Approval of Mechanically Stabilized Earthen Berm

Response to Comments

May 30, 2013

State of Oregon
Department of
Environmental
Quality

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DEQ is a leader in restoring, maintaining and enhancing the quality of Oregon's air, land and water.

was, are any of these comments that we're making going to make any difference, and if so, what difference are they going to make? I still don't really have my answer to that question. Someone else said, can you say what diff -- someone else said, "Do you think that it should be up to the people of Yamhill County to decide what happens in Yamhill County?" We were told that well, you vote for the commissioners. Well, we all kind of know what the story is with the commissioners in Yamhill County. About six months ago, I started to get educated, all the way back to the 1500s and the beginning of corporations, and how we got to be in the predicament that we're in today. And I started getting educated through a group that's now forming here in Yamhill County, called Yamhill County Community Rights. And we're working with a national organization called The Community Environmental Legal Defense Fund. These attorneys who are working nationally have already started ordinances at 150 communities, where the people in the communities actually take back their rights. We're all here tonight, pouring our hearts out, and our passion, and our brilliance, and our studies, and our research, and all of this, but we are on the wrong road. That is where we are. There is a path, and it is through these community ordinances where we can take back our power as local people. There is going to be a democracy school here that is being held by this organization on May 10th and 11th. You can -- I invite you to -- there's several of us in the room tonight -- there's about 30 of us, Linda Grove, myself, Bill Newman. I don't know who else is here. John, are you here?

Anyway, one of the things I started to learn in this school -- 'cause we've done several workshops now with them -- is that you know, when there is a regulatory agency, which the DEQ is a regulatory agency, all of our regulatory agencies are created to regulate harm. I'm going to say that again. They are here to regulate harm. They are not here to stop harm. They're here regulate it, because they are in bed with the corporations, and the corporations are in bed with our governments, and you check where the salaries all come from. So instead of the people asserting our rights, and having our say, it's now -- you know, we have these regulatory agencies whose missions are beautiful, you know, to be a leader in restoring, maintaining, and enhancing the quality of Oregon's air, land and water? Duh! You know, I mean, look what they're doing. They are totally on the side. So I would like very much to close it up.

DEQ RESPONSE. Ms. Marshall refers to the creation of an ordinance to address concerns about the landfill. If such an ordinance were passed, we agree that this would affect future decisions regarding the landfill.

Regarding the comment that DEQ's purpose is not to stop harm but to regulate harm, we also agree. People use and dispose of materials that contain harmful chemicals. It is not possible to prevent every molecule of those chemicals from entering the environment. It is possible to control them, by requiring safeguards such as landfill liner systems, gas management systems, and leachate management systems, and by requiring environmental testing to assess the effectiveness of those safeguards.

DEQ staff have conducted a thorough review of the proposed berm and expansion. DEQ must base its decision regarding any landfill proposal on whether that proposal meets the requirements specified in federal and state regulations and guidance. The MSE berm proposal meets those requirements.

<u>COMMENT 19</u>. (Jim Kreutzbender)
Hi, my name is Jim Kreutzbender. I've lived around in this area for 30 years. I'd like to respond to DEQ. There's – here in 2011, the Oregon Resilience Plan came out. This plan is to reduce the risk, and improving recovery for the next Cascadia earthquake and tsunami, from the Oregon

Seismic Safety Policy Advisory Commission. This is 150 people - well, this was in 2011. A house resolution commissioned this study. 150 people volunteered; scientists, engineers, and -- came up with this report, and it took them one year. "This plan is to help Oregonians know what to expect from the state's infrastructure, and proposes the level of infrastructure, reliability, that a resilient state should provide. Oregon at its best is tackling a risk with imagination and resourcefulness by sharing the knowledge gained. We can choose a future in which the earthquake results" -- they were talking about a 9.0 earthquake, subduction earthquake -- in this whole report. "We can choose a future in which the earthquake results in grim damage, losses, and a society diminished for generations, or a future in which the earthquake is a manageable disaster without lasting impact." The resilience plan earthquake scenario, they studied all your energy, and buildings, and bridges, and transportation and everything. Unfortunately, they didn't have a section in there on landfills. But under this one section from the engineers, they said "cities along the I-5 corridor will experience a strong to very strong shaking. In all areas, the strong shaking will last two to four minutes." Well that is far more than the 8.5 and 30-second shake that Riverbend Landfill is proposing for their berm. This is not a plan for the future, or not being resilient, or just a good neighbor. Riverbend has never been a good neighbor. So Riverbend's proposal is all about making money, and not being a resilient participant in Yamhill County's future. So close Riverbend Landfill in 2014. Their permit is filled to capacity. Thank you.

DEQ RESPONSE. DEQ and its seismic consultant reviewed the seismic characterization and design thoroughly over the past several months. This review considered many issues, including liquefaction, earthquake magnitude, source to site distance, and associated ground motions. We conclude that the design meets the regulations for municipal solid waste landfills. We also point out that these regulations are more stringent than those used for most other structures.

COMMENT 20. (Susan Watkins)
Thank you. My name is Susan Watkins. I'm a landfill neighbor, and I'm also on the board of directors of Waste Not in Yamhill County, and Stop the Dump coalition. Nine days ago, I was in Christchurch, New Zealand, which you'll recall, two years previously, suffered a series of unexpected and very devastating earthquakes, and they are still a long, long way from being back to normal. They didn't have a good resilience plan. There in Christchurch, the need was probably more for a change in mindset, which I know is what OSPAC and the State of Oregon wants to do with their resilience plan here, and a change of mindset across institutions, rather than just upper building standards for, you know, an MSE berm on our river bank. The point that struck me, though, is that when the earthquake comes here, we want our landfills to be part of the solution, not part of the problem. And it's clear, I think, to anybody who's looked in any detail into Riverbend, that it is going to be part of the problem. The landfill itself, as far as I was able to tell from documents that we've looked at, was spec'd to be engineered to a 7.5 earthquake standard, although I think Leonard Rydell has cast a lot of doubt on whether it was actually built to the specs. Nothing that Waste Management has proposed in this berm plan is designed to keep waste out of the river when the earthquake strikes. To me, the point here is not how strong is the berm, but the addition of another million tons on top of the 13 million that will be there when it reaches current capacity, which will all be heading downstream into the river when the earthquake hits. I think that's where we should be focusing our -- our target when we approve these things is do we need another million tons out there on that pile.

And the second point I would like to make has to do with the original document designed for this dump is -- as I mentioned, my understanding is that it was spec'd to be built for a 7.5, but Paul

Mr. McJunkin incorrectly states that the landfill is adjacent to the South Yamhill River. The landfill is 400 feet from the river.

COMMENT 52. (Richard McJunkin)
SUBJECT: BIASED NEAR-SURFACE S-WAVE VELOCITY SURVEY DATA FOR MSE WALL (BERM)

Comments for the 'fabricated' near-surface shear-wave (s-wave) velocity survey by Waste Management Inc. (WMI) are provided. Data for comment are in the "March 22, 2012 Phase 1 MSE berm design report - part 3 of 4" and counter s-wave data obtained from previous down-borehole geophysical surveys.

Basically, the s-wave study described by Geosyntec in the March 22, 2012 Phase 1 MSE berm report was to counter s-wave data obtained from "down-hole logging" (e.g., boreholes GT11-01 and GT11-02). In the GT11-01 and GT11-02 boreholes, data collected show that the majority of depth for each borehole provides s-wave velocities LESS THAN 900 FT/SECOND. This suggests a strong potential for liquefaction which is a fact stated in reports by Waste Management, Inc. (WMI) to Oregon Department of Environmental Quality (DEQ) AND by DEQ in public meetings. These biased velocity data are TOTALLY verified as being biased when velocities are compared against the physical description(s) of soil samples in the geologic drilling logs. There are several physical descriptive indications for liquefiable soils being present in the Riverbend Landfill geologic foundation: 1) low blow counts for soil sampling, 2) loose consolidation of samples collected, 3) soil samples that flowed from the split-spoon sampler and were lost = this material liquefied by energy from insertion of the soil sampler and then flowed from the sampler as it was retrieved to the surface, 4) wood fragments at depths of 65-feet below-ground-surface which indicates that the South Yamhill River (SYR) has HUGE amounts of flow-energy that may change 'cut and fill' areas in its channel in short periods of time. Curiously, WMI is reporting that 'Native American' burial sites are totally safe from any landfill impacts to the SYR without mentioning a very possible change in channel position from their future ~1-million cubic-yard excavation (borrow site) in the terrace below the landfill.

FACT: S-wave velocities less than 900 ft/sec indicate that geologic materials being surveyed are 'very suspect' for undergoing liquefaction during a seismic event. I submit that WMI "went searching" for a way to gather high s-wave velocity data to counter the earlier and much slower s-wave velocity data obtained from boreholes GT11-01 and GT11-02. Without exception, GT11-01 and GT11-02 s-wave data could easily be considered an indication of liquefiable soils forming the geologic foundation of Riverbend Landfill.

Bob: The re-done s-wave velocity survey study referenced in the "March 22, 2012 Phase 1 MSE berm design report - part 3 of 4" document is just one more attempt by WMI to alter data for their benefit in ways reviews will not notice. A previous example of WMI deceiving the data set is provided in the liquefaction study of two soil samples by Geosyntec. In this study, the samples selected by 'Hari Sharma,' a licensed Ph.D. in geophysics, were so consolidated they could not liquefy with any amount of input energy:

this is total DECEIT IN REPORTING!!! The fact that the two soil samples selected by Geosyntec (Hara Sharma) would not liquefy is very obvious in the geologic drilling logs where high 'blow counts' were required to drive the down-hole hammer and sampler, thus meaning consolidation properties that would not provide for liquefaction of the sample. Research data support that highly consolidated soils will not liquefy so why were these types of soils selected for reporting?

For this deceitful effort in presenting false technical liquefaction data by WMI and Geosyntec, you received a great deal of public criticism. You further stated you would "require WMI to perform additional liquefaction studies of physical soil samples." Unfortunately, you showed no follow through and this analytical effort has never happened. If it has been performed, please send me the data report!

It now appears that DEQ (you) have allowed WMI to re-perform s-wave velocity studies as a 'magic method' to gather biased data and obscure facts – s-wave velocities less than 900-ft/sec that indicate a strong potential for liquefaction in the geologic foundation of Riverbend Landfill!! Bob, this verges on being shamefully derelict and reflects a 'pick and choose' provision for data collection! Why did you buy into this deceit??

Shear-Wave Velocity - Data Collection Discussion:
S-wave velocity studies are very critical for evaluating seismic site response. The collection of these data are usually very specific to a site-specific place where seismic site response data are needed; for an example, at a place where strong-motion 'acceleration data' are collected by a strong-motion accelerograph.

Seismic engineers use down-hole s-wave velocity data, in conjunction with strong-motion data, to determine seismic site response and potential surface impacts which affect engineered structures. To obtain these needed data, vertical boreholes are drilled "within feet" of the strong-motion accelerograph and 'down-hole' s-wave velocity studies are performed, at depth increments dependant on the need for resolution. These data indicate with 'accuracy and precision' the seismic site response at a particular place on the ground surface. This detail of borehole drilling and s-wave logging is a major expense for the installation of a strong-motion accelerograph (recall that I worked a number of years for the California 'Strong-Motion Instrumentation Program' and have published on this subject). Normally and without exception, s-wave velocity data derived from 'horizontal surface arrays' are not used!!! Therefore, why is WMI being allowed by DEQ to use such data? Are you so non-technical that you do not understand or desire to research site-specific methods for determining how to collect accurate and precise subsurface s-wave velocity data? And, once s-wave data are collected, how to apply it?

There are technical reasons why horizontal geophysical surface arrays to collect s-wave velocity data are not used. This fact was totally disregarded by WMI and unfortunately, it appears that DEQ is willing to accept such data. Using down-borehole survey measurements for s-wave velocity studies provides for the collection of direct distance measurement between input energy at the surface and the measuring point at varying depths in the subsurface. As the sensor (i.e., geophone) is lowered in the borehole to different depths, and a velocity measurement obtained for each incremental depth, s-wave velocities are thus a true measurement of s-wave velocity for the ALL soils between energy

input at the surface and each monitoring point in the borehole. It thus provides for a cumulative record of the s-wave velocity from surface to total depth of surveying in a borehole. This technique further provides for 'accurate and precise' s-wave velocity data collection to (almost) any depth. An inaccurately performed s-wave velocity data set appears to have been provided by WMI and submitted to DEQ, and it appears that DEQ is ready to accept these incorrect (biased) data.

Using a linear array of geophones at the surface provides for an entirely different path of s-wave measurement which yields inaccurate and biased data that that do not apply to a specific place on the ground. As input s-wave energy enters the ground, at some point in depth, a more consolidated geologic material is encountered which will transmit wave energy at a higher velocity; this is what yields inaccurate s-wave data. The high-velocity geologic layer transmits the moving s-wave (from input energy) in the subsurface where it is registered on geophones at the surface. At some distance from the source of input energy along the geophone array, the s-wave at depth will arrive more quickly than the surface s-wave, even though it travels a greater distance. This detail in transmission of s-waves is not reversible to detect slower velocity geologic materials that may be encountered below the higher-velocity layer(s); thus, slower velocity geologic materials underlying higher velocity geologic materials are masked and do not become part of the final data set. This is a misrepresentation of the true potential for seismic liquefaction in the geologic foundation of Riverbend Landfill!

It appears that DEQ is unaware that the failure of a large landfill such as Riverbend, which is adjacent to a major river, would probably be the largest environmental disaster in the history of Oregon; a disaster costing tens-of-millions of dollars (~$100-million++ for starters) to remediate, with environmental damage, never possible to fully remediate.

RECOMMENDATION:
WMI needs to complete additional s-wave velocity surveys from boreholes. Data collected from these surveys needs to be from down-hole velocity measurements in boreholes where such boreholes are sited along the surface path of construction of the future MSE Wall/Berm. Total borehole depth needs to be 'AT LEAST' 100-feet below-ground-surface which is the depth interpreted to be liquefiable during a magnitude 9 earthquake as dictated by standard practice in the field of geophysical surveying.
Proposed boreholes for s-wave velocity studies should also characterize subsurface geologic materials (i.e., soils) by collecting continuous cores for the entire length of borehole drilled – no exceptions! At present, subsurface characterization of the geologic foundation of Riverbend landfill and the proposed MSE Wall/Berm is inadequate. Bob: It totally amazes me that you, as a licensed Professional Engineer in the State of Oregon, are incapable of observing (or choose not to) physical facts that are clearly represented in the record from geologic drilling logs! Let me re-state: I AM TRULY AMAZED BY YOUR PROFESSIONAL ACTIONS FOR INTERPRETING AND ACCEPTING INACCURATE GEOLOGIC/ENGINEERING DATA!!!

In closing, I do not wish you luck in future discussions with the Oregon Board of Professional Engineers which regulates all aspects of technical competency.
Richard McJunkin
Small Woodlands Owner

Professional Geologist**
****Certification Licenses:**
Engineering Geology
Hydrogeology

DEQ RESPONSE. DEQ concludes that this site does not pose a risk of significant liquefaction-induced deformation. This conclusion is based on soil classification, SPT density measurements, plasticity index of fine grained soil, and shear wave velocity results.

We agree with the comment that the information provided in the March 2012 report was not adequate for us to assess seismic stability and liquefaction potential. However, the subsequent work, documented in Geosyntec reports that we made available on our website, provided the necessary information.

The letter states that the shear wave velocity data (V_s data) is "*biased*", "*fabricated*", and that the MASW method is a "*magic method*." The MASW (Multi-Channel Analysis of Surface Waves) method of geophysical exploration is a widely-adopted and accepted procedure in engineering practice for measuring surface wave phase velocity in soil and rock. The surface waves (Rayleigh waves) are converted to shear waves using algorithms that have been well-defined and established in applied geophysics. Surface wave techniques have been widely used on major projects throughout North America. These projects include major bridges, building foundations, proposed LNG facilities, dam foundations, etc. The MASW method is not viewed by knowledgeable professionals as a "*magic method*." There are several very reputable and respected geophysical and geotechnical consultancies in Oregon that routinely use surface wave measurement techniques for obtaining V_s profiles for dynamic soil response analyses. The use of MASW in engineering practice is quite common.

The letter states that the MASW study *"…was to counter s-wave data obtained from "downhole logging" (e.g., boreholes GT11-01 and GT11-02).*" Please note that no downhole logging of shear wave velocity has been performed in boreholes GT11-01 and GT11-02, nor in any of the boreholes advanced during the investigation for the Phase 1 MSE Berm. We are unaware of any shear wave testing performed in proximity to the proposed MSE Berm alignment prior to the MASW investigation conducted and presented for WMI by Zonge International, Inc.

The shear wave velocity profiles presented for borehole locations GT11-01 and GT11-02 (March 22, 2012 Geosyntec report) were based on general, practice-oriented correlations between engineering parameters (e.g., SPT N-value, undrained shear strength). The basis for these initial V_s profiles was well explained in Appendix E of that report (Dynamic Response Analyses). Estimating V_s from engineering parameters is common in engineering practice; however, site-specific measurement of V_s using surface or downhole methods is always preferred.

The V_s data obtained by the MASW investigation provided the first site-specific data for the foundation soils along the alignment of the proposed MSE Berm, therefore this data did not "*counter*" or supersede any measured data.

The letter suggests that the geotechnical evaluation should include continuous cores for the entire length of the borehole. We disagree, because this is not standard practice for this type of evaluation. The frequency of sampling for soil classification, density testing and lab analysis was within the standard of practice for this work.

The letter includes this statement: "*I submit that WMI "went searching" for a way to gather high s-wave velocity data to counter the earlier and much slower s-wave velocity data obtained from boreholes GT11-01 and GT11-02. Without exception, GT11-01 and GT11-02 s-wave data could be easily be considered an indication of liquefiable soils forming the geologic foundation of Riverbend Landfill*."

We restate for the benefit of Mr. McJunkin and interested parties that the "…*much slower s-wave velocity data* obtained from boreholes…" that he refers to was based on empirical correlations and not based on field measurements. The MASW investigation provided the first and only V_s data at the project site. The MASW data is considered much more representative than the V_s estimates made using general correlations.

The letter states that "*In the GT11-01 and GT11-02 boreholes, data collected show that <u>the majority</u> of depth for each borehole provides s-wave velocities <u>LESS THAN 900 FT/SEC</u>. This suggests a strong potential for liquefaction…*" Emphasis by Mr. McJunkin.

This comment touches on several related issues, addressed as follows:

1. As previously clarified, no V_s data was obtained in boreholes GT11-01 and GT11-02. We hope that this misconception has been amply addressed.

2. All of the comments made with respect to V_s < 900 ft/sec and liquefaction potential fail to note the importance of soil type(s) in liquefaction potential evaluation. The fine-grained, cohesive, over-consolidated soils at the site are not susceptible to liquefaction due to factors related to composition, stress history, and undrained shearing resistance. The shear wave velocity in these soils is not indicative of the potential for liquefaction.

3. Comments related to the liquefaction resistance of soils based on measured V_s values should focus on deposits that are predominantly sand.

4. A comment pertaining to the evaluation of soil liquefaction using in-situ methods is warranted; the standard of practice places a much higher reliance on assessments based on standard penetration test (SPT) and cone penetrometer test (CPT) data than on V_s data for several reasons that have been well addressed in the contemporary technical literature.

It should be mentioned that SPT- and CPT-based methods have been used to evaluate the liquefaction potential and portions of the foundation soils have been characterized as potentially liquefiable under design level ground motions. This is discussed in Geosyntec letter reports dated June 22, 2012 and September 26, 2012. These were independently reviewed by two reputable consulting firms, and consensus reached regarding the potential impact of the liquefiable soils on the computed seismic performance of the landfill and MSE berm.

The letter states: *"FACT: S-wave velocities less than 900 ft/sec indicate that geologic materials being surveyed are 'very suspect' for undergoing liquefaction during a seismic event."*

This comment requires the reiteration of several important and relevant points.

1. The susceptibility of the soil to earthquake-induced liquefaction is a function of the cyclic resistance, which includes soil type. All comments pertaining to the use of V_s as an indicator of liquefaction resistance must include reference to soil type, fines content, and effective confining stress. None of these requisite parameters are provided in the comments.

2. The susceptibility of the soil to earthquake-induced liquefaction is also a function of the strength of shaking (amplitude and duration of cyclic loading), therefore all comments pertaining to liquefaction hazard must include reference to the design earthquake parameters; earthquake magnitude as a proxy to duration and the ground motion amplitude. None of these requisite parameters are provided in the comments.

3. Again, the standard of practice places a much higher reliance on liquefaction assessments based on SPT and CPT data than on V_s data for several reasons that have been well addressed in the contemporary technical literature.

4. Finally, the unqualified statement regarding the basis for V_s of 900 ft/sec as an indicator of liquefaction susceptibility is not supported by case histories.

Mr. McJunkin has addressed concerns pertaining to the following liquefaction-related issues; specifically that the following indicate a higher potential susceptibility to liquefaction than indicated based on SPT- and CPT-based procedures:

1. "*Low blow counts for soil sampling*" – Liquefaction triggering evaluations have been conducted using all of the SPT N-values obtained in sandy soils. Those sandy soils with low N-values have been evaluated.

2. "*Loose consolidation of samples collected*" – The "*loose consolidation*" of sandy soils would very likely be exhibited by a correspondingly low SPT N-value or CPT q_c value, therefore this has been indirectly evaluated.

3. "S*oil samples that flowed from the split spoon sampler and were lost*" – This could have been due to several different reasons; plugged check valves in the sampler-drill stem system and resulting high fluid pressure from drilling mud, or loose sandy or silty soils in the sampler. If the latter, then the associated N-value should have been low thereby indicating a potentially liquefiable soils.

The liquefaction triggering analyses based on SPT and CPT data have been thoroughly reviewed by DEQ and its seismic consultant, and by a consultant hired by landfill opponents. These issues have been well-reviewed and addressed by reputable consulting firms.

The letter states: *"WMI needs to complete additional s-wave velocity surveys from boreholes. Data from these surveys needs to be from down-hole velocity measurements in boreholes where such boreholes are sited along the surface path of construction of the future MSW Wall/Berm."*

DEQ and its seismic consultant disagree; we believe the MASW explorations performed to date are adequate for the dynamic soil response analyses performed for this project.

The letter states: *"Total borehole depth needs to be "AT LEAST" 100-ft below-ground-surface which is*

the depth interpreted to be liquefiable during a M 9 earthquake as dictated by standard practice in the field of geophysical surveying."

Evaluating liquefaction hazards to a depth of 100 feet is by no means the "*standard practice in the field of geophysical surveying.*" It appears that important points are being mixed in this statement. Liquefaction hazard analyses are routinely performed by geotechnical engineers or engineering geologists, while geophysical surveying is focused on different aspects of site characterization. Along these lines, it is important to note that the standard of practice for evaluating liquefaction triggering (routinely used in engineering practice) is recommended to a maximum depth of only 60 to 70 feet.

COMMENT 53. (Leonard Rydell)
[The following was provided in a letter dated January 16, 2013, prior to the public comment period. During the comment period, however, Mr. Rydell requested its inclusion as a public comment.]

Dear Mr. Schwarz,

I am concerned about the assumptions and documentation submitted by Geosyntec regarding the analysis of the Riverbend Landfill. As you are aware, engineering is the mathematical application of common sense. Formulas have many inputs, computer programs are inflexible, and the practice of engineering requires professional judgment in determining input parameters. Reasonable assumptions do not always lead to reasonable answers.

My concerns about the submitted documentation submitted are as follows:

1. Mr. Sharma's letter dated 9 January 2013 on the second page states, that, `*As shown in the figure, the corresponding seismic deformation is about 9.5 inches which is less than the generally accepted deformation level of 12 inches.*" I would not accept this statement at face value without additional investigation. It may be valid for a landfill such as Coffin Butte or those East of the Cascades, but is it a valid assumption for a landfill in a flood plain that is subject to liquefaction and infiltration by ground water. Other issues that should be considered are:

a. The calculations are based on incomplete soil samples. Some samples fell out of the sample tubes. Landfill standards for the State of Ohio require liquefaction calculations for each soil layer. We only have one calculation based on incomplete analysis of all soil layers.

b. What happens when the liner gets ripped or torn by repeated quakes? Besides, don't all liners eventually leak?

c. What does the term `*generally accepted*" mean? More specifics should be provided and reviewed site specifically for the conditions at Riverbend Landfill.

DEQ RESPONSE. The geotechnical evaluation, including the liquefaction analysis, is based on data from 14 borings and seven test pits constructed in and near the location of the MSE berm. Soil was characterized in the field based on visual observation, and density was estimated using standard penetration tests. Samples were then sent to the lab to evaluate strength, plasticity and other parameters. The subsurface soil was further evaluated using a MASW analysis to estimate shear wave velocity. This information was carefully reviewed by DEQ and its geotechnical consultant over several months.

The review documents between the consultants for DEQ and Waste Management have been posted on DEQ's Riverbend Landfill website. The statement that "we only have one calculation based on incomplete analysis of all soil layers" is incorrect.

Liners do have a finite life, as Mr. Rydell suggests. Research indicates that geomembrane liners last hundreds of years. We note that the liner system for the more recent cells at this landfill include two liners separated by a leak detection system. The upper liner is a composite liner, and includes a geomembrane on top of a geocomposite clay liner, which includes a layer of processed clay between two layers of geotextile. In addition, the soil beneath these liners is a low-permeable, clayey soil, which also provides a barrier to contaminant migration.

The phrase, "Generally accepted deformation of 12 inches" was used by Geosyntec, not DEQ, so we will not speculate on what the author had in mind. However, we do note that this amount of deformation is discussed in EPA guidance regarding seismic design of landfills. (RCRA Subtitle D Seismic Design Guidance for MSW Landfill Facilities. EPA/600/R-95/051 April 1995.)

2. The latest letter from Norman Abrahamson dated 8 January 2013 suggests two magnitudes of M8.0-8.5 and 8.5-9.0. Mr. Abrahamson makes an engineering judgment of the average of 8.5. This conclusion may be appropriate for a landfill such as Coffin Butte that does not have ground water problems and is not located in the flood plain of a river. I urge you to require a magnitude of 9.0 based on the location of the landfill and generally accepted magnitudes.

DEQ RESPONSE. The seismic hazard evaluation was thoroughly reviewed by our seismic consultant prior to DEQ recommending approval of the proposal. We also note that groundwater monitoring at the site indicates that the landfill is in compliance with its permit.

Under Section 4, it appears the Mr. Abrahamson applies a factor of 1.5 to the average recurrence interval of 400 years to get an interval of 600 years. I am attaching a map of the historical record prepared by Chris Goldfinger, PhD, that gives a history of the Cascade Subduction Zone earthquakes for the past 10,000 years. Over 10,000 years, there were 19 quakes with an average occurrence interval of one every 526 years. Over the last 4000 years, there were ten earthquakes for an average of one every four hundred years. Over the last 1,000 years, there where three earthquakes or one on the average of every 333 years. As you can see, the earthquakes seem to be increasing in frequency. Since we are talking about a permanent installation that will be there forever (a geologic time scale) versus a limited life structure such as building, good engineering judgment would favor a more conservative frequency.

DEQ RESPONSE Section 4 in Dr. Abrahamson's January 8, 2013 letter was a response to the question about the overall suitability of the 2011 seismic hazard study prepared by Dr. Abrahamson. As part of Dr. Abrahamson's response in Section 4, he addressed the issue of what changes there would be in the hazard if the study were conducted in 2013. For the source characterization evaluation, Dr. Abrahamson considered how a recently developed model for the Cascadia subduction zone (BCHydro 2012 study) compared to the model that Dr. Abrahamson had used in the 2011 study. While both Dr. Abrahamson's 2011 study and the 2012 BCHydro study considered clustering of earthquakes, Dr. Abrahamson's 2011 model applied higher weight to the clustered model and used a shorter mean recurrence interval for the non-clustered model. This difference led to an increased mean recurrence interval for the BCHydro model as compared to Dr. Abrahamson's 2011 model. The scaling of the recurrence interval from 400 to 600 years represents the difference between Dr. Abrahamson's 2011 study and the 2012 BCHydro study. The intent of his response in Section 4 was to show that the model

used in his 2011 study is still reasonable compared to other studies.

As noted in the comment, there is a difference in the average recurrence interval over the long term and average recurrence interval over the last few earthquakes. This is the issue of temporal clustering of earthquakes. Do these recent earthquakes represent a change in the behavior of the Cascadia subduction zone that will continue or do these three earthquakes with shorter recurrence intervals just represent randomness in the process?

One way to evaluate this issue is to compute the probability that three or more earthquakes occur in 1000 years. Earthquake recurrence intervals are often modeled as Poisson processes. If the mean recurrence interval is 600 years, then for a Poisson process, there is a 23 percent chance that three or more earthquakes occur in 1000 years. If the mean recurrence interval is 400 years (as given in Dr. Abrahamson's 2011 seismic hazard study for the Riverbend site), then there is a 45 percent chance of three or more earthquakes in 1000 years. So there is a significant chance that the occurrence of the three most recent earthquakes in a shorter than average time interval is just due to chance.

In most models of the Cascadia zone, both clustered and non-clustered models are captured in the scientific uncertainty of the source characterization. In the clustered models, the mean recurrence interval will be about 250-350 years and in the non-clustered models, the mean recurrence interval will be about 500-800 years. So the mean recurrence interval could be about 300 years or it could be about 600 years.

The comment suggests that, based on the recent behavior, it would be good judgment to use the shorter (more conservative) recurrence intervals. This is not consistent with the objectives of a probabilistic seismic hazard analysis (PSHA) as described below.

The objective of a PSHA is to estimate the chance of large shaking occurring at a given site. If conservative approaches are used for the inputs (such as recurrence interval) to the PSHA, then the results will not be estimates of the chance of the large ground motion occurring at the site, defeating the purpose of a PSHA. Therefore, the standard approach for selecting the inputs to PSHA is to use mean centered models but with the scientific uncertainty considered through the use of alternative models and weights associated with those models. The mean hazard is then used. Because the distribution of the hazard from the alternative models is usually skewed to the high values, the mean hazard will be larger than the best estimate. In this way, the mean hazard captures some of the uncertainty. The larger the uncertainty, the higher the mean hazard will be as compared to the best estimate.

Both clustered and non-clustered models are defensible scientific interpretations of the behavior of the Cascadia subduction zone. Because the objective of a PSHA is to estimate the chance of strong shaking at a site, it is not appropriate to use conservative values for the inputs in a PSHA. The approach of considering the uncertainty and using the mean hazard is the standard of practice for PSHA.

In contrast, it is common to use conservative approaches for selecting scenario earthquakes for deterministic seismic hazard analyses. A deterministic approach develops the shaking for assumed rare large earthquakes and does not develop estimates of the chance of the ground motion occurring. That is, a deterministic approach assumes that the large earthquakes occurs, regardless of its recurrence interval.

3. Under Figure 6, Mr. Abrahamson defends his use of using *"a single time history".* As you are aware, most of our knowledge of the Cascadia Subduction Zone has occurred over the last 15-30 years, and new revelations are occurring with increasing frequency. Why Mr. Abrahamson's conclusions may be appropriate to most landfills, good engineering judgment would lead to a more rigorous review of Riverbend which is located below ground water, 29% being unlined and located next to a river that may erode up to the perimeter berm within 73 to 313 years.

DEQ RESPONSE. We are not aware of a technical basis for the comment that the landfill is "next to a river that may erode up to the perimeter berm within 73 to 313 years". In any case, a seismic hazard evaluation is unrelated to site factors such as groundwater elevation, landfill design, and proximity to a river. The seismic design, however, was based on the highest groundwater elevations recorded during the past ten years.

4. I know nothing about earthquake analysis, but using conclusions from one part of the world to another that may not have the same conditions needs to be reviewed thoroughly. I recommend that the DEQ get a second opinion.

DEQ RESPONSE. DEQ hired a seismic consultant in July 2012, who has been assisting us in this review.

A 3-D analysis of the wall and landfill should be provided to obtain a truer picture of the risks.

DEQ RESPONSE. Geosyntec evaluated slope stability of the MSE berm and the landfill using two dimensional techniques which are accepted in geotechnical and landfill design practice for earthen structures such as dams, levees, landfills, etc. Two dimensional analyses for the MSE berm and the landfill were performed for the worst-case scenario (i.e., highest or steepest slopes) cross sections. In addition, experience has shown that if 3-D analyses were performed for this kind of geometry, the 3-D factor of safety will be similar or higher than the 2-D factor of safety; therefore, 2-D is the more conservative approach and three dimensional analyses are not needed.

I have also looked at the letter dated 26 December 2012 by Geosyntec Consultants. Comments on that letter are as follows:

A. The letters only show two cross sections, both labeled "Section 14". Where is it located? The report should include more cross sections that represent the changing conditions along the wall. I recommend an interval of every 40 feet.

DEQ RESPONSE. Cross section locations for the slope stability analyses are found on Figure 1 in Appendix G of the March 2012 Geosyntec MSE berm report. This document is on DEQ's Riverbend Landfill website (http://www.deq.state.or.us/nwr/RiverbendLandfill.htm).

B. The cross sections are based on a garbage density of 70 pounds per cubic foot. The DEQ approved closure plan approved a density of 1.115 tons per cubic yard (page attached) or a density of 82.59 pounds per cubic foot. Alternate calculations should be provided for the increased density. I give the credit for catching this discrepancy to the PSU students.

DEQ RESPONSE. The unit weights of municipal solid waste vary depending on location, waste composition, and soil usage. In response to this comment, Geosyntec reviewed historical tonnages and volume information provided by Waste Management between 2004 and 2012. Based on this

information, they calculated an average unit weight of 1.0 ton per cubic yard (74 pounds per cubic foot, or pcf). They re-analyzed Section 14, the most critical section for slope stability, with a unit weight of 74 pcf; the factors of safety were still higher than the design minimums.

The cross sections do not appear to reflect the position of the as-built bottom. The models need to be revised to reflect actual conditions.

DEQ RESPONSE. From left to right, the cross section shows the proposed MSE berm, proposed liner, and Modules 8D, 8C, and 8B.

For the slope stability evaluation, the area of higher importance is the area of the MSE berm, the proposed liner, and Module 8D which are below the area where the MSW slope is located.

For all practical purposes, the cross section is correct.

C. Separate cross sections need to be done at the South end where the proposed wall is next to or near excavated Cell No. 1. The location of the landfill perimeter on the drawings in the report do not match my staking drawings from the 1980's.

DEQ RESPONSE. Sections 15 and 16 do pass through this portion of the landfill. However, section 14 was found to be the critical cross section because it includes the steepest waste slopes.

D. The ground on the West side of the Southern half of the wall slopes down up to approximately 10%. This should be reflected on the cross sections.

DEQ RESPONSE. Cross sections 15 and 16 reflect this.

My construction staking records show that Cell 1 extends to about 50 feet from the inside of the proposed berm, and the cell has been excavated below existing grade. The depth needs to be verified and shown on the cross section and new calculations provided.

DEQ RESPONSE. We do not have your as-surveyed construction staking records for Cell 1. However, based on the survey records at the site, the distance may vary as shown on Figure 1of the December 26, 2012 Geosyntec letter report. All the analyses and evaluations are based on this record. Therefore, no new calculations need to be performed.

D. The cross sections do not have a legend identifying each type of material making it difficult to verify the inputs. A color coded legend needs to be provided prior to review.

DEQ RESPONSE. While the cross section figures do not have a color-coded legend, the material types are defined, along with their assumed properties. We note that three of these materials (reinforced fill zone, engineered clay backfill, and engineered foundation fill) are not labeled in the drawing. These can be seen in sheet 8 of Appendix H in the March 2012 Geosyntec MSE berm report. This document is on DEQ's Riverbend Landfill website (http://www.deq.state.or.us/nwr/RiverbendLandfill.htm).

I note that there is a small berm and excavated area shown on the outside of the wall. This area appears to extend about 15-feet into the adjoining property. This is a zoning violation. The MSE

Wall (Berm) detail does not show this encroachment, so the calculations do not match the construction plans. The DEQ should require a clarification and or revised drawings and land use approvals prior to further review.

DEQ RESPONSE. The design does not involve a small berm outside of the MSE berm. We are therefore not aware of any planned construction outside the Public Works Safety zone.

E. The drawings show the shear plane extending about 250 feet into the landfill, and an "Existing Base Liner" at an elevation of approximately 155 feet. Since the landfill was constructed by excavating the original ground elevations of between 120 to 150 feet, the cross sections do not reflect actual conditions. Cell 1 does not have a base liner. Calculations and cross sections should be shown reflecting actual conditions and without a base liner in the appropriate locations.

DEQ RESPONSE. The cross section does not involve Cell 1. The section analyzed was the most critical (i.e., highest and steepest). It therefore reflects the most conservative scenario.

F. There is a layer shown below the "Base Liner (Existing)", and without a legend, it is impossible to determine what it is. I am concerned that Cell No. 1 does not have a compacted clay bottom, and that one may have been assumed for calculations purposes. Verification of the actual conditions should be received and verified prior to approval.

DEQ RESPONSE. The analysis does not involve Cell 1 which, as Mr. Rydell notes, does not have a composite liner at the base. In the area of Cell 1, the MSE berm is slightly shorter and the landfill slopes are flatter. Therefore, slopes associated with this cell would be more stable than the slope associated with section 14. For this reason, section 14 represents the worst case (i.e., lowest factor of safety).

G. A layer of "Foundation Soils" is shown uniformly throughout the landfill. Again, the thickness, depth and location of this layer should be verified throughout the failure zone prior to approval, or much more conservative conditions assumed.

DEQ RESPONSE. The foundation material thicknesses have been developed based on a conservative interpretation of the boring logs drilled at the site. Boring logs are included in the September 26, 2012 letter from Geosyntec. This document is available for review on DEQ's Riverbend Landfill website.

H. The soil layers should be verified with the boring logs either by your office or your consultants. As Mr. Richard McJunkin has repeatedly pointed out, only about 40% of each boring was tested, so either full tests should be required to determine actual conditions, or conservative assumptions used.

In conclusion, I suggest that the documentation submitted is incomplete, is based on incomplete sampling, does not reflect actual on-site conditions, and does not take the special circumstances of Riverbend Landfill including its location in a floodway, existing landfill bottom depths, topography, geologic time scale life of the structure,

DEQ RESPONSE. Based on a thorough review, DEQ and its geotechnical consultant conclude that the geotechnical investigation and design of the MSE berm have been conducted within the standard of practice.

Furthermore, there are no financial plans in place to cover any failure from events other than

closure activities. The public would have to bear the financial burden at a time when damages to our homes and businesses would be a much larger, more important priority.

I encourage you to require a more accurate, conservative and comprehensive review to protect the health, safety and welfare of the public as well as the waters of the state.

Thank you. Sincerely yours,

Leonard A. Rydell, P.E., P.L.S., W.R.E.

DEQ RESPONSE. Permit condition 19.2 requires the submittal and maintenance of a worst case closure and post-closure plan so that financial assurance can be obtained to cover the cost of that closure and post-closure scenario. DEQ does not have the authority to require landfills to factor all catastrophic events into the worst case closure plan. The financial assurance provided for landfills considers a 30-year post closure period. However, landfill owners know the regulations allow the states to extend the post closure period for a landfill based on site specific conditions. Activities required in post closure include, but are not limited to, operation and maintenance of any systems that are necessary to protect human health and the environment such as leachate collection and removal systems and gas extraction systems. DEQ approval is required before a landfill shuts down any of these systems. As long as any of these systems are operating, a permit and financial assurance will be required. However, in the event of an earthquake or other major problem, the landfill owner is responsible for providing the necessary money to address the problem.

COMMENT 54. (Leonard Rydell)
[The following was provided in a letter dated January 31, 2013, prior to the public comment period. During the comment period, however, Mr. Rydell requested its inclusion as a public comment.]

Dear Mr. Schwarz,

This is a follow up to my e-mail and attachments last night where I raised the issue of "standard of practice", the question being, "Do we follow a literal interpretation of the rules, or do we apply good engineering judgment based on current knowledge?"

One of the items that Richard McJunkin and I discussed with you at the Waste Management Community Meeting last Tuesday was the requirements of CFR 258.14. Unless I misunderstood you, it appeared to me that you were unaware, nor have you verified the EPA the requirements for expansion at Riverbend were met as stated in the section as follows(red highlight added):

§§ 258.14 Seismic impact zones.

(a) New MSWLF units and lateral expansions shall not be located in seismic impact zones, unless the owner or operator demonstrates to the Director of an approved State/Tribe that all containment structures, including liners, leachate collection systems, and surface water control systems, are de- signed to resist the maximum horizontal acceleration in lithified earth material for the site. The owner or operator must place the demonstration in the operating record and notify the State Director that it has been placed in the operating record.
(b) For the purposes of this section:

(1) Seismic impact zone means an area with a ten percent or greater probability that the maximum horizontal acceleration in lithified earth material, expressed as a percentage of the earth's gravitational pull (g), will exceed 0.10g in 250 years.
(2) Maximum horizontal acceleration in lithified earth material <u>means the maximum expected horizontal acceleration depicted on a seismic hazard map,</u> with a 90 percent or greater probability that the acceleration will not be exceeded in 250 years, or the maximum expected horizontal acceleration based on a site specific seismic risk assessment.
(3) Lithified earth material means all rock, including all naturally occurring and naturally formed aggregates or masses of minerals or small particles of older rock that formed by crystallization of magma or by induration of loose sediments. This term does not include man-made materials, such as fill, concrete, and asphalt, or unconsolidated earth materials, soil, or regolith lying at or near the earth surface.

I understand that the clause allows an exception when the applicant shows that the horizontal acceleration is less than 0.1g. Calculations and assumptions have been submitted that indicates compliance for the upland areas of the revised MSE Wall submission.

It occurred to me this morning that if you were unaware of the requirement, that you may also be unaware of the conditions of the original site and the substantial difference between the soils in the lowlands versus the soils in the uplands for which calculations were submitted. Basically, soils and calculations for the MSE Wall are based on liquefiable materials being 40 feet or deeper, but liquefiable materials in the lowlands are only about 26 feet deep. As an example, I am attaching a copy of Bore Log GT10-05 which is located at the outside toe near the Southwest corner of the flood control berm.

It wasn't until last night when I e-mailed my original site plans to a concerned audience member that I realized that having come into the landfill late in the game, you may not be aware of the original ground contours, focusing instead only on the application materials submitted.

I am attaching Sheet 2 of the original plans for your information, and my formal request is for the DEQ to not avoid the analysis of the entire landfill and the intent of CFR 258.14 without verifying that an analysis of all existing facilities located in the 52% of the existing landfill that is located in the original flood plain demonstrates compliance with the 0.1g exception.

This analysis should be completed prior to approval of the MSE wall. Thank you.

Sincerely yours,

Leonard A. Rydell, P.E., P.L.S., W.R.E.

<u>DEQ RESPONSE</u>. Structures associated with the MSE berm have been evaluated for static and seismic stability. The letter indicates that Mr. Rydell believes that the design must include a stability analysis for the entire landfill. This is not correct. EPA guidance (530-R-93-017, *Solid Waste Disposal Facility Criteria*) discusses this issue. Section 2.6.2 of that document notes that new units or expansions of landfills must withstand the specified seismic ground motions, but that existing units are

not required to be retrofitted.

COMMENT 55. (Leonard Rydell)
(March 7, 2013 email)

Thank you for your time on the phone today.
I am still concerned about the cross sections:

1. Are there cross sections for the entire flood control berm based on the latest borings?

DEQ RESPONSE. The original proposal for the MSE berm, submitted in September 2011, included a berm around most of the landfill perimeter. As a result, some borings were installed at several locations along the existing flood control berm and slope stability was analyzed for these areas. That proposal was replaced by the March 2012 proposal, which limited the MSE berm to the west side of the landfill. The more detailed geotechnical evaluation discussed in Geosyntec documents subsequent to March 2012 is limited to the west side of the landfill.

2. Where are the cross sections of the proposed berm?

DEQ RESPONSE. The locations of the cross sections for the slope stability analyses are shown on Figure 1 in Appendix G of the March 2012 Geosyntec MSE berm report. This document is on DEQ's Riverbend Landfill website (http://www.deq.state.or.us/nwr/RiverbendLandfill.htm). A cross section showing components of the berm is on sheet 8 in Appendix H of that document.

3. The 26 December 2012 letter only contains two cross sections for Section 14. Conveniently, limiting the horizontal acceleration to 0.73 means that the slip zone does not extend into the greenish zone from the cross section generated on 3 December 2012 that are based on a horizontal acceleration of 0.1 and appear to have a number of 0.98 in the motion chart (factor of safety, failure?)

DEQ RESPONSE. Two output files were presented in the December 26, 2012 Geosyntec letter-report: static case and seismic case. Following the state of the practice procedures, the horizontal acceleration of 0.073 is the yield acceleration for the cross section analyzed. Using a yield acceleration of 0.073, the seismic deformation was estimated to be less than the maximum acceptable landfill industry value of 1 foot.

a. What is the vertical acceleration? How was it accounted for in the calculations? Are there separate calculations for that?

DEQ RESPONSE. Vertical acceleration was not calculated. The standard of practice is to neglect vertical acceleration because it does not have a significant negative impact on slope stability.

b. At what point does the green zone get impacted? Did you request an analysis of how much of a change would produce failure like the PSU students did?

DEQ RESPONSE. The computer analysis lists all the factors of safety through the various layers and ranks them from lowest to highest. The results presented are those for the lowest number.

4. On the attached cross section, what does the number 1.58 mean?

DEQ RESPONSE. 1.58 is the calculated safety factor under static conditions.

COMMENT 56. (Leonard Rydell)
(March 13, 2013 email)

Bob,
The DEQ's report indicates that the landfill has a slope stability problem with the MSE wall.

DEQ RESPONSE. This is not correct. We believe this comment is based on the assumption that a seismic factor of safety less than 1 indicates failure. This is not necessarily the case, because the time over which the earthquake occurs is fairly short. A factor of safety less than 1 does indicate, however, that there will be some deformation during the earthquake. To estimate how much deformation occurs, a sliding block analysis is performed. In this case, the analysis indicates that this deformation is less than 1 foot, and is therefore considered acceptable according to landfill industry standards .

1. Has the existing flood control berm been studied using the same standards? Yes or No. If so, may I get a copy of the report.

DEQ RESPONSE. The original proposal for the MSE berm, submitted in September 2011, included a berm around most of the landfill perimeter. As a result, some borings were installed at several locations along the existing flood control berm and slope stability was analyzed for these areas. That proposal was replaced by the March 2012 proposal, which limited the MSE berm to the west side of the landfill. The more detailed geotechnical evaluation discussed in Geosyntec documents subsequent to March 2012 is limited to the west side of the landfill.

A copy of the September report can be provided upon request. However, because Waste Management withdrew its application for the longer berm, our review has focused on the west side of the landfill, where the berm is currently proposed.

2. What are the standards for the top liners? Also, this was recalculated

DEQ RESPONSE. The question is somewhat unclear. However, as it implies, it is possible that seismic waves could amplify as they move up through landfilled waste. As a result, geomembranes used to cover waste could deform more than geomembrane liners under the waste. If this were to occur, these vibrations would likely disturb the cover soil to the extent that the damaged Geosynthetic layers would be visible. In that case, the cover system would be inspected and repaired if necessary.

3. What are the standards for leachate piping systems?

DEQ RESPONSE. Leachate piping systems must be designed to withstand the weight of the overlying waste, cover soil and equipment. Design for movement during an earthquake is not considered a concern because the pipes are within the landfill, which is a fairly flexible

structure. Damage may occur at the point where a pipe within the landfill connects to piping leaving the landfill. However, such damage is accessible for inspection and repair.

4. What are the standards for gas collection systems.

DEQ RESPONSE. As noted in the preceding comment, design for movement of pipes during an earthquake is not considered a concern because the pipes are within the landfill, which is a fairly flexible structure.

5. The allowable movement of 6" to 10" is for the bottom liner. Documentation submitted by Geosyntec indicates that forces are greater at the top of the landfill, indicating that movement will be greater and that the top and mid liners will be damaged.

a. What is the plan to repair the top liners?
b. How will the problem areas be found since the landfill will be covered with three feet of dirt?

DEQ RESPONSE. If geosynthetic components of a landfill cover system were to be damaged during an earthquake, these vibrations would likely disturb the cover soil to the extent that the damaged geosynthetics would be visible. In that case, the cover system would be inspected and repaired if necessary.

6. How will the leachate system be repaired if it is damaged during an earthquake?

DEQ RESPONSE. There are limits to how much leachate piping systems can be repaired when buried under waste. Pipe cleanouts along the edge of the landfill allow access for inserting cameras for inspection and high-pressure hoses for flushing, to the extent that the integrity of the pipe allows passage of this equipment. In the event of an earthquake, response measures would be determined based on site conditions.

As noted above, the critical design issue for pipes is not seismic motion, but adequate strength to withstand the weight of the waste, cover soil and equipment.

7. Has the DEQ required analysis of the existing landfill to ensure that the existing landfill meets seismic standards? Yes or No

DEQ RESPONSE. Design of each new cell must include a seismic analysis. Old cells are not evaluated based on current seismic requirements. The analysis done for the MSE berm includes slope stability analyses for the western portion of the landfill. EPA guidance (530-R-93-017, *Solid Waste Disposal Facility Criteria*), Section 2.6.2 notes that new units or expansions of landfills must withstand the specified seismic ground motions, but that existing units are not required to be retrofitted.

8. Has the DEQ required a new LUCS for encroachment into the adjoining property as shown by Cross Section 14 submitted by Geosyntec?

DEQ RESPONSE. Cross section 14 does not show encroachment into adjoining property. Mr.

Rydell may be referring to the arc representing the critical slope failure surface. This is one of many potential failure surfaces considered in a slope stability analysis. It does not indicate that the soil/waste mass will travel along the entire length of the arc shown. Based on the deformation analysis, movement during the design earthquake event is expected to be approximately 10 inches.

9. If the DEQ has not requested a new LUCS for the encroachment, will the DEQ make it a Condition of Approval? Yes or No.

DEQ RESPONSE. The design of the MSE berm does not involve encroachment onto the adjacent parcel.

10. Past experience indicates that pollutants leave the landfill through ground water when gas pressure builds up within the landfill. After a big quake, damaged systems may not get repaired for significant times, and some may not be repairable due to failures in transportation systems, higher priorities, staff concerned about families, etc. Does the DEQ agree that pollutants have a possibility of leaving the landfill footprint after a subduction zone earthquake? Yes or No.

DEQ RESPONSE. Response to an earthquake will depend on specific circumstances. However, if the active gas extraction system is not functioning and can not be repaired quickly, site personnel will convert the extraction wells to passive vents so that gas pressure does not build up. This can be done in less than a day. For this reason, we do not anticipate that gas pressure will cause a significant release of contaminants to groundwater.

11. The movement standard for bottom liners is 6 to 12 inches. Is 6 inches or 12 inches more appropriate for the 52% of the landfill located in the former flood plain? 6" or 12".

DEQ RESPONSE. For landfills generally, 12 inches of deformation is considered acceptable. This does not depend on site-specific factors. However, other safeguards are required for landfills such as Riverbend, which are in areas with relatively high precipitation and shallow groundwater. DEQ requires a more substantial liner system for landfills at such locations than is specified in federal regulations. In particular, the liner system for this landfill includes an upper or primary liner, underlain by a leak detection system, which is underlain by a secondary liner.

COMMENT 57. (Leonard Rydell)
(March 20, 2013 letter)

Bob,
I haven't has a response from you regarding my questions on slope stability.

In trying to explain this issue to others, I recognized that perhaps you do not have the background to understand the impact of what you just approved.

The attached diagram is from my college mechanics of soils text book, and shows how sliding forces work, and what the slide looks like when it occurs. If you compare that

diagram to Section 14, you can see that they are solving the same problem.

Since failure conditions are not shown on Section 14 submitted by Waste Management's consultants, one has to refer to the "after the slide condition" depicted on the text book diagram to fully understand what failure means.

The conclusion of this is when the Factor of Safety is less than one that you approved, it doesn't make any difference what the horizontal movement of the bottom liner is, the perimeter berm has failed. If fact, since movement is greater at the top of the mountain of garbage, the top liners have failed also.

If one looks at the flood control berm on the South side of the landfill that is not Mechanically Stabilized and for which I have raised compaction issues, one can assume that the perimeter berm will fail also opening the 52% of the landfill located in the original flood plain to flood waters of the South Yamhill River.

You have approved the numbers to be fudged in order to approve landfill expansion, but the calculations still show that not only the new MSE wall will fail, but likely the rest of the landfill perimeter during the next subduction zone earthquake.

Are you sure that you and the DEQ want to subject the citizens of Oregon to this catastrophe at the next earthquake? And have garbage strewn down the South Yamhill River to the Willamette to the Columbia to the ocean? And when this happen, just who do you expect to pay for all of this?

Thanks,

Leonard

DEQ RESPONSE. The comment is based on the assumption that a seismic factor of safety less than 1 indicates failure. This is not necessarily the case, because the time over which the earthquake occurs is fairly short. A factor of safety less than 1 does indicate, however, that there will be some deformation during the earthquake. To estimate how much deformation occurs, a sliding block analysis is performed. In this case, the analysis indicates that this deformation is less than 1 foot, and is therefore considered acceptable by landfill industry standards. For the seismic conditions specified in federal landfill regulations, the large-scale failure suggested by Mr. Rydell would not occur.

COMMENT 58. (Leonard Rydell)
(March 28, 2013 letter)

Dear Mr. Schwarz,

We should not be having this hearing. The DEQ should not have approved the expansion of Riverbend Landfill, as it is already doomed to failure. The proposed wall is doomed to failure, and the DEQ is derelict in its task to protect the health, safety and welfare of the public and our environment. The DEQ should not have lobbied the Oregon Department of Geology and Mineral Industries in an attempt to reduce the standard of practice. This is only inexcusable.

We should be having a hearing on how we are going to make the existing mountain stable and safe, not how we can build a wall around it to magnify the problem.

The DEQ must realize that early construction of 29% of the landfill is unlined and uncompacted. I was there. This problem will never go away. Ground water flows into and out of the waste. 52% of the landfill is located in the original flood plain of the South Yamhill River. Flood waters lap up to the perimeter of 60% of the mountain of garbage. Standards that may be acceptable to Coffin Butte or Short Mountain are not acceptable for a landfill in a flood plain. 10% of the landfill is in the former floodway of the South Yamhill River at the same point that the previous Whitson Landfill also encroached into the flood plain and floodway, creating a choke point in the river. This increases flow velocities and flood elevations. The DEQ has permitted excavation outside of the perimeter berm without excavation ever being subject to an engineering review and approved with public comment at the local level. The DEQ has ignored evidence showing that the river is moving and misled the public on the impacts. The DEQ states that the while the proposed berm will be subject to a landslide even with DEQ's acceptance of reduced earthquake standards, it is okay because the upper limit of liner accepted liner deformations in California of 6" to 12" is not exceeded.

This is insanity, and raises the question, "If a reinforced berm will fail, how about the 4,200 feet of flood control berm or the rest of the landfill with no berm? This question has not been answered.

DEQ RESPONSE. Although Mr. Rydell states that the proposed expansion is "doomed to failure," DEQ has concluded that this is not the case. This is based on a thorough review by DEQ and its geotechnical consultant. This review has involved numerous written exchanges between the landfill's and DEQ's consultants over an eight-month period.

The statement that DEQ "lobbied" the Oregon Department of Geology and Mineral Industries (DOGAMI) is incorrect. Landfill opponents stated in writing that DEQ should require a design based on a magnitude 9.0 earthquake, noting that other agencies require this. To address this concern, DEQ contacted DOGAMI and requested a written opinion as to whether a 9.0 magnitude earthquake should be considered in the design of Riverbend Landfill.

In a January 16, 2013 letter, DOGAMI recommended that DEQ "consider in designs for expansion to this landfill the magnitude 9.0 Cascadia Subduction Zone earthquake." Following receipt of this letter, DEQ met with DOGAMI twice, on January 29 and February 4, 2013. Based on these meetings, DOGAMI concluded that the probabilistic seismic-hazard analysis completed for the site used a reasonable approach and that the magnitude 9.0 earthquake was considered and integrated into the probabilistic seismic-hazard analysis. DOGAMI staff also noted that there is room for professional differences in how a probabilistic seismic hazard analysis is conducted and that some of the individual assumptions used in this analysis would tend to reduce the calculated hazard at the site. DOGAMI staff did conclude that, generally, the assumptions and analysis used met the standard of practice for this work.

We agree that the quality of design, construction and operation of the landfill is much improved compared to the conditions described by Mr. Rydell in the early 1980s. DEQ will continue to require well-documented, thorough inspection of site conditions, including comprehensive groundwater monitoring. It is true that groundwater is above the bottom of waste in portions of the landfill at some times of the year. This will be a factor in future decisions regarding the need to extend the 30 year post-closure period.

A portion of the landfill is within the historic floodplain boundary. Until recently, FEMA maps also showed the floodway boundary passing through the landfill. This was resolved recently when FEMA issued revised flood maps. Contrary to the statement by Mr. Rydell, it is not within the historic floodway boundary.

Mr. Rydell notes that "DEQ has permitted excavation outside the perimeter berm without excavation ever being subject to an engineering review and approved with public comment at the local level." Please note that DEQ neither permits nor prohibits soil excavation, other than that we require that soil excavation be conducted in a manner that minimizes erosion.

Recommendations:

1. **When in a hole, stop digging. Stop making the landfill higher and steeper, and immediately start diverting garbage to safer landfills.**

2. **Put your MSE Berm approval on hold until the entire landfill and all of its associated systems are analyzed to a 9.0 Cascade Subduction Zone earthquake using 48 Kilometers to the rupture zone and generally accepted peak ground accelerations. Analysis should be based on on 100% sampled and tested soil logs on a spacing of one cross section every 50 feet.**

3. **Landfill side slopes should be reduced to produce stability with acceptable seismic factors of safety in a 9.0 earthquake.**

4. **The 4,200 feet of flood control berm should be tested and proven to be stable during a 9.0 seismic event.**

5. **Set up a funding mechanism for the repairs necessary to bring the existing facilities to a 9.0 earthquake standard.**

6. **Set up a funding mechanism for the repairs necessary for the coming earthquake. This could be an insurance policy with the deductible set aside in an interest bearing account. The insurance policy should have no expiration date.**

It is difficult to admit a mistake, and standards have changed. The DEQ needs to change with them.

Thank you. Sincerely yours,

Leonard A. Rydell, P.E., P.L.S., W.R.E. LAR/lar

DEQ RESPONSE. Regarding Mr. Rydell's recommendations, we note that the seismic characterization and design have been thoroughly review by DEQ and its seismic consultant. The portion of the existing flood control berm associated with the MSE berm has been tested as part of the recent geotechnical investigation. Closure and post-closure funding are required. However, DEQ does not have the authority to require funding for all possible disaster scenarios; these would be assessed once a problem occurs. Response to such disasters is the responsibility of the landfill owner.

P.S., I have sent countless e-mails, letters and maps to the DEQ along with copies of e-mails and letters to others, and I hereby request that all letters, maps, e-mails and copies of emails submitted to the DEQ be included in the records of this hearing.

DEQ RESPONSE. In a response document dated January 25, 2013, DEQ provided responses to comments submitted by Mr. Rydell between April 6, 2012 and January 8, 2013. These are not reproduced here but are available on the Riverbend Landfill website. The responses to his comments since then are provided above. While he has submitted several other documents in addition, we believe the comments addressed here include all the substantive comments he has raised since January 9, 2013. All the submittals he has provided have been added to the project file.

COMMENT 59. (Leonard Rydell)
(April 1, 2013 email)

Bob,
Thank you for taking the time to provide background information on your approval of the expansion of Riverbend Landfill at the Public Hearing on Thursday, 28 March 2013/

I did not hear you say anything about the stability of the existing 4,200 feet of flood control berm that buffers the 52% of Riverbend Landfill located in the original flood plain of the South Yamhill River.

QUESTION: Has a study supported by bore logs been completed for the stability of the existing flood control berm for an 8.5 or 9.0 earthquake?

DEQ RESPONSE. The original proposal for the MSE berm, submitted in September 2011, included a berm around most of the landfill perimeter. As a result, some borings were installed at several locations along the existing flood control berm and slope stability was analyzed for these areas. That proposal was replaced by the March 2012 proposal, which limited the MSE berm to the west side of the landfill. The more detailed geotechnical evaluation discussed in Geosyntec documents subsequent to March 2012 is limited to the west side of the landfill, in accordance with EPA guidance.

QUESTION: If not, has the DEQ requested that it be studied?

DEQ RESPONSE. Please see preceding response.

You stated that the seismic Factor of Safety for slope stability for the proposed MSE wall is less than one for a horizontal acceleration of 1.0. That means that there will be a landslide of the slope as shown by Section 14 within the shaded arc. However, you said that it was not a problem because the calculated seismic deformation at a 0.073g horizontal acceleration is 10", and said that 10" meets the generally accepted standard of 12". Actually, the standard is 6" to 12" for liner systems in California, and I note that unsurprisingly, both the DEQ and Geosyntec only quote the upper limit of 12".

DEQ RESPONSE. If a static (non-earthquake) slope stability analysis indicates a factor of safety less than 1, that does indicate the risk of a slope failure. This is not the case for seismic slope stability analyses, because earthquakes conditions are very temporary. If the seismic analysis indicates a factor

of safety less than 1, this does, however, require an analysis to determine how much deformation occurs. This analysis was done for the MSE berm, and showed that deformation is less than 12 inches.

The arc referred to by Mr. Rydell is one of many potential failure surfaces analyzed in a slope stability analysis. The one shown is the most critical, based on a comparison of driving forces and resisting forces for each surface analyzed. It should not be interpreted as indicating that a large-scale failure will occur along this surface.

QUESTION: How was the suitability of using the upper limit of 12" versus the lower limit of 6" determined?

DEQ RESPONSE. Given the redundant protective measures included in the landfill design (leachate collection system, composite primary liner, secondary leachate collection system, secondary liner, low-permeability underlying soil), we consider the seismic deformation limit of 12 inches to be adequate. We also note that a deformation limit of 12 inches is standard in landfill design.

QUESTION: Why would a seismic deformation standard for bottom liners apply to a landslide?

DEQ RESPONSE. As described above, the static and seismic slope stability analyses and seismic deformation analysis indicate that a landslide will not occur.

QUESTION: If it applies to a land slide, where is the 10" measured? Please plot out one of the cross sections attached, mark up the location of the 10" and return it to me.

DEQ RESPONSE. As described above, the static and seismic slope stability analyses and seismic deformation analysis indicate that a landslide will not occur. The calculated seismic deformation corresponds to the base of the critical slip surface at a depth of approximately 35 feet below the liner.

I note that Section 14 requires construction into the adjacent property. The land is zoned EFU.

QUESTION: Has Yamhill County issued a Land Use Compatibility Statement to the DEQ for construction of the MSE Berm Improvements on Tax Lot 400, Tax Map 5-5-01?

DEQ RESPONSE. The MSE berm project does not involve construction on the adjacent property.

I am doing a Newberg City Club presentation tomorrow at noon, so would appreciate a prompt answer.

Thanks,

Leonard

PS Please include this e-mail along with all of the other e-mails that I sent you as part of the Public Hearing Record

COMMENT 60. (Leonard Rydell)
(April 3, 2013 letter)

Dear Mr. Schwarz,

Thank you for taking the time to provide background information on your approval of the expansion of Riverbend Landfill at the Public Hearing on Thursday, 28 March 2013.

I was disappointed to hear your comments regarding the "new study" that shows that the effects of a 9.0 earthquake are less than those from an 8.5. This again, continues to mislead the public in favor of Waste Management's expansion plans.

I received the series of e-mail regarding the deformation study of Riverbend landfill that you quoted at the public hearing on Thursday, 28 March 2013. This series of e-mails basically compares the results of a *"deterministic M9.0 response spectrum with the PSHA response spectrum".*

QUESTION: The basis of the PHZ calculations is not made clear. Is it based on a 9.0 quake at 50 kilometers, or is it the previous calculations based on a mean average of an 8.0 - 8.5 quake and a 8.5 - 9.0 quake at a distance of 75km?

Engineers know that there are different methods to solve problems, and the answers do not always agree as different assumptions for different variables are used. It is not unusual that different methods produce different results. That is why it is called "the practice of Engineering", and it is the Engineer's responsibility to determine the correct method. However, comparing the result of one method to justify a different method is not appropriate, particularly when it defies common sense. Even my retaining wall software has a cautionary note that larger earthquakes require different methods of analysis.

It does appear that the <u>method</u> used for the PSHA analysis is a more conservative design which is good, but does it really reflect a 9.0 quake of which 5 have occurred in the past 2,000 years?

RECOMMENDATION: I would like to see an "apples to apples" comparison of the PSHA analysis of 9.0 at 48 km compared with the 8.5 mean average at 48 km and a deformation analysis of 8.5 at 48 km compared to the 9.0 at 48 km. Then, we could see if your statement that the "new study" is accurate or just another deception of the public.

<u>DEQ RESPONSE</u>. As indicated by these comments, Waste Management recently informed DEQ that its consultant had evaluated the performance of the landfill for a magnitude 9.0 earthquake, based on a deterministic site hazard analysis. They concluded that ground motions associated with an earthquake based on this analysis are actually less severe than those associated with the probabilistic seismic hazard analysis conducted for the MSE berm design.

Kleinfelder, the seismic consultant for the landfill opponents, has submitted written comments questioning these conclusions.

DEQ wishes to point out that we did not request this recent evaluation, nor did we base our decision to approve the MSE berm on these recent findings. We mentioned it at the March 28 public meeting

because someone in the audience asked whether such an analysis had been done. As we said at the meeting, we had received information about this only the day before, on March 27.

I did not hear you say anything about the seismic stability of the existing 4,200 feet of flood control berm that buffers the 52% of Riverbend Landfill in the flood plain of the South Yamhill River.

QUESTION: Has a study supported by bore logs been completed for the stability of the flood control berm for an 8.5 or 9.0 earthquake?

QUESTION: If not, has the DEQ requested that it be studied?

DEQ RESPONSE. The original proposal for the MSE berm, submitted in September 2011, included a berm around most of the landfill perimeter. As a result, some borings were installed at several locations along the existing flood control berm and slope stability was analyzed for these areas. That proposal was replaced by the March 2012 proposal, which limited the MSE berm to the west side of the landfill. The more detailed geotechnical evaluation discussed in Geosyntec documents subsequent to March 2012 is limited to the west side of the landfill.

The letter indicates that Mr. Rydell believes that the design must include a stability analysis for the entire landfill. This is not correct. EPA guidance (530-R-93-017, *Solid Waste Disposal Facility Criteria*) discusses this issue. Section 2.6.2 states that new units or expansions of landfills must withstand the specified seismic ground motions, but that existing units are not required to be retrofitted.

You stated that the seismic Factor of Safety for slope stability for the proposed MSE wall is less than one for a horizontal acceleration of 1.0g. That means that there will be a landslide of the slope as shown by Section 14 within the shaded arc. However, you said that it was not a problem because the calculated seismic deformation at a 0.073g horizontal acceleration is 10", and said that 10" meets the generally accepted standard of 12". Actually, the standard is 6" to 12" for liner systems in California, and I note that unsurprisingly, both the DEQ and Geosyntec only quote the upper limit of 12". Isn't this a big risk to the citizens and environment of the State of Oregon?

DEQ RESPONSE. DEQ has stated that the seismic factor of safety for slope stability is less than 1 based on the design earthquake event. We did not refer to a horizontal acceleration of 1.0g, as mentioned by Mr. Rydell. Contrary to his statement, the seismic stability analysis does not indicate that a landslide will occur. We suspect this confusion may be due to the calculated seismic factor of safety, which is less than 1. If a static (non-earthquake) slope stability analysis indicates a factor of safety less than 1, that does indicate the risk of a slope failure. This is not the case for seismic slope stability analyses, because earthquake conditions are very temporary. If the seismic analysis indicates a factor of safety less than 1, this does, however, require an analysis to determine how much deformation occurs. This analysis was done for the MSE berm, and showed that deformation is less than 12 inches. A deformation limit of 12 inches is standard in landfill design.
The arc referred to by Mr. Rydell is one of many potential failure surfaces analyzed in a slope stability analysis. The one shown is the most critical, based on a comparison of driving forces and resisting forces for each surface analyzed. It should not be interpreted as indicating that a large-scale failure will occur along this surface.

Given the redundant protective measures included in the landfill design (leachate collection system, composite primary liner, secondary leachate collection system, secondary liner, low-permeability underlying soil), we consider the seismic deformation limit of 12 inches to be adequate. . A deformation limit of 12 inches is standard in landfill design.

QUESTION: While this standard may be appropriate for Coffin Butte or Arlington landfills, is it really appropriate for Riverbend?

DEQ RESPONSE. Please see preceding response.

QUESTION: How was the suitability of using the upper limit of 12" versus the lower limit of 6" determined?

DEQ RESPONSE. Please see preceding response.

QUESTION: Why would a seismic deformation standard for bottom liners apply to a landslide?

DEQ RESPONSE. As described above, the static and seismic slope stability analyses and seismic deformation analysis indicate that a landslide will not occur.

QUESTION: If it applies to a land slide, where is the 10" measured? Please plot out one of the cross sections attached, mark up the location of the 10" and return it to me.

DEQ RESPONSE. As described above, the static and seismic slope stability analyses and seismic deformation analysis indicate that a landslide will not occur. The calculated seismic deformation corresponds to the base of the critical slip surface at a depth of approximately 35 feet below the liner.

I note that the Peak Ground Acceleration used for the Yield Acceleration is 0.073g (three decimal places), yet the Horizontal acceleration for the stability is 1.0 (one decimal place). Is it really 1.000 or could it be 1.001 because if it is greater than one, CFR 248.14 requires the entire landfill and its existing systems be analyzed. Of course, good engineering practice would dictate that as the original landfill design standard was a 7.5 magnitude, so the DEQ should ensure that existing facilities are also safe based on our increased knowledge. This should be done before expansion. There seems to be a reluctance of the DEQ and Waste Management to perform this study, but since 52% of the landfill is in the original flood plain and 10% of the existing landfill is in the original floodway, it should not be ignored.

DEQ RESPONSE. The yield acceleration of 0.073g is unrelated to peak ground acceleration. It is not clear what is meant by "the horizontal acceleration for the stability is 1.0." Yield acceleration is a theoretical, continuous horizontal acceleration that corresponds to a factor of safety of 1.0. This yield acceleration is then used to estimate seismic deformation.

Mr. Rydell notes that 40 CFR 248.14 requires the entire landfill and its existing systems be analyzed for seismic stability. This is not the case. EPA guidance states that existing units are not required to be retrofitted to meet current seismic requirements. (EPA 530-R-93-017, *Solid Waste Disposal Facility Criteria*, section 2.6.2 paragraph 2).

I note that the South end of the proposed MSE wall is approximately 25 feet from the top of a steep bank that extends down to the flood plain. Obviously, if there is a seismic landslide in the wall at this

location, it could possibly result in garbage into the flood plain.

QUESTION: Has a seismic analysis of this section been performed? Since it is documented that a landslide will happen, how will garbage in the flood plain be prevented?

DEQ RESPONSE. As noted above, the geotechnical evaluation indicates that a landslide will not happen. Seismic analyses were done for four cross sections in this portion of the landfill. These were labeled 14, 15, 16 and 17. Of these, two (15 and 16) pass through the southern end of the MSE berm and include the sloping ground surface to the south. Note that the slope stability analyses showed higher factors of safety for these sections than for cross section 14, which runs perpendicular to the MSE berm and therefore takes into account the steepest and tallest cross section.

The "*Geomorphic Analysis"* of movement of the South Yamhill River does not specifically address the erosion at the upper end of the horseshoe bend of the South Yamhill River. I am attaching a slide of my Powerpoint presentation to the Newberg City Club showing the movement of the channel of the South Yamhill River towards the toe of the flood control berm at that point. The location of this erosion is at the choke point between the Riverbend and Whitson Landfills, both of which have encroached into the flood plain and floodway.

Barring a catastrophic channel change caused by removing hundreds of thousands of cubic yards from inside the horseshoe bend, this could happen within 300 years.

DEQ RESPONSE. Contrary to the statement, Riverbend Landfill does not extend into the floodway. We are not aware of information to support the statement that the South Yamhill River could migrate to the toe of the landfill within 300 years. As discussed above, the author of the geomorphic analysis referred to in this comment has stated that this is not his conclusion. We also note that the proposal now under consideration is limited to the MSE berm, which is on the west side of the landfill. The river is south of the landfill.

Again, your statement on the DEQ website that, *"The report concludes that the river has not migrated in this direction substantially in the past"* misleads the public. A more appropriate response would be to require a full analysis prior to new excavations in the floodway.

DEQ RESPONSE. Waste Management has told DEQ that it plans to excavate up to 50,000 cubic yards from soil excavation areas south of the landfill. Given that this area covers approximately 12 acres, this would mean excavating to an average depth of 2.5 feet. The soil excavation areas are a minimum of 100 feet from the river. Soil disturbance near a river is generally reviewed by the US Army Corps of Engineers and the Oregon Department of State Lands. In response to public concerns about potential impacts of soil excavation on the river, we contacted both agencies to ask whether they have jurisdiction over these soil excavation activities. They noted that they have jurisdiction over activities within ordinary high water. The soil excavation areas are outside the boundaries of ordinary high water.

Finally, I am concerned that the DEQ is assuming that Waste Management will maintain Riverbend Landfill long after the revenue stream has stopped. We all know that corporations buy other corporations, and that the corporations acquired don't always survive. We also know that corporations that fail are not always supported in perpetuity by their parent corporation.

The land is owned by Riverbend Landfill, and they now want to "be a good corporate citizen" by

giving it to the public. I don't know why no one believes that Waste Management would not have an "Exit Strategy" for Riverbend Landfill Company. Would it be leased equipment, and only one toxic asset with no income but with permanent liabilities including leachate pumping and treatment for Cells 1, 2 and 3, well testing, MSE wall repairs, earthquake repairs and a future of being next to the meandering channel of the South Yamhill River? There would be no assets for attorneys to fight over to get money to clean up the mess, so the public would be stuck with the cost.

In conclusion, please exercise your responsibilities to the Citizens of Oregon, not the corporate welfare gained by expanding a pile of garbage in the flood plain of the South Yamhill River. Thank you.

DEQRESPONSE. DEQ has the authority to require landfills to provide funding for corrective action once the need for a specific action has been identified. We do not have the authority to require funding for all possible future problems in advance of them occurring.

Because the landfill is in a seismically active zone, we did require that seismic conditions be addressed in the design of the landfill.

Financial assurance currently in place for the Riverbend Landfill covers the anticipated costs of closure and 30 years of post-closure care and these cost estimates are updated annually. This coverage (essentially a form of insurance) has DEQ listed as the beneficiary which guarantees that this work will be paid for, and completed, even if Waste Management or the Riverbend Landfill Company goes out of business. The extent to which a 30-year post-closure period needs to be extended will be evaluated towards the end of the first 30 years, based on site conditions.

COMMENT 61. (Brian Doyle)
(April 5, 2013 letter)

Mr. Schwarz,
My comments deal mainly with seismic issues – specifically the impact of a Cascadia Subduction Zone (CSZ) earthquake on the landfill and the potential environmental impacts.

Potential Impacts

A seismic induced structural failure of the landfill might not kill anyone during the event, so in this respect, the structural design can be regarded as less critical than that of a bridge or dam. However, the resulting environmental impacts will be difficult to resolve and there may well be loss of life over a longer time period. If the berm moves substantially or if soil liquefaction beneath the landfill causes differential settlement, the liner will be ruptured and the gas suction mains will be ruptured at one or more locations. Short of removing all the waste, there is no way to repair the liner, so leachate will almost certainly contaminate the ground water and require permanent perimeter remediation. Likewise the gas mains will be difficult or impossible to repair, leaving much less control of air pollution and offsite odors. A bridge or dam can be rebuilt. Repairing an earthquake damaged landfill is likely to be prohibitive even if ample funding is available. The design of the berm should be regarded just as seriously as the design of other major structures.

DEQ RESPONSE. We agree that damage to a landfill during an earthquake is more serious in

some ways and less serious in others than damage to other major structures. More importantly, we agree that the seismic characterization and design of a landfill is essential. With this in mind, DEQ hired a seismic expert to assist us with this work. This review has occurred over several months, and is documented in reports from DEQ's and Waste Management's consultants located on our website at http://www.deq.state.or.us/nwr/RiverbendLandfill.htm.

In the event that the liner is severely damaged, we would determine the appropriate response based on groundwater impacts, as determined by groundwater monitoring data. Similarly, if gas wells or lateral gas lines were damaged, repair and replacement of this equipment would be evaluated based on an assessment of that equipment and the results of landfill gas and groundwater monitoring. Shallow lateral gas lines and vertical gas wells could be installed if necessary. We agree that deep lateral lines could not be repaired or replaced.

Bedrock Focusing of Seismic Waves

Data by SCS engineers (Sharma, letter to Waste Management (WM) dated 26Sep12, Figure 2) in August 2012 shows a dish in the bed rock centered below the berm. This bowl shape will focus seismic waves leading to substantially higher ground acceleration above the bowl. The focusing effect of the bedrock shape will increase the seismic wave impact on the berm and is very likely to push one or more of the design parameters beyond acceptable limits. WM is using a minimum acceptable value for ground acceleration and a questionably high value for soil deamplification in order to justify the current berm/wall design. So there is little or no margin for increased wave magnitude. The increased wave magnitude may affect the analysis for liquefaction. Seismic wave focusing needs to be included in the analysis in order to accurately determine seismic ground motion and an acceptable berm design.

DEQ RESPONSE. DEQ's consultant has evaluated the concern raised about focusing of seismic waves as a result of the bowl shape, or depression in the bedrock beneath the proposed MSE berm. While this may be an issue in some cases, it would not be at this site, because the bedrock elevations change too gradually. Based on the bedrock contours shown in the figure that Mr. Doyle mentions (Figure 2 in the September 26, 2012 Geosyntec report), the bedrock depression beneath the MSE berm has a slope of less than 2 percent. Our seismic consultant informs us that slopes would have to be considerably steeper for this to be a concern.

The basis for the estimated ground acceleration is discussed in the March 2012 Geosyntec report. At the request of DEQ's consultant, Geosyntec and Dr. Abrahamson provided an updated assessment of the ground acceleration in a January 9, 2013 report. DEQ's consultant, Hart Crowser, concurs with these analyses.

Regarding Mr. Doyle's reference to a questionably high value for soil deamplification, we note that Hart Crowser commented on this in their August 14, 2012 review memo. However, Geosyntec revised their soil deamplification estimates based on the geotechnical testing documented in their September 26, 2012 report. As shown in Figure 2 of Geosyntec's October 23, 2012 report, their reassessment shows no deamplification.

Use of Magnitude 8.5

The WM commitment to design to magnitude 8.5 appears to have been made prior to the Tohoku M9.0 earthquake in March 2011. Landfills are required to design to a quake with a 10% chance of occurring in 250 years. This is equivalent to an earthquake with a 2400 year recurrence interval. There is no question that the CSZ will generate five or six major earthquakes over the next 2400 years. Fossil evidence shows that past events have been magnitude 9 (more or less based on fossil evidence). Future events won't all be the same magnitude – some will be greater and others less than the average. Using M8.5 as the design basis is assuming that the largest of the next five or six CSZ events will only be M8.5. This defies common sense. In fact it seems quite possible that the largest CSZ quake in the next 2400 years could be larger than M9.0. The intent of the rule is to design to the largest quake, not an average. Hari Sharma has tenaciously argued for M8.5, even to the point of implying (27 March 2013) that M8.5 is a more severe design that M9.0. DEQ does itself no favor by accepting Sharma's artful explanations that are contrary both to common sense and nearly all other advice.

DEQ RESPONSE. The original seismic hazard analysis was completed a few weeks before the March 2011 Tohoku earthquake. Because this analysis is two years old, DEQ requested that Waste Management's consultant determine whether the analysis needed to be modified. The consultant, Norm Abrahamson, conducted this re-evaluation and documented his conclusions in a report dated January 8, 2013. This is an appendix to a January 9, 2013 Geosyntec report that is provided on DEQ's Riverbend Landfill website. For reasons stated in this report, Dr. Abrahamson states that the 2011 probabilistic seismic hazard analysis (PSHA) remains a reasonable characterization of the hazard at the Riverbend Landfill site. DEQ's consultant reviewed this report and concurs.

Mr. Doyle states that "Use of M8.5 as the design basis is assuming that the largest of the next five or six CSZ events will only be M8.5." Our consultant disagrees, and notes that the site-specific PSHA resulted in a design spectrum that considers Cascadia subduction zone events up to M9.1. Use of a M8.5 event in selecting the design ground motion results in a ground motion with an amplitude representative of the full PSHA hazard and a duration representative of a M8.5 event.

Mr. Doyle also states that "The intent of the rule is to design to the largest quake, not an average." Please note that 40 CFR 258.14 states that the design earthquake is defined as one with maximum expected horizontal acceleration with a 10 percent chance of being exceeded in 250 years, which corresponds to an average return period of 2,373 years. Based on a probabilistic seismic hazard analysis, Waste Management's consultant recommended using a magnitude 8.5 earthquake with a peak ground acceleration of 0.415g. This peak ground acceleration was calculated for a rock site. Subsequently, seismic response analysis was performed to determine the amplification or attenuation of the rock peak ground acceleration based on the site specific soil profile obtained from the shear wave velocity testing conducting using the MASW technique (multichannel analysis of surface waves).

DEQ's seismic consultant concludes that the earthquake parameters selected for this site adequately address the requirements of the federal regulations.

Conservative Design

Within EPA's *Solid Waste Disposal Facility Criteria* is the phrase "structural components

should have built-in conservative design factors". Geosyntec has repeatedly used design parameters that are at the limit of the acceptable range of values rather than using mid-range or normally accepted values. Some examples:

- **use of 0.417g ground acceleration rather than the USGS value of 0.479g**
- **use of M8.5 rather than M9.0**
- **assuming the quake is centered 75 km away rather than the commonly accepted value of 50 km**
- **using a soil deamplification of 33% rather than the code maximum value of 10%**

While Geosyntec has tried to justify their choice in each case, they are using the opinions of a single expert. This can not be considered conservative when their choices are questioned by other qualified professionals.

Engineering design always incorporates a factor of safety to cover the uncertainty in the various elements of the design. When all the elements are well known and/or well defined and the consequences of failure aren't catastrophic, the factor of safety can be low – values range from 1.1 to 3 depending on the system being designed. As the uncertainty in the design elements increases, so should the factor of safety. When some (or all) of the design elements are not conservative, as is the case here, rational engineering requires a larger than normal factor of safety. Accepting minimum factors of safety in this case is equivalent to gambling that Geosyntec will be correct in all of their assumptions. The odds are strongly against this and DEQ is unwise to accept this lopsided analysis. Perhaps the saving grace is another gamble (with fairly good odds) – that the CSZ won't release its energy before the participants in this project retire.

DEQ RESPONSE. The earthquake parameters used in the design (peak ground acceleration of 0.415g, magnitude 8.5, and source-to-site distance of 75 km) have been the topic of much discussion. The basis for them is discussed in the numerous reports prepared by the consultants, which are available on our Riverbend Landfill website. DEQ's decision to approve the seismic analysis and design followed a thorough review by our independent seismic expert.

As noted above, Geosyntec revised their soil deamplification estimates based on the geotechnical testing documented in their September 26, 2012 report. As shown in Figure 2 of Geosyntec's October 23, 2012 report, their reassessment shows no deamplification.

Unstable Soil

Riverbend Landfill is located in an area of the Willamette Valley that is classified as being at medium risk for soil liquefaction. The location in proximity to a river puts Riverbend Landfill at higher risk than the surrounding terrain because the river is the main source of the unconsolidated sediments that lead to liquefaction. Given this general risk of liquefaction, it is incumbent on WM to clearly show that the sediments under the site are consolidated and not subject to liquefaction. Absent this demonstration, DEQ should presume liquefaction will occur during the next CSZ earthquake. No partial or general demonstration stability should be accepted.

In its original report (22 March 2012) WM included soil data from bores at only two locations. I noted, in my letter of 11 May 2012, the need for addition test bores. In September WM reported the results and analysis from additional testing at points along the line of the proposed berm. This included 8 bores that extend below 50' and two lines of shear velocity tests. Soil in the top 40' to 50' doesn't appear to be vulnerable to liquefaction. However, the bore data below a depth of 40' to 50' indicates there are lenses of sandy soil that may not be sufficiently consolidated to avoid liquefaction. The spacing of the test points, with gaps of 280' and 350' is such that the number, size and thickness of these lenses cannot be determined. In my opinion a maximum bore spacing of 200' would be appropriate and a mapping of shear velocity under the entire berm should be required. Soil sampling methods and laboratory analysis must be targeted at assessing liquefaction potential. The existing bore samples were collected before the 22Mar12 report was issued and before the public highlighted liquefaction as a serious issue. Thus a number of critical soil samples were not recovered and the sampling methods did not preserve samples in a manner that supported analysis for liquefaction. The potential for liquefaction and differential settlement of the landfill cannot be determined until there is sufficient information – test bores and shear velocity tests – to fill in the gaps and provide a better assessment of liquefaction potential under and adjacent to the entire berm.

DEQ has assumed that soil with a shear wave velocity higher than 700 ft/sec is not liquefiable, but Kleinfelder has pointed out that liquefaction has been observed in soils with a shear wave velocity of 1200 ft/sec. Geosyntec's MASW data of 7Sep12 (Figure 2 of the Zonge report on pdf page 91) shows extensive zones with velocities that are higher than 700 ft/sec but less than 1200 ft/sec. For DEQ to declare 700 ft/sec as a safe minimum shear wave velocity ignores a valid dissenting opinion. While the shear wave velocity test data provides a useful picture and additional traverses will be valuable, the question of liquefaction potential cannot be answered without a sufficient number of soil samples and analysis conducted for the specific purpose of assessing liquefaction.

DEQ RESPONSE. The potential for liquefaction at this site was based on information obtained from 14 borings and seven test pits in the area of the proposed MSE berm. Soil characteristics were determined based on visual classification and standard penetration tests in the field, followed by soil lab testing. In addition, a geophysical survey was conducted to obtain shear wave velocity information for site soils. We believe this information is adequate for assessing the potential for liquefaction at this site. Our consultant concluded that this combination of information was sufficient for evaluating the risk of liquefaction, and agrees with Waste Management's consultant that significant liquefaction will not occur.

Mr. Doyle states that "DEQ has assumed that soil with a shear wave velocity higher than 700 ft/sec is not liquefiable." DEQ has stated that a shear wave velocity of 900 ft/sec, not 700 ft/sec, indicates that soil is not liquefiable assuming the seismic conditions considered in this evaluation.

Context

WM has a very large financial stake in this expansion. They have told me they have "millions" invested in infrastructure at Riverbend. And the additional million tons of waste stored behind the proposed retaining wall will have a gate value of $30 or $40 million. Their consultants,

Geosyntec and others, are under great pressure to support the proposed berm design. I suspect that the current design is close enough to its maximum limit that a significant increase in any of the seismic parameters would put the project in jeopardy. Geosyntec has shown that it will vigorously defend its work even when other qualified professionals pose legitimate questions about marginal assumptions or tenuous data. Of course Waste Not is arguing against the berm/wall so their consultant, Kleinfelder, may also be biased. But there is more than an order of magnitude difference in the economic value of preparing and defending the berm plan compared with the effort to question it.

There is more at stake here than the berm permit. If investigations cannot demonstrate the stability of the soil under the berm and, by extension, under the existing landfill, then 40CFR258.15 would kick in – forcing closure of the landfill.

My point is that Geosyntec is under tremendous pressure to support the proposed design and is unlikely to admit any error. Neither Kleinfelder nor Hart Crowser have much to gain by biasing their opinions. Their reputations are far more valuable than the potential for future work for DEQ and Waste Not. I believe that opinions submitted by the reviewing consultants deserve more respect than DEQ has given them to date.

Respectfully submitted,

Brian W. Doyle, PhD, PE

DEQ RESPONSE. During our review of the seismic evaluation of the MSE berm, we have learned that numerous seismic experts have numerous opinions about the many factors involved in the seismic analysis. We have reviewed all these assessments. Our decision is based primarily on the recommendation of our expert, Hart Crowser.

The seismic analysis is based primarily on geotechnical information obtained beneath the location of the proposed berm. Although more limited investigation was done elsewhere along the landfill perimeter, this is not required according to EPA guidance, which notes that existing portions of the landfill do not need to be retrofitted based on subsequent seismic analyses. (EPA 530-R-93-017, *Solid Waste Disposal Facility Criteria*, section 2.6.2 paragraph 2).

COMMENT 62. (Brian Doyle)
(April 5, 2013 letter)

Bob,
In regard to the Riverbend berm permit, here's a list of letter's I've submitted that should be part of the record. All but the last were sent by US mail

19 April 2012 (gas, leachate and seismic concerns)
11 May 2012 (overview of Riverbend history and comments on CSZ earthquakes and liquefaction)
29 June 2012 (recommended DEC retain a technical consultant and expressed seismic concerns)
11 January 2013 (odor)

As noted above, the geotechnical investigation indicates that the soil beneath the waste will not undergo significant liquefaction either. The berm design incorporates rigorous seismic standards. Finally, the landfill is 400 feet from the South Yamhill River. Even if a portion of the landfill were to fail, the waste would therefore not enter the river.

COMMENT 197. (Laura McMasters)
I am a life time resident of Yamhill County. My father was Kenneth Fender. He was an entomologist and discovered the little blue butterfly, the "Fender's blue".
I was one of the people who met with DEQ in 1991 to point out the need for wells and monitoring of the Whiteson landfill.

I attended the DEQ hearing in Amity and the most recent one here in McMinnville.
I am pleased that members of the local Grand Ronde tribe have finally come forward to verbalize publicly what has been torturing them about the placement of these garbage dumps.

You and I both know that Ezra Koch's landfills do not belong along this river! It is way past time to recognize the insanity of his "plan" for the valley. This has become way out of control and yours is the entity that we depend on for protection of our water and land.
Please listen to us and not to the giant corporation that has taken over this acreage of our beautiful little valley. Thank you, Laura (Fender) McMasters

DEQ RESPONSE. DEQ must evaluate the suitability of a landfill's location based on location criteria that are specified in federal and state regulations (40 CFR 258 and OAR 340-094-0030). Riverbend Landfill meets these regulations..

We were aware of the issue of potential impact to cultural resources, but we appreciated hearing directly from individuals at this meeting. DEQ was informed by Waste Management that they have been working with the State Historic Preservation Office and the Confederated Tribes of the Grand Ronde to address these issues. Based on that information we have been in contact with Dennis Griffin at SHPO and Eirik Thorsgard. Mr. Thorsgard is the Cultural Protection Program Manager and Tribal Historic Preservation Officer for the Confederated Tribes of the Grand Ronde Community of Oregon. Both have told us that adequate precautions have been taken to protect cultural resources at this site.

COMMENT 198. (Millie Brosius-Boggie / Edward S. Boggie)
My husband and I live in McMinnville, Oregon. I am writing to ask you to make sure the landfill here is closed in 2014. I know the company is trying every way it can to keep it open and expand it. We hate having garbage hauled in here from surrounding areas. It is a threat to the river. WE WANT IT CLOSED. PLEASE DO NOT ALLOW THEM TO CONTINUE. Thank you.

DEQ RESPONSE. We must base our decision regarding approval of the berm on the landfill's conformance to federal and state landfill regulations and guidance. Regarding impact to the river, we require regular testing of groundwater and surface water. These results indicate that the landfill is not a threat to the river.

COMMENT 199. (Scott Burns)
I am a professor of geology at Portland State University – I have been teaching for 43 years, with the last 23 at PSU. I teach many graduate level engineering geology and environmental geology classes.

In our fall quarter this year, some of my graduate students did a project that examined the expansion of the Riverbend Landfill in McMinnville from an environmental geology, hydrogeology and engineering geology standpoint. It was a great class project in real work data. My students looked at the interaction of the landfill and the migration of the river, movement of groundwater and slope stability of the berm being built for the expansion from a slope stability standpoint. One thing we noted was that the consultant for the slope stability of the berm was only using an 8.5 magnitude quake for the scenario. The berm was stable in that scenario. We recommended that the slope stability be rerun using a 9.0 magnitude (standard of practice for a subduction zone quake) with higher accelerations associated with the higher magnitude, and that it be run under winter conditions (wetter conditions). DOGAMI also made the same recommendation of modeling with a higher magnitude.

I received a copy of a report done by a consultant for Waste Management that said that it was actually more stable at 9.0 than at 8.5 using his model. It is hard for me to believe this because the magnitude scale is logarithmic and that is a huge increase in energy between 8.5 and 9.0, and to have more stability, it is hard to imagine this. Was the model run under winter conditions? I have a friend who will be visiting Portland State in May and he is a specialist in paleoseismology. I will have him go over these results. It will be too late for you based on your deadlines, but I am sure he will have something to say. His name is Dr. James McCalpin and he is doing a national lecture tour from an award he earned in geology. I will let you know the results then.

I strongly recommend asking Waste Management's consultants to rerun the slope stability of the berm at Riverbend using the scenario of 9.0 magnitude using winter conditions. If you have any questions, please call (503-725-3389) or email (burnss@pdx.edu). I have strong feelings about the extension of the life of this landfill – we should be keeping landfills out of the flood plains of rivers. It would never have been cited there today.
Sincerely, Scott Burns, Professor of Geology,

DEQ RESPONSE. A deterministic M8.5 spectrum would have a lower hazard than a deterministic M9.0 spectrum. However, there is a basis for a probabilistic (uniform hazard) spectrum to have a larger hazard than a deterministic (M 9.0) spectrum, as shown in the Geosyntec letter dated March 27, 2013. The reason for this is that the probabilistic spectrum is based on the sum of the hazards from all known sources and is calculated for a relatively long return period (~2,400 years) while the deterministic spectrum is calculated for just a single event. In addition, we believe the deterministic spectrum is the median response. The deterministic spectrum calculated for something higher (i.e., less likely to occur) than the median response would be larger.

Note: The March 27, 2013 report to which Professor Burns refers was not requested by DEQ. Although DEQ and its seismic consultant agree with this report, our decision is based on the previous documents regarding the seismic characterization.

Professor Burns asks if the design considered winter conditions. We assume he is referring to high groundwater conditions. The ground water elevations considered for both the static slope stability and seismic slope stability analyses were approximately 147 feet in the northern area and approximately 130 feet in the southern area of the proposed MSE berm. These groundwater elevations were based on: (i) Information obtained during 2011 field investigation program, and (ii) shallow water-bearing zone potentiometric surface contours measured by SCS Engineers. During the winter of 2012, additional

field investigations were performed. The investigations showed that for all practical purposes the results confirmed the validity for using the above mentioned groundwater elevations.

COMMENT 200. (Liz Marlia-Stein)
As a very active member of our community for over 25 years, I have stood up for the good people of our community all too often. I am sure you know how difficult it is for citizens to have a voice as loud as corporations like Waste Management. What I am trying to understand is why an agency who is supposed to look after our interests would favor this corporation over us. Please tell me why your agency, which is supposed to support "Environmental Quality" would allow Waste Management to build a berm at the specifications of an 8.5 earthquake when every other project in Oregon has to abide by the 9.0 specifications.

Active citizens like me are trying to help people see the good in our government these days. The DEQ is making my job very difficult right now. With all the apathy and anger there is toward our government, it would be most helpful if you would do what is right and just for the people. Not only would this give a more positive image about government but would help us in our efforts to sustain a better environment in Yamhill County.

There are much better ways now to deal with garbage. Have you looked into them? Have you seen what Germany is doing, and even some of our communities across America. Waste Management wants to do what will bring them the most profit. They don't care about our livelihood. Do you? Respectfully, Liz Marlia-Stein

DEQ RESPONSE. Our decision to approve the berm is based on the fact that the location of the landfill and the design of the berm meet the criteria established in federal and state regulations. DEQ and its seismic consultant reviewed the seismic characterization and design thoroughly over the past several months. This review considered many issues, including liquefaction, earthquake magnitude, source to site distance, and associated ground motions. We conclude that the design meets the regulations for municipal solid waste landfills. We also point out that these regulations are more stringent than those used for most other structures.

We agree that we (DEQ, local governments, businesses and individuals) should continue to reduce our consumption and increase reuse and recycling. Several efforts are underway to increase plastics recycling. DEQ supports innovative technologies to derive energy from waste but the efforts do this in Oregon are still in research and development stages. At this point, landfills are still necessary.

Other programs, such as the bottle bill and the recycling opportunity act, have been around for more than 20 years. Oregon generally ranks as one of the highest states in the nation in terms of the percentage of material that we recover and the per capita recycling rate. Still, more needs to be done.

COMMENT 201. (Dorothy Shoemaker)
I look over DEQ public notices, and I just got an announcement of a public hearing about a landfill in McMinnville, Oregon. I'd like a little information, so this isn't really a comment yet. I've worked on decision-making about berms like this proposed MSE berm, and they aren't usually a good idea. I don't think a soil berm with plastic will hold in landfill well. But this is just a first impression.