



MEMORANDUM

TO: Mayor Winstead and City Councilmembers

FROM: Jessica Simulcik Smith, City Clerk

DATE: May 20, 2014

RE: Documents received at 5/19/14 Council Meeting

CC: Debbie Tarry, City Manager
John Norris, Assistant City Manager

Attached hereto are documents received from the public at the May 19, 2014 City Council Business Meeting.

- 1) Letter from Diane Pottinger, North City Water District, dated May 19, 2014 (p. 1)
- 2) Public comment regarding Point Wells submitted by Tom Mailhot (p. 20)
- 3) Information submitted by Lance Young regarding SCL Franchise (p. 22)
- 4) Report on "Damage Due to Liquefaction During the 2011 Tohoku Earthquake" submitted by John Demur (p. 23)

NORTH CITY 
Water District

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Commissioners:

Ron Ricker

Charlotte Haines

Larry Schoonmaker

District Manager:

Diane Pottinger, P.E.

May 19, 2014

Ms. Debbie Tarry
City Manager
City of Shoreline
17500 Midvale Avenue N
Shoreline, WA 98133-4905

RE: City Council 5-19-2014 Agenda Item 8(b)
Utility Unification and Efficiency Study

Dear Ms. Tarry:

As an experienced consultant in the State of Washington since the mid-1980s, the manager of a water utility within the City of Shoreline, and a member of the City of Shoreline's SPU Steering Committee, I took some time to review the City's Utility Unification and Efficiency Study. I believe my background makes me uniquely qualified to offer comments on the report for consideration by the City Council and staff prior to accepting the report. This written letter is a support my public comments here tonight.

I am unclear why the City of Shoreline desires to go into the water and sewer utility business given the current state of affairs of utilities in our nation. In Portland Oregon, the voters are deciding tomorrow, May 20th, if a special purpose district should be formed to oversee the water and sewer utilities instead of the City of Portland run water and sewer utility. In Washington, there is a city with a water utility that is looking at how to form a special purpose district to service that area outside the city limit separate from the City, as it has become challenging. And yet here in Shoreline, Washington, the city council is considering unifying the utilities. Is that really what is best for the ratepayer?

I was surprised to see a fifth assumption added to this study since the draft was shared in April. We, along with the general public in Shoreline, have assumed the Cities of Shoreline and Seattle are close to announcing an agreement has been reached regarding the price of the SPU system. Adding this option to assume RWD in 2018 then North City Water District in 2028 but not acquiring SPU system again has me baffled. This study shows there is little to no savings for ratepayers to assume only the special purpose districts within the City. The only real savings occur if the City of Shoreline were to acquire the SPU system for \$26.6 million.

I believe that there are many flawed or faulty assumptions that are the foundation of this report. I have summarized my comments below and provide a detailed discussion on subsequent pages. The biggest misinformation is the statement that specific projected savings would occur in specific years. Joining the three utilities will take far more time than what the consultant is projecting and will require significant patience with some savings taking several years to be realized.

1. City Water Utility Assumptions

- Wholesale costs are too low.
- Water sales compared to wholesale water costs should be parallel, not divergent.
- Staff size of the potential city water utility is different in three separate reports
- North City Water District assumption (take over) of staff, assets and debt is incorrect.
- In Options 3 and 5, the projection of the City's assumption of 77% of the NCWD expenses is not correct.
- New Option 5 to assume (take over) North City Water District without acquiring SPU but assuming (taking over) Ronald Wastewater District appears to not be cost effective.

2. City Sewer Utility Assumptions

- Elimination of existing contracting services is not logical.
- Shared services allocation back to the sewer utility is not specifically identified.

3. General City Overhead Assumptions

- The shared administration costs incurred by the other city services – parks, neighborhoods, surface water management, roads etc. are not included.

4. Water, Sewer and General Capital Funds Assumptions

- City's Sewer Utility will reduce reinvestment into the sewer system by half compared to Ronald Wastewater District.
- Debt payments are not sufficient to acquire the SPU system. As the final purchase price has yet to be established, this amount could be significantly higher.
- The added debt service coverage component is not included in this report.
- North City Water District's capital assets are assumed but not all the debt (NCWD's recent property purchase is not included in this analysis).
- The beginning balances of the different options are incorrect.
- The operating capital and emergency cash reserves for the SPU utility are incorrect in 2020.
- Ronald Wastewater District is shown to amortize the cost savings from the surplus of the existing buildings over 20 years while at the same time the land and building payments for purchasing and developing Brugger's Bog are not included.

Below is a more detailed list of my comments and the data sources I have about the draft report.

1. City Water Utility Assumptions

- a. **Wholesale costs are too low.** The North City Water District's wholesale water cost is projected to be \$1.1 million in 2020 (*Appendix E, page 8b-81*). The cost was \$1.5 million in 2013 and is expected to increase over time (*Appendix D, page 8b-75 and comparison of prior year audit, Operating Expenses, Water purchased for resale*). In NCWD's 60 year contract with Seattle Public Utilities, all the utilities have agreed to pay SPU's Rate of Return on Investment, which does not allow wholesale costs to reduce. The report's assumption of wholesale expenses is not large enough for the baseline assumption [*Appendix E, page 8b-82*] even if the rates were to remain equal (assuming zero growth between 2014 and 2020) and assuming there is no increase in inflation. This gives the appearance of unlikely large projected savings for all options.
- b. **Water sales compared to wholesale water costs should be parallel, not divergent.** The rate revenues should increase similar to increasing wholesale expenses. However, the report shows that it is opposite - as the rate revenues increase, the wholesale expenses are projected to decrease. If growth occurs in Shoreline, the water utility would see an increase in water sales and wholesale water costs. This report says that as water sales increase, wholesale water costs will decrease which is not true. [*Appendix E, pages 8b-77 and -78 for the SPU scenarios as well as pages 8b-81 and -82 rate revenues compared to the wholesale water supply/treatment lines*]. Again, this projection of wholesale water costs projects savings for Options 2, 4 and 5 that are very unlikely to happen [*Appendix F, pages 8b-88 through 8b-95*]. Options 1a and 3 are not included in this appendix so I can't comment on these assumptions.
- c. **Staff size of the potential city water utility is different in three separate city reports.** In the 2012 SPU study, EES assumed 21 people to operate the SPU water utility [*Table 4, Engineering Review, page 29*]. The City of Shoreline staff then did an Efficiency Study and further reduced that number to 17.25 people [*Table 5, Operational Efficiency Report, page 8*]. Appendix C of this new report shows that, after the SPU acquisition, there will be 23 people in the city water department [*Option 1a, Public Works Department Proposed Organizational Change, page 8b-61*]. It is not clear as well as confusing as to how the consultant determined the utility staffing needs as well as the Shared Services Department staffing needs, of the new water utility.
- d. **The City's assumption (take over) of North City Water District staff, assets and debt is incorrect.** Option 3 of the report "assumes" or projects that the NCWD's staff will not be assumed (taken over) nor the office buildings (*page 8b-32*). According to RCW 35.13A.090, the City's assumption (take over) of NCWD will require that the City offer employment to all NCWD's employees if the City of Shoreline assumes all of the District, and if there is a partial assumption, the City must offer employment to any employees not retained by the remaining district. The City will also have to take all the debt and assets in a full assumption, but in a partial assumption, the City will need to pay for proportional debt but will not receive any liquid assets (cash and investments).

- e. **The report projects that the City of Shoreline would assume (take over) 77% of the district and the remaining 23% taken over by the City of Lake Forest Park is not correct.** The water sales within a water utility varies from year to year, or even a 2 year average, so it is not appropriate to divide a utility based on water use (*page 8b-33*). A more standard methodology is to consider the number of miles of pipes or the age of the system or the labor hours spent maintaining the system.
- f. **The new Option 5 to assume (take over) North City Water District without acquiring SPU but assuming (taking over) Ronald Wastewater District is not cost effective.** Table 32 [*page 8b-53*] indicates the expected savings of acquiring both special purpose districts but not the SPU system appears to have only a 1.2% savings in 2020. Given the number of incorrect assumptions in the report, it is likely going to cost ratepayers and the citizens of Shoreline, more than if both special purpose districts continue to operate separate from the City unless the City of Shoreline were to acquire the SPU system for \$26.6 million. Since all of the employees will need to be offered employment, the main reason at least in the initial years will be the added city-wide indirect cost allocation. Perhaps some savings might be realized as long as the overhead cost allocations is cost neutral, e.g, offset by office staff salary and benefits being absorbed into general fund departments. However, that information was not included in the report presented here tonight.

2. City Sewer Utility Assumptions

- a. **Elimination of existing contracting services is not logical.** The text described how 100% of the cost of the buildings will be eliminated as well as all legal and financial costs [*page 8b-36*]. Given that the City does not have experience in operating a sewer utility, most likely there will be a time lag that the City will continue to contract for these additional services or there will be a need to expand legal and financial staff.
- b. **Legal work will have to be done by an outside consultant or additional staff.** The report indicates that the City can absorb the administrative overhead with the existing staff. For the City's 2013 Budget, the City used MaxCars – Cost Allocation Module by Maximus, to allocate costs to the City Departments (*separate document prepared by the City of Shoreline and attached*). From this evaluation, the City attorney's time was spent 98% on general city services and 2% to the surface water utility. It is not apparent as to how the city's existing legal department will be able to handle the additional, significant legal workload that in my experience will come from a water and/or sewer utility (to deal with developer's agreements, capital construction, consulting contracts, liens and claims) without adding any staff or outside assistance.
- c. **Financial modeling will have to be done by an outside consultant or additional staff.** We recognize that while the City Manager has a financial background, it will be more appropriate to use an outside consultant that specialize in utility

rate work and financial planning, much like they did with the SPU study. The City staff will need outside help in establishing rates so including time for a financial consultant would be appropriate. The majority of cities the size of Shoreline retain consultants to do this type of specialized work. This is true throughout the country.

- d. **Shared services allocation back to the sewer utility is not identified.** Adding a sewer utility will have an impact on the city's budget. The city has used MaxCars to allocate costs to the various city departments in the 2013 budget (see attached). The tables in Appendix E should have a line item to show the additions to the city's general fund to see how the General Fund will be first impacted by the acquisition of utilities before reallocating appropriate costs to the new utilities. A copy of the MaxCars – Cost Allocation Module should be generated for each of the study years and a copy of which should also be included in the appendix (Attachment 1). The City should calculate the costs for all the "Shared Services" of the city, especially in light of the 2011 Washington State Audit report overhead allocation [*Local Government Allocating Overhead Costs, Washington State Audit report 1006136*]. This information should be provided in an appendix to validate the values shown on lines "Amount of Shared Services Allocation" in Appendix C.

3. General City Overhead

- a. **Shared services allocation on other city services such as parks, neighborhoods, surface water management, roads is not included.** The graphs in Appendix B show there will be an increase in the staffing levels in both the City's Public Works Department and Administrative Services Department [*Public Works Department – Proposed Organizational Chart page 8b-61*]. The report states there will be a projected savings to the City when new utilities transfer into the City of Shoreline because there will be less staff assigned to the utility compared to having all of Ronald Wastewater District staff being paid for by the sewer rates. The flaw in that assumption is that these people are not all needed, and that also should apply to existing City staff who already have full plates. Provide an example of the MaxCars allocation in the appendix, as discussed in the previous comment, because there will be an increase in city wide overhead costs because of the additional people being added to the overall city overhead. It is very likely that these departments will all be impacted by having higher administrative overhead from the additional personnel associated with the potential sewer and water utilities. An update of the Maximum cost allocation software database should be made for each option.

4. Sewer, Water and City Capital Funds

- a. **City's Sewer Utility will reduce reinvestment into the sewer system by half compared to Ronald Sewer District.** First, the Capital Contributions, projected non-operating revenue) of approximately \$500,000 for Ronald Wastewater District are too high compared to historical actual contributions (*Appendix D,*

2014 Adopted Budget for RWD, page 8b-74). In communications with the General Manager at RWD and a review of historical audits, this line item is generally less than \$100,000 annually. Further, in Appendix E, it appears the water utility in the SPU area will be expecting facility charges approximately \$60,000, significantly less than what is expected for the sewer utility. The two utilities should show a similar growth pattern and not be different by an order of magnitude. Not only is the assumed capital contribution too high, even if it is \$500,000, the annual capital improvement program is estimated to be \$1.1 million. Thus, it appears that the City's potential sewer utility will only be able to do ½ of what Ronald Wastewater District is currently able to do. Those capital expenditures should continue to occur and the \$500,000 annual revenue assumption be reduced to \$100,000 or less.

- b. **Debt payments in this study are not sufficient to acquire the SPU system.** The borrowing amount included in the SPU analysis that was done in 2012 showed that an annual debt payment of approximately \$3 million which remained constant throughout the study [*Appendix A of the SPU Financial Analyses (2012), Updated Case A page 40 line "Total Initial Debt" compared to Appendix E, Option 1a, line item Debt payments – Initial, page 8b-77*]. Yet, in this Unification study, the debt payment begins at \$2.3 million and decreases to less than \$1 million in 2040. This does not make sense to me; the debt service does not decline. Given the final purchase price has yet to be agreed upon with the City of Seattle, this amount could be significantly different, but assuming that revenue bonds will be issued, annual level debt service should be assumed, not declining debt service
- c. **The added debt service coverage component is not included in this report.** In this market, revenue bond covenants could require that net operating income available for debt service should be 1.7 times or higher than the annual debt service. A 1.5 coverage ratio for the SPU system [Appendix E, page 8b-77] is usually the very minimum these days for an existing utility with a proven debt service track record.
- d. **North City Water District's capital assets are assumed but not all the debt (our recent property purchase is not included in this analysis).** Appendix D [page 8b-75] shows the capital expenses of \$850,813 in 2013 for North City Water District. This is our annual debt service, a capital related expense and is not discretionary. On page 8b-27, it shows a different amount for debt of \$442,939. These need to be consistent. The Capital Improvement Program that was used in the latest Comprehensive Plan Update does not include public private partnerships or drinking water state revolving fund loan payments and is incomplete. The study includes Net Book Value of the RWD facilities and the budgeted amount for the District facilities in the comprehensive plan. Using two different sources has identified incorrect costs. It does not include the purchase of our new NW Church property at 15555 15th Ave NE. An assumption was made that each of

the properties would be able to be sold for Net Book Value and the estimates in the comprehensive plan. This is an aggressive estimate.

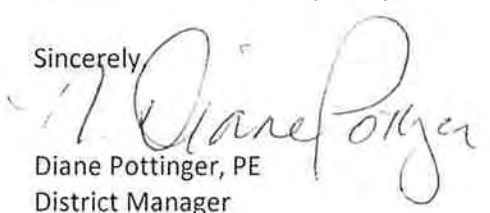
- e. **The beginning balances of different options are incorrect.** Assuming the utilities remain separately, Option 1 on page 8b-85, shows a beginning balance of \$6,029,999. Assuming the three utilities are combined under the city, the city sewer and water utility appear to start out with \$9,056,893 for 2020 [page 8a-93, Reserve Fund Balance]. This does not make sense to have a \$3,000,000 difference for the starting year. Again, for the North City Water District options, the City should understand that if it is unable to assume 100% of the utility, then it will not receive much cash or cash equivalent funds from the remaining District. Option 5 indicates that there will be a reserve fund balance of \$3,265,269 in 2020 [page 8b-94] but that differs from the RWD Standalone amount of \$3,000,000 [page 8b-79]. It is not clear where the city run sewer utility will gain additional \$4,000,000 revenue and acquire a \$443,939 annual debt payment compared to the Ronald Standalone option. Both revenue and expense options should be identical until 2028.
- f. **Operating capital and emergency cash reserves for the SPU utility in 2020 are incorrect.** Option 1b, the reserve fund balance in 2020 is \$3,705,811 [page 8b-88]. Appendix F, Option 2, when the city assumes Ronald and SPU, the starting balance is, \$4,411,315 in 2020 [page 8b-90]. The sources for the starting fund balances in 2020 for the SPU area are not identified. It is unclear where the City will get an additional \$1.4 million when they assume SPU in 2020.
- g. **Ronald Wastewater District is shown to amortize the cost of the existing buildings over 20 years while at the same time the land and building payments for purchasing and developing Brugger's Bog are not included.** The report shows that the District's building is assumed to be sold for \$2.3 million and the revenue "could offset other capital costs required for the new water/wastewater utility" [page 8b-36]. When NCWD considered relocating to the Shoreline City Hall, we would have had an estimated capital expense of \$500,000 to prepare the facility for our utility. The SPU study indicated the shop facilities would be \$714,150 capital cost without land and site development [Table 11, page 49, SPU Engineering Report]. The location of the additional funds have not been identified ($\$2,300,000 - \$500,000 - \$714,150 = \$1,085,850$)? Brugger's Bog will require clean up as the site has contamination on it, there are issues with stormwater associated with the development of the site, the decant facility will have to be upgraded and there are substantial frontage improvements associated with redevelopment. Yet, the City has been working with Tom Beckwith on the site development since 2012. A list of the equipment and vehicles are attached to show you the level of detail the staff have been working on with Tom. The city's 2014-2019 adopted capital budget does not show any structures being built during the next 6 years for the parks, public works and surface water utility budgets. Therefore, we are assuming the Ronald Facility will be sold prior to 2020 and a new structure being constructed in 2020. The annual debt payment for Brugger's Bog is approximately \$260,000 for 20 years (City

Ordinance 670). The annual loan payments or a portion of their payments, are not included in this study. The city's 2014-2019 budget shows the surface water utility paying the full annual payment of \$260,000 until 2019 at which time a \$130,000 payment (*page 304 current city budget*) will be made from the storm water utility. It is unclear what department will be paying the second half of the bond payment for the Brugger's Bog facility in 2019. A portion of improvements and related on-going utility and maintenance costs at this site as well as improves required at the city hall for the additional administrative staff, must be included in this unification study. The sale of the existing Ronald facility is proposed to be \$115,000 annual projected savings which should be compared to these likely incremental costs allocable to the sewer and water utilities. It is not clear what happens in Option 5 if the SPU system is not acquired as there will not be any need to construct any building for water utilities until the attempt to assume (take over) NCWD.

To summarize, there has been a significant overstatement of projected savings calculations in the city's Utility Unification and Utility Report. This will be misleading to the public in terms of what they might expect as near and long-term cost benefits. The use of a 20 year savings forecast will confuse members of the public as they do not have the knowledge or expertise to operate a public utility. In time there may be real annual savings as employees retire or leave and as real cost savings from shared non-labor assets occur. I recommend the City hold off on accepting the study here tonight and allow staff and the consultant to review and correct the assumptions in the report then come back to the City council in 4-6 weeks with an updated report. By then, we are expecting the Cities of Seattle and Shoreline will have finalized their agreement to purchase the water system in Shoreline and corrected numbers can be used in this analysis and we can also provide the city with 2013 financial information for North City Water District. Then, the reader, city council and the ratepayers will have a better handle on the true impacts of a city run utility versus the current situation.

As I stated to the City Manager in a letter in January and last month during Public Comment at the April 21st, 2014 City Council meeting, I or anyone on the NCWD staff would be happy to provide the City a copy of the updated NCWD 2014 financials in June to show how we operate our water utility and provide the City an opportunity to correct their assumptions.

Sincerely,


Diane Pottinger, PE
District Manager

Attachments

cc: Board of Commissioners
Andrew Maron, District Attorney

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MAXIMUS
Allocated Costs By Department

Central Service Departments	Neighborhoods	Animal Control	Citywide - Non Departmental	Customer Response Team	Prosecuting Attorney	Police Administration	Police Community Storefronts
City Council	2,260	9,041	4,521	0	0	2,260	0
City Manager's Office	6,373	12,249	8,521	13,799	879	7,215	2,006
City Clerks Office	2,383	9,534	4,767	0	0	2,383	0
Communications	1,183	4,731	2,366	0	0	1,183	0
Government Relations	1,589	6,357	3,179	0	0	1,589	0
City Attorney	6,603	6,603	0	0	13,206	6,603	0
Budget and Financial	3,054	3,156	3,189	9,398	591	3,581	1,348
Web Development	92	436	440	245	82	494	186
IT Strategic Plan	3,032	0	0	9,682	0	0	0
Financial Operations	4,009	4,164	4,207	12,339	780	4,723	1,778
Financial Purchasing	1,051	4,979	5,031	2,800	932	5,649	2,127
IT - GIS	0	0	0	0	0	0	0
IT - Telephone	2,077	0	0	6,630	0	0	0
City Wide Office Equipment	436	0	0	1,393	0	0	0
Finance Director	2,411	2,511	2,537	7,419	470	2,849	1,073
IT Ops & Security	7,473	0	0	23,859	0	0	0
Human Resources	5,039	0	0	16,089	0	0	0
Grants Development	0	0	0	0	0	6,049	0
PW Facilities	3,802	0	83,959	19,937	0	0	0
Total Allocated	52,867	63,761	122,717	123,590	16,940	44,578	8,518
Roll Forward	0	0	0	0	0	0	0
Cost With Roll Forward	52,867	63,761	122,717	123,590	16,940	44,578	8,518
Adjustments	0	0	0	0	0	0	0
Proposed Costs	52,867	63,761	122,717	123,590	16,940	44,578	8,518



MAXIMUS
Allocated Costs By Department

2013 Budget Plan

2013

Version 1.0012-1

Detail

Central Service Departments	Police Investigation	Police Patrol	Police Special Support	Police Traffic Enforcement	School Resource Officer	Emergency Management Planning	Police Investigation - Street Crimes
City Council	0	0	0	0	0	9,041	0
City Manager's Office	5,099	28,542	7,712	4,914	998	12,421	4,702
City Clerks Office	0	0	0	0	0	9,534	0
Communications	0	0	0	0	0	4,731	0
Government Relations	0	0	0	0	0	6,357	0
City Attorney	0	0	0	0	0	0	0
Budget and Financial	3,427	19,187	5,184	3,303	671	3,310	3,161
Web Development	473	2,648	716	456	93	128	436
IT Strategic Plan	0	0	0	0	0	3,032	0
Financial Operations	4,522	25,311	6,838	4,357	885	4,348	4,170
Financial Purchasing	5,407	30,267	8,177	5,210	1,059	1,454	4,987
IT - GIS	0	0	0	0	0	6,229	0
IT - Telephone	0	0	0	0	0	2,077	0
City Wide Office Equipment	0	0	0	0	0	436	0
Finance Director	2,727	15,266	4,124	2,628	534	2,614	2,515
IT Ops & Security	0	0	0	0	0	7,473	0
Human Resources	0	0	0	0	0	5,039	0
Grants Development	0	0	0	0	0	0	0
PW Facilities	0	0	0	0	0	11,406	0
Total Allocated	21,655	121,221	32,751	20,868	4,240	89,630	19,971
Roll Forward	0	0	0	0	0	0	0
Cost With Roll Forward	21,655	121,221	32,751	20,868	4,240	89,630	19,971
Adjustments	0	0	0	0	0	0	0
Proposed Costs	21,655	121,221	32,751	20,868	4,240	89,630	19,971



MAXIMUS
Allocated Costs By Department

Central Service Departments	Criminal Justice - Jail Services	Criminal Justice - District Court	Criminal Justice - Public Defense	Human Services	Parks Administration	Parks Operations	Parks Aquatics
City Council	4,521	0	2,260	15,821	22,603	11,301	0
City Manager's Office	9,326	3,754	3,162	21,037	30,944	34,623	20,413
City Clerks Office	4,767	0	2,383	16,684	23,835	11,917	0
Communications	2,366	0	1,183	8,279	11,828	5,913	0
Government Relations	3,179	0	1,589	11,124	15,893	7,946	0
City Attorney	0	6,603	0	6,603	19,809	0	0
Budget and Financial	3,730	2,523	856	5,299	8,209	17,118	13,890
Web Development	515	348	118	355	241	705	463
IT Strategic Plan	0	0	0	3,455	8,215	15,257	13,378
Financial Operations	4,921	3,328	1,129	6,968	10,780	22,492	18,244
Financial Purchasing	5,884	3,980	1,351	4,066	2,747	8,056	5,296
IT - GIS	0	0	0	0	9,342	3,114	0
IT - Telephone	0	0	0	2,366	5,625	10,447	9,162
City Wide Office Equipment	0	0	0	497	1,182	2,196	1,926
Finance Director	2,968	2,007	681	4,193	6,482	13,529	10,972
IT Ops & Security	0	0	0	8,514	20,244	37,596	32,969
Human Resources	0	0	0	5,741	13,651	25,353	22,233
Grants Development	0	0	0	6,049	3,024	0	0
PW Facilities	0	0	0	8,708	10,697	18,715	4,866
Total Allocated	42,177	22,543	14,712	135,759	225,351	246,278	153,812
Roll Forward	0	0	0	0	0	0	0
Cost With Roll Forward	42,177	22,543	14,712	135,759	225,351	246,278	153,812
Adjustments	0	0	0	0	0	0	0
Proposed Costs	42,177	22,543	14,712	135,759	225,351	246,278	153,812



MAXIMUS
Allocated Costs By Department

2013 Budget Plan

2013

Version 1.0012-1

Detail

Central Service Departments	Park Facilities	Parks General Recreation	Parks Cultural Services	Parks Teen Program	Economic Development	PADS City Planning	PADS Building & Engineering
City Council	4,521	0	6,780	0	4,521	40,685	2,260
City Manager's Office	8,780	17,015	8,930	13,685	7,707	50,140	17,724
City Clerks Office	4,767	0	7,150	0	4,767	42,902	2,383
Communications	2,366	0	3,549	0	2,366	21,289	1,183
Government Relations	3,179	0	4,767	0	3,179	28,606	1,589
City Attorney	0	0	0	0	0	59,422	19,809
Budget and Financial	3,407	11,564	2,215	9,321	2,672	10,996	10,785
Web Development	81	506	128	241	114	300	295
IT Strategic Plan	3,579	10,034	1,643	9,624	2,347	11,202	10,984
Financial Operations	4,473	15,194	2,913	12,238	3,510	14,437	14,160
Financial Purchasing	930	5,780	1,453	2,751	1,299	3,431	3,368
IT - GIS	0	0	0	0	0	18,685	0
IT - Telephone	2,451	6,871	1,125	6,589	1,607	7,671	7,522
City Wide Office Equipment	515	1,444	237	1,385	338	1,612	1,580
Finance Director	2,689	9,141	1,752	7,358	2,111	8,681	8,515
IT Ops & Security	8,821	24,727	4,049	23,715	5,784	27,607	27,069
Human Resources	5,948	16,674	2,730	15,991	3,900	18,616	18,254
Grants Development	0	0	0	0	0	0	0
PW Facilities	4,866	4,866	3,743	22,596	4,472	30,693	32,131
Total Allocated	61,373	123,816	53,164	125,494	50,694	396,975	179,611
Roll Forward	0	0	0	0	0	0	0
Cost With Roll Forward	61,373	123,816	53,164	125,494	50,694	396,975	179,611
Adjustments	0	0	0	0	0	0	0
Proposed Costs	61,373	123,816	53,164	125,494	50,694	396,975	179,611



MAXIMUS
Allocated Costs By Department

Central Service Departments	PADS Code Enforcement	Permit Services	PADS Current Planning	PADS Administrative Services	SWM Management	Street R-O-W	PW Administration
City Council	0	0	9,041	9,041	18,082	2,260	15,821
City Manager's Office	7,605	23,462	19,544	13,989	30,970	8,029	17,648
City Clerks Office	0	0	9,534	9,534	19,068	2,383	16,684
Communications	0	0	4,731	4,731	9,462	1,183	8,279
Government Relations	0	0	6,357	6,357	12,714	1,589	11,124
City Attorney	33,015	6,603	6,603	0	13,206	13,206	6,603
Budget and Financial	5,179	15,982	8,165	4,382	10,784	4,183	3,011
Web Development	136	382	222	113	443	105	122
IT Strategic Plan	5,328	16,782	8,332	4,523	9,624	4,342	2,699
Financial Operations	6,800	20,984	10,721	5,754	14,168	5,491	3,956
Financial Purchasing	1,554	4,370	2,531	1,297	5,059	1,204	1,397
IT - GIS	0	3,114	0	0	65,400	0	0
IT - Telephone	3,649	11,492	5,706	3,097	6,589	2,974	1,848
City Wide Office Equipment	766	2,415	1,199	651	1,385	625	389
Finance Director	4,089	12,617	6,447	3,460	8,523	3,301	2,380
IT Ops & Security	13,130	41,356	20,534	11,146	23,715	10,701	6,652
Human Resources	8,853	27,888	13,846	7,516	15,991	7,216	4,486
Grants Development	0	0	0	0	0	0	0
PW Facilities	4,886	32,131	0	11,919	4,669	13,790	10,362
Total Allocated	94,990	219,578	133,513	97,510	269,852	82,582	113,461
Roll Forward	0	0	0	0	0	0	0
Cost With Roll Forward	94,990	219,578	133,513	97,510	269,852	82,582	113,461
Adjustments	0	0	0	0	0	0	0
Proposed Costs	94,990	219,578	133,513	97,510	269,852	82,582	113,461



MAXIMUS
Allocated Costs By Department

Central Service Departments	Street Operations	Street Traffic Services	SWM - Roads	Environmental Services	General Capital	General Captial Eng	Roads Capital
City Council	13,562	11,301	0	0	11,301	2,260	13,562
City Manager's Office	42,078	15,198	14,960	5,664	25,788	4,480	203,468
City Clerks Office	14,301	11,917	0	0	11,917	2,383	14,301
Communications	7,096	5,913	0	0	5,913	1,183	7,096
Government Relations	9,536	7,946	0	0	7,946	1,589	9,536
City Attorney	0	0	0	6,603	0	0	52,823
Budget and Financial	20,903	3,914	10,179	3,848	11,071	1,765	129,410
Web Development	868	157	349	187	816	52	15,684
IT Strategic Plan	18,566	3,520	9,717	3,168	6,549	1,760	20,001
Financial Operations	27,464	5,142	13,369	5,056	14,566	2,316	170,605
Financial Purchasing	9,916	1,801	3,988	2,134	9,331	597	179,310
IT - GIS	34,256	0	0	0	3,114	3,114	3,114
IT - Telephone	12,713	2,411	6,654	2,170	4,485	1,206	13,696
City Wide Office Equipment	2,672	506	1,398	456	943	253	2,877
Finance Director	16,521	3,092	8,041	3,042	8,770	1,394	102,854
IT Ops & Security	45,752	8,676	23,946	7,808	16,137	4,338	49,286
Human Resources	30,852	5,850	16,147	5,265	10,882	2,925	33,235
Grants Development	0	0	0	0	3,024	0	24,190
PW Facilities	9,575	11,820	9,575	7,604	12,706	4,905	51,102
Total Allocated	316,631	99,164	118,323	53,005	165,259	36,520	1,096,150
Roll Forward	0	0	0	0	0	0	0
Cost With Roll Forward	316,631	99,164	118,323	53,005	165,259	36,520	1,096,150
Adjustments	0	0	0	0	0	0	0
Proposed Costs	316,631	99,164	118,323	53,005	165,259	36,520	1,096,150



MAXIMUS
Allocated Costs By Department

Central Service Departments	Roads Capital Eng	SWM Capital	Facility Major Maintenance	SubTotal	Direct Billed	Unallocated	Total
City Council	0	2,260	6,780	257,667	0	0	257,667
City Manager's Office	5,358	18,297	6,587	825,795	0	0	825,795
City Clerks Office	0	2,383	7,150	271,711	0	0	271,711
Communications	0	1,183	3,549	134,835	0	0	134,835
Government Relations	0	1,589	4,767	181,172	0	0	181,172
City Attorney	0	0	0	283,923	0	0	283,923
Budget and Financial	3,648	11,107	619	413,295	0	0	413,295
Web Development	98	865	86	32,020	0	0	32,020
IT Strategic Plan	3,732	6,150	0	230,257	0	0	230,257
Financial Operations	4,792	14,616	817	543,835	0	0	543,835
Financial Purchasing	1,121	9,885	976	365,993	0	0	365,993
IT - GIS	3,114	3,114	0	155,710	0	0	155,710
IT - Telephone	2,555	4,211	0	157,676	0	0	157,676
City Wide Office Equipment	537	885	0	33,134	0	0	33,134
Finance Director	2,880	8,801	493	327,462	0	0	327,462
IT Ops & Security	9,197	15,154	0	567,428	0	0	567,428
Human Resources	6,201	10,219	0	382,630	0	0	382,630
Grants Development	0	6,049	0	48,385	0	0	48,385
PW Facilities	11,486	21,532	0	483,519	0	0	483,519
Total Allocated	54,719	138,300	31,824	5,696,447	0	0	5,696,447
Roll Forward	0	0	0	0	0	0	0
Cost With Roll Forward	54,719	138,300	31,824	5,696,447	0	0	5,696,447
Adjustments	0	0	0	0	0	0	0
Proposed Costs	54,719	138,300	31,824	5,696,447	0	0	5,696,447



Vehicle		Stall/bay size				Building environment				Comments	
#	description	200	300	360	600	heat	enclose	cover	open		
126	186 Ford Ranger									1	
127	187 Ford Escape									1	
128	249 Ford/Gruman hi-cube van									1	
129	277 Ford F150 pickup truck									1	
130	280 Ingersoll Rand air compressor									1	
131	392 Peterbuilt Vactor									1	
132	395 trailer mount diesel rodder									1	
Water SPU		0	0	0	0	0	0	0	0	19	
133	Case 580 backhoe									1	stored on trailer
134	Case 580 backhoe									1	stored on trailer
135	backhoe trailer									1	
136	backhoe trailer									1	
137	shoring box									1	stored on trailer
138	shoring box									1	stored on trailer
139	shoring box trailer									1	
140	shoring box trailer									1	
141	6 yard dump truck									1	
142	6 yard dump truck									1	
143	boom truck									1	
144	Service van 6200 lb									1	
145	Service van 6200 lb									1	
146	Service van 6200 lb									1	
147	F250 pickup									1	
148	F250 pickup									1	
149	F250 pickup									1	
150	F250 pickup									1	
151	F250 pickup									1	
Total		12	6	9	0	1	14	29	38		

The Point Wells Traffic Corridor Study is not on the agenda tonight but I want to express some thoughts about how you as City Council members should be thinking about the results of the study as they become available.

The one result most people are thinking about is whether the study will show that Shoreline's road system can handle the projected 11,000 + additional daily trips generated by development at Point Wells without making our level of service sink to an unacceptable level.

That's an important thing to understand but it should not be the only question you want answered by the study. To represent the citizens of our city you should demand the study answer a number of other equally important questions:

- Will Richmond Beach and Innes Arden still be walkable neighborhoods? Will people still want to walk to the library, the Community Park, Saltwater Park, the Innes Arden Clubhouse, or will the increased traffic scare them into either not going out or adding to the traffic by driving their cars to these destinations?
- Richmond Beach Road and 3rd NW is the most dangerous intersection in Shoreline. Will this intersection be less dangerous or more dangerous?
- Will there be grid lock on Richmond Beach Road between 8th NW and 3rd NW causing businesses to lose customers who decide it's easier to drive to the QFC or Starbucks in Edmonds?
- What other arterials will receive more traffic as people avoid Richmond Beach Road?
How will that increased traffic on these arterials affect pedestrian safety and traffic safety

at intersections that will be much busier than before? Will one of these intersections replace 3rd NW as the most dangerous intersection in Shoreline?

- Will the morning backup at 175th and I-5 extend west beyond Meridian? How does that affect safety for students at Meridian Park Elementary?
- Will the evening backup at 175th and I-5 extend south on I-5? Does that cause more collisions on I-5?

We congratulate the city on its effort to have a public process to identify mitigation issues but as citizens we can't anticipate all the possible mitigation measures needed until we see the results of the traffic study.

- Will we need sidewalks on 15th NW for kids walking to Syre?
- Will we need a better sidewalk on 3rd NW for kids walking to Einstein?
- Will we need sidewalks on Fremont for kids walking to Shorewood?
- Will cut through traffic turn neighborhood streets into arterials that need sidewalks?

We can't say until we see what the traffic study predicts will happen with the increased number of daily trips. We need to see the results of the study and then have an opportunity to suggest additional measures based on the predicted future traffic patterns.

The answers to these questions are what will determine what it will be like to live in Shoreline in 20 years and whether the Point Wells development is considered a success – it's not whether our streets can handle the 11,587 additional daily trips allowed for in the MOU.

Please demand answers and send the study back for more work if it can't provide them.

Thank you.

City of Shoreline Municipal Power Franchise Agreement,

Vegetation Management Clearance Distances Section 6.9.4.

6.9.4.

VM Clearance Distances. Clearance Distances for VM between SCL's electrical facilities and the surrounding vegetation, INCLUDING PRUNING OF EXISTING TREES, AND REPLACEMENT TREE MATURE HEIGHTS, shall align with SCL's Distribution and Transmission Tree Trimming Construction Guidelines (standard number D9-80) and shall be in accordance with clearance criteria found in WAC 296-24-960 and RCW 64.12.035. Clearance distances for distribution (lines rated 50kV or below) and transmission (lines rated 51kV or above) power lines shall conform with utility, ISA and SCL best practices. SCL standard number D9-80 is attached to this Agreement as Exhibit A, but may be subject to change with SCL's regular review of standards and practices.



DAMAGE DUE TO LIQUEFACTION DURING THE 2011 TOHOKU EARTHQUAKE

Shoichi Nakai¹ and Toru Sekiguchi²

SUMMARY

The 2011 Tohoku earthquake caused a devastating damage to the eastern part of Japan. The Tokyo metropolitan area that is located more than 300 km away from its hypocenter suffered from strong ground shaking followed by extensive liquefaction damage along the coastal area. The authors have conducted an exhaustive investigation of damage due to liquefaction in Chiba city immediately after the quake. The resulted damage map has shown an extreme maldistribution. This article describes some of the liquefaction damage and then examines the damage distribution by looking into boring logs, aerial photography and microtremor measurement results. It was found from the study that the extreme maldistribution of liquefaction damage is mainly due to the very complex and varying soil profiles of the reclaimed ground along the coast.

INTRODUCTION

The 2011 Tohoku earthquake (M_w 9.0) that struck the eastern part of Japan on March 11 caused a devastating damage to this area resulting in about 20,000 fatalities. The Tokyo metropolitan area, that is located more than 300 km away from its hypocenter, was no exception. The areas along the Tokyo bay and the Tone river valley have suffered from not only strong shaking but also extensive liquefaction damage due to the main and after shocks (Figure 1). The authors have carried out an exhaustive survey on the damage due to liquefaction in Mihama ward of Chiba city, that is located about 50 km east of Tokyo, immediately after the quake for about ten days. The survey was conducted for all the public roads and most of the parks as well as some of the private properties. This survey revealed that due to liquefaction a huge amount of sand boiling, ground deformation and inclination and subsidence of the buildings were found in almost all areas of Mihama ward, which is entirely a reclaimed ground. Photograph 1 shows some of the typical damage found in this area.

Although small sand boiling was found on the main road, narrower streets inside a city block were almost completely covered with sand boiling as thick as 45 cm. One of the interesting phenomena, however, is that there are some no-damage blocks right next to heavily damaged blocks, in other

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words, the liquefaction damage map has shown an extreme maldistribution. The objective of this study is to evaluate the effects of the local site conditions on the liquefaction damage distribution in Mihama ward of Chiba city due to the 2011 Tohoku earthquake based on the damage survey immediately after the earthquake, the existing soil investigation data and the soil exploration conducted after the quake [1].



Figure 1 Target area



(a) Residential area



(b) Business/industrial area

Photo 1 Typical liquefaction damage in Mihama ward, Chiba city

LIQUEFACTION DAMAGE DISTRIBUTION

Figure 2 shows the map of Mihama ward with the constitution of districts. Mihama ward is located in the western part of Chiba city along the coast of Tokyo Bay and consists entirely of the reclaimed ground. It was reclaimed by dredge soil consisting of sand or sandy silt taken from the sea bed of Tokyo Bay. Reclamation was carried out from the southern part of the ward toward north from 1960s until mid-1980s.

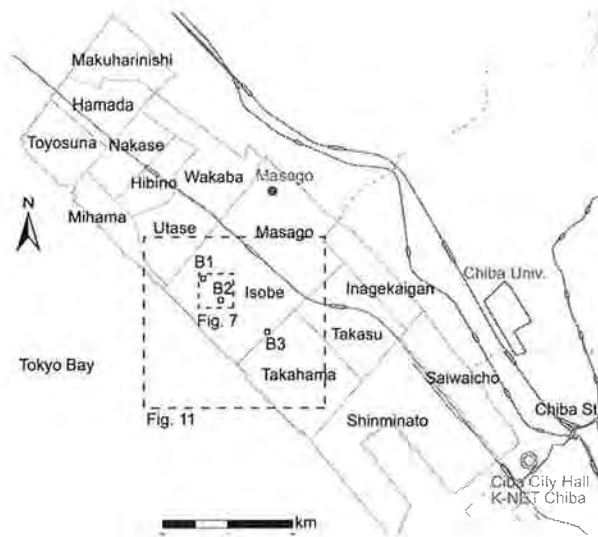


Figure 2 Map of Mihama ward

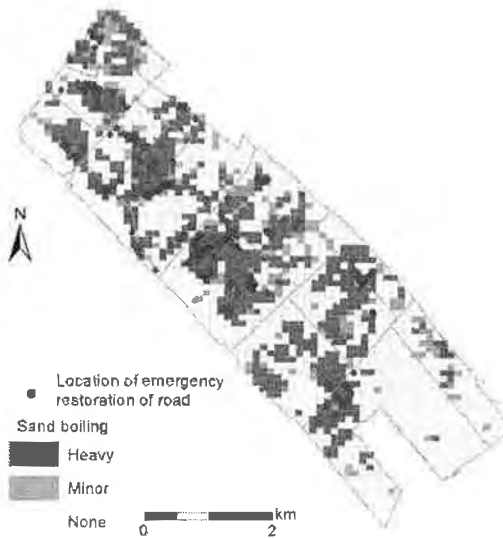


Figure 3 Distribution of sand boiling

A huge amount of sand boiling due to soil liquefaction occurred in almost all areas in Mihama ward during the earthquake. Sand boiling was hardly found on the main road and small sand boiling was found at the edge of the asphaltic pavement or on the sidewalk of the main road. On the other hand, some narrower streets inside a city block were almost completely covered with sand boiling as thick as 45 cm.

The sand which spouted out on the roads was removed by Chuo-Mihama civil engineering office of Chiba city within one week right after the quake. According to the office, the amount of the removed sand reached 8,500 m³.

The liquefaction damage distribution was surveyed on public roads in Mihama ward immediately after the earthquake from March 12 to 20. The target of the survey includes all the public roads, most of the parks and some of the private properties situated in Mihama ward, which could be entered at that time. The severity of sand boiling is classified into three levels ; heavy, minor and none. The case in which the overflow area of sand boiling found in the spot is more than about 1 m is classified as 'heavy'. The case in which the overflow area is less than about 1 m is classified as 'minor'. The case in which no sand boiling was found is classified as 'none'.

Figure 3 shows the distribution of sand boiling using 100 m square grids together with the locations of emergency restoration of roads conducted by the Chuo-Mihama civil engineering office. White grids indicate the areas which could not be entered. Heavy sand boiling and road restoration locations are densely distributed in the coastal area when compared to the inland area. A number of spots associated with minor sand boiling are found in the inland area. The districts where widespread heavy sand boiling was found include Nakase, Hibino, Isobe, Takasu, Takahama and western part of Shinminato as shown in Figure 3. On the other hand, there are some districts, where only small sand boiling was found, namely Utase, the area between Isobe and Takahama and the inland part of Shinminato.

Figure 4 shows the distribution of liquefaction during the 1987 Chibaken-toho-oki earthquake [2] in addition to contour lines of the basement depth of an alluvial deposit [3]. Most of the past liquefaction areas are inclusive to the damage area shown in Figure 3. It is also seen from these figures that the liquefaction damage area of the 2011 earthquake is more widespread than that of the

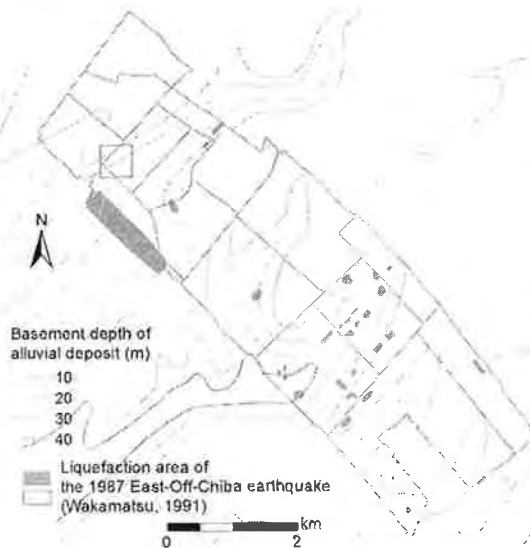


Figure 4 Historical liquefaction sites and alluvial deposit basement

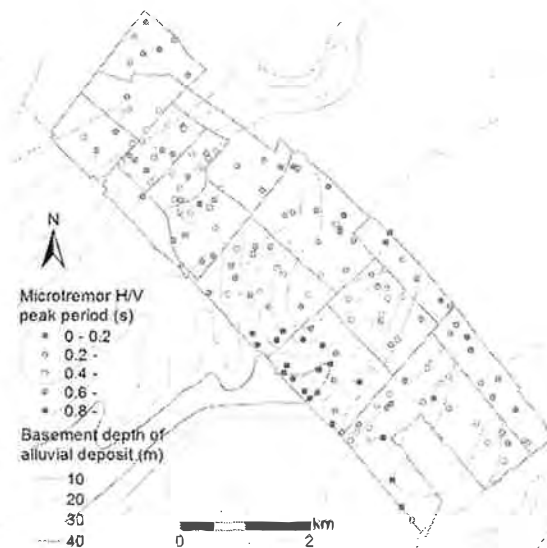


Figure 5 Peak period distribution obtained from microtremor measurements

past earthquake.

In the districts of Nakase, Hibino, Takasu and Takahama where heavy sand boiling was found, the basement depth of the alluvial deposit is deep compared to other districts, meaning that these districts are located on the so-called alluvial valley where thick alluvial deposits are accumulated. The areas in the northern part of Isobe and the western part of Shinminato where heavy sand boiling was also found, however, are situated on the ridge in the old times which is covered with thinner alluvial deposits in the present time.

PRELIMINARY ANALYSIS AND DISCUSSIONS

Microtremor Measurements

In order to estimate the natural period of the surface soil, microtremor measurements with a three-component sensor were conducted at 163 sites in Mihama ward. Figure 5 shows the peak periods of H/V spectra calculated from the three component motions of observed microtremors. The peak periods of microtremor H/V spectra are in fairly good agreement with the basement depth of alluvial deposits. The peak periods in the coastal area tend to be longer than those in the inland area. The peak periods in the districts such as Nakase, Isobe, Takahama and the western part of Shinminato, where heavy sand boiling was observed, tend to be longer than those in other districts. In addition the peak periods in Utase where only a small sand boiling was observed are shorter. However, in the area where small sand boiling was found such as the area between Isobe and Takahama, the long peak periods of microtremor H/V spectra are observed. This indicates that the severity of sand boiling cannot be explained only by the thickness of alluvial deposits.

Soil Profiles

Figure 6 shows the borehole logs at site B1 where heavy sand boiling was observed and site B2 where no sand boiling was observed. Site locations are shown in Figure 2. The thickness of the reclaimed soil is estimated to be 5 to 10 m at these sites. At site B1 whose natural period from

microtremor measurements is estimated to be longer compered to other areas, fine sand and silt with low SPT- N values are found to accumulate alternately. At site B2 whose natural period is also estimated to be longer, the surface soil, in contrast, consists of fills with N values of about 10 and silts with low N values with the thickness of 11 m, which is underlain by fine sands with N values of more than 10. It seems that this is the reason why liquefaction damage is different between the two sites despite the similar peak periods of microtremor H/V spectra.

A series of cone penetrometer tests (CPT's) were conducted along a line crossing the border between heavily and less damaged areas in Isobe district as shown in Figure 7 in which the areas where sand boiling was observed are also shown. Figure 8 shows the estimated profiles of soil types obtained from CPT loggings at 6 locations. At the locations C1 and C2 near the damaged area by sand boiling, sand prevails to the depth of about 10 m. At the locations C3, C5 and C6 where no sand boiling was observed, silt and clay are predominant to the depth of 20 m.

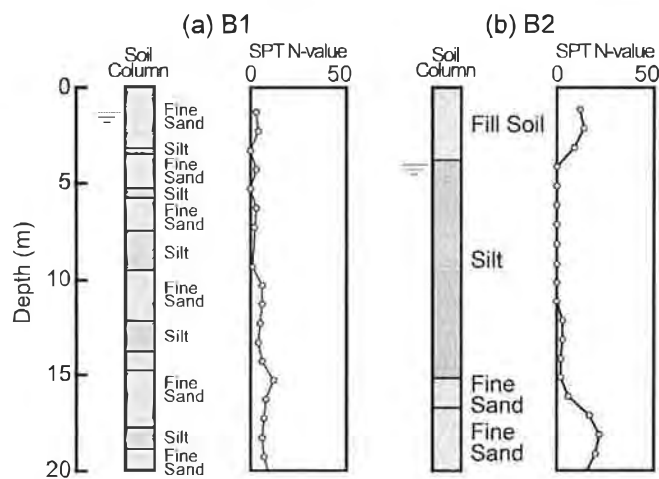


Figure 6 Boring logs in Isobe district

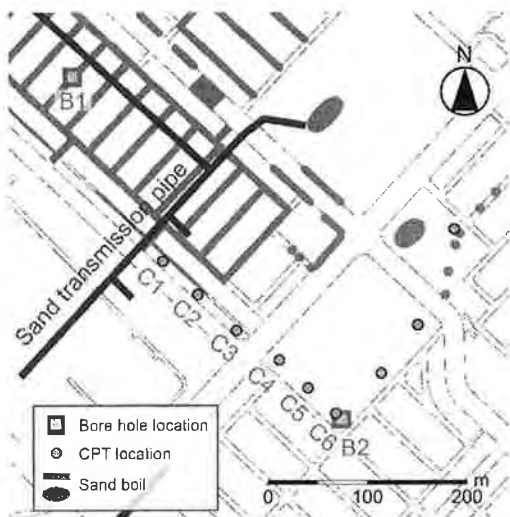


Figure 7 CPT locations

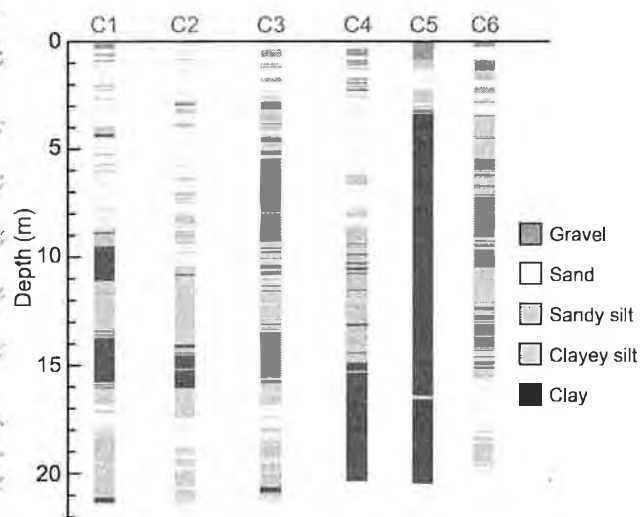


Figure 8 CPT logs



The above findings and discussions indicate that the difference in type of surface soil as well as the soil amplification characteristics significantly affected the difference in liquefaction damage in Mihama ward during the 2011 Tohoku earthquake.

Estimation of Maximum Strain during Earthquake

The previous discussions can lead to a tentative conclusion that liquefaction damage is severe in the area in which two conditions are met: there exists a thick layer of soft alluvial soils where the ground motion gets amplified significantly, and sand prevails in the soil profile especially in the shallow part. Based on this assumption, the authors have conducted a preliminary analysis [4] to estimate the maximum shear strain distribution of the target area during the earthquake and compared the results with the liquefaction damage distribution shown in Figure 3.

We have collected a total of about 600 boring logs in this area, as shown by the dots in Figure 9. Based on these data, three-dimensional soil model of this area has been constructed in the following way:

- The target area is partitioned into a number of small areas, each of which has the size of 100 m by 100 m.
- The soil profile for each subdivided area is determined by the weighted average of surrounding eight boring logs nearest to the area.

The ground motions during the main shock were recorded at a number of locations in the target area, among which the recorded ground motion at Masago, where no sand boiling was observed, has been used to obtain the input motion to the bedrock by the deconvolution process. This input motion to the bedrock was then applied to each of the soil model constructed above. Since liquefaction occurs in a sand layer, the maximum shear strain of sand layers up to the depth of 20 m from the ground surface was selected for each subdivided area. Figure 10 shows the distribution of maximum shear strain of sands. By the comparison of Figures 3 and 10, it can be pointed out that the assumption of two main factors for liquefaction damage being amplification due to soft soil deposits and dominance of sands in its profile explains well about the damage distribution.

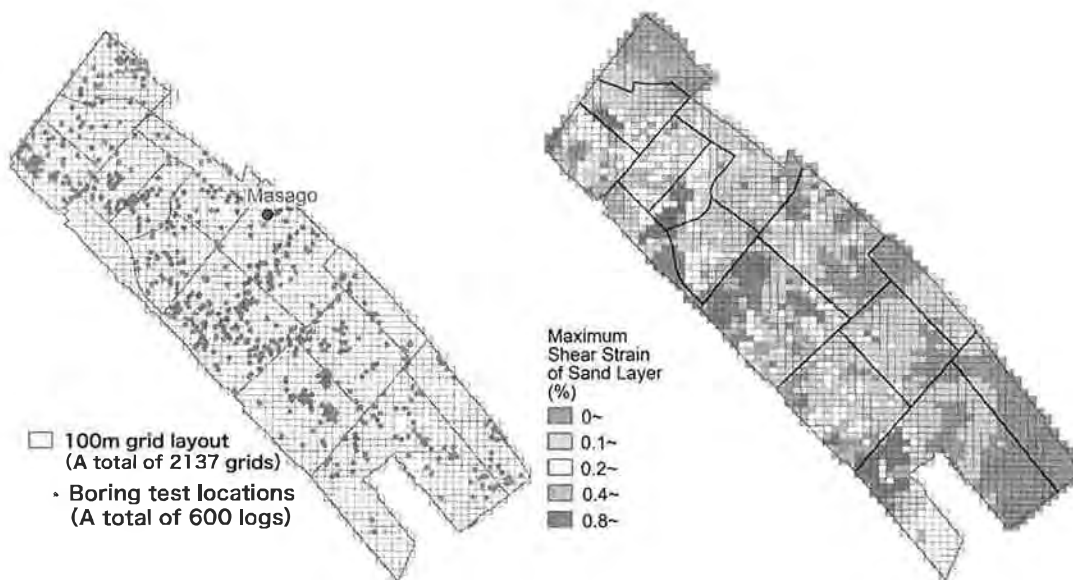


Figure 9 Boring test locations

Figure 10 Maximum shear strain distribution



Effect of Land Reclamation Process

The sand pumping process was used for reclaiming the land in Mihama ward [5]. In the process, the soil consisting of sand and sandy silt accumulated on the sea bed of Tokyo bay was dredged, transmitted through sand pipes to another sea bottom surrounded by an embankment and then discharged from outlets. In this process, sand with low fine-grain content accumulates near the outlets of the sand transmission pipes, and silty sand with high fine-grain content accumulates in the area which is far from the outlets. In addition, accumulated soils tend to be loose and soft because of the sedimentary environment. This land reclamation process may explain why the soil profile varies in a short distance and liquefaction damage shows an extreme maldistribution.

Figure 11 shows the aerial photography of Isobe and Takahama districts shown in Figure 2 at the time of land reclamation back in 1972. The sand transmission pipes are found in this photography and are indicated by the purple lines. The pipe layout is indicated also in Figure 7. Sand boiling is found near the pipes such as CPT locations C1 and C2. CPT locations C3, C5 and C6 where surface soils mainly consist of silt are situated between the pipes, as can be seen in Figure 11.

There is a drainage canal called Kusano canal that runs between Isobe and Takahama districts crossing the reclaimed ground from inland to Tokyo Bay as shown in Figure 11. The surplus water contained in pumped dredge soils was drained away through Kusano canal to Tokyo Bay. There used to exist storage reservoirs in the both sides of Kusano canal that were used to precipitate fine grains in the drained water. It is understood from Figure 11 that site B3 where the surface soil mainly consists of silt is situated in this reservoir.

From the above findings and discussions, it is possible to suggest that the distance from the outlet of sand transmission pipes affected the distribution of liquefaction damage in Mihama ward due to the 2011 Tohoku earthquake.

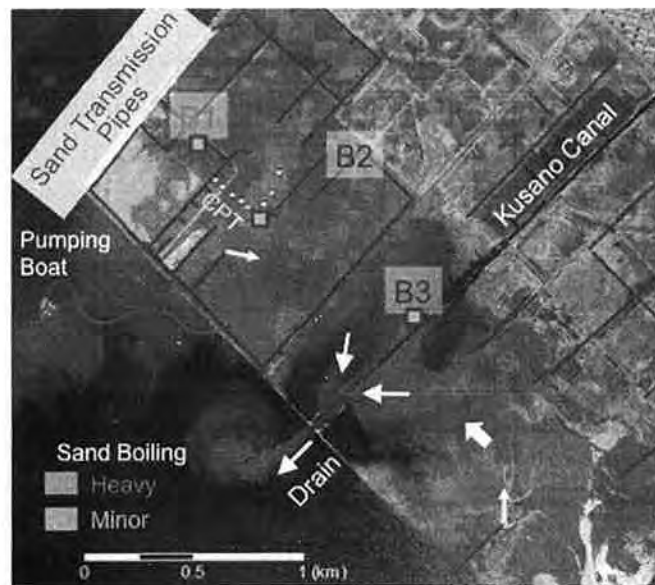


Figure 11 Aerial photography of Isobe and Takahama districts at the time of reclamation in 1972



CONCLUSIONS

The distribution of liquefaction damage in Mihama ward of Chiba city during the 2011 Tohoku earthquake was investigated by conducting an exhaustive search for all the public roads and parks. The effects of local site conditions on the damage distribution in the region were examined based on the field survey, microtremor measurements, analysis based on the boring logs and the aerial photography. From the results and discussions, the following conclusions are made:

1. Liquefaction damage in Mihama ward of Chiba city showed an extreme maldistribution.
2. The soil type of the surface soil as well as its amplification characteristics are the major factors that affected the severity of liquefaction damage.
3. The variation of soil profiles in a short distance may be resulted from the ground reclamation process.

ACKNOWLEDGMENTS

The information about the emergency road restoration and land reclamation process was provided by Chuo-Mihama civil engineering office of Chiba city. The borehole data were provided by Chiba city and Chiba prefecture.

REFERENCES

1. Sekiguchi, T. and Nakai, S. "Effects of local site conditions on liquefaction damage in Mihama ward of Chiba city." Proc. International Symposium on Engineering Lessons Learned from the 2011 Great East Japan Earthquake, 2012: 865-870.
2. Wakamatsu, K. "Maps for historic liquefaction sites in Japan." 1991. (in Japanese)
3. Kaizuka, S. "The topography, geological feature and water of Tokyo Bay." Tsukiji Shokan 1993 (in Japanese)
4. Sekiguchi, T., Mori, T. and Nakai, S. "Effects of surface soil amplification characteristics on liquefaction damage in Mihama ward of Chiba city - Part 2: Evaluation of surface soil amplification based on borehole data." Proc. 47th Japan National Conference on Geotechnical Engineering, Paper No.756, 2012: 1503-1504. (in Japanese)
5. Waterfront development department of Chiba city. "Strides of Inage Kaihin newtown." 1984 (in Japanese)