Comments and Responses for the 2003 Draft SEIS, Modified Montlake Route Addendum, and 2005 Draft SEIS

Book One: Comments 1 to 150

Contents

University of Washington Comments

Responses to Public Comments

Sound Transit has catalogued the public comments received, and identified individual topics raised by each party. Following each letter or comment document, Sound Transit has provided responses. The responses are either a direct response to the comment, or, when the comment is one that was commonly made, Sound Transit refers to a common comment and response. The common comments and their responses are included in Chapter 7 of the Final SEIS; Chapter 7 is also reprinted here for ease of reference.

connections to the existing Montlake bus flyer stop at SR 520, including a potential light rail station at that location. Except from the University of Washington, there were few comments about the original Montlake Station/Rainier Vista and route in the University District. Some comments encouraged the consideration of a NE 45th Station with a new Modified Montlake route. The University District Community Council, while listing a number of issues and concerns about the overall project, preferred the Modified Montlake route with a NE 45th Station. The community council and the Chamber also stated that funding for the Northgate extension should be secured before making a decision to extend light rail to the University District.

The University of Washington, the City of Seattle, WSDOT and King County Metro provided comments about the potential for increased traffic and pedestrian activity on the roadways surrounding the University of Washington Station, and requested that Sound Transit include grade-separated pedestrian passages across Montlake Boulevard and Pacific Place. These parties also provided comments about the need for effective transit circulation in the area, and safe and efficient access and connections for station patrons.

7.4 OTHER COMMENTS

Comments were also provided on topics related to Sound Transit's proposal to implement North Link, raising issues that have previously been voiced in the Central Link EIS related to the overall Central Link Project and the Initial Segment. These issues include concerns related to the costs of the project, the technology choice, extensions beyond the Northgate Segment, Sound Transit's Regional Transit Long-Range Plan, and voter approvals.

7.5 COMMENTS BY PUBLIC AGENCIES

7.5.1 University of Washington

The University of Washington provided several written comments on the 2003 Draft SEIS, including the initial letter from the University of Washington Board of Regents advising Sound Transit of the initial conclusions of the Regents regarding the alternatives under consideration. The correspondence emphasized the importance of protecting the University's research mission. The Regents' letter stated that the West Tunnel route with two stations could be supported by the University, and that the Montlake (Rainier Vista) route could not be supported. The Regents' letter encouraged review of a Modified Montlake Route farther east of the Montlake alternative examined in the 2003 Draft SEIS. As a result, Sound Transit issued the Modified Montlake Addendum, examining an alternative east of the earlier routes, and later issued the 2005 Draft SEIS with further updates to the alternative.

The University letters provided detailed comments on the 2003 Draft SEIS, the Modified Montlake Route Addendum, and the 2005 Draft SEIS. These letters reiterated the importance of the research mission to education and the economy, discussing concerns related to light rail construction and operation in relation to University facilities and activities (including the University of Washington Medical Center). An interim terminus station or systemwide tunnel spoils removal at a station on University property were stated as unacceptable to the University. They noted the expectation that their concerns would need to be addressed in an amended memorandum of agreement between Sound Transit and the University. Attachments to their 2003 Draft SEIS letter express detailed concerns regarding potential construction impacts (noise, dust, economic hardship, and vibration), electromagnetic field and vibration impacts during operation, and the need for Sound Transit to mitigate these impacts.

Their letter in 2005 again expressed concerns about impacts to research facilities, but also discussed construction impacts, circulation issues in the University of Washington staging area, and their preferences for an underground walkway under NE Pacific Place and the Burke-Gilman Trail.

7.5.2 Seattle Department of Transportation (SDOT)

In its letters, SDOT expressed appreciation for the strong partnership that Sound Transit and SDOT have developed, and generally found the North Link 2003 Draft SEIS a thorough and well-researched document. To strengthen the Final SEIS analysis, SDOT suggested more detail on bicycle and pedestrian accessibility, truck

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NL 208

UNIVERSITY OF WASHINGTON

OFFICE OF REGIONAL AFFAIRS
Theresa Doherty, Assistant Vice President

January 30, 2004

James Irish
Link Environmental Manager
Sound Transit, Union Station
401 South Jackson
Seattle, WA. 98104-2826

Dear James:

The University of Washington would like to thank you for the opportunity to review the November 2003 Draft Supplemental Environmental Impact Statement (DSEIS) for the North Link. Attached are our detailed comments.

Protecting the University's research mission is of critical importance to the University and the Region. Based on our review of the analysis in the DSEIS, the Board of Regents alerted Sound Transit on December 5, 2003, to their conclusion that the University's objectives for protecting sensitive research in the core of campus cannot be met by the Montlake (Rainier Vista) alignment. (See enclosure dated December 5, 2003, Letter from University Regent Sally Jewell to Sound Transit Chief Executive Officer Joni Earl). Consequently, the Regents have asked the Sound Transit Board to evaluate a minor variation to the Montlake alignment to avoid the heart of the science and engineering corridor. 1

For the past two years we have worked together on assessing the impacts and the potential mitigations for those impacts. During the course of our conversations we have had the opportunity to comment on the scoping process for the North Link Project and the Preliminary Draft Supplemental Environmental Impact Statements (PDSEIS). While we do not anticipate the Final Environmental Impact Statement (FEIS) will respond to these previous comment letters, we would like to make them part of the record. These comments are contained in the November 16, 2001 scoping letter to Ms. Earl and the September 16, 2002 and October 7, 2002 letters to James Irish on packets 1 and 2 of the PDSEIS. 2

In earlier comment letters we have noted that an interim terminus on University property is not an acceptable solution to the University of Washington or the University 3
district transportation needs. We have also noted that using any station on UW property 4

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for system wide spoils removal is also not acceptable. Managing such large amounts of dirt next to a regional medical center or in the middle of a student housing corridor, would adversely impact the University and its community. 4 cont.

In addition to the comments on the scoping and preliminary impact statements, we have attached our detailed comments on the November 2003 DSEIS. The attached comments are very detailed by design. They have been compiled from University faculty and staff comments and represent the UW response to the DSEIS. 5

As you know, our relationship is governed by the Memorandum of Agreement (MOA) of 2000, and we expect many of the issues contained in the following comments to be reflected, ultimately, as we amend that Agreement. We hope that the initial comments and concerns in this response will help you select a route and design a system that will give the University the confidence it needs to provide access to and ongoing cooperation in support of the North Link. 6

Please feel free to contact me if you have any questions.

Sincerely,

Theresa Doherty
Assistant Vice President

cc: Joni Earl, Sound Transit Chief Executive Officer
Ron Endlich, Sound Transit North Link Program Manager
Tracy Reed, Sound Transit North Link Segment Manager
Weldon Ihrig, UW Executive Vice President
John Brandon, UW Consultant on Sound Transit

encl: 1. VACC Review of "North Link UW Vibration Background Report" by PSTC (Dated November 14, 2003 by Ahmad Bayat)
2 .VACC Review of: November 2003 North Link Draft DSEIS Comments (Dated January 23, 2003 by J. Byron Davis)
3. Letter from Regent Sally Jewell to Chief Executive Officer Joni Earl dated December 5, 2003 regarding Montlake (Rainier Vista) alignment
4. UWMC Contract specifications for Surgery Pavilion

University of Washington
Comments on
Sound Transit Draft Environmental Impact Statement
January 2004

Economic Impact of the University of Washington to the City, State and Region.

Maintaining the research viability of the Seattle campus is critical to the University's mission as a public institution and has economic consequences for the City, State and Region. This past year the University celebrated the enterprise and excellence of University of Washington faculty as demonstrated by their success in competing for funding – bringing in a total of $933 million in research awards during the FY 2003. This was a 12% increase over 2002 and accounted for more than 31% of the University's revenues. Sponsored research projects included 5,247 active grants, including 122 grants over a million dollars each. In 2001, the most recent year that comparative information is available from the National Science Foundation, the UW was first among public universities in federal research awards. The University has held this position since 1974. The City, State and Region benefit directly and indirectly from the amount of money the University receives in research grants. From researching the cures to diseases to the creation of new jobs – continued research funding is important not only to the University community but to the broader community as well. Jobs are a direct result of the grant funding as well as jobs that are created as a spin off of direct University employment. The DSEIS did not adequately analyze the impact to the City, State and Region of University research funding and what the economic consequences would be of the unmitigated adverse impacts to the UW research mission and the funding it brings to the City, State and Region. 1 Additionally, the DSEIS appears to question the legitimacy of the University's concern regarding the impact of a light rail alignment to the University's mission. The DSEIS needs to acknowledge the importance of the University's mission to the City, State and Region and analyze impacts to the broader community of these unmitigated impacts. 2 It also needs to include what specific mitigations Sound Transit will commit to ensure University thresholds to preserve research are maintained during construction and operation. (There is a discussion on page 4-25 entitled "Indirect Local Economic Impacts" and 4-18 of the Land Use section, where this information should be added) 3

Notwithstanding the critical focus on research, it is also important that the DSEIS address the University's need to conduct its teaching and service activities at quality levels during both construction and operation of a light rail line. We need to maintain an environment that attracts, not repels, students, patients, and others who support the University financially. Congestion from electing an interim terminus on campus, dust and dirt generating spoils collected on University property, and noise that inhibits the teaching environment are but a few examples of issues that must be addressed to ensure the University is able to conduct its business without interference from the programs outlined in the DSEIS to construct and operate a light rail system on University property. 4

Memorandum of Agreement

In spring 2000, Sound Transit and the University of Washington entered into the Memorandum of Agreement (MOA). One of the purposes of which is to "establish the guidelines by which the University and Sound Transit will cooperate in the planning, design, construction, operation, and maintenance of Sound Transit's Link through the University District and in the McClellan Street Station area affecting University property or programs." Please refer to the MOA, particularly to Appendices B and C. The design and mitigation measures agreed to in the MOA affect the analysis of impact in the EIS, but are not discussed in the EIS. In these comment, we note specific sections where the MOA should be noted. In addition, for each alternative in the North Link Light Rail Study EIS, prepare an analysis of the impacts on the MOA, including but not limited to the Siting and Design Principles set forth in Appendix B and the Mitigation Program set forth in Appendix C of the MOA. 5

As we look forward to amending the MOA of 2000 to reflect your new alternatives, it will be important to address the current uncertainty in Sound Transit's financial outlook and plans. The University will need assurances that it will be able to restore itself and be made whole in the event Sound Transit is unable to afford current or future acceptable construction an/or operation mitigation, or to commit to extending the line to Northgate in a time frame that the University considers acceptable. 6

Impacts to University mission during Construction

In reviewing the DSEIS and the reports that have been generated by UW consultants as well as ST consultants, it is clear to us that there will be adverse impacts to the University's mission if vibration, EMI, noise, and dirt accumulation issues are not mitigated during construction. These impacts must be mitigated and the FEIS needs to outline the specific mitigation protocol that will be implemented to eliminate all adverse impacts. The DSEIS does not commit to any specific mitigation plan. Specific questions and comments related to this subject are throughout the document and the vibration and EMI issues are listed on pages 34 to 36 of this letter. 7

Impacts to University mission of research during Operation

In reviewing the DSEIS and the reports that have been generated by UW consultants as well as ST consultants, it is clear to us that there will be adverse impacts to the University's research mission if vibration and EMI issues are not mitigated during operation. These impacts must be mitigated and the FEIS needs to outline the specific mitigation protocol that will be implemented to eliminate all adverse impacts. The DSEIS does not commit to any specific mitigation plan. Specific questions and comments related to this subject are listed on pages 12 to 33 of this letter. 8

Maintenance Plan as part of Vibration and EMI Mitigation Plan

The proposed Hi-Lo mitigation strategy outlined in the DSEIS depends on an extraordinarily high quality, and possibly unprecedented, mitigation protocol. To ensure this strategy works as planned, ST assumes an excellent maintenance plan. Although the "Link Maintenance Plan" is frequently referred to in the DSEIS, the University has not seen the final plan. Because the EMI and vibration mitigation schemes rely on a well maintained system, ST needs to state how the maintenance plan will be maintained over time if funding or budgets are curtailed. In addition, there are other questions that need to be answered that are directly related to the vibration and EMI mitigation plans. These questions are on page 26 of this letter. 9

Comments from University Faculty and Staff

The following is a compilation of comments from many University faculty and staff. There original language is kept intact to assure that the entire intent of their concerns is communicated. Also attached to this letter are two memos from the UW vibration consultants, VACC which comment on the DSEIS as well as the Vibration background report by PSTC. Both memos are part of our official comment letter. 10

Executive Summary

Page ES-9, S.3.5. Whether interim termini will be approved by the Regents for stations that are on the UW campus, will be a matter for future discussions between ST and the Regents. 11

Page ES-16, Displacements and Relocations. Compensation and relocation assistance would be provided to the UW pursuant to the MOA. 12

Page ES-18, Noise and Vibration. Please note that the threshold requested by the UW is the level of the ambient vibration currently available for vibration-sensitive research on campus. 13

Page ES-22, Table S-7, Footnote 1. Whether interim termini will be approved by the Regents for stations that are on the UW campus, will be a matter for future discussions between ST and the Regents. 14

Page ES-28, S.13.3, Segment B, Paragraph 5. For each alternative near the University, the relative costs of mitigation should be analyzed as a part of the total relative costs. 15

Page ES-29, 1st Full Paragraph. The statement, "…but would require University property, particularly during construction" creates confusion regarding the use of University property for the other alternatives where no such statement is made. 16

Page ES-31, S.16, Issues to be Resolved, 2nd Paragraph. The MOA will need to be amended to reflect the new schedule and the change in property to be possessed and used. 17

Page A-2, Table A-1, Local/Regional Agencies. The University of Washington should be listed with state agencies. 18

Chapter 1: Purpose and Need

1.1. Introduction
1.2. Background
1.3. Purpose and Need
1.4. Goals and Objectives

No comments

Chapter 2: Alternatives Considered

Page 2-14, 2.2.6, Potential Termini and Deferred Stations:
Whether interim termini will be approved by the Regents for stations that are on the UW campus, will be a matter for future discussions between ST and the Regents. 19

Page 2-23, 2.10, Benefits and Disadvantages of Delaying Project Implementation:
Please identify the additional disadvantage of securing less than the full funding necessary to complete the segment from the University District to Northgate. Interim termini will create greater local impacts and greater stop and start-up costs. 20

Chapter 3: Transportation Impacts and Mitigation

Page 3-41. Clearly there are impacts to the Burke Gilman Trail, traffic safety, and access and circulation. Please outline what the impacts are and exactly how they will be mitigated. The Burke Gilman trail is a City resource that is widely used by University and non-University personnel as they travel to and from their places of employment. The viability of the trail must be maintained during construction and operation and the EIS needs to detail exactly how this will happen. 21

Page 3-44. The University questions the statement in the first paragraph that most light rail patrons would find that parking cost, added transit transfer time, and light rail fare would make hide and ride cost prohibitive. Please outline what information you have that supports this statement. The University is very concerned about the impact of "hide-and- ride" impacts and feels the University parking lots and parking enforcement efforts would be adversely impacted from an interim terminus on University property. 22

Page 3-18, University District: "In the University District, the Brooklyn Station would generate slightly higher ridership than the NE 45th Station." "The optional Southwest Campus Station (with Alternatives B1.Gd, B3.Gb, and B4.Gd) would generate the lowest ridership due to the combination of a slightly higher travel time and the fact that the station would not serve the University of Washington Campus or University Hospital as well as the Pacific and Montlake Stations;…" Please expand upon the rationale behind this statement. 23

Pages 3-34 and 3-35, Segment B (University District to Westlake Station). The local impacts of interim termini on University property or in the University District are not sufficiently identified and analyzed. The University believes there will be adverse impacts to the surrounding area if any one of the stations in the University District area are identified as an "interim" terminal. Please identify and analyze these impacts and describe exactly what mitigations will be employed. 24

Chapter 4: Environmental Impacts and Mitigation

4.3.2. Impacts, Safety and Security page 38 and 4.13.2 impacts page 114.
"Currently the UW responds to all security calls on campus, and SPD provides assistance only upon request of the UWPD. If there is an increase in crime or security calls on the UW campus resulting from light rail stations, there may be an increased demand on UWPD resources. Sound Transit will work with the UW and SPD to determine responsibilities for providing security service to stations on the University. These discussions would include reporting, training, and liability issues, in the form of interagency agreements." According to statements in the DSEIS, there is no question that there **will be** increases in crimes in and around the stations**.** The University police force is not responsible for providing security for the stations. It is the responsibility of Sound Transit to pay for and provide the security staffing necessary to make the stations and the areas around them safe for University and non-University personnel as well as report the crimes in the area. Please identify how ST will provide and pay for police services around the stations. 25

Page 4-3, Segment B (University District to Downtown Seattle). Possession and use by Sound Transit of University property is guided by the MOA. Any acquisition of property would have to be approved by the University. 26

Page 4-9, Segment B: University District to Downtown Seattle, 2nd Paragraph. The paragraph contains a confusing sentence. Please clarify that the UWMC is a part of the University and not a separate employer. 27

Page 4-17, Paragraph headed "NE 45th Station…" "There would be long-term benefits associated with having a light rail station serve the campus." This sentence and its conclusion are not appropriate in this section and should be moved to the appropriate section. The long-term benefits of a light rail station would accrue to the University District, of which the University of Washington is a part. 28

Page 4-25, 4.2.4, Mitigation, 2nd Paragraph. Property use, possession, and relocation at the University will be conducted under the MOA. 29

Page 4-45, Segment B (University District to Downtown Seattle). Design of the structures on the UW campus would be conducted pursuant to the MOA. 30

Page 4-48, 4.4.3, Mitigation Measures, bulleted section headed "Montlake Station Options." The nature of University trees as a teaching feature should be noted. This will dictate replacement location and species. Discussion of this issue is on page 28 in the Campus Master Plan. 31

Page 4-106, 4.12.3, Mitigation. Please refer to the letter from Sally Jewell to Joni Earl dated December 5, 2003. The University does not believe the quiet zone of the science 32

and engineering corridor along the Rainier Vista or the EMI impacts in the that area can be adequately mitigated for the Rainier Vista Montlake route alternative. 32 cont.

Page 4-188, paragraph following heading "Mitigation." It is not sufficient to say that the "trail would be closed and detour created during construction." The trail is important to University and non-University commuters and the exact location of the re-routed trail needs to be outlined in the EIS. 33

Page 4-4. Property acquisition and re-locations are guided by the MOA and this should be described in the EIS. 34

Page 4-5, 4.1.2 Mitigation. Property acquisition and re-locations are guided by the MOA and this should be noted in the EIS. 35

Page 4-18. Southwest Campus Station. The development of a station close to Stevens Court and Mercer Hall will have adverse economic impacts on Housing and Food Services. See comments from Paul Brown on pages 38, 39 and 40 for details. 36

Please change all references in the EIS regarding the "future master plan" to "approved Master Plan." The Campus Master Plan was approved by the Seattle City Council in December 2002. There is a reference to the CMP in the middle of the page. 37

Page 4-33 4.3.2. The impacts to the "University community" or "University neighborhood" during construction will be significant. There will be adverse impacts to research and adverse impacts to, for example, the Housing and Food services operations if a Brooklyn alignment is chosen. Each of the alignments will have significant impacts on the quality of the neighborhoods on the campus as they are presently configured. As outlined in the comments from Paul Brown on page 38 - 40 safety in and around the stations will be a concern once the light rail line is in operation. 38

4.6.6 University of Washington, Page 4-69 - 77. Preserving the ability for the University to conduct current and future, more sensitive research, is critically important to the University as well as the region. This section details the University's thresholds for protecting research. Detailed comments on this section are provided by UW faculty members on pages 12 - 33 of this document. 39

4.76-78. There seems to be no commitment from Sound Transit to employ any of the mitigation measures mentioned in this section, only that Sound Transit will "coordinate with the UW" once a preferred alignment is identified. Sound Transit should be aware that failure to accomplish that coordination before identifying a "preferred alignment" could result in that alignment being unacceptable to the University under the MOA. 40

4.110. Sound Transit should be aware that maintaining a great research environment is of paramount importance to the University. No matter how far into the final design of the 41

light rail system, UW will reserve the right to revoke Sound Transit access to campus if Sound Transit fails to convince UW of the quality of Sound Transit's elected mitigation. 41 cont.

Page 4-121 4.14.3 Mitigation. Working with the UW in and of itself is not "mitigation". Please clarify what mitigation will occur or if the impact will be unmitigated. 42

Page 4-173 Vibration Mitigation. There is no commitment in the DSEIS to mitigation therefore the impacts is unmitigated. Construction impacts will be significant as outlined in later sections of this document. 43

Page P4.2-23. The EIS came out after the Campus Master Plan was adopted this section should be revised to state the plan has been adopted and replaces both the GPDP and the Southwest Campus Plan. On page P4.2-28 there is also reference to the plan as if it is not adopted. It was adopted by the City Council in December of 2002 and the Board of Regents in January 2003. 44

Page P4.18.4. Under University of Washington: Campus Master Plan, it should reference the benefit of the UW as the state's leading research institution. This is also important to the City of Seattle and its new commitment to Biotech development in South Lake Union. 45

Section 4.6 In table 4.6-6. The University does not agree with Sound Transit's characterization of the "VC" curves as its threshold for preserving research as outlined in the following comments from Professor Reid and others. Never the less, Physics/Astronomy is labeled with the VC-E criterion with no further notation, yet most buildings meeting this criterion in that table refer to footnote 6 which explains that some equipment housed therein requires a still more stringent rating. Most Physics/Astronomy labs are blessed with ambient vibration levels well below VC-E and at least one, currently occupied by Professor Boynton, contains instrumentation so sensitive as to be limited even by that extremely low ambient. Consequently, PAB should be listed as "below VC-E". 46

Section 4.6.6
Reviewers: Associate Professor Philip Reid, Bryant Fujimoto, Ph.D., and Professor J. Michael Schurr

I. On the "reasonableness" of the UW thresholds

The UW's vibration thresholds represent the amount of increased vibration noise from the operation of light rail that can be tolerated while still leaving the UW with a competitive research environment. Specifically, the thresholds allow for a 41% increase in the average ambient vibration levels relative to current ambient conditions with the operation of light rail. Ambient vibration levels were established using measurements performed by UW vibration consultants Vibro-Acoustic Consultants (VACC). The accuracy and legitimacy of these measurements is questioned by ST (page 4-70 and 4-76 of the SEIS) 47

since the measurements "were conducted for a 20 second sampling period and excluded extraordinary events such as a door being slammed in the vicinity of the measurement." ST also questions the legitimacy of comparing average vibration levels to maximum noise levels associated with train operation. We have a few comments with respect to these issues: 47 cont.

a). Concerns about the accuracy of these measurements were first raised by ST in November of 2002, and at that time ST requested that further ambient measurements be performed by their consultants. The UW accommodated this request, and provided access to research labs for additional measurements that were performed by ST consultants Wilson, Ihrig and Associates between December 4th and 9th of 2002. The results of this study are documented in a report entitled "Ambient Vibration Measurements, Final Report" dated January 15, 2003. In this second study, measurements were performed for 1 hour time periods throughout the day, doors were allowed to open and close, and extraordinary events were not excised from the data. In the Chemistry Building, a comparison of original VACC measurements to those measured at four time periods by the ST consultants reveals that the vibration noise levels in ALL 1/3 octave bands were below those previously reported by the UW consultant for ALL times. That is, the UW ambient values actually represent an upper limit to the ambient noise levels as verified by ST's own consultants. The SEIS mentions the ST measurements later in the document in passing (4-72), but implies that these measurements were simply "generally consistent" with earlier measurements. In fact, these measurements demonstrated that the UW levels could be considered charitable, and therefore refute ST's claims to the contrary as presented on pages 4-70 through 4-72. 48

b) The comparison of ambient vibration levels as an average to the maximum levels from the operation of light rail is an entirely appropriate comparison, and is in fact a standard practice as outlined in the Federal Transportation Authority protocols for estimating vibration noise impacts of light rail. 49

c) We note that the 41% increase in ambient vibration levels due to the operation of light rail is a significant increase over earlier thresholds employed by the UW in original analyses of vibration impacts performed from 1997 through 1999. The past threshold was that the maximum levels of the train itself could not surpass ambient minus 10 dB. In effect, the new thresholds are 10 dB more lenient with respect to earlier criteria, a change that was largely made to accommodate previous ST concerns that the earlier threshold was too rigid. 50

d) We continue to object to ST's use of standard vibration criteria (the so-called VC criteria) to characterize the required vibration levels in buildings on the UW campus (Table 4.6-6). 51

b) Previous UW vibration consultants Colin Gordon and Assoc., experts in the area of light-rail vibration impact on research facilities, raised two issues regarding the uncertainty of FDLs in their memorandum sent to the UW on December 15, 1999. To quote from that memorandum: 58

b.1) FDLs "are based on data from ST, the accuracy of which can (and has been) questioned." We have asked for, but have never seen, the raw data from which the FDL was generated, and previous measurements of the Tri-Met train reported in 1999 PSTC vibration report suggest that the accuracy of the FDL at 1/3 octave band frequencies below 31.5 Hz is extremely poor. These same measurements are apparently employed in the analysis presented in the current SEIS. 59

b.2) FDLs "assume a certain "quality" of rolling stock. That quality can vary widely depending upon manufacturer and ST maintenance." In short, variance in the quality of one train relative to the next necessitates uncertainty in the FDLs. With respect to this point, the 1999 PSTC final vibration report demonstrates that for two "identical" Tri-Met trains moving at the same speed, up to 8 dB differences in vibration noise levels are observed. 60

c) The FDLs were derived from the Tri-Met system by applying "an adjustment for direct fixation track stiffness relative to that of ballasted track..." (2003 final vibration report from ST consultants). The magnitude of this adjustment, or any data to support such an adjustment, has not been provided by ST to date. 61

d) The trains to be employed in the Link light rail line will be similar, but not identical, to the Tri-Met vehicles. ST has assumed that there will be no difference in FDL, a questionable assumption at best. 62

e) The train weight employed in the estimates is incorrect. The estimates employ a single-car weight of 100,000 lbs, yet the operational weight is 135, 000. Therefore, the FDL should be increased by 2.2 dB across all 1/3 octave bands. For the Rainier Vista route, this will result in predicted vibration levels greater than the UW tolerances at Bagley Hall, New Chemistry, Roberts, Wilcox, and the UW Medical Center. That a seemingly small increase of 2.2 dB would result in the violation of the UW criteria at so many buildings is demonstrative of the absence of any margin of error in the predictions. 63

IIB. LSR uncertainty. LSR are determined using "borehole testing" in which a 125 lb weight is dropped into a hole, and vibration intensities are measure as a function of distance away from the weight. The borehole test data used to determine LSRs for the Montlake Alignment are poor as evidenced by the following: 64

a) The vibration intensity arising from dropping the weight at 1/3 octave band frequencies below 25 Hz is quite small, and must be discerned in the presence of background vibration noise. One's ability to discern "data" from background noise is

measured by its "coherence", and the coherence depicted in the WIA report (September
2002) is exceedingly poor (< 0.3) at frequencies below 25 Hz. As such, the LSRs for 64 cont.
frequencies ≤25 Hz are highly uncertain.

b) In addition to being uncertain, the LSRs for frequencies ≤31.5 Hz are nonphysical. Specifically, the LSRs employed in the analysis for frequencies at or below 31.5 Hz exhibit a maximum at 125 feet, suggesting that as one gets CLOSER to the noise source,
the vibration intensity will decrease. Both UW researchers and the UW vibration 65
consultant have asked for an explanation of this behavior, and have yet to receive a response from ST or their consultants. It should be noted that LSRs employed by ST consultants in 1999 do not demonstrate this behavior, but instead show an expected decrease in vibration amplitude as one proceeds away from the noise source.

c) The complex geology of the UW campus necessitates that the vibration predictions be considered uncertain. Colin Gordon and Associates stated in their 1999 memo that with respect to attenuation due to soil, "That parameter may vary widely depending upon
location, depth and, perhaps, time of year (as the depth of the water table changes)." As 66
such, testing at a single borehole followed by extrapolation to removed areas from the region of the test is a highly uncertain exercise.

III. The mitigation analysis employs a litany of unrealistic and unsupported
assumptions. One can write an entire manuscript on this issue; however, we provide a 67
quick overview of the most salient points.

Train Speed. ST's choice of train speed in their analysis is designed to minimize the true impact of light rail. For example, a reduction of up to 17 dB is claimed at 8 Hz when the train speed is reduced from 45 to 30 mph. However, if the train is projected to go 25 mph, the vibration amplitudes increase. The original document from which the "speed
profiles" were derived ("Tri-Met Track Vibration Isolation Tests, Wilson Ihrig and 68
Assoc., October 30, 1998) states that the variation in vibration levels with train speed indicates that "either a periodic wave exists in the rail roughness profile or wheel tread profile, or that there is an imbalance in the wheel sets or traction system." That is, to reproduce the effects claimed in the SEIS, the trains and rails employed in the North Link line must be an identical replica of the trains the measurements were taken from. The assumptions employed with respect to train speed are far from "conservative" as claimed in the SEIS.

Floating Slab. The 8-Hz floating slab employed in the analysis has not been built, nor is there any data available with which to project the efficiency of this device. Furthermore, the performance assumed for this hypothetical slab is far from conservative: 69

a) As stated by Colin Gordon and Associates, "a 20 dB limit on the attenuation of elastometric systems is commonly given in the literature." Yet PSTC has claimed attenuation on the order of 28 dB at certain frequencies. When questioned about this,

PSTC responded, "The effect of lowering the design resonance of a floating slab on the
performance of a floating slab is estimated by simply shifting the single-degree-of-
freedom response curve in the frequency domain." We followed this procedure for the 69 cont.
predicted performance of a 10-Hz slab relative to a 16-Hz slab, and obtained the same values for the 10-Hz slab reported by ST consultants in 1999. However, the claimed performance of the 8-Hz slab cannot be reproduced using this same protocol. Unfortunately, ST claims their 8-Hz slab will show significant increases in attenuation relative to these other slabs, and a reasonable explanation for this behavior has yet to be provided by ST.

b) The performance of the 8-Hz slab is hypothetical. After repeated questioning about
the existence and measured performance of an 8-Hz slab, ST has stated that two slabs 70
have been built, but their performance has not yet been measured.

c) To incorporate an 8-Hz slab into the planned tunnel diameter, ST must increase the slab mass relative to a 16-Hz slab of similar footprint by a factor of four. When questioned about the reasonableness of this task, ST responded, "our design team has spent more time with this question and now believe it is feasible to increase the mass of a
floating slab without increasing the size substantially using lead or other heavyweight
concrete additives." A simple density comparison between cement and lead 71
demonstrates that the slab must be roughly 72% lead in order to reach the required mass needed for a slab with an 8-Hz resonance frequency. Can such a slab be constructed, how will it perform, and what are the compatibility issues associated with a slab with this much conducting metal and the EMI mitigation scheme? At this point, no one knows.

d) The long-term performance of the slab has yet to be described. The vibration attenuation of the slab relies on a natural rubber pad serving as a kind of "shock absorber". This material is subject to significant degradation, including chemical attack
by ozone (that will be created during train operation, especially given the increase in 72
operating voltage of the train to 1500 V relative to the 750 V typically employed). As the rubber degrades, the effectiveness of the 8-Hz slab will correspondingly decrease. ST has made no plans for periodic testing, maintenance, and replacement of the natural rubber pad employed in the floating slab.

e) ST has not actually committed to building an 8 Hz isolation slab. While the predictions given in the appendix include the attenuation of an 8 Hz slab for all of the alignments, the text speaks of an 8-12 Hz slab. A slab with a higher resonance frequency
would be both less effective at attenuation vibrations above 12 Hz and cheaper for ST to 73
build. In effect, ST wishes their mitigation methods to be judged by what they claim can be achieved with an 8 Hz slab, while allowing them the option of building a significantly cheaper and less effective slab of a higher frequency.

f) ST admits that there are additional unanswered questions about the performance of the 8-Hz slab. In answer to our questions about the performance of slab isolation systems, ST's consultant writes 74

"If an alignment requiring an 8 Hz floating slab for mitigation is chosen, additional performance measurements and analysis of an existing 8 Hz floating slab would be undertaken during the engineering phases of the Project. The additional analysis would

include a multi-degree-of-freedom analysis of the slab, track, and vehicle to consider rocking, lateral and vertical vibration modes. A finite element model may be employed. A detailed analysis may be used to specify vehicle performance characteristics, such as primary suspension stiffness or resonance frequency, secondary suspension stiffness, etc." (Steven Wolf to Tracy Reed, October 23, 2003).

It is important to note the timing of this additional analysis. By putting it off until the engineering phase, it will mean that if problems are found, a significant amount of money may have been spent on engineering for a route that would have to be abandoned. This would be a waste of money, and place both the UW and ST in an awkward and probably contentious situation. To protect itself, the UW would have to withhold approval until this additional analysis was performed. 74 cont.

Aging of the System. Vibration noise from light rail will increase as the rails and/or trains age. The UW has been assured by ST that an unparalleled maintenance program will be employed since such a program is in the financial interest of ST. Table 4.6-5 of the SEIS lists several operational/maintenance measures "... that can be taken to ensure that noise and vibration levels related to Link operation remain at the levels projected in the analysis." What is the timescale for maintenance, and how will the need for maintenance be determined? With respect to corrugated rails, page 4-68 states that rail grinding will occur once "every three to five years". No mention of wheel flat correction is made. It should be noted that standard vibration noise estimation protocols allow for the inclusion of up to 10 dB increases due to wheel flats and/or corrugated rail. 75

To be fair, a list of maintenance/operational activities is provided in the SEIS. However, in the text we find that "if only one of the items in the table was not performed, it may not pose a significant increase in noise or vibration levels..." (page 4-67). In other words, the SEIS lays the groundwork for less than stellar maintenance. This will have the effect of increasing vibration well beyond estimated levels.

Special Trackwork. All of the proposed routes through the University District include a crossover where trains may cross between the north and south bound tracks. Ordinarily, the special track work associated with a crossover includes a gap in the rails. When a wheel rolls over the gap, the impact of the wheel with the rail on the far side of the gap can substantially increase the vibration levels nearby. ST proposes using movable frog points to close the gap and eliminate the additional vibration. However, even with the movable frog points the crossovers would not be as smooth as welded rail should be. Therefore, it is not clear, and no supporting evidence has been provided, that there is no noise contribution from crossovers, even with the use of movable frog points. 76

Cars will never simultaneously pass. Somewhere along the line a northbound and southbound train must pass. When they do, the vibration levels will increase 3 dB over the estimates provided. This can be circumvented to a certain extent by operational 77

measures; however, what occurs when scheduling of trains comes in conflict with the environmental needs of UW researchers? 77 cont.

Effects of Braking are Ignored. Regenerative braking will not be employed due to EMI concerns; therefore, frictional braking must be employed. We have been told by ST that braking has no effect on vibration noise, but measurements of other light rail systems have shown braking to make a significant contribution to noise levels from light rail. The effect of braking on vibration noise levels remains unexplored. 78

IV. **Receiver-based mitigation schemes are unacceptable to the UW since it will significantly impact the competitive ability of the UW with respect to research initiatives and recruiting.**

In the DSEIS, Sound Transit states:

"... at those buildings and research facilities where the existing average ambient vibration levels would be exceeded by the light rail trains, the use of receiver based mitigation would be effective in reducing vibration levels..." (page 4-78) 79

In short, ST believes receiver-based mitigation to be a viable alternative to the source based mitigation. This naiveté is perhaps not surprising given that ST and their consultants have no background regarding the ongoing research at the UW. There are a variety of reasons why receiver-based designs are not acceptable. These reasons have been explained to ST at length, but are repeated here for the interested reader:

a. *Receiver-based techniques are already being employed in labs that will be affected by increased vibration noise from the light rail trains*. In many of the impacted buildings receiver based mitigation techniques are already being employed, and the current use of these techniques is not by accident. Many experiments cannot be performed with the ambient vibration levels unless vibration-isolation techniques are employed. Modern scanning microscopes, photolithography equipment, and other instruments are designed with vibration isolation in place such that the single factor in determining instrument performance is the extent of ambient vibration noise. It should also be noted that research institutions generally push equipment to its ultimate response, and beyond the specifications of the manufacturer. As such, simply using manufacturer specifications to determine environmental requirements ignores the basic nature of research. 80

b. *Receiver-based mitigation is simply a way to cover up the increased noise levels from light rail, and in no way preserves ambient conditions*. With advances in many fields necessitating lower vibration levels, it is certain that further demands will be placed on ambient vibration conditions. With our current vibration noise levels, the UW is in the enviable position of having an environment that allows for the pursuit of cutting-edge research initiatives. This is especially true along the Rainier Vista corridor and elsewhere 81

(e.g., the Physics and Astronomy Building) that is characterized by very low ambient noise levels, as verified by ST's own measurements (vida infre). Vibration noise from light rail trains will simply erode current conditions; therefore, it is essential that source-based mitigation techniques be employed to limit additional train noise to acceptable levels as defined by the UW tolerances. 81 cont.

c. Relying on receiver-based techniques will severely compromise research efforts at the UW. Many emerging areas of research require a quick and timely response to research developments. Burdening researchers with excess train vibration noise, and requiring them to design schemes to limit this noise, will restrict the rate at which research initiatives can be pursued, and is therefore to the UW's competitive disadvantage. 82

d. Continued reliance on receiver-based mitigation techniques will severely compromise recruiting efforts at the UW. Given the choice of working in an environment free from the constraints of excess vibration noise, or continually employing receiver-based techniques in an attempt eliminate noise, prospective faculty and students will chose the former course. It should be noted that in recent faculty searches in Chemistry, candidates have expressed concern about vibration noise, and reservations about beginning a career at an institution where the construction and operation of light rail along the Montlake alignment would severely limit their opportunity for success. Already, candidates expressing such concerns have gone elsewhere to begin their academic careers. 83

e. Receiver-based techniques cannot be used in all experiments. In a tour of the Chemistry dept by ST and their consultant, it was pointed out that many experiments share equipment such as lasers, and this equipment cannot be shared when experiments spatially move independent of each other, as will be the case with receiver-based mitigation. The only way around this problem is to redesign the entire laboratory so that all equipment is physically linked and isolated as a single unit. This is clearly problematic when a researcher wants to try out an idea (a common occurrence at a research institution), and is unable to do so since the needed equipment is not physically joined. 84

f. Receiver-based mitigation techniques limit research productivity. In experiments where receiver based mitigation is employed, the tables supporting instrumentation cannot be used for physical support (that is, you can't touch the table). Unfortunately, experiments require interaction between the apparatus and the user (adjustment, alignment, etc.). For experiments performed on large, pneumatically-isolated tables, researchers are forced to lean over the table without touching it for extended periods of time. Back and leg fatigue generally sets in after a few hours, and injuries can occur such that the researcher is faced with the choice of not using isolation, or not working. Therefore, pneumatic isolation is only used as a last resort in any experiment since it is accompanied by a substantial reduction in productivity. 85

The second proposed "receiver-based" mitigation approach is to simply relocate affected researchers. If vibration noise were simply a problem for one or two researchers working in isolation from the rest of their department, then moving affected researchers is a potential solution, and the UW has considered this issue. However, many of the research facilities that will be affected by light-rail vibration noise are used by entire academic units; therefore, entire departments must be relocated. For example, the NMR facility is widely used in chemistry, biochemistry, materials science, and nanotechnology. The recent initiative in photonics relies heavily on the optical facilities in chemistry. Relocation of these resources to other areas of campus will severely burden research activities in these fields. Finally, much of the sensitive instrumentation has been placed in spaces designed to minimize environmental noise. For example, the vibration-sensitive equipment in Chemistry is placed in the center of buildings, or located in rooms employing floors that are structurally isolated from the building. The EE building was designed to house sensitive instrumentation in laboratories closest to Rainier Vista, the quietest part of the campus. Moving experiments away from the train would simply result in moving experiments closer to other sources of noise. Moving equipment to minimize noise from light rail train while maximizing noise from other sources is fruitless. 86

Section 4.12: Electromagnetic Fields
Reviewers: Professor J. Michael Schurr, Associate Professor Philip Reid and Bryant Fujimoto, Ph.D.

Of primary concern with respect to the Rainier Vista alignment is the Nuclear Magnetic Resonance (NMR) instrumentation housed in Bagley Hall and New Chemistry. NMR is a major analytical technique in chemistry, and plays a major role in the research programs of many researchers in chemistry, biochemistry, and materials science. The NMR facility is used extensively by researchers in numerous departments at the UW such that the impact this facility has on grant and contract revenue throughout the University is substantial. 87

A primary concern in regard to the Rainier Vista route is the potential impact of electromagnetic (EMF) generated by Sound Transit trains on the high-resolution nuclear magnetic resonance (NMR) instruments in Bagley Hall and New Chemistry. Interference from electromagnetic fields is often referred to as electromagnetic interference (EMI). NMR is THE major tool used by practically all synthetic chemists to ascertain what molecules they have made. It also is the principal tool used by many structural chemists and biochemists to determine the unknown structures, and changes in structure, of proteins, DNAs, RNAs, drugs and their complexes with other molecules. NMR plays a major role in the research programs of many UW researchers in the Chemistry, Biochemistry, Pharmacy, Materials Science, and Bioengineering Departments. The total value of the NMR facility in Bagley Hall exceeds $10 million. The acquisition of a new, cutting-edge spectrometer in the near future will push this value considerably higher. This facility has a substantial impact on the grant and contract revenue of the UW.

When light-rail has come in proximity to NMR facilities, the facilities have suffered significant degradation in performance. The final EMI report by ST's consultants provides a survey of NMR facilities that are in close proximity to light rail lines (in addition to those suggested by UW researchers). The central conclusion of this survey is that significant impacts have been observed for rail line-facility distances of 200 meters. The Rainier Vista alignment would place a light-rail line within 50 meters of EMI sensitive buildings. To our knowledge the Rainier Vista Alignment would be the closest approach of light rail to an existing NMR facility. As such, light-rail EMI impacts on the NMR facility are expected to be substantial. Consistent with this expectation, the SEIS states that the light-rail EMI levels arising from train operation along the Rainier Vista alignment will be in significant excess of UW tolerances in Bagley Hall **and** New Chemistry. 87 With this conclusion, the "reasonableness" of the UW tolerances is questioned, and the proposed EMI mitigation has some important shortcomings that are not clearly defined in the SEIS. Our comments regarding these issues are as follows: 88

I. The EMI criteria employed by the UW are extremely reasonable, experimentally verified, and supported by industry. The UW's criteria for Bagley Hall and Chemistry were developed based on measurements performed using the NMR spectrometer itself. With these measurements and basic considerations of magnetic field stabilities relative to the fields inside the NMR spectrometers, an EMI tolerance of 0.1 mG in Bagley Hall and Chemistry was established. This criteria was further verified by the following:

A. ST's own consultant. Chapter 8 of the final EMI report issued by LTK consultants outlines a series of conversations between the ST consultant, Ross Holmstrom, and NMR manufacturers. In these conversations, Holmstrom was informed by NMR manufacturers that stray magnetic fields "... as low as 0.2 mG would generally be disruptive", and that "... the effects of levels as low as 0.05 mG could be observed" in sensitive NMR experiments thereby degrading the performance of these instruments. 89 In addition, the manufacturers told him that the recommended minimum distance between a rail transit line and an NMR facility is 200 to 240 meters, far from the 50 meters from New Chemistry and 60 meters from Bagley Hall accompanying the Rainier Vista Alignment.

B. Chapter 11 of the LTK report presents a UW ambient EMI study performed by the UW EMI consultant (Dan Bracken). This study demonstrated that in the quietest areas of the campus removed from bus and trolley traffic, ambient EMI levels are as low as 0.02 mG. Additional EMI measurements were obtained by the UW consultant in early December at Chemistry, and the ambient levels were determined to be entirely consistent with the 0.1 mG levels specified by the UW.

In other words, the EMI study commissioned by ST has shown that the 0.1 mG threshold specified for Bagley Hall and New Chemistry is reasonable, and that ambient EMI levels for the quiet regions of the campus removed from traffic associated with Pacific Ave. and

15th Ave are characterized by ambient levels as low as 0.02 mG, also consistent with the UW thresholds. 89 cont.

The SEIS notes that the UW did not provide a numerical criterion for the rate of change of the magnetic field for Bagley Hall. We should note that a general criterion was given to ST since ST has no way to state with confidence what their rate of change of B-fields will be. Slow changes in the earth's magnetic field (which can take several seconds or even minutes to occur) can be mitigated using field stabilization circuitry in a high resolution NMR. 90 However, the more rapid changes in magnetic field typically associated with light rail (a few seconds or less) cannot be compensated for. This is the primary problem when light-rail lines come in proximity to NMR facilities. The tolerance set by the UW is such that if met, the rate of B-field change is not an issue.

II. The SEIS states clearly that ST cannot meet the UW's criteria for stray magnetic fields at Bagley Hall and Chemistry (Rainier Vista alignment). Sound Transit's own conclusion is that the magnetic fields produced by the train will exceed the UW thresholds for Bagley Hall and Chemistry. Sound Transit's EMI consultant, Ross Holmstrom, lists some additional methods to mitigate the stray magnetic fields from the train source (Section 5.5), but states that they are not practical. 91 The only source mitigation method he believes will enable Sound Transit to meet the UW's criteria is physical separation (Section 5.6 of ST's EMI report); that is, move the train further from Bagley Hall and Chemistry. Since the Rainier Vista corridor is narrow, the rail line can not be moved far enough from Bagley Hall and Chemistry to meet the UW criteria.

III. The EMI mitigation schemes described in the SEIS are unproven and have never been attempted. Specifically, "Quadrupole Mitigation" (page 4-106 through 4-110) is discussed extensively in the SEIS. In this approach, the power lines providing propulsion and return currents to the light-rail train are arranged in a geometry that (in principle) will provide a more rapid decrease of EMI levels with separation distance relative to standard propulsion schemes. 92 This propulsion scheme is presented as a *fait accompli*. In fact, the quadrupolar mitigation scheme has never been built, prototyped, or experimentally verified. The estimate of light-rail EMI noise is derived from a model and nothing more.

In order to meet the UW threshold at New Chemistry, the B-fields arising from the propulsion currents must be mitigated, or attenuated, by a factor of 107. Even if such a great attenuation factor could be achieved for the fields arising from the propulsion currents, one must be concerned that other sources of magnetic fields that were not previously considered to be significant will now become significant, or even dominant, at the new lower field levels. In fact, this has already proved to be the case. 93 As Dr. Bracken pointed out, the train cars themselves are magnetized. Indeed, they are predicted to give rise to larger fields than the propulsion currents after mitigation of the latter. How many other magnetic fields, which were previously negligible compared to those of the propulsion currents, are still not taken into account? Leakage currents are another very worrisome source of extraneous B-fields that are discussed below. Although these kinds

of fields, except for those from leakage currents, are normally insignificant, they may become significant in the quadrupolar or Hi-Lo design, and need to be checked out ahead of time. Before the UW accepts a "Hi-Lo" mitigation scheme along any route, it should require that ST demonstrate proof of concept by constructing a prototype model to demonstrate that all works as planned. 93 cont.

One of the difficulties in evaluating Sound Transit's proposed propulsion B-field mitigation scheme is defining all the possible uncertainties in the model. While some of the uncertainties are discussed in the final EMI report, and potential magnitudes are presented, there still remain many unanswered questions regarding how well this mitigation will work in practice. For example, the magnitude of the B-fields due to the leakage current and resistance of the cable connections are not estimated. There is no effort to define or propose any sort of safety margin between what the theory predicts and what might actually happen in practice. Finally, maintaining such a current balancing scheme will be extremely challenging, and essentially no thought has been given to this issue. That is, even if this mitigation works as designed on the first day of operation, we are extremely skeptical that such performance can be maintained without substantial, frequent, and costly maintenance. 94

IV. **EMI interference from "leakage" currents has been significantly underestimated in the current SEIS.** Leakage current is essentially the loss of return current from the rails into the ground. Such leakage results in EMI interference that falls off as 1/distance. Very little thought has been given the problems associated with leakage currents, and mitigating such currents. Specifically, the sole statement provided in the SEIS regarding leakage currents is (page 4-104):

"... *stray currents* leaking into the ground from the running rails may lead to current imbalances resulting in additional B-field levels. However, Holmstrom (2002) calculates that the additional B-field produced from stray currents would only be about 0.01 mG at a distance of 52 feet from the running rails." 95

The calculations referred to in this statement are extremely naïve. Specifically:

A. In an attempt to minimize EMI interference from propulsion currents, the voltage of the light rail system has been increased by a factor of two. As such, there will be a greater electromotive force driving current leakage such that leakage current problems of this design should be significantly greater than existing light rail facilities.

B. Leakage must be minimized by insulation of the rails from the ground. It is currents flowing along the surface of the rail fasteners that will be most problematic, and this has not been considered in ST's calculation. For example, the elevated operational voltage will increase the amount of ozone production, and ozone will react with the plastic and/or rubber insulation providing a hydrophilic surface that will be much more conductive than what one would expect from the design value of the rail fastener system. This problem is expected to increase with age and will be aggravated if the tracks cannot be kept extremely clean and dry. 96

C. If the leakage current should reach a metal pipe, currents could travel a significant distance away from the rail line spreading potentially disruptive magnetic fields over a very large area of the UW campus. This problem is entirely ignored in the SEIS. 97

D. ST has provided no examples where the stray current of an operating light rail line has been reduced to a sufficiently low level that the associated magnetic fields will be under the UW criteria. Furthermore, the leakage current estimates provided by ST are substantially less than known values for operating systems. ST's approach to this problem apparently relies on an unprecedented maintenance program, but how effective will this approach be? Unless ST can show examples, on comparable transit systems, where stray currents have been reduced to levels required here, the SEIS should acknowledge the fact that the required maintenance program is unprecedented. The SEIS should also state what steps ST is prepared to take if ordinary maintenance is not sufficient to control stray currents from their transit system. 98

E. The SEIS discusses mitigation measures for the section of track closest to the UW research buildings. However, due to the long range effects of these currents, it is also necessary to consider the sections of track north and south of the mitigated section under the UW. The SEIS should discuss what measures ST will undertake to ensure that leakage currents from adjacent sections of the tracks will not migrate into or through the UW. 99

In short, uncertainties regarding leakage currents remain substantial, and have not been adequately addressed in the SEIS or background EMI reports. The magnetic fields produced by stray currents extend over a very large distance; therefore, they are a concern to any researcher conducting research sensitive to stray magnetic fields *regardless of where the research is located on campus.* After the publication of the SEIS, a modified Montlake route has been suggested which would lie approximately 1000 feet away from Chemistry and Bagley Hall. For that route, the primary concern with respect to the NMR facility is leakage current. 100

V. **ST claims regarding the impact of campus bus and truck traffic on EMI levels are incorrect, inconsistent with measured ambient levels, and defy the laws of physics.**

Given the inability of ST to mitigate light-rail EMI noise levels to UW tolerances, a great deal of space in the SEIS is devoted to attacking the UW tolerances themselves. For example, the SEIS states "It is likely that there are some existing magnetic fields generated from within or external to the sensitive UW research buildings that can disrupt activities such as research experiments." This report goes on to state that "... preliminary calculations indicate that existing electric trolley bus service on NE Pacific Street and 101

diesel bus and truck traffic on Stevens Way may generate magnetic fields at Bagley Hall and Chemistry with intensities greater than the UW's requested level of 0.1 mG." With respect to Bagley Hall and New Chemistry, such comments can be dismissed as nothing more than a self-serving canard. Specifically: 101 cont.

(1) Recent measurements made near the chemistry buildings by the UW's EMI consultant show no disruptive magnetic fields beyond the 0.1 mG threshold. (Measurements made by Dan Bracken on December 9, 2003 between 4:30 and 5:00 pm.) 102

(2) ST's consultant has also made measurements of the ambient magnetic fields (November 12, 2003). To date ST has not disclosed the results of those measurements to the UW after frequent request. The few verbal and email indications which the UW has received suggest that ST's consultant did not observe any disruptive magnetic fields from bus/truck traffic on campus consistent with the claims in the SEIS. If ST feels there is anything in those measurements to bolster their claims, they should release the data to us so that we can comment on them. It should be noted that ST commissioned these measurements **after** submitting the SEIS for printing. That is, ST's claims regarding bus/truck perturbations were made with no experimental support. 103

(3) EMI measurements made by the UW's consultant have demonstrated that ST's calculations of bus/truck EMI noise are HIGHLY inflated, and that the fluctuations arising from traffic on Stevens Way are below measurement thresholds (<0.02 mG). We have attempted to reproduce ST's estimates of EMI noise originating from bus/truck traffic, but the numerical results listed in their technical report (EMI – North Link Preliminary Design, October 7, 2003) cannot be reproduced given the information provided. More troubling is the fact that the reported noise values are nonsensical. For example, despite the fact that a bus is significantly smaller that a train and contains 10-fold less steel, ST's estimates suggest that a bus will produce a larger fluctuation in the earth magnetic field at 50 meters than was actually *measured* for a one-car light rail train at the same distance. Since larger objects with more steel would be expected to produce larger fluctuations in the earth magnetic field, ST's prediction is clearly unreasonable. In summary, the calculations are nonphysical, and without experimental support. One can only regard the comments made regarding bus/truck traffic as an attempt to cast doubt on the UW tolerances. 104

VI. Where is the Link Maintenance Plan?

ST's proposed Hi-Lo mitigation strategy depends very much upon an extraordinarily high quality, and possibly unprecedented, mitigation protocol. Although they frequently refer to the Link Maintenance Plan, and we have repeatedly asked to see their plan, they have so far provided no information of substance. ST need to describe in detail (1) the proposed monitoring systems to assess changes in transient B-fields due to passing trains; (2) the time for intended response to an indication from the monitor that UW thresholds are exceeded; (3) the nature of the actions that will be taken when those thresholds are 105

exceeded for various reasons; (4) the time schedule for regular cleaning and maintenance of the insulating materials; and (5) the time schedule for replacement of various parts, including the connectors for the overhead contact wires and the wires themselves, the internal contacts with the wheels, etc. It would be very helpful to have some idea of their proposed budgets for (1) regular maintenance in regard to EMI, and (2) fixing acute problems that arise. 105 cont.

VII. With regards to moving affected facilities.

The DSEIS states (page 4-106) "In some instances, it may also be practical to relocate some of the research facilities." The UW rejects any mitigation that calls for relocation of the high resolution NMR facility. As has been explained to ST on numerous occasions, the NMR facility is used by multiple departments, and is the central diagnostic tool employed by chemists. Moving the NMR facility would require relocation of the entire Chemistry department at a cost that would be born by the State of Washington. Even if the entire department were moved, to where would it be located? The operation of light rail along Rainier Vista would significantly degrade the research environment of the "quietest" real estate on the UW campus. To suggest that moving facilities elsewhere is to ignore the central problem: ST is unable to mitigate to UW requested thresholds along Rainier Vista such that the operation of light rail would result in permanent, irreversible loss of an important asset of the UW campus, the ambient environment itself. 106

Section 4.12 Electromagnetic Fields
Reviewer: Robert S. Van Dyck, Jr., Physics

One of the major conditions that many of the researchers at the University of Washington will require in order to be successful in their work is low ambient magnetic noise. The EIS acknowledges that transit operation on or near campus will impact the ambient magnetic environment for one or more University buildings (through propulsion currents and geomagnetic perturbations) and thus describes methods to mitigate these impacts. However, what is basically lost in most of the EIS (except for three lines at the bottom of page 4-110) is the lack of serious attention to sneak-paths for ground currents and leakage currents associated with the huge currents required to operate the trains. In the worst-case scenario, these "sneak currents" will appear effectively as a single unbalanced line of current whose magnetic field will fall off inversely with distance from the source. Thus, a 100 amp unbalanced current will produce a 0.2 mG magnetic field at a distance of 1000 meters away or a 0.5 mG field at a distance for 400 meters away. These fields would impact many buildings on campus. 107

"ST Link Light Rail Project EMI – North Link Preliminary Design Prepared by LTK Engineering Services" Document # LTK.ST 0903.001 October 7, 2003
Reviewer: Robert S. Van Dyck, Jr., Physics

II. ST has failed to provide evidence to support their vibration estimates. Furthermore, the uncertainty in their predictions is substantially greater than the zero margin for error evident from their predictions. 52

A central concern in the analysis of light-rail vibration impacts is the validity and accuracy of the predictions provided by ST in Appendix P4.6. To date, ST's response has provided essentially no experimental support to justify these predictions. In our review of the limited information provided by ST, it is apparent that the vibration impact of light rail is significantly underestimated in the SEIS. 53

A simple "order of magnitude" estimate will serve to illustrate this issue. On page 4-69 a table of VC criteria is provided. In this table, the VC-E criteria or 125 microinches/sec is described as "a difficult criteria to achieve in most instances." Yet, the vibration predictions state that ST will be able to take a 500,000 lb train going 35 mph past the Electrical Engineering building some 100 feet away and achieve train vibration levels at or below 30 microinches/sec, or a factor of 4 reduced from the VC-E level. However, experimental verification of predicted train vibration-noise levels has been performed in only a "few" instances (and we have yet to see the data for these instances, few they may be). When asked about this issue, the UW was informed by the ST vibration consultant that such measurements are only performed if someone "bellyaches" about vibration noise. Finally, in discussion with both ST's and UW's vibration consultants it is not clear that the methods for predicting train vibration noise have ever been extended to the exceedingly low levels that characterize the current UW research environment. Clearly, the burden is on ST to demonstrate that they can achieve such unparalleled vibration levels is high, and that burden goes unmet in the current SEIS. 54

The vibration noise predictions rely on two essential parameters: the vibration amplitude from the train itself (referred to as the force-density level or FDL), and falloff of vibration amplitudes as a function of distance from the train (referred to as a line-source response function, or LSR). Each of these parameters has inherent uncertainty, and ST has stated that the uncertainty in their vibration estimates in total is +2 to –4 dB. We strongly disagree with the uncertainty estimate provided by ST for the following reasons: 55

IIA. FDL uncertainty. ST's consultants have employed an FDL that was derived using measurements of the Tri-Met system in Portland. Potential sources of error in the FDL can arise from the following: 56

a) In 1999, STs own consultant recognized the inherent uncertainty in FDLs by incorporating a "5 dB safety factor" in their estimates where the projected vibration levels were increased by 5 dB at all frequencies. A similar safety factor has not been incorporated into the present predictions. If it were, the predicted vibration noise levels would exceed the UW tolerance at every building in direct proximity to the Montlake Alignment with the exception of Johnson Hall. 57

To put the possible EMI problems that could be encountered with the new ST-light Rail system into perspective, let me recount some past history. When the Physics Department moved into PAB, there was a magnetic noise observed that had the same characteristic spectrum that had been observed in the old Physics Hall, but with 30 times the magnitude. This was traced to unbalanced currents in the electric trolley lines. After contacting the folks at METRO, we were able to convince them that they were generating this noise and they were extremely helpful in reducing it by almost an order of magnitude. This entailed isolating the section of trolley line that ran along N.E. Pacific St. and 15th Ave. N.E. The size of the magnetic noise at that time in the old Physics Hall was about 0.3 mG. Since the Chemistry Department is closer to these roads than the old Physics Hall, their background field then clearly exceeded the limit which they now request (0.1 mG). I mention this because I suspect that Henderson Hall is in the same position that Chemistry and Physics were in about 10 years ago. Henderson Hall requests a limit of 0.04 to 0.2 mG, but they may not be observing this at the present time (see #20 below concerning comment on page 133 made by reviewer, Ross Holmstrom). However, they might get close to these limits if they contact METRO to see if there are other trolley lines which could be isolated to reduce their magnetic noise. I should point out that the old Physics Hall was over 1000 feet from these roads, and unbalanced currents generate magnetic fields that fall off as 1/distance (as a monopole). 108

1. In Table 3.1 on page 3, the limit on the rate of change of magnetic field at Henderson Hall should be in units of mG/sec, not mG/sec2, consistent with the discussion of this time dependence in Section 4.3 on page 26 and Table 4.3 on page 32. 109

2. On page 8 (second paragraph from the bottom), there is a discussion of the need for maintenance of the light rail system and that it would be updated as needed to include any maintenance "that are identified as necessary for EMF mitigation." This statement suggests that there will be magnetic field monitoring stations. Will the University be responsible for these or ST? 110

3. On page 22 (about 1/3rd down the page), there is a statement that the resulting value of [gamma] = 0.077 is close enough to 1/[rho] = 0.09 for rough estimating." This statement could have been more accurate, since in the limit that [rho] >> 1, [gamma] = 1/(2+[rho]). 111

4. On page 23, the equations near the middle of the page are written twice. 112

5. On page 33 (in the second paragraph from the top), there is a reference to Figure 4.13. This should be a reference to Figure 4.11 instead. 113

6. On page 34 (at the bottom of this page), there is a reference to Figure 4.11. This should be a reference to Figure 4.12 instead. 114

7. On page 35 (near the center of this page), there is a reference to a resistance of 1.5x10-5 ?/m which should be 1.5x10-5 [ohms]/m. A similar problem of units occurs on page 36 (second paragraph from the top), which should read Rr [ohms]/m. 115

8. On page 38 (in the first paragraph in Section 5.1) the quantity aBe would make smoother reading as "aBe". 116

9. On page 39 (in the second paragraph from the top), there is a reference to Table 5.3 which should be to Table 5.1 instead. 117

10. On page 58, scenario #1 should be scenario #3 and scenario #2 should be scenario #4, consistent with the labeling in Table 6.3. 118

11. On page 59, scenario #1 should be scenario #5 and scenario #2 should be scenario #6, consistent with the labeling in Table 6.4. 119

12. On page 79 (second paragraph from the bottom), there is a discussion of the worst case contingency operation which would necessitate closing the normally-open tie-switches. It would be in the best interest of the researchers at the university that they be contacted by ST through an email (using a special email list of concerned researchers) that tells them when this contingency is invoked and what the projected duration of the voided mitigation will be. 120

13. On page 80 (top paragraph), there is a reference to the positive feeder cables buried below the centroid of the running rails that will be two continuous 1000 kcmil cables buried to a depth of 18 inches (46 cm). However, on page 15, in Table 4.1, these cables are modeled as a total of 2400 kcmil buried to a depth of 28 cm below the centroid of the running rails. No explanation is given for the discrepancy. Why are the cables 20 cm deeper now? On page 34, third paragraph from the top states that "to keep B-fields within 0.02 mG of the minimum level, the vertical position (of the buried cable) can shift no more than 3 cm from the minimum-B location." 121

14. On page 91 (second paragraph from the bottom), there is a sentence that starts as "Note that at half-height the magnitude B-field plot for 1 car is approximately 15 sec,...." This probably should read: "Note that at the half-height magnitude B-field for 1 car, the time duration width is approximately 15 sec,...." 122

15. In Table 9.2 on page 94, the last three columns are labeled incorrectly. The third column from the end is "2-train un-mitig B,Total" The second column from the end is "1-train B,Total" The last column at the end is "2-train B,Total" 123

16. On page 104 (last paragraph), there is a reference to Figure 10.3(a). This figure is missing. 124

17. Between pages 110 and 111, figure 10.5(d) is missing. 125

18. On page 118 (near the bottom), there is a description of "location 1" which refers to Figure 1 and Figure 2. These should be Figure 11.1 and Figure 11.2 instead. 126

19. On page 119 (near the top), there is a description of "location 4" which refers to Figure 7, Figure 8 and Figure 9. These should be Figure 11.7, Figure 11.8 and Figure 11.9 instead. 127

20. On page 133, the reviewer is conjecturing that the Henderson Hall magnetic noise may be dominated by geomagnetic field perturbations. However, the electric trolleys are quite pervasive (except along N.E. Pacific St. and 15th Ave. N.E. where the feeder lines have been isolated). As indicated earlier, it is possible to observe 0.3 mG field from the trolleys which have unbalanced currents in the feeder lines that are over 1000 feet away. Thus, I conjecture that Henderson Hall could have a still quieter environment, if they wished to contact METRO and experiment with isolating nearby trolley lines. However, the subway is another story. 128

"ST Link Light Rail Project EMI – North Link Preliminary Design Prepared by LTK Engineering Services" Document # LTK.ST 0903.001 October 7, 2003
Reviewer: Dan Bracken, UW EMI Consultant

It would be helpful to summarize the assumptions and design features that went into the models for magnetic field computations. The summary could be done in tabular form with the quantity, its assumed value and the uncertainties associated with that parameter of the model. For example, the cable locations would be listed with the results of the sensitivity analysis in Section 4.4.1. The distances to buildings were taken to the nearest point and uncertainties in laboratory location would increase distance. The currents were assumed to be at maximum(?) levels with uncertainties contributed by several described factors. This table could demonstrate that all the assumptions are reasonable and attainable in the design and construction. It will facilitate evaluation of the proposed design. 129

Specific Comments

Page	Section	Comment
1	Forward	T. Dan Bracken is with T. Dan Bracken, Inc. not the UofW
21	7th eq'n	Missing Im*Rr term on left side of equation
22	4th para.	Condition on gamma*N << 1 seems to be contradictory with text. As N gets larger gamma would have to get smaller.
58	Table 6.3	There is considerable difference in the fields at Bagley Hall predicted by Table 4.2 (0.16 mG) and those from Table 6.3 (0.025 mG). Can these be reconciled to give confidence in

		the results of both computations?
94-95	Table 9.2	Last 3 columns are mislabeled.
94	Table 9.2	last entry in first row should be".02" not "< .02"
104	Figure 10.3a	Missing Figure 10.3a
134-135	Section 11.3	Additional details on calculations of field perturbations from buses and garbage trucks should be provided, such as a table of distances and other assumptions.
135	Table 11.9	It would be useful to have measurements of background field changes at Bagley and New Chemistry to compare with predicted bus and garbage truck changes.
144	Section 13.3	Reconciliation of the St. Louis and Seattle designs should be demonstrated by a more quantitative approach using up-to-date design features of the St. Louis design.

129 cont.

Section 4.12 EMI
Prepared by T. Dan Bracken

EMI calculations are based on an idealized model with infinite straight conductors and defined current paths. Some of the uncertainties inherent in this model, such as buried and overhead feed cable conductor locations and catenary location and wear, have been discussed in the October 7, 2003 ST report. However, other uncertainties that could impact the final performance of the magnetic field mitigation scheme have not been quantified. These include the effect of track curvature, the length of the mitigation section, contributions of unmitigated sections to the total magnetic field, and leakage currents from the rails to earth. An estimate of the expected fields from the system that incorporates these and other uncertainties is needed for comparison with the University of Washington criteria. The estimate should include an expected value plus a range of uncertainty. The current field estimates are only point estimates for ideal conditions that do not express an uncertainty associated with the value. 130

For example, the October 7 EMI report indicates a tolerance from the point estimates of ± 10% associated with catenary wear for the initial installation of an oversize wire. However, the change in magnetic fields from the point estimate would only be positive for the change in contact wire diameter/resistance. Such estimates can be made for the other parameters and then combined to produce an overall estimate of uncertainty in the field produced by the train. Several parameters in the model are for worst case conditions but others are for optimum conditions. How the propagation of these uncertainties will affect the expected field estimate is not clear.

Several uncertainties that enter into the current idealized model for EMI mitigation are listed in Table 1. Completion of such a table and incorporation of the results into a model for the fields would provide a representative estimate of the expected fields and a tool for assessing the likelihood of the University of Washington criteria being met. 131

This table is intended to illustrate the many uncertainties involved in the model and how many of them can result in an increase in the field at selected locations. Information (and time) was not available to complete all entries in the table. Completion of this type of analysis during the impact assessment is intended to provide confidence that these uncertainties can be dealt with in the design and operations stage. Thus the uncertainties should be addressed quantitatively as was done with some parameters already. In addition, they should be combined, preferably in a probabilistic model, to provide an expected value with uncertainty. 131 cont.

Consideration of the uncertainties raises specific concerns that should be addressed further:

Stray (leakage) currents: the estimate of stray current given in Holmstrom (2002) (0.082 A/mile) was not substantiated in that document and no uncertainties were given for the resistance to ground values. The change in field for certain contingencies were not examined: for example, bridging across one or two of the insulating rail pads to ground or degradation of the insulation level, say, by 50 percent. Since stray currents will cause current unbalance with fields that fall off as 1/R, they are of particular concern and additional information on levels expected under real world scenarios is needed. The anticipated maintenance and monitoring measures needed to ensure minimal leakage currents over decades are also required. Will real time monitoring of current balance be employed to identify the need for maintenance? 132

Propagation of uncertainties: the current model provides point estimates for an output dependent on many factors. Confidence in the predicted fields would be enhanced by a model that produced or estimated the distribution of expected outcomes around the point estimates. 133

Other real-world factors: several factors that will be a part of the actual design have not been incorporated into the ideal model. These include the curvature of the tracks in the design, the exact track locations, end effects of the mitigated section, and the contributions of adjacent unmitigated sections to magnetic fields at sensitive locations. 134

Safety Factors in Design Criteria: What will be the design philosophy *vis-à-vis* the University of Washington mitigation criteria? For an untried mitigation scheme with as many unknowns as this one has, it would be prudent to use a final design criteria that is well below that required by the University, say, a factor of two or three lower. It will be very difficult, if not impossible to make any adjustments to the as-built system short of imposing operational constraints on the system, if the as-built system produces fields that exceed the University's criteria. Therefore recognition of possible uncertainties in the engineering design criteria will be important. In other words, it would not be appropriate to design the system to produce an estimated 0.099 mG at Bagley Hall. 135

Table 1: Examples of Estimated Uncertainties in Magnetic-field Mitigation Model for Bagley Hall from Original Montlake Alignment. Estimates based on calculations in ST October 7, 2003 report.

Parameter		Point Estimate	Uncertainty	Effect on field at 60 m		Comments
Type	Specific					
Location	Tracks	60 m from Bagley	- 0, +18 m		Decrease as go into building	0 at edge of buildings
	Buried cable	Optimal location	Lateral ± 1 cm Vertical ± 1 cm	+ 0.01 mG + 0.007 mG	Increases as deviates from optimum	Placing cable in conduit & following OH contact wire offset
	OH contact wire	Centered	Lateral ± 30 cm	~ + 0.01	Increase (estimated)	Contact wire offset from center if buried cable in center
Resistance	Contact wire	Optimum	-10% initial +10% final	+ 0.02 mG	Increase	To account for contact current wear
	Current imbalance	Optimum	± 10%	+ 0.025 mG	Increase	
Leakage currents	Track to ground resistance	1000 Ω 100 Ω 10 Ω	0.02 A 0.2 A 2.0 A	+0.0007 mG + 0.007 mG + 0.07 mG	Increase	R-rail = 0.008 Ω, 520m parallel rails Current depends on track-to-ground resistance only.
Operations	Number of trains	1	2			Point estimates based on one train. Inclusion of second train will not necessarily double uncertainties
	Current	2800 A	+ 0, - ?			Peak current at building location may be less than maximum during operation
Field Perturbation	Dependence: $1/R^n$	N = 2.2 for x < L				Empirical result
	Magnetic moment					Empirical result
Other effects	Curved track					Will enhance field on inside of track
	Finite mitigation section					Mitigation will decrease near end of section.
	Adjacent section					Unmitigated section will also have end effects.

Section 4.17
Reviewer: David Ogrodnik, Senior Facilities Engineer

1) Section 4.17.14, page 4-180: Typo. "Table 4.17-12" should be "Table 4.17-14" 137

2) Section 4.17.12, page 4-177: Please note that hazardous material releases to soils and/or groundwater exist in the vicinity of the UW Bryants Building, UW BioEngineering Building (now under construction), and the former City of Seattle landfill located east of Montlake Blvd. 138

Section 4.17
Joe Wells, Facilities Project Engineer

Under paragraph 4.17.14, Construction Impacts - Utilities, the potential impact to University utility tunnels is understated. The tunnels are included under Table 4.17-14, but are not discussed as a major utility that could be impacted. There are multiple utilities inside the campus tunnels, which are very deep, including steam, condensate return, power (up to 13.8 KV), communications, signal and alarm wires, compressed air, and chilled water. Work that may interrupt these services could have a major negative impact on University operations. 139

Section 4.17.3 Construction Impacts
Reviewers: Associate Professor Philip Reid and Bryant Fujimoto, Ph.D.

It is important to note that research grants are typically awarded for periods ranging from 3 to 5 years. The most disruptive construction impacts described by ST extend for a significant portion of that time (the smallest period quoted by ST is 10-14 months). If research is disrupted for such a period, then affected researchers will be unable to produce enough research results to satisfy the granting agencies, which will result in a loss of grant support. The consequences of disruption of research due to construction must be more clearly acknowledged and described in the SEIS. 140

Construction Impacts:
Table 4.17-12 (pages 4.172 of the DSEIS) offers ranges of vibration at a variety of distances from a variety of construction equipment. Even at 400 feet, the range of data show significant vibration impact. Most troubling is the data given for the TBM, offering a lower estimate of 500 micro-inches/sec at 400 feet. Since it is likely that the greatest (campus wide) vibration impact will result from excavation and spoils-hauling, it is important that an accurate schedule be developed so that the University will know what to expect and when to expect it. In addition, as an alignment is chosen and construction techniques are finalized, ST will need to provide the UW with better data about specific activities with specific durations. 141

With respect to the TBM vibration, if one assumes that the upper vibration limits apply to UW, then with little extrapolation it is clearly evident that the ambient threshold of most campus buildings will be exceeded from the operation of this equipment. Therefore, the use of the TBM at any location within the campus grounds (from south end to the north) will impact and exceed the ambient threshold of the majority of the UW buildings. This means that the TBM impact, unlike the operation impact, is not limited to the buildings in the vicinity of an alignment. To better understand this issue, we request that ST provide UW with an accurate duration for the use of TBM on the campus grounds, the zone of influence of the vibration from TBM (i.e. the radius that the TBM vibration will drop to our ambient threshold such as 30 microinches/sec.). Considering that the TBM is only one of the construction sources which will be superimposed on the vibration from other construction sources, we are concerned about the cumulative effect of all of the construction activities. 142

Page 4-159
The comment about vibration, dust and construction traffic impacting UW research is incomplete. It should include a comment about the dollar value of the grants involved. We note that on page 4-158 the DSEIS gives the value of sales at the University District Farmers Market, and the UW deserves a similar acknowledgement. The amount of research grants secured by the UW in 2002 was $933 million. 143

Page 4-161
Actual and perceived disruption during construction would create hardships for sensitive research and disrupt the recruitment and retention of faculty and the recruitment of graduate students in the affected departments. Sensitive research groups could lose grant support (e.g., go out of business). Departments may be unable to expand into promising areas of research due to difficulties in obtaining grant support, in recruiting and retaining faculty and in recruiting graduate students. Undergraduate instruction might be impacted as well for the following reasons. First, the UW is committed to creating opportunities for undergraduate research. In chemistry, this research is financed out of faculty research grants, and anything that adversely affects grant support and faculty retention will reduce opportunities for undergraduate research. Second, graduate students perform a significant amount of undergraduate teaching. However, without an active research program it will be difficult to recruit qualified graduate students who might serve as teaching assistants. 144

A statement similar to the preceding paragraph should be incorporated into the final SEIS. We note that a similar statement describing the effect of construction on businesses other than the UW is already in the DSEIS. 145

Section 4.17.7

page 4-171. The SEIS stated that during construction "impacts will be no greater than what is already experienced" during the course of other construction on campus. This statement is incorrect. When ST performed additional measurements of ambient vibration levels in electrical engineering, construction was ongoing at the adjacent site. At no time did the vibration levels measured by ST even approach the predicted levels that will accompany construction (roughly 20,000 microinches/sec). That is, ST's own data has established that the impacts to campus vibration noise will be well beyond anything experienced during the course of standard construction. 146

page 4-171
The sentence
"Some of the most sensitive research requires vibration levels at or below the ambient levels" is incorrect. It should read "The most sensitive research requires that the current low ambient be maintained." It is possible that this misstatement shows ST's continuing misunderstanding of how to account for the use of receiver based mitigation (described in the comments to 4.6.6, part-**IV**). 147

page 4-172
The statement "The current vibration sensitivity of the most sensitive research on campus is at or below 0.000125 inches/sec or 125 microinches/sec" is misleading. The current vibration sensitively of the most sensitive research on campus is roughly 20-30 microinches/sec. It is substantially less than the 125 microinches/sec number which ST quotes, and masks the degree of the problem. The statement should read: "The current vibration sensitivity of the research on campus can be as low as 20-30 microinches/sec." 148

page 4-173
"The period of impact would not be continuous but would rather be spread out and interspersed with periods of no vibration impact." The statement does not state how long the quiet periods might be. While some experiments can be scheduled into short periods, others cannot. In particular, some experiments may require an indeterminate amount of time to allow for alignment and data collection. If the quiet periods are too short, they may not be usable for some experiments. Therefore, the amount of relief the no impact periods would provide may be significantly less than might be expected, and the amount of time during which experiments are disturbed would be larger than the 10-14 month number quoted. 149

Chapter 5: Financial Analysis

5.1 Subareas and subarea equity
5.2 Costs
5.3 Sound Transit Baseline 2003 Financial Plan
5.4 Funding North Link
5.5 Risks and Uncertainties
5.6 Next steps

No comments

Chapter 6: Evaluation of Alternatives

Page 6-7, Segment B
"…some research facilities could be relocated as practicable." This statement suggests, inaccurately, that relocation is a feasible alternative. It is not due to the need to preserve the campus for research and the need to co-locate research and education. 150

Page 6-7, 6.2.4, Financial: Achieve Financial Feasibility. Because interim termini are presented as an alternative, this analysis needs to include the financial implications for the delay and stop-restart of construction. 151

Page 6-9, Cost Effectiveness. The comparative cost of mitigation associated with each alternative is not included here. Where is it? 152

Page 6-14, 4th Paragraph. "The difference in costs is relatively small for all two station alternatives, with the Montlake alternatives having the lowest cost and West Tunnel alternatives the highest cost. …. The Montlake alignment is the most cost-effective." How do mitigation costs affect this conclusion? 153

Page iv, Other. An additional approval step will be amendment of the Memorandum of Agreement (MOA) allowing Sound Transit access to University of Washington property. 154

Paul Brown, Director, Housing and Food Services
HFS response to Sound Transit Draft SEIS

This memorandum serves as the Department of Housing and Food Services (HFS) response to the Sound Transit Draft SEIS, released November 2003. In the Draft SEIS, Sound Transit recommends two alternative routes through the University District to service the North Link: 1) the Montlake Route; and 2) the Brooklyn Route. The Brooklyn Route—specifically the Southwest Campus Station—is unacceptable to HFS. 155

HFS is a self-sustaining, auxiliary unit of the University of Washington and does not receive any University, state, federal or other outside funds. As such, we rely fully on revenues from student housing, retail and residential food service, catering and conference services. HFS works hard to maintain facilities at a competitive market value and to attract future students to the UW.

In our review of the Draft SEIS, we have found that Sound Transit has misjudged the impact of their construction activities on our Department and the south campus community. In addition to the Department's previously stated concerns about resident 156

safety, we are very concerned about construction noise that will impact the entire southwest residential community: 2,500 students in all. 156 cont.

The Draft SEIS identifies only Stevens Court Apartments as impacted by the construction and operational activities. In fact, there are six residence halls in close proximity to the proposed Southwest Campus Station, three of which (Stevens Court, Stevens Court Addition, Lander Hall) are directly adjacent to the proposed Station. 157

Sound Transit asks for permission to continuously construct the tunnel 24 hours per day, for an estimated five years. It proposes a "cut-and-cover" method of construction, and predicts negative impacts from noise, vibration, dust, and construction traffic on nearby multi-family residences, adjacent UW housing, and other facilities. The construction noise described by Sound Transit is not conducive to an academic environment, nor to the positive student residential experience that we work hard to maintain. We find this to be an unacceptable exception to the strict enforcement of our residence facilities' quiet hours and a great burden to our community. 158

Our residents may view the construction activities and resulting conditions as untenable, and we foresee the possibility of a dramatic reduction in occupancy. Once occupancy declines, it will be very difficult for HFS to attract new residents. We have calculated the impacts based on a 10% to 50% reduction in occupancy due to construction of the station and subsequent tunnel work. The estimated annual financial impact for a 10% reduction of occupancy is $415,168 and a 50% reduction of occupancy, is $2,075,840 (Please see attachment). This loss of revenue would severely impact our ability to meet our financial obligations and to meet the student demand for on-campus housing. 159

As stated in my letter dated June 20, 2002, I remain very concerned about the security of our residents once the transit system is in operation. The unmonitored public traffic at all hours of the day and night is a serious safety concern to our residents. I urge you to consider the negative impact the Brooklyn Route imposes on our community and the Department of Housing and Food Services. 160

Housing & Food Services Attachment

	Amount	Capacity	Reduction 10%	20%	30%	40%	50%
Stevens Court Buildings B and C							
Residents		180	18	36	54	72	90
Financial Impact	$6,036		$ 108,648	$ 217,296	$ 325,944	$ 434,592	$ 543,240
Lander Hall							
Residents		790	79	158	237	316	395
Financial Impact	$3,387		$ 267,573	$ 535,146	$ 802,719	$ 1,070,292	$ 1,337,865
Total Room							
Residents		970	97	194	291	388	485
Financial Impact			$ 376,221	$ 752,442	$ 1,128,663	$ 1,504,884	$ 1,881,105
Terry Café							
Residential Customers		790	79	158	237	316	395
Financial Impact	$ 493		$ 38,947	$ 77,894	$ 116,841	$ 155,788	$ 194,735
Total Financial Impact			$	$	$	$	$

159 cont.

NL 208a (cont'd)

559

415,168	830,336	1,245,504	1,660,672	2,075,840

NL 208a (cont'd)

Sound Transit North Link Draft SEIS – Montlake Option
Reviewer: Helen Shawcroft, Associate Administrator, UWMC Administration

UWMC's comments on the DSEIS are noted in bold below. The comments not in bold were UWMC's comments on the Preliminary Draft SEIS. In general, these comments address the Rainier Vista Montlake Option contained in the Draft SEIS and the "modified Montlake option" discussed in late December 2003.

Construction Impacts

- Table 4.17-4 shows for the Montlake Station and Crossover the most intensive hauling period being 3 to 4 years. The table also shows 30 to 170 (average) truck trips to and from the site per day or 3 to 17 truck trips per hour. *This is an incredibly long time period to sustain this type of activity!* **This table is now Table 4.17-3. The statistics have not changed. Our comment is still applicable.** 161

- *We need to know the potential haul routes for the Montlake construction site.* The preliminary draft indicates that the potential haul routes are shown in the Transportation Technical Report. The portion of the 1999 Transportation Technical Report UWMC reviewed did not include the Montlake Station and Crossover. Is this information available? The haul routes, along with the times of the hauling activity, will determine the traffic impact of the hauling. For the UWMC Surgery Pavilion, we ended up hauling out dirt at night because it caused less traffic impact and the amount of time between the end of the am traffic peak and the beginning of the pm traffic peak in the Montlake Boulevard and NE Pacific St corridor was not a full 8 hours. **We still need to know the haul routes and the times of hauling activity. At a December 15 meeting, James Irish indicated that the times of the hauling would be set by the City. This timing will be critical for assessing traffic impacts. The University needs to know these issues sooner rather than later.** 162

- *Dust from the trucks hauling the dirt from the Montlake construction site is a concern to UWMC.* Dust can come both from the load itself and the dusty trucks. Dust is bad for immunocompromised patients and UWMC has lots of them. We would need to require the following types of mitigation and have it tightly enforced (as is done on all UWMC jobs): 163
  - ✓ Washing down trucks as they leave the construction site
  - ✓ Keeping streets free of dust (probably by street washing, not sweeping)
  - ✓ Covering all loads
  - ✓ Special filters on the UWMC air intakes we identify

  This is still a major concern for UWMC. Washing down the truck wheels of the trucks hauling the dirt (there are specially made wheel/tire washers) as the trucks leave the site is especially important, as is street washing. These are precautions we believe Sound Transit should write into their construction contract specifications. A

hard copy of sections of UWMC contract specifications for the Surgery Pavilion is attached. A copy of the drawings that show where UWMC required the wheel wash to be located and where UWMC required pre-filtering blankets over the air intakes to the hospital are identified in the drawings. 163 cont.

This concern grows under the "modified Montlake option." To have dirt stored on the construction staging site in the Husky Stadium lot makes the situation different. That dirt would have to be kept damp, and otherwise "managed."

- Parking for construction workers must also be considered. *If the Montlake Option is selected, both* the *Triangle Parking Garage and the Surgery Pavilion Parking Garage will have to be off limits to construction workers in order to have sufficient parking for UWMC patients and their visitors.* The next to the last paragraph on page 4.17-11 states that a relatively high number of construction workers are expected in the Montlake area. **This comment is still relevant, especially in light of the loss of up to 470 parking spaces in the Stadium lots during the construction phase of the "modified Montlake option." We believe that the majority of employees parking in the Stadium lots are UWMC, School of Medicine and Health Sciences employees. The second to the last paragraph on page 4-155 acknowledges that the "UW would likely prohibit construction workers from parking on UW parking lots, such as the Triangle Parking Garage and the Surgery Pavilion Parking Garage." It is also unclear on page 4-156 what the impact of the Montlake option would be on UWMC's ability to use the Rainier Vista as part of its valet parking program.** 164

- **Please detail what is the impact of construction related vibration on UWMC, especially our new Surgery Pavilion.** 165

- The last paragraph on page 4.17-31 states that during construction "Sound Transit would attempt to keep at least one lane of traffic open at all times, especially on main arterials." Later in that same paragraph it is stated that the UW would review and approve all traffic control plans. *Lane closures on Montlake Boulevard and NE Pacific Street cannot be tolerated at any but a few limited times. Access for emergency vehicles must be maintained.* **This comment is still valid, given the bullet points on page 4-147. Availability of Montlake Boulevard and NE Pacific Street for our patients to get to our facility is critical for our financial viability. Page 4-178 states that UW would review traffic control plans for "on-campus site." We assume that includes the Montlake option and the "modified Montlake option."** 166

- Sound Transit needs to review the locations of the utilities that run from Upper Campus to UWMC and outline how these facilities will be protected during construction and operation. These include all our emergency power (we have to have emergency power), steam lines and utilities tunnels. **This comment is still valid.** 167

- **Noise during construction could be a concern. We would expect close coordination with UWMC on the noise issue, especially regarding hours of noisy work.** 168

Public Services

- The first paragraph under section 4.13.1 states, "Several hospitals provide emergency medical services near the proposed light-rail routes." *Is there any special enhanced role that is expected of UWMC in servicing the needs of the Sound Transit ridership?* **This comment is still valid.** 169

Transportation Impacts

- **We understand that the goal of the light rail system is to reduce the reliance on the automobile. However, we continue to have concerns about the permanent loss of parking spaces in the Husky Stadium lots under the "modified Montlake option." We need to know how many spaces will be lost on a permanent basis. We expect that the UW and Sound Transit will have continuing discussions on this issue.** 170

- **We have concerns about "hide and ride" parking for the Montlake Station under either the Montlake option or the "modified Montlake option." How will Sound Transit mitigate this impact for stations on or near campus?** 171

- **The first new paragraph on page 3-33 indicates that: "The NE Pacific Place/Montlake Boulevard NE intersection operates at an unacceptable LOS F with the No-Build Alternative due to high-volume eastbound left, southbound through, and northbound through movements, as well as the high-volume westbound movement exiting from Husky Stadium. Minor increases in delay would be experienced with Build Alternative B1,D, B3.D and B4.D." This is a concern. How will Sound Transit mitigate this impact?** 172

- **What are the impacts of having the Montlake Station (under either the Montlake option or the "modified Montlake option") serving as an interim terminus? What are the impacts and how will they be mitigated? UWMC and the University have grave concerns about this possibility and believe the impacts to the campus and the street networks in the area to be significant.** 173

Sound Transit DSEIS
Reviewer: Denis Martynovych

The Burke has completed a long range strategic plan that confirms its expansion will occur at its present location. The Burke remains very interested in a routing approach that results in a station at NE 45th & 15th NE. A station beside or integrated into an expanded museum will result in high visibility for the museum and have a positive impact on attendance. In twenty years, attendance to the museum has been conservatively estimated at well over 500,000 visitors per year. Therefore it is critical to think about these long term impacts on the University, transit ridership, and the neighborhood. 174

However, we remain concerned that impacts are mitigated during construction and train operations takes into account vibration needs of the museum. These issues need to be reviewed in detail even if the alignment passes near the museum.

Construction and transit operational mitigation was extensively discussed in the original MOA addressing the 15th Ave NE alignment and the points remain relevant. In brief they include: 175

1) construction vibration mitigation that provided equipment isolation tables for sensitive equipment and source isolation to maintain vibration below levels detrimental to the collections

2) Dust mitigation including the need for AC if the we are required to keep windows shut during construction. 176

3) Compensation for loss of museum patronage during construction. This can be negotiated to include funds for increased media exposure to maintain attendance at acceptable levels. 177

4) The tunnel and stations are designed to lower or at least not add additional costs to construction cost estimates for museum expansion and the University's related 500 stall underground parking garage. 178

It is our understanding that discussions are underway for a new alignment, not described in the current EIS, and referred to as the Modified Montlake Alignment. The Burke has a strong interest in modifying this proposal in a way the results in at least one end of the station beside or incorporated into an expansion of the museum. We are eager to work with Sound Transit and the University to make the most this rare opportunity. 179

NL 208B

VACC, INC.
dba VIBRO-ACOUSTIC CONSULTANTS

490 POST STREET • SUITE 1441
SAN FRANCISCO • CA • 94102 • USA
TEL: (+1) 415-693-0424
FAX: (+1) 415-693-1398
http://www.va-consult.com

MEMORANDUM

DATE: 14 November 2003

TO: John Brandon, JB&A — **E-MAIL:** jbanda@aol.com

FROM: Ahmad Bayat, P.E. — **E-MAIL:** abayat@va-consult.com

SUBJECT: *North Link UW Vibration Background Report by PSTC (9/2003) – Review Comments*
Project N° VAC-2002-008

Dear John,

We have completed an overall review of the document submitted by Sound Transit, "North Link University of Washington Vibration Background Report", prepared by PSTC, dated September 2003.

As background to the issue of ST train vibration impact on UW research activities, we wish to bring up to your attention that the most critical train impact is in the low frequency region below about 20Hz. The low frequency criticality is due to a number of factors as outlined below. 1

- Train forcing function does have strong low frequency content associated with the internal train/track system components. The larger train force means higher vibration amplitudes.
- Source mitigation in order to eliminate the low frequency train forcing function is very difficult if not impossible as the ST's report indicates.
- In general, the low frequency vibrations propagate more efficiently in soil due to their larger wavelengths.

Therefore, we have to be more vigilant in scrutinizing all components of the ST's prediction approach in the low frequency region.

The following are our overall comments on the ST document:

1. Under "Vibration Criteria" heading, all references to generic vibration criterion curves such as VC-A, etc. for each building is extracted from one of our previous reports; this has since been superceded. In fact, references to these criterion curves contradict the paragraph on top of page 9, which refers to the current position of UW in regards to the use of ambient vibration as the criterion for each building. 2
2. On page 10, under "Predicted Ground Vibrations at UW Buildings" heading, ST lists out several "Modeling assumptions, which were used to determine a worst- 3

NL 208b (cont'd)

case scenario of future ground vibration levels at UW…" There are a number of more fundamental assumptions left out which collectively contribute to the error margin associated with their prediction. We had previously commented on their prediction approach when reviewing their detailed reports from WIA and ST. For example, the use of limited field data to develop the line source response, and the variables associated with train forcing functions, etc. are just two missing items. Please refer to our previous detailed comments in this regard. In fact, all these assumptions lead to an error margin that is not quantified by ST. Without the error bar, one cannot state that their prediction yields "worst case scenario". Even if we assume 10 dB to account for all the assumptions and uncertainties in the prediction, we can readily see that ST train vibrations would exceed most building limits. 3 cont.

3. In Figure 29, no backup is provided for the insertion loss associated with the floating slab options. 4
4. Some data reported in the figures seem not to agree with data presented in the June 2003 report. Specifically, in some cases the unmitigated vibration levels differ, while the mitigated levels are the same. There is no explanation for this discrepancy. 5

We make the following notes regarding specific passages in the September 2003 document:

- (P7) Regarding Bagley Hall, we note that the Brucker Biospin dmx750 sensitivity is significantly below VC-B in the low-frequency regime; at any rate, we continue to object to discussions of individual tool sensitivity in place of the generic criterion as defined by the UW for sensitive buildings. 6
- (P7) Regarding Benson Hall, the TopoMetrix AFM sensitivity is significantly below VC-B in the low-frequency regime; at any rate, we continue to object to discussions of individual tool sensitivity in place of the generic criterion as defined by the UW for sensitive buildings. 7
- (P8) In the notes regarding Henderson Hall, no easily-defined criterion exists for this building. One aspect of the saltwater tank experiment has *measurement capabilities* down to 780 micro-inches/sec as noted; however, this should not be taken to imply that the equipment is not sensitive to lower vibration levels. 8
- (P8) In the notes regarding the Bioengineering/Genomics Building, it should be noted that while *some* of the equipment expected to be installed here is currently located on upper floors, *not all* of the expected equipment could be considered insensitive. 9
- (P10) It is noted that the average ambient data used to state the UW thresholds "[do] not fully reflect the variation in background vibration levels from transient events". These thresholds were developed based on ambient data collected at multiple positions within each building at multiple times of day. In all cases, the data were collected during the mid-day hours, which experience (and long-term measurements carried out by the ST subconsultant at four UW buildings) indicates is the noisiest part of the day. Therefore, the ambient levels reported tend towards the high end of the range over the course of the day. 10

- (P12) The notes regarding movable point frogs indicates that the movable frogs generate no more vibration than regular tangent track. We would like to see some backup information validating this claim. 11
- (P13) Regarding the note that "average ambient thresholds should not be treated as a hard and fixed line and that a small exceedance at one or two frequencies reasonably meets the ambient criteria", the UW position represents a compromise position. In addition, given the multiplicity of uncertainties in the prediction methods, the definition of a "small exceedance" is ambiguous. 12

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Please feel free to call if you have any questions; we may be reached in our San Francisco office by telephone at (+1) 415-693-0424 or via email at abayat@va-consult.com .

Sincerely,

Ahmad Bayat, P.E.
Vibro-Acoustic Consultants

VACC, INC.
dba VIBRO-ACOUSTIC CONSULTANTS

490 POST STREET • SUITE 1441
SAN FRANCISCO • CA • 94102 • USA
TEL: (+1) 415-693-0424
FAX: (+1) 415-693-1398
http://www.va-consult.com

MEMORANDUM

PAGE 1 OF 4

DATE: 23 January 2004

TO: John Brandon, JB&A — **E-MAIL:** jbanda@aol.com

FROM: J. Byron Davis — **E-MAIL:** byron@va-consult.com

SUBJECT: UW / ST Vibration Impact: November 2003 North Link Draft DSEIS Comments

Dear John,

We are pleased to submit these comments on the DSEIS documentation received by us in December 2003 and dated November 2003.

Section 4.6.5, p. 4-67: Language in the DSEIS states that not performing one of the maintenance measures listed in Table 4.6-5 "may not pose a significant increase in noise or vibration levels". This is a subjective statement and implies that ST may arbitrarily not perform one of the listed maintenance items. Since ST has not quantified the vibration amplitude of any of the listed maintenance items, this statement should be removed from the document. 1

Section 4.6.6, p. 4-69 ("University of Washington Criteria and Methods"): The DSEIS relates the Vibration Criterion (VC) curves as defined by IEST. It is instructive to note that these criteria have been widely applied in industry; while they have been used in the research community, many institutions have implemented criteria that are more demanding. For example, the National Institute of Standards and Technology (NIST) has developed for its facilities two vibration criteria curves for which are considerably more stringent than the VC curves. ST should remove any references to VC curves since they do not apply to UW buildings. Earlier reference to VC curves in UW consultants reports have been superceded by the current position of the UW, which is based on actual ambient vibration measured at the foundation of each building. The UW current position is articulated in the last paragraph on page 4-69. 2

Section 4.6.6, p. 4-69 ("University of Washington Criteria and Methods"): In the list of VC curves shown, the notes for VC-E indicate that this is "a difficult criterion to achieve in most instances". While this is the standard language used in defining the VC curves, it is instructive to note that VC-E is a difficult criterion to achieve in *industrial* settings such as cleanroom facilities. Clearly, ambient vibration levels well below VC-E are currently achieved at the foundation level of most UW buildings. Please see our above comment regarding removal of any references to VC curves. These curves simply do not apply to UW buildings and the UW requirements are as stated at the bottom of page 4-69 of DSEIS. 3

Section 4.6.6, p. 4-70: The DSEIS states that the UW ambient data "quantify the ambient vibration levels … likely experienced during the quietest times of day". This is incorrect. The ambient data provided by the UW are representative of average vibration levels experienced during working hours. Data developed during extensive testing at four UW buildings in December 2002 by the ST vibration subconsultant illustrates that vibration levels vary considerably over the course of the day, with daytime levels consistently higher than evening levels. Various comparisons of the data generated by the UW and the ST subconsultants affirm that the ambient data provided by UW are clearly ***not*** representative of the quietest vibration levels experienced during the day, and in fact generally lie at the upper end of the measured range, depending on the expression. 4

Section 4.6.6, p. 4-72: The DSEIS states that the results of the December 2002 re-testing of selected UW buildings by ST yielded data showing that "vibration levels were generally consistent with the average ambient measurements conducted by VAC" and offered by the UW as the ambient criteria. We again point out that the data gathered by the ST subconsultant during this testing succeeded only in re-affirming the quiet ambient vibration environment enjoyed by the UW community. 5

Section 4.6.6, p. 4-73: The DSEIS states that the "analysis assumptions lead to conservatively high prediction of train generated vibration". Our understanding is that no safety factor has been incorporated into the predictions. In addition, the engineering variables used to develop the predictions are subject to uncertainty; we do not see what values for these variables have been assigned which will result in conservative prediction. In fact, some ***known*** variables have been omitted, such as the 3dB increase in vibration levels during simultaneous train passages (see comments below regarding p. 4-76). 6

Section 4.6.6, p. 4-73: The DSEIS states that "vibration velocity estimates are usually within a few decibels of actual measured levels for well-maintained transit systems". If a reasonable safety factor has previously been experimentally determined, we would suggest that this figure be added to the predicted spectra. 7

Section 4.6.6, p. 4-76: The DSEIS states that if the track profile is raised closer to the surface, "vibration levels could increase by about 1-2 dB at the seven affected buildings. However, the impacts relative to the unmitigated UW equipment sensitivities and UW requested threshold would not change". We do not understand the meaning of this language. A shallower tunnel necessarily implies greater impact. In addition, we understand that this additional impact has not been accounted for in the predictions. 8

Section 4.6.6, p. 4-76 ("Number of trains"): The DSEIS states that for simultaneous train passages, "the increase could be as little as 1 to 2dB" for buildings at moderate lateral offset. The additional distance between the tracks translates into significant differences in slant distance for buildings at considerable lateral offset (where impact is already diminished). A 3dB increase in the predicted levels should be included to account for simultaneous train passages. 9

VIBRO-ACOUSTIC CONSULTANTS • 490 POST STREET, SUITE 1441 • SAN FRANCISCO, CA • 94102 • USA
PHONE: (+1) 415-693-0424 • FAX: (+1) 415-693-1398 • INTERNET: http://www.va-consult.com

NL 208c (cont'd)

Section 4.6.6, p. 4-76 ("Peak and off-peak periods"): The DSEIS states that the "predicted maximum train vibration levels … would occur for approximately 5 seconds during a single train pass-by at 45 mph". Although ***maximum*** impact would persist for 5 seconds, ***significant*** impact might persist for considerably longer. The duration of the train impact is so long that medium-duration experiments (with time constants on the order of tens or hundreds of seconds) will often be subject to LRT impact for longer than the 1.7% or 3.4% of the time implied by the average headways. Later DSEIS language states that "sensitive experiments occur over the course of a few minutes to several hour or days time". In actuality, experiments typical of campus research span a wide array of data collection time constants, from microseconds to days. Clearly, maximum train vibration must be used in determining the train impact on the UW research activities. 10

Section 4.6.6, p. 4-76 ("Source-based mitigation"): The DSEIS states that for a moveable frog, "the gap is eliminated and one end of the frog moves in the direction of the train travel thereby eliminating the wheel impact". We have not received any information to validate the notion that vibration impact from the crossover is ***eliminated*** by the moveable frog. 11

Section 4.6.6, p. 4-77: The DSEIS states, "speed reductions … would only be employed if absolutely necessary … once the actual vibration levels from the constructed system are determined". We suggest that designing the system for full speed and later negotiating speed reductions will lead to quagmire. If speed reductions are necessary to meet the UW criteria, then these speeds should be designed into the system from the beginning. We also have the same concerns as Professors Reid and Fujimoto regarding the reduction of vibration one can achieve by reducing train speed from 45 to 30 mph. Since the most critical train impact is in the low frequency region, which is also difficult to mitigate, any reduction of the low frequency train vibration using speed reduction must be justified before UW accepts this as a mitigation measure. 12

Section 4.6.6, p. 4-77: The DSEIS states, "with source-only mitigation, all of the … alternatives are projected to have vibration levels lower than the existing building sensitivities…" This is incorrect. It has been discussed previously that research in some buildings is already limited by the current ambient condition. Therefore, ***any*** increase in vibration levels necessarily impacts this research. 13

Section 4.6.6, p. 4-77: We have received conflicting transmissibility curves for 8-Hz floating slab option, some based on theoretical curves and some based on measurements. To date we are still not satisfied what is the correct and actual transmissibility curve of an 8-Hz floating slab. Since this is the best source mitigation option available besides the speed reduction, we need more engineering data to confirm the expected performance of this type of isolation system. 14

Section 4.6.6, p. 4-78: The DSEIS states "if the profile is raised, vibration levels could increase by about 1-2 dB and cause the mitigated vibration levels at some affected buildings to exceed the UW requested threshold". This language contradicts previous language noted in the comments regarding p. 4-76 above. 15

VIBRO-ACOUSTIC CONSULTANTS • 490 POST STREET, SUITE 1441 • SAN FRANCISCO, CA • 94102 • USA
PHONE: (+1) 415-693-0424 • FAX: (+1) 415-693-1398 • INTERNET: http://www.va-consult.com

Section 4.17.7, p. 4-171: Table 4.17-12 provides range of vibration that different construction equipment might generate at a given site. Obviously the applicability of this data to UW campus must be justified. Additionally, ST must provide vibration prediction from all of the construction activities. The prediction should include the superposition of various construction activities, which could occur simultaneously. The prediction will provide UW with an understanding of construction-generated vibration and the extent of impact on each building. This data is an integral part of decision-making process for selection of an acceptable alignment. Since the duration of construction can span several years and its impact is more severe than normal train operation (i.e. larger radius of impact), an acceptable alignment should satisfy the UW requirements both during construction and operation. 16

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Please feel free to call if you have any questions; we may be reached in our San Francisco office by telephone at (+1) 415-693-0424 or via email at byron@va-consult.com.

Sincerely,

J. Byron Davis

Vibro-Acoustic Consultants

NL 208c (cont'd)

5. Soiling, staining and corrosion.
6. Unusual wear or other misuse.
7. Excessive weathering.
8. Unprotected storage.
9. Improper shipping or handling.
10. Theft
11. Vandalism.

3.3 WORK ADJACENT TO OCCUPIED AREAS

A. The project areas abutting construction will be fully functioning during the day with staff in close proximity to the Contractor's operations. Work involving any potential disruption or adverse effects to building occupants shall be coordinated with the Owner in advance. The Owner may, at its option, require such work to be conducted off-hours and special provisions such as temporary barriers provided to shield building occupants from noise, heat, dust, fumes, and other sources of irritation.

B. The adjacent Cascade Tower is extremely sensitive to dust. Clean construction procedures are to be implemented for mitigating demolition and construction dust.

C. Fire and Emergency Exiting: Maintain corridors and stairwell as emergency exits at all times.

D. Medical Center Air Quality Control: The Medical Center will be in full operation during all phases of construction.

1. It is essential that all sources of fumes, vapor, and installation of out gassing materials be under sufficient control to avoid occupants discomfort.
2. The use of temporary air barriers and portable fans to evacuate objectionable odors may be required by the Owner.
3. It may be necessary for the Owner to require off-hours work for such activities in addition to off-hours work required for other reasons.
4. Arrange with the Owners Representative well in advance for work which might involve the generation of objectionable odors.

3.4 NON-SMOKING FACILITY

A. The University Medical Center is a non-smoking facility and no smoking will be tolerated on the jobsite in any fashion. This includes smoking on the grounds immediately adjacent to the UWMC, within the UWMC itself, and in the doorways, loading docks or other areas on the site. No smoking room or area will be set aside for smoking and no tobacco products of any kind will be tolerated on the project site.

END OF SECTION

4. Immediately clean up any spilled material. Clean all trash and debris from work area daily. Keep work area, site, and adjacent properties free from accumulations of waste materials, rubbish and windblown debris resulting from construction operations. Provide on-site containers for collection of waste materials, debris and rubbish. Periodically remove waste from the site.
5. Do not use Owner's waste containers for construction waste.
6. Dispose of all flammable, hazardous, and toxic waste materials daily. Storage of these materials will not be permitted on the interior of building. Coordinate dumpster location with Owner's Representative.
7. The contractor is responsible for the overall project clean up and waste disposal, though the subcontract bids may include the costs for the clean up and disposal associated with each subcontract.

G. Odor Control:
1. General: The use of solvents and materials producing noxious fumes or any non-specified product or equipment or vehicle that adversely impacts indoor air quality, shall be subject to the approval of Owner. Contractor shall submit a written procedure for the control of construction odors. Isolate odor causing work away from air intakes or pedestrian traffic areas.
2. Work Plan: the work plan shall consist of at a minimum the following items:
   a. Products to be used (MSDS sheets)
   b. Location of work
   c. Application
   d. Ventilation plan
   e. Hours of operation
   f. Material handling/storage
3. Considerations include:
   a. Concrete curing
   b. Roofing and waterproofing
   c. Welding
   d. Painting
   e. Equipment and trucks producing fumes

1.3 PROTECTION OF EXISTING UTILITIES

A. Concealed utilities shown on the drawings are not necessarily exact with respect to location or completeness; therefore, Contractor shall take the following steps:
1. Notify Owner in writing, on each occasion, of the intent to work near existing underground utility services or structures or when a new excavation operation is about to begin. Submit procedure for approval to assure safe and continuous operation of the services.
2. Proceed with sufficient caution to preclude damaging any utilities known or unknown i.e. hand digging or probing. In the event unidentified utilities are encountered, notify Owner's Representative immediately.
3. In the event utilities are damaged during construction, temporary services and/or repairs must be made immediately to maintain continuity of services at Contractor's expense.

B. Security: Protect Work, stored products, and construction equipment from theft and vandalism; and protect premises from entry by unauthorized persons. At the end of work day, close temporary enclosures and lock exterior doors and/or gate. Secure all openings at any time site is left unoccupied.

C. Fences and Barricades: Provide temporary six (6) foot high chain link fence panels with top rail securely fastened to tubular metal posts set in heavy concrete bases to prevent ready relocation unless otherwise indicated. Panels are to be anchored together to prevent entry between panels. Provide fence around construction laydown area and as indicated on Drawings. No barbed wire permitted.

D. Dust Proof Enclosures: For all work within the existing facility, provide dust-proof enclosures to separate the work from occupied areas. These enclosures shall be one-hour rated walls as required plus dust-proof polyethylene plastic with all edges caulked. Prior to construction of these enclosures, submit plan showing proposed locations. This work may be part of the subcontract bids.

1.9 NOISE CONTROL

A. Maintain the sound pressure level of construction noise inside adjacent buildings and/or rooms from exceeding a 60 DB(A) (with windows closed) between the hours of 7:30 AM and 9:00 PM daily. Contractor shall meet this criterion by erecting barriers between equipment or job and such interior areas, or by providing equipment noise attenuators. This cost may be part of the subcontract bid.

B. Machinery & Equipment: Electric-driven is preferred in place of gas or diesel powered machinery. If noise levels on any gear cannot reasonably be brought down to criteria, either that gear will not be allowed on the job or use times will have to be scheduled subject to approval of the Owner. Conformance to this specification shall be included in the Contract price and no compensation will be allowed for special equipment, overtime, etc. that may be required.

C. Outdoor Vehicle and Internal Combustion Engine Noise: The sound pressure level of each piece of equipment shall not be greater than 85 DB(A) at a distance of 50 feet as measured under noisiest operating conditions. Rubber-tired equipment will be used whenever possible instead of equipment with metal tracks. Mufflers for stationary engines shall be hospital-area quality of silencing. Construction traffic plan shall be approved by the Owner. Routing should be through the nearest campus exit, subject to approval of Owner.

D. Air Compressors: Equip air compressors with silencing packages. Electric-driven preferred.

E. Jack Hammers and Roto Hammers: May be used where no other alternative is available if permitted by the Owner. The use of core-drilling or saw cutting equipment or electric driven drills preferred. Time of use subject to approval by Owner.

F. Arc Welders: No arc welders are to be connected to University utilities, unless approved by the Owner. Provide separate gas generators for arc welders.

G. Limited Hours of Use Within Buildings: Within occupied facilities, work is subject to approval of Owner and will be, in general, allowed only between the hours of 8:00 AM and 8:00 PM daily. Specific scheduling is required, with two (2) weeks advance notice required and approval by Owner.

H. Equipment and Vehicle Exhaust: No engine shall be idled or run in close proximity to the Medical Center. Any equipment location that produces exhaust shall be approved in advance with the Owner.

1.10 PUBLIC TRANSPORTATION

A. Use of public transportation to the University of Washington is encouraged. Metro and Community Transit bring many direct route to campus and the University District.

B. If interested in further information regarding routes, schedules or Park & Ride locations, call Metro or Community Transit for advice or pick up bus timetables that are available at various locations around campus.

1.11 PARKING

A. Parking on or near the University of Washington is congested. To minimize the disruptions to University operations and the impact on the adjacent neighborhoods, Contractor shall limit the number of vehicle trips to the Project site by encouraging carpooling. In addition, the contractor shall advise construction workers not to park in neighboring residential areas. This information shall be posted along with the bus pass/ticket information.

B. The Contractor shall limit construction parking to approved area(s) shown on drawings or indicated in the contract documents. Parking permits are required for all vehicles parking on campus.

C. There are different types of permits that may be issued by the Owner's Representative to the Contractor, depending on length of need and number of spaces required.
   1. Construction Parking Permits, issued at no cost to contractor:
      a. A limited number of permits for short term parking for the purpose of staging and administration within the fenced construction site work area.

D. Construction parking will be located at a remote parking lot until such time as the project parking garage is available for Contractor's use. The GC/CM is to provide a shuttle bus service for all construction personnel for as long as required. This bus service may be part of the subcontract bids.
   1. Designated parking area is for workers personal vehicles only and not for the storage of equipment or materials.
   2. There shall be no charge. All Contractor personal/workers will be restricted to the designated area.
   3. Contractor will provide Owner's Representative with the projected number of spaces required two weeks prior to the month required.
   4. Owner's Representative will provide to Contractor the requested number of monthly parking permits no later than the 25th day of the preceding month prior to the month for which permits are to be used.

E. University parking and traffic regulations are available upon request. Parking citations, impounding of vehicles and loss of parking privileges on campus may result from failure to comply with these regulations.

UWMC INFECTION CONTROL AND INTERIM LIFE SAFETY REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL

A. Section Includes:
   1. Infection Control
   2. Life Safety

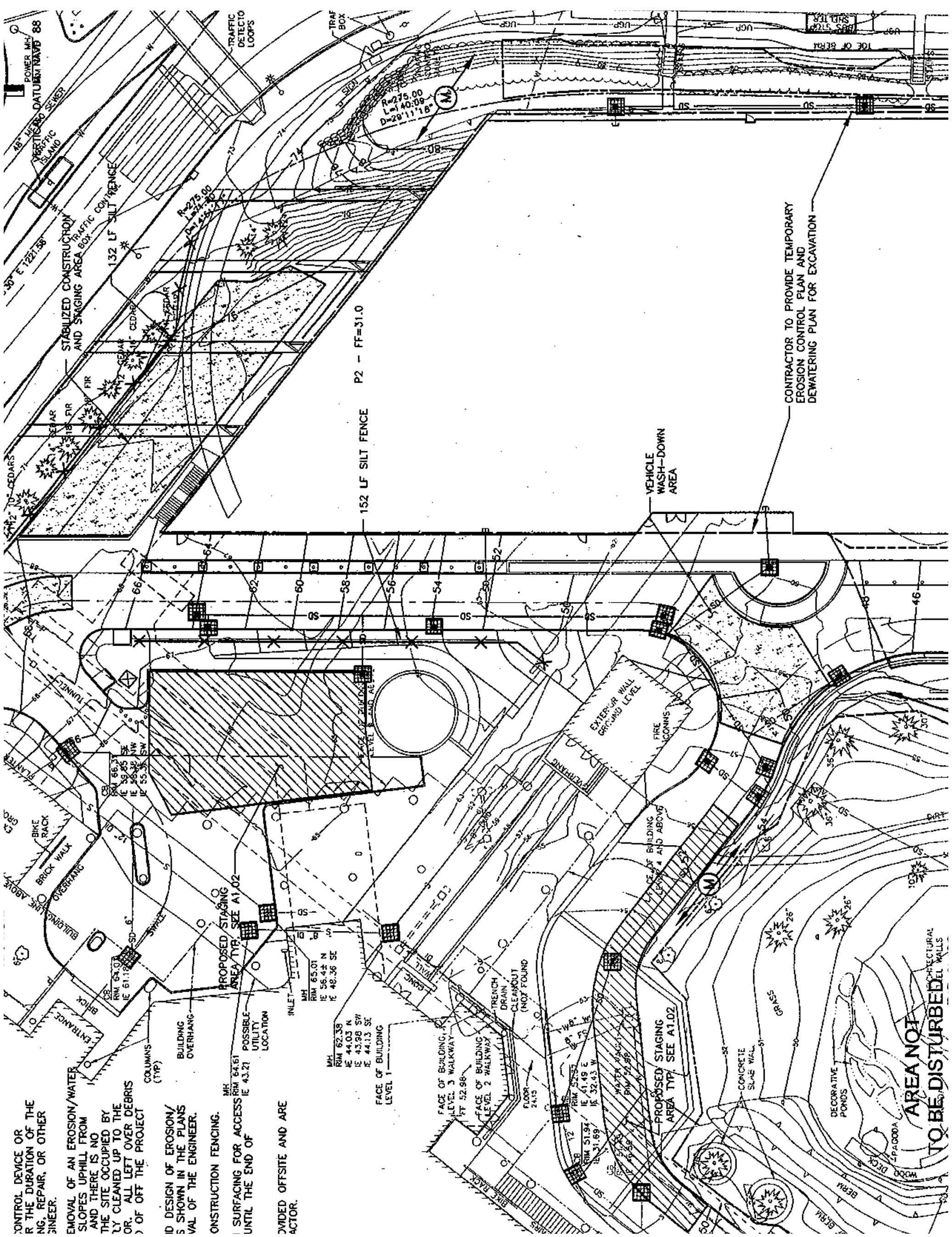
1.2 DESCRIPTION OF REQUIREMENTS

A. Specific minimum administrative and procedural actions are specified in this section, as extensions of provisions in the drawings and general provisions of the contract, including General and Supplementary Conditions and other Division 1 Specification Sections with special attention given to section 01500. These requirements have been included for specific purposes as indicated for work within the occupied Medical Center. Work of this section may be part of the subcontract bids..

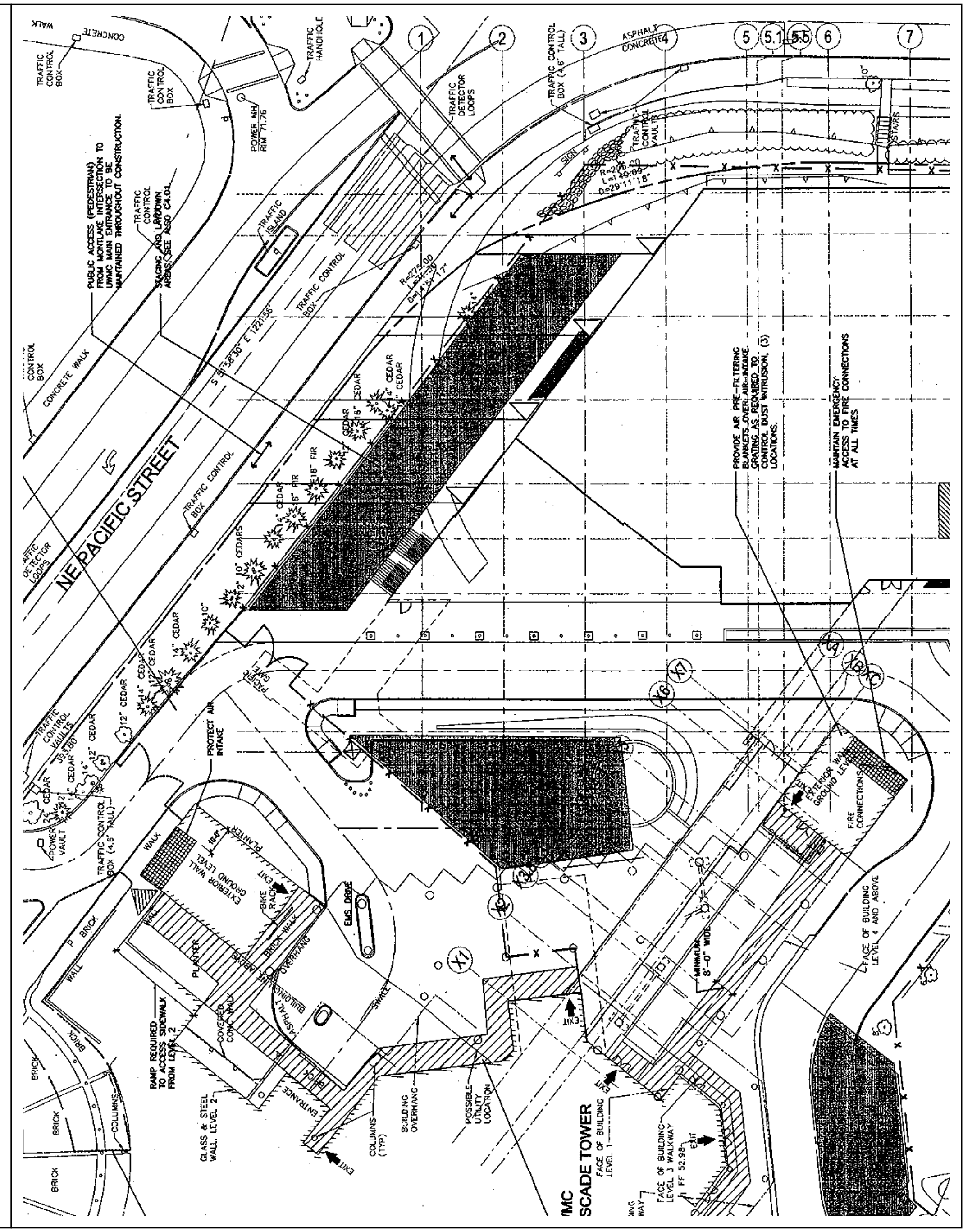
B. A written plan outlining the contractors methods of meeting the Infection Control/Interim Life Safety specification must be submitted to owner for approval upon issuance of the notice to proceed. The plan shall include, but not be limited to, construction barrier locations, exit path routing, temporary signage design and locations, proposed materials, negative air routing, proposed cleaning equipment, and a completed ILSM Pre-construction Worksheet.

1.3 INFECTION CONTROL

A. Barriers
   1. The contractor shall provide appropriate barriers to isolate the construction area from any patient care or other occupied areas. The barriers shall be constructed:
      a. To be tightly sealed from wall to wall and floor to structure above. This includes areas above suspended ceilings, unless ceilings are not to be disturbed, in which case, seal will occur at ceiling tile.
      b. Out of the following materials:
         (1) For projects with little anticipated noise and no hot work, 6-mil fire-retardant (Rexam StarTex or approved equal) visqueen with zipper openings.
         (2) For all other projects , barriers below suspended ceilings shall be minimum 1/4" thick, plastic coated, low VOC, fire treated melamine panels. Sealed with tape at all joints and other connection points. All construction barriers must be constructed to be smoke tight and of non-combustible or limited-combustible materials. Above ceiling barriers shall be minimum 6-mil fire-retardant visqueen.
         (3) Where barriers are provided in place of a fire rated wall (corridor, smoke barrier, fire wall) barriers shall be minimum 1/4" thick, plastic coated, low VOC, fire treated melamine panels. Sealed with tape at all joints and other connection points. All construction barriers must be constructed to be smoke tight and of non-combustible or limited-combustible materials. Solid barriers shall be provided above the suspended ceiling to the structure above unless previously approved by the owner.



STABILIZED CONSTRUCTION AND STAGING AREA
132 LF SILT FENCE
P2 - FF=31.0
152 LF SILT FENCE
CONTRACTOR TO PROVIDE TEMPORARY EROSION CONTROL PLAN AND DEWATERING PLAN FOR EXCAVATION
VEHICLE WASH-DOWN AREA
PROPOSED STAGING AREA TYP. SEE A1.02
AREA NOT TO BE DISTURBED



NE PACIFIC STREET
TRAFFIC CONTROL BOX
PROTECT AIR INTAKE
MAINTAIN EMERGENCY ACCESS TO FIRE CONNECTIONS AT ALL TIMES
CASCADE TOWER

NL 208 University of Washington/Theresa Doherty

NL 208-1

Per the University's request, a Modified Montlake Route was proposed and evaluated in the Modified Montlake Route Addendum (February 2004). This route was identified as part of the Preferred Alternative. The Sound Transit Board will select the project to be built after the Final SEIS is published.

NL 208-2

Comment noted.

NL 208-3

Sound Transit notes the University's opinion regarding an interim terminus station on University property. However, Sound Transit also believes that the issues and concerns raised by the University can be addressed, and has provided additional information in the Final SEIS in response to the University's comments.

NL 208-4

Sound Transit notes the University's opinion regarding system-wide spoils removal from University property and the potential impacts. Sound Transit believes that impacts associated with spoils removal can be adequately addressed and has provided additional information in the Final SEIS in response to the University's comments.

NL 208-5

Sound Transit appreciates the efforts of University of Washington faculty and staff in providing comments.

NL 208-6

Comment noted. Sound Transit anticipates working collaboratively with the University of Washington to implement or supplement the MOA as appropriate.

NL 208A-1

Comments noted. The 2003 Draft SEIS (Section 4.2.2, page 4-25) identifies research and related grant funding concerns raised by the University of Washington (UW) and identifies the potential for lost employment should grant funding be reduced. Updated discussion has been provided in the Final SEIS Land Use Section. The project would include measures to mitigate vibration, electromagnetic, and construction impacts to the University and minimize the potential for adverse economic impacts.

NL 208A-2

Sound Transit acknowledges the University's concerns. The 2003 Draft SEIS provided a detailed analysis of the potential vibration, EMF, and construction impacts to the University and measures to mitigate those impacts. Additionally, Sound Transit prepared a separate document, the Modified Montlake Route Addendum (February 2004), to develop an alternative that could satisfy the needs of the University and Sound Transit. Sound Transit has continued coordination with the University to address specific concerns

in developing the Preferred Alternative and in analyzing the impacts and potential mitigation measures that are discussed in the Final SEIS.

NL 208A-3

Pages 4-75 and 4-106 of the 2003 Draft SEIS list mitigation measures for vibration and EMF impacts to the University of Washington campus. The preliminary mitigation commitments for the project are provided in Appendix M of the Final SEIS. These will be finalized in the FTA Record of Decision. In addition, Sound Transit anticipates implementing and/or supplementing the MOA with the University as appropriate to provide additional detail for specific mitigation measures.

NL 208A-4

As noted in the 2003 Draft SEIS Section 4.17.3, Sound Transit has acknowledged that the construction of a tunnel and station or interim terminus on the University of Washington campus would have construction impacts that could adversely affect research, educational, or medical facilities. Pages 4-157, 4-160, 4-163, 4-169, 4-173, and 4-188 of the 2003 Draft SEIS list mitigation measures that address construction impacts applicable to the entire alignment. Further analysis and information on proposed mitigation is in the Final SEIS addressing impacts from dust, noise, and other potential construction impacts. Traffic congestion during operation of the University of Washington Station would only be slightly greater if it is an interim terminus than if the light rail extended to Northgate. See response to NL 208A-4 above.

NL 208A-5

In 2000, Sound Transit and the University of Washington signed a Memorandum of Agreement (2000 MOA) that is based on the original [Central Link] light rail project selected by Sound Transit in 1999. Sound Transit and the University recognize that the ultimate project plans and designs for North Link may be different than contemplated in the 2000 MOA. They also recognize that the project will gain more precision with time and additional design and that one or more subsequent agreements will be necessary to implement the 2000 MOA. The first of these will be an agreement that is specific to the project to be built, as selected by the Sound Transit Board, after issuance of the North Link Final SEIS. The 2000 MOA includes a Design and Mitigation Plan approval process that provides for review and approval of the light rail design and detailed mitigation plans by the University of Washington. Most of the Siting and Design Principles in MOA Appendix B are specific to the original project (Alternative B1.A – First Hill to 15th Avenue NE) and are either not relevant to other alternatives in the Final SEIS or will need modification if the selected project is different than Alternative B1.A. Many of the mitigation measures described in MOA Appendix C are also specific to Alternative B1.A while others are related to the final design and construction coordination between Sound Transit and the University.

NL 208A-6

Sound Transit has worked collaboratively with the University and anticipates implementing and/or supplementing the MOA as appropriate to address these issues.

NL 208A-7

Please see responses to comments NL 208A-3 and NL 208A-4.

NL 208A-8

Please see response to comment NL 208A-3.

NL 208A-9

Comment noted. A detailed Maintenance Plan has not been developed for North Link although it is expected to be similar to the plan currently under development for the Initial Segment. Sound Transit would maintain the light rail system to minimize EMF levels and long-term degradation of EMF levels over time on the University campus.

NL 208A-10

Comment noted, the comments put forth by University faculty, staff, and the comments contained within the memos from the University's vibration consultants are addressed below.

NL 208A-11

Comment noted.

NL 208A-12

It is acknowledged that compensation and relocation assistance to the University of Washington (or tenants on University of Washington displaced property) would be guided by the MOA and supplemental implementation agreements, consistent with applicable Federal and state law.

NL 208A-13

The text from page ES-18 of the 2003 Draft SEIS has been updated in the Final SEIS to note that the threshold requested by the University of Washington is the level of ambient vibration currently available for vibration-sensitive research on campus.

NL 208A-14

Footnote 1 of Table S-7 is an indication of ridership for those stations with an interim terminus in south University District. Sound Transit is aware that stations on the University campus will require University of Washington Board of Regents approval.

NL 208A-15

As stated in 2003 Draft and Final SEIS Chapter 5 Financial Analysis, comparative capital costs do account for anticipated mitigation costs for each alternative. Costs for the alternatives within the University District include allowances based on the range of mitigation options such as floating slab, vibration resilient track fasteners, and receiver mitigation. Updated information on costs and mitigation for the Preferred Alternative has been included in the Final SEIS.

NL 208A-16

The statement is a comparison of the NE 45th Street Station and Brooklyn Stations, which do not require University property. Use of University property for the southern University district stations is described.

NL 208A-17

Comment noted.

NL 208A-18

2003 Draft SEIS Table A-1 and Appendix C, Distribution List, have been revised in the Final SEIS to include the University of Washington as a state agency.

NL 208A-19

Comment noted. Please see response to comment NL 208-3.

NL 208A-20

The text has been revised in the Final SEIS to reflect the comment. Please note that funding for extension to Northgate was not included in *Sound Move*.

NL 208A-21

Impacts to the Burke-Gilman Trail are discussed in Sections 3.3.2 (page 3-42), 4.16.2, and 4.17.16 of the 2003 Draft SEIS. The effects of the station activity on the trail are further discussed for the Preferred Alternative in the Final SEIS.

NL 208A-22

Hide-and-ride parking impacts are discussed in Section 3.3.2 (page 3-43) of the 2003 Draft SEIS and have been updated in the Final SEIS. The transportation analysis considered the fact that the University's parking is by permit or for fee, and concluded that the restrictions and rates, in combination with added travel time, would not be likely to draw in transit patrons. On street parking in the District is also time-limited, further discouraging hide-and-ride activity.

NL 208A-23

Tables 3.2-11a and 3.2-11b of the 2003 Draft SEIS show that the Southwest Campus Station would have lower ridership. Given the lower ridership, greater distance from the University campus, and longer travel time, the SEIS concluded that the Southwest Campus Station would not serve the University as well as the Pacific or Montlake/University of Washington Station sites.

NL 208A-24

The 2003 Draft SEIS provided a discussion of the adverse effects (Section 3.3.2, pages 3-30 and 3-35, and throughout the 2003 Draft SEIS in their respective sections), and the Final SEIS provides updated information on interim termini, including the interim termini options for the Preferred Alternative.

NL 208A-25

The 2003 Draft SEIS does not conclude that there will be an increase in crime in and around the stations. Rather, the document states on page 4-115 that studies show that crime in transit facilities is directly related to crime in the surrounding areas. The document does state that light rail operation would likely require additional police and security staff and that security measures would include personnel who rove between stations whether contracted with law enforcement or private agencies or provided directly by Sound Transit. In addition, page 4-116 of the 2003 Draft SEIS states that if there is an increase in crime or security calls on the University of Washington campus resulting from light rail stations and an increased demand on University of Washington Police resources, Sound Transit will work with the University of Washington and Seattle Police Department to determine responsibilities for providing security services to stations on the University.

NL 208A-26

Comment noted.

NL 208A-27

The Final SEIS text is revised to clarify that UWMC is part of the University and not a separate employer.

NL 208A-28

Comment noted. The statement has been removed from that section.

NL 208A-29

Comment noted.

NL 208A-30

Comment noted.

NL 208A-31

The discussion of visual impacts in the Final SEIS has been revised to reflect that the nature of University trees as a teaching feature, which will dictate replacement location and species.

NL 208A-32

Comment noted. The Modified Montlake Route has been selected as part of the Preferred Alternative.

NL 208A-33

Sound Transit anticipates developing details of potential Burke-Gilman detours, if detours are required, in coordination with the University during final design.

NL 208A-34

It is acknowledged that compensation and relocation assistance to the University of Washington (or tenants on University of Washington displaced property) would be guided by the MOA and supplemental implementation agreements, consistent with applicable Federal and state law.

NL 208A-35

Comment noted as above.

NL 208A-36

Please see responses to comments NL 208A-155 through NL 208A-160.

NL 208A-37

Since the Campus Master Plan was approved in December 2002. References to "future master plan" are revised to say "approved Master Plan."

NL 208A-38

Impacts to the University during construction are described in Chapter 4.17 Construction. Responses to specific points Mr. Brown's memorandum are provided with those comments below.

NL 208A-39

Sound Transit agrees that the ability of the University to conduct current and future, more sensitive research, is important to the University and the region. This issue is discussed in several sections of the 2003 Draft and Final SEIS, including 4.2, Land Use and Economics, in 4.6, Noise and Vibration, and 4.11, Electromagnetic Fields. Please see responses to comments NL 208A-47 through 136.

NL 208A-40

The proposed mitigation commitments for the project are described in Appendix M of the Final SEIS. Sound Transit has worked collaboratively with the University and anticipates dressing vibration mitigation commitments in accordance with the MOA and supplemental implementation agreement.

NL 208A-41

Comment noted. Please see response to comment NL 208A-40.

NL 208A-42

It is acknowledged that simply "working with the University of Washington in and of itself is not 'mitigation.'" The 2003 Draft and Final SEIS Section 4.14.3 lists the potential mitigation measures.

NL 208A-43

Page 4-173 of the 2003 Draft SEIS lists potential mitigation measures for vibration impacts during construction. The Final SEIS Appendix M describes proposed mitigation commitments, and the Record of Decision to be issued by the Federal Transit Administration (FTA) will specify mitigation commitments.

NL 208A-44

The Final SEIS has been revised to refer to the adopted Campus Master Plan.

NL 208A-45

This appendix is a description of the University's master plan and not a discussion of economic benefits. The fact that the University is the state's leading research institution has been added to the Land Use discussion in Section 4.2.

NL 208A-46

Comment noted. Final SEIS characterization of Physics/Astronomy reflects a current threshold below VC-E.

NL 208A-47

The Federal Transit Administration published methodology for vibration impact assessment in *Transit Noise and Vibration Impact Assessment states that t*he appropriate methods of characterizing ambient vibration are dependent on the type of information required for the analysis. It defines ambient vibration

as usually characterized with a continuous 10 to 30 minute measurement of vibration. The Leq of the vibration velocity level over the measurement period gives an indication of the average vibration energy. Leq is equivalent to a long averaging time rms level. Specific events can be characterized by the maximum rms level (Lmax) of the event or by performing a statistical analysis of rms levels over the measurement period. For "special needs" situations such as scientific experimentation, the ambient measurement may need to be tailored to suit the particular experiment. All vibration environments have some variability. Relative to the vibration sensitivity of experiments, the germane "ambient" vibration level is not necessarily the lowest vibration occurring during an experiment, and could be the highest. If, for example, an extremely vibration sensitive experiment is conducted over several days, measuring the ambient vibration over at least one full day would be prudent to quantify the vibration environment. The ambient vibration velocities reported by VACC in their 4 October 2002 report were measured over 20 seconds (0.33 minutes). Actually, the report of 4 October suggests that the measurement period was 16 seconds for each location tested. Furthermore, the measurements selectively excluded "extraordinary events, such as a door being slammed" in the vicinity of the measurement. Vibration from construction activities occurring at a nearby site was also excluded from the data. In effect, these measurements quantify the background floor vibration velocities in the labs. In terms of statistical vibration levels, these measurements probably correspond to the level exceeded 90% of the time, referred to as the L_{90}.

NL 208A-48

During these ambient measurements there were no normal activities or equipment operating within any of the laboratories where measurements were being conducted. Nonetheless, Sound Transit has recognized the University of Washington ambient measurements as representative of the background vibration levels.

NL 208A-49

The FTA standard practice is to compare the maximum vibration levels with the FTA vibration criteria. The criteria are based on the maximum level at which there would be no impact and/or disruption to the activity being assessed and is not based on ambient levels.

NL 208A-50

Comment noted.

NL 208A-51

The VC criteria are based on the University of Washington's consultant's characterization of research activities on campus in 2003. The VC criteria are a reasonable means to define the vibration levels that are needed to support the research as revealed by the consultant's inventory. The ambient threshold requested by the University of Washington is required to support current University of Washington research needs in some buildings and the future needs in other buildings.

NL 208A-52

Sound Transit has updated the vibration predictions as described in Chapter 4.6.6 which includes a discussion of uncertainty in the predictions. For the Final SEIS, Sound Transit prepared a more detailed vibration analysis based on the following: (1) additional bore hold LSR tests along the Preferred Alternative; (2) FDL tests of a similar vehicle that will be procured by Sound Transit for this project, the Kinkisharyo vehicle, at Santa Clara Valley Transportation Authority (VTA) in San Jose, California. Vehicles were tested at different operating speeds in revenue service at three unique locations on the VTA system. The results were supported with vehicle maintenance records; and (3) the in-situ insertion loss of an existing floating slab design tuned to a similar frequency as proposed for this project was used to

estimate mitigation effectiveness. The test data collected helped determine the relationships that were used in the EIS analysis such as reduction of low frequency vibration at lower operating speeds; floating slab insertion losses higher than the normally assumed limit of 20 dB; and more confidence in the LSR data defining the reduction in vibration over distance. Both the raw and post processed test data were made available to the University of Washington for their independent analysis. The updated Sound Transit vibration predictions have been reviewed by the University and its representatives, who have expressed their general concurrence that the methods and data are reasonable (University of Washington and Sound Transit meeting October 10/27/06).

NL 208A-53

Please see response to comment NL 208A-52.

NL 208A-54

Please see response to comment NL 208A-52. The statement 'A difficult criterion to achieve in most instances' is a direct quote from the Institute of Environmental Sciences (IES) Recommended Practice CC012.1, C*onsiderations in Cleanroom Design*, describing the VC-E criterion. The IES is an industry-based group that is concerned with recommending desirable vibration environments for microprocessor fabrication plants. These generic criteria have also been applied to research institutes and other facilities where highly sensitive manufacturing or research occurs.

NL 208A-55

Please see response to comment NL 208A-52.

NL 208A-56

Please see response to comment NL 208A-52.

NL 208A-57

No safety factor is included in the assumptions concerning the 1998 Force Density Level used for the 2003 Draft SEIS analysis. While safety factors are desirable for design of a system, the use of such in an environmental assessment would be overstating the most probable impact. The previous use of a 5 dB safety factor was applied to the uncertainty of the March 20, 1999 FDL measurements conducted of the Tri-Met vehicle operating in the tunnel near the Washington Park Station in Portland. The FDL has been updated using tests of a similar vehicle that will be procured by Sound Transit for this project, the Kinkisharyo vehicle. The Final SEIS discusses the uncertainties associated with the vibration predictions.

NL 208A-58

Based on the comments made by University of Washington's consultant, Colin Gordon & Associates, the March 20,1999 FDL measurements conducted of the Tri-Met vehicle operating in the tunnel near the Washington Park Station in Portland was not used for the most recent vibration predictions. In his written comments of September 22, 1999, Colin Gordon suggested that the force density level of the Tri-Met trains be measured at a surface track since the FDL is independent of the geological conditions. The measured FDL obtained in 1999 in Portland was discarded and at-grade FDL test data for the Tri-Met vehicle conducted by Wilson Ihrig & Associates, and contained in the report *Tri-Met Track Vibration Isolation Tests*, October 30, 1998, was used for the 2003 Draft SEIS analyses. The San Jose tests used for the Final SEIS analysis represent a range of vehicle wear conditions.

NL 208A-59

Please see response to comment NL 208A-58.

NL 208A-60

Please see response to comment NL 208A-52.

NL 208A-61

Please see response to comment NL 208a-52. The adjustment was based on the assumed difference between track stiffness, or rail support moduli, of the direct fixation track and ballasted track, and on guidelines provided in the US DOT, *Handbook of Urban Rail Noise and Vibration Control*. In general, the FDL for direct fixation track is expected to be higher than the FDL for ballasted track at frequencies above 25 Hz. The following are the adjustment factors added to the ballasted track FDL measurements. These adjustments are based on the differences in track support modulus of ballasted track and direct fixation track, 2,500 psi and 4,600 psi respectively.

Frequency (Hz)	6.3	8	10	12.5	16	20	25	31.5	40	50	63	80	100	125
Adjustment Factor	0	0	-1	-2	-2	-1	0	+2	+5	+6	+6	+6	+6	+6

NL 208A-62

Please see response to comment NL 208A-52.

NL 208A-63

The indication of train weight for a prototype vehicle is for informational purposes only, and is not used in prediction. The FDL is to a first order approximation independent of train weight, because the secondary suspension effectively decouples the vehicle body from the truck at frequencies above a few Hertz. A second order effect of train weight is the non-linearity of the primary suspension stiffness, which can increase slightly as the vehicle weight is increased due to passenger loading. This increase would have a second-order effect on primary suspension resonance frequency and unsprung mass. A slight increase of secondary suspension stiffness would be expected with an increase in train weight, which would also have a second-order effect on truck characteristics. However, it is not standard practice to consider the weight of the vehicle when conducting a ground vibration analysis. This approach is based on FTA's detailed vibration analysis, which does not consider the weight of the vehicle. Train speed, wheel and rail condition, vehicle suspension, track design, are more important than overall train weight.

NL 208A-64

The LSR used for the updated Final SEIS analysis uses information from additional borehole tests. The LSR coherence is reduced by the presence of background vibration and instrumentation noise. The measurement of the LSR involves averaging of cross-spectral components for a large number of samples, typically thirty. If the coherence were of the order of 90 percent or higher, no more than two or three samples would be required to develop an LSR. Our experience is that a reasonable estimate of the LSR can be obtained – even if the coherence were of the order of 10 percent to 20 percent, provided that a sufficient number of samples were included. The LSR is obtained by integration of regression curves representing the point source response over the train length. The 1/3 octave response to a point source is

obtained in part by energy averaging the transfer function magnitude over the 1/3 octave bandwidth. The individual transfer function components are weighted by the coherence function to de-emphasize frequency components with poor coherence, thus further improving the LSR estimate. Predictions for offsets beyond 300 feet from the tunnel were based on numerical analysis of layered soils models based on shear wave velocity data measured on the University of Washington campus at three boreholes along the alignment. These numerical estimates of LSRs were then adjusted to match empirically determined LSRs at shorter distances. These numerical predictions extend the prediction to very low frequencies in addition to larger distances. Thus, three procedures are employed to improve the LSR estimate in the presence of poor coherence: 1) average of 30 or more samples when measuring the response; 2) coherence weighting, and 3) numerical extrapolation of measured LSRs. A detailed description of the empirical LSR measurement data analysis can be found in the *University of Washington Vibration Study, Final Report*, September 10, 2002, prepared by Wilson Ihrig & Associates, and the *Preliminary Engineering Vibration Control for the University of Washington North Link Segment Preferred Alternative,* (2006).

NL 208A-65

The measured LSR is based on field data, which characterizes the ground attenuation of the geology and soils. The decrease of the vertical response of the ground surface to a vertical source at depth as one approaches the epicenter is a consequence of the radiation pattern associated with shear waves generated by the source at depth. While both pressure and shear waves are generated, the shear wave carries by far more energy than the pressure wave at low frequencies. The pressure wave may have greater influence at high frequencies, and high-frequency scattering by in-homogeneities in the soil will confound this effect. Hence, there may be less of the effect at frequencies above 30 Hz than below. Further, for soils with Poisson ratio of 0.25, a Rayleigh surface wave may develop at the ground surface at a distance of five times the source depth, thus augmenting the response at this distance. Thus, rather than being considered "non-physical", the behavior of the LSR would be expected to decline as one approaches the epicenter within a certain distance. The LSR used for the updated Final SEIS analysis uses information from additional borehole tests.

NL 208A-66

Additional borehole tests were performed to determine the soil response along the Modified Montlake Route (Preferred Alternative). Uncertainty of the predictions is discussed in the Final SEIS Section 4.6.6.

NL 208A-67

The primary mitigation measures proposed have been used successfully on other transit systems with the exception of the 8 Hz floating slab which has been constructed in a box tunnel and has not been used in bore tunnel. The effectiveness of straight rail has yet to be determined.

NL 208A-68

The effects of train speed have been updated based on the measurements of the Kinkisharyo vehicle in San Jose.

NL 208A-69

Based on test data collected during Preliminary Engineering, the Force Density Levels for the Kinkisharyo vehicle exhibit low frequency peaks in the range of 6.3 to 10Hz 1/3 octave bands and high frequency peak at the track resonance frequency of about 80Hz. An 8Hz floating slab would simply amplify the low frequency vibration component and exacerbate the vibration impact of Sound Transit on

distant buildings. For this reason, an 8Hz floating slab is not recommended. A floating slab with design resonance frequency of 12.5 to 16 is recommended because this frequency would fall between the low and high frequency peaks of the FDL at nominally 8Hz and 80Hz.

In the 2003 Draft SEIS analysis, the insertion loss of the 8Hz floating slab was estimated based on empirical data measurements of vibration reductions for floating slabs of resonance frequency 12 to 16Hz. One such measurement was of the continuous floating slab installation on Noe Street in San Francisco, and the other was of the discontinuous double tie at the Los Angeles Metro Redline. The performance is based on the concept of a single degree-of-freedom oscillator, with modifications based on experience. The floating slab design resonance includes the slab mass and the vehicle truck mass distributed over the length of the vehicle. The carbody mass is assumed to be decoupled from the truck and track above the secondary resonance frequency, which is typically about 1 to 2Hz. Thus, the floating slab design resonance frequency is given by $f = (1/2\pi)(K/M)^{1/2}$, where K and M are the stiffness and mass per unit track length, respectively. The stiffness includes that of the main support pads and that of the side and separation pads. Air entertainment may also be considered. A ratio of dynamic to static stiffness of 1.4 is typically included in estimates of resonance frequency. The performance of a floating slab is reasonably well represented by the vibration isolation curve of a single-degree-freedom oscillator up to the track resonance frequency of about 80Hz. Below the design resonance, little or no vibration isolation is expected. At the design resonance, some modest amplification by about 3 dB, or a factor of 1.4, can be expected, consistent with a damped oscillator. Above the design resonance frequency, a vibration reduction is expected.

While extension of floating slab performance to 8Hz has been done for residential or commercial building vibration impact control by scaling the performance of higher resonance frequency slabs, substantial care must be exercised to guard against interaction between the slab and suspension of the vehicle. This is all the more important at lower frequencies, such as at 4Hz, where the vehicle's secondary suspension system with resonance frequency of perhaps 2Hz may interact with the slab. If so, results may be considerably counter-productive. The critical nature of the University of Washington research environment dictates that extreme care be exercised during design of the floating slab track vibration isolation, regardless of resonance frequency, to avoid adverse affects that could be avoided.

NL 208A-70

See response to NL 208A-69.

NL 208A-71

The design of an 8 Hz slab would require increasing the mass of the concrete and reducing the stiffness of the rubber isolators. The low frequency slab design proposed by GERB with spring isolators also needs to be investigated for low frequency vibration attenuation. The design of the slab will be determined during final design.

NL 208A-72

The proposed floating slab isolators are natural rubber, which have a life expectancy of 50 years. In case of future maintenance of natural rubber isolators, the floating slab system will be designed so the isolators can be easily accessed and replaced during non-revenue hours without cutting the rail.

NL 208A-73

For the Final SEIS, the trackwork mitigation measures recommended for the Preferred Alternative were refined. The slab frequency is now recommended to be 12-16Hz to avoid resonance frequencies at 8Hz, although a low frequency slab proposed by GERB will be investigated during final design.

NL 208A-74

Comment noted. The updated analysis in the Final SEIS has provided information that appears acceptable to the University. See response to comment NL 208A-52.

NL 208A-75

Sound Transit will monitor vibration levels from the light rail system in order to track changes in vibration levels as the light rail system ages and allow the appropriate level of maintenance to be performed to prevent exceedances of the vibration levels agreed to with the University.

NL 208A-76

The moveable point frog bridges the gap in the rail and thereby eliminates the impact caused by the train traversing over the frog.

NL 208A-77

In general, vibration from two four-car trains passing simultaneously in opposite directions will result in vibration velocity levels as much as 3 dB greater than the values of a single train. The Final SEIS analysis has been revised to include a 3 dB impact from passing trains for all sensitive receivers. The predicted impacts in are based on two four-car trains passing-by on the nearest track (northbound or southbound) for each building site studied. The location of where two trains from opposite directions would pass under the University of Washington campus would be fairly random and the frequency of a two train impact is dependent on the location of the sensitive building and the two train pass-by.

NL 208A-78

Regenerative braking will be used and has not been precluded by the EMI analysis or mitigation requirements. We are not aware of any measured data that demonstrates an increase in vibration levels during braking. If there is such measurement data from other transit systems as the comment states, we would like the University of Washington to make this information available to Sound Transit for review.

NL 208A-79

Sound Transit understands the University position concerning current and future research needs on campus and the desire for mitigation at the source. Receiver mitigation includes active or pneumatic (passive) vibration isolation systems for individual equipment or relocating sensitive research. Sound Transit is proposing that the University of Washington consider receiver mitigation at those buildings and/or research labs where the maximum practical source mitigation does not reduce vibration levels to meet the ambient threshold requested by the University of Washington. Receiver mitigation is an option in the current MOA between Sound Transit and the University.

NL 208A-80

Comment noted. See response to comment NL 208A-79.

NL 208A-81

Comment noted. See response to comment NL 208A-79.

NL 208A-82

Comment noted. See response to comment NL 208A-79.

NL 208A-83

Comment noted. See response to comment NL 208A-79.

NL 208A-84

Comment noted. See response to comment NL 208A-79.

NL 208A-85

Comment noted. See response to comment NL 208A-79.

NL 208A-86

Comment noted. See response to comment NL 208A-79.

NL 208A-87

These comments relate directly to the proximity of Bagley Hall and the Chemistry Building to the original Montlake Route. The Modified Montlake Route (Preferred Alternative) avoids impacts to these two buildings and the concerns raised in these comments. The Modified Montlake Route lies at far greater distance from Bagley Hall and the Chemistry Building than did the original Montlake Route.

NL 208A-88

Please see response to comment NL 208A-87.

NL 208A-89

Comment noted. Sound Transit recognizes the 0.1 mG requested by the University of Washington for Bagley and New Chemistry.

NL 208A-90

Comment noted. Rate of change for electromagnetic fields at Bagley Hall is described in the Final SEIS Section 4.12.2.

NL 208A-91

Please see response to comment NL 208A-87.

NL 208A-92

The quadrupole mitigation concept for reducing stray B-fields from DC propulsion currents has been employed in at least one operating light rail line, and is being installed in another.

The same basic concept of a large cross section buried cable used jointly with a standard overhead contact wire with periodically spaced riser cables linking them electrically has been employed for a number of years on a light rail line running past the University of Bielefeld in northern Germany. A report on this installation, written by faculty members from the University of Bielefeld, has been provided to the

University of Washington and is available in English translation from Sound Transit. Additional information on the performance of the mitigation at Bielefeld is forthcoming. In addition, the same quadrupole mitigation approach is being installed in a new light rail line to run past Washington University in St. Louis. The Bielefeld and St. Louis projects are discussed at greater length below in the response to comment NL 208A-130, as are their implications for providing knowledge useful for the Seattle North Link project.

NL 208A-93

This comment relates in part to the overall level of understanding that does or does not exist concerning all possible sources of stray B-fields caused by North Link.

To date, the following sources of stray B-fields have been identified and investigated:

- Stray B-fields from propulsion currents flowing in the DC propulsion system conductors, including cables, contact wire, and rails,
- Geomagnetic field perturbations arising from cars,
- Stray B-field components resulting from leakage of propulsion currents from running rails into the ground, thereby upsetting the magnetic flux cancellation that would otherwise occur, and
- Stray B-fields arising from propulsion currents following momentary "sneak paths" created when car wheel sets bridge insulated rail joints separating different sections of track or when car pantographs bridge different contact wire sections in a corresponding manner.

Sound Transit believes that this is an exhaustive list of the sources of stray B-field that must be considered, and that an acceptable overall system design can be achieved by dealing properly with each of these four B-field sources. We are aware that B-fields arising from currents in the conductor’s track sections north and south of the University of Washington campus must be considered along with the track sections passing through the campus. But, as discussed in a later response, we believe that if we can solve the hardest problems arising from worst-case combinations of lab-to-track distance and equipment sensitivity, we should be able to solve the easier problems as well.

NL 208A-94

The prime method of providing an overall margin for error in the design has been to identify an alignment that lies far enough away from most sensitive locations that the design-level B-fields at those locations are well below specified maximum levels. When the most critical combinations of laboratory B-field sensitivity and distance to track are known, more detailed statistical analysis of the most critical case or cases can be performed. Statistical variations in conductor placement, conductor cross-sections, and contact resistances can be considered. Data on parameter variations will have to be gathered.

To deal with uncertainties in cable contact resistances, brazed or welded joints will be used wherever desirable and possible. This practice will eliminate to as great a degree as possible the effects of variation in resistance from contact to contact, and also variation in resistance over time.

In the face of some uncertainty, a basic "reasonableness check" has been used to judge the expected tolerances required in the quadrupole mitigation system. As described below in response NL 208A-135, for critical B field-distance combinations, the width of an additional effective 2.8 kA dipole loop that would push total B-field over the limit has been calculated. This effective dipole loop would represent, for instance, the distance between the centroids of positive and negative propulsion currents down the track. For the case of Fluke Hall, lying 103 meters from the Modified Montlake route, the width of such an effective loop could be as large as 30 cm. Sound Transit believes that the tolerances required to achieve this target are attainable.

NL 208A-95

These comments relate to the effects of propulsion currents leaking from the rails into the ground. Sound Transit realizes that this is an important issue that must be effectively dealt with in order to meet the North Link EMF goals. A design employing insulating rubber pads between running rails and underlying supports is planned.

The performance history of such pads in environments similar to North Link will be factored into the design of the system, and into the plan for maintaining the system. Such data as exist will be gathered, and tests to gather more data will be performed as required.

Based on computations (see response to comment NL 208A-132 below), it is predicted that if the insulating rail pads maintain resistance at even a small fraction of their specified level, leakage currents will be small enough not to be a problem.

The maintenance of high resistance levels between running rails and the underlying ground is only of moderate priority in most light rail systems. In many rail transit systems the ties rest on crushed stone ballast, and the rails come directly in contact with the ballast, yielding rail-to-ground conductances on the order of 0.1 to 1 mS per meter of track length (1 to 10 kohm-meters rail-to-ground resistance). The insulating rail pads to be used for North Link will be counted upon to provide far greater rail-to-ground resistance levels.

One technical note regarding comment 95: Doubling the North Link design operating voltage has halved the peak propulsion current level, and consequently halved the maximum end-to-end voltage drop expected when a train is at the opposite end of a track segment from the DC substation. Since it is the voltage drop down the running rail that drives leakage current into the ground at one end of a running rail and back up out of the ground at the other, doubling the voltage decreased, not increased, any potential leakage current problems.

Maintaining a proper level of cleanliness of insulating rail pads will be a part of an overall North Link maintenance program, as will periodic measurement of overall rail-to-ground resistance. Once the resistance degradation rate for insulating rail pads is determined, it will be possible to monitor this parameter and replace pads before leakage currents become too large.

NL 208A-96

Please see response to comment NL 208A-95.

NL 208A-97

Please see response to comment NL 208A-95.

NL 208A-98

Please see response to comment NL 208A-95.

NL 208A-99

Please see response to comment NL 208A-95. Sound Transit is aware that B-fields arising from currents in the conductors of track sections north and south of the University of Washington campus must be considered along with the track sections passing through the campus. And while these will have to be addressed with sufficient thoroughness, the problems presented should be easier to overcome than those due to tracks immediately adjacent to sensitive labs.

NL 208A-100

Please see response to comment NL 208A-95.

NL 208A-101

These comments relate to levels of stray B-field from geomagnetic field perturbations due to campus bus and truck traffic. They were made before the commenter had the opportunity to read the Sound Transit-LTK report, "Stray Magnetic Fields from Transit Buses on the University of Washington Seattle Campus", prepared for Sound Transit and LTK, F. Ross Holmstrom, Ph.D., December 2003.

The report noted presents the results of the November 2003 measurements. The data and results presented in that report supercedes the information in the 2003 Draft SEIS.

In November 2003, B-field data were obtained for a range of distances shorter than those from Stevens Way to Bagley Hall or the Chemistry Building. Extrapolating out to the 48 meter Chemistry-to-Stevens distance, a peak level of 0.05 mG is predicted at Chemistry, and 0.012 mG at Bagley Hall, 74 meters from Stevens Way. Observations indicate that these values can be doubled when two buses simultaneously pass.

Observations made that November day showed no stray propulsion B-fields that could be detected above the 0.05-0.1 mG background at a measurement point 120 meters from NE Pacific Street, a shorter distance than that from Pacific to Bagley Hall or the Chemistry Building.

However, at other critical campus locations much closer to Stevens Way, higher levels of stray B-fields from vehicular geomagnetic field perturbations were observed and these are described in Chapter 4.12 of the Final SEIS.

NL 208A-102

Please see response to comment NL 208A-101.

NL 208A-103

Please see response to comment NL 208A-101.

NL 208A-104

Please see response to comment NL 208A-101.

NL 208A-105

A detailed Maintenance Plan has not been developed for North Link although it is expected to be similar to the plan currently under development for the Initial Segment. Sound Transit would maintain the light rail system to minimize EMF levels and long-term degradation of EMF levels over time on the University campus. Sound Transit will monitor EMF levels from the light rail system in order to track changes in EMF levels as the light rail system ages and allow the appropriate level of maintenance to be performed to prevent exceedances of the EMF levels agreed to with the University.

NL 208A-106

Comment noted. Sound Transit has modified the Montlake alternative presented in the 2003 Draft SEIS to move it further from the Physics/Astronomy Build and chemistry department. Sound Transit does not

intend to relocate the Chemistry department, however based on conversations with the University, relocation of some research adjacent to the light rail alignment may be required.

NL 208A-107

Please see responses to comments NL 208A-95.

NL 208A-108 to NL 208A-136

Comments noted. These comments pertain to a reference report not part of the SEIS. A more current report has been prepared updating the EMF analysis: "North Link Hi-Lo Mitigation EMI Report," March 2006. Comments NL 208A-130 to NL 208A-136 are substantive and responses are provided as a courtesy to the University but are not part of the SEIS.

NL 208A-130

These comments pertain to a reference report not part of the SEIS. A more current report has been prepared updating the EMF analysis: "North Link Hi-Lo Mitigation EMI Report, March 2006. The assumptions and design features that went into the B-field modeling efforts are reiterated below as succinctly as possible. A variation of parameters were incorporated into updated B-field calculations for the Final SEIS and preliminary engineering to determine tolerance limits that must be achieved to meet B-field specifications.

The physical circuit layout assumed for propulsion current caused B-fields consists of two straight, level tracks fed by a traction power substation at their southern end. All conductors, including running rails, buried and overhead feed cables, riser cables, and current paths through pantograph contact points through cars back to running rails, are modeled as straight finite-length conductors carrying specified DC currents. In the case of riser cables, each one is modeled as four segments respectively going laterally from buried cable to tunnel wall, straight up, laterally back to a point above the contact wire, and then down to the contact wire. The x, y, and z coordinates of each end of each conductor segment are noted. The Biot-Savart Law is used to calculate individual contributions from each conductor segment to x, y, and z components of B-field at desired points in space. These are then added up. Currents have been assumed to have maximum operational values. This is realistic, given the grade existing from the NE to SW corner of the University of Washington campus.

Built into the Excel spreadsheets used for these computations are provisions for easily varying the positions of overhead contact wire and buried cable. Calculations have been performed to assess the consequences of such variation.

Following is a description of the measures included in the MetroLink design to reduce magnetic fields associated with the MetroLink traction electrification system that could affect the stability of the ambient static magnetic field, and therefore the measurement baseline of specific scientific instruments located on the Washington University Hilltop Campus.

1. The typical MetroLink traction electrification system consists of:
   - An Overhead Contact System (OCS) over each track. The OCS consists of a messenger (or catenary) wire and a contact wire suspended from the messenger wire by hangers. The OCS carries positive supply current from the traction power substation to a Light Rail Vehicle (LRV).
   - Two steel running rails for each track. The running rails carry negative return current from the LRV back to the traction power substation.

   The contact and messenger wires are electrically connected and both supply positive current to the train. The running rails under the train complete the Direct Current (DC) electrical circuit by returning negative return current to the substation. The flow of current in the OCS and in the running rails generates a magnetic field that perturbs the earth's geomagnetic field. These magnetic field perturbations, while weak, will create a disturbance to the earth's magnetic field that may affect scientific experiments being performed on the Washington University Hilltop Campus using NMR spectrometers.

2. The traction electrification system adjacent to the Hilltop Campus includes features designed to reduce the static magnetic field from the MetroLink system at selected campus locations. The design area extends from project stationing 3408+60 (approximately 100 ft east of the east end of the Skinker station platform) to project stationing 3440+80 (adjacent to the Washington University Millbrook parking facility). The traction electrification system in the design zone consists of:
   - An Overhead Contact System (OCS) over each track. The contact wires in the design zone are located 15 ft above the top of the corresponding running rails. The messenger wires in the design zone are electrically isolated from the contact wires above each track and from the messenger wires outside of the design zone by electrical insulators at project stationing 3408+70 and 3440+70 (approximately 10 ft inside the design zone at the east and west ends of the zone).
   - Two steel running rails for each track.
   - A parallel electrical feeder cable in a 4" fiberglass reinforced epoxy (FRE) conduit under each track. Each feeder cable consists of 1-250 and 2-750 kcmil copper cables. The feeder cable conduits are centered between and 32 inches below the top of the corresponding MetroLink running rails.
   - 26 riser cables per track. The riser cables connect the under-track parallel feeder cable to the OCS. The riser cables at each end of the design zone connect the OCS messenger wire to the parallel feeder cable. The end risers consist of 2-750 kcmil copper cables. The 24 intermediate riser cables (between the end riser cables) connect the OCS contact wire to the parallel feeder cable. The intermediate risers consist of 1-350 kcmil copper cable.
   - The two parallel electrical feeder cables (one cable under each track) are cross-connected through normally-closed tie-breaker switches at each end of the design zone. The four running rails (two rails for each track) are cross-connected at each end of the design zone. The cross-connects allow the supply and return currents to be balanced across the two OCS and four running rails, respectively. The tie-breaker switches allow isolation of the parallel electrical feeders during contingency outages.

3. With the typical traction electrification system, the OCS and running rails form a magnetic dipole source. The traction electrification system in the design zone adjacent to the Hilltop Campus creates two opposite dipole sources, the first formed by the running rails and the OCS and the second formed by the running rails and the parallel feeder cable installed (buried) below the running rails. The two dipole sources combine with opposite polarity, and tend to cancel each other out, thus reducing the magnetic field from the traction system. The height of the design zone contact wire above top of rail, the insulators in the design zone messenger wire (which reduce the electrical current that flows into the OCS within the design zone from the OCS outside of the design zone), the size and depth below top of rail of the design zone supply cable, and the size and number of feeder cables have been selected through engineering analysis summarized in the Enertech report dated May 29, 2002 and Zaffanella email of August 24, 2002 to substantially reduce magnetic fields from the traction system.

In addition to the St. Louis information, Sound Transit has received information on the tram line in Bielefeld, Germany passing near the University of Bielefeld, built by the Siemens Corporation, which served as the basis for the new St. Louis design.

In comparing the Seattle design to the St. Louis design one sees that the St. Louis design's buried cable is three times as deep as Seattle's. The St. Louis ratio of contact wire height to buried cable depth is approximately 6:1, as opposed to Seattle's 15:1. Therefore, the quadrupole moment of magnetic field in the St. Louis design would be larger than in the Seattle design.

The risers in the St. Louis design are 36.4 meters apart at least on average, as opposed to Seattle's 20 meters. The Seattle and St. Louis values of γ, the riser-to-riser current ratio are essentially equal, at 0.077 for Seattle and 0.078 for St. Louis based on as much dimensional information as is provided in the St. Louis document above. The greater size of St. Louis's riser loops will once again adversely affect predicted B-field performance relative to the Seattle design.

The running rails in the St. Louis design rest directly on ties on stone ballast as they do in fact in Bielefeld. This design feature will have a decided impact on leakage current performance, compared to the Seattle design using insulated pads between running rails over a concrete roadbed with no ballast to contact the rails.

Based on a description of the Bielefeld installation's performance and the St. Louis design it appears that neither the Bielefeld installation nor the St. Louis design are intended to meet B-field criteria as stringent as those requested by University of Washington. However, both the St. Louis and Bielefeld designs meet the objectives of the corresponding locations. Sound Transit will use all available data from the St. Louis and Bielefeld installations to inform the North Link design work. However, the Seattle design will differ from these other two cases, because it is intended to meet different requirements.

NL 208A-131

See response to comment NL 208A-130.

NL 208A-132

These comments pertain to a reference report not part of the SEIS. A more current report has been prepared updating the EMF analysis: "North Link Hi-Lo Mitigation EMI Report," March 2006.

Stray Leakage Currents - Ideal Theory

Updated information on this topic is provided in the Final SEIS and the North Link Hi-Lo Mitigation EMI Report, March 2006. The derivation of the stray leakage current relation is as follows, with track current equal to 2.8 kA as opposed to the earlier 2.5 kA

Assume we have two rails in parallel yielding series track resistance R_{tk} ohms/m, and we have rail pads with net leakage conductance to ground for the two rails of G_L S/m, as pictured above:

Current I_{tk} flows from left to right in the rails. A very small fraction of this current leaks off to the ground through the insulating pads, giving rise to ground leakage current $I_{gnd}(x)$. End-to-end circuit length is D meters.

For $-D/2 < x < +D/2$, leakage current to ground in an incremental length dx is

$$dI_{gnd} = V(x)\, G_L\, dx$$

Since I_{gnd} is very small, track current in the rails is approx. constant at value I_{tk}, independent of x. Therefore, V(x) is given by the relation

$$V(x) = -R_{tk}\, I_{tk}\, x$$

Putting this relation for V(x) into the one above for dI_{gnd} and integrating from x = -D/2 to 0, yields the value of peak leakage current I_L, defined as the ground current at the midpoint of the circuit:

$$I_L = I_{gnd}(x=0) = I_{tk}\, R_{tk}\, G_L\, D^2/8$$

Using values D = 1600 meters (1 mile), I_{tk} = 2.8 kA, Rtk = $1.56\text{x}10^{-5}$ Ω/m, and $G_L = 6.56\text{x}10^{-6}$ S/m the peak leakage current is 0.092 amperes.

The relation for B-field in the vicinity of a single long straight conductor (with I in amperes and B in gauss) is

$$B=0.002I/r$$

As close as r=18 meters 0.092 A of unbalanced current would only produce additional B-field of 0.01 mG. This level is well below that deemed critical by any of the University of Washington researchers.

Stray Leakage Currents - Assurance of Performance over Time

The above analysis indicates that if the insulating pads are performing up to specifications, the resulting leakage currents will be acceptable. Examination of the relations shows that there is a fair amount of leeway in the value of pad resistance before leakage currents will rise to the level of being a problem. It will be part of the continuing diagnosis and maintenance program for the Link light rail system to keep leakage currents to an acceptable level.

NL 208A-133

See response to comment NL 208A-130.

NL 208A-134

These comments pertain to a reference report not part of the SEIS. A more current report has been prepared updating the EMF analysis: "North Link Hi-Lo Mitigation EMI Report," March 2006.

Other real-world factors - track curvature

The curvature of the track in the Modified Montlake Alignment (MMA) was taken into account in modeling its stray B-fields.

In making a heuristic assessment of the effect of track curvature, one must remember that for the Hi-Lo mitigated case, perturbation B-fields are approximately 2/3 the total. Based on testing performed by Sound Transit in Portland, the knowledge of those fields is very good. So what is left to discuss is what the curvature does to one third of the stray B-field, not all of it.

For example, the bend in the Preferred Alternative (Modified Montlake Alignment) under campus has a radius of 450 meters. A 4-car train is approx. 100 meters long. On the inside of the bend, the ends of the train move west approximately 2.5 meters. For calculating perturbation B-fields for Mechanical Engineering, Electrical Engineering/Computer Science, Bagley and Chemistry, a straight train was positioned on a chord of the bend, i.e., horizontal distance to train for modeling was made 2.5 meters less than actual horizontal distance to track. For Fluke, on the outside of the bend, the horizontal distance to track was used directly.

Out to a few hundred meters distance away from the track, the predominant contribution to propulsion B-fields are the currents in the risers and contact wire closest to the train. Once again, these fields are very slightly affected by the amount of track curvature in a train length.

Bagley and Chemistry are near the center of curvature of the Preferred Alternative's (Modified Montlake Alignment) bend and are a long way from the tracks. At that location, track curvature increases unmitigated B-fields by approximately 50% over the straight-track case. It also increases Hi-Lo mitigated propulsion B-fields by approximately 50%. But having moved the tracks nine times farther away from Bagley and Chemistry than they were in original Montlake alignment, Hi-Lo mitigated B-fields are predicted to be low enough to meet University of Washington standards.

The Preferred Alternative (Modified Montlake Alignment) bend will make the outside rail roughly 1.5 meters longer than the inside rail over an arc length of roughly 350 meters. Depending on where the rail-to-rail DC shorts provided by the impedance bonds are eventually placed, this will cause currents in the outer rail to be less than in the inner rail by approximately 0.35%. To counter this shift, the buried cable will have to be shifted horizontally by at most a few centimeters to counter the shift in current and the altered geometry.

Other real-world factors - exact track locations

Updated predictions for the Final SEIS use track locations from the Preliminary Engineering design of the Preferred Alternative. During Final Design, B-fields will be modeled using the exact track locations determined during civil engineering design.

Other real-world factors - end effects and nearby unmitigated sections

See response to comment NL 208A-95.

NL 208A-135

A measure called the Compliance Factor (CF) has been developed to quantify the margin of safety for the Hi-Lo Mitigation design. The CF is the factor by which calculated B_{prop} values must be multiplied in order to make the overall B-field from a light rail train equal to the University of Washington specified B-field level. The CF provides a convenient means of assessing the likelihood that total B-fields will exceed University of Washington specific B-field levels at a particular sensitive building as well as comparing the margins of safety for sensitive buildings on campus. A minimum CF of 2 times the calculated B_{prop} values is recommended as a design safety factor. A more detailed discussion for the CF is contained in the "North Link Hi-Lo Mitigation EMI Report," March 2006.

NL 208A-136

These comments pertain to a reference report not part of the SEIS. A more current report has been prepared updating the EMF analysis: "North Link Hi-Lo Mitigation Report," March 2006.

Table 1, listed as comment NL 208A-136, is really part of comment NL 208A-131 where it is referenced.

NL 208A-137

Comment noted. Section 4.17.14, page 4-180 of the 2003 Draft SEIS, Table 4.17-12 will be appropriately revised in the Final SEIS.

NL 208A-138

Comments noted. The landfill is described in the Final SEIS. Releases near the Bryant Building, the Bioengineering Building are included in more detailed maps and lists of release sites in Appendix P4.11 of the 2003 Draft and Final SEIS.

NL 208A-139

The Final SEIS has been updated to include additional information on utilities, including the tunnels under the University.

NL 208A-140

In Section 4.17 the text in the Final SEIS states the consequences of disruption of research due to construction.

NL 208A-141

The Final SEIS and Noise and Vibration Technical Report includes updated discussion of construction impacts, including noise and vibration within the University of Washington. As project construction schedules are developed, Sound Transit will provide more detailed information to the University of Washington.

NL 208A-142

Measured vibration data of TBM are not very extensive. The levels presented in the 2003 Draft SEIS are a range of the average vibration levels measured in soft ground conditions and hard rock. The lower end of the range is the mean of ground vibration levels estimated using data from of the East Central Interceptor Sewer (ECIS) Project in Los Angeles, CA. The higher end is the mean of ground vibration levels estimated using data from three tunnel projects in hard rock (Buffalo Light Rail Rapid Transit Tunnel, Metro West Water Supply Tunnel, and Chattahoochie Tunnel). Vibration levels from above ground construction activities would be similar to other University of Washington campus projects. The Final SEIS and Noise and Vibration Technical Report contain an updated analysis of the vibration impacts during construction.

NL 208A-143

Thank you for additional information. The 2003 Draft SEIS Section 4.17 noted the impact and the concern to research facilities and future competitiveness for grant fundings, but it is useful to have current grant funding levels. The Final SEIS Land Use discussion (Section 4.2) has been revised to address the amount of research grants the University receives.

NL 208A-144

Thank you for the additional information. The 2003 Draft SEIS discussed the University's concerns regarding construction impacts to research in Section 4.17 in terms of direct impacts during construction (Section 4.17.7, for instance, described vibration impacts at the University and their potential effects on research) The Final SEIS has been revised with additional information, and notes the University's concerns stated in this letter.

NL 208A-145

Comment noted. Please see response to comment NL 208A-144.

NL 208A-146

The text is incorrectly quoted. The page referred states that "cut and cover and station construction activities are expected to produce similar vibration levels as other ongoing University of Washington

construction projects that are in close proximity to vibration sensitive research facilities." The SEIS states that vibration impacts from tunneling would be greater than typical campus construction activities.

NL 208A-147

Comment noted. This revision has been made in Final SEIS.

NL 208A-148

The Final SEIS discussion of impacts has been revised.

NL 208A-149

The intermittent durations of these activities cannot be determined at this level of project development and would require coordination with the construction contractor.

NL 208A-150

Relocation of research is a mitigation described in the Final SEIS and in the current MOA with the University of Washington.

NL 208A-151

The cost comparison is structured around the discrete alternatives in Segment A and B. For each alternative, the cost range captures the range of configurations that could be constructed for the purpose of comparing alternative alignments. Phased or incremental completion would marginally increase the cost of each of the alternatives but not change the comparison of route alternatives in the SEIS.

NL 208A-152

Cost-effectiveness calculations in the draft North Link Supplemental Environmental Impact Statement were calculated used the comparative capital cost estimates provided in 2003 Draft SEIS Chapter 5, Financial Analysis. Therefore, because the comparative capital cost estimates include anticipated mitigation costs for each alternative, the cost-effectiveness calculations account for mitigation costs.

NL 208A-153

As stated in 2003 Draft SEIS Chapter 5, Financial Analysis, 5.2.1 Capital Costs, comparative capital costs do account for anticipated mitigation costs for each alternative. Costs for the alternatives within the University District include allowances based on the range of mitigation options such as floating slab, vibration resilient tract fasteners, and receiver mitigation. Therefore, mitigation costs are accounted for in this conclusion.

NL 208A-154

See response to comment NL 208A-5. This approval step has been added to the list of Anticipated Permits and Approvals in the Final SEIS.

NL 208A-155

The 2003 Draft SEIS does not make any recommendations or preferences for the route alternatives. The Final SEIS identified the Modified Montlake route as the Preferred Alternative identified by the Sound Transit Board. Sound Transit notes the University's Housing and Food Services' concerns regarding the

Brooklyn route, with a Southwest Campus Station. If the Southwest Campus Station was to be built, Sound Transit would work with the University to determine appropriate relocation efforts as applicable.

NL 208A-156

Please see Section 4.17 of the 2003 Draft SEIS addresses construction noise impacts.

NL 208A-157

Comment noted. The Final SEIS has been revised to indicate there are several residence halls near the station.

NL 208A-158

Please see response to comment NL 208A-156.

NL 208A-159

Comment noted. Section 4.17 of the 2003 Draft SEIS provides various mitigation measures that would reduce the magnitude of impacts to which residents of HFS facilities would be subjected. The Final SEIS, Section 4.17, has also been updated.

NL 208A-160

Please see Sections 4.13.2 and 4.13.3 of the 2003 Draft SEIS and response to comment NL 208A-25.

NL 208A-161

As noted previously, the haul volumes and frequencies remain conservative estimates based on all phases of construction, although the project is a very large and complex construction undertaking. It should be noted that the periods of activity may be intermittent, based on the phase of construction. The Final SEIS has been updated with additional information based on construction staging and contracting alternatives developed through advanced engineering.

NL 208A-162

The 1999 Transportation Technical Report was for the Central Link Final EIS. The 2003 North Link Draft SEIS provided information for each alternative. The streets used for the haul routes are identified in the Final SEIS by name in Table 4.17.2, and shown in the Draft SEIS background Transportation Technical Report (2003). As stated in Section 4.17.2 of the 2003 Draft SEIS, Sound Transit will coordinate with the City of Seattle and the Washington State Department of Transportation during final engineering and permitting to ensure that streets and highways are provided with adequate signage and traffic control measures. The proposed haul route for the University of Washington is south along Montlake Boulevard to SR 520. This is shown in the Final SEIS, Appendix J.

NL 208A-163

Comment noted. This information was discussed in the 2003 Draft and Final SEIS under Air Quality, Section 4.17.6, which also states that buildings with unusually high air quality requirements (such as the University) that are located adjacent to high-generating dust activities may require additional mitigation.

NL 208A-164

Comment noted. The 2003 Draft SEIS discussion remains accurate but has been updated in the Final SEIS to included additional information about construction parking impacts and mitigation.

NL 208A-165

The Final SEIS includes updated information on construction impacts and mitigation for North Link, including the Preferred Alternative. Sound Transit also anticipates that construction planning and mitigation measures developed in consultation with the University/UWMC will also be progressively more detailed as the project enters final design and construction stages. Commitments regarding the process to be used are anticipated to be elements of the Record of Decision and the MOA between Sound Transit and the University.

NL 208A-166

Comment noted. Sound Transit agrees, and the issues raised are consistent with the 2003 Draft SEIS discussions cited in the comment.

NL 208A-167

Comment noted. Utility impacts have been updated in the Final SEIS, and additional background information will be made available to the University. Further review and coordination with the University of Washington will continue during final design.

NL 208A-168

Comment noted. Discussion of noise impacts during construction has been updated in the Final SEIS, including for the UWMC. Please see Section 4.17 of the Final SEIS for additional information.

NL 208A-169

Precise emergency procedures and necessary medical equipment will be determined during final design. As stated in Section 4.13.2 of the 2003 Draft SEIS, an emergency response plan is currently being prepared in close coordination with the Link Fire/Life Safety Committee, and will continue to evolve during final design, construction, and operation of the proposed facilities.

NL 208A-170

The 2003 North Link Draft SEIS and Addendum for the Modified Montlake Route, and 2005 Draft SEIS provided information on parking impacts and these have been updated in the Final SEIS. The University of Washington Station, the Preferred Alternative, displaces between 100 and 135 campus parking spaces in lots E10, E11, and C12. Sound Transit will continue to work with the University of Washington throughout the station design process to replace any permanent parking losses. Please also see Section 3.3.2 of the Final SEIS.

NL 208A-171

As described on page 4-4 of the 2003 North Link Draft SEIS and 2004 Addendum for the Modified Montlake Route, “there is little potential for hide-and-ride impacts due to high parking utilization rates in the University District.” To mitigate for potential hide-and-ride parking impacts, Sound Transit and the City of Seattle signed a letter of concurrence on August 25, 2003, describing their commitment to aggressively pursue appropriate on-street parking measures to discourage hide-and-ride parking activity

in neighborhoods around Sound Transit Link light rail stations. Text has been added to the Final SEIS to describe the mitigation plan, which would implement parking controls prior to the start of light rail operations at a cost to Sound Transit.

NL 208A-172

The addition of a second westbound left-turn lane was suggested on page 3-44 of the 2003 North Link Draft SEIS as a potential improvement that would lower intersection delay at the NE Pacific Place/Montlake Boulevard NE intersection to better than No-Build conditions.

NL 208A-173

Terminating North Link at the Montlake/Rainier Vista or University of Washington Station would not be expected to result in a substantial increase in traffic or parking impacts as compared to the full-length alternative. As described on pages 3-19 and 3-20 of the 2003 Draft SEIS, ridership at the University District Stations could increase if North Link terminates in this area. Pages 3-40 and 3-41 of the 2003 Draft SEIS explain that if light rail terminates at the Montlake Station, boardings at this station would increase by approximately 28 percent in the year 2015 and by approximately 30 percent in the year 2030 compared to the full-length alternative. However, the resulting increase in project trips to the area would only minimally affect delays in the area. Parking impacts would not be expected to increase in the area, since no parking would be provided to serve light rail patrons. This information is updated in the Final SEIS.

Based on the evaluation conducted, no mitigation measures in addition to those identified for the full-length alternatives, would be required if North Link terminates at the Montlake/Rainier Vista or University of Washington Station. However, as the Final SEIS notes, a variety improvement and enhancement options have been developed to maximize the benefits of light rail as part of the areas transportation system.

NL 208A-174

Thank you for sharing information on the Burke Museum and the potential benefits of placing a station at 45th and 15th. Vibration impacts to the Burke Museum are described in Section 4.6.6 of the Final SEIS.

NL 208A-175

Sound Transit anticipates implementing and/or supplementing the MOA as appropriate to address light rail construction and transit operation issues, including mitigation of impacts appropriate for the selected project. Proposed mitigation is described in the SEIS and Appendix M.

NL 208A-176

Sound Transit anticipates implementing and/or supplementing the MOA as appropriate to address light rail construction and transit operation issues, including mitigation of impacts appropriate for the selected project. Proposed mitigation is described in the SEIS and Appendix M.

NL 208A-177

Sound Transit anticipates implementing and/or supplementing the MOA as appropriate to address light rail construction and transit operation issues, including mitigation of impacts appropriate for the selected project. Proposed mitigation is described in the SEIS and Appendix M.

NL 208A-178

Sound Transit anticipates implementing and/or supplementing the MOA as appropriate to address light rail construction and transit operation issues, including mitigation of impacts appropriate for the selected project. Proposed mitigation is described in the SEIS and Appendix M.

NL 208A-179

The Modified Montlake Route was studied in a subsequent Addendum, February 2004. Your preference for a northern University Station beside or incorporated into an expansion of the Burke Museum has been noted. The Brooklyn Station has been identified as the Preferred Alternative in the Final SEIS.

NL 208B

These comments pertain to a reference report not part of the SEIS. A more current report has been prepared updating the vibration analysis: "Preliminary Engineering Vibration Control for the University of Washington North Link Segment, 2006." Responses are provided as a courtesy to the University but are not part of the Final SEIS.

NL 208B-1

The concern of the University of Washington on the low frequency region is noted. Please see response to comment NL 208A-52.

NL 208B-2

Sound Transit's recognizes the University's request for ambient vibration thresholds. Discussion of the existing sensitivity is provided for context of existing research currently on campus and the understanding that the sensitivity of research is becoming more sensitive. Representation of the University of Washington's vibration sensitivity is based on the VACC reports that identify the current sensitivity of different buildings in terms of VC levels and the future research needs in terms of the existing ambient.

NL 208B-3

The predicted mitigated vibration levels are worst case, because some of the analysis elements have been minimized such as the use of theoretical rather than measured empirical values for the floating slab insertion loss and not assuming any building response attenuation.

NL 208B-4

The insertion loss data for the floating slabs are included in Figure 29 of the *North Link University of Washington Vibration Background Report*, September 2003. The analysis has been updated, please see response to comment NL 208A-52.

NL 208B-5

The comment is not clear, commenter needs to be more specific on these differences.

NL 208B-6

Comment noted.

NL 208B-7

Comment noted.

NL 208B-8

Comment noted.

NL 208B-9

Comment noted.

NL 208B-10

During these ambient measurements there were no normal activities or equipment operating within any of the laboratories where measurement were being conducted. Nonetheless, Sound Transit has recognized the University of Washington ambient measurements as representative of the background vibration levels.

NL 208B-11

The moveable point frog eliminates the frog flangeway by laterally moving the nose of the frog in the direction in which the train is traveling. Please refer to the Transportation Research Board (TRB) *Track Design Handbook for Transit Design* for more backup information on moveable point frogs.

NL 208B-12

A small exceedance is 1 to 2 dB over the requested University of Washington ambient threshold levels. Given that the ambient varies over time by as much as 10 dB, a 1 to 2 dB difference between the train maximum vibration levels and the University of Washington threshold would be difficult to detect.

NL 208C-1

A detailed Maintenance Plan has not been developed for North Link although it is expected to be similar to the plan currently under development for the Initial Segment. Sound Transit would maintain the light rail system to minimize vibration levels and long-term degradation of vibration levels over time on the University campus.

NL 208C-2

During these ambient measurements there were no normal activities or equipment operating within any of the laboratories where measurements were being conducted. Nonetheless, Sound Transit has recognized the University of Washington ambient measurements as representative of the background vibration levels.

NL 208C-3

See response to comment NL 208C-2. These curves do apply to the equipment used in the University of Washington research spaces as presented by Vibro-Acoustics Consultants' in their reports dated October 2002 and February 2003.

NL 208C-4

See response to comment NL 208C-2.

NL 208C-5

Comment noted. The Sound Transit measurements were also conducted in unoccupied laboratories with no lab equipment operating.

NL 208C-6

While safety factors are desirable for design of a system, the use of such in an environmental assessment would be overstating the most probably impact. The Final SEIS analysis is based on two trains under campus at one time and also discusses the uncertainties associated with the vibration predictions.

NL 208C-7

The Final SEIS analysis discusses the uncertainties associated with the vibration predictions.

NL 208C-8

This means that there are no new University of Washington buildings that would be impacted if the tunnel were shallower.

NL 208C-9

In general, vibration from two four-car trains passing simultaneously in opposite directions will result in vibration velocity levels as much as 3 dB greater than the values of a single train. The Final SEIS analysis has been revised to include a 3 dB impact from passing trains for all sensitive receivers. The predicted impacts in are based on two four-car trains passing-by on the nearest track (northbound or southbound) for each building site studied. The location of where two trains from opposite directions would pass under the University of Washington campus would be fairly random and the frequency of a two train impact is dependent on the location of the sensitive building and the two train pass-by.

NL 208C-10

Comment noted. Maximum train vibration levels were predicted in the analysis.

NL 208C-11

The design of the frog is such that the gap is bridged when a train passes through the crossover trackwork. The impact of the wheel traversing an open gap is eliminated. Please refer to the Transportation Research Board (TRB) *Track Design Handbook for Transit Design* for more backup information on moveable point frogs.

NL 208C-12

Speed reductions have been included as mitigation in the Final SEIS. Please see the response to comment NL 208A-52.

NL 208C-13

The existing sensitivities referred to are the VC levels provided by VACC. The SEIS also evaluates the impacts compared to the University requested thresholds.

NL 208C-14

Please see the response to comment NL 208A-52.

NL 208C-15

Comment noted. The text has been revised in the Final SEIS.

NL 208C-16

More detailed analysis of construction vibration has been conducted and is included in the Noise and Vibration Technical Report.

NL 208D

Thank you for providing information on the UWMC Surgery Pavilion.

RECEIVED MAR 12 2004

NL 309

UNIVERSITY OF WASHINGTON

OFFICE OF REGIONAL AFFAIRS
Theresa Doherty, Assistant Vice President

March 11, 2004

James Irish
Link Environmental Manager
Sound Transit, Union Station
401 South Jackson
Seattle, WA. 98104-2826

Dear James:

The University of Washington would like to thank you for the opportunity to review the February 11, 2004, North Link Modified Montlake Route Addendum.

On January 30, 2004, the University of Washington commented on the January 30, 2003, Draft Supplemental Environmental Impact Statement for the North Link. Our comments were extensive and covered many issues. I will not repeat the comments here because I understand the comments from that letter and this letter will both be responded to in the Final Environmental Impact Statement when it is published. 1

Again, thank you for the opportunity to comment on this Addendum. If there is any additional information Sound Transit needs from the University as the Sound Transit Board prepares to make its alignment choice, please feel free to call upon us.

Sincerely,

Theresa Doherty
Assistant Vice President for Regional Affairs

cc: Joni Earl, Sound Transit Chief Executive Officer
Ron Endlich, Sound Transit North Link Program Manager
Tracy Reed, Sound Transit North Link Segment Manager
Weldon Ihrig, UW Executive Vice President
John Brandon, UW Consultant on Sound Transit

Draft Supplemental Environmental Impact Statement
Addendum
North Link Modified Montlake Route

University of Washington Comments

1. PURPOSE OF THIS ADDENDUM

Paragraph 2, p 1-1, section 1.1.
The University requested that Sound Transit consider an alternative to the Montlake alignment in the December 5, 2003 letter from Regent Jewell to CEO Earl. The letter stated "… a minor variation of the Montlake route that shifts the alignment east of Rainier Vista so that the tunnels avoid the heart of the science and engineering corridor, and moves the station east of Montlake Boulevard adjacent to Husky Stadium, is an alignment that has the potential to mitigate UW's research concerns while preserving the attractive advantages of the original Montlake route." The University requested that Sound Transit vary the alignment but the exact location of the alignment described in this addendum was determined by Sound Transit. Consequently, the language in the second paragraph in section 1.1 should be changed to read: "In a December 5, 2003 letter to Sound Transit, the UW expressed its support for light rail, and asked the agency to consider **a** route alternative." The word "**the**" should be replaced with "**a**" so that it is clear to the reader that Sound Transit staff considered the information in the University letter and then chose the alignment modification that is studied in this addendum. The University of Washington did not pick the alignment that is studied in the addendum. 2

2. PROJECT BACKGROUND

No comments.

3. PROJECT MODIFICATION

Section 3, page 3-1
In this section you note that the feasibility of a modified Montlake route connected to the 45th and 15th street station is "being investigated." Please explain where the results of the investigation will be made public. 3

The description of the project modification states, "This passageway to the stadium and the garage could also provide a connection with an existing underground passageway between the Triangle Parking Garage and the Medical Center to the south." While the University understands the idea of an underground connection from the station to the UWMC, the UWMC is very concerned about this concept. The pedestrian-car conflicts that will occur if the garage is used as the underground passageway have not been fully studied in this addendum. The garage was not built to act as passageway for the thousands of pedestrians anticipated by the Sound Transit ridership estimates. Sound Transit needs to consider a larger range of alternatives to get pedestrians safely across Montlake, using underground connections as well as at street level connections. A new 4

underground connection that brings riders from the station at Husky Stadium to the metro stop in front of the UWMC would be one idea. With this concept, the riders are safely delivered to a connection point between the UWMC, the Health Sciences Center or upper campus. The underground garage passageway concept would drop off all of the riders in the center of the UWMC, which cannot accommodate that number of pedestrians and is not where the majority of the riders wish to be delivered. 4 cont.

4. CHANGES IN ENVIRONMENTAL EFFECTS AND MITIGATION

4.1 Transportation Effects

The fourth paragraph on page 4-4 states that 36 spaces in lot E-11 and 30 spaces in the Triangle Garage will be lost. Sound Transit needs to outline how these permantely lost spaces will be replaced. The number of parking stalls on campus is capped at 12,300 and the retention of each of those spaces is critical to the operation of the University. 5

Paragraph 6 on page 4-4 talks about adding a second westbound left-turn lane at the NE Pacific Place/Montlake Boulevard NE intersection. Please explain how this will be accomplished and the rationale for such a change. 6

4.2 Acquisitions

This section states that UW is the owner of the property where the station would be located. This conclusion needs to be verified by survey. The University has determined that Montlake Boulevard is not physically located exactly where it was platted, and as a result there may be a mix of ownerships on and immediately adjacent to Montlake Boulevard including UW, City and State. 7

4.3 page 4-5

For ease of reading, this section should be split into two sections, one on UW related impacts and one on non-UW related impacts 8

The University is very concerned about the temporary (5 to 7 year) loss of 350 parking spaces during construction and the permanent loss of 37 to 66 parking stalls once the line is operational. The addendum does not adequately address the range of mitigations that Sound Transit plans to pursue to assure the University that it's temporary and permanent loss of parking will be replaced. Consideration should be given to Sound Transit paying for the current RPZ's in the area and/or the creation of new ones to mitigate the "hide and ride" issue. Other mitigation considerations could be valet parking for patients and visitors, shuttles, stacked parking in E-11 and E-12 during business hours, and the creation of a permanent or temporary parking structure to make up for the loss of 350 parking stalls as well as well other ideas to effectively alleviate the loss of parking on a temporary basis. 9

Table 4-5, p. 4-13: "Marine Sciences" should be "Marine Studies". The Marine Studies building houses the Marine Microbiology Laboratory (MMBL). The same change should be made in Table 4-6 (p. 4-13) and Table 4-7 (p. 4-17). 10

NL 309 (cont'd)

Table 4-6 (page 4-13) and Table 4-7 (page 4-17): It is not possible to check the projected fields in these two tables. It would be helpful if the distances to the various buildings that were assumed were given in at least the first table. This would permit at least a cursory check on the values. 11

Page 4-15, last paragraph: This paragraph does not reflect all the assumptions that went into these calculations. For example, how long were the mitigated sections of track? Will the effect of the route curving around the sensitive areas (Mechanical Engineering and Wilcox Halls) increase the field? 12

Page 4-18, last paragraph: In the conclusions drawn from the results in Table 4-7, there is no discussion of the likelihood of the calculated values being achieved in practice and of the commitment of Sound Transit to achieve these levels. The calculated values are "best case" lowest levels and there is likely to be some deviation from these values in a real system. There is no indication in this paragraph as to how the "amount of sensitive research" at Mechanical Engineering was determined to be "less than the research in Bagley and Chemistry". Please explain how this conclusion was reached. 13

Section 4.18.1, page 4-21

The last sentence in the second to the last paragraph on this page states, "The UW would likely prohibit construction workers from parking on UW parking lots, such as the Triangle Parking Garage and the Surgery Pavilion Parking Garage." There is no question that UWMC would prohibit construction workers from parking in the Triangle Parking Garage and the Surgery Pavilion Parking Garage since these facilities are for the use of patients and their visitors. 14

Page 4-22

The second paragraph on this page suggests that the E1 and E4/5 lots could be used as replacement parking for the spaces lost during construction in E11 and E12. It is suggested that a shuttle could be run between the remote lots and UWMC and Health Sciences. While this is one option that has been considered by Sound Transit, it is not the option that would work best for the UWMC. Sound Transit needs to consider a broader range of mitigations for the temporary loss of parking including valet parking, stacked parking, parking structures, and shuttle parking and other means that will allow the nurses and staff that park in E11 and E12 lots to continue serving their patients during construction and operation. 15

Section 4.18.2 Other Construction Effects

Since so many of the construction impacts would fall on UWMC, Sound Transit needs to consider how this project will link with UWMC operations and should consider the hiring of a construction liaison for the duration of the project. This type of position has been used very successfully on all UWMC big projects and the liaison is a person who works for UWMC to coordinate between UWMC operations and the contractor. 16

5. CAPITAL COSTS, COST EFFECTIVENESS, CONSTRUCTION RISK

Section 5.1
In regards to this section and section 4.1 and 4.4, interim termini on University property south of the 45th Street Station is not permitted by the MOA because of the adverse impacts it would have on the mission of the University. The University does not agree with Sound Transit that there would be no "hide and ride" adverse impacts on traffic because of interim termini. On the contrary, the University believes the impacts to the area, including the business district, would be significant. These impacts include an added burden to UWPD given the location but not the jurisdiction of the stations, extended construction time due to the stopping and re-starting of construction at the interim termini site, and an increase in the likelihood that the interim termini will be used as the system wide spoils site for the entire North alignment. Managing such a large amount of system wide spoils next to a regional Medical Center is an impact the University is very concerned about. Each of these impacts is adverse and is not permitted under the MOA. 17

Section 5.2
ST's comparison of the cost effectiveness for different routes does not take into account the lost revenue to the UW due to the disruption of research by light rail. ST has never included estimated costs of lost UW dollars due to disruption of research, housing and other business activity during the construction and operation of light rail. This issue was raised in the UW's initial response to the SEIS, and remains a concern for this addendum. 18

<u>Bryant Fujimoto, Ph.D., Research Scientist</u>
<u>Department of Chemistry</u>
<u>Associate Professor Philip Reid</u>
<u>Department of Chemistry</u>

The majority of our concerns regarding the nature of the vibrational predictions expressed in our reply to the SEIS also apply to the addendum regarding the modified Montlake alignment (MMA). We echo those concerns here, but the details of our concerns are spelled out in our previous response.

Section 4.7 (Noise and Vibration)
All of the UW's previous comments on errors and omissions in ST's SEIS apply to the addendum, so ST should respond to them in the context of the addendum in addition to the original SEIS. 19

I. Sound Transit misrepresents the vibrational sensitivity of UW research buildings.
We continue to object to ST's use of standard vibrational criteria (the so-called VC criteria) to characterize the currently required vibrational levels in buildings on the UW campus (Table 4.6-6). Simply labeling some buildings as "Below VC-E" obscures their actual sensitivity. In particular, Chemistry's current sensitivity is not "<42 dB" as 20

implied by the "Below VC-E" label, but the current UW threshold. Similar considerations apply to Physics-Astronomy. For buildings such as Roberts, Wilcox, Bagley and EE, attaching the phrase "Indicates that some equipment in the building has a greater sensitivity, but is represented by vibration velocity levels above for the majority of the frequency range" does not accurately represent their current sensitivity. 20 cont.

II. The addendum makes no commitment as to the mitigation methods that will be used, and no justification that the claimed levels will be achieved.
The addendum does not explicitly state what methods would be used to mitigate the vibrations. The phrase "... a combination of specialized track fasteners, floating track slabs, moveable point frog for crossover trackwork, and reduction in train speeds to 30 mph as necessary. More information on these strategies is in the Draft SEIS, Section 4.6." Our earlier response detailed a number of serious errors and omissions in Section 4.6, and there is no evidence provided that the accuracy of the levels in the addendum is any better than those included in Second 4.6 of the SEIS. 21

Our comments will refer to the graphs in Appendix B of the addendum and Section 4.6 of the SEIS. As noted earlier Sound Transit's mitigation analysis employs a litany of what we consider to be unrealistic and unsupported assumptions. We discuss a few of them that are particularly relevant to the MMA. 22

Train Speed. ST's choice of train speed in their analysis is designed to minimize the true impact of light rail. For example, a reduction of up to 17 dB is claimed at 8 Hz when the train speed is reduced from 45 to 30 mph. However, if the train is projected to go 25 mph, the vibrational amplitudes increase. The original document from which the "speed profiles" were derived ("Tri-Met Track Vibration Isolation Tests, Wilson Ihrig and Assoc., October 30, 1998) states that the variation in vibrational levels with train speed indicates that "either a periodic wave exists in the rail roughness profile or wheel tread profile, or that there is an imbalance in the wheel sets or traction system." That is, to reproduce the effects claimed in the SEIS, the trains and rails employed in the North Link line must be an identical replica of the trains the measurements were taken from. The assumptions employed with respect to train speed are far from the spirit of the "conservative" nature of the estimates as claimed in the SEIS. 23

To support their claims about train speed, ST provided the UW with excerpts of a memo written by Wilson, Ihrig and Associates (dated October 23, 2002). However, not only do those excerpts not support ST's claims, they appear to contradict them. We requested that ST allow us to see the entire memo, but ST refused to release it to us. We also attempted to obtain permission to have one of authors of that memo answer our questions, but ST refused to grant permission. To date, the information that ST has given us about train speeds and vibration levels contradicts their claims and therefore we feel justified in rejecting them. We note that ST's Vibration Background Report (September 2003) merely repeats the claims and does not offer any justification for them. 24

Cars will never simultaneously pass. Somewhere along the line a northbound and southbound train must pass. When they do, the vibrational levels will increase 3 dB over 25

the estimates provided. This can be circumvented in some cases by the careful scheduling of trains, but it is not clear if this is possible for the MMA. 25 cont.

Aging of the System. Vibrational noise from light rail will increase as the rails and/or trains age. The standard vibrational noise estimation protocols allow for the inclusion of up to 10 dB increases due to wheel flats and/or corrugated rail. ST's predicted vibration levels are based on measurements made on the Portland Tri-Met transit system. By not including any allowance for aging, ST is claiming, in effect, that their system will be maintained in the same condition as the track and transit car(s) used for the Portland measurements. Therefore, it is important for ST to document the actual condition of the track and transit car(s) upon which their predictions are based and to date they have not done so. If the car and track were in new condition at the time of the measurement (and some documents we have seen suggest that they were), then ST is claiming that it can maintain its tracks and cars in nearly new condition. 26

III. An examination of ST's data predicts that vibrations from the Modified Montlake Route will exceed the UW's vibration criteria for Bagley Hall and Chemistry.

At the longer distances between the Chemistry Department and the Modified Montlake Route, the disruption caused by light rail will be primarily at low frequencies (less than 12 Hz). The only method that ST has ever offered to mitigate low frequency vibrations is a reduction in train speed to 30 mph. However, as noted above, ST has offered no justification for their claims. What little documentation ST has offered contradicts their claims about train speed, so we feel justified in rejecting ST's claims. Since ST has not offered any other way to mitigate these low frequency vibrations, the unmitigated train vibration levels should be used for low frequencies. In Appendix B, we see that the unmitigated train vibration levels equal or exceed the UW criteria at Bagley Hall and Chemistry at 8 Hz. However, this is for a single train. If two trains should simultaneously pass underneath the UW, the combined vibration levels would increase by 3 dB. The resulting vibration levels would exceed the UW criteria for both buildings. 27

IV. The mitigation of vibrations at low frequencies is a problem that ST has not addressed.

As noted above, ST has not proposed a reasonable method for mitigating the low frequency vibrations, and this is a considerable problem. The analysis by ST's train vibration experts, WIA, indicates that low frequency vibrations can be expected to propagate widely, potentially disrupting research at considerable distances. ST's unwillingness to address this problem suggests that ST is unwilling to make a commitment to mitigate low frequency vibrations. Two examples from Appendix B illustrate ST's failure to deal consistently and accurately with the problem of low frequency vibrations produced by light rail. 28

Figures 10 and 11 (Bagley and Chemistry) do not show what the train vibration levels would be with an 8 Hz isolation slab (which is proposed for other buildings). If an 8 Hz slab were used, it would increase vibrations at Bagley and Chemistry at 8 Hz. Since, as noted in III, the 8 Hz vibration levels will likely exceed the UW criteria at those buildings

in the absence of any isolation slab, the use of an 8 Hz slab will result in vibrations which substantially exceed the UW criteria at Chemistry and Bagley Hall. 28 cont.

Figures 6 and 7 (Wilcox and Roberts Halls) do not show the maximum train vibration values before ST's unjustified reductions for speed. Given the lack of justification offered for ST's claimed vibration reductions due to speed, the maximum train vibration levels at 45 mph should be shown on all graphs and ST's claimed vibrations reductions due to speed should either not be used or acknowledged as speculative. To mitigate vibrations at higher frequencies, the use of an 8 Hz slab is proposed for those buildings. However, the slab will amplify vibrations at 8 Hz and result in vibration levels at 8 Hz that exceed the UW criteria. 29

V. ST's maintenance program may not be sufficient to deliver the low vibration levels that ST claims are possible.

As noted, ST has not justified the omission of any increase in vibration levels due to the aging of the rail system. Such an increase, which may be as large as 10 dB, will result in train vibration levels that substantially exceed the UW criteria, even for buildings that are 1000 feet away from the light rail line. ST includes a list of maintenance/operational activities in the SEIS intended to ensure low vibration levels. However, in the text we find that "if only one of the items in the table was not performed, it may not pose a significant increase in noise or vibration levels..." (page 4-67 of SEIS). We infer that ST hopes that it will not have to adhere to this level of maintenance and is laying the groundwork to abandon or curtail one or more of the proposed maintenance/operational activities. This suggests that actually maintaining low vibration levels requires more effort and expense than is normally required for a light rail line. Given the requirements put forth by the UW, it is exceedingly unlikely that an ordinary maintenance program will be sufficient to protect vibrationally sensitive research. 30

Given the uncertainties surrounding their predictions and the necessity of preserving the vibrationally quiet environment on the UW campus, ST should state what additional measures they are prepared to take should the actual vibration levels be larger than predicted. If there are no additional measures that ST is willing to take, and the UW must appeal to the state for money to repair its damaged research environment, then that should be clearly stated. 31

Section 4.13 (Electromagnetic Fields)

For the MMA, Chemistry's primary concern involves leakage currents, an issue that ST has never seriously addressed. If the leakage current should reach a metal pipe, currents could travel a significant distance away from the rail line spreading potentially disruptive magnetic fields over a very large area of the UW campus. This problem is entirely ignored in the SEIS. The shape of the Modified Montlake Route, which arcs around Chemistry and Bagley Hall, is of particular concern, since leakage currents from the north end of the route could travel close to Rainier Vista as they return to the power substation located at the south end of the route. ST has provided no examples where the stray current of an operating light rail line has been reduced to a sufficiently low level that the associated magnetic fields will be under the UW criteria. Furthermore, the 32

leakage current estimates provided by ST are substantially less than known values for operating systems. ST's approach to this problem apparently relies on an unprecedented maintenance program, but how effective will this approach be? Unless ST can show examples, on comparable transit systems, where stray currents have been reduced to levels required here, the SEIS should acknowledge the fact that the required maintenance program is unprecedented. The SEIS should also state what steps ST is prepared to take if ordinary maintenance is not sufficient to control stray currents from their transit system. 32 cont.

Section 4.18 (Construction Impacts)
All of the UW's previous comments on ST's SEIS apply to the addendum, so ST should respond to them in the context of the addendum in addition to the original SEIS. 33

J. Byron Davis
Ahmad Bayat
UW Consultants on Vibration

Regarding Section 4.7 (Noise and Vibration), we make the following comments:

- Reference is made to the mitigation strategies discussed in the Draft SEIS, Section 4.6. Our previously communicated comments in the DSEIS letter on these mitigation strategies still apply. 34
- No reference is made to the "high resilience direct fixation" mitigation method noted in some figures in Appendix B. We request further information on this method, and engineering data to support the results. 35
- No discussion of the predictions is made, including any discussion of the potential for additional vibration impact of a curved alignment. We request additional engineering data on this issue. 36

Regarding Table 4-3 and Table 4-4, we make the following comments:

- In both tables, reference is made to VC criteria. As we have commented previously, the VC curves do not apply here and do not define the sensitivity of UW research activities. The column associated with VC curve references should be deleted entirely. The UW vibration requirements for each building are tabulated under "UW requested Train Vibration Level (ambient)" heading. 37
- While we continue to reject all expressions of criteria or sensitivities for the UW campus in terms of VC curves, the stated VC criteria for Bagley Hall, Fluke Hall, Wilcox Hall, and the Mechanical Engineering Building are misleading and/or potentially inappropriate. 38
- In Table 4-3, many numbers in the "UW Requested Train Vibration Level (ambient)" column are in error or come from outside the stated frequency range:
    - For Bagley Hall, the upper end of the quoted ambient range (36dB) does not occur within the stated 4-100Hz frequency range. In this case, the highest 1/3 octave band value is actually 35dB (the 36dB figure occurs in the 2.5Hz 1/3 octave band). 39

- For the New Chemistry Building (CHB), the upper end of the quoted ambient range (31dB) does not occur within the stated 4-100Hz frequency range. In this case, the highest 1/3 octave band value is actually 30dB (the 31dB figure occurs in the 2.5Hz 1/3 octave band).
- For the Physics and Astronomy Building (PAB), the upper end of the quoted ambient range (36dB) does not occur within the stated 4-100Hz frequency range. In this case, the highest 1/3 octave band value is actually 30dB (the 36dB figure occurs in the 3.15Hz 1/3 octave band). 39 Cont.
- For the Mechanical Engineering Building (MEB), the lower end of the quoted ambient range (8dB) is incorrect. In this case, the lowest value is actually 18dB, in the 100Hz 1/3 octave band. We cannot find a source for the erroneous figures.
- For the Center on Human Development and Disability (CHDD), the upper end of the quoted ambient range (45dB) is incorrect. In this case, the highest value is actually 35dB, in the 31.5Hz 1/3 octave band. We cannot find a source for the erroneous figure.

Regarding Section 4.18 (Construction Impacts), we make the following comments:

- With the exception of notes regarding operation of the tunnel-boring machine (TBM), our previously communicated comments in the DSEIS letter still apply.
- The vibration data regarding the TBM have been revised downward significantly from earlier ST memos on the subject. We request backup information supporting the new estimates. We are also interested in knowing what type of soil condition led to the higher estimates previously communicated. 40
- In Table 4-12, the distance shown from the Option B tunnel to Mechanical Engineering appears to be for the original building only, not the annex. 41
- Since construction vibration will have significant impact on UW research activities in various buildings, ST should provide an accurate prediction of vibration amplitudes at each building and discuss mitigated options that would bring these types of vibration within UW vibration requirements for each building. The construction generated vibration prediction must include the cumulative effect of various construction activities and details of mitigation measures for each construction equipment or activity. 42
- Paragraph two of Section 4.18.2 refers to "…current vibration sensitivity of the most sensitive research on campus is at or below 125 microinches/sec…" This statement should change to only refer to ambient threshold vibration that UW has provided to ST as the requirement for each building. Any references to VC curves are only misleading and irrelevant. 43
- How will the above errors be corrected?

Regarding Appendix B (Vibration Graphs), we make the following comments:

- No new backup information regarding the predictions is provided. Our previously communicated comments regarding the predictions in the DSEIS letter still apply. 44
- Many figures plot "Maximum Train Vibration Levels – 45mph" alongside "Source Mitigated Maximum Train Vibration Levels" that include a speed reduction as well as a floated slab. 45
- The title for Figure 3 implies that the data are for Room 135 of the Mechanical Engineering Building. In fact, the current-ambient spectrum is an average of three locations in the MEB. 46
- For all buildings, the ambient data are the same as in the most recently produced data from PSTC, dated November 2003 and appear to be correct with respect to our previously reported data. 47
- For some buildings, the "Maximum Train Vibration Level" data are the same as in the most recently produced data from PSTC, dated November 2003. The data appear to be unchanged for Fluke (Fig. 1), Mechanical Engineering Building (Fig. 2) and Annex (Fig. 4), More Hall (Fig. 5), and the Electrical Engineering Building (Fig. 8). 48
- For some buildings, the "Maximum Train Vibration Level" data differ from the most recently produced data from PSTC, dated November 2003. The difference appears to be due to the "Maximum Train Vibration Level" having been calculated based on a 35 mph train instead of a 45 mph train for Wilcox Hall (Fig. 6), Roberts Hall (Fig. 7), and Winkenwerder Hall (Fig. 9). Is the train speed the reason for the difference? 49
- For two buildings, the "Maximum Train Vibration Level" data differ from the most recently produced data from PSTC, dated November 2003. The data appear to incorporate subtle and unexplained changes at a variety of frequencies for Bagley Hall (Fig. 10) and the Chemistry Building (Fig. 11). In the case of Bagley, the change makes the "Maximum Train Vibration Level" spectrum meet the ambient criterion where it previously required mitigation. Please explain. 50

[Note: For the remaining buildings, no prediction data for the Modified Montlake Alignment were previously available.]

- The predicted mitigated vibration levels have changed slightly in the figures when compared with earlier reports and we would request that ST explain the reason for the change: 51
    - As we previously requested, data at frequencies below the isolator frequency now indicate no attenuation for the floating-slab cases.
    - We do not have access to figures explicitly illustrating the insertion loss spectra used for the floating-slab cases. Aside from the change noted above, no other changes in the insertion loss spectra are obvious. As we have commented previously, we believe that the insertion loss spectra (especially in the 8Hz case) might be difficult to achieve in practice.

- Some figures show data incorporating mitigation provided by "high resilience direct fixation". As mentioned above, we have not received any description or engineering data to support the attenuation claimed for this mitigation method. 52

NL 309 University of Washington/Theresa Doherty

NL 309-1

Sound Transit appreciates the input and continuous involvement of the University of Washington.

NL 309-2

Comment noted. This paragraph is not repeated in the Final SEIS, but references to the Modified Montlake route will reflect this change as requested.

NL 309-3

Sound Transit investigations have found that the Modified Montlake route (Preferred Alternative) can connect to the NE 45th Street Station.

NL 309-4

In response to the issues, Sound Transit has conducted additional design and analysis at the University of Washington Station and its connections and this option is not longer proposed as part of the Preferred Alternative. Sound Transit acknowledges the potential for vehicle-pedestrian conflicts associated with an underground passageway between the Triangle Parking Garage and the University of Washington Medical Center.

NL 309-5

Updated information on the University of Washington Station (Preferred Alternative) was provided in the 2005 Draft SEIS and incorporated within the North Link Final SEIS. Mitigation for other alternatives with parking loss, including the Rainier Vista Station, was described on page 3-45 in Section 3.3.2 of the North Link 2003 Draft SEIS for all other alignment alternatives being considered. Potential mitigation for off-street parking losses due to partial property displacements is described in Section 4.1.2 (Mitigation discussion under Acquisitions, Displacements, and Relocation). Sound Transit will work cooperatively with the University of Washington to provide just compensation and/or replacement parking for displaced parking stalls in the Triangle Parking Garage and other areas. Updated information is provided in the Final SEIS.

NL 309-6

As described in paragraph 4 on page 4-3 of the Addendum, "the NE Pacific Place/Montlake Boulevard NE intersection would operate at LOS F with the No-Build Alternative due to high-volume eastbound left, southbound through, and northbound through movements, as well as the high-volume westbound movement exiting from Husky Stadium." Updated information on mitigation for the University of Washington Station was provided in the 2005 Draft SEIS and included in the Final SEIS. The addition of a second westbound left-turn lane was suggested in the 2003 Draft SEIS as a potential improvement that would lower intersection delay to better than No-Build conditions. Further development of the mitigation at this location will be determined during the design process, in coordination with other projects and agencies, including the University of Washington, City of Seattle, and WSDOT.

NL 309-7

Surveys and appropriate right-of-way processes will be conducted during final design.

NL 309-8

The analysis of the Modified Montlake Route Addendum is now incorporated within the Final SEIS.

NL 309-9

The impacts and mitigation for parking displaced permanently and during construction has been updated in the Final SEIS. Sound Transit and the University have preliminary agreement that the parking be replaced on campus. Other measures are described in Chapter 3 and Section 4.17. Please see response to comment NL 309-5 for a discussion of how to mitigate permanent off-street parking losses. With regard to hide-and-ride parking impacts, Sound Transit and the City of Seattle signed a letter of concurrence on August 25, 2003 describing their commitment to aggressively pursue appropriate on-street parking measures to discourage hide-and-ride parking activity in neighborhoods around Sound Transit Link light rail stations.

NL 309-10

Thank you for the clarifications. The names of buildings used on the official University campus map will be used in the SEIS.

NL 309-11

The distances from sensitive buildings to the centerlines of the nearest track are shown below. The analysis has been updated for the Final SEIS and distances to the potentially affected buildings for the updated analysis are provided in the North Link Hi-Lo Mitigation EMI Report, March 2006.

	Modified Montlake Route meters	Rainier Vista Route meters
Bagley Hall	300	61
Chemistry Building	309	48
EE-CS	105	40
Physics-Astronomy	401	202
Johnson Hall	217	41
CHDD*	208	202
Health Sciences Imaging	288	181
Fisheries Center*	361	308
Marine Sciences Building*	660	511
New Surgery Pavilion*	74	43
Fluke Hall	103	368
Wilcox Hall	51	106
Roberts Hall	86	75
ME-ME Annex	33	178

NL 309-12

The assumptions and design features that went into the B-field modeling efforts are reiterated below as succinctly as possible.

The physical circuit layout assumed for propulsion current caused B-fields consists of two straight, level tracks fed by a traction power substation at their southern end. All conductors, including running rails, buried and overhead feed cables, rider cables, and current paths through pantograph contact points through cars back to running rails, are modeled as straight finite-length conductors carrying specific DC current. In the case of riser cables, each one is modeled as four segments respectively going laterally from buried cable to tunnel wall, straight up, laterally back to a point above the contact wire, and then down to the contact wire. The x, y, and z coordinates of each end of each conductor segment to x, y, and z components of B-field at desired points in space. These are then added up. Currents have been assumed to have maximum operational values. This is realistic, given the grade existing from the northeast to the southwest corner of the University of Washington campus. Built into the Excel spreadsheets used for these computations are provisions for easily varying the positions of overhead contact wire and buried cable. Calculations have been performed to assess the consequences of such variation.

The mitigated section of track for the calculations in the Modified Montlake Addendum was assumed to extend from the traction power substation at the south end of the campus to the insulated joints in the running rails near the NE 45th Street Station at the north end of the campus. The effects of track curvature on B-field levels was accounted for in calculations. The analysis has been updated for the Final SEIS and a detailed discussion of the assumptions is provided in the North Link Hi-Lo Mitigation EMI Report, March 2006.

NL 309-13

This comment relates to the issue. These issues of uncertainties and tolerances in the design and implementation of the North Link B-field mitigation efforts are addressed in the response to comments NL 208A-95 and NL 208A-130 of the University's January 30, 2004 letter.

The Mechanical Engineering Building is considered by Sound Transit to house less sensitive research than Bagley Hall and the Chemistry Building, because the University of Washington's requested B-field threshold at Mechanical Engineering is twice that of Bagley and Chemistry. Furthermore, the University of Washington has consistently emphasized the importance and critical sensitivity of research housed in Bagley and Chemistry.

NL 309-14

The Final SEIS reflects your comment. Section 4.18.1, page 4-21 of the Addendum states "The University of Washington would likely prohibit construction workers…" and has been revised to "The University of Washington has stated it will prohibit construction workers…"

NL 309-15

Sound Transit recognizes the important function that parking lots E11 and E12 play in University of Washington Medical Center operations and is considering a full range of possible mitigations as suggested. One new alternative under consideration is expanded surface parking south of lots E11 and E12 and on the Campus Triangle for temporary use during construction.

NL 309-16

Comment noted. This suggestion is an example of the type of issues that will be addressed in detail through interagency implementation and operating agreements prior to construction.

NL 309-17

Sound Transit notes the University's opinion regarding an interim terminus station on University property. However, Sound Transit also believes that the issues and concerns raised by the University can be addressed. The impacts of an interim terminus at the University of Washington Station are described in the Final SEIS.

NL 309-18

Project costs used in cost-effectiveness calculations include mitigation measures but do not include potential lost revenue to the University or businesses. The Final SEIS discusses impacts to University research, the medical center and other University activities and facilities from light rail construction and operation. Mitigation for these impacts is described.

NL 309-19

Comment noted.

NL 309-20

Sound Transit's recognizes the University's request for ambient vibration thresholds. Discussions of the existing sensitivity is provided for context of existing research currently on campus and the understanding that the sensitivity of research is becoming more sensitive. Representation of the University of Washington's vibration sensitivity is based on the VACC reports that inventory and identify the current sensitivity of different buildings and future research needs.

NL 309-21

Sound Transit has updated the vibration predictions as described in Chapter 4.6.6 which includes a discussion of uncertainty in the predictions. For the Final SEIS, Sound Transit prepared a more detailed vibration analysis based on the following: (1) additional borehole LSR tests along the Preferred Alternative; (2) FDL tests of a similar vehicle that will be procured by Sound Transit for this project, the Kinkisharyo vehicle, at Santa Clara Valley Transportation Authority (VTA) in San Jose, California. Vehicles were tested at different operating speeds in revenue service at three unique locations on the VTA system. The results were supported with vehicle maintenance records; and (3) the in-situ insertion loss of an existing floating slab design tuned to a similar frequency as proposed for this project was used to estimate mitigation effectiveness. The test data collected helped determine the relationships that were used in the EIS analysis such as reduction of low frequency vibration at lower operating speeds; floating slab insertion losses higher than the normally assumed limit of 20 dB; and more confidence in the LSR data defining the reduction in vibration over distance. Both the raw and post processed test data were made available to the University of Washington for their independent analysis. The updated Sound Transit vibration predictions have been reviewed by the University and its representatives, who have expressed their general concurrence that the methods and data are reasonable (University of Washington and Sound Transit meeting October 10/27/05).

NL 309-22

Comment noted. Responses to specific subjects are addressed below.

NL 309-23

Sound Transit has identified Kinkisharyo as the provider for their transit vehicle. The same transit vehicle is currently in operation at the Santa Clara Valley Transit Authority (VTA) in San Jose, California. FDL measurements will be conducted on several VTA Kinkisharyo transit vehicles at different operating speeds in three unique locations. The FDL test results provide the data that correlates train speed to low frequency vibration.

NL 309-24

Please see response to comment NL 309-21 and NL 309-23. The 1998 test data from Tri-Met's system are no longer used to estimate vibration impacts from the Sound Transit project on the University campus. All new field data collected by Sound Transit in San Jose were made available to the University.

NL 309-25

In general, vibration from two four-car trains passing simultaneously in opposite directions will result in vibration velocity levels as much as 3 dB greater than the values of a single train. The Final SEIS analysis has been revised to include a 3 dB impact from passing trains for all sensitive receivers. The predicted impacts in are based on two four-car trains passing-by on the nearest track (northbound or southbound) for each building site studied. The location of where two trains from opposite directions would pass under the University of Washington campus would be fairly random and the frequency of a two train impacts is dependent on the location of the sensitive building and the two train pass-by.

NL 309-26

Please see response to comment NL 309-21. The effect of rail and wheel aging was considered when the FDL measurements are conducted of the Kinkisharyo transit vehicle at the Santa Clara Valley Transit Authority (VTA) in San Jose, California.

NL 309-27

Please see responses to comments NL 309-21, NL 309-23 and NL 309-25.

NL 309-28

Sound Transit shares the University's concern about low frequency vibration impacts and maintains that the final frequency of floating slab mitigation should not be determined until Final Design. The current proposal calls for speed reductions and a 12-16 Hz floating slab along the alignment which is recommended to avoid amplifying vibrations contributed from the vehicle wheel-rail interface at or near 8 Hz as observed on the Kinkisharyo vehicle in San Jose.

NL 309-29

The updated analysis in the Final SEIS predicts vibration levels from maximum operating speeds and with speed reductions as a mitigation measure. See response to comment NL 309-28.

NL 309-30

A detailed Maintenance Plan has not been developed for North Link although it is expected to be similar to the plan currently under development for the Initial Segment. Sound Transit would maintain the light rail system to minimize vibration levels and long term degradation of vibration levels over time on the University campus. Sound Transit will monitor vibration levels from the light rail system in order to track

changes in vibration levels as the light rail system ages and allow the appropriate level of maintenance to be performed to prevent exceedances of the vibration levels agreed to with the University.

NL 309-31

Potential mitigation measures are described in Section 4.6.6 and proposed mitigation commitments described in Appendix M.

NL 309-32

This comment relates to leakage currents. Please see responses to the University of Washington's previous letter from January 30, 2004, comments NL 208A-95, NL 208A-99, and NL 208A-132.

NL 309-33

The Addendum and the 2003 Draft SEIS have been integrated into the Final SEIS and responses to those comments apply.

NL 309-34

Sound Transit's responses to comments made by the University of Washington on mitigation strategies (Section 4.6) still apply. Sound Transit has also updated discussions on the impacts and mitigations in the Final SEIS.

NL 309-35

High resilience track fasteners have a vertical stiffness of approximately 50,000 lbs./in. A proprietary type of resilient fastener is the Cologne Egg, which has been used for vibration reduction on the LA Red Line, Boston MBTA, and Washington WMATA transit systems.

NL 309-36

There is no measured data that supports that assumption of increased train vibration levels for trains operating on curved trackwork.

NL 309-37

Sound Transit recognizes the University's request for ambient vibration thresholds. Discussion of the existing sensitivity is provided for context of existing research currently on campus and the understanding that the sensitivity of research is becoming more sensitive. Representation of the University of Washington's vibration sensitivity is based on the VACC reports that inventory and identify the current sensitivity of different buildings and the future research needs.

NL 309-38

Please see responses to comments NL 309-37. Sensitivity of some buildings has been updated in the Final SEIS where specific new information has been provided.

NL 309-39

The range of frequencies has been revised in the Final SEIS and all ambient levels have been updated per the most current information from the University.

NL 309-40

Measured vibration data of tunnel boring machines (TBM) are not very extensive. The upper range of the higher levels was based on tunneling in hard rock. The levels presented in the 2003 Draft SEIS are a range of the average vibration levels measured in soft ground conditions and hard rock. The lower end of the range is the mean of ground vibration levels estimated using data from of the East Central Interceptor Sewer (ECIS) Project in Los Angeles, CA. The higher end is the mean of ground vibration levels estimated using data from three tunnel projects in hard rock (Buffalo Light Rail Rapid Transit Tunnel, Metro West Water Supply Tunnel, and Chattahoochie Tunnel). The Final SEIS and Noise and Vibration Technical Report contain an updated analysis of the vibration impacts during construction.

NL 309-41

In 2003 Draft SEIS Table 4-12, the distance shown for 'Mechanical Engineering' for the Option B tunnel does apply to just the Mechanical Engineering building as opposed to the Engineering Annex.

NL 309-42

A more detailed construction analysis for each building is provided in the Noise and Vibration Technical Report. Vibration impact predictions from the TBM and mine train will be refined further after measuring vibration levels from the Beacon Hill tunnel construction for the Initial Segment.

NL 309-43

Some of the most sensitive research on campus currently requires vibration levels at or below the ambient level. However, for other research facilities the ambient threshold requested by the University is necessary to protect the potential for future research and the sensitivity of research at the time of construction is more relevant than the University of Washington requested ambient threshold because construction on campus is planned to occur within the next ten years.

NL 309-44

In cooperation with the University of Washington, Sound Transit has reanalyzed vibration impact predictions for the Final SEIS. See response to comment NL 309-21.

NL 309-45

Comment noted.

NL 309-46

Comment noted. The Final SEIS will no longer predict vibration levels in Room 135 of the Mechanical Engineering Building.

NL 309-47

Comment noted. The most current ambient data from the University is used in the Final SEIS.

NL 309-48

Comment noted. The analysis has been updated in the Final SEIS.

NL 309-49

The vibration predictions presented in Figure 3 are at Room 135 of the Mechanical Engineering Building, and assume the average ambient vibration level measured by Vibro-Acoustics Consultants at three locations in the same building.

A more detailed speed profile was prepared by Sound Transit's design consultants (PSTC), which resulted in lower speeds at some locations along the alignment.

NL 309-50

Both these buildings are further than 800 feet from the Modified Montlake Route alignment. The earlier calculations presented in November 2003 used the LSR at 800 feet, which is the maximum distance at which the borehole test was conducted. The later calculations presented in the February 2004 Draft SEIS Addendum extrapolated to the actual distances to each of these buildings resulting in an approximately 2 dB lower maximum vibration level.

NL 309-51

The changes from the previous reports are: (1) the vibration reduction for the 16 Hz floating slab has been changed to the theoretical insertion loss of a single-degree-freedom oscillator isolation curve, consistent with the attenuation used for the 2003 Draft SEIS and presented in the *North Link University of Washington Vibration Background Report,* prepared by PSTC, September 2003. The previous analyses, submitted in a series of memos between November 26, 2003 and January 6, 2004, used the installed test results of a similar 16 Hz floating slab designed for the Los Angles Metro Red Line; and (2) for buildings further than 800 feet from the Modified Montlake Route alignment, the earlier calculations presented in November 2003 used the LSR at 800 feet, which is the maximum distance at which the borehole test was conducted. The later calculations presented in the Modified Montlake Addendum extrapolated to the actual distances to each of these buildings resulting in an approximately 2 dB lower maximum vibration level. The insertion loss data for the floating slabs are included in Figure 29 of the *North Link University of Washington Vibration Background Report*, September 2003. The analysis has been updated for the Final SEIS and the reference report Preliminary Engineering Vibration Control for the University of Washington North Line Segment, 2006, provides additional detail supporting the analysis.

NL 309-52

High resilience track fasteners have a vertical stiffness of approximately 50,000 lbs./in. A proprietary type of resilient fastener is the Cologne Egg, which has been used for vibration reduction on the LA Red Line, Boston MBTA, and Washington WMATA transit systems.

NL 391

UW
UNIVERSITY OF WASHINGTON

Associate Vice President for Capital Projects

November 30, 2005

Mr. James Irish
Link Environmental Manager
Sound Transit
Union Station
401 S. Jackson Street
Seattle, WA 98104

Dear Mr. Irish:

1

These comments supplement our letters dated January 30, 2004, on the 2003 Draft Supplemental Environmental Impact Statement for the North Link, and March 11, 2004 letter on the North Link Modified Montlake Route Addendum.

Sound Transit is the lead agency for SEPA compliance for its proposal to construct and operate the North Link. However, the University of Washington Board of Regents, as a public agency with a separate decision authority regarding use of its property, must assure compliance with SEPA for its decision and must have SEPA documentation on which it can rely. As stated in our previous comment letters, the University is very concerned about construction impacts. The documents, to date, do not adequately identify and analyze the proposed potential construction impacts and possible mitigation measures specific to the University campus. The University hoped it could adopt Sound Transit's Final SEIS; however, since the Draft SEIS is deficient regarding construction impacts and mitigation, the University will be faced with the problem of determining whether it will need to supplement the environmental analysis before the Board of Regents can approve the Design and Mitigation Plans. Please advise us when this level of analysis will be available if it is not contained in the Final SEIS.

Specific Comments:

2

In Table S-2 Segment B Summary of Impacts, the electromagnetic field impacts to University buildings before/after mitigation for the Preferred Alternative are given as 6 and 2, respectively. We currently understand from discussions associated with the Master Implementation Agreement that four University buildings will be affected after mitigation. It would seem that whatever environmental information you publish now should reflect the information you are providing to the University as part of the negotiation for the Master Implementation Agreement that would allow Sound Transit access to University properties in support of the North Link in Seattle.

Box 352205 Seattle, Washington 98195-2205 VM: 206-543-5200 FAX: 206-543-1277

2 cont.

Actually, nine University buildings will be affected without mitigation as listed in Table 4-6 of the North Link Modified Montlake Route Draft SEIS Addendum dated February 2004.

3

It is not clear where the entries in the column for "Other Segment B Alternatives" in Table S-2 come from, since no optional or alternative routes through the University are shown in Figure S-2 of the Draft SEIS.

4

There was no mention of electromagnetic fields in Section 3 of the document presumably because it was covered in the Modified Montlake Route Addendum.

Section 3.1.4 University of Washington Station

5

As the University has discussed with Sound Transit, the University is concerned with the pedestrian and automobile conflicts which will occur on Pacific Place without adequate mitigation. The University would prefer mitigation in the form of an underground tunnel. The need for this type of mitigation is shared by other agencies. The University's ADA Committee supports the University's position. We are also concerned with impacts to the Burke Gilman Trail, which is a critical transportation link for the City and the University.

Sincerely,

Richard Chapman
Associate Vice President for Capital Projects

cc: Weldon Ihrig, John Brandon, Theresa Doherty, Jan Arntz, Peter Dewey, Joni Earl, Ron Lewis, Ron Endlich, Tracy Reed

NL 391 University of Washington – Richard Chapman

NL 391-1

Updated analysis of construction impacts and mitigation are included in the Final SEIS. The 2005 Draft SEIS was intended to describe the differences and changes in impacts between the alternatives as described in the 2003 Draft SEIS and Modified Montlake Addendum, and any refinements that have occurred since that time.

As you are aware, review under the State Environmental Policy Act (SEPA) should be conducted at the earliest possible point in the planning and decision-making process when the principle features of a proposal and its environmental impacts can be reasonably identified (see WAC 197-11-055). SEPA review for the North Link light rail project has been conducted consistent with this requirement and the project construction impacts are reasonably covered in the Final SEIS and appropriate mitigation identified. We anticipate additional specificity on mitigation measures will be developed in accordance with the MOA with the University and any subsequent amendments or implementing agreements.

Compliance with SEPA for Sound Transit's North Link light rail project will be completed with Sound Transit's publication of this Final SEIS. Sound Transit has concluded that the Final SEIS and supporting documentation provides the appropriate substantive and procedural compliance pursuant to SEPA for the project. We believe the University can use these documents unchanged (per WAC 197-11-600) in support of any actions related to the project by the University.

NL 391-2

The summary information provided in the 2005 Draft SEIS reflected the available information at the time of publication review, and was primarily based on the earlier 2003 Draft SEIS and the Montlake Addendum. The Final SEIS reflects updated analysis that is also informing the development of the Master Implementation Agreement.

NL 391-3

In Table S-2, the "Other Segment B Alternatives" refer to those alternatives included in the 2003 Draft SEIS (Alternatives B1.A, B1.D, B1.Ga, B3.D, B3.Ga, B4.D, and B4.Ga,b).

NL 391-4

This is correct. See response to comment NL 391-2.

NL 391-5

Sound Transit has proposed as mitigation an entrance or access point for the University of Washington Station that provides a grade-separated crossing north of NE Pacific Place and the Burke-Gilman Trail. The Sound Transit Board is expected to decide on this issue following the release of the Final SEIS. Sound Transit recognizes the University's ongoing concern regarding this station and will continue to work the City and other affected parties throughout the course of the project.

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