Q Assessment of likely effects of NOx and ammonia, including methodological issues; the relevant development scenarios (DS2-DS5); and confidence in findings.

1. This response has largely been drafted by Dr Caroline Chapman, Director of DTA Ecology Ltd and co-Director of DTA Publications Ltd. Dr Chapman is a specialist in the interpretation and application of the Habitats Regulations and is co-author of *The Habitats Regulations Assessment Handbook*. Subscribers to the Handbook include Governments in England, Wales, and Northern Ireland; Natural England; The Environment Agency; Natural Resources Wales; The Planning Inspectorate; the Marine Management Organisation; all Welsh Planning Authorities and numerous authorities in England together with a growing list of lawyers, consultants, NGOs and practitioners.

2. Dr Chapman was previously the National Specialist for Air Pollution for Natural England and frequently advises on issues relating to the interface between air pollution impacts and the application of the Habitats Regulations. She sat on the first Air Quality Technical Advisory Group (AQTAG) and the Steering Group for the development of the widely used Air Pollution Information System.

Issue of potential concern relating to the assessment of NO_x

3. Paragraphs 2.28-2.29 of the HRA explain that there are two measures of particular relevance to air quality impacts from road emissions. The first is the concentration of NO_x in the atmosphere, and the second is the rate of resulting nitrogen deposition.

4. The appropriate assessment explains at para 6.4 that direct effects of NO_x may arise other than through its role as a contributor to overall nitrogen deposition but then asserts that *'the experimental studies that have investigated such physiological and biochemical effects of NO_x have used doses far in excess of those measures or forecast in Epping Forest'*. It states, '*the critical level for NOx is set as low as 30ug/m³ largely because this is the concentration above which the nitrogen-mediated growth effects of the gas are known to occur*'. On this basis the appropriate assessment proceeds on the basis that the main effect mechanisms are nitrogen deposition and gaseous ammonia, and fails to further address NO_x. Para 6.5 states, *'Focusing on nitrogen deposition rates in ecological interpretation, rather than relying on scrutiny of NOx concentrations in atmosphere has the advantage of being habitat specific and more directly relatable to effects on vegetation… the critical level for NOx is entirely generic; in reality different habitats have varying tolerance to nitrogen… The rest of this analysis therefore focuses on nitrogen deposition and ammonia'*.

5. Until recently Natural England accepted these assertions at face value. Whilst we have raised the issue of high NO_x concentrations before, we did not pursue the lack of further, habitat-specific assessment of the impact of NO_x emissions in the document as a primary issue.

6. However, we have recently had cause to scrutinise the Appendix F air quality monitoring results in more detail and the NOx concentrations are potentially of greater concern than suggested by paragraph 6.4-6.5.

7. For many transects the 2014 concentrations show significant exceedances of the critical level. Of the 19 transects for which data is presented the critical level for NOx (30ug/m³) is exceeded

along the entire transect (up to a distance of 200m from the road edge) for seven: B1, B2, C1, D1, E2, O and P. The 2017 modelling results show some improvement from 2014 levels but, even by 2017, estimated levels at the roadside significantly exceeded the critical level (being in excess of 140ug/m^3 on two transects). Table 1 below summarises the distance from the road within which the critical level for NOx is exceeded for each transect, based on 2017 modelled data.

Table 1: Distances from roads in exceedance of the critical level of NO_x and maximum concentrations (model for year 2017)

Transect	Exceeded (m)	Max (ug/m^3)	Transect	Exceeded (m)	Max (ug/m^3)
A1	70	58.13	H	15	51.18
A2	60	66.86	I	61	94.63
B1	200	73.81	J	0	31.77
B2	30	51.61	K	15	49.48
C1	200	142.13	L	N/A	26.00
C2	30	79.25	M	N/A	24.25
D1	30	59.62	N	N/A	28.96
D2	60	65.99	O	127.5	94.65
E1	60	76.40	P	200	146.56
E2	100	106.63			

8. The scale and extent of the exceedance are potentially of concern and call into question whether excluding further analysis of NO_x as part of the appropriate assessment can, in fact, be justified?

9. Whilst these levels reflect historic pollution, the DS2 scenario (with growth - unmitigated) still shows a clear picture of continued exceedances of the critical level beyond the road verge as summarised in table 2:

Table 2: Distances from roads in exceedance of the critical level of NO_x and maximum concentrations (model for year 2033, DS2 with-growth, unmitigated)

Transect	Exceeded (m)	Max (ug/m^3)	Transect	Exceeded (m)	Max (ug/m^3)
A1	20	52.57	H	5	44.45
A2	20	48.94	I	31	79.48
B1	30	66.21	J	N/A	24.53
B2	10	50.18	K	5	49.07
C1	80	119.51	L	N/A	29.28
C2	10	65.98	M	N/A	22.85
D1	10	62.02	N	20	41.86
D2	20	64.22	O	82.5	97.19
E1	10	52.85	P	101	109.12
E2	30	73.39			

11. Natural England also note that the scenario DS5 (mitigated) still shows exceedance of critical levels for NO_x at 43 transect locations across the forest. Exceedances in the mitigated scenario extend to 40m at transect C1, 20m at transect I, 42.5m at transect O and 61m at transect P. Natural England have therefore considered the argument that it was warranted to dispense with

further analysis of NO_x concentrations in more detail, and present the following observations below

Key contextual information:

12. Epping Forest is unusual when compared with the SAC series as a whole that form part of the Natura 2000 network in England. Generally speaking, averaged NOx concentrations (across modelled grid squares) rarely exceed the critical level and exceedance are usually only apparent within close proximity to a road. However, at Epping Forest SAC the averaged NO_x concentrations exceed the critical level across many of the grid squares that cover the area of the SAC. This provides some explanation as to why the concentrations adjacent to the road are so high within the forest itself. The relevant data is available from the Air Pollution Information System and is reproduced as Appendix 1: http://www.apis.ac.uk/popup/gridded-concentration-deposition-2015?sitecode=UK0012720&deptype=F&featurecode=H9120&accode=UMW

13. By way of comparison, the gridded concentration data for Ashdown Forest (which has been the subject to intense scrutiny and legal challenge in respect of air pollution) show no grid squares where averaged concentrations exceed the critical level for NOx. See web link information which is reproduced as appendix 2: http://www.apis.ac.uk/popup/gridded-concentration-deposition-2015?sitecode=UK0030080&deptype=M&featurecode=H4030&accode=CA

14. Accordingly, Epping Forest is considered to be a high risk site in respect to potential effects from *concentrations* of NO_x as existing averaged levels are already high.

Evidence basis for the critical level (set at 30ug/m^3)

15. The HRA asserts that direct effects from NO_x are observed from '*doses far in excess of those measured or forecast in Epping Forest (hundreds, and in some cases thousands of ug/m^3)'.* There are indeed studies which identify direct effects at these levels, as referenced within the HRA. However, the Air Pollution Information System website includes a page summarising the effects and implications of nitrogen oxides on woodland habitats which is available here: http://www.apis.ac.uk/nitrogen-oxides-broadleaved-mixed-and-yew-woodland

16. Whilst this page notes that visible decline symptoms can occur at very high concentrations (>400ug/m^3), it also notes that '*effects are mainly on growth, photosynthesis and nitrogen assimilation/metabolism with few species showing visible injury*', and that they can lead to reductions in species diversity through direct damage to mosses, liverworts and lichens. It notes, '*Davies et al (2007) found a significant inverse relationship between the diversity of epiphytes and NOx concentrations in London. Diversity declined where NOx exceeded 70 µgm-3 and NO2 exceeded 40 µgm-3*'.

17. Importantly this APIS webpage also notes that *'Nitrogen oxides are known to have greater adverse effects in the presence of SO_2 or O_3 and hence the critical level should apply where these pollutants are also close to their critical level.'* The APIS guidance there also notes that the evidence for the critical level is 'quite reliable'.

18. This suggestion that the NO_x critical level takes account of the combined effects with other pollutants echoes earlier guidance published by the WHO in the 2nd Edition of their *Air Quality Guidelines for Europe'*. These were published in the year 2000 and so pre-date the study by *Davies et al* cited by APIS. There are two versions available of this document which have been

referred to as the 'short' and 'long' version. The 'short' version[1] appears to be the Expert Group report whilst the 'long' version[2] is a background document prepared in advance to inform the Expert Group discussions. The long version is therefore most useful in understanding how the WHO guideline critical level was set and provides a table (ch.11, p.8, Table 2) showing the lowest exposure concentrations at which nitrogen dioxide - NO_2 - caused significant effects in the underlying research they consider:

Table 2: Lowest exposure concentrations (in µg/m³) and durations at which NO_2 caused significant effects*

Exposure duration	Effect		
	(Bio)chemical	Physiological	Growth aspects
Long-term		128; 8 months[9]	85; 7 months[17] 120; 5 months[18] 122; 37 weeks[19]
Growing season or winter	50; 39 days[1] 125; 140 days[2] 940; 19 days[3]	120; 22 days[10] 190 (65); 105 hours in 15 days[11]	10–43; 130 days[20] 55–75; 62 days[21] 150–190 (28–33); 120 hours in 40 days[22]
Air pollution episodes	140; 1 day[4] 95; 7 days[5] 65; 1 day[6]	375 (165); 35 hours in 5 days[12] 190; 20 hours[13]	375; 2 weeks[23] 100 (25); 20 hours in 5 days[24]
Short-term	7500; 6 hours[7] 7500; 4 hours[8]	190; 1 hour[14] 850; 7 hours[15] 1100; 1.5 hours[16]	2000–3000; 3.5 hours[25]

* If fumigation was not continuous, an average was estimated and is given in parentheses (calculated assuming a background concentration of 10 µg/m³ during the periods of no fumigation).

19. This table suggest growth and physiological effects from long term exposure of between 85-128ug/m³. These levels – for NO_2 only - are notably higher than the critical level but are, nevertheless, both measured and forecast to occur within the Epping Forest SAC.

20. The WHO guidance goes onto (long version, chapter 11, p.21) to offer an alternative explanation to that put forward in the HRA as to why the critical level is set below these observed effects levels with reference to studies into the combined effects of NO_2 with nitric oxide, SO_2 and O_3. The 'General conclusions on critical levels' reads as follows:

> *'In the majority of studies with NO and NO_2 there were no significant effects at levels below 100 µg/m³ when applied singly, but in combination the effects are obvious. NO_2 changed the response to O_3 mainly with a less-than-additive interaction. In combination with SO_2, NO_2 acted more-than-additively in most cases. In general no interaction (and thus additivity) was found with CO_2 and with NO.*

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[1] Shorter version of WHO NO_x vegetation chapter (Working Group Report):
http://www.euro.who.int/__data/assets/pdf_file/0005/74732/E71922.pdf

[2] Longer version of WHO NOx vegetation chapter. (apparently an informing Background Document to inform the activity of the Working Group):
http://www.euro.who.int/__data/assets/pdf_file/0005/123098/AQG2ndEd_11no2level.pdf?ua=1

In the first edition of these guidelines (1) a CLE for an annual average NO_2 concentration was 30 µg/m^3. Based on current information, we estimate the no-effect level for an annual average at around 15–20 µg/m^3 for NO_2, both when present as a single compound and in combination with SO_2 and O_3 (the nature of the NO_2 effect changes, but not the no-effect level). For NO a no-effect level for an annual average can only be estimated by extrapolation, but may well be around 15–20 µg/m^3 as well. ***Taking the additivity of NO and NO_2 effects into account, a CLE for NO_x that protects all plants from adverse effects should be lower than 15 µg/m^3. On the other hand, experimental evidence exists to indicate that the great majority of plant species (though not all) are protected at a NO_x level of 30 µg/m^3. We propose this level for the annual mean.'*** **[emphasis added]**

21. This explanation is consistent with the APIS website advising that the critical level set for NO_x should be applied when the levels of SO_2 or O_3 are <u>also</u> close to their critical levels.

22. Professor Mark Sutton of the Centre for Ecology and Hydrology has also made similar observations as part of his regulation 19 submissions in respect of the Wealden District Council Local Plan HRA[3] and the assessment of air pollution effects within Ashdown Forest. Professor Sutton is an environmental physicist who led the first European Nitrogen Assessment, chairs the International Nitrogen Initiative and is co-chair on the Task Force on Reactive Nitrogen which is a body of the UNECE Convention on Long Range Transboundary Air Pollution.[4] He recognises that the critical level values for NO_x have not been substantively reviewed in the past 20 years, and continues to advise that

    'My own expert judgement is that we should consider the NOx annual critical level as uncertain to +/-50% (as illustrated in the AQC Report following my advice) subject to the findings of a future international expert review'.

23. A footnote to Professor Suttons submission continues as follows with reference to the WHO guidelines quoted from above:

    'It should be noted that I earlier made this expert judgement of 30ug/m^3 +/-50% uncertainty in the NO_x critical level (CLE) independently, in order to advise on revision of the AQC Report. Reviewing the longer text of the WHO (2000, p 21) (footnote 11, above), my attention is now drawn to its important statement: "Taking the additivity of NO and NO_2 effects into account, a CLE for NOx that protects all plants from adverse effects should be lower than 15 µg/m3. On the other hand, experimental evidence exists to indicate that the great majority of plant species (though not all) are protected at a NO_x level of 30 µg/m$_3$. We propose this level for the annual mean". This is important as it means that the proposed uncertainty range, which I estimated independently, is broadly consistent with an implicit WHO (2000) uncertainty range for protection of all plant species, including those that are most sensitive. As far as I am aware, it is not known whether heathland plants especially sensitive to NO_x compared with other plant species, which again emphasizes the importance of considering an uncertainty range.'

24. The 'short' version of the WHO guidelines is more concise than the 'long' version, but still recognises the combined effects of NO_x with other pollutants. It states:

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[3] Habitats Regulations Assessment - January 2019 (pdf) refer appendix 12© starting on page 850
[4] https://www.ceh.ac.uk/staff/mark-sutton

'Interactive effects between NO_2 and sulfur [sic] dioxide and/or ozone have been reported frequently (8–13). From a review of recent literature, however, it was concluded that the lowest effective levels for NO_2 are approximately equal to those for combination effects (although in general, at concentrations near to its effect threshold, NO_2 causes growth stimulation if it is the only pollutant, while in combination with sulfur dioxide and/or ozone it results in growth inhibition). Critical levels for a 1-year period are recommended to cover relatively long term effects. The critical level for NO_x (NO and NO_2, added in ppb and expressed as NO_2 in µg/m3) is 30 µg/m3 as an annual mean.'

Summary

25. In answering the question posed by the Inspector in her recent agenda for the hearing on 21 May 2019, in in respect of the effects of NO_x and 'confidence in the findings', Natural England consider it is appropriate for the Inspector to be aware of these recent findings to ensure a full, thorough evaluation of the Council's HRA can be undertaken. In particular, the Inspector should consider whether it was justified to exclude NO_x concentrations from further analysis as part of the appropriate assessment when they were substantially in excess of critical levels. Natural England notes that, apart from the contribution to nitrogen deposition, there is credible evidence of a real risk to natural habitats when the critical level is exceeded, particularly in combination with either SO_2 and/or O_3. It would therefore be reasonable for any further analysis of NO_x to be informed by data on existing levels of these pollutants within the SAC.

26. In this regard Natural England notes that the Air Pollution Information System indicates that levels of SO_2 within the SAC are significantly below the relevant critical level (APIS provides an averaged concentration of 0.33ug/m^3 against a critical level for SO_2 of 10ug/m^3). However we are not in a position to be able to provide such reassurance in respect of ground level ozone. We note that Table 5.12 in the 2012 *Review of Transboundary Air Pollution* report[5] estimates that 57.3% of deciduous woodland in the UK exceeds the critical level for ozone of an AOT40 of 5ppm.h over 6 months. However this report also raises questions over important trends in the exposure of vegetation to ozone across the UK which may not be captured by the AOT40 approach. Section 5.4.7 notes *'Of particular relevance is a significant body of experimental research that has been supported by Defra… which has assessed the effects of relatively low O_3 exposures on species and communities of conservation value in the UK'*.

27. It will be for the competent authority to obtain the information that might reasonably be required to undertake a more detailed analysis of the potential effects from NO_x in light of further information in respect of ground level ozone should the Inspector consider that some further analysis is appropriate.

[5] http://www.rotap.ceh.ac.uk/files/CEH%20RoTAP_0.pdf

Appendix 1: Gridded average NO_x concentrations within the 1km grid squares that comprise the Epping Forest SAC. Levels above 30ug/m^3 exceed the critical level as an averaged value.

Grid Reference (km)	Designation	Site Area (ha)	% Area of Gridsquare covering the site	Nitrogen oxide (NOx) concentration (µg/m3)	Sulphur dioxide (SO2) (µg/m3)
537500,194500	SAC	1605	0 (0%)	32.86	0.36
537500,195500	SAC	1605	0.15 (0.1%)	34.28	0.41
537500,196500	SAC	1605	0.02 (0%)	30.80	0.34
538500,188500	SAC	1605	0.24 (0.2%)	44.14	0.43
538500,189500	SAC	1605	0.16 (0.1%)	41.64	0.46
538500,190500	SAC	1605	0.57 (0.4%)	47.36	0.44
538500,191500	SAC	1605	0.1 (0.1%)	39.50	0.41
538500,194500	SAC	1605	0.78 (0.5%)	32.90	0.37
538500,195500	SAC	1605	2.88 (1.8%)	27.29	0.33
538500,196500	SAC	1605	0.29 (0.2%)	28.85	0.34
539500,188500	SAC	1605	2.98 (1.9%)	41.10	0.40
539500,189500	SAC	1605	2.28 (1.5%)	38.85	0.38
539500,190500	SAC	1605	1.81 (1.2%)	47.99	0.39
539500,191500	SAC	1605	1.9 (1.2%)	38.85	0.37
539500,192500	SAC	1605	0.9 (0.6%)	33.63	0.35
539500,193500	SAC	1605	1.42 (0.9%)	31.87	0.35
539500,194500	SAC	1605	1.58 (1%)	29.94	0.34
539500,195500	SAC	1605	3.82 (2.5%)	28.70	0.34
539500,196500	SAC	1605	1.08 (0.7%)	26.72	0.32
540500,192500	SAC	1605	0.16 (0.1%)	34.76	0.34
540500,193500	SAC	1605	1.87 (1.2%)	32.04	0.34
540500,194500	SAC	1605	2.66 (1.7%)	28.56	0.34
540500,195500	SAC	1605	5.33 (3.4%)	28.41	0.33

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540500,196500	SAC	1605	5.66 (3.6%)	26.13	0.32
540500,197500	SAC	1605	2.75 (1.8%)	24.89	0.34
540500,198500	SAC	1605	0.99 (0.6%)	24.73	0.32
540500,199500	SAC	1605	0 (0%)	33.80	0.33
541500,192500	SAC	1605	0.08 (0.1%)	34.23	0.35
541500,193500	SAC	1605	2 (1.3%)	31.73	0.39
541500,194500	SAC	1605	0.35 (0.2%)	29.52	0.38
541500,195500	SAC	1605	1.58 (1%)	27.11	0.33
541500,196500	SAC	1605	4.29 (2.8%)	24.74	0.32
541500,197500	SAC	1605	6.03 (3.9%)	22.73	0.30
541500,198500	SAC	1605	5.69 (3.7%)	24.18	0.32
541500,199500	SAC	1605	3.89 (2.5%)	26.84	0.33
542500,196500	SAC	1605	0.5 (0.3%)	29.31	0.46
542500,197500	SAC	1605	3.95 (2.5%)	23.80	0.35
542500,198500	SAC	1605	6.04 (3.9%)	21.94	0.30
542500,199500	SAC	1605	4.29 (2.8%)	24.57	0.31
542500,200500	SAC	1605	0.8 (0.5%)	30.76	0.35
543500,198500	SAC	1605	3.17 (2%)	21.29	0.32
543500,199500	SAC	1605	5.67 (3.6%)	21.20	0.29
543500,200500	SAC	1605	2.47 (1.6%)	29.89	0.35
544500,198500	SAC	1605	0.27 (0.2%)	21.47	0.33
544500,199500	SAC	1605	2.33 (1.5%)	21.34	0.30
544500,200500	SAC	1605	4.2 (2.7%)	25.02	0.35
544500,201500	SAC	1605	0.01 (0%)	26.66	0.36

Appendix 2: For purpose of comparison, gridded average NO_x concentrations within the 1km grid squares that comprise the Ashdown Forest SAC where **no grid square averages exceed the critical level for NO_x**.

Grid Reference (km)	Designation	Site Area (ha)	% Area of Gridsquare covering the site	Nitrogen oxide (NOx) concentration (µg/m3)	Sulphur dioxide (SO2) (µg/m3)
539500,131500	SAC	2729	0.15 (0.2%)	11.89	0.23
539500,132500	SAC	2729	0.31 (0.3%)	12.13	0.26
539500,133500	SAC	2729	0.49 (0.5%)	12.15	0.25
540500,130500	SAC	2729	0 (0%)	12.07	0.24
540500,131500	SAC	2729	1.58 (1.7%)	11.98	0.23
540500,132500	SAC	2729	2.08 (2.3%)	12.09	0.23
540500,133500	SAC	2729	2.3 (2.5%)	12.09	0.23
541500,130500	SAC	2729	1.18 (1.3%)	12.30	0.26
541500,131500	SAC	2729	1.21 (1.3%)	12.23	0.23
541500,132500	SAC	2729	0.89 (1%)	12.57	0.23
541500,133500	SAC	2729	2.23 (2.4%)	12.74	0.24
542500,128500	SAC	2729	0.19 (0.2%)	11.70	0.24
542500,129500	SAC	2729	1.91 (2.1%)	11.83	0.24
542500,130500	SAC	2729	3.19 (3.5%)	11.88	0.23
542500,131500	SAC	2729	0.97 (1.1%)	12.49	0.23
542500,133500	SAC	2729	1.39 (1.5%)	12.42	0.23
542500,134500	SAC	2729	0.38 (0.4%)	14.09	0.28
543500,128500	SAC	2729	0.17 (0.2%)	11.47	0.22
543500,129500	SAC	2729	2.35 (2.6%)	11.64	0.22
543500,130500	SAC	2729	1.36 (1.5%)	12.10	0.22
543500,132500	SAC	2729	1.57 (1.7%)	11.65	0.23
543500,133500	SAC	2729	0.82 (0.9%)	11.72	0.23

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543500,134500	SAC	2729	1.01 (1.1%)	13.00	0.25
544500,126500	SAC	2729	0.13 (0.1%)	11.62	0.24
544500,127500	SAC	2729	1.19 (1.3%)	12.37	0.30
544500,128500	SAC	2729	0.82 (0.9%)	12.11	0.27
544500,129500	SAC	2729	3.03 (3.3%)	11.35	0.22
544500,130500	SAC	2729	0.3 (0.3%)	11.20	0.24
544500,131500	SAC	2729	2.04 (2.2%)	11.18	0.21
544500,132500	SAC	2729	3.06 (3.3%)	11.35	0.22
544500,133500	SAC	2729	2.51 (2.7%)	11.56	0.23
544500,134500	SAC	2729	0.22 (0.2%)	12.30	0.35
545500,126500	SAC	2729	0.53 (0.6%)	11.99	0.24
545500,127500	SAC	2729	2.79 (3.1%)	11.26	0.23
545500,128500	SAC	2729	3.46 (3.8%)	11.19	0.23
545500,129500	SAC	2729	1.99 (2.2%)	10.97	0.22
545500,130500	SAC	2729	3.02 (3.3%)	10.89	0.21
545500,131500	SAC	2729	2.65 (2.9%)	10.92	0.21
545500,132500	SAC	2729	1.81 (2%)	11.13	0.22
545500,133500	SAC	2729	0.03 (0%)	11.59	0.22
546500,126500	SAC	2729	0.82 (0.9%)	11.91	0.25
546500,127500	SAC	2729	2.47 (2.7%)	11.46	0.23
546500,128500	SAC	2729	2.57 (2.8%)	11.27	0.22
546500,129500	SAC	2729	3.19 (3.5%)	10.87	0.21
546500,130500	SAC	2729	3.58 (3.9%)	10.95	0.21
546500,131500	SAC	2729	2.41 (2.6%)	11.23	0.21
546500,132500	SAC	2729	3.12 (3.4%)	11.02	0.21

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546500,133500	SAC	2729	0.3 (0.3%)	11.27	0.22
547500,126500	SAC	2729	0.29 (0.3%)	11.59	0.23
547500,127500	SAC	2729	1.01 (1.1%)	11.14	0.23
547500,128500	SAC	2729	2.03 (2.2%)	11.12	0.21
547500,129500	SAC	2729	3.48 (3.8%)	11.12	0.21
547500,130500	SAC	2729	2.02 (2.2%)	11.35	0.21
547500,131500	SAC	2729	3.38 (3.7%)	11.09	0.21
547500,132500	SAC	2729	2.91 (3.2%)	11.18	0.21
547500,133500	SAC	2729	0.54 (0.6%)	11.32	0.22
548500,128500	SAC	2729	1.46 (1.6%)	11.55	0.22
548500,129500	SAC	2729	2.4 (2.6%)	10.96	0.21
548500,130500	SAC	2729	0.03 (0%)	11.02	0.21
548500,131500	SAC	2729	0.28 (0.3%)	11.12	0.21
548500,132500	SAC	2729	0.2 (0.2%)	11.08	0.21
549500,128500	SAC	2729	0.04 (0%)	11.63	0.23
549500,129500	SAC	2729	0.56 (0.6%)	11.39	0.23
549500,131500	SAC	2729	0.74 (0.8%)	11.12	0.21
549500,132500	SAC	2729	2.19 (2.4%)	11.37	0.30
549500,133500	SAC	2729	0.05 (0.1%)	11.33	0.23
550500,131500	SAC	2729	0.58 (0.6%)	12.69	0.23
550500,132500	SAC	2729	0.04 (0%)	11.62	0.25