# 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	July 2014 – September 2014
Guidance from Government Authorities	

#### 2. Mitigation Measures

The summary of the Environmental Monitoring is shown below.

#### [Construction Phase]

ltem	Parameter	Frequency and Duration	Locations( At least)
Air	PM <sub>10</sub>	2x24hours 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	All the trees felled and newly planted trees

			planted	
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ltem	Parameter	Frequency and Duration	Locations
Air	PM <sub>10</sub>	2x24hours Once/month	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: August 2014

Location: CC-27(Hauz Khas- Vasant vihar) (UG)

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country 's Standar ds	Referred Internation al Standards	Remarks (Measurement Point, Frequency, Method, etc.)
PM <sub>10</sub>	µg/m³	Hauz Khas-164.5 IIT – 157.5 Munirika – 166.5 Vasant Vihar - 163	167 163 172 168	100 (24hours) (CPCB)	-	2x24hours Twice/month During entire civil construction stage or even later, if directed by DMRC

Date: August 2014

Location: CC-28(Shakurpur- Mayapuri) (Elevated)

ltem	Unit	Measured Value (Mean)	Measured Value (Max.)	Country 's Standar ds	Referred Internation al Standards	Remarks (Measurement Point, Frequency, Method, etc.)
PM <sub>10</sub>	µg/m³	Shivaji park-159.25 Shakurpur- 170.7 PunjabiBagh -166.5 Mayapuri – 174.45 Rajouri station– 170.5	160.3 174.2 169.6 176.2 172.7	100 (24hours) (CPCB)	-	2x24hours Twice/month During entire civil construction stage or even later, if directed by DMRC

Date: August 2014

Location: CC-32(Dwarka-IGD) (UG)

ltem	Unit	Measured Value (Mean)	Measured Value (Max.)	Country 's Standar ds	Referred Internation al Standards	Remarks (Measurement Point, Frequency, Method, etc.)
PM <sub>10</sub>	µg/m³	Dwarka -160 Palam Station – 169 IGD - 174	168 172 178	100 (24hours) (CPCB)	_	2x24hours Twice/month During entire civil construction stage or even later, if directed by DMRC

Date: July 2014

## Location: CC-50Dwarka (Elevated)

ltem	Unit	Measured Value (Mean)	Measured Value (Max.)	Country 's Standar ds	Referred Internation al Standards	Remarks (Measurement Point, Frequency, Method, etc.)
PM <sub>10</sub>	µg/m³	Dwarka- 143	149	100 (24hours) (CPCB)	-	2x24hours Twice/month During entire civil construction stage or even later, if directed by DMRC

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

Date: June 2014

Location: Dwarka (Elevated)

ltem	Unit	Measure d Value (Mean)	Measured Value (Max.)	Country's Standards	Referred Internation al Standards	Remarks (Measurem ent Point, Frequency, Method, etc.)
Color,Hazen units,Max			Colourless	5(25)	-	20 locations Once/6
Odour	-		Unobjection able	Unobjectiona ble	-	months
Taste	-		Agreeable	Agreeable	-	During
Turbidity,NTU, Max	-		2.51	5(10)	-	entire civil construction
pH Value	-		7.81	6.5-8.5	-	stage or
Total Hardness (as CaCO <sub>3</sub> ), Max	mg/l		253.6	300(600)	-	even later, if directed by DMRC
Iron(as Fe) ,max	mg/l		0.05	0.3(1.0)	-	
Chloride(as Cl), Max	mg/l		87.4	250(1000)	-	
Residual free Chlorine, Min	mg/l		0.16	0.2	-	
Fluoride(as F), Max	mg/l		1.37	1.0(1.5)	-	
Dissolved solids, Max	mg/l		1149	500(2000)	-	

Calcium(as Ca), Max	mg/l		75(200)	-	
Magnesium(as Mg), Max	mg/l	BDL	30(100)	-	
Copper(as Cu), Max	mg/l	BDL	0.05(1.5)	-	
Manganese(as Mn), Max	mg/l	BDL	0.1(0.3)	-	
Sulphate(as SO <sub>4</sub> ), Max	mg/l	51.6	200(400)	-	
Nitrate(as NO <sub>2</sub> ), Max	mg/l	7.24	45(100)	-	
Phenolic compounds (as C <sub>6</sub> H₅OH),Max	mg/l	BDL	0.001(0.002)	-	
Mercury(as Hg), Max	mg/l	BDL	0.001	-	
Cadmium(as Cd), Max	mg/l	BDL	0.01	-	
Selenium(as Se), Max	mg/l	BDL	0.01	-	
Arsenic( as As), Max	mg/l	BDL	0.05	-	
Cyanide(as CN), Max	mg/l	BDL	0.05	-	
Lead(as Pb), Max	mg/l	BDL	0.05	-	
Zinc(as Zn), Max	mg/l	0.54	5(15)	-	
Anionic Detergents (as MBAS),Max	mg/l	BDL	0.2(1.0)	-	
Chromium (as Cr6⁺),Max	mg/l	BDL	0.05	-	
Polynuclear aromatic hydrocarbons( as PAH),Max	mg/l	BDL	-	-	
Mineral Oil	mg/l	BDL	0.01	-	
Pesticides, Max	mg/l		Absent	-	
Radioactive Materials, Max	Bq/l		-(0.1)	-	

a) Alpha emitters				
Radioactive Materials, Max b) Beta emitters	Pci/l		-(1)	-
Alkalinity, Max	mg/l	91.8	200(600)	-
Aluminum(as Al), Max	mg/l	BDL	0.03(0.2)	-
Boron,Max	mg/l	BDL	1(5)	-

Date: July 2014

Location: Hauzkhas (UG)

Item	Unit	Measure d Value (Mean)	Measured Value (Max.)	Country's Standards	Referred Internation al Standards	Remarks (Measurem ent Point, Frequency, Method, etc.)
Color,Hazen units,Max			<5	5(25)	-	20 locations Once/6
Odour	-		Unobjection able	Unobjection able	-	months
Taste	-		Agreeable	Agreeable	-	During
Turbidity,NTU, Max	-		<1	5(10)	-	entire civil construction
pH Value	-		7.54	6.5-8.5	-	stage or
Total Hardness (as CaCO <sub>3</sub> ), Max	mg/l		232	300(600)	-	even later, if directed by DMRC
Iron(as Fe) ,max	mg/l		0.02	0.3(1.0)	-	
Chloride(as Cl), Max	mg/l		36.12	250(1000)	-	
Residual free Chlorine, Min	mg/l		Nil	0.2	-	
Fluoride(as F), Max	mg/l		0.44	1.0(1.5)	-	
Dissolved solids, Max	mg/l		402	500(2000)	-	
Calcium(as Ca), Max	mg/l		52.90	75(200)	-	
Magnesium(as Mg), Max	mg/l		24.3	30(100)	-	
Copper(as Cu), Max	mg/l		<0.01	0.05(1.5)	-	
Manganese(as Mn), Max	mg/l		<0.01	0.1(0.3)	-	

Sulphate(as SO <sub>4</sub> ), Max	mg/l	75.04	200(400)	-	
Nitrate(as NO <sub>2</sub> ), Max	mg/l	0.18	45(100)	-	
Phenolic compounds (as C <sub>6</sub> H₅OH),Max	mg/l	<0.001	0.001(0.002)	-	
Mercury(as Hg), Max	mg/l	<0.001	0.001	-	
Cadmium(as Cd), Max	mg/l	<0.01	0.01	-	
Selenium(as Se), Max	mg/l	<0.01	0.01	-	
Arsenic( as As), Max	mg/l	<0.01	0.05	-	
Cyanide(as CN), Max	mg/l	<0.005	0.05	-	
Lead(as Pb), Max	mg/l	<0.01	0.05	-	
Zinc(as Zn), Max	mg/l	<0.01	5(15)	-	
Anionic Detergents (as MBAS),Max	mg/l	<0.01	0.2(1.0)	-	
Chromium (as Cr6⁺),Max	mg/l	<0.01	0.05	-	
Polynuclear aromatic hydrocarbons( as PAH),Max	mg/l	NDL	-	-	
Mineral Oil	mg/l	< 0.01	0.01	-	
Pesticides, Max	mg/l		Absent	-	
Radioactive Materials, Max c) Alpha emitters	Bq/l	ND	-(0.1)	-	
Radioactive Materials, Max d) Beta emitters	Pci/I	ND	-(1)	-	
Alkalinity, Max	mg/l	244.86	200(600)	-	
Aluminum(as Al), Max	mg/l	<0.01	0.03(0.2)	-	
Boron,Max	mg/l	<0.01	1(5)	-	

Date: June 2014

# Location: Dwarka Sector-20 (UG)

ltem	Unit	Measure d Value (Mean)	Measured Value (Max.)	Country's Standards	Referred Internation al Standards	Remarks (Measurem ent Point, Frequency, Method, etc.)
Color,Hazen units Max			<5	5(25)	-	20 locations
Odour	-		Unobjection able	Unobjection able	-	months
Taste	-		Agreeable	Agreeable	-	During
Turbidity,NTU, Max	-		12	5(10)	-	entire civil construction
pH Value	-		7.32	6.5-8.5	-	stage or
Total Hardness (as CaCO <sub>3</sub> ), Max	mg/l		2760	300(600)	-	even later, if directed by DMRC
Iron(as Fe) ,max	mg/l		1.18	0.3(1.0)	-	
Chloride(as Cl), Max	mg/l		2340.87	250(1000)	-	
Residual free Chlorine, Min	mg/l		NIL	0.2	-	
Fluoride(as F), Max	mg/l		0.28	1.0(1.5)	-	
Dissolved solids, Max	mg/l		5074	500(2000)	-	
Calcium(as Ca), Max	mg/l		641.28	75(200)	-	
Magnesium(as Mg), Max	mg/l		281.88	30(100)	-	
Copper(as Cu), Max	mg/l		<0.01	0.05(1.5)	-	-
Manganese(as Mn), Max	mg/l		<0.01	0.1(0.3)	-	
Sulphate(as SO <sub>4</sub> ), Max	mg/l		26.28	200(400)	-	
Nitrate(as NO <sub>2</sub> ), Max	mg/l		4.88	45(100)	-	
Phenolic compounds (as C <sub>6</sub> H₅OH),Max	mg/l		<.001	0.001(0.002)	-	
Mercury(as	mg/l			0.001	-	

Hg), Max		<0.001			
Cadmium(as Cd), Max	mg/l	<0.01	0.01	-	
Selenium(as Se), Max	mg/l	<0.01	0.01	-	
Arsenic( as As), Max	mg/l	<0.01	0.05	-	
Cyanide(as CN), Max	mg/l	<0.005	0.05	-	
Lead(as Pb), Max	mg/l	<0.01	0.05	-	
Zinc(as Zn), Max	mg/l	<0.01	5(15)	-	
Anionic Detergents (as MBAS),Max	mg/l		0.2(1.0)	-	
Chromium (as Cr6⁺),Max	mg/l	<0.01	0.05	-	
Polynuclear aromatic hydrocarbons( as PAH),Max	mg/l		-	-	
Mineral Oil	mg/l	<0.01	0.01	-	
Pesticides, Max	mg/l		Absent	-	
Radioactive Materials, Max e) Alpha emitters	Bq/l		-(0.1)	-	
Radioactive Materials, Max f) Beta emitters	Pci/l		-(1)	-	
Alkalinity, Max	mg/l	252.42	200(600)	-	
Aluminum(as Al), Max	mg/l	<0.01	0.03(0.2)	-	
Boron,Max	mg/l	<.01	1(5)	-	

Date: June 2014

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Location: ESI (Elevated)

ltem	Unit	Measure d Value (Mean)	Measured Value (Max.)	Country's Standards	Referred Internation al Standards	Remarks (Measurem ent Point, Frequency, Method, etc.)
Color,Hazen units Max			<5	5(25)	-	20 locations

Odour	-	Unobjection	Unobjection	-	months
Tasta		 able	able		
	-	Saline	Agreeable	-	During
Turbiality, INTU,	-	<2	5(10)	-	construction
	_	6.01	65-85		stage or
Total Hardnoss	-	0.91	0.0-0.0	-	even later if
	ma/l	1040	300(600)	_	directed by
Max $Oacos),$	iiig/i	1040	300(000)		DMRC
Iron(as		0.36			
Fe) .max	mg/l	0.00	0.3(1.0)	-	
Chloride(as					
CI).	ma/l	719.8	250(1000)	-	
Max	5		(/		
Residual free		0.2	0.0		
Chlorine, Min	mg/i		0.2	-	
Fluoride(as F),		0.98	1 O(1 E)		
Max	mg/i		1.0(1.5)	-	
Dissolved					
solids,	mg/l	1904	500(2000)	-	
Max					
Calcium(as	ma/l		75(200)	_	
Ca),	mg/i	262.9	73(200)	-	
Max					
Magnesium(as	ma/l	93.3	30(100)	-	
Mg), Max	iiig/i		50(100)	_	
Copper(as Cu),	ma/l		0.05(1.5)	-	
Max		 0.024	0100(110)		
Manganese(as	/1				
Mn),	mg/l	93.3	0.1(0.3)	-	
Max Culabata (ac					
Sulphate(as		070.0	200(400)		
$50_4$ ),	mg/i	270.2	200(400)	-	
Nitroto/oo					
	ma/l	35.0	45(100)	_	
$MO_2$ ,	mg/i	55.9	45(100)	-	
Phonolic		< 001			
compounds		<.001			
(as	mg/l		0.001(0.002)	-	
(as C <sub>2</sub> H <sub>2</sub> OH) Max					
Mercury(as					
Ha)	ma/l	<0.001	0.001	-	
Max	iiig/i	<0.001	0.001		
Cadmium(as					
Cd).	ma/l	< 0.01	0.01	-	
Max					
Selenium(as					
Se),	ma/l	<0.01	0.01	-	
Max	0.1				
Arsenic( as					
As),	mg/l	<0.01	0.05	-	
Max					
Cyanide(as	mg/l		0.05	-	

CN), Max		<0.05			
Lead(as Pb), Max	mg/l	0.012	0.05	-	
Zinc(as Zn), Max	mg/l	0.81	5(15)	-	
Anionic Detergents (as MBAS),Max	mg/l	<0.05	0.2(1.0)	-	
Chromium (as Cr6⁺),Max	mg/l	0.05	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	328	200(600)	-	
Aluminum(as Al), Max	mg/l	<0.01	0.03(0.2)	-	
Boron,Max	mg/l	<.25	1(5)	-	

### Noise / Vibration

Date: August 2014

# Location: CC-32 (Dwarka to IGD) (UG)

ltem	Unit	Measured Value (L <sub>eq</sub> )	Meas ured Value (L <sub>Max</sub> )	Country's Standards (Environmental Management Manual by DMRC)	Occupancy	Remarks (Measure - ment Point, Frequen cy, Method, etc.)
Noise level (Leq) and Lmax	dB(A)	Dwarka Sector - 20 Leq(Day)-67.2 Leq(night)– 53.9 Lmin- 40.8	77.5	National StandardsAreaLeq(d)Leq(n)	Residentia I	30locatio ns 24hours/ti me Once/we ek

Palam Station Leq(Day)-64.9 Leq(night)– 59.2 Lmin- 44.2	77.8	Indstl 70 Silence 40	75 50	Commerci al/Residen tial*	During entire civil constructi on stage
IGD Mehramnagar Leq(Day)-65.8 Leq(night)– 58.4 Lmin- 39.7	77.9	DMRC Env M (when construction are not known Resi Lmax Daytime: 75 Nighttime: 65 Comm & and At all 85	lanual pre levels า) Indstl time:	Commerci al (Near to Airport)	or even later, if directed by DMRC

Date: August 2014

Location: CC-28 (Shakurpur- mayapuri) (Elevated)

ltem	Unit	Measured Value (L <sub>eq</sub> )	Meas ured Value (L <sub>Max</sub> )	Country's Standards (Environmental Management Manual by DMRC)	Occupancy	Remarks (Measure- ment Point, Frequenc y, Method, etc.)
Noise				National Standards		30location
level		Mayapuri		<u>Area</u> <u>Leq(d)</u>	Commerci	S
(Leq)	dB(A)	Leq – 67.6	67.6	Leq(n)	al/	24hours/ti
and		L90 -60.8		Resi 55	residential	me
Lmax		L50 – 65.3		45	*	Once/wee
		L10 – 69.2		Comm 65		k
		Lmin- 50.2		55		During
		Delevel Conden		Indsti 75		During
		Rajouri Garden		70 Silanaa 50	Commorei	entire civil
		Leq – 61.6		Silence 50		
			77.6	40	ai/	n slage of
		1.10 - 65.8	11.0	DMRC Env Manual	*	if directed
		L min- 38 1		(when nre		hy DMRC
				construction levels		
		Puniabi Baqh		are not known)		
		Leg – 59.3		Resi		
		L90 -50.6	69.9	Lmax		
		L50 – 57.2		Daytime:	Commerci	
		L10 – 63.6		75	al /	
		Lmin- 41.0		Nighttime:	residential	
				65	*	
		Shakurpur		Comm & and Indstl		
		Leq – 65.8		At all time:	Commerci	
		L90 -59.8	77.2	85	al /	

L50 – 64.1 L10 – 67.3 Lmin- 46.0		residential *	
ESI station Leq – 55.8 L90 -44.8 L50 – 54.2 L10 – 60.4 Lmin- 36.1	70.3	Commerci al / residential *	

Date: August, 2014

Location: CC-27(Hauz khas- Vasant vihar)(UG)

ltem	Unit	Measured Value (L <sub>eq</sub> )	Meas ured Value (L <sub>Max</sub> )	Country's Standards (Environmental Management Manual by DMRC)	Occupancy	Remarks (Measure- ment Point, Frequenc y, Method, etc.)
Noise level (Leq) and Lmax	dB(A)	Hauz Khas L50 - 71.27 L90 - 68.81 L10- 73.23 Leq- 71.27 IIT L50 - 71.69 L90 - 69.21 L10 - 73.63 Leq -71.69 Munirika L50 - 71.54 L90 - 69.05 L10- 73.48 Leq -71.54 Vasant Vihar L50 - 71.64 L90 - 69.18 L10- 73.6 Leq- 71.64	74.12 74.18 74.07 74.19	National StandardsAreaLeq(d)Leq(n)FesiResi5545CommComm6555Indstl70SilenceSilence5040DMRCDMRCEnvManual (whenpre construction levels are not known)ResiLmaxDaytime:75Nighttime:	Residential Residential Commercia I/Residentia I*	30location s 24hours/ti me Once/wee k During entire civil constructi on stage or even later, if directed by DMRC
				65 Comm & and Indstl At all time: 85		

Date:August 2014

# Location: CC-50 (Elevated)

ltem	Unit	Measured Value (L <sub>eq</sub> )	Meas ured Value (L <sub>Max</sub> )	Country's Standards (Environmental Management Manual by DMRC)	Occupancy	Remarks (Measure- ment Point, Frequency, Method, etc.)
Noise level (Leq) and Lmax	dB(A)	Dwarka Leq-69.4 L10- 70.8 L90- 62.3	81.3	National StandardsAreaLeq(d)Leq(n)Resi5545Comm6555Indstl7570Silence5040DMRC Env Manual(whenpreconstructionlevelsare not known)ResiLmaxDaytime:75Nighttime:65Comm & and IndstlAtalltime:85	Residential	30locations 24hours/tim e Once/week During entire civil constructio n stage or even later, if directed by DMRC

\* Commercial/Residential indicates exposed building along the viaduct is used for commercial purpose however subsequent rows of buildings are residential.

#### Excavated soil (Leaching test)

Date: June 2014

Location: Hauz khas

ltem	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		≤0.01	-	0.0005	In each Underground
Cadmium(as Cd)	mg/l		≤0.01	-	0.01	Construction Contract
Arsenic( as As)	mg/l		≤0.1	-	0.01	Once/6month s

Cyanide(as CN)	mg/l	ND	-	Not detected	During entire civil
Lead(as Pb)	mg/l	18.15	-	0.01	construction stage
Chromium(as Cr6⁺)	mg/l	≤0.01	-	0.05	Samples should be taken from the underground lowest point

Date:August 2014

Location:BCP

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
Cadmium(as Cd)	mg/l		≤0.005	-	0.01	Construction Contract
Arsenic( as As)	mg/l		≤0.01	-	0.01	Once/6month s
Cyanide(as CN)	mg/l		≤0.05	-	Not detected	During entire
Lead(as Pb)	mg/l		≤0.01	-	0.01	stage
Chromium(as Cr6⁺)	mg/l		≤0.05	-	0.05	samples should be taken from the underground lowest point.

## Excavated soil (Amount)

Date:

Line	Excavated Amou Approx.('000 m <sup>3</sup> )	Name of Disposed Site	Disposed Amount Approx.('000 m3)
Line-2			-
Line-6			-
Line-7			-
Line-8			-

# **Ecological Monitoring (Flora Monitoring)**

CPM	Permissio	No. of	No of	No of	Location of plantation
	n to fell trees	trees actually	trees planted	trees transpla	
		felled	-	nted	

CPM-1			
CPM-2			
CPM-3			
CPM-4			
CPM-5			
CPM-6			
CPM-7			
CPM-8			
CPM-9			