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ABLED AT HEARING
tion: Applicants evidence
- Helen Mongillo
6/3/2018

Zeb Etheridge
Environment Canterbury
Christchurch

CLS-A0272-008L-v1

Dear Zeb

Re: Mitigation of Leaching at Canterbury Landscape Supplies - Diversion Road, Swannanoa

Brett Mongillo and I have reviewed the initial conceptual site model used as the basis for a conservative numerical contaminant transport model for Canterbury Landscape Supplies (CLS) Diversion Road composting facility. The review was based on the concerns you've raised about the model and your perceived need for a pilot study to demonstrate that a sawdust/bark fine pad under and around the compost piles would mitigate leaching of nitrogen from the site.

This letter discusses:

- The site conditions and how the composting facility will be operated,
- The absorptive nature of the compost, sawdust and bark fines and why it is unlikely that precipitation will pass through and be released from the compost piles, and
- A monitoring scheme that is likely to confirm effects of composting are less than minor.

1.0 Site Conditions

The following is a summary of the site conditions. Phil Wylie, the manager of the CLS Diversion Road Facility, has described how nitrogen-rich materials will be managed, as follows:

- The area CLS plans to use for composting and curing composted material at the site is estimated to be 3 ha (30,000 m^2).
- A small, cement-sealed area of the site will be used for mixing sawdust and bark fines with nitrogen-rich materials (e.g., paunch grass).
- Approximately 2,000 m^2 of the site will be used for the early phase of composting in which piles are hydrated as necessary and turned weekly to promote a moist, aerobic environment for the microbes. This process takes approximately 12 weeks. Windrows of compost in this area are typically 3 m wide x 2-2.5 m tall with 3 m between rows.
- Approximately 28,000 m^2 of the site will be used to cure the turned compost for a minimum of about 2 months (weeks 12 to 20). These piles are turned every 4 weeks. The windrows are typically 5-6 m wide and 4.5 m tall, with 3 m between rows.
- The site is relatively flat with an estimated 1 to 3% slope. A 0.5 m pad of sawdust and bark fines surround each pile, edged by a sawdust and bark fine bund. Stormwater that runs off the piles is retained by the bund and sits on the pad until absorbed. In periods of excess rain, a trash pump is used to pump water into a storage tank for reuse through irrigation of the piles. An ample supply of sawdust and bark fines are continually present on site for use in runoff control. If the sawdust and bark fines become overly moist, they can be readily

replaced with fresh dry sawdust and bark fines so they are able to absorb the stormwater that runs off the piles.

- Assuming 3 m wide windrows with 3 m between windrows, a rough estimation of space which does not contain compost will be 50% of 30,000 m^2 or 15,000 m^2.
- The concentration of nitrate, nitrite and ammonia-nitrate have been tested in on-site material and the results summarised in Table 6 of the August 2017 Preliminary Hydrogeologic and Nitrogen Transport Assessment report by Sephira Environmental Limited (Sephira). The data is provided below as Table 1. Due to mixing and decomposition, the nitrogen-rich materials tend to go from heterogeneous within the young piles to homogeneous in the more mature piles.

Table 1. Compost Testing to Support Transport Modelling

Samples	Nitrate-N mg/kg (dry weight)	Nitrite-N mg/kg (dry weight)	Ammonia-N mg/kg (dry weight)	Moisture Content %	Total Organic Carbon %
C1 Upper (aged pile)	658	4.46	201	51	-
C1 Lower (aged pile)	636	4.37	118	58/57[1]	27
C-2 Middle (middle-aged pile)	2040	17	744	61	-
C-3 Upper (new pile)	23.3	<1	74.3	55	-
C-3 Lower (new pile)	21.5	<1	61.5	56/61[1]	15.5
Sawdust	-	-	-	-	36
Bark fines	-	-	-	-	33
Average Compost	677.76	8.61	239.76	57	21.25

1. Results from two laboratories for a split sample. The samples were collected by Sephira Environmental and tested by their subcontract laboratories.

2.0 Absorptive Capacity of the Compost, Sawdust and Bark Fines

As discussed in Appendix B (attached) of the August 2017, Preliminary Hydrogeologic and Nitrogen Transport Assessment (by Sephira Environmental), the compost, sawdust and bark fines have a high capacity to absorb water. Table 2 provides the testing data from that assessment. The plant cells take in and retain water making these materials hydrophilic (water attracting). Just as peat formations can be relatively dry in an otherwise saturated hydrogeologic profile, the absorptive capacity of compost, sawdust and bark fines will tend to slowly absorb water and reduce infiltration. This material does not behave like a predominantly soil-based media. Therefore, application of contaminant in soil transport modelling techniques to this material is limited in its relevance, and the results must be qualified.

Table 2. Moisture Content and Absorptive Capacity

	Dry Sawdust	Sawdust from stockpile	Bark fines from stockpile	Fresh compost saturated	Aged compost saturated
Moisture Content %	-	69	67	57	55
Absorption capacity %	55.4	327	245	180	185

1. Moisture content is the ratio of the mass of water to the mass of the total wet sample.
2. Absorption capacity is the ratio of the mass of the maximum amount of water that a mass of dry sawdust can hold at saturated conditions, expressed as percentage of the mass of wood. I.e., mass of the water to the mass of the dry sample.

Rainfall statistics for the site area indicate:

- the average total rainfall (NIWA Cliflo database) is 6.8 cm per month or 0.223 cm per day (see Sephira Environmental 2017 reports);
- the average 5-year, 24-hour storm is estimated to produce 79 mm of rain per day (HIRDS, see attached, factoring in a 2-degrees increase for climate change)
- the average 50-year, 24-hour storm is estimated produce 142 mm of rain (factoring in a 2-degrees increase for climate change).

Canterbury weather includes many days (approximately 70%) with no rain or just a mist. On dry days evaporation from the compost will occur. If the compost is in a heating phase, further water will be driven off the compost pile. The compost will absorb precipitation from small rainfall events and in higher intensity rainfall events the water will run off into the trough between the piles. The percentage of water that would infiltrate versus runoff is difficult to quantify.

We contend that no water will seep out of the bottom of the compost pile as originally modelled in our highly conservative vadose zone and groundwater contaminant transport model (SEVIEW), as described in the Sephira Environmental August 2017 Nitrogen Transport Model Report. The previous model did not have the capacity to account for absorption of water into the highly hydrophilic media. The model was run to see if dilution would reduce nitrogen levels should it be released to groundwater assuming that the compost stockpile would behave consistently with a similar size stockpile of soil with the same porosity and total organic carbon content as the compost.

The following analytical assessment of the compost's capacity to absorb water is provided to show that even if no rain water ran off the pile, the compost would be able to absorb the water. Table 3 provides the amount of water that could be absorbed in one square metre area of compost pile in relation to the pile thickness. Table 3 shows that a 2- to 2.5-m thick pile would hold rain water for the initial 3-month composting period. Compaction of the pile could reduce its capacity to absorb water but we consider that there is ample extra capacity (more than twice) to account for this unquantified factor. The table also shows that a 4.5-metre pile would hold the rain water for the anticipated additional 2-month period that the compost would be cured.

The values in Table 3 are overly conservative because much of the rain water is likely to run off the piles. The information is adequate to conclude that the compost pile is unlikely to release water and associated nitrogen from the base of the pile.

This conclusion is supported by ample anecdotal evidence from the compost facility operators who claim that the bottom of a compost pile is characteristically dry. The effect of the transport of small quantities of the compost and/or leachate to the outer perimeter (toe) of the stockpile and into the spaces between the stockpiles through rain run off and erosion is addressed below.

Table 3. Evidence that Compost Piles are Unlikely to Release Water

Thickness of compost (m)	Amount of water compost can absorb (L per m^2 of pile area)	Months of precipitation that could be absorbed in compost before becoming saturated
1	260	3.8
2	520	7.7
3	780	11
4	1,040	15

1. Results would apply to any stage of composting (early or mature)
2. Calculation accounts for the moisture already in the pile before adding the precipitation.
3. Results assume monthly rainfall of 6.8 cm completely infiltrates into the pile, which is highly conservative as much of the water will run off during storms and many days will have no rain, but instead evaporation.

The next stage of conservatively evaluating site conditions is to determine how much water may run off the piles during regular rain conditions and during high intensity storm events. Table 4 shows the capacity for various thickness of pad to hold water. It should be noted that the sawdust/bark fine pad itself will not leach nutrients, but compost may be entrained in surface water runoff and form a thin layer on top of a sawdust/bark fine pad created between and around the piles. On the outer perimeter of the piles, the sawdust/bark fine pad is assumed to be constructed as a bund so stormwater and mobilised compost does not run off the pad itself.

The results in Table 4 are conservative since all water is assumed to run off. The calculations show that between 0.5 and 0.75 m of sawdust and bark fines should be adequate to absorb 1 to 1.5 months of regular precipitation. A 5-year, 24-hour storm could be absorbed by the same pad. However, it is likely that following such a storm a large percentage of the rain water will be ponded on the pad and would be collected and containerised for reuse in the composting process. We consider that a 0.5 m pad would be adequate when considering only a portion of the rain would run off. The pad thickness could be increased, or the material replaced if the moisture content approaches the saturation point. Regular monitoring of the moisture content of the pad would facilitate proper maintenance of it to prevent approaching the saturation point.

A 50-year storm would not be retained, but the potential nitrogen loss in an event such is considered minor in relation to the life of the composting facility and frequency of occurrence.

The assessment shows that the day to day potential nitrogen loss from compost entrained in runoff could be controlled through the use of sawdust/bark fine pads around the compost piles.

Table 4. Evidence that Sawdust/Bark Fine Pads Around Piles Can Absorb Stormwater

Thickness of sawdust/bark fine pad (m)	Amount of water sawdust pad can absorb (L per m^2 of pad)	Amount of water a bark fine pad can absorb (L per m^2 of pad)	Months of precipitation (average 6.8 cm/month) that could be absorbed in compost before becoming saturated (sawdust/bark fines)
0.5	129	125	1.9/1.9
0.6	154	151	2.3/2.2
0.75	193	189	2.9/2.8
1	258	252	3.8/3.7
5-yr, 24-hr storm would have an estimated 79.4 L of precipitation per m^2 of pad			
50-yr, 24-hr storm would have an estimated 142.2 L of precipitation per m^2 of pad			

1. Calculation accounts for the moisture already in the sawdust or bark fines before adding the precipitation.
2. Results assume monthly rainfall (6.8 cm on average) runs off and is ponded over the sawdust/bark fine pad between the windrows. This is highly conservative as some precipitation will infiltrate and be absorbed by the compost or would evaporate on dry days.

3.0 Loading in a 50-Year Storm

Should water overrun the pad and bunds that surround the compost piles during a 50-year 24-hour storm, the potential loss of nitrogen has been estimated. The calculation assumes:

- Nitrate-N, Nitrite-N and Ammonia-N are present in the compost at the average concentration measured at the Division Road site.
- Up to 0.3 m of compost has been transported to the pad and therefore becomes saturated and has the capacity to leach.
- 1 to 10% of the nitrogen leaches from the compost . With the C:N ratio at 40:1 the nitrate-N and nitrite-N would not leach. Therefore, only the ammonia-nitrogen is assumed to be lost during the storm event.

Using these assumptions, the mass of ammonia-nitrogen potentially lost during the 50-year storm event would be 6 to 65 kg.

When diluted with the expected 142.2 mm of rainfall anticipated to fall during this event, the concentration of ammonia-nitrogen is expected to be 1.5 mg/L in the stormwater. This water concentration is based on all rainfall from the 30,000 m2 of the site available to dilute the leached water from the 0.3 m of compost between the piles.

Table 5 shows the surface water concentrations measured at the site. The October samples represent the surface water concentration after the C:N ratio was improved. The projected concentration of surface water during the 50-year storm does not exceed the NZ Drinking Water Standard (aesthetic) for ammonia-nitrogen. It is likely that the water from this one event would be diluted in groundwater such that the surface water concentration at Silverstream won't be affected by ammonia-nitrogen, or nitrate-nitrogen, should the oxidising conditions in groundwater convert the nitrogen to another form4

Table 5. Nitrogen Results for Surface Water

	Total Nitrogen	NOx (oxides of Nitrogen)	Ammonia	Nitrate	Nitrite
20 July 2017 SW-1 (near middle-aged pile)	**550.23**	0.23	**550**	0.21	<0.02
20 July 2017 SW-2 (near new pile)	**210.15**	0.15	**210**	0.12	0.03
12 October 2017 SW-1 (between middle-aged piles)	**60.02**	0.02	**60**	<0.02	<0.02
12 October 2017 SW-2 (run off slightly distant from outside of oldest pile)	**19.2**	<0.02	**19.2**	<0.02	<0.02
Anticipated surface water concentration in a 50-year, 24-hr storm that could potentially be lost to groundwater	1.5	<0.02	1.5	<0.02	<0.02
Groundwater					
NZ DWS[2]	--		1.5[3]	50	0.2 /3[4]
ANZECC Stock Water [5]	--	--	--	400	30
Surface Water					
ANZECC Recreational[6]				10	1
ANZECC Lowland River[7]	0.614	0.444	0.021	--	--

1. Results in mg/l (referred to as g/m^3, mg/l or mg-N/l). Bolded values exceed the adopted assessment criteria.
2. New Zealand Drinking Water Standards (NZDWS)– Maximum Allowable Value (MAV), New Zealand Ministry of Health, Revised 2008. Nitrate standard in mg/L as NO_3 and nitrate standard in mg/L as NO_2.
3. NZDWS (2008) aesthetic guideline value.
4. NZDWS for nitrite (short-term)/Standard for nitrite (long-term)
5. Australian and New Zealand Guidelines for Fresh and Marine Water Quality - Stock water quality guidelines for cattle. Australian and New Zealand Environment and Conservation Council (ANZECC) October 2000.
6. Australian and New Zealand Guidelines for Fresh and Marine Water Quality - Recreational guidelines. Australian and New Zealand Environment and Conservation Council (ANZECC) October 2000.
7. Australian and New Zealand Guidelines for Fresh and Marine Water Quality – Table 3.3.10 Default trigger values for physical and chemical stressors in New Zealand for slightly disturbed ecosystems. Australian and New Zealand Environment and Conservation Council (ANZECC) October 2000.

4.0 Conclusion and Proposed Monitoring

Based on this revised conceptual site model and supporting calculations, the operation of the composting facility at Diversion Road is considered to have less than minor adverse effects in relation to nitrogen loading to the groundwater system. This assumes that 0.5 m of uncompacted sawdust and bark fines are maintained between the compost windrows and that ponded water on the pad would be collected for reuse in compositing.

The effectiveness of the mitigation can be monitored as follows:

- Visual inspection of the sawdust / bark fine pad between the piles to confirm that 0.5 m has been applied and that the material is not overly saturated.
- Quarterly moisture content tests of the sawdust / bark fines during the first year and annually thereafter. Tests should be taken from the bottom of the pad, after a large rain event. If the material is below 75% of full saturation (based on the August 2017 test results) for 5 consecutive tests, the testing can be discontinued.

Groundwater monitoring from a shallow upgradient and downgradient well near the property boundary. Monitoring from a newly installed downgradient pumping well would be acceptable. Annual monitoring should be acceptable based on the expected slow movement of contaminant through the vadose zone, and since the facility has been in operation for a year. After 5 years, biannual monitoring (once every 2 years) should be acceptable.

Kind regards,

Helen Mongillo
Principal Environmental and Engineering Manager, Hydrogeologist
Sephira Environmental Limited
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Attachments:

1. Revised Appendix B from the Preliminary Hydrogeologic and Nitrogen Transport Model Report (Sephira 2017).
2. HIRDS output
3. Calculation Sheet (sent as an excel spreadsheet)

1 L of water = 1 kg of water, therefore:

3.27 kg of water = 3.27 L of water

3.27 L x 1 m^3/1000 L = 0.00327 m^3 of water

Therefore, the volume of saturated sawdust and water is:

0.0011 m^3 + 0.00327 m^3 = 0.00438 m^3

Wet density of the saturated sawdust = 4.27 kg / 0.00494 m^3 = 974.6 kg/m^3

Using the same logic, we calculate the wet density of the stockpiled sawdust (69% moisture content) as follows:

1 kg sawdust + 0.69 kg H_20 = total mass of 1.69 kg

1 kg sawdust = 0.00167 m^3 sawdust (see above)

0.69 kg of water = 0.69 L of water

0.69 L x 1 m^3/1000 L = 0.00069 m^3 of water

Therefore, the volume of stockpile sawdust and water is:

0.00167 m^3 + 0.00069 m^3 = 0.00236 m^3

Wet density of the stockpile sawdust = 1.69 kg/0.00236 m^3 = 716.1 kg/m^3

Therefore, the volume of water that can be absorbed into stockpile sawdust is:

974.6 kg/m^3 – 717.1 kg/m^3 = 257.5 kg/m^3 or 257.5 L of water per 1 m^3 of sawdust

The average total rainfall the Diversion Road site is estimated to be 6.8 cm per month. Divide this by 30.4 days per month and the estimated total rainfall is 0.223 cm per day or 0.00223 m per day.

The amount of precipitation that would fall over a square m of the site is:

1 m x 1 m x 0.00223 m x 1000 L/m^3 = 2.23 L

Therefore, rainfall volume of 2.23 L/day/m^2 can be used to estimate how much sawdust would be needed to absorb all of the rainwater, on average.

The composting operation can place 0.5 m of sawdust around the compost piles to absorb runoff.

If 1 m^3 of sawdust can absorb 257.5 L of water, 0.5 m of sawdust can absorb 128.8 L of water.

The number of days for 0.5 m of sawdust to reach saturation would be

128.8 L / 2.23 L/day = 57.8 days OR 8.3 weeks.

Similarly, the number of days for 0.5 m of bark fines to reach saturation would be

125.8 L / 2.23 L/day = 56.5 days OR 8.1 weeks.

High Intensity Rainfall System V3

Results for Canterbury Landscape Supplies

Depth-Duration-Frequency results (produced on Friday 26th of January 2018)

Sitename: Canterbury Landscape Supplies

Coordinate system: NZMG

Easting: 2471187

Northing: 5753564

Rainfall depths (mm)

ARI (y)	aep	Duration 10m	20m	30m	60m	2h	6h	12h	24h	48h	72h
1.58	0.633	3.9	5.7	7.2	10.5	14.9	25.7	36.3	51.3	62.5	70.2
2.00	0.500	4.3	6.3	7.9	11.7	16.4	28.2	39.6	55.7	67.9	76.2
5.00	0.200	6.0	8.8	11.0	16.2	22.4	37.5	51.8	71.7	87.4	98.2
10.00	0.100	7.4	10.9	13.6	20.1	27.5	45.2	61.9	84.8	103.4	116.1
20.00	0.050	9.1	13.3	16.7	24.6	33.4	54.2	73.4	99.6	121.4	136.3
30.00	0.033	10.2	15.0	18.8	27.7	37.4	60.1	81.0	109.2	133.2	149.6
40.00	0.025	11.1	16.3	20.5	30.2	40.5	64.6	86.8	116.6	142.2	159.6
50.00	0.020	11.8	17.4	21.8	32.2	43.1	68.4	91.6	122.6	149.5	167.9
60.00	0.017	12.4	18.3	23.0	33.9	45.3	71.6	95.7	127.8	155.8	174.9
80.00	0.012	13.5	19.9	25.0	36.8	49.0	77.0	102.5	136.3	166.2	186.6
100.00	0.010	14.4	21.2	26.7	39.3	52.1	81.5	108.1	143.3	174.7	196.2

Coefficients

c1	c2	c3	d1	d2	d3	e	f
0.0003	-0.0197	-0.0002	0.5578	0.4980	0.2864	0.2860	2.3548

Standard errors (mm)

ARI (y)	aep	Duration 10m	20m	30m	60m	2h	6h	12h	24h	48h	72h
1.58	0.633	0.4	0.4	0.4	0.5	0.5	0.7	0.9	1.0	1.1	1.3
2.00	0.500	0.4	0.4	0.4	0.5	0.5	0.8	1.0	1.1	1.3	1.4
5.00	0.200	0.4	0.5	0.5	0.7	0.7	1.1	1.6	1.6	1.9	2.1
10.00	0.100	0.5	0.6	0.7	0.9	1.0	1.7	2.3	2.2	2.7	3.0
20.00	0.050	0.6	0.9	1.1	1.4	1.4	2.5	3.5	3.2	3.9	4.4
30.00	0.033	0.8	1.1	1.3	1.8	1.8	3.2	4.5	4.0	4.9	5.5
40.00	0.025	0.9	1.3	1.6	2.2	2.1	3.8	5.2	4.6	5.6	6.4
50.00	0.020	1.0	1.4	1.8	2.5	2.4	4.3	5.9	5.2	6.3	7.1
60.00	0.017	1.1	1.6	2.0	2.8	2.6	4.7	6.5	5.6	6.8	7.7
80.00	0.012	1.2	1.8	2.3	3.3	3.0	5.4	7.5	6.4	7.8	8.8
100.00	0.010	1.4	2.1	2.6	3.7	3.4	6.0	8.4	7.1	8.6	9.8

Extreme rainfall assessment with climate change

Projected temperature change: 1.0 ° C
Rainfall depths (mm)

ARI (y)	aep	Duration 10m	20m	30m	60m	2h	6h	12h	24h	48h	72h
1.58	0.633	4.2	6.1	7.7	11.2	15.8	27.1	38.0	53.5	64.9	72.7
2.00	0.500	4.6	6.8	8.5	12.5	17.4	29.7	41.5	58.1	70.5	78.9
5.00	0.200	6.5	9.5	11.8	17.4	23.9	39.8	54.8	75.6	91.8	102.9
10.00	0.100	8.0	11.8	14.6	21.6	29.5	48.3	65.9	90.1	109.7	122.9
20.00	0.050	9.8	14.4	18.0	26.5	35.9	58.2	78.8	106.8	130.0	145.8
30.00	0.033	11.0	16.2	20.3	29.9	40.4	64.9	87.5	117.9	143.6	161.1
40.00	0.025	12.0	17.6	22.1	32.6	43.7	69.8	93.7	125.9	153.4	172.1
50.00	0.020	12.7	18.8	23.5	34.8	46.5	73.9	98.9	132.4	161.5	181.3
60.00	0.017	13.4	19.8	24.8	36.6	48.9	77.3	103.4	138.0	168.3	188.9
80.00	0.012	14.6	21.5	27.0	39.7	52.9	83.2	110.7	147.2	179.5	201.5
100.00	0.010	15.6	22.9	28.8	42.4	56.3	88.0	116.7	154.8	188.7	211.9

Projected temperature change: 2.0 ° C
Rainfall depths (mm)

ARI (y)	aep	Duration 10m	20m	30m	60m	2h	6h	12h	24h	48h	72h
1.58	0.633	4.5	6.6	8.2	11.9	16.7	28.4	39.8	55.7	67.2	75.1
2.00	0.500	5.0	7.3	9.0	13.3	18.4	31.2	43.4	60.5	73.1	81.5
5.00	0.200	7.0	10.2	12.6	18.5	25.4	42.1	57.8	79.4	96.1	107.6
10.00	0.100	8.6	12.6	15.7	23.1	31.5	51.3	69.9	95.5	116.0	129.8
20.00	0.050	10.6	15.4	19.3	28.4	38.5	62.2	84.1	113.9	138.6	155.4
30.00	0.033	11.8	17.4	21.8	32.1	43.4	69.7	94.0	126.7	154.0	172.6
40.00	0.025	12.9	18.9	23.8	35.0	47.0	74.9	100.7	135.3	164.7	184.7
50.00	0.020	13.7	20.2	25.3	37.4	50.0	79.3	106.3	142.2	173.4	194.8
60.00	0.017	14.4	21.2	26.7	39.3	52.5	83.1	111.0	148.2	180.7	202.9
80.00	0.012	15.7	23.1	29.0	42.7	56.8	89.3	118.9	158.1	192.8	216.5
100.00	0.010	16.7	24.6	31.0	45.6	60.4	94.5	125.4	166.2	202.7	227.6

Projected temperature change: 3.0 ° C
Rainfall depths (mm)

ARI (y)	aep	Duration 10m	20m	30m	60m	2h	6h	12h	24h	48h	72h
1.58	0.633	4.8	7.0	8.8	12.6	17.7	29.8	41.5	57.9	69.6	77.6
2.00	0.500	5.3	7.8	9.6	14.1	19.5	32.7	45.3	62.9	75.6	84.2
5.00	0.200	7.4	10.8	13.4	19.7	26.9	44.4	60.8	83.3	100.5	112.3
10.00	0.100	9.2	13.5	16.7	24.6	33.4	54.4	74.0	100.8	122.3	136.6
20.00	0.050	11.3	16.5	20.6	30.3	41.0	66.2	89.5	121.1	147.3	164.9
30.00	0.033	12.6	18.6	23.3	34.3	46.4	74.5	100.4	135.4	164.4	184.2
40.00	0.025	13.8	20.2	25.4	37.4	50.2	80.1	107.6	144.6	175.9	197.2
50.00	0.020	14.6	21.6	27.0	39.9	53.4	84.8	113.6	152.0	185.4	208.2
60.00	0.017	15.4	22.7	28.5	42.0	56.2	88.8	118.7	158.5	193.2	216.9
80.00	0.012	16.7	24.7	31.0	45.6	60.8	95.5	127.1	169.0	206.1	231.4
100.00	0.010	17.9	26.3	33.1	48.7	64.6	101.1	134.0	177.7	216.6	243.3