Appendix D1

Sample Train Noise Calculation

Formulae employed in the Noise Prediction

(1) Determination of Lmax

The correction for the distance is given by :-

$$\text{Correction for distance} = 10 \log_{10} (D/d_1)$$

The correction for 'airborne' Speed is given by :-

$$\text{Correction for speed} = 30 \log_{10} (V/130 \text{ kph})$$

(2) Determination of SEL

The Sound Exposure Level can be converted from L_{max} by employing the following standard equation:

$$SEL = L_{max} + 10 \log_{10} (M/V) + 10.5 - 10 \log_{10} ((4D+(4D^2+1) + 2\tan^{-1}(1/2D))$$

Where M is train length (m)
V is the train speed (kph)
d is the distance from track
and, D = d/M

(3) Determination of Leq

The correction for the angle of view of the section of railway line extended at the noise sensitive receivers for a particular train pass event is given by :-

$$\text{Correction for view angle} = 10 \log_{10} (\theta/\theta_1)$$

The continuous sound pressure level L_{eq} is determined from the measured single event exposure level, SEL, for a particular train type over the period T (T=24 hours and 30 minutes in this case) employing the following equation :-

$$L_{eq} = SEL - 10 \log_{10} T$$

The overall L_{eq} contributing from N train is given by :-

$$(L_{eq})_{total} = L_{eq} + 10 \log_{10} N/T + 10 \log_{10} (\theta/\theta_1)$$

Train Noise Assessment

Summary of NSR Data

Job Title : KCR East Rail Extension
Job No. : 21282
Date : 6/1/00

NSR	Day Time	Night Time	
	$L_{eq, 0.5\ hr}$	$L_{eq, 0.5\ hr}$	L_{max}
T1-1/F	61.2	58.8	74.2
T1-2/F	61.2	58.8	74.2
T1-3/F	61.1	58.8	74.2
T1-4/F	61.1	58.8	74.1
T1-5/F	61.1	58.8	74.1
T1-6/F	61.1	58.8	74.1
T1-7/F	61.1	58.7	74.1
T1-8/F	61.1	58.7	74.1
T1-9/F	61.0	58.7	74.0
T1-10/F	61.0	58.7	74.0
T1-11/F	61.0	58.7	74.0
T1-12/F	61.0	58.6	73.9
T1-13/F	60.9	58.6	73.9
T1-14/F	60.9	58.6	73.8
Max.	61	59	74
Criteria	70	60	85
Exceedance	0	0	0
No. of NSR exceed criteria	0	0	0

Train Noise Assessment

Summary of NSR Data

Job Title : KCR East Rail Extension
Job No. : 21282
Date : 6/1/00

Train Noise Assessment for all NSR

	EMU											
NSR	Hori. Dist		Vert. Dist.		View Angle				Barrier			
	East	West	East	West	East Bound		West Bound		East Bound		West Bound	
					Approaching	Leaving	Approaching	Leaving	Approaching	Leaving	Approaching	Leaving
T1-1/F	112.0	120.0	8.5	8.5	33	0	0	31	0.0	0.0	0.0	0.0
T1-2/F	112.0	120.0	11.5	11.5	33	0	0	31	0.0	0.0	0.0	0.0
T1-3/F	112.0	120.0	14.5	14.5	33	0	0	31	0.0	0.0	0.0	0.0
T1-4/F	112.0	120.0	17.5	17.5	33	0	0	31	0.0	0.0	0.0	0.0
T1-5/F	112.0	120.0	20.5	20.5	33	0	0	31	0.0	0.0	0.0	0.0
T1-6/F	112.0	120.0	23.5	23.5	33	0	0	31	0.0	0.0	0.0	0.0
T1-7/F	112.0	120.0	26.5	26.5	33	0	0	31	0.0	0.0	0.0	0.0
T1-8/F	112.0	120.0	29.5	29.5	33	0	0	31	0.0	0.0	0.0	0.0
T1-9/F	112.0	120.0	32.5	32.5	33	0	0	31	0.0	0.0	0.0	0.0
T1-10/F	112.0	120.0	35.5	35.5	33	0	0	31	0.0	0.0	0.0	0.0
T1-11/F	112.0	120.0	38.5	38.5	33	0	0	31	0.0	0.0	0.0	0.0
T1-12/F	112.0	120.0	41.5	41.5	33	0	0	31	0.0	0.0	0.0	0.0
T1-13/F	112.0	120.0	44.5	44.5	33	0	0	31	0.0	0.0	0.0	0.0
T1-14/F	112.0	120.0	47.5	47.5	33	0	0	31	0.0	0.0	0.0	0.0
<End of NSR>												

Noise Level		
Day Time	Night Time	
$L_{eq, 0.5 hr}$	$L_{eq, 0.5 hr}$	L_{max}
61.2	58.8	74.2
61.2	58.8	74.2
61.1	58.8	74.2
61.1	58.8	74.1
61.1	58.8	74.1
61.1	58.8	74.1
61.1	58.7	74.1
61.1	58.7	74.1
61.0	58.7	74.0
61.0	58.7	74.0
61.0	58.7	74.0
61.0	58.6	73.9
60.9	58.6	73.9
60.9	58.6	73.8

Train Noise Assessment

Template

Train Noise Assessment for single NSR

T1-1/F 1

Job Title: KCR East Rail Extension
Job No: 21282
Date: 6/1/00

Description	Train type & direction											
	EMU				N/A				N/A			
	East Bound		West Bound		East Bound		West Bound		East Bound		West Bound	
	Approaching	Leaving	Approaching	Leaving	Approaching	Leaving	Approaching	Leaving	Approaching	Leaving	Approaching	Leaving
L_{max} [1], dB(A)	86	86	86	86	65	65	65	65	65	65	65	65
SEL [2], dB(A)	96	96	96	96	71	71	71	71	71	71	71	71
Speed, kph	100	100	100	100	50	50	50	50	50	50	50	50
Distance from Mic to track, d1, m	25	25	25	25	25	25	25	25	25	25	25	25
Length of 1train, M1, m	290	290	290	290	40	40	40	40	40	40	40	40
View angle (at Mic), q1, deg	180	180	180	180	180	180	180	180	180	180	180	180
Total number of events, N (24 hour)	312	0	0	312	0	0	0	0	0	0	0	0
Total number of events, N (1/2 hr, day time	12	0	0	12	0	0	0	0	0	0	0	0
Total number of events, N (1/2 hr, night tim	7	0	0	7	0	0	0	0	0	0	0	0

NSR	EMU										N/A										N/A									
	Hori. Dist		Vert. Dist.		View Angle				Barrier				Hori. Dist		Vert. Dist.		View Angle				Barrier				Hori. Dist		Vert. Dist.		View Angle				Barrier			
	East	West	East	West	East Bound		West Bound		East Bound		West Bound		East	West	East	West	East Bound		West Bound		East Bound		West Bound		East	West	East	West	East Bound		West Bound		East Bound		West Bound	
					Approaching	Leaving	Approaching	Leaving	Approaching	Leaving	Approaching	Leaving					Approaching	Leaving	Approaching	Leaving	Approaching	Leaving	Approaching	Leaving					Approaching	Leaving	Approaching	Leaving	Approaching	Leaving	Approaching	Leaving
T1-1/F	112.0	120.0	8.5	8.5	33	0	0	31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0.0	0.0	0.0	0.0

[1] L_{max} is provided by KCRC for worst-case scenario.

[2] The calculation of SEL from Lmax is based on the following equation:

$SEL = L_{max} + 10\log(M/V) + 10.5 - 10\log(4D/(4D^2+1) + 2\tan^{-1}(1/2D))$

Where M = train length, m
V = train speed, kph
d = distance from track, m
D = d/M

Train Noise Assessment

Calculations of Train Noise

Job Title : KCR East Rail Extension
Job No. : 21282
Date : 6/1/00

NSR: T1-1/F

TRAIN NOISE CALCULATION

Parameters: (Source)			Parameters: (EMU Train)	
	Speed of train, V_1, kph =	100	Speed of train, V_2, kph =	55
	Length of train, M_1, m =	290	Length of train, M_2, m =	290
	View angle (at Mic), θ_1, deg =	180	Facade Correction =	2.5
	Distance from Mic to track, d_1, m =	25		
	Lmax[1], dB(A) =	86		

Period	Description	Train type: EMU			
		East Bound		West Bound	
		Approaching	Leaving	Approaching	Leaving
L_{max}	L_{max}[2], dB(A)	86	86	86	86
	Horiz. distance from track to NSR, m	112	112	120	120
	Vert. distance from track to NSR, m	9	9	9	9
	Slant distance from track to NSR, d_2, m	112	112	120	120
	Corr for speed, $30\log(V_2/V_1)$, dB(A)	-8	-8	-8	-8
	Corr for distance, $10\log(d_1/d_2)$, dB(A)	-7	-7	-7	-7
	Corr for screening/absorption, dB(A)	0	0	0	0
	Facade correction	2.5	2.5	2.5	2.5
	L_{max} for each train activity, dB(A)	74	0	0	74
	L_{max} for all train activities, dB(A)	74			
	Criterion	85			
	Exceedence	0			
L_{eq}, 0.5hr (Daytime)	SEL[2], dB(A)	87	87	88	88
	Total number of events, N	12	0	0	12
	Corr for no. of events, $10\log(N/T)$, dB(A)	-22	0	0	-22
	Corr for view angle, $10\log(\theta_2/\theta_1)$, dB(A)	-7	0	0	-8
	$L_{eq, 0.5hrs}$ for each train activity, dB(A)	58	0	0	58
	$L_{eq, 0.5hrs}$ for all train activities, dB(A)	61			
	Criterion	70			
	Exceedence	0			
L_{eq}, 0.5hr (Night-time)	SEL[2], dB(A)	87	87	88	88
	Total number of events, N	7	0	0	7
	Corr for no. of events, $10\log(N/T)$, dB(A)	-24	0	0	-24
	Corr for view angle, $10\log(\theta_2/\theta_1)$, dB(A)	-7	0	0	-8
	$L_{eq, 0.5hrs}$ for each train activity, dB(A)	56	0	0	56
	$L_{eq, 0.5hrs}$ for all train activities, dB(A)	59			
	Criterion	60			
	Exceedence	0			

[1] L_{max} is provided by KCRC for worst-case scenario

[2] The calculation of SEL from Lmax is based on the following equation:

$SEL = L_{max} + 10\log(M/V) + 10.5 - 10\log(4D/(4D^2+1) + 2\tan^{-1}(1/2D))$

Where M = train length, m
V = train speed, kph
d = distance from track, m
D = d/M

```
'
' Macro TrainNoise_S &
'       TrainNoise_A
' by Makim W. Ma
' on 14/6/96
'
Sub TrainNoise_S()

'   Noise Data extracted from Sheet "Summary _NoiseData"
    Sheets("Summary_NoiseData").Select
    Range("G14:R22").Select
    Selection.Copy
    Sheets("Template").Select
    Range("E14").Select
    ActiveSheet.Paste

'   Noise Data extracted from Sheet "Summary_NSRData"
    Sheets("Template").Select
    RowNo = Range("F4")
    Sheets("Summary_NSRData").Select
    RowNo = RowNo + 13
    Cell1$ = "A" + RowNo
    Cell2$ = ":AK" + RowNo
    RangeName$ = Cell1$ + Cell2$
    Range(RangeName$).Select
    Selection.Copy
    Sheets("Template").Select
    Range("A28").Select
    ActiveSheet.Paste

'   Rearrange the workbook
    Sheets("Summary_NSRData").Select
    Range("A1").Select
    Application.CutCopyMode = False
    Sheets("Summary_NoiseData").Select
    Range("A1").Select
    ActiveWindow.LargeScroll Down:=-1
    Range("A1").Select
    Sheets("Summary_NSRData").Select
    ActiveWindow.LargeScroll Down:=-1
    Range("A1").Select
    Sheets("Template").Select
    ActiveWindow.LargeScroll Down:=-1
    Range("A1").Select
    Sheets("Train_Noise").Select
    ActiveWindow.SmallScroll ToRight:=-3
    Range("C61").Select

End Sub

Sub TrainNoise_A()

'   Noise Data extracted from Sheet "Summary _NoiseData"
    Sheets("Summary_NoiseData").Select
    Range("G14:R22").Select
    Selection.Copy
    Sheets("Template").Select
    Range("E14").Select
    ActiveSheet.Paste

'   Noise Data extracted from Sheet "Summary_NSRData"
```

```
    Sheets("Summary_NSRData").Select
    Cells.Find(What:="<End of NSR>", After:=ActiveCell, LookIn:= _
        xlFormulas, LookAt:=xlPart, SearchOrder:=xlByRows, _
        SearchDirection:=xlNext, MatchCase:=False).Activate
    EndRow = ActiveCell.Row
    StartRow = 14

    NoNSR = EndRow - StartRow

    For i = 1 To NoNSR
    RowNo = 13 + i
    Cell1$ = "A" + RowNo
    Cell2$ = ":AK" + RowNo
    RangeName$ = Cell1$ + Cell2$
    Range(RangeName$).Select
    Selection.Copy
    Sheets("Template").Select
    Range("A28").Select
    ActiveSheet.Paste
    Application.CutCopyMode = False
    Sheets("Train_Noise").Select
    Leq24 = Range("C46").Value
    LeqDT = Range("C56").Value
    LeqNT = Range("C66").Value
    Lmax = Range("C33").Value
    Sheets("Summary_NSRData").Select
    CellName$ = "AM" + RowNo
    Range(CellName$).Value = Leq24
    CellName$ = "AN" + RowNo
    Range(CellName$).Value = LeqDT
    CellName$ = "AO" + RowNo
    Range(CellName$).Value = LeqNT
    CellName$ = "AP" + RowNo
    Range(CellName$).Value = Lmax

    Next i

End Sub
```