Attachment 2

MONITORING FORM

If environmental reviews indicate the need of monitoring by JICA, JICA undertakes monitoring for necessary items that are decided by environmental reviews. JICA undertakes monitoring based on regular reports including measured data submitted by the project proponent. When necessary, the project proponent should refer to the following monitoring form for submitting reports.

When monitoring plans including monitoring items, frequencies and methods are decided, project phase or project life cycle (such as construction phase and operation phase) should be considered.

1. Responses/Actions to Comments and Guidance from Government Authorities and the Public

Monitoring Item	Monitoring Results during Report Period
ex.) Responses/Actions to Comments and Guidance from Government Authorities	July 2016 – September 2016

2. Mitigation Measures

The summary of the Environmental Monitoring is shown below.

[Construction Phase]

Item	Parameter	Frequency and Duration	Locations(At least)
Air	PM_{10}	2×24hours Twice/month During entire civil construction stage or even later, if directed by DMRC	20 locations
Water	Groundwater quality (IS 10500:1991)	Once/6months During entire civil construction stage or even later, if directed by DMRC	20 locations
Noise	Noise Level (Leq and Lmax)	24hours Once/week During entire civil construction stage or even later, if directed by DMRC	30 locations
Vibration	Vibration (RMS)	24hours Once/week During entire civil construction stage or even later, if directed by DMRC	10 locations
Soil	Heavy Metal	Once/6moths During entire civil construction stage	In each Underground Construction Contract
Ecology	Felled and planted trees	Once a year till all trees that were to be planted by Delhi Government on behalf of DMRC, are planted	All the trees felled and newly planted trees

[Operation Phase]

Item	Parameter	Frequency and Duration	Locations
Air	PM_{10}	2×24hours Once/month For 3years	10 locations
Water	Effluent	Once/4months For 3years	3 locations(Depot)
	Groundwater quality (IS 10500:1991)	Once/year For 3years	3 locations(Depot)
Noise	Noise Level (Leq)	24hours Once/year For 3years	15 locations (Sensitive Receptors along the elevated section)
Vibration	Vibration level VdB	24hours Once/year For 3years	15 locations (Sensitive Receptors along the elevated and underground section)
Ecology	Bird Strike	4times/year(If no bird hit is reported in this duration, then this monitoring may be discontinued, else it will continue). From the beginning, DMRC will instruct its train operator to compulsorily blow the horn while on the bridge across the Yamuna.	On the DMRC Yamuna bridge near Okhla Bird Sanctuary

2.1 During Construction

When a measured value exceeds the standards, the value is written in bold letters.

Air Quality (Ambient Air Quality)

Date: July 2016 Location: CC-30(NSP- Shalimar Bagh) (UG)

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
PM_{10}	$\mu g/m^3$	Netaji Subash palace -148.5 Shalimar Bagh–159	168 185	100 (24hours) (CPCB)	-	2×24hours Twice/month During entire civil construction stage or even later, if directed by DMRC

Date: July 2016 Location: CC-28(Shakurpur- Mayapuri) (Elevated)

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
PM_{10}	$\mu g/m^3$	ESI -190 Shakurpur- 189.5 PunjabiBagh -185.5 Mayapuri – 186 Rajouri stn–195.5 Zakhira - 196	190 197 192 192 201 203	100 (24hours) (CPCB)	-	2×24hours Twice/month During entire civil construction stage or even later, if directed by DMRC

Date: July 2016 Location: CC-32(Dwarka-IGD) (UG)

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
PM_{10}	$\mu g/m^3$	Dwarka – 183.5 Palam – 189.5 IGD – 177.5	191 196 185	100 (24hours) (CPCB)	-	2×24hours Twice/month During entire civil construction stage or even later, if directed by DMRC

Date: July 2016 Location: CC-64R (Karkardooma-Maujpur) (Elevated)

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
PM_{10}	$\mu g/m^3$	Karkardooma-183.18 Maujpur- 187 Sabapur – 149.6	183.25 188.5 151.14	100 (24hours) (CPCB)	-	2×24hours Twice/month During entire civil construction stage or even later, if directed by DMRC

Ground Water Quality (Drinking Water Quality: IS 10500:1991)

Date: July 2016 Location: Mukundpur CC-04 (UG)

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
Color,Hazen units,Max			<1.0	5(25)	-	20 locations Once/6 months During entire civil construction stage or even later, if directed by DMRC
Odour	-		Agreeable	Unobjectionable	-	
Taste	-		Not Agreeable	Agreeable	-	
Turbidity,NTU, Max	-		<1.0	5(10)	-	
pH Value	-		7.35	6.5-8.5	-	
Total Hardness (as $CaCO_3$), Max	mg/l		190	300(600)	-	
Iron(as Fe) ,max	mg/l		ND	0.3(1.0)	-	
Chloride(as Cl), Max	mg/l		172	250(1000)	-	
Residual free Chlorine, Min	mg/l		ND	0.2	-	
Fluoride(as F), Max	mg/l		ND	1.0(1.5)	-	
Dissolved solids, Max	mg/l		463	500(2000)	-	
Calcium(as Ca), Max	mg/l		52	75(200)	-	
Magnesium(as	mg/l		13.8	30(100)	-	

Mg), Max						
Copper(as Cu), Max	mg/l		ND	0.05(1.5)	-	
Manganese(as Mn), Max	mg/l		ND	0.1(0.3)	-	
Sulphate(as SO_4), Max	mg/l		45.4	200(400)	-	
Nitrate(as NO_2), Max	mg/l		3.68	45(100)	-	
Phenolic compounds (as C_6H_5OH),Max	mg/l		ND	0.001(0.002)	-	
Mercury(as Hg), Max	mg/l		ND	0.001	-	
Cadmium(as Cd), Max	mg/l		ND	0.01	-	
Selenium(as Se), Max	mg/l		ND	0.01	-	
Arsenic(as As), Max	mg/l		ND	0.05	-	
Cyanide(as CN), Max	mg/l		ND	0.05	-	
Lead(as Pb), Max	mg/l		ND	0.05	-	
Zinc(as Zn), Max	mg/l		ND	5(15)	-	
Anionic Detergents (as MBAS),Max	mg/l		ND	0.2(1.0)	-	
Chromium (as $Cr6^+$),Max	mg/l		ND	0.05	-	
Polynuclear aromatic hydrocarbons(as PAH),Max	mg/l		ND	-	-	
Mineral Oil	mg/l		ND	0.01	-	
Pesticides, Max	mg/l		ND	Absent	-	
Radioactive Materials, Max a) Alpha emitters	Bq/l		---	-(0.1)	-	
Radioactive Materials, Max b) Beta emitters	Pci/l		-------	-(1)	-	
Alkalinity, Max	mg/l		110	200(600)	-	

Aluminum(as Al), Max	mg/l		ND	0.03(0.2)	-	
Boron,Max	mg/l		ND	1(5)	-	

Date: July 2016 Location: Panchsheel Park CC-23 (UG)

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
Color,Hazen units,Max			<5	5(25)	-	20 locations Once/6 months During entire civil construction stage or even later, if directed by DMRC
Odour	-		Agreeable	Unobjectionable	-	
Taste	-		Saline	Agreeable	-	
Turbidity,NTU, Max	-		<1	5(10)	-	
pH Value	-		7.14	6.5-8.5	-	
Total Hardness (as $CaCO_3$), Max	mg/l		632	300(600)	-	
Iron(as Fe) ,max	mg/l		0.16	0.3(1.0)	-	
Chloride(as Cl), Max	mg/l		207.9	250(1000)	-	
Residual free Chlorine, Min	mg/l		<0.2	0.2	-	
Fluoride(as F), Max	mg/l		<1.0	1.0(1.5)	-	
Dissolved solids, Max	mg/l		1048	500(2000)	-	
Calcium(as Ca), Max	mg/l		155.5	75(200)	-	
Magnesium(as Mg), Max	mg/l		59.3	30(100)	-	
Copper(as Cu), Max	mg/l		<0.01	0.05(1.5)	-	
Manganese(as Mn), Max	mg/l		<0.1	0.1(0.3)	-	
Sulphate(as SO_4), Max	mg/l		143.8	200(400)	-	
Nitrate(as NO_2), Max	mg/l		9.15	45(100)	-	

(as MBAS),Max						
Chromium (as $Cr6^{+}$),Max	mg/l		ND	0.05	-	
Polynuclear aromatic hydrocarbons(as PAH),Max	mg/l		———	-	-	
Mineral Oil	mg/l		----------	0.01	-	
Pesticides, Max	mg/l		———	Absent	-	
Radioactive Materials, Max g) Alpha emitters	Bq/l		———	-(0.1)	-	
Radioactive Materials, Max h) Beta emitters	Pci/l		———	-(1)	-	
Alkalinity, Max	mg/l		74	200(600)	-	
Aluminum(as Al), Max	mg/l		ND	0.03(0.2)	-	
Boron,Max	mg/l		ND	1(5)	-	

Noise / Vibration

Date: July 2016 Location: CC-32(Dwarka to IGD) (UG)

Item	Unit	Measured Value (L_{eq})	Measured Value (L_{Max})	Country's Standards (Environmental Management Manual by DMRC)	Occupancy	Remarks (Measure-ment Point, Frequency, Method, etc.)
Noise level (Leq) and Lmax	dB(A)	**Dwarka Sector - 20** Leq(Day)-67.2 Leq(night)– 53.9 Lmin- 40.8 **Palam Station** Leq(Day)-64.9 Leq(night)– 59.2 Lmin- 44.2 **IGD Mehramnagar** Leq(Day)-65.8 Leq(night)– 58.4 Lmin- 39.7	77.5 77.8 77.9	National Standards Area Leq(d) Leq(n) Resi 55 45 Comm 65 55 Indstl 75 70 Silence 50 40 DMRC Env Manual (when pre construction levels are not known) Resi Lmax Daytime:	Commercial / residence	30locations 24hours/time Once/week During entire civil construction stage or even later, if directed by DMRC

				Nighttime: 65 Comm & and Indstl At all time: 85		
Vibration level	RMS (mm/s)			Structures in good condition:25 in fair condition:12 in poor condition:5 Water supply Structures:5 Heritage structure/ Bridge structures:5		10locations 24hours/time Once/week During entire civil constructio n stage or even later, if directed by DMRC

Date: July 2016 Location: CC-64 Karkardooma- Maujpur (Elevated)

Item	**Unit**	**Measured Value (L_{eq})**	**Measured Value (L_{Max})**	**Country's Standards (Environmental Management Manual by DMRC)**	**Occupancy**	**Remarks (Measure-ment Point, Frequency, Method, etc.)**
Noise level (Leq) and Lmax	dB(A)	**Karkardooma** Leq (d)-64.9 Leq (n)- 51.21 Lmin- 41.7 **Maujpur** Leq (d)-67.2 Leq (n)- 48.38 Lmin- 39.1 **Sabapur** Leq (d)- 53.5 Leq (n)- 44.4 Lmin- 39.2	73.4 75.1 58.4	National Standards Area Leq(d) Leq(n) Resi 55 45 Comm 65 55 Indstl 75 70 Silence 50 40 DMRC Env Manual (when pre construction levels are not known) Resi Lmax Daytime: 75 Nighttime: 65 Comm & and Indstl At all time: 85	Commercial / residence	30locations 24hours/time Once/week During entire civil constructio n stage or even later, if directed by DMRC
Vibration level	RMS (mm/s)			Structures in good	-	10locations 24hours/tim

				condition:25 in fair condition:12 in poor condition:5 Water supply Structures:5 Heritage structure/ Bridge structures:5		e Once/week During entire civil constructio n stage or even later, if directed by DMRC

Excavated soil (Leaching test)

Date: July 2016 Location: Kalkajji CC-23

Item	Unit	Measure d Value (Mean)	Measure d Value (Max.)	Country's Standards	Referred Internation al Standards	Remarks (Measuremen t Point, Frequency, Method, etc.)
Mercury(as Hg)	mg/l		<0.001	-	0.0005	In each Underground Construction Contract Once/6month s During entire civil construction stage Samples should be taken from the underground lowest point.
Cadmium(as Cd)	mg/l		<0.005	-	0.01	
Arsenic(as As)	mg/l		<0.01	-	0.01	
Cyanide(as CN)	mg/l		<0.05	-	Not detected	
Lead(as Pb)	mg/l		<0.01	-	0.01	
Chromium(as $Cr6^{+}$)	mg/l		<0.05	-	0.05	

Date: July 2016 Location: Nehru Enclave CC-23

Item	Unit	Measure d Value (Mean)	Measure d Value (Max.)	Country's Standards	Referred Internation al Standards	Remarks (Measuremen t Point, Frequency, Method, etc.)
Mercury(as Hg)	mg/l		<0.001	-	0.0005	In each Underground Construction Contract Once/6month s During entire civil construction stage Samples should be taken from the underground
Cadmium(as Cd)	mg/l		<0.005	-	0.01	
Arsenic(as As)	mg/l		<0.01	-	0.01	
Cyanide(as CN)	mg/l		<0.05	-	Not detected	
Lead(as Pb)	mg/l		<0.01	-	0.01	
Chromium(as $Cr6^{+}$)	mg/l		<0.05	-	0.05	

						lowest point.

Excavated soil (Amount)

Line	Excavated Amou Approx.('000 m^3)	Name of Disposed Site	Disposed Amount Approx.('000 m3)
Line-2	15368	Used for backfilling at Site	Nil
Line-6*	—	———	—
Line-7*	14317.2	Used at Azadpur, Badli etc.	7818
Line-8*	—	—	—

Ecological Monitoring (Flora Monitoring)

CPM	Permission to fell trees	No. of trees actually felled	No of trees planted	No of trees transplanted	Location of plantation
CPM-1	Nil	Nil	Nil	Nil	
CPM-2*	—	—	—	—	
CPM-3*	—	—	—	—	
CPM-4*	—	—	—	—	
CPM-5*	—	—	—	—	
CPM-6*	—	—	—	—	
CPM-7*	—	—	—	—	
CPM-8*	—	—	—	—	
CPM-9*	—	—	—	—	
CPM-10	Nil	Nil	Nil	Nil	

*Complete details not received.

2.2 During Operation

When a measured value exceeds the standards, the value is written in bold letters.

Air Quality (Ambient Air Quality)

Date Location:

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
PM_{10}	$\mu g/m^3$			100 (24hours) (CPCB)	IS 5182 (Part 23)	48hours/time Once/month For 3 years

Effluent at Depot

Date: Location:

Item	Unit	Measured Value (Mean)		Measured Value (Max.)	Country's Standards	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
		Inlet	Outlet				
pH	-			-	5.5-9.0	-	(Depot) Once/4months For 3 years
TSS	mg/l			-	100	-	
BOD	mg/l			-	30	-	
COD	mg/l			-	250	-	
Oil/Grease	mg/l			-	10	-	

Ground Water Quality (Drinking Water Quality: IS 10500:1991)

Date: Location:

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
Color,Hazen units,Max	-		-	5(25)	-	(Depot) Once/year For 3years
Odour	-		-	Unobjectionable	-	
Taste	-		-	Agreeable	-	
Turbidity,NTU,Max	-		-	5(10)	-	
pH Value	-		-	6.5-8.5	-	
Total Hardness (as $CaCO_3$), Max	mg/l		-	300(600)	-	
Iron(as Fe) ,max	mg/l		-	0.3(1.0)	-	
Chloride(as Cl), Max	mg/l		-	250(1000)	-	
Residual free Chlorine, Min	mg/l		-	0.2	-	
Fluoride(as F),	mg/l		-	1.0(1.5)	-	

Max						
Dissolved solids, Max	mg/l		-	500(2000)	-	
Calcium(as Ca), Max	mg/l		-	75(200)	-	
Magnesium(as Mg), Max	mg/l		-	30(100)	-	
Copper(as Cu), Max	mg/l		-	0.05(1.5)	-	
Manganese(as Mn), Max	mg/l		-	0.1(0.3)	-	
Sulphate(as SO_4), Max	mg/l		-	200(400)	-	
Nitrate(as NO_2), Max	mg/l		-	45(100)	-	
Phenolic compounds (as C_6H_5OH),Max	mg/l		-	0.001(0.002)	-	
Mercury(as Hg), Max	mg/l		-	0.001	-	
Cadmium(as Cd), Max	mg/l		-	0.01	-	
Selenium(as Se), Max	mg/l		-	0.01	-	
Arsenic(as As), Max	mg/l		-	0.05	-	
Cyanide(as CN), Max	mg/l		-	0.05	-	
Lead(as Pb), Max	mg/l		-	0.05	-	
Zinc(as Zn), Max	mg/l		-	5(15)	-	
Anionic Detergents (as MBAS),Max	mg/l		-	0.2(1.0)	-	
Chromium (as $Cr6^+$),Max	mg/l		-	0.05	-	
Polynuclear aromatic hydrocarbons(as PAH),Max	mg/l		-	-	-	
Mineral Oil	mg/l		-	0.01	-	
Pesticides, Max	mg/l		-	Absent	-	
Radioactive Materials, Max i) Alpha emitters	Bq/l		-	-(0.1)	-	
Radioactive Materials, Max j) Beta	Pci/l		-	-	-	

emitters						
Alkalinity, Max	mg/l		-	200(600)	-	
Aluminum(as Al), Max	mg/l		-	0.03(0.2)	-	
Boron,Max	mg/l		-	1(5)	-	
TSS	mg/l		-	600	-	
BOD	mg/l		-	350	-	
COD	mg/l		-	-	-	
Oil/Grease	mg/l		-	20	-	

Noise / Vibration

Date: Location:

Item	Unit	Measured RMS Value (Mean)	Measured RMS Value (Max.)	Country's Standards Max. PPV mm/s	Referred International Standards	Remarks (Measure-ment Point, Frequency, Method, etc.)
Vibration level	mm/s			Structures in:- Good condition = 25 Fair condition = 12 Poor condition = 5 Water supply structures = 5 Heritage structures = 5	Federal Transmission Administration (FTA), US	As and when complaint arises at the ground floor of building above the tunnel.

Ecological Monitoring (Bird Strike near Okhla Bird Sanctuary)

Date: Location:

Duration: From / / to / /

Item	Number of Interviews with Train Operators who reported the accident during monitoring period	Number of Accidents Reported during the monitoring period	Name of Species lost in the accident	Remarks (Place of accident, frequency, Method, etc.)
Train Accidents involving bird				4times/year For 2years Visual

fatality				observation (If no bird hit is reported in this duration, then this monitoring may be discontinued, else it will continue). From the beginning, DMRC will instruct its train operator to compulsorily blow the horn while on the bridge across the Yamuna.