to enhance understanding of groundwater flow in an unconfirmed and leaky confined aquifer system. The project included the use of the PHREEQE geochemical computer model. This computer software program complied with the State of Washington Department of Ecology (Ecology) requirements for a preliminary groundwater investigation and determined the hydrochemical characteristics of the Natural Water System and effects of the wastes at the site on the water chemistry. The project included environmental sampling and monitoring of major elements and priority pollutants; analysis for major elements, heavy metals and volatile organic compounds; and interpretation of the data and preparation of a final report.

Haleina Shopping Center, Oahu, Hawaii

Parametrix was responsible for modeling a proposed infiltration gallery for a sewage effluent disposal system. The computer model used was FLOWPATH, a two-dimensional, finite difference flow model.

LANDFILLS - GREATER PORTLAND METROPOLITAN AREA

Hillsboro Landfill - Sanifill, Washington County, OR

Client: Sanifill 1225 North Loop West, Suite 550 Houston, TX 77008

Contact: Charles E. Williams (713) 865-9800

Parametrix, Inc., conducted an environmental data review and environmental site investigation of Hillsboro Landfill. Historical analytical laboratory test data was compiled and evaluated. Parametrix developed a soil and groundwater sampling plan, supervised the installation of three groundwater monitoring wells, collected groundwater quality samples for analytical testing and evaluated the test results. Parametrix presented our findings of the site investigation with an assess of the hydrogeologic conditions and groundwater quality of the project site.

Lakeside Reclamation Landfill Washington County, OR

Client: Grabhorn, Inc. 14930 S.W. Vandermost Rd., Beaverton, OR 97007

Contact: Howard Grabhorn (503) 628-1866

Parametrix was retained by Grabhorn, Inc. to prepare a site evaluation and capacity analysis of the Lakeside Reclamation Landfill in Washington County, OR. The evaluation consisted of expanding and upgrading the limited purpose landfill. The scope of work included assisting with the Solid Waste Disposal Permit renewal, development of alternative grading plans with subsequent site life estimates, review of soil and groundwater quality conditions, developing a leachate and gas control system preliminary design of a future cell bottom liner and final top cover system. Parametrix also assisted Grabhorn with capital and operational cost estimates for development and closure/post closure of the landfill. For the landfill, Parametrix has reviewed the available hydrogeologic information and historic groundwater quality data and prepared a Water Quality Assessment Report (WQAR) and a Revised Water Quality Sampling and Analysis Plan. The WQAR included completing a statistical analysis and evaluation of groundwater quality data and preparing groundwater level contour maps for each sampling event.

David W. Morton, P.G.

Bachelor of Science, Geology
Registered Professional Geologist (P.G.), Oregon
Underground Storage Tank (UST) Cleanup Service Supervisor, Oregon
Registered Washington DOE UST Program Site Assessor (1991)

Mr. Morton, a Hydrogeologist with 14 years of experience, is located the Portland office of Parametrix, Inc. He is a registered professional geologist with a diverse background in environmental and hydrogeologic consulting, geotechnical engineering consulting, petroleum and minerals exploration, and geological research. His professional experience as a project manager/project hydrogeologist and geologist on various projects:

- Hydrogeologic and/or Geologic Investigations
- Solid/Hazardous Waste Facilities Site Investigations
- Property Transfers/Environmental Site Assessments
- Underground Storage Tank (UST) Decommissioning Monitoring
- Contaminated Soil/Groundwater Remediation
- Borrow Source and Rock Quarry Resource Investigation and Evaluation
- Roadway and Bridge Geotechnical Investigations
- Environmental Impact Statement - Geology, Soils, Hydrology & Water Quality

His relevant project experience with Parametrix and prior to joining Parametrix is listed below.

PARAMETRIX PROJECT EXPERIENCE

Groundwater Contamination/Site Investigations

Treatment of Combined Sewer Overflows (CSO) through Constructed Wetlands: Black & Veatch/City of Portland BES, Multnomah County Oregon

Parametrix conducted Environmental Site Assessments (ESAs), Site Investigations and Environmental Sampling and Analysis Programs at three industrial/wetland sites in the Rivergate Industrial District of Multnomah County, Oregon. Mr. Morton was environmental project manager/hydrogeologist on this project which included conducting environmental site investigations, compiling and evaluating surface water and groundwater data, collecting environmental quality samples, evaluating analytical test result data, writing technical reports and preparing technical documents for the feasibility study. This included preparing the scope of work and cost estimates for each task and participating in client/public work shops and meetings.

Landfill Site Characterization and Environmental Monitoring

Lakeside Reclamation Landfill, Washington County, Oregon

Mr. Morton is the project hydrogeologist performing the site characterization, hydrogeologic investigation, and environmental monitoring data review and evaluation on the Lakeside Reclamation Landfill. This includes reviewing monitoring well design/installation procedures, evaluating historical environmental monitoring data for annual statistical analysis, planning monitoring locations, and collecting environmental samples. This project involves direct interaction with the client and DEQ Solid Waste staff.

Hillsboro Landfill, Washington County, Oregon

Mr. Morton was the project hydrogeologist for this site characterization and Hydrogeologic Investigation project of the landfill. He prepared the proposed scope of work and cost estimate, completed the site characterization and hydrogeologic evaluation, planned the proposed groundwater monitoring well locations, monitored the well installations, collected the required water quality samples, compiled and evaluated the water quality results, and completed the final hydrogeologic investigation report.

Demolition Landfill Site Characterization & Hydrogeologic Investigation: Clark County, Washington

Mr. Morton was the project manager/hydrogeologist for this site characterization and Hydrogeologic Investigation project of a demolition landfill. He prepared the proposed scope of work and cost estimate, completed the site characterization and hydrogeologic evaluation, planned the proposed perimeter groundwater monitoring well locations, monitored the well installations, collected the required water quality samples, compiled and evaluated the water quality results, and completed the final hydrogeologic investigation report.

Reverse Osmosis Pilot Test and Leachate Characterization Study
North Marion County Disposal Facility, Woodburn, Oregon

Mr. Morton was the project hydrogeologist for a reverse osmosis pilot test and leachate characterization study at the North Marion County Landfill. He prepared the leachate field sampling plan, coordinated the leachate sampling program, compiled and reviewed the leachate characterization data, and assisted in preparing the final report for this reverse osmosis study.

Groundwater and Leachate Sampling, and Well Extension and/or Abandonment:
St. Johns Landfill, Portland Oregon

Mr. Morton was the project hydrogeologist for the St. Johns Landfill located in Portland, Oregon. He prepared proposals and costs estimates for water quality sampling at interior leachate wells, and well extension and/or abandonment projects, conducted groundwater and leachate water quality sampling, prepared final report documents, and coordinated activities with subconsultants and client.

Washington State University - Vancouver Branch Campus, Clark County, Washington

Mr. Morton was the project hydrogeologist for the proposed WSU-Vancouver Branch Campus project in the Salmon Creek Area of Clark County, Washington. He provided technical support and guidance on hydrogeologic conditions and groundwater impacts, drainage and erosion control, and surface water quality issues for the master plan design and Supplemental Environmental Impact Statement (SEIS) documents.

East Multnomah County Database & Model Project: ODEQ-Multnomah County, Oregon

Mr. Morton collected, compiled and evaluated geologic, hydrogeologic, water resources and groundwater and surface water data, performed monitoring and water supply well water level elevation measurements, prepared request for proposals, conducted public and confidential interviews, and supervised subcontractors for this groundwater contamination investigation.

Lakewood Estates Groundwater Contamination Investigation: ODEQ
Marion County, near Aurora, Oregon

Mr. Morton performed environmental site investigations, geologic and hydrogeologic assessment reconnaissance, located accessible water wells for water level measurement and water quality sampling, conducted public interviews, performed environmental sampling, prepared geologic diagrams and technical reports, coordinated work program planning with client, and prepared water resource information on this groundwater contamination investigation.

ODEQ Preliminary Environmental Site Assessment: ODEQ-ECD
Willamette Valley and Northwest Region Projects, Oregon

Mr. Morton was the project manager or hydrogeologist on numerous Preliminary Assessments (PAs) hazardous waste facilities/sites identified by DEQ. He conducted the agency file review, site investigation and reconnaissance, collected and analyzed pertinent environmental data on different sites, and prepared the final preliminary assessment report. This included preparing the project scope of work and cost estimate.

Environmental Site Assessment/Hydrogeologic Investigations: Vancouver, Washington

Mr. Morton performed environmental site assessment and hydrogeologic investigation of two parcels in Vancouver, Washington. This included researching historical background information, reviewing government agency files and other consultant files and hydrogeologic reports, conducting site reconnaissance, collecting environmental samples and preparing the final technical report. He reviewed and evaluated the subsurface conditions information and prepared a recommended scope of work for additional soil and groundwater contamination investigation prior to the proposed property transfer.

Richard S. Malin

Master of Science, Geology/Geohydrology
Bachelor of Science, Geology

Mr. Malin has developed groundwater modeling skills derived through a combination of education and project application experiences. He has groundwater model application experience in assessing both groundwater contamination issues and water resource evaluations. These groundwater modeling efforts range from large fully three dimensional applications to small efficient analytical code applications. Mr. Malin also has experience in conducting pump tests, pump test evaluations, and other site characterization activities that are necessary to develop site-specific hydrogeologic data that allow for calibration and verification of groundwater flow models.

He graduated under Portland State University's Master of Science geohydrology program. This program blended applicable groundwater, surface water, and soil science courses offered by both the geology and engineering curriculums.

Mr. Malin has applied the following groundwater modeling codes on one or more projects: ASM (flow/delineation/transport), Random-Walk (transport), RESSQ (flow /transport), MODFLOW (flow), HST3D (flow/transport/thermal). He is familiar with the following groundwater model codes: CAPZONE (flow/delineation), PLASM (flow), GWPATH (delineation), MOC (transport), DREAM (flow), WHPA (flow/delineation), SUTRA (flow/transport). Mr. Malin is also familiar with several pre- and post-processor software programs such as ModelCad, PreMOD, PostMOD, Surfer, and MODPATH

<u>Relevant Applied Groundwater Modeling Projects</u>

UST Client, Vancouver, Washington

ASM was applied to design a multi-well remedial extraction system at a former gas station. ASM was selected because of its capabilities to adequately simulate known site conditions, assess capture zones through its linked particle tracking package, and allow for flush time estimates using the models' linked isochrone package.

Yamhill County, McMinnville, Oregon

MODFLOW was initially applied to design a single point extraction trench in a low permeability aquifer. The MODFLOW model was reproduced using ASM due to its interlinked particle tracking and isochrone package that allowed for capture zone and flush time estimation.

UST Clients; Springfield, Oregon; Hillsboro, Oregon, and LaPine Oregon

DREAM and RESSQ were used interactively to assess flow characteristics at each site and groundwater remediation design. DREAM was used to help calibrate RESSQ models for these leaking UST sites. RESSQ was employed to determine pumping requirements needed to generate the desired capture zone and estimate aquifer flush time.

East Multnomah County Manufacturing Facility, Portland, Oregon

RESSQ was employed to design a multi-point extraction well system. The RESSQ model was calibrated using an existing in operation extraction well.

U.S. Army Corps of Engineers; Bonneville Dam, Oregon

Member of the Bonneville Dam Fish Hatchery groundwater modeling project. HST3D was employed to develop a complex flow and thermal groundwater model to guide management decision regarding the groundwater resources for the fish hatchery. Specific concerns were the development of a wider groundwater temperature range and increase potential of groundwater contamination due to construction and implementation of the new navigation lock at Bonneville Dam. His thesis, *Interpretation of the Thermal Behavior of Groundwater in an Alluvial Terrace – Bonneville Dam, Columbia River, Oregon*, 1991, was associated with the U.S. Army Corps of Engineers Bonneville Dam Fish Hatchery groundwater modeling project. The three dimensional groundwater flow, thermal, and solute code, HST3D, was employed to develop a groundwater flow and thermal model of an alluvial terrace. The model was used to help guide management decision regarding potential impact to the groundwater resources of a fish hatchery due construction of a new navigation lock.

Victoria B. Martinez

Master of Science, Geology/Hydrogeology
Bachelor of Science, Geology

Vicki Martinez is a Project Hydrochemist/Hydrogeologist at Parametrix. Her experience includes management of groundwater monitoring well installation long-term monitoring programs, computer modeling, performing laboratory and field procedures used in the determination of standard drinking water parameters, contaminant fate and transport, the chemistry of natural waters, soil chemistry, and groundwater physical flow characteristics.

Ms. Martinez' computer modeling experience includes the use of finite element (i.e., SUTRA), finite difference (i.e., MODFLOW, FLOWPATH), and random walk groundwater flow models as well as WATEQ and PHREEQE geochemical models.

Project Experience

Lake Union Contaminated Sediment Capping Project, Seattle, Washington
Project Hydrogeologist – Responsible for performing groundwater modeling of contaminant flux through sediments and possible contamination of capping materials. The model being used was SUTRA, a two-dimensional finite element flow and contaminant transport model. Contaminants of concern were polynuclear aromatic hydrocarbons (PAHs), metals, and polychlorinated biphenyls (PCBs).

Washington State University, Pullman, Washington
Project Hydrogeologist – Responsible for evaluating major ion chemistry to enhance understanding of flow in an unconfined and leaky confined aquifer system. The project included the use of the PHREEQE geochemical computer model. This program complied with Department of Ecology requirements for a preliminary groundwater investigation and determined the hydrochemical characteristics of the natural water system and effects of the wastes at the site on the water chemistry. She also carried out sample collection for major elements and priority pollutants, analysis for major elements heavy metals and volatile organic compounds, interpreted the data and prepared the final report.

Haleina Shopping Center, Oahu, Hawaii
Project Hydrogeologist – Responsible for modeling a proposed infiltration gallery for a sewage effluent disposal system. The model being used was FLOWPATH, a two-dimensional, finite difference flow model.

Susan Harrington

Master of Science, Geology
Bachelor of Arts, Geology
Washington State Department of Ecology Licensed Underground Storage Tank Supervisor

Susan Harrington is a member of the Geosciences and Water Resources Group at Parametrix. She completed an undergraduate degree in geology at Pomona College in 1986, and a masters degree in geology at the University of Maryland in 1990. Her graduate research was part of a joint project with NASA Goddard Space Flight Center involving the application of geographic information systems (GIS) and satellite remote sensing as tools in exploration for ultramafic rocks in Ontario, Canada. At Parametrix, Ms. Harrington applies her knowledge of GIS to many projects. She also provides technical support on geologic and hydrologic components of solid waste, hazardous waste, and planning projects.

Project Experience

East Multnomah County Groundwater Database and Model, Oregon
Assisted with reviewing hydrogeologic data pertaining to the site. Coordinated entry of hydrogeologic data into the project database, and assisted with preparation of hydrogeologic datafiles for input to the groundwater model. Prepared project area base maps and geologic maps with ARC/INFO GIS package on Parametrix' SunStation. Used compiled hydrogeologic data from the database to generate well location maps, water level by aquifer maps, chemical distribution maps, and other interim and final project deliverables.

Linda R. Johnson-Logan, Ph.D.

Ph.D., Environmental Geochemistry and Health
Master of Science, Environmental Technology
Bachelor of Environmental Science, Geological Sciences

Linda Johnson-Logan, Ph.D., is a Toxicologist/Environmental Chemist in the Environmental Toxicology and Chemistry Division at Parametrix. She has six years of experience including: environmental chemistry, analytical chemistry, geochemistry and health, contaminant fate and transport, environmental toxicology, and risk assessment.

Selected Project Experience

Ecological Risk Assessment—Fugacity Modeling

Dr. Logan provided technical support for an ecological risk assessment in Puget Sound. Specifically, this involved the use of the Quantitative Water, Air, Sediment Interaction (QWASI) fugacity model to determine the partitioning and fate of sediment bound polyaromatic hydrocarbons and polychlorinated biphenols. This model uses the concept of fugacity to predict the partitioning of a chemical between the sediment, the water column, suspended particulate matter, the air and the biota of an aquatic system. Predicted water column concentrations were used to assess potential ecological risk to the aquatic biota.

State Pollution Control Commission, New South Wales, Australia

Dr. Logan was project manager for a peer review of a study conducted off the Sydney coastline concerning contaminant enrichment of the air-sea microlayer as a result of sewage discharge from the Malabar outfall. This involved reviewing a number of analytical reports on the concentrations of heavy metals, polyaromatic hydrocarbons, chlorinated organics and bacteria in and below the microlayer, and a critique of the summary reports. This review required an understanding of expected contaminant fate processes at the air-sea interface. A report on the findings of the review was submitted to the State Pollution Control Commission.

Rocky Mountain Arsenal Risk Characterization

Dr. Logan was principal investigator on a "position paper" discussing the inclusion of chemical degradation in a Human Health Risk Characterization being conducted for Rocky Mountain Arsenal. This involved a thorough literature search for degradation data and calculation of chemical half-lives using first order kinetics. Dr. Logan also worked with QA/QC parameter data for biota models at Rocky Mountain Arsenal that are to be used in the Ecological Risk Characterization. This included the QA/QC of a computer-based Importance Analysis on a general predator biota model.

Natural Enrichment of Arsenic in Loch Lomond Sediments (Doctoral Thesis)

The natural post-depositional remobilization of arsenic in the sediments of Loch Lomond was investigated via the speciation of arsenic in the sediment porewaters. Porewater arsenic III concentrations peaked in the reduction zone at depths of 5-11cm and decreased abruptly at 2-3cm, coinciding with peak arsenic concentrations in the solid phase. This confirmed the reduction and remobilization of arsenic at depth, followed by upward migration and near-surface oxidation with preferential adsorption of arsenic V on precipitated oxides and/or hydroxides of iron.

Chlordane Mobilization and Transport at a Hazardous Waste Site (Post Doctoral Research)

The impact of dissolved organic carbon (DOC) in groundwater on the mobilization and transport of chlordane was assessed through a series of batch solubility and sorption experiments in conjunction with soil column studies. Although batch sorption studies demonstrated the tenacious binding of chlordane to the solid phase, soil columns eluted with solutions of varying DOC showed enhanced chlordane mobilization with increased DOC concentration in the leachate. As a result, retardation factors determined from column studies were greater than those predicted by batch sorption studies.

Surface Water Runoff Evaluation, Anzon Inc., Texas

Dr. Logan was involved in investigating potential antimony contamination of surface water and sediments downstream of an antimony processing operation in Texas. This involved an in-depth examination of analytical data on antimony measurements in water and sediments; evaluation of sediments as a source of antimony to the overlying water column; and the preparation of associated exhibits for use by attorneys and as expert witness material.

Previous Experience

Memphis State University, Memphis, Tennessee. Department of Biology, Toxicology Laboratory, Post Doctoral Research Associate

Post doctoral research, in collaboration with the U.S. Geological Survey, on potential chlordane mobilization and transport at a hazardous waste site. In addition, Dr. Logan supervised the Toxicology Laboratory for one year which included ensuring data quality for several post-graduate research projects and conducting a number of acute and chronic (static renewal) daphnia bioassays for several industrial clients.

Springborn Lifesciences, Wareham, Massachusetts

Staff specialist, FIFRA residue study for pesticide registration - field manager. Devised standard operating procedures for sampling strategy, sample collection and documentation.

Schering Plough, Memphis, Tennessee
Laboratory Technician, Quality Control Laboratories. Familiarized with GLP and Strict SOP Protocols.

Agricultural Research Council, Wantage, Oxforshire, United Kingdom
Field Studies Department. Collection of agricultural samples, sample processing, sample characterization and documentation.

Professional Affiliations

- American Chemical Society (ACS)
- Society for Environmental Toxicology and Chemistry (SETAC)
- American Society for Testing Materials (ASTM)

Publications

Hooven-Spence, M.E., L.R. Johnson-Logan, and R.D. Cardwell. 1992. Evaluation of AETs in Aquatic Ecological Risk Assessment of Contaminated Urban Bay Sediments. (In preparation)

Johnson-Logan, L.R., S.J. Klaine and R.E. Broshears. 1992. Partitioning Behavior and the Mobility of Chlordane in Groundwater. Submitted to Environmental Science and Technology. Vol. 26, No. 11, pp 2234-2239.

Johnson-Logan, L.R. and R.D. Cardwell. 1991. Peer Review of Microlayer Studies Associated with Sewage Discharge from Malabar. Parametrix, December, 1991.

Johnson, L.R. and J.G. Farmer. 1991. Use of Human Metabolic Studies and Urinary Arsenic Speciation in Assessing Arsenic Exposure. Bulletin Environmental Contamination Toxicology. 46:53-61.

Farmer, J.G. and L.R. Johnson. 1990. The Assessment of Occupational Exposure to Inorganic Arsenic based on Urinary Concentrations and Speciation of Arsenic. British Journal of Industrial Medicine. 47:342-348.

Johnson-Logan, L.R. and S.J. Klaine. 1990. Potential Chlordane Mobilization and Transport at a Hazardous Waste Site. Preprint Extended Abstract, American Chemical Society, division of Environmental Chemistry 30(1):404-406.

Farmer, J.G., L.R. Johnson and M.A. Lovell. 1989. Urinary arsenic speciation and the assessment of U.K. dietary, environmental and occupational exposures to arsenic. Short note. Environmental Geochemistry Health 11 (3/4):p. 93.

Johnson, L.R. and J.G. Farmer. 1989. Urinary Arsenic Concentrations and Speciation in Cornwall Residents. Environmental Geochemistry Health 11(2):39-44.

Johnson, L.R. and J.G. Farmer. 1987. Arsenic Mobility and Speciation in the Sediments of Scottish Inland and Coastal Waters. Conference proceedings, C.E.P. consultants, Eds. S.E. Lindburg and T.C. Hutchinson. International Conference for Heavy Metals in the Environment, New Orleans. September 1987. pp. 218-222.

Farmer, J.G. and L.R. Johnson. 1985. The Arsenic Content of Bottled Mineral Waters. Environmental Geochemistry and Health 7(4);124-126.

Culbard, E.B. and L.R. Johnson. 1984. An assessment of arsenic in housedust and garden soils from Southwest England and their implications for human health. Environmental Contamination, C.E.P. Edinburgh pp. 276-281.

Presentations

Leedle, B., L.R. Johnson-Logan, R.D. Cardwell. 1993. Performance of Analytical Methods and Laboratories: Measuring Tributylins in Aqueous Environmental Samples. Presented at the Organotin Environmental Program. March 6 - 7. Charleston, South Carolina.

Johnson-Logan, L.R., E.Y. Wu, J.A. Simmonds, D.A. Maclellan, R.D. Cardwell, and D. Taylor. 1993. Case study: Human Health and Ecological Baseline Risk Assessment of Wastewater Reuse for Seattle Metro. Presented at the 86th Annual Meeting and Exhibition. June 13 - 18. Denver, Colorado.

Brancato, M.S., L.R. Johnson-Logan and R.D. Cardwell. 1992. Aquatic Ecological Risk Assessment of Produced Waters from Oil and Gas Platforms and Treatment Facilities in Alaska. 13th International Annual Meeting of the Society of Toxicology and Chemisty. November 8-12. Cincinnati, Ohio.

Hooven-Spence, M.E., L.R. Johnson-Logan and R.D. Cardwell. 1992. Evaluation of AETs in Aquatic Ecological Risk Assessment of Contaminated Urban Bay Sediments. 12th International Annual Meeting of the Society of Environmental Toxicology and Chemistry. November 3-7. Seattle, Washington.

Johnson-Logan, L.R., R. Russell and S.J. Klaine. 1990. Potential Chlordane Mobilization and Trasnport at a hazardous Waste Site. 199th American Chemical Society National Meeting and Exposition. April 22-27, Boston, MA. Division of Environmental Chemistry.

Novack, S., L.R. Johnson-Logan and S. Pavlou. 1990. The Use of Dependency Trees in Exposure Assessment. 11th International Annual Meeting of Society of Toxicology and Chemistry. November 11-15. Arlington, Virginia.

Pavlou, S.P., S.C. Robinson and L. Logan. 1990. How Clean is Clean: Application of Exposure Pathway Analysis to Ecological Criteria Development. Presented at the International Specialty Conference on How Clean is Clean? Cleanup Criteria for Contaminated Soil and Groundwater. November 6-9, 1990. Boston, Massachusetts.

Byl T.D., S.J. Klaine and L.R. Johnson-Logan. 1989. Influence of Sediment Quality Characteristics on Heavy Metal Toxicity. Research Group Meeting of the Tennessee Soil and Water Research and Education Committee, November 28-29, 1989. Pigeon Forge, Tennessee.

Farmer, J.G., and L.R. Johnson. 1989. Urinary Arsenic speciation and the Assessment of U.K. Dietary, Environmental and Occupational Exposures to Arsenic. Society of Environmental Geochemistry and Health, 7th European meeting April 11-14, 1989, Royal Holloway and Bedford New College, University of London. The Environmental Geochemical and Health Aspects of Arsenic, Nickel and other elements.

Hankin, H., S.J. Klaine and L.R. Johnson-Logan. 1989. Influence of Dissolved Organic Carbon on the Chronic Toxicity of Pesticides to Ceriodaphnia Dubia. Research Group Meeting of the Tennessee Soil and Water Research and Education Committee, November 28-29, 1989. Pigeon Forge, Tennessee.

Johnson-Logan, L.R. 1989. Chlordane Mobility at North Hollywood Dump, Coloquium on Biology in the Mid-south, Memphis State University, Memphis, Tennessee.

Johnson-Logan, L.R. and S.J. Klaine. 1989. Mobility of Chlordane at North Hollywood Dump, Memphis, Tennessee. Research Group Meeting of the Tennessee Soil and Water Research and Education Committee. November 28-29, 1990. Pigeon Forge, Tennessee.

Johnson-Logan, L.R. and S.J. Klaine. 1989. Factors Affecting Mobility of Chlordane in a Hazardous Waste Site. Combined meeting of the Central State Chapter of the Society of Toxicology and Ozark-Prairie Chapter of the Society of Toxicology and Chemistry. April 28-29, 1989. Columbia, Missouri.

Johnson-Logan, L.R., R. Russell and S.J. Klaine. 1989. Physical/Chemical Factors Affecting Chlordane Mobility at a Hazardous Waste Site. 10th International Annual Meeting of Society of Toxicology and Chemistry. October 28 - November 2, 1989. Toronto, Ontario, Canada.

Rowe, S.L., S.J. Klaine and L.R. Johnson-Logan. 1989. Characterization of Pesticide Mobility in a West Tennessee Soil. Research Group Meeting of the Tennessee Soil and Water Research and Education Committee. November 28-29, 1990. Pigeon Forge, Tennessee.

Johnson, L.R. and J.G. Farmer. 1988. Natural Enrichment Profiles and Prewater Arsenic Speciation in Sediments of Loch Lomond. Society of Toxicology and Chemistry, 9th International Annual Meeting, November 13-17, 1988. Arlington, Virginia.

Johnson, L.R. and J.G. Farmer. 1987. Arsenic Mobility and Speciation in the Sediments of Scottish Inland and Coastal Waters. Keynote paper presented at the International Conference for Heavy Metals in the Environment. New Orleans, September 1987.

Rick D. Cardwell, Ph.D.

Ph.D., Fisheries (Aquatic Toxicology)
Master of Science, Fisheries (Fish Physiology)
Bachelor of Science, Fisheries Science

Rick Cardwell manages the 20-member consulting and laboratory testing sections of the Environmental Toxicology and Chemistry Division, conducts human health and ecological risk assessments of wastes, and manages environmental affairs and permitting issues for industrial and public agency clients. He has 25 years of experience conducting scientific investigations and managing projects in environmental toxicology, environmental chemistry, and aquatic biology.

In previous positions, Dr. Cardwell directed the operations of two aquatic toxicology laboratories, worked as an environmental consultant specializing in aquatic toxicology and aquatic biology, and conducted aquatic toxicological research with the Washington Department of Fisheries. His responsibilities included client relations, quality assurance, analytical chemistry, culture and aquatic toxicity testing of freshwater and saltwater algae, fish and invertebrates, and field studies of pesticide effects.

Project Experience

Fate and Transport Modeling: Simazine and Atrazine Leaching to Groundwater
Dr. Cardwell managed a project for CIBA-Geigy Corporation that examined the potential for two herbicides to leach through the soil into groundwater. This work was done in north, central, and southern California. Both herbicides had been found in groundwaters in these areas, and the question was whether one would expect leaching to groundwater based on the herbicides' properties and site-specific soil and rainfall characteristics. The Pesticide Root Zone Model (PRZM) was the model used to examine the fate and transport of the herbicides.

Fate and Transport Modeling: Chlorpyrifos in Ponds
Dr. Cardwell managed a project that examined the potential fate and transport of chlorpyrifos, applied on golf courses, to (1) leach into the soil column, (2) runoff into adjacent ponds, and (3) persist in the pond waters and sediments and tissues of fish. The work was performed for an Israeli pesticide manufacturer, Makhteshim Agan (Americas), for golf courses in Georgia and Florida. The models used included the Pesticide Root Zone Model (PRZM), a surface water runoff model, Simulator for Water Resources, Rural Basins or SWRRB, and the Exposure Analysis Modeling System (EXAMS).

Fate and Transport Modeling: DDT in Estuarine Sediments
Dr. Cardwell was the project manager for a study that examined the potential for DDT to leach from sediments within a harbor in San Francisco Bay for a consortium of chemical manufacturer companies. The Superfund site was a former pesticide reformulation plant, and the sediment contained extremely high concentrations of DDT.

A version of Don Mackay's fugacity model, the Quantitative Water Air Sediment Interaction (QWASI) model, developed by J. Southwood was used to partition DDT between the sediment, water column, air, and biota. A transport model was coupled with this model to examine the flux of DDT from the sediments.

Fate and Transport Modeling: Contaminants in Estuarine Sediments

Dr. Cardwell was the project manager for a study that examined the potential for many chemicals to leach from the sediments into the water column around Harbor Island, a Superfund site in the State of Washington. This work was performed for EPA Region 10. A version of Don Mackay's fugacity model, the Quantitative Water Air Sediment Interaction (QWASI) model, developed by Dr. J. Southwood was used to partition the chemicals between the sediment, water column, air, and biota.

Previous Experience

Dr. Cardwell served as Principal Investigator for a variety of research projects that evaluated how marine crustacea, bivalve mollusks, and fish are affected by toxic chemicals associated with petroleum hydrocarbons, detergents, metals, municipal and industrial effluents, and dredged materials. His evaluations relied upon both laboratory and field toxicity tests and analyses of contaminants in water, sediments, and effluents. He also conducted studies of the effects on dredging in Grays Harbor on oyster larvae.

In other related areas, Dr. Cardwell managed a second aquatic toxicology laboratory that conducted acute toxicity, chronic toxicity, and bioaccumulation tests on a variety of fish and aquatic invertebrate species (brook trout, bluegill sunfish, fathead minnow, *Daphnia*, amphipods, and chironomids) and chemicals (e.g., chlordane, selenium, beryllium, lead, arsenic, cyanide, a surfactant and a solvent). Chlordane is a pesticide with properties similar to DDT and PCBs. All tests included strict protocols for data recording, quality control, and analytical chemistry in water, biological tissues, or both.

In graduate school he researched the effects of petroleum products on marine fish and invertebrates and studied how salmon are physiologically affected by stress, such as poor water quality, fisheries research techniques (e.g., tagging and handling), and natural conditions.

Professional Affiliations

American Society for Testing and Materials (since 1975)

- Chairman of Committee E-47: Biologic Effects and Environmental Fate (1986-1989)
- Chairman of Task Group that developed the national test method: "Standard Practice for Conducting Basic Acute Toxicity Tests with Four Species of Bivalve Mollusks," (1978-1980)
- Symposium Co-chairman and editor: ASTM Sixth Aquatic Toxicology and Hazard Evaluation Symposium, St. Louis, Missouri (1981)

- Symposium Chairman and editor: ASTM Seventh Aquatic Toxicology and Hazard Evaluation Symposium, Milwaukee, Wisconsin (1983)

Society for Environmental Toxicology and Chemistry (since 1985)

American Fisheries Society (since 1967)
- President, North-Pacific International Chapter: 1979-1980
- Symposium Program Chairman: Symposium on Salmon Enhancement, Bellingham, Washington (1979)
- Coordinator for American Fisheries Society review of the Environmental Protection Agency's "Red Book" on national water quality criteria, specifically the section on a water quality criterion for selenium.

American Institute of Fishery Research Biologists (since 1973)
- Secretary-Treasurer, Northwest Washington District: 1975 - 1978
- Fellow: 1987

American Society of Limnology and Oceanography (since 1979)

Pacific Fisheries Biologists (since 1970)

<u>Advisory Positions</u> (1988-1990)

Assignment: Member, Washington State Science Advisory Board for Development of Biomonitoring Methods for Marine Discharges.
Sponsor: Washington Department of Ecology, 1991-1992.

Assignment: Member, Technical Advisory Panel, Water Quality Management Plan for Willamette River
Sponsor: Oregon Department of Environmental Quality, 1992.

Assignment: Featured speaker and advisor on Risk Assessment Methodologies Bioaccumulation Workshop - Chemicals in Sewage Wastewaters.
Sponsor: Water Board, Sydney, Australia, 1991, 1992.

Assignment: Member, Washington State Biomonitoring Science Advisory Board: Concerning Toxicity Testing of Pulp Mill Effluents.
Sponsor: Washington Dept. of Ecology and Northwest Pulp and Paper Mill Association, 1991-1992.

Assignment: Peer Reviewer, Development of Methodology for Ecological Risk Assessment.
Sponsor: U.S. Environmental Protection Agency. 1990.

Assignment: Speaker, EPA Workshop on Approaches to Revising the National Water Quality Criteria Guidelines (Guest Speaker on Acute-Chronic Ratios).
Sponsor: U.S. Environmental Protection Agency. 1990.

Assignment: Member, Ecological Advisory Subcommittee of Science Advisory Board: Development of Environmental Quality Standards and Standards Setting Procedures.
Sponsor: Washington Department of Ecology. 1990-1992.

Assignment: National Peer Reviewer, Marine Complex Effluent Toxicity Testing Program.
Sponsor: U.S. Environmental Protection Agency, Environmental Research Laboratory, Narragansett, RI. 1989

Assignment: National Peer Reviewer, Toxicology Program of Laboratory's Aquatic Toxicology Program.
Sponsor: Environmental Protection Agency, Environmental Research Laboratory, Gulf Breeze, Florida. 1988

Assignment: Peer Reviewer of Risk Assessment Procedures Used for Setting Water Quality Standards for Metals and Rice Herbicides, Sacramento River.
Sponsor: California State Water Resources Control Board, Sacramento. 1989.

Expert Testimony

Washington Energy Facility Site Evaluation Council (1980)
Presented pre-filed and oral testimony concerning potential impacts of a spill of Prudhoe Bay crude oil in Puget Sound.

U.S. Attorney General (1981)
Prepared technical brief which successfully argued that heavy metal discharges from a Puget Sound Naval Facility was not responsible for mortality of oysters in a nearby hatchery.

Washington Shorelines Hearings Board (1983)
Presented pre-filed and oral testimony concerning impacts of proposed expansion to Skyline marina on water quality.

New York Power Authority (1986)
Developed pre-filed testimony and participated in mock hearing.

Colorado Water Quality Commission (April 1990)
Submitted pre-filed testimony and presented oral testimony on quality of fish habitat and proposed water quality standards for upper Arkansas River.

Arizona Department of Environmental Quality (March 1990)
Member of group of toxicology experts rendering opinions on methods for calculating surface water quality standards for state.

Florida Power and Light (November 1990)
Prepared pre-filed testimony on water quality impact of proposed coal-fired power plant on aquatic life.

Texas Water Commission (February 1992)
Prepared expert testimony on the source, environmental fate, and aquatic toxicity of antimony.

Publications

Cardwell, R.D. 1968. Qualitative and quantitative changes in the plasma proteins of Pacific salmon resulting from natural and induced stresses. M.S. Thesis, University of Washington, Seattle, Washington. 94 pages.

Cardwell, R.D., J.B. Saddler, and L.S. Smith. 1971. Hematological effects of Dennison tagging upon juvenile pink salmon (*Oncorhynchus gorbuscha*). Comparative Biochemistry and Physiology 38A:497-508.

Smith, L.S., J.B. Saddler, R.D. Cardwell, A.J. Mearns, H.M. Miles, T.W.Newcomb, and K.C. Watters. 1971. Responses of teleost fish to environmental stress. U.S. Environmental Protection Agency Water Pollution Control Research Series, No. 18050EBK02/71. 114 pages.

Saddler, J.B. and R.D. Cardwell. 1971. The effect of tagging upon the fatty acid metabolism of juvenile pink salmon. Comparative Biochemistry and Physiology 39A:709-721.

Cardwell, R.D. and L.S. Smith. 1971. Hematological manifestations of vibriosis upon juvenile chinook salmon. The Progressive Fish-Culturist 33(4):323-235.

Saddler, J.B., K.V. Koski, and R.D. Cardwell. 1972. Fatty acid alterations during migration and early sea water growth of chum salmon (*Oncorhynchus gorbuscha*). Lipids 7(2):90-95.

Cardwell, R.D. 1973. Acute toxicity of No. 2 diesel oil to selected species of marine invertebrates, marine sculpins, and juvenile salmon. Ph.D. Dissertation, University of Washington, Seattle, Washington. 124 pages.

Cardwell, R.D., D.G. Foreman, T.R. Payne, and D.J. Wilbur. 1976. Acute toxicity of selected toxicants to six species of fish. Environmental Protection Agency Ecological Research Series, EPA-600/3-76-008. 117 pages.

Cardwell, R.D., D.G. Foreman, T.R. Payne, and D.J. Wilbur. 1976. Acute toxicity of selenium dioxide to freshwater fishes. Archives of Environmental Contamination and Toxicology 4:129-144.

Cardwell, R.D., C.E. Woelke, M.I. Carr, and E.W. Sanborn. 1976. Sediment and elutriate toxicity to oyster larvae. Pages 684-718. In: P.A. Krenkel, J. Harrison, and J.C. Burdick III (editors). Proceedings of the Specialty Conference on Dredging and Its Environmental Effects. Mobile, Alabama, January 26-28, 1976. American Society of Civil Engineers, New York, New York.

Cardwell, R.D., C.E. Woelke, M.I. Carr, and E.W. Sanborn. 1976. Toxicity of marine waters near Everett and Port Angeles, Washington to Pacific oysters, 1972 through 1975, Section IV, 88 pages. In: Ecological Baseline and Monitoring Study for Port Gardner and Adjacent Waters. Washington State Department of Ecology, Olympia, Washington.

Cardwell, R.D., D.G. Foreman, T.R. Payne, and D.J. Wilbur. 1977. Acute and chronic toxicity of chlordane to fish and invertebrates. Environmental Protection Agency Ecological Research Series, EPA-600/3-77-019. 126 pages.

Cardwell, R.D., C.E. Woelke, M.I. Carr, and E.W. Sanborn. 1977. Evaluation of the efficacy of sulfite pulp mill pollution abatement using oyster larvae. pp.:281-295. In: Mayer, F.L. and Hamelink, J.L. (editors). Aquatic toxicology and hazard evaluation, American Society for Testing and Materials, Special Technical Publication 634, ASTM, Philadelphia, Pennsylvania.

Cardwell, R.D., C.E. Woelke, M.I. Carr, and E.W. Sanborn. 1977. Acute toxicity of sediments and associated chemicals to larval Pacific oysters (*Crassostrea gigas*), Appendix L, 149 pages. In: Maintenance dredging and the environment of Grays Harbor, Washington. U.S. Army Corps of Engineers District, Seattle, Washington.

Cardwell, R.D., C.E. Woelke, M.I. Carr, and E.W. Sanborn. 1977. Appraisal of a reference toxicant for estimating the quality of oyster larvae. Bulletin of Environmental Contamination and Toxicology 18:719-725.

Hirota, J., R.D. Cardwell, A.W. Kendall, Jr., P.O. LaRock, S.M. Novak, and N.J. Prouse. 1977. The plankton, Chapter 4, Pages 40-56. In: Oil spill studies: strategies and techniques. Publication No. 4286, American Petroleum Institute, Washington, D.C.

Cardwell, R.D., C.E. Woelke, M.I. Carr, and E.W. Sanborn. 1978. Variation in toxicity tests of bivalve mollusc larvae as a function of termination technique. Bulletin of Environmental Contamination and Toxicology 20: 128-134.

Cardwell, R.D., T.C. Carver, Jr., P.H. Davies, J.P. Goettl, Jr., P.V. Hodson, and S.J. Olsen. 1978. Selenium. Pages 46-1 to 46-11. In: Thurston, R.V., R.C. Russo, E.M. Fetterolf, T.A. Edsall, and Y.M. Barber, Jr. (editors). Review of the EPA Red Book: Quality

Criteria for Water. Water Quality Section, American Fisheries Society, Bethesda, Maryland.

Cardwell, R.D., M.I. Carr, S.J. Olsen, and E.W. Sanborn. 1978. Water quality and biotic characteristics of Birch Bay Village marina in 1977 (October 1, 1976 to December 31, 1977). Progress Report 69, Washington Department of Fisheries, Olympia, Washington. 90 pages.

Cardwell, R.D. and C.E. Woelke. 1979. Marine water quality compendium for Washington state. Washington Department of Fisheries, Olympia. Vol. 1, 75 pages and Vol. II. 528 pages.

Cardwell, R.D., C.E. Woelke, M.I. Carr, and E.W. Sanborn. 1979. Toxic substance and water quality effects on larval marine organisms. Washington Department of Fisheries, Olympia, Technical Report 45. 71 pages.

Cardwell, R.D., S. Olsen, M.I. Carr, and E.W. Sanborn. 1980. Biotic, water quality, and hydrologic characteristics of Skyline Marina in 1978. Washington Department of Fisheries, Olympia, Technical Report 54. 103 pages.

Cardwell, R.D., M.I. Carr, and E.W. Sanborn. 1980. Water quality and flushing of five Puget Sound marinas. Washington Department of Fisheries, Olympia, Technical Report 56. 77 pages.

Cardwell, R.D., R.E. Nece, and E.P. Richey. 1980. Fish, flushing and water quality; their roles in marina design. Pages 84-103, Vol. I. In: Edge, B.L. (editor). Coastal Zone 80, Proceedings of the Second Symposium on Management, Conservation, and Utilization of the Coastal Zone, November 17-20, 1980. Hollywood, Florida.

Cardwell, R.D. and D.C. Garen. 1981. Causes of larval Pacific oyster mortality: An analysis of the case of Sea Farms, Inc. versus the United States of America. Contract Report for the U.S. Department of Justice, Western District of Washington, Seattle. Envirosphere Company, Bellevue, Washington. 70 pages plus appendices.

Cardwell, R.D. and R. Koons. 1981. Biological considerations for the siting and design of marinas and affiliated structures. Washington Department of Fisheries, Olympia, Technical Report 60. 31 pages.

Koons, R.R. and R.D. Cardwell. 1981. Significant areas for certain species of food fish and shellfish in Puget Sound. Washington Department of Fisheries, Olympia, Technical Report 59. 46 pages.

Cardwell, R.D. 1981. Water quality: biological implications in Pacific Northwest marinas. Pages 96-106. In: Goodwin, R.F. (editor). Boating and moorage in the '80s, Proceedings of a workshop held in Seattle, Washington, November 4-6, 1981. Washington Sea Grant Program, WSG-WO 82-1.

Fresh, K.L., R.D. Cardwell, and R.R. Koons. 1981. Food habits of Pacific salmon, baitfish, and their potential predators and competitors in the marine waters of Washington. Washington Department of Fisheries, Olympia, Progress Report 145. 58 pages.

Fresh, K.L., R.D. Cardwell, B.P. Snyder, and E.O. Salo. 1982. Hatchery strategies for reducing predation upon chum salmon (*Oncorhynchus keta*) in freshwater. Pages 79-89. In: Proceeding of the North Pacific Aquaculture Symposium (Melteff, B. and R.A. Neve', editors). University of Alaska Sea Grant Report 82-2.

Cardwell, R.D., R.L. Fairbanks, and P.S. Korsmo. 1982. Potential site study for Northern Tier Pipeline Company "Around the Sound" route: An assessment of aquatic, wetland, and terrestrial biological resources, impacts, and mitigation measures. 70 pages. In: Potential site study, Northern Tier project, western Washington pipeline and marine terminal, State of Washington, Energy Facility Site Evaluation Council, Olympia, Washington.

Bishop, W.B., R.D. Cardwell, and B.B. Heidolph (editors). 1983. Aquatic toxicology and hazard assessment: Sixth symposium, Special Technical Publication 802, St. Louis, Missouri. American Society for Testing and Materials, Philadelphia, Pennsylvania.

Cardwell, R.D., S.P. Pavlou, and R.D. Kadeg. 1984. An assessment of the environmental chemistry and aquatic toxicology of trialkyltin compounds. Report prepared for the Organotin Environmental Programme Association. Envirosphere Company, Bellevue, Washington.

Cardwell, W.B., R.C. Bahner, and R. Purdy (editors). 1985. Aquatic toxicology and hazard assessment: Seventh Symposium, Special Technical Publication 854. Milwaukee, Wisconsin. American Society for Testing and Materials, Philadelphia, Pennsylvania.

Cardwell, R.D., M. Brancato, and J. Knutzen. 1986. Annual Report. Benthic macroinvertebrate monitoring program for streams adjacent to ASARCO's Troy, Montana, Unit: Analyses of August 1985, October 1985, and April 1986 samples. Envirosphere Company, Bellevue, Washington.

Cardwell, R.D. and A.W. Sheldon. 1986. A risk assessment concerning the fate and effects of tributyltins on the aquatic environment. Pages 1117-1129. In: Oceans '86 Conference Record, Volume 4. Marine Technology Society, Washington, D.C.

Stuart, R. and R. Cardwell. 1987. Aquatic ecological risk assessment of polynuclear aromatic hydrocarbons, phthalates, copper and lead in an urban lake. Prepared for Municipality of Metropolitan Seattle, Seattle. 80 pages.

Cardwell, R.D., K. Johnson, and M.S. Brancato. 1987. Assessment of the transport of simazine through shallow soils of Glenn, Tulare, Los Angeles, and Riverside counties of the state of California. Prepared for CIBA-Geigy Corporation, Greensboro, N.C.

Cardwell, R.D. 1988. Fate and effects of tributyltin in the marine environment - An update on knowledge. pp. 138-145. In: Proceedings of the First Annual Meeting on Puget Sound Research, Volume 1. Puget Sound Water Quality Authority, Seattle, Washington.

Cardwell, R.D. 1989. Tributyltin in the environment: an overview and key issues. pp. 537-544 of Volume 2. In: Oceans '89 Proceedings. Marine Technology Society, Washington, D.C.

Cardwell, R.D. 1989. Aquatic ecological risk assessment methodologies. pp. 659-663 of Volume 2. In: Oceans '89 Proceedings. Marine Technology Society, Washington, D.C.

Cardwell, R.D. [In Press]. Probabilistic-based methods for aquatic ecological risk assessment. In: Puget Sound Research Conference, Puget Sound Water Quality Authority, Seattle, Washington.

Cardwell, R.D. 1992. Methods for evaluating risks to aquatic life and human health from exposure to marine discharges of municipal wastewaters. In: Proceedings of a Bioaccumulation Workshop—Assessment of the Distribution, Impacts and Bioaccumulation of Contaminants in Aquatic Environments (Ed. A.G. Miskiewicz), pp. 235-252. Water Board and Australian Marine Sciences Association Inc., Sydney.

<u>Presentations</u> (1988 — 1990)

February 1991. Sydney, Australia Bioaccumulation Workshop.

January 1991. Puget Sound Research Conference. "Probabilistic-based methods for ecological risk assessment."

October 1990. "Presentation on aquatic ecological risk assessment methodologies." Water Pollution Control Federation, Washington D.C.

July 1990. Colorado Biomonitoring Task Force. "Methodologies for addressing natural dilution water toxicity in Toxicity Reduction Evaluations," Denver, CO.

March 1990. Expert Panel of Toxicologists, Round Table Forum on Surface Water Quality Standards for the State of Arizona, Arizona Department of Environmental Quality, Phoenix, AZ.

October 1989. "Sediment bioassays -- current developments and technical issues/ concerns." Presented to the West Coast regional meeting of the National Council of the Paper Industry for Air and Stream Improvement, Inc., Portland, OR.

September 1989: "Tributyltin in the environment: an overview and key issues." Presented at Oceans '89 national conference, Seattle, WA.

September 1989: "An overview of aquatic ecological risk assessment methodologies." Presented at Oceans '89 national conference, Seattle, WA.

June 1989: "Expert panel on use of bivalve mollusks for toxicity testing." Seattle District, Corps of Engineers, Seattle.

July 1988: "Current concepts concerning contaminant bioavailability, fate and effects in sediments and effluents." Presented at the METRO Forum, Municipality of Metropolitan Seattle, WA.

March 1988: "Fate and effects of tributyltin in the marine environment: an update on knowledge." Presented at the First Annual Meeting on Puget Sound Research, Seattle, WA.

February 1988: "Antifouling, organotin paints and marine life: an overview of research and knowledge." Presented to the Washington Chapter of the American Institute of Fishery Research Biologists, Seattle, WA.

Jan 1988: "Antifouling, organotin, and marine life: A review." Seminar to Department of Fisheries and Wildlife, Oregon State University, Corvallis, OR.

___ 1993: "Methodology for aquatic ecological risk assessment." Presenting to the Water Environment Research Foundation Annual Meeting, ______, _____.

___ 1993: "Methodology for aquatic ecological risk assessment to a stream receiving municipal wastewater discharges." Presenting to the Water Environment Research Foundation Annual Meeting, ______, _____.

600 NORTHEAST GRAND AVENUE | PORTLAND, OREGON 97232 2736
TEL 503 797 1700 | FAX 503 797 1797

7

METRO

November 23, 1993

Shu-Guang Li
Portland State University
Dept. of Civil Engineering
School of Engineering and Applied Science
Portland State University
PO Box 751
Portland, OR 97207-0851

Re: Groundwater Services for St. Johns Landfill (RFP#93R-43-SW)

Dear Dr. Li:

Thank you for your proposal regarding groundwater modeling services for St. Johns Landfill. We received five very competitive proposals.

Based on our evaluation, we are awarding you a "Notice of Conditional Award", contingent upon your fulfillment of our insurance requirements, as per the contract I will be sending you.

I am looking forward to continuing to work with you.

Sincerely,

Joanna Karl

Joanna Karl, PE, Senior Engineer
Solid Waste Department

JK:clk
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600 NORTHEAST GRAND AVENUE | PORTLAND, OREGON 97232 2736
TEL 503 797 1700 | FAX 503 797 1797

8

METRO

November 24, 1993

Mr. Michael Pottinger
Geraghty & Miller Inc.
8330 154th Avenue N.E.
Redmond, WA 98052-3864

Re: Groundwater Modeling Services for St. Johns Landfill (RFP# 93R-43-SW)

Dear Mr. Pottinger:

Thank you for your proposal regarding groundwater modeling services for St. Johns Landfill. We received five very competitive proposals. The contract has been conditionally awarded to Portland State University.

We appreciate your interest in this work and the time you took to prepare the proposal. The competitive Request for Proposal is an important part of Metro's effort to conduct its operations efficiently and effectively. We hope that you will continue to respond to future Metro RFPs.

Sincerely,

Joanna Karl, PE, Senior Engineer
Solid Waste Department

JK:clk
cc: Jim Watkins, Engineering & Analysis Manager
s:\share\karl\gw-1123.ltr

600 NORTHEAST GRAND AVENUE | PORTLAND, OREGON 97232 2736
TEL 503 797 1700 | FAX 503 797 1797

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METRO

November 26, 1993

Jim Luzier
Luzier Hydrosciences, Inc.
Two Gershwin Court
Lake Oswego, OR 97035

RE: Groundwater Modeling Services for St. Johns Landfill, RFP #93R-43-SW

Dear Jim:

As you know, the groundwater modeling services for St. Johns Landfill contract has been awarded to Portland State University. In our phone conversations, you indicated concerns about competing with the University.

In a competitive request for proposal process, Metro has no basis to exclude the University's participation. If you choose to protest Metro's decision, it is necessary to deliver your appeal in writing to Rich Wiley, Metro's Procurement Officer (797-1713), within five (5) working days of the postmarked date on the Notice of Award. The written appeal must describe the specific citation of law, rule, regulation, or procedure upon which the appeal is based. Also, for your information, disagreement with the judgment exercised in scoring by evaluators is not a basis for appeal. I have attached a copy of the portion of the Metro code explaining the process.

Metro values your involvement in our projects, and would like to continue to work with you in the future.

Sincerely,

Joanna Karl

Joanna Karl, PE
Senior Solid Waste Engineer

JK:gbc
Attachment
cc: Jim Watkins, Engineering & Analysis Manager
Craig Lewis, Contract Compliance
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(f) Monthly Contract Report: The Executive Officer will provide a monthly report to the Council, pursuant to Section 2.04.032, of all contracts, including extensions and amendments, which have been executed during the preceding month; provided, however, that such monthly report need not include purchase orders under $500.

(g) Federal/State Agency Approval: When required by federal or state law or regulations, review and approval of Metro contracts shall include prior concurrence or approval by appropriate federal or state agencies.

(h) No contract or contract amendment may be approved or executed for any amount in excess of the amount authorized in the budget.

(Ordinance No. 82-130, Sec. 2; amended by Ordinance No. 84-175, Sec. 8 & 10, Ordinance No. 84-176, Sec. 4, Ordinance No. 84-179, Sec. 2; all previous Ordinances repealed by Ordinance No. 87-216, Sec. 2, amended by Ordinance No. 88-249, Sec. 2; amended by Ordinance No. 89-305A, Section 6)

2.04.031 Notice of Award and Appeals:

(a) At least five (5) days prior to the execution of any Public Contract over $15,000 or a Personal Services Contract over $10,000 the District shall provide a Notice of Award to the contractor selected and to all contractors who submitted unsuccessful bids or proposals. This requirement may be waived by the Executive Officer for any emergency contract entered into pursuant to this Code.

(b) Bid/Request for Proposals Appeal Procedures: The following procedure applies to aggrieved bidders and proposers who wish to appeal an award of a Public Contract above $15,000 and a Personal Services Contract above $10,000. The appeal process for bids is the same as for Requests for Proposals. In the case of Requests for Proposals, disagreement with the judgment exercised in scoring by evaluators is not a basis for appeal.

(1) All appeals shall be made in writing and shall be delivered to the Contracts Administrator at Metro's main office within five (5) working days of the postmarked date on the Notice of Award. The written appeal must describe the specific citation of law, rule, regulation, or procedure upon which the appeal is based.

(2) The Contracts Administrator shall forthwith notify the appropriate department head and the Executive Officer of the appeal. Within ten (10) working

days of the receipt of notice of appeal, the Executive Officer shall send a notice of rejection of the appeal or a notice of acceptance of the appeal as applicable to the appellant. The appellant may appeal the Executive Officer's decision to reject the appeal in writing to the Contract Review Board within five (5) working days from the postmarked date on the Notice of Rejection.

(3) The Contract Review Board will review the grounds for appeal, all pertinent information, and the Executive Officer's recommendation, and make a decision. The decision of the Contract Review Board is final.

(4) No contract which is the subject of a pending appeal may be executed unless the Contract Review Board shall have given its approval at the request of the Executive Officer. The Executive Officer may request the Contract Review Board to determine a matter without waiting for the expiration of the time periods provided for herein.

(Ordinance No. 89-271, Sec. 1)

2.04.032 Contract Information Reports:

(a) The Executive Officer shall provide a monthly report to the Council showing the status of all contracts in effect at Metro as of the date of the report. The report shall be divided into four sections: (a) Contracts Awarded; (b) Contracts Amended; (c) Open Contracts; and (d) Contracts Closed.

(1) Contracts Awarded: This section shall report all new contracts awarded since the date of the previous report to the Council of all new contracts. Information contained in this report will be the cost center of the department responsible for the contract, contract number, starting and ending dates of the contract, type of contract, amount of the contract, vendor name, and a brief description of the purpose of the contract.

(2) Contracts Amended: This section shall report all contracts amended by Change Order since the date of the previous report to the Council of contract amendments. Information contained in this report will be the contract number, vendor name, amendment number, type of amendment, the original amount of the contract, the amount of the contract

10

LUZIER HYDROSCIENCES
Two Gershwin Court, Lake Oswego, Oregon 97035
Fax (503) 636-7664 *(503) 636-1012*

December 2, 1993

Mr. Richard Wiley, Procurement Officer
METRO
600 N.E. Grand Avenue
Portland, Oregon 97232-2736

This is an Appeal of: Contract Award to Portland State University for Groundwater Modeling Services for St. Johns Landfill, RFP#93R-43-SW. *(Estimated project budget $80,000 to $100,000).*

Dear Mr. Wiley:

In accordance with METRO's Appeal Procedures, Metro Code Section 2.04.03 *(pages 2.04-09 and 2.04.10, supplied by the Metro Project Manager for the subject RFP #93R-43-09),* Luzier Hydrosciences respectfully submits this Appeal of the above Contract Award, and requests an independent review of the selection process and reconsideration of the Contract Award in favor of Luzier Hydrosciences.

Basis for Appealing the Contract Award to Portland State University:

1. According to the METRO code 2.04.031 (b) (1), regarding appeal procedures, LHS must describe "the specific violation of law, rule, regulation, or procedure upon which the appeal is based", within (5) working days of the Notice of Contract Award *(Nov. 23 for other firms; Nov. 26 for LHS).* The extremely short 5 day time frame does not allow sufficient time to conduct proper and complete legal research, and METRO has refused to provide a time extension for the Appeal. Unresolved questions include:

   (a) Why has the selection team used a consensus approach rather than the published evaluation criteria percentage scores outlined in the RFP. Is the consensus procedure in violation with METRO's stated policies and the METRO code? This is not a disagreement with scoring by the evaluators which is exempt from the appeal process; rather, the question is -- why were the evaluation criteria ignored in favor of a consensus approach? If the evaluation criteria ranking is in favor of Luzier Hydrosciences, the contract should have been and should be awarded to Luzier Hydrosciences.

(b) When METRO publicly advertises for proposals from private sector firms, surely the private sector firms have a right to expect a level playing field, without competition from taxpayer supported institutions. How does METRO resolve the use of raw labor costs as the basis for estimating as in the PSU cost proposal, vs. our costs which include all overhead items?

2. The RFP clearly called for (a) private sector firms to submit proposals and (b) private sector firms to submit with the ability to obtain professional liability insurance. PSU is not a consulting firm, does not have the ability to obtain professional liability insurance, and should not have been qualified.

3. Applicability of State of Oregon Registration Statutes: Oregon Statutory requirements seem to be well established regarding the registered "Public Practice of Geology". Based on previous Geology Board findings, METRO's contracting practices may contribute to violations of State law or public agency policy as follows:

(a) ORS 672.695: This statute concerns the requirement that Public Agencies in Oregon must contract only with geologists registered by the Oregon State Board of Geologist Examiners *(subsurface geologic mapping, reconstruction of the formation layer boundaries and interconnections between layers and fluids, are the types of special understandings and geologic activities essential to produce a reliable groundwater flow model of St. Johns Landfill region).*

(b) ORS 672.535-545: According a legal review of this statute and an Opinion prepared for the Board by Mr. Mike Wyrick, Assistant Attorney General in October, 1984, the only way to legally practice geology in the State of Oregon is as follows *(exact quote)*:

(1) You are a subordinate to a registered geologist, or
(2) You are a partner, or associate in a corporation, with a principal who is registered as a geologist.

(c) The statutory based ruling suggests that the Contract Award to PSU may constitute a violation of Oregon registration statutes by PSU, violations of stipulated Agreements with Oregon Boards of Registration (see item [d] below), and violations by METRO via ORS 672.695. Any claims for statutory exemption from registration requirements by viewing the groundwater modeling project as a research study, cannot be justified because the entire work effort is focused clearly on problem solving and pollution abatement/definition objectives using standard geological and engineering practices and methodology.

(d) According to the Board of Geologist Examiners *(meeting minutes of Sept. 9, 1985, p.4, and Nov. 11, 1985, p.4)*, following high level meetings in the Governor's Office with the Department of Higher Education and the Attorney Generals Office, the Board agreed to drop a penalty of $1,000. against a highly qualified Oregon State University Professor of Oceanography, in turn for a stipulated Agreement in which the Professor would agree "to refrain from the public practice of geology".

At the above referenced meeting, the Department of "Higher Education also agreed to send out a policy cautioning teachers to be aware of licensing requirements and to draft a stipulated agreement for Board consideration". If the PSU project manager in question is not registered and qualified by training and experience to publicly practice geology in Oregon, and otherwise does not comply with statutory requirements, a violation of the stipulated Agreements may occur because of the contract award to PSU.

The records of action and interpretations by the Board of Geologist Examiners and the Attorney General, deserve serious consideration by METRO because any type of groundwater modeling and pollution evaluation effort at St. Johns Landfill, will receive strict and legal based regulatory review by DEQ and EPA. Because the calibrated model formulations *(the primary project deliverables)*, are interpretations of subsurface geology and groundwater/surface water interactions, the requested modeling services should be accomplished under the supervision of properly registered private firms and individuals as required of all firms in Oregon.

In order to expedite the Appeal review process and to ensure that the above referenced Board findings are applicable, accurate, and stated within the proper context, we urge METRO to independently obtain a formal review and opinion by the Board of Geologist Examiners.

As part of your Appeal review process, Luzier Hydrosciences respectfully urges you to review, and to take responsible charge of and preserve, all relevant pre-proposal and RFP documents, interview tapes, selection committee meeting tapes, scoring evaluations, memos, notes, phone logs, and voice mail records. These records need to be retained until the entire legal Appeal and/or litigation process is resolved. If any of the relevant documents are available now or will become available, please contact LHS so that we can help screen or facilitate the request for copies.

Luzier Hydrosciences regrets that it must file this Appeal but requests for reconsideration, and extension of the Appeal deadline have been rejected. Luzier Hydrosciences and other firms are facing increasingly unfair competition from tax payer supported agencies and institutions. We and our subconsultants expend a great deal of unpaid effort in preparing technical proposals and exposing our best ideas for the benefit of the Client. We have a right to expect absolute integrity and fairness in the selection process and we must make every effort to exclude unfair competition and protect our ability to earn a living.

Please contact me if you have any questions or need additional information.

Sincerely,

Luzier Hydrosciences,

James E. Luzier, P.G., Geohydrologist
President

Foundation Engineering, Inc.

Frederick G. Thrall, PhD., P.E.
Senior Consultant

cc: Christopher H. Kent, Esq.

EVALUATION OF
RFPs for GROUNDWATER MODELING SERVICES FOR ST. JOHNS LANDFILL

Five proposals were received.

The following ranking was used to compare the five proposers. PSU and Luzier Hydrosciences were interviewed. Members of the selection committee included: Joanna Karl, Senior Engineer, Metro; Jim Morgan, Senior Regional Planner, Metro; Dennis O'Neil, Senior Solid Waste Planner, Metro; Julia Bascom, Metro; and Randy Albright, Hydrogoeologiest, DEQ. The committee ranked the first two categories (Project Work Plan and Project Staffing Experience). The budget/cost proposal ranking was a cost efficiency, and its computation is shown below.

	PSU	LUZIER	GERAGHTY & MILLER	HART CROWSER	RIEDEL
PROJECT WORK PLAN* (35%)	34	30	24	25	21
PROJECT STAFFING EXPERIENCE** (35%)	35	33	30	28	28
BUDGET/COST PROPOSAL*** (30%)	30	30	22	22	21
TOTAL	99	93	77	75	70

*This category includes: Clarity, understandability, and completeness of proposal; Demonstrated understanding of the project objectives; Responsiveness to project objectives; and Commitment to the project's timely completion.

**This category includes: Project organization: specific identification of the Project Manager, all technical and support staff, and subconsultants, their qualifications and references; Specific demonstrated knowledge of the strengths and weaknesses of modeling techniques; and Documented compliance with similar work schedule deadlines.

***Budget/cost proposal includes: Documented commitment to complete the project within budget; Balanced and comprehensive cost proposal with pricing most advantageous to Metro. Budget/cost proposal was determined as follows: The total points for the first two categories (Project Work Plan and Project Staffing Expaerience) were added together and divided by a normalized cost (i.e., the lowest cost was 1.0, and the highest cost was 1.29). A multiplier was then found such that the highest score equaled 30.

PSU:

$$\frac{69}{\left(\frac{\$87,837}{\$80,000}\right)} = \frac{69}{1.098} = 62.8$$

LUZIER:

$$\frac{63}{\left(\frac{\$80,000}{\$80,000}\right)} = \frac{63}{1.0} = 63.0$$

Geraghty & Miller:

$$\frac{55}{\left(\frac{\$95,921}{\$80,000}\right)} = \frac{55}{1.199} = 45.9$$

Hart Crowser:

$$\frac{52}{\left(\frac{\$91,700}{\$80,000}\right)} = \frac{52}{1.15} = 45.4$$

RIEDEL:

$$\frac{49}{\left(\frac{\$87,460}{\$80,000}\right)} = \frac{49}{1.093} = 44.8$$

The final calculation involves finding a multiplier (30/63 = .4762), such that the highest score is 30.

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EVALUATION OF
RFPs for GROUNDWATER MODELING SERVICES FOR ST. JOHNS LANDFILL

Five proposals were received.

The following ranking was used to compare the five proposers. PSU and Luzier Hydrosciences were interviewed. Members of the selection committee included: Joanna Karl, Senior Engineer, Metro; Jim Morgan, Senior Regional Planner, Metro; Dennis O'Neil, Senior Solid Waste Planner, Metro; Julia Bascom, Metro; and Randy Albright, Hydrogoeologiest, DEQ. The committee ranked the first two categories (Project Work Plan and Project Staffing Experience). The budget/cost proposal ranking was a cost efficiency, and its computation is shown below.

	PSU	LUZIER	GERAGHTY & MILLER	HART CROWSER	RIEDEL
PROJECT WORK PLAN (35%)	34	30	25	24	21
Clarity, understandability, and completeness of proposal;	20[1,2]	16[1]	12[3]	12[3]	12[3]
Demonstrated understanding of the project objectives;	4[4]	4[4]	5[3]	5[3]	3[6]
Responsiveness to project objectives; and	5[13]	5[7]	4[8]	3	2[6]
Commitment to the project's timely completion.	5	5	4[3]	4[3]	4[3]
PROJECT STAFFING EXPERIENCE (35%)	35	33	30	28	28
Project organization: specific identification of the Project Manager, all technical and support staff, and subconsultants, their qualifications and references;	15	15	12[9]	13	13
Specific demonstrated knowledge of the strengths and weaknesses of modeling techniques; and	15[10]	13[11]	13[12]	10	10
Documented compliance with similar work schedule deadlines.	5	5	5	5	5
BUDGET/COST PROPOSAL* (30%)	30	30	22	22	21
TOTAL	99	93	77	74	70

*Budget/cost proposal includes: Documented commitment to complete the project within budget; Balanced and comprehensive cost proposal with pricing most advantageous to Metro. Budget/cost proposal was determined as follows: The total points for the first two categories (Project Work Plan and Project Staffing Expaerience) were added together and divided by a normalized cost (i.e., the lowest cost was 1.0, and the highest cost was 1.29). A multiplier was then found such that the highest score equaled 30.

PSU:

$$\frac{69}{\left(\frac{\$87,837}{\$80,000}\right)} = \frac{69}{1.098} = 62.8$$

LUZIER:

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RIEDEL:

$$\frac{49}{\left(\frac{\$87,460}{\$80,000}\right)} = \frac{49}{1.093} = 44.8$$

The final calculation involves finding a multiplier (30/63=.4762), such that the highest score is 30.

1. Demonstrated familiarity with St. Johns Landfill site.
2. Very detailed workscope.
3. Lacks familiarity with landfill site and sources of info - creating disadvantage regarding conceptual model development in accurate/timely manner.
4. Doesn't include sensitivities

5. Includes sensitivity analyses

6. Proposal doesn't address management scenarios

7. Wants to incorporate potential model scenarios into model set-up to more efficiently use the model.

8. Apparent reluctance to model transient conditions, as reflected in proposal text and list of recommended models. List of deliverables is good.

9. Modeler and project manager in different locations

10. Greater theoretical understanding of numerical models

11. Greater geotechnical and hydrological understanding of landfill environment and data sources

12. Good modeling experience

13. Will give as much time as required to train Metro employees to use the model.

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~~Randy's concerns:~~
Aquifer hydr. properties - not enough data

10/28/93

Quality of existing data

- PSU
(1) - Joint venture, or
Subcontract w/ Parametrix ?

Bruce Gillis (DEQ) -
Parametrix hasn't delivered
w/ database (~~E~~ East Mult
Co.

- ~~Geo~~ Geraghty & Miller

-

Luzier
- How will consolidation concerns be approached in model?
- Querried Re: any biases he may have? (he Challenged Randy Sweet's assumption Re: upwelling in Bybee Lake)

Riedel - petroleum rem. proj -
~~...~~ not big modeling proj.

PSU - 1 (tremendous detail)
Luzier - 2 ~~(could have some)~~ } local geology - given limited
G&M 3 steep learning curve - complex area
Hart Crowser } 4 general proposal, not specific to our proj
Riedel } not experience } lack of fam. w/ local geology

poss dates for interview {
- ~~Thurs~~ Monday, Nov 8
- Wed, before 4. (Nov 10)

11/18/93

F/U -
Refine model to run w/ smaller domain (perhaps not to boundaries of rivers?)

Luzier -
Verification

Jim - Luzier
Julie - PSU

Jim Luzier
Rick Thrall - point of view.

PSU - more unbiased

	PSU	Luzier
Demonstrate understandg of proj obj. Responsiveness to proj. obj		
Spec. exper. dem. knowl. of strengths/weaknesses		
PSU - "PYRO" techniques Luzier -		

Shu-guang Li -
type of product!
Keep him focused on product } Re-work work scope.

Luzier - review for hydrog -

JUANNA KARL, METRO
FAX 797-1795
FROM: RANDY ALBRIGHT

State of Oregon
Department of Environmental Quality

Memorandum

Date: November 5, 1993

To: Randy Albright

From: Jerry Grondin

Subject: Review of METRO St. Johns Landfill Groundwater Modeling Proposals

I have complete a review of three groundwater flow and contaminant transport modeling proposals related to the St Johns Landfill. The proposals were submitted by Luzier Hydrosciences, Portland State University, and Geraghty & Miller, Inc. in response to METRO's RFP #93R-43-SW. Proposals submitted by Hart Crowser, Inc. and Reidel Environmental Services, Inc. were not reviewed, because a preliminary review by METRO and DEQ staff rated these proposals lower than the other three.

All three proposals are very good. However, each has offsetting strengths and weaknesses. Each proposal is discussed below.

Luzier Hydrosciences Proposal

Strengths:

- The Luzier Hydrosciences proposal reflected greater geotechnical and hydrogeologic understanding of the landfill environment and available data sources than the other proposals. This understanding is fundamental for developing a representative and timely conceptual model upon which a numerical flow and transport model is based.
- Luzier Hydrosciences also has long term groundwater modeling experience which includes running models on personal computers.
- Luzier Hydrosciences staff are located in the Portland area. This is important for accessing information and consulting METRO staff more easily.

Potential Offsetting Weaknesses:

- METRO needs to use publicly available, well tested, and respected modeling software. This criteria is important for professional and legal defense of modeling results if that becomes necessary. Information about RAND3D, INTERSAT, and INTERTRANS is needed to assure the criteria is met.

Memo To: Randy Albright
November 5, 1993
Page 2

- The proposal does not list the scenarios for model application. What are the scenarios that will be modeled?

- The proposal does not mention sensitivity analyses. These analyses are important. Will they be done and reported?

- The proposal does not list the software and model data sets that will be transferred to METRO and what training METRO staff will receive.

- METRO should be assured that models they receive include easy to use pre- and post-processors as well as the ability to convert modeling results into easy to understand tables, graphs and maps.

Portland State University

Strengths:

- The PSU proposal reflects a greater theoretical understanding of numerical models. This is important for model selection and development.

- The PSU proposal reflects a greater understanding of the surface water system which is important for addressing surface water-groundwater inter-relationship issues.

- The proposed calibration process is good.

- PSU staff are located in the Portland area. This is important for accessing information and consulting METRO staff more easily.

Potential Offsetting Weaknesses:

- METRO needs to use publicly available, well tested, and respected modeling software. This criteria is important for professional and legal defense of modeling results if that becomes necessary. Information about PATH3D and MT3D is needed to assure the criteria is met.

- The proposal does not mention sensitivity analyses. These analyses are important. Will they be done and reported?

- PSU recommends creating a large numerical model (100,000 to 500,000 nodes and 50 to 500 time steps) to provide better detail of the system modeled. This is desirable. However, this requires a computer more powerful than a PC. This may inhibit transferring the complete model to METRO for METRO staff use.

+ This may constrain METRO to rely on PSU for all future model simulations; or

+ PSU may be forced to transfer a simplified version of the model. The applicability of the simplified model could be questionable.

o The proposal does not list the software and model data sets that will be transferred to METRO and what training METRO staff will receive.

o METRO should be assured that models they receive include easy to use pre- and post-processors as well as the ability to convert modeling results into easy to understand tables, graphs and maps.

Geraghty & Miller, Inc. Proposal

Strengths:

o Geraghty & Miller has good modeling experience.

o The criteria for model selection listed in the proposal is appropriate.

o This is the only proposal that includes a sensitivity analyses.

o The list of deliverables is very good.

Potential Offsetting Weaknesses:

o There is an apparent reluctance to model transient conditions. This is reflected in the proposal text and the list of recommended models.

o Geraghty & Miller appear to lack familiarity with the landfill site and sources of information. This puts them at a significant disadvantage regarding conceptual model development in an accurate and timely manner.

o Geraghty and Miller staff are located a significant distance from Portland. This will impede important communication and data acquisition activities.

Conclusion

I hope these observations are useful to you. They should help you and METRO frame your interview questions. I apologize that I can not participate in the interviews.

Please contact me at 229-6743 if you have any questions or comments.

PSU	GERAGHTY & MILLER	LUZIER HYDROSCIENCES	HART CROWSER	RIEDEL ENV. SERV
Approach: -Transient model	Approach: -Steady-state first -easier to est. aquifer prop. -heads computed by steady st are starting cond. for transnt	Approach: -Consolidatn effects -hydr cond -potentiometric head -Chemical effects of leachate on soft alluvium -Condition of perimeter dike -Account for: -Silt settlement -permeability reductn -Elevated leachate hydrost. levels elev'd due to LF gas -Closure -Decr. level of gas -Decr. driving head in leacht -Decr. variatn leacht comp.	Approach: -Steady-state first -Transient -will add parameters for: -aquifer storage -seasonal/tidal fluctuatns -recharge variatn from precip	Approach: -Steady-state first -using SJL data for selected time period -result of steady-st used as IC for transient model -Transient flow -simulated using pre-determined stress period and time steps
Boundaries: -Bottom/east boundaries -arbitrary -Bottom: assume flat (horiz. flow) -Top: no Dupuit assumptn (not essentially horiz. flow) -surf. water-tidal effect -East: near N Portland Rd -contingent on gwater flow pattern in area	Boundary Conditions: -will use natural boundaries -constant head or head-depndnt flux boundaries (surf. water) -seasonal/daily fluctuatn -layer penetr of hydr. feature -interconn of hydr. feature and groundwater -feature prox. to area of intrst	Boundary Conditions: -will use natural boundaries	Boundary Conditions: -Use aquifer geometry to define -Will use natural boundaries	
Aquifer Framework: -Landfill refuse + 4 geological units	Aquifer Framework: -Possible formatns will be split into add. layers -Overbank silt deposits -Columbia River Sand -Pleistocene gravel	Aquifer Framework: -Min. 4 layers and poss. 5 -Overbank deposits, lakes, sloughs, LF mass -Deeper subdivsn of overbank deposits -Columbia sand -Pleistocene gravels -Troutdale form. (maybe)		
Driving Dynamics: -Gravity -Tides -Seasonal forces				
Models: -MODFLOW (3D transnt flow) -RIVER-sloughs, rivers, lakes -DRAIN-leachate coll. sys. -BCF2-leachate mounding -PATH3D (3D trans part track) -post-MODFLOW post-proc. -flowpath -cont. travel time (MODPATH-steady-st only) -MT3D (3D tran cont. transp)	Models: -MODFLOW -MODPATH (steady-state) -PATH3D or own module (3D) -MT3D -Alt. SWIFT III -more extensive history of use -much more difficult to use	Models: -MODFLOW (3D flow) -not interactive -RAND3D or Intertrans (transp) -fully interactive on screen -LH has not used new comm. version or: -Intersat (3D flow) -fully interactive -LH has not used new comm. version -Intertrans (3D transport) -LH has not used new comm. version	Models: -MODFLOW (3D flow) or: -FEMWATER (finite element) -may repr stratigraphy better -more diff. to incorp. w/ solute transp & geochem mod MT3D (3D trasnport) -ext. of MODFLOW -allows assessmt of retardtn -sorption -other physical processes -simple chemical decay functions -assesses mult. cont. sources	Models: -MODFLOW -MODPATH, PATH3D -particle trackg -MT3D

Grid Design-Spatial grids: -100,000-500,000nodes -Aquitard: refuse,silt,dr.sand -head varies fast -flow predominantly vertical -Aquifer: gravels -Vertical: -Multiple computtnl layers within geological grid -convergg flow in sloughs -vertical upwelling-lakes -5-20' -lower limit-sloughs,lakes -Lateral: -50-250' in LF -lower limit-sloughs - >250' outside LF -lower limit-Bybee Lake	**Grid Design:** -ModelCad^{386} -user-friendly pre-processor -can be used w/ diff. codes -Grid -finer grid within landfill	**Grid Design:** -Min. res.: 20-100' -Fine grid: local area features -leachate drains -dikes -lakes -leakage parameters -layer thickness -MODFLOW-Input with one of: -Premod -ModelCad -GIS Intersat: -contouring and graphic displays instantly avail.		**Model Grid:** -fine grid-SJL area -coarse grid-remaining area -Interfaces- -ModelCad^{386} -MODFLOW, MT3D -ModelCad -MODPATH, PATH3D
Grid Design-Time steps: -Hours -Simulates years -with diurnal cycle -Months -simulates 20-100 years -Seasonal variation -Annual trend -Years -Net annual trends -Even larger time step -Asymptotic steady state				
Initial Conditions: -pre-landfilling flow cond. -run pre-landf. to steady-st	**Initial Conditions:** -run to steady-st => heads (IC)			
			Aquifer properties: -Obtained from: -Metro data -USGS reports for region -other applic. sources typical of LF area	**Aquifer properties:** -Hydraulic parameters -existing Metro data -est. based on: -soil type -parti. size distr. -prev. published doc. in similar water-bearg matrx
Calibration: -Accuracy: 10% total head loss	**Calibration:** -Steady-state -from spec. sampling event or -based on long-term avgs -depends on magn. H2O fluc -Accuracy: -residual stand dev. <15% of range in water levels used as calibration targets -residual mean <5% of range in water levels used as calibration targets -Transient: -Accuracy: -residual stand dev. <25% of range in water level changes -residual mean <10% of range in head changes	**Calibration:** -Consolidation effects will incr. potentiometric head (Rick T) -Goodness of fit		**Calibration:** -within 5' of observed groundw surf elev -Residual mean: $\pm$1.5' -Transport: $\pm$5% concentratn
Post-processing: -SitePlanner	**Post-processing:** -commercl software, i.e. Surfer	**Post-processing:** -PostMod to: -Golden software (i.e., Surfer)	**Post-processing:** -Software available: -Surfer (referenced thruout) -Autocad -Microstation -Postmod -Corel -Lotus -Excel -Modelcad -GIS (can be subcontracted)	**Post-processing:** -Surfer -Grapher (sensitivity anal.) -Electronic data -DXF -HPGL -ASCII

Non-conserv Solute Trans: -sorption -retardation factor -hydrolysis -decay -first order decay constant -sorptive process -rapid compared to flow vel -equilibrium sorption isotherm -Initial condition -zero or backgr. concentrtn -Domain -not nec. same as flow -plume scale smaller than flow domain -Grid -same as flow -vert. grid limited by transp (to see sharp conctrtn distr) Calibration -5-10% of source concentratn	Non-conserv Solute Trans: -Calibration -not enough $ for detailed cal. -cal. to one constituent -sens. anal of: -porosity -loading rate -dispersivity -retardatn factors	Non-conserv Solute Trans: -Porosity & hydr. cond. effected by settlement (Rick T)	Non-conserv Solute Trans: -will be challenge w/o geochem model	Non-conserv Solute Trans: -assumes changes in conc. field not affect flow field sign. (transp. model not affectd by flow model)
	Documentation/Training: -Report for outside review (EPA), as well as Metro -Training: -Day 1: general use of software -Day 2: SJL model			
Staff: -Project Mngr: -Shu-Guang Li (PSU) -Primarily PSU (~10% $ to Parametrix) -Local (Portland, OR) -Familiar with site -prev SJL work by grad st.	Staff: -Project Mngr: -Michael Pottinger (Redmond) -Modeling: Reston, Virginia -Support/local hydrology: Redmond, WA	Staff: -Project Mngr: -Jim Luzier (Portland, 42%).	Staff: -Project Mngr: -Chris Neaville	Staff: -Project mngr: -I-Sen Wang
Cost: Required tasks: $57,837 Optional tasks: $25,622 $83,459 1.098 87,537	Cost: Required tasks: $66,619 Optional tasks: $29,302 $95,921 1.202 96,619	Cost: Required tasks: $50,000 Optional tasks: $30,000 $80,000 1	Cost: Required tasks: $61,700* Optional tasks: $30,000 $91,700 1.146 *Includes summary report	Cost: Required tasks: $57,460* Optional tasks: $30,000 $87,460 1.093

C:\WP51\GWMODEL\GW-EVAL.MTX

REGIONAL SERVICES

600 NORTHEAST GRAND AVENUE | PORTLAND, OREGON 97232 2736
TEL 503 797 1700 | FAX 503 797 1797

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METRO

December 15, 1993

Mr. James E. Luzier, President
Luzier Hydrosciences
Two Gershwin Court
Lake Oswego, OR 97035

Re: Notice of Rejection of Appeal of Contract Award, Groundwater Modeling Services for St. Johns Landfill, RFP #93R-43-SW

Dear Mr. Luzier:

By this letter, I am rejecting your appeal of Metro's award of the above-referenced contract to Portland State University (PSU). This letter responds to the points you raised in objection to the award in your letter to Metro's Rich Wiley, dated December 2, 1993. The points you have raised are paraphrased and answered below.

1. You state that "the selection team used a consensus approach rather than the published evaluation criteria percentage scores outlined in the RFP." You ask whether the consensus procedure is in violation of Metro's stated policies or the Metro Code. You want to know why the evaluation criteria were ignored in favor of a consensus approach.

In reviewing this matter, my legal staff (Todd Sadlo, Senior Assistant Counsel, Office of General Counsel) interviewed the project manager, Joanna Karl, P.E., Senior Engineering Planner, and reviewed all relevant interview materials. Ms. Karl apparently stated to you by phone that the scores awarded to proposers in each evaluation category were established by the consensus of the committee. This approach is common in evaluating proposals. While there are numerous ways of ranking proposals (ex: averaging the rankings of individual evaluators), the method used did not violate Metro policies or the Metro Code, and was consistent with the evaluation process set forth in the RFP. The RFP listed weighted criteria, but did not require or forbid evaluation by consensus, averaging, or any other method. The process outlined in the RFP was followed, and Portland State University received the highest ranking of all applicants.

2. You have stated, "When METRO publicly advertises for proposals from private sector firms, surely the private sector firms have a right to expect a level playing

> field, without competition from taxpayer supported institutions. How does METRO resolve the use of raw labor costs as the basis for estimating as in the PSU cost proposal, v. our costs which include all overhead items?"

This does not appear to be a claim that the RFP review process was legally deficient, but an objection to PSU's ability to compete for the RFP in question. As such it is better directed to either PSU or the legislature.

To the extent that you believe Metro's process of selection was unfair, it should be pointed out that under Oregon public contracting law, personal service contracts are exempt from competitive bidding requirements (ORS 279.011(5), 279.015). In addition, both state law and the Metro Code allow Metro to enter into a contract with another governmental entity without soliciting proposals from anyone (ORS 279.015, Metro Code Section 2.04.041). In this instance therefore, Metro used a competitive procurement process in excess of what is required under state law or the Metro Code.

You also appear to believe it is unfair for Metro, as a governmental entity, to hire another governmental entity that, due to public support, may be capable of performing more cheaply. For its part, PSU has stated that it is required under its procedures to include overhead in its proposals. More importantly however, because this was not a bid, Metro was under no obligation to award to the lowest bidder. This fact removes some force from your claim that the "playing field" was not level. Cost was a consideration in the review of proposals, and it appears that the cost of your proposal was similar to the cost of the PSU proposal. Oddly, you appear to suggest that we should penalize a proposer who includes little or no profit in its proposal, in favor of those seeking higher profit.

The expense to a proposer of providing a service was not a criterion in evaluating the proposals, and it is hard to see how or why Metro would want to use such a criterion. Public bidding laws are intended to make sure that the agency procuring goods or services awards contracts in a manner likely to save the agency money and to prevent favoritism. Procedures for obtaining personal services are geared to obtaining the best possible service at a reasonable price. The process used by Metro in this instance accomplished these goals while treating all applicants fairly. We are not inclined to penalize nonprofit or governmental agencies to make them less competitive with the private sector. Our responsibility is to use limited public resources to obtain the best services possible.

3. You state that the RFP clearly called for private sector firms to submit proposals and only private sector firms with the ability to obtain professional liability insurance. You state that PSU should have been disqualified on this basis.

On the contrary, the RFP stated that Metro was "requesting proposals for groundwater modeling services" (p. 1). It also said that "Metro is seeking proposals from firms qualified to perform the services and deliver the products described in the attached Scope of Work" (p. 1). It does not specify private firms, or specifically exclude public or nonprofit entities. The same is true of the RFP advertisement, which stated only that "Metro is soliciting proposals..." Metro is inclined, whenever possible, to interpret its procurement documents in a manner that increases competition. Through your interpretation of the RFP, you are attempting to improve your position by limiting competition. In this instance, we believe that the RFP can reasonably be interpreted to allow a public entity to compete for the award.

The RFP also states that "The prime contractor shall have, or be capable of obtaining, professional liability insurance..." Contrary to your assertions, we do not, in fact, know whether PSU is capable of obtaining professional liability insurance. The more relevant point is that Metro did not require that you or any of the proposers demonstrate that you had or could obtain such insurance. The RFP also included a contract form and Scope of Work. The contract form stated that the contractor was only to obtain professional liability insurance "If required by the Scope of Work." (Section 4.e.) The Scope of Work does not require professional liability insurance. The statement in the RFP that professional liability insurance would be required is incorrect, but its erroneous inclusion in no way prejudiced your ability to participate in the process. It would not be appropriate to disqualify PSU on the basis of the statement, when Metro did not require that any proposers demonstrate their ability to obtain professional liability insurance, and the contract Scope of Work did not require it.

4. Your last claim is that "METRO's contracting practices may contribute to violations of State law or public agency policy..." The discussion that follows this claim suggests that you believe that the work in the RFP might require the services of a registered professional geologist.

Metro's Office of General Counsel has reviewed the statutory provisions for licensing of geologists and concluded that this claim has no merit. The RFP does not state that all proposers must be registered professional geologists. Metro's project manager and those involved in the selection believe that that work in question, which is primarily mathematical modeling, can be performed by a hydrologist, environmental engineer, or perhaps a team of individuals from several disciplines. Furthermore, the PSU proposal specifically notes the intent to use the services of Parametrix, a private consulting firm that will provide the services of Dave Morton, a registered professional geologist.

ORS 672.695, which you cite, states:

> "This state and its political subdivisions, such as a county, city or a legally constituted board, district, commission or authority, shall contract for geological services only with persons registered under ORS 672.505 to 672.705, or a firm employing a registered geologist."

As stated, it is Metro's position that the work in question can be performed by persons skilled in any number of disciplines, and is therefore not "geological services." Through a subcontract, PSU is utilizing a firm employing a registered professional geologist. Allowing PSU to do the work requested in the RFP will not violate ORS 672.695.

In suggesting that PSU is practicing geology without a license, your claim is better directed to PSU. Although Metro disagrees with you, if it is your position that PSU is not qualified or entitled under Oregon law to do the work in question, it is you who should seek guidance from the State Board of Geologist Examiners.

We are confident that PSU can perform the work in question. Indeed, PSU received a higher score than your firm in "Project Staffing Experience." While it is clear that you and your firm are highly qualified to perform the work in question and produce results that would withstand close scrutiny by the public, regulatory agencies and other experts, the same is clearly true for PSU. Randy Albright, a hydrogeologist employed by DEQ, was on the selection committee that chose PSU for this work. Jerry Grondin, also a hydrogeologist from DEQ, participated in the review process. Neither Mr. Albright nor Mr. Grondin stated that they believed that the PSU staff committed to this project were unqualified to carry it out. To the contrary, the evaluation team concluded that PSU was most qualified of all applicants to do the work in question.

For the reasons stated in this letter, I am rejecting your appeal of award by Metro of a contract to PSU for groundwater modeling services. Within five days of the postmark on this Notice of Rejection, you may appeal my decision to the Metro Contract Review Board.

Whether you choose to appeal, Metro thanks you for participating in this procurement process. Having scored highly in the review of proposals for this project, it is apparent that yours is a highly qualified firm. It is obvious from the concluding paragraph of your appeal that you are most upset that you lost this contract to a public entity. In my review of Metro's procurement process, it is clear that Metro exercised "absolute integrity and fairness." To the extent you believe that PSU's participation in governmental procurement is unfair, your objections are misdirected.

Sincerely,

Rena Cusma
Executive Officer

1292

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LUZIER HYDROSCIENCES
Two Gershwin Court, Lake Oswego, Oregon 97035
Fax (503) 636-7664 *(503) 636-1012*

RECEIVED
DEC 22 1993
TIME: 4:20 pm
METRO SERVICE DISTRICT
OFFICE GENERAL COUNSEL

December 22, 1993

Rena Cusma, Executive Officer
METRO
600 N.E. Grand Avenue
Portland, Oregon 97232-2736

This is an Appeal to Metro Contract Review Board Regarding:
Notice of Rejection of Appeal of Contract Award (Cusma, 12-15-93):

Ref: Luzier Hydrosciences/Foundation Engineering 12/2/93 Appeal of
Contract Award to Portland State University for Groundwater Modeling Services for St. Johns Landfill, RFP#93R-43-SW*(Project budget $80,000 to $100,000).*

Dear Ms. Cusma:

In accordance with METRO's Appeal Procedures, Metro Code Section 2.04.03 *(pages 2.04-09 and 2.04.10, supplied by the Metro Project Manager for the subject RFP #93R-43-09)*, we respectfully challenge the Notice of Rejection of our Appeal of the Contract Award to Portland State University. We stand by our original Appeal and restate our request for an independent review of the RFP selection process, and reconsideration of the Contract Award for Groundwater Modeling Services in favor of Luzier Hydrosciences.

Starting on page 4, we will rebut and discuss the four summary points of argument you have raised. However, new documents requested prior to -- but provided by Metro after our Appeal deadline of Dec. 2 expired, raise serious legal and procedural questions involving this Appeal process.

The newly supplied documents (via FAX from Richard Wiley on Dec. 10), include:

- (1) The PSU undated proposal cover letter,
- (2) A "Notice of Conditional Contract Award" to Dr. Li of PSU, dated 11/23/93 from Metro,
- (3) An example letter of the required "notices" to the losing firms (i.e., the letter to Mr. Pottinger of Geraghty & Miller, Inc., dated 11/24/93, informally stating that the "contract has been conditionally awarded" to PSU, and
- (4) The FAX cover note from Richard Wiley indicating that a copy of our Dec. 2, 1993 Appeal had been provided to PSU.

Discussion:

1. Notably, Luzier Hydrosciences was the last firm to be contacted by Metro (letter date Nov.26), and no mention is made that the PSU contract award is "conditional". The conditional aspect of the contract award was not known to this project team at any time prior to prior to receiving the documents on Dec. 10, or prior to the Appeal deadline of Dec. 2, 1993 (any assertion otherwise will constitute a material omission).

2. Had we known that the contract award was conditional, we would not *(emphatically not!)*, have filed an Appeal, thereby risking the professional reputation and good standing of our team with Metro and PSU. Such a premature move would have eliminated any possibility of our team receiving the Award of Contract -- but in fact, that is exactly what has happened.

3. The procedural errors and short deadlines imposed by Metro (effectively 3 working days), forced our team into a premature Appeal process prior to a formal Notification of Contract Award. To this date, Luzier Hydrosciences has not received a valid Notification of Award, nor have the other firms as evidenced by item (3) above.

4. The Metro Code clearly and specifically requires a formal **Notification of Award** -- to all firms. According to the applicable Metro code supplied to LHS by Metro on Nov. 26, no provision exists for a "Notification of Conditional Contract Award".

5. We have confirmed Richard Wiley's note that our Appeal documents of Dec. 2, were sent by Joanna Karl via fax to Dr. Li, project manager of the PSU team.

6. The Appeal documents are sensitive and confidential legal documents which should not have been released by Metro staff. Such unauthorized public release of sensitive documents, has the potential to cause long term intangible damage to our professional reputations, both with Portland State University Faculty, students, and consulting firms. Furthermore, public release of the documents has probably damaged the integrity of the Contract Appeal process. Notably, in your Rejection of the Appeal, you repeatedly make the point that our objections should be directed to PSU, but the actions of your staff have preempted your suggestions.

Conclusions:

1. Metro has not yet issued a valid Notice of Award (unconditioned) -- to LHS or to the other firms. Unless Metro's Office of General Counsel can weave a tortuous explanation, you have no choice but abide by the Metro Code, and issue a formal Notice of Award to all parties once the "conditional aspects" of the pending contract are resolved.

2. Metro should immediately cease the public release of confidential and sensitive Appeal documents, at least while the Appeal is in progress. A written apology to our professional team by the Executive Officer, is certainly in order.

3. Metro should make an effort to recapture all copies of the Appeal documents that have been released or are in the process of being released, and provide LHS a list of firms or individuals who have received the documents.

4. In the event that PSU has recieved informal permission to proceed on the contract, a stop work order should be issued until the Appeal process is complete.

Appeal of the Notice of Rejection of Appeal, follows this page!

Appeal of the Dec. 15, 1993 Notice of Rejection of Appeal of Contract Award, Groundwater Modeling Services for St. Johns Landfill, RFP #93R-43-SW

1. This rebuttal of the Notice of Rejection assumes that Metro attorneys will try to find a way to explain the procedural and legal errors cited above, and keep the existing Appeal process alive.

2. Page 1, Point 1 of Rejection of Appeal letter: My question to Ms.Karl was approximately "how did we show up in DEQ's scoring? She did not want to answer the question, but then added "we did not use scoring, we used a consensus approach". Considering that the team is weighted 3:1 in favor of Metro, why would you need to avoid direct scoring in favor of a consensus approach? Obviously scoring was used on page 4 of the Rejection letter to show that we scored lower than PSU on Project Staffing Experience -- your failure to show other "lower" scores, by implication, suggests that we might have scored higher in the other categories on the proposal review. How did we score on the interview? This point of argument can be put to rest by providing us copies of all scoring sheets, notes, and documentation on the selection process.

3. Page 2, Paragraphs 2,3,4: No -- we do not object to Metro hiring another government entity -- its the unfairness of how you enticed consulting firms into the process, while actively encouraging PSU (we have confirmed this), to enter the private sector competition.

4. Many points raised by your attorneys on these pages are intentionally misconstrued and are blatant attempts to discredit our Appeal. Please read carefully what we have said in our Appeal, and compare it with the extensions and omissions by your legal staff. We standby our original Appeal in its entirety.

5. Page 3 and 4, Point 4: Metro's Office of General Counsel surely is aware of the importance of precedent in legal proceedings and should have taken our suggestion to contact the Board's of Registration and the Attorney General in Salem. Formal legal opinions have already been rendered covering every statutory issue raised in our Appeal. The opinions of your legal Counsel and Metro staff have no legal bearing on who can do math modeling -- obviously anyone can -- but not in Oregon. The Board of Geologist Examiner's and the Attorney general have already ruled on these exact issues several times. If you do not like it, contact the Geology Board -- but that's the law and you may be in violation!

6. Page 4, paragraph 2: You have rejected outright our advice for Metro to get clarification from the Board's of Registration. We will take your advice and seek

guidance from the State Boards of Geologist and Engineer's Examiner's. Therefore, with this letter, we are requesting both Boards and the Attorney General to investigate and rule on all relevant statutory issues raised in this RFP process.

7. Again, many of your comments are misdirected -- we have given technical seminars at PSU, we employ students and faculty on projects, and we think PSU is a great University with exceptional talent -- but PSU is not a consulting firm, and PSU should not be encouraged by Metro to compete directly with private sector firms.

Thanks for the complimentary remarks regarding our professional team. We are still willing to work with Metro and PSU, but we must remind you of our viewpoint. Luzier Hydrosciences regrets that it must file this Appeal of but early requests for reconsideration, and extension of the Appeal deadline were rejected. Luzier Hydrosciences and other firms are facing increasingly unfair competition from tax payer supported agencies and institutions. We and our subconsultants expend a great deal of unpaid effort in preparing technical proposals and exposing our best ideas for the benefit of the Client. We have a right to expect absolute integrity and fairness in the selection process and we must make every effort to exclude unfair competition and protect our ability to earn a living.

Please contact me if you have any questions or need additional information.

Sincerely,

Luzier Hydrosciences,

James E. Luzier

James E. Luzier, P.G., Geohydrologist
President

Foundation Engineering, Inc.

Frederick G. Thrall, PhD., P.E.
Senior Consultant

cc: Christopher H. Kent, Esq.
Board's of Geology and Engineering Registration

M E M O R A N D

METRO

//

RECEIVED
DEC - 7 1993
TIME 10:08
METRO SERVICE DISTRICT
OFFICE GENERAL COUNSEL

DATE: December 6, 1993

TO: Neil Saling, Director of Regional Facilities

FROM: Joanna Karl, PE, Senior Solid Waste Engineer

RE: Luzier Hydrosciences 12/2/93 appeal of Contract Award to Portland State University for Groundwater Modeling Services for St. Johns Landfill

The selection committee had two meetings - one to shortlist for interviews, and the second to interview and make a selection. Interviews were held with PSU and Luzier Hydrosciences. The final meeting was an exhaustive meeting as it immediately followed the two interviews and continued until well past 5 p.m. Although the criteria was qualitatively discussed throughout this meeting, the committee requested that I (as project manager) quantify the ranking as soon as possible for the committee's approval. This was done, and there was consensus by the committee on the rankings. Another reason the committee chose to complete its selection process that day was because one of the committee members was about to leave on vacation for a week, and so we would not have been able to meet again for over a week.

Attached please find the following:

(1) Detailed quantitative ranking (consensus agreement by selection committee)

(2) My notes from the two decision-making meetings: to shortlist the proposers, and to select a contractor.

(3) Memo from Jerry Grondin (DEQ-Groundwater Section) to Randy Albright (hydrogeologist in DEQ's Solid and Hazardous Waste Section), regarding three of the proposals received by Metro for this project. Metro requested Jerry Grondin's participation because he has an extensive groundwater modeling background.

(4) Matrix summary of all five proposals, prepared by me for the first of the two selection committee meetings.

JK:clk
Attachments
cc: Todd Sadlo, Senior Assistant Counsel
Craig Lewis, Contracts Compliance Officer
Rich Wiley, Procurement Officer

S:\SHARE\KARL\SAL1206.MEM