2-2-2-2 Water Supply Facility Plan

The study of water facility design shall comply with the common specifications of the water facilities in The Gambia. In The Gambia, however, there is no such design standards for water supply facilities as the "Design Criteria for Water Supply Facilities (Japan Water Works Association)", and the donors and international organizations have used the individual design standards which are used in each country or region. Thus, the "Design Criteria for Water Supply Facilities (Japan Water Works Association)" will apply correspondingly to the design of the water facilities in The Gambia in the Project, based on various specifications applicable in The Gambia.

(1) Target Year

The target year of the Project design is set to 2020 in accordance with the master plans of The Gambia, "Vision 2020" (1996) and "Poverty Reduction Strategy Paper" (2006).

(2) Population Growth Rate and Population of Project Site

In comparison of the current population (2009) based on the latest population statistics (Census 2003) and the present status of the Project sites, some differences were made clear, and a new population survey was conducted (June 2009). Based on the result of the Survey, the size of population served with water supply in the Project target year was estimated. The size of population served with water supply at project sites and the outline of water supply facilities are shown in Table 2-23 below. As shown in Table 2-24, the tendency of population growth is different from region to region according to the population census (Census 2003). Thus, this value will be used to predict the future population.

Table 2-23 Population Growth Rate by Regions

Region	Population Growth Rate (%)
Western	5.2
Lower River	1.0
North Bank	1.0
Central River (North)	1.5
Central River (South)	2.0
Average in The Gambia	**2.7**

(3) Unit Water Supply Rate and Design Supply Rate

The unit water supply rate for the piped water supply facilities as established by Department of Water Resources (DWR) is 35ℓ/capita/day, which will be adopted for the Project. The design supply rate is obtained by multiplying the design population served with water supply by the unit water supply rate (35ℓ/capita/day) and the maximum daily coefficient (1.2). The maximum daily coefficient of water supply is 1.2 to 1.4 in accordance with the Rural Water Supply Facility Standard. In considering the seasonal change in The Gambia, increase in water supply volume in the dry season, and the characteristics and economy of pumping by means of solar power, the maximum daily coefficient of 1.2 will be adopted in the Project. The water to livestock will be considered to be supplied from existing water supply facilities such as shallow wells, but it will not be included in the water supply volume under the Project.

Design Supply Rate = Design Served Population (capita)×35((ℓ/capita/day) Unit Water Supply Rate)×1.2 (Maximum Daily Coefficient)

Table 2-24 Project Sites and Water Supply Facilities Plan

	No	Village Name	New / Rehabilitation/ Supplementary/	Power Source: Solar/ Electricity	Survey Population (2009)	Growth Rate (%)	Supply Population (2020)	Water Demand (m^3)	Discharge (m^3/h)	Tank Capacity (m^3)	Distribution Line (Km)	Public Faucet (unit)
Priority Sites	N-1	Kabocorr Tampapo & Killing	Construction	Solar	1,389	5.2	2,426	102	17.0	50	7.7	29
	N-4	Kerr Katim Wolof + Fula	Construction	Solar	1,200	1.0	1,339	56	9.3	30	1.5	11
	N-5	Madina Kaif	Construction	Solar	1,661	1.0	1,853	78	13.0	40	2.3	18
	N-7	Ballangharr Complex	Construction	Solar	3,139	1.5	3,698	155	25.8	50	6.1	36
	N-8	Jimbala Complex	Construction	Solar	1,319	1.5	1,554	65	(10.8)	30	2.5	15
	N-9	Fass	Construction	Solar	1,296	1.5	1,527	64	10.7	30	1.7	14
	N-11	Kerewan Sambia Sira	Construction	Solar	4,341	2.0	5,397	227	37.8	70	5.4	39
	N-12	Fula Bantang & Sinchu Sora	Construction	Solar	1,280	2.0.	1,592	67	11.2	30	2.6	16
	N-13	Jissadi	Construction	Solar	1,731	2.0	2,152	90	15.0	40	3.9	21
	N-14	Sotokoi	Construction	Solar	1,079	2.0	1,342	56	9.3	30	1.4	13
	N-15	Maka & Njie Kunda	Construction	Solar	3,807	2.0	4,734	199	33.2	60	4.2	30
Supplementary Sites	N-16	Lamin Koto + Badala + Sotokoi	Construction	Solar	1,449	1.5	1,707	72	12.0	30	4.0	18
	N-17	Gidda	Construction	Solar	1,356	5.2	2,368	99	(16.5)	50	6.4	24
	N-18	Kerr Mama	Construction	Solar	1,245	1.0	1,389	58	(9.7)	30	2.3	14
	N-19	Kerr Cherno	Construction	Solar	1,819	1.0	2,029	85	(14.2)	40	3.1	20
	N-20	Banta Killing	Supplementary Site		-	-	-	-	-	-	-	-
Rehabilitation	R-01	Toniataba	Conversion	Electricity	1,996	-	1,996	-	-	-	-	Repair
	R-02	Bureng	Conversion	Solar	2,331	-	2,331	-	-	-	-	Repair
	R-03	Barrow Kunda	Conversion	Solar	3,762	-	3,762	-	-	-	-	Repair

(4) Results of Test Drilling (Water Sources)

The test drilling boreholes installed at 14 sites. The 11 boreholes out of 14 have been decided as successful ones, and will be used as production wells in the project.

According to the water analysis of samples from 14 boreholes, the 5 borehole showed iron concentrations exceeding the criteria of WHO guidelines for drinking water quality. As a result of discussions with DWR, the 3 boreholes with especially higher iron concentrations have been cancelled (N-03, N-06 and N-10).

(5) Construction of Boreholes (5 Sites) during Facility Construction Works

As the 3 sites were cancelled due to water quality as a result of test drilling survey, the alternative construction work of boreholes will be carried out in the 3 supplementary sites (N-17, N-18 and N-19) during the facility construction.
Meanwhile, the drilling work in the priority site N-08 had been halted on the way due to the beginning of the rainy season and Ramadan during the survey period. The work in this site will be resumed during the facility construction.

In addition, one existing borehole in R-02, which is to be converted to the solar powered system, is reported to have been suffering the damage on its well screen caused by a fallen object and the secular change of water quality (especially increase of iron component). Therefore, the dropped object in the borehole will be removed and the pumping test and water quality analysis will be carried out during the detailed design survey on the condition that the existing borehole will be used, but if it is decided that the continuous use as a water source is impossible, a new production well will be drilled in the vicinity of the present water source.
The successful rate of 78% (11 successful boreholes out of 14 test drilling boreholes) will be adopted for the drilling work during the facility construction works.

If any unsuccessful borehole in the facility construction works is found, the following procedure will be taken:

① Re-drilling at the same site
② Change into a supplementary site
③ However, the number of sites may finally result in less than 15 sites.

Conditions for Construction of Boreholes during Facility Construction Works

- Success rate: 78%
- Borehole diameter: 10 inches; Average drilling depth: 80m
- Surface borehole diameter: 18 inches
- Surface borehole depth: 2m
- Surface casing diameter: 14 inches
- Screen casing diameter: 6 inches, PVC-made
- Screen installed in the aquifer and gravel packing between borehole and screen
- Well development
- Water shielding and cementing in the upper pert of surface borehole
- Pumping test (appropriate pumping capacity: $5m^3/h$ or more)
- Water quality analysis
  - Analysis by DWR laboratory (The results shall comply with the WHO guidelines for drinking water quality, but if the iron concentration is higher, the discussions with the executing agency of DWR will be made during implementation of the facility construction works.)
  - Decision of drinking water quality by representatives of residents

(6) Water In-take/Conveyance Facilities

For pumping water from a borehole as a water source by installing a submersible motor pump, the minimum pipeline equipment including check valve, water meter, pressure gauge and control valve, and a protection facility will be installed. The facilities will prevent any trouble in operation and facilitate maintenance of the other facilities, and will be economical.

(7) Power Source

In comparison of the initial investment costs and the maintenance and operation costs, the national electric power and solar power generation are preferred as power sources for the water supply facilities, as the lessons in the past experiences in The Gambia tell. However, the national electric power line (National Water & Electricity Company, NAWEC) is available only at one site, Toniataba (R-01), of the Project sites. In The Gambia, the rural electrification is less developed and there is no future plan yet to electrify other project sites and the surrounding areas. As described in 2-2-1 (4), the comparison between the diesel engine generator system and the solar power generation system has made it clear that the solar power generation system is more advantageous.

Thus, the solar power generation system will be adopted at all the Project sites except the site R-01.

(8) Protection Fences for Water Sources and Water Conveyance Facilities

The solar-powered water supply system in The Gambia is operated under the maintenance and operation agreement between each Village Water Committee (VWC) and a private OM company. Under the agreement, each VWC is required to have the responsibility for security and to install a watch shed/watchman house

As the protective fences are integrated with the water supply facilities, they will be constructed as part of the water supply facilities.

In the Project for Rural Water Supply (Phase II in 2004), the net-fence type was adopted, but the burglar intrusion by cutting the lower part of a net fence was found in another donor's facilities. In the Project, the block fence combined with illumination will be adopted as a protective fence.

(9) Storage/Distribution Reservoir

① Materials

As a result of comparison of three types of materials for reservoirs, reinforced concrete, FRP panel and steel panel, the reinforced concrete-made storage/distribution reservoir is recommended. The comparison results are shown in Table 2-25.

As shown in Table 2-25, the comparison of three types, the reinforced concrete construction is the most economical in work in The Gambia. This method was adopted in Phase I Japanese grant aid project and has performance record of over 17 years. Therefore, the reinforced concrete-made reservoir will be selected in the Project.

However, concrete cracks was caused and repaired in the reinforced concrete storage/distribution reservoir at some sites in Phase II (2004). The causes of these troubles were presumed to be attributable to improper management of concrete placing and curing and insufficient waterproof treatment in the construction works. By learning a lesson from these troubles, the construction work and its quality will be improved in the Project. As to the waterproof treatment, the groundwater in The Gambia shows generally an acidic quality caused by free carbonic acid. If a mortar waterproofing is adopted, it will deteriorate very rapidly and affect the concrete inevitably. Therefore, the inner surface of a water storage tank will be coated with a waterproof material of urethane resin type which has a chemical anti-acid effect and is publicly authorized for drinking water supply facilities.

② Capacity

In considering that the power source will be available from solar power generation (providing the effective operation time of 6 hours) and that drinking water will be used by long daily span, it will be necessary to reserve water on a previous day and supply it on the early morning of the next day. For this purpose, the basic reservoir capacity is obtained by multiplying the design supply rate by the cumulative consumption rate (29.5%) up to the water consumption peak (9:00 am) as shown in Fig. 2-4.

However, in case the basic capacity is less than $40m^3$, an additional capacity (a pumped volume for one hour) will be added to the basic capacity. It is because the water use by time span is dispersed in small villages and because water should be reserved for the rainy season when the duration of sunshine is decreased.

- Basic capacity = Cumulative consumption rate (29.5%) up to the water consumption peak×Design supply rate
- Additional capacity * = 1 hour×Yield volume (Q/h)
- * The above additional capacity is considered if the basic capacity is less than $40m^3$.

Hourly Water Usage Rate

Time	Consumption rate (%)	
	Cumulative per time	Cumulative total
6:00	0.00	0.00
7:00	4.63	4.63
8:00	12.21	16.84
9:00	**12.58**	**29.42**
10:00	10.50	39.92
11:00	9.57	49.49
12:00	8.79	58.28
13:00	3.60	61.88
14:00	0.98	62.86
15:00	6.44	69.30
16:00	12.25	81.55
17:00	11.13	92.68
18:00	6.74	99.42
19:00	0.58	100.00

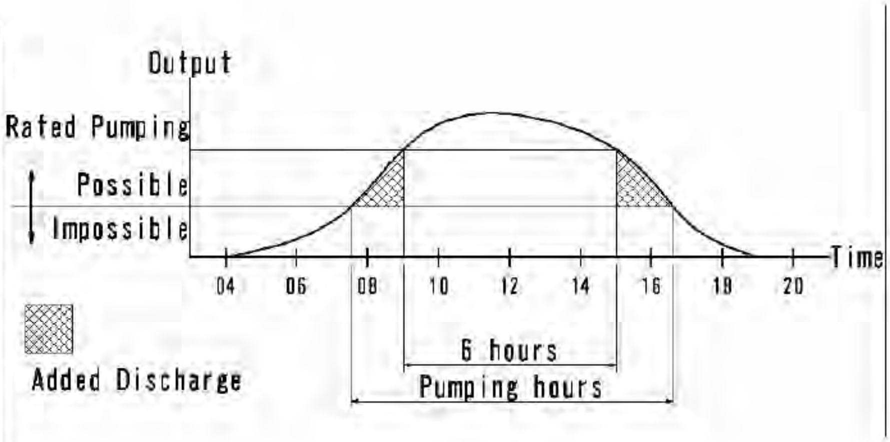


Fig. 2-4 Village Water Usage and Supply Pattern by Solar Pumping System

③ Structure

The structure of the distribution reservoir will be of elevated type of GL+5.0m at each site based on the flow calculation to ensure that the residual water head of public faucets at the end terminals is 1.0m or more with the flow velocity of 0.3m/sec.

④ Foundation

The depth of foundation at each site will be determined based on the results of the subsurface exploration that will be conducted at each construction site by a local soil engineering subcontractor.

At present, ① the ground engineering condition will be categorized by a similar foundation depth; and ② the foundation depth will be checked again in the detailed design survey and in implementation of the project in order to adopt the appropriate foundation depth and structure.

The estimated ground stress intensity is examined at present as follows:

Ground stress intensity (X) = Storage tank (dead weight) + Wind load/Bottom area×Safety factor (3) < Long-time bearing power (Y)
Ground stress intensity (X) = 180 – 230 kN/m²
Long-time bearing power (Y) = 230 – 1,550 kN/m²
Foundation depth (Z) = 1.5 – 5.0 m

Table 2-25 Comparison of Structural Materials for Storage/Distribution Reservoir

Main Material	Reinforced Concrete (50m^3, H=5m)		Steel Panel (50m^3, H=5m)		FRP Panel (50m^3, H=5m)	
Construction Cost	Approx.7,100,000 yen Most economical	◎	Approx. 22,500,000 yen Most expensive	×	Approx. 16,000,000 yen More expensive than reinforced concrete	△
Procured from	The Gambia or Senegal	○	A third country or Japan	△	A third country or Japan	△
Work Period	Approx. 3 months	△	Approx. 1 month (excl. transportation period)	○	Approx. 1 month (excl. transportation)	○
Constructor	Contractor in The Gambia or Senegal under the engineer of Japanese constructor	○	Assembling by technicians dispatched from any third country or Japan	△	Assembling by technicians dispatched from any third country or Japan	△
Construction/ Quality Control	As there is no plant in the rural area, concrete is mixed at each site and it is important to manage the materials, concrete-placing work and quality control, and also important to make hot-weather concreting control and waterproof treatment. Concrete was adopted in Phase I (early in the 1990's) and Phase II (2004), and cracks were caused by construction faults at some sites in Phase II (2004) and repaired in the fault inspection. These faults were caused by insufficient waterproof treatment and curing supervision. Making the most of the lesson from these troubles, it is necessary to make thorough hot-weather concreting control. Especially, concrete is mixed at each site and it is important to perfectly manage the construction and quality control for materials, mixture, mixing and placing of concrete. In the Project, the management will be thoroughly improved.	△	A shorter work period is expected because the entire "tank" is structured by assembling panels of approx. 1m x 1m. The panels are ready-made products and the waterproof treatment of those panels is made under the quality control at the plant.	○	A shorter work period is expected because the entire "tank" is structured by assembling panels of approx. 1m x 1m. The panels are ready-made products and the waterproof treatment of those panels is made under the quality control at the plant.	○
Maintenance & Management	The reservoirs constructed in Phase I remain robust as of 2009 even after an elapse of 17 years and the maintenance (repair) of them is carried out by village residents. In Phase II, cracks were found by construction cracks at some sites, but those faults are easily maintained (repaired) by village residents. From this viewpoint, DWR is making examination to specify the reinforced concrete tank of Phase II type as the standard type in The Gambia.	○	This type of tank has been used as the standard type by the international organizations such as UNDP/EDF, and EU countries. In the capital city and its surrounding cities, the maintenance is carried out by contractors, while the maintenance after construction is mainly carried out by village residents in rural areas. Thus, it is difficult to cope sufficiently with erosion and water leakage.	×	The reservoir was constructed early in the 1990's and left unmaintained and unrepaired because the management (maintenance/repair) by village residents has been impossible. This type is not recommended by DWR at present. There are many sites in which it is difficult for residents to manage (maintenance/repair) independently.	×
Overall Evaluation	○		×		△	

Based on the above evaluation, the reinforced concrete will be adopted in the Project. The estimated prices of steel and FRP panels are from a Japanese company, Sekisui Aqua Systems Co. (2006).

(10) Piped Facilities

① Pipe materials

The pipelines linking a water source with a storage/distribution facility and a water supply facility will be laid along a road (public land) as far as possible in general, but it will be examined to lay some pipelines in farming fields in considering the topographic conditions. If a pipeline passes across a private land, the rules of acquisition of the approval by the landowner and restoration of the original state after digging and laying pipelines will be observed. It is important to acquire the consent by the owner, normally there are no problems with formalities.

As pipe material, PVC pipes which are commercially available in The Gambia at a low price and have a certain level of strength against earth pressure and water pressure will basically be used, but PVC pipes are fragile against an external large impact or ultraviolet rays, so that they can not be adopted on the ground and at externally exposed parts of structures. Therefore, stainless steel pipes (SSP) or steel pipes (GIP) will be used in the places for which PVC pipes cannot be used. However, if GIP is adopted as the pipe material, it will deteriorate rapidly due to rust because the groundwater from borehole in The Gambia is acid. In consideration of economy, therefore, SSP will be used from a water source to a distribution reservoir and GSP from a distribution reservoir to public faucets by dividing the pipeline route by the boundary of distribution reservoir.

・PVC: Pressure resistance 1.0Mpa; Distributing pipe ISO 4422-1,2 (PN10)
・SSP: Pressure resistance 1.0Mpa; Conveyance pipe ISO9329-4, ISO 9330-6
・GIP: Pressure resistance 1.0Mpa; Distribution pipe ISO 65-1981

If a pipeline passes across a road or river (canal), the passing method and the protection after laying the pipeline will be designed properly. If the length of passing across a river is almost equal to the straight pipe length (5.5m), GIP will basically be laid overhead. If the length is longer, a PVC pipe will be laid in a siphon culvert, but a protective work with concrete lining will be constructed and a pipe-in-pipe system using a steel pipe will be used to avoid scorning.

② Construction Method

The pipe laying depth will be in accordance with the Design Criteria for Water Supply Facilities and the earth covering of 600mm will basically be provided. The work (pipe laying work) will be done manually. The residual concrete materials and crashed pavement materials from a paved section where a pipeline is laid will be disposed of at a place as designated by the road administrator (NRA: National Road Agency).

(11) Public Faucet

There is no standard design of public faucet in The Gambia. Based on the examples of past construction works by Japan and other donors, the faucet design will be determined to be improved and through discussions and coordination with the executing agency. The main material is reinforced concrete.

The required number of public faucets will be calculated based on the design population to be served with water supply (2020) and the water supply population per public faucet (100 capita/unit) and the places of installation will be determined properly by DWR, beneficiary rural residents and the Survey Team taking into account various site conditions including dense distribution of villages, expansion of villages and topographical conditions.

(12) Auxiliary Facilities (Pipeline Equipment)

The adjusting valves and air valves in the distribution facilities will be designed properly in accordance with the Design Criteria for Water Supply Facilities. A public faucet will be installed with a water meter and valves housed in a valve box for maintenance use. Each auxiliary facility including the valve box will be designed based on the past construction examples.

2-2-2-3 Equipment and Materials Plan

(1) Policy on Equipment Procurement (Necessity of Procurement)

The requested items for equipment procurement are vehicles, pumping test equipment, geophysical prospecting equipment, borehole logging equipment and GPS receivers.

1) Vehicles

For the procurement of vehicles, a letter of request was submitted by DWR requesting the procurement of one vehicle each for the following 3 fields:

① Vehicle for water quality monitoring

② Vehicle for groundwater monitoring, and geophysical logging and prospecting equipment

③ Vehicle for project management

In the minutes of discussions of the meeting on May 22, 2009, DWR was requested to submit a report on the activities with existing vehicles, the budget of fuel cost and the future plan of using vehicles as the materials for verifying the relevance of vehicle procurement. DWR submitted the vehicle use status in September 2009 during this

Survey and the activity plan (October 2009). The information available from these materials is summarized in Table 2-26 below.

Table 2-26 Report of DWR Vehicle Activities and Budget for Fuel（September 2009）

Items	1. Water quality monitoring vehicle	2. Groundwater monitoring vehicle including geophysical survey	3. Project operation and maintenance vehicle
DWR and Divisions	Water Quality Monitoring and Management Division	1)Hydrology, Meteorology and Water Resources Division 2)The Gambia River Development Project（OMVG)	Rural Water Supply Division
2. Annual Budget of Fuel, 2009 (GMD/year)	D230, 400.00（Apr.¥920,000) 燃料 7200 Litres x@GMD32	D153, 600.00（Apr.¥610,000) 4800Ltrs x@GMD32	D96,000.00（Appr.¥380,000) 3000Ltrs x@GMD32
3. Member of survey	9 persons	16 persons	10 persons
4. Working days in September 2009	27 days/month	25 days/month	20 days/month
5. Number of target sites and villages	Rural water supply facilities at 1,700 systems, and Primary school at 300 points	Groundwater monitoring 31 points (monthly bases), and Request from VWC 25 water supply systems annually.	1)New target sites at 18, JICA and existing JICA 30 sites. 2)Meeting with other donors, regional offices and technical support to the VWC s .
6. Future plan when JICA project will be started.	28 days/month （Water sampling works JICA for additional 1day)	25 days/month （New survey sites will be within routine works)	25 days/month （New target 18 sites and additional works 5 days will be increased)
7. Actual Activities in September 2009（model of 1 month)	Field works at 25 days/month Banjul office at 5 days/month Others : 0 days/month	Field works at 23 days/month Banjul office at 7 days/month Others : 0 days/month	Field works at 12 days/month Banjul office at 8 days/month Others : 10 days/month

- DWR's activity in September 2009 was accompanied by the JICA Survey Team. So, it is not a normal use of vehicles and activity states supporting the budget and personnel.
- The days of vehicle operation to be increased due to implementation of the Project are only 6 days, which are deemed to be covered by the existing vehicles.
- The policy of the Japanese side that it is basically difficult to procure vehicles was informed to DWR at the meetings held in March and May, 2009. As the result of the survey, no information to justify the relevance of vehicle procurement was obtained. Therefore, no vehicle will be procured.

2) Pumping test equipment

- DWR had been only one agency engaged in groundwater development in Gambia and had been conducting the well drilling and pumping tests by itself. Thus, the pumping test equipment had been needed. However, DWR was restructured into an agency responsible for supporting villages and local governments in monitoring of water resources, and operation and maintenance of water supply facilities.
- This Survey was conducted at the conversion sites of existing water supply

facilities using the decrepit pumping test equipment owned by DWR.

- On the other hand, the test drilling survey was subcontracted with a private company because DWR's own equipment was shut down and needed to be repaired.
- The private company owned pumping test equipment and some companies are engaged in commercial activities. Therefore, the opportunity for DWR to possess equipment and directly manage the support of villages has been reducing.
- The necessity of DWR's monitoring survey and village supporting activity is surely acceptable, but the commercial activities of private companies are increasing. Thus, the pumping test equipment will not be procured.

3) Geophysical prospecting equipment

- The existing geophysical prospecting equipment was procured under the first grant aid project by Japan in 1991. Since then, it has been used for 18 years or more and is now in deteriorated conditions.
- The request for groundwater survey are submitted from 100 villages per year and the groundwater development is carried out at 25 to 30 sites a year and 5 DWR engineers use the equipment for such activities.
- It will also be one of DWR's services to select well drilling points in villages in future, and the geophysical prospecting will be conducted. Therefore, it is deemed that geophysical prospecting equipment will continuously be used by DWR.
- There is no private company which possesses the geophysical prospecting equipment which will be necessary for DWR's service. Therefore, it is appropriate to procure new geophysical prospecting equipment.

4) Borehole logging equipment

- The borehole logging equipment was required for DWR to make groundwater development independently, but the well drilling works are done by private companies these days. Accordingly, the necessity of DWR's own borehole logging equipment has been reduced. On the other hand, the equipment is necessary for monitoring of water resources and aquifer evaluation.
- There is no private company in Gambia which possesses this type of equipment.
- It is not essential that DWR has its own equipment and provides technical assistance to private companies. However, there were some cases in which DWR provided assistance to private companies in trial boring surveys, but DWR's own equipment was out of order. Therefore, the Survey Team dealt with those surveys by modifying the geophysical prospecting equipment.
- The test drilling survey made clear that the good aquifer had the hydrological conditions in which the alternation of sand layers containing confined groundwater

with clay layers is clearly shown. During this survey, there was geophysical prospecting equipment provided with simple logging accessory equipment. This dual-function equipment can make necessary measurements if the Project sites have the same hydrological conditions. Therefore, the equipment dedicated to borehole logging will not be procured.

5) Conclusion on equipment procurement

The possibility of equipment procurement was examined from both aspects of past equipment use record and future use plan as shown in Table 2-27 below. As a result, only the geophysical resistivity survey equipment will be procured because other equipment has not been deemed to be essentially needed.

Table 2-27 Conclusion of Equipment Procurement

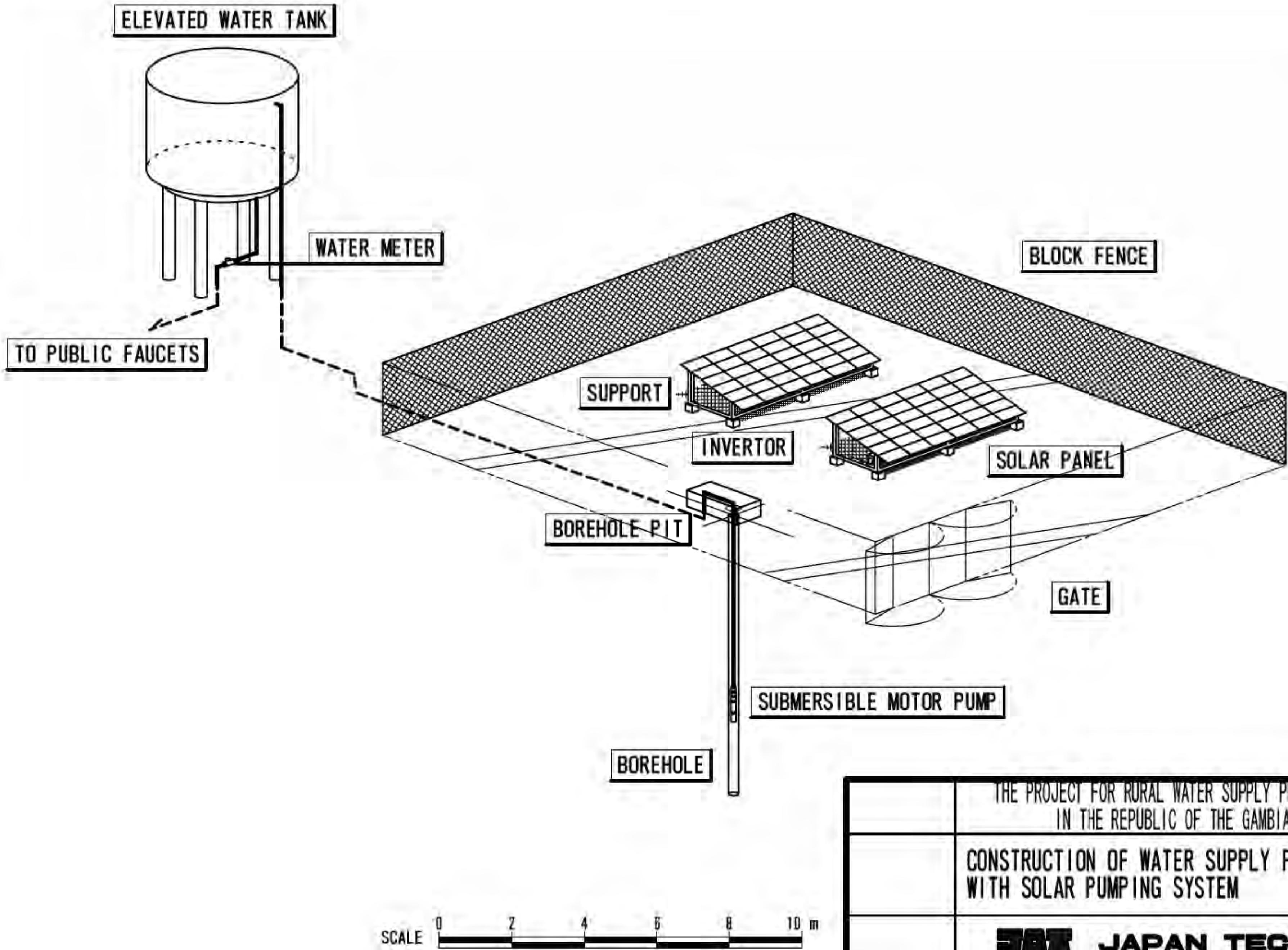
Item	Request (May 2009)	Qt	Evaluation	Preparatory Survey Results (December 2009)
Equipment Requested	1)Water quality monitoring Vehicle*	1	×	Geophysical Resistivity Survey Equipment 1 set
	2)Groundwater monitoring Vehicle*	1	×	
	3)Project operation and monitoring vehicle*	1	×	
	4)Pumping test equipment	1	×	
	5)Geophysical survey equipment	1	○	
	6)Borehole logging equipment	1	×	
	7)GPS	1	×	

* Vehicles requested in September 16, 2009 by DWR

2-2-3 Outline Design Drawing

The preliminary design drawings of water supply facilities at project sites are shown in Fig. 2-5 through Fig. 2-9 as attached hereto.

Fig. 2-5 Construction of Water Supply Facility with Solar Pumping System
Fig. 2-6 Borehole (Standard Structural Drawing)
Fig. 2-7 Elevated Water Tank (Basic Structure Drawings for Distribution Reservoir)
Fig. 2-8 Public Faucet (Basic Structure Drawing)
Fig. 2-9 Site Plan (Location Maps of Water Supply Facilities of 15 Sites)

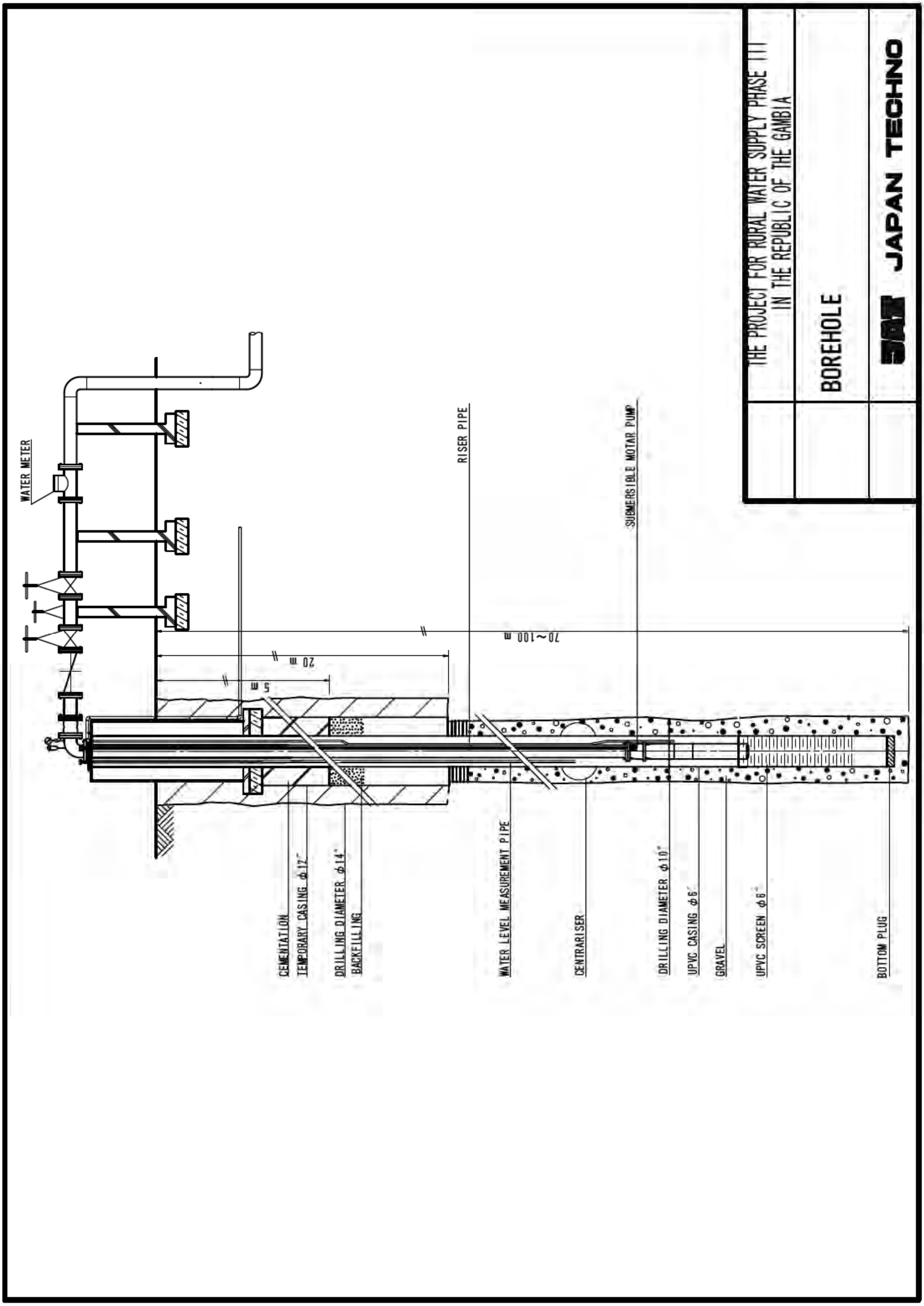


THE PROJECT FOR RURAL WATER SUPPLY PHASE III
IN THE REPUBLIC OF THE GAMBIA

CONSTRUCTION OF WATER SUPPLY FACILITY
WITH SOLAR PUMPING SYSTEM

JAPAN TECHNO

Fig.2-5



WATER METER
RISER PIPE
SUBMERSIBLE MOTAR PUMP
70～100 m
20 m
5 m
CEMENTATION
TEMPORARY CASING φ12"
DRILLING DIAMETER φ14"
BACKFILLING
WATER LEVEL MEASUREMENT PIPE
CENTRARISER
DRILLING DIAMETER φ10"
UPVC CASING φ6"
GRAVEL
UPVC SCREEN φ6"
BOTTOM PLUG
THE PROJECT FOR RURAL WATER SUPPLY PHASE III
IN THE REPUBLIC OF THE GAMBIA
BOREHOLE
JAPAN TECHNO

Fig.2-6

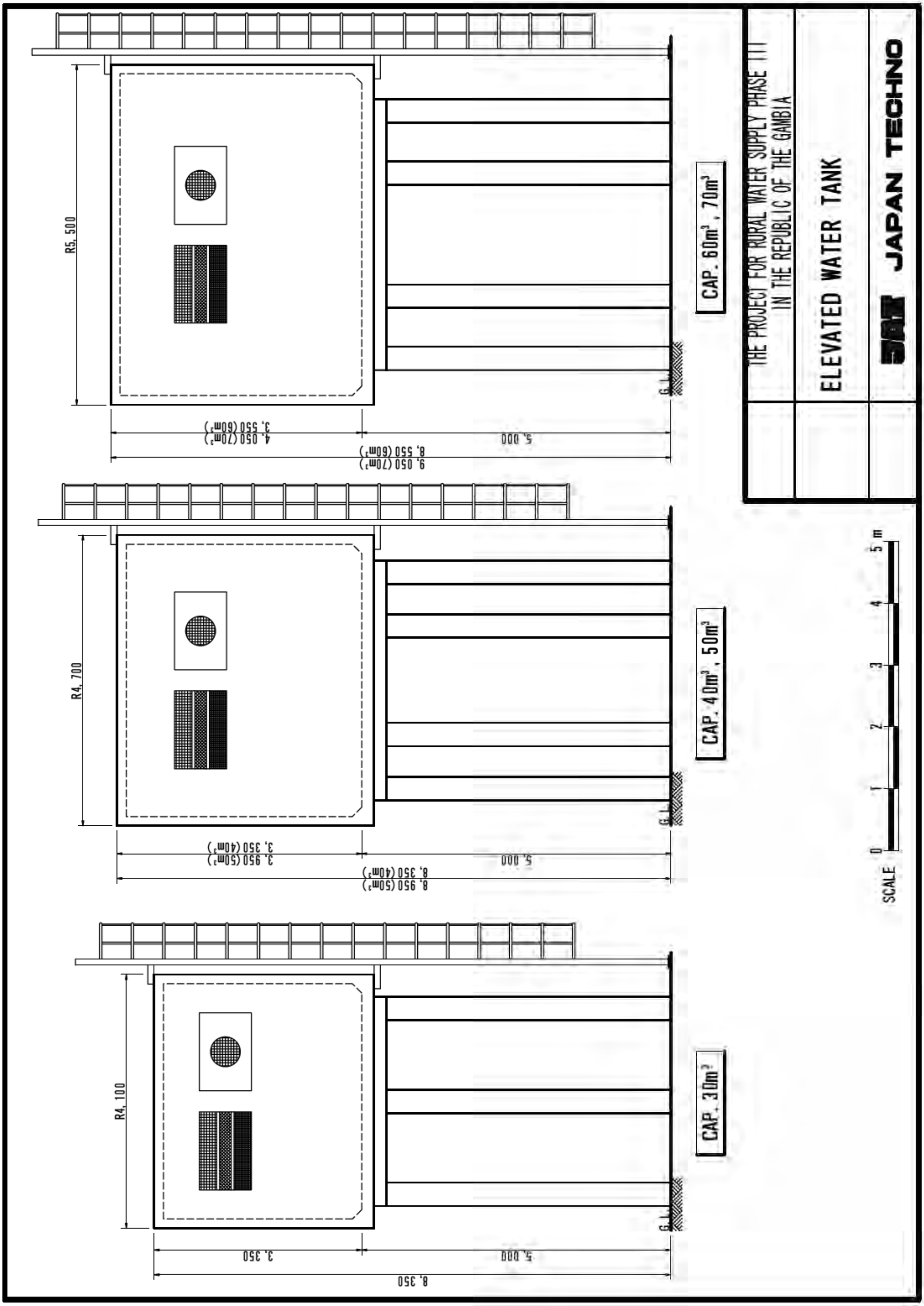

THE PROJECT FOR RURAL WATER SUPPLY PHASE III
IN THE REPUBLIC OF THE GAMBIA
ELEVATED WATER TANK
JAPAN TECHNO
CAP. 60m³, 70m³
R5, 500
3, 550 (60m³)
4, 050 (70m³)
5, 000
8, 550 (60m³)
9, 050 (70m³)
G.L
CAP. 40m³, 50m³
R4, 700
3, 350 (40m³)
3, 950 (50m³)
5, 000
8, 350 (40m³)
8, 950 (50m³)
G.L
CAP. 30m³
R4, 100
3, 350
5, 000
8, 350
G.L
SCALE
0
1
2
3
4
5 m

Fig.2-7

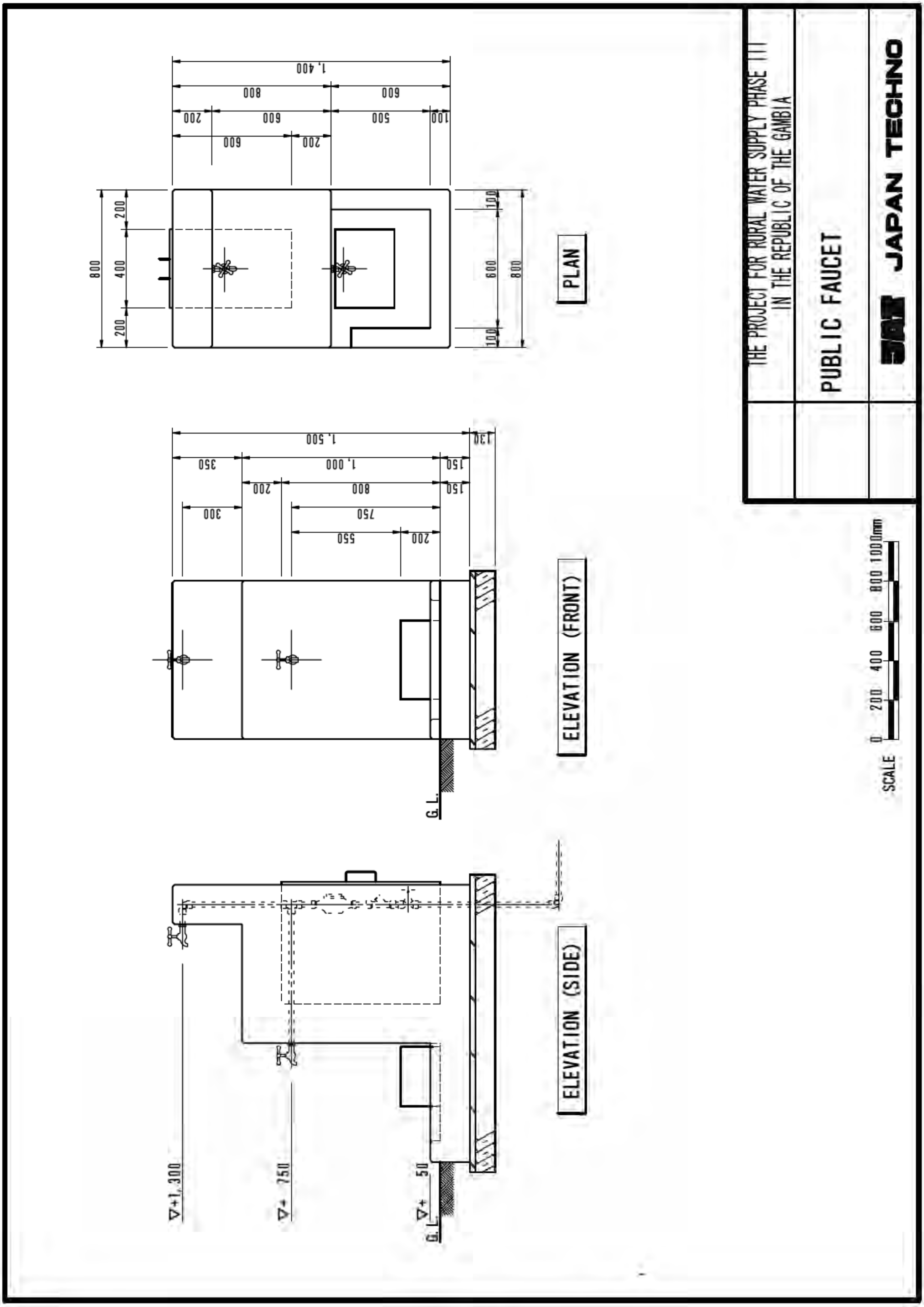
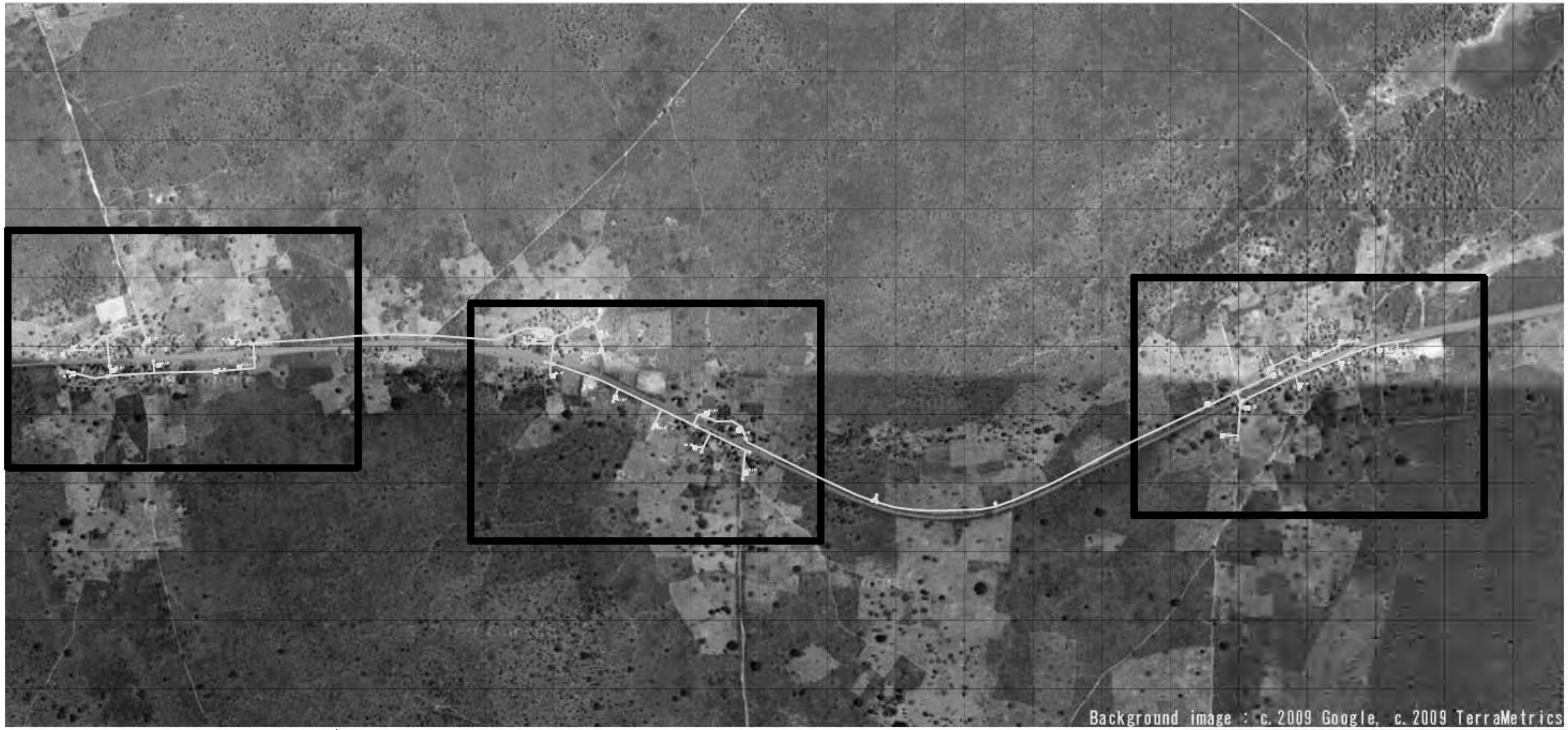

THE PROJECT FOR RURAL WATER SUPPLY PHASE III
IN THE REPUBLIC OF THE GAMBIA
PUBLIC FAUCET
JAPAN TECHNO
PLAN
ELEVATION (FRONT)
ELEVATION (SIDE)
G.L.
SCALE
0 200 400 600 800 1000mm

Fig.2-8

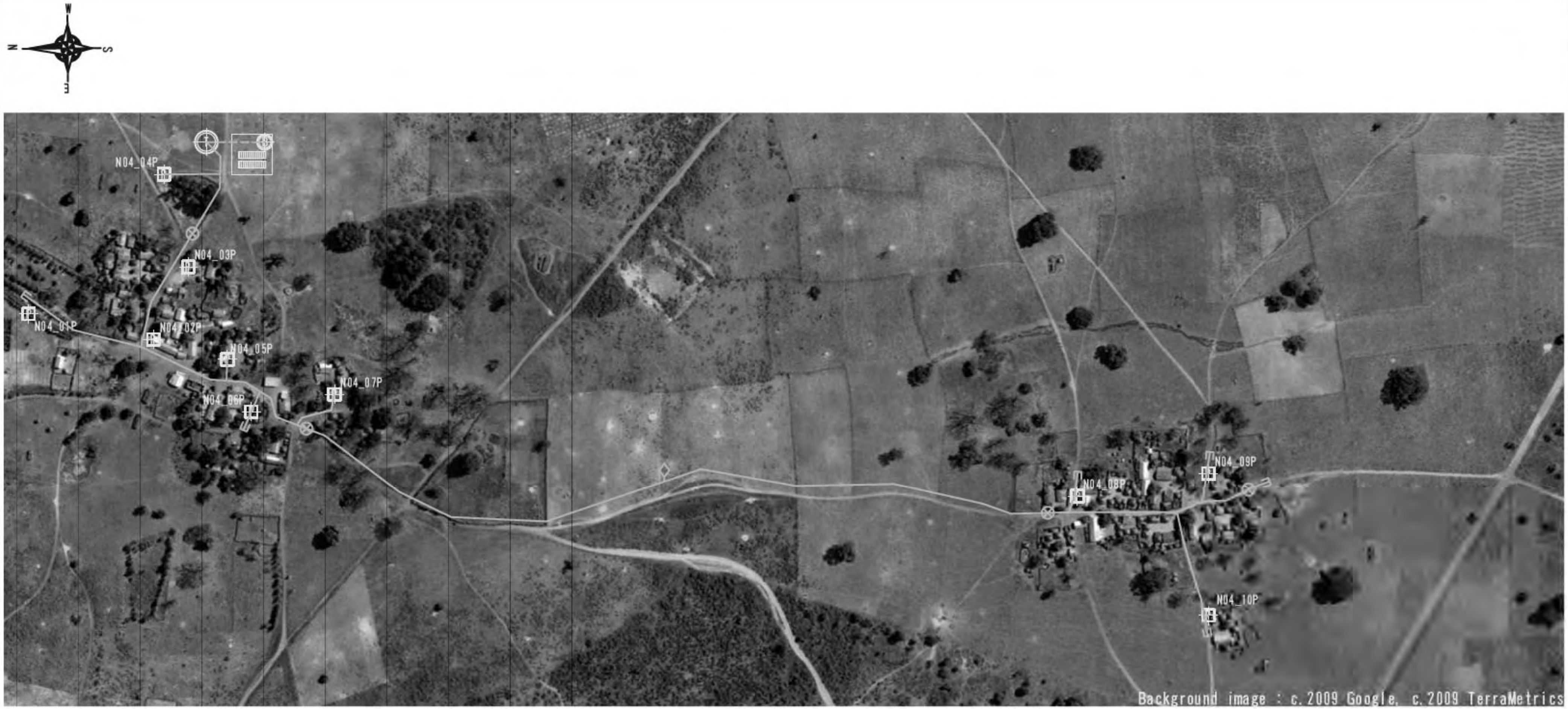


: WATER TANK 50m³
: SOLAR PANELS AND PANEL YARD
: BOREHOLE
: PUBLIC FAUCET
: VALVE CASING
: AIR VALVE
: TRANSMISSION LINE
: DISTRIBUTION LINE
: PIPE END/SERVICE BLANCH

SCALE 0 100 250 500 1000 m

PROJECT NAME	THE PROJECT FOR RURAL WATER SUPPLY PHASE III IN THE REPUBLIC OF THE GAMBIA		
DRAWING TITLE	SITE PLAN : N-01 Tampoto, Kabocorr, Killi		
DRAWN DATE	28th September, 2009		
SCALE	1 : 15000	DRAWING NO.	N-01_00
CONSULTANT	JAPAN TECHNO		
OWNER	JICA / JAPAN TECHNO CO., LTD.		

Fig.2-9(1)



: WATER TANK 30m³

: SOLAR PANELS AND PANEL YARD

: BOREHOLE

: PUBLIC FAUCET

: VALVE CASING

: AIR VALVE

: TRANSMISSION LINE

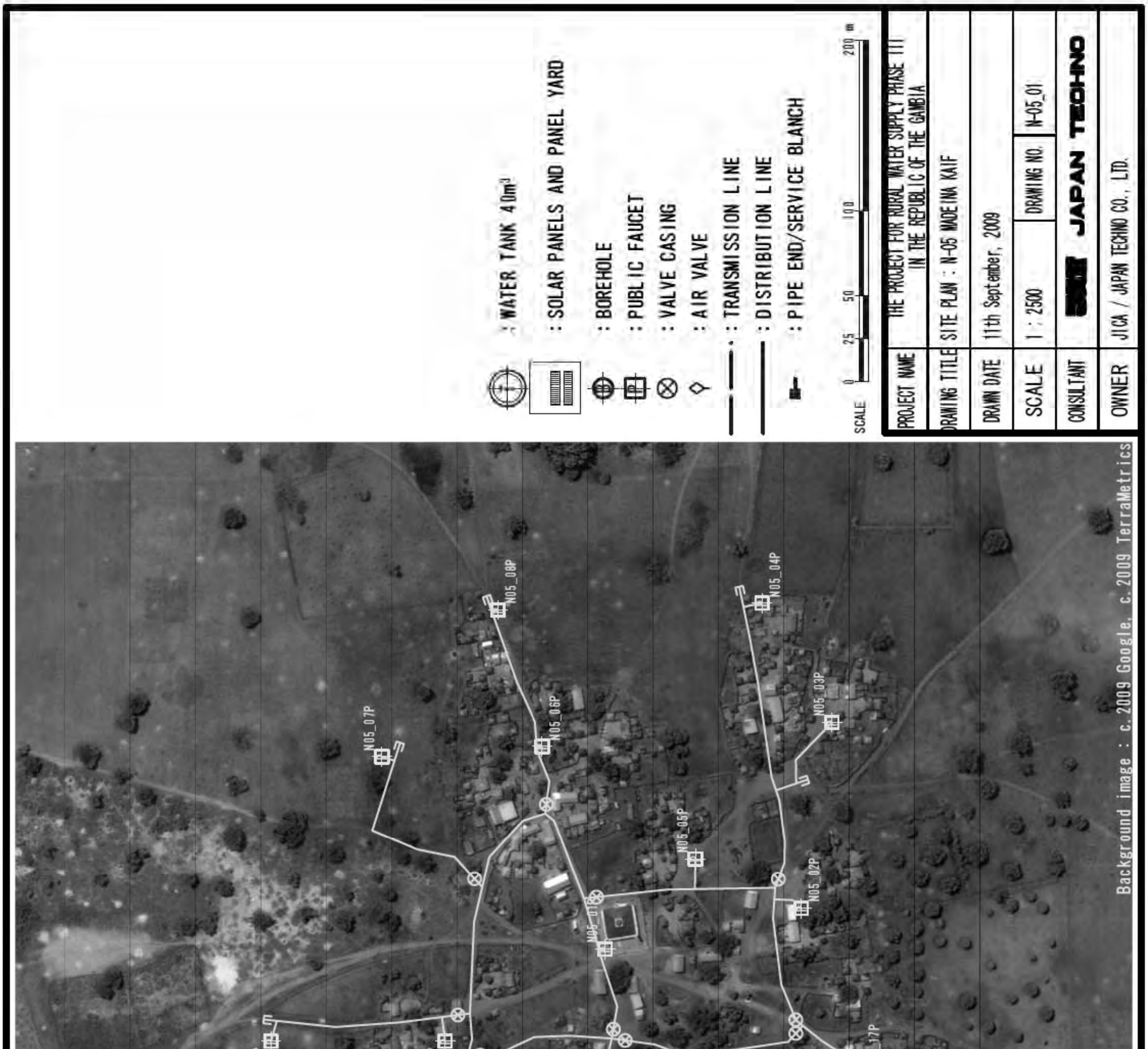
: DISTRIBUTION LINE

: PIPE END/SERVICE BLANCH

SCALE 0 20 50 100 200 m

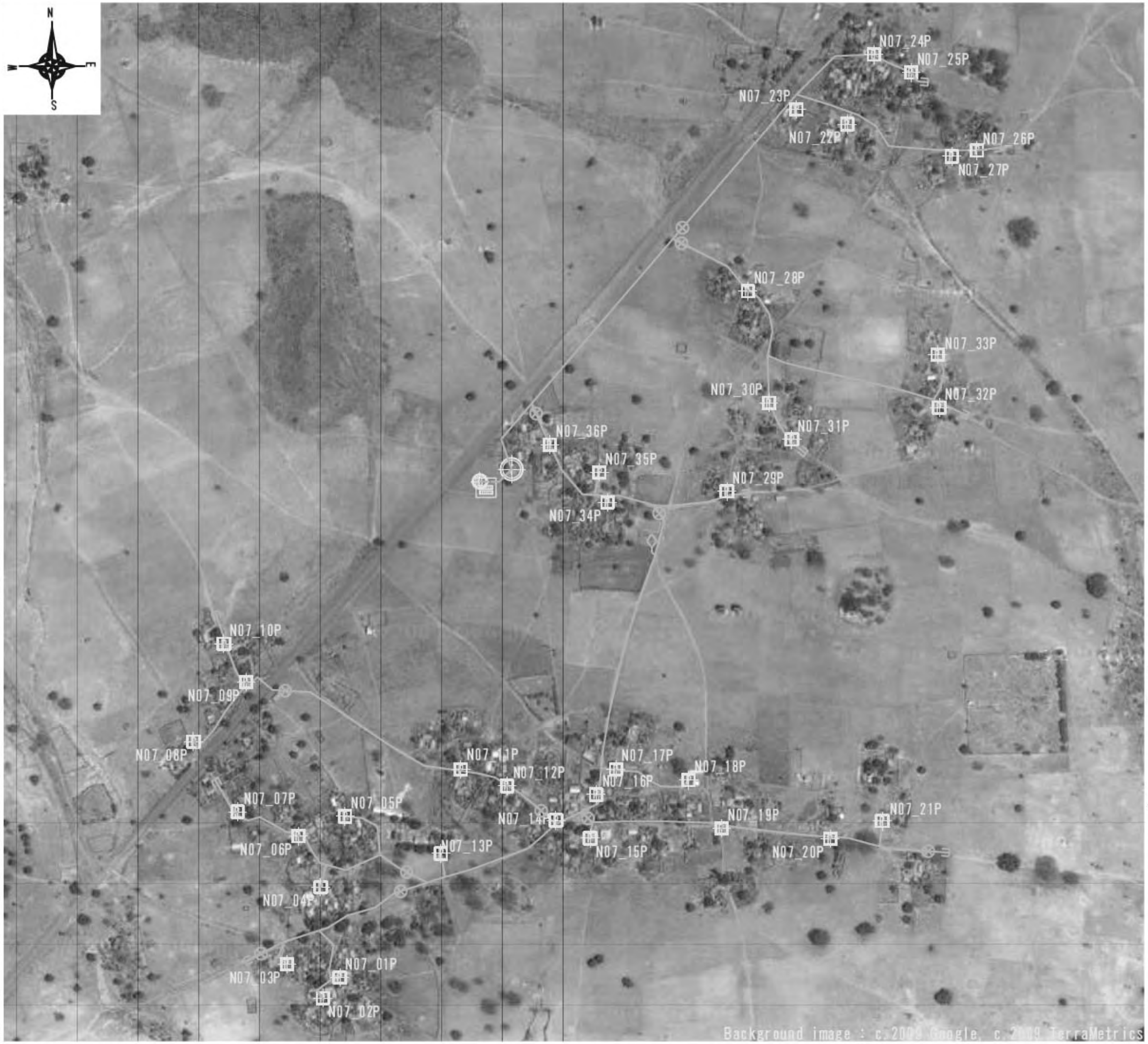
PROJECT NAME	THE PROJECT FOR RURAL WATER SUPPLY PHASE III IN THE REPUBLIC OF THE GAMBIA		
DRAWING TITLE	SITE PLAN : N-04_Kerr Katim		
DRAWN DATE	2nd October, 2009		
SCALE	1 : 3000	DRAWING NO.	N-04_01
CONSULTANT	JAPAN TECHNO		
OWNER	JICA / JAPAN TECHNO CO., LTD.		

Fig.2-9(2)



: WATER TANK 40m3
: SOLAR PANELS AND PANEL YARD
: BOREHOLE
: PUBLIC FAUCET
: VALVE CASING
: AIR VALVE
: TRANSMISSION LINE
: DISTRIBUTION LINE
: PIPE END/SERVICE BLANCH
SCALE 0 25 50 100 200 m
PROJECT NAME
THE PROJECT FOR RURAL WATER SUPPLY PHASE III IN THE REPUBLIC OF THE GAMBIA
DRAWING TITLE
SITE PLAN : N-05 MADEINA KAIF
DRAWN DATE
11th September, 2009
SCALE
1 : 2500
DRAWING NO.
N-05_01
CONSULTANT
JAPAN TECHNO
OWNER
JICA / JAPAN TECHNO CO., LTD.
N05_02P
N05_03P
N05_04P
N05_05P
N05_06P
N05_07P
N05_08P
N05_09P
N05_10P
N05_11P
N05_12P
N05_13P
N05_14P
N05_15P
N05_16P
N05_17P
N05_18P
Background image : c.2009 Google, c.2009 TerraMetrics
E
N
S
W

Fig.2-9(3)

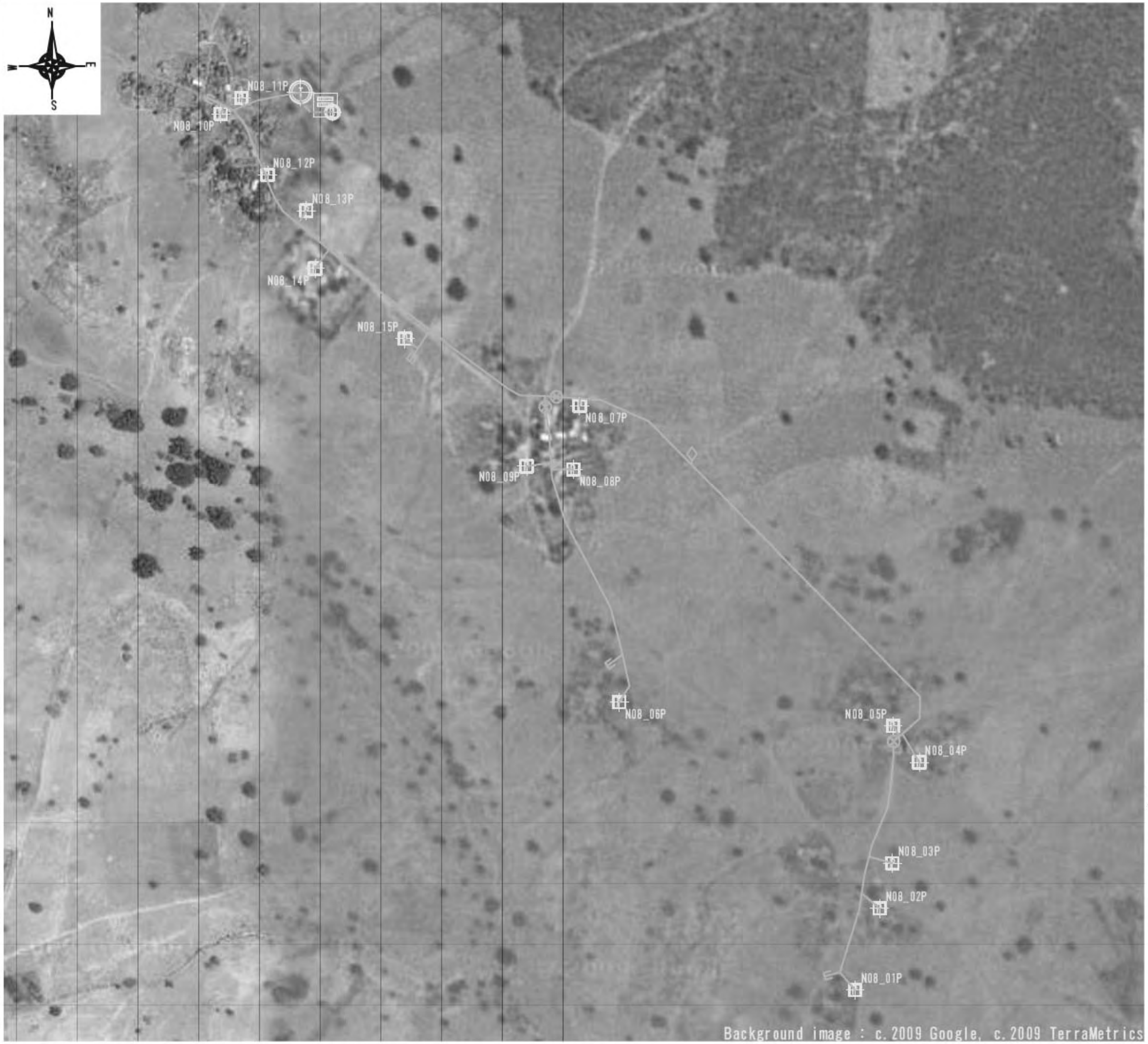


: WATER TANK 50m³
: SOLAR PANELS AND PANEL YARD
: BOREHOLE
: PUBLIC FAUCET
: VALVE CASING
: AIR VALVE
: TRANSMISSION LINE
: DISTRIBUTION LINE
: PIPE END/SERVICE BLANCH

SCALE 0 50 125 250 500 m

PROJECT NAME	THE PROJECT FOR RURAL WATER SUPPLY PHASE III IN THE REPUBLIC OF THE GAMBIA		
DRAWING TITLE	SITE PLAN : N-07_BALLANGHARR COMPLEX		
DRAWN DATE	17th October, 2009		
SCALE	1 : 6000	DRAWING NO.	N-07_00
CONSULTANT	JAPAN TECHNO		
OWNER	JICA / JAPAN TECHNO CO., LTD.		

Fig.2-9(4)



: WATER TANK 30m³
: SOLAR PANELS AND PANEL YARD
: BOREHOLE
: PUBLIC FAUCET
: VALVE CASING
: AIR VALVE
: TRANSMISSION LINE
: DISTRIBUTION LINE
: PIPE END/SERVICE BLANCH

SCALE 0 50 100 200 400 m

PROJECT NAME	THE PROJECT FOR RURAL WATER SUPPLY PHASE III IN THE REPUBLIC OF THE GAMBIA		
DRAWING TITLE	SITE PLAN : N-08_JIMBALA COMPLEX		
DRAWN DATE	2nd October, 2009		
SCALE	1 : 5000	DRAWING NO.	N-08_01
CONSULTANT	JAPAN TECHNO		
OWNER	JICA / JAPAN TECHNO CO., LTD.		

Fig.2-9(5)

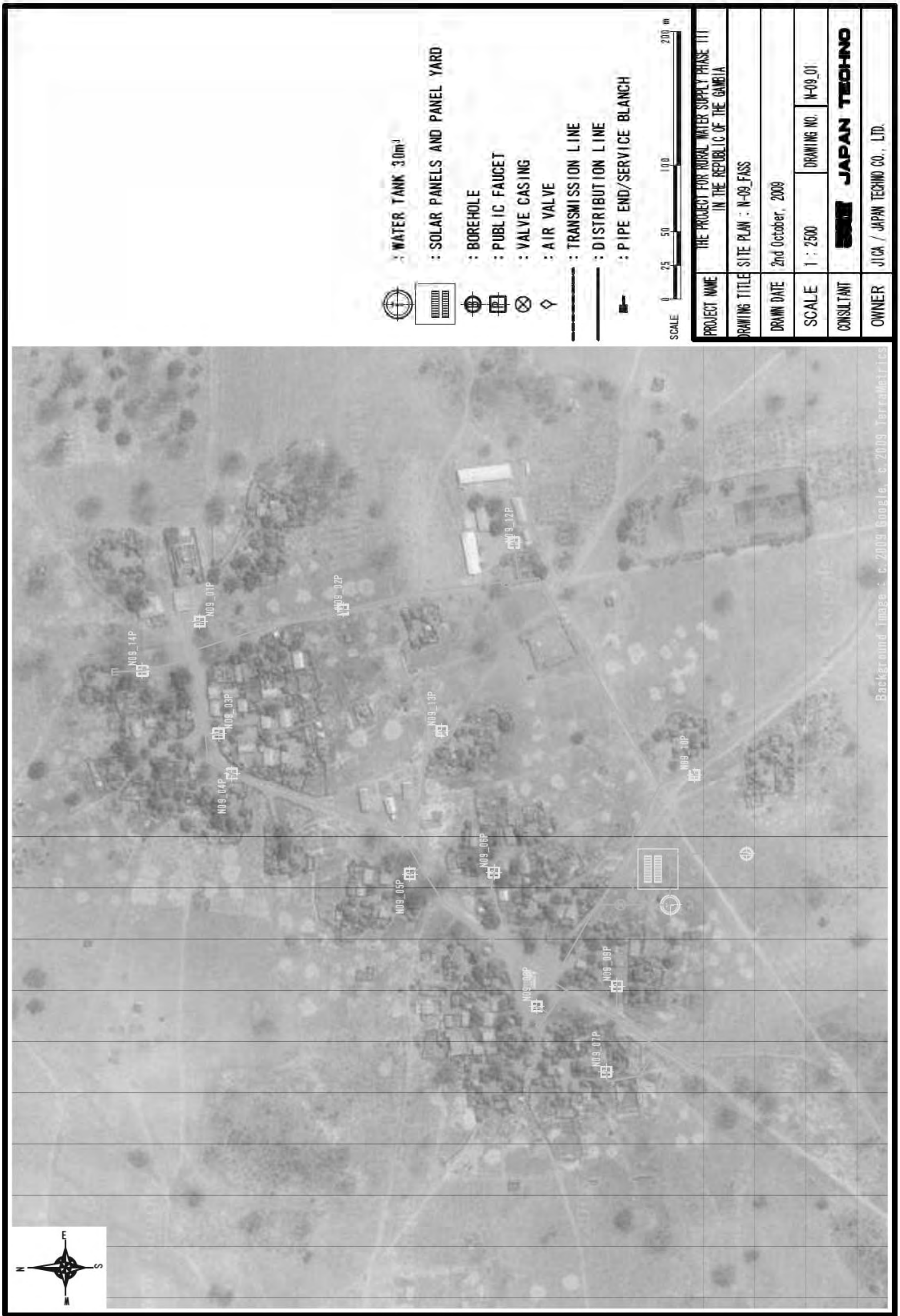
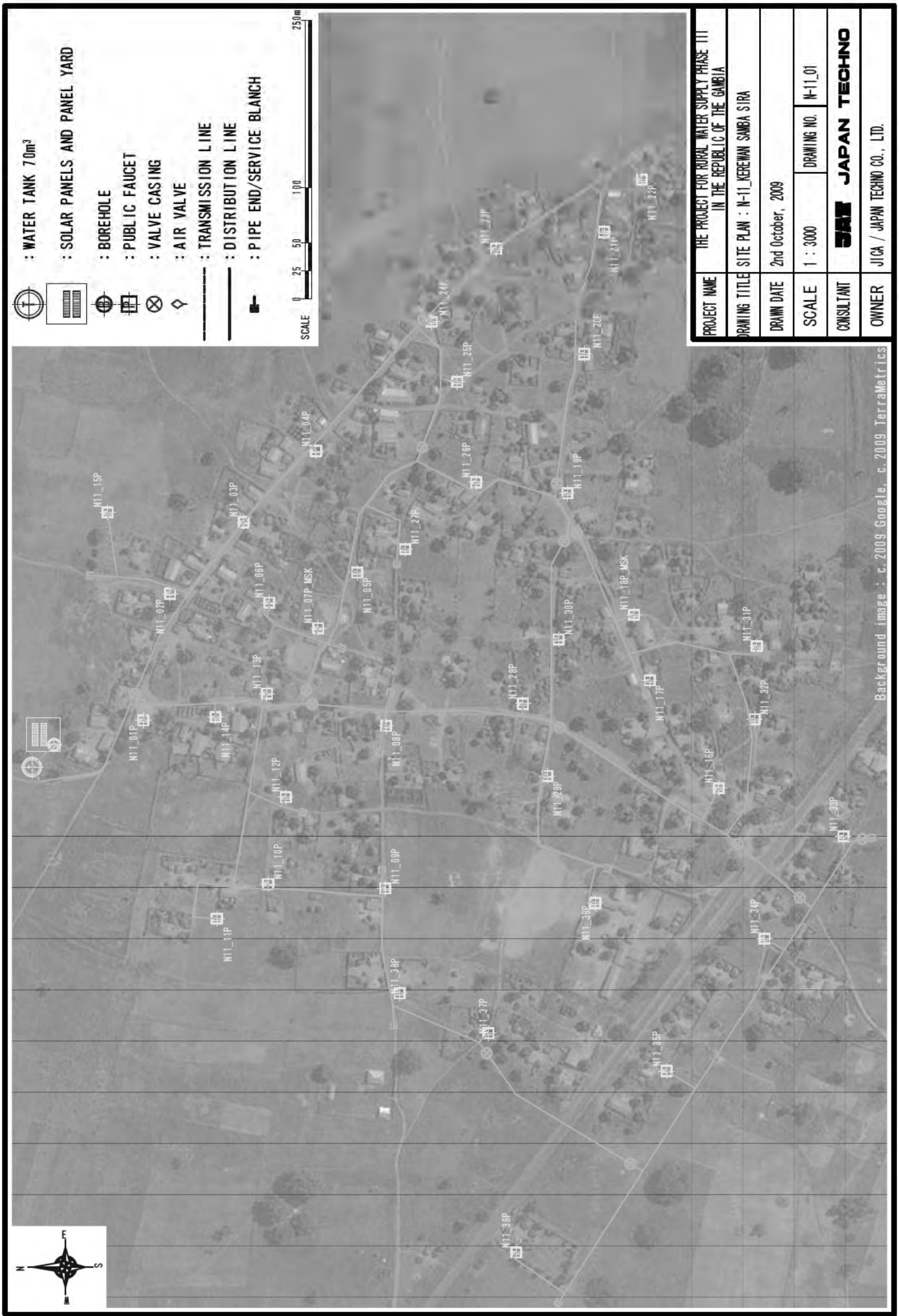

: WATER TANK 30m³
: SOLAR PANELS AND PANEL YARD
: BOREHOLE
: PUBLIC FAUCET
: VALVE CASING
: AIR VALVE
: TRANSMISSION LINE
: DISTRIBUTION LINE
: PIPE END/SERVICE BLANCH
SCALE 0 25 50 100 200 m
PROJECT NAME
THE PROJECT FOR RURAL WATER SUPPLY PHASE III IN THE REPUBLIC OF THE GAMBIA
DRAWING TITLE
SITE PLAN : N-09_FASS
DRAWN DATE
2nd October, 2009
SCALE
1 : 2500
DRAWING NO.
N-09_01
CONSULTANT
JAPAN TECHNO
OWNER
JICA / JAPAN TECHNO CO., LTD.
N09_01P
N09_02P
N09_03P
N09_04P
N09_05P
N09_06P
N09_07P
N09_09P
N09_10P
N09_12P
N09_13P
N09_14P
N
E
S
W
Background Image : c 2009 Google, c 2009 TerraMetrics

Fig.2-9(6)



: WATER TANK 70m³
: SOLAR PANELS AND PANEL YARD
: BOREHOLE
: PUBLIC FAUCET
: VALVE CASING
: AIR VALVE
: TRANSMISSION LINE
: DISTRIBUTION LINE
: PIPE END/SERVICE BLANCH
SCALE
0 25 50 100 250m
PROJECT NAME
THE PROJECT FOR RURAL WATER SUPPLY PHASE III IN THE REPUBLIC OF THE GAMBIA
DRAWING TITLE
SITE PLAN : N-11_KEREWAN SAMBA SIRA
DRAWN DATE
2nd October, 2009
SCALE
1 : 3000
DRAWING NO.
N-11_01
CONSULTANT
JAPAN TECHNO
OWNER
JICA / JAPAN TECHNO CO., LTD.
Background image : c.2009 Google, c.2009 TerraMetrics
N11_01P
N11_02P
N11_03P
N11_04P
N11_05P
N11_06P
N11_07P_MSK
N11_08P
N11_09P
N11_10P
N11_11P
N11_12P
N11_13P
N11_14P
N11_15P
N11_16P
N11_17P
N11_18P_MSK
N11_19P
N11_20P
N11_21P
N11_22P
N11_23P
N11_24P
N11_25P
N11_26P
N11_27P
N11_28P
N11_29P
N11_30P
N11_31P
N11_32P
N11_33P
N11_34P
N11_35P
N11_36P
N11_37P
N11_38P
N11_39P
N
E
S
W

Fig.2-9(7)

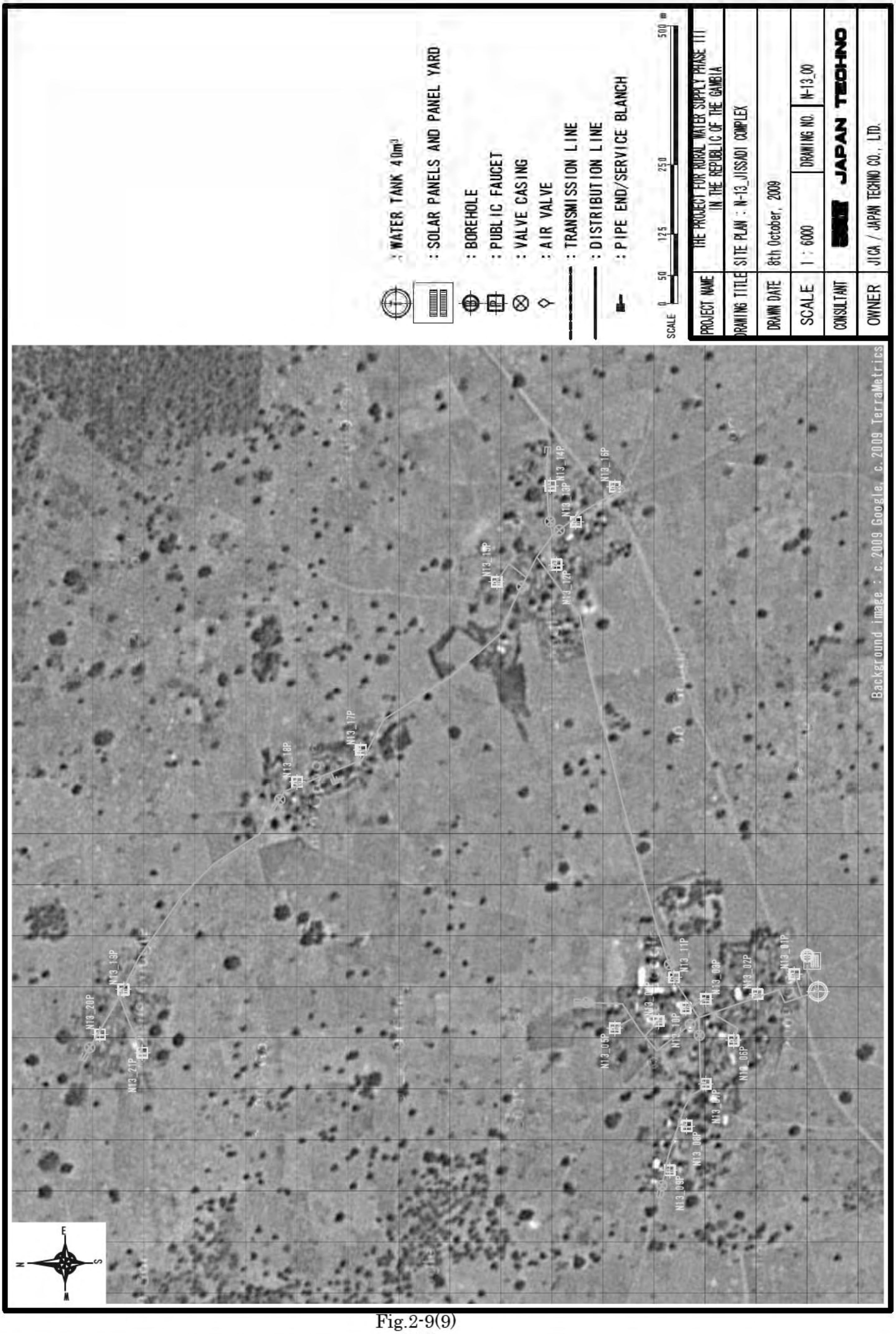
: WATER TANK 30m³
: SOLAR PANELS AND PANEL YARD
: BOREHOLE
: PUBLIC FAUCET
: VALVE CASING
: AIR VALVE

: TRANSMISSION LINE
: DISTRIBUTION LINE
: PIPE END/SERVICE BLANCH

SCALE 0 20 50 100 200 m

PROJECT NAME	THE PROJECT FOR RURAL WATER SUPPLY PHASE III IN THE REPUBLIC OF THE GAMBIA		
DRAWING TITLE	SITE PLAN : N-12_FULA BANTANG, SINCHU SORA		
DRAWN DATE	2nd October, 2009		
SCALE	1 : 3000	DRAWING NO.	N-12_01
CONSULTANT	JAPAN TECHNO		
OWNER	JICA / JAPAN TECHNO CO., LTD.		

Fig.2-9(8)



: WATER TANK 40m³
: SOLAR PANELS AND PANEL YARD
: BOREHOLE
: PUBLIC FAUCET
: VALVE CASING
: AIR VALVE
: TRANSMISSION LINE
: DISTRIBUTION LINE
: PIPE END/SERVICE BLANCH
SCALE 0 50 125 250 500 m
PROJECT NAME
THE PROJECT FOR RURAL WATER SUPPLY PHASE III IN THE REPUBLIC OF THE GAMBIA
DRAWING TITLE
SITE PLAN : N-13_JISSADI COMPLEX
DRAWN DATE
8th October, 2009
SCALE
1 : 6000
DRAWING NO.
N-13_00
CONSULTANT
JAPAN TECHNO
OWNER
JICA / JAPAN TECHNO CO., LTD.
N13_01P
N13_02P
N13_03P
N13_05P
N13_06P
N13_08P
N13_09P
N13_10P
N13_11P
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N13_15P
N13_16P
N13_17P
N13_18P
N13_19P
N13_20P
N13_21P
N
E
S
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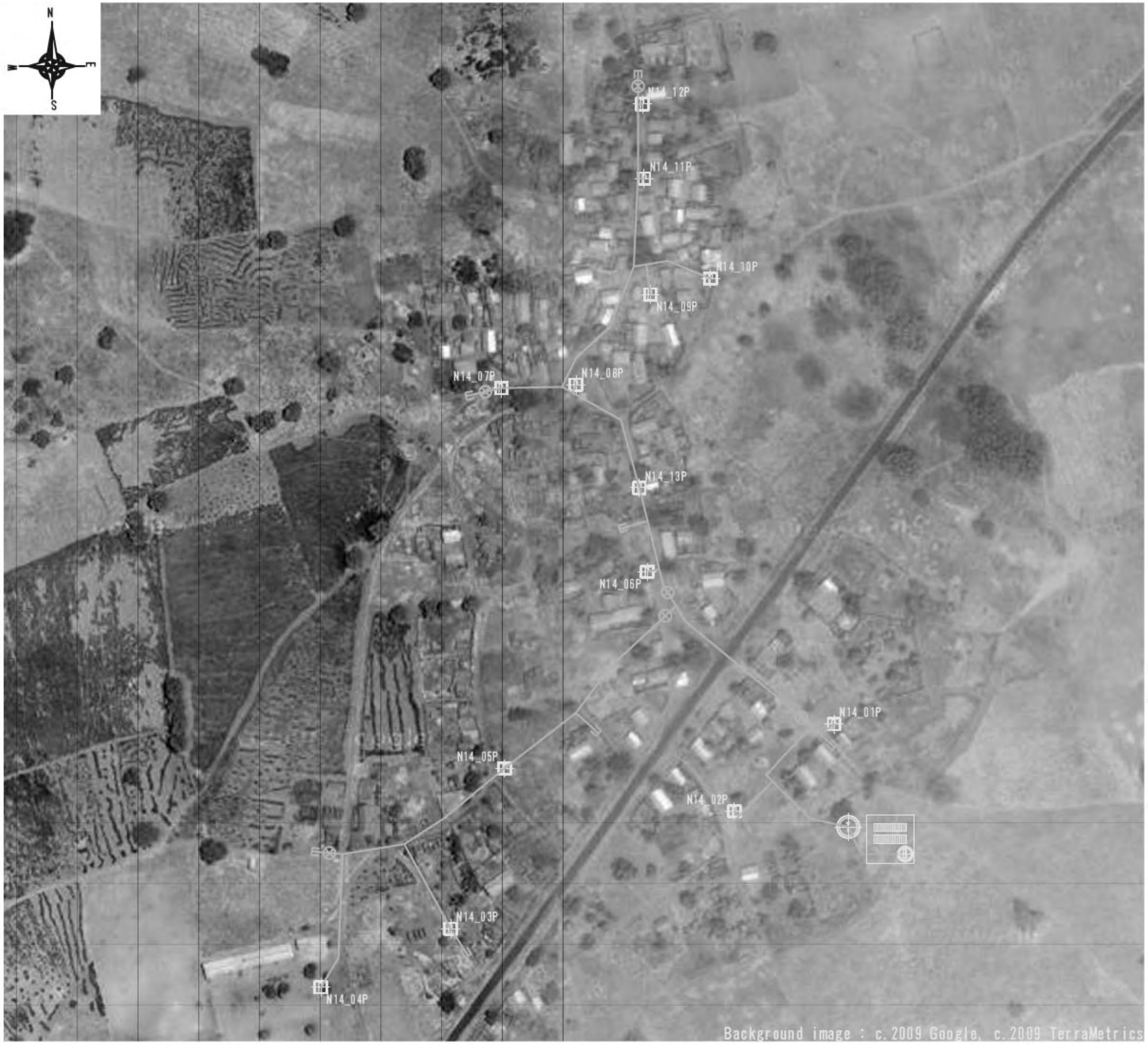
Background image : c.2009 Google, c.2009 TerraMetrics

Fig.2-9(9)



: WATER TANK 30m³
: SOLAR PANELS AND PANEL YARD
: BOREHOLE
: PUBLIC FAUCET
: VALVE CASING
: AIR VALVE
: TRANSMISSION LINE
: DISTRIBUTION LINE
: PIPE END/SERVICE BLANCH

SCALE 0 25 50 100 200 m

PROJECT NAME	THE PROJECT FOR RURAL WATER SUPPLY PHASE III IN THE REPUBLIC OF THE GAMBIA		
DRAWING TITLE	SITE PLAN : N-14_SOTOKOI		
DRAWN DATE	20th October, 2009		
SCALE	1 : 2500	DRAWING NO.	N-14_01
CONSULTANT	JAPAN TECHNO		
OWNER	JICA / JAPAN TECHNO CO., LTD.		

Fig.2-9(10)