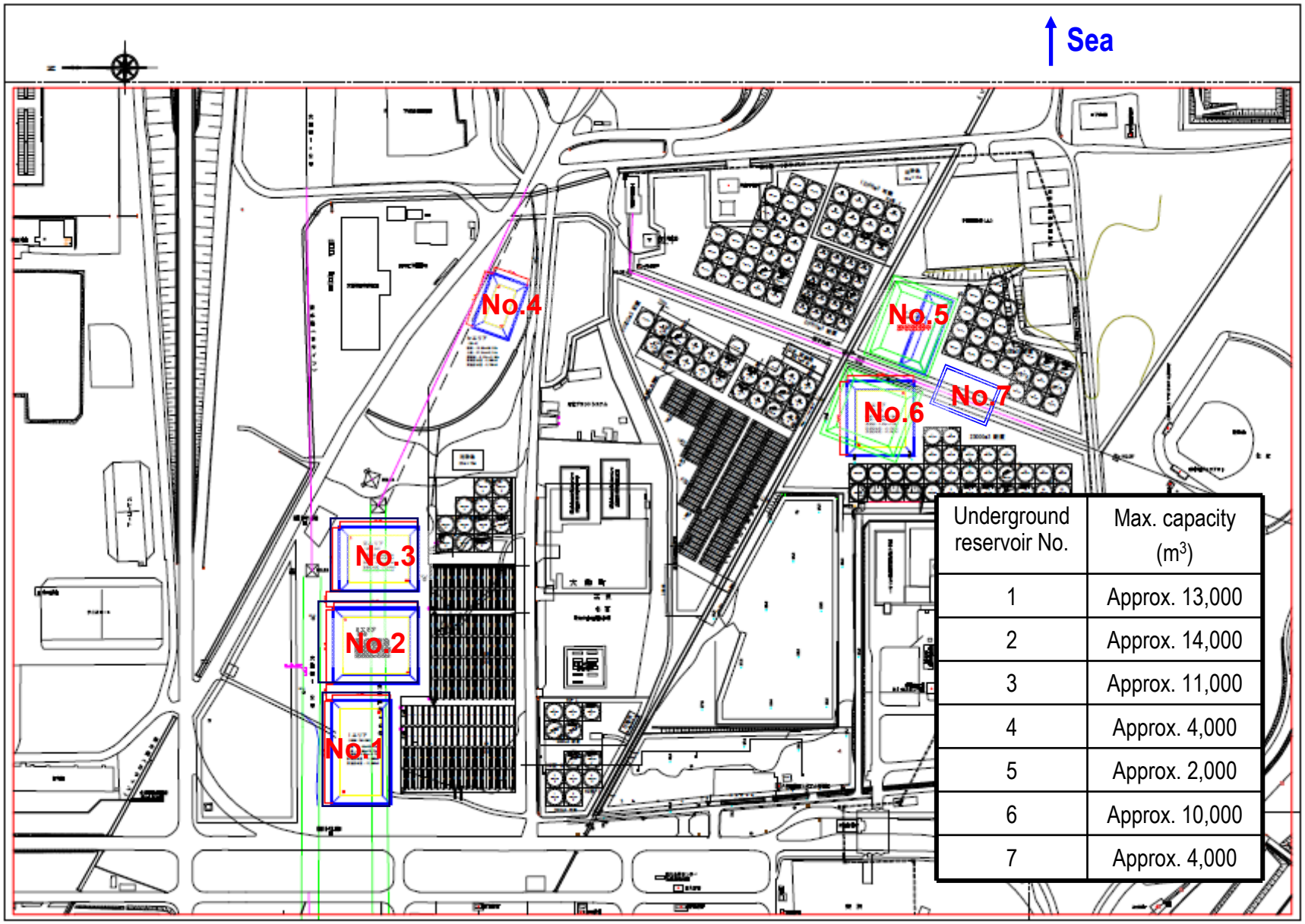
Countermeasures against the Uplift of the Underground Reservoirs

August 21, 2013

Tokyo Electric Power Company

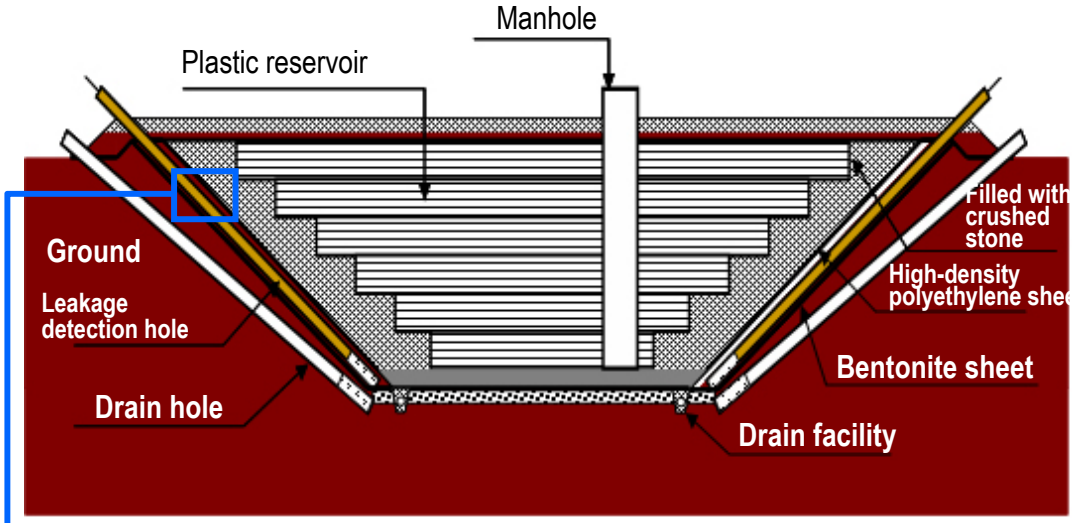
TEPCO 東京電力

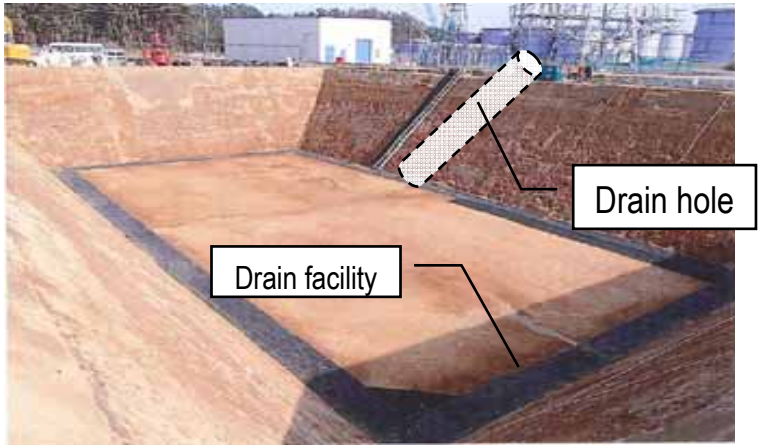
1-1 . Outline of the underground reservoirs

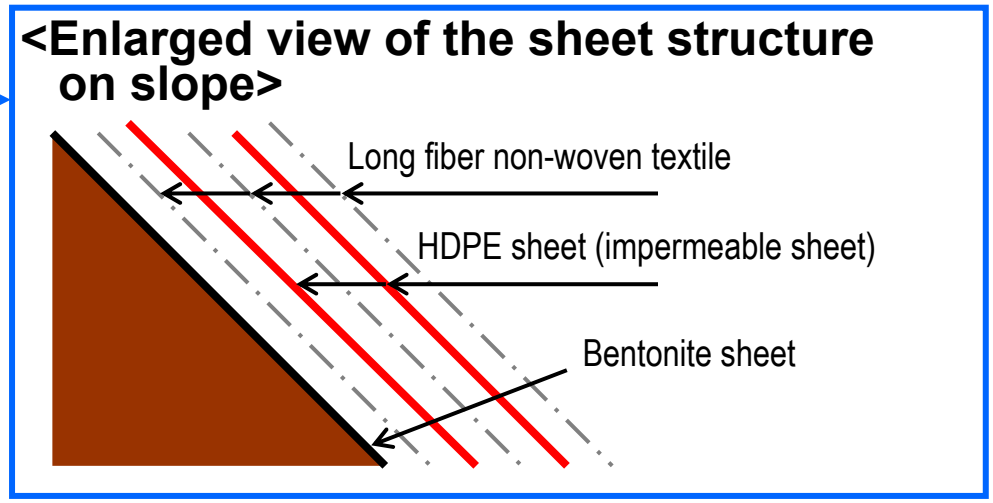


Underground reservoir No.	Max. capacity (m^3)
1	Approx. 13,000
2	Approx. 14,000
3	Approx. 11,000
4	Approx. 4,000
5	Approx. 2,000
6	Approx. 10,000
7	Approx. 4,000

1-2. Structure drawing of the underground reservoir







2-1. Chronological change of the uplift (Underground reservoir No.3)

- Uplift of max. approx. 40cm was detected on August 10 with the underground reservoir No.3.
- At present, no obvious progress is detected.

Unit: mm

	8/10	8/11		8/12		8/13	8/14	8/15	8/16	8/17	8/18	8/19	8/20	8/21
		1st	2nd	1st	2nd									
(1) Center	400	412	383	399	373	346	370	392	413	424	433	437	447	450
(2) N-E side	160	165	152	157	144	128	137	146	157	159	161	164	162	168
(3) N-W side	280	286	259	270	249	228	243	257	273	281	286	294	295	303
(4) S-W side	340	350	327	338	316	292	310	325	343	350	357	364	367	371
(5) S-E side	200	203	185	192	176	157	168	176	190	191	193	196	197	198

N: North, S: South, E: East, W: West

2-2. Chronological change of the uplift (Underground reservoir No.4)

- Uplift was detected on August 10 with the underground reservoir No.4 (approx. 15cm as of the measurement on August 11).
- At present, no obvious progress is not detected.

Unit: mm

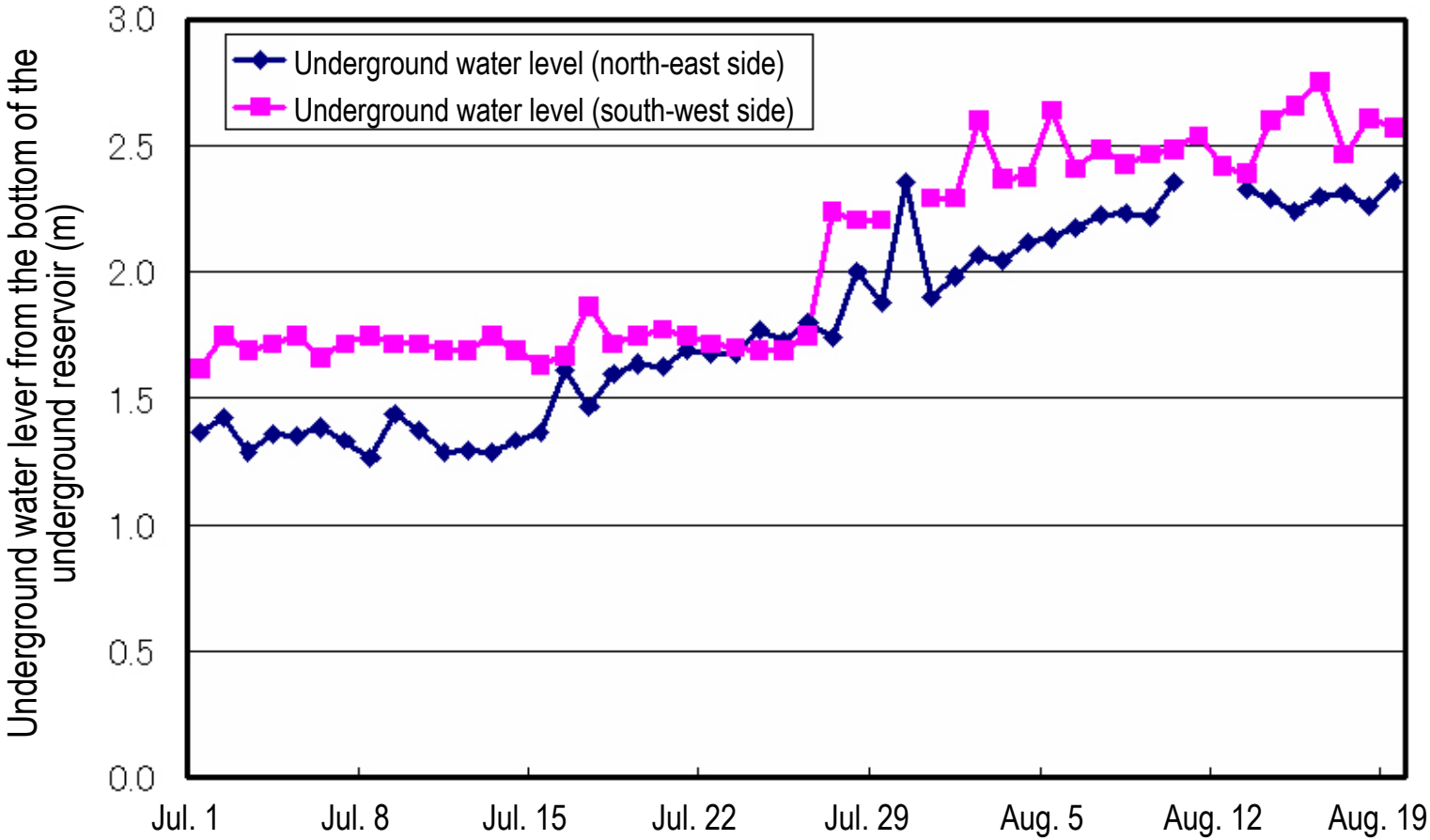
	8/11	8/12	8/13	8/14	8/15	8/16	8/17	8/18	8/19	8/20	8/21
(1) Center	153	157	160	160	160	155	155	153	161	150	147
(2) N-E side	33	35	36	36	35	34	30	33	40	32	30
(3) N-W side	42	44	45	45	44	43	43	42	48	42	37
(4) S-W side	35	38	39	39	40	38	37	36	43	25	34
(5) S-E side	-7	-5	-5	-5	-4	-7	-5	-6	2	-8	-8

N: North, S: South, E: East, W: West

3-1. Chronological change of underground water level (Underground reservoir No.3)

- Since mid July, the underground water level around the underground reservoir has increased.
- The underground water level decreased on August 11. However, it repeated up and down from August 14 to18.

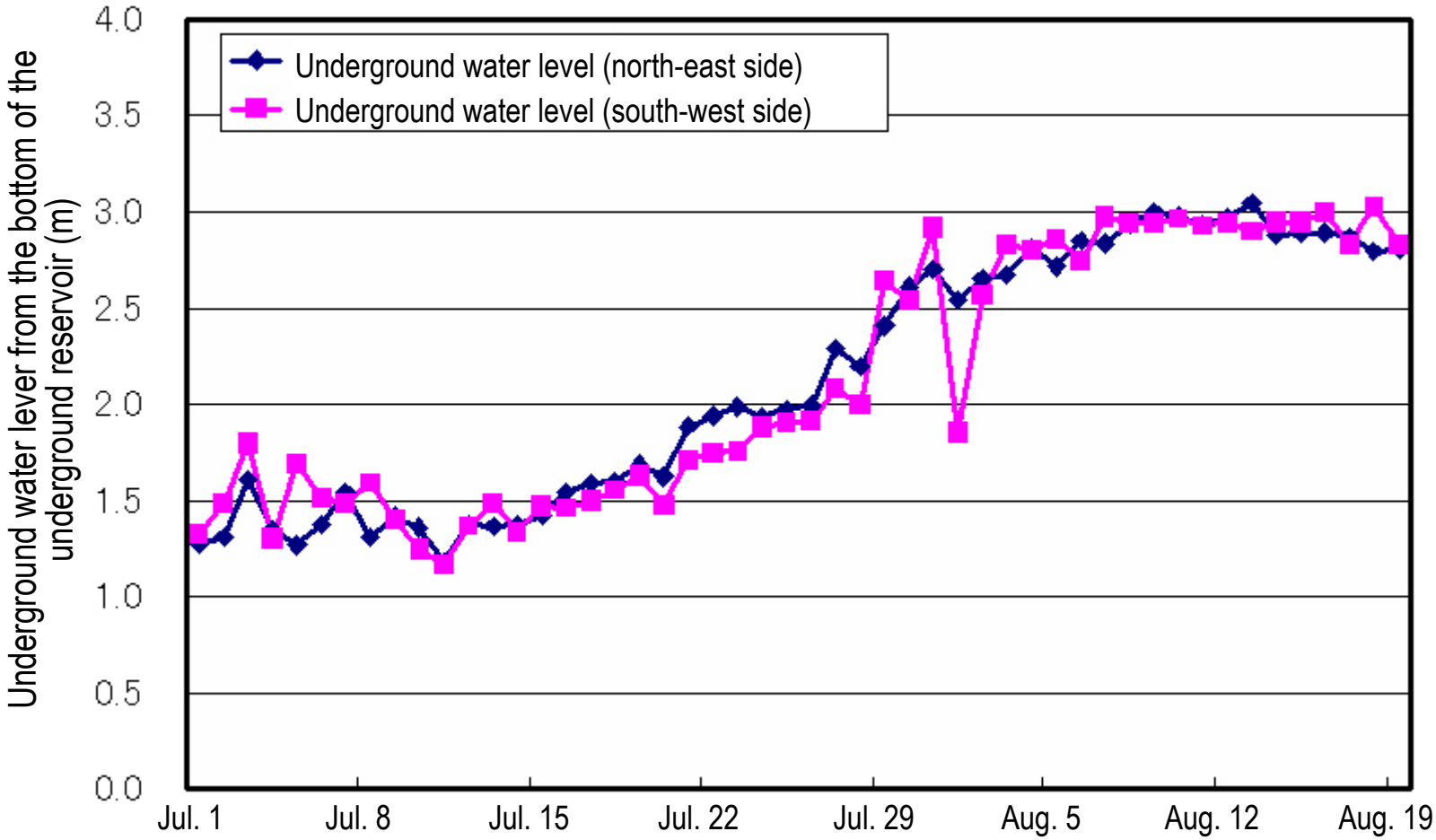
Water level around the underground reservoir No.3 (water lever from the bottom of the pool)



3-2. Chronological change of underground water level (Underground reservoir No.4)

- Since mid July, the underground water level around the underground reservoir has increased.
- The underground water level has been consistent at approximately 3m since August 10.

Water level around the underground reservoir No.4 (water lever from the bottom of the pool)

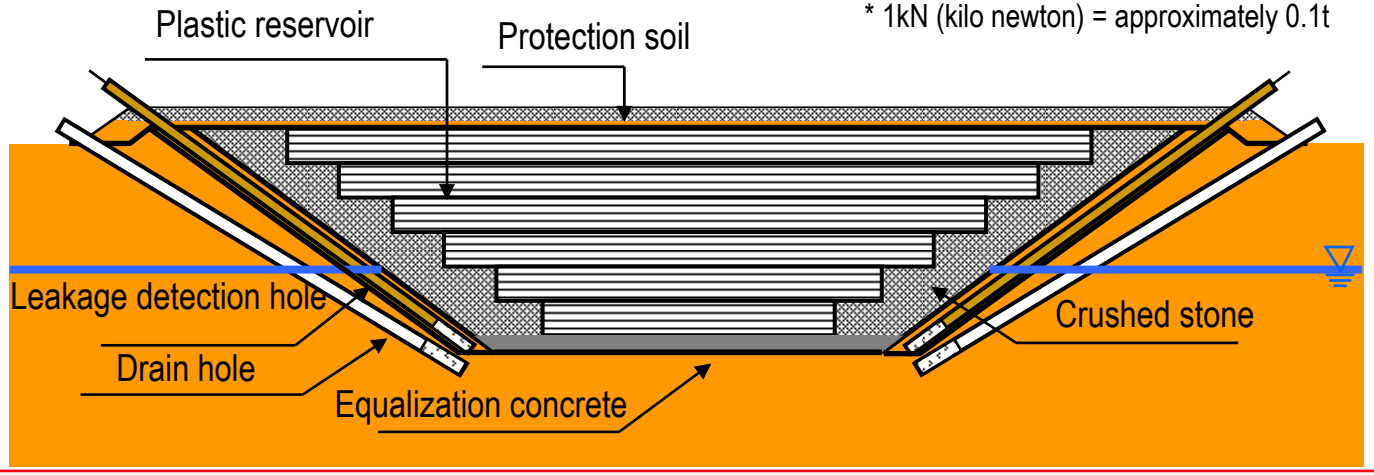


4. Initial estimate concerning the uplift

- The uplift was examined by regarding the underground reservoir as an integrated moving structure.
- Based on the weight of the underground reservoir, it is estimated that uplift of 3.2m or more and 4.4m or more will be generated with the underground reservoir No.3 and No.4, respectively.

		No.3	No.4
Underground reservoir	Shape of the top surface	58m × 47m	42m × 27m
	Shape of the bottom surface	46m × 36m	30m × 16m
	Protection soil	0.7m	0.7m
	Plastic storage pool	5.7m	5.9m
	Concrete	0.1m	0.1m
	Weight (including crushed stone)	61,345kN*	30,985kN*
Underground water level equivalent to the reservoir weight		**3.2m**	**4.4m**

* 1kN (kilo newton) = approximately 0.1t

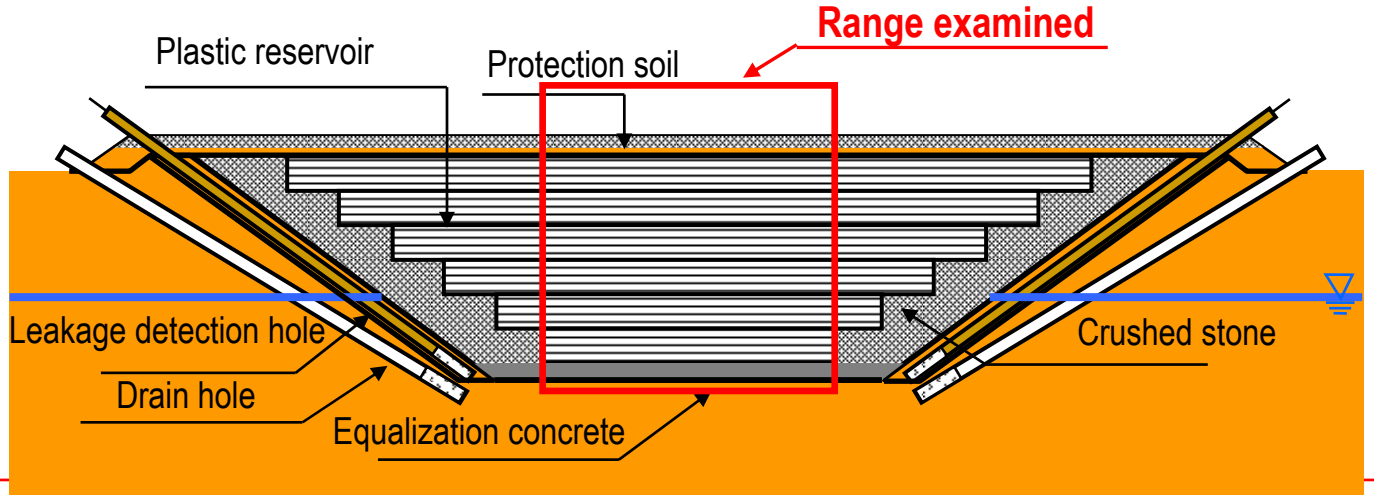


5. Load added on to eliminate the uplift

- The recent uplift was detected mainly at the center around which there was no weight of crushed stone.
- To resolve this issue, weight required to eliminate the uplift was calculated in the range where there was no crushed stone (within the red frame) (calculated by the unit area).
- Based on the groundwater water level, 70cm and 80cm of crushed stone will be added for equalization to the underground reservoir No.3 and No.4, respectively (However, the layer thickness will be re-examined depending on the condition).

		No.3	No.4
Underground reservoir	**Addition of crushed stone**	**0.7m**	**0.8m**
	Weight per unit area	29kN/m^2 *	31kN/m^2 *
Underground water level equivalent to the weight		**2.95m**	**3.13m**
Max underground water level until now		**2.752m （8/16）**	**3.043m （8/14）**

* 1kN (kilo newton) /m^2 = approximately 0.1t /m^2



6. Risk of construction

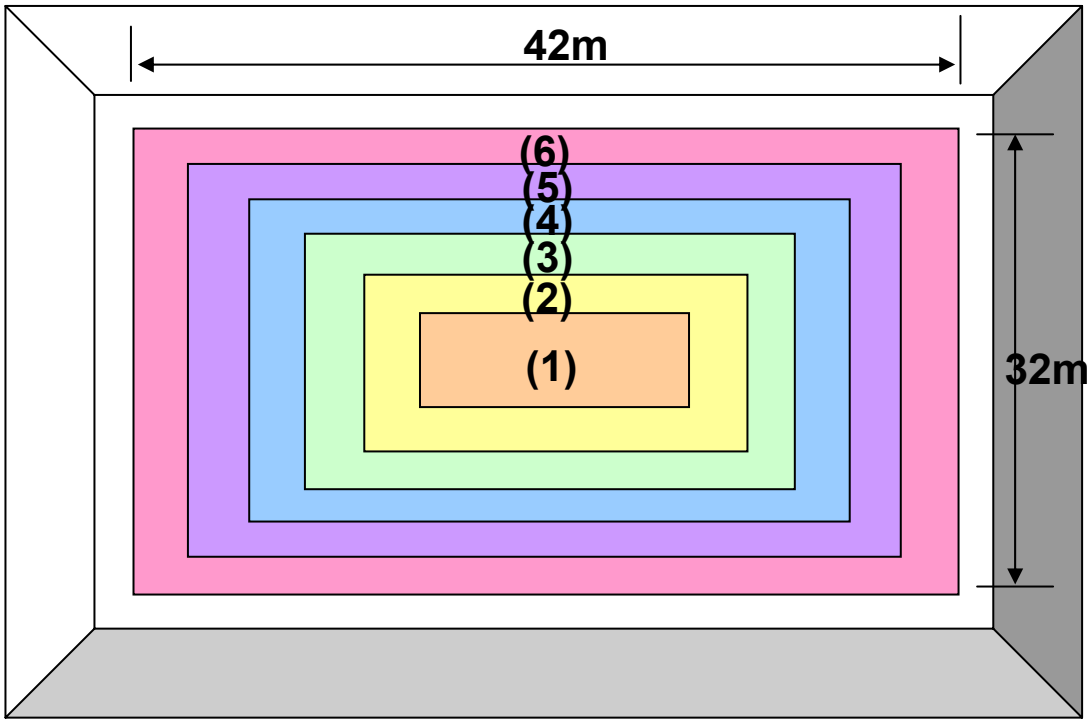
- Prior to addressing the issue of uplift of the underground reservoir, risks of the construction to install crushed stone on the top surface of the reservoir and policy to resolve these risks are summarized below.

  * **This countermeasure construction will be implemented from the underground reservoir No.3 with which the uplift volume is larger than that of No.4.**

Assumed risks	Countermeasures
By locally applying large load, the sheet may deform and damage	■To reduce load applied per one location, the addition of crushed stone is divided into 3 layers. ■The construction range (42m x 32m) is divided into 6 parts. Crushed stone is added from the center to the side for each.
By adding load, underground water between the reservoir and the improved ground may move, causing new uplift	■During the construction, underground water is discharged from the drain hole.

7-1. Outline of the construction (Underground reservoir No.3)

- Range: 42m x 32m (a range with crushed stone around the underground reservoir)
- Layer thickness: 70cm (The layer thickness will be re-examined depending on the condition)
- Construction method
  - To reduce weight applied, the application of crushed stone is divided into 3 layers.
  - For each layer, the construction range is divided into 6 parts. Crushed stone is added from the center to the side.



7-2. Outline of the construction (Underground reservoir No.3)

Water discharge plan

[Purpose] Underground water estimated to be accumulated between the ground and the reservoir will be discharged and, by adding load, new uplift will be prevented.

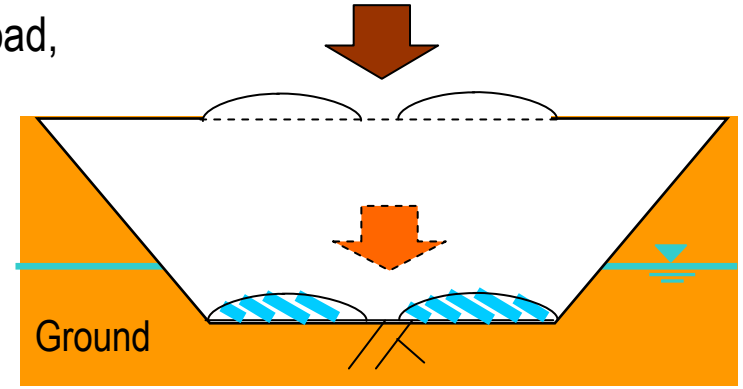
[Estimated water volume] Approx. 200m^3

[Hole used for collection] South-west side drain hole

* To prevent drawing the contaminated water to the north-east side

[Transfer destination] Tank in the G6 area (capacity: approx. 500m^3)

Load applied by adding crushed stone



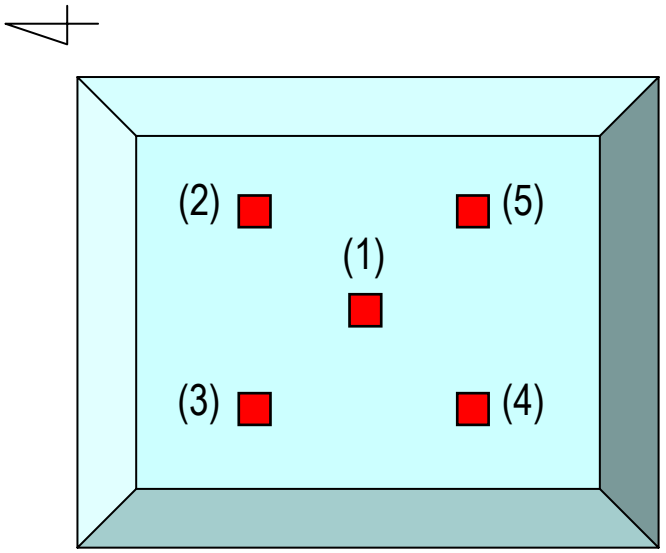
If the underground water is not collected, there is a concern that the accumulated underground water may move and generate new uplift.

Construction schedule

	Number of work days (Sundays are excluded)																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Preparation			(Transfer of obstacles and piping, etc.)																						(Removal)	
Installation of temporary facilities						(Construction of slope and installation of iron setting board)																				
Addition of crushed stone																										
Installation of settlement plate																										

7-3. Outline of the construction (Underground reservoir No.3)

- Measurement management during construction
  To check for any abnormality of the uplift condition caused by adding crushed stone for equalization and evaluate the effect of the countermeasure, measurement will be conducted at 5 points on the top surface of the underground reservoir.



Measurement points
on the underground reservoir No.3

[Reference] Analysis results on the drain and detection holes of the underground reservoir No.3

- There is no significant change in the analysis results related to all β of the drain and detection holes from mid July to August 10. Therefore, no leak of contaminated water is recognized caused by uplift.
- Since August 12, all β density has been detected on the north-east side. As of August 19, the density was at 5.7E-01(Bq/cm^3) at the drain hole.
- As there was no significant progress in the uplift, it is estimated that this is not new leak caused by any uplift, but the impact of groundwater collection from the drain hole (on the north-east side) from August 11 to 12.

Measurement results of all β related to the drain and detection holes of the underground reservoir No.3 (Bq/cm^3)