BOSTON GROUNDWATER TRUST (BGwT)
BOARD MEETING
February 15, 2007
The Lenox Hotel – Copley Room

The meeting of the Board of Trustees of the Boston Groundwater Trust was called order at 4:11 pm in the Copley meeting room. The meeting notice was posted at City Hall in accordance with provision of the Commonwealth's Open Meeting Law.

Trustees in attendance, comprising a quorum, were:

Mr. Tim Mitchell, Neighborhood Association of the Back Bay
Mr. Gary Saunders, Boston Back Bay Association
Mr. Peter Sherin, Greater Boston Chamber of Commerce
Mr. Galen Gilbert, Fenway Community Development Corporation (CDC)
Mr. William Moy, Chinatown Neighborhood Council
Mr. Michael Nairne, Ellis Neighborhood Association
Mr. Jim Hunt, City of Boston
Ms. Nancy Grilk, Mayor's office
Ms. Nikko Mendoza, Mayor's office

Also present were:

Elliott Laffer, BGwT Executive Director; Christian Simonelli, BGwT Technical Coordinator; Eve Pasterio, North End Water Front Residents Association (NEWRA) Groundwater Working Group; Edward Flynn, South Boston Resident

## 1. Adoption of the minutes of the January 18, 2007 Meeting

Minutes were distributed to board members for review.

Trustee Grilk moved to adopt the minutes. Trustee Nairne seconded the motion.

**Voted:** To accept the minutes of the January 18, 2007 meeting.

## 2. Resignation of Trustee

Mr. Laffer noted that Trustee Stetson has resigned from the board. Mr. Laffer referred to a letter (*Resignation from Boston Groundwater Trust and Frog Pond Advisory Board)*, that was sent to Mayor Menino's office stating that he has accepted an appointment to a position in Washington, DC.

Trustee Mitchell suggested that Mr. Laffer send a gracious thank you letter on behalf of the BGwT to Mr. Stetson for all his work and years service.

## 3. Expansion of GCOD

Mr. Laffer reviewed and commented on meetings that took place in the North End and Fort Point Channel in regards to expanding the Groundwater Conservation Overlay District (GCOD). He noted the wide acceptance of the expansion of the district at the meetings. Discussion followed. Trustee Saunders inquired about known cutoff elevations in the area. Mr. Laffer noted that little or no information exists.

Discussion followed. Trustee Gilbert inquired about tidal influence in the North End wells. Mr. Laffer that we have seen some but not much.

Trustee Mitchell moved to accept the proposed GCOD expansion in the North End and Fort Point Channel areas. Trustee Nairne seconded.

**Voted:** To accept the proposed GCOD expansion in the North End and Fort Point Channel areas..

## 4. Finance Report

Trustee Sherin reviewed the BGwT *Financial Report and Reconciliation Detail*. Discussion followed.

## 5. Storrow Drive Update

Mr. Laffer updated the BGwT on the Storrow Drive Project. He noted that progress has been made in discussions to transport water from the Charles River over to the BWSC's Back St. recharge chambers. Discussion followed.

Trustee Sherin expressed concerns over the long term maintenance of the system citing that the BWSC will not maintain the system and that it's the responsibility of residents. Trustee Hunt noted that John Sullivan of the BWSC will be at the next meeting and the issue can be raised then. Discussion followed.

Mr. Laffer reviewed his appointment as the chair of the traffic subcommittee of the Storrow Drive civic review process. Discussion followed. Trustee Mitchell noted that if any board member had an objection to this now was the time to do so. No board member did so.

## 6. Meeting with Undersecretary Griffiths

Mr. Laffer updated the BGwT on meeting with Undersecretary Phil Griffiths. He noted that it went well and that the state is willing to continue working with city to help fix the groundwater problem. Discussion followed. Trustee Hunt echoed Mr. Laffer stating that he felt confident that the state will continue its work with the city. Discussion followed.

## 7. Research Projects

Mr. Laffer updated the BGwT on proposals that were sent to the BGwT regarding finding woodpile cutoff elevations using wave based methods and an alternative to underpinning using a slab-on grade method. Refer to the attached proposals for full description of proposed work. Discussion followed.

Mr. Laffer requested authority from the board to enter into agreements with the parties for both proposals. Discussion followed.

Trustee Gilbert motioned to authorize Mr. Laffer to enter into agreements with the parties for both proposals. Discussion followed.

Trustee Hunt expressed his concerns on the BGwT recieving royalties from the proposal for finding woodpile cutoff elevations using wave based methods. Discussion followed. Trustee Hunt then seconded Trustee Gilbert motioned to authorize Mr. Laffer to enter into agreements with the party's for both proposals.

**Voted:** To accept the authorization of Mr. Laffer entering into agreements with the parties for both proposals.

## 8. Status Of Large Development Projects

Mr. Laffer reviewed the Status Of Large Development Projects. Discussion followed. Refer to the attached *Status Of Large Development Projects*.

## 9. Technical Coordinator's Report

BGwT Technical Coordinator Mr. Christian Simonelli presented his activities of the past month. Discussion followed. Refer to the attached *Technical Coordinator's Well Monitoring Update BGwT Meeting: February 15, 2007* for a complete list of all activities.

## 10. Executive Director's Report

BGwT Executive Director Mr. Elliott Laffer distributed his report and reviewed his activities since the last meeting. Discussion followed. Refer to the attached *Executive Director's Report: February 15, 2007*, for a complete list of all activities.

**The meeting adjourned at 5:44 p.m.**

Respectfully submitted,

Galen Gilbert

Galen Gilbert, Secretary

**NEXT MEETING: March 22, 2007 @ 4:00 pm at the Lenox Hotel.**

**Notes submitted by Christian Simonelli, BGwT Technical Coordinator, on 2/16/07.**

# Wave Based Methods to Assess Foundation Piling Heights in the Back Bay

Carey Rappaport
Bernard Gordon Center for Subsurface Sensing and Imaging Systems
Northeastern University

and

Robin Cleveland
Bernard Gordon Center for Subsurface Sensing and Imaging Systems
Boston University

Proposal submitted to
Elliott Laffer
Boston Groundwater Trust
February 2007

## Introduction

Wave-based methods, including acoustic and microwave sensing are often used to sense variation in subsurface material properties. Both penetrate considerable distances in dry solids, with acoustic waves also penetrating through liquids and wet soil, and microwaves penetrating air easily. They both generate reflections, or echoes, when they encounter differing media. As such they can be used to distinguish the boundaries of granite blocks, wooden pilings, and surrounding soil.

The major difficulty in using these sensing modalities is that variations in intervening media also produce reflections, which confuse the received signals. The closer the sensing antenna or transducer is to the volume of interest, the lower the potential for clutter to obscure the desired information.

This project considers placing acoustic transducers and ground penetrating radar antennas in a small diameter borehole installed near the base of a building's foundation, at the depth where piling height and integrity information is desired. Since the transmitting and receiving elements will be below the pavement and ground surface, most of the intervening clutter will be absent, and the piling target reflections should be clearly interpretable.

## Proof-of-Principle Experiments

Two sets of proof-of-principle experiments will be carried out part of this project: the first in our indoor controlled soil tank, and the second at a test site provided by the Boston Groundwater Trust (BGWT). We will study both radar and acoustic sensors. In both cases, sensors will be lowered into a borehole that is close to the simulated (or actual) building to be assessed. The acoustic sensor will operate in a pulse-echo mode as described in the technical brief submitted in December 2006. The radar sensor will measure electromagnetic impedance in terms of the wideband reflection scattering parameter $S_{11}$.in the 400 MHz – 2 GHz frequency range. In addition, we will investigate surface-based acoustic sensing that avoids the need for a borehole, but will likely generate less clear target signals. The surface-based tests will be performed solely at the outdoor test site.

The indoor experiments will be carried out at Northeastern University's SoilBED controlled soil test tank. This 9 by 5 by 4 foot tank is filled with sand, wetted to match the anticipated ground water moisture. A section of wooden piling will be installed vertically, with a granite block positioned over it. A borehole will be pounded into the sand using a 1 inch diameter PVC tub, which will have each type of sensor inserted and then filled with either air, for the radar experiments, or water for the acoustic experiments. A feasibility study will be conducted to determine detection sensitivity with borehole distance from piling and granite block, the discrimination target features from the sensed signal with transducer/antenna depth, and the directionality of the sensing system.

For outdoor tests, first a borehole will be positioned as close as possible to the building, ideally with in 1 m. The BGWT will drill the borehole which will need to be approximately 1 inch in diameter and at least as deep as the top of the pilings. The acoustic sensor will be lowered into the hole and will be operated in pulse-echo mode. It will send out an ultrasonic pulse at around 50 kHz and will listen to echoes. Measurements will be taken at various depths within the hole. Analysis of the echo signal will be carried out to ascertain if pilings and granite blocks can be detected and distinguished.

If the results are promising boreholes at distances further from the building will be drilled and measurements repeated to determine how far from the building the sensor can be and still result in acceptable signal levels.

If the bore-hole acoustic tests demonstrate that the pilings result in very strong (easily detectable) signal then a further test will be conducted to determine whether it is possible to detect the top of the pilings using airborne acoustic sensors. An array consisting of four microphones will be mounted close to the ground. A thumper plate will be used to excite waves in the ground and the microphone array will be used to detect echoes from the building the granite blocks and pilings. Appropriate signal processing will be employed to steer the array in order to detect the top of the pilings.

For the outdoor test site, the acoustic equipment that will be brought to the site will include: ultrasound transducer mounted to a steel rod, an amplifier, a function generator, a thumper plate, a microphone array, a digital oscilloscope, and computer. It will be necessary to have access to standard 110 V power socket to power the equipment. The measurements will likely require two sets of approximately 5 hours of continuous access to the site.

The deliverable will be a report showing analysis of the data and discussing practical suggestions for implementing borehole radar and acoustic-based assessment of piling heights and condition.

**ASSESSMENT OF SLAB-ON-GRADE UNDERPINNING SYSTEMS FOR RESUPPORT OF ROWHOUSES HAVING ROTTED WOOD PILES, With Particular Focus on Application in East Boston**

**Problem Statement and Background:**
There appears to be particularly widespread foundation support problem in areas of East Boston where rowhouses and individual houses were originally constructed with wood pile foundations. Uneven settlement of many houses is readily apparent from visual observation of exterior conditions. The problem of uneven settlement is most apparent in houses with brick bearing walls at the front and rear. It is known that at several houses, test pits excavated to reveal the tops of wood piles beneath the load bearing walls have uncovered severely rotted wood over the top one to several feet of wood pile top. Research by the BGwT into Boston Building Inspector Reports from the late 1800s and early 1900s has revealed that the tops of piles at many of the house building sites were cut off at Elev. 7, 8 or 9 (BCB). This top of pile elevation was probably higher that the local groundwater level at the time of construction, but is several feet above that used throughout Back Bay, the Fenway and South End areas. With time and changes to the topography of East Boston, groundwater has apparently been lowered below tops of piles, and the wood has rotted.

The typical rowhouse building in East Boston is three stories high, not the 4 to 5 stories seen in Back Bay, and other areas of Boston across the harbor. The property values of the rowhouses in East Boston are typically much lower than in Back Bay, South End, Fenway and other areas, where the cost to underpin one rowhouse to repair the wood piles and restore full wood pile foundation support to one rowhouse can run from $280,000 to $650,000. Therefore, it becomes uneconomical to apply the 'usual' underpinning methods to most buildings in East Boston. However, other alternate load re-support techniques may be feasible at far less expense; the principal candidate system is a concrete mat-slab. The mat-slab foundation system would provide a rigid structural slab at basement floor level which would distribute the loads from the house onto the ground, spreading it across the width of the house. However, some settlement could still occur because the soils beneath the basement may include the old mud flat and swamp deposits that were recorded to be present in colonial times and up to the 1900s. The presence of these soft compressible soils (which were covered over with fill and harbor dredgings) was the original reason that wood piles were driven for foundations for the rowhouses when the areas of East Boston were originally developed.

In recent years, an alternate type of support system has been used at a few rowhouses in the South End in lieu of full-repair underpinning in recent years, namely bracket piles. This system has had substantially lesser cost than the "full-repair", but poses some inherent problems that make the longevity of its support mechanism somewhat questionable. However, it should also be evaluated as a possible alternate in East Boston. Both of these alternative systems are less expensive than the "full-repair" underpinning, but what are their shortcomings? A purpose of this Task Study is to define the two alternative systems with text and drawings, and to assess their positive and negative aspects. This study will also look for other possible alternative underpinning schemes. Input will be solicited from knowledgeable structural and geotechnical engineers in the Boston area who have had first hand work on such underpinning projects.

**Background on Underpinning Systems:** Underpinning to repair the rotted tops of wood pile foundations of rowhouses and larger buildings such as the Boston Public Library has been necessary at individual locations since the mid-1920's. The methods used 80 years ago are still the predominate means for repairing wood pile tops. These repairs are affected by excavating (usually by hand digging) to expose the decayed top and several feet of the wood pile while

supporting the overlying granite block with timber shoring. The top several feet of the wood pile is then cut off and immediately replaced with a steel post that is jacked and tightly wedged into place. The steel member is later encased in concrete, usually several steel posts are enclosed in one massive pour of concrete. In this manner the top of the wood pile is lowered to such elevation below which the groundwater table is not expected to fall in the future. This process is tedious and time consuming, and expensive, taking several months and costing several hundred thousand dollars per rowhouse.

In a few instances, a quicker, cheaper method that provides an alternative support system of *bracket piles* has been applied. In such repairs, new piles (steel pipes or screwed-in augers) are pushed (or screwed) into the ground next to the party wall, and a structural steel frame bracket system is used to attach the pile top to the brick party wall. The bracket pile system introduces a different stress regime into the brick party wall, which should receive special analysis and perhaps needs supplemental restraint to avoid overstressing the wall. The cost and time of installation of bracket pile system can be one-half or even one-third of that for the "standard method" underpinning, and is therefore an attractive option to homeowners who have the work space in the lowest level of the house for the work to be carried out.

Other structural re-support systems have been considered in lieu of the "full-repair" standard method underpinning. It has been suggested that it might be feasible to inject cement-based grout below the granite block pile caps to solidify the granular fill in the several feet below the granite block pile caps, however the ability to drill the distances necessary and the locating of the proper position for this grouting have not be reliably addressed. The principal alternative method to be investigated in this study involves the forming of a concrete mat-slab within the footprint of the house to carry the weight of the house to the fill soil between the walls, with the slab framed into the perimeter foundation walls of the house at the slab bearing level. Both of these alternatives will support the load of the house on the top of the fill stratum rather than at the deeper level of the ends of the wood piles some 20 ft to 35 ft below the house on the hard crust of the clay or sand stratum. The effects of such change in load bearing level and its possible impacts to the abutting houses must be considered before these radically different systems can be recommended to homeowners. However, these systems are again attractive to the homeowner because they can be installed much more quickly and at substantially lower cost than the "standard method" of underpinning.

Other underpinning is understood to have been carried out wherein only the rotted top few inches of each existing wood pile is replaced with a short piece of pressure treated wood to re-establish pile support to the house loads. However, the issue of groundwater level relative to the top of untreated wood may not be addressed, and rotting below the pressure treated wood will resume.

The issue of appropriate underpinning systems is both; one that most individual homeowners will not be able to adequately assess due to the technical the differences between the several potential underpinning or foundation supplementation schemes, and secondly is a public safety issue that overlaps to the adjacent properties. There are currently no guidelines in Boston city regulations for such repairs/re-support systems. It is expected that the proposed study and summary report will provide a basis for appropriate City agencies to make rulings as to acceptable systems and how these can/will be implemented. The ISD does require that the foundation repairs be approved and sealed by a registered professional engineer. However, there are presently no requirements for future life expectancy of the repairs. Some neighborhoods in which the repairs are made are now more than 125 years old, and future life expectancy of the rowhouses can easily be projected a century or more into the future. Therefore, the longevity of satisfactory performance for any type of wood pile repair or supplementation scheme must likewise be as long.

The study task herein proposed is principally focused on the situations prevalent in East Boston where the mat-slab support system would appear to have greatest likelihood for successful application. However, it may have some application in the South End and Chinatown areas

where buildings are of similar 3-story heights. The following outlines the technical issues to be addressed and reported on.

**Topics/Issues/Tasks Included in this Study:**

As noted in the Background above, there have been several methods employed over the past two decades for underpinning rowhouses to repair the rotted tops of wood piles. As a background summary, these three and the proposed 'mat-slab' system will each be described in sufficient detail and with appropriate drawings to permit understanding by lay-people. The descriptions will address details of these underpinning systems, explain nuances of each and potential pitfalls, describe long-term performance concerns that must be addressed when any method is considered.

As part of this Study Task, the Boston Inspectional Services Department building permit records will be researched for the past 15 years (1992-2007) to determine each underpinning project for which a building permit was issued, and the means used for the underpinning. In the course of the research, other possible schemes will be solicited from local contractors and structural engineers, along with their thought on particular construction considerations with each, and in particular the method of installing a structural mat slab over the floor area of the house with it being framed into the perimeter walls to support the house loads.

Questions to be assessed for each underpinning system evaluated include;

- how does each system support building loads?
- what is the bearing soil stratum?
- is the new support system a change from original construction?
- what is the expected performance of the new load support system in the rowhouse structure?
- what are the access requirements for installing each system? (with particular regard to house configurations in East Boston.

These questions are particularly focused on the mat-slab system, which is recognized as a distinct change in load support from that afforded at the time of construction. Diagrams will be developed to illustrate these issues for each underpinning system. The behavior of the ground, the underpinned house and the adjacent houses will be evaluated. The differential settlement can occur as the marsh deposits of organic silt stratum undergoes long-term compression. The potential adverse impacts to the neighboring houses will be evaluated and listed. Important element of the study is to adequately assess the expected long term performance of the mat-slab system. The longevity of the steel piles and helical anchors used in the bracket pile system will also be assessed, because these elements will be exposed to the potentially corrosive effects of the organic silt stratum, and the surficial fill.

The approximate costs for each system in use today, and the mat-slab system will be estimated by interviewing contractors. Calculations and extrapolations will be made to address different access conditions that occur at houses so as to provide a range of costs for different conditions. The costs for yet untried underpinning systems (mat-slab) will have to be developed as a rough estimate because such installation has not yet been made. Local specialty contractors will be contacted and the approximate costs determined for given assumed access conditions. The goal of this part of the Study Task is to determine the relative magnitude of costs between the various underpinning methods and determine if there is significant financial advantage of various schemes.

Finally, an assessment will be made of potential situations where mat-slab underpinning is completely unacceptable. Part of this answer will come from estimates of longevity, since the system life expectancy must be not less than that of the house. Likewise, if a system would be expected to cause damage to the adjacent rowhouse at the neighboring property, then it should not be permitted.

**Deliverables Expected:**

Two reports would be prepared for this Study Task. The first will be an overall detailed report with most of the information uncovered in the research summarized in some detail. The second report would be the condensed version in "homeowner brochure" format that will have simple sketches and descriptions that are easily understood by the average homeowner.

**Budget Estimate for the Underpinning Systems Assessment Study Task:**

The expected duration of the study on underpinning systems for East Boston is two terms of co-op student study. Depending on the phase of the study, and the education level of the co-op student, about 30% to 50% of the weekly time of the co-op student will be expended on this study. Assuming that a year of co-op student work effort is $30,000, then 50% for 2/3 of a year would be $12,000.

Supervising Professor cost would be similarly active on the research effort, with an expected 25% of his time for the projected two semesters being spent on this study task. The cost for the Supervising Professor for the underpinning study task would be estimated to be $22,250, which is one-quarter of annual (two-semester) salary, plus 50% fee for institute overhead.

It is expected that structural engineers and contractors who would be queried on the various underpinning systems would provide information gratis, so not additional costs are expected to be incurred. Allow about $1,750 for CAD printing and miscellaneous other computer costs at WIT

Total cost for this study task is therefore estimated to be $36,000.

## STATUS OF LARGE DEVELOPMENT PROJECTS

1. **Northeastern University St. Botolph St. Dorm –** Project has been approved by BRA. Construction will follow completion of dormitory across from Ruggles Station.
2. **1330 Boylston Street –** Under construction.
3. **Prudential Center –** Mandarin Oriental is under construction with regular reports on groundwater levels. 888 Boylston Street office building is approved but on hold. No plan has been put forth for potential apartment building on Exeter Street.
4. **Museum of Fine Arts –** Under construction with regular reports on groundwater levels.
5. **Simmons College School of Management –** Approved by BRA.
6. **The Clarendon –** Under construction with regular reports on groundwater levels. Report on causes of low groundwater in area is almost complete.
7. **Columbus Center –** We have been receiving preconstruction reports of groundwater levels. Installation of wells along Turnpike is supposed to happen during early construction work for deck installation this spring.

# TECHNICAL COORDINATOR'S WELL MONITORING UPDATE BGwT Meeting: February 15, 2007

WELL M0NITORING

- We are in the process of reading the well network.
- 14 of the 22 Zones have been read and are posted on the website. We hope to finish the readings by the end of this month.

EMPLOYEES

- Anthony Bernardi of Wentworth Institute of Technology was hired and started work on Saturday January 13, 2007. Anthony is a part-time employee of the trust (15-20 hrs./week). His duties will include reading the BGwT observation well network and assisting the Technical Coordinator.

LEVELOGGERS

- Group 5 dataloggers have been installed in 18 wells. Data is scheduled to be uploaded in March.
- As per agreement with GEI Consultants Inc., loggers (there are a total of 4) installed in and around Cazenove St. continue to be uploaded once a week and sent to GEI Consultants Inc. The purpose is to observe the water levels in the area where the recharge systems have been installed.
- We have also uploaded data from our East Boston set of wells and will be reviewing those with the Technical Committee.

ISD Research

- We continue to look for any underpinned buildings. Data has been scarce up to this point.

**EXECUTIVE DIRECTOR'S REPORT**
**February 15, 2007**

1. **City-State Groundwater Working Group –** Ian Bowles, the new Secretary of Energy and Environmental Affairs, attended the January meeting of the Working Group and expressed the new administration's support for the group. Last week, Jim Hunt, Nancy Grilks, and I met with Phil Griffiths, the new undersecretary, who will be cochairing the Working Group to update him on how it has been working.
2. **Zoning –** There were public meetings in the North End and Fort Point Channel neighborhoods to discuss extending the GCOD. Because groundwater levels in these areas are generally high, there will be no recharge requirement and the zoning will only apply to those projects digging down below Elevation 7 Boston City Base or covering 50 square feet or more. The zoning is scheduled to go to the BRA Board and then the Zoning Commission in March.
3. **Public Improvement Commission –** The PIC adopted its rules for recharge systems extending under public ways this morning. The rules require that an applicant only use the public space if he cannot install a system on his own property and set requirements for avoiding interference with existing or potential infrastructure.
4. **BWSC –** The work on Back Street continues with continuing praise for the efforts of BWSC and its contractor. BWSC and DCR are studying how to utilize the recharge system being installed in Back Street as part of the recharge requirements for the Storrow Drive Underpass project.
5. **DCR –** I was elected chair of the traffic subcommittee of the Storrow Drive civic review process. The project is studying whether they can install the portion of the recharge system that will utilize BWSC's Back Street system before the rest of the project, now scheduled to begin construction no sooner than 2010.
6. **MBTA –** We continue to work with the T as part of their Action Team deciding how best to remedy the low groundwater problem in the St. Charles/Cazenove Street area. The recharge well at Berkeley Street appears to be having a positive impact on nearby observation wells; unfortunately, that has not yet been true for the recharge well on Cazenove Street. All parties are trying to figure out why. The Action Team is scheduled to recommend a long term solution to the MBTA's General manager at the end of March.
7. **MTA –** The MTA will be inspecting its drains in the area of Exeter Street and Huntington Avenue when the weather warms. There has been a drop in levels at that corner in recent months.
8. **MWRA –** The MWRA repairs completed in December have not yet led to an increase in groundwater levels in East Boston. We will continue to look for causes.
9. **East Boston –** Jim Lambrechts, Nancy Grilks, Christian Simonelli, and I did a walk through of the Paris Flats area of East Boston, where groundwater readings are particularly low, last week to gain a better appreciation for the area and for what steps might be the best to take to address groundwater related problems there. We will have a meeting tomorrow with Jim Hunt to discuss what we have found and how best to proceed. There will be a public meeting in East Boston early next month.
10. **Columbus Center –** Columbus Center will be starting some preliminary work along the Turnpike shortly. It will probably be March or April before they get to the point where they will install the wells along the Turnpike.
11. **The Clarendon –** We expect to receive shortly the report the project has commissioned from Haley and Aldrich about why groundwater levels are low in the area. Based on what I have heard informally from H&A, I think that the document will be very thorough.
12. **Website –** Traffic on the website picked up in late January and has been very high so far in February, with the highest number of average daily visits that we have ever seen.
13. **Potential Research Projects –** We have received a proposal from Northeastern University for a project to determine pile cut off elevations and possibly pile conditions without digging test pits. We have also received a proposal from Jim Lambrechts of Wentworth to develop an alternative method of repairing the foundations of lighter buildings that might have particular application in East Boston.

14. **Press –** There are new articles from the Boston Courant posted on our website. The article on extension of the GCOD into the North End from Sunday's Boston Globe will be posted shortly.

**Budget**

The work described above will be performed for the cost of Boston Groundwater Trust's one-year membership in Gordon-CenSSIS: $25,000. As a member of Gordon-CenSSIS, BGWT will not be charged the 57% overhead rate usually charged on research grants. Any intellectual property generated by this project will remain the property of Gordon-CenSSIS, with BGWT having non-exclusive royalty-free rights to use it.

This figure includes:

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| Salary support for: project management; and for ground penetrating radar experiment design, measurement and analysis by Prof. Carey Rappaport for 3 weeks. | $11,000 |
| Consulting services for experiment design, measurement and analysis by Dr. Robin Cleveland 35 hours at $200/hour | $7000 |
| Student salary support for data collection and processing for 2 months | $4000 |
| Experimental access to the indoor controlled SoilBED facility in Northeastern University's Snell building basement; all materials and equipment to model the problem geometry, and generate, measure, analyze, and interpret signals. | $3000 |