

# MONITORING FORM

Attachment

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 2015 – September 2015

## 2. Mitigation Measures

The summary of the Environmental Monitoring is shown below.

### [Construction Phase]

Item	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/6months 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 <sub>10</sub>	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

## Air Quality (Ambient Air Quality)

Date: July 2015

Location: CC-63 (Badli) (Elevated)

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
PM <sub>10</sub>	µg/m <sup>3</sup>	Badli -165.5	169.73	100 (24hours) (CPCB)	-	2×24hours Twice/month During entire civil construction stage or even later, if directed by DMRC

Date: July 2015

Location: CC-47 (MIA-Tikri Border) (Elevated)

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
PM <sub>10</sub>	µg/m <sup>3</sup>	Mundka-177 MIA-145.5 Ghevra-181 Tikri Kalan-157.5 Tikri Border-161	181 166 193 158 167	100 (24hours) (CPCB)	-	2×24hours Twice/month During entire civil construction stage or even later, if directed by DMRC

Date: July 2015

Location: CC-04(Azadpur-Mukundpur) (Underground)

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
PM <sub>10</sub>	µg/m <sup>3</sup>	Azadpur- 165.96 Mukundpur- 169.07 Mundka CY – 164.76	171.29 173.87 169.56	100 (24hours) (CPCB)	-	2×24hours Twice/month During entire civil construction stage or even later, if directed by DMRC

Date: July 2015

Location: CC-32 (IGD-Dwarka Sec. 20) (Elevated)

Attachment 2

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
PM <sub>10</sub>	µg/m <sup>3</sup>	IGD- 168.5 Palam- 159 Dwarka Sec. 20- 165	173 165 170	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: September 2015

Location: Dwarka CC-29 (Elevated)

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
Odour	-		Unobjectionable	Unobjectionable	-	
Taste	-		Agreeable	Agreeable	-	
Turbidity, NTU, Max			2	5(10)	-	During entire civil construction stage or even later, if directed by DMRC
pH Value			7.6	6.5-8.5	-	
Total Hardness (as CaCO <sub>3</sub> ), Max	mg/l		120	300(600)	-	
Iron (as Fe), max	mg/l		0.02	0.3(1.0)	-	
Chloride (as Cl), Max	mg/l		168	250(1000)	-	
Residual free Chlorine, Min	mg/l		Nil	0.2	-	
Fluoride (as F), Max	mg/l		0.5	1.0(1.5)	-	
Dissolved solids, Max	mg/l		625	500(2000)	-	
Calcium (as Ca), Max	mg/l		22	75(200)	-	
Magnesium (as Mg), Max	mg/l		6	30(100)	-	
Copper (as Cu), Max	mg/l		0.004	0.05(1.5)	-	

Manganese(as Mn), Max	mg/l		0.03	0.1(0.3)	-
Sulphate(as SO <sub>4</sub> ), Max	mg/l		102	200(400)	-
Nitrate(as NO <sub>2</sub> ), Max	mg/l		3	45(100)	-
Phenolic compounds (as C <sub>6</sub> H <sub>5</sub> OH), Max	mg/l		Nil	0.001(0.002)	-
Mercury(as Hg), Max	mg/l		Nil	0.001	-
Cadmium(as Cd), Max	mg/l		Nil	0.01	-
Selenium(as Se), Max	mg/l		-	0.01	-
Arsenic( as As), Max	mg/l		Nil	0.05	-
Cyanide(as CN), Max	mg/l		-	0.05	-
Lead(as Pb), Max	mg/l		Nil	0.05	-
Zinc(as Zn), Max	mg/l		0.03	5(15)	-
Anionic Detergents (as MBAS), Max	mg/l		Nil	0.2(1.0)	-
Chromium (as Cr <sup>6+</sup> ), Max	mg/l		0.002	0.05	-
Polynuclear aromatic hydrocarbons( as PAH), Max	mg/l		-	-	-
Mineral Oil	mg/l		-	0.01	-
Pesticides, Max	mg/l		-	Absent	-
Radioactive Materials, Max a) Alpha emitters	Bq/l		-	-(0.1)	-
Radioactive Materials, Max b) Beta emitters	Pci/l		-	-(1) -	-
Alkalinity, Max	mg/l		142	200(600)	-
Aluminum(as Al), Max	mg/l		0.002	0.03(0.2)	-
Boron, Max	mg/l		0.03	1(5)	-

Date: September 2015

Location: Palam CC-32 (Underground)

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 months
Odour	-		Agreeable	Unobjection able	-	
Taste	-		Agreeable	Agreeable	-	During entire civil construction stage or even later, if directed by DMRC
Turbidity, NTU, Max	-		0.4	5(10)	-	
pH Value	-		8.0	6.5-8.5	-	
Total Hardness (as CaCO <sub>3</sub> ), Max	mg/l		396	300(600)	-	
Iron(as Fe), max	mg/l		0.09	0.3(1.0)	-	
Chloride(as Cl), Max	mg/l		610	250(1000)	-	
Residual free Chlorine, Min	mg/l		Nil	0.2	-	
Fluoride(as F), Max	mg/l		0.41	1.0(1.5)	-	
Dissolved solids, Max	mg/l		1470	500(2000)	-	
Calcium(as Ca), Max	mg/l		85	75(200)	-	
Magnesium(as Mg), Max	mg/l		44	30(100)	-	
Copper(as Cu), Max	mg/l		Absent	0.05(1.5)	-	
Manganese(as Mn), Max	mg/l		Absent	0.1(0.3)	-	
Sulphate(as SO <sub>4</sub> ), Max	mg/l		169	200(400)	-	
Nitrate(as NO <sub>2</sub> ), Max	mg/l		3.5	45(100)	-	
Phenolic compounds (as C <sub>6</sub> H <sub>5</sub> OH), Max	mg/l		Absent	0.001(0.002)	-	
Mercury(as Hg), Max	mg/l		Absent	0.001	-	
Cadmium(as Cd), Max	mg/l		Absent	0.01	-	

Selenium(as Se), Max	mg/l		Absent	0.01	-
Arsenic( as As), Max	mg/l		Absent	0.05	-
Cyanide(as CN), Max	mg/l		Absent	0.05	-
Lead(as Pb), Max	mg/l		Absent	0.05	-
Zinc(as Zn), Max	mg/l		Absent	5(15)	-
Anionic Detergents (as MBAS), Max	mg/l		Absent	0.2(1.0)	-
Chromium (as Cr <sup>6+</sup> ), Max	mg/l		Absent	0.05	-
Polynuclear aromatic hydrocarbons( as PAH), Max	mg/l		Absent	-	-
Mineral Oil	mg/l		-	0.01	-
Pesticides, Max	mg/l		-	Absent	-
Radioactive Materials, Max c) Alpha emitters	Bq/l		-	-(0.1)	-
Radioactive Materials, Max d) Beta emitters	Pci/l		-	-(1)	-
Alkalinity, Max	mg/l		381	200(600)	-
Aluminum(as Al), Max	mg/l		Absent	0.03(0.2)	-
Boron, Max	mg/l		Absent	1(5)	-

Date: July 2015

Location: Mayapuri CC-20(Underground)

Item	Unit	Measure d Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
Color, Hazen units, Max			Colourless	5(25)	-	20 locations Once/6 months
Odour	-		Unobjectionable	Unobjectionable	-	
Taste	-		Caustic	Agreeable	-	During entire civil construction stage or even later, if directed by DMRC
Turbidity, NTU, Max	-		36	5(10)	-	
pH Value	-		7.92	6.5-8.5	-	
Total Hardness (as CaCO <sub>3</sub> ), Max	mg/l		839	300(600)	-	

Iron(as Fe), max	mg/l		0.48	0.3(1.0)	-
Chloride(as Cl), Max	mg/l		187	250(1000)	-
Residual free Chlorine, Min	mg/l		Nil	0.2	-
Fluoride(as F), Max	mg/l		3.87	1.0(1.5)	-
Dissolved solids, Max	mg/l		3427	500(2000)	-
Calcium(as Ca), Max	mg/l			75(200)	-
Magnesium(as Mg), Max	mg/l			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		469	200(400)	-
Nitrate(as NO <sub>2</sub> ), Max	mg/l		81	45(100)	-
Phenolic compounds (as C <sub>6</sub> H <sub>5</sub> OH), 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		1.64	5(15)	-
Anionic Detergents (as MBAS), Max	mg/l		BDL	0.2(1.0)	-
Chromium (as Cr <sup>6+</sup> ), Max	mg/l		BDL	0.05	-
Polynuclear aromatic	mg/l		BDL		-



hydrocarbons(as PAH), Max					
Mineral Oil	mg/l		BDL	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		359	200(600)	-
Aluminum(as Al), Max	mg/l		BDL	0.03(0.2)	-
Boron, Max	mg/l		BDL	1(5)	-

Date: July 2015

Location: Shiv Vihar CC-41 (Elevated)

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
Color, Hazen units, Max			<5.0	5(25)	-	20 locations Once/6 months  During entire civil construction stage or even later, if directed by DMRC
Odour	-		Agreeable	Unobjectionable	-	
Taste	-		Agreeable	Agreeable	-	
Turbidity, NTU, Max	-		<1.0	5(10)	-	
pH Value	-		7.14	6.5-8.5	-	
Total Hardness (as CaCO <sub>3</sub> ), Max	mg/l		1300	300(600)	-	
Iron(as Fe), max	mg/l		0.11	0.3(1.0)	-	
Chloride(as Cl), Max	mg/l		496	250(1000)	-	
Residual free Chlorine, Min	mg/l		Nil	0.2	-	
Fluoride(as F), Max	mg/l		0.08	1.0(1.5)	-	
Dissolved solids, Max	-mg/l		1300	500(2000)	-	
Calcium(as Ca), Max	mg/l		171	75(200)	-	
Magnesium(as Mg), Max	mg/l		37.5	30(100)	-	
Copper(as Cu), Max	mg/l		ND	0.05(1.5)	-	
Manganese(as Mn),	mg/l		0.08	0.1(0.3)	-	

Max					
Sulphate(as SO <sub>4</sub> ), Max	mg/l		132	200(400)	-
Nitrate(as NO <sub>2</sub> ), Max	mg/l		5.0	45(100)	-
Phenolic compounds (as C <sub>6</sub> H <sub>5</sub> OH), Max	mg/l		<0.001	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		0.06	5(15)	-
Anionic Detergents (as MBAS), Max	mg/l		ND	0.2(1.0)	-
Chromium (as Cr <sup>6+</sup> ), 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 g) Alpha emitters	Bq/l		-	-(0.1)	-
Radioactive Materials, Max h) Beta emitters	Pci/l		-	-(1)	-
Alkalinity, Max	mg/l		414	200(600)	-
Aluminum(as Al), Max	mg/l		ND	0.03(0.2)	-
Boron, Max	mg/l		ND	1(5)	-





Date: July 2015

Location: CC-47(MIA- Tikri Border) (Elevated)

Item	Unit	Measured Value (L <sub>eq</sub> )	Measured Value (L <sub>Max</sub> )	Country's Standards (Environmental Management Manual by DMRC)	Occupancy	Remarks (Measurement Point, Frequency, Method, etc.)
Noise level (Leq) and Lmax	dB(A)	<p>MIA Leq(Day) – 67.8 Leq(night)–62.7 Lmin - 51.8</p> <p>Ghevra Leq (day) – 75.8 Leq(Night)–70.3 Lmin – 50.2</p> <p>Tikri Kalan Leq(Day) – 75.3 Leq(Night)-65.4 Lmin – 56.9</p> <p>Casting Yard Leq (Day)- 78.4 Leq(Night)-68.0 Lmin – 51.5</p> <p>Tikri Border Leq(Day) – 75.9 Leq(Night)-72.8 Lmin – 59.0</p>	<p>86.0</p> <p>81.6</p> <p>81.8</p> <p>84.7</p> <p>82.2</p>	<p>National Standards Area Leq(d) Leq(n) Resi 55 45 Comm 65 55 Indstl 75 70 Silence 50 40</p> <p>DMRCEnv Manual (when pre construction levels are not known) Resi Lmax Daytime: 75 Nighttime: 65 Comm &amp; and Indstl At all time: 85</p>	Commercial / residence	<p>30locations 24hours/time Once/week</p> <p>During entire civil construction stage or even later, if directed by DMRC</p>
Vibration level	RMS (mm/s)			<p>Structures in good condition:25 in fair condition:12 in poor condition:5 Water supply Structures:5 Heritage structure/ Bridge structures:5</p>		<p>10locations 24hours/time Once/week</p> <p>During entire civil construction stage or even later, if directed by DMRC</p>

Date: July 2015

Location: CC-63 (Badli) (Elevated)

Item	Unit	Measured Value (L <sub>eq</sub> )	Measured Value (L <sub>Max</sub> )	Country's Standards (Environmental Management Manual by DMRC)	Occupancy	Remarks (Measurement Point, Frequency, Method, etc.)
Noise level (Leq) and L <sub>max</sub>	dB(A)	Badli Leq (Day)- 71.5 Leq(night)-49.09 Lmin- 40.7	75.8	<u>National Standards</u> Area <u>Leq(d)</u> Resi                              55 45 Comm                            65 55 Indstl                            75 70 Silence                           50 40  <u>DMRC Env Manual</u> (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 e Once/week  During entire civil construction stage or even later, if directed by DMRC
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 e Once/week  During entire civil construction stage or even later, if directed by DMRC

**Excavated soil (Leaching test)**

Date: September 2015

Location: IGD CC-32 (Underground)

Item	Unit	Measured Value (Mean)	Country's Standards	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
Mercury(as Hg)	mg/l	Absent	-	0.0005	In each Underground Construction Contract Once/6months During entire civil construction stage Samples should be taken from the underground lowest point.
Cadmium(as Cd)	mg/l	Absent	-	0.01	
Arsenic( as As)	mg/l	Absent	-	0.01	
Cyanide(as CN)	mg/l	Absent	-	Not detected	
Lead(as Pb)	mg/l	Absent	-	0.01	
Chromium(as Cr6 <sup>+</sup> )	mg/l	Absent	-	0.05	

Date: July 2015

Location: Narayana Vihar CC-20 (Underground)

Item	Unit	Measured Value (Mean)	Country's Standards	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
Mercury(as Hg)	mg/l	ND	-	0.0005	In each Underground Construction Contract Once/6months During entire civil construction stage Samples should be taken from the underground lowest point.
Cadmium(as Cd)	mg/l	ND	-	0.01	
Arsenic( as As)	mg/l	ND	-	0.01	
Cyanide(as CN)	mg/l	ND	-	Not detected	
Lead(as Pb)	mg/l	ND	-	0.01	
Chromium(as Cr6 <sup>+</sup> )	mg/l	ND	-	0.05	

**Excavated soil (Amount)**

Date:

Line	Excavated Amou Approx.('000 m <sup>3</sup> )	Name of Disposed Site	Disposed Amount Approx.('000 m3)
Line-2	Nil	-	Nil
Line-6	39206.98	Mukundpur, DDA Dhirpur	39206.98
Line-7	192326.4	Mukundpur, Vinod nagar, Ghaziabad.	187753.4

Line-8	80945.56	Dwarka Sector 25, RSS Dhaula Kuan, etc.	67777.56
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The data collection for soil excavation & tree cutting is under process and complete details will be provided in next report.

#### 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	126	0	0	0	
CPM-3	Available	3	0	0	-
CPM-4	3575	5	0	0	
CPM-5	Nil	Nil	Nil	Nil	
CPM-6	Nil	Nil	Nil	Nil	-
CPM-7	Nil	Nil	Nil	Nil	
CPM-8	Available	2	1100	0	Waqf Border land near ITO, Delhi gate
CPM-9	Nil	Nil	Nil	Nil	
CPM-10	513	98	0	7	