STA. 3+900, Mamti Khola Causeway

Contour drawings with overlay of Drone image

PROFILE	CO-ORDINATES		ELEVATION (A.M.S.L.)	REMARKS
	EASTING	NORTHING		
G-6	379387.772	3036132.225	626.687	
G-7	379320.174	3036181.741	633.448	
G-8	379550.027	3036240.139	616.213	
G-9	379666.328	3036174.142	607.361	
G-10	379727.709	3036254.705	600.138	

NOTES:

1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

LEGENDS:

MAJOR CONTOUR 640

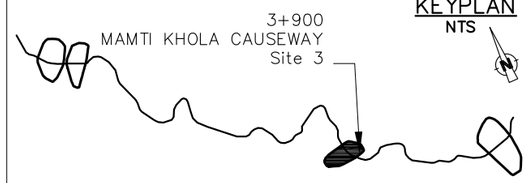
MINOR CONTOUR 638

SCALE: 0 5 10 15 20 25m

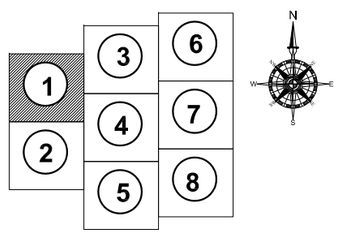
1:500

KEYPLAN

NTS



SHEET PLAN



PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

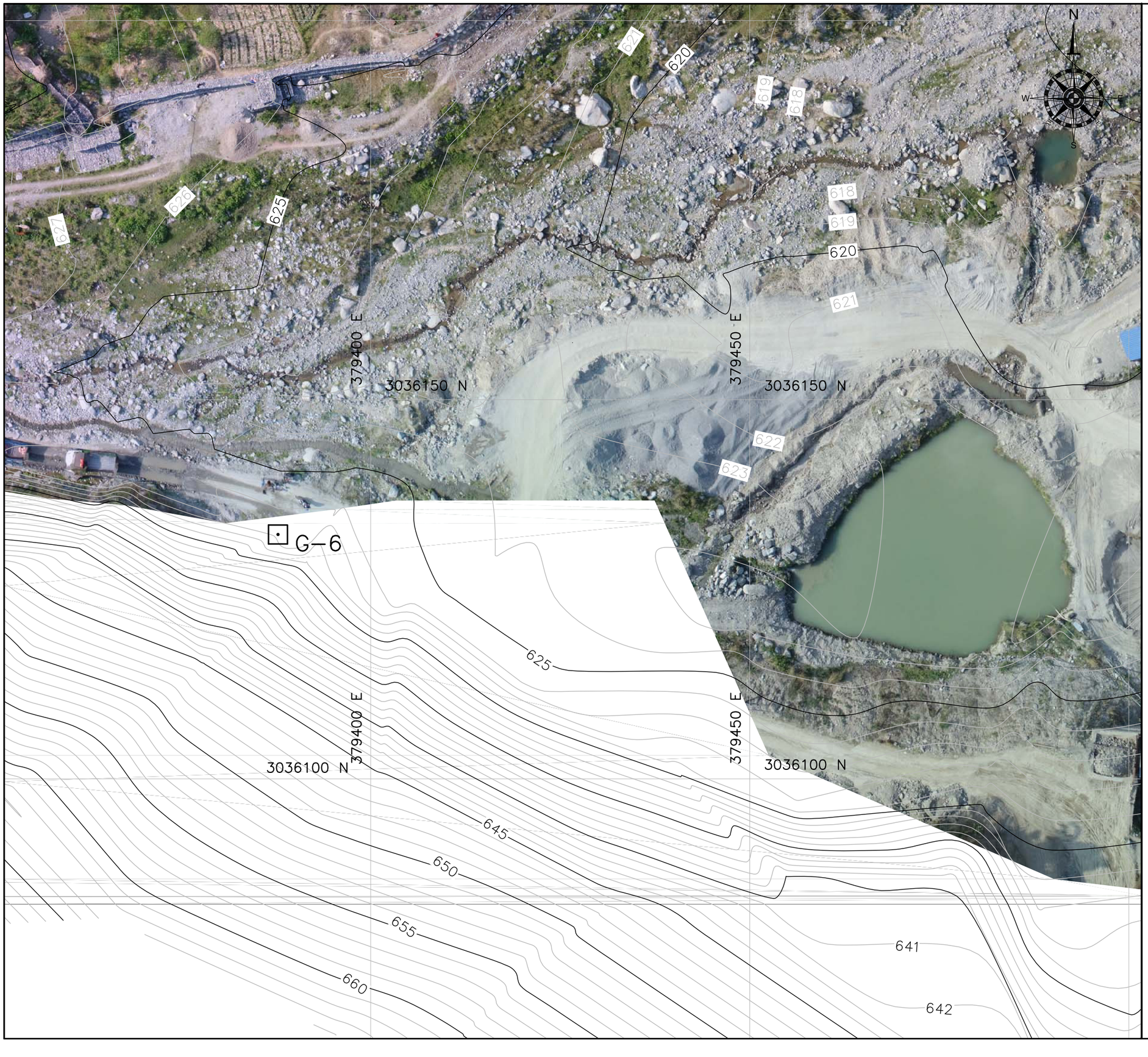
Client: Nippon Koei Co., Ltd.

Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Mamti Khola Causeway

Contour drawings with overlay of Drone image

Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-MKC-CD-001	Rev. –	Date: June, 2019



PROFILE	CO-ORDINATES		ELEVATION (A.M.S.L.)	REMARKS
	EASTING	NORTHING		
G-6	379387.772	3036132.225	626.687	
G-7	379320.174	3036181.741	633.448	
G-8	379550.027	3036240.139	616.213	
G-9	379666.328	3036174.142	607.361	
G-10	379727.709	3036254.705	600.138	

NOTES:

1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

LEGENDS:

MAJOR CONTOUR 640

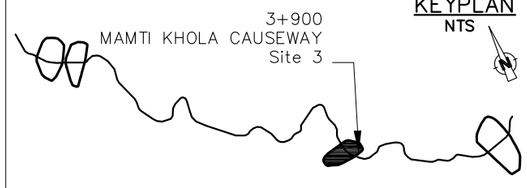
MINOR CONTOUR 638

SCALE: 0 5 10 15 20 25m

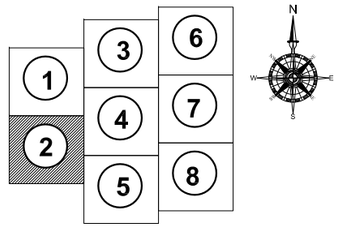
1:500

KEYPLAN

NTS



SHEET PLAN



PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

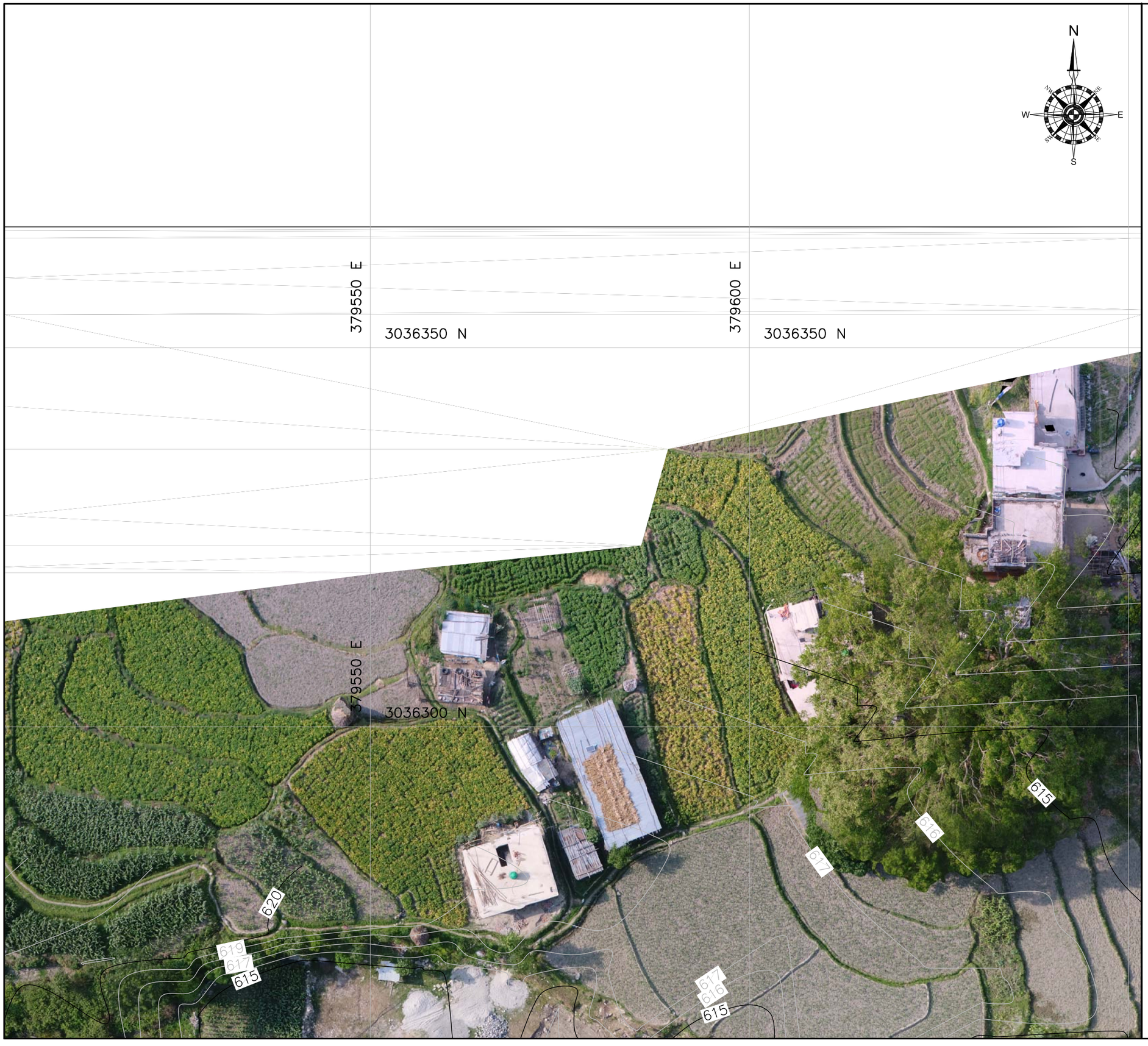
Client: Nippon Koei Co., Ltd.

Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Mamti Khola Causeway

Contour drawings with overlay of Drone image

Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-MKC-CD-002	Rev. –	Date: June, 2019



PROFILE	CO-ORDINATES		ELEVATION (A.M.S.L.)	REMARKS
	EASTING	NORTHING		
G-6	379387.772	3036132.225	626.687	
G-7	379320.174	3036181.741	633.448	
G-8	379550.027	3036240.139	616.213	
G-9	379666.328	3036174.142	607.361	
G-10	379727.709	3036254.705	600.138	

NOTES:

1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

LEGENDS:

MAJOR CONTOUR 640

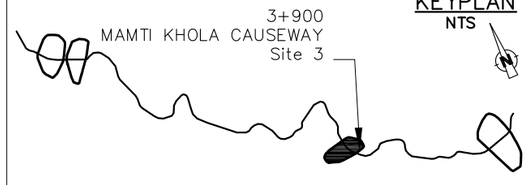
MINOR CONTOUR 638

SCALE: 0 5 10 15 20 25m

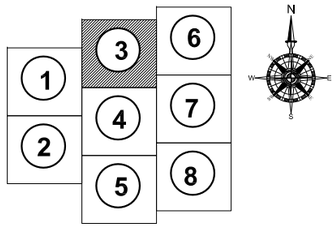
1:500

KEYPLAN

NTS



SHEET PLAN



PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Mamti Khola Causeway

Contour drawings with overlay of Drone image

Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-MKC-CD-003	Rev. –	Date: June, 2019

PROFILE	CO-ORDINATES		ELEVATION (A.M.S.L.)	REMARKS
	EASTING	NORTHING		
G-6	379387.772	3036132.225	626.687	
G-7	379320.174	3036181.741	633.448	
G-8	379550.027	3036240.139	616.213	
G-9	379666.328	3036174.142	607.361	
G-10	379727.709	3036254.705	600.138	

NOTES:

1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

LEGENDS:

MAJOR CONTOUR 640

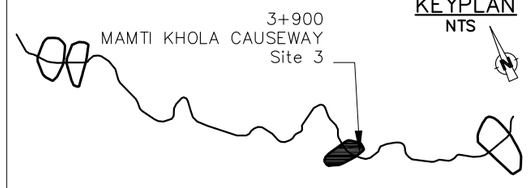
MINOR CONTOUR 638

SCALE: 1:500

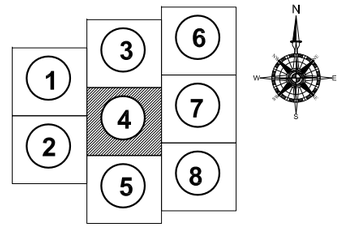
0 5 10 15 20 25m

KEYPLAN

NTS



SHEET PLAN



PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

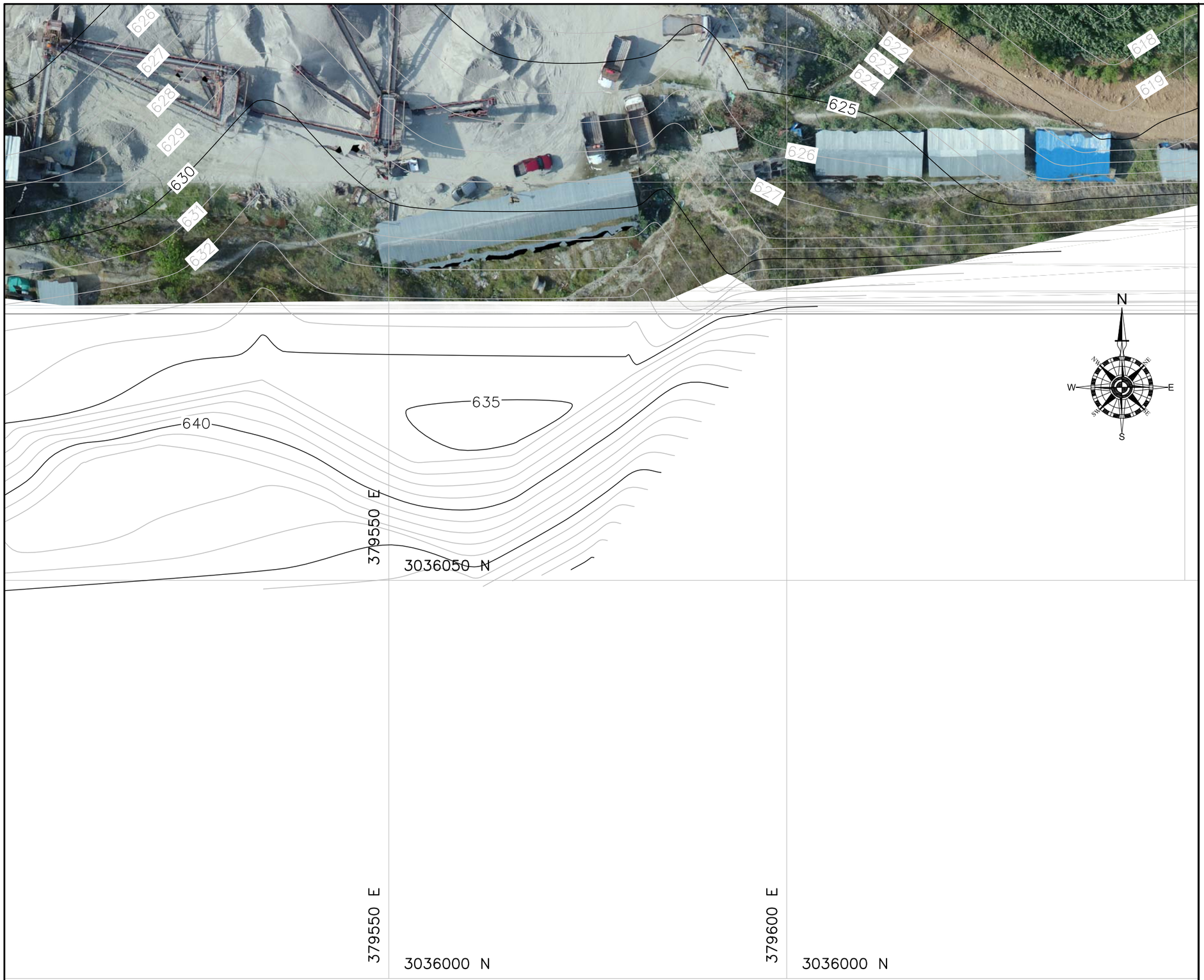
Client: Nippon Koei Co., Ltd.

Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Mamti Khola Causeway

Contour drawings with overlay of Drone image

Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-MKC-CD-004	Rev.: –	Date: June, 2019



PROFILE	CO-ORDINATES		ELEVATION (A.M.S.L.)	REMARKS
	EASTING	NORTHING		
G-6	379387.772	3036132.225	626.687	
G-7	379320.174	3036181.741	633.448	
G-8	379550.027	3036240.139	616.213	
G-9	379666.328	3036174.142	607.361	
G-10	379727.709	3036254.705	600.138	

NOTES:

1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

LEGENDS:

MAJOR CONTOUR 640

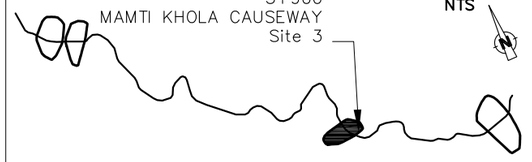
MINOR CONTOUR 638

SCALE: 0 5 10 15 20 25m

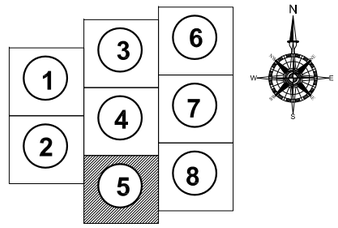
1:500

KEYPLAN

NTS



SHEET PLAN



PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Mamti Khola Causeway

Contour drawings with overlay of Drone image

Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-MKC-CD-005	Rev. –	Date: June, 2019

379700 E

3036400 N

379750 E

3036400 N

PROFILE	CO-ORDINATES		ELEVATION (A.M.S.L.)	REMARKS
	EASTING	NORTHING		
G-6	379387.772	3036132.225	626.687	
G-7	379320.174	3036181.741	633.448	
G-8	379550.027	3036240.139	616.213	
G-9	379666.328	3036174.142	607.361	
G-10	379727.709	3036254.705	600.138	

NOTES:

1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

LEGENDS:

MAJOR CONTOUR 640

MINOR CONTOUR 638

SCALE: 0 5 10 15 20 25m

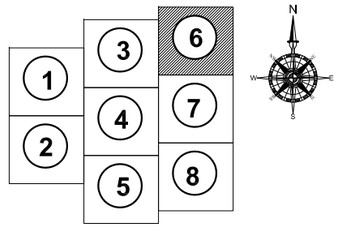
1:500

KEYPLAN

NTS

3+900
MAMTI KHOLA CAUSEWAY
Site 3

SHEET PLAN



PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Mamti Khola Causeway
Contour drawings with overlay of Drone image

Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-MKC-CM-006	Rev. –	Date: June, 2019

PROFILE	CO-ORDINATES		ELEVATION (A.M.S.L.)	REMARKS
	EASTING	NORTHING		
G-6	379387.772	3036132.225	626.687	
G-7	379320.174	3036181.741	633.448	
G-8	379550.027	3036240.139	616.213	
G-9	379666.328	3036174.142	607.361	
G-10	379727.709	3036254.705	600.138	

NOTES:

1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

LEGENDS:

MAJOR CONTOUR 640

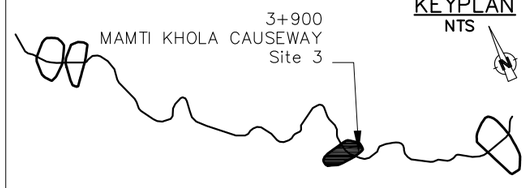
MINOR CONTOUR 638

SCALE: 0 5 10 15 20 25m

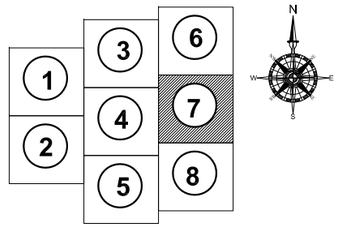
1:500

KEYPLAN

NTS



SHEET PLAN



PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title:

Mamti Khola Causeway

Contour drawings with overlay of Drone image

Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-MKC-CD-007	Rev.: –	Date: June, 2019

379700 E
3036050 N

379750 E
3036050 N

PROFILE	CO-ORDINATES		ELEVATION (A.M.S.L.)	REMARKS
	EASTING	NORTHING		
G-6	379387.772	3036132.225	626.687	
G-7	379320.174	3036181.741	633.448	
G-8	379550.027	3036240.139	616.213	
G-9	379666.328	3036174.142	607.361	
G-10	379727.709	3036254.705	600.138	

NOTES:

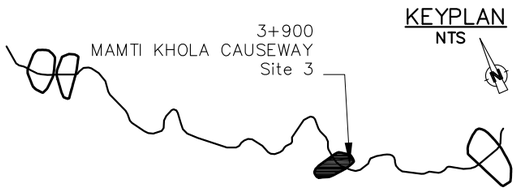
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

LEGENDS:

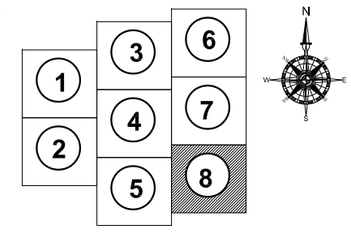
MAJOR CONTOUR 640
MINOR CONTOUR 638

SCALE: 0 5 10 15 20 25m
1:500

KEYPLAN
NTS



SHEET PLAN



PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

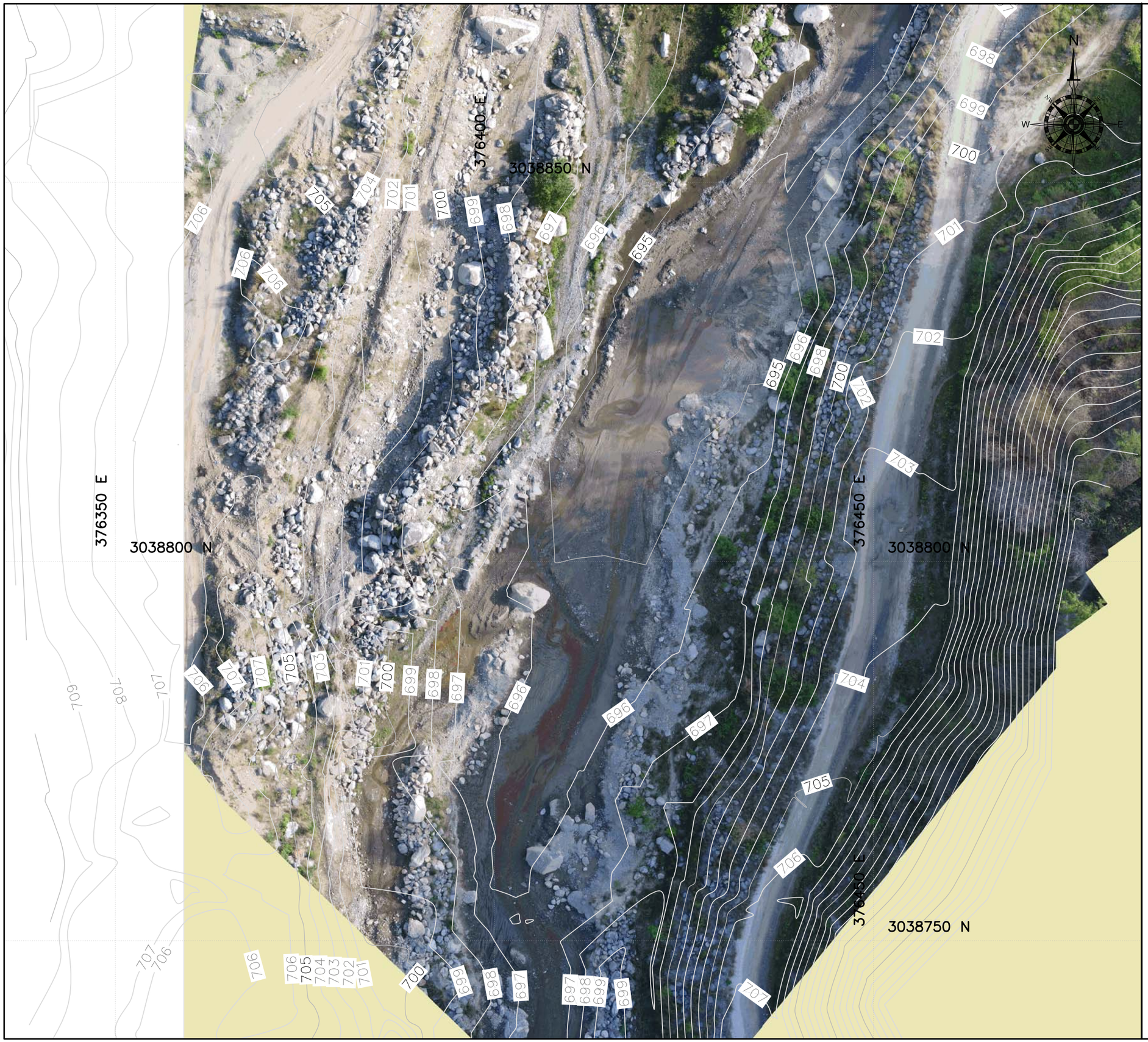
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Mamti Khola Causeway
Contour drawings with overlay of Drone image

Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-MKC-CD-008	Rev. –	Date: June, 2019

STA.9+700 Bhyakure Khola Causeway

Contour drawings with overlay of Drone image



PROFILE	CO-ORDINATES		ELEVATION (A.M.S.L.)	REMARKS
	EASTING	NORTHING		
G-11	376408.165	3038669.19	701.6804	
G-12	376375.906	3038892.369	705.8871	
G-13	376586.161	3039037.172	692.535	
G-14	376560.622	3039166.569	682.2846	

NOTES:

1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

LEGENDS:

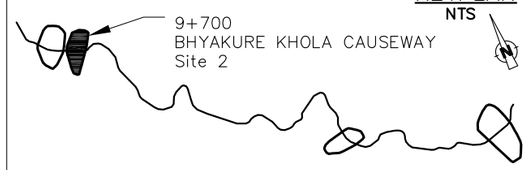
MAJOR CONTOUR 640

MINOR CONTOUR 638

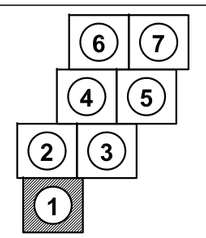
SCALE: 0 5 10 15 20 25m

1: 500

KEYPLAN NTS



SHEET PLAN



PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

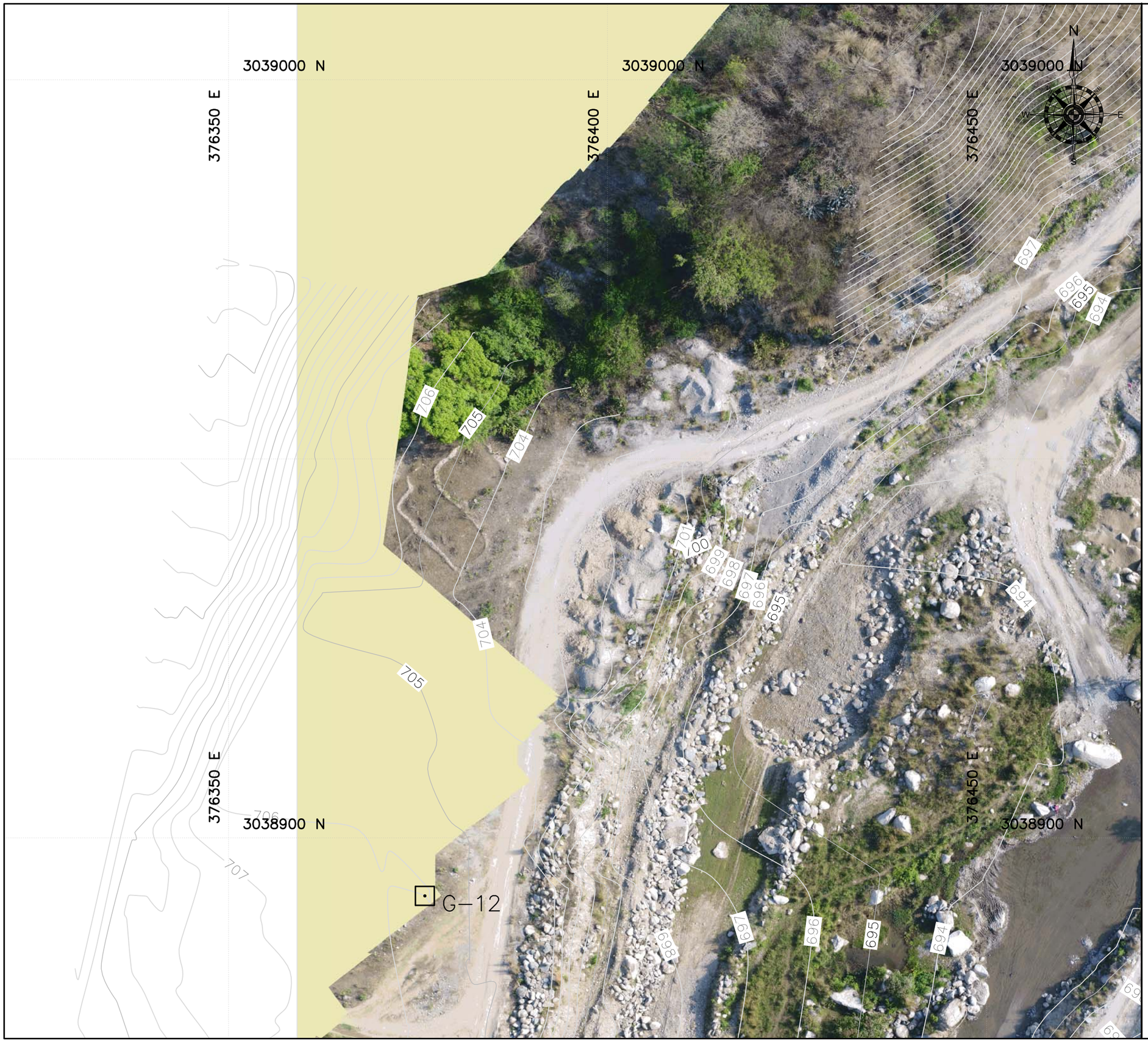
Client: Nippon Koei Co., Ltd.

Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Bhyakure Khola Causeway

Contour drawings with overlay of Drone image

Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-BKC-CD-001	Rev. –	Date: June, 2019



PROFILE	CO-ORDINATES		ELEVATION (A.M.S.L.)	REMARKS
	EASTING	NORTHING		
G-11	376408.165	3038669.19	701.6804	
G-12	376375.906	3038892.369	705.8871	
G-13	376586.161	3039037.172	692.535	
G-14	376560.622	3039166.569	682.2846	

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

LEGENDS:
MAJOR CONTOUR 640
MINOR CONTOUR 638

SCALE: 0 5 10 15 20 25m
1:500

KEYPLAN
NTS
9+700
BHYAKURE KHOLA CAUSEWAY
Site 2

SHEET PLAN
6 7
4 5
2 3
1

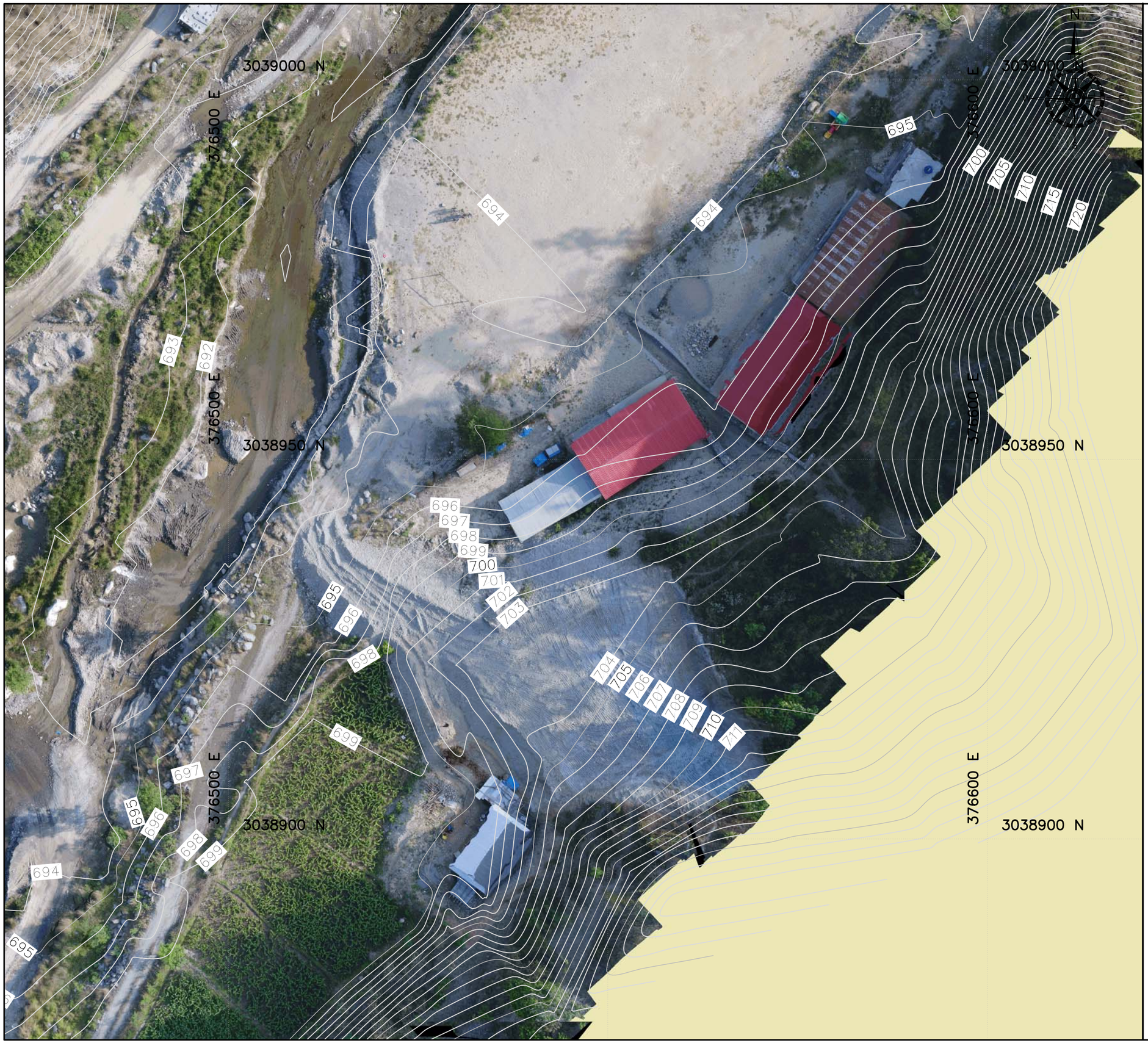
PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Bhyakure Khola Causeway
Contour drawings with overlay of Drone image

Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-BKC-CD-002	Rev.: –	Date: June, 2019



PROFILE	CO-ORDINATES		ELEVATION (A.M.S.L.)	REMARKS
	EASTING	NORTHING		
G-11	376408.165	3038669.19	701.6804	
G-12	376375.906	3038892.369	705.8871	
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G-14	376560.622	3039166.569	682.2846	

NOTES:

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2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

LEGENDS:

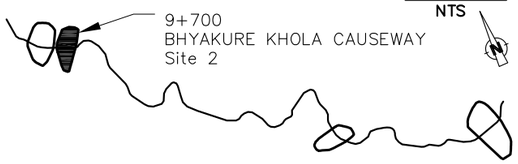
MAJOR CONTOUR 640

MINOR CONTOUR 638

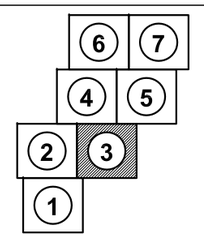
SCALE: 0 5 10 15 20 25m

1:500

KEYPLAN NTS



SHEET PLAN



PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Bhyakure Khola Causeway

Contour drawings with overlay of Drone image

Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-BKC-CD-003	Rev. –	Date: June, 2019

PROFILE	CO-ORDINATES		ELEVATION (A.M.S.L.)	REMARKS
	EASTING	NORTHING		
G-11	376408.165	3038669.19	701.6804	
G-12	376375.906	3038892.369	705.8871	
G-13	376586.161	3039037.172	692.535	
G-14	376560.622	3039166.569	682.2846	

NOTES:

1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
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LEGENDS:

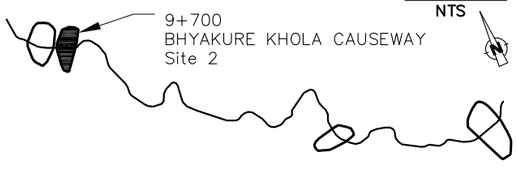
MAJOR CONTOUR 640

MINOR CONTOUR 638

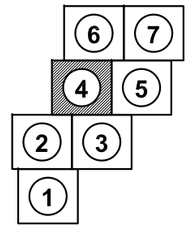
SCALE: 0 5 10 15 20 25m

1:500

KEYPLAN NTS



SHEET PLAN



PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Bhyakure Khola Causeway

Contour drawings with overlay of Drone image

Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-BKC-CD-004	Rev. –	Date: June, 2019

PROFILE	CO–ORDINATES		ELEVATION (A.M.S.L.)	REMARKS
	EASTING	NORTHING		
G–11	376408.165	3038669.19	701.6804	
G–12	376375.906	3038892.369	705.8871	
G–13	376586.161	3039037.172	692.535	
G–14	376560.622	3039166.569	682.2846	

NOTES:

1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

LEGENDS:

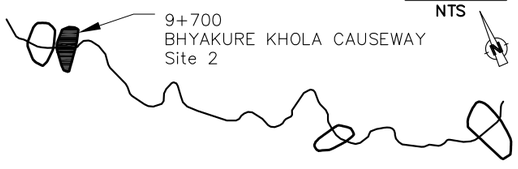
MAJOR CONTOUR 640

MINOR CONTOUR 638

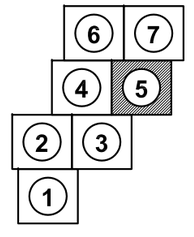
SCALE: 0 5 10 15 20 25m

1:500

KEYPLAN NTS



SHEET PLAN



PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Bhyakure Khola Causeway

Contour drawings with overlay of Drone image

Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-BKC-CD-005	Rev. –	Date: June, 2019

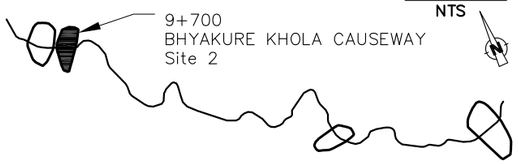
PROFILE	CO-ORDINATES		ELEVATION (A.M.S.L.)	REMARKS
	EASTING	NORTHING		
G-11	376408.165	3038669.19	701.6804	
G-12	376375.906	3038892.369	705.8871	
G-13	376586.161	3039037.172	692.535	
G-14	376560.622	3039166.569	682.2846	

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

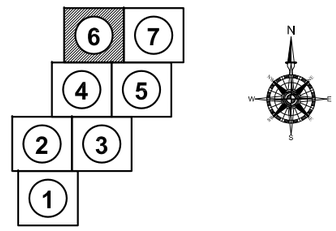
LEGENDS:
MAJOR CONTOUR 640
MINOR CONTOUR 638

SCALE: 0 5 10 15 20 25m
1:500

KEYPLAN
NTS



SHEET PLAN



PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Bhyakure Khola Causeway
Contour drawings with overlay of Drone image

Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-BKC-CD-006	Rev. –	Date: June, 2019

PROFILE	CO-ORDINATES		ELEVATION (A.M.S.L.)	REMARKS
	EASTING	NORTHING		
G-11	376408.165	3038669.19	701.6804	
G-12	376375.906	3038892.369	705.8871	
G-13	376586.161	3039037.172	692.535	
G-14	376560.622	3039166.569	682.2846	

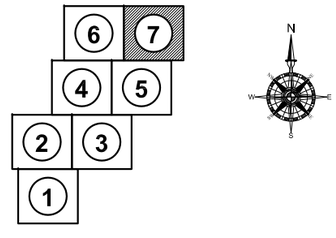
NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

LEGENDS:
MAJOR CONTOUR 640
MINOR CONTOUR 638

SCALE: 0 5 10 15 20 25m
1:500

KEYPLAN
NTS
9+700
BHYAKURE KHOLA CAUSEWAY
Site 2

SHEET PLAN



PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

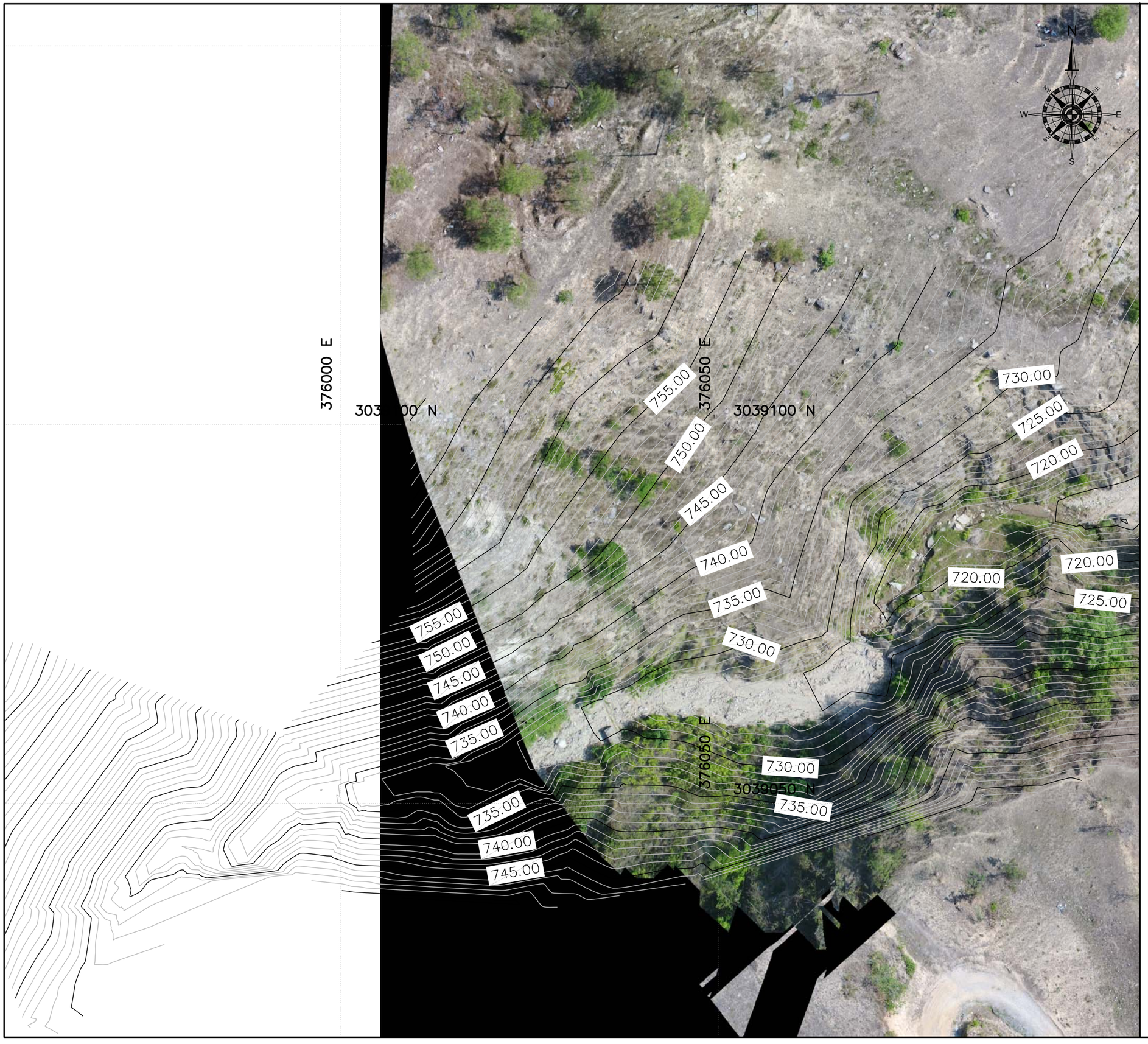
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Bhyakure Khola Causeway
Contour drawings with overlay of Drone image

Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-BKC-CD-007	Rev. –	Date: June, 2019

STA. 10+100 Kaldhunga Roadway

Contour drawings with overlay of Drone image



PROFILE	CO-ORDINATES		ELEVATION (A.M.S.L.)	REMARKS
	EASTING	NORTHING		
G-15	376130.090	3039255.041	689.453	
G-16	376147.196	3039115.340	705.137	
G-17	376274.910	3039289.985	687.878	
G-18	376203.976	3039208.555	692.411	

NOTES:

1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

LEGENDS:

MAJOR CONTOUR 640

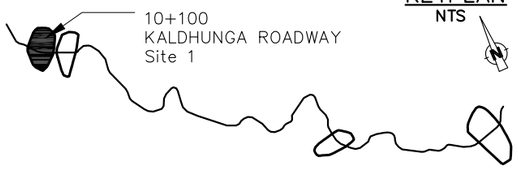
MINOR CONTOUR 638

SCALE: 0 5 10 15 20 25m

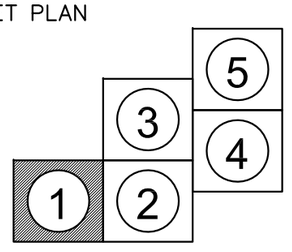
1:500

KEYPLAN

NTS



SHEET PLAN



PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

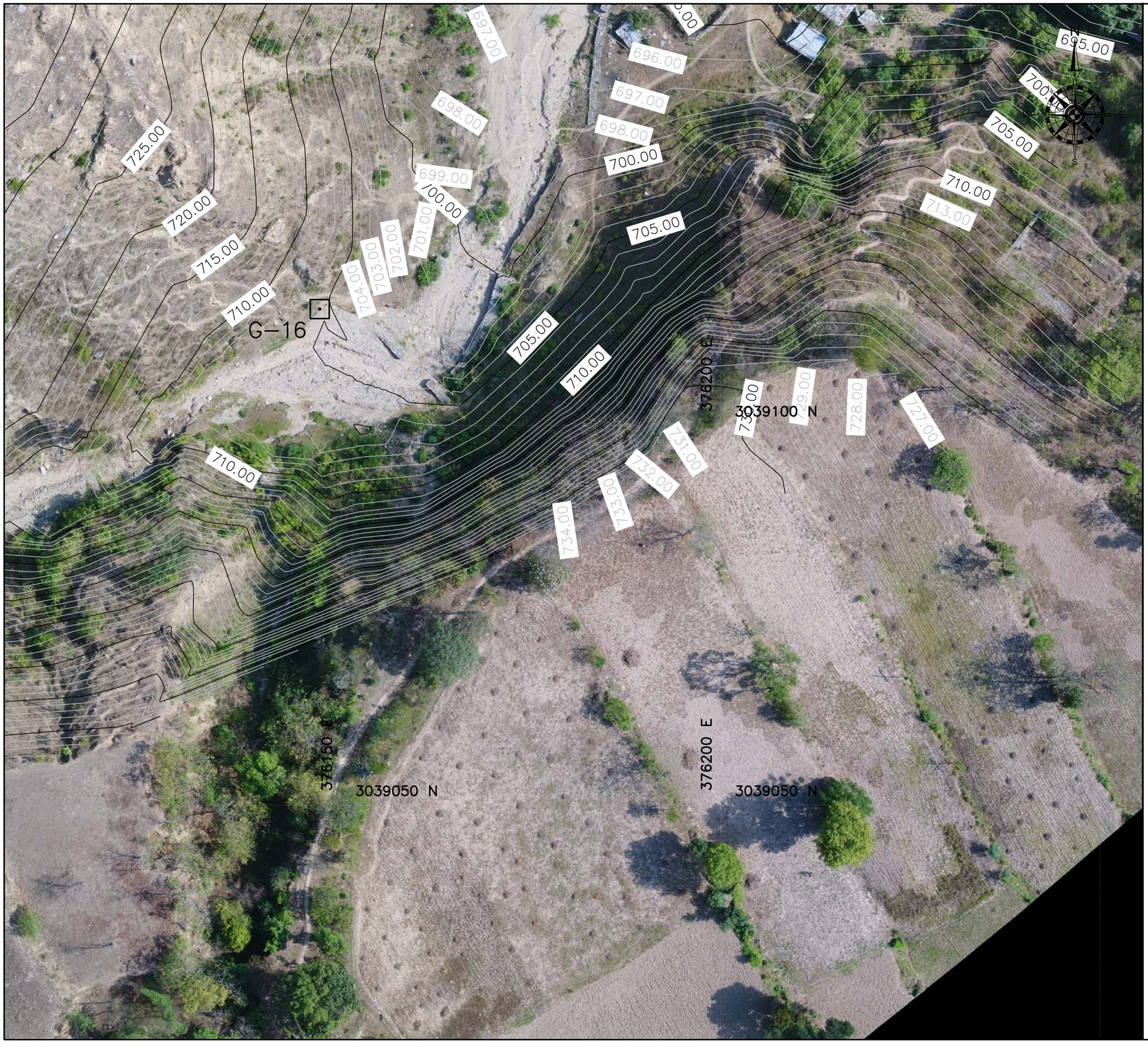
Client: Nippon Koei Co., Ltd.

Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Kaldhunga Roadway

Contour drawings with overlay of Drone Image

Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-KDR-CD-001	Rev. –	Date: June, 2019



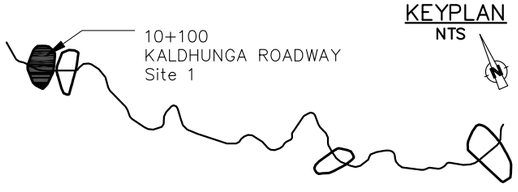
PROFILE	CO–ORDINATES		ELEVATION (A.M.S.L.)	REMARKS
	EASTING	NORTHING		
G–15	376130.090	3039255.041	689.453	
G–16	376147.196	3039115.340	705.137	
G–17	376274.910	3039289.985	687.878	
G–18	376203.976	3039208.555	692.411	

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

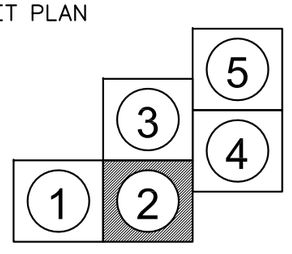
LEGENDS:
MAJOR CONTOUR 640
MINOR CONTOUR 638

SCALE: 0 5 10 15 20 25m
1:500

KEYPLAN
NTS



SHEET PLAN



PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Kaldhunga Roadway
Contour drawings with overlay of Drone Image

Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-KDR-CD-002	Rev.: –	Date: June, 2019

PROFILE	CO–ORDINATES		ELEVATION (A.M.S.L.)	REMARKS
	EASTING	NORTHING		
G–15	376130.090	3039255.041	689.453	
G–16	376147.196	3039115.340	705.137	
G–17	376274.910	3039289.985	687.878	
G–18	376203.976	3039208.555	692.411	

NOTES:

1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

LEGENDS:

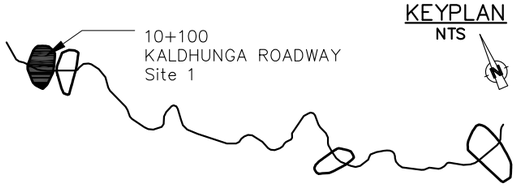
MAJOR CONTOUR 640

MINOR CONTOUR 638

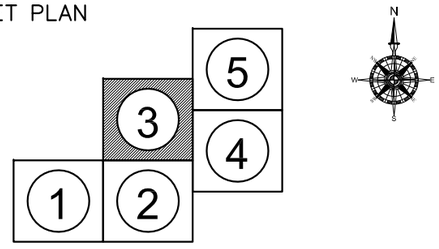
SCALE: 0 5 10 15 20 25m

1:500

KEYPLAN NTS



SHEET PLAN



PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Kaldhunga Roadway
Contour drawings with overlay of Drone Image

Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-KDR-CD-003	Rev. –	Date: June, 2019

PROFILE	CO-ORDINATES		ELEVATION (A.M.S.L.)	REMARKS
	EASTING	NORTHING		
G-15	376130.090	3039255.041	689.453	
G-16	376147.196	3039115.340	705.137	
G-17	376274.910	3039289.985	687.878	
G-18	376203.976	3039208.555	692.411	

NOTES:

1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

LEGENDS:

MAJOR CONTOUR 640

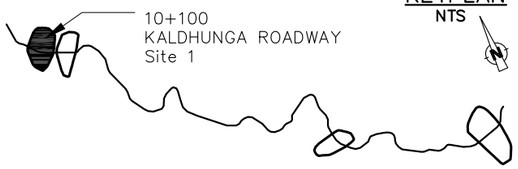
MINOR CONTOUR 638

SCALE: 0 5 10 15 20 25m

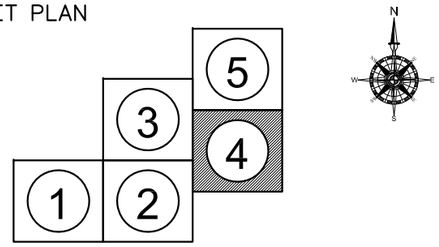
1:500

KEYPLAN

NTS



SHEET PLAN



PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Kaldhunga Roadway

Contour drawings with overlay of Drone Image

Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-KDR-CD-004	Rev. –	Date: June, 2019

PROFILE	CO–ORDINATES		ELEVATION (A.M.S.L.)	REMARKS
	EASTING	NORTHING		
G–15	376130.090	3039255.041	689.453	
G–16	376147.196	3039115.340	705.137	
G–17	376274.910	3039289.985	687.878	
G–18	376203.976	3039208.555	692.411	

NOTES:

1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

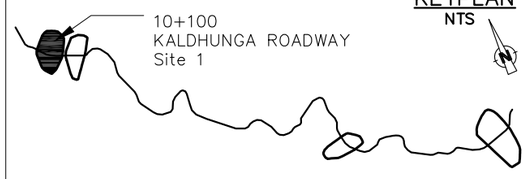
LEGENDS:

MAJOR CONTOUR 640

MINOR CONTOUR 638

SCALE: 0 5 10 15 20 25m

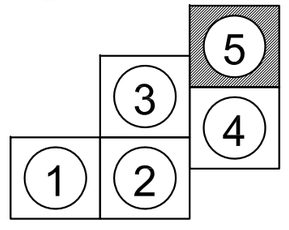
1:500



KEYPLAN

NTS

SHEET PLAN



PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

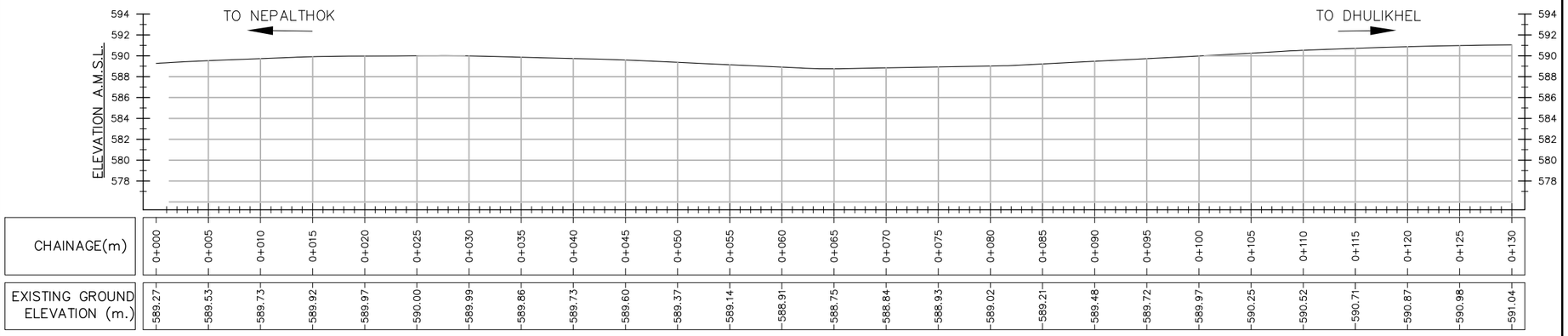
Title: Kaldhunga Roadway
Contour drawings with overlay of Drone Image

Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-KDR-CD-005	Rev. –	Date: June, 2019

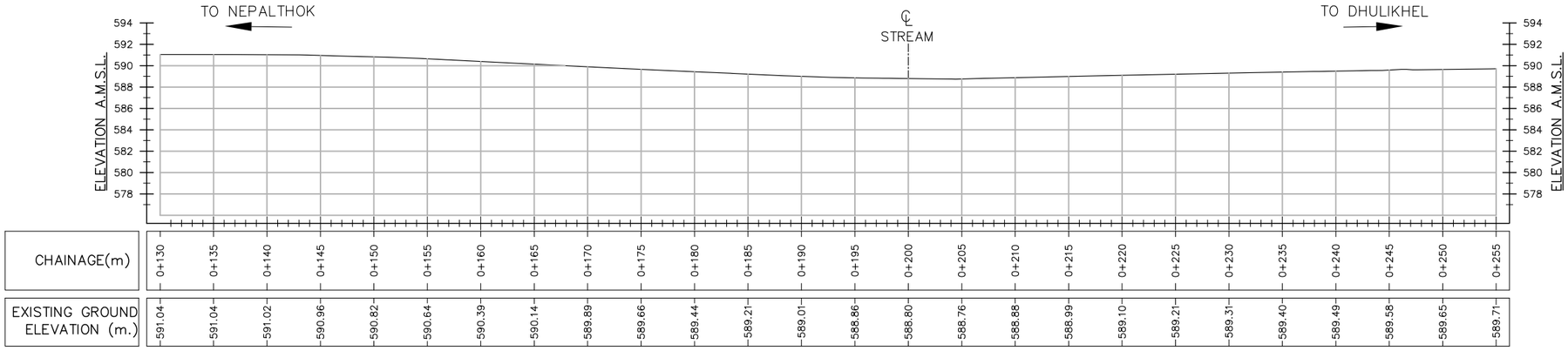
APPENDIX 6: LONGITUDINAL PROFILE & CROSS SECTIONS OF ROAD/HIGHWAY

STA. 1+400, Ghyampe Khola Causeway

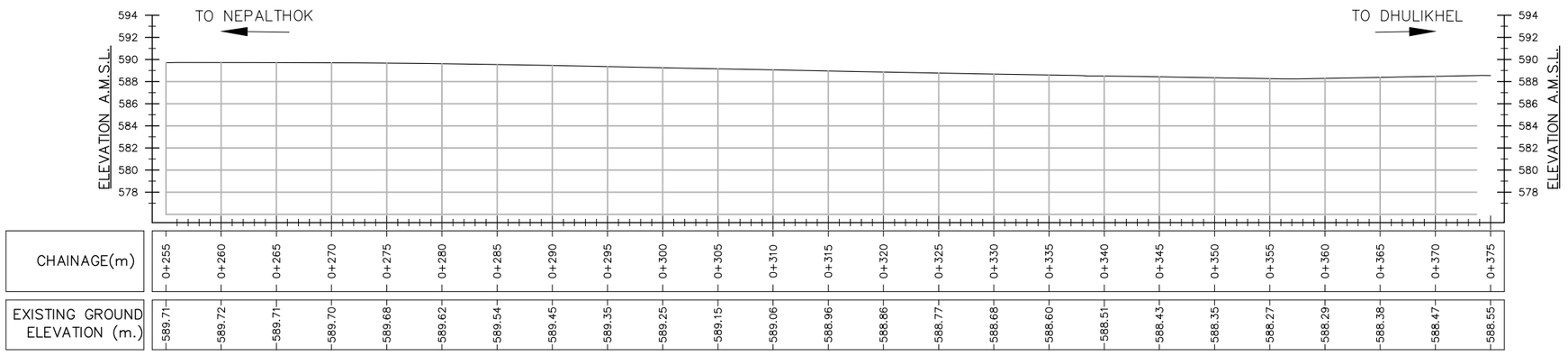
LONGITUDINAL PROFILE & CROSS SECTIONS OF ROAD/HIGHWAY



GHYAMPE KHOLA CAUSEWAY
MAIN ROAD/HIGHWAY LONGITUDINAL PROFILE
(CH 0+000 – 0+130)
SCALE: 500



GHYAMPE KHOLA CAUSEWAY
MAIN ROAD/HIGHWAY LONGITUDINAL PROFILE
(CH 0+130 – 0+255)
SCALE: 500

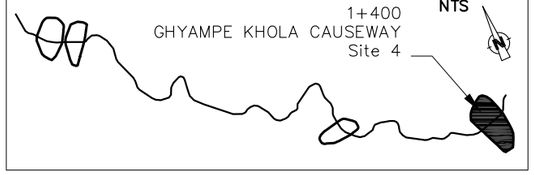


GHYAMPE KHOLA CAUSEWAY
MAIN ROAD/HIGHWAY LONGITUDINAL PROFILE
(CH 0+255 – 0+375)
SCALE: 500

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 0 5 10 15 20 25m
1: 500

KEYPLAN
NTS



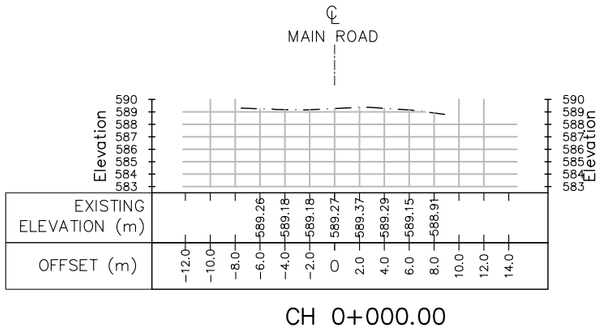
PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

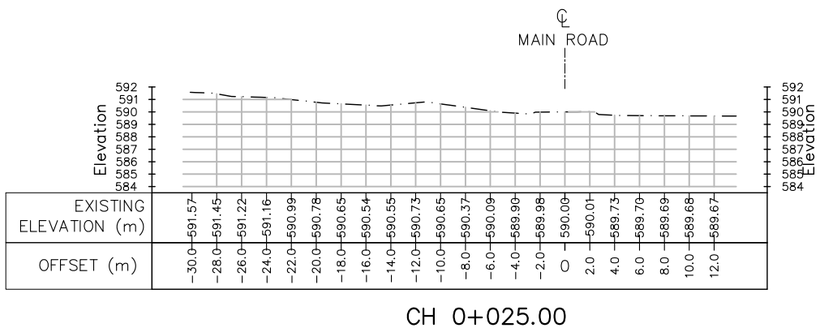
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Ghyampe Khola Causeway
Longitudinal Profile of Main Road
CH 0+000 – 0+375

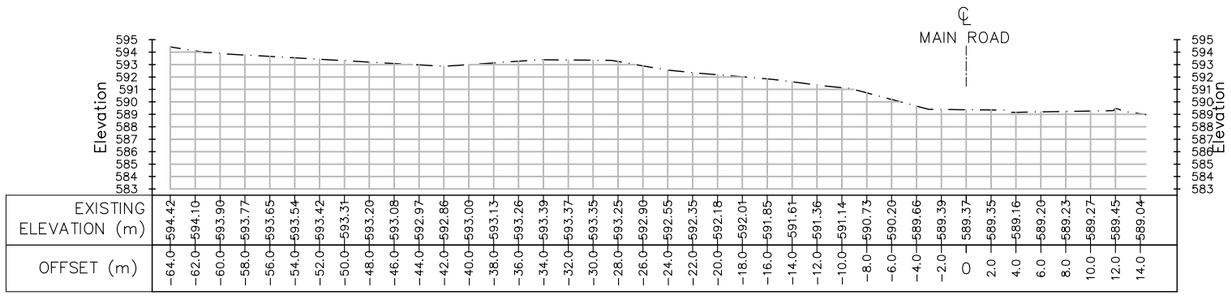
Scale A1: 1: 250 Scale A3: 1: 500	Drawing No.: SR2-GKC-LPR-001	Rev. --	Date: June, 2019



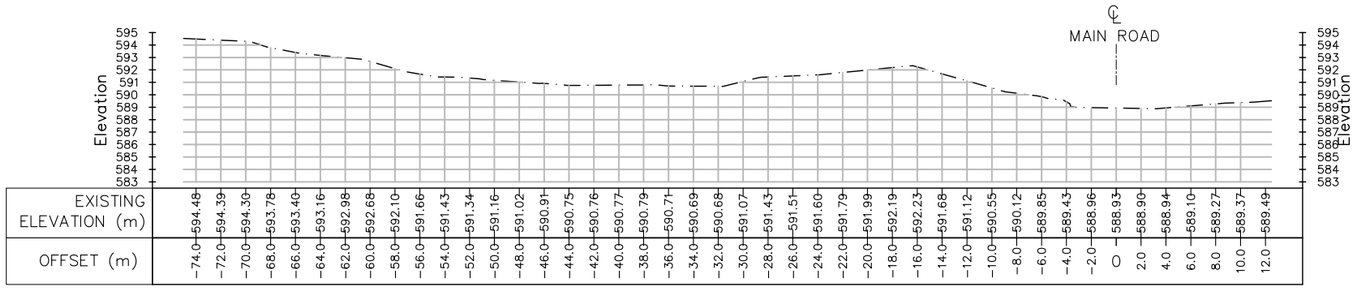
CH 0+000.00



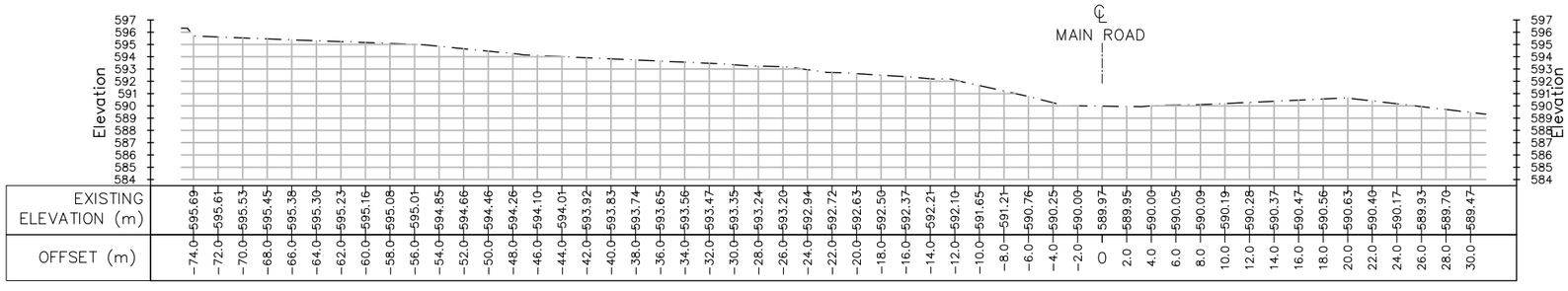
CH 0+025.00



CH 0+050.00



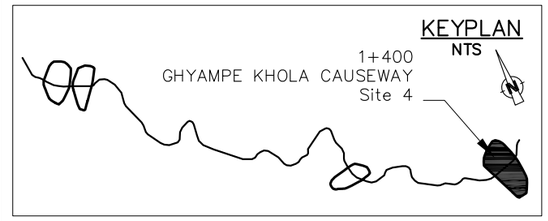
CH 0+075.00



CH 0+100.00

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 1:500



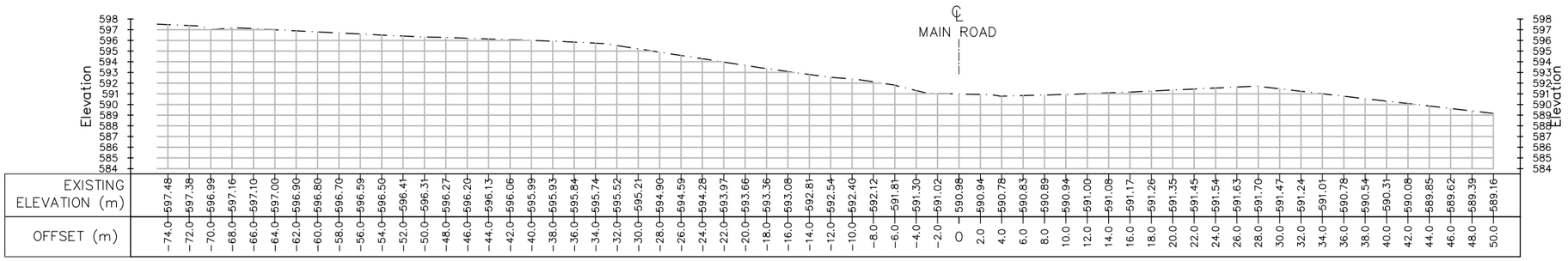
PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

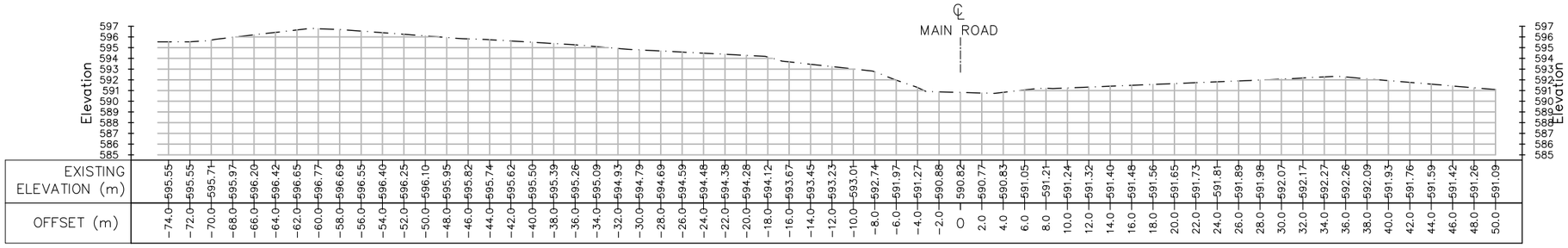
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Ghyampe Khola Causeway
Cross Section of Road
CH 0+000 TO 0+100

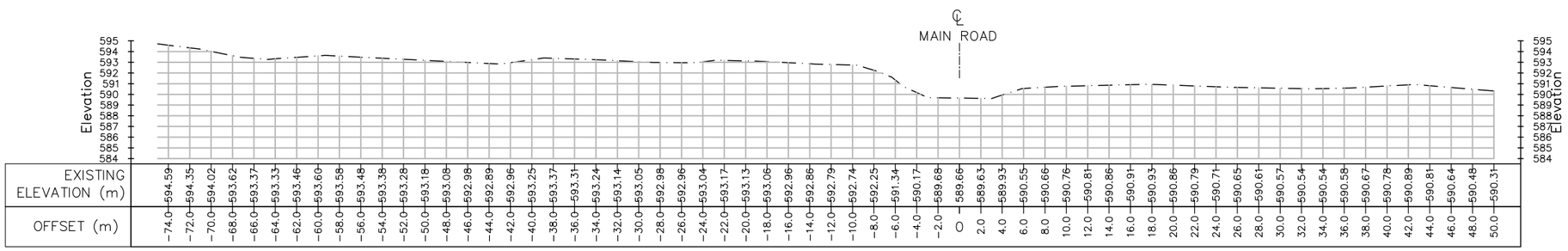
Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-GKC-CSR-001	Rev. –	Date: June, 2019



CH 0+125.00



CH 0+150.00



CH 0+175.00

NOTES:

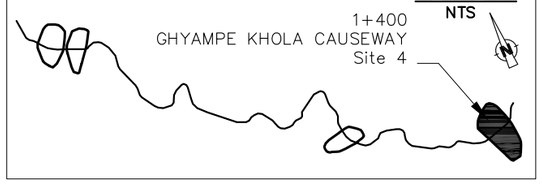
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 1:500

0 5 10 15 20 25m

KEYPLAN

NTS



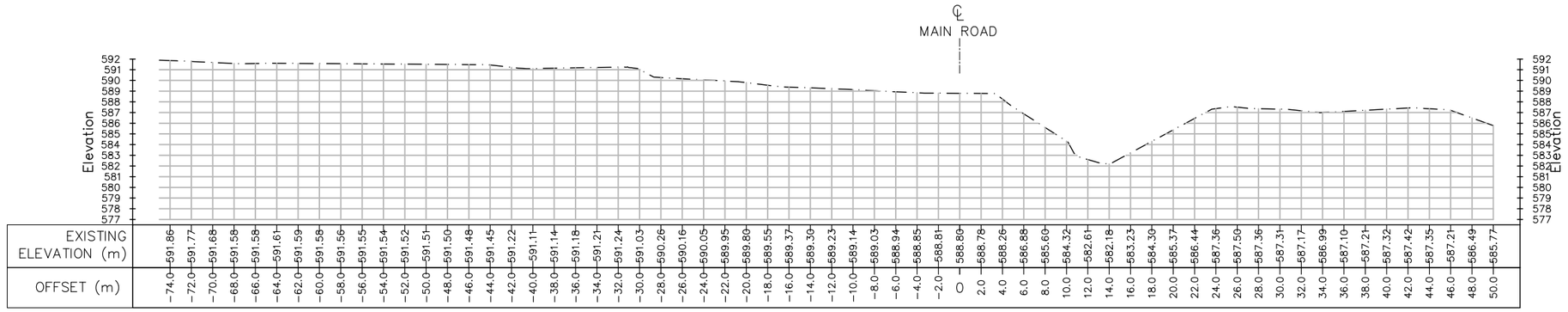
PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

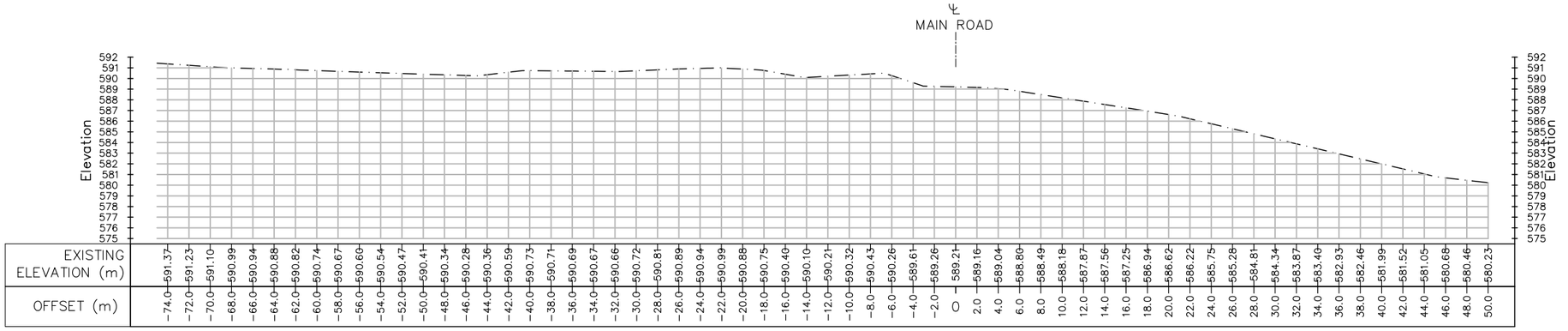
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Ghyampe Khola Causeway
Cross Section of Road
CH 0+125 TO 0+175

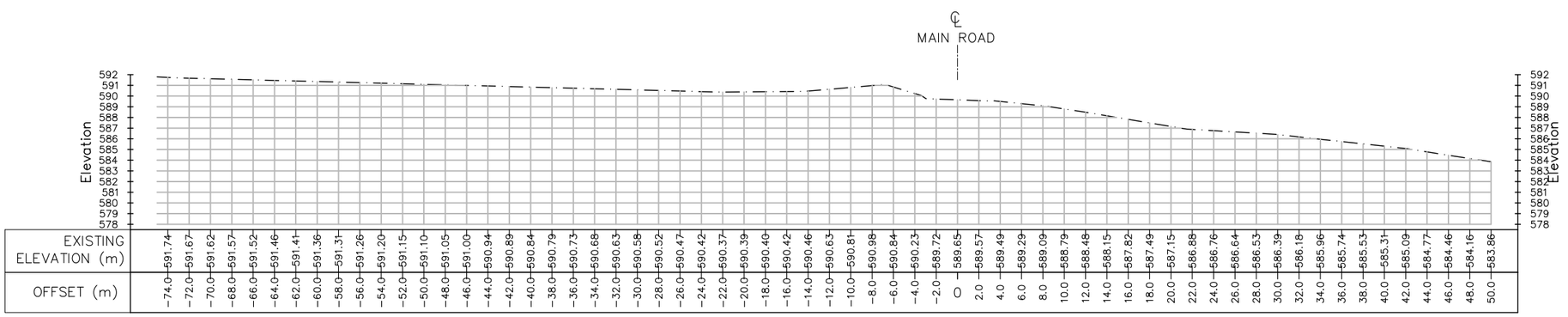
Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-GKC-CSR-002	Rev. –	Date: June, 2019



CH 0+200.00



CH 0+225.00



CH 0+250.00

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 1:500
0 5 10 15 20 25m

KEYPLAN
NTS
1+400
GHYAMPE KHOLA CAUSEWAY
Site 4

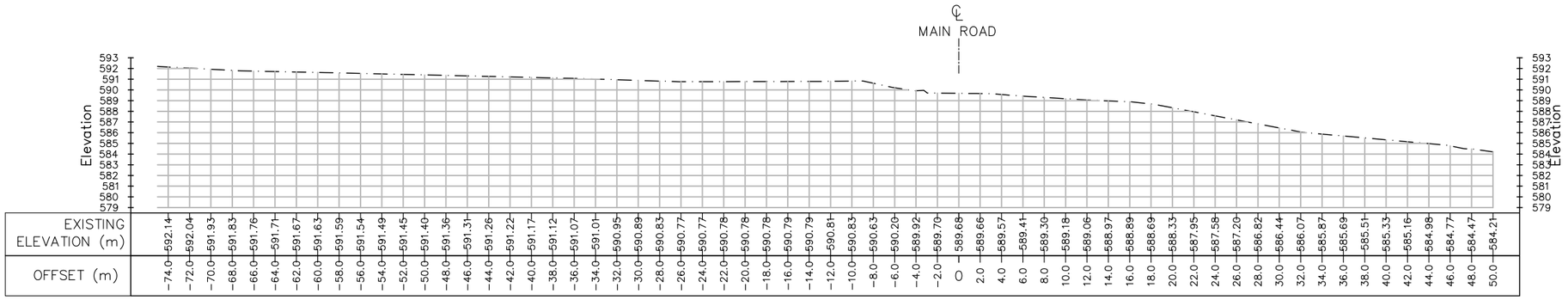
PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

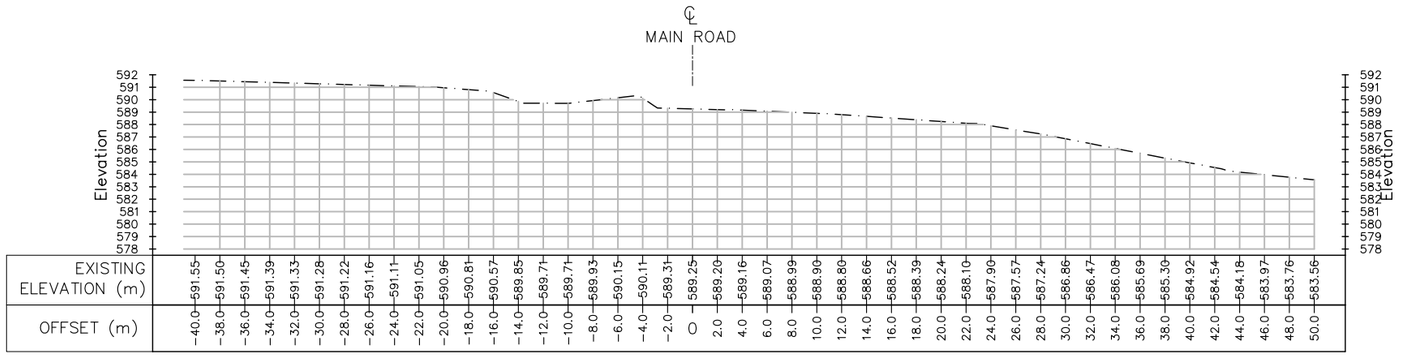
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Ghyampe Khola Causeway
Cross Section of Road
CH 0+200 TO 0+250

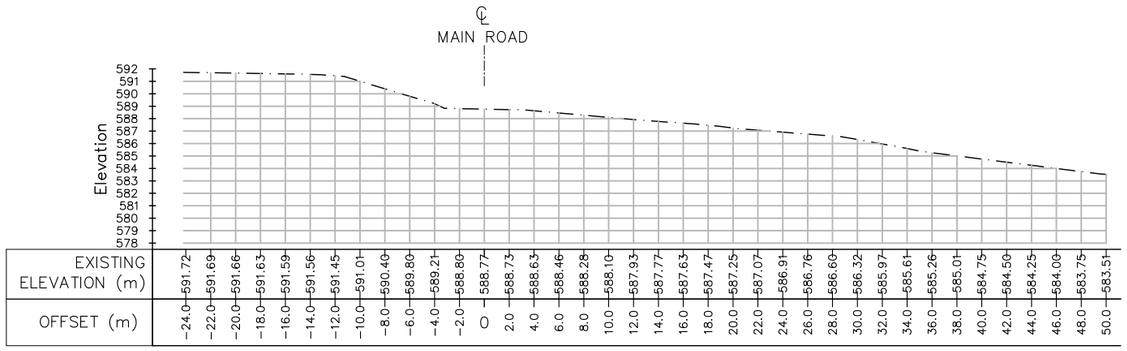
Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-GKC-CSR-003	Rev. –	Date: June, 2019



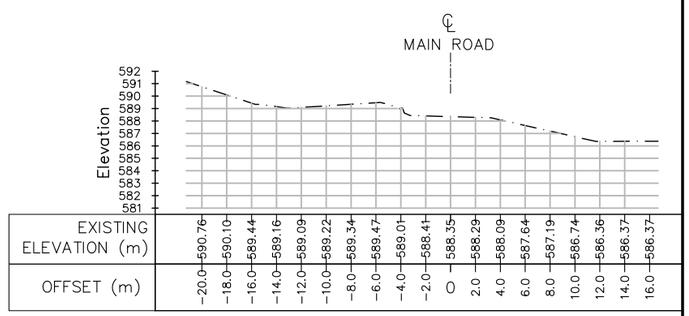
CH 0+275.00



CH 0+300.00



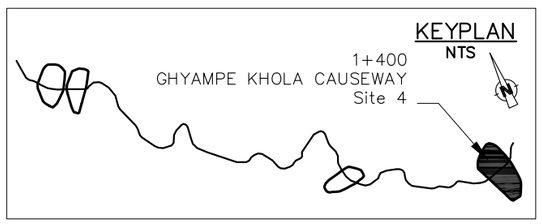
CH 0+325.00



CH 0+350.00

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 1:500



PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

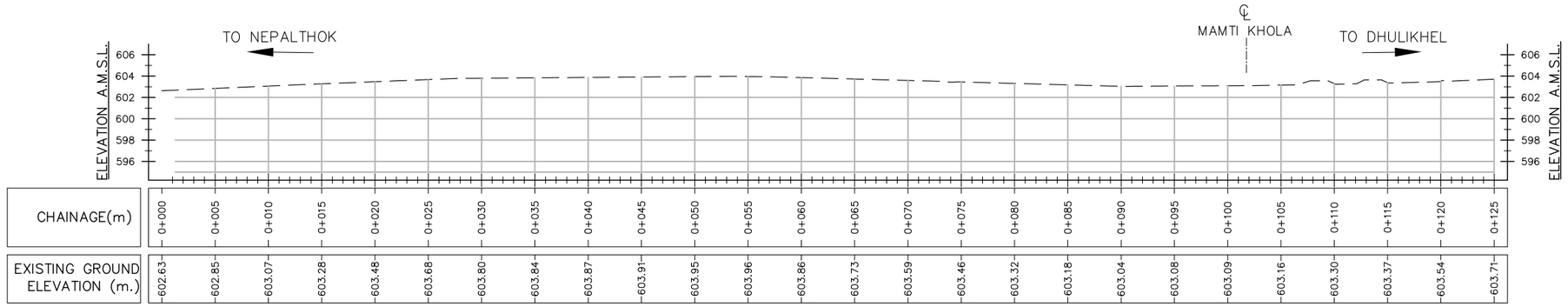
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Ghyampe Khola Causeway
Cross Section of Road
CH 0+275 TO 0+350

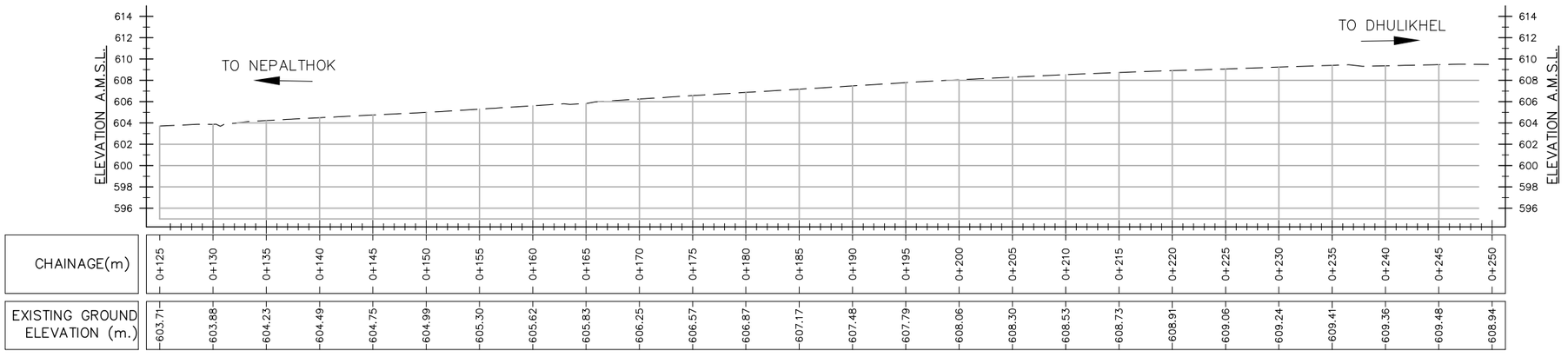
Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-GKC-CSR-004	Rev.: –	Date: June, 2019

STA. 3+900, Mamti Khola Causeway

LONGITUDINAL PROFILE & CROSS SECTIONS OF ROAD/HIGHWAY



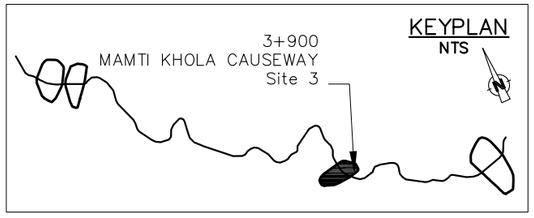
MAMTI KHOLA CAUSEWAY
MAIN ROAD/HIGHWAY LONGITUDINAL PROFILE
(CH 0+000 – 0+125)
SCALE: 500



MAMTI KHOLA CAUSEWAY
MAIN ROAD/HIGHWAY LONGITUDINAL PROFILE
(CH 0+125 – 0+250)
SCALE: 500

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 0 5 10 15 20 25m
1:500



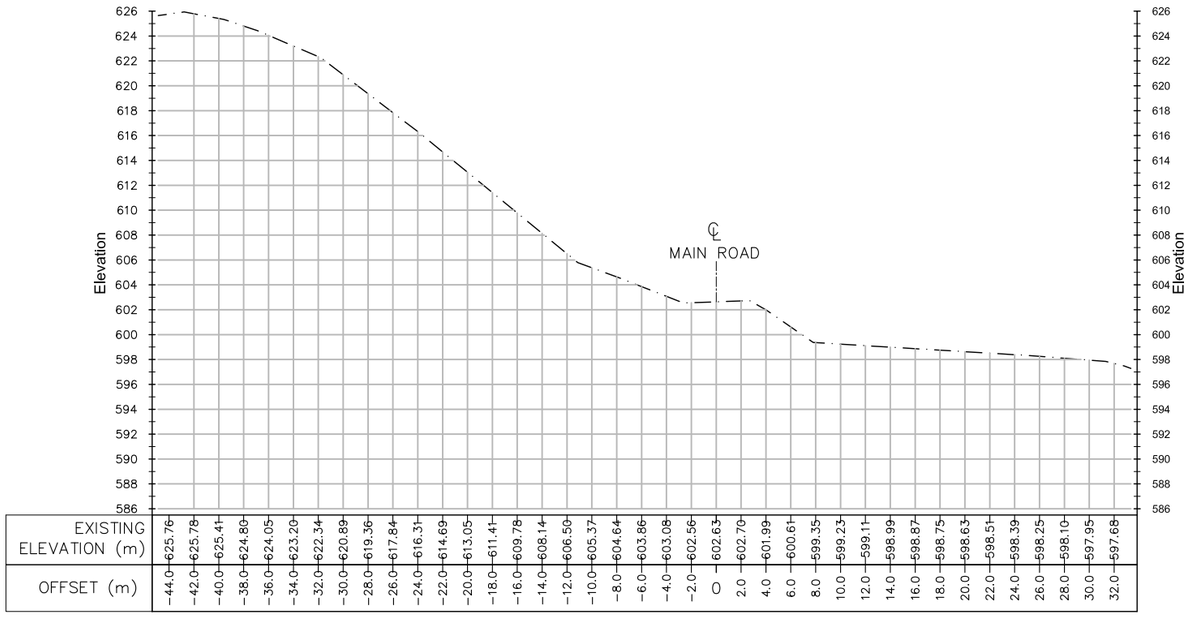
PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

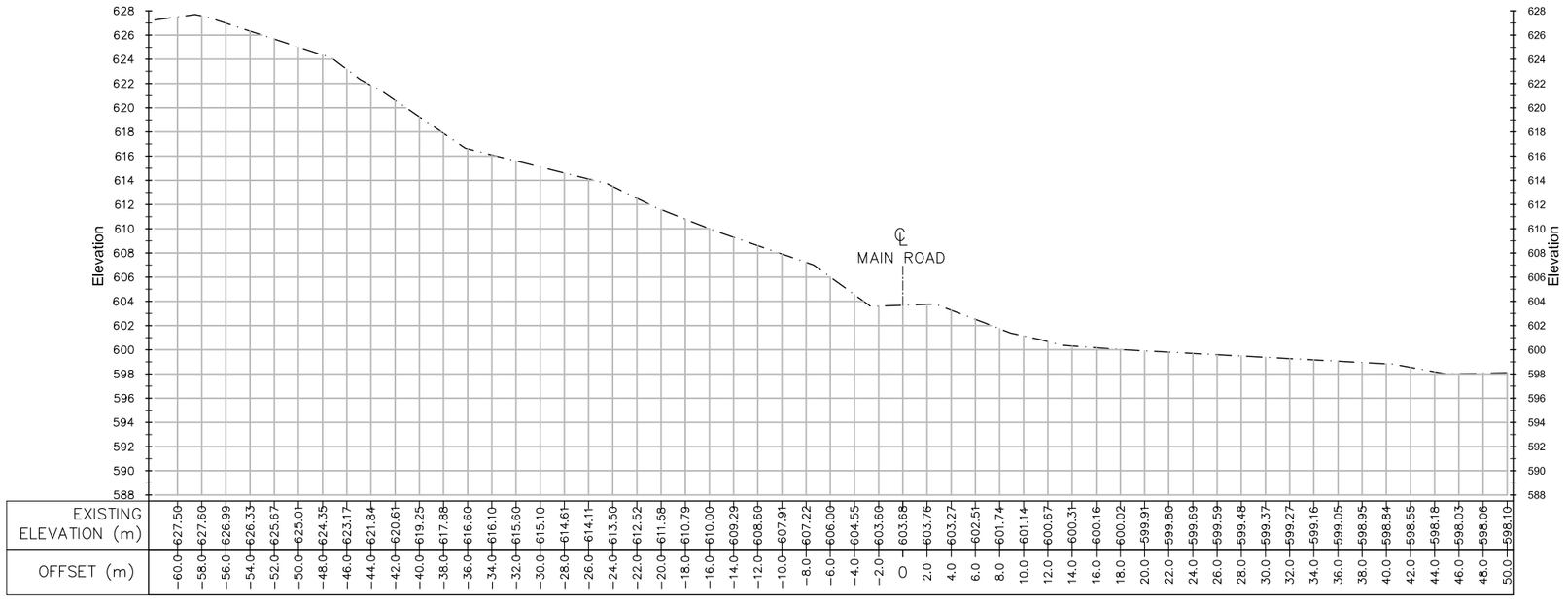
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: MAMTI Khola Causeway
Longitudinal Profile of Main Road
CH 0+000 – 0+250

Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-MKC-LPR-001	Rev. --	Date: June, 2019



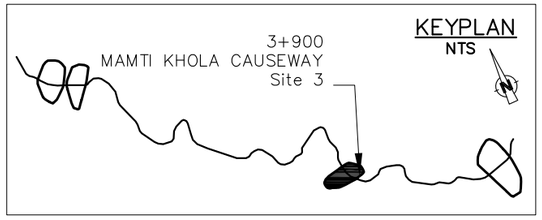
CH 0+000.00



CH 0+025.00

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 0 5 10 15 20 25m
1:500



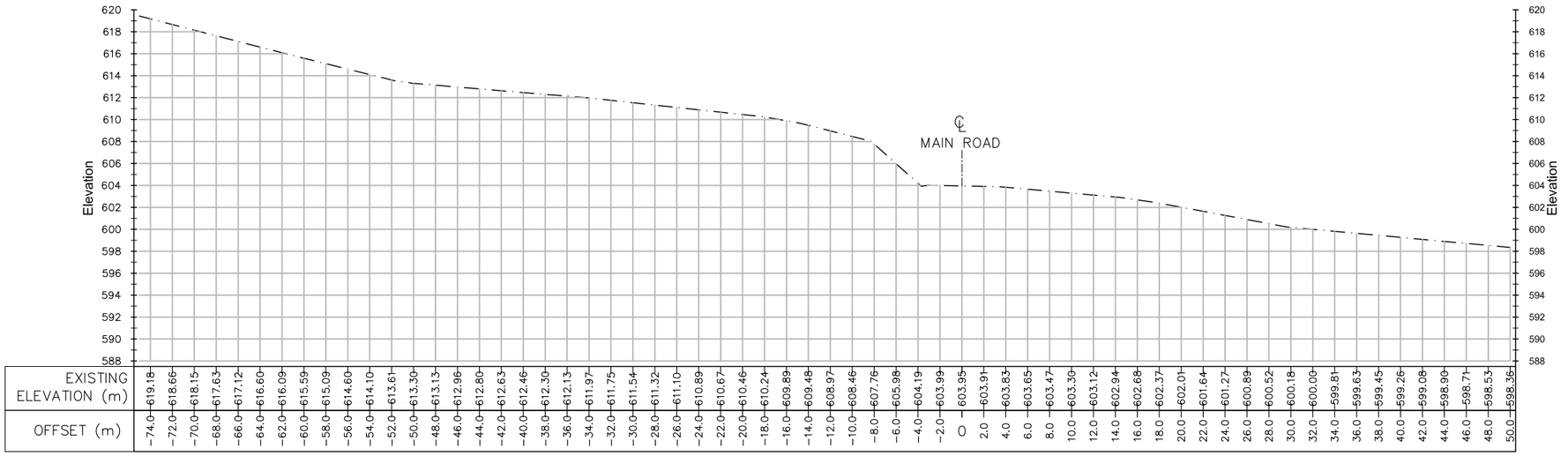
PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: MAMTI Khola Causeway
Cross Section of Road
CH 0+000 TO 0+025

Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-MKC-CSR-001	Rev. –	Date: June, 2019



EXISTING ELEVATION (m)	619.18	618.66	618.15	617.63	617.12	616.60	616.09	615.59	615.09	614.60	614.10	613.61	613.30	613.13	612.96	612.80	612.63	612.46	612.30	612.13	611.97
OFFSET (m)	−74.0	−72.0	−70.0	−68.0	−66.0	−64.0	−62.0	−60.0	−58.0	−56.0	−54.0	−52.0	−50.0	−48.0	−46.0	−44.0	−42.0	−40.0	−38.0	−36.0	−34.0

EXISTING ELEVATION (m)	611.75	611.54	611.32	611.10	610.89	610.67	610.46	610.24	609.89	609.48	608.97	608.46	607.76	605.98	604.19	603.99	603.95	603.91	603.83	603.65	603.47
OFFSET (m)	−32.0	−30.0	−28.0	−26.0	−24.0	−22.0	−20.0	−18.0	−16.0	−14.0	−12.0	−10.0	−8.0	−6.0	−4.0	−2.0	0	2.0	4.0	6.0	8.0

EXISTING ELEVATION (m)	603.30	603.12	602.94	602.68	602.37	602.01	601.64	601.27	600.89	600.52	600.18	600.00	599.81	599.63	599.45	599.26	599.08	598.90	598.71	598.53	598.36
OFFSET (m)	10.0	12.0	14.0	16.0	18.0	20.0	22.0	24.0	26.0	28.0	30.0	32.0	34.0	36.0	38.0	40.0	42.0	44.0	46.0	48.0	50.0

CH 0+050.00

EXISTING ELEVATION (m)	613.59	613.12	612.81	612.69	612.57	612.46	612.34	612.23	612.11	611.99	611.88	611.68	611.46	611.23	611.01	610.78	610.55	610.33	610.10	609.49	609.09
OFFSET (m)	−74.0	−72.0	−70.0	−68.0	−66.0	−64.0	−62.0	−60.0	−58.0	−56.0	−54.0	−52.0	−50.0	−48.0	−46.0	−44.0	−42.0	−40.0	−38.0	−36.0	−34.0

EXISTING ELEVATION (m)	608.52	607.86	607.27	606.76	606.25	606.04	605.97	605.87	605.78	605.69	605.61	605.53	604.96	604.39	603.50	603.52	603.46	603.40	603.25	602.94	602.67
OFFSET (m)	−32.0	−30.0	−28.0	−26.0	−24.0	−22.0	−20.0	−18.0	−16.0	−14.0	−12.0	−10.0	−8.0	−6.0	−4.0	−2.0	0	2.0	4.0	6.0	8.0

EXISTING ELEVATION (m)	602.56	602.45	602.34	602.23	602.12	602.04	601.97	601.90	601.85	601.82	601.56	600.77	601.31	602.17	603.02	602.47	602.22	601.64	601.07	600.45	599.43
OFFSET (m)	10.0	12.0	14.0	16.0	18.0	20.0	22.0	24.0	26.0	28.0	30.0	32.0	34.0	36.0	38.0	40.0	42.0	44.0	46.0	48.0	50.0

CH 0+075.00

NOTES:

1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 0 5 10 15 20 25m
1:500

KEYPLAN
NTS

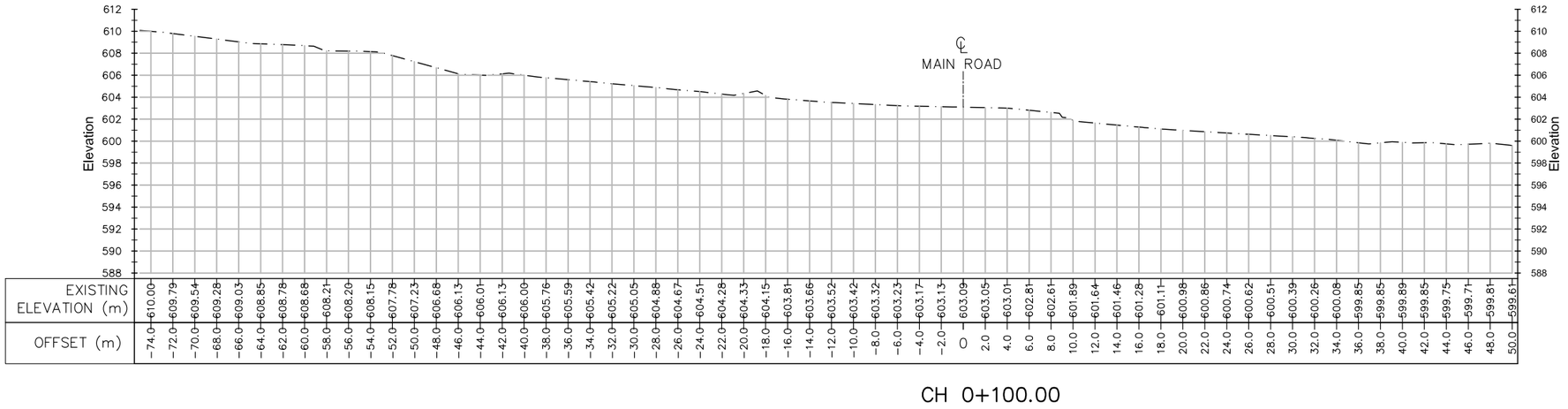
PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

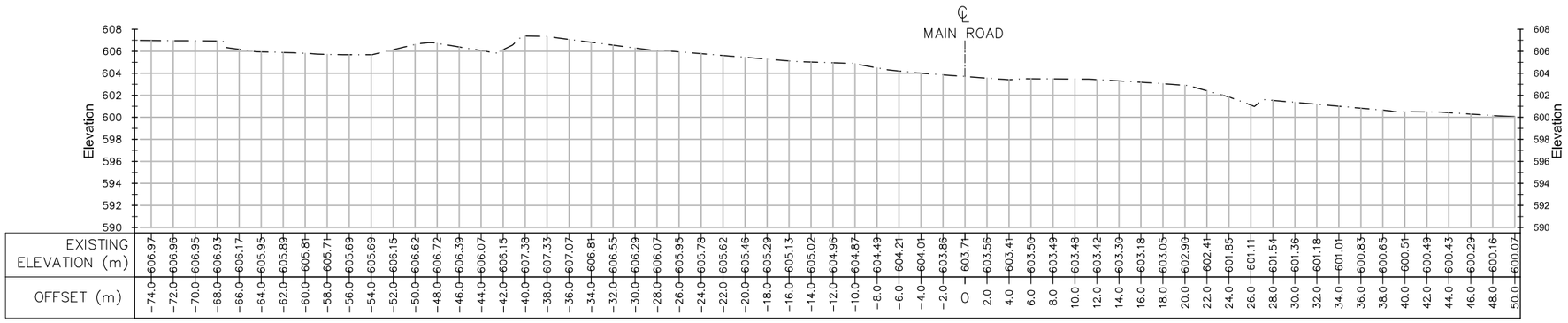
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: MAMTI Khola Causeway
Cross Section of Road
CH 0+050 TO 0+075

Scale	Drawing No.:	Rev.	Date:
Scale A1: 1:250 Scale A3: 1:500	SR2-MKC-CSR-002	--	June, 2019



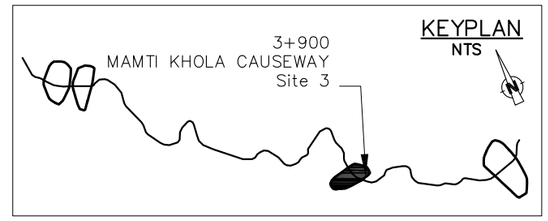
CH 0+100.00



CH 0+125.00

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 0 5 10 15 20 25m
1:500



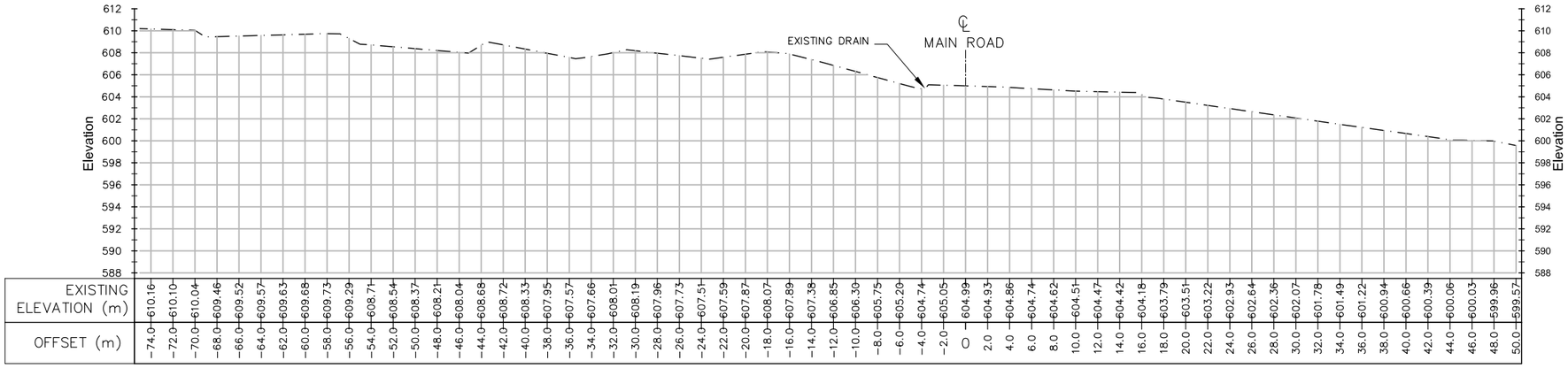
PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

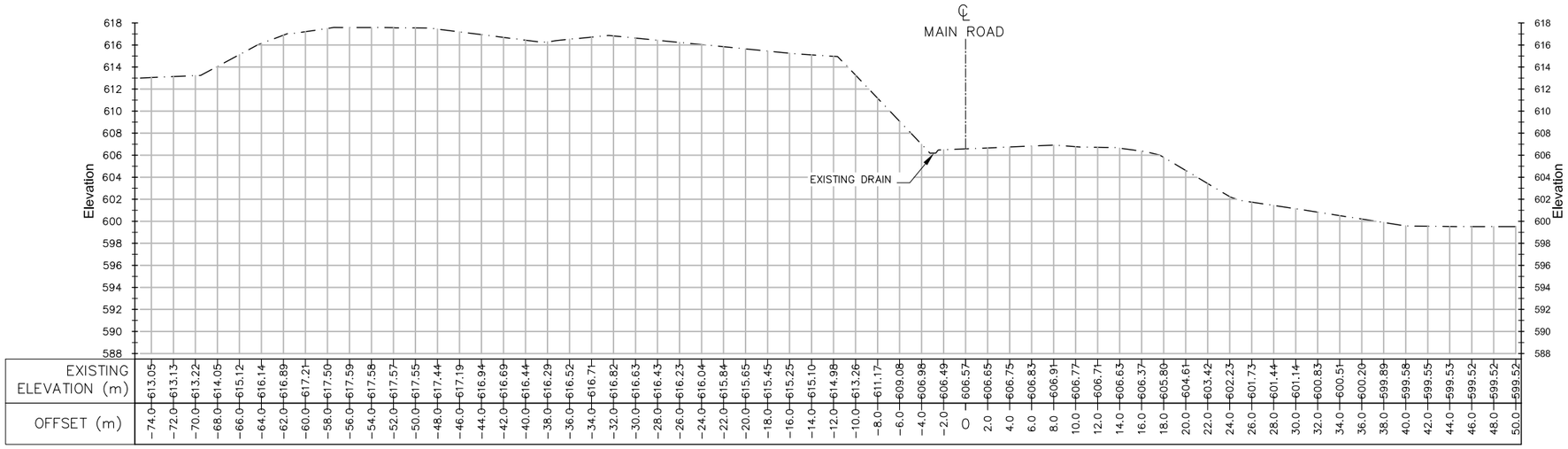
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: MAMTI Khola Causeway
Cross Section of Road
CH 0+100 TO 0+125

Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-MKC-CSR-003	Rev. –	Date: June, 2019



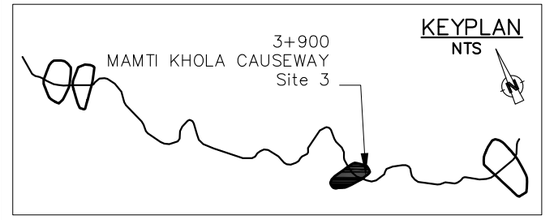
CH 0+150.00



CH 0+175.00

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 1:500



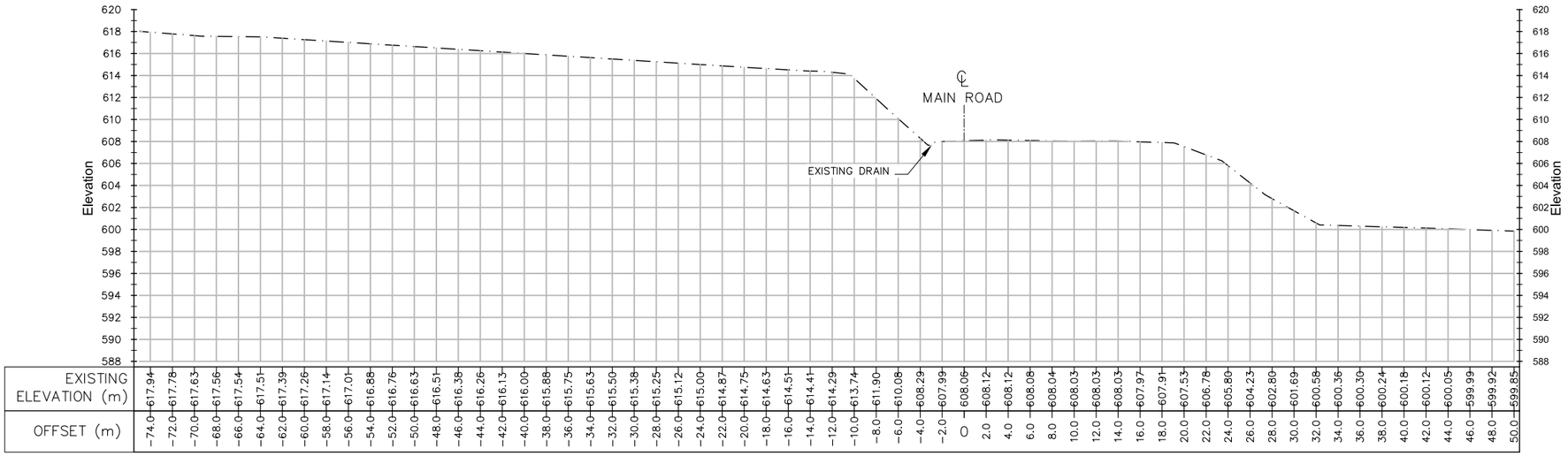
PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

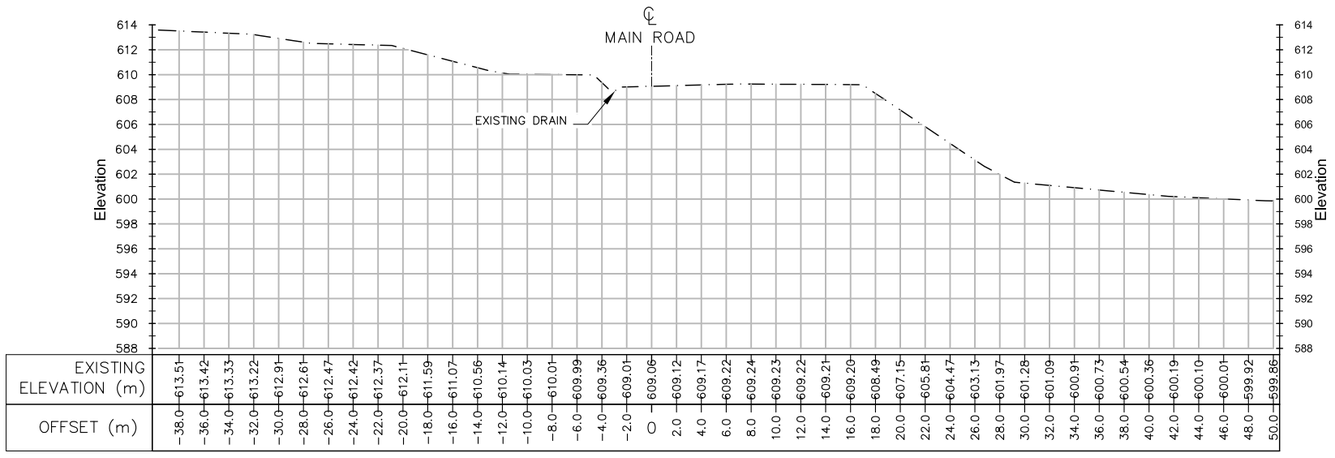
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: MAMTI Khola Causeway
Cross Section of Road
CH 0+125 TO 0+175

Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-MKC-CSR-004	Rev. –	Date: June, 2019



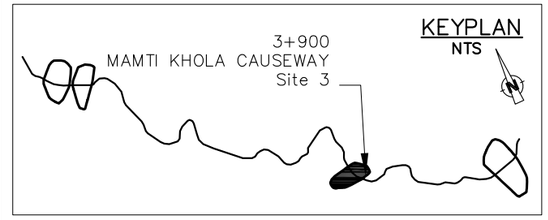
CH 0+200.00



CH 0+225.00

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 0 5 10 15 20 25m
1:500



PROJECT FOR THE OPERATION AND MAINTENANCE OF
THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

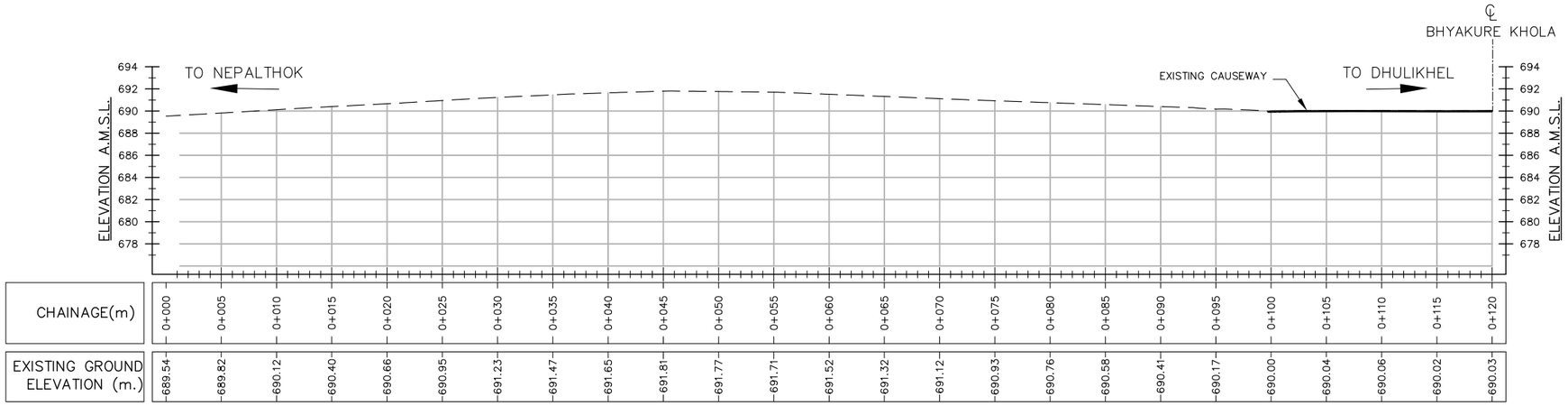
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: MAMTI Khola Causeway
Cross Section of Road
CH 0+200 TO 0+225

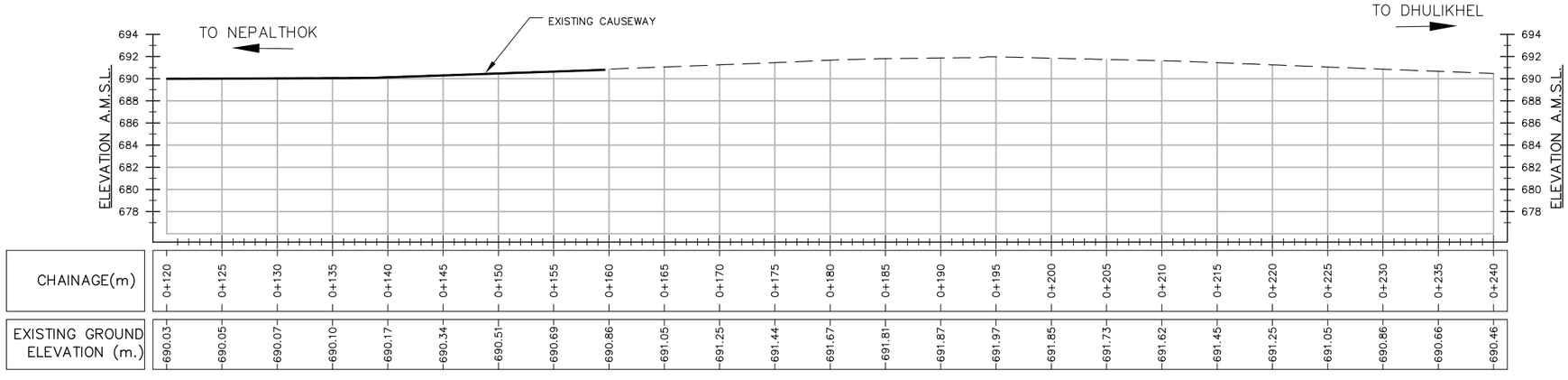
Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-MKC-CSR-005	Rev. –	Date: June, 2019

STA.9+700 Bhyakure Khola Causeway

LONGITUDINAL PROFILE & CROSS SECTIONS OF ROAD/HIGHWAY



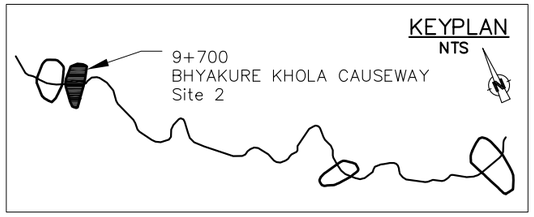
BHYAKURE KHOLA CAUSEWAY
MAIN ROAD/HIGHWAY LONGITUDINAL PROFILE
(CH 0+000 – 0+120)
SCALE: 500



BHYAKURE KHOLA CAUSEWAY
MAIN ROAD/HIGHWAY LONGITUDINAL PROFILE
(CH 0+120 – 0+240)
SCALE: 500

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 0 5 10 15 20 25m
1:500



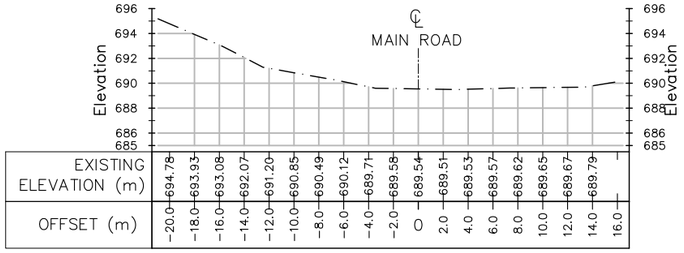
PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

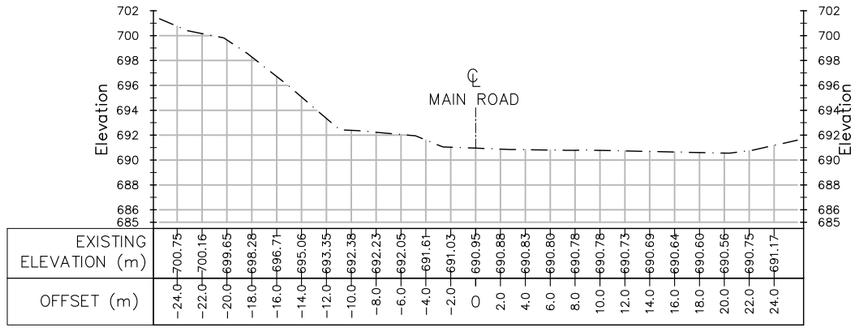
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Bhyakure Khola Causeway
Longitudinal Profile of Main Road
CH 0+000 – 0+240

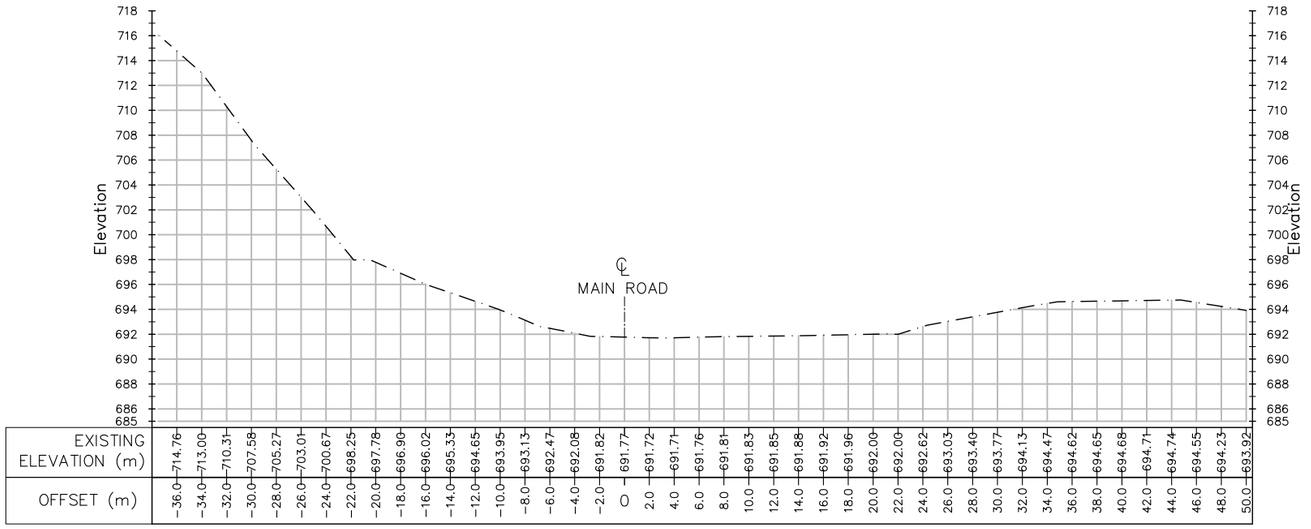
Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-BKC-LPR-001	Rev. --	Date: June, 2019



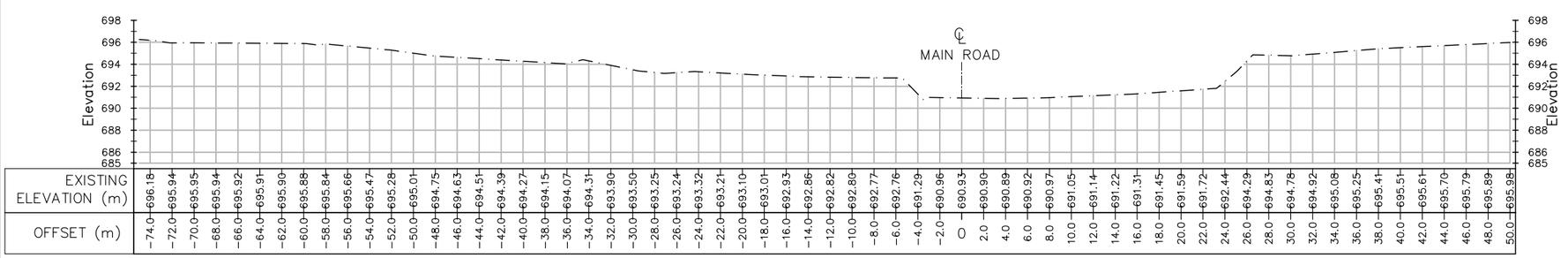
CH 0+000.00



CH 0+025.00



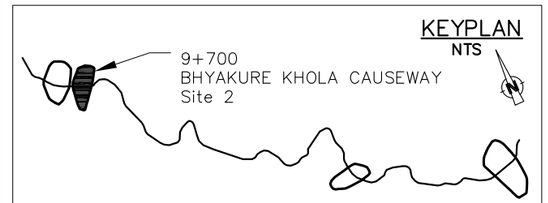
CH 0+050.00



CH 0+075.00

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 1:500



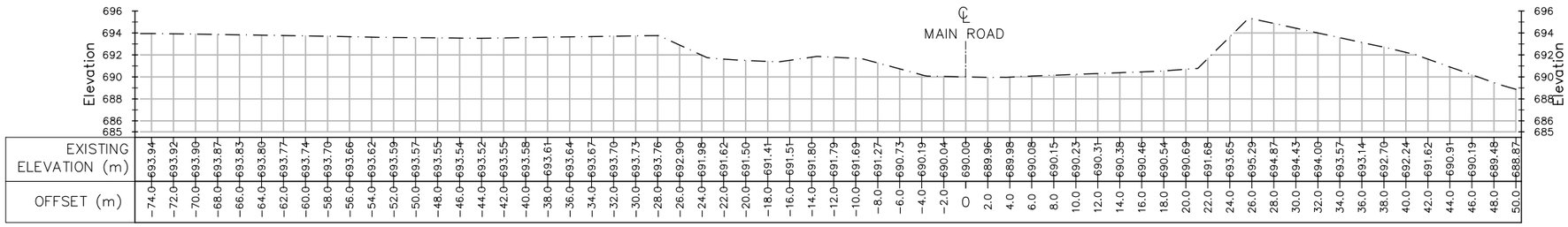
PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

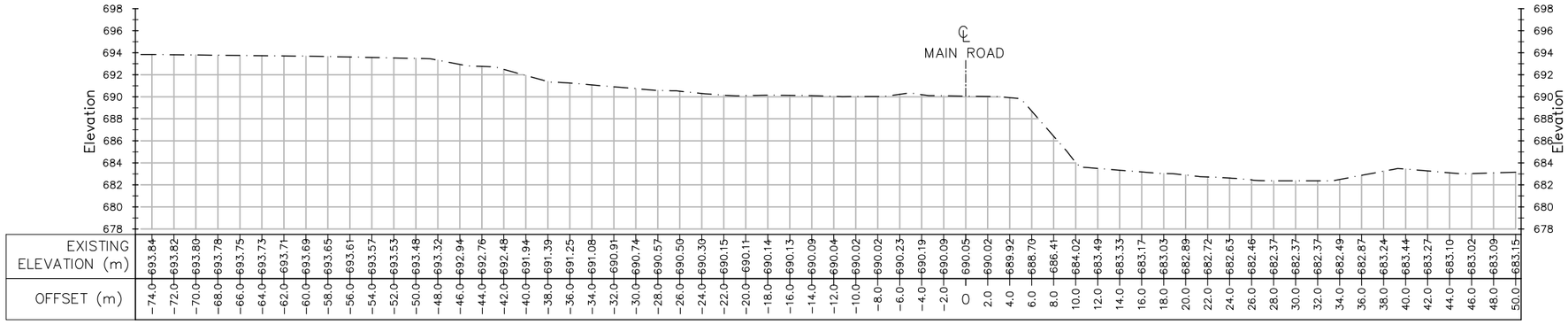
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Bhyakure Khola Causeway
Cross Section of Road
CH 0+000 TO 0+075

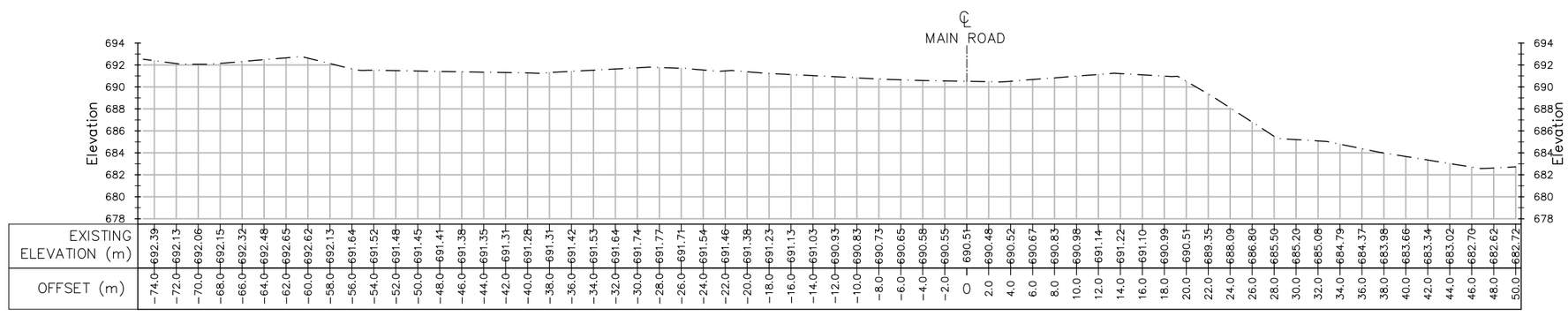
Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-BKC-CSR-001	Rev.: –	Date: June, 2019



CH 0+100.00



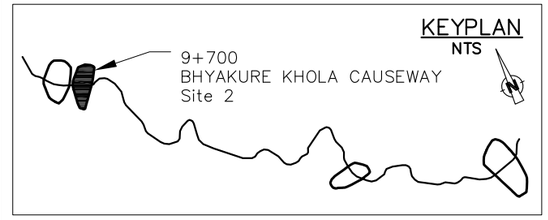
CH 0+125.00



CH 0+150.00

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 0 5 10 15 20 25m
1:500



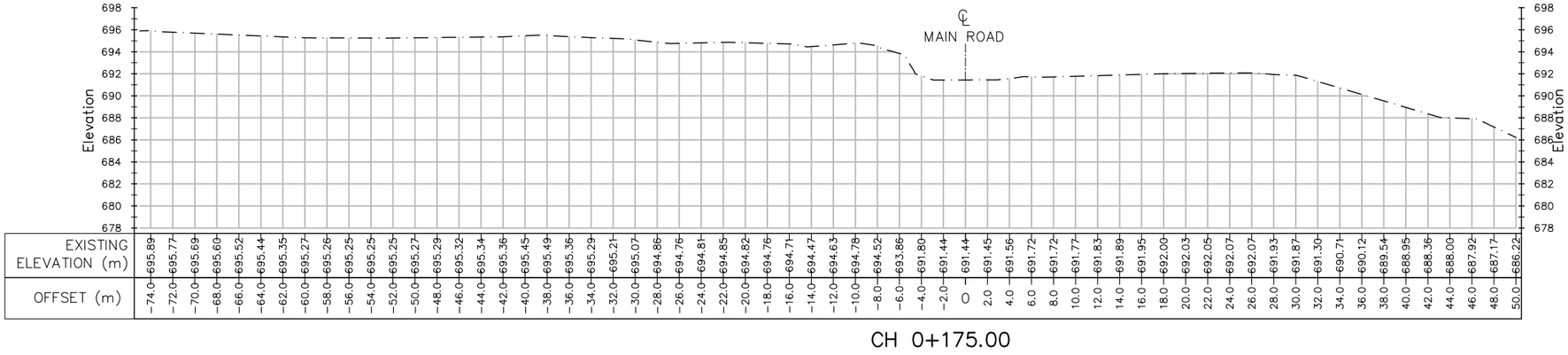
PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

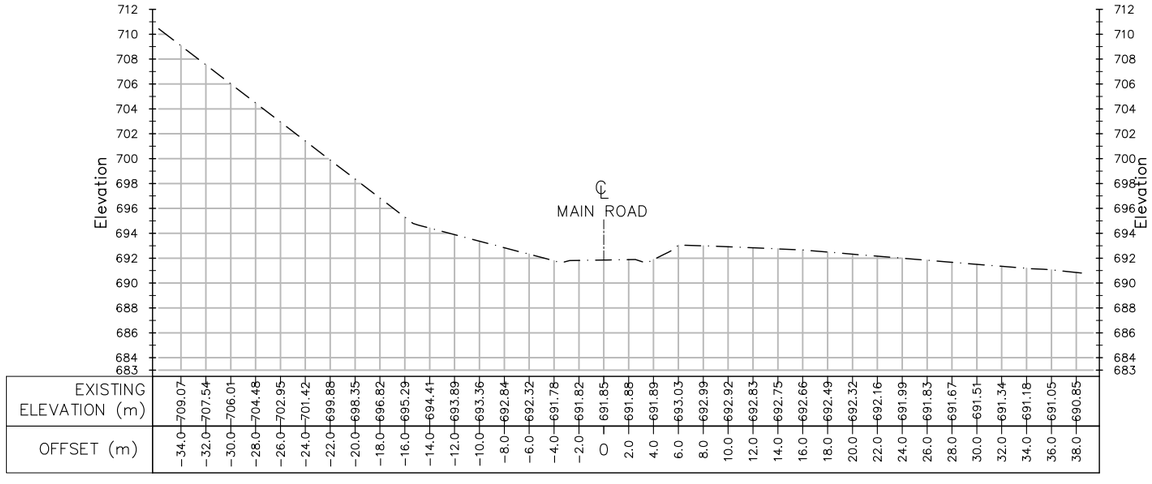
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Bhyakure Khola Causeway
Cross Section of Road
CH 0+100 TO 0+150

Scale A1: 1:250 Scale A3: 1:500	Drawing No.:	Rev.	Date:
	SR2-BKC-CSR-002	–	June, 2019



CH 0+175.00

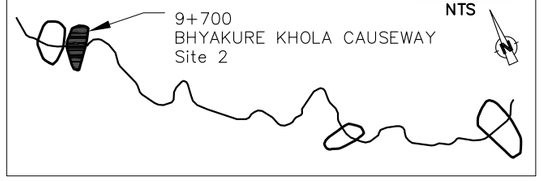


CH 0+200.00

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 0 5 10 15 20 25m
1:500

KEYPLAN
NTS



PROJECT FOR THE OPERATION AND MAINTENANCE OF
THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

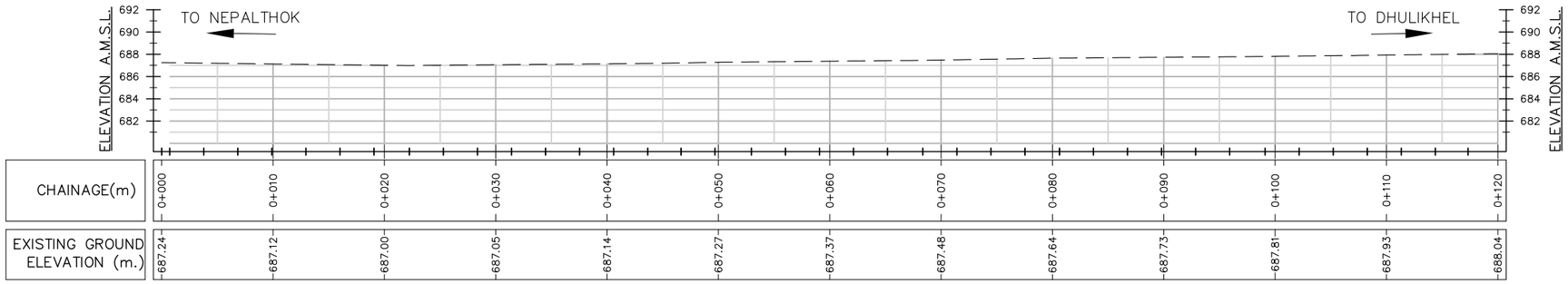
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Bhyakure Khola Causeway
Cross Section of Road
CH 0+175 TO 0+200

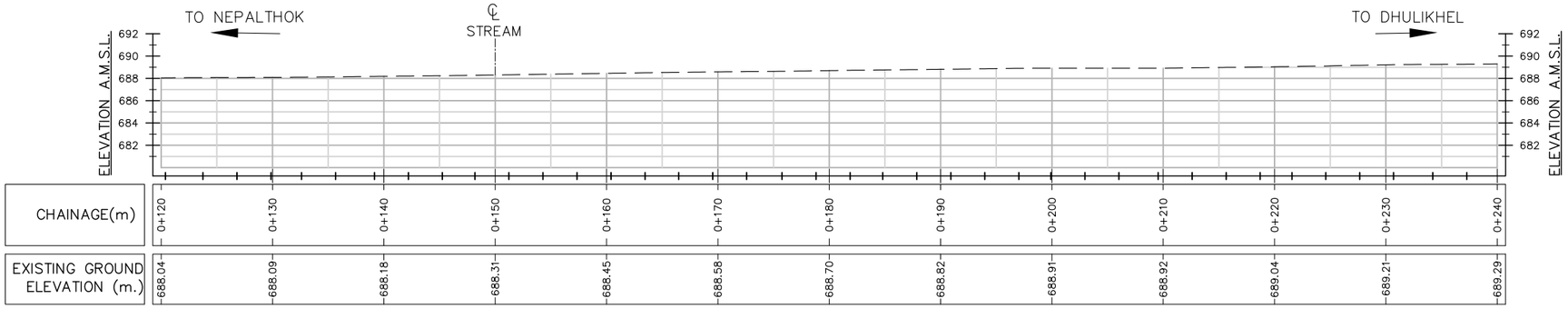
Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-BKC-CSR-003	Rev. –	Date: June, 2019

STA. 10+100 Kaldhunga Roadway

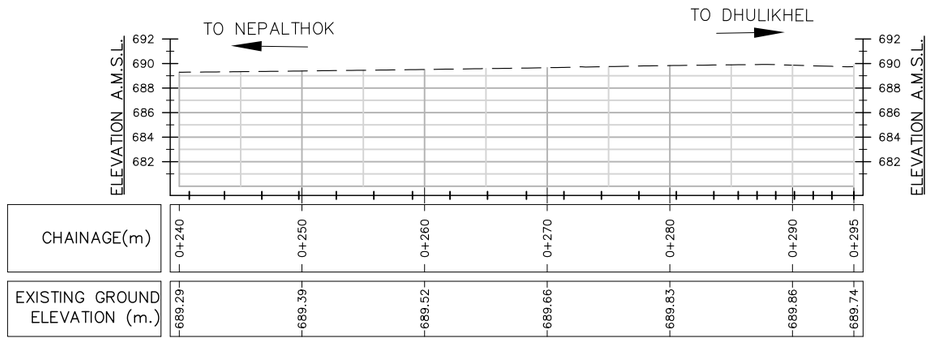
LONGITUDINAL PROFILE & CROSS SECTIONS OF ROAD/HIGHWAY



KALDHUNGA ROADWAY
MAIN ROAD/HIGHWAY LONGITUDINAL PROFILE
(CH 0+000 – 0+120)
SCALE: 500



KALDHUNGA ROADWAY
MAIN ROAD/HIGHWAY LONGITUDINAL PROFILE
(CH 0+120 – 0+240)
SCALE: 500

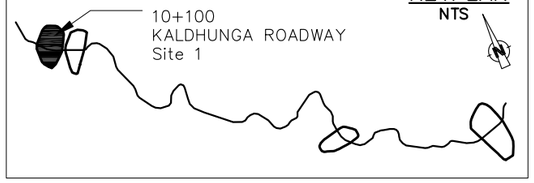


KALDHUNGA ROADWAY
MAIN ROAD/HIGHWAY LONGITUDINAL PROFILE
(CH 0+240 – 0+295)
SCALE: 500

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 0 5 10 15 20 25m
1: 500

KEYPLAN
NTS



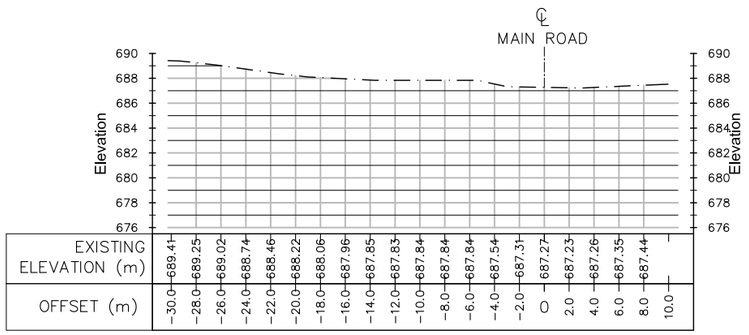
PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

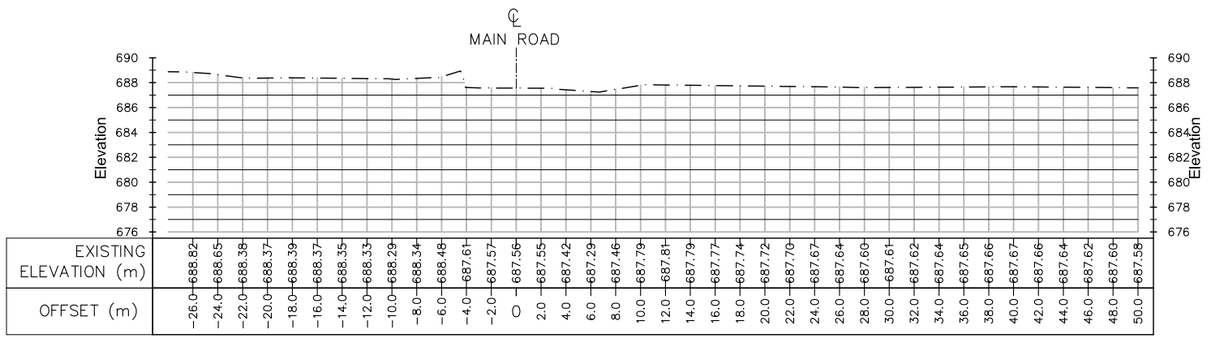
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Kaldhunga Roadway
Longitudinal Profile of Main Road
CH 0+000 – 0+295

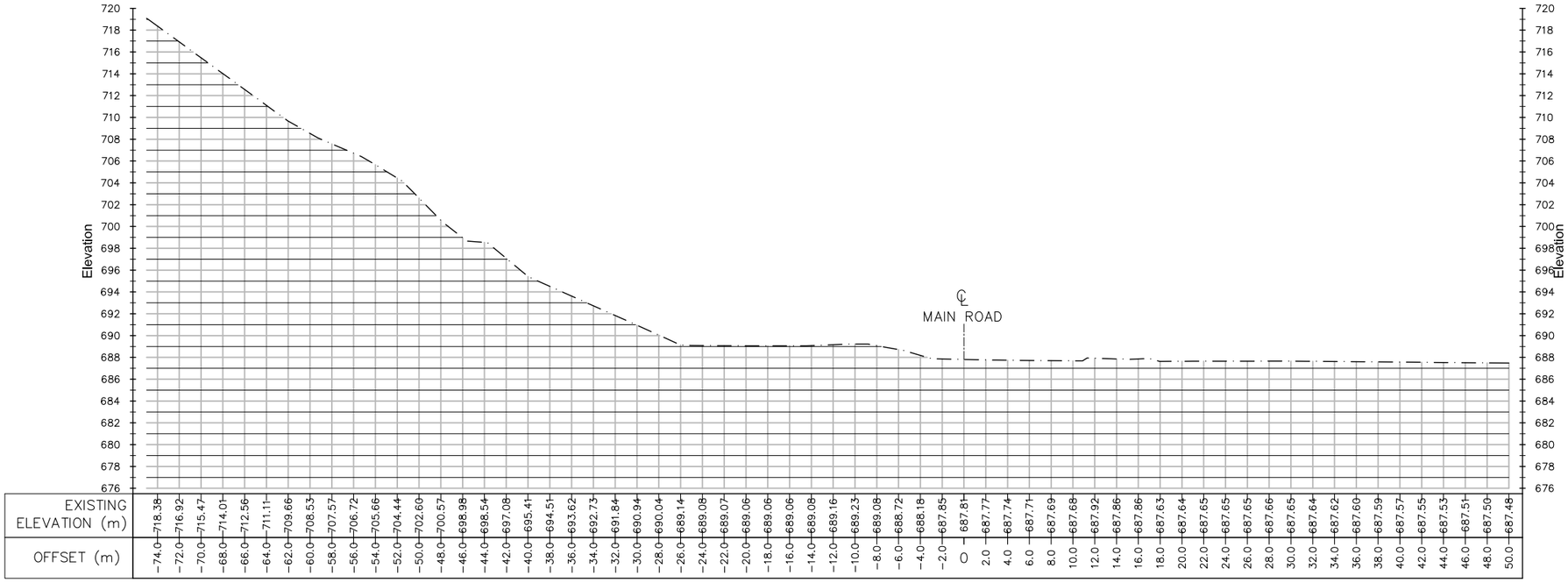
Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-KDR-LPR-001	Rev. --	Date: June, 2019



CH 0+050.00



CH 0+075.00

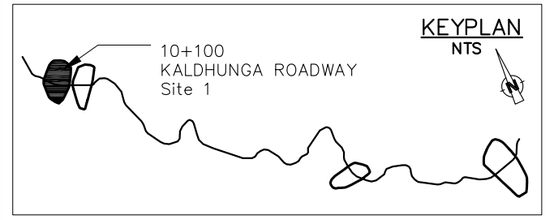


CH 0+100.00

NOTES:

1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 0 5 10 15 20 25m
1:500



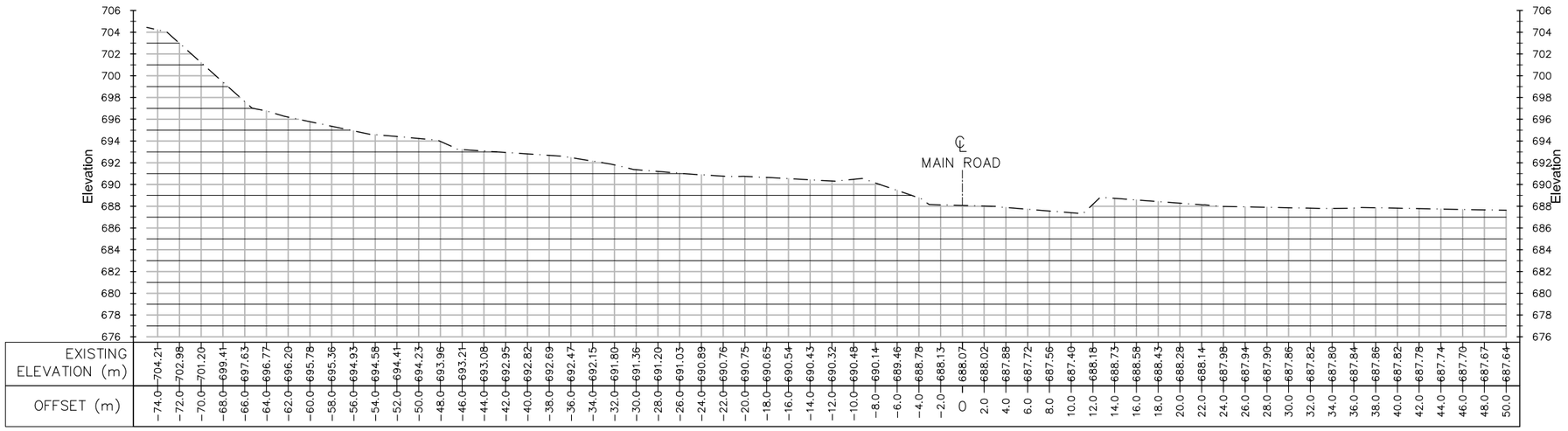
PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

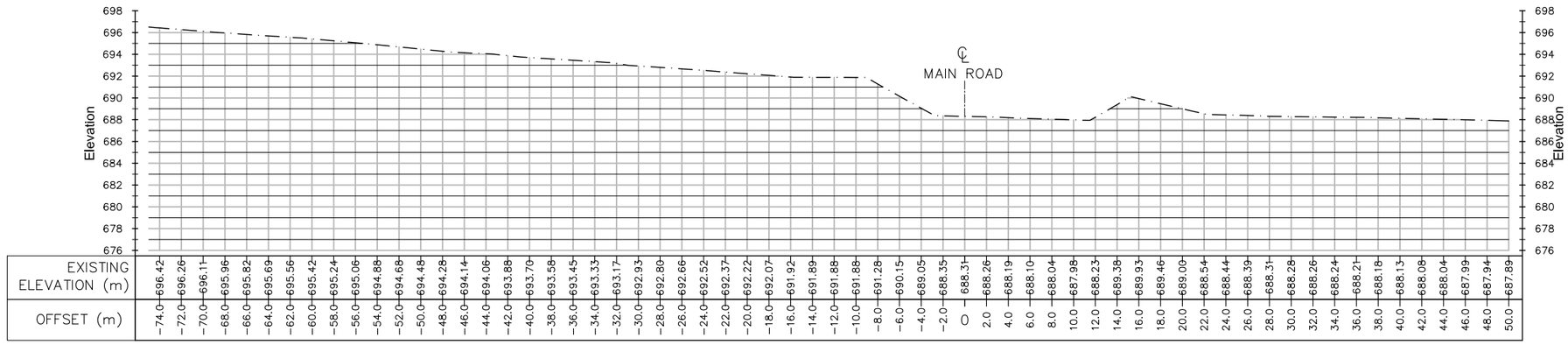
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Kaldhunga Roadway
Cross Section of Road
CH 0+000 TO 0+100

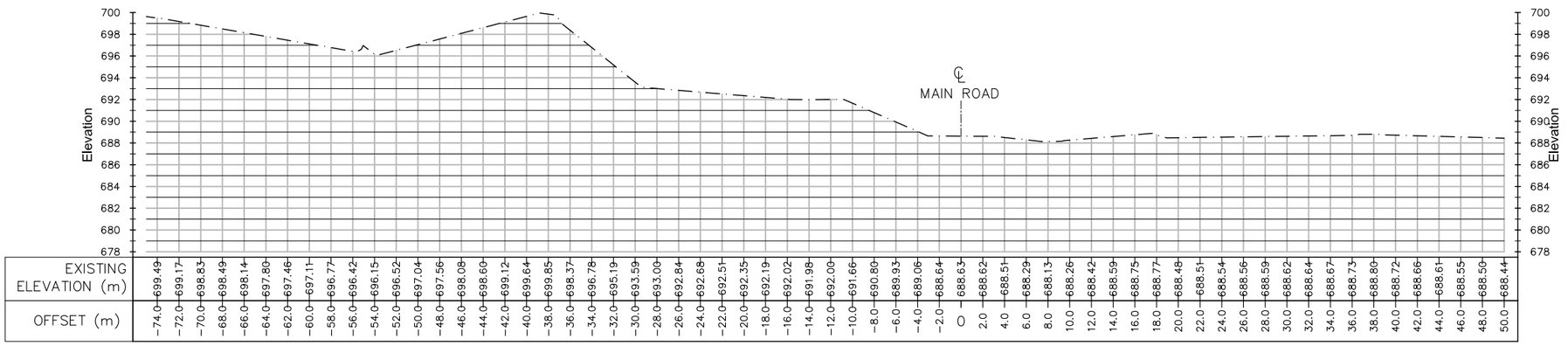
Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-KDR-CSR-001	Rev. –	Date: June, 2019



CH 0+125.00



CH 0+150.00

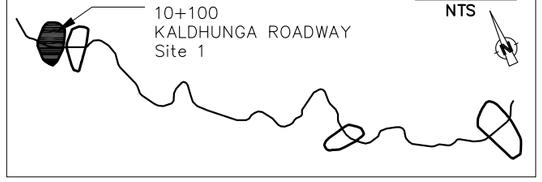


CH 0+175.00

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 0 5 10 15 20 25m
1:500

KEYPLAN
NTS



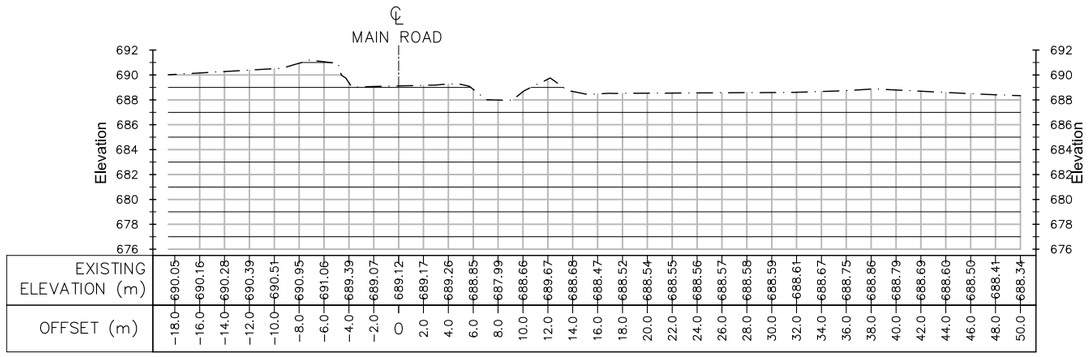
PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

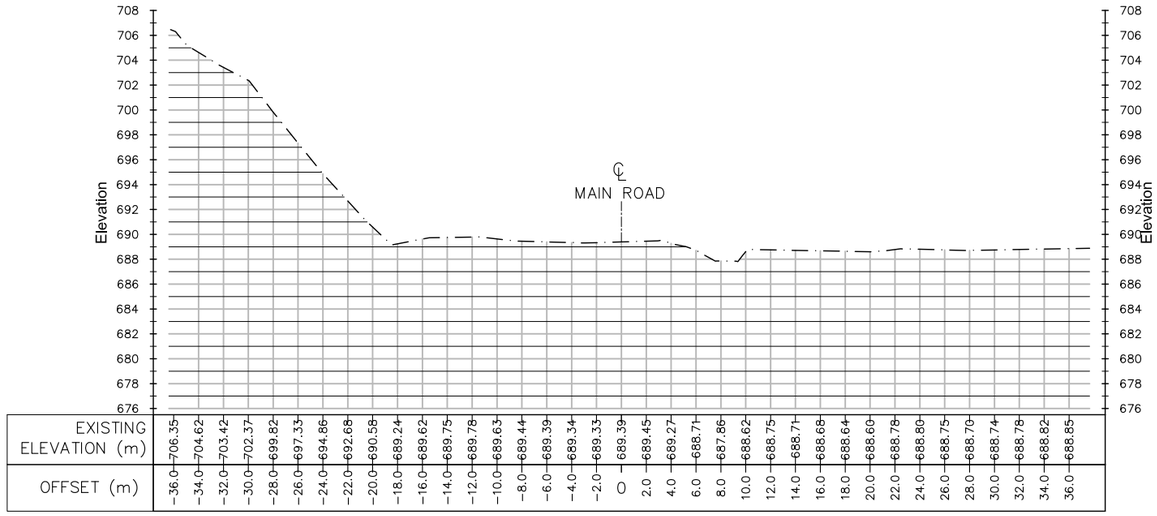
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Kaldhunga Roadway
Cross Section of Road
CH 0+125 TO 0+175

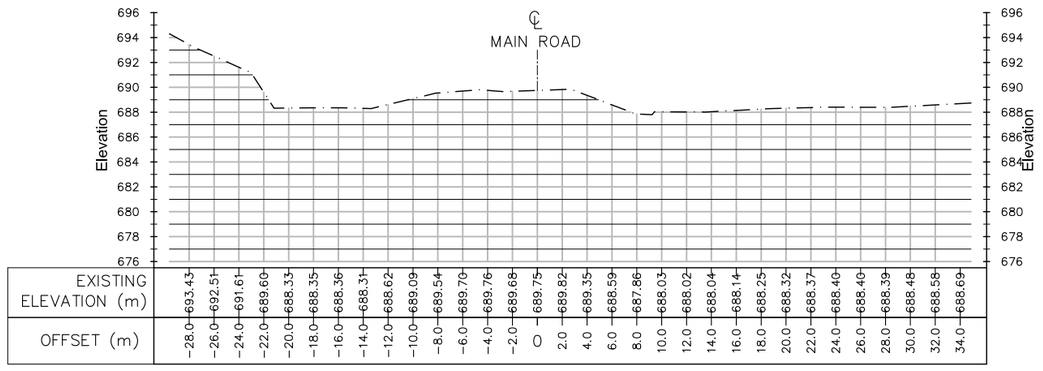
Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-KDR-CSR-002	Rev. –	Date: June, 2019



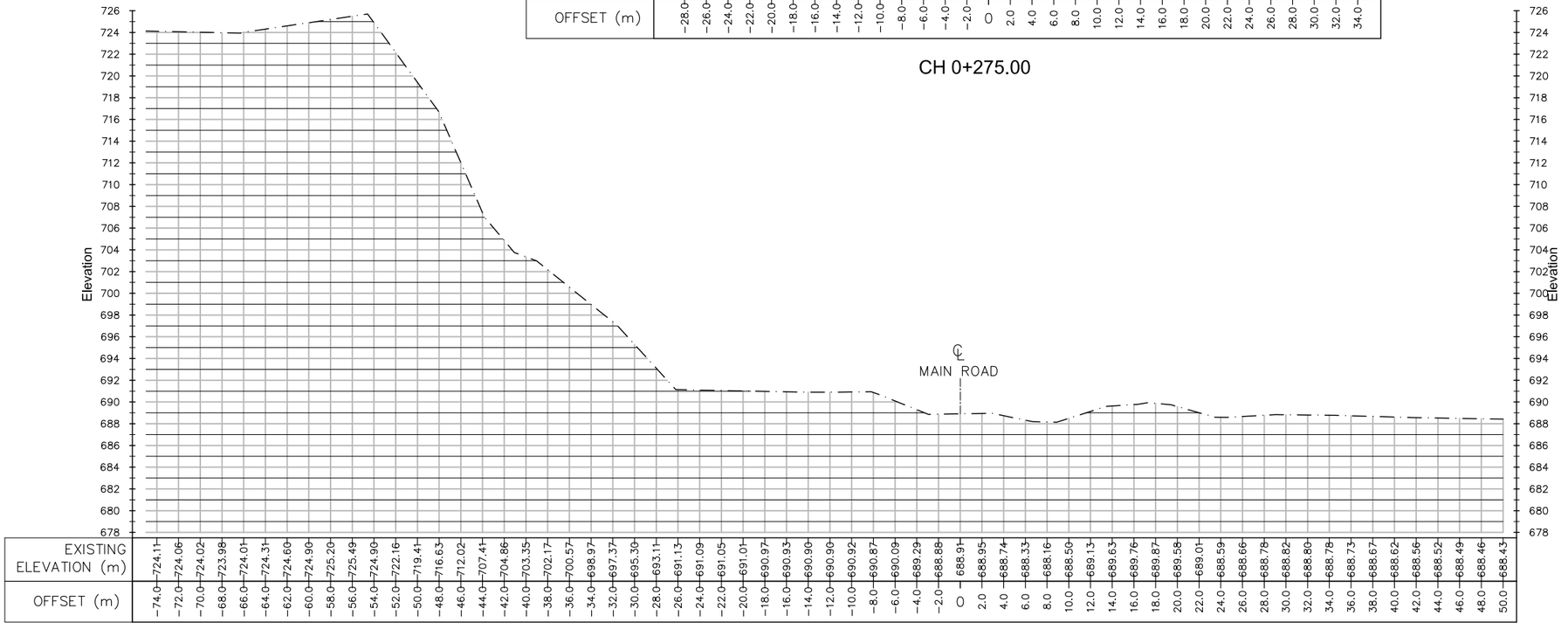
CH 0+225.00



CH 0+250.00



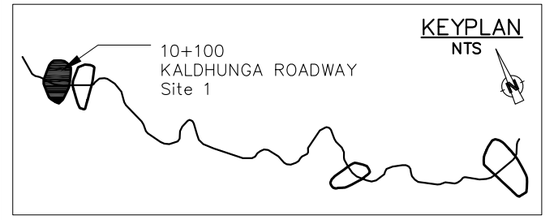
CH 0+275.00



CH 0+200.00

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 0 5 10 15 20 25m
1:500



PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

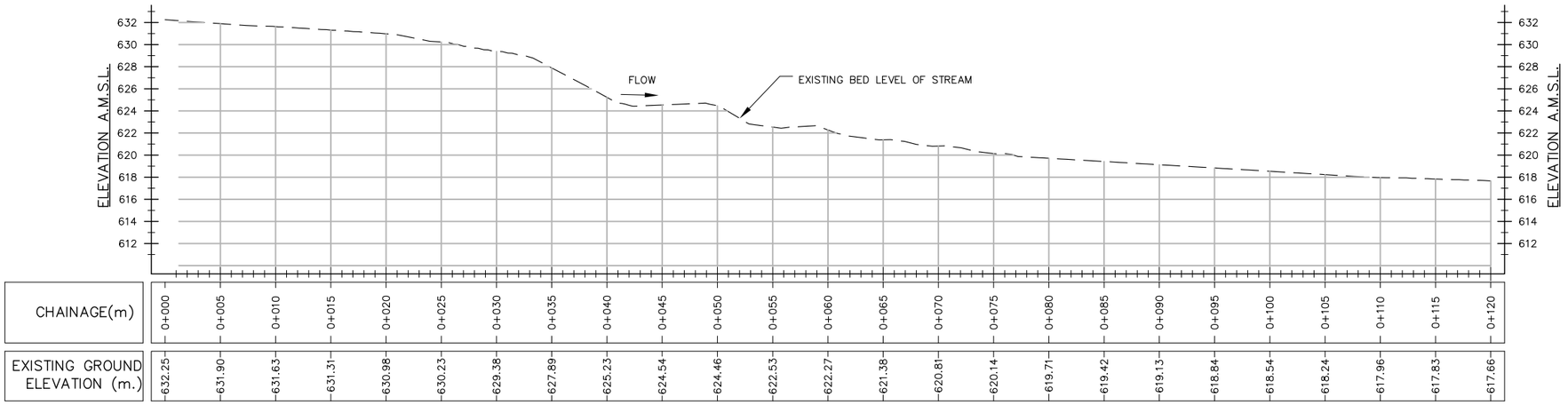
Title: Kaldhunga Roadway
Cross Section of Road
CH 0+200 TO 0+275

Scale A1: 1:250 Scale A3: 1:500	Drawing No.:	Rev.	Date:
	SR2-KDR-CSR-003	–	June, 2019

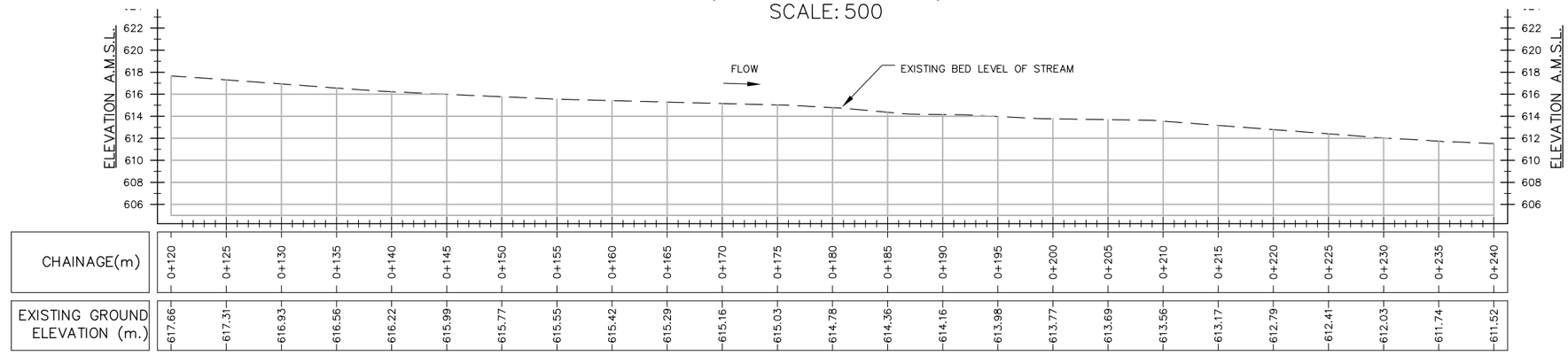
APPENDIX 7: WATER COURSE PROFILE & CROSS SECTIONS OF RIVER/STREAM

STA. 1+400, Ghyampe Khola Causeway

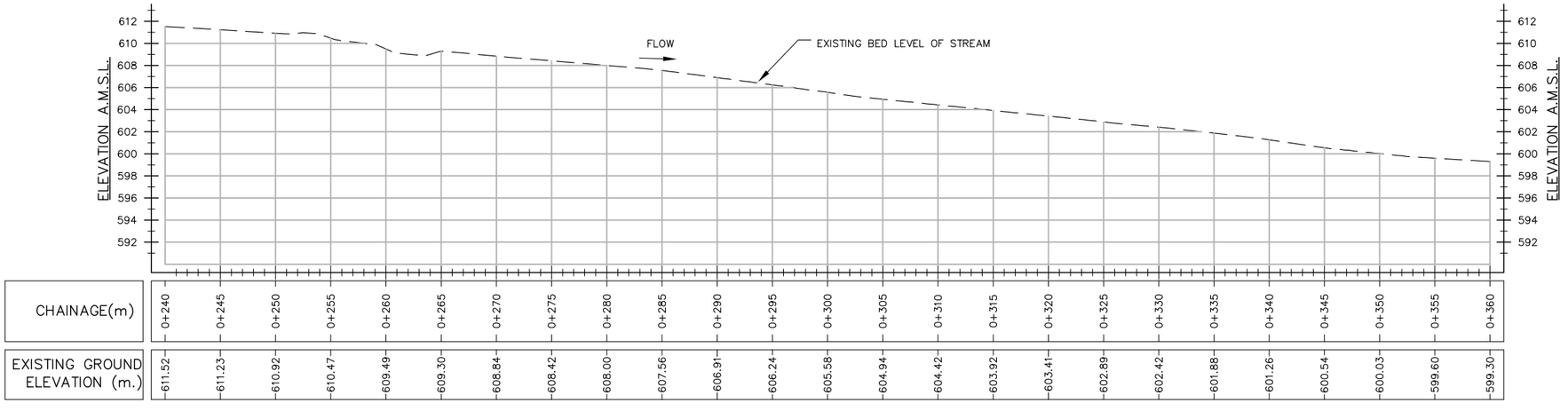
WATER COURSE PROFILE & CROSS SECTIONS OF RIVER/STREAM



GHYAMPE KHOLA CAUSEWAY
STREAM LONGITUDINAL PROFILE
(CH 0+000 – 0+120)
SCALE: 500



GHYAMPE KHOLA CAUSEWAY
STREAM LONGITUDINAL PROFILE
(CH 0+120 – 0+240)
SCALE: 500

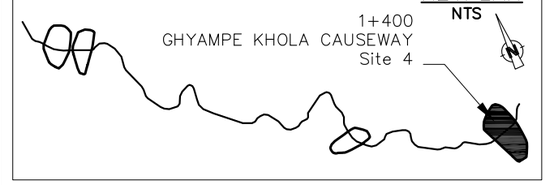


GHYAMPE KHOLA CAUSEWAY
STREAM LONGITUDINAL PROFILE
(CH 0+240 – 0+360)
SCALE: 500

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 0 5 10 15 20 25m
1:500

KEYPLAN
NTS



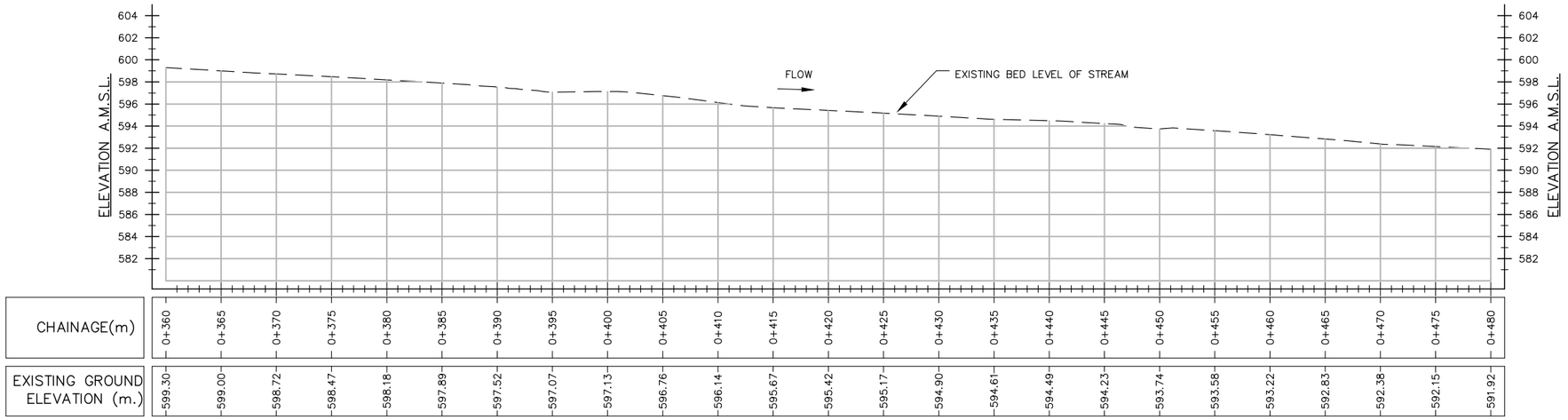
PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

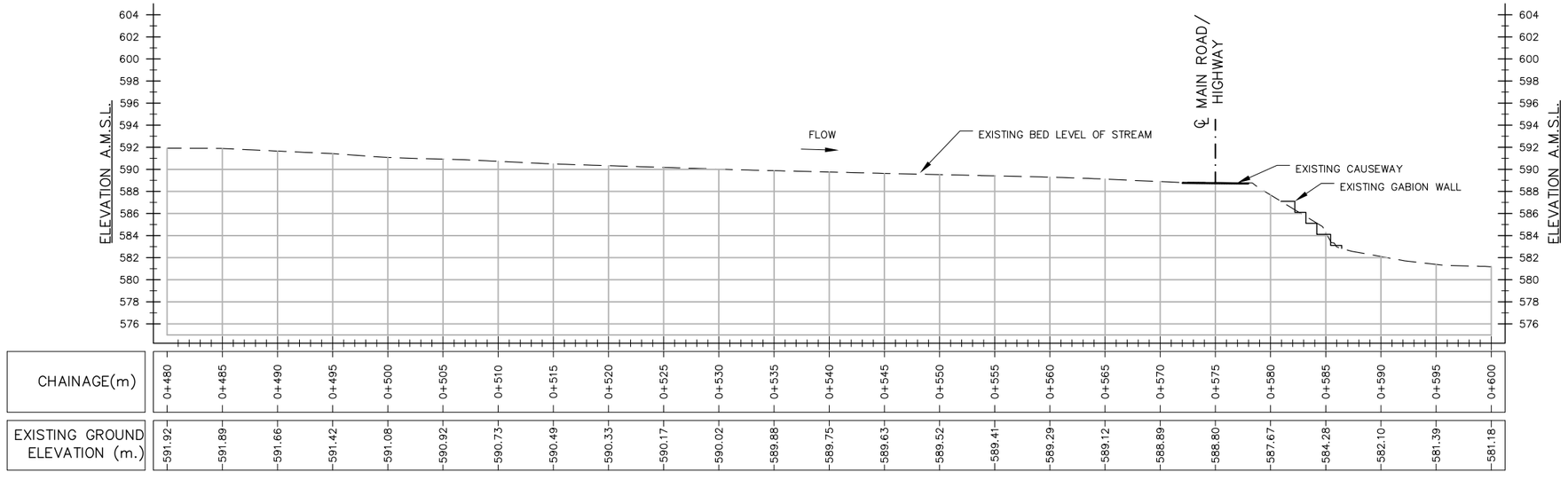
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Ghyampe Khola Causeway
Longitudinal Profile of Stream
CH 0+000 TO 0+360

Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-GKC-LPS-001	Rev.: –	Date: June, 2019



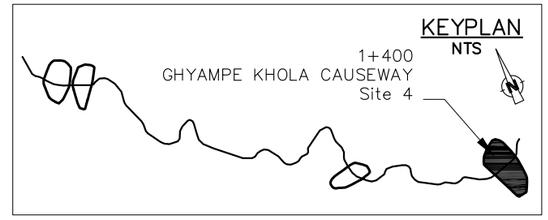
GHYAMPE KHOLA CAUSEWAY
STREAM LONGITUDINAL PROFILE
(CH 0+360 – 0+480)
SCALE: 500



GHYAMPE KHOLA CAUSEWAY
STREAM LONGITUDINAL PROFILE
(CH 0+480 – 0+600)
SCALE: 500

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 0 5 10 15 20 25m
1:500



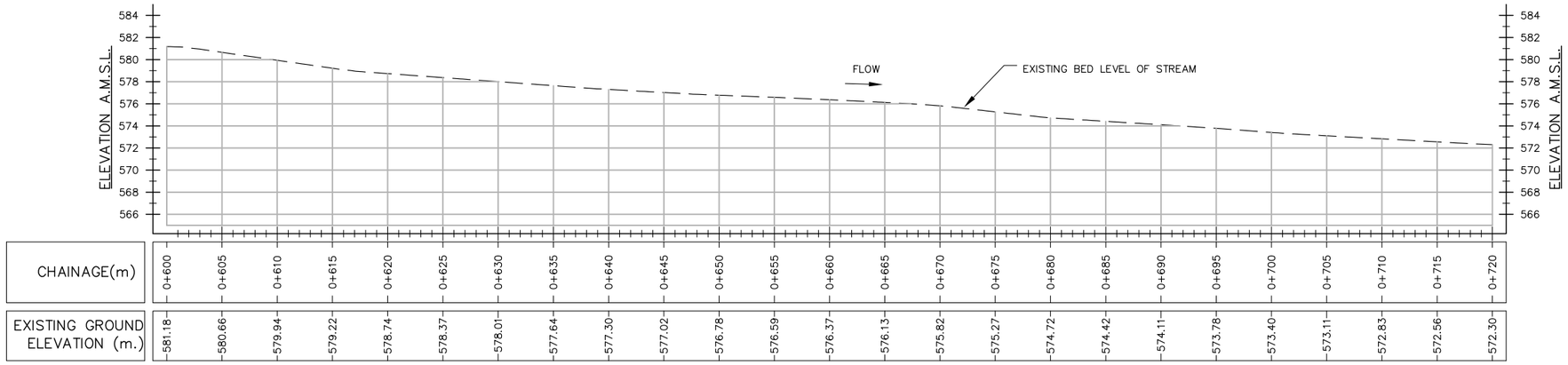
PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

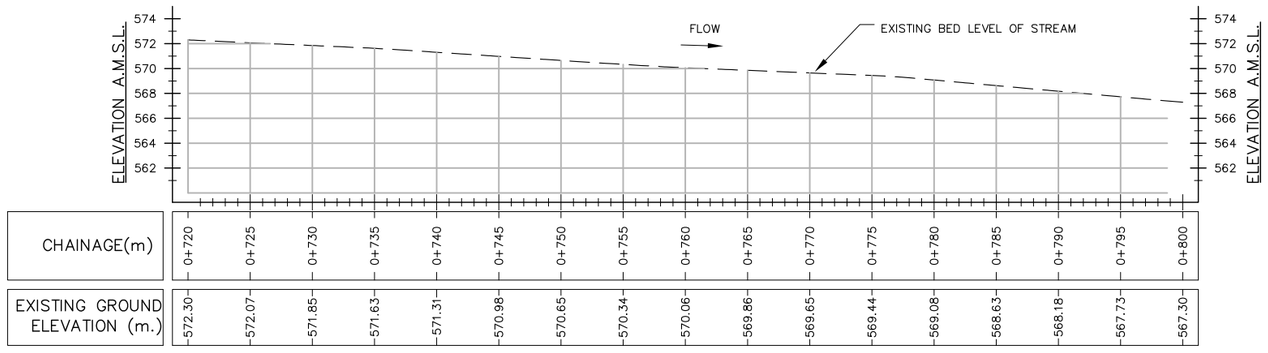
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Ghyampe Khola Causeway
Longitudinal Profile of Stream
CH 0+360 TO 0+600

Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-GKC-LPS-002	Rev. –	Date: June, 2019



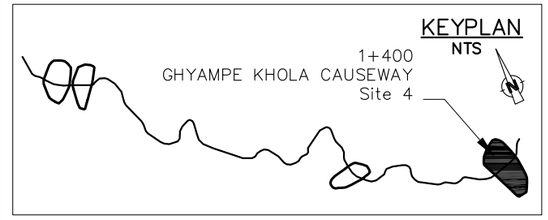
GHYAMPE KHOLA CAUSEWAY
STREAM LONGITUDINAL PROFILE
(CH 0+600 – 0+720)
SCALE: 500



GHYAMPE KHOLA CAUSEWAY
STREAM LONGITUDINAL PROFILE
(CH 0+720 – 0+800)
SCALE: 500

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 0 5 10 15 20 25m
1:500



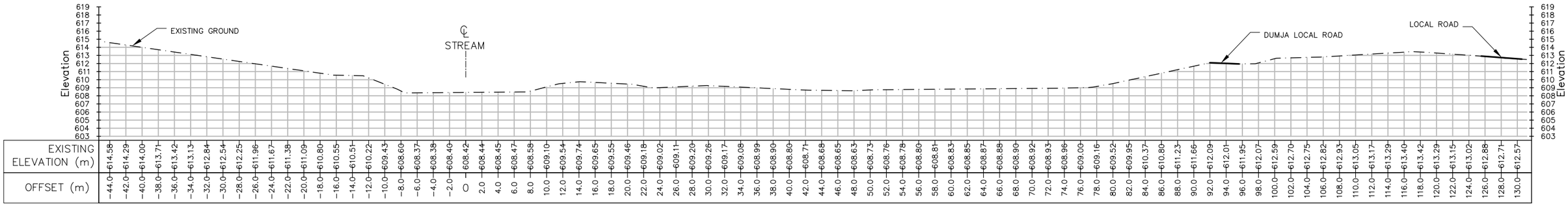
PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

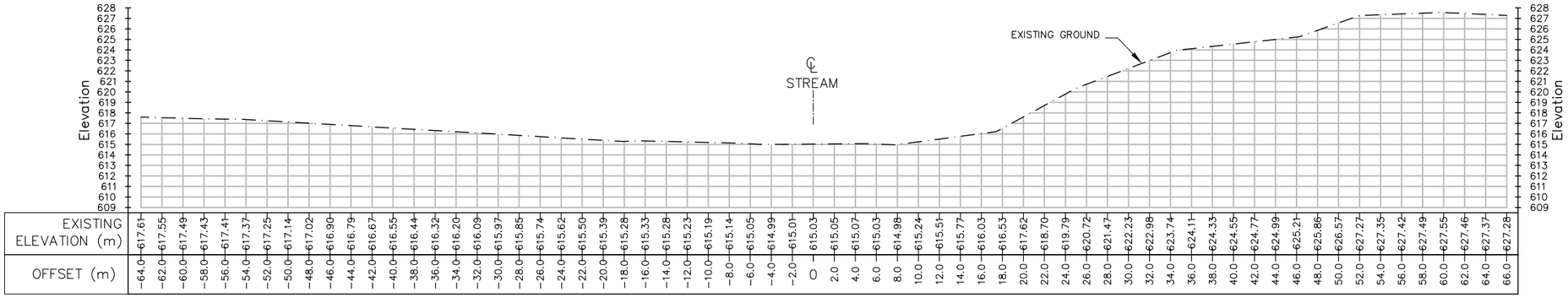
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Ghyampe Khola Causeway
Longitudinal Profile of Stream
CH 0+600 TO 0+800

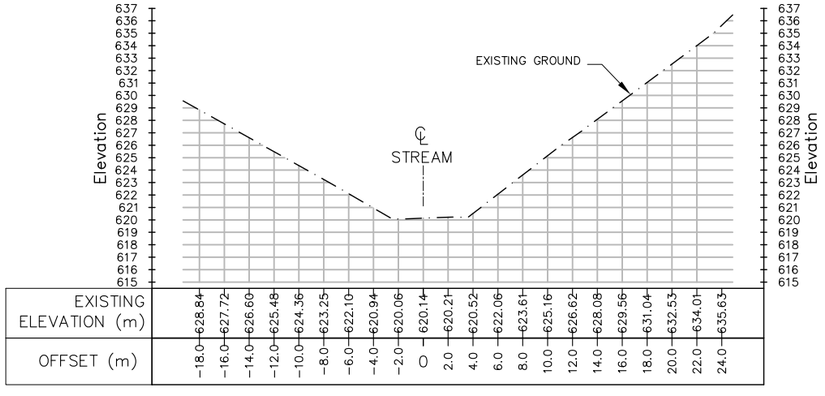
Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-GKC-LPS-003	Rev. –	Date: June, 2019



CROSS SECTION OF STREAM
300m U/S OF MAIN ROAD/HIGHWAY
SCALE 1:500



CROSS SECTION OF STREAM
400m U/S OF MAIN ROAD/HIGHWAY
SCALE 1:500

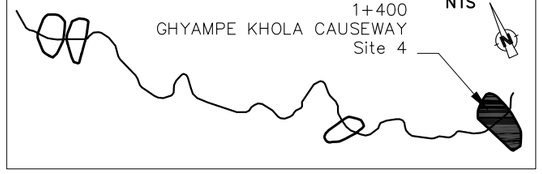


CROSS SECTION OF STREAM
500m U/S OF MAIN ROAD/HIGHWAY
SCALE 1:500

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 0 5 10 15 20 25m
1:500

KEYPLAN
NTS



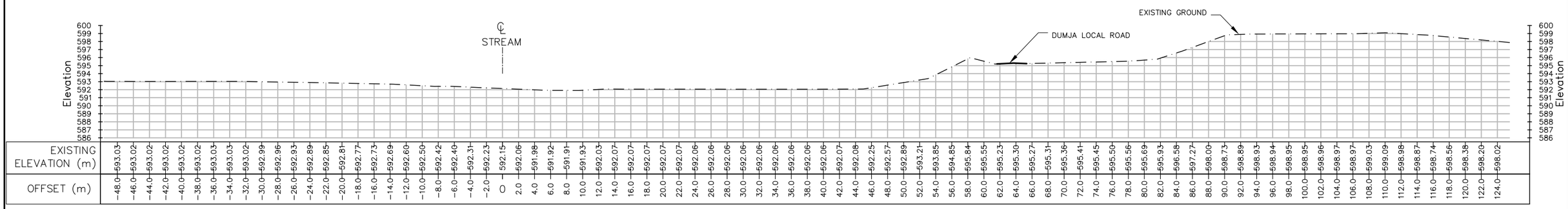
PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

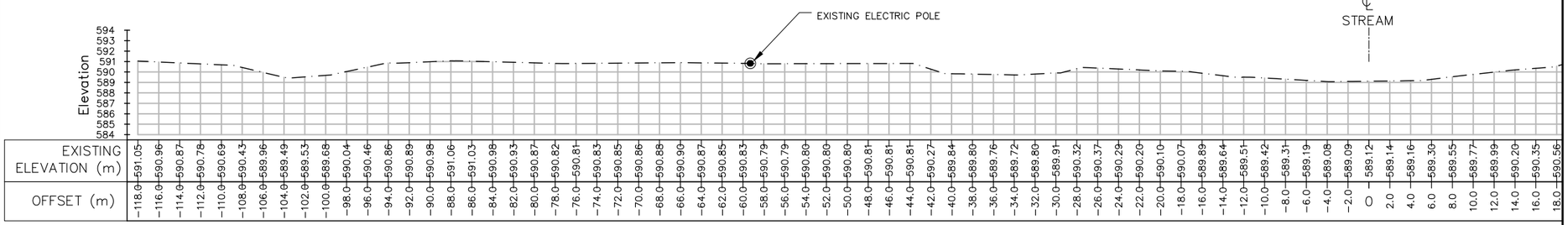
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Ghyampe Khola Causeway
Cross Section of Stream
300m, 400m & 500m UPSTREAM OF HIGHWAY

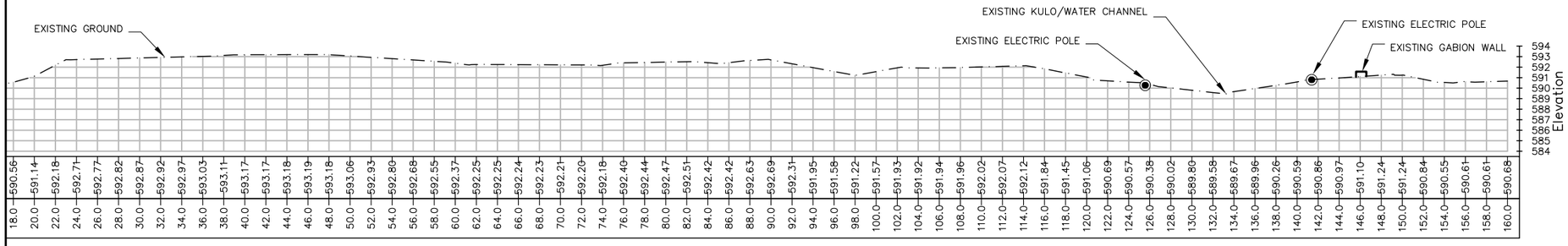
Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-GKC-CSS-001	Rev.: –	Date: June, 2019



CROSS SECTION OF STREAM
100m U/S OF MAIN ROAD/HIGHWAY
SCALE 1:500



CROSS SECTION OF STREAM
10m U/S OF MAIN ROAD/HIGHWAY
(LEFT SIDE OF STREAM)
SCALE 1:500



CROSS SECTION OF STREAM
10m U/S OF MAIN ROAD/HIGHWAY
(RIGHT SIDE OF STREAM)
SCALE 1:500

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 0 5 10 15 20 25m
1:500

KEYPLAN
NTS
1+400
GHYAMPE KHOLA CAUSEWAY
Site 4

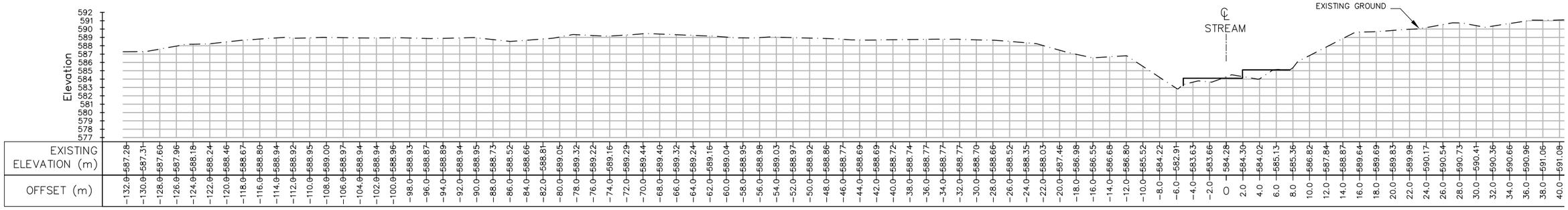
PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

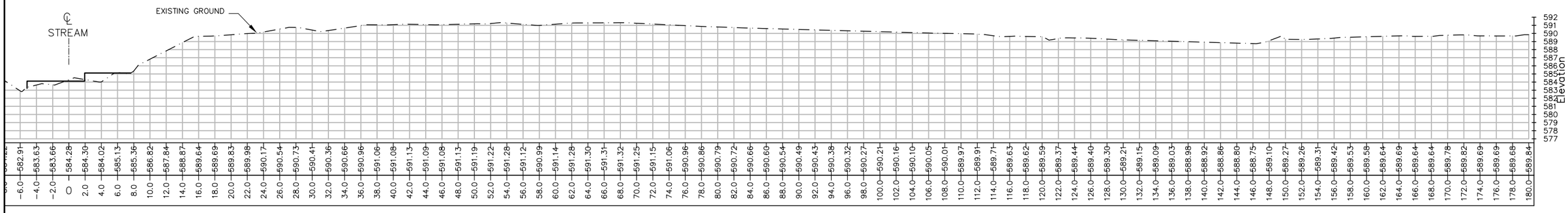
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Ghyampe Khola Causeway
Cross Section of Stream
100m & 10m UPSTREAM OF HIGHWAY

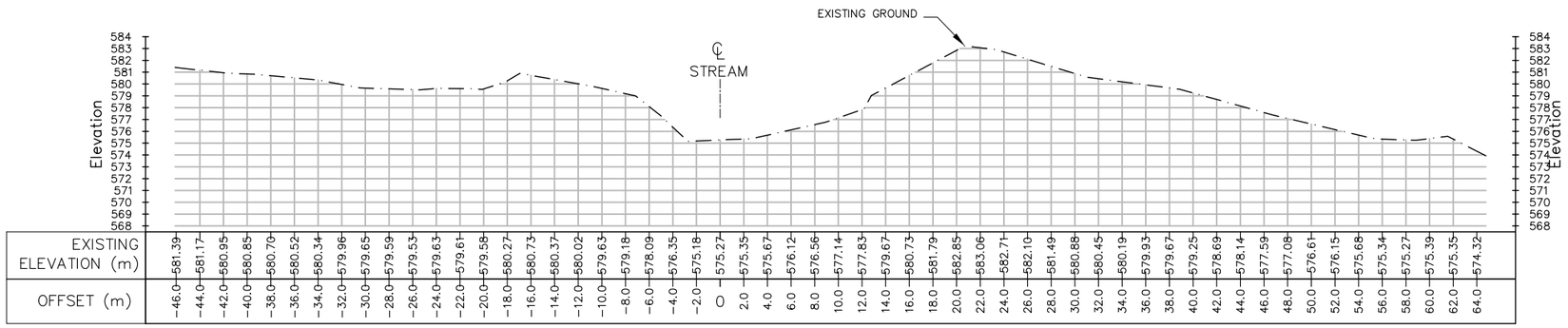
Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-GKC-CSS-002	Rev. –	Date: June, 2019



CROSS SECTION OF STREAM
10m D/S OF MAIN ROAD/HIGHWAY
(LEFT SIDE OF STREAM)
SCALE 1:500



CROSS SECTION OF STREAM
10m D/S OF MAIN ROAD/HIGHWAY
(RIGHT SIDE OF STREAM)
SCALE 1:500



CROSS SECTION OF STREAM
100m D/S OF MAIN ROAD/HIGHWAY
SCALE 1:500

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 0 5 10 15 20 25m
1:500

KEYPLAN
NTS
1+400
GHYAMPE KHOLA CAUSEWAY
Site 4

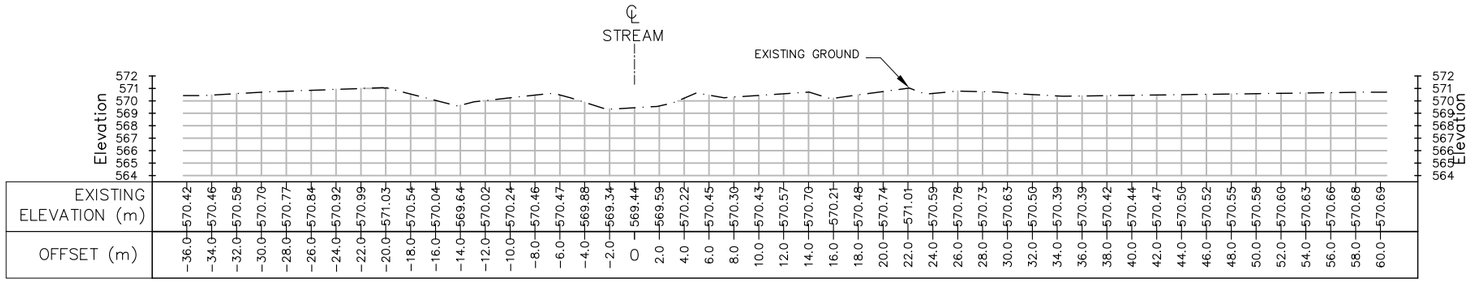
PROJECT FOR THE OPERATION AND MAINTENANCE OF
THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Ghyampe Khola Causeway
Cross Section of Stream
10m & 100m DOWNSTREAM OF HIGHWAY

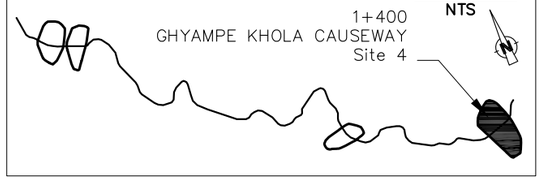
Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-GKC-CSS-003	Rev. –	Date: June, 2019



CROSS SECTION OF STREAM
200m D/S OF MAIN ROAD/HIGHWAY
SCALE 1:500

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 0 5 10 15 20 25m
1:500



PROJECT FOR THE OPERATION AND MAINTENANCE OF
THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

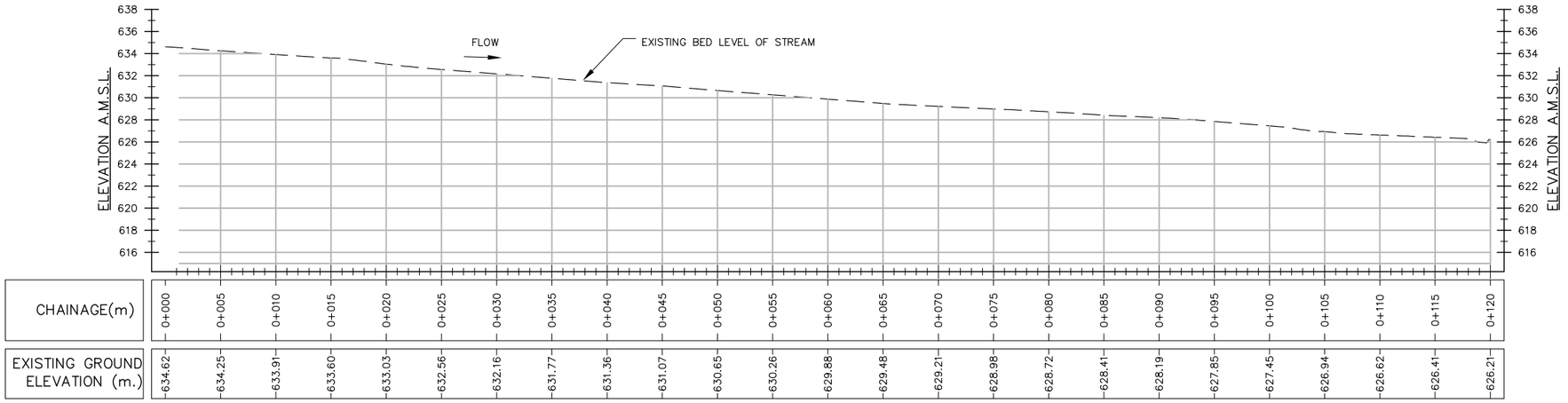
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Ghyampe Khola Causeway
Cross Section of Stream
200m DOWNSTREAM OF HIGHWAY

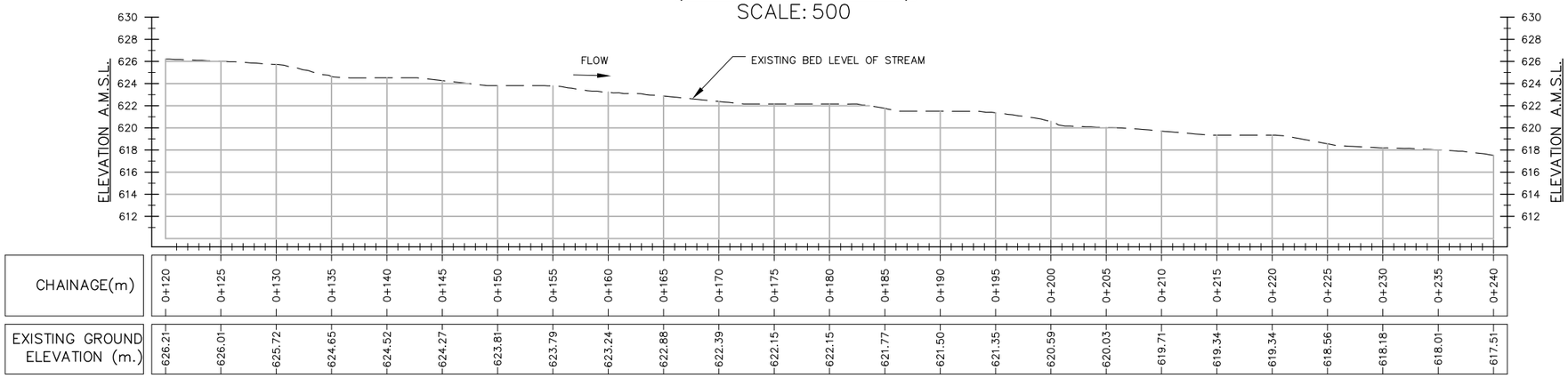
Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-GKC-CSS-004	Rev.: –	Date: June, 2019

STA. 3+900, Mamti Khola Causeway

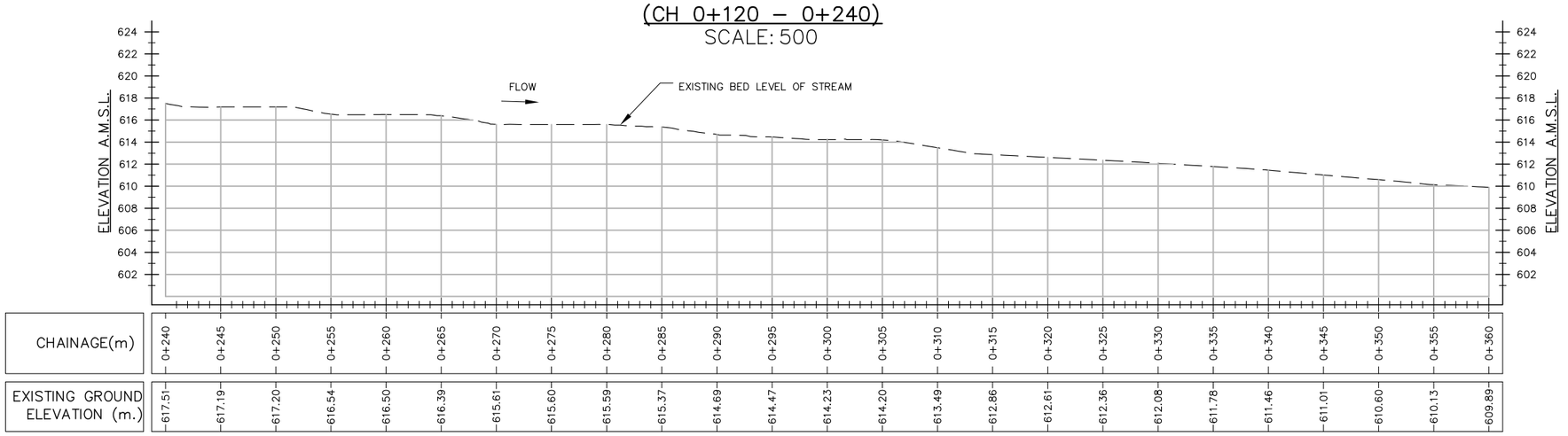
WATER COURSE PROFILE & CROSS SECTIONS OF RIVER/STREAM



MAMTI KHOLA CAUSEWAY
STREAM LONGITUDINAL PROFILE
(CH 0+000 – 0+120)
SCALE: 500



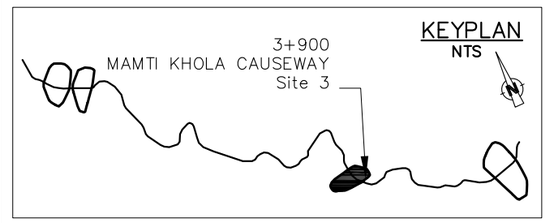
MAMTI KHOLA CAUSEWAY
STREAM LONGITUDINAL PROFILE
(CH 0+120 – 0+240)
SCALE: 500



MAMTI KHOLA CAUSEWAY
STREAM LONGITUDINAL PROFILE
(CH 0+240 – 0+360)
SCALE: 500

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 0 5 10 15 20 25m
1:500



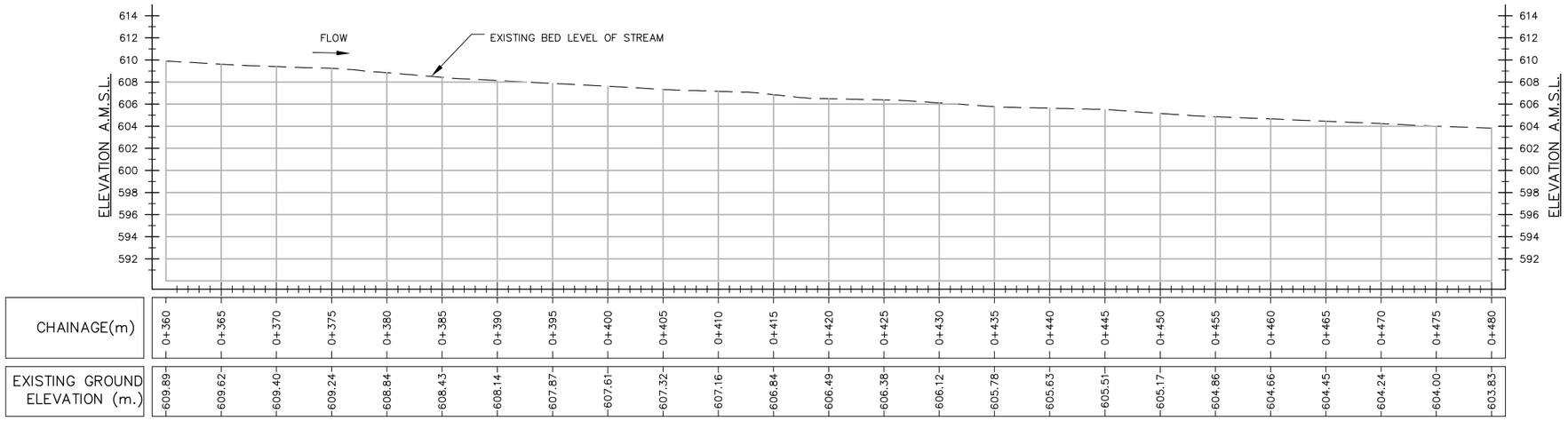
PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

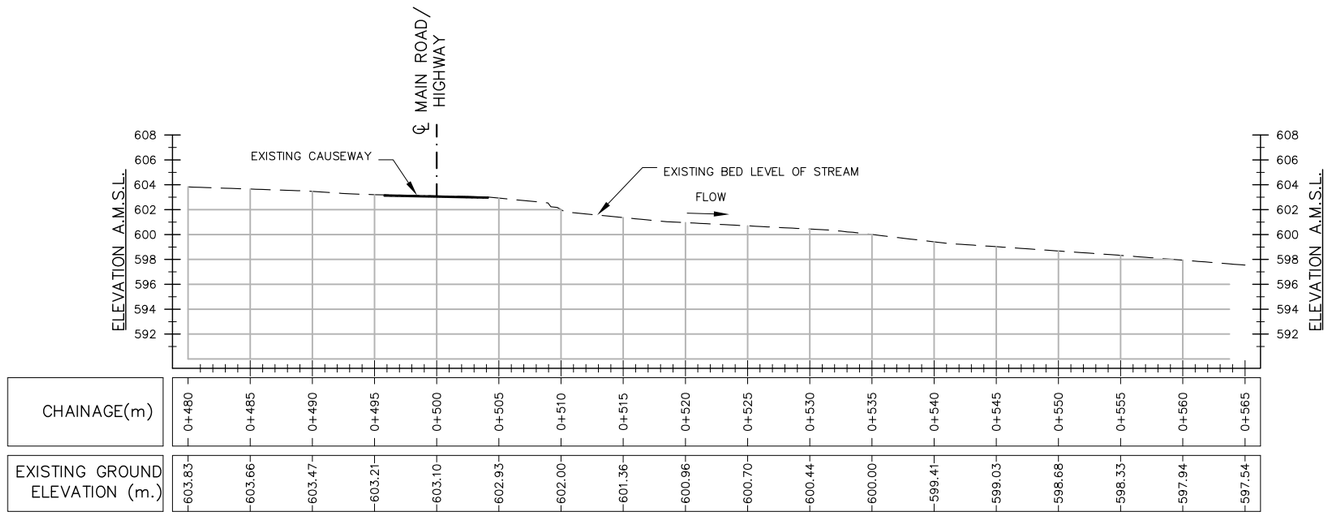
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: MAMTI Khola Causeway
Longitudinal Profile of Stream
CH 0+000 TO 0+360

Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-MKC-LPS-001	Rev.: –	Date: June, 2019



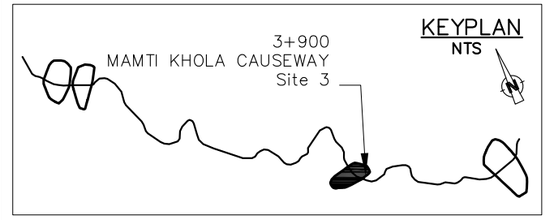
MAMTI KHOLA CAUSEWAY
STREAM LONGITUDINAL PROFILE
(CH 0+360 – 0+480)
SCALE: 500



MAMTI KHOLA CAUSEWAY
STREAM LONGITUDINAL PROFILE
(CH 0+480 – 0+565)
SCALE: 500

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 0 5 10 15 20 25m
1: 500



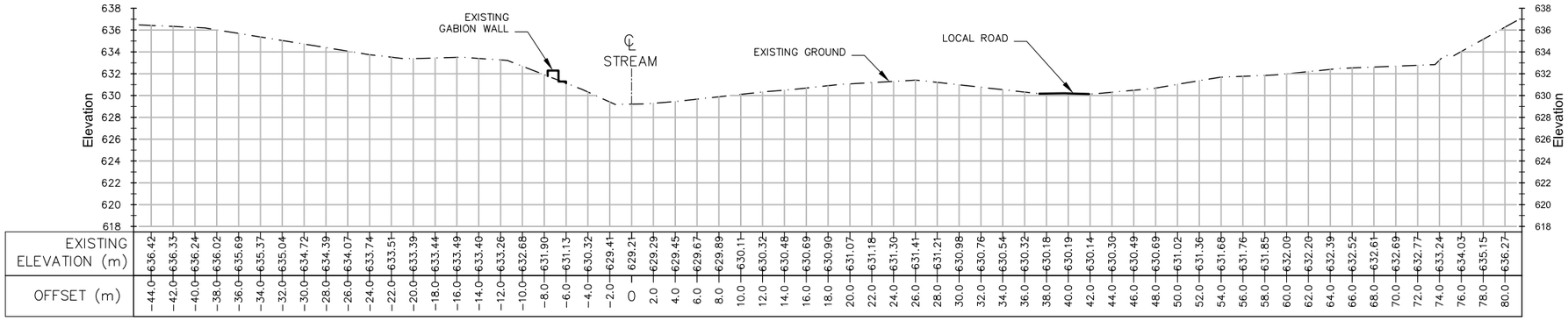
PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

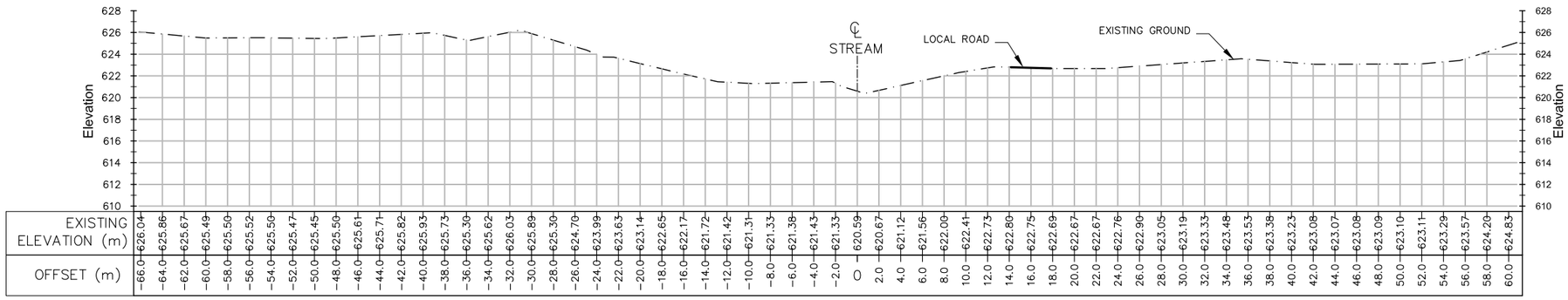
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: MAMTI Khola Causeway
Longitudinal Profile of Stream
CH 0+360 TO 0+565

Scale A1: 1: 250 Scale A3: 1: 500	Drawing No.: SR2-MKC-LPS-002	Rev. –	Date: June, 2019



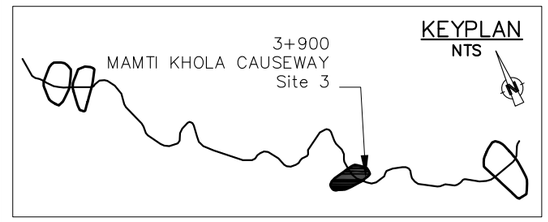
CROSS SECTION OF STREAM
430m U/S OF MAIN ROAD/HIGHWAY
SCALE 1:500



CROSS SECTION OF STREAM
300m U/S OF MAIN ROAD/HIGHWAY
SCALE 1:500

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 0 5 10 15 20 25m
1:500



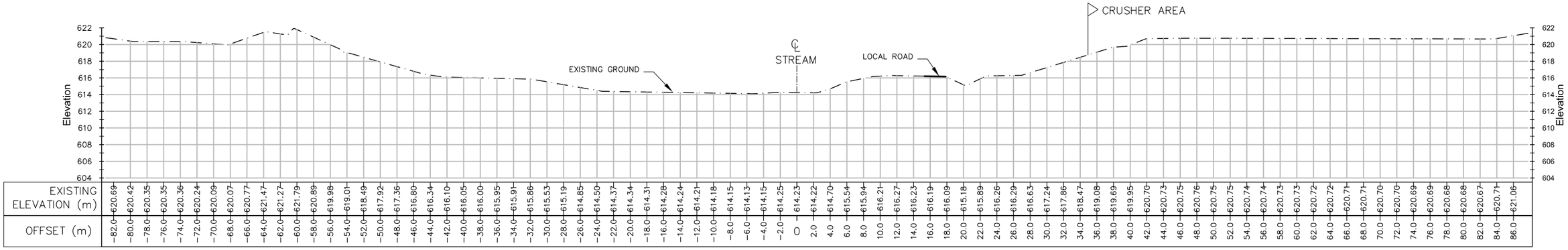
PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

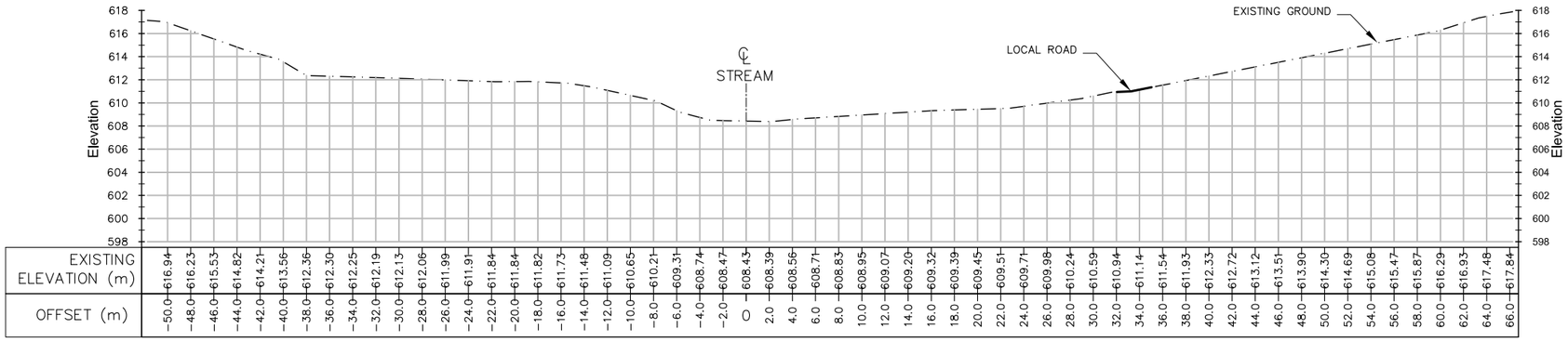
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: MAMTI Khola Causeway
Cross Section of Stream
430m & 300m UPSTREAM OF HIGHWAY

Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-MKC-CSS-001	Rev. –	Date: June, 2019



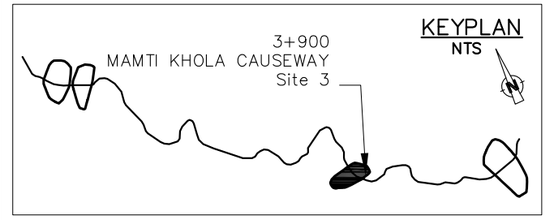
CROSS SECTION OF STREAM
200m U/S OF MAIN ROAD/HIGHWAY
SCALE 1:500



CROSS SECTION OF STREAM
115m U/S OF MAIN ROAD/HIGHWAY
SCALE 1:500

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 0 5 10 15 20 25m
1:500



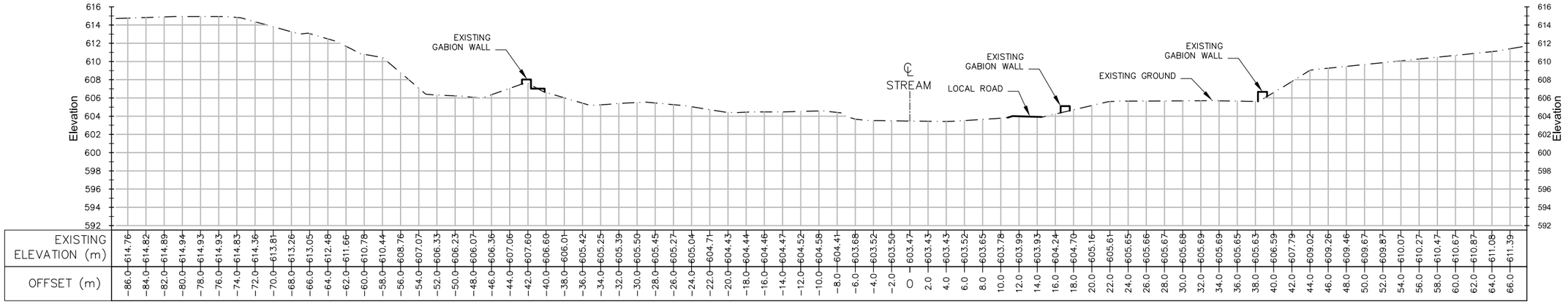
PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

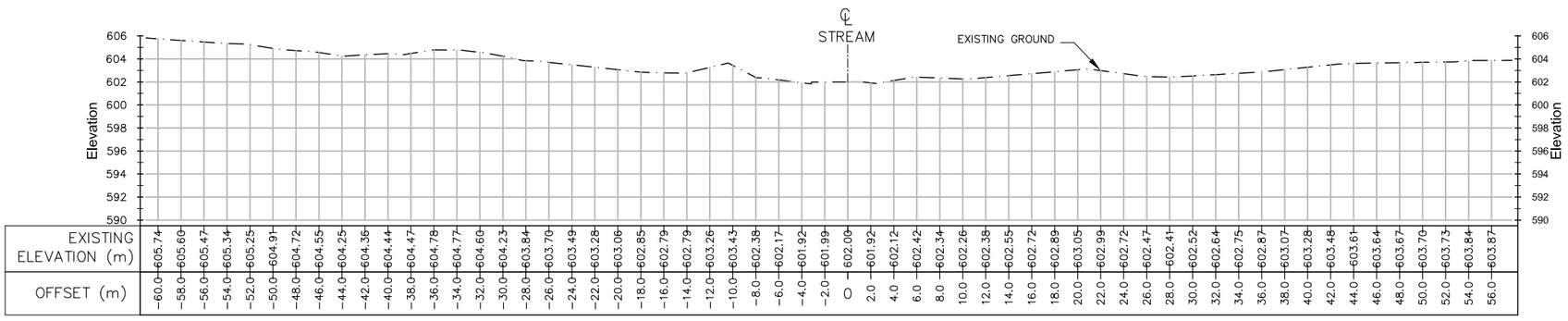
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: MAMTI Khola Causeway
Cross Section of Stream
200m & 115m UPSTREAM OF HIGHWAY

Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-MKC-CSS-002	Rev. –	Date: June, 2019



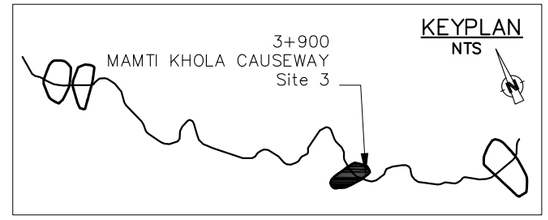
CROSS SECTION OF STREAM
10m U/S OF MAIN ROAD/HIGHWAY
SCALE 1:500



CROSS SECTION OF STREAM
10m D/S OF MAIN ROAD/HIGHWAY
SCALE 1:500

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 0 5 10 15 20 25m
1:500



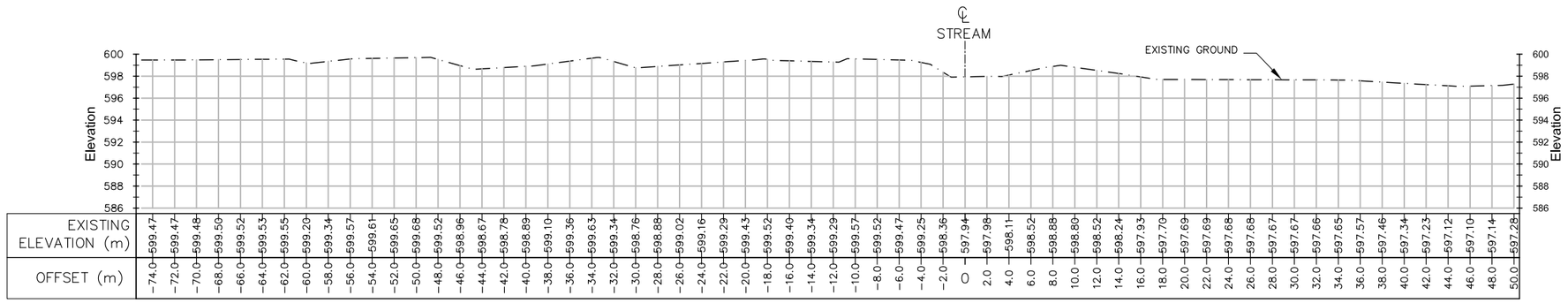
PROJECT FOR THE OPERATION AND MAINTENANCE OF
THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: MAMTI Khola Causeway
Cross Section of Stream
10m UPSTREAM & 10m DOWNSTREAM OF HIGHWAY

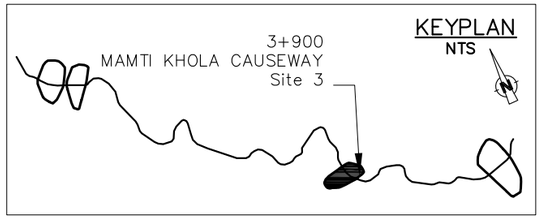
Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-MKC-CSS-003	Rev. –	Date: June, 2019



CROSS SECTION OF STREAM
60m D/S OF MAIN ROAD/HIGHWAY
SCALE 1:500

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 0 5 10 15 20 25m
1:500



PROJECT FOR THE OPERATION AND MAINTENANCE OF
THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

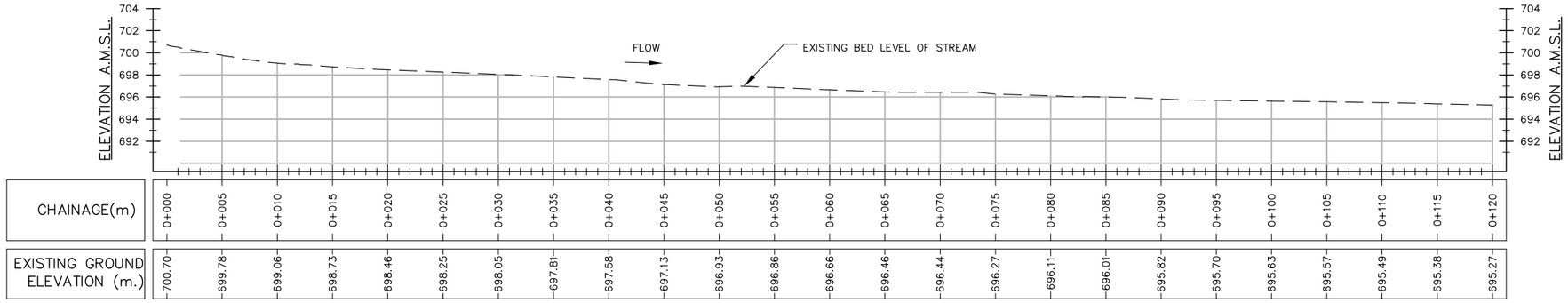
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: MAMTI Khola Causeway
Cross Section of Stream
200m DOWNSTREAM OF HIGHWAY

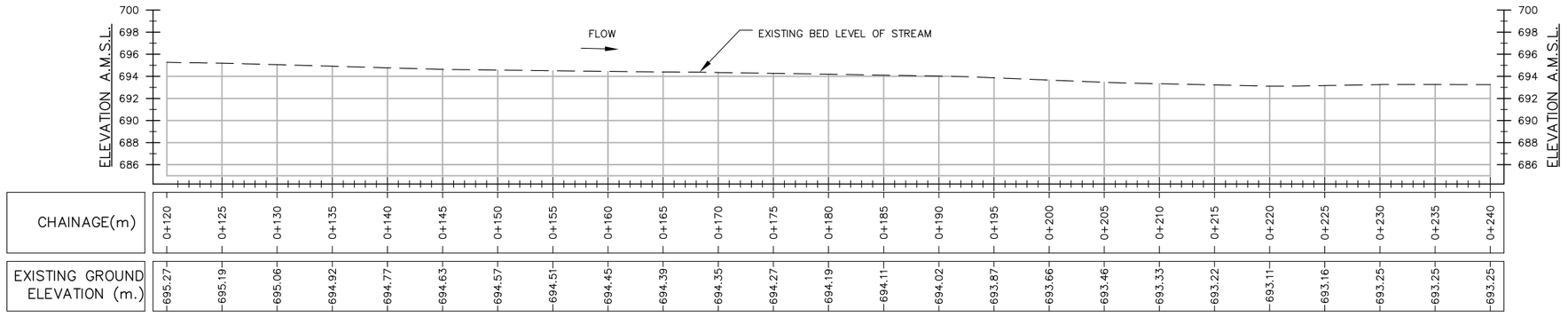
Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-MKC-CSS-004	Rev.: –	Date: June, 2019

STA.9+700 Bhyakure Khola Causeway

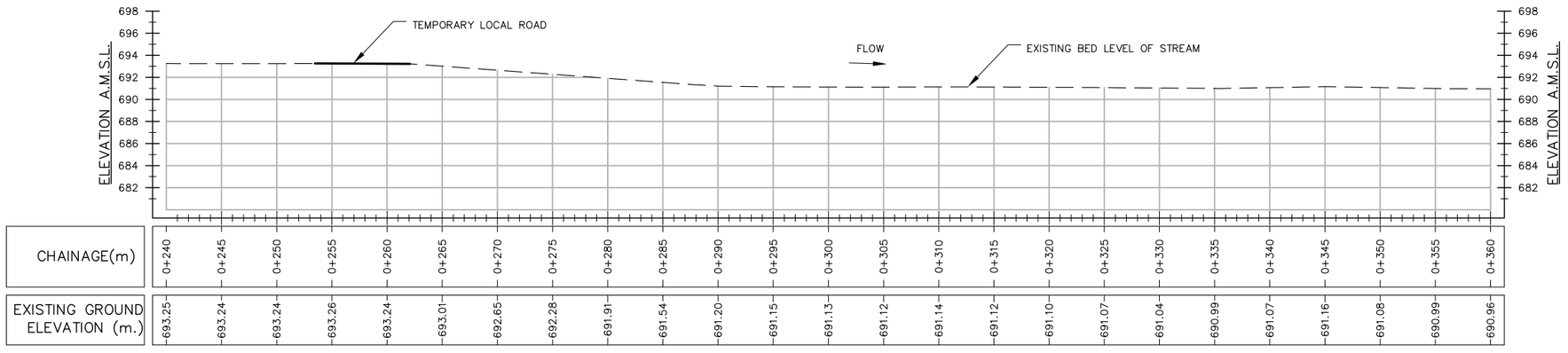
WATER COURSE PROFILE & CROSS SECTIONS OF RIVER/STREAM



BHYAKURE KHOLA CAUSEWAY
STREAM LONGITUDINAL PROFILE
(CH 0+000 – 0+120)
SCALE: 500



BHYAKURE KHOLA CAUSEWAY
STREAM LONGITUDINAL PROFILE
(CH 0+120 – 0+240)
SCALE: 500

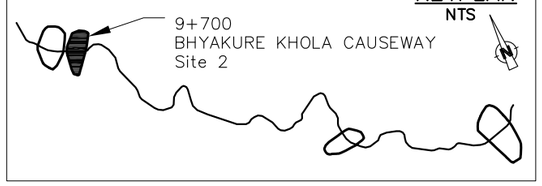


BHYAKURE KHOLA CAUSEWAY
STREAM LONGITUDINAL PROFILE
(CH 0+240 – 0+360)
SCALE: 500

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 0 5 10 15 20 25m
1:500

KEYPLAN
NTS



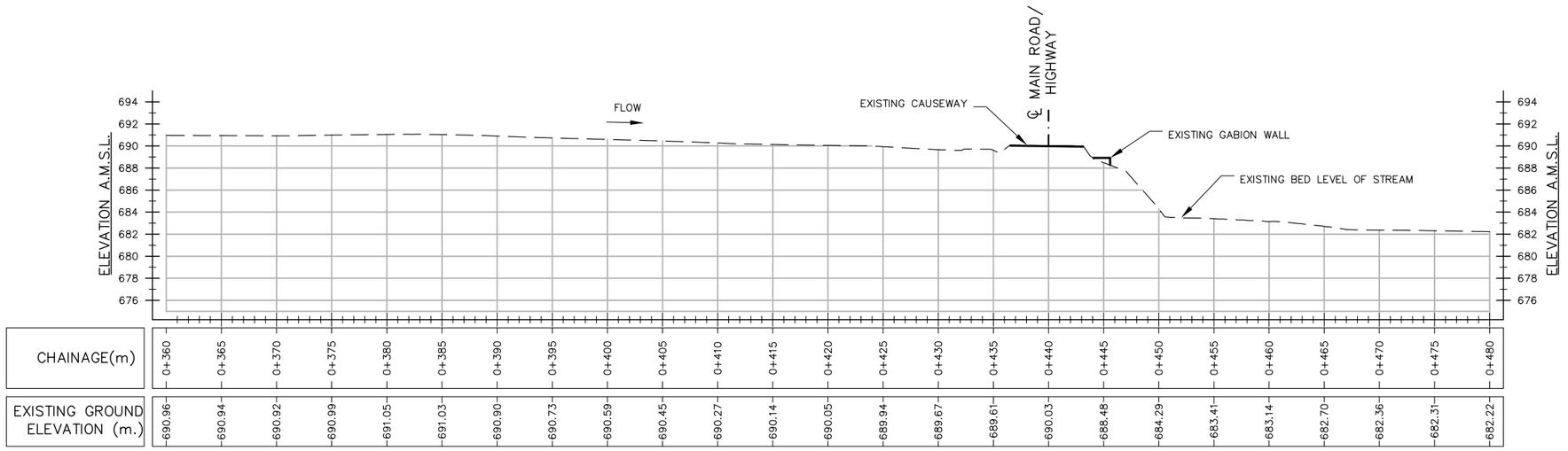
PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

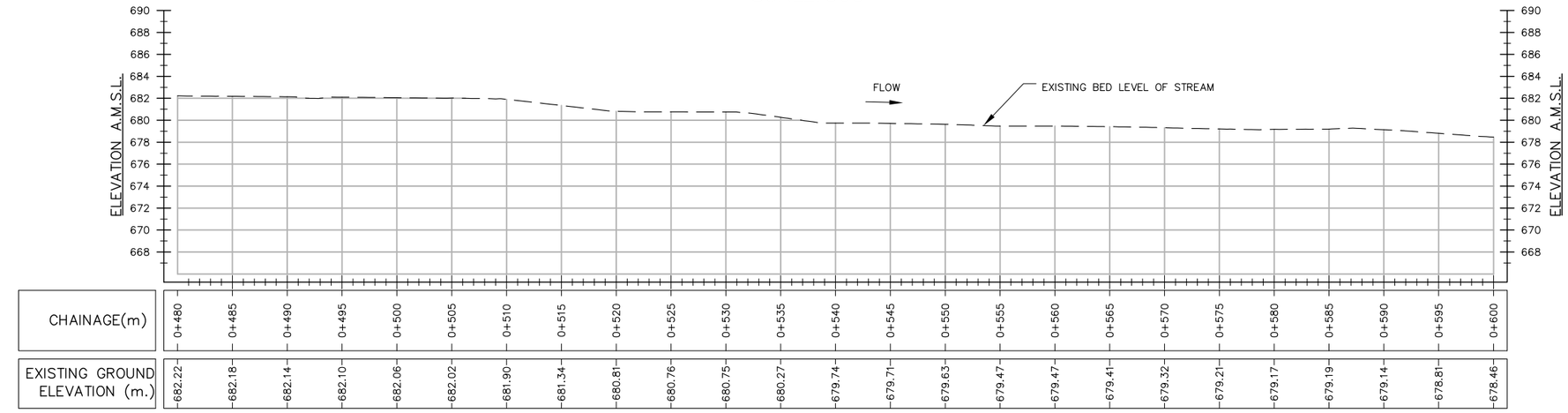
Title: Bhyakure Khola Causeway
Longitudinal Profile of Stream
CH 0+000 TO 0+360

Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-BKC-LPS-001	Rev.: –	Date: June, 2019



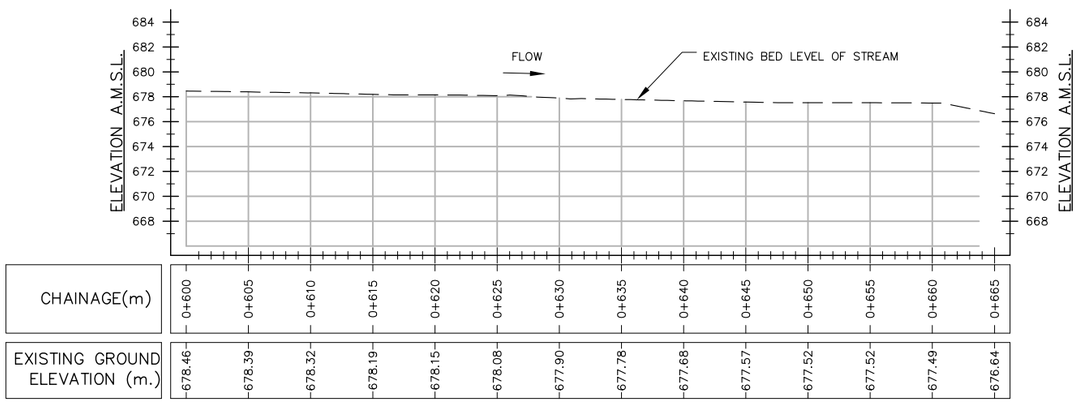
BHYAKURE KHOLA CAUSEWAY STREAM LONGITUDINAL PROFILE (CH 0+360 – 0+480)

SCALE: 500



BHYAKURE KHOLA CAUSEWAY STREAM LONGITUDINAL PROFILE (CH 0+480 – 0+600)

SCALE: 500



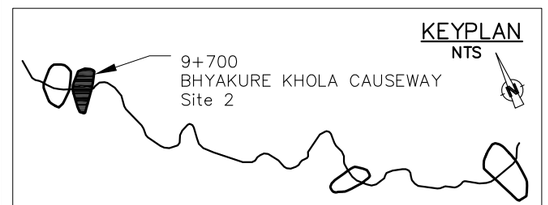
BHYAKURE KHOLA CAUSEWAY STREAM LONGITUDINAL PROFILE (CH 0+600 – 0+665)

SCALE: 500

NOTES:

1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 0 5 10 15 20 25m
1:500



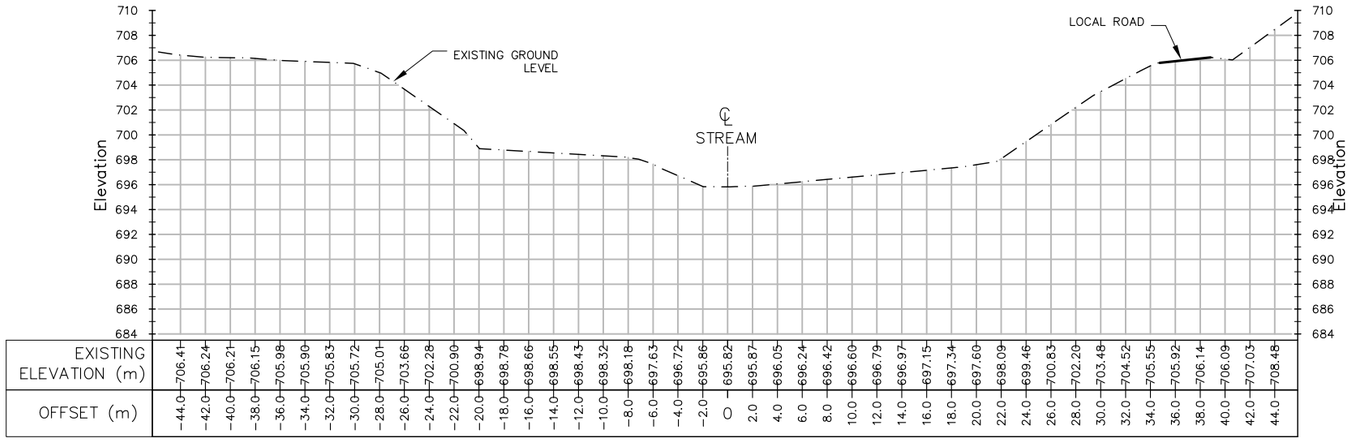
PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

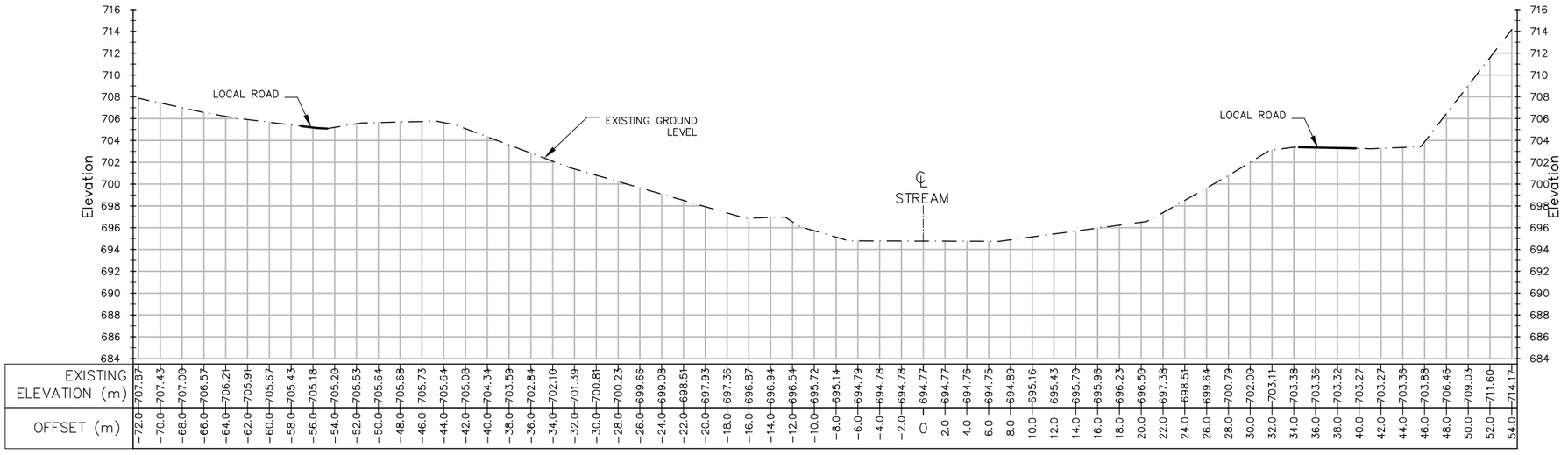
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Bhyakure Khola Causeway
Longitudinal Profile of Stream
CH 0+360 TO 0+665

Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-BKC-LPS-002	Rev.: –	Date: June, 2019



CROSS SECTION OF STREAM
350m U/S OF MAIN ROAD/HIGHWAY
SCALE 1:500

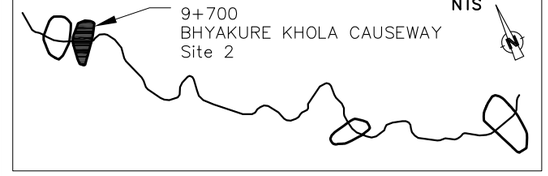


CROSS SECTION OF STREAM
300m U/S OF MAIN ROAD/HIGHWAY
SCALE 1:500

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 0 5 10 15 20 25m
1:500

KEYPLAN
NTS



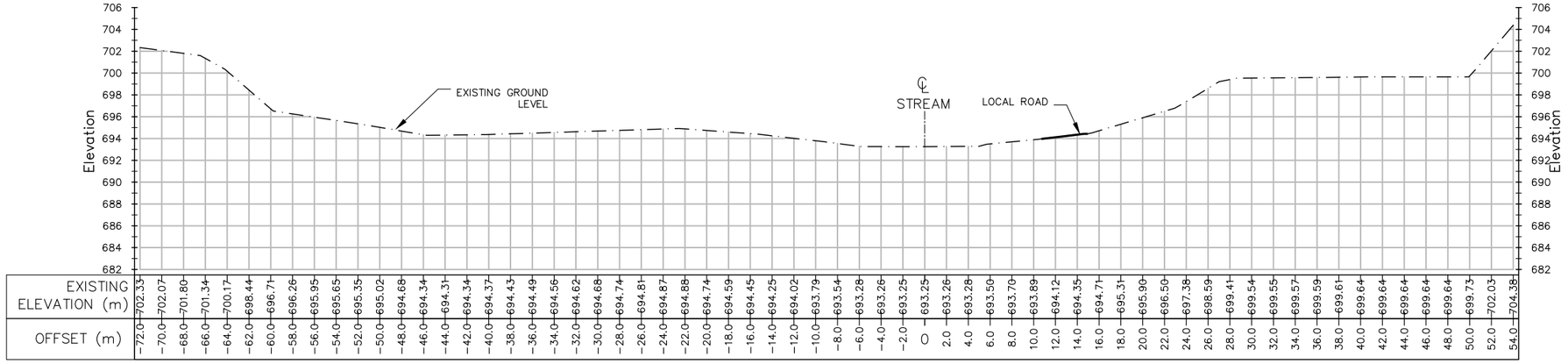
PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

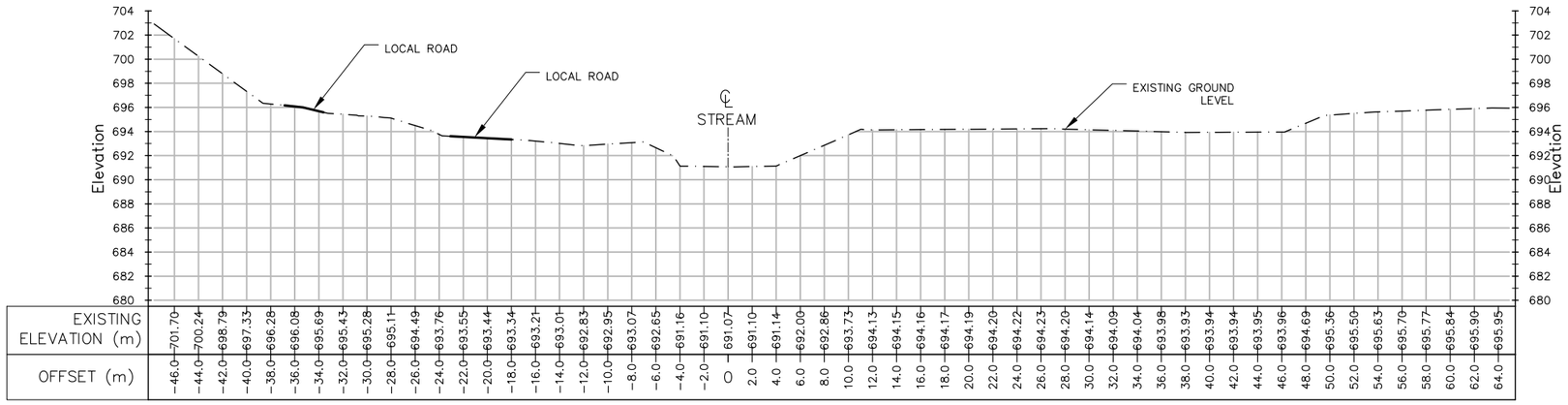
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Bhyakure Khola Causeway
Cross Section of Stream
350m & 300m UPSTREAM OF HIGHWAY

Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-BKC-CSS-001	Rev. –	Date: June, 2019



CROSS SECTION OF STREAM
200m U/S OF MAIN ROAD/HIGHWAY
SCALE 1:500

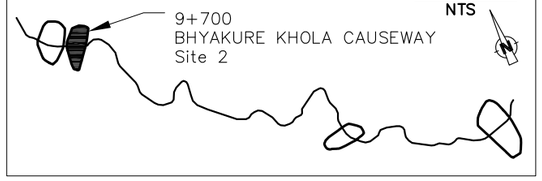


CROSS SECTION OF STREAM
100m U/S OF MAIN ROAD/HIGHWAY
SCALE 1:500

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 0 5 10 15 20 25m
1:500

KEYPLAN
NTS



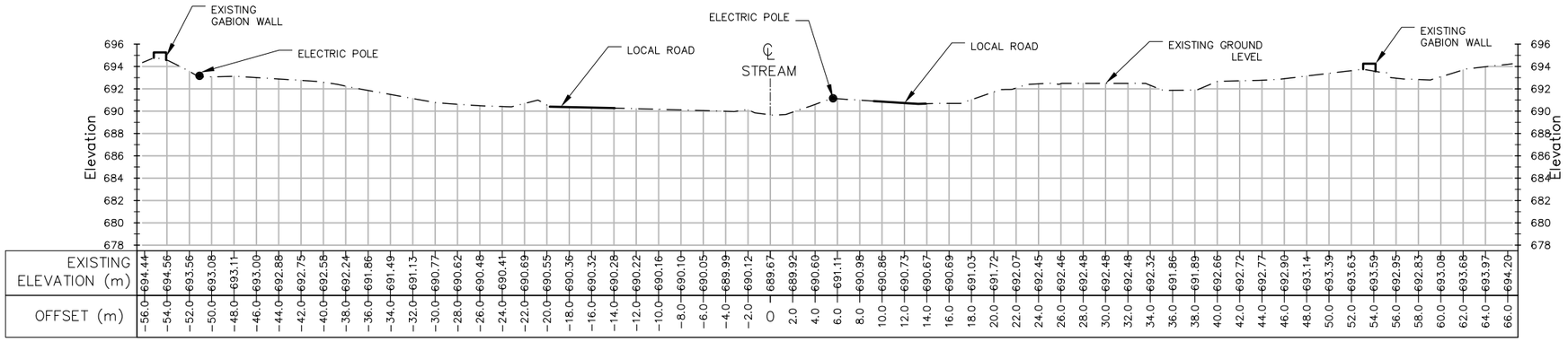
PROJECT FOR THE OPERATION AND MAINTENANCE OF
THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

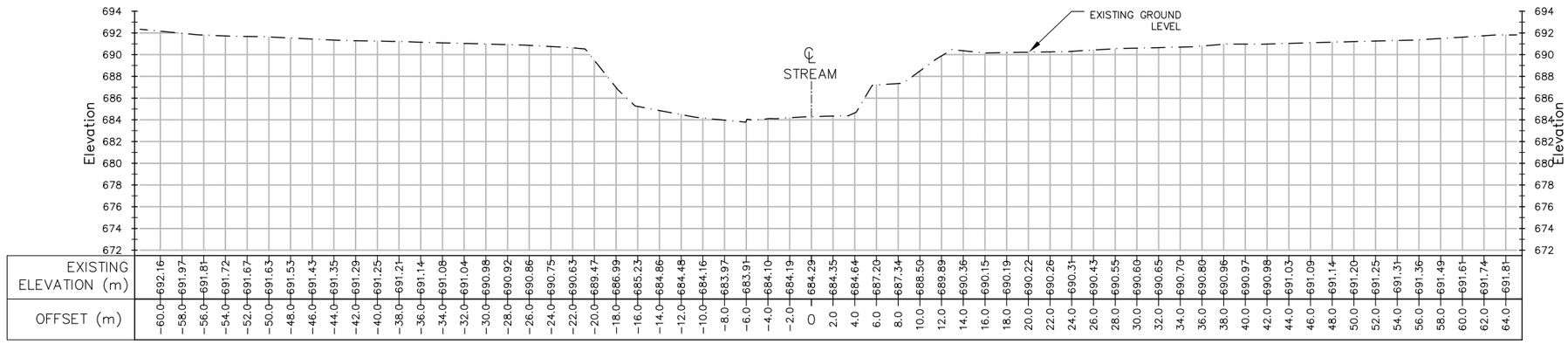
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Bhyakure Khola Causeway
Cross Section of Stream
200m & 100m UPSTREAM OF HIGHWAY

Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-BKC-CSS-002	Rev. –	Date: June, 2019



CROSS SECTION OF STREAM
10m U/S OF MAIN ROAD/HIGHWAY
SCALE 1:500

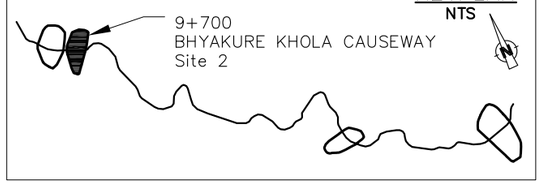


CROSS SECTION OF STREAM
10 m D/S OF MAIN ROAD/HIGHWAY
SCALE 1:500

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 0 5 10 15 20 25m
1:500

KEYPLAN
NTS



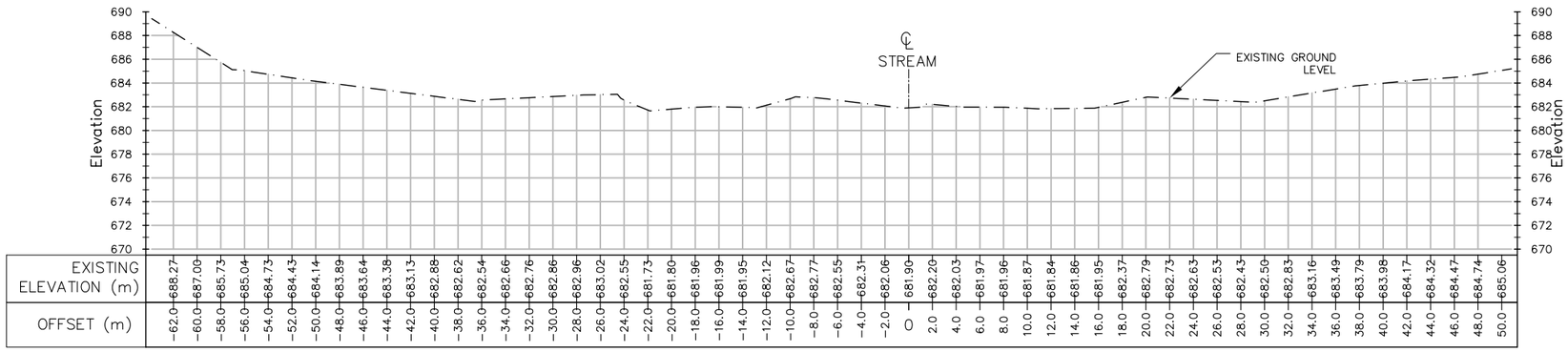
PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

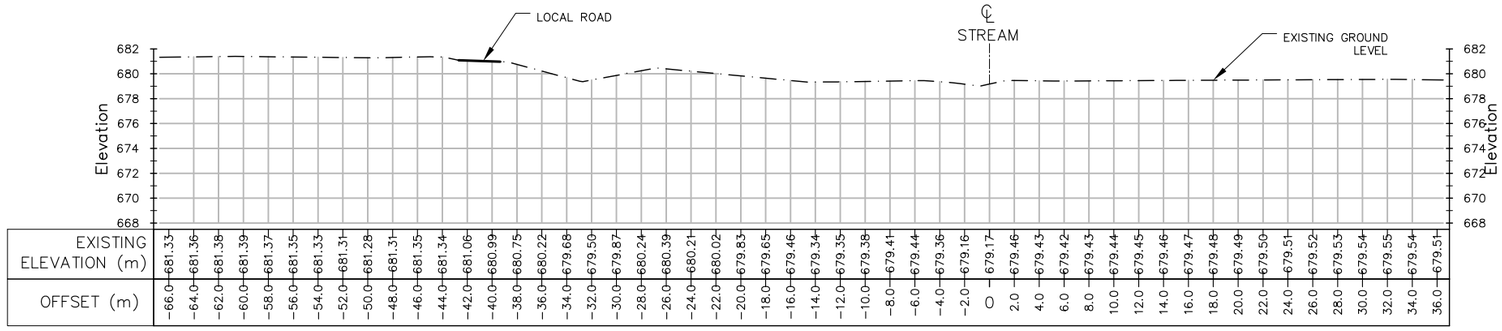
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Bhyakure Khola Causeway
Cross Section of Stream
10m UPSTREAM & 10m DOWNSTREAM OF HIGHWAY

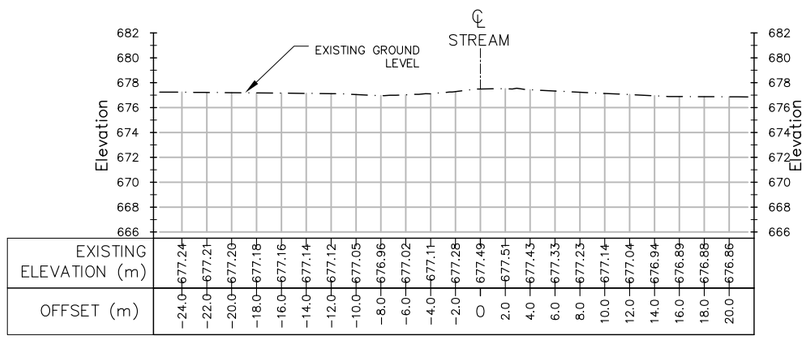
Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-BKC-CSS-003	Rev.: –	Date: June, 2019



CROSS SECTION OF STREAM
70m D/S OF MAIN ROAD/HIGHWAY
SCALE 1:500



CROSS SECTION OF STREAM
140m D/S OF MAIN ROAD/HIGHWAY
SCALE 1:500

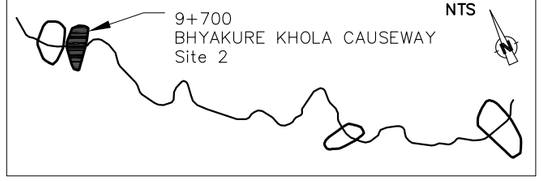


CROSS SECTION OF STREAM
220m D/S OF MAIN ROAD/HIGHWAY
SCALE 1:500

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 0 5 10 15 20 25m
1:500

KEYPLAN
NTS



PROJECT FOR THE OPERATION AND MAINTENANCE OF
THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

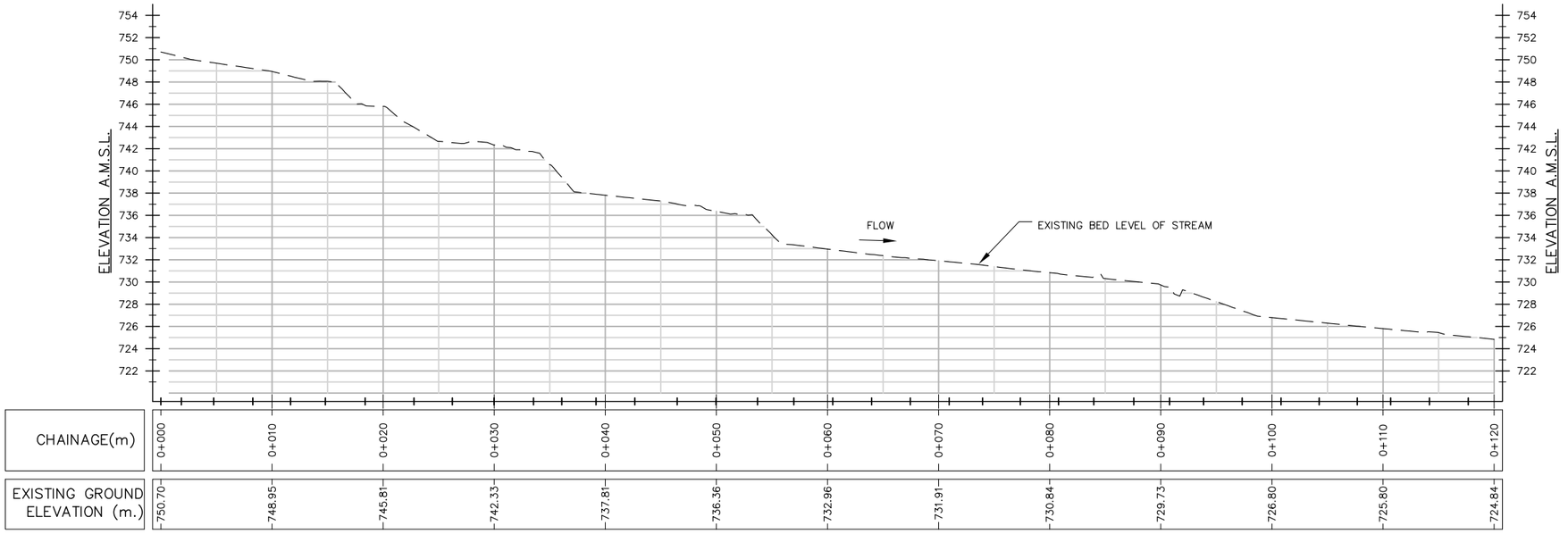
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Bhyakure Khola Causeway
Cross Section of Stream
70m, 140m & 220m DOWNSTREAM OF HIGHWAY

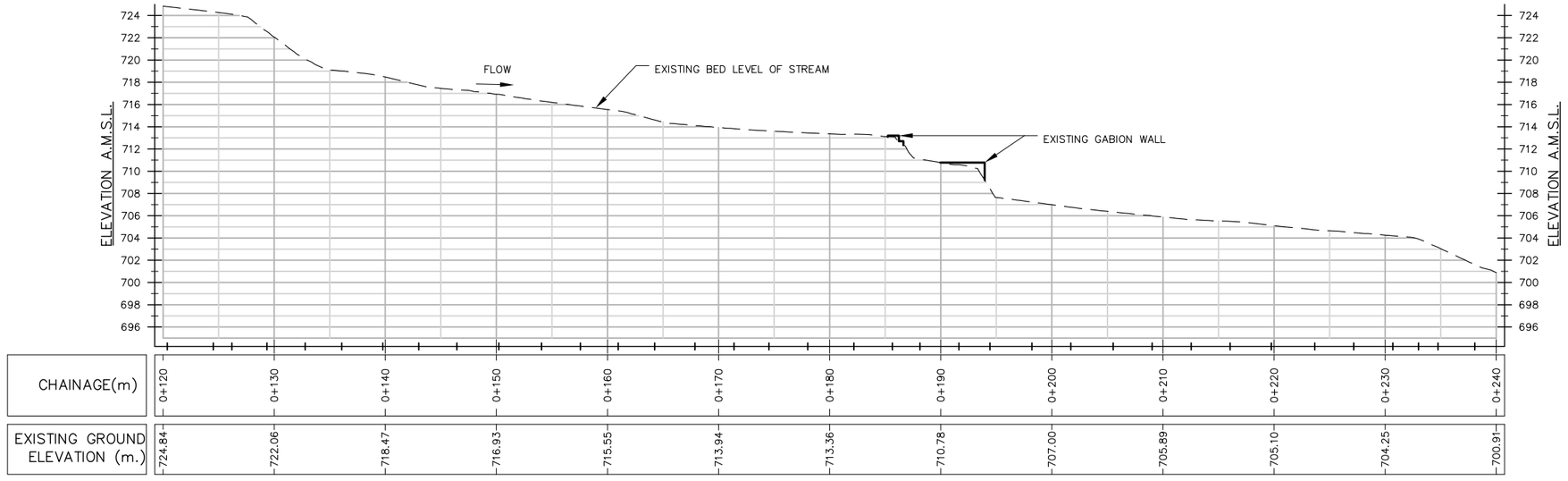
Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-BKC-CSS-004	Rev. –	Date: June, 2019

STA. 10+100 Kaldhunga Roadway

WATER COURSE PROFILE & CROSS SECTIONS OF RIVER/STREAM



KALDHUNGA ROADWAY
STREAM LONGITUDINAL PROFILE
(CH 0+000 – 0+120)
SCALE: 500

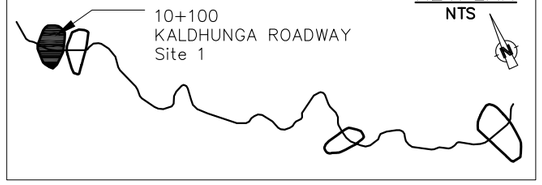


KALDHUNGA ROADWAY
STREAM LONGITUDINAL PROFILE
(CH 0+120 – 0+240)
SCALE: 500

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 0 5 10 15 20 25m
1:500

KEYPLAN
NTS



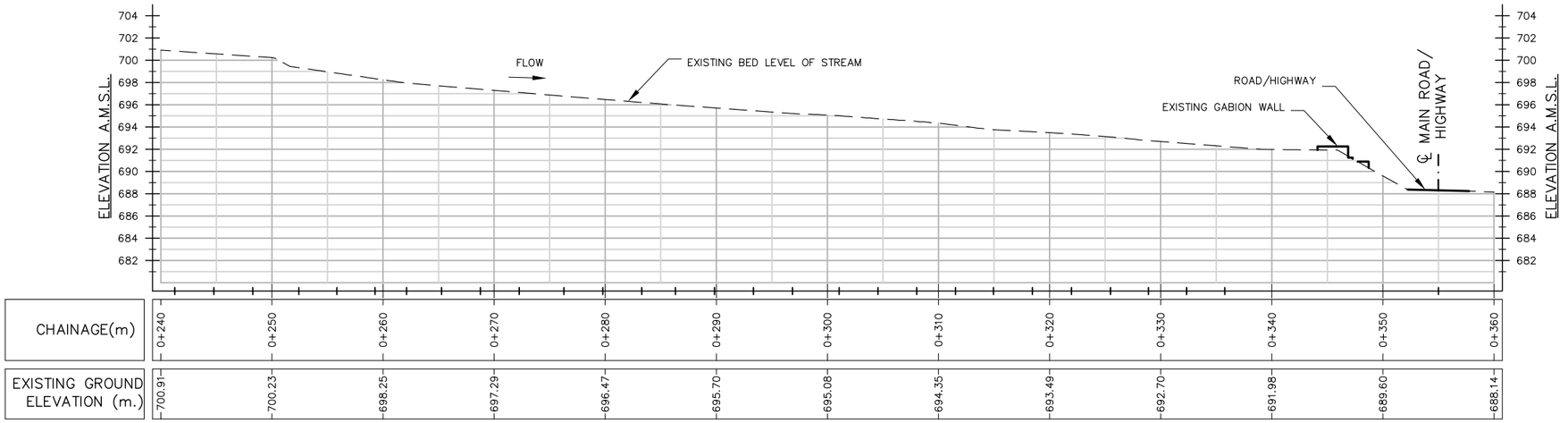
PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

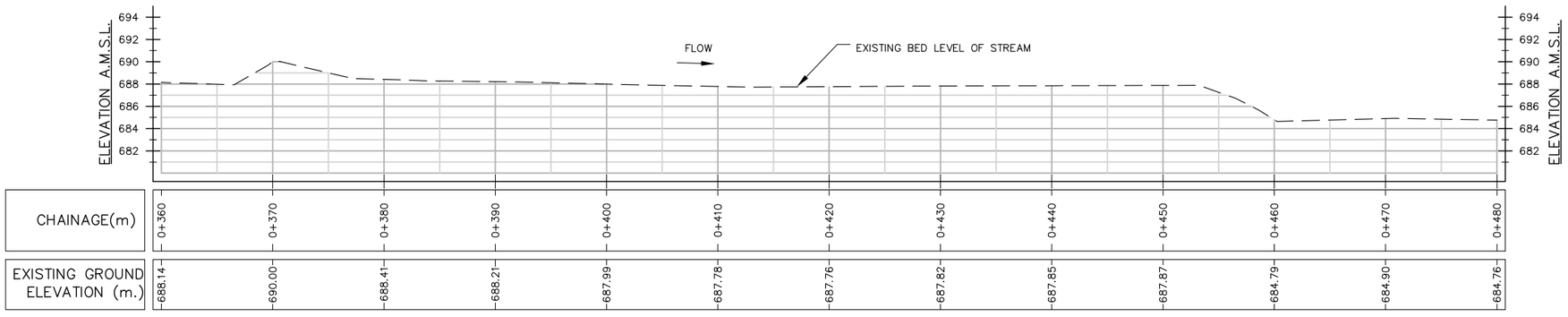
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Kaldhunga Roadway
Longitudinal Profile of Stream
CH 0+000 TO 0+240

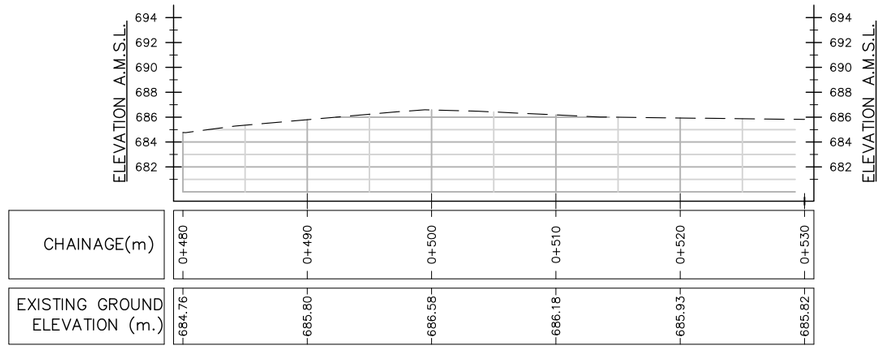
Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-KDR-LPS-001	Rev. –	Date: June, 2019



KALDHUNGA ROADWAY
STREAM LONGITUDINAL PROFILE
(CH 0+240 – 0+360)
SCALE: 500



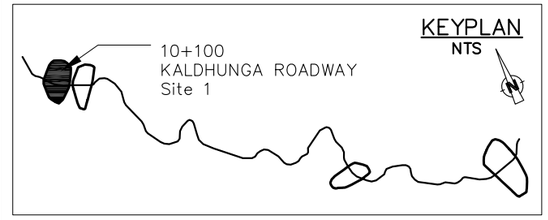
KALDHUNGA ROADWAY
STREAM LONGITUDINAL PROFILE
(CH 0+360 – 0+480)
SCALE: 500



KALDHUNGA ROADWAY
STREAM LONGITUDINAL PROFILE
(CH 0+480 – 0+530)
SCALE: 500

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 0 5 10 15 20 25m
1:500



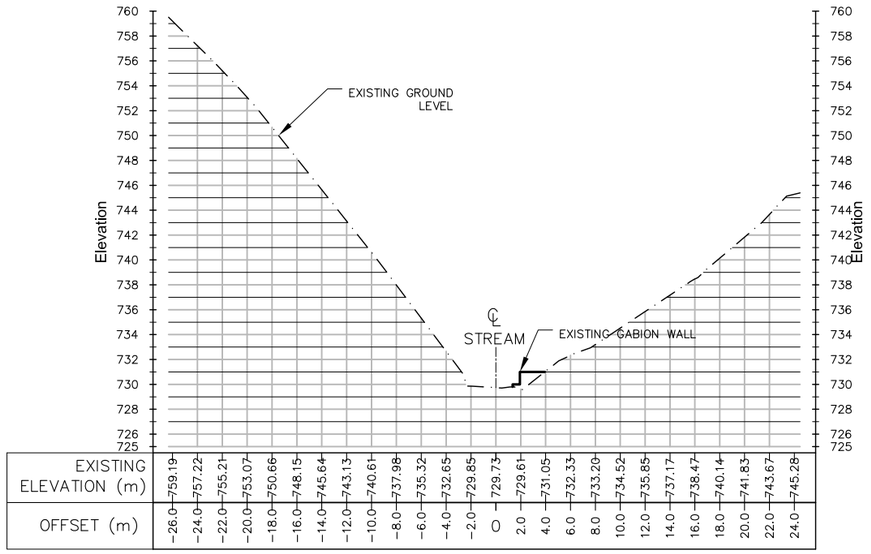
PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

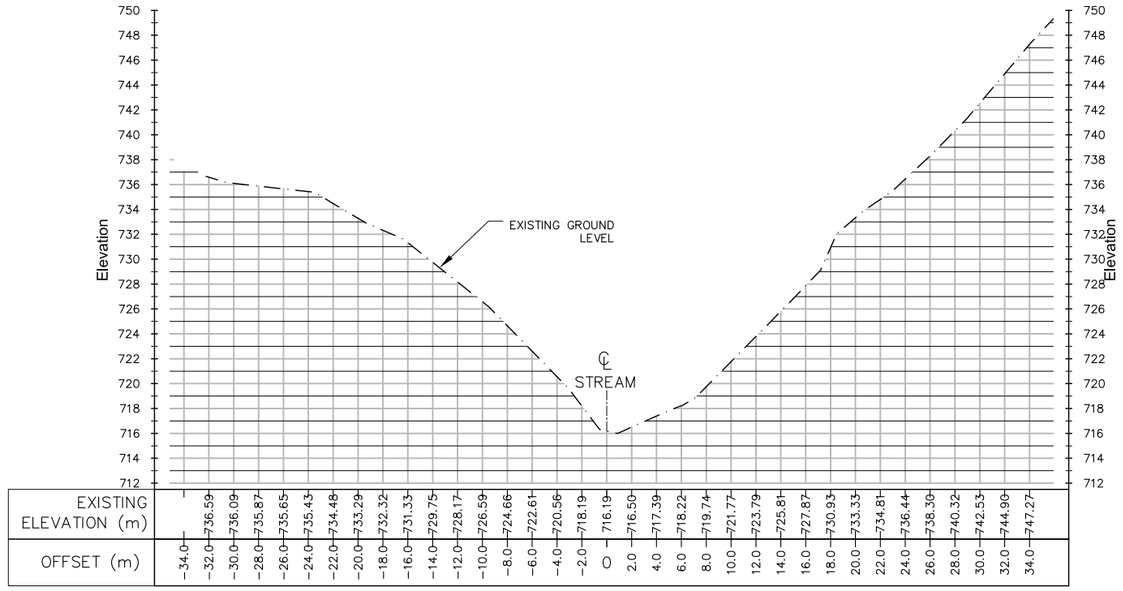
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Kaldhunga Roadway
Longitudinal Profile of Stream
CH 0+240 TO 0+530

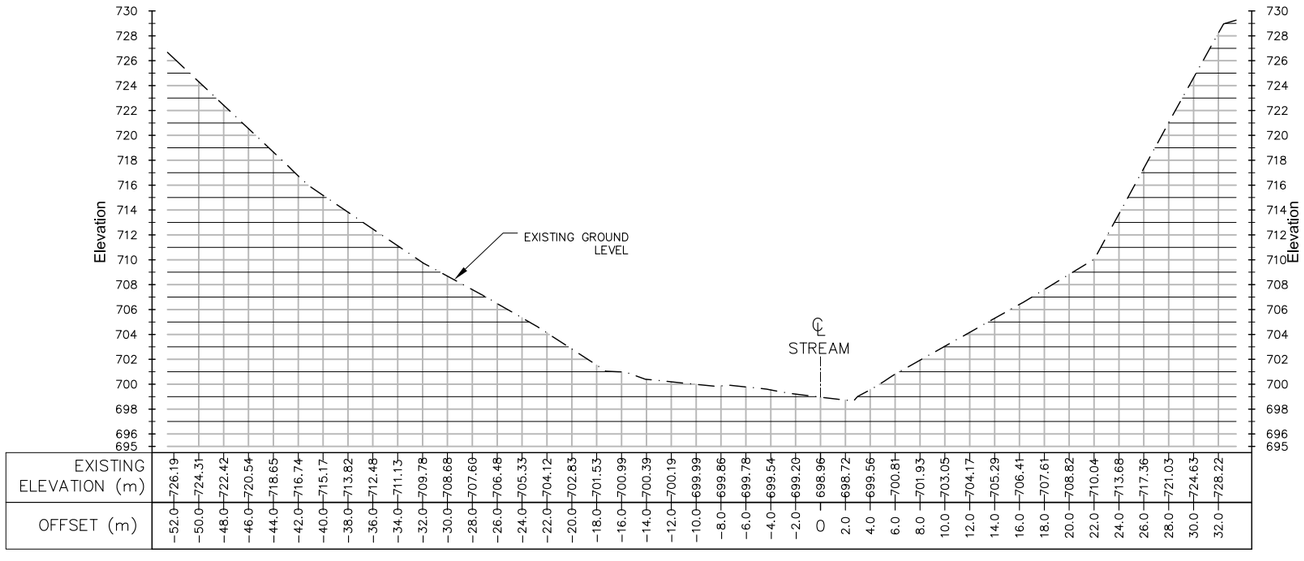
Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-KDR-LPS-002	Rev. –	Date: June, 2019



CROSS SECTION OF STREAM
265m U/S OF MAIN ROAD/HIGHWAY
SCALE 1:500



CROSS SECTION OF STREAM
200m U/S OF MAIN ROAD/HIGHWAY
SCALE 1:500

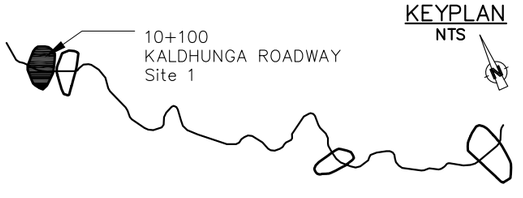


CROSS SECTION OF STREAM
100m U/S OF MAIN ROAD/HIGHWAY
SCALE 1:500

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 0 5 10 15 20 25m
1:500

KEYPLAN
NTS



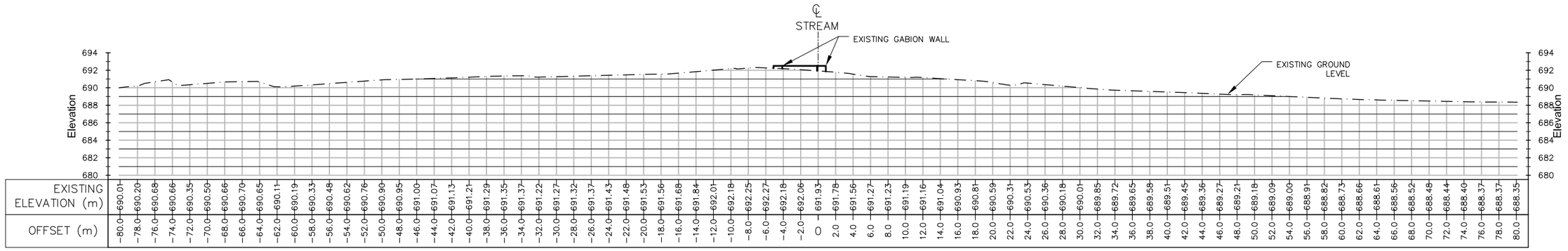
PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

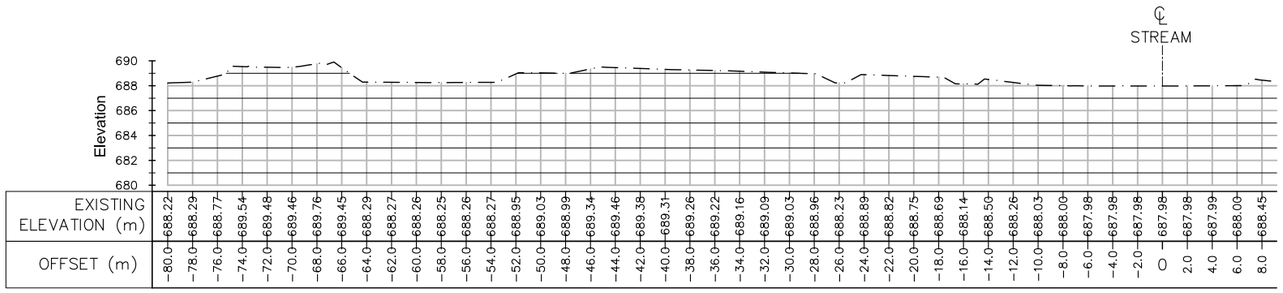
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Kaldhunga Roadway
Cross Section of Stream
265m, 200 & 100m UPSTREAM OF HIGHWAY

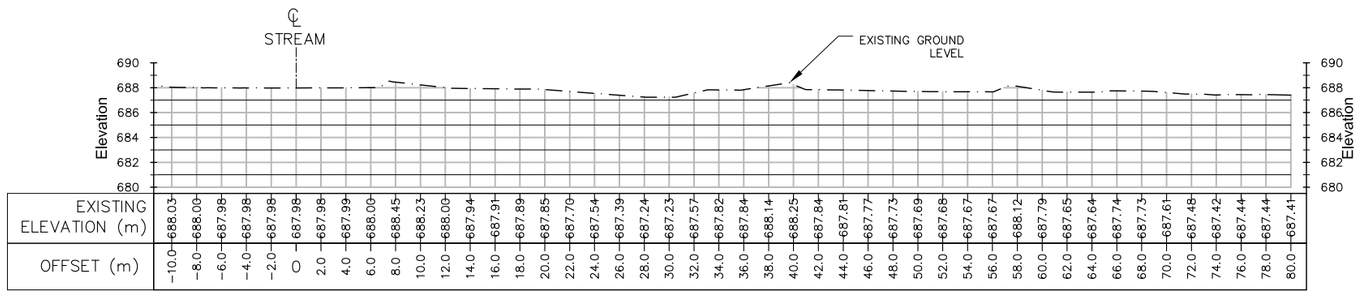
Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-KDR-CSS-001	Rev.: –	Date: June, 2019



CROSS SECTION OF STREAM
10m U/S OF MAIN ROAD/HIGHWAY
SCALE 1:500



CROSS SECTION OF STREAM
10m D/S OF MAIN ROAD/HIGHWAY
(LEFT SIDE OF STREAM)
SCALE 1:500

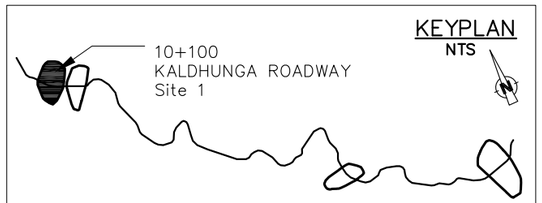


CROSS SECTION OF STREAM
10m D/S OF MAIN ROAD/HIGHWAY
(RIGHT SIDE OF STREAM)
SCALE 1:500

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 1:500
0 5 10 15 20 25m

KEYPLAN
NTS



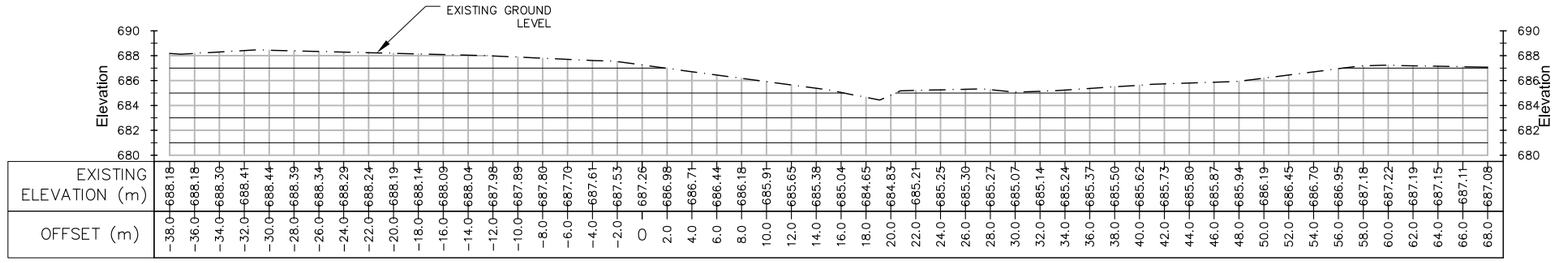
PROJECT FOR THE OPERATION AND MAINTENANCE OF
THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

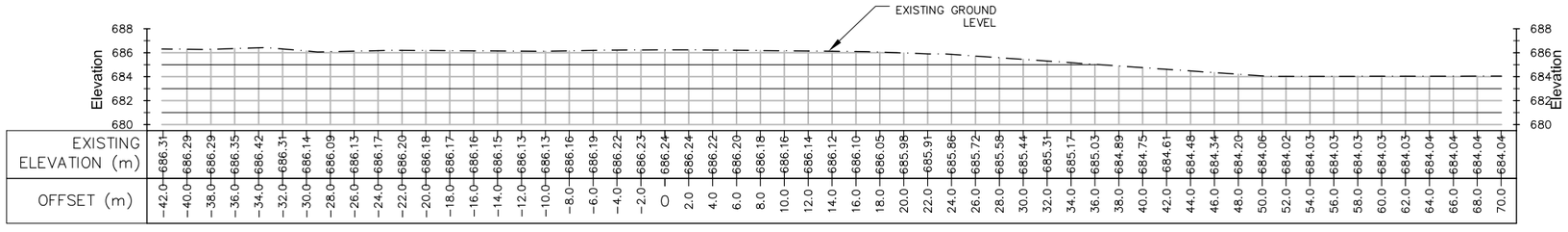
Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Kaldhunga Roadway
Cross Section of Stream
10m UPSTREAM & 10m DOWNSTREAM OF HIGHWAY

Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-KDR-CSS-002	Rev. –	Date: June, 2019



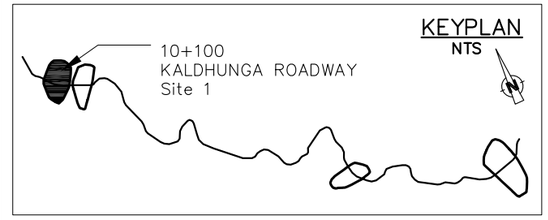
CROSS SECTION OF STREAM
100m D/S OF MAIN ROAD/HIGHWAY
SCALE 1:500



CROSS SECTION OF STREAM
140m D/S OF MAIN ROAD/HIGHWAY
SCALE 1:500

NOTES:
1. DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL

SCALE: 0 5 10 15 20 25m
1:500



PROJECT FOR THE OPERATION AND MAINTENANCE OF
THE SINDHULI ROAD PHASE 2

Client: Nippon Koei Co., Ltd.

Consultant: Soil Test (P) Ltd.
CONSULTING ENGINEERS
Sanepa, P.O. Box 2967, Kathmandu, NEPAL

Title: Kaldhunga Roadway
Cross Section of Stream
100m & 140m DOWNSTREAM OF HIGHWAY

Scale A1: 1:250 Scale A3: 1:500	Drawing No.: SR2-KDR-CSS-003	Rev. –	Date: June, 2019

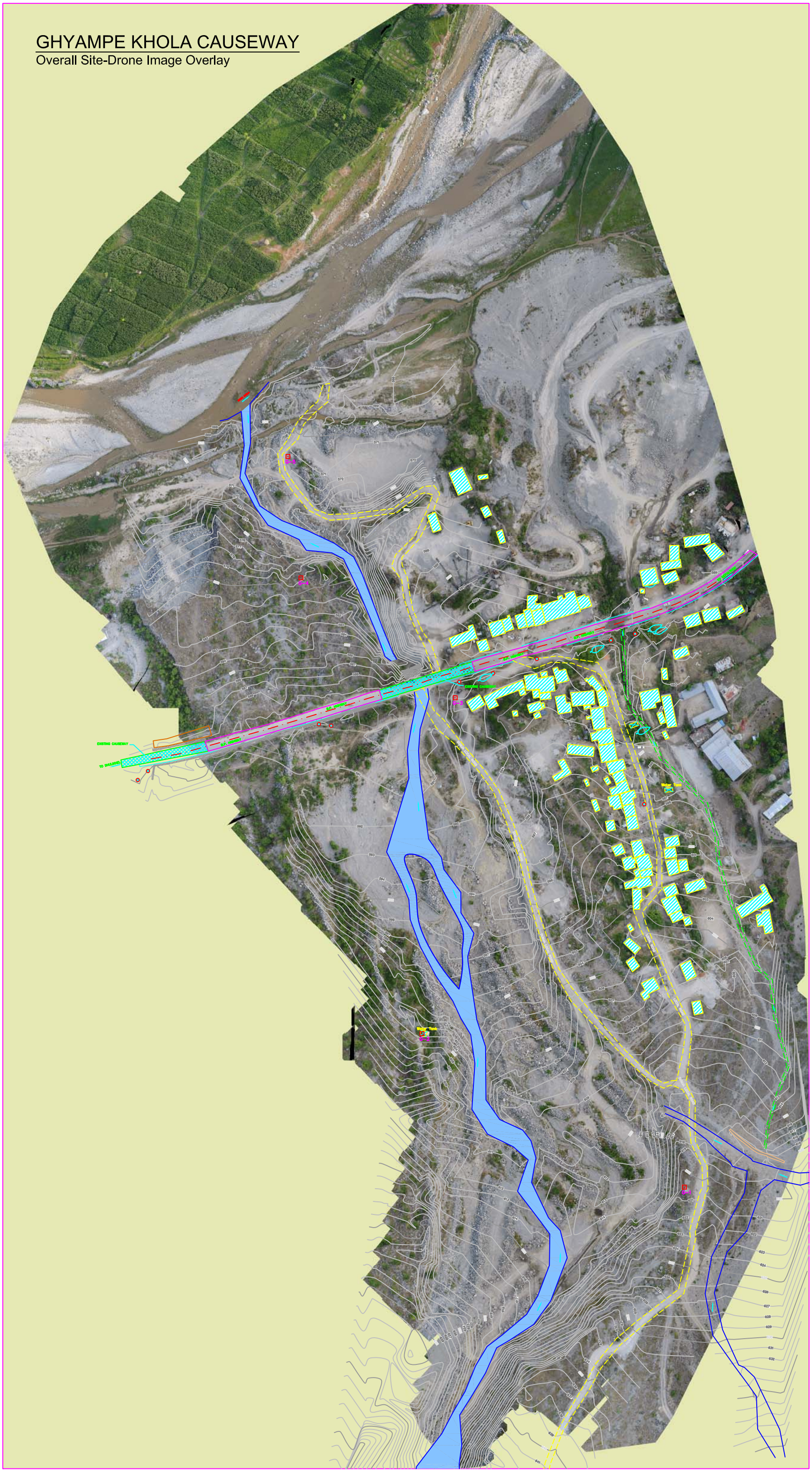
APPENDIX 8: DRONE IMAGES OVERLAID IN TOPOGRAPHICAL MAP

STA. 1+400, Ghyampe Khola Causeway

DRONE IMAGES OVERLAID IN TOPOGRAPHICAL MAP

GHYAMPE KHOLA CAUSEWAY

Overall Site-Drone Image Overlay



STA. 3+900, Mamti Khola Causeway

DRONE IMAGES OVERLAID IN TOPOGRAPHICAL MAP

MAMTI KHOLA CAUSEWAY

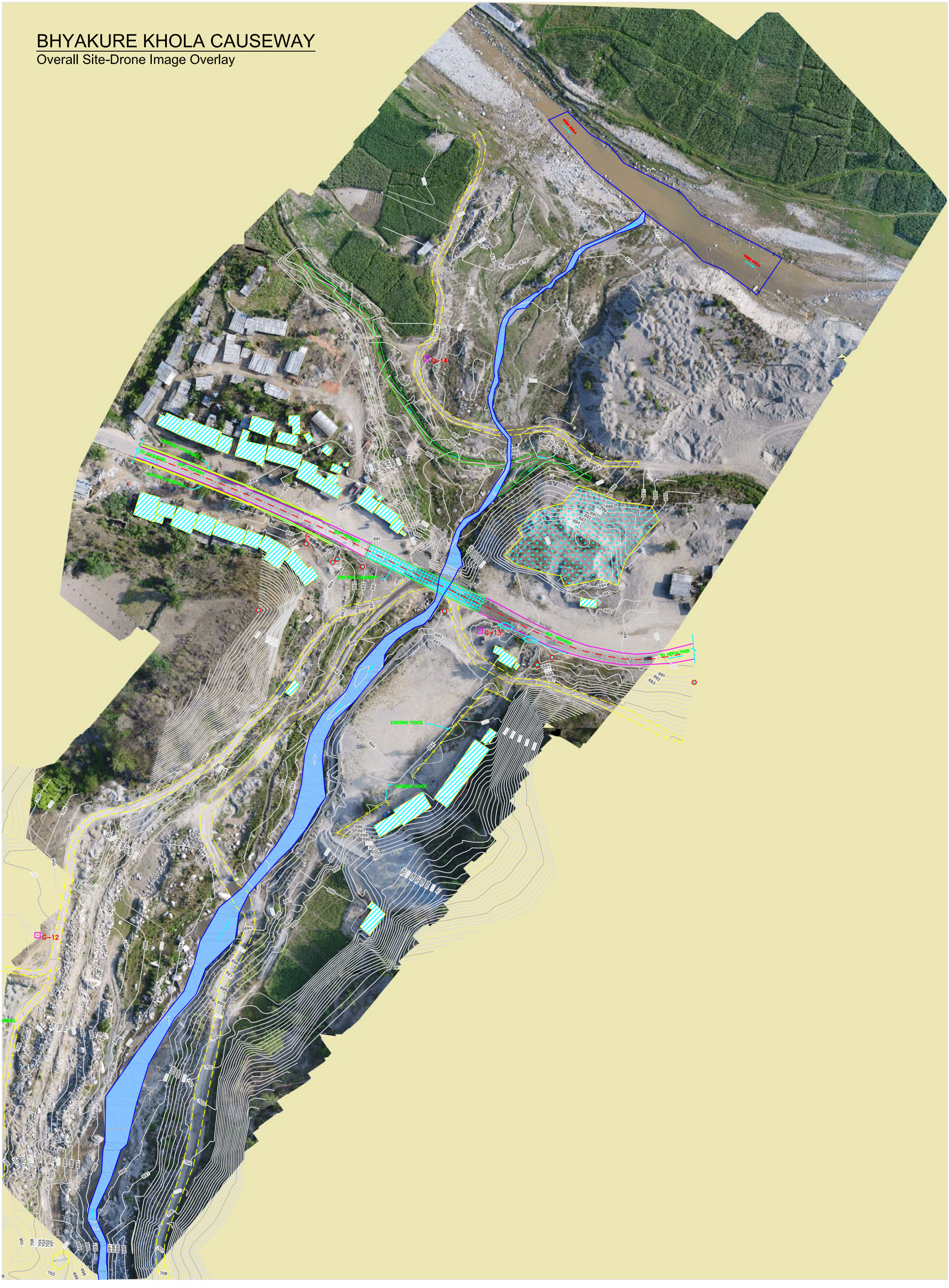
Overall Site-Drone Image Overlay

STA.9+700 Bhyakure Khola Causeway

DRONE IMAGES OVERLAID IN TOPOGRAPHICAL MAP

BHYAKURE KHOLA CAUSEWAY

Overall Site-Drone Image Overlay



STA. 10+100 Kaldhunga Roadway

DRONE IMAGES OVERLAID IN TOPOGRAPHICAL MAP

KALDHUNGA ROADWAY

Overall Site-Drone Image Overlay

APPENDIX 9: FIELD PHOTOGRAPHS

The Project for the Operation and Maintenance of the Sindhuli Road Phase 2

Draft Geological and Geotechnical Report for Bhyakure Khola and Ghyampe Khola

Submitted By:

Soil Test P. Ltd.
Sanepa
www.soiltest.com.np
support@soiltest.com.np
Date: 11th Nov 2019

Submitted To:

Nippon Koei Co., Ltd.
Thapathali Nippon Koei Project Office
1-14-6 Kudan-kita, Chiyoda-ku,
Tokyo 102-8539, Japan

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Notations used

N	=	Observed SPT value
N_{60}	=	SPT value corrected for energy, borehole diameter, sampling method, rod length
C_E	=	Energy (hammer) correction factor
C_B	=	Borehole diameter correction factor
C_R	=	Rod length correction factor
C_S	=	Sampling barrel correction factor
N'	=	SPT value corrected for overburden
C'	=	correction due to overburden
ϕ	=	Friction angle
ϕ'	=	Mobilized friction angle
R.D.	=	Relative density
q_{nu}	=	Net ultimate bearing capacity
q_{ns}	=	Net safe bearing capacity
q_s	=	Gross safe bearing capacity
N_c, N_q, N_γ	=	Bearing capacity factors
s_c, s_q, s_γ	=	Shape factors
d_c, d_q, d_γ	=	Depth factors
i_c, i_q, i_γ	=	Inclination factors
α	=	Inclination of the load to the vertical in degrees
N_c', N_q', N_γ'	=	Bearing capacity factors obtained from mobilized friction angle ϕ'
c	=	Cohesion
q	=	Effective surcharge at the base level of foundation
γ	=	Bulk unit weight of foundation soil
B	=	Width of footing
L	=	Length of footing
R_{w1}	=	Water table correction for surcharge
R_{w2}	=	Water table correction for water level below base of footing
D_f	=	Depth of footing
D_w	=	Depth of water table from ground level
a	=	Height of water table above the base of footing
b	=	Depth of water table below the base
ρ	=	Density of soil sample in gm/cc
D_{10}	=	Particle size corresponding to % of fines 10%
D_{50}	=	Particle size corresponding to % of fines 50%
D_{60}	=	Particle size corresponding to % of fines 60%
D_{90}	=	Particle size corresponding to % of fines 90%
C_u	=	Coefficient of uniformity
C_c	=	Coefficient of curvature

Chapter 1: **INTRODUCTION**

1.1 Project Background

Sindhuli road is one of the major road that links Kathmandu (capital of Nepal) with the Eastern Terai region of Nepal. Sindhuli road, having 160 km in total was constructed with grant assistance of government of Japan through JICA. The road has been in operation since 2015. Sindhuli road covers Bardibas, Sindhuli, Khurkot, Nepalthok and Dhulikhel.

Due to the heavy rainfall, the seasonal rivers (Bhyakure Khola, Ghyampe Khola) were over flooded causing substantial damage to the local road further resulting in delays in daily traffic flow. This called for the engineering assistance for its maintenance and design of the road structure accordingly for the sections of the road damage by the flood.

Hence, Nippon Koei appointed Soil Test P. Ltd to undertake the geotechnical drilling at each of the proposed bridge location. This geotechnical investigation report is prepared based on the results of the site works carried out by Soil Test P. Ltd, Sanepa, Lalitpur for proposed site of bridge foundation of Bhyakure Khola Bridge at Khaldhunga of Kavrepalanchok district and at Sunkoshi Gaupalika at Sindhuli District of Nepal. This report uses the result of borehole investigation to characterize the subsurface conditions and propose safe bearing capacities of the bridge foundation.

The soil investigation works for the four (4) boreholes were carried out from 10th September 2019 to 29th September, 2019.

1.2 Location of the Proposed Bridges

1.2.1 Bridge at Bhyakure Khola

The proposed bridge over Bhyakure Khola at Khaldhunga of Kavrepalanchok district lies in Roshi Gaupalika. The location of drilling points at Bhyakure Khola is shown in figure 1.1

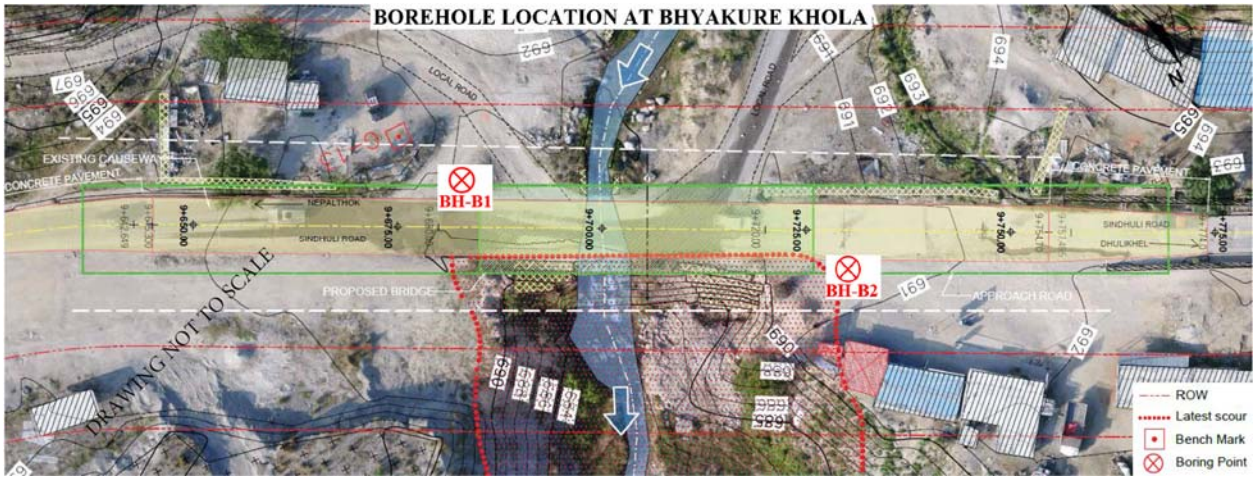


Figure 1.1 Location of Bhyakure Khola Bridge

1.2.2 Bridge at Ghyampe Khola

The proposed bridge over Ghyampe Khola at Sindhuli district lies in Sunkoshi Gaupalika. The location of drilling points at Ghyampe Khola is shown in figure 1.2.

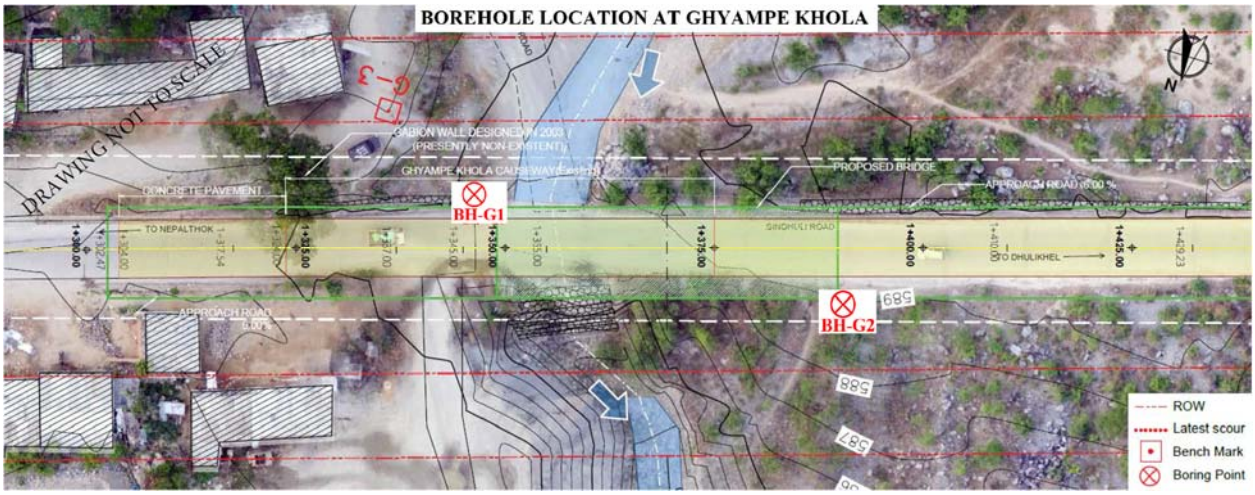


Figure 1.2: Location of Ghyampe Khola Bridge.

1.3 Scope of Work

This report includes:

- The findings of the geotechnical drilling of boreholes.
- The presentation, interpretation of the field data, borehole logs and calculation safe bearing capacities (Annex attached)

1.4 Collection and Review of Available Data

Literature Review of site conditions, topographical and geological characteristic of the project area was conduction via collecting and previously conducted soil investigation reports of nearby corridors, existing geological maps. Information stored in the form of maps, tables and published papers are collected from various sources. However, none of these institutions has a database to store and manage this valuable information, and a comprehensive computerized soil information system is not established.

Chapter 2: **ENGINEERING GEOLOGY**

2.1 General Geology

As per the Geological map of Nepal, the project site lies in Nawakot Group where rocks like phyllite, sandstones and quartzite were encountered.

Geological map of Nepal with the project area is shown in (Fig. 2-1). The Geological map of Nepal was published by the Department of Mines and Geology, Government of Nepal.

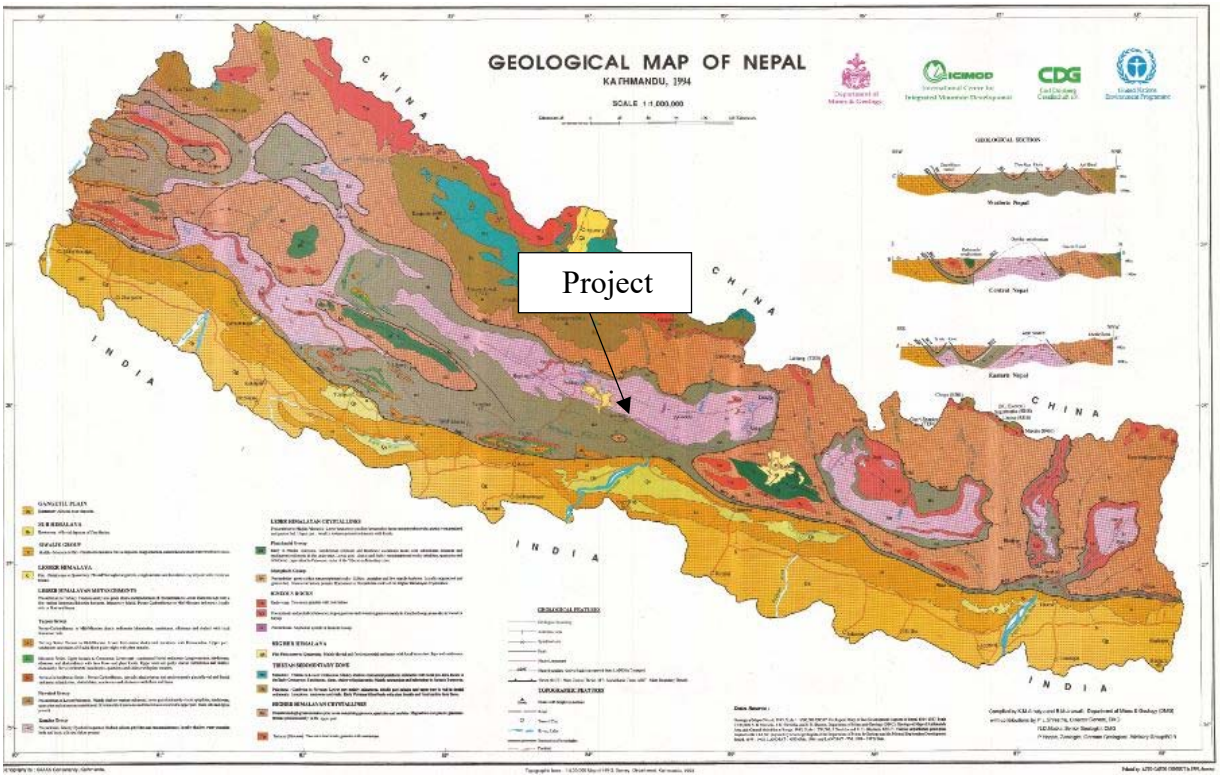


Figure 2.1 Geological map of Nepal including project area

2.2 Geological background of the area

The area comprises of Higher Himalaya, Lesser Himalaya along the sections. The area falls under the Central Nepal with most of the rocks from the Kathmandu complex. The rocks of central Nepal are differentiated into the Nawakot Complex, representing the Lesser Himalayan sequence and the physically overlying Kathmandu Complex (Stöcklin and Bhattarai 1977; Stöcklin 1980), belonging to the Higher Himalayan crystallines and Tethyan Himalayan sequence. The two complexes differ basically in their lithostratigraphic characteristics and are separated from each other by the Mahabharat Thrust, which is the southern continuation of the Main Central Thrust (Stöcklin et al. 1982). On the other hand,

the Lesser Himalayan rocks are thrust over the Siwaliks along the Narayani alias Main Boundary Thrust.

Hagen (1969) incorporated the elevated terrain north of Kathmandu into his Gosaikunda tectonic bridge, which has survived erosion from two mighty rivers: the Trishuli on the west and Sun Koshi on the east (Fig. 10.1). The region also contains to the south, a large doubly plunging megafold, called the Mahabharat Synclinorium. It has a well-developed west closure and a narrow and elongated east wing (Stöcklin 1980). Paleozoic granites preponderate in this region, especially within the synclinorium. Arita et al. (1973) made fairly detailed descriptions of the Higher Himalayan metamorphic mineral assemblages. Nadgir (1976) separated his Kathmandu Group into the Bhimphedi, Chitlang, and Chandragiri formations. He envisaged the Sheopuri Gneisses as intrusive and, contrary to Auden (1935), did not favor their correlation with the Darjeeling Gneiss.

The Lesser Himalayan rocks of this region compose a relatively wide portion of the Great Midland Antiform in the inner zone between Nuwakot and Dhunche. The rocks reappear in the Okhaldhunga tectonic window, which is separated from the inner zone by the Gosaikunda tectonic bridge. A narrow and discontinuous Lesser Himalayan strip stretches along the foothills of the Mahabharat Range, and a few of its slivers crop up amid the Siwaliks in the Bagmati River and north of the Marin Khola. In the Bagmati–Gosaikunda region too, the grade of metamorphism steadily increases from the foreland to the hinterland (Beyssac et al. 2004). As a result, the black slates of the outer zone pass into the inner zone as graphitic schist

2.3 Surface Geology

The area around the bridge location is covered by river deposit mostly of Quartzite, dolomite, granite and schist. The rock around the area is schist and quartzite. Quartzite is blueish grey, medium to fine grained, intercalated with schist. The Schist is intercalated in quartzite but as we move towards upstream the proportion of schist at Bhyakure Khola increases whereas at Ghyampe Khola the nearby area is dominated by quartzite. At Bhyakure Khola small stream is available all year round but during monsoon the khola is flooded. Ghyampe Khola is dry during winter whereas at monsoon the river has water with occasional debris flow. The photo of outcrop of Bedrock exposed in field is shown in Figure 2.2. The photo at the upstream of Bhyakure khola is shown in Figure 2.3.

Figure 2.2: Exposed outcrop on the hill side at Ghyampe khola.

Figure 2.3: Gravel with Boulder at the upstream Bhyakure Khola.

2.3.1 Surface Geology around Bhyakure Khola

The riverbed of the Bhyakure River is covered by alluvial deposits and bedrocks of Schist and quartzite. The place where the bridge is to be constructed consist of alluvial deposit which are mostly gravel with boulder and cobbles. Sand is light grey medium to coarse with angular to sub angular. Boulders are of Dolomite, granite, quartzite and schist. The river is extensively mined for aggregates in the locality.

2.3.2 Surface Geology around Ghyampe Khola

The riverbed of Ghyampe Khola is covered by alluvial deposit. The place where the bridge is to be constructed consist of alluvial deposit which is mostly gravel with boulder and cobbles. Sand is light grey to dark grey, fine to coarse grained with 5% silt. Boulders are of dolomite, calc quartzite, metasandstone, and schists.

Chapter 3: **GEOTECHNICAL INVESTIGATION METHODOLOGY**

Geological condition/stratum at the test site is important aspect to determine the depth, size and types of foundation. Drilling can define the characteristic and strength of soil and rock in both unstable and stable zones. Standard Penetration Tests and Dynamic Cone Penetration Tests carried out in different depths can give appropriateness of the densification of the soil strata.

The proposed drilling site area is known to have overlain by gravelly and boulder area from preliminary site visits. Therefore, the drilling team mobilized a rotary drilling rig for undertaking the drilling of the proposed drill holes. A site specific safety protocols were developed for technical team and workers working at site including compulsion uses of safety helmets, boots and safety gloves while working.

3.1 Drilling

Boring investigation was performed in the subsoil to abstract information of soil state, thickness and depth of layers etc. The subsoil distribution, fractured zone and soft ground shall be grasped for the foundation design of structures depending on boring test results. In addition, in-situ tests, sounding, and underground water level measurement were performed using bore-holes.

The drilling works were carried out using Rotary Drilling Rig. The diameter of 75mm borehole at all the locations of the site used was used at the locations of the drill sites. The boreholes were logged continuously in the field. The borehole logs included visual classification of soil, records of SPT for penetration of 450 mm, records of DCPT for penetration of 300mm and position of water table. The borehole logs for site are presented in Annex-1 including general ground water table.

Table 3-1: Location of Boreholes

SINDHULI ROAD PROJECT										
S.N.	BORE HOLE	LOCATION	COORDINATES			START DATE	END DATE	DEPTH	TESTS NO	WATER TABLE
			NORTHING	EASTING	ELEVATION (m)					
1	B1	Bhyakure Khola (Nepalthok side)	27.469377	85.750832	691	9/15/2019	9/19/2019	16 m	7	12.5 m
2	B2	Bhyakure Khola (Dhulikhel side)	27.469628	85.750558	691	9/11/2019	9/14/2019	16 m	7	12.5 m
3	G1	Ghyampe khola (Nepalthok side)	27.4369	85.8040	589	9/22/2019	9/24/2019	16 m	7	6.9 m
4	G2	Ghyampe khola (Dhulikhel side)	27.4369	85.8038	590	9/25/2019	9/28/2019	16 m	7	5.0 m

3.2 Soil Sampling

Due to presence of gravelly and boulder strata no samples of soil were obtained from the site for lab testing. The rock samples obtained in the barrel and casing of the equipment along with wash samples obtained through flow of return water during drilling was collected and analyzed visually and recorded in bore logs.

Only barrel and wash samples were obtained and collected in core boxes to have general idea of the strata.

3.3 Field Test

The field test conducted at the site consists of Standard Penetration Test (SPT) and Dynamic Cone Penetration Test (DCPT). They are the method for measuring soil characteristics of relative density and strength simply and quickly by penetrating resistance into the ground and pulling out it onto the ground.

Figure 3.1 Field photograph of DCPT test

3.3.1 Standard Penetration Test (SPT)

A standard split barrel sampler was used in the test. The SPT tests were conducted in all the boreholes of the site at a depth interval of every 1.5 m. The driving of split-spoon barrel was recorded at first 150 mm and then after at every 150 mm of penetration till the total penetration was 450 mm. The number of blows recorded for the first 150 mm of penetration is disregarded. The number of blows recorded for the last two 150 mm intervals are added and expressed as SPT N-value. The records of the SPT values obtained are presented in borehole logs in Annex-1.

The recorded SPT values are without any correction of overburden pressure and water table. The test was conducted without using liner.

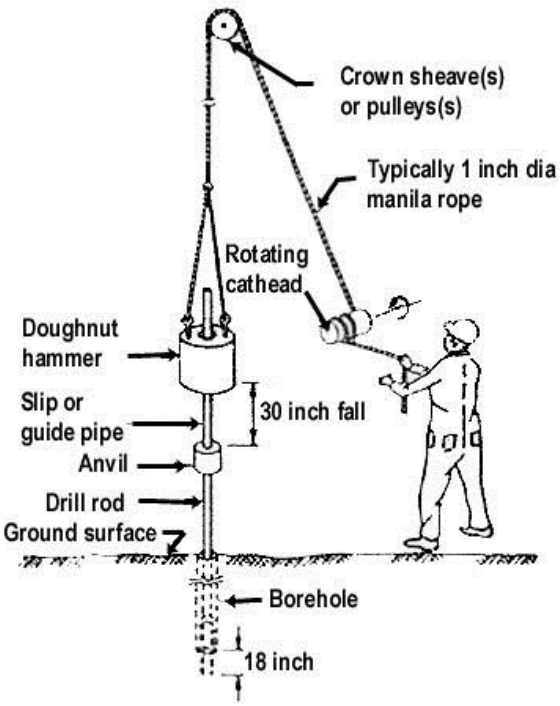


Figure 3.2: Schematic Description of Standard Penetration Test/Dynamic Cone Penetration Test

3.3.2 Dynamic Cone Penetration Test (DCPT)

It consists of driving a cone by blows of hammers. The number of blows for driving the cone through a specified distance is a measure of the dynamic cone resistance. Dynamic Cone Penetration tests are performed by a 50-mm solid cone. The driving energy is given by a 63.5 kg monkey hammer falling freely through a height of 750 mm onto the drive head. First of all, the cone is driven 100 mm into the soil at the bottom of the bore hole. It is then driven further 200 mm and the number of blows (N_{cbr} values) required to drive this distance is recorded.

The result i.e., N_c values first corrected to the Standard Penetration Test (SPT) value (N) and that provides and estimation of degree of compaction of soil strata, values of angles of internal friction (Φ) and allowable bearing capacity. The dynamic cone resistance is correlated with the SPT (N) as given below.

N_c = 1.5 N for depth up to 3 m

= 1.75 N for depth 3 to 6 m

= 2 N for depth greater than 6 m

The records of the DCPT values obtained are also presented in borehole logs in Annex-1

3.4 Ground Water Table Monitoring

The position of ground water table was measured at each borehole from the ground surface. The water level observed in the boreholes at the end of a 24 hours long period after completion of boring work was taken as the position of ground water table. The depth to ground water table observed are recorded in the borehole logs presented.

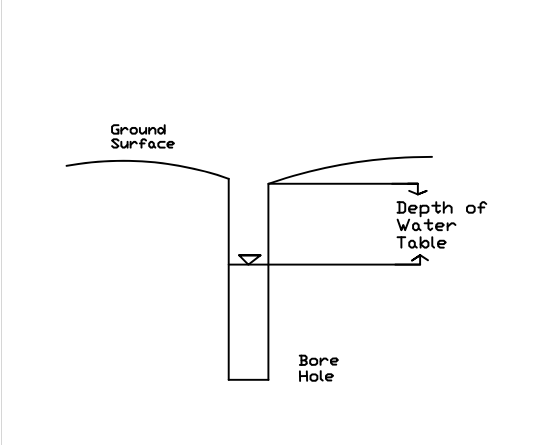


Figure 3.3 Reference point for measuring water level

3.5 Laboratory Testing

No undisturbed samples and representative samples could be collected for laboratory tests due to presence of gravelly and boulder strata. Only boulders/gravels stuck in the barrel of the drilling equipment and wash materials are kept layer wise to have the general idea of the strata at the borehole location. Some of the core samples kept in the core box are shown below:

Chapter 4: **FINDINGS ON GEOTECHNICAL INVESTIGATIONS**

4.1 Bhyakure Khola

4.1.1 At the location of B-1

This core drill is conducted along the riverbed of the Bhyakure Khola, on left bank, from top layer to bottom up to 16 m depth boulder mixed soil can be found. The field photograph at Bhyakure site is shown in figure 3.4. Boulders and gravel are of quartzite (white to bluish grey, coarse grained), dolomite (Bluish grey, fine grained). Clasts are angular to sub-angular. The DCPT value shows that the strata is very dense. The core box, in-situ test and site photographs are attached at Annex-2, Annex-3, and Annex-4

Figure 4.1 panorama photograph of Bhyakure site

4.1.2 At the location of B-2

This core drill is conducted along the riverbed of the Bhyakure Khola, on right bank, from top layer to bottom up to 7 m depth the area seems to be filled by artificial method but after 7m the area is boulder mixed soil. Boulders and gravel are of quartzite (white to bluish grey, coarse grained), dolomite (Bluish grey, fine grained); granite. Clasts are angular to sub-angular. The DCPT value shows that the strata are very dense. The field photograph at Bhyakure site is shown in figure 3.5. The core box, in-situ test and site photographs are attached at Annex-2, Annex-3, and Annex-4.

Figure 4.2 Site photograph at Ghyampe khola.

4.2 Ghyampe Khola

4.2.1 At the location of G-1

This core drill is conducted on the right bank of the Ghyampe khola, from the top layer is boulder dominated with gravels. The borehole was drilled up to 16 m. Boulders and gravel are of calc quartzite (white to bluish grey, coarse grained), siliceous dolomite (Bluish grey, fine grained). Clasts are angular to sub-angular. The DCPT value shows that the strata are very dense. The core box, in-situ test and site photographs are attached at Annex-2, Annex-3, and Annex-4.

4.2.2 At the location of G-2

Drill hole G-2 is conducted on the left bank of Ghyampe khola up to 16m deep. The core reviles that the strata are boulder mix soil. Most of the boulder are of siliceous dolomite, calc quartzite, metasandstone and schist. Boulder and gravel are angular to sub angular. The DCPT values shows that the strata are very dense. The core box, in-situ test and site photographs are attached at Annex-2, Annex-3, and Annex-4.

Chapter 5: **RESULTS**

5.1 Geotechnical Domain Identification

The following sub-soil materials (up to 16m from existing ground level), has been deduced from the drilling of the borehole and geological site inspection:

5.1.1 Borehole B1

- Sub soil profile observed was pebbly sand up to 0.5 m. Beyond 0.5 m, predominantly boulder with gravel and cobble was observed along the excavated depth.
- Water table was encountered at the depth of 12.5 m from the existing ground level.
- DCPT was performed along the depth 10-16 m from existing ground level and mostly, medium dense to very dense soil strata was observed. A relatively weak stratum was observed at a depth of 15 m.

5.1.2 Borehole B2

- Sub soil profile observed was gravel with cobble up to the depth of 0.5 m. Up to the depth of 5.5 m, predominantly sand was obtained with boulders at certain depths. Beyond 5.5 m, gravel and boulders were observed mostly, with sand at certain depths up to the explored depth.
- Water table was encountered at the depth of 12.5 m from the existing ground level.
- DCPT was performed from the depth of 10 m to 16 m from existing ground level and mostly, medium dense to very dense soil strata was observed.

5.1.3 Borehole G1

- Sand was observed up to the depth of 0.4 m. Beyond this, mostly boulder with gravel was seen along the depth of excavation i.e. up to 16 m.
- Water table was encountered at the depth of 6.9 m from existing ground level.
- DCPT was performed from the depth of 10 m to 16 m from existing ground level and mostly, dense to very dense soil strata was observed.

5.1.4 Borehole G2

- Sub soil profile observed was sand up to the depth of 0.6 m. From 0.6 m to the explored depth, boulder and gravel was observed predominantly.
- Water table was encountered at the depth of 5 m from the existing ground level.

- DCPT was performed from the depth of 10 m to 16 m from existing ground level and very dense soil strata was observed.

The final bore logs from the field in is presented in ***Annex B***. From these, DCPT N-value can be obtained, which is converted to equivalent SPT N-value as presented in the table below. Please Refer ***Annex C*** for DCPT-SPT conversion of all the bore holes.

Table 5-1: Sample DCPT-SPT conversion

Depth	Elevation	Test Method for N-value	1st drive		2nd drive		3rd drive		DCPT N-value (for 20cm penetration)	DCPT N-value (for 30cm penetration)	Coefficient to convert DCPT to SPT	SPT N-value
			No. of blows (N1)	Penetration	No. of blows (N2)	Penetration	No. of blows (N3)	Penetration				
m	m		blows	cm	blows	cm	blows	cm	blows	blows		blows
10	681	DCPT	13	10	26	10	37	10	63	95	1	95
11	680	DCPT	25	10	30	10	42	10	72	108	1	108
12	679	DCPT	37	10	50	4	Refusal*		100	375	1	375
13	678	DCPT	35	10	40	10	55	10	95	143	1	143
14	677	DCPT	15	10	21	10	29	10	50	75	1	75
15	676	DCPT	5	10	18	10	27	10	45	68	1	68
16	675	DCPT	5	10	22	10	37	10	59	89	1	89

It is recommended that the SPT values obtained in Table 5-1 be corrected for energy, borehole diameter, sampling method, rod length and overburden.

$$N_{60} = C_E C_B C_R C_S N$$

Table 5-2: Recommended corrections for SPT blow count values, taken from Robertson and Wride (1997), as modified from Skempton (1986)

Factor	Equipment Variable	Term	Correction
Energy Ratio	Donut Hammer	C_E	0.5 to 1.0
	Safety Hammer		0.7 to 1.2
	Automatic Hammer		0.8 to 1.5
Borehole Diameter	65 mm to 115 mm	C_B	1.0
	150 mm		1.05
	200 mm		1.15
Sampling Method	Standard Sampler	C_S	1.0
	Sampler without liners		1.1 to 1.3
Rod Length	3 m to 4 m	C_R	0.75
	4 m to 6 m		0.85
	6 m to 10 m		0.95
	10 m to 30 m		1.0
	>30 m		<1.0

Taking C_E = 0.5 (for Donut Hammer), C_B = 1 (for borehole diameter 65 mm), C_S = 1 (for standard sampler) and C_R = 1 (for rod length >10 m), N_{60} value is obtained, which is then corrected for overburden pressure as per IS: 2131-1981. Correction for dilatancy is not required as the strata consists of gravel and boulders.

Table 5-3: Correction of SPT N-value

Depth	Elevation	SPT N-value	N_{60}-value	Correction of N-value for Overburden as per IS: 2131-1981					
				Saturated Unit weight	Total stress	Pore water Pressure	Effective Overburden Pressure (P)	C' =0.77[log(2000/P)]	N' value
m	m	blows	blows	KN/m^3	KPa	KPa	KPa		blows
10	681	95	71	17	170	0.00	170.00	0.824347427	58
11	680	108	81	17	187	0.00	187.00	0.79247506	64
12	679	375	281	17	204	0.00	204.00	0.763377868	215
13	678	143	107	20	224	4.91	219.10	0.739506097	79
14	677	75	56	20	244	14.72	229.29	0.724303851	41
15	676	68	51	20	264	24.53	239.48	0.70976	36
16	675	89	66	20	284	34.34	249.67	0.695827696	46

Now, underlying geotechnical domain and soil properties are determined using the corrected N’ value.

Table 5-4: Geotechnical Domain Identification

Depth	Elevation	N' value	Soil properties as per Meyerhof 1956			IS: 6403-1981		Underlying Geotechnical Domain
			Soil Packing categorization	Relative Density	Friction angle φ	Friction angle φ	Soil Packing categorization	
m	m	blows		%	°	°		
10	681	58	Very Dense	88	47	42	Very Dense	L1 - Very Dense
11	680	64	Very Dense	94	49	43	Very Dense	
12	679	215	Very Dense	245	86	45	Very Dense	
13	678	79	Very Dense	109	52	45	Very Dense	
14	677	41	Dense	71	43	39	Dense	L2 - Dense
15	676	36	Dense	66	41	38	Dense	
16	675	46	Dense	76	44	40	Dense	

Tentative subsoil profile of Bhyakure and Ghyampe Khola obtained is presented below.

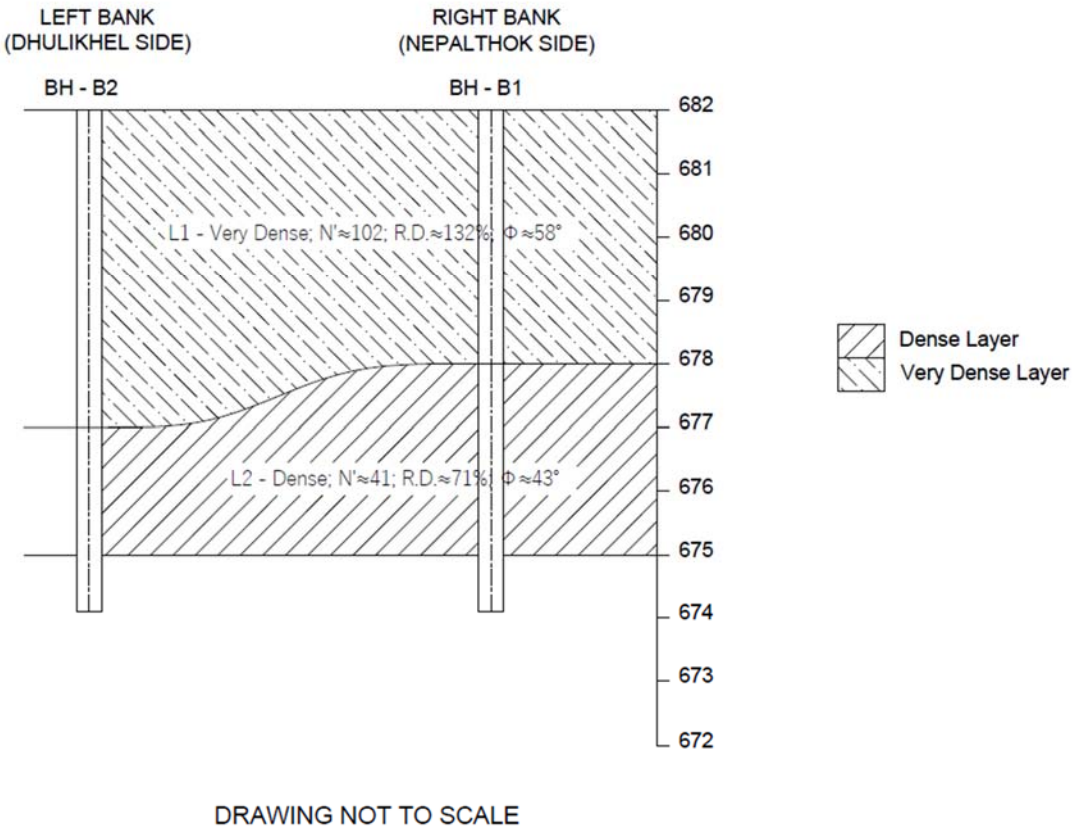


Figure 5.1: Subsoil profile - Bhyakure Khola

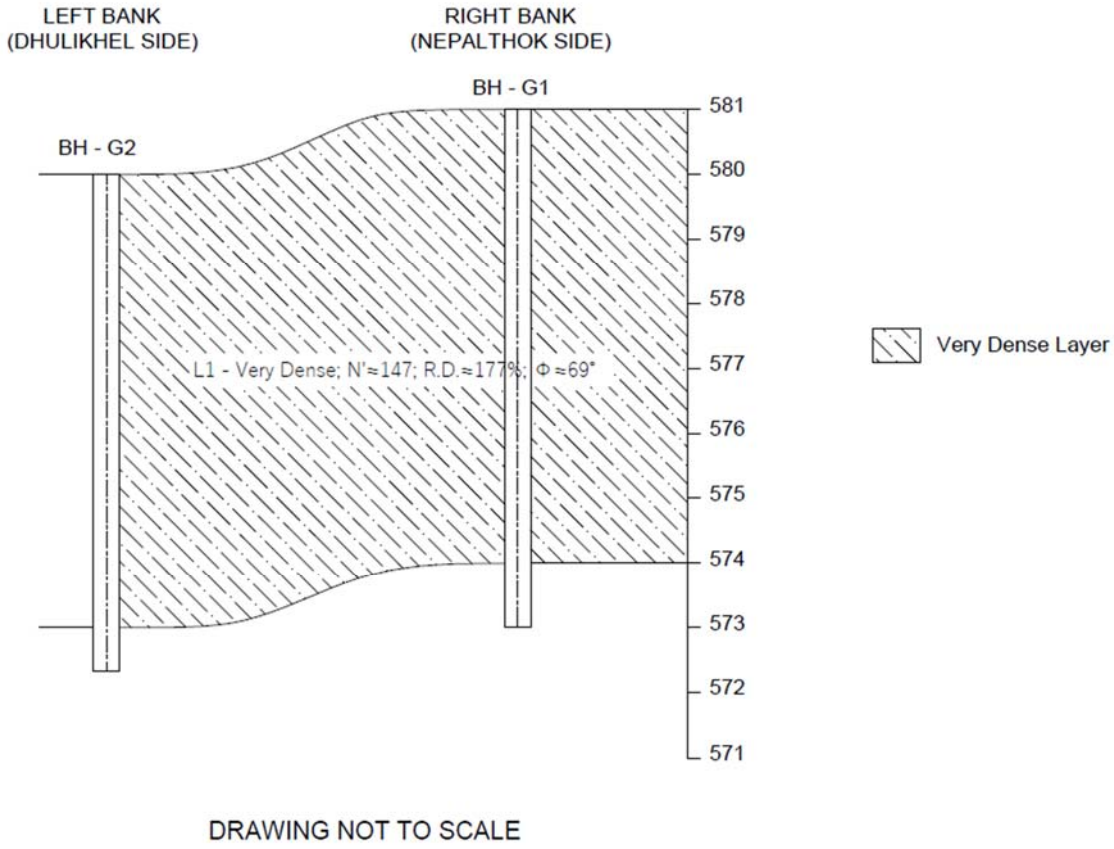


Figure 5.2: Subsoil profile - Ghyampe Khola

Chapter 6: **CALCULATION OF ALLOWABLE BEARING CAPACITY**

Any geotechnical design deals with various loads. The design criteria should satisfy both strength and serviceability criteria as per the loads applied to the soil. To satisfy the strength criteria, adequate factor of safety is applied to ultimate net bearing capacity to obtain net safe bearing capacity. Ultimate safe bearing capacity is the maximum pressure the foundation can apply to the soil before it undergoes shear failure. Again, allowable bearing capacity is calculated based on the permissible settlement to satisfy the serviceability criteria. Allowable bearing capacity is determined as minimum of the allowable pressures obtained from strength and serviceability criteria.

Allowable bearing capacity values are calculated for following foundation parameters.

Table 6-1: Foundation Parameters

Type of footing	Foundation Size
Square footing	4.0 x 4.0 m
Square footing	5.0 x 5.0 m
Square footing	6.0 x 6.0 m
Square footing	7.0 x 7.0 m
Square footing	8.0 x 8.0 m
Square footing	10.0 x 10.0 m
Rectangular footing	10.0 x 11.0 m

6.1 Shear Failure Analysis

Bearing Capacity of the foundation is determined as per IS: 6403-1981.

Net ultimate bearing capacity in case of general shear failure:

$$q_{nu} = cN_c s_c d_c i_c + q(N_q - 1)s_q d_q i_q R_{w1} + \frac{1}{2}B\gamma N_\gamma s_\gamma d_\gamma i_\gamma R_{w2}$$

Net ultimate bearing capacity in case of local shear failure:

$$q_{nu} = \frac{2}{3}cN_c' s_c d_c i_c + q(N_q' - 1)s_q d_q i_q R_{w1} + \frac{1}{2}B\gamma N_\gamma' s_\gamma d_\gamma i_\gamma R_{w2}$$

As recommended by the IS code, net ultimate bearing capacity is calculated by general shear when soil condition is dense, by local shear when soil condition is loose and by interpolating between the two values when soil condition is medium.

Table 6-2: Determination of method of analysis for net ultimate bearing capacity calculation

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	Friction angle φ (°)	Mobilized Friction angle φ' (°)	Soil Condition	Method of Analysis for q_{nu}
10	2.78	681	42	-	Very Dense	General Shear
11	3.78	680	43	-	Very Dense	General Shear
12	4.78	679	45	-	Very Dense	General Shear
13	5.78	678	45	-	Very Dense	General Shear
14	6.78	677	39	-	Dense	General Shear
15	7.78	676	38	-	Dense	General Shear
16	8.78	675	40	-	Dense	General Shear

The shape factors (s_c, s_q, s_γ), depth factors (d_c, d_q, d_γ) and inclination factors (i_c, i_q, i_γ) are determined as follows as per the code.

Table 6-3: Shape Factors

S. No.	Shape of base	Shape Factors		
		s_c	s_q	s_γ
1	Continuous strip	1	1	1
2	Rectangle	1+0.2B/L	1+0.2B/L	1-0.4B/L
3	Square	1.3	1.2	0.8
4	Circle	1.3	1.2	0.6

Depth factors:

$$d_c = 1 + 0.2\frac{D_f}{B}\tan\left(\frac{\pi}{4} + \frac{\phi}{2}\right)$$

$$d_c = d_\gamma = 1 \text{ for } \phi < 10°$$

$$d_c = d_\gamma = 1 + 0.1\frac{D_f}{B}\tan\left(\frac{\pi}{4} + \frac{\phi}{2}\right) \text{ for } \phi > 10°$$

Inclination factors:

$$i_c = i_q = \left(1 - \frac{\alpha}{90}\right)^2$$

$$i_\gamma = \left(1 - \frac{\alpha}{\phi}\right)^2$$

Water Table factors:

$$R_{w1} = 1 - 0.5\frac{a}{D_f} \leq 1$$

$$R_{w2} = 0.5 + 0.5\frac{b}{B} \leq 1$$

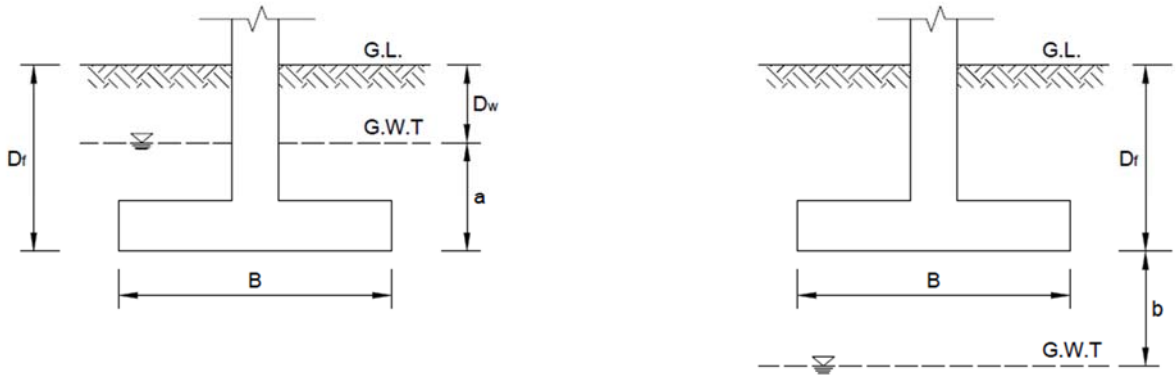


Figure 6.1: Location of water table above and below the base of footing

Table 6-4: Determination of Bearing capacity factors, shape factors, depth factors, inclination factors and water table correction factors

Bearing Capacity Factors						Shape Factors			Depth Factors			Inclination Factors			Water table correction factors	
N_c	N_q	N_γ	N_c'	N_q'	N_γ'	S_c	S_q	S_γ	d_c	d_q	d_γ	i_c	i_q	i_γ	R_{w1}	R_{w2}*
104.9	97.1	184.9	-	-	-	1.182	1.182	0.636	1.126	1.063	1.063	1	1	1	1.00	0.50
116.9	110.4	215.5	-	-	-	1.182	1.182	0.636	1.175	1.087	1.087	1	1	1	1.00	0.50
138.9	134.9	271.8	-	-	-	1.182	1.182	0.636	1.231	1.115	1.115	1	1	1	1.00	0.50
144.2	142.5	292.0	-	-	-	1.182	1.182	0.636	1.281	1.140	1.140	1	1	1	0.96	0.50
68.1	56.6	94.3	-	-	-	1.182	1.182	0.636	1.283	1.141	1.141	1	1	1	0.89	0.50
61.5	49.6	80.3	-	-	-	1.182	1.182	0.636	1.32	1.16	1.16	1	1	1	0.84	0.50
75.1	64.0	109.1	-	-	-	1.182	1.182	0.636	1.376	1.188	1.188	1	1	1	0.80	0.50

** Water table correction R_{w2} is taken as 0.5 for safety as there is a possibility that the water table may rise to the surface of foundation*
*Here, calculations are done for trial footing size 11 m * 10 m.*

Net ultimate bearing capacity is now calculated as mentioned in above equation.

Table 6-5: Calculation of net safe bearing capacity by shear failure criteria

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	Cohesion c (KN/m^2)	Unit weight of soil γ (KN/m^3)	Surcharge at the base of the footing q (KN/m^2)	Net ultimate bearing capacity from general shear failure criteria q_{nu} (KN/m^2)	Net ultimate bearing capacity from local shear failure criteria q_{nu} (KN/m^2)	q_{nu} (KN/m^2)	FOS **	Net safe bearing capacity q_{ns} (KN/m^2)
10	2.78	681	0	17	47.26	11020	-	11020	2.5	4408
11	3.78	680	0	17	64.26	15375	-	15375	2.5	6150
12	4.78	679	0	17	81.26	22539	-	22539	2.5	9016
13	5.78	678	0	20	98.26	31682	-	31682	2.5	12673
14	6.78	677	0	20	115.26	12472	-	12472	2.5	4989
15	7.78	676	0	20	132.26	11641	-	11641	2.5	4656
16	8.78	675	0	20	149.26	16567	-	16567	2.5	6627

*** Factor of safety 2.5 is adopted*

6.2 Settlement Analysis

Bearing capacity of the foundation to satisfy serviceability criteria is calculated considering the permissible settlement as 50 mm; referring to Clause 16.3.4 of IS: 1904-1986.

Settlement of a footing of width B under unit intensity of pressure with known SPT N-value is calculated from IS: 8009 (Part1)-1976, Fig 9. Pressure for settlement of 50 mm is then computed by assuming that the settlement is proportional to the intensity of pressure.

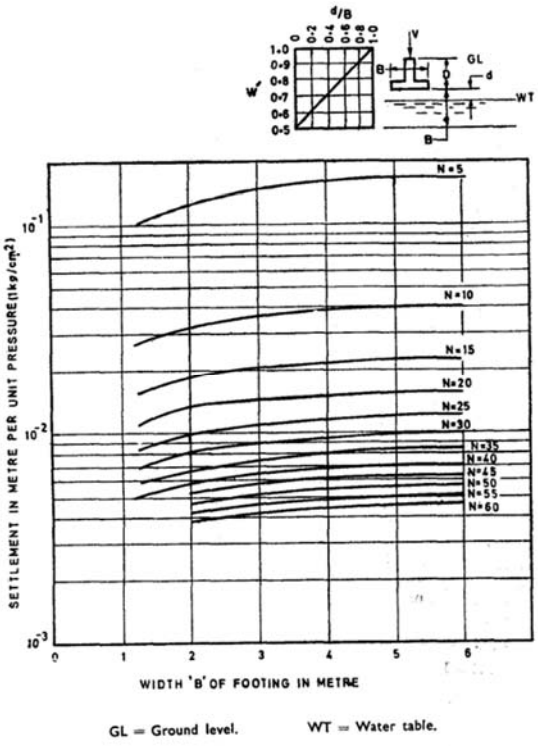


Figure 6.2: Settlement per unit pressure from SPT N-value as per IS:8009 (Part I)-1976

Table 6-6: Calculation of bearing capacity by settlement criteria

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	N' value	Settlement (m per 1kg/cm^2) *using graph, FIG 9 - IS 8009 (Part I) - 1976*	W'	Settlement after water table correction	Settlement (mm) *for reinforced concrete structures*	Reduced safe bearing capacity q_{ns} (KN/m^2)	Gross safe bearing capacity q_s (KN/m^2)	Existing Soil/Rock Description
10	2.78	681	58	0.0044	0.5	0.0089	50	552	599	Gravel with cobbles and boulders, greater boulder percentage
11	3.78	680	64	0.0039	0.5	0.0078	50	627	691	Gravel with cobbles and boulders, greater cobble percentage
12	4.78	679	215	0.0010	0.5	0.0020	50	2453	2534	Gravel with cobbles and boulders, greater cobble percentage
13	5.78	678	79	0.0025	0.5	0.0051	50	962	1078	Gravel with cobbles and boulders, greater cobble percentage
14	6.78	677	41	0.0068	0.5	0.0137	50	359	494	Gravel with cobbles and boulders, greater boulder percentage
15	7.78	676	36	0.0094	0.5	0.0188	50	262	417	Gravel with cobbles and boulders, greater boulder percentage
16	8.78	675	46	0.0058	0.5	0.0115	50	426	602	Gravel with cobbles and boulders, greater boulder percentage

Calculation of bearing capacity is done for various foundation sizes and at various depths by shear failure criteria as well as settlement criteria.

Detailed calculation for different various footing size is presented in ***Annex D***.

6.3 Foundation Recommendations

Net safe bearing capacity from both shear failure and settlement criteria, and gross safe bearing capacity for various foundation sizes can be summarized in the table below.

Table 6-7: Bearing capacity from shear failure and settlement criteria for **Borehole B1**

Depth of foundation D_f (m)	Net safe bearing capacity q_{ns}	Reduced safe bearing capacity from settlement criteria q_{ns}	Gross safe bearing capacity q_s	Net safe bearing capacity q_{ns}	Reduced safe bearing capacity from settlement criteria q_{ns}	Gross safe bearing capacity q_s	Net safe bearing capacity q_{ns}	Reduced safe bearing capacity from settlement criteria q_{ns}	Gross safe bearing capacity q_s	Net safe bearing capacity q_{ns}	Reduced safe bearing capacity from settlement criteria q_{ns}	Gross safe bearing capacity q_s	Net safe bearing capacity q_{ns}	Reduced safe bearing capacity from settlement criteria q_{ns}	Gross safe bearing capacity q_s	Net safe bearing capacity q_{ns}	Reduced safe bearing capacity from settlement criteria q_{ns}	Gross safe bearing capacity q_s	Net safe bearing capacity q_{ns}	Reduced safe bearing capacity from settlement criteria q_{ns}	Gross safe bearing capacity q_s
	Width of Foundation B = 4 m			Width of Foundation B = 5 m			Width of Foundation B = 6 m			Width of Foundation B = 7 m			Width of Foundation B = 8 m			Width of Foundation B = 10 m			Rectangular Footing; L = 11 m, B = 10 m		
2.78	3687	549	596	3870	530	578	4075	525	572	4294	532	579	4521	552	599	4990	552	599	4408	552	599
3.78	5542	637	702	5687	615	679	5882	606	670	6105	610	674	6345	627	691	6858	627	691	6150	627	691
4.78	8633	2453	2534	8702	2453	2534	8870	2453	2534	9097	2453	2534	9358	2453	2534	9947	2453	2534	9016	2453	2534
5.78	12669	1093	1208	12610	1041	1156	12726	1003	1119	12942	978	1093	13221	962	1078	13892	962	1078	12673	962	1078
6.78	5174	356	491	5097	342	477	5096	338	473	5139	343	479	5209	359	494	5397	359	494	4989	359	494
7.78	4966	260	415	4853	250	405	4821	247	402	4835	251	406	4878	262	417	5014	262	417	4656	262	417
8.78	7281	401	577	7055	389	564	6963	388	564	6947	400	576	6978	426	602	7127	426	602	6627	426	602

Table 6-8: Bearing capacity from shear failure and settlement criteria for **Borehole B2**

Depth of foundation D_f (m)	Net safe bearing capacity q_{ns}	Reduced safe bearing capacity from settlement criteria q_{ns}	Gross safe bearing capacity q_s	Net safe bearing capacity q_{ns}	Reduced safe bearing capacity from settlement criteria q_{ns}	Gross safe bearing capacity q_s	Net safe bearing capacity q_{ns}	Reduced safe bearing capacity from settlement criteria q_{ns}	Gross safe bearing capacity q_s	Net safe bearing capacity q_{ns}	Reduced safe bearing capacity from settlement criteria q_{ns}	Gross safe bearing capacity q_s	Net safe bearing capacity q_{ns}	Reduced safe bearing capacity from settlement criteria q_{ns}	Gross safe bearing capacity q_s	Net safe bearing capacity q_{ns}	Reduced safe bearing capacity from settlement criteria q_{ns}	Gross safe bearing capacity q_s	Net safe bearing capacity q_{ns}	Reduced safe bearing capacity from settlement criteria q_{ns}	Gross safe bearing capacity q_s
	Width of Foundation B = 4 m			Width of Foundation B = 5 m			Width of Foundation B = 6 m			Width of Foundation B = 7 m			Width of Foundation B = 8 m			Width of Foundation B = 10 m			Rectangular Footing; L = 11 m, B = 10 m		
2.78	4996	855	903	5249	820	867	5534	800	847	5838	792	839	6153	796	844	6803	796	844	5995	796	844
3.78	4515	520	585	4631	503	568	4786	499	563	4963	507	571	5155	527	591	5564	527	591	4999	527	591
4.78	8633	2453	2534	8702	2306	2388	8870	2087	2169	9097	1873	1954	9358	1671	1752	9947	1671	1752	9016	1671	1752
5.78	11933	2453	2568	11872	2453	2568	11976	2453	2568	12175	2453	2568	12432	2453	2568	13054	2453	2568	11918	2453	2568
6.78	12815	882	1018	12627	845	981	12640	823	959	12768	814	949	12968	816	952	13497	816	952	12377	816	952
7.78	5872	361	517	5736	348	503	5698	344	500	5714	351	506	5765	368	524	5929	368	524	5499	368	524
8.78	6618	367	543	6416	354	529	6334	351	526	6320	358	534	6350	377	553	6485	377	553	6033	377	553

Table 6-9: Bearing capacity from shear failure and settlement criteria for **Borehole G1**

Depth of foundation D_f (m)	Width of Foundation B = 4 m			Width of Foundation B = 5 m			Width of Foundation B = 6 m			Width of Foundation B = 7 m			Width of Foundation B = 8 m			Width of Foundation B = 10 m			Rectangular Footing; L = 11 m, B = 10 m		
	Net safe bearing capacity q_{ns}	Reduced safe bearing capacity from settlement criteria q_{ns}	Gross safe bearing capacity q_s	Net safe bearing capacity q_{ns}	Reduced safe bearing capacity from settlement criteria q_{ns}	Gross safe bearing capacity q_s	Net safe bearing capacity q_{ns}	Reduced safe bearing capacity from settlement criteria q_{ns}	Gross safe bearing capacity q_s	Net safe bearing capacity q_{ns}	Reduced safe bearing capacity from settlement criteria q_{ns}	Gross safe bearing capacity q_s	Net safe bearing capacity q_{ns}	Reduced safe bearing capacity from settlement criteria q_{ns}	Gross safe bearing capacity q_s	Net safe bearing capacity q_{ns}	Reduced safe bearing capacity from settlement criteria q_{ns}	Gross safe bearing capacity q_s	Net safe bearing capacity q_{ns}	Reduced safe bearing capacity from settlement criteria q_{ns}	Gross safe bearing capacity q_s
2.62	3066	2453	2497	3399	2453	2497	3744	2453	2497	4095	2453	2497	4452	2453	2497	5173	2453	2497	4350	2453	2497
3.62	3891	2453	2514	4186	2453	2514	4506	2453	2514	4839	2453	2514	5182	2453	2514	5884	2453	2514	5034	2453	2514
4.62	4783	2453	2531	5026	2453	2531	5312	2453	2531	5621	2453	2531	5946	2453	2531	6622	2453	2531	5743	2453	2531
5.62	6665	961	1073	6874	919	1031	7155	891	1004	7479	876	989	7829	872	985	8577	872	985	7525	872	985
6.62	6841	707	839	6946	681	813	7140	668	801	7385	669	802	7661	683	815	8272	683	815	7333	683	815
7.62	5374	478	631	5381	463	616	5467	460	613	5598	470	622	5758	493	645	6127	493	645	5495	493	645
8.62	9801	812	985	9703	780	952	9772	762	934	9935	757	929	10158	764	937	10712	764	937	9633	764	937

Table 6-10: Bearing capacity from shear failure and settlement criteria for **Borehole G2**

Depth of foundation D_f (m)	Width of Foundation B = 4 m			Width of Foundation B = 5 m			Width of Foundation B = 6 m			Width of Foundation B = 7 m			Width of Foundation B = 8 m			Width of Foundation B = 10 m			Rectangular Footing; L = 11 m, B = 10 m		
	Net safe bearing capacity q_{ns}	Reduced safe bearing capacity from settlement criteria q_{ns}	Gross safe bearing capacity q_s	Net safe bearing capacity q_{ns}	Reduced safe bearing capacity from settlement criteria q_{ns}	Gross safe bearing capacity q_s	Net safe bearing capacity q_{ns}	Reduced safe bearing capacity from settlement criteria q_{ns}	Gross safe bearing capacity q_s	Net safe bearing capacity q_{ns}	Reduced safe bearing capacity from settlement criteria q_{ns}	Gross safe bearing capacity q_s	Net safe bearing capacity q_{ns}	Reduced safe bearing capacity from settlement criteria q_{ns}	Gross safe bearing capacity q_s	Net safe bearing capacity q_{ns}	Reduced safe bearing capacity from settlement criteria q_{ns}	Gross safe bearing capacity q_s	Net safe bearing capacity q_{ns}	Reduced safe bearing capacity from settlement criteria q_{ns}	Gross safe bearing capacity q_s
3.62	3292	2453	2514	3608	2453	2514	3942	2453	2514	4286	2453	2514	4637	2453	2514	5349	2453	2514	4507	2453	2514
4.62	4154	2453	2531	4425	2453	2531	4729	2453	2531	5051	2453	2531	5386	2453	2531	6075	2453	2531	5205	2453	2531
5.62	5081	2453	2548	5294	2453	2548	5559	2453	2548	5854	2453	2548	6167	2453	2548	6828	2453	2548	5929	2453	2548
6.62	7147	2453	2585	7313	2453	2585	7568	2453	2585	7875	2453	2585	8214	2453	2585	8949	2453	2585	7858	2453	2585
7.62	8393	2453	2605	8459	2453	2605	8648	2453	2605	8907	2453	2605	9211	2453	2605	9896	2453	2605	8771	2453	2605
8.62	9717	1786	1959	9668	1670	1842	9780	1559	1731	9984	1455	1627	10246	1357	1530	10874	1357	1530	9714	1357	1530
9.62	11119	2453	2645	10939	2453	2645	10964	2453	2645	11106	2453	2645	11321	2453	2645	11883	2453	2645	10688	2453	2645

Chapter 7: **RIVER BED SAMPLING**

To determine the size of materials on the bed of river at Bhyakure, Mamti and Ghyampe, representative sample from each site was extracted and then sieve analysis was performed at the laboratory. The primary objective is to obtain the particle size distribution curve.

In order to extract representative sample, test pit of size 1m x 1m was excavated and soil sample up to depth 50 cm was removed. Below the depth of 50 cm, pit of size 50 cm x 50 cm was dug and soil sample from this excavation was taken. Sample of about 50-100 kg was extracted for sieve analysis in the lab.

Some boulders of larger size were also encountered, which was not feasible to be carried for lab test. In such case, dimensions of those boulders were taken to determine its weight and then the weight was added to the weight of sample retained in respective sieve sizes.

The calculation and result of sieve analysis i.e. particle size distribution curve and particle size corresponding to % of fines 10%, 30%, 60% and 90% is presented in ***Annex E.***

Table 7-1: Particle size corresponding to various % of fines at Bhyakure, Mamti and Ghyampe site

Bhyakure Khola soil sample size	Mamti Khola soil sample size	Ghyampe Khola soil sample size
D_{10} = 2.32 mm	D_{10} = 2.27 mm	D_{10} = 3.92 mm
D_{30} = 38.60 mm	D_{30} = 20.44 mm	D_{30} = 37.38 mm
D_{50} = 149.11 mm	D_{50} = 151.47 mm	D_{50} = 175.64 mm
D_{60} = 216.01 mm	D_{60} = 203.78 mm	D_{60} = 232.58 mm
D_{90} = 331.39 mm	D_{90} = 318.85 mm	D_{90} = 320.16 mm

Chapter 8: **CONCLUSION**

The following recommendations are made based on the analysis undertaken in this report.

It is recommended that the rectangular footing of size 11 m x 10 m is selected based on this geotechnical analysis undertaken at this phase for reporting. Nevertheless, the bridge designers can optimize the design as per requirements for design criteria of the bridge incorporating our geotechnical analysis.

Table 8-1: Option Recommendations of base level of foundation, corresponding gross safe bearing capacity and settlement at location of Ghyampe and Byakhure

Site Area	Borehole No.	Depth of foundation D_f (m)	Elevation of base of foundation (m)	Allowable Bearing Capacity	
				Net safe bearing capacity from shear failure criteria (KN/m^2)	Gross safe bearing capacity from settlement 50mm criteria (KN/m^2)
Bhyakure Khola	**B1**	5.78	677	4989	494
	B2	6.78	677	12377	952
Ghyampe Khola	**G1**	4.62	575	5495	645
	G2	6.62	575	8771	2605

The gross safe bearing capacity obtained is further checked with suggested allowable bearing values for average condition from IRC: 78-2000.

Table 8-2: Presumptive bearing capacity values for average condition as per IRC: 78-2000

Types of Rock/Condition	Suggested Allowable Bearing Values for Average Condition
Hard Rocks	2.0 to 3.0 MPa
Soft Rocks	1.0 to 2.0 MPa
Weathered Rocks, Conglomerates and Laterites	Not more than 1.0 MPa

Chapter 9: **REFERENCES**

9.1 For SPT N-value

i. IS: 2131 (1981) Methods for Standard Penetration Test for Soils, Bureau of Indian Standards

ii. IS:4968-1 (1976) Method for subsurface soundings for soils, Part 1: Dynamic method using 50mm cone without bentonite slurry

iii. Various ASTM and British Standard Documents for ground investigation and soil in-situ testing

9.2 For Determination of Bearing Capacity

i. IS: 6403 (1981) Code of practice for determination of bearing capacity of shallow foundations, Bureau of Indian Standards

ii. IS: 1904 (1986) Code of practice for design and construction of foundations in soils: General requirements

iii. IS: 8009-1 (1976) Code of practice for calculation of settlements of foundations, Part 1: Shallow foundations subjected to symmetrical static vertical loads

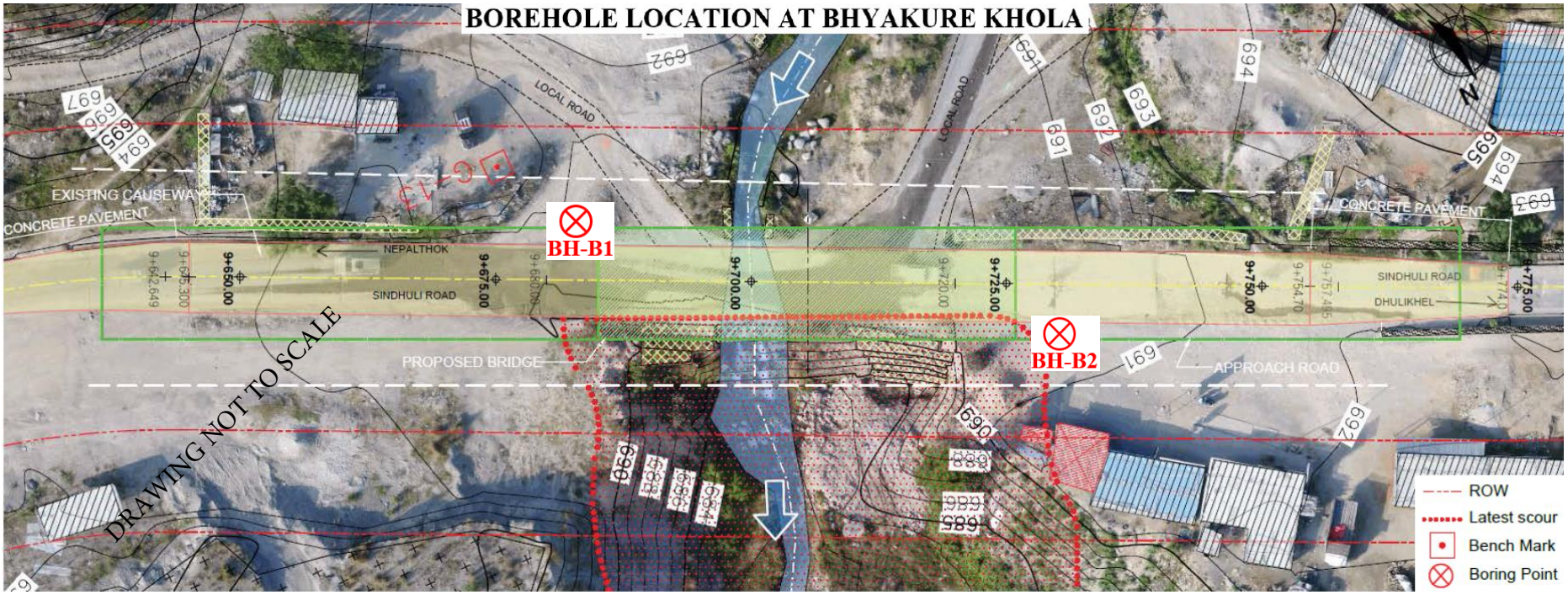
iv. IRC: 78 (2000) Code of practice for road bridges, Section VII: Foundations and Substructure

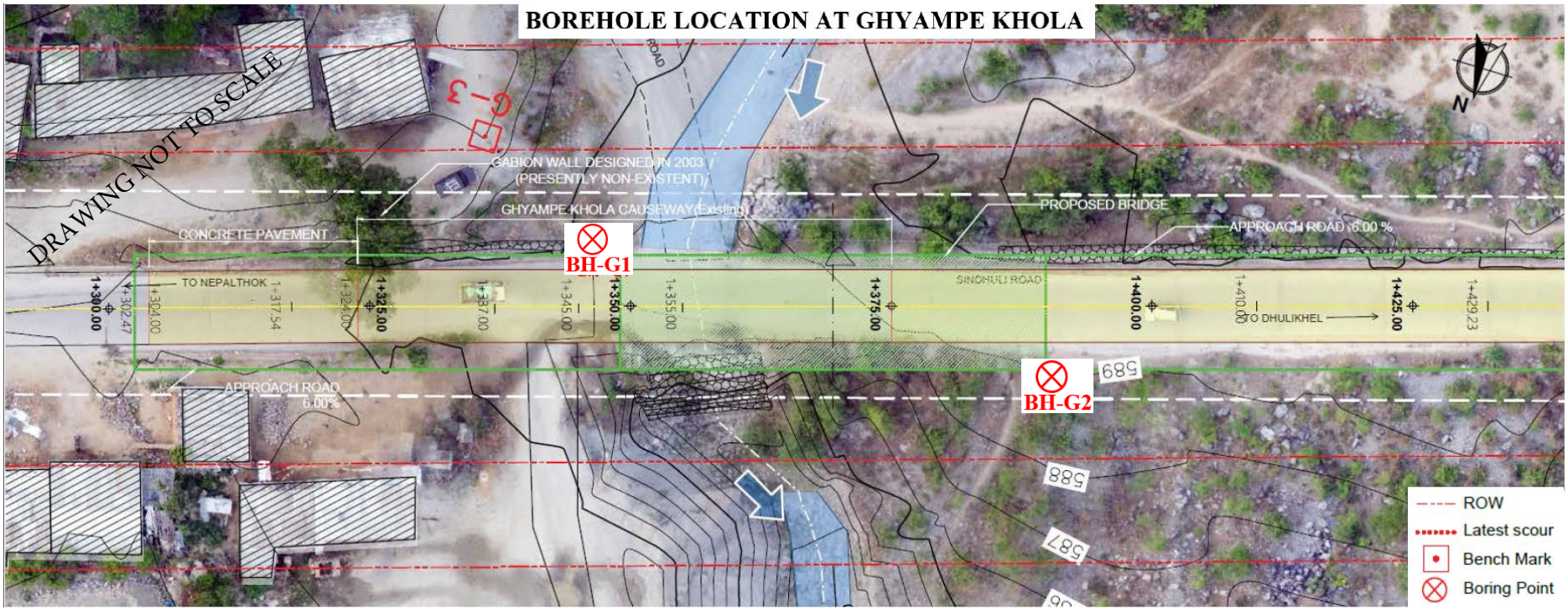
ANNEX A

BOREHOLE LOCATION MAP

A1 – BOREHOLE LOCATION MAP AT BHYAKURE

A2 – BOREHOLE LOCATION MAP AT GHYAMPE


BOREHOLE LOCATION AT BHYAKURE KHOLA
BH-B1
BH-B2
EXISTING CAUSEWAY
CONCRETE PAVEMENT
NEPALTHOK
SINDHULI ROAD
PROPOSED BRIDGE
LOCAL ROAD
APPROACH ROAD
DHULIKHEL
9+650.00
9+675.00
9+700.00
9+725.00
9+750.00
9+775.00
DRAWING NOT TO SCALE
ROW
Latest scour
Bench Mark
Boring Point


BOREHOLE LOCATION AT GHYAMPE KHOLA
DRAWING NOT TO SCALE
GABION WALL DESIGNED IN 2003
(PRESENTLY NON-EXISTENT)
GHYAMPE KHOLA CAUSEWAY(Existing)
PROPOSED BRIDGE
APPROACH ROAD 6.00 %
CONCRETE PAVEMENT
BH-G1
BH-G2
TO NEPALTHOK
SINDHULI ROAD
TO DHULIKHEL
APPROACH ROAD
6.00%
1+300.00
1+302.47
1+304.00
1+317.54
1+325.00
1+337.00
1+345.00
1+350.00
1+355.00
1+375.00
1+400.00
1+410.00
1+425.00
1+429.23
589
588
587
N
ROW
Latest scour
Bench Mark
Boring Point

ANNEX B

BOREHOLE LOGS

B1 – BOREHOLE LOG OF BHYAKURE (B1)

B2 – BOREHOLE LOG OF BHYAKURE (B2)

B3 – BOREHOLE LOG OF GHYAMPE (G1)

B4 – BOREHOLE LOG OF GHYAMPE (G2)

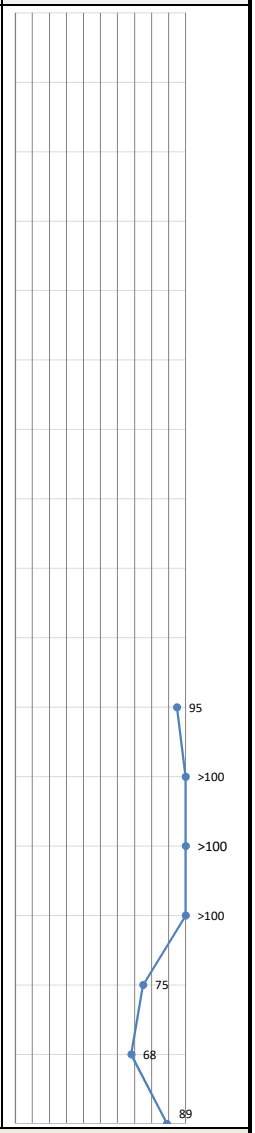
ANNEX B - B1 - BOREHOLE LOG OF BHYAKURE (B1)

BORING LOG - BOREHOLE BHYAKURE B1

Project: Sindhuli Road Project	**Start: 15th September 2019**	**Boring method: Rotary**	**Surface Elevation: 691 m**
Location: Bhyakure Khola	**Finish: 19th September 2019**	**Driller: Khadka.M**	**Water Table: 12.5 m**
Bore Hole No.: B1 (Nepalthok side)	**Drilling Machine: XUL 100**	**Logged by: Bhandari.A**	**Easting (m): 85.750832**
Depth: 16 m	**Bit Condition: Good**	**Checked by: Karki.M**	**Northing (m): 27.469377**

Elevation (m)	Depth (m)	Casing (m)	Test Type	Ground Water Table	Recovery % /run. m.	Graphical log	Soil/Rock Description	N1	N2	N3	N2+N3	Relative Density	Number of blows per 20 cm penetration	Number of blows per 30 cm penetration	SPT N-value
691.0	0.0	HX 0 m to 6 m			0		0 to 0.5 m :- Pebbly sand: light grey coarse grained, subangular to surrounded.								
690.5	0.5				60		0.5 to 1.8m BOULDER with gravel; light grey to blueish grey, angular to sub-angular gravel; boulders are light grey to blueish grey. Clasts are of quartzite silicious limestone.								
690.0	1.0														
689.5	1.5				38										
689.0	2.0				17		1.8 to 2.5m: Gravel with cobble: light grey to bluish grey, medium to coarse grained, sub-angular to sub-rounded and are of quartzite								
688.5	2.5														
688.0	3.0				23		2.5m to 3.5m: Cobbles percentage decreased.								
687.5	3.5				95		3.5m to 4m Boulder: Light grey to blueish grey and clast are of quartzite, dolomite.								
687.0	4.0						4m to 5m Gravel with Cobbles and boulders; light grey to blueish grey, angular to sub-angular clasts. Clasts are of quartzite and dolomite.								
686.5	4.5				30										
686.0	5.0	NX- 6 m to 12 m			50		5m to 5.5m Boulders of quartzite and dolomite are observed.								
685.5	5.5														
685.0	6.0				0		5.5m to 6.8m Boulder percentage very minimal								
684.5	6.5														
684.0	7.0				30		From 6.8m to 8m, boulder percentage increasing.								
683.5	7.5														
683.0	8.0				27										
682.5	8.5														
682.0	9.0				40		From 8m to 10m increase in percentage of cobble								
681.5	9.5														
681.0	10.0	BX- 12 m to 16 m	DCPT		15			13/10	26/10	37/10	63	Dense	63/20	95/30	95
680.5	10.5						10 to 11 m Boulder percentage increases								
680.0	11.0		DCPT		35			25/10	30/10	42/10	72	Dense	72/20	108/30	108
679.5	11.5														
679.0	12.0		DCPT		25			37/10	50/4	Refusal	50/4	Very dense	50/4	375/30	375
678.5	12.5						11 to 14m Percentage of cobble increases								
678.0	13.0		DCPT		20			35/10	40/10	55/10	95	Very dense	95/20	143/30	143
677.5	13.5														
677.0	14.0		DCPT		10			15/10	21/10	29/10	50	Medium dense	50/20	75/30	75
676.5	14.5														
676.0	15.0		DCPT		15		14m to 16 m Percentage of boulder increases.	5/10	18/10	27/10	45	Medium dense	45/20	68/30	68
675.5	15.5														
675.0	16.0		DCPT		7			5/10	22/10	37/10	59	Dense	59/20	89/30	89

END OF HOLE @16m



LEGEND

Clay
Silt
Sand
79
Gravel
Boulders

Proportion used
0 to 10% : Trace (..With a Trace of..)
10 to 20 % : Few (..With a Little..)
20 to 35% : Some (..With some..)
30 to 50% : And (..And..)

N<SPT Clay &Silt:
<2: Very Loose
2-4: Soft
Apr-50
8-15: Stiff
15-30: Vey Stiff
>30: Hard

N-SPT SAND:
<4: Very Loose
4-10 : Loose
10-30: Medium Dense
30-50: Dense
>50 : Very Dense

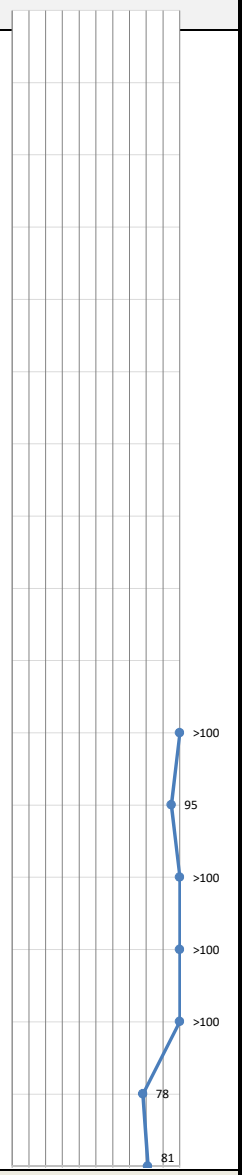
ANNEX B - B2 - BOREHOLE LOG OF BHYAKURE (B2)

BORING LOG - BOREHOLE BHYAKURE B2

Project: Sindhuli Road Project	**Start: 11th September 2019**	**Boring method: Rotary**	**Surface Elevation: 691 m**
Location: Bhyakure Khola	**Finish: 14th September 2019**	**Driller: Khadka.M**	**Water Table: 12.5 m**
Bore Hole No.: B2 (Dhulikhel side)	**Drilling Machine: XUL 100**	**Logged by: Bhandari.A**	**Easting (m): 85.750558**
Depth: 16 m	**Bit Condition: Good**	**Checked by: Karki.M**	**Northing (m): 27.469628**

Elevation (m)	Depth (m)	Casing (m)	Test Type	Ground Water Table	Recovery % /run. m.	Graphical log	Soil/Rock Description	N1	N2	N3	N = N2+N3	Relative Density	Number of blows per 20 cm penetration	Number of blows per 30 cm penetration	SPT N-value
691.0	0.0	HX 0 m to 6 m					0 to 0.8m : Gravel with cobble:- Brown, medium to coarse grained and boulder are of dolomite and quartzite.								
690.5	0.5														
690.0	1.0				11		0.8 to 2.2m Sand with boulder, brown medium to fine grained with traces of silt.								
689.5	1.5														
689.0	2.0						2.2 to 3m: boulder decreasing to minimal.								
688.5	2.5				13										
688.0	3.0						3m to 3.3m Boulder and cobble of dolomite: light grey, angular.								
687.5	3.5				20										
687.0	4.0						3.3m to 5.5m : Sand, dark brown, fine to medium grained with quartzite gravel.								
686.5	4.5				6										
686.0	5.0	NX- 6 m to 12 m					5.5m to 6m: Gravel with Cobbles, light grey, coarse grained to fine grained sand, gravel are of quartzite, limestone and dolomite, sub angular to sub rounded gravels.								
685.5	5.5				20										
685.0	6.0						6m to 6.5m: Sand, light grey, coarse grained to fine grained.								
684.5	6.5				21										
684.0	7.0						6.5m to 16m Boulder with gravel,grey to dark grey, coarse to fine grained, subangular to sub rounded grain. Boulder and gravel are of quartzite, dolomite and limestone.								
683.5	7.5				18										
683.0	8.0				12										
682.5	8.5				40										
682.0	9.0						From 9m to 10m increasing sand percentage.								
681.5	9.5				10										
681.0	10.0	BX- 12 m to 16 m	DCPT					15/10	29/10	50/10	79	Dense	79/20	119/30	119
680.5	10.5				13										
680.0	11.0		DCPT		50			18/10	20/10	43/10	63	Dense	63/20	95/30	95
679.5	11.5														
679.0	12.0		DCPT		20			19/10	29/4	45/10	74	Very dense	74/14	159/30	159
678.5	12.5														
678.0	13.0		SPT		25		From 10 to 16m gravel percentage increasing.	25/15	50/4	Refusal	50/4	Very dense	50/4	375/30	375
677.5	13.5				15										
677.0	14.0		SPT					32/15	50/11	Refusal	50/11	Dense	50/11	136/30	136
676.5	14.5				0										
676.0	15.0		DCPT					20/10	22/10	30/10	52	Medium dense	52/20	78/30	78
675.5	15.5														
675.0	16.0		DCPT		15			10/10	20/10	34/10	54	Medium dense	54/20	81/30	81

END OF HOLE @16m



LEGEND

- Clay
- Silt
- Sand
- Batu Lempung/Claystone
- Gravel
- Boulders

Propotion used
0 to 10% : Trace (..With a Trace of..)
10 to 20 % : Few (..With a Little..)
20 to 35% : Some (..With some..)
30 to 50% : And (..And..)

N<SPT Clay &Silt:
<2: Very Loose
2-4: Soft
4-8: Medium Stiff
8-15: Stiff
15-30: Vey Stiff
>30: Hard

N-SPT SAND:
<4: Very Loose
4-10 : Loose
10-30: Medium Dense
30-50: Dense
>50 : Very Dense

ANNEX B - B3 - BOREHOLE LOG OF GHYAMPE (G1)

BORING LOG - BOREHOLE GHYAMPE G1

Project: Sindhuli Road Project	**Start: 22nd September 2019**	**Boring method: Rotary**	**Surface Elevation: 590 m**
Location: Ghyampe Khola	**Finish: 24th September 2019**	**Driller: Khadka.M**	**Water Table: 6.9 m**
Bore Hole No.: G1 (Nepalthok side)	**Drilling Machine: XUL 100**	**Logged by: Bhandari.A**	**Easting (m): 85.8040**
Depth: 16 m	**Bit Condition: Good**	**Checked by: Karki.M**	**Northing (m): 27.4369**

Elevation (m)	Depth (m)	Casing (m)	Test Type	Ground Water Table	Recovery % /Run (m)	Graphical log	Soil/Rock Description	N1	N2	N3	N = N2+N3	Relative Density	Number of blows per 20 cm penetration	Number of blows per 30 cm penetration	SPT N-value	N- Value
590.0	0.0	HX 0 m to 5 m					0 to 0.4 m SAND, dark grey, medium to fine grained with 5% silt.									
589.5	0.5				50		0.4 to 1 m BOULDER, light grey to blueish grey, angular to sub-angular, clast are of silicous dolomite.									
589.0	1.0															
588.5	1.5						1 m to 2.7m GRAVEL, bluish grey , medium to coarse grained, sub-angular to angular. Most of the gravel are of dolomite (Bluish grey, fine to medium grained)									
588.0	2.0				8											
587.5	2.5															
587.0	3.0				82		2.7 m to 4 m BOULDER with gravel, light grey to blueish grey, angular to sub-angular gravel boulders are light grey to blueish grey. Clasts are of quartzite.									
586.5	3.5															
586.0	4.0				33		From 4m to 5 m propotion of sand increases, light grey, coarse to fine grained sand .									
585.5	4.5															
585.0	5.0	NX- 5 m to 10 m			63											
584.5	5.5															
584.0	6.0				50											
583.5	6.5			▼												
583.0	7.0															
582.5	7.5				35											
582.0	8.0															
581.5	8.5				63											
581.0	9.0															
580.5	9.5				49											
580.0	10.0	BX- 10 m to 16 m	DCPT					50/10	50/6	Refusal	50/6	Very dense	50/6	250/30	250	>100
579.5	10.5				44		5m to 16m Boulder with Gravel, light grey to grey, angular to sub-angular gravel clasts are of quartzite.									
579.0	11.0		DCPT					50/4	Refusal	Refusal	50/4	Very dense	50/4	375/30	375	>100
578.5	11.5				40											
578.0	12.0		DCPT					50/7	Refusal	Refusal	50/7	Very dense	50/7	214/30	214	>100
577.5	12.5				40											
577.0	13.0		DCPT					30/10	33/10	48/10	81	Very dense	81/20	122/30	122	>100
576.5	13.5				20											
576.0	14.0		DCPT					27/10	26/4	33/12	59	Dense	59/16	111/30	111	>100
575.5	14.5				10											
575.0	15.0		DCPT					22/10	27/10	32/10	59	Dense	59/20	89/30	89	89
574.5	15.5				27											
574.0	16.0		DCPT					29/10	37/10	45/10	82	Dense	82/20	123/30	123	>100

END OF HOLE @16m

LEGEND

- Clay
- Silt
- Sand
- Batu Lempung/Claystone
- Gravel
- Boulders

Propotion used
0 to 10% : Trace (..With a Trace of..)
10 to 20 % : Few (..With a Little..)
20 to 35% : Some (..With some..)
30 to 50% : And (..And..)

N<SPT Clay &Silt:
<2: Very Loose
2-4: Soft
4-8: Medium Stiff
8-15: Stiff
15-30: Vey Stiff
>30: Hard

N-SPT SAND:
<4: Very Loose
4-10 : Loose
10-30: Medium Dense
30-50: Dense
>50 : Very Dense

ANNEX B - B4 - BOREHOLE LOG OF GHYAMPE (G2)

BORING LOG - BOREHOLE GHYAMPE G2

Project: Sindhuli Road Project	**Start: 25th September 2019**	**Boring method: Rotary**	**Surface Elevation: 589 m**
Location: Ghyampe Khola	**Finish: 28th September 2019**	**Driller: Khadka.M**	**Water Table: 5 m**
Bore Hole No.: G2 (Dhulikhel side)	**Drilling Machine: XUL 100**	**Logged by: Bhandari.A**	**Easting (m): 85.8038**
Depth: 16 m	**Bit Condition: Good**	**Checked by: Karki.M**	**Northing (m): 27.4369**

Elevation (m)	Depth (m)	Casing (m)	Test Type	Ground Water Table	Recovery % /run. m.	Graphical log	Soil/Rock Description	N1	N2	N3	N = N2+N3	Relative Density	Number of blows per 20 cm penetration	Number of blows per 30 cm penetration	SPT N-value	N- Value
589.0	0.0	HX 0 m to 5 m					0 to 0.6 m :- SAND light grey, with silt.									0 10 20 30 40 50 60 70 80 90100
588.5	0.5				60											
588.0	1.0						0.6 to 2.7 m GRAVEL dark grey to milky white, coarse grained , angular to sub-angular, clasts are of quartzite,schist, silicous dolomite.									
587.5	1.5				80											
587.0	2.0				82											
586.5	2.5						2.7 m to 3 m BOULDER grey, fine to medium grained , silicious dolomite									
586.0	3.0				67											
585.5	3.5						3m to 4m: GRAVEL, dark grey to grey, coarse grained , angular to sub-angular, clasts are of quartzite,schist, silicous dolomite.									
585.0	4.0				40											
584.5	4.5			▼												
584.0	5.0	NX- 5 m to 10 m			70											
583.5	5.5				50											
583.0	6.0															
582.5	6.5				30											
582.0	7.0															
581.5	7.5				30											
581.0	8.0															
580.5	8.5				40											
580.0	9.0															
579.5	9.5				20											
579.0	10.0	BX- 10 m to 16 m	DCPT				4m to 16 m BOULDER with gravel; light grey to blueish grey. Gravel are angular to sub-angular with clasts are of quartzite silicious limestone.	28/10	50/7	Refusal	50/7	Very dense	50/7	214/30	214	>100
578.5	10.5				20											
578.0	11.0		DCPT					10/10	50/4	Refusal	50/4	Very dense	50/4	375/30	375	>100
577.5	11.5				30											
577.0	12.0		DCPT					50/10	50/4	Refusal	50/4	Very dense	50/4	375/30	375	>100
576.5	12.5				25											
576.0	13.0		DCPT					46/10	50/5	Refusal	50/5	Very dense	50/5	300/30	300	>100
575.5	13.5				20											
575.0	14.0		DCPT					47/10	50/6	Refusal	50/6	Very dense	50/6	250/30	250	>100
574.5	14.5				10											
574.0	15.0		DCPT					36/10	45/10	48/10	93	Very dense	93/20	140/30	140	>100
573.5	15.5				10											
573.0	16.0		DCPT					29/10	50/7	Refusal	50/7	Very dense	50/7	214/30	214	>100

END OF HOLE @16m

LEGEND

- Clay
- Silt
- Sand
- Batu Lempung/Claystone
- Gravel
- Boulders

Propotion used
0 to 10% : Trace (..With a Trace of..)
10 to 20 % : Few (..With a Little..)
20 to 35% : Some (..With some..)
30 to 50% : And (..And..)

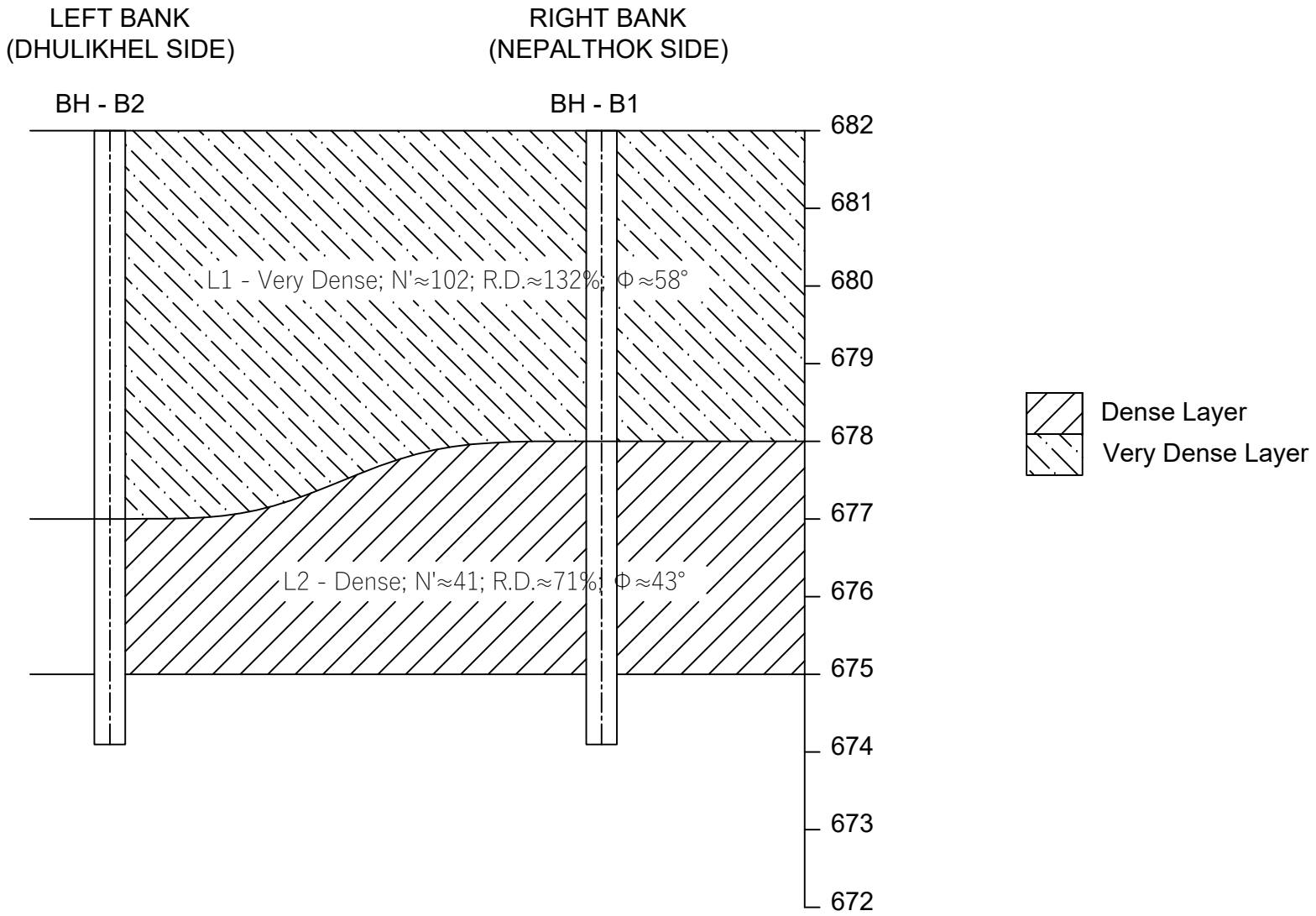
N<SPT Clay &Silt:
<2: Very Loose
2-4: Soft
4-8: Medium Stiff
8-15: Stiff
15-30: Vey Stiff
>30: Hard

N-SPT SAND:
<4: Very Loose
4-10 : Loose
10-30: Medium Dense
30-50: Dense
>50 : Very Dense

ANNEX C

GEOTECHNICAL DOMAIN IDENTIFICATION

GEOTECHNICAL DOMAIN INTERPRETATION : BHYAKURE KHOLA



DRAWING NOT TO SCALE

GEOTECHNICAL DOMAIN IDENTIFICATION

Project:	Sindhuli Road Project	Casing Depth:	HX 6m, NX 12m, BX 16m	Bore Hole No.:	**B1 (Nepalthok side)**
Location:	Bhyakure Khola	Drilling mothod:	Rotary	Surface Elevation:	691 m
Easting (m):	85.750832	Drilling Machine:	XUL 100	Ground Level:	0 m
Northing (m):	27.469377	Bit Name:	Impregnated Diamond Bit	Depth of Exploration:	16 m
Hole Inclination:	Vertical	Bit Condition:	Good	Water table depth:	12.5 m

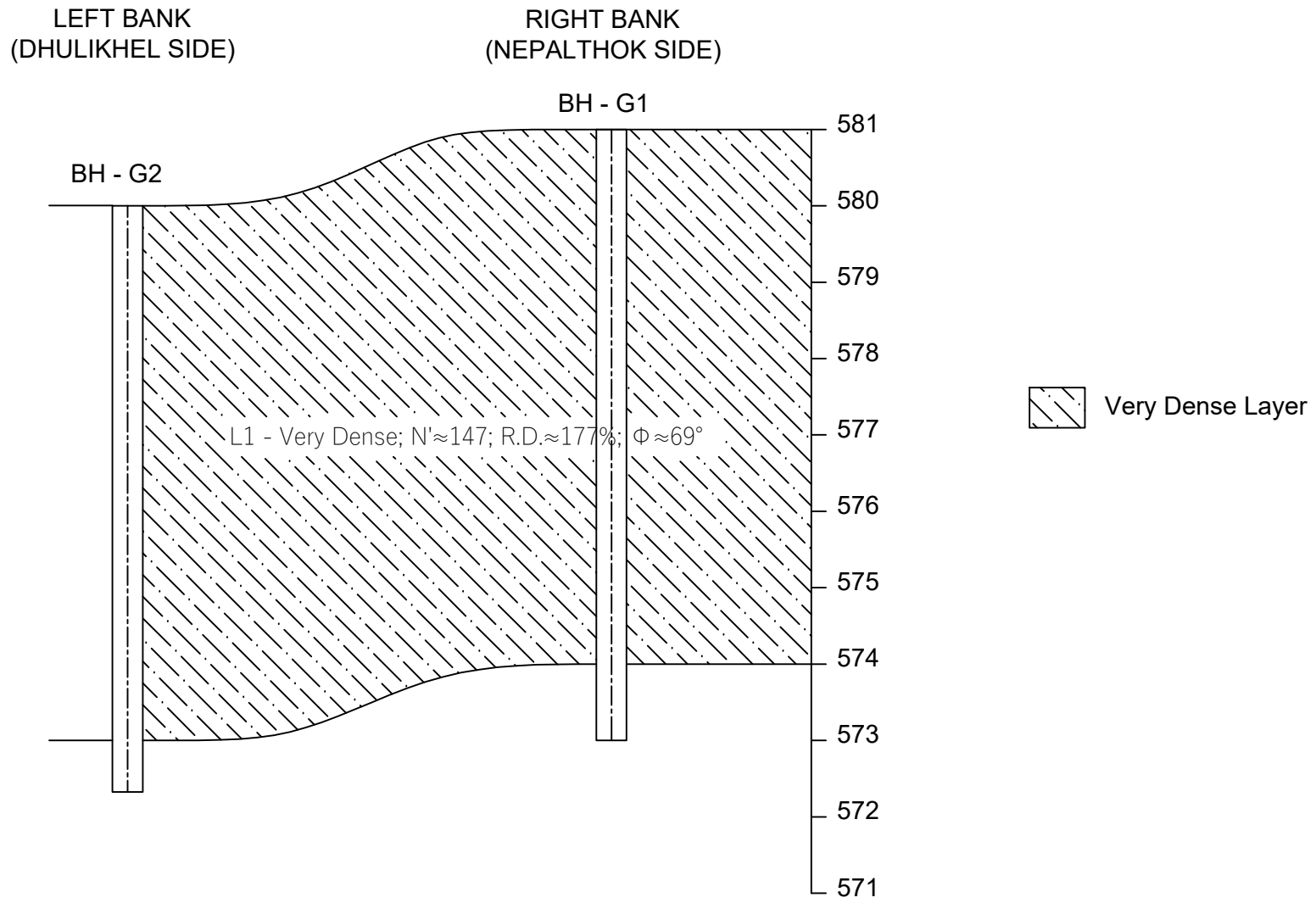
Depth	Elevation	Test Method for N-value	1st drive		2nd drive		3rd drive		DCPT N-value (for 20cm penetration)	DCPT N-value (for 30cm penetration)	Coefficient to convert DCPT to SPT	SPT N-value	N_{60}-value	Correction of N-value for Overburden as per IS: 2131-1981						Soil properties as per Meyerhoff 1956			IS 6403		Underlying Geotechnical Domain
			No. of blows (N1)	Penetration	No. of blows (N2)	Penetration	No. of blows (N3)	Penetration						Saturated Unit weight	Total stress	Pore water Pressure	Effective Overburden Pressure (P)	C' =0.77[log(2000/P)]	N' value	Soil Packing categorisation	Relative Density	Friction angle ϕ	Friction angle ϕ	Soil Packing categorisation	
m	m		blows	cm	blows	cm	blows	cm	blows	blows		blows	blows	KN/m^3	KPa	KPa	KPa		blows		%	°	°		
10	681	DCPT	13	10	26	10	37	10	63	95	1	95	71	17	170	0.00	170.00	0.82435	58	Very Dense	88	47	42	Very Dense	
11	680	DCPT	25	10	30	10	42	10	72	108	1	108	81	17	187	0.00	187.00	0.79248	64	Very Dense	94	49	43	Very Dense	L1 - Very Dense
12	679	DCPT	37	10	50	4	Refusal*		-	375	1	375	281	17	204	0.00	204.00	0.76338	215	Very Dense	245	86	45	Very Dense	
13	678	DCPT	35	10	40	10	55	10	95	143	1	143	107	20	224	4.91	219.10	0.73951	79	Very Dense	109	52	45	Very Dense	
14	677	DCPT	15	10	21	10	29	10	50	75	1	75	56	20	244	14.72	229.29	0.7243	41	Dense	71	43	39	Dense	
15	676	DCPT	5	10	18	10	27	10	45	68	1	68	51	20	264	24.53	239.48	0.70976	36	Dense	66	41	38	Dense	L2 - Dense
16	675	DCPT	5	10	22	10	37	10	59	89	1	89	66	20	284	34.34	249.67	0.69583	46	Dense	76	44	40	Dense	

Project:	Sindhuli Road Project	Casing Depth:	HX 6m, NX 12m, BX 16m	Bore Hole No.:	**B2 (Dhulikhel side)**
Location:	Bhyakure Khola	Drilling mothod:	Rotary	Surface Elevation:	691 m
Easting (m):	85.750558	Drilling Machine:	XUL 100	Ground Level:	0 m
Northing (m):	27.469628	Bit Name:	Impregnated Diamond Bit	Depth of Exploration:	16 m
Hole Inclination:	Vertical	Bit Condition:	Good	Water table depth:	12.5 m

Depth	Elevation	Test Method for N-value	1st drive		2nd drive		3rd drive		DCPT N-value (for 20cm penetration)	DCPT N-value (for 30cm penetration)	Coefficient to convert DCPT to SPT	SPT N-value	N_{60}-value	Correction of N-value for Overburden as per IS: 2131-1981						Soil properties as per Meyerhoff 1956			IS 6403		Underlying Geotechnical Domain
			No. of blows (N1)	Penetration	No. of blows (N2)	Penetration	No. of blows (N3)	Penetration						Saturated Unit weight	Total stress	Pore water Pressure	Effective Overburden Pressure (P)	C' =0.77[log(2000/P)]	N' value	Soil Packing categorisation	Relative Density	Friction angle ϕ	Friction angle ϕ	Soil Packing categorisation	
m	m		blows	cm	blows	cm	blows	cm	blows	blows		blows	blows	KN/m^3	KPa	KPa	KPa		blows		%	°	°		
10	681	DCPT	15	10	29	10	50	10	79	119	1	119	89	17	170	0.00	170.00	0.82435	73	Very Dense	103	51	45	Very Dense	
11	680	DCPT	18	10	20	10	43	10	63	95	1	95	71	17	187	0.00	187.00	0.79248	56	Very Dense	86	47	42	Very Dense	L1 - Very Dense
12	679	DCPT	19	10	29	4	45	10	74	159	1	159	119	17	204	0.00	204.00	0.76338	91	Very Dense	121	55	45	Very Dense	
13	678	SPT	25	15	50	4	Refusal*		-	375	1	375	281	20	224	4.91	219.10	0.73951	208	Very Dense	238	84	45	Very Dense	
14	677	SPT	32	15	50	11	Refusal*		-	136	1	136	102	20	244	14.72	229.29	0.7243	74	Very Dense	104	51	45	Very Dense	
15	676	DCPT	20	10	22	10	30	10	52	78	1	78	59	20	264	24.53	239.48	0.70976	42	Dense	72	43	39	Dense	L2 - Dense
16	675	DCPT	10	10	20	10	34	10	54	81	1	81	61	20	284	34.34	249.67	0.69583	42	Dense	72	43	39	Dense	

**When a hard stratum is encountered, N-value is greater than 50, which is the case of refusal. In such cases, equivalent number of blows is taken as 50.*

GEOTECHNICAL DOMAIN INTERPRETATION : GHYAMPE KHOLA



DRAWING NOT TO SCALE

GEOTECHNICAL DOMAIN IDENTIFICATION

Project: Sindhuli Road Project
Location: Ghyampe Khola
Easting (m): 85.8040
Northing (m): 27.4369
Hole Inclination: Vertical

Casing Depth: HX 5m, NX 10m, BX 16m
Drilling mothod: Rotary
Drilling Machine: XUL 100
Bit Name: Impregnated Diamond Bit
Bit Condition: Good

Bore Hole No.: **G1 (Nepalthok side)**
Surface Elevation: 590 m
Ground Level: 0 m
Depth of Exploration: 16 m
Water table depth: 6.9 m

Depth	Elevation	Test Method for N-value	1st drive		2nd drive		3rd drive		DCPT N-value (for 20cm penetration)	DCPT N-value (for 30cm penetration)	Coefficient to convert DCPT to SPT	SPT N-value	N_{60}-value	Correction of N-value for Overburden as per IS: 2131-1981						Soil properties as per Meyerhoff 1956			IS 6403		Underlying Geotechnical Domain
			No. of blows (N1)	Penetration	No. of blows (N2)	Penetration	No. of blows (N3)	Penetration						Saturated Unit weight	Total stress	Pore water Pressure	Effective Overburden Pressure (P)	C' =0.77[log(2000/P)]	N' value	Soil Packing categorisation	Relative Density	Friction angle Φ	Friction angle Φ	Soil Packing categorisation	
m	m		blows	cm	blows	cm	blows	cm	blows	blows		blows	blows	KN/m^3	KPa	KPa	KPa		blows		%	°	°		
10	580	DCPT	50	10	50	6	Refusal*		-	250	1	250	188	17	170	30.41	139.59	0.89026	167	Very Dense	197	74	45	Very Dense	
11	579	DCPT	50	4	Refusal*				-	375	1	375	281	17	187	40.22	146.78	0.87346	246	Very Dense	276	94	45	Very Dense	
12	578	DCPT	50	7	Refusal*				-	214	1	214	161	17	204	50.03	153.97	0.85747	138	Very Dense	168	67	45	Very Dense	
13	577	DCPT	30	10	33	10	48	10	81	122	1	122	91	20	224	59.84	164.16	0.83604	76	Very Dense	106	52	45	Very Dense	L1 - Very Dense
14	576	DCPT	27	10	26	4	33	12	59	111	1	111	83	20	244	69.65	174.35	0.8159	68	Very Dense	98	49	44	Very Dense	
15	575	DCPT	22	10	27	10	32	10	59	89	1	89	66	20	264	79.46	184.54	0.79691	53	Very Dense	83	46	41	Very Dense	
16	574	DCPT	29	10	37	10	45	10	82	123	1	123	92	20	284	89.27	194.73	0.77893	72	Very Dense	102	50	44	Very Dense	

Project: Sindhuli Road Project
Location: Ghyampe Khola
Easting (m): 85.8038
Northing (m): 27.4369
Hole Inclination: Vertical

Casing Depth: HX 5m, NX 10m, BX 16m
Drilling mothod: Rotary
Drilling Machine: XUL 100
Bit Name: Impregnated Diamond Bit
Bit Condition: Good

Bore Hole No.: **G2 (Dhulikhel side)**
Surface Elevation: 589 m
Ground Level: 0 m
Depth of Exploration: 16 m
Water table depth: 5 m

Depth	Elevation	Test Method for N-value	1st drive		2nd drive		3rd drive		DCPT N-value (for 20cm penetration)	DCPT N-value (for 30cm penetration)	Coefficient to convert DCPT to SPT	SPT N-value	N_{60}-value	Correction of N-value for Overburden as per IS: 2131-1981						Soil properties as per Meyerhoff 1956			IS 6403		Underlying Geotechnical Domain
			No. of blows (N1)	Penetration	No. of blows (N2)	Penetration	No. of blows (N3)	Penetration						Saturated Unit weight	Total stress	Pore water Pressure	Effective Overburden Pressure (P)	C' =0.77[log(2000/P)]	N' value	Soil Packing categorisation	Relative Density	Friction angle Φ	Friction angle Φ	Soil Packing categorisation	
m	m		blows	cm	blows	cm	blows	cm	blows	blows		blows	blows	KN/m^3	KPa	KPa	KPa		blows		%	°	°		
10	579	DCPT	28	10	50	7	Refusal*		-	214	1	214	161	17	170	49.05	120.95	0.93819	151	Very Dense	181	70	45	Very Dense	
11	578	DCPT	10	10	50	4	Refusal*		-	375	1	375	281	17	187	58.86	128.14	0.91888	258	Very Dense	288	97	45	Very Dense	
12	577	DCPT	50	10	50	4	Refusal*		-	375	1	375	281	17	204	68.67	135.33	0.90062	253	Very Dense	283	96	45	Very Dense	
13	576	DCPT	46	10	50	5	Refusal*		-	300	1	300	225	20	224	78.48	145.52	0.87634	197	Very Dense	227	82	45	Very Dense	L1 - Very Dense
14	575	DCPT	47	10	50	6	Refusal*		-	250	1	250	188	20	244	88.29	155.71	0.85371	160	Very Dense	190	73	45	Very Dense	
15	574	DCPT	36	10	45	10	48	10	93	140	1	140	105	20	264	98.10	165.90	0.83251	87	Very Dense	117	54	45	Very Dense	
16	573	DCPT	29	10	50	7	Refusal*		-	214	1	214	161	20	284	107.91	176.09	0.81258	131	Very Dense	161	65	45	Very Dense	

**When a hard stratum is encountered, N-value is greater than 50, which is the case of refusal. In such cases, equivalent number of blows is taken as 50.*

ANNEX D

CALCULATION OF BEARING CAPACITY

D1 – CALCULATION OF BEARING CAPACITY FOR VARYING DIMENSION OF FOUNDATION – BHYAKURE KHOLA

D2 – CALCULATION OF BEARING CAPACITY FOR VARYING DIMENSION OF FOUNDATION – GHYAMPE KHOLA

ANNEX - D1

CALCULATION OF BEARING CAPACITY – BHYAKURE KHOLA

CALCULATION OF BEARING CAPACITY FOR VARYING DIMENSION OF FOUNDATION - BHYAKURE KHOLA

Project:	**Sindhuli Road Project**	**Drilling mothod:**	**Rotary**	**Hole Inclination:**	**Vertical**	**Surface Elevation:**	**691 m**	**Bore Hole No.:**	**B1 (Nepalthok side)**
Location:	**Bhyakure Khola**	**Drilling Machine:**	**XUL 100**	**Bit Name:**	**Impregnated Diamond Bit**	**Ground Level:**	**0 m**	**Easting (m):**	**85.750832**
		Casing Depth:	**HX 6m, NX 12m, BX 16m**	**Bit Condition:**	**Good**	**Depth of Exploration:**	**16 m**	**Northing (m):**	**27.469370**

Shape of footing considered: Square footing

Surface Elevation: 691 m

Ground Level: 0 m

Surface Elevation of starting of bore hole 681 m

Surface Elevation of end of bore hole 675 m

Depth of Exploration: 16 m

Level of Excavation: 683.8 m

Depth of Water Table from existing ground level: 12.5 m

Surface elevation of water table: 678.5 m

Depth of Water Table from excavated level: 5.3 m

Trial 1 **Width of footing B: 4 m**

IS Code Bearing Capacity by Shear Failure Criteria

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	Friction angle φ (°)	Mobilized Friction angle φ' (°)	Soil Condition	Method of Analysis for q_{nu}	Cohesion c (KN/m^2)	Unit weight of soil γ (KN/m^3)	Surcharge at the base of the footing q (KN/m^2)	N_c	N_q	N_γ	N_c'	N_q'	N_γ'	S_c	S_q	S_γ	d_c	d_q	d_γ	i_c	i_q	i_γ	Water table correction R_{w1}	Water table correction R_{w2}*	Net ultimate bearing capacity from general shear failure criteria q_{nu} (KN/m^2)	Net ultimate bearing capacity from local shear failure criteria q_{nu} (KN/m^2)	q_{nu} (KN/m^2)	FOS**	Net safe bearing capacity q_{ns} (KN/m^2)
10	2.78	681	42	-	Very Dense	General Shear	0	17	47.26	104.9	97.1	184.9	-	-	-	1.3	1.2	0.8	1.31	1.16	1.16	1	1	1	1.00	0.50	9217	-	9217	2.5	3687
11	3.78	680	43	-	Very Dense	General Shear	0	17	64.26	116.9	110.4	215.5	-	-	-	1.3	1.2	0.8	1.44	1.22	1.22	1	1	1	1.00	0.50	13854	-	13854	2.5	5542
12	4.78	679	45	-	Very Dense	General Shear	0	17	81.26	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.58	1.29	1.29	1	1	1	1.00	0.50	21583	-	21583	2.5	8633
13	5.78	678	45	-	Very Dense	General Shear	0	20	115.6	144.2	142.5	292.0	-	-	-	1.3	1.2	0.8	1.70	1.35	1.35	1	1	1	0.96	0.50	31673	-	31673	2.5	12669
14	6.78	677	39	-	Dense	General Shear	0	20	135.6	68.1	56.6	94.3	-	-	-	1.3	1.2	0.8	1.71	1.35	1.35	1	1	1	0.89	0.50	12935	-	12935	2.5	5174
15	7.78	676	38	-	Dense	General Shear	0	20	155.6	61.5	49.6	80.3	-	-	-	1.3	1.2	0.8	1.79	1.40	1.40	1	1	1	0.84	0.50	12414	-	12414	2.5	4966
16	8.78	675	40	-	Dense	General Shear	0	20	175.6	75.1	64.0	109.1	-	-	-	1.3	1.2	0.8	1.94	1.47	1.47	1	1	1	0.80	0.50	18202	-	18202	2.5	7281

Settlement Criteria Limiting to 50 mm as per Table 1 - IS:1904-1986

Depth from existing G.L (m)	Depth of foundation Df (m)	Elevation (m)	N' value	Settlement (m per $1kg/cm^2$) *using graph, FIG 9 - IS 8009 (Part I) - 1976*	W'	Settlement after water table correction	Settlement (mm) *for reinforced concrete structures*	Reduced safe bearing capacity q_{ns} (KN/m^2)	Gross safe bearing capacity q_s (KN/m^2)
10	2.78	681	58	0.0045	0.5	0.0089	50	549	596
11	3.78	680	64	0.0038	0.5	0.0077	50	637	702
12	4.78	679	215	0.0010	0.5	0.0020	50	2453	2534
13	5.78	678	79	0.0022	0.5	0.0045	50	1093	1208
14	6.78	677	41	0.0069	0.5	0.0138	50	356	491
15	7.78	676	36	0.0094	0.5	0.0189	50	260	415
16	8.78	675	46	0.0061	0.5	0.0122	50	401	577

** Water table correction R_{w2} is taken as 0.5 for safety as there is a possibility that the water table may rise to the surface of foundation*

*** Factor of safety required 3 (for sound rock) to 6 (Weak or Fissured rock)*

CALCULATION OF BEARING CAPACITY FOR VARYING DIMENSION OF FOUNDATION - BHYAKURE KHOLA

Project:	**Sindhuli Road Project**	**Drilling mothod:**	**Rotary**	**Hole Inclination:**	**Vertical**	**Surface Elevation:**	**691 m**	**Bore Hole No.:**	**B1 (Nepalthok side)**
Location:	**Bhyakure Khola**	**Drilling Machine:**	**XUL 100**	**Bit Name:**	**Impregnated Diamond Bit**	**Ground Level:**	**0 m**	**Easting (m):**	**85.750832**
		Casing Depth:	**HX 6m, NX 12m, BX 16m**	**Bit Condition:**	**Good**	**Depth of Exploration:**	**16 m**	**Northing (m):**	**27.469370**

Shape of footing considered: Square footing

Surface Elevation: 691 m

Ground Level: 0 m

Surface Elevation of starting of bore hole 681 m

Surface Elevation of end of bore hole 675 m

Depth of Exploration: 16 m

Level of Excavation: 683.8 m

Depth of Water Table from existing ground level: 12.5 m

Surface elevation of water table: 678.5 m

Depth of Water Table from excavated level: 5.3 m

Trial 2 **Width of footing B: 5 m**

IS Code Bearing Capacity by Shear Failure Criteria

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	Friction angle φ (°)	Mobilized Friction angle φ' (°)	Soil Condition	Method of Analysis for q_{nu}	Cohesion c (KN/m^2)	Unit weight of soil γ (KN/m^3)	Surcharge at the base of the footing q (KN/m^2)	N_c	N_q	N_γ	N_c'	N_q'	N_γ'	S_c	S_q	S_γ	d_c	d_q	d_γ	i_c	i_q	i_γ	Water table correction R_{w1}	Water table correction R_{w2}*	Net ultimate bearing capacity from general shear failure criteria q_{nu} (KN/m^2)	Net ultimate bearing capacity from local shear failure criteria q_{nu} (KN/m^2)	q_{nu} (KN/m^2)	FOS**	Net safe bearing capacity q_{ns} (KN/m^2)
10	2.78	681	42	-	Very Dense	General Shear	0	17	47.26	104.9	97.1	184.9	-	-	-	1.3	1.2	0.8	1.25	1.13	1.13	1	1	1	1.00	0.50	9674	-	9674	2.5	3870
11	3.78	680	43	-	Very Dense	General Shear	0	17	64.26	116.9	110.4	215.5	-	-	-	1.3	1.2	0.8	1.35	1.17	1.17	1	1	1	1.00	0.50	14218	-	14218	2.5	5687
12	4.78	679	45	-	Very Dense	General Shear	0	17	81.26	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.46	1.23	1.23	1	1	1	1.00	0.50	21754	-	21754	2.5	8702
13	5.78	678	45	-	Very Dense	General Shear	0	20	115.6	144.2	142.5	292.0	-	-	-	1.3	1.2	0.8	1.56	1.28	1.28	1	1	1	0.96	0.50	31524	-	31524	2.5	12610
14	6.78	677	39	-	Dense	General Shear	0	20	135.6	68.1	56.6	94.3	-	-	-	1.3	1.2	0.8	1.57	1.28	1.28	1	1	1	0.89	0.50	12743	-	12743	2.5	5097
15	7.78	676	38	-	Dense	General Shear	0	20	155.6	61.5	49.6	80.3	-	-	-	1.3	1.2	0.8	1.63	1.32	1.32	1	1	1	0.84	0.50	12133	-	12133	2.5	4853
16	8.78	675	40	-	Dense	General Shear	0	20	175.6	75.1	64.0	109.1	-	-	-	1.3	1.2	0.8	1.75	1.38	1.38	1	1	1	0.80	0.50	17638	-	17638	2.5	7055

Settlement Criteria Limiting to 50 mm as per Table 1 - IS:1904-1986

Depth from existing G.L (m)	Depth of foundation Df (m)	Elevation (m)	N' value	Settlement (m per $1kg/cm^2$) *using graph, FIG 9 - IS 8009 (Part I) - 1976*	W'	Settlement after water table correction	Settlement (mm) *for reinforced concrete structures*	Reduced safe bearing capacity q_{ns} (KN/m^2)	Gross safe bearing capacity q_s (KN/m^2)
10	2.78	681	58	0.0046	0.5	0.0092	50	530	578
11	3.78	680	64	0.0040	0.5	0.0080	50	615	679
12	4.78	679	215	0.0010	0.5	0.0020	50	2453	2534
13	5.78	678	79	0.0024	0.5	0.0047	50	1041	1156
14	6.78	677	41	0.0072	0.5	0.0144	50	342	477
15	7.78	676	36	0.0098	0.5	0.0196	50	250	405
16	8.78	675	46	0.0063	0.5	0.0126	50	389	564

** Water table correction R_{w2} is taken as 0.5 for safety as there is a possibility that the water table may rise to the surface of foundation*

*** Factor of safety required 3 (for sound rock) to 6 (Weak or Fissured rock)*

CALCULATION OF BEARING CAPACITY FOR VARYING DIMENSION OF FOUNDATION - BHYAKURE KHOLA

Project:	**Sindhuli Road Project**	**Drilling mothod:**	**Rotary**	**Hole Inclination:**	**Vertical**	**Surface Elevation:**	**691 m**	**Bore Hole No.:**	**B1 (Nepalthok side)**
Location:	**Bhyakure Khola**	**Drilling Machine:**	**XUL 100**	**Bit Name:**	**Impregnated Diamond Bit**	**Ground Level:**	**0 m**	**Easting (m):**	**85.750832**
		Casing Depth:	**HX 6m, NX 12m, BX 16m**	**Bit Condition:**	**Good**	**Depth of Exploration:**	**16 m**	**Northing (m):**	**27.469370**

Shape of footing considered: Square footing

Surface Elevation: 691 m

Ground Level: 0 m

Surface Elevation of starting of bore hole 681 m

Surface Elevation of end of bore hole 675 m

Depth of Exploration: 16 m

Level of Excavation: 683.8 m

Depth of Water Table from existing ground level: 12.5 m

Surface elevation of water table: 678.5 m

Depth of Water Table from excavated level: 5.3 m

Trial 3 **Width of footing B: 6 m**

IS Code Bearing Capacity by Shear Failure Criteria

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	Friction angle φ (°)	Mobilized Friction angle φ' (°)	Soil Condition	Method of Analysis for q_{nu}	Cohesion c (KN/m^2)	Unit weight of soil γ (KN/m^3)	Surcharge at the base of the footing q (KN/m^2)	N_c	N_q	N_γ	N_c'	N_q'	N_γ'	S_c	S_q	S_γ	d_c	d_q	d_γ	i_c	i_q	i_γ	Water table correction R_{w1}	Water table correction R_{w2}*	Net ultimate bearing capacity from general shear failure criteria q_{nu} (KN/m^2)	Net ultimate bearing capacity from local shear failure criteria q_{nu} (KN/m^2)	q_{nu} (KN/m^2)	FOS**	Net safe bearing capacity q_{ns} (KN/m^2)
10	2.78	681	42	-	Very Dense	General Shear	0	17	47.26	104.9	97.1	184.9	-	-	-	1.3	1.2	0.8	1.21	1.10	1.10	1	1	1	1.00	0.50	10189	-	10189	2.5	4075
11	3.78	680	43	-	Very Dense	General Shear	0	17	64.26	116.9	110.4	215.5	-	-	-	1.3	1.2	0.8	1.29	1.15	1.15	1	1	1	1.00	0.50	14705	-	14705	2.5	5882
12	4.78	679	45	-	Very Dense	General Shear	0	17	81.26	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.38	1.19	1.19	1	1	1	1.00	0.50	22176	-	22176	2.5	8870
13	5.78	678	45	-	Very Dense	General Shear	0	20	115.6	144.2	142.5	292.0	-	-	-	1.3	1.2	0.8	1.47	1.23	1.23	1	1	1	0.96	0.50	31814	-	31814	2.5	12726
14	6.78	677	39	-	Dense	General Shear	0	20	135.6	68.1	56.6	94.3	-	-	-	1.3	1.2	0.8	1.47	1.24	1.24	1	1	1	0.89	0.50	12741	-	12741	2.5	5096
15	7.78	676	38	-	Dense	General Shear	0	20	155.6	61.5	49.6	80.3	-	-	-	1.3	1.2	0.8	1.53	1.26	1.26	1	1	1	0.84	0.50	12053	-	12053	2.5	4821
16	8.78	675	40	-	Dense	General Shear	0	20	175.6	75.1	64.0	109.1	-	-	-	1.3	1.2	0.8	1.63	1.31	1.31	1	1	1	0.80	0.50	17407	-	17407	2.5	6963

Settlement Criteria Limiting to 50 mm as per Table 1 - IS:1904-1986

Depth from existing G.L (m)	Depth of foundation Df (m)	Elevation (m)	N' value	Settlement (m per $1kg/cm^2$) *using graph, FIG 9 - IS 8009 (Part I) - 1976*	W'	Settlement after water table correction	Settlement (mm) *for reinforced concrete structures*	Reduced safe bearing capacity q_{ns} (KN/m^2)	Gross safe bearing capacity q_s (KN/m^2)
10	2.78	681	58	0.0047	0.5	0.0093	50	525	572
11	3.78	680	64	0.0040	0.5	0.0081	50	606	670
12	4.78	679	215	0.0010	0.5	0.0020	50	2453	2534
13	5.78	678	79	0.0024	0.5	0.0049	50	1003	1119
14	6.78	677	41	0.0073	0.5	0.0145	50	338	473
15	7.78	676	36	0.0099	0.5	0.0199	50	247	402
16	8.78	675	46	0.0063	0.5	0.0126	50	388	564

** Water table correction R_{w2} is taken as 0.5 for safety as there is a possibility that the water table may rise to the surface of foundation*

*** Factor of safety required 3 (for sound rock) to 6 (Weak or Fissured rock)*

CALCULATION OF BEARING CAPACITY FOR VARYING DIMENSION OF FOUNDATION - BHYAKURE KHOLA

Project:	**Sindhuli Road Project**	**Drilling mothod:**	**Rotary**	**Hole Inclination:**	**Vertical**	**Surface Elevation:**	**691 m**	**Bore Hole No.:**	**B1 (Nepalthok side)**
Location:	**Bhyakure Khola**	**Drilling Machine:**	**XUL 100**	**Bit Name:**	**Impregnated Diamond Bit**	**Ground Level:**	**0 m**	**Easting (m):**	**85.750832**
		Casing Depth:	**HX 6m, NX 12m, BX 16m**	**Bit Condition:**	**Good**	**Depth of Exploration:**	**16 m**	**Northing (m):**	**27.469370**

Shape of footing considered: Square footing

Surface Elevation:	691 m		
Ground Level:	0 m	Level of Excavation:	683.8 m
Surface Elevation of starting of bore hole	681 m	Depth of Water Table from existing ground level:	12.5 m
Surface Elevation of end of bore hole	675 m	Surface elevation of water table:	678.5 m
Depth of Exploration:	16 m	Depth of Water Table from excavated level:	5.3 m

Trial 4 **Width of footing B: 7 m**

IS Code Bearing Capacity by Shear Failure Criteria

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	Friction angle φ (°)	Mobilized Friction angle φ' (°)	Soil Condition	Method of Analysis for q_{nu}	Cohesion c (KN/m^2)	Unit weight of soil γ (KN/m^3)	Surcharge at the base of the footing q (KN/m^2)	N_c	N_q	N_γ	N_c'	N_q'	N_γ'	S_c	S_q	S_γ	d_c	d_q	d_γ	i_c	i_q	i_γ	Water table correction R_{w1}	Water table correction R_{w2}*	Net ultimate bearing capacity from general shear failure criteria q_{nu} (KN/m^2)	Net ultimate bearing capacity from local shear failure criteria q_{nu} (KN/m^2)	q_{nu} (KN/m^2)	FOS**	Net safe bearing capacity q_{ns} (KN/m^2)
10	2.78	681	42	-	Very Dense	General Shear	0	17	47.26	104.9	97.1	184.9	-	-	-	1.3	1.2	0.8	1.18	1.09	1.09	1	1	1	1.00	0.50	10736	-	10736	2.5	4294
11	3.78	680	43	-	Very Dense	General Shear	0	17	64.26	116.9	110.4	215.5	-	-	-	1.3	1.2	0.8	1.25	1.12	1.12	1	1	1	1.00	0.50	15262	-	15262	2.5	6105
12	4.78	679	45	-	Very Dense	General Shear	0	17	81.26	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.33	1.16	1.16	1	1	1	1.00	0.50	22741	-	22741	2.5	9097
13	5.78	678	45	-	Very Dense	General Shear	0	20	115.6	144.2	142.5	292.0	-	-	-	1.3	1.2	0.8	1.40	1.20	1.20	1	1	1	0.96	0.50	32355	-	32355	2.5	12942
14	6.78	677	39	-	Dense	General Shear	0	20	135.6	68.1	56.6	94.3	-	-	-	1.3	1.2	0.8	1.40	1.20	1.20	1	1	1	0.89	0.50	12848	-	12848	2.5	5139
15	7.78	676	38	-	Dense	General Shear	0	20	155.6	61.5	49.6	80.3	-	-	-	1.3	1.2	0.8	1.45	1.23	1.23	1	1	1	0.84	0.50	12088	-	12088	2.5	4835
16	8.78	675	40	-	Dense	General Shear	0	20	175.6	75.1	64.0	109.1	-	-	-	1.3	1.2	0.8	1.54	1.27	1.27	1	1	1	0.80	0.50	17367	-	17367	2.5	6947

Settlement Criteria Limiting to 50 mm as per Table 1 - IS:1904-1986

Depth from existing G.L (m)	Depth of foundation Df (m)	Elevation (m)	N' value	Settlement (m per $1kg/cm^2$) *using graph, FIG 9 - IS 8009 (Part I) - 1976*	W'	Settlement after water table correction	Settlement (mm) *for reinforced concrete structures*	Reduced safe bearing capacity q_{ns} (KN/m^2)	Gross safe bearing capacity q_s (KN/m^2)
10	2.78	681	58	0.0046	0.5	0.0092	50	532	579
11	3.78	680	64	0.0040	0.5	0.0080	50	610	674
12	4.78	679	215	0.0010	0.5	0.0020	50	2453	2534
13	5.78	678	79	0.0025	0.5	0.0050	50	978	1093
14	6.78	677	41	0.0072	0.5	0.0143	50	343	479
15	7.78	676	36	0.0098	0.5	0.0196	50	251	406
16	8.78	675	46	0.0061	0.5	0.0123	50	400	576

** Water table correction R_{w2} is taken as 0.5 for safety as there is a possibility that the water table may rise to the surface of foundation*

*** Factor of safety required 3 (for sound rock) to 6 (Weak or Fissured rock)*

CALCULATION OF BEARING CAPACITY FOR VARYING DIMENSION OF FOUNDATION - BHYAKURE KHOLA

Project:	**Sindhuli Road Project**	**Drilling mothod:**	**Rotary**	**Hole Inclination:**	**Vertical**	**Surface Elevation:**	**691 m**	**Bore Hole No.:**	**B1 (Nepalthok side)**
Location:	**Bhyakure Khola**	**Drilling Machine:**	**XUL 100**	**Bit Name:**	**Impregnated Diamond Bit**	**Ground Level:**	**0 m**	**Easting (m):**	**85.750832**
		Casing Depth:	**HX 6m, NX 12m, BX 16m**	**Bit Condition:**	**Good**	**Depth of Exploration:**	**16 m**	**Northing (m):**	**27.469370**

Shape of footing considered: Square footing

Surface Elevation: 691 m

Ground Level: 0 m

Surface Elevation of starting of bore hole 681 m

Surface Elevation of end of bore hole 675 m

Depth of Exploration: 16 m

Level of Excavation: 683.8 m

Depth of Water Table from existing ground level: 12.5 m

Surface elevation of water table: 678.5 m

Depth of Water Table from excavated level: 5.3 m

Trial 5 **Width of footing B: 8 m**

IS Code Bearing Capacity by Shear Failure Criteria

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	Friction angle φ (°)	Mobilized Friction angle φ' (°)	Soil Condition	Method of Analysis for q_{nu}	Cohesion c (KN/m^2)	Unit weight of soil γ (KN/m^3)	Surcharge at the base of the footing q (KN/m^2)	N_c	N_q	N_γ	N_c'	N_q'	N_γ'	S_c	S_q	S_γ	d_c	d_q	d_γ	i_c	i_q	i_γ	Water table correction R_{w1}	Water table correction R_{w2}*	Net ultimate bearing capacity from general shear failure criteria q_{nu} (KN/m^2)	Net ultimate bearing capacity from local shear failure criteria q_{nu} (KN/m^2)	q_{nu} (KN/m^2)	FOS**	Net safe bearing capacity q_{ns} (KN/m^2)
10	2.78	681	42	-	Very Dense	General Shear	0	17	47.26	104.9	97.1	184.9	-	-	-	1.3	1.2	0.8	1.16	1.08	1.08	1	1	1	1.00	0.50	11303	-	11303	2.5	4521
11	3.78	680	43	-	Very Dense	General Shear	0	17	64.26	116.9	110.4	215.5	-	-	-	1.3	1.2	0.8	1.22	1.11	1.11	1	1	1	1.00	0.50	15863	-	15863	2.5	6345
12	4.78	679	45	-	Very Dense	General Shear	0	17	81.26	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.29	1.14	1.14	1	1	1	1.00	0.50	23396	-	23396	2.5	9358
13	5.78	678	45	-	Very Dense	General Shear	0	20	115.6	144.2	142.5	292.0	-	-	-	1.3	1.2	0.8	1.35	1.18	1.18	1	1	1	0.96	0.50	33053	-	33053	2.5	13221
14	6.78	677	39	-	Dense	General Shear	0	20	135.6	68.1	56.6	94.3	-	-	-	1.3	1.2	0.8	1.35	1.18	1.18	1	1	1	0.89	0.50	13022	-	13022	2.5	5209
15	7.78	676	38	-	Dense	General Shear	0	20	155.6	61.5	49.6	80.3	-	-	-	1.3	1.2	0.8	1.40	1.20	1.20	1	1	1	0.84	0.50	12194	-	12194	2.5	4878
16	8.78	675	40	-	Dense	General Shear	0	20	175.6	75.1	64.0	109.1	-	-	-	1.3	1.2	0.8	1.47	1.24	1.24	1	1	1	0.80	0.50	17446	-	17446	2.5	6978

Settlement Criteria Limiting to 50 mm as per Table 1 - IS:1904-1986

Depth from existing G.L (m)	Depth of foundation Df (m)	Elevation (m)	N' value	Settlement (m per $1kg/cm^2$) *using graph, FIG 9 - IS 8009 (Part I) - 1976*	W'	Settlement after water table correction	Settlement (mm) *for reinforced concrete structures*	Reduced safe bearing capacity q_{ns} (KN/m^2)	Gross safe bearing capacity q_s (KN/m^2)
10	2.78	681	58	0.0044	0.5	0.0089	50	552	599
11	3.78	680	64	0.0039	0.5	0.0078	50	627	691
12	4.78	679	215	0.0010	0.5	0.0020	50	2453	2534
13	5.78	678	79	0.0025	0.5	0.0051	50	962	1078
14	6.78	677	41	0.0068	0.5	0.0137	50	359	494
15	7.78	676	36	0.0094	0.5	0.0188	50	262	417
16	8.78	675	46	0.0058	0.5	0.0115	50	426	602

** Water table correction R_{w2} is taken as 0.5 for safety as there is a possibility that the water table may rise to the surface of foundation*

*** Factor of safety required 3 (for sound rock) to 6 (Weak or Fissured rock)*

CALCULATION OF BEARING CAPACITY FOR VARYING DIMENSION OF FOUNDATION - BHYAKURE KHOLA

Project:	**Sindhuli Road Project**	**Drilling mothod:**	**Rotary**	**Hole Inclination:**	**Vertical**	**Surface Elevation:**	**691 m**	**Bore Hole No.:**	**B1 (Nepalthok side)**
Location:	**Bhyakure Khola**	**Drilling Machine:**	**XUL 100**	**Bit Name:**	**Impregnated Diamond Bit**	**Ground Level:**	**0 m**	**Easting (m):**	**85.750832**
		Casing Depth:	**HX 6m, NX 12m, BX 16m**	**Bit Condition:**	**Good**	**Depth of Exploration:**	**16 m**	**Northing (m):**	**27.469370**

Shape of footing considered: Square footing

Surface Elevation: 691 m

Ground Level: 0 m

Surface Elevation of starting of bore hole 681 m

Surface Elevation of end of bore hole 675 m

Depth of Exploration: 16 m

Level of Excavation: 683.8 m

Depth of Water Table from existing ground level: 12.5 m

Surface elevation of water table: 678.5 m

Depth of Water Table from excavated level: 5.3 m

Trial 6 **Width of footing B: 10 m**

IS Code Bearing Capacity by Shear Failure Criteria

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	Friction angle φ (°)	Mobilized Friction angle φ' (°)	Soil Condition	Method of Analysis for q_{nu}	Cohesion c (KN/m^2)	Unit weight of soil γ (KN/m^3)	Surcharge at the base of the footing q (KN/m^2)	N_c	N_q	N_γ	N_c'	N_q'	N_γ'	S_c	S_q	S_γ	d_c	d_q	d_γ	i_c	i_q	i_γ	Water table correction R_{w1}	Water table correction R_{w2}*	Net ultimate bearing capacity from general shear failure criteria q_{nu} (KN/m^2)	Net ultimate bearing capacity from local shear failure criteria q_{nu} (KN/m^2)	q_{nu} (KN/m^2)	FOS**	Net safe bearing capacity q_{ns} (KN/m^2)
10	2.78	681	42	-	Very Dense	General Shear	0	17	47.26	104.9	97.1	184.9	-	-	-	1.3	1.2	0.8	1.13	1.06	1.06	1	1	1	1.00	0.50	12475	-	12475	2.5	4990
11	3.78	680	43	-	Very Dense	General Shear	0	17	64.26	116.9	110.4	215.5	-	-	-	1.3	1.2	0.8	1.17	1.09	1.09	1	1	1	1.00	0.50	17144	-	17144	2.5	6858
12	4.78	679	45	-	Very Dense	General Shear	0	17	81.26	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.23	1.12	1.12	1	1	1	1.00	0.50	24868	-	24868	2.5	9947
13	5.78	678	45	-	Very Dense	General Shear	0	20	115.6	144.2	142.5	292.0	-	-	-	1.3	1.2	0.8	1.28	1.14	1.14	1	1	1	0.96	0.50	34731	-	34731	2.5	13892
14	6.78	677	39	-	Dense	General Shear	0	20	135.6	68.1	56.6	94.3	-	-	-	1.3	1.2	0.8	1.28	1.14	1.14	1	1	1	0.89	0.50	13492	-	13492	2.5	5397
15	7.78	676	38	-	Dense	General Shear	0	20	155.6	61.5	49.6	80.3	-	-	-	1.3	1.2	0.8	1.32	1.16	1.16	1	1	1	0.84	0.50	12536	-	12536	2.5	5014
16	8.78	675	40	-	Dense	General Shear	0	20	175.6	75.1	64.0	109.1	-	-	-	1.3	1.2	0.8	1.38	1.19	1.19	1	1	1	0.80	0.50	17818	-	17818	2.5	7127

Settlement Criteria Limiting to 50 mm as per Table 1 - IS:1904-1986

Depth from existing G.L (m)	Depth of foundation Df (m)	Elevation (m)	N' value	Settlement (m per $1kg/cm^2$) *using graph, FIG 9 - IS 8009 (Part I) - 1976*	W'	Settlement after water table correction	Settlement (mm) *for reinforced concrete structures*	Reduced safe bearing capacity q_{ns} (KN/m^2)	Gross safe bearing capacity q_s (KN/m^2)
10	2.78	681	58	0.0044	0.5	0.0089	50	552	599
11	3.78	680	64	0.0039	0.5	0.0078	50	627	691
12	4.78	679	215	0.0010	0.5	0.0020	50	2453	2534
13	5.78	678	79	0.0025	0.5	0.0051	50	962	1078
14	6.78	677	41	0.0068	0.5	0.0137	50	359	494
15	7.78	676	36	0.0094	0.5	0.0188	50	262	417
16	8.78	675	46	0.0058	0.5	0.0115	50	426	602

** Water table correction R_{w2} is taken as 0.5 for safety as there is a possibility that the water table may rise to the surface of foundation*

*** Factor of safety required 3 (for sound rock) to 6 (Weak or Fissured rock)*

CALCULATION OF BEARING CAPACITY FOR VARYING DIMENSION OF FOUNDATION - BHYAKURE KHOLA

Project:	**Sindhuli Road Project**	**Drilling mothod:**	**Rotary**	**Hole Inclination:**	**Vertical**	**Surface Elevation:**	**691 m**	**Bore Hole No.:**	**B1 (Nepalthok side)**
Location:	**Bhyakure Khola**	**Drilling Machine:**	**XUL 100**	**Bit Name:**	**Impregnated Diamond Bit**	**Ground Level:**	**0 m**	**Easting (m):**	**85.750832**
		Casing Depth:	**HX 6m, NX 12m, BX 16m**	**Bit Condition:**	**Good**	**Depth of Exploration:**	**16 m**	**Northing (m):**	**27.469370**

Shape of footing considered: Rectangular footing

Surface Elevation: 691 m

Ground Level: 0 m

Surface Elevation of starting of bore hole 681 m

Surface Elevation of end of bore hole 675 m

Depth of Exploration: 16 m

Level of Excavation: 683.8 m

Depth of Water Table from existing ground level: 12.5 m

Surface elevation of water table: 678.5 m

Depth of Water Table from excavated level: 5.3 m

Trial 7 **Width of footing B: 10 m** **Length of footing L: 11 m**

IS Code Bearing Capacity by Shear Failure Criteria

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	Friction angle φ (°)	Mobilized Friction angle φ' (°)	Soil Condition	Method of Analysis for q_{nu}	Cohesion c (KN/m^2)	Unit weight of soil γ (KN/m^3)	Surcharge at the base of the footing q (KN/m^2)	N_c	N_q	N_γ	N_c'	N_q'	N_γ'	S_c	S_q	S_γ	d_c	d_q	d_γ	i_c	i_q	i_γ	Water table correction R_{w1}	Water table correction R_{w2}*	Net ultimate bearing capacity from general shear failure criteria q_{nu} (KN/m^2)	Net ultimate bearing capacity from local shear failure criteria q_{nu} (KN/m^2)	q_{nu} (KN/m^2)	FOS**	Net safe bearing capacity q_{ns} (KN/m^2)
10	2.78	681	42	-	Very Dense	General Shear	0	17	47.26	104.9	97.1	184.9	-	-	-	1.18	1.18	0.64	1.13	1.06	1.06	1	1	1	1.00	0.50	11020	-	11020	2.5	4408
11	3.78	680	43	-	Very Dense	General Shear	0	17	64.26	116.9	110.4	215.5	-	-	-	1.18	1.18	0.64	1.17	1.09	1.09	1	1	1	1.00	0.50	15375	-	15375	2.5	6150
12	4.78	679	45	-	Very Dense	General Shear	0	17	81.26	138.9	134.9	271.8	-	-	-	1.18	1.18	0.64	1.23	1.12	1.12	1	1	1	1.00	0.50	22539	-	22539	2.5	9016
13	5.78	678	45	-	Very Dense	General Shear	0	20	115.6	144.2	142.5	292.0	-	-	-	1.18	1.18	0.64	1.28	1.14	1.14	1	1	1	0.96	0.50	31682	-	31682	2.5	12673
14	6.78	677	39	-	Dense	General Shear	0	20	135.6	68.1	56.6	94.3	-	-	-	1.18	1.18	0.64	1.28	1.14	1.14	1	1	1	0.89	0.50	12472	-	12472	2.5	4989
15	7.78	676	38	-	Dense	General Shear	0	20	155.6	61.5	49.6	80.3	-	-	-	1.18	1.18	0.64	1.32	1.16	1.16	1	1	1	0.84	0.50	11641	-	11641	2.5	4656
16	8.78	675	40	-	Dense	General Shear	0	20	175.6	75.1	64.0	109.1	-	-	-	1.18	1.18	0.64	1.38	1.19	1.19	1	1	1	0.80	0.50	16567	-	16567	2.5	6627

Settlement Criteria Limiting to 50 mm as per Table 1 - IS:1904-1986

Depth from existing G.L (m)	Depth of foundation Df (m)	Elevation (m)	N' value	Settlement (m per $1kg/cm^2$) *using graph, FIG 9 - IS 8009 (Part I) - 1976*	W'	Settlement after water table correction	Settlement (mm) *for reinforced concrete structures*	Reduced safe bearing capacity q_{ns} (KN/m^2)	Gross safe bearing capacity q_s (KN/m^2)	Existing Soil/Rock Description
10	2.78	681	58	0.0044	0.5	0.0089	50	552	599	Gravel with cobbles and boulders, greater boulder percentage
11	3.78	680	64	0.0039	0.5	0.0078	50	627	691	Gravel with cobbles and boulders, greater cobble percentage
12	4.78	679	215	0.0010	0.5	0.0020	50	2453	2534	Gravel with cobbles and boulders, greater cobble percentage
13	5.78	678	79	0.0025	0.5	0.0051	50	962	1078	Gravel with cobbles and boulders, greater cobble percentage
14	6.78	677	41	0.0068	0.5	0.0137	50	359	494	Gravel with cobbles and boulders, greater boulder percentage
15	7.78	676	36	0.0094	0.5	0.0188	50	262	417	Gravel with cobbles and boulders, greater boulder percentage
16	8.78	675	46	0.0058	0.5	0.0115	50	426	602	Gravel with cobbles and boulders, greater boulder percentage

** Water table correction R_{w2} is taken as 0.5 for safety as there is a possibility that the water table may rise to the surface of foundation*

*** Factor of safety required 3 (for sound rock) to 6 (Weak or Fissured rock)*

CALCULATION OF BEARING CAPACITY FOR VARYING DIMENSION OF FOUNDATION - BHYAKURE KHOLA

Project: Sindhuli Road Project	**Drilling mothod:**	**Rotary**	**Hole Inclination:**	**Vertical**	**Surface Elevation:**	**691 m**	**Bore Hole No.:**	**B2 (Dhulikhel side)**
Location: Bhyakure Khola	**Drilling Machine:**	**XUL 100**	**Bit Name:**	**Impregnated Diamond Bit**	**Ground Level:**	**0 m**	**Easting (m):**	**85.750558**
	Casing Depth:	**HX 6m, NX 12m, BX 16m**	**Bit Condition:**	**Good**	**Depth of Exploration:**	**16 m**	**Northing (m):**	**27.469628**

Shape of footing considered: Square footing
Surface Elevation: 691 m
Ground Level: 0 m
Surface Elevation of starting of bore hole 681 m
Surface Elevation of end of bore hole 675 m
Depth of Exploration: 16 m
Level of Excavation: 683.78 m
Depth of Water Table from existing ground level: 12.5 m
Surface elevation of water table: 678.5 m
Depth of Water Table from excavated level: 5.3 m

Trial 1 **Width of footing B: 4 m**

IS Code Bearing Capacity by Shear Failure Criteria

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	Friction angle φ (°)	Mobilized Friction angle φ' (°)	Soil Condition	Method of Analysis for q_{nu}	Cohesion c (KN/m^2)	Unit weight of soil γ (KN/m^3)	Surcharge at the base of the footing q (KN/m^2)	N_c	N_q	N_γ	N_c'	N_q'	N_γ'	S_c	S_q	S_γ	d_c	d_q	d_γ	i_c	i_q	i_γ	Water table correction R_{w1}	Water table correction R_{w2}*	Net ultimate bearing capacity from general shear failure criteria q_{nu} (KN/m^2)	Net ultimate bearing capacity from local shear failure criteria q_{nu} (KN/m^2)	q_{nu} (KN/m^2)	FOS**	Net safe bearing capacity q_{ns} (KN/m^2)
10	2.78	681	45	-	Very Dense	General Shear	0	17	47.26	133.0	128.3	256.7	-	-	-	1.3	1.2	0.8	1.33	1.17	1.17	1	1	1	1.00	0.50	12490	-	12490	2.5	4996
11	3.78	680	42	-	Very Dense	General Shear	0	17	64.26	99.8	91.4	172.0	-	-	-	1.3	1.2	0.8	1.42	1.21	1.21	1	1	1	1.00	0.50	11287	-	11287	2.5	4515
12	4.78	679	45	-	Very Dense	General Shear	0	17	81.26	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.58	1.29	1.29	1	1	1	1.00	0.50	21583	-	21583	2.5	8633
13	5.78	678	45	-	Very Dense	General Shear	0	20	115.6	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.70	1.35	1.35	1	1	1	0.96	0.50	29832	-	29832	2.5	11933
14	6.78	677	45	-	Very Dense	General Shear	0	20	135.6	134.3	129.8	260.0	-	-	-	1.3	1.2	0.8	1.81	1.41	1.41	1	1	1	0.89	0.50	32038	-	32038	2.5	12815
15	7.78	676	39	-	Dense	General Shear	0	20	155.6	69.2	57.7	96.5	-	-	-	1.3	1.2	0.8	1.81	1.41	1.41	1	1	1	0.84	0.50	14679	-	14679	2.5	5872
16	8.78	675	39	-	Dense	General Shear	0	20	175.6	70.2	58.7	98.6	-	-	-	1.3	1.2	0.8	1.92	1.46	1.46	1	1	1	0.80	0.50	16544	-	16544	2.5	6618

Settlement Criteria Limiting to 50 mm as per Table 1 - IS:1904-1986

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	N' value	Settlement (m per $1kg/cm^2$) *using graph, FIG 9 - IS 8009 (Part 1) - 1976*	W'	Settlement after water table correction	Settlement (mm) *for reinforced concrete structures*	Reduced safe bearing capacity q_{ns} (KN/m^2)	Gross safe bearing capacity q_s (KN/m^2)
10	2.78	681	73	0.0029	0.5	0.0057	50	855	903
11	3.78	680	56	0.0047	0.5	0.0094	50	520	585
12	4.78	679	91	0.0010	0.5	0.0020	50	2453	2534
13	5.78	678	208	0.0010	0.5	0.0020	50	2453	2568
14	6.78	677	74	0.0028	0.5	0.0056	50	882	1018
15	7.78	676	42	0.0068	0.5	0.0136	50	361	517
16	8.78	675	42	0.0067	0.5	0.0134	50	367	543

** Water table correction R_{w2} is taken as 0.5 for safety as there is a possibility that the water table may rise to the surface of foundation*

*** Factor of safety required 3 (for sound rock) to 6 (Weak or Fissured rock)*

CALCULATION OF BEARING CAPACITY FOR VARYING DIMENSION OF FOUNDATION - BHYAKURE KHOLA

Project: Sindhuli Road Project	**Drilling mothod:**	**Rotary**	**Hole Inclination:**	**Vertical**	**Surface Elevation:**	**691 m**	**Bore Hole No.:**	**B2 (Dhulikhel side)**
Location: Bhyakure Khola	**Drilling Machine:**	**XUL 100**	**Bit Name:**	**Impregnated Diamond Bit**	**Ground Level:**	**0 m**	**Easting (m):**	**85.750558**
	Casing Depth:	**HX 6m, NX 12m, BX 16m**	**Bit Condition:**	**Good**	**Depth of Exploration:**	**16 m**	**Northing (m):**	**27.469628**

Shape of footing considered: Square footing
Surface Elevation: 691 m
Ground Level: 0 m
Surface Elevation of starting of bore hole 681 m
Surface Elevation of end of bore hole 675 m
Depth of Exploration: 16 m
Level of Excavation: 683.78 m
Depth of Water Table from existing ground level: 12.5 m
Surface elevation of water table: 678.5 m
Depth of Water Table from excavated level: 5.3 m
Trial 2 **Width of footing B: 5 m**

IS Code Bearing Capacity by Shear Failure Criteria

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	Friction angle φ (°)	Mobilized Friction angle φ' (°)	Soil Condition	Method of Analysis for q_{nu}	Cohesion c (KN/m^2)	Unit weight of soil γ (KN/m^3)	Surcharge at the base of the footing q (KN/m^2)	N_c	N_q	N_γ	N_c'	N_q'	N_γ'	S_c	S_q	S_γ	d_c	d_q	d_γ	i_c	i_q	i_γ	Water table correction R_{w1}	Water table correction R_{w2}*	Net ultimate bearing capacity from general shear failure criteria q_{nu} (KN/m^2)	Net ultimate bearing capacity from local shear failure criteria q_{nu} (KN/m^2)	q_{nu} (KN/m^2)	FOS**	Net safe bearing capacity q_{ns} (KN/m^2)
10	2.78	681	45	-	Very Dense	General Shear	0	17	47.26	133.0	128.3	256.7	-	-	-	1.3	1.2	0.8	1.27	1.13	1.13	1	1	1	1.00	0.50	13123	-	13123	2.5	5249
11	3.78	680	42	-	Very Dense	General Shear	0	17	64.26	99.8	91.4	172.0	-	-	-	1.3	1.2	0.8	1.34	1.17	1.17	1	1	1	1.00	0.50	11577	-	11577	2.5	4631
12	4.78	679	45	-	Very Dense	General Shear	0	17	81.26	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.46	1.23	1.23	1	1	1	1.00	0.50	21754	-	21754	2.5	8702
13	5.78	678	45	-	Very Dense	General Shear	0	20	115.6	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.56	1.28	1.28	1	1	1	0.96	0.50	29680	-	29680	2.5	11872
14	6.78	677	45	-	Very Dense	General Shear	0	20	135.6	134.3	129.8	260.0	-	-	-	1.3	1.2	0.8	1.65	1.32	1.32	1	1	1	0.89	0.50	31567	-	31567	2.5	12627
15	7.78	676	39	-	Dense	General Shear	0	20	155.6	69.2	57.7	96.5	-	-	-	1.3	1.2	0.8	1.65	1.33	1.33	1	1	1	0.84	0.50	14341	-	14341	2.5	5736
16	8.78	675	39	-	Dense	General Shear	0	20	175.6	70.2	58.7	98.6	-	-	-	1.3	1.2	0.8	1.74	1.37	1.37	1	1	1	0.80	0.50	16040	-	16040	2.5	6416

Settlement Criteria Limiting to 50 mm as per Table 1 - IS:1904-1986

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	N' value	Settlement (m per $1kg/cm^2$) *using graph, FIG 9 - IS 8009 (Part I) - 1976*	W'	Settlement after water table correction	Settlement (mm) *for reinforced concrete structures*	Reduced safe bearing capacity q_{ns} (KN/m^2)	Gross safe bearing capacity q_s (KN/m^2)
10	2.78	681	73	0.0030	0.5	0.0060	50	820	867
11	3.78	680	56	0.0049	0.5	0.0097	50	503	568
12	4.78	679	91	0.0011	0.5	0.0021	50	2306	2388
13	5.78	678	208	0.0010	0.5	0.0020	50	2453	2568
14	6.78	677	74	0.0029	0.5	0.0058	50	845	981
15	7.78	676	42	0.0071	0.5	0.0141	50	348	503
16	8.78	675	42	0.0069	0.5	0.0139	50	354	529

** Water table correction R_{w2} is taken as 0.5 for safety as there is a possibility that the water table may rise to the surface of foundation*
*** Factor of safety required 3 (for sound rock) to 6 (Weak or Fissured rock)*

CALCULATION OF BEARING CAPACITY FOR VARYING DIMENSION OF FOUNDATION - BHYAKURE KHOLA

Project: Sindhuli Road Project	**Drilling mothod:**	**Rotary**	**Hole Inclination:**	**Vertical**	**Surface Elevation:**	**691 m**	**Bore Hole No.:**	**B2 (Dhulikhel side)**
Location: Bhyakure Khola	**Drilling Machine:**	**XUL 100**	**Bit Name:**	**Impregnated Diamond Bit**	**Ground Level:**	**0 m**	**Easting (m):**	**85.750558**
	Casing Depth:	**HX 6m, NX 12m, BX 16m**	**Bit Condition:**	**Good**	**Depth of Exploration:**	**16 m**	**Northing (m):**	**27.469628**

Shape of footing considered: Square footing
Surface Elevation: 691 m
Ground Level: 0 m
Surface Elevation of starting of bore hole 681 m
Surface Elevation of end of bore hole 675 m
Depth of Exploration: 16 m
Level of Excavation: 683.78 m
Depth of Water Table from existing ground level: 12.5 m
Surface elevation of water table: 678.5 m
Depth of Water Table from excavated level: 5.3 m
Trial 3 **Width of footing B: 6 m**

IS Code Bearing Capacity by Shear Failure Criteria

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	Friction angle φ (°)	Mobilized Friction angle φ' (°)	Soil Condition	Method of Analysis for q_{nu}	Cohesion c (KN/m^2)	Unit weight of soil γ (KN/m^3)	Surcharge at the base of the footing q (KN/m^2)	N_c	N_q	N_γ	N_c'	N_q'	N_γ'	S_c	S_q	S_γ	d_c	d_q	d_γ	i_c	i_q	i_γ	Water table correction R_{w1}	Water table correction R_{w2}*	Net ultimate bearing capacity from general shear failure criteria q_{nu} (KN/m^2)	Net ultimate bearing capacity from local shear failure criteria q_{nu} (KN/m^2)	q_{nu} (KN/m^2)	FOS**	Net safe bearing capacity q_{ns} (KN/m^2)
10	2.78	681	45	-	Very Dense	General Shear	0	17	47.26	133.0	128.3	256.7	-	-	-	1.3	1.2	0.8	1.22	1.11	1.11	1	1	1	1.00	0.50	13836	-	13836	2.5	5534
11	3.78	680	42	-	Very Dense	General Shear	0	17	64.26	99.8	91.4	172.0	-	-	-	1.3	1.2	0.8	1.28	1.14	1.14	1	1	1	1.00	0.50	11964	-	11964	2.5	4786
12	4.78	679	45	-	Very Dense	General Shear	0	17	81.26	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.38	1.19	1.19	1	1	1	1.00	0.50	22176	-	22176	2.5	8870
13	5.78	678	45	-	Very Dense	General Shear	0	20	115.6	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.47	1.23	1.23	1	1	1	0.96	0.50	29940	-	29940	2.5	11976
14	6.78	677	45	-	Very Dense	General Shear	0	20	135.6	134.3	129.8	260.0	-	-	-	1.3	1.2	0.8	1.54	1.27	1.27	1	1	1	0.89	0.50	31599	-	31599	2.5	12640
15	7.78	676	39	-	Dense	General Shear	0	20	155.6	69.2	57.7	96.5	-	-	-	1.3	1.2	0.8	1.54	1.27	1.27	1	1	1	0.84	0.50	14245	-	14245	2.5	5698
16	8.78	675	39	-	Dense	General Shear	0	20	175.6	70.2	58.7	98.6	-	-	-	1.3	1.2	0.8	1.62	1.31	1.31	1	1	1	0.80	0.50	15835	-	15835	2.5	6334

Settlement Criteria Limiting to 50 mm as per Table 1 - IS:1904-1986

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	N' value	Settlement (m per $1kg/cm^2$) *using graph, FIG 9 - IS 8009 (Part I) - 1976*	W'	Settlement after water table correction	Settlement (mm) *for reinforced concrete structures*	Reduced safe bearing capacity q_{ns} (KN/m^2)	Gross safe bearing capacity q_s (KN/m^2)
10	2.78	681	73	0.0031	0.5	0.0061	50	800	847
11	3.78	680	56	0.0049	0.5	0.0098	50	499	563
12	4.78	679	91	0.0012	0.5	0.0023	50	2087	2169
13	5.78	678	208	0.0010	0.5	0.0020	50	2453	2568
14	6.78	677	74	0.0030	0.5	0.0060	50	823	959
15	7.78	676	42	0.0071	0.5	0.0143	50	344	500
16	8.78	675	42	0.0070	0.5	0.0140	50	351	526

** Water table correction R_{w2} is taken as 0.5 for safety as there is a possibility that the water table may rise to the surface of foundation*
*** Factor of safety required 3 (for sound rock) to 6 (Weak or Fissured rock)*

CALCULATION OF BEARING CAPACITY FOR VARYING DIMENSION OF FOUNDATION - BHYAKURE KHOLA

Project: Sindhuli Road Project	**Drilling mothod:**	**Rotary**	**Hole Inclination:**	**Vertical**	**Surface Elevation:**	**691 m**	**Bore Hole No.:**	**B2 (Dhulikhel side)**
Location: Bhyakure Khola	**Drilling Machine:**	**XUL 100**	**Bit Name:**	**Impregnated Diamond Bit**	**Ground Level:**	**0 m**	**Easting (m):**	**85.750558**
	Casing Depth:	**HX 6m, NX 12m, BX 16m**	**Bit Condition:**	**Good**	**Depth of Exploration:**	**16 m**	**Northing (m):**	**27.469628**

Shape of footing considered: Square footing
Surface Elevation: 691 m
Ground Level: 0 m
Surface Elevation of starting of bore hole 681 m
Surface Elevation of end of bore hole 675 m
Depth of Exploration: 16 m
Level of Excavation: 683.78 m
Depth of Water Table from existing ground level: 12.5 m
Surface elevation of water table: 678.5 m
Depth of Water Table from excavated level: 5.3 m
Trial 4 **Width of footing B: 7 m**

IS Code Bearing Capacity by Shear Failure Criteria

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	Friction angle φ (°)	Mobilized Friction angle φ' (°)	Soil Condition	Method of Analysis for q_{nu}	Cohesion c (KN/m^2)	Unit weight of soil γ (KN/m^3)	Surcharge at the base of the footing q (KN/m^2)	N_c	N_q	N_γ	N_c'	N_q'	N_γ'	S_c	S_q	S_γ	d_c	d_q	d_γ	i_c	i_q	i_γ	Water table correction R_{w1}	Water table correction R_{w2}*	Net ultimate bearing capacity from general shear failure criteria q_{nu} (KN/m^2)	Net ultimate bearing capacity from local shear failure criteria q_{nu} (KN/m^2)	q_{nu} (KN/m^2)	FOS**	Net safe bearing capacity q_{ns} (KN/m^2)
10	2.78	681	45	-	Very Dense	General Shear	0	17	47.26	133.0	128.3	256.7	-	-	-	1.3	1.2	0.8	1.19	1.09	1.09	1	1	1	1.00	0.50	14595	-	14595	2.5	5838
11	3.78	680	42	-	Very Dense	General Shear	0	17	64.26	99.8	91.4	172.0	-	-	-	1.3	1.2	0.8	1.24	1.12	1.12	1	1	1	1.00	0.50	12408	-	12408	2.5	4963
12	4.78	679	45	-	Very Dense	General Shear	0	17	81.26	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.33	1.16	1.16	1	1	1	1.00	0.50	22741	-	22741	2.5	9097
13	5.78	678	45	-	Very Dense	General Shear	0	20	115.6	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.40	1.20	1.20	1	1	1	0.96	0.50	30437	-	30437	2.5	12175
14	6.78	677	45	-	Very Dense	General Shear	0	20	135.6	134.3	129.8	260.0	-	-	-	1.3	1.2	0.8	1.46	1.23	1.23	1	1	1	0.89	0.50	31919	-	31919	2.5	12768
15	7.78	676	39	-	Dense	General Shear	0	20	155.6	69.2	57.7	96.5	-	-	-	1.3	1.2	0.8	1.47	1.23	1.23	1	1	1	0.84	0.50	14286	-	14286	2.5	5714
16	8.78	675	39	-	Dense	General Shear	0	20	175.6	70.2	58.7	98.6	-	-	-	1.3	1.2	0.8	1.53	1.26	1.26	1	1	1	0.80	0.50	15801	-	15801	2.5	6320

Settlement Criteria Limiting to 50 mm as per Table 1 - IS:1904-1986

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	N' value	Settlement (m per $1kg/cm^2$) *using graph, FIG 9 - IS 8009 (Part I) - 1976*	W'	Settlement after water table correction	Settlement (mm) *for reinforced concrete structures*	Reduced safe bearing capacity q_{ns} (KN/m^2)	Gross safe bearing capacity q_s (KN/m^2)
10	2.78	681	73	0.0031	0.5	0.0062	50	792	839
11	3.78	680	56	0.0048	0.5	0.0097	50	507	571
12	4.78	679	91	0.0013	0.5	0.0026	50	1873	1954
13	5.78	678	208	0.0010	0.5	0.0020	50	2453	2568
14	6.78	677	74	0.0030	0.5	0.0060	50	814	949
15	7.78	676	42	0.0070	0.5	0.0140	50	351	506
16	8.78	675	42	0.0068	0.5	0.0137	50	358	534

** Water table correction R_{w2} is taken as 0.5 for safety as there is a possibility that the water table may rise to the surface of foundation*
*** Factor of safety required 3 (for sound rock) to 6 (Weak or Fissured rock)*

CALCULATION OF BEARING CAPACITY FOR VARYING DIMENSION OF FOUNDATION - BHYAKURE KHOLA

Project: Sindhuli Road Project	**Drilling mothod:**	**Rotary**	**Hole Inclination:**	**Vertical**	**Surface Elevation:**	**691 m**	**Bore Hole No.:**	**B2 (Dhulikhel side)**
Location: Bhyakure Khola	**Drilling Machine:**	**XUL 100**	**Bit Name:**	**Impregnated Diamond Bit**	**Ground Level:**	**0 m**	**Easting (m):**	**85.750558**
	Casing Depth:	**HX 6m, NX 12m, BX 16m**	**Bit Condition:**	**Good**	**Depth of Exploration:**	**16 m**	**Northing (m):**	**27.469628**

Shape of footing considered: Square footing
Surface Elevation: 691 m
Ground Level: 0 m
Surface Elevation of starting of bore hole 681 m
Surface Elevation of end of bore hole 675 m
Depth of Exploration: 16 m
Level of Excavation: 683.78 m
Depth of Water Table from existing ground level: 12.5 m
Surface elevation of water table: 678.5 m
Depth of Water Table from excavated level: 5.3 m
Trial 5 **Width of footing B: 8 m**

IS Code Bearing Capacity by Shear Failure Criteria

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	Friction angle φ (°)	Mobilized Friction angle φ' (°)	Soil Condition	Method of Analysis for q_{nu}	Cohesion c (KN/m^2)	Unit weight of soil γ (KN/m^3)	Surcharge at the base of the footing q (KN/m^2)	N_c	N_q	N_γ	N_c'	N_q'	N_γ'	S_c	S_q	S_γ	d_c	d_q	d_γ	i_c	i_q	i_γ	Water table correction R_{w1}	Water table correction R_{w2}*	Net ultimate bearing capacity from general shear failure criteria q_{nu} (KN/m^2)	Net ultimate bearing capacity from local shear failure criteria q_{nu} (KN/m^2)	q_{nu} (KN/m^2)	FOS**	Net safe bearing capacity q_{ns} (KN/m^2)
10	2.78	681	45	-	Very Dense	General Shear	0	17	47.26	133.0	128.3	256.7	-	-	-	1.3	1.2	0.8	1.17	1.08	1.08	1	1	1	1.00	0.50	15382	-	15382	2.5	6153
11	3.78	680	42	-	Very Dense	General Shear	0	17	64.26	99.8	91.4	172.0	-	-	-	1.3	1.2	0.8	1.21	1.11	1.11	1	1	1	1.00	0.50	12888	-	12888	2.5	5155
12	4.78	679	45	-	Very Dense	General Shear	0	17	81.26	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.29	1.14	1.14	1	1	1	1.00	0.50	23396	-	23396	2.5	9358
13	5.78	678	45	-	Very Dense	General Shear	0	20	115.6	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.35	1.17	1.17	1	1	1	0.96	0.50	31081	-	31081	2.5	12432
14	6.78	677	45	-	Very Dense	General Shear	0	20	135.6	134.3	129.8	260.0	-	-	-	1.3	1.2	0.8	1.41	1.20	1.20	1	1	1	0.89	0.50	32419	-	32419	2.5	12968
15	7.78	676	39	-	Dense	General Shear	0	20	155.6	69.2	57.7	96.5	-	-	-	1.3	1.2	0.8	1.41	1.20	1.20	1	1	1	0.84	0.50	14413	-	14413	2.5	5765
16	8.78	675	39	-	Dense	General Shear	0	20	175.6	70.2	58.7	98.6	-	-	-	1.3	1.2	0.8	1.46	1.23	1.23	1	1	1	0.80	0.50	15874	-	15874	2.5	6350

Settlement Criteria Limiting to 50 mm as per Table 1 - IS:1904-1986

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	N' value	Settlement (m per $1kg/cm^2$) *using graph, FIG 9 - IS 8009 (Part I) - 1976*	W'	Settlement after water table correction	Settlement (mm) *for reinforced concrete structures*	Reduced safe bearing capacity q_{ns} (KN/m^2)	Gross safe bearing capacity q_s (KN/m^2)
10	2.78	681	73	0.0031	0.5	0.0062	50	796	844
11	3.78	680	56	0.0047	0.5	0.0093	50	527	591
12	4.78	679	91	0.0015	0.5	0.0029	50	1671	1752
13	5.78	678	208	0.0010	0.5	0.0020	50	2453	2568
14	6.78	677	74	0.0030	0.5	0.0060	50	816	952
15	7.78	676	42	0.0067	0.5	0.0133	50	368	524
16	8.78	675	42	0.0065	0.5	0.0130	50	377	553

** Water table correction R_{w2} is taken as 0.5 for safety as there is a possibility that the water table may rise to the surface of foundation*
*** Factor of safety required 3 (for sound rock) to 6 (Weak or Fissured rock)*

CALCULATION OF BEARING CAPACITY FOR VARYING DIMENSION OF FOUNDATION - BHYAKURE KHOLA

Project: Sindhuli Road Project	**Drilling mothod:**	**Rotary**	**Hole Inclination:**	**Vertical**	**Surface Elevation:**	**691 m**	**Bore Hole No.:**	**B2 (Dhulikhel side)**
Location: Bhyakure Khola	**Drilling Machine:**	**XUL 100**	**Bit Name:**	**Impregnated Diamond Bit**	**Ground Level:**	**0 m**	**Easting (m):**	**85.750558**
	Casing Depth:	**HX 6m, NX 12m, BX 16m**	**Bit Condition:**	**Good**	**Depth of Exploration:**	**16 m**	**Northing (m):**	**27.469628**

Shape of footing considered: Square footing
Surface Elevation: 691 m
Ground Level: 0 m
Surface Elevation of starting of bore hole 681 m
Surface Elevation of end of bore hole 675 m
Depth of Exploration: 16 m
Level of Excavation: 683.78 m
Depth of Water Table from existing ground level: 12.5 m
Surface elevation of water table: 678.5 m
Depth of Water Table from excavated level: 5.3 m
Trial 6 **Width of footing B: 10 m**

IS Code Bearing Capacity by Shear Failure Criteria

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	Friction angle φ (°)	Mobilized Friction angle φ' (°)	Soil Condition	Method of Analysis for q_{nu}	Cohesion c (KN/m^2)	Unit weight of soil γ (KN/m^3)	Surcharge at the base of the footing q (KN/m^2)	N_c	N_q	N_γ	N_c'	N_q'	N_γ'	S_c	S_q	S_γ	d_c	d_q	d_γ	i_c	i_q	i_γ	Water table correction R_{w1}	Water table correction R_{w2}*	Net ultimate bearing capacity from general shear failure criteria q_{nu} (KN/m^2)	Net ultimate bearing capacity from local shear failure criteria q_{nu} (KN/m^2)	q_{nu} (KN/m^2)	FOS**	Net safe bearing capacity q_{ns} (KN/m^2)
10	2.78	681	45	-	Very Dense	General Shear	0	17	47.26	133.0	128.3	256.7	-	-	-	1.3	1.2	0.8	1.13	1.07	1.07	1	1	1	1.00	0.50	17008	-	17008	2.5	6803
11	3.78	680	42	-	Very Dense	General Shear	0	17	64.26	99.8	91.4	172.0	-	-	-	1.3	1.2	0.8	1.17	1.08	1.08	1	1	1	1.00	0.50	13910	-	13910	2.5	5564
12	4.78	679	45	-	Very Dense	General Shear	0	17	81.26	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.23	1.12	1.12	1	1	1	1.00	0.50	24868	-	24868	2.5	9947
13	5.78	678	45	-	Very Dense	General Shear	0	20	115.6	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.28	1.14	1.14	1	1	1	0.96	0.50	32635	-	32635	2.5	13054
14	6.78	677	45	-	Very Dense	General Shear	0	20	135.6	134.3	129.8	260.0	-	-	-	1.3	1.2	0.8	1.32	1.16	1.16	1	1	1	0.89	0.50	33744	-	33744	2.5	13497
15	7.78	676	39	-	Dense	General Shear	0	20	155.6	69.2	57.7	96.5	-	-	-	1.3	1.2	0.8	1.33	1.16	1.16	1	1	1	0.84	0.50	14823	-	14823	2.5	5929
16	8.78	675	39	-	Dense	General Shear	0	20	175.6	70.2	58.7	98.6	-	-	-	1.3	1.2	0.8	1.37	1.18	1.18	1	1	1	0.80	0.50	16213	-	16213	2.5	6485

Settlement Criteria Limiting to 50 mm as per Table 1 - IS:1904-1986

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	N' value	Settlement (m per $1kg/cm^2$) *using graph, FIG 9 - IS 8009 (Part I) - 1976*	W'	Settlement after water table correction	Settlement (mm) *for reinforced concrete structures*	Reduced safe bearing capacity q_{ns} (KN/m^2)	Gross safe bearing capacity q_s (KN/m^2)
10	2.78	681	73	0.0031	0.5	0.0062	50	796	844
11	3.78	680	56	0.0047	0.5	0.0093	50	527	591
12	4.78	679	91	0.0015	0.5	0.0029	50	1671	1752
13	5.78	678	208	0.0010	0.5	0.0020	50	2453	2568
14	6.78	677	74	0.0030	0.5	0.0060	50	816	952
15	7.78	676	42	0.0067	0.5	0.0133	50	368	524
16	8.78	675	42	0.0065	0.5	0.0130	50	377	553

** Water table correction R_{w2} is taken as 0.5 for safety as there is a possibility that the water table may rise to the surface of foundation*
*** Factor of safety required 3 (for sound rock) to 6 (Weak or Fissured rock)*

CALCULATION OF BEARING CAPACITY FOR VARYING DIMENSION OF FOUNDATION - BHYAKURE KHOLA

Project: Sindhuli Road Project	**Drilling mothod:**	**Rotary**	**Hole Inclination:**	**Vertical**	**Surface Elevation:**	**691 m**	**Bore Hole No.:**	**B2 (Dhulikhel side)**
Location: Bhyakure Khola	**Drilling Machine:**	**XUL 100**	**Bit Name:**	**Impregnated Diamond Bit**	**Ground Level:**	**0 m**	**Easting (m):**	**85.750558**
	Casing Depth:	**HX 6m, NX 12m, BX 16m**	**Bit Condition:**	**Good**	**Depth of Exploration:**	**16 m**	**Northing (m):**	**27.469628**

Shape of footing considered: Rectangular footing

Surface Elevation: 691 m

Ground Level: 0 m

Surface Elevation of starting of bore hole 681 m

Surface Elevation of end of bore hole 675 m

Depth of Exploration: 16 m

Level of Excavation: 683.78 m

Depth of Water Table from existing ground level: 12.5 m

Surface elevation of water table: 678.5 m

Depth of Water Table from excavated level: 5.3 m

Trial 7 **Width of footing B: 10 m** **Length of footing L: 11 m**

IS Code Bearing Capacity by Shear Failure Criteria

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	Friction angle φ (°)	Mobilized Friction angle φ' (°)	Soil Condition	Method of Analysis for q_{nu}	Cohesion c (KN/m^2)	Unit weight of soil γ (KN/m^3)	Surcharge at the base of the footing q (KN/m^2)	N_c	N_q	N_γ	N_c'	N_q'	N_γ'	S_c	S_q	S_γ	d_c	d_q	d_γ	i_c	i_q	i_γ	Water table correction R_{w1}	Water table correction R_{w2}*	Net ultimate bearing capacity from general shear failure criteria q_{nu} (KN/m^2)	Net ultimate bearing capacity from local shear failure criteria q_{nu} (KN/m^2)	q_{nu} (KN/m^2)	FOS**	Net safe bearing capacity q_{ns} (KN/m^2)
10	2.78	681	45	-	Very Dense	General Shear	0	17	47.26	133.0	128.3	256.7	-	-	-	1.18	1.18	0.64	1.13	1.07	1.07	1	1	1	1.00	0.50	14988	-	14988	2.5	5995
11	3.78	680	42	-	Very Dense	General Shear	0	17	64.26	99.8	91.4	172.0	-	-	-	1.18	1.18	0.64	1.17	1.08	1.08	1	1	1	1.00	0.50	12497	-	12497	2.5	4999
12	4.78	679	45	-	Very Dense	General Shear	0	17	81.26	138.9	134.9	271.8	-	-	-	1.18	1.18	0.64	1.23	1.12	1.12	1	1	1	1.00	0.50	22539	-	22539	2.5	9016
13	5.78	678	45	-	Very Dense	General Shear	0	20	115.6	138.9	134.9	271.8	-	-	-	1.18	1.18	0.64	1.28	1.14	1.14	1	1	1	0.96	0.50	29795	-	29795	2.5	11918
14	6.78	677	45	-	Very Dense	General Shear	0	20	135.6	134.3	129.8	260.0	-	-	-	1.18	1.18	0.64	1.32	1.16	1.16	1	1	1	0.89	0.50	30943	-	30943	2.5	12377
15	7.78	676	39	-	Dense	General Shear	0	20	155.6	69.2	57.7	96.5	-	-	-	1.18	1.18	0.64	1.33	1.16	1.16	1	1	1	0.84	0.50	13749	-	13749	2.5	5499
16	8.78	675	39	-	Dense	General Shear	0	20	175.6	70.2	58.7	98.6	-	-	-	1.18	1.18	0.64	1.37	1.18	1.18	1	1	1	0.80	0.50	15083	-	15083	2.5	6033

Settlement Criteria Limiting to 50 mm as per Table 1 - IS:1904-1986

Depth from existing G.L (m)	Depth of foundation Df (m)	Elevation (m)	N' value	Settlement (m per $1kg/cm^2$) *using graph, FIG 9 - IS 8009 (Part I) - 1976*	W'	Settlement after water table correction	Settlement (mm) *for reinforced concrete structures*	Reduced safe bearing capacity q_{ns} (KN/m^2)	Gross safe bearing capacity q_s (KN/m^2)	Existing Soil/Rock Description
10	2.78	681	73	0.0031	0.5	0.0062	50	796	844	Boulder with greater percentage of gravel
11	3.78	680	56	0.0047	0.5	0.0093	50	527	591	Boulder with greater percentage of gravel
12	4.78	679	91	0.0015	0.5	0.0029	50	1671	1752	Boulder with greater percentage of gravel
13	5.78	678	208	0.0010	0.5	0.0020	50	2453	2568	Boulder with greater percentage of gravel
14	6.78	677	74	0.0030	0.5	0.0060	50	816	952	Boulder with greater percentage of gravel
15	7.78	676	42	0.0067	0.5	0.0133	50	368	524	Boulder with greater percentage of gravel
16	8.78	675	42	0.0065	0.5	0.0130	50	377	553	Boulder with greater percentage of gravel

** Water table correction R_{w2} is taken as 0.5 for safety as there is a possibility that the water table may rise to the surface of foundation*

*** Factor of safety required 3 (for sound rock) to 6 (Weak or Fissured rock)*

ANNEX – D2

CALCULATION OF BEARING CAPACITY – GHYAMPE KHOLA

CALCULATION OF BEARING CAPACITY FOR VARYING DIMENSION OF FOUNDATION - GHYAMPE KHOLA

Project:	**Sindhuli Road Project**	**Drilling mothod:**	**Rotary**	**Hole Inclination:**	**Vertical**	**Surface Elevation:**	**590 m**	**Bore Hole No.:**	**G1 (Nepalthok side)**
Location:	**Ghyampe Khola**	**Drilling Machine:**	**XUL 100**	**Bit Name:**	**Impregnated Diamond Bit**	**Ground Level:**	**0 m**	**Easting (m):**	**85.8040**
		Casing Depth:	**HX 6m, NX 12m, BX 16m**	**Bit Condition:**	**Good**	**Depth of Exploration:**	**16 m**	**Northing (m):**	**27.4369**

Shape of footing considered: Square footing
Surface Elevation: 590 m
Ground Level: 0 m
Surface Elevation of starting of bore hole 580 m
Surface Elevation of end of bore hole 574 m
Depth of Exploration: 16 m
Level of Excavation: 582.62 m
Depth of Water Table from existing ground level: 6.9 m
Surface elevation of water table: 583.1 m
Depth of Water Table from excavated level: -0.5 m

Trial 1 **Width of footing B: 4 m**

IS Code Bearing Capacity by Shear Failure Criteria

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	Friction angle φ (°)	Mobilized Friction angle φ' (°)	Soil Condition	Method of Analysis for q_{nu}	Cohesion c (KN/m^2)	Unit weight of soil γ (KN/m^3)	Surcharge at the base of the footing q (KN/m^2)	N_c	N_q	N_γ	N_c'	N_q'	N_γ'	S_c	S_q	S_γ	d_c	d_q	d_γ	i_c	i_q	i_γ	Water table correction R_{w1}	Water table correction R_{w2}*	Net ultimate bearing capacity from general shear failure criteria q_{nu} (KN/m^2)	Net ultimate bearing capacity from local shear failure criteria q_{nu} (KN/m^2)	q_{nu} (KN/m^2)	FOS**	Net safe bearing capacity q_{ns} (KN/m^2)
10	2.62	580	45	-	Very Dense	General Shear	0	17	44.54	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.32	1.16	1.16	1	1	1	0.41	0.50	7665	-	7665	2.5	3066
11	3.62	579	45	-	Very Dense	General Shear	0	17	61.54	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.44	1.22	1.22	1	1	1	0.43	0.50	9728	-	9728	2.5	3891
12	4.62	578	45	-	Very Dense	General Shear	0	17	78.54	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.56	1.28	1.28	1	1	1	0.45	0.50	11956	-	11956	2.5	4783
13	5.62	577	45	-	Very Dense	General Shear	0	20	112.4	137.5	133.3	268.2	-	-	-	1.3	1.2	0.8	1.68	1.34	1.34	1	1	1	0.46	0.50	16663	-	16663	2.5	6665
14	6.62	576	44	-	Very Dense	General Shear	0	20	132.4	123.5	117.8	232.5	-	-	-	1.3	1.2	0.8	1.78	1.39	1.39	1	1	1	0.46	0.50	17103	-	17103	2.5	6841
15	7.62	575	41	-	Very Dense	General Shear	0	20	152.4	92.1	82.9	152.3	-	-	-	1.3	1.2	0.8	1.84	1.42	1.42	1	1	1	0.47	0.50	13434	-	13434	2.5	5374
16	8.62	574	44	-	Very Dense	General Shear	0	20	172.4	130.7	125.8	250.9	-	-	-	1.3	1.2	0.8	2.02	1.51	1.51	1	1	1	0.47	0.50	24503	-	24503	2.5	9801

Settlement Criteria Limiting to 50 mm as per Table 1 - IS:1904-1986

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	N' value	Settlement (m per $1kg/cm^2$) *using graph, FIG 9 - IS 8009 (Part I) - 1976*	W'	Settlement after water table correction	Settlement (mm) *for reinforced concrete structures*	Reduced safe bearing capacity q_{ns} (KN/m^2)	Gross safe bearing capacity q_s (KN/m^2)
10	2.62	580	167	0.0010	0.5	0.0020	50	2453	2497
11	3.62	579	246	0.0010	0.5	0.0020	50	2453	2514
12	4.62	578	138	0.0010	0.5	0.0020	50	2453	2531
13	5.62	577	76	0.0026	0.5	0.0051	50	961	1073
14	6.62	576	68	0.0035	0.5	0.0069	50	707	839
15	7.62	575	53	0.0051	0.5	0.0103	50	478	631
16	8.62	574	72	0.0030	0.5	0.0060	50	812	985

** Water table correction R_{w2} is taken as 0.5 for safety as there is a possibility that the water table may rise to the surface of foundation*

*** Factor of safety required 3 (for sound rock) to 6 (Weak or Fissured rock)*

CALCULATION OF BEARING CAPACITY FOR VARYING DIMENSION OF FOUNDATION - GHYAMPE KHOLA

Project: Sindhuli Road Project	**Drilling mothod:**	**Rotary**	**Hole Inclination:**	**Vertical**	**Surface Elevation:**	**590 m**	**Bore Hole No.:**	**G1 (Nepalthok side)**
Location: Ghyampe Khola	**Drilling Machine:**	**XUL 100**	**Bit Name:**	**Impregnated Diamond Bit**	**Ground Level:**	**0 m**	**Easting (m):**	**85.8040**
	Casing Depth:	**HX 6m, NX 12m, BX 16m**	**Bit Condition:**	**Good**	**Depth of Exploration:**	**16 m**	**Northing (m):**	**27.4369**

Shape of footing considered: Square footing
Surface Elevation: 590 m
Ground Level: 0 m
Surface Elevation of starting of bore hole 580 m
Surface Elevation of end of bore hole 574 m
Depth of Exploration: 16 m
Level of Excavation: 582.62 m
Depth of Water Table from existing ground level: 6.9 m
Surface elevation of water table: 583.1 m
Depth of Water Table from excavated level: -0.5 m
Trial 2 **Width of footing B: 5 m**

IS Code Bearing Capacity by Shear Failure Criteria

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	Friction angle φ (°)	Mobilized Friction angle φ' (°)	Soil Condition	Method of Analysis for q_{nu}	Cohesion c (KN/m^2)	Unit weight of soil γ (KN/m^3)	Surcharge at the base of the footing q (KN/m^2)	N_c	N_q	N_γ	N_c'	N_q'	N_γ'	S_c	S_q	S_γ	d_c	d_q	d_γ	i_c	i_q	i_γ	Water table correction R_{w1}	Water table correction R_{w2}*	Net ultimate bearing capacity from general shear failure criteria q_{nu} (KN/m^2)	Net ultimate bearing capacity from local shear failure criteria q_{nu} (KN/m^2)	q_{nu} (KN/m^2)	FOS**	Net safe bearing capacity q_{ns} (KN/m^2)
10	2.62	580	45	-	Very Dense	General Shear	0	17	44.54	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.25	1.13	1.13	1	1	1	0.41	0.50	8496	-	8496	2.5	3399
11	3.62	579	45	-	Very Dense	General Shear	0	17	61.54	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.35	1.17	1.17	1	1	1	0.43	0.50	10465	-	10465	2.5	4186
12	4.62	578	45	-	Very Dense	General Shear	0	17	78.54	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.45	1.22	1.22	1	1	1	0.45	0.50	12565	-	12565	2.5	5026
13	5.62	577	45	-	Very Dense	General Shear	0	20	112.4	137.5	133.3	268.2	-	-	-	1.3	1.2	0.8	1.54	1.27	1.27	1	1	1	0.46	0.50	17184	-	17184	2.5	6874
14	6.62	576	44	-	Very Dense	General Shear	0	20	132.4	123.5	117.8	232.5	-	-	-	1.3	1.2	0.8	1.62	1.31	1.31	1	1	1	0.46	0.50	17365	-	17365	2.5	6946
15	7.62	575	41	-	Very Dense	General Shear	0	20	152.4	92.1	82.9	152.3	-	-	-	1.3	1.2	0.8	1.67	1.34	1.34	1	1	1	0.47	0.50	13452	-	13452	2.5	5381
16	8.62	574	44	-	Very Dense	General Shear	0	20	172.4	130.7	125.8	250.9	-	-	-	1.3	1.2	0.8	1.82	1.41	1.41	1	1	1	0.47	0.50	24258	-	24258	2.5	9703

Settlement Criteria Limiting to 50 mm as per Table 1 - IS:1904-1986

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	N' value	Settlement (m per $1kg/cm^2$) *using graph, FIG 9 - IS 8009 (Part 1) - 1976*	W'	Settlement after water table correction	Settlement (mm) *for reinforced concrete structures*	Reduced safe bearing capacity q_{ns} (KN/m^2)	Gross safe bearing capacity q_s (KN/m^2)
10	2.62	580	167	0.0010	0.5	0.0020	50	2453	2497
11	3.62	579	246	0.0010	0.5	0.0020	50	2453	2514
12	4.62	578	138	0.0010	0.5	0.0020	50	2453	2531
13	5.62	577	76	0.0027	0.5	0.0053	50	919	1031
14	6.62	576	68	0.0036	0.5	0.0072	50	681	813
15	7.62	575	53	0.0053	0.5	0.0106	50	463	616
16	8.62	574	72	0.0031	0.5	0.0063	50	780	952

** Water table correction R_{w2} is taken as 0.5 for safety as there is a possibility that the water table may rise to the surface of foundation*
*** Factor of safety required 3 (for sound rock) to 6 (Weak or Fissured rock)*

CALCULATION OF BEARING CAPACITY FOR VARYING DIMENSION OF FOUNDATION - GHYAMPE KHOLA

Project: Sindhuli Road Project	**Drilling mothod:**	**Rotary**	**Hole Inclination:**	**Vertical**	**Surface Elevation:**	**590 m**	**Bore Hole No.:**	**G1 (Nepalthok side)**
Location: Ghyampe Khola	**Drilling Machine:**	**XUL 100**	**Bit Name:**	**Impregnated Diamond Bit**	**Ground Level:**	**0 m**	**Easting (m):**	**85.8040**
	Casing Depth:	**HX 6m, NX 12m, BX 16m**	**Bit Condition:**	**Good**	**Depth of Exploration:**	**16 m**	**Northing (m):**	**27.4369**

Shape of footing considered: Square footing
Surface Elevation: 590 m
Ground Level: 0 m
Surface Elevation of starting of bore hole 580 m
Surface Elevation of end of bore hole 574 m
Depth of Exploration: 16 m
Level of Excavation: 582.62 m
Depth of Water Table from existing ground level: 6.9 m
Surface elevation of water table: 583.1 m
Depth of Water Table from excavated level: -0.5 m
Trial 3 **Width of footing B: 6 m**

IS Code Bearing Capacity by Shear Failure Criteria

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	Friction angle φ (°)	Mobilized Friction angle φ' (°)	Soil Condition	Method of Analysis for q_{nu}	Cohesion c (KN/m^2)	Unit weight of soil γ (KN/m^3)	Surcharge at the base of the footing q (KN/m^2)	N_c	N_q	N_γ	N_c'	N_q'	N_γ'	S_c	S_q	S_γ	d_c	d_q	d_γ	i_c	i_q	i_γ	Water table correction R_{w1}	Water table correction R_{w2}*	Net ultimate bearing capacity from general shear failure criteria q_{nu} (KN/m^2)	Net ultimate bearing capacity from local shear failure criteria q_{nu} (KN/m^2)	q_{nu} (KN/m^2)	FOS**	Net safe bearing capacity q_{ns} (KN/m^2)
10	2.62	580	45	-	Very Dense	General Shear	0	17	44.54	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.21	1.11	1.11	1	1	1	0.41	0.50	9359	-	9359	2.5	3744
11	3.62	579	45	-	Very Dense	General Shear	0	17	61.54	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.29	1.15	1.15	1	1	1	0.43	0.50	11264	-	11264	2.5	4506
12	4.62	578	45	-	Very Dense	General Shear	0	17	78.54	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.37	1.19	1.19	1	1	1	0.45	0.50	13279	-	13279	2.5	5312
13	5.62	577	45	-	Very Dense	General Shear	0	20	112.4	137.5	133.3	268.2	-	-	-	1.3	1.2	0.8	1.45	1.23	1.23	1	1	1	0.46	0.50	17888	-	17888	2.5	7155
14	6.62	576	44	-	Very Dense	General Shear	0	20	132.4	123.5	117.8	232.5	-	-	-	1.3	1.2	0.8	1.52	1.26	1.26	1	1	1	0.46	0.50	17850	-	17850	2.5	7140
15	7.62	575	41	-	Very Dense	General Shear	0	20	152.4	92.1	82.9	152.3	-	-	-	1.3	1.2	0.8	1.56	1.28	1.28	1	1	1	0.47	0.50	13668	-	13668	2.5	5467
16	8.62	574	44	-	Very Dense	General Shear	0	20	172.4	130.7	125.8	250.9	-	-	-	1.3	1.2	0.8	1.68	1.34	1.34	1	1	1	0.47	0.50	24429	-	24429	2.5	9772

Settlement Criteria Limiting to 50 mm as per Table 1 - IS:1904-1986

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	N' value	Settlement (m per $1kg/cm^2$) *using graph, FIG 9 - IS 8009 (Part I) - 1976*	W'	Settlement after water table correction	Settlement (mm) *for reinforced concrete structures*	Reduced safe bearing capacity q_{ns} (KN/m^2)	Gross safe bearing capacity q_s (KN/m^2)
10	2.62	580	167	0.0010	0.5	0.0020	50	2453	2497
11	3.62	579	246	0.0010	0.5	0.0020	50	2453	2514
12	4.62	578	138	0.0010	0.5	0.0020	50	2453	2531
13	5.62	577	76	0.0028	0.5	0.0055	50	891	1004
14	6.62	576	68	0.0037	0.5	0.0073	50	668	801
15	7.62	575	53	0.0053	0.5	0.0107	50	460	613
16	8.62	574	72	0.0032	0.5	0.0064	50	762	934

** Water table correction R_{w2} is taken as 0.5 for safety as there is a possibility that the water table may rise to the surface of foundation*
*** Factor of safety required 3 (for sound rock) to 6 (Weak or Fissured rock)*

CALCULATION OF BEARING CAPACITY FOR VARYING DIMENSION OF FOUNDATION - GHYAMPE KHOLA

Project:	**Sindhuli Road Project**	**Drilling mothod:**	**Rotary**	**Hole Inclination:**	**Vertical**	**Surface Elevation:**	**590 m**	**Bore Hole No.:**	**G1 (Nepalthok side)**
Location:	**Ghyampe Khola**	**Drilling Machine:**	**XUL 100**	**Bit Name:**	**Impregnated Diamond Bit**	**Ground Level:**	**0 m**	**Easting (m):**	**85.8040**
		Casing Depth:	**HX 6m, NX 12m, BX 16m**	**Bit Condition:**	**Good**	**Depth of Exploration:**	**16 m**	**Northing (m):**	**27.4369**

Shape of footing considered: Square footing
Surface Elevation: 590 m
Ground Level: 0 m
Surface Elevation of starting of bore hole 580 m
Surface Elevation of end of bore hole 574 m
Depth of Exploration: 16 m
Level of Excavation: 582.62 m
Depth of Water Table from existing ground level: 6.9 m
Surface elevation of water table: 583.1 m
Depth of Water Table from excavated level: -0.5 m
Trial 4 **Width of footing B: 7 m**

IS Code Bearing Capacity by Shear Failure Criteria

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	Friction angle φ (°)	Mobilized Friction angle φ' (°)	Soil Condition	Method of Analysis for q_{nu}	Cohesion c (KN/m^2)	Unit weight of soil γ (KN/m^3)	Surcharge at the base of the footing q (KN/m^2)	N_c	N_q	N_γ	N_c'	N_q'	N_γ'	S_c	S_q	S_γ	d_c	d_q	d_γ	i_c	i_q	i_γ	Water table correction R_{w1}	Water table correction R_{w2}*	Net ultimate bearing capacity from general shear failure criteria q_{nu} (KN/m^2)	Net ultimate bearing capacity from local shear failure criteria q_{nu} (KN/m^2)	q_{nu} (KN/m^2)	FOS**	Net safe bearing capacity q_{ns} (KN/m^2)
10	2.62	580	45	-	Very Dense	General Shear	0	17	44.54	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.18	1.09	1.09	1	1	1	0.41	0.50	10239	-	10239	2.5	4095
11	3.62	579	45	-	Very Dense	General Shear	0	17	61.54	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.25	1.12	1.12	1	1	1	0.43	0.50	12099	-	12099	2.5	4839
12	4.62	578	45	-	Very Dense	General Shear	0	17	78.54	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.32	1.16	1.16	1	1	1	0.45	0.50	14053	-	14053	2.5	5621
13	5.62	577	45	-	Very Dense	General Shear	0	20	112.4	137.5	133.3	268.2	-	-	-	1.3	1.2	0.8	1.39	1.19	1.19	1	1	1	0.46	0.50	18698	-	18698	2.5	7479
14	6.62	576	44	-	Very Dense	General Shear	0	20	132.4	123.5	117.8	232.5	-	-	-	1.3	1.2	0.8	1.44	1.22	1.22	1	1	1	0.46	0.50	18462	-	18462	2.5	7385
15	7.62	575	41	-	Very Dense	General Shear	0	20	152.4	92.1	82.9	152.3	-	-	-	1.3	1.2	0.8	1.48	1.24	1.24	1	1	1	0.47	0.50	13996	-	13996	2.5	5598
16	8.62	574	44	-	Very Dense	General Shear	0	20	172.4	130.7	125.8	250.9	-	-	-	1.3	1.2	0.8	1.59	1.29	1.29	1	1	1	0.47	0.50	24838	-	24838	2.5	9935

Settlement Criteria Limiting to 50 mm as per Table 1 - IS:1904-1986

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	N' value	Settlement (m per $1kg/cm^2$) *using graph, FIG 9 - IS 8009 (Part I) - 1976*	W'	Settlement after water table correction	Settlement (mm) *for reinforced concrete structures*	Reduced safe bearing capacity q_{ns} (KN/m^2)	Gross safe bearing capacity q_s (KN/m^2)
10	2.62	580	167	0.0010	0.5	0.0020	50	2453	2497
11	3.62	579	246	0.0010	0.5	0.0020	50	2453	2514
12	4.62	578	138	0.0010	0.5	0.0020	50	2453	2531
13	5.62	577	76	0.0028	0.5	0.0056	50	876	989
14	6.62	576	68	0.0037	0.5	0.0073	50	669	802
15	7.62	575	53	0.0052	0.5	0.0104	50	470	622
16	8.62	574	72	0.0032	0.5	0.0065	50	757	929

** Water table correction R_{w2} is taken as 0.5 for safety as there is a possibility that the water table may rise to the surface of foundation*
*** Factor of safety required 3 (for sound rock) to 6 (Weak or Fissured rock)*

CALCULATION OF BEARING CAPACITY FOR VARYING DIMENSION OF FOUNDATION - GHYAMPE KHOLA

Project:	**Sindhuli Road Project**	**Drilling mothod:**	**Rotary**	**Hole Inclination:**	**Vertical**	**Surface Elevation:**	**590 m**	**Bore Hole No.:**	**G1 (Nepalthok side)**
Location:	**Ghyampe Khola**	**Drilling Machine:**	**XUL 100**	**Bit Name:**	**Impregnated Diamond Bit**	**Ground Level:**	**0 m**	**Easting (m):**	**85.8040**
		Casing Depth:	**HX 6m, NX 12m, BX 16m**	**Bit Condition:**	**Good**	**Depth of Exploration:**	**16 m**	**Northing (m):**	**27.4369**

Shape of footing considered: Square footing
Surface Elevation: 590 m
Ground Level: 0 m
Surface Elevation of starting of bore hole 580 m
Surface Elevation of end of bore hole 574 m
Depth of Exploration: 16 m
Level of Excavation: 582.62 m
Depth of Water Table from existing ground level: 6.9 m
Surface elevation of water table: 583.1 m
Depth of Water Table from excavated level: -0.5 m
Trial 5 **Width of footing B: 8 m**

IS Code Bearing Capacity by Shear Failure Criteria

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	Friction angle φ (°)	Mobilized Friction angle φ' (°)	Soil Condition	Method of Analysis for q_{nu}	Cohesion c (KN/m^2)	Unit weight of soil γ (KN/m^3)	Surcharge at the base of the footing q (KN/m^2)	N_c	N_q	N_γ	N_c'	N_q'	N_γ'	S_c	S_q	S_γ	d_c	d_q	d_γ	i_c	i_q	i_γ	Water table correction R_{w1}	Water table correction R_{w2}*	Net ultimate bearing capacity from general shear failure criteria q_{nu} (KN/m^2)	Net ultimate bearing capacity from local shear failure criteria q_{nu} (KN/m^2)	q_{nu} (KN/m^2)	FOS**	Net safe bearing capacity q_{ns} (KN/m^2)
10	2.62	580	45	-	Very Dense	General Shear	0	17	44.54	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.16	1.08	1.08	1	1	1	0.41	0.50	11130	-	11130	2.5	4452
11	3.62	579	45	-	Very Dense	General Shear	0	17	61.54	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.22	1.11	1.11	1	1	1	0.43	0.50	12956	-	12956	2.5	5182
12	4.62	578	45	-	Very Dense	General Shear	0	17	78.54	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.28	1.14	1.14	1	1	1	0.45	0.50	14864	-	14864	2.5	5946
13	5.62	577	45	-	Very Dense	General Shear	0	20	112.4	137.5	133.3	268.2	-	-	-	1.3	1.2	0.8	1.34	1.17	1.17	1	1	1	0.46	0.50	19574	-	19574	2.5	7829
14	6.62	576	44	-	Very Dense	General Shear	0	20	132.4	123.5	117.8	232.5	-	-	-	1.3	1.2	0.8	1.39	1.19	1.19	1	1	1	0.46	0.50	19154	-	19154	2.5	7661
15	7.62	575	41	-	Very Dense	General Shear	0	20	152.4	92.1	82.9	152.3	-	-	-	1.3	1.2	0.8	1.42	1.21	1.21	1	1	1	0.47	0.50	14394	-	14394	2.5	5758
16	8.62	574	44	-	Very Dense	General Shear	0	20	172.4	130.7	125.8	250.9	-	-	-	1.3	1.2	0.8	1.51	1.26	1.26	1	1	1	0.47	0.50	25396	-	25396	2.5	10158

Settlement Criteria Limiting to 50 mm as per Table 1 - IS:1904-1986

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	N' value	Settlement (m per $1kg/cm^2$) *using graph, FIG 9 - IS 8009 (Part I) - 1976*	W'	Settlement after water table correction	Settlement (mm) *for reinforced concrete structures*	Reduced safe bearing capacity q_{ns} (KN/m^2)	Gross safe bearing capacity q_s (KN/m^2)
10	2.62	580	167	0.0010	0.5	0.0020	50	2453	2497
11	3.62	579	246	0.0010	0.5	0.0020	50	2453	2514
12	4.62	578	138	0.0010	0.5	0.0020	50	2453	2531
13	5.62	577	76	0.0028	0.5	0.0056	50	872	985
14	6.62	576	68	0.0036	0.5	0.0072	50	683	815
15	7.62	575	53	0.0050	0.5	0.0100	50	493	645
16	8.62	574	72	0.0032	0.5	0.0064	50	764	937

** Water table correction R_{w2} is taken as 0.5 for safety as there is a possibility that the water table may rise to the surface of foundation*
*** Factor of safety required 3 (for sound rock) to 6 (Weak or Fissured rock)*

CALCULATION OF BEARING CAPACITY FOR VARYING DIMENSION OF FOUNDATION - GHYAMPE KHOLA

Project:	**Sindhuli Road Project**	**Drilling mothod:**	**Rotary**	**Hole Inclination:**	**Vertical**	**Surface Elevation:**	**590 m**	**Bore Hole No.:**	**G1 (Nepalthok side)**
Location:	**Ghyampe Khola**	**Drilling Machine:**	**XUL 100**	**Bit Name:**	**Impregnated Diamond Bit**	**Ground Level:**	**0 m**	**Easting (m):**	**85.8040**
		Casing Depth:	**HX 6m, NX 12m, BX 16m**	**Bit Condition:**	**Good**	**Depth of Exploration:**	**16 m**	**Northing (m):**	**27.4369**

Shape of footing considered: Square footing
Surface Elevation: 590 m
Ground Level: 0 m
Surface Elevation of starting of bore hole 580 m
Surface Elevation of end of bore hole 574 m
Depth of Exploration: 16 m
Level of Excavation: 582.62 m
Depth of Water Table from existing ground level: 6.9 m
Surface elevation of water table: 583.1 m
Depth of Water Table from excavated level: -0.5 m
Trial 6 **Width of footing B: 10 m**

IS Code Bearing Capacity by Shear Failure Criteria

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	Friction angle φ (°)	Mobilized Friction angle φ' (°)	Soil Condition	Method of Analysis for q_{nu}	Cohesion c (KN/m^2)	Unit weight of soil γ (KN/m^3)	Surcharge at the base of the footing q (KN/m^2)	N_c	N_q	N_γ	N_c'	N_q'	N_γ'	S_c	S_q	S_γ	d_c	d_q	d_γ	i_c	i_q	i_γ	Water table correction R_{w1}	Water table correction R_{w2}*	Net ultimate bearing capacity from general shear failure criteria q_{nu} (KN/m^2)	Net ultimate bearing capacity from local shear failure criteria q_{nu} (KN/m^2)	q_{nu} (KN/m^2)	FOS**	Net safe bearing capacity q_{ns} (KN/m^2)
10	2.62	580	45	-	Very Dense	General Shear	0	17	44.54	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.13	1.06	1.06	1	1	1	0.41	0.50	12931	-	12931	2.5	5173
11	3.62	579	45	-	Very Dense	General Shear	0	17	61.54	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.17	1.09	1.09	1	1	1	0.43	0.50	14710	-	14710	2.5	5884
12	4.62	578	45	-	Very Dense	General Shear	0	17	78.54	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.22	1.11	1.11	1	1	1	0.45	0.50	16554	-	16554	2.5	6622
13	5.62	577	45	-	Very Dense	General Shear	0	20	112.4	137.5	133.3	268.2	-	-	-	1.3	1.2	0.8	1.27	1.14	1.14	1	1	1	0.46	0.50	21443	-	21443	2.5	8577
14	6.62	576	44	-	Very Dense	General Shear	0	20	132.4	123.5	117.8	232.5	-	-	-	1.3	1.2	0.8	1.31	1.16	1.16	1	1	1	0.46	0.50	20680	-	20680	2.5	8272
15	7.62	575	41	-	Very Dense	General Shear	0	20	152.4	92.1	82.9	152.3	-	-	-	1.3	1.2	0.8	1.34	1.17	1.17	1	1	1	0.47	0.50	15317	-	15317	2.5	6127
16	8.62	574	44	-	Very Dense	General Shear	0	20	172.4	130.7	125.8	250.9	-	-	-	1.3	1.2	0.8	1.41	1.20	1.20	1	1	1	0.47	0.50	26779	-	26779	2.5	10712

Settlement Criteria Limiting to 50 mm as per Table 1 - IS:1904-1986

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	N' value	Settlement (m per $1kg/cm^2$) *using graph, FIG 9 - IS 8009 (Part I) - 1976*	W'	Settlement after water table correction	Settlement (mm) *for reinforced concrete structures*	Reduced safe bearing capacity q_{ns} (KN/m^2)	Gross safe bearing capacity q_s (KN/m^2)
10	2.62	580	167	0.0010	0.5	0.0020	50	2453	2497
11	3.62	579	246	0.0010	0.5	0.0020	50	2453	2514
12	4.62	578	138	0.0010	0.5	0.0020	50	2453	2531
13	5.62	577	76	0.0028	0.5	0.0056	50	872	985
14	6.62	576	68	0.0036	0.5	0.0072	50	683	815
15	7.62	575	53	0.0050	0.5	0.0100	50	493	645
16	8.62	574	72	0.0032	0.5	0.0064	50	764	937

** Water table correction R_{w2} is taken as 0.5 for safety as there is a possibility that the water table may rise to the surface of foundation*
*** Factor of safety required 3 (for sound rock) to 6 (Weak or Fissured rock)*

CALCULATION OF BEARING CAPACITY FOR VARYING DIMENSION OF FOUNDATION - GHYAMPE KHOLA

Project:	**Sindhuli Road Project**	**Drilling mothod:**	**Rotary**	**Hole Inclination:**	**Vertical**	**Surface Elevation:**	**590 m**	**Bore Hole No.:**	**G1 (Nepalthok side)**
Location:	**Ghyampe Khola**	**Drilling Machine:**	**XUL 100**	**Bit Name:**	**Impregnated Diamond Bit**	**Ground Level:**	**0 m**	**Easting (m):**	**85.8040**
		Casing Depth:	**HX 6m, NX 12m, BX 16m**	**Bit Condition:**	**Good**	**Depth of Exploration:**	**16 m**	**Northing (m):**	**27.4369**

Shape of footing considered: Rectangular footing

Surface Elevation: 590 m

Ground Level: 0 m

Surface Elevation of starting of bore hole 580 m

Surface Elevation of end of bore hole 574 m

Depth of Exploration: 16 m

Level of Excavation: 582.62 m

Depth of Water Table from existing ground level: 6.9 m

Surface elevation of water table: 583.1 m

Depth of Water Table from excavated level: -0.5 m

Trial 7 **Width of footing B: 10 m** **Length of footing L: 11 m**

IS Code Bearing Capacity by Shear Failure Criteria

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	Friction angle φ (°)	Mobilized Friction angle φ' (°)	Soil Condition	Method of Analysis for q_{nu}	Cohesion c (KN/m^2)	Unit weight of soil γ (KN/m^3)	Surcharge at the base of the footing q (KN/m^2)	N_c	N_q	N_γ	N_c'	N_q'	N_γ'	S_c	S_q	S_γ	d_c	d_q	d_γ	i_c	i_q	i_γ	Water table correction R_{w1}	Water table correction R_{w2}*	Net ultimate bearing capacity from general shear failure criteria q_{nu} (KN/m^2)	Net ultimate bearing capacity from local shear failure criteria q_{nu} (KN/m^2)	q_{nu} (KN/m^2)	FOS**	Net safe bearing capacity q_{ns} (KN/m^2)
10	2.62	580	45	-	Very Dense	General Shear	0	17	44.54	138.9	134.9	271.8	-	-	-	1.18	1.18	0.64	1.13	1.06	1.06	1	1	1	0.41	0.50	10875	-	10875	2.5	4350
11	3.62	579	45	-	Very Dense	General Shear	0	17	61.54	138.9	134.9	271.8	-	-	-	1.18	1.18	0.64	1.17	1.09	1.09	1	1	1	0.43	0.50	12584	-	12584	2.5	5034
12	4.62	578	45	-	Very Dense	General Shear	0	17	78.54	138.9	134.9	271.8	-	-	-	1.18	1.18	0.64	1.22	1.11	1.11	1	1	1	0.45	0.50	14358	-	14358	2.5	5743
13	5.62	577	45	-	Very Dense	General Shear	0	20	112.4	137.5	133.3	268.2	-	-	-	1.18	1.18	0.64	1.27	1.14	1.14	1	1	1	0.46	0.50	18811	-	18811	2.5	7525
14	6.62	576	44	-	Very Dense	General Shear	0	20	132.4	123.5	117.8	232.5	-	-	-	1.18	1.18	0.64	1.31	1.16	1.16	1	1	1	0.46	0.50	18332	-	18332	2.5	7333
15	7.62	575	41	-	Very Dense	General Shear	0	20	152.4	92.1	82.9	152.3	-	-	-	1.18	1.18	0.64	1.34	1.17	1.17	1	1	1	0.47	0.50	13736	-	13736	2.5	5495
16	8.62	574	44	-	Very Dense	General Shear	0	20	172.4	130.7	125.8	250.9	-	-	-	1.18	1.18	0.64	1.41	1.20	1.20	1	1	1	0.47	0.50	24083	-	24083	2.5	9633

Settlement Criteria Limiting to 50 mm as per Table 1 - IS:1904-1986

Depth from existing G.L (m)	Depth of foundation Df (m)	Elevation (m)	N' value	Settlement (m per $1kg/cm^2$) *using graph, FIG 9 - IS 8009 (Part I) - 1976*	W'	Settlement after water table correction	Settlement (mm) *for reinforced concrete structures*	Reduced safe bearing capacity q_{ns} (KN/m^2)	Gross safe bearing capacity q_s (KN/m^2)	Existing Soil/Rock Description
10	2.62	580	167	0.0010	0.5	0.0020	50	2453	2497	Boulder with gravel
11	3.62	579	246	0.0010	0.5	0.0020	50	2453	2514	Boulder with gravel
12	4.62	578	138	0.0010	0.5	0.0020	50	2453	2531	Boulder with gravel
13	5.62	577	76	0.0028	0.5	0.0056	50	872	985	Boulder with gravel
14	6.62	576	68	0.0036	0.5	0.0072	50	683	815	Boulder with gravel
15	7.62	575	53	0.0050	0.5	0.0100	50	493	645	Boulder with gravel
16	8.62	574	72	0.0032	0.5	0.0064	50	764	937	Boulder with gravel

** Water table correction R_{w2} is taken as 0.5 for safety as there is a possibility that the water table may rise to the surface of foundation*

*** Factor of safety required 3 (for sound rock) to 6 (Weak or Fissured rock)*

CALCULATION OF BEARING CAPACITY FOR VARYING DIMENSION OF FOUNDATION - GHYAMPE KHOLA

Project: Sindhuli Road Project	**Drilling mothod:**	**Rotary**	**Hole Inclination:**	**Vertical**	**Surface Elevation:**	**589 m**	**Bore Hole No.:**	**G2 (Dhulikhel side)**
Location: Ghyampe Khola	**Drilling Machine:**	**XUL 100**	**Bit Name:**	**Impregnated Diamond Bit**	**Ground Level:**	**0 m**	**Easting (m):**	**85.8038**
	Casing Depth:	**HX 6m, NX 12m, BX 16m**	**Bit Condition:**	**Good**	**Depth of Exploration:**	**16 m**	**Northing (m):**	**27.4369**

Shape of footing considered: Square footing

Surface Elevation: 589 m

Ground Level: 0 m

Surface Elevation of starting of bore hole 579 m

Surface Elevation of end of bore hole 573 m

Depth of Exploration: 16 m

Level of Excavation: 582.62 m

Depth of Water Table from existing ground level: 5 m

Surface elevation of water table: 584.0 m

Depth of Water Table from excavated level: -1.4 m

Trial 1 **Width of footing B: 4 m**

IS Code Bearing Capacity by Shear Failure Criteria

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	Friction angle φ (°)	Mobilized Friction angle φ' (°)	Soil Condition	Method of Analysis for q_{nu}	Cohesion c (KN/m^2)	Unit weight of soil γ (KN/m^3)	Surcharge at the base of the footing q (KN/m^2)	N_c	N_q	N_γ	N_c'	N_q'	N_γ'	S_c	S_q	S_γ	d_c	d_q	d_γ	i_c	i_q	i_γ	Water table correction R_{w1}	Water table correction R_{w2}*	Net ultimate bearing capacity from general shear failure criteria q_{nu} (KN/m^2)	Net ultimate bearing capacity from local shear failure criteria q_{nu} (KN/m^2)	q_{nu} (KN/m^2)	FOS**	Net safe bearing capacity q_{ns} (KN/m^2)
10	3.62	579	45	-	Very Dense	General Shear	0	17	61.54	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.44	1.22	1.22	1	1	1	0.31	0.50	8231	-	8231	2.5	3292
11	4.62	578	45	-	Very Dense	General Shear	0	17	78.54	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.56	1.28	1.28	1	1	1	0.35	0.50	10385	-	10385	2.5	4154
12	5.62	577	45	-	Very Dense	General Shear	0	17	95.54	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.68	1.34	1.34	1	1	1	0.38	0.50	12704	-	12704	2.5	5081
13	6.62	576	45	-	Very Dense	General Shear	0	20	132.4	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.80	1.40	1.40	1	1	1	0.40	0.50	17867	-	17867	2.5	7147
14	7.62	575	45	-	Very Dense	General Shear	0	20	152.4	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.92	1.46	1.46	1	1	1	0.41	0.50	20983	-	20983	2.5	8393
15	8.62	574	45	-	Very Dense	General Shear	0	20	172.4	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	2.04	1.52	1.52	1	1	1	0.42	0.50	24293	-	24293	2.5	9717
16	9.62	573	45	-	Very Dense	General Shear	0	20	192.4	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	2.16	1.58	1.58	1	1	1	0.43	0.50	27797	-	27797	2.5	11119

Settlement Criteria Limiting to 50 mm as per Table 1 - IS:1904-1986

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	N' value	Settlement (m per $1kg/cm^2$) *using graph, FIG 9 - IS 8009 (Part I) - 1976*	W'	Settlement after water table correction	Settlement (mm) *for reinforced concrete structures*	Reduced safe bearing capacity q_{ns} (KN/m^2)	Gross safe bearing capacity q_s (KN/m^2)
10	3.62	579	151	0.0010	0.5	0.0020	50	2453	2514
11	4.62	578	258	0.0010	0.5	0.0020	50	2453	2531
12	5.62	577	253	0.0010	0.5	0.0020	50	2453	2548
13	6.62	576	197	0.0010	0.5	0.0020	50	2453	2585
14	7.62	575	160	0.0010	0.5	0.0020	50	2453	2605
15	8.62	574	87	0.0014	0.5	0.0027	50	1786	1959
16	9.62	573	131	0.0010	0.5	0.0020	50	2453	2645

** Water table correction R_{w2} is taken as 0.5 for safety as there is a possibility that the water table may rise to the surface of foundation*

*** Factor of safety required 3 (for sound rock) to 6 (Weak or Fissured rock)*

CALCULATION OF BEARING CAPACITY FOR VARYING DIMENSION OF FOUNDATION - GHYAMPE KHOLA

Project: Sindhuli Road Project	**Drilling mothod:**	**Rotary**	**Hole Inclination:**	**Vertical**	**Surface Elevation:**	**589 m**	**Bore Hole No.:**	**G2 (Dhulikhel side)**
Location: Ghyampe Khola	**Drilling Machine:**	**XUL 100**	**Bit Name:**	**Impregnated Diamond Bit**	**Ground Level:**	**0 m**	**Easting (m):**	**85.8038**
	Casing Depth:	**HX 6m, NX 12m, BX 16m**	**Bit Condition:**	**Good**	**Depth of Exploration:**	**16 m**	**Northing (m):**	**27.4369**

Shape of footing considered: Square footing
Surface Elevation: 589 m
Ground Level: 0 m
Surface Elevation of starting of bore hole 579 m
Surface Elevation of end of bore hole 573 m
Depth of Exploration: 16 m

Level of Excavation: 582.62 m
Depth of Water Table from existing ground level: 5 m
Surface elevation of water table: 584.0 m
Depth of Water Table from excavated level: -1.4 m

Trial 2 **Width of footing B: 5 m**

IS Code Bearing Capacity by Shear Failure Criteria

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	Friction angle φ (°)	Mobilized Friction angle φ' (°)	Soil Condition	Method of Analysis for q_{nu}	Cohesion c (KN/m^2)	Unit weight of soil γ (KN/m^3)	Surcharge at the base of the footing q (KN/m^2)	N_c	N_q	N_γ	N_c'	N_q'	N_γ'	S_c	S_q	S_γ	d_c	d_q	d_γ	i_c	i_q	i_γ	Water table correction R_{w1}	Water table correction R_{w2}*	Net ultimate bearing capacity from general shear failure criteria q_{nu} (KN/m^2)	Net ultimate bearing capacity from local shear failure criteria q_{nu} (KN/m^2)	q_{nu} (KN/m^2)	FOS**	Net safe bearing capacity q_{ns} (KN/m^2)
10	3.62	579	45	-	Very Dense	General Shear	0	17	61.54	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.35	1.17	1.17	1	1	1	0.31	0.50	9021	-	9021	2.5	3608
11	4.62	578	45	-	Very Dense	General Shear	0	17	78.54	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.45	1.22	1.22	1	1	1	0.35	0.50	11062	-	11062	2.5	4425
12	5.62	577	45	-	Very Dense	General Shear	0	17	95.54	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.54	1.27	1.27	1	1	1	0.38	0.50	13235	-	13235	2.5	5294
13	6.62	576	45	-	Very Dense	General Shear	0	20	132.4	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.64	1.32	1.32	1	1	1	0.40	0.50	18282	-	18282	2.5	7313
14	7.62	575	45	-	Very Dense	General Shear	0	20	152.4	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.74	1.37	1.37	1	1	1	0.41	0.50	21148	-	21148	2.5	8459
15	8.62	574	45	-	Very Dense	General Shear	0	20	172.4	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.83	1.42	1.42	1	1	1	0.42	0.50	24170	-	24170	2.5	9668
16	9.62	573	45	-	Very Dense	General Shear	0	20	192.4	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.93	1.46	1.46	1	1	1	0.43	0.50	27347	-	27347	2.5	10939

Settlement Criteria Limiting to 50 mm as per Table 1 - IS:1904-1986

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	N' value	Settlement (m per $1kg/cm^2$) *using graph, FIG 9 - IS 8009 (Part I) - 1976*	W'	Settlement after water table correction	Settlement (mm) *for reinforced concrete structures*	Reduced safe bearing capacity q_{ns} (KN/m^2)	Gross safe bearing capacity q_s (KN/m^2)
10	3.62	579	151	0.0010	0.5	0.0020	50	2453	2514
11	4.62	578	258	0.0010	0.5	0.0020	50	2453	2531
12	5.62	577	253	0.0010	0.5	0.0020	50	2453	2548
13	6.62	576	197	0.0010	0.5	0.0020	50	2453	2585
14	7.62	575	160	0.0010	0.5	0.0020	50	2453	2605
15	8.62	574	87	0.0015	0.5	0.0029	50	1670	1842
16	9.62	573	131	0.0010	0.5	0.0020	50	2453	2645

** Water table correction R_{w2} is taken as 0.5 for safety as there is a possibility that the water table may rise to the surface of foundation*

*** Factor of safety required 3 (for sound rock) to 6 (Weak or Fissured rock)*

CALCULATION OF BEARING CAPACITY FOR VARYING DIMENSION OF FOUNDATION - GHYAMPE KHOLA

Project: Sindhuli Road Project	**Drilling mothod:**	**Rotary**	**Hole Inclination:**	**Vertical**	**Surface Elevation:**	**589 m**	**Bore Hole No.:**	**G2 (Dhulikhel side)**
Location: Ghyampe Khola	**Drilling Machine:**	**XUL 100**	**Bit Name:**	**Impregnated Diamond Bit**	**Ground Level:**	**0 m**	**Easting (m):**	**85.8038**
	Casing Depth:	**HX 6m, NX 12m, BX 16m**	**Bit Condition:**	**Good**	**Depth of Exploration:**	**16 m**	**Northing (m):**	**27.4369**

Shape of footing considered: Square footing
Surface Elevation: 589 m
Ground Level: 0 m
Surface Elevation of starting of bore hole 579 m
Surface Elevation of end of bore hole 573 m
Depth of Exploration: 16 m
Level of Excavation: 582.62 m
Depth of Water Table from existing ground level: 5 m
Surface elevation of water table: 584.0 m
Depth of Water Table from excavated level: -1.4 m
Trial 3 **Width of footing B: 6 m**

IS Code Bearing Capacity by Shear Failure Criteria

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	Friction angle φ (°)	Mobilized Friction angle φ' (°)	Soil Condition	Method of Analysis for q_{nu}	Cohesion c (KN/m^2)	Unit weight of soil γ (KN/m^3)	Surcharge at the base of the footing q (KN/m^2)	N_c	N_q	N_γ	N_c'	N_q'	N_γ'	S_c	S_q	S_γ	d_c	d_q	d_γ	i_c	i_q	i_γ	Water table correction R_{w1}	Water table correction R_{w2}*	Net ultimate bearing capacity from general shear failure criteria q_{nu} (KN/m^2)	Net ultimate bearing capacity from local shear failure criteria q_{nu} (KN/m^2)	q_{nu} (KN/m^2)	FOS**	Net safe bearing capacity q_{ns} (KN/m^2)
10	3.62	579	45	-	Very Dense	General Shear	0	17	61.54	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.29	1.15	1.15	1	1	1	0.31	0.50	9856	-	9856	2.5	3942
11	4.62	578	45	-	Very Dense	General Shear	0	17	78.54	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.37	1.19	1.19	1	1	1	0.35	0.50	11821	-	11821	2.5	4729
12	5.62	577	45	-	Very Dense	General Shear	0	17	95.54	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.45	1.23	1.23	1	1	1	0.38	0.50	13897	-	13897	2.5	5559
13	6.62	576	45	-	Very Dense	General Shear	0	20	132.4	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.53	1.27	1.27	1	1	1	0.40	0.50	18920	-	18920	2.5	7568
14	7.62	575	45	-	Very Dense	General Shear	0	20	152.4	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.61	1.31	1.31	1	1	1	0.41	0.50	21621	-	21621	2.5	8648
15	8.62	574	45	-	Very Dense	General Shear	0	20	172.4	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.69	1.35	1.35	1	1	1	0.42	0.50	24450	-	24450	2.5	9780
16	9.62	573	45	-	Very Dense	General Shear	0	20	192.4	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.77	1.39	1.39	1	1	1	0.43	0.50	27409	-	27409	2.5	10964

Settlement Criteria Limiting to 50 mm as per Table 1 - IS:1904-1986

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	N' value	Settlement (m per $1kg/cm^2$) *using graph, FIG 9 - IS 8009 (Part I) - 1976*	W'	Settlement after water table correction	Settlement (mm) *for reinforced concrete structures*	Reduced safe bearing capacity q_{ns} (KN/m^2)	Gross safe bearing capacity q_s (KN/m^2)
10	3.62	579	151	0.0010	0.5	0.0020	50	2453	2514
11	4.62	578	258	0.0010	0.5	0.0020	50	2453	2531
12	5.62	577	253	0.0010	0.5	0.0020	50	2453	2548
13	6.62	576	197	0.0010	0.5	0.0020	50	2453	2585
14	7.62	575	160	0.0010	0.5	0.0020	50	2453	2605
15	8.62	574	87	0.0016	0.5	0.0031	50	1559	1731
16	9.62	573	131	0.0010	0.5	0.0020	50	2453	2645

** Water table correction R_{w2} is taken as 0.5 for safety as there is a possibility that the water table may rise to the surface of foundation*
*** Factor of safety required 3 (for sound rock) to 6 (Weak or Fissured rock)*

CALCULATION OF BEARING CAPACITY FOR VARYING DIMENSION OF FOUNDATION - GHYAMPE KHOLA

Project: Sindhuli Road Project	**Drilling mothod:**	**Rotary**	**Hole Inclination:**	**Vertical**	**Surface Elevation:**	**589 m**	**Bore Hole No.:**	**G2 (Dhulikhel side)**
Location: Ghyampe Khola	**Drilling Machine:**	**XUL 100**	**Bit Name:**	**Impregnated Diamond Bit**	**Ground Level:**	**0 m**	**Easting (m):**	**85.8038**
	Casing Depth:	**HX 6m, NX 12m, BX 16m**	**Bit Condition:**	**Good**	**Depth of Exploration:**	**16 m**	**Northing (m):**	**27.4369**

Shape of footing considered: Square footing
Surface Elevation: 589 m
Ground Level: 0 m
Surface Elevation of starting of bore hole 579 m
Surface Elevation of end of bore hole 573 m
Depth of Exploration: 16 m
Level of Excavation: 582.62 m
Depth of Water Table from existing ground level: 5 m
Surface elevation of water table: 584.0 m
Depth of Water Table from excavated level: -1.4 m
Trial 4 **Width of footing B: 7 m**

IS Code Bearing Capacity by Shear Failure Criteria

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	Friction angle φ (°)	Mobilized Friction angle φ' (°)	Soil Condition	Method of Analysis for q_{nu}	Cohesion c (KN/m^2)	Unit weight of soil γ (KN/m^3)	Surcharge at the base of the footing q (KN/m^2)	N_c	N_q	N_γ	N_c'	N_q'	N_γ'	S_c	S_q	S_γ	d_c	d_q	d_γ	i_c	i_q	i_γ	Water table correction R_{w1}	Water table correction R_{w2}*	Net ultimate bearing capacity from general shear failure criteria q_{nu} (KN/m^2)	Net ultimate bearing capacity from local shear failure criteria q_{nu} (KN/m^2)	q_{nu} (KN/m^2)	FOS**	Net safe bearing capacity q_{ns} (KN/m^2)
10	3.62	579	45	-	Very Dense	General Shear	0	17	61.54	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.25	1.12	1.12	1	1	1	0.31	0.50	10716	-	10716	2.5	4286
11	4.62	578	45	-	Very Dense	General Shear	0	17	78.54	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.32	1.16	1.16	1	1	1	0.35	0.50	12628	-	12628	2.5	5051
12	5.62	577	45	-	Very Dense	General Shear	0	17	95.54	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.39	1.19	1.19	1	1	1	0.38	0.50	14634	-	14634	2.5	5854
13	6.62	576	45	-	Very Dense	General Shear	0	20	132.4	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.46	1.23	1.23	1	1	1	0.40	0.50	19687	-	19687	2.5	7875
14	7.62	575	45	-	Very Dense	General Shear	0	20	152.4	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.53	1.26	1.26	1	1	1	0.41	0.50	22269	-	22269	2.5	8907
15	8.62	574	45	-	Very Dense	General Shear	0	20	172.4	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.59	1.30	1.30	1	1	1	0.42	0.50	24961	-	24961	2.5	9984
16	9.62	573	45	-	Very Dense	General Shear	0	20	192.4	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.66	1.33	1.33	1	1	1	0.43	0.50	27764	-	27764	2.5	11106

Settlement Criteria Limiting to 50 mm as per Table 1 - IS:1904-1986

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	N' value	Settlement (m per $1kg/cm^2$) *using graph, FIG 9 - IS 8009 (Part I) - 1976*	W'	Settlement after water table correction	Settlement (mm) *for reinforced concrete structures*	Reduced safe bearing capacity q_{ns} (KN/m^2)	Gross safe bearing capacity q_s (KN/m^2)
10	3.62	579	151	0.0010	0.5	0.0020	50	2453	2514
11	4.62	578	258	0.0010	0.5	0.0020	50	2453	2531
12	5.62	577	253	0.0010	0.5	0.0020	50	2453	2548
13	6.62	576	197	0.0010	0.5	0.0020	50	2453	2585
14	7.62	575	160	0.0010	0.5	0.0020	50	2453	2605
15	8.62	574	87	0.0017	0.5	0.0034	50	1455	1627
16	9.62	573	131	0.0010	0.5	0.0020	50	2453	2645

** Water table correction R_{w2} is taken as 0.5 for safety as there is a possibility that the water table may rise to the surface of foundation*
*** Factor of safety required 3 (for sound rock) to 6 (Weak or Fissured rock)*

CALCULATION OF BEARING CAPACITY FOR VARYING DIMENSION OF FOUNDATION - GHYAMPE KHOLA

Project:	**Sindhuli Road Project**	**Drilling mothod:**	**Rotary**	**Hole Inclination:**	**Vertical**	**Surface Elevation:**	**589 m**	**Bore Hole No.:**	**G2 (Dhulikhel side)**
Location:	**Ghyampe Khola**	**Drilling Machine:**	**XUL 100**	**Bit Name:**	**Impregnated Diamond Bit**	**Ground Level:**	**0 m**	**Easting (m):**	**85.8038**
		Casing Depth:	**HX 6m, NX 12m, BX 16m**	**Bit Condition:**	**Good**	**Depth of Exploration:**	**16 m**	**Northing (m):**	**27.4369**

Shape of footing considered: Square footing
Surface Elevation: 589 m
Ground Level: 0 m
Surface Elevation of starting of bore hole 579 m
Surface Elevation of end of bore hole 573 m
Depth of Exploration: 16 m
Level of Excavation: 582.62 m
Depth of Water Table from existing ground level: 5 m
Surface elevation of water table: 584.0 m
Depth of Water Table from excavated level: -1.4 m
Trial 5 **Width of footing B: 8 m**

IS Code Bearing Capacity by Shear Failure Criteria

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	Friction angle φ (°)	Mobilized Friction angle φ' (°)	Soil Condition	Method of Analysis for q_{nu}	Cohesion c (KN/m^2)	Unit weight of soil γ (KN/m^3)	Surcharge at the base of the footing q (KN/m^2)	N_c	N_q	N_γ	N_c'	N_q'	N_γ'	S_c	S_q	S_γ	d_c	d_q	d_γ	i_c	i_q	i_γ	Water table correction R_{w1}	Water table correction R_{w2}*	Net ultimate bearing capacity from general shear failure criteria q_{nu} (KN/m^2)	Net ultimate bearing capacity from local shear failure criteria q_{nu} (KN/m^2)	q_{nu} (KN/m^2)	FOS**	Net safe bearing capacity q_{ns} (KN/m^2)
10	3.62	579	45	-	Very Dense	General Shear	0	17	61.54	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.22	1.11	1.11	1	1	1	0.31	0.50	11592	-	11592	2.5	4637
11	4.62	578	45	-	Very Dense	General Shear	0	17	78.54	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.28	1.14	1.14	1	1	1	0.35	0.50	13464	-	13464	2.5	5386
12	5.62	577	45	-	Very Dense	General Shear	0	17	95.54	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.34	1.17	1.17	1	1	1	0.38	0.50	15418	-	15418	2.5	6167
13	6.62	576	45	-	Very Dense	General Shear	0	20	132.4	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.40	1.20	1.20	1	1	1	0.40	0.50	20534	-	20534	2.5	8214
14	7.62	575	45	-	Very Dense	General Shear	0	20	152.4	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.46	1.23	1.23	1	1	1	0.41	0.50	23026	-	23026	2.5	9211
15	8.62	574	45	-	Very Dense	General Shear	0	20	172.4	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.52	1.26	1.26	1	1	1	0.42	0.50	25616	-	25616	2.5	10246
16	9.62	573	45	-	Very Dense	General Shear	0	20	192.4	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.58	1.29	1.29	1	1	1	0.43	0.50	28302	-	28302	2.5	11321

Settlement Criteria Limiting to 50 mm as per Table 1 - IS:1904-1986

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	N' value	Settlement (m per $1kg/cm^2$) *using graph, FIG 9 - IS 8009 (Part I) - 1976*	W'	Settlement after water table correction	Settlement (mm) *for reinforced concrete structures*	Reduced safe bearing capacity q_{ns} (KN/m^2)	Gross safe bearing capacity q_s (KN/m^2)
10	3.62	579	151	0.0010	0.5	0.0020	50	2453	2514
11	4.62	578	258	0.0010	0.5	0.0020	50	2453	2531
12	5.62	577	253	0.0010	0.5	0.0020	50	2453	2548
13	6.62	576	197	0.0010	0.5	0.0020	50	2453	2585
14	7.62	575	160	0.0010	0.5	0.0020	50	2453	2605
15	8.62	574	87	0.0018	0.5	0.0036	50	1357	1530
16	9.62	573	131	0.0010	0.5	0.0020	50	2453	2645

** Water table correction R_{w2} is taken as 0.5 for safety as there is a possibility that the water table may rise to the surface of foundation*
*** Factor of safety required 3 (for sound rock) to 6 (Weak or Fissured rock)*

CALCULATION OF BEARING CAPACITY FOR VARYING DIMENSION OF FOUNDATION - GHYAMPE KHOLA

Project: Sindhuli Road Project	**Drilling mothod:**	**Rotary**	**Hole Inclination:**	**Vertical**	**Surface Elevation:**	**589 m**	**Bore Hole No.:**	**G2 (Dhulikhel side)**
Location: Ghyampe Khola	**Drilling Machine:**	**XUL 100**	**Bit Name:**	**Impregnated Diamond Bit**	**Ground Level:**	**0 m**	**Easting (m):**	**85.8038**
	Casing Depth:	**HX 6m, NX 12m, BX 16m**	**Bit Condition:**	**Good**	**Depth of Exploration:**	**16 m**	**Northing (m):**	**27.4369**

Shape of footing considered: Square footing
Surface Elevation: 589 m
Ground Level: 0 m
Surface Elevation of starting of bore hole 579 m
Surface Elevation of end of bore hole 573 m
Depth of Exploration: 16 m
Trial 6 **Width of footing B: 10 m**

Level of Excavation: 582.62 m
Depth of Water Table from existing ground level: 5 m
Surface elevation of water table: 584.0 m
Depth of Water Table from excavated level: -1.4 m

IS Code Bearing Capacity by Shear Failure Criteria

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	Friction angle φ (°)	Mobilized Friction angle φ' (°)	Soil Condition	Method of Analysis for q_{nu}	Cohesion c (KN/m^2)	Unit weight of soil γ (KN/m^3)	Surcharge at the base of the footing q (KN/m^2)	N_c	N_q	N_γ	N_c'	N_q'	N_γ'	S_c	S_q	S_γ	d_c	d_q	d_γ	i_c	i_q	i_γ	Water table correction R_{w1}	Water table correction R_{w2}*	Net ultimate bearing capacity from general shear failure criteria q_{nu} (KN/m^2)	Net ultimate bearing capacity from local shear failure criteria q_{nu} (KN/m^2)	q_{nu} (KN/m^2)	FOS**	Net safe bearing capacity q_{ns} (KN/m^2)
10	3.62	579	45	-	Very Dense	General Shear	0	17	61.54	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.17	1.09	1.09	1	1	1	0.31	0.50	13374	-	13374	2.5	5349
11	4.62	578	45	-	Very Dense	General Shear	0	17	78.54	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.22	1.11	1.11	1	1	1	0.35	0.50	15188	-	15188	2.5	6075
12	5.62	577	45	-	Very Dense	General Shear	0	17	95.54	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.27	1.14	1.14	1	1	1	0.38	0.50	17069	-	17069	2.5	6828
13	6.62	576	45	-	Very Dense	General Shear	0	20	132.4	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.32	1.16	1.16	1	1	1	0.40	0.50	22372	-	22372	2.5	8949
14	7.62	575	45	-	Very Dense	General Shear	0	20	152.4	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.37	1.18	1.18	1	1	1	0.41	0.50	24739	-	24739	2.5	9896
15	8.62	574	45	-	Very Dense	General Shear	0	20	172.4	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.42	1.21	1.21	1	1	1	0.42	0.50	27185	-	27185	2.5	10874
16	9.62	573	45	-	Very Dense	General Shear	0	20	192.4	138.9	134.9	271.8	-	-	-	1.3	1.2	0.8	1.46	1.23	1.23	1	1	1	0.43	0.50	29708	-	29708	2.5	11883

Settlement Criteria Limiting to 50 mm as per Table 1 - IS:1904-1986

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	N' value	Settlement (m per $1kg/cm^2$) *using graph, FIG 9 - IS 8009 (Part I) - 1976*	W'	Settlement after water table correction	Settlement (mm) *for reinforced concrete structures*	Reduced safe bearing capacity q_{ns} (KN/m^2)	Gross safe bearing capacity q_s (KN/m^2)
10	3.62	579	151	0.0010	0.5	0.0020	50	2453	2514
11	4.62	578	258	0.0010	0.5	0.0020	50	2453	2531
12	5.62	577	253	0.0010	0.5	0.0020	50	2453	2548
13	6.62	576	197	0.0010	0.5	0.0020	50	2453	2585
14	7.62	575	160	0.0010	0.5	0.0020	50	2453	2605
15	8.62	574	87	0.0018	0.5	0.0036	50	1357	1530
16	9.62	573	131	0.0010	0.5	0.0020	50	2453	2645

** Water table correction R_{w2} is taken as 0.5 for safety as there is a possibility that the water table may rise to the surface of foundation*
*** Factor of safety required 3 (for sound rock) to 6 (Weak or Fissured rock)*

CALCULATION OF BEARING CAPACITY FOR VARYING DIMENSION OF FOUNDATION - GHYAMPE KHOLA

Project:	**Sindhuli Road Project**	**Drilling mothod:**	**Rotary**	**Hole Inclination:**	**Vertical**	**Surface Elevation:**	**589 m**	**Bore Hole No.:**	**G2 (Dhulikhel side)**
Location:	**Ghyampe Khola**	**Drilling Machine:**	**XUL 100**	**Bit Name:**	**Impregnated Diamond Bit**	**Ground Level:**	**0 m**	**Easting (m):**	**85.8038**
		Casing Depth:	**HX 6m, NX 12m, BX 16m**	**Bit Condition:**	**Good**	**Depth of Exploration:**	**16 m**	**Northing (m):**	**27.4369**

Shape of footing considered: Rectangular footing

Surface Elevation: 589 m

Ground Level: 0 m

Surface Elevation of starting of bore hole 579 m

Surface Elevation of end of bore hole 573 m

Depth of Exploration: 16 m

Level of Excavation: 582.62 m

Depth of Water Table from existing ground level: 5 m

Surface elevation of water table: 584.0 m

Depth of Water Table from excavated level: -1.4 m

Trial 7 **Width of footing B: 10 m** **Length of footing L: 11 m**

IS Code Bearing Capacity by Shear Failure Criteria

Depth from existing G.L (m)	Depth of foundation D_f (m)	Elevation (m)	Friction angle φ (°)	Mobilized Friction angle φ' (°)	Soil Condition	Method of Analysis for q_{nu}	Cohesion c (KN/m^2)	Unit weight of soil γ (KN/m^3)	Surcharge at the base of the footing q (KN/m^2)	N_c	N_q	N_γ	N_c'	N_q'	N_γ'	S_c	S_q	S_γ	d_c	d_q	d_γ	i_c	i_q	i_γ	Water table correction R_{w1}	Water table correction R_{w2}*	Net ultimate bearing capacity from general shear failure criteria q_{nu} (KN/m^2)	Net ultimate bearing capacity from local shear failure criteria q_{nu} (KN/m^2)	q_{nu} (KN/m^2)	FOS**	Net safe bearing capacity q_{ns} (KN/m^2)
10	3.62	579	45	-	Very Dense	General Shear	0	17	61.54	138.9	134.9	271.8	-	-	-	1.18	1.18	0.64	1.17	1.09	1.09	1	1	1	0.31	0.50	11268	-	11268	2.5	4507
11	4.62	578	45	-	Very Dense	General Shear	0	17	78.54	138.9	134.9	271.8	-	-	-	1.18	1.18	0.64	1.22	1.11	1.11	1	1	1	0.35	0.50	13013	-	13013	2.5	5205
12	5.62	577	45	-	Very Dense	General Shear	0	17	95.54	138.9	134.9	271.8	-	-	-	1.18	1.18	0.64	1.27	1.14	1.14	1	1	1	0.38	0.50	14823	-	14823	2.5	5929
13	6.62	576	45	-	Very Dense	General Shear	0	20	132.4	138.9	134.9	271.8	-	-	-	1.18	1.18	0.64	1.32	1.16	1.16	1	1	1	0.40	0.50	19645	-	19645	2.5	7858
14	7.62	575	45	-	Very Dense	General Shear	0	20	152.4	138.9	134.9	271.8	-	-	-	1.18	1.18	0.64	1.37	1.18	1.18	1	1	1	0.41	0.50	21927	-	21927	2.5	8771
15	8.62	574	45	-	Very Dense	General Shear	0	20	172.4	138.9	134.9	271.8	-	-	-	1.18	1.18	0.64	1.42	1.21	1.21	1	1	1	0.42	0.50	24286	-	24286	2.5	9714
16	9.62	573	45	-	Very Dense	General Shear	0	20	192.4	138.9	134.9	271.8	-	-	-	1.18	1.18	0.64	1.46	1.23	1.23	1	1	1	0.43	0.50	26721	-	26721	2.5	10688

Settlement Criteria Limiting to 50 mm as per Table 1 - IS:1904-1986

Depth from existing G.L (m)	Depth of foundation Df (m)	Elevation (m)	N' value	Settlement (m per $1kg/cm^2$) *using graph, FIG 9 - IS 8009 (Part I) - 1976*	W'	Settlement after water table correction	Settlement (mm) *for reinforced concrete structures*	Reduced safe bearing capacity q_{ns} (KN/m^2)	Gross safe bearing capacity q_s (KN/m^2)	Existing Soil/Rock Description
10	3.62	579	151	0.0010	0.5	0.0020	50	2453	2514	Boulder with gravel
11	4.62	578	258	0.0010	0.5	0.0020	50	2453	2531	Boulder with gravel
12	5.62	577	253	0.0010	0.5	0.0020	50	2453	2548	Boulder with gravel
13	6.62	576	197	0.0010	0.5	0.0020	50	2453	2585	Boulder with gravel
14	7.62	575	160	0.0010	0.5	0.0020	50	2453	2605	Boulder with gravel
15	8.62	574	87	0.0018	0.5	0.0036	50	1357	1530	Boulder with gravel
16	9.62	573	131	0.0010	0.5	0.0020	50	2453	2645	Boulder with gravel

** Water table correction R_{w2} is taken as 0.5 for safety as there is a possibility that the water table may rise to the surface of foundation*

*** Factor of safety required 3 (for sound rock) to 6 (Weak or Fissured rock)*

ANNEX E

LAB TEST RESULTS

SIEVE ANALYSIS

Project: Sindhuli Road
Client: JICA
Location: Bhyakure Khola
Sample: Pit Sample
Depth: below 50 cm

Sampling date: 29th Sept. 2019
Testing date: 16th Oct. 2019
Tested by: S. Parajuli
Checked by: A. Karmacharya

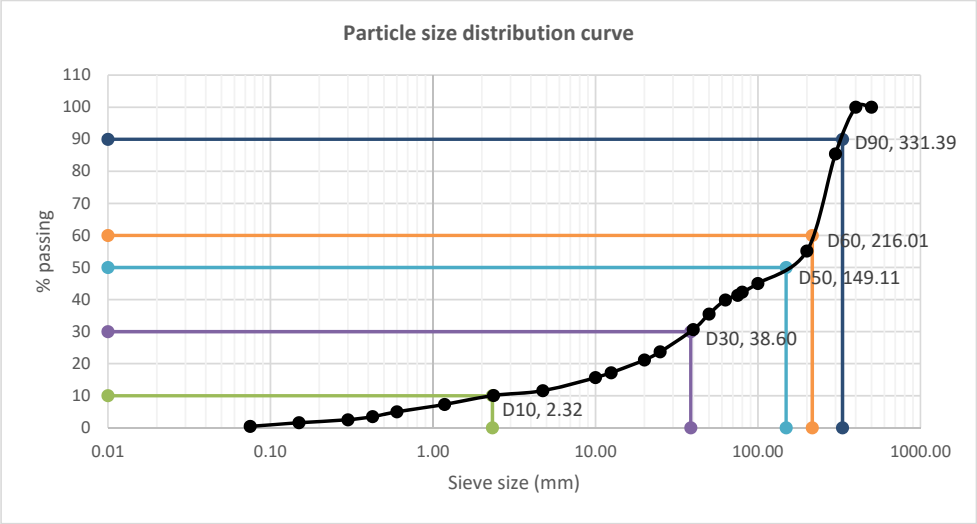
Total weight of sample (gm): 210574.50

Sieve size (mm)	Wt. of soil retained (gm)	Cu. wt. retained (gm)	Cu. % retained	% passing
500	0.00	0.00	0.00	100.00
400	0.00	0.00	0.00	100.00
300	30691.00	30691.00	14.57	85.43
200	63745.50	94436.50	44.85	55.15
100	21320.00	115756.50	54.97	45.03
80	5748.00	121504.50	57.70	42.30
75	2050.00	123554.50	58.67	41.33
63	3018.00	126572.50	60.11	39.89
50	9254.00	135826.50	64.50	35.50
40	10208.00	146034.50	69.35	30.65
25	14650.00	160684.50	76.31	23.69
20	5372.00	166056.50	78.86	21.14
12.5	8340.00	174396.50	82.82	17.18
10	3232.00	177628.50	84.35	15.65
4.75	8588.00	186216.50	88.43	11.57
2.36	3116.00	189332.50	89.91	10.09
1.18	5876.00	195208.50	92.70	7.30
0.6	4898.00	200106.50	95.03	4.97
0.425	3128.00	203234.50	96.51	3.49
0.3	2088.00	205322.50	97.51	2.49
0.15	1922.00	207244.50	98.42	1.58
0.075	2428.00	209672.50	99.57	0.43
Pan	902.00	210574.50	100.00	0.00

Density of soil sample (ρ)= 2.61 gm/cc

Soil sample retained in 100 mm sieve:	
size 100-200mm	11736 gm
size 200-300 mm	2850 gm
size >300 mm	0 gm

weight i.e. Σ(V*ρ) of rocks existing in area of 1 sq. m. but not sampled	
size 100-200 mm	9584 gm
size 200-300 mm	60895.5 gm
size >300 mm	30691 gm



D_{10} =	2.32 mm
D_{30} =	38.60 mm
D_{50} =	149.11 mm
D_{60} =	216.01 mm
D_{90} =	331.39 mm

Clay	0%
Silt	0%
Sand	11%
Gravel	88%

C_u=	92.99
C_c=	2.97

SIEVE ANALYSIS

Project: Sindhuli Road
Client: JICA
Location: Mamti Khola
Sample: Pit Sample
Depth: below 50 cm

Sampling date: 28th Sept. 2019
Testing date: 17th Oct. 2019
Tested by: S. Parajuli
Checked by: A. Karmacharya

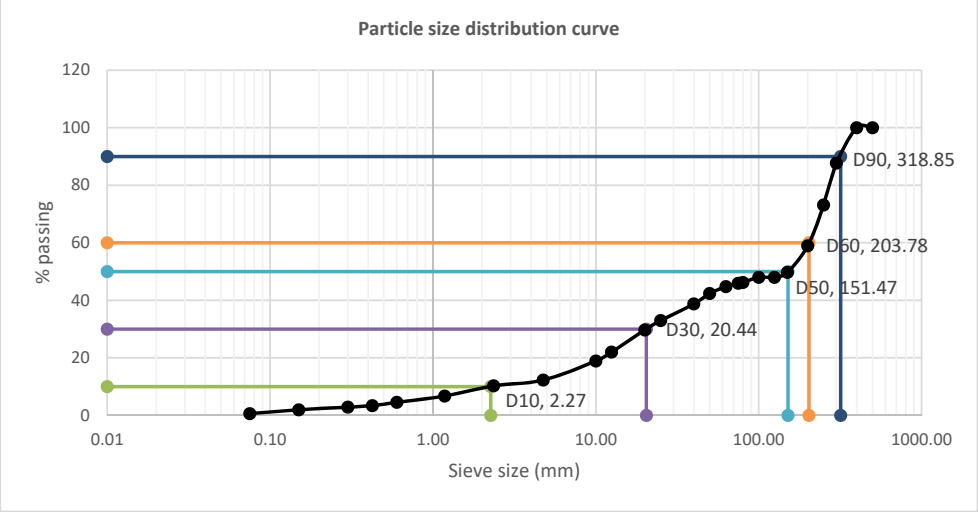
Total weight of sample (gm): 210695.20

Sieve size (mm)	Wt. of soil retained (gm)	Cu. wt. retained (gm)	Cu. % retained	% passing
500	0.00	0.00	0.00	100.00
400	0.00	0.00	0.00	100.00
300	25965.00	25965.00	12.32	87.68
250	30694.20	56659.20	26.89	73.11
200	29875.00	86534.20	41.07	58.93
150	19383.00	105917.20	50.27	49.73
125	3602.00	109519.20	51.98	48.02
100	0.00	109519.20	51.98	48.02
80	3830.00	113349.20	53.80	46.20
75	588.00	113937.20	54.08	45.92
63	2422.00	116359.20	55.23	44.77
50	5078.00	121437.20	57.64	42.36
40	7620.00	129057.20	61.25	38.75
25	12212.00	141269.20	67.05	32.95
20	6812.00	148081.20	70.28	29.72
12.5	16206.00	164287.20	77.97	22.03
10	6548.00	170835.20	81.08	18.92
4.75	13976.00	184811.20	87.71	12.29
2.36	4216.00	189027.20	89.72	10.28
1.18	7444.00	196471.20	93.25	6.75
0.6	4672.00	201143.20	95.47	4.53
0.425	2416.00	203559.20	96.61	3.39
0.3	1040.00	204599.20	97.11	2.89
0.15	2024.00	206623.20	98.07	1.93
0.075	2728.00	209351.20	99.36	0.64
Pan	1344.00	210695.20	100.00	0.00

Density of soil sample (ρ)= 2.61 gm/cc

Soil sample retained in 100 mm sieve:	
size 100-125mm	0 gm
size 125-150 mm	3602 gm
size >150 mm	10296 gm

weight i.e. Σ(V*ρ) of rocks existing in area of 1 sq. m. but not sampled	
size 125-150 mm	0 gm
size 150-200 mm	9087 gm
size 200-250 mm	29875 gm
size 250-300 mm	30694.2 gm
size >300 mm	25965 gm



D_{10} =	2.27 mm
D_{30} =	20.44 mm
D_{50} =	151.47 mm
D_{60} =	203.78 mm
D_{90} =	318.85 mm

Clay	0%
Silt	1%
Sand	12%
Gravel	88%

C_u=	89.96
C_c=	0.90

SIEVE ANALYSIS

Project: Sindhuli Road
Client: JICA
Location: Ghyampe Khola
Sample: Pit Sample
Depth: below 50 cm

Sampling date: 26th Sept. 2019
Testing date: 11th Oct. 2019
Tested by: S. Parajuli
Checked by: A. Karmacharya

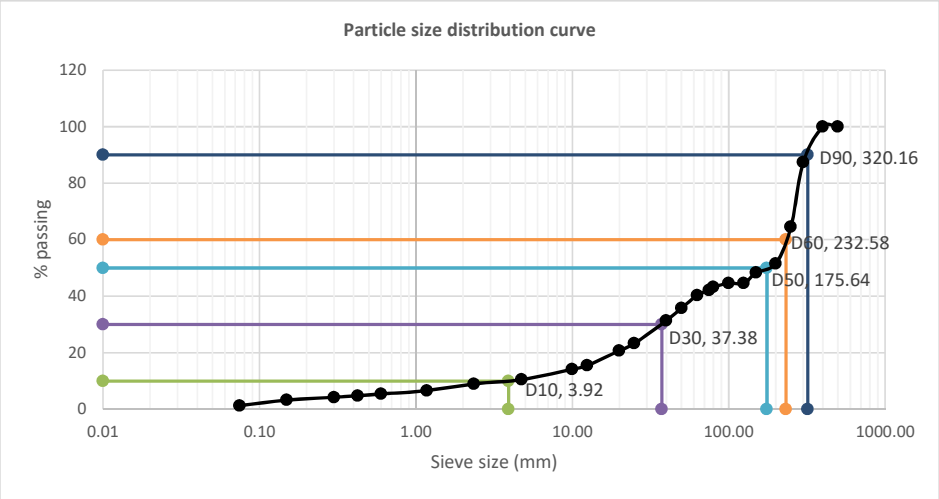
Total weight of sample (gm): 226925.88

Sieve size (mm)	Wt. of soil retained (gm)	Cu. wt. retained (gm)	Cu. % retained	% passing
500	0.00	0.00	0.00	100.00
400	0.00	0.00	0.00	100.00
300	28422.90	28422.90	12.53	87.47
250	52116.48	80539.38	35.49	64.51
200	29362.50	109901.88	48.43	51.57
150	7308.00	117209.88	51.65	48.35
125	8436.00	125645.88	55.37	44.63
100	0.00	125645.88	55.37	44.63
80	3184.00	128829.88	56.77	43.23
75	2438.00	131267.88	57.85	42.15
63	4180.00	135447.88	59.69	40.31
50	10184.00	145631.88	64.18	35.82
40	9994.00	155625.88	68.58	31.42
25	18428.00	174053.88	76.70	23.30
20	5732.00	179785.88	79.23	20.77
12.5	11906.00	191691.88	84.47	15.53
10	3072.00	194763.88	85.83	14.17
4.75	8294.00	203057.88	89.48	10.52
2.36	3388.00	206445.88	90.98	9.02
1.18	5424.00	211869.88	93.37	6.63
0.6	2672.00	214541.88	94.54	5.46
0.425	1392.00	215933.88	95.16	4.84
0.3	1304.00	217237.88	95.73	4.27
0.15	2176.00	219413.88	96.69	3.31
0.075	4528.00	223941.88	98.69	1.31
Pan	2984.00	226925.88	100.00	0.00

Density of soil sample (ρ)= 2.61 gm/cc

Soil sample retained in 100 mm sieve:	
size 100-125mm	0 gm
size 125-150 mm	8436 gm
size >150 mm	0 gm

weight i.e. Σ(V*ρ) of rocks existing in area of 1 sq. m. but not sampled	
size 125-150 mm	0 gm
size 150-200 mm	7308 gm
size 200-250 mm	29362.5 gm
size 250-300 mm	52116.48 gm
size >300 mm	28422.9 gm



D_{10} =	3.92 mm
D_{30} =	37.38 mm
D_{50} =	175.64 mm
D_{60} =	232.58 mm
D_{90} =	320.16 mm

Clay	0%
Silt	1%
Gravel	89%
Sand	9%

C_u=	59.32
C_c=	1.53

ANNEX F

PHOTOGRAPHS

F1 – SITE PHOTOS

F2 – RIVER BED SAMPLING PHOTOS

F3 – IN-SITU TEST PHOTOS

ANNEX F1.1 – SITE PHOTOS OF BHYAKURE KHOLA (B1)

Figure 1: Panorama photograph of site at B1

Figure 2: Photo from upstream of Bhyakure Khola at B1

Figure 3: Photo from downstream of Bhyakure Khola at B1

Figure 4: Operating Drill rig at B1

Figure 5: Operating Drill rig at B1

ANNEX F1.2 – SITE PHOTOS OF BHYAKURE KHOLA (B2)

Figure 1: Photo from upstream of Bhyakure Khola at B2

Figure 2: Photo from left bank of Bhyakure Khola at B2

Figure 3: Photo from right bank of Bhyakure Khola at B2

Figure 4: Drill rig before operation at B2

Figure 5: Operating Drill rig at B2

Figure 6: Operating Drill rig at B2

ANNEX F1.3 – SITE PHOTOS OF GHYAMPE KHOLA (G1)

Figure 1: Panorama photograph of site at Ghyampe Khola (G1)

Figure 2: Photo from upstream of Ghyampe Khola at G1

Figure 3: Photo from downstream of Ghyampe Khola at G1

Figure 4: Photo from left bank of Ghyampe Khola at G1

Figure 5: Drill rig before operation at G1

Figure 6: Operating Drill rig at G1

ANNEX F1.4 – SITE PHOTOS OF GHYAMPE KHOLA (G2)

Figure 1: Panorama photograph of site at Ghyampe Khola (G2)

Figure 2: Photo from upstream of Ghyampe Khola at G2

Figure 3: Photo from left bank of Ghyampe Khola at G2

Figure 4: Operating Drill rig at G2

ANNEX F2.1 – RIVER BED SAMPLING PHOTOS

Figure 1: Test Pit layout at Bhyakure Khola

Figure 2: Test Pit layout at Mamti Khola

Figure 3: Digging of Test Pit at Mamti Khola

Figure 4: Test Pit layout at Ghyampe Khola

Figure 5: Test Pit at Ghyampe Khola

Figure 6: Digging of Test Pit at Ghyampe Khola

ANNEX F3.1 – IN-SITU TEST PHOTOS OF BHYAKURE KHOLA (B1)

Figure 1: DCPT at borehole B1 (at depth 10 m)

Figure 2: DCPT at borehole B1 (at depth 11 m)

Figure 3: DCPT at borehole B1 (at depth 12 m)

Figure 4: DCPT at borehole B1 (at depth 13 m)

Figure 5: DCPT at borehole B1 (at depth 14 m)

Figure 6: DCPT at borehole B1 (at depth 15 m)

Figure 7: DCPT at borehole B1 (at depth 16 m)

Figure 8: DCPT Rod

Figure 9: SPT tube

ANNEX F3.2 – IN-SITU TEST PHOTOS OF BHYAKURE KHOLA (B2)

Figure 1: DCPT at borehole B2 (at depth 10 m)

Figure 2: DCPT at borehole B2 (at depth 11 m)

Figure 3: DCPT at borehole B2 (at depth 12 m)

Figure 4: DCPT at borehole B2 (at depth 13 m)

Figure 5: DCPT at borehole B2 (at depth 14 m)

Figure 6: Tube sample at 14 m of borehole B2

Figure 7: DCPT at borehole B2 (at depth 15 m)

Figure 8: DCPT at borehole B2 (at depth 16 m)

ANNEX F3.3 – IN-SITU TEST PHOTOS OF GHYAMPE KHOLA (G1)

Figure 1: DCPT at borehole G1 (at depth 10 m)

Figure 2: DCPT at borehole G1 (at depth 11 m)

Figure 3: DCPT at borehole G1 (at depth 12 m)

Figure 4: DCPT at borehole G1 (at depth 13 m)

Figure 5: DCPT at borehole G1 (at depth 14 m)

Figure 6: DCPT at borehole G1 (at depth 15 m)

Figure 7: DCPT at borehole G1 (at depth 16 m)

ANNEX F3.4 – IN-SITU TEST PHOTOS OF GHYAMPE KHOLA (G2)

Figure 1: DCPT at borehole G2 (at depth 11 m)

Figure 2: DCPT at borehole G2 (at depth 12 m)

Figure 3: DCPT at borehole G2 (at depth 13 m)

Figure 4: DCPT at borehole G2 (at depth 14 m)

Figure 5: DCPT at borehole G2 (at depth 15 m)

Figure 6: DCPT at borehole G2 (at depth 16 m)