Adjaristsqali Cascade Project ESIA

Appendices – Volume III

March 2012

Adjaristsqali Georgia LLC (AGL)

Clean Energy Group

Mott MacDonald

Adjaristsqali Cascade Project ESIA

Appendices – Volume III

March 2012

Adjaristsqali Georgia LLC (AGL)

Mott MacDonald, Victory House, Trafalgar Place, Brighton BN1 4FY, United Kingdom
T +44(0) 1273 365 000 F +44(0) 1273 365 100, W www.mottmac.com

Issue and revision record

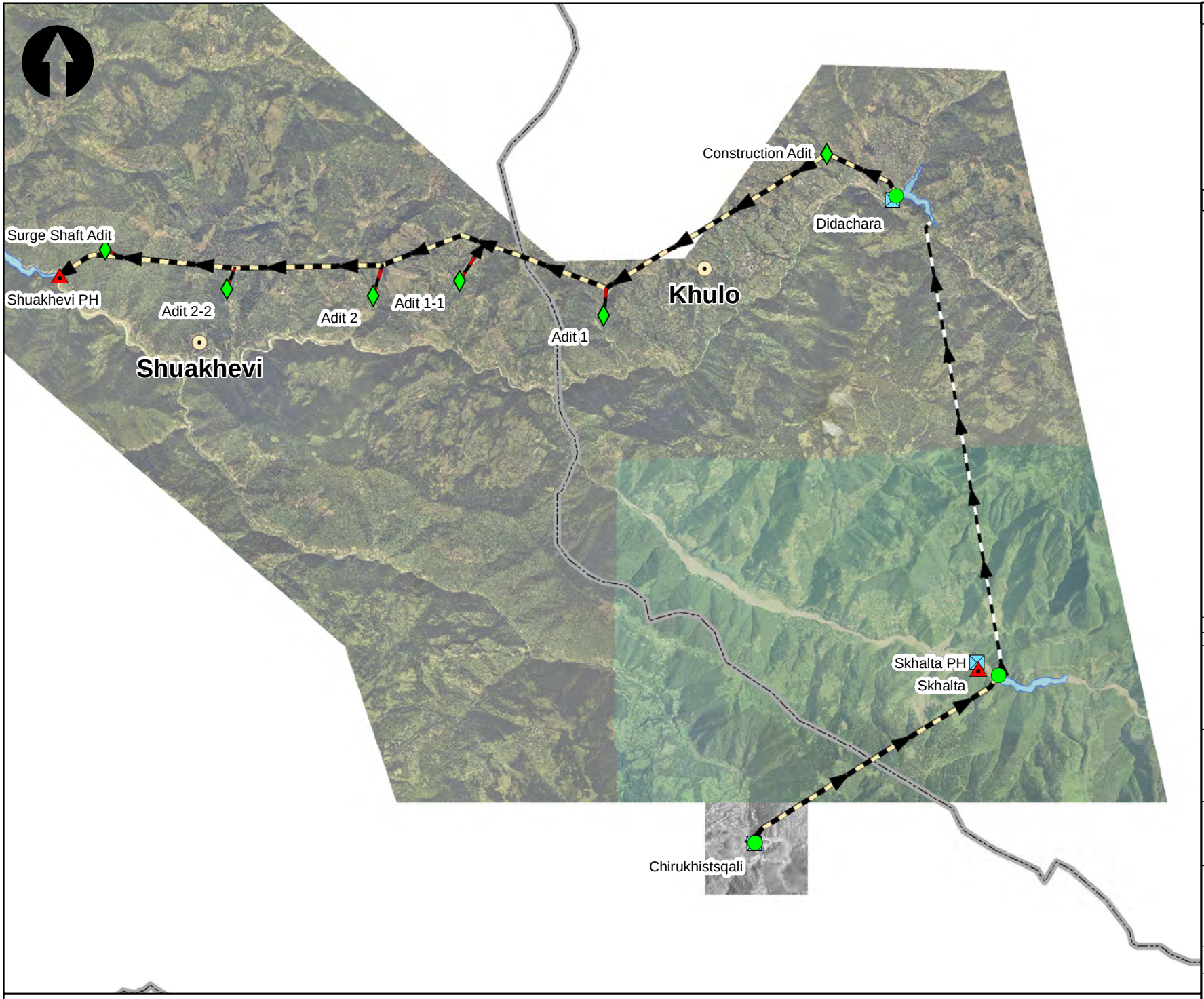
Revision	*Date*	*Originator*	*Checker*	*Approver*	*Description*
A	07.02.12	J. Glass	V. Hovland	L. Chapman	Draft for Client Review
B	16.03.12	J. Glass	V. Hovland	L. Chapman	Final Draft for Disclosure

Mott MacDonald, Victory House, Trafalgar Place, Brighton BN1 4FY, United Kingdom
T +44(0) 1273 365 000 F +44(0) 1273 365 100, W www.mottmac.com

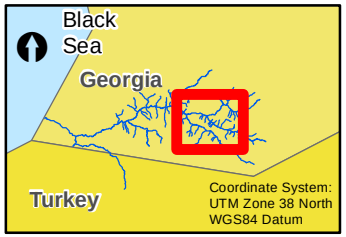
Content

Appendix A. Figures

A.1. Shuakhevi Scheme



Location Map



Legend

Permanent Structures

- Adit
- Dam
- Powerhouse
- Surge Shaft
- Intake
- Reservoir

Underground Tunnel

- Adit Tunnel
- Headrace Tunnel
- Transfer Tunnel
- Municipality Boundary

0 500 1,000 2,000 3,000 4,000 Meters

Rev	Date	Description	Drawn	Ch'k'd	App'd
P1	25/01/2012	For Information	WJG	JG	VH

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi
Georgia

Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

Gamma Consulting Limited
9, Merab Aleksidze Street,
Tbilisi 0193, Georgia

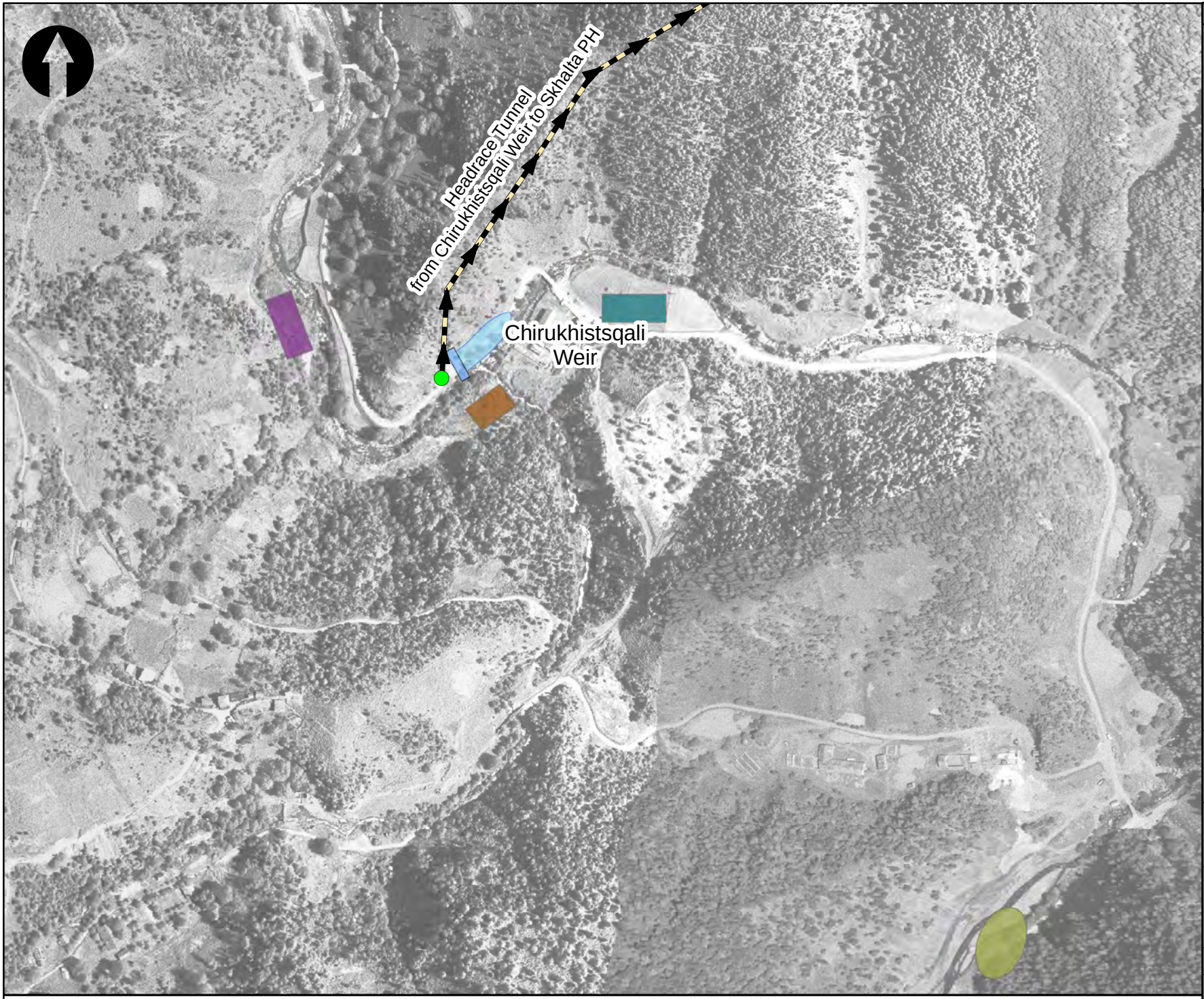
Drawing Title

Adjaristsqali Hydropower
Cascade Project
Shuakhevi Scheme Layout (Aerial)

Scale @ A4	MM Project No.	Status
1:100,000	290039	PRE

GIS File
20120112_Shuakhevi_Reservoir.mxd

Drawing No.	Rev
MMD-290039-MNC-SHU-07-001	P1



Location Map

Legend

Temporary Construction Structures

- Contractor Colony
- Existing Quarry
- Job Facility Area
- Office
- Proposed Quarry

Permanent Structures

- Portal
- Dam/Weir
- Powerhouse
- Reservoir
- Substation
- Surge Shaft

Underground Tunnel

- Adit Tunnel
- Headrace Tunnel
- Transfer Tunnel
- Intake

0 25 50 100 150 200 Meters

Rev	Date	Description	Drawn	Ch'k'd	App'd
P1	25/01/2012	For Information	WJG	JG	VH

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi
Georgia

Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

Gamma Consulting Limited
9, Merab Aleksidze Street,
Tbilisi 0193, Georgia

Drawing Title

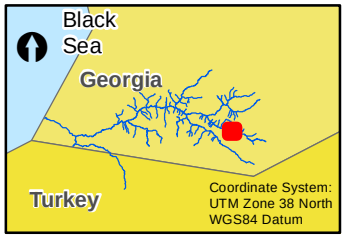
Adjaristsqali Hydropower
Cascade Project
Chirukhistsqali Weir

Scale @ A4	MM Project No.	Status
1:5,000	290039	PRE

GIS File
20120117_Chirukhistsqali.mxd

Drawing No.	Rev
MMD-290039-MNC-SHU-07-003	P1

Location Map



Legend

Temporary Construction Structures

- Contractor Colony
- Existing Quarry
- Job Facility Area
- Office
- Proposed Quarry

Permanent Structures

- Portal
- Dam
- Powerhouse
- Reservoir
- Substation
- Surge Shaft

Underground Tunnel

- Adit Tunnel
- Headrace Tunnel
- Transfer Tunnel
- Intake

0 50 100 200 300 400 Meters

Rev	Date	Description	Drawn	Ch'k'd	App'd
P1	25/01/2012	For Information	WJG	JG	VH

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi
Georgia

Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

Gamma Consulting Limited
9, Merab Aleksidze Street,
Tbilisi 0193, Georgia

Drawing Title

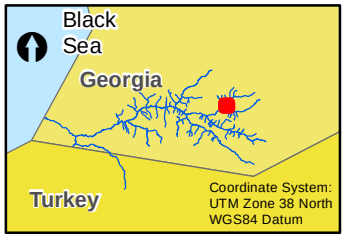
Adjaristsqali Hydropower
Cascade Project
Skhalta Reservoir

Scale @ A4	MM Project No.	Status
1:15,000	290039	PRE

GIS File
20120117_Skhalta.mxd

Drawing No.	Rev
MMD-290039-MNC-SHU-07-004	P1

Location Map



Legend

Temporary Construction Structures

- Contractor Colony
- Existing Quarry
- Job Facility Area
- Office
- Proposed Quarry

Permanent Structures

- Portal
- Dam
- Powerhouse
- Reservoir
- Substation
- Surge Shaft

Underground Tunnel

- Adit Tunnel
- Headrace Tunnel
- Transfer Tunnel
- Intake

0 50 100 200 300 400 Meters

Rev	Date	Description	Drawn	Ch'k'd	App'd
P1	25/01/2012	For Information	WJG	JG	VH

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi
Georgia

Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

Gamma Consulting Limited
9, Merab Aleksidze Street,
Tbilisi 0193, Georgia

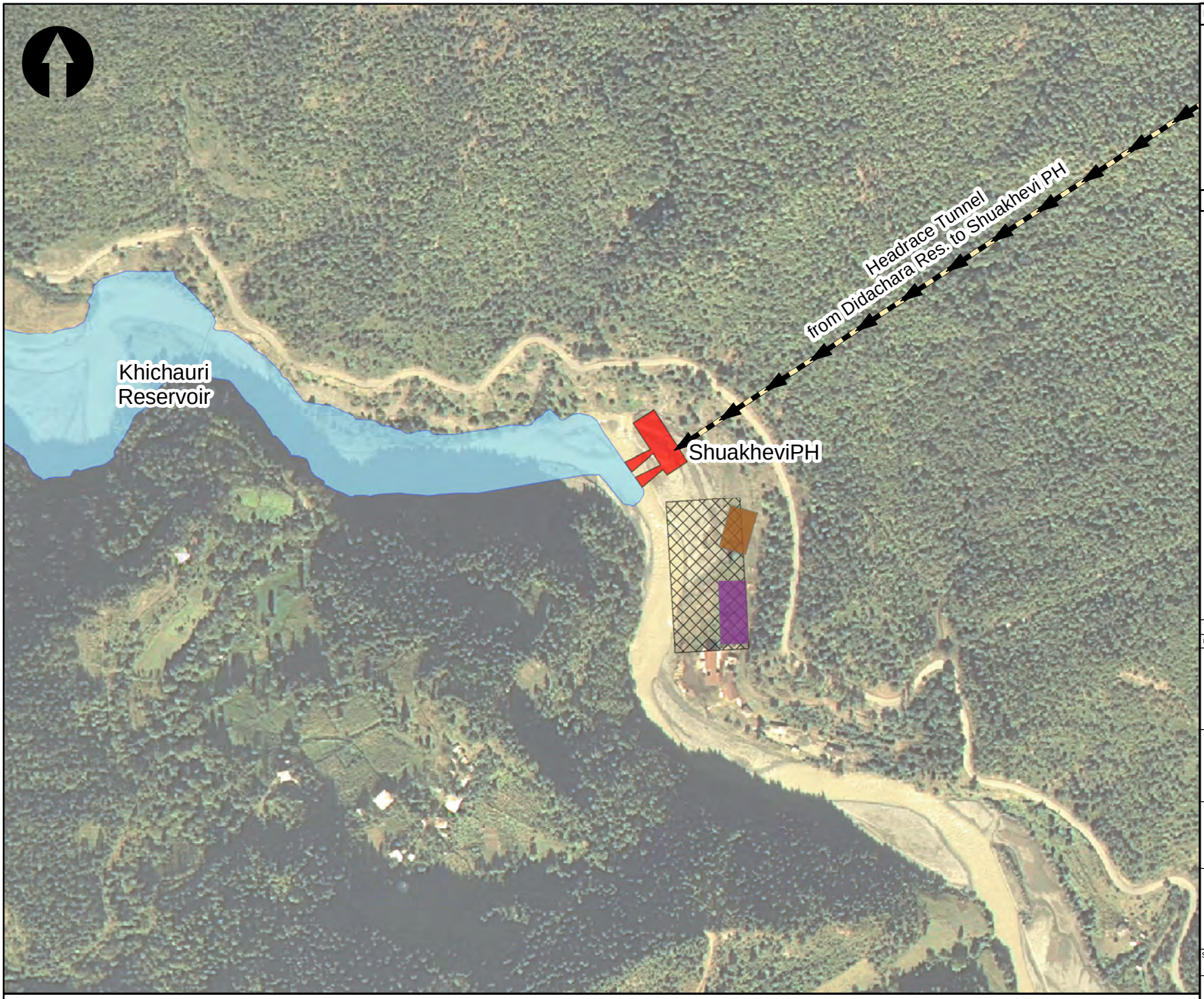
Drawing Title

Adjaristsqali Hydropower
Cascade Project
Didachara Reservoir

Scale @ A4	MM Project No.	Status
1:10,000	290039	PRE

GIS File
20120117_Didachara.mxd

Drawing No.	Rev
MMD-290039-MNC-SHU-07-005	P1



Location Map

Legend

Temporary Construction Structures

- Contractor Colony
- Existing Quarry
- Job Facility Area
- Office
- Proposed Quarry

Permanent Structures

- Portal
- Dam
- Powerhouse
- Reservoir
- Substation
- Surge Shaft

Underground Tunnel

- Adit Tunnel
- Headrace Tunnel
- Transfer Tunnel
- Intake

0 25 50 100 150 200 Meters

Rev	Date	Description	Drawn	Ch'k'd	App'd
P1	25/01/2012	For Information	WJG	JG	VH

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi
Georgia

Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

Gamma Consulting Limited
9, Merab Aleksidze Street,
Tbilisi 0193, Georgia

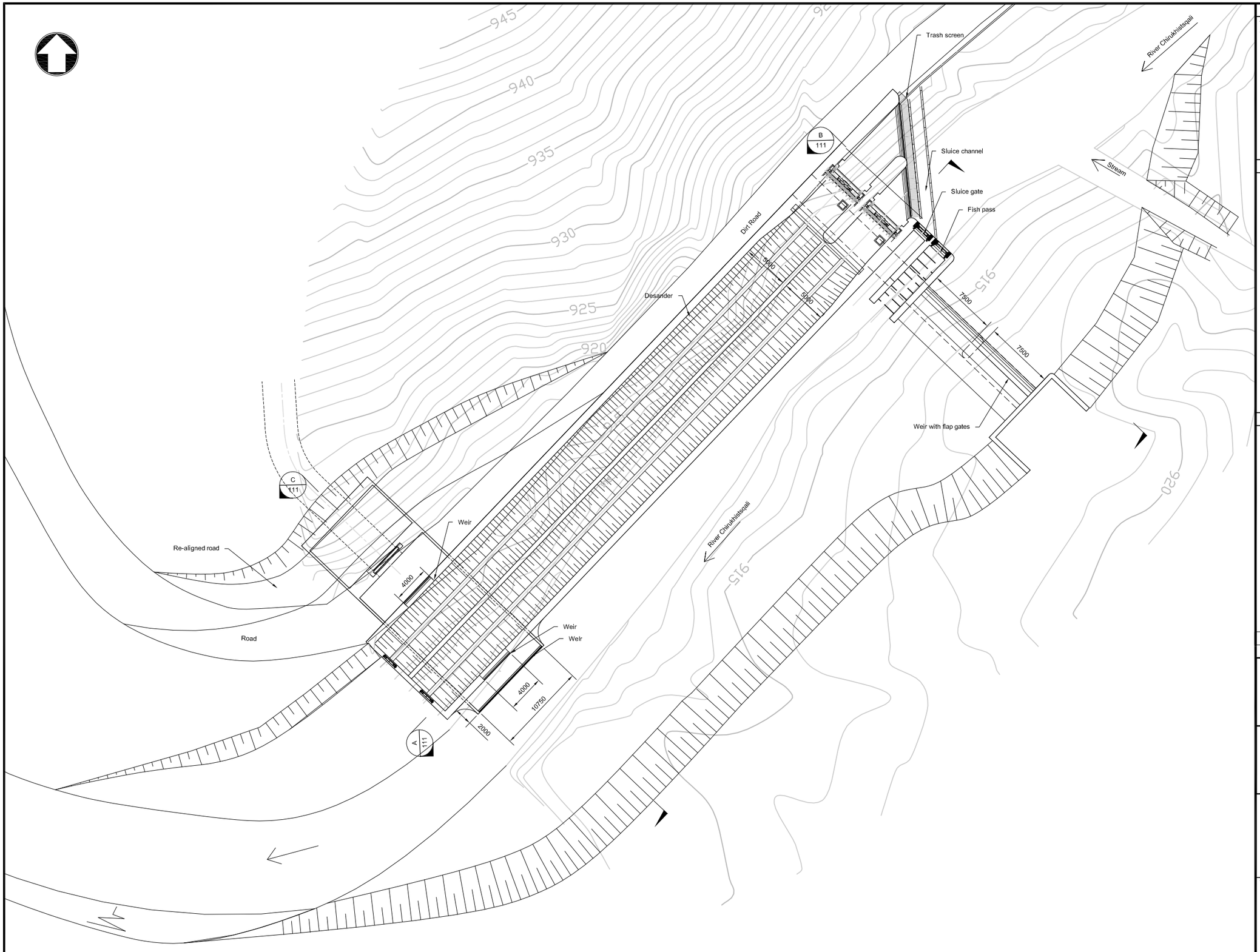
Drawing Title

Adjaristsqali Hydropower
Cascade Project
Shuakhevi Power House

Scale @ A4	MM Project No.	Status
1:5,000	290039	PRE

GIS File
20120117_Shuakhevi_Powerhouse.mxd

Drawing No.	Rev
MMD-290039-MNC-SHU-07-006	P1



Notes

1. All levels are in metres elevation.
2. All dimensions are in millimetres unless otherwise stated.

Key to symbols

Reference drawings

1:200 @A1 — 0, 10m, 20m

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	09/12/11	TW	Preliminary Issue	JDP	JHM

Mott MacDonald

Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

GEG GROSS ENERGY GROUP Engineering & Consulting

DOLSAR Engineering Ltd

Client

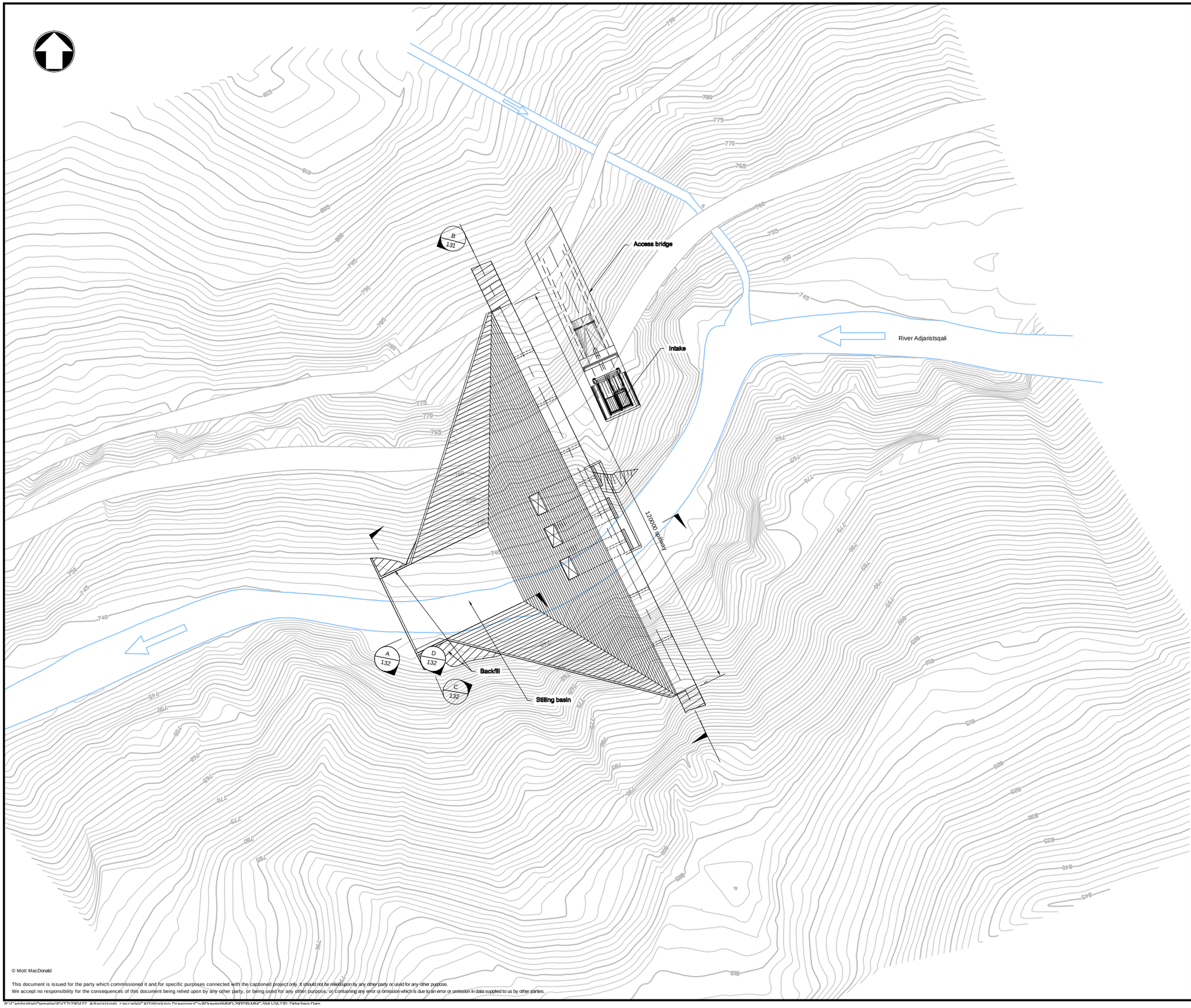
Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi Georgia

Title

Adjaristsqali Hydropower Cascade Feasibility Study
Chirukhistsqali Weir and Desilting Basin
Plan

Designed	P Harvey		Eng check	J Prytherch	
Drawn	T Wood		Coordination	-	
Dwg check	J Prytherch		Approved	J Meldrum	
Scale at A1	1:200	Status	PRE	Rev	P1

Drawing Number
MMD-290039-MNC-SHU-04-110



Notes

1. All levels are in metres elevation.
2. All dimensions are in millimetres unless otherwise stated.

Key to symbols

Reference drawings

1:500 @A1 — 0 — 25m — 50m

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	02/12/11	TW	Preliminary Issue	JDP	JHM

Mott MacDonald
Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

GEG
GROSS ENERGY GROUP
Engineering & Consulting

DOLSAR
Engineering Ltd

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi Georgia

Title

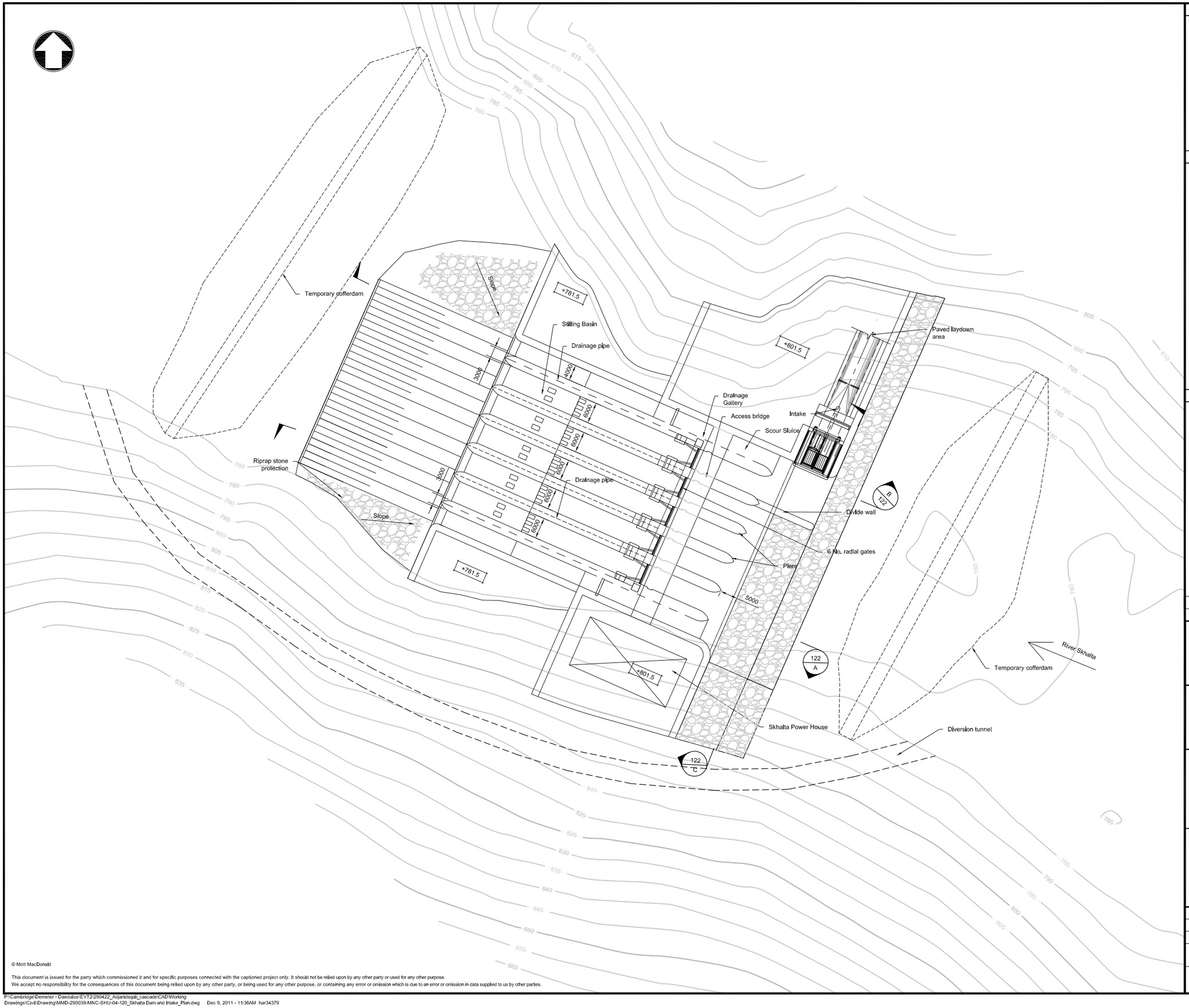
Adjaristsqali Hydropower Cascade
Feasibility Study
Didachara Dam and Intake
Plan

Designed	P Harvey		Eng check	J Prytherch	
Drawn	T Wood		Coordination	x	
Dwg check	P Harvey		Approved	J Meldrum	

Scale at A1	Status	Rev
As Shown	PRE	P1

Drawing Number
MMD-290039-MNC-SHU-04-130

P:\Cambridge\Damster\EVT\290422_Adjaristsqali_cascade\CAD\Working Drawings\Civil\Drawing\MMD-290039\MMD-SHE\04-130_Didachara Dam



P:\Cambridge\Demeter - Daedalus\EVT2\290422_Adjaristsqali_cascade\CAD\Working Drawings\Civil\Drawing\MMD-290039-MNC-SHU-04-120_Skhalta Dam and Intake_Plan.dwg Dec 9, 2011 - 11:36AM har34379

Notes

1. All levels are in metres elevation.
2. All dimensions are in metres unless otherwise stated.

Key to symbols

Reference drawings

1:500 @A1 — 0 — 25m — 50m

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	15/11/11	TW	Preliminary Issue	JDP	JHM

Mott MacDonald
Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

GEG
GROSS ENERGY GROUP
Engineering & Consulting

DOLSAR
Engineering Ltd

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi Georgia

Title

Adjaristsqali Hydropower Cascade Feasibility Study
Skhalta Dam and Intake
Plan

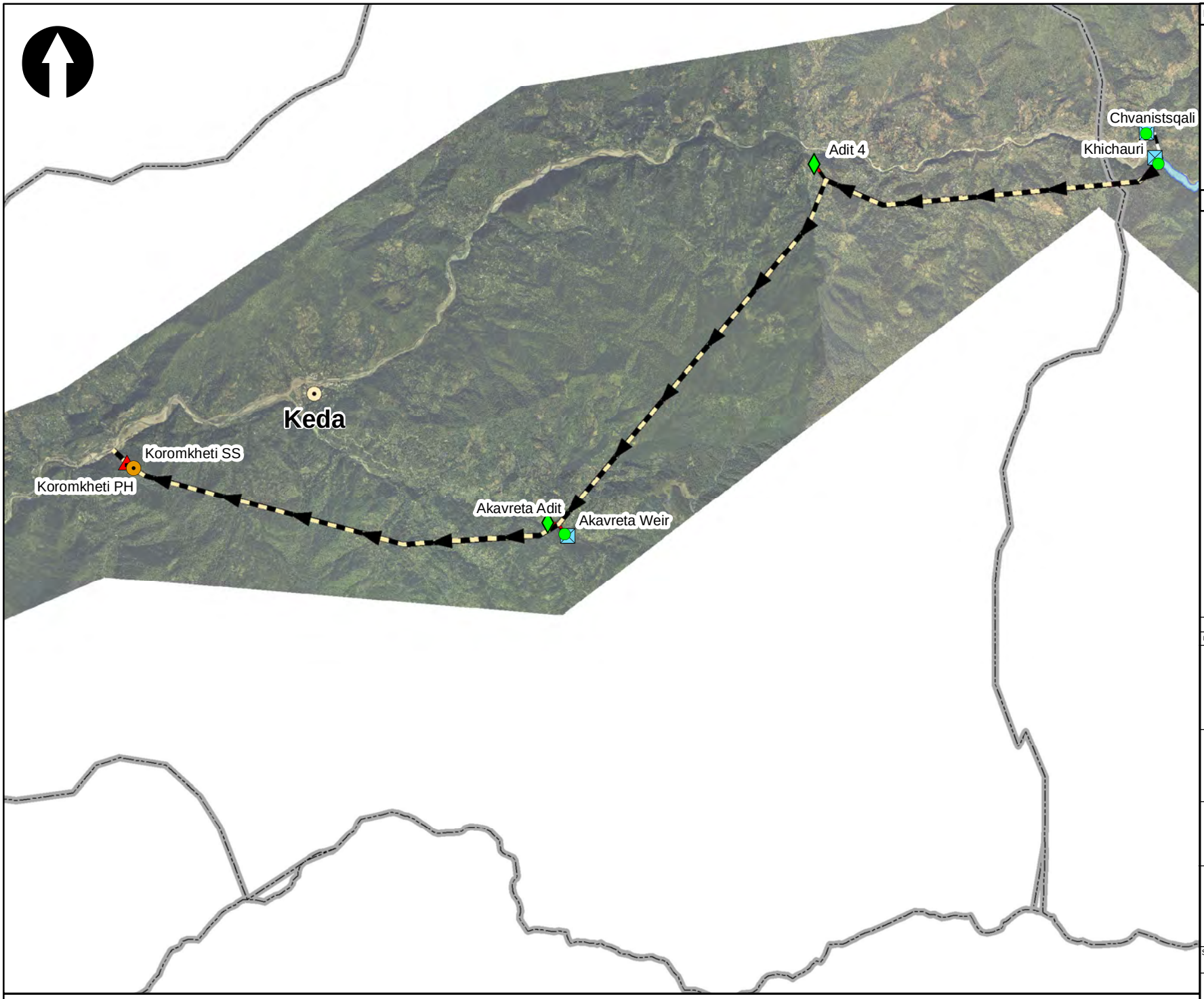
Designed	P Harvey		Eng check	J Prytherch	
Drawn	T Wood		Coordination	-	
Dwg check	J Prytherch		Approved	J Meldrum	

Scale at A1	Status	Rev
1:500	PRE	P1

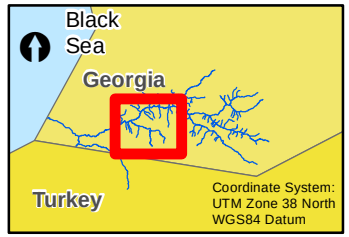
Drawing Number

MMD-290039-MNC-SHU-04-120

A.2. Koromkheti Scheme



Location Map



Legend

Permanent Structures

- Adit
- Dam/Weir
- Powerhouse
- Surge Shaft
- Intake
- Reservoir

Underground Tunnel

- Adit Tunnel
- Headrace Tunnel
- Transfer Tunnel
- Municipality Boundary

0 500 1,000 2,000 3,000 4,000 Meters

Rev	Date	Description	Drawn	Ch'k'd	App'd
P1	25/01/2012	For Information	WJG	JG	VH

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi
Georgia

Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

Gamma Consulting Limited
9, Merab Aleksidze Street,
Tbilisi 0193, Georgia

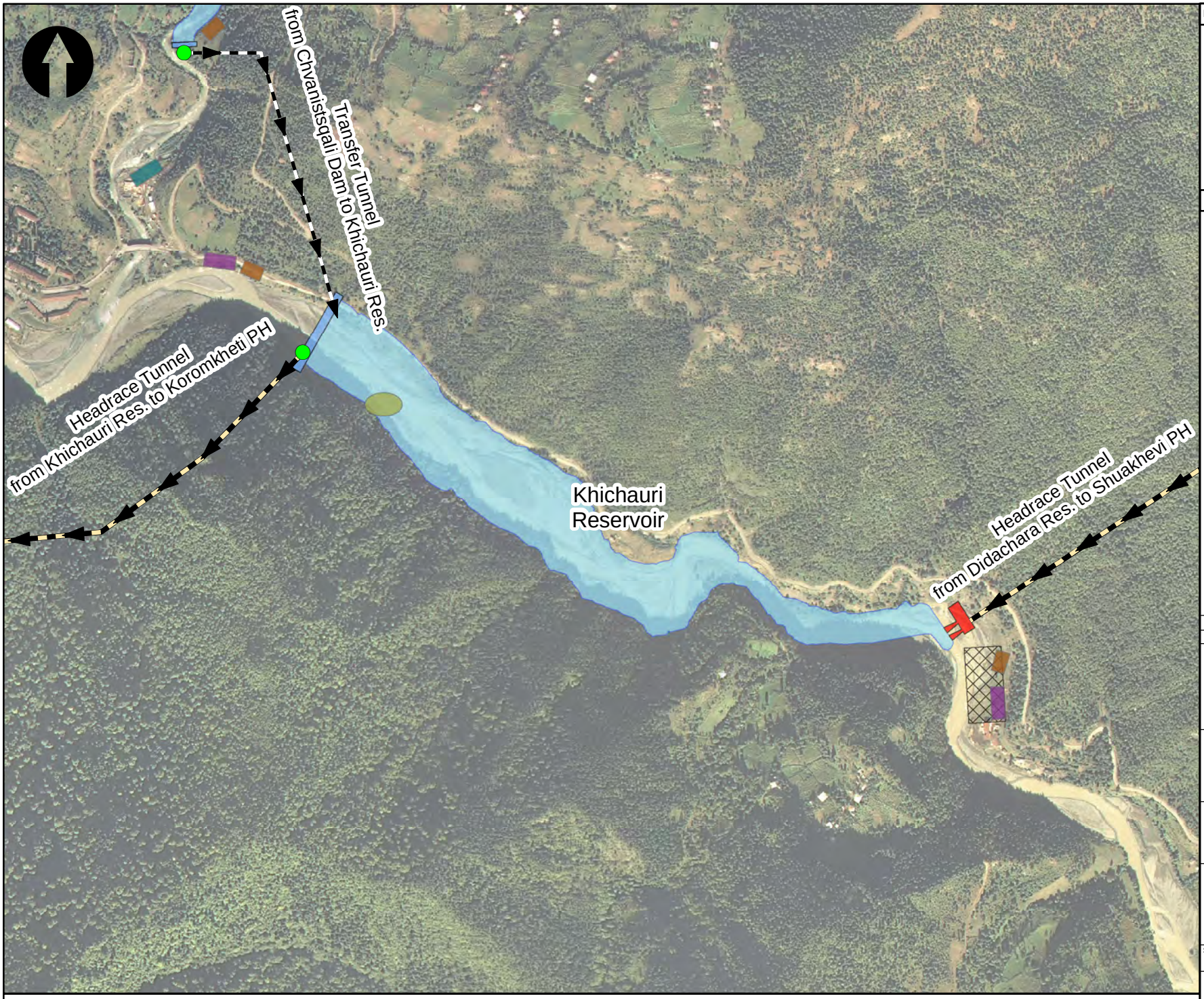
Drawing Title

Adjaristsqali Hydropower
Cascade Project
Khoromkheti Scheme Layout (Aerial)

Scale @ A4	MM Project No.	Status
1:100,000	290039	PRE

GIS File
20120112_Koromkheti_Reservoir.mxd

Drawing No.	Rev
MMD-290039-MNC-KOR-07-001	P1



Location Map

Legend

Temporary Construction Structures

- Contractor Colony
- Existing Quarry
- Job Facility Area
- Office
- Proposed Quarry

Permanent Structures

- Portal
- Dam
- Powerhouse
- Reservoir
- Substation
- Surge Shaft

Underground Tunnel

- Adit Tunnel
- Headrace Tunnel
- Transfer Tunnel
- Intake

0 50 100 200 300 400 Meters

Rev	Date	Description	Drawn	Ch'kd	App'd
P1	25/01/2012	For Information	WJG	JG	VH

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi
Georgia

Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

Gamma Consulting Limited
9, Merab Aleksidze Street,
Tbilisi 0193, Georgia

Drawing Title

Adjaristsqali Hydropower
Cascade Project
Khichauri Reservior

Scale @ A4	MM Project No.	Status
1:10,000	290039	PRE

GIS File
20120117_Khichauri.mxd

Drawing No.	Rev
MMD-290039-MNC-KOR-07-003	P1

Location Map

Legend

Temporary Construction Structures

- Contractor Colony
- Existing Quarry
- Job Facility Area
- Office
- Proposed Quarry

Permanent Structures

- Portal
- Dam
- Powerhouse
- Reservoir
- Substation
- Surge Shaft

Underground Tunnel

- Adit Tunnel
- Headrace Tunnel
- Transfer Tunnel
- Intake

0 25 50 100 150 200 Meters

Rev	Date	Description	Drawn	Ch'k'd	App'd
P1	25/01/2012	For Information	WJG	JG	VH

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi
Georgia

Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

Gamma Consulting Limited
9, Merab Aleksidze Street,
Tbilisi 0193, Georgia

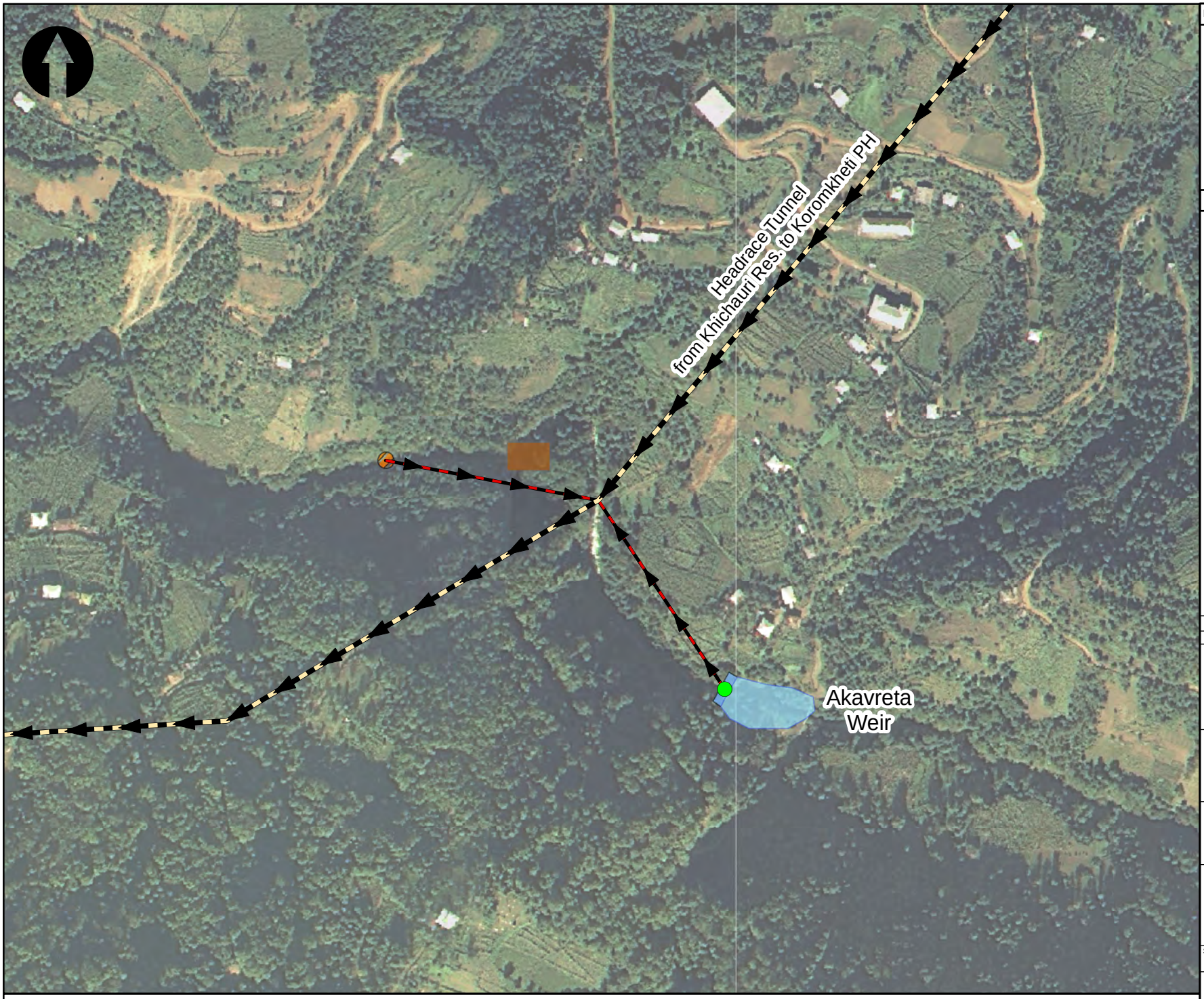
Drawing Title

Adjaristsqali Hydropower
Cascade Project
Chvanistsqali Dam

Scale @ A4	MM Project No.	Status
1:5,000	290039	PRE

GIS File
20120117_Chvanistsqali.mxd

Drawing No.	Rev
MMD-290039-MNC-KOR-07-004	P1



Location Map

Legend

Temporary Construction Structures

- Contractor Colony
- Existing Quarry
- Job Facility Area
- Office
- Proposed Quarry

Permanent Structures

- Portal
- Dam/Weir
- Powerhouse
- Reservoir
- Substation
- Surge Shaft

Underground Tunnel

- Adit Tunnel
- Headrace Tunnel
- Transfer Tunnel
- Intake

0 25 50 100 150 200 Meters

Rev	Date	Description	Drawn	Ch'k'd	App'd
P1	25/01/2012	For Information	WJG	JG	VH

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi
Georgia

Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

Gamma Consulting Limited
9, Merab Aleksidze Street,
Tbilisi 0193, Georgia

Drawing Title

Adjaristsqali Hydropower
Cascade Project
Akavreta Weir

Scale @ A4	MM Project No.	Status
1:5,000	290039	PRE

GIS File
20120117_Akavreta.mxd

Drawing No.	Rev
MMD-290039-MNC-KOR-07-005	P1

Location Map

Legend

Temporary Construction Structures

- Contractor Colony
- Existing Quarry
- Job Facility Area
- Office
- Proposed Quarry

Permanent Structures

- Portal
- Dam
- Powerhouse (Underground)
- Reservoir
- Substation
- Surge Shaft

Underground Tunnel

- Adit Tunnel
- Headrace Tunnel
- Transfer Tunnel
- Intake

0 25 50 100 150 200 Meters

Rev	Date	Description	Drawn	Ch'k'd	App'd
P1	25/01/2012	For Information	WJG	JG	VH

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi
Georgia

Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

Gamma Consulting Limited
9, Merab Aleksidze Street,
Tbilisi 0193, Georgia

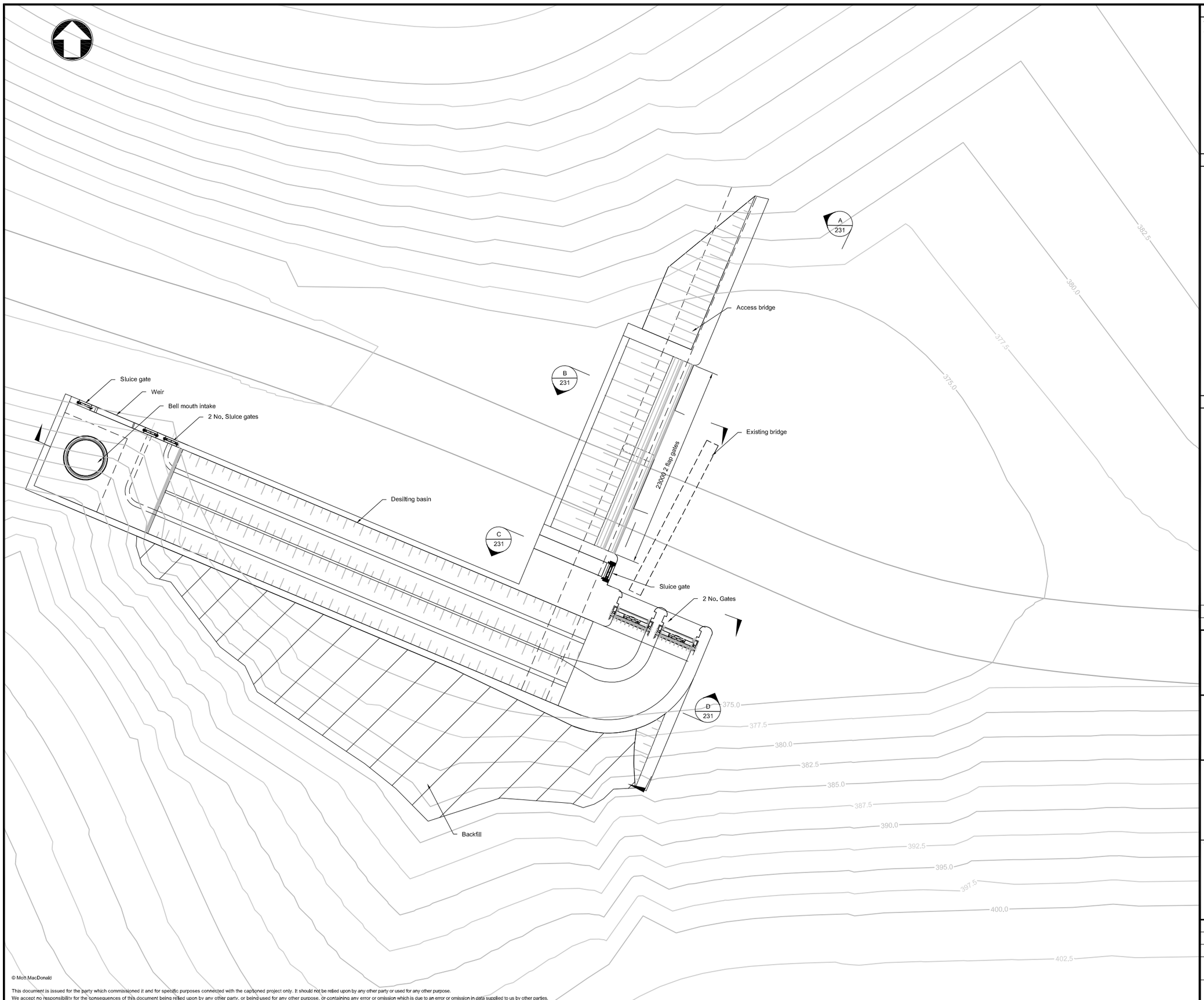
Drawing Title

Adjaristsqali Hydropower
Cascade Project
Koromkheti Power House

Scale @ A4	MM Project No.	Status
1:5,000	290039	PRE

GIS File
20120117_Koromkheti_Powerhouse.mxd

Drawing No.	Rev
MMD-290039-MNC-KOR-07-006	P1



P:\Cambridge\Demeter - Daedalus\EVT2\290422_Adjaristsqali_cascade\CAD\Working Drawings\Civil\Drawing\MMD-290039-MNC-KOR-04-230_Akavreta weir and intake_Plan.dwg Dec 22, 2011 - 5:57PM woo43004

Notes

1. All levels are in metres elevation.
2. All dimensions are in millimetres unless otherwise stated.

Key to symbols

Reference drawings

0 10m 20m
1:200
@A1

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	22/12/11	TW	Preliminary Issue	JDP	JHM

Mott MacDonald
Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

GEG
GROSS ENERGY GROUP
Engineering & Consulting

DOLSAR
Engineering Ltd

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi Georgia

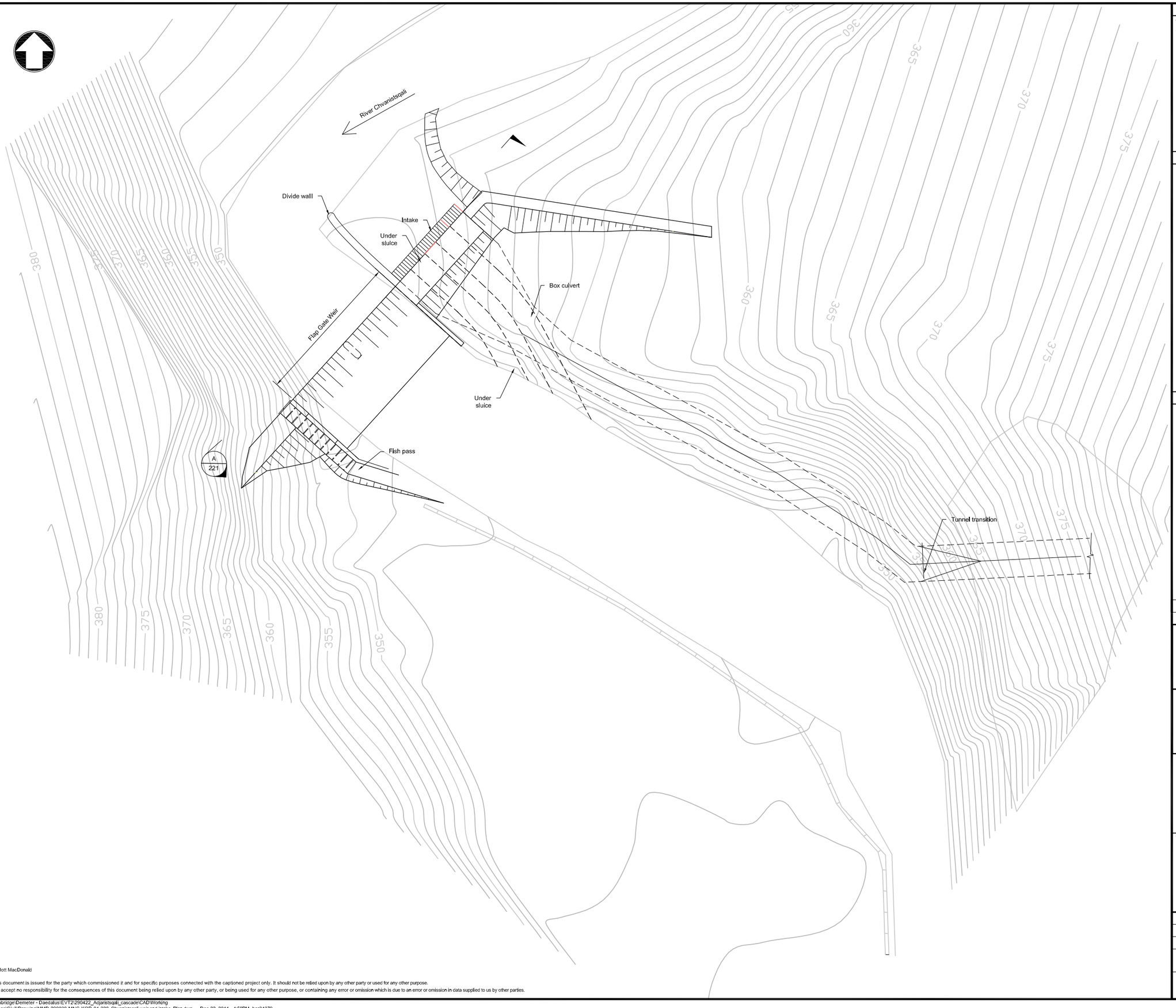
Title

Adjaristsqali Hydropower Cascade Feasibility Study Akavreta Weir and Intake Plan

Designed	P Harvey		Eng check	J Prytherch	
Drawn	T Wood		Coordination	-	
Dwg check	J Prytherch		Approved	J Meldrum	

Scale at A1	Status	Rev
1:200	PRE	P1

Drawing Number
MMD-290039-MNC-KOR-04-230



Notes

1. All levels in metres elevation.
2. All dimensions in millimetres unless otherwise stated.

Key to symbols

Reference drawings

1:250 @A1 — 0 — 12.5m — 25m

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	19/12/11	TW	Preliminary Issue	JDP	JHM

Mott MacDonald
Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

GEG GROSS ENERGY GROUP Engineering & Consulting

DOLSAR Engineering Ltd

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi Georgia

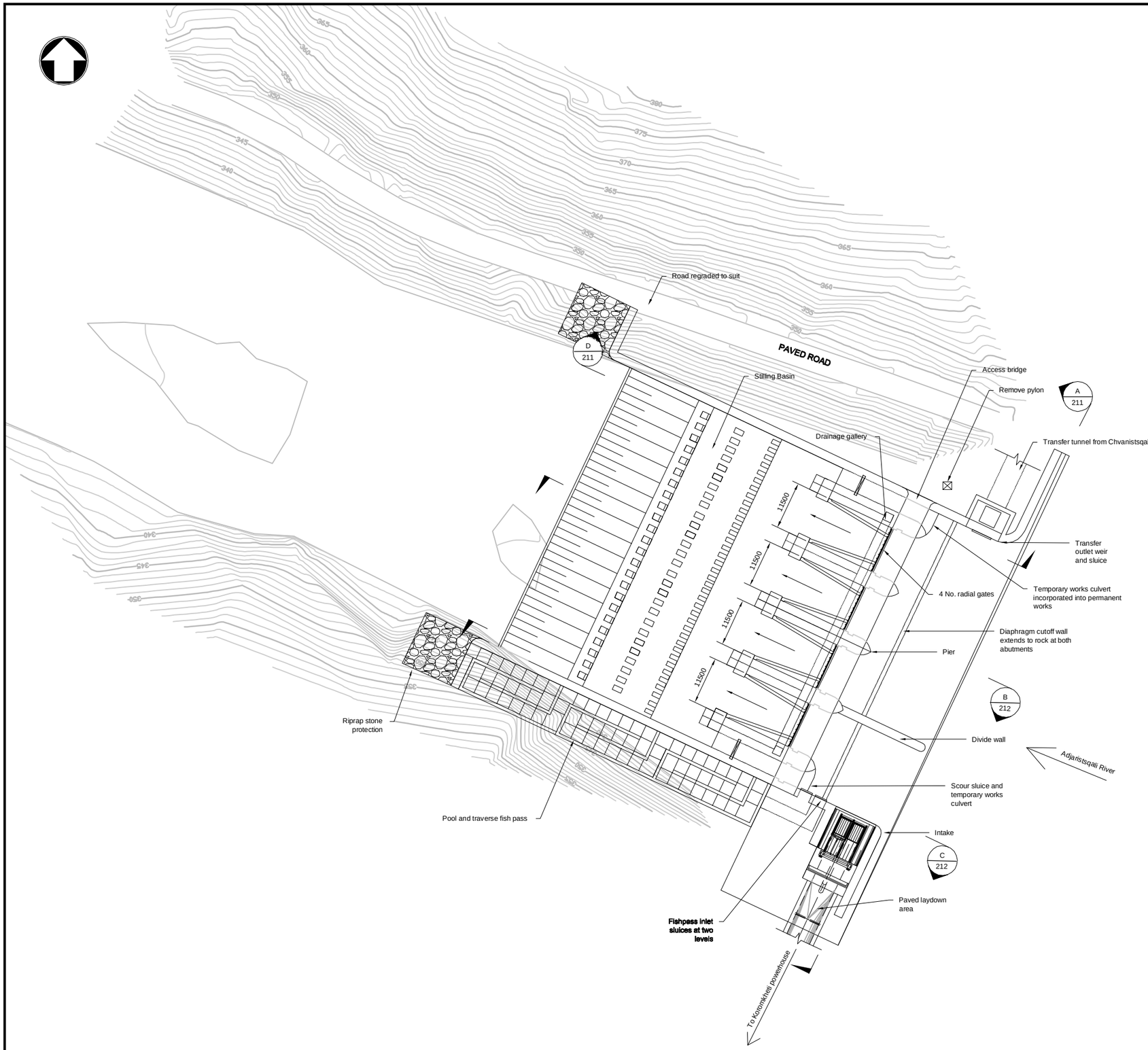
Title

Adjaristsqali Hydropower Cascade Feasibility Study Chvanistsqali Weir and Intake Plan

Designed	P Harvey		Eng check	J Prytherch	
Drawn	T Wood		Coordination	-	
Dwg check	J Prytherch		Approved	J Meldrum	

Scale at A1	Status	Rev
1:250	PRE	P1

Drawing Number
MMD-290039-MNC-KOR-04-220



Notes

1. All levels in metres elevation.
2. All dimensions in millimetres unless otherwise stated.

Key to symbols

Reference drawings

1:500 @A1

0 25m 50m

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	22/12/11	TW	Preliminary Issue	JDP	JHM

Mott MacDonald
Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

GEG
GROSS ENERGY GROUP
Engineering & Consulting

DOLSAR
Engineering Ltd

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi Georgia

Title

Adjaristsqali Hydropower Cascade
Feasibility Study
Khichauri Dam and Intake
Plan

Designed	R Gauldie		Eng check	J Prytherch	
Drawn	T Wood		Coordination	-	
Dwg check	J Prytherch		Approved	J Meldrum	

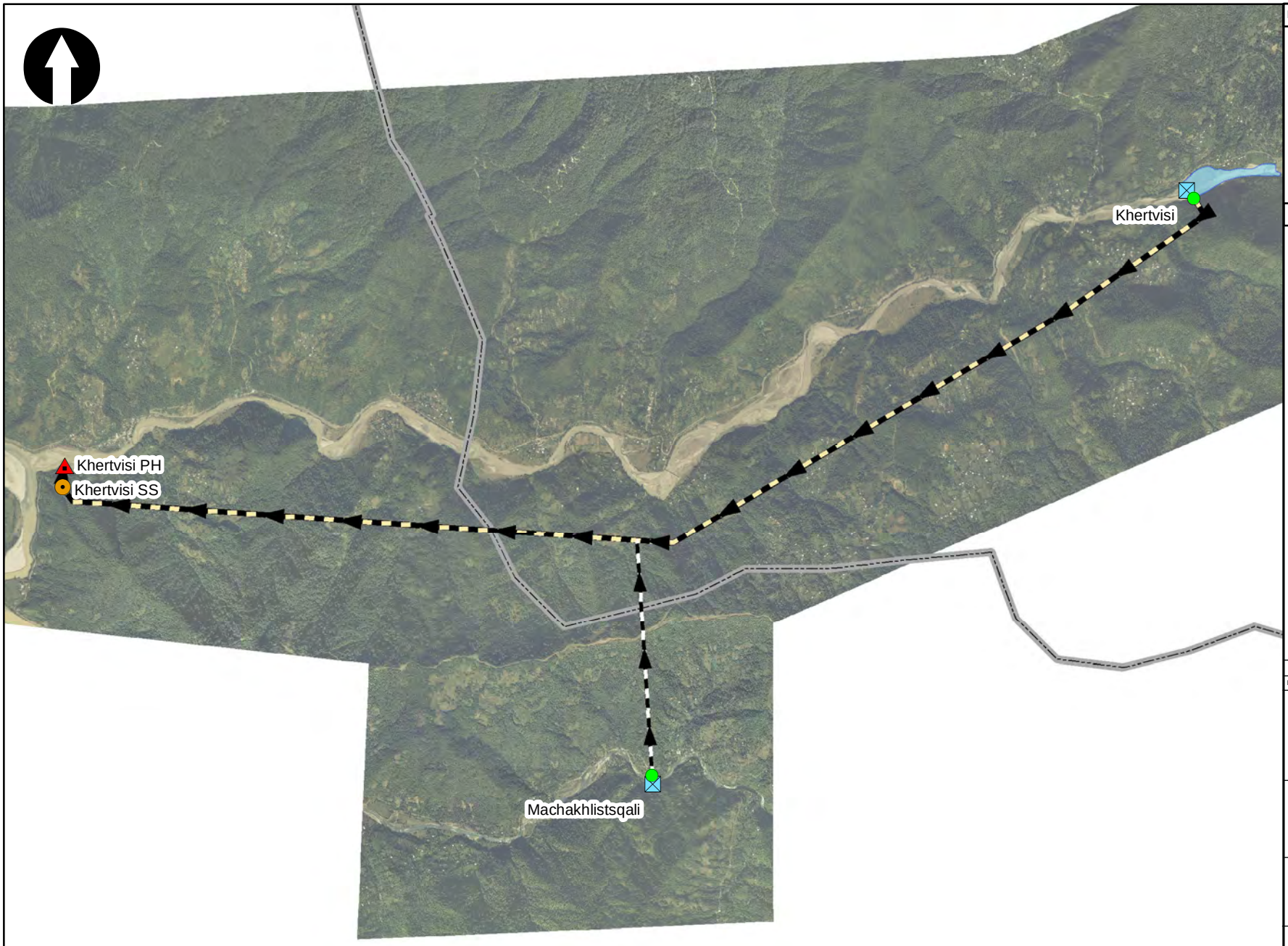
Scale at A1	Status	Rev
1:500	PRE	P1

Drawing Number

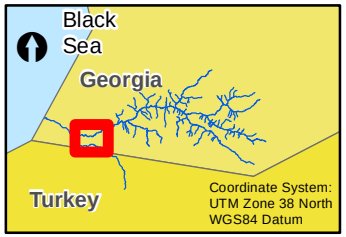
MMD-290039-MNC-KOR-04-210

P:\Cambridge\Dgmeter\EVT2\290422_Adjaristsqali_cascade\CAD\Outgoing Drawings\Draft\2011.12.22\MMD-290039-MNC-KOR-04-210_khichauri

A.3. Khertvisi Scheme



Location Map



Legend

Permanent Structures

- Adit
- Dam/Weir
- Powerhouse
- Surge Shaft
- Intake
- Reservoir

Underground Tunnel

- Adit Tunnel
- Headrace Tunnel
- Transfer Tunnel
- Municipality Boundary

0 250 500 1,000 1,500 2,000 Meters

Rev	Date	Description	Drawn	Ch'k'd	App'd
P1	25/01/2012	For Information	WJG	JG	VH

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi
Georgia

Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

Gamma Consulting Limited
9, Merab Aleksidze Street,
Tbilisi 0193, Georgia

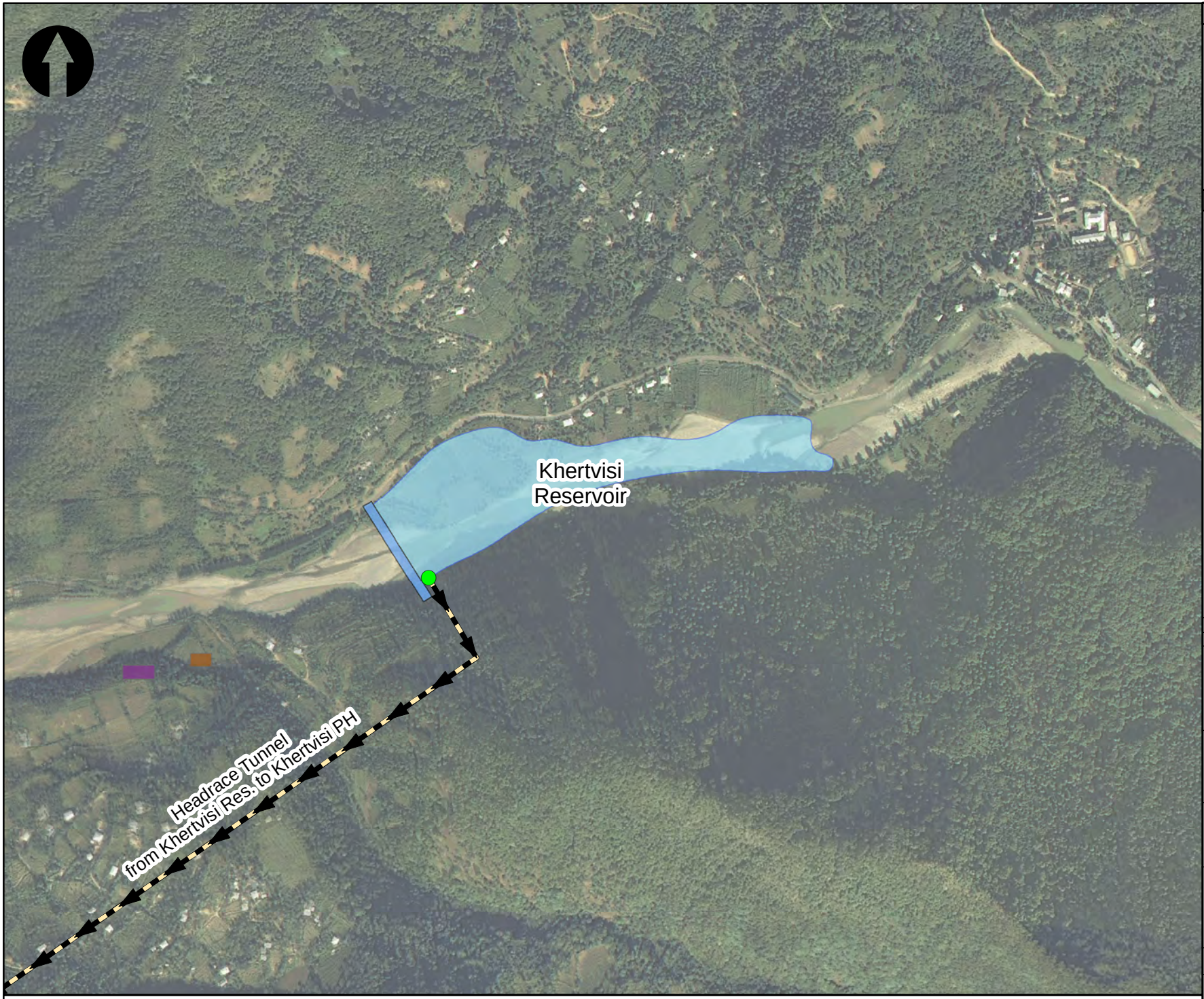
Drawing Title

Adjaristsqali Hydropower
Cascade Project
Khertvisi Overall Scheme Layout (Aerial)

Scale @ A4	MM Project No.	Status
1:50,000	290039	PRE

GIS File
20120112_Khertvisi_Reservoir.mxd

Drawing No.	Rev
MMD-290039-MNC-KHE-07-001	P1



Location Map

Legend

Temporary Construction Structures

- Contractor Colony
- Existing Quarry
- Job Facility Area
- Office
- Proposed Quarry

Permanent Structures

- Portal
- Dam/Weir
- Powerhouse
- Reservoir
- Substation
- Surge Shaft

Underground Tunnel

- Adit Tunnel
- Headrace Tunnel
- Transfer Tunnel
- Intake

0 50 100 200 300 400 Meters

Rev	Date	Description	Drawn	Ch'k'd	App'd
P1	25/01/2012	For Information	WJG	JG	VH

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi
Georgia

Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

Gamma Consulting Limited
9, Merab Aleksidze Street,
Tbilisi 0193, Georgia

Drawing Title

Adjaristsqali Hydropower
Cascade Project
Khertvisi Reservoir

Scale @ A4	MM Project No.	Status
1:10,000	290039	PRE

GIS File
20120117_Khertvisi.mxd

Drawing No.	Rev
MMD-290039-MNC-KHE-07-003	P1

Location Map

Legend

Temporary Construction Structures

- Contractor Colony
- Existing Quarry
- Job Facility Area
- Office
- Proposed Quarry

Permanent Structures

- Portal
- Dam/Weir
- Powerhouse
- Reservoir
- Substation
- Surge Shaft

Underground Tunnel

- Adit Tunnel
- Headrace Tunnel
- Transfer Tunnel
- Intake

0 50 100 200 300 400 Meters

Rev	Date	Description	Drawn	Ch'k'd	App'd
P1	25/01/2012	For Information	WJG	JG	VH

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi
Georgia

Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

Gamma Consulting Limited
9, Merab Aleksidze Street,
Tbilisi 0193, Georgia

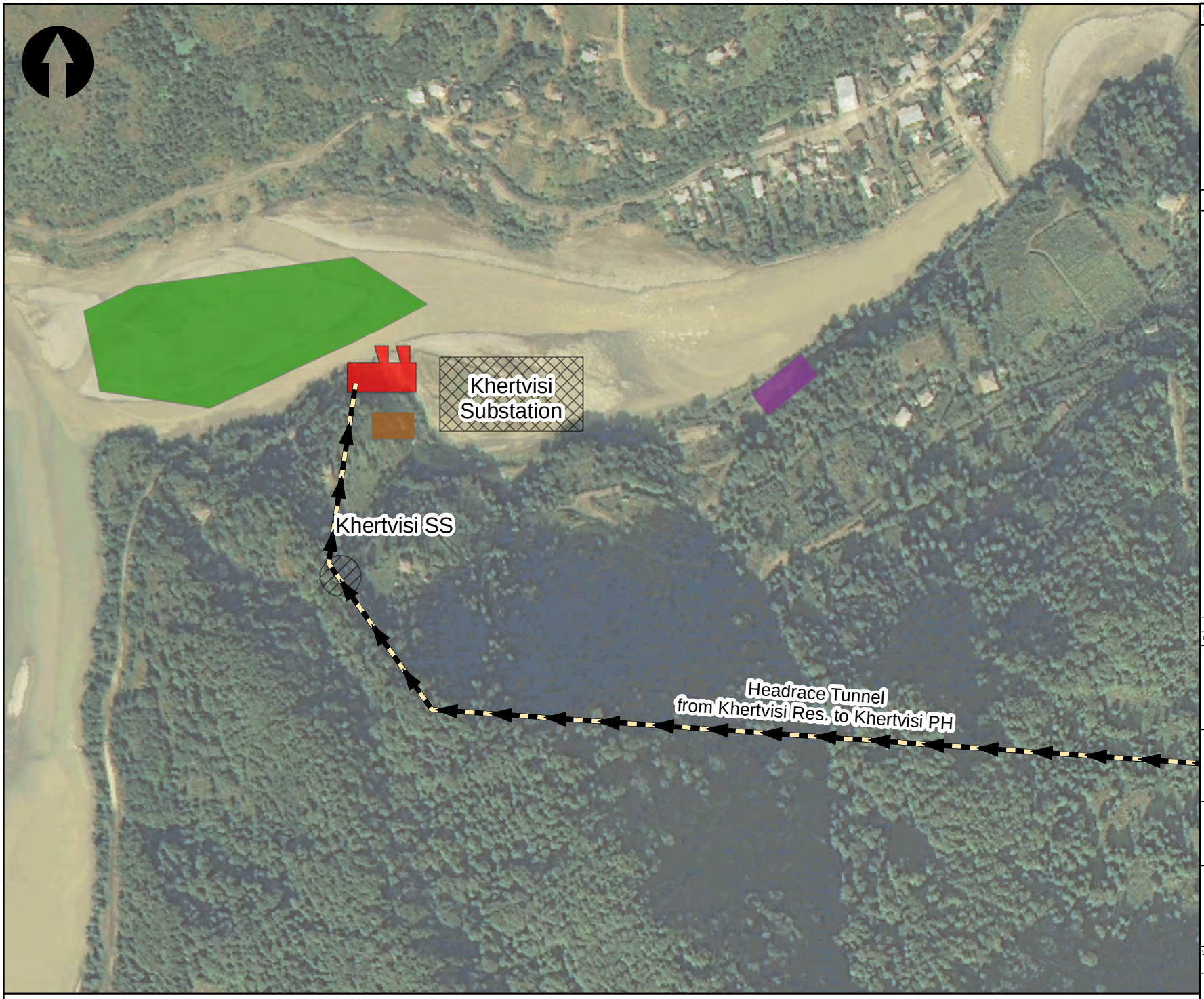
Drawing Title

Adjaristsqali Hydropower
Cascade Project
Machakhlistsqali Weir

Scale @ A4	MM Project No.	Status
1:10,000	290039	PRE

GIS File
20120117_Machakhlistsqali.mxd

Drawing No.	Rev
MMD-290039-MNC-KHE-07-004	P1



Location Map

Legend

Temporary Construction Structures

- Contractor Colony
- Existing Quarry
- Job Facility Area
- Office
- Proposed Quarry

Permanent Structures

- Portal
- Dam/Weir
- Powerhouse
- Reservoir
- Substation
- Surge Shaft

Underground Tunnel

- Adit Tunnel
- Headrace Tunnel
- Transfer Tunnel
- Intake

0 25 50 100 150 200 Meters

Rev	Date	Description	Drawn	Ch'k'd	App'd
P1	25/01/2012	For Information	WJG	JG	VH

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi
Georgia

Mott MacDonald
Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

Gamma Consulting Limited
9, Merab Aleksidze Street,
Tbilisi 0193, Georgia

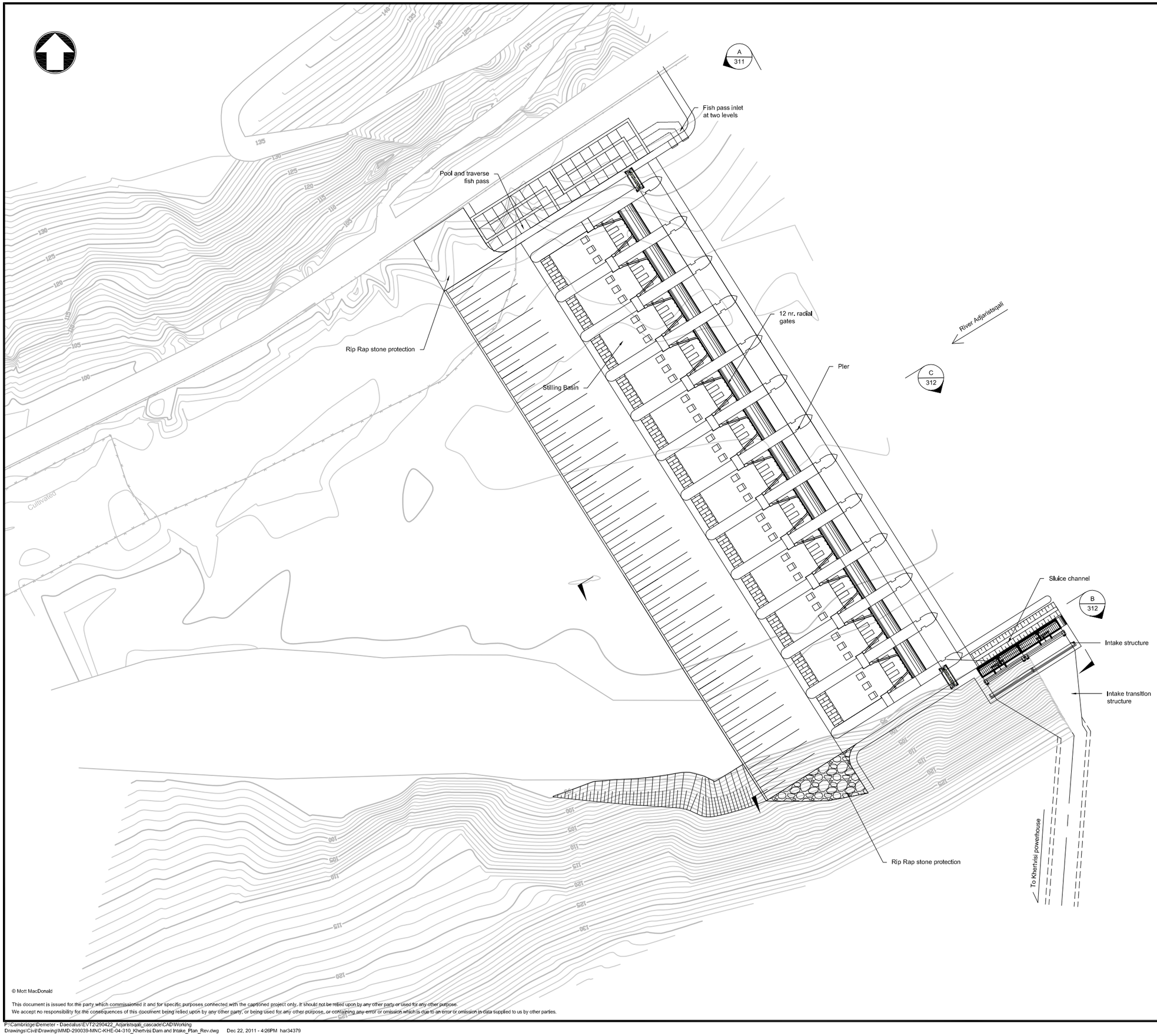
Drawing Title

Adjaristsqali Hydropower
Cascade Project
Khertvisi Power House

Scale @ A4	MM Project No.	Status
1:5,000	290039	PRE

GIS File
20120117_Khertvisi_Powerhouse.mxd

Drawing No.	Rev
MMD-290039-MNC-KOR-07-005	P1



Notes

1. All levels in meters elevation
2. All dimensions in millimetres unless otherwise stated

Key to symbols

Reference drawings

1:500 @A1 — 0, 25m, 50m

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	22/12/11	TW	Preliminary Issue	JDP	JHM

Mott MacDonald
Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

GEG
GROSS ENERGY GROUP
Engineering & Consulting

DOLSAR
Engineering Ltd

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi Georgia

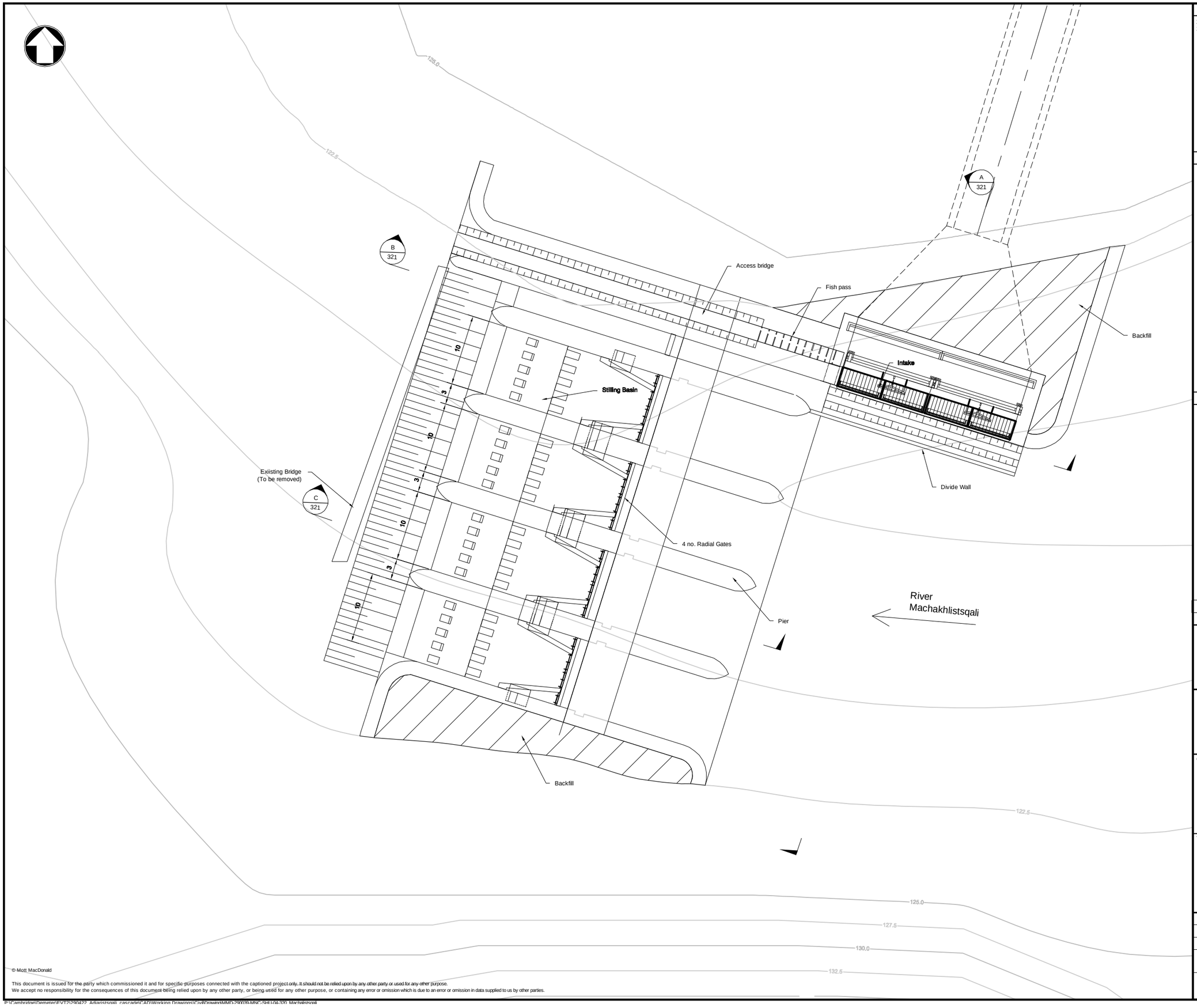
Title

Adjaristsqali Hydropower Cascade Feasibility Study Khertvisi Dam and Intake Plan

Designed	P Harvey		Eng check	J Prytherch	
Drawn	T Wood		Coordination	-	
Dwg check	J Prytherch		Approved	J Meldrum	

Scale at A1	Status	Rev
1:500	PRE	P1

Drawing Number
MMD-290039-MNC-KHE-04-310



Notes

1. All levels are in metres elevation.
2. All dimensions are in millimetres unless otherwise stated.

Key to symbols

Reference drawings

1:250 @A1

0 12.5m 25m

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	29/12/11	TW	Preliminary Issue	JDP	JHM

Mott MacDonald

Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

GEG
GROSS ENERGY GROUP
Engineering & Consulting

DOLSAR
Engineering Ltd

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi Georgia

Title

Adjaristsqali Hydropower Cascade Feasibility Study
Machakhlistsqali Weir and Intake Plan

Designed	P Harvey		Eng check	J Prytherch	
Drawn	T Wood		Coordination	-	
Dwg check	J Prytherch		Approved	J Meldrum	

Scale at A1	Status	Rev
1:250	PRE	P1

Drawing Number

MMD-290039-MNC-KHE-04-320

P:\Cambridge\Demeter\FVT\290d22_Adjaristsqali_cascade\CAD\Working Drawings\Civil\Drawn\MMD-290039-MNC-SHE-04-320 Machakhlistsqali

Appendix B. Consultation

B.1. Summary of Consultation and Disclosure Activities

Table B.1: Municipality Consultation Meetings[1]

Location / Date	Attendees	Summary of Issues raised by stakeholders	AGL Response at Scoping Exhibition	Location in ESIA Report
Khulo Municipality (Khulo Municipality) 19th of July 2011 (time 15:00)	Governor of Khulo Municipality (Temur Bolkvadze); Member of Parliament of Georgia from Khulo Municipality (Anzor Bolkvadze); Representatives from Mott MacDonald and Gamma Consulting; (21 additional attendees).	One issue raised was whether there were going to be ***future opportunities for public discussions*** on the Project other than during Project implementation.	According to International Financial Organizations (in this case the International Financial Corporation), Environmental and Social Impact Assessment policy as well as per Georgian Environmental legislation – there should be a second round of stakeholder meetings that take place after preparation of the preliminary Environmental and Social Impact Assessment report and after publication of information on public discussions in a newspaper. As the activity implementation Company "Adjaristsqali Georgia LLC (AGL)" and Consulting Companies we are in charge of providing complete information which represents the subjects that are of interest for you. Contact information was given in an informational booklet which has been distributed among the participants.	Chapter 6 discusses future consultations. The Stakeholder Engagement Plan (SEP) available from the Project website (www.adjaristsqali.com) discusses future consultations in greater detail.
		One stakeholder raised the issue of whether the Project team believed that there will be enough water left in the river after the cascade construction to use for ***irrigation***.	According to Environmental legislation and International Ecological Standards ecological flow issues must be considered as a priority for each dam. Calculations will assess aquatic ecology and water resource user (irrigation, fish farms) requirements. Preliminary studies show that river water in the area is not used for irrigation. This issue will be clarified as a result of a detailed survey; calculations of environmental flow will consider the interests of water consumers.	Chapter 10 discusses environmental flows
		One stakeholder raised the issue of whether there are going to be improvements made to ***local roads***.	According to the feasibility study there is a planned dam that will be constructed, on the territory of Khulo Municipality at the confluence of the river Adjaristsqali and Ghorjomi. This dam will be high and will cause water to constantly stand on the existing road. Before commencement of the Project works plans will be made for the construction of new roads as well as reconstruction-rehabilitation of the existing roads.	Chapter 13 discusses Transport and Traffic issues, and Chapter 7.4.1.3 – 7.4.1.5 include social impacts of reconstructing and rehabilitating local roads
		One stakeholder asked whether the dam construction will affect ***local tariffs*** for power supply or not. Or if there will be any special privileges for local people.	In compliance with Georgian Legislation power supply tariffs are defined by the State Regulation Committee throughout the country. The hydro power operation company is not empowered to give discounts to local consumers.	Chapter 7 (7.5.3.1) covers recommendations on community investments.

[1] Further details are included in the Stakeholder Engagement Plan (SEP) available from the the Project Website (www.adjaristsqali.com).

Location / Date	Attendees	Summary of Issues raised by stakeholders	AGL Response at Scoping Exhibition	Location in ESIA Report
Shuakhevi Municipality (Shuakhevi Municipality) 19th of July, 2011 at (time 11:00)	Governor of Shuakhevi Municipality (Nugzar Amaglobeli); Shuakhevi Municipality member of Legislative Body (Sakrebulo) (Guram Abashidze); Otar Tsintsadze – Editor of "Shuakhevi" Newspaper; Representatives from Mott MacDonald, Clean Energy Group and Gamma Consulting; (30 additional attendees including several members of the Shuakhevi Municipality Board of Administration).	One stakeholder was concerned about how the presence of the dams will influence ***Black Seas salmon*** migration.	As a rule construction and operation of dams on the rivers causes significant negative impacts on fish, specifically because it is impossible for a fish to pass the dam's forebay (upstream reach) to places of reproduction. Possible impacts may influence species included in Red Book as well as Black Sea salmon. During the ESIA process measures will be prepared that will consider: insertion of fish ways on dams and fish protection facility construction on water intakes. Fish stocking may be considered.	Information on Black Sea Salmon and other fish species can be found in Chapter 8 which discusses ecology and biodiversity and possible impacts can also be found in Chapter 10 which discusses environmental flows.
		One stakeholder asked whether the ***existing hydropower plant*** on the river Chirukhistsqali would remain operational.	Further functional-operational studies of the existing Hydropower plant on Chirukhistsqali river shall be done during preparation of final version of the Project and during the ESIA process. Any issues mentioned shall be solved with the existing Hydropower plant owner on the basis of agreement. Information about final decision shall be submitted in the preliminary version of the ESIA report during the public discussion process.	Section 4.4.4 describes the affects on the existing hydropower plant.
		One stakeholder wanted to know whether the villages ***historical bridges*** would be under threat of flooding.	According to current preliminary design decisions no historical buildings or bridges existing within the frame of the present Project will be subjected to flooding.	Chapter 17 discusses places of cultural heritage and whether they will be affected or not by the Project.
		One stakeholder requested to know who would be responsible for addressing ***employment opportunities*** for local populations.	In order to clarify employment issues for the local population you should address the AGL Public Relations Specialist Miss. N. Diasamidze whose contact information is given in informational booklets.	Section 7.4 discusses the possible employment opportunities for local people in the construction phase (Section 7.4.1.1) and in the operational phase (Section 7.4.2.1).
		One stakeholder was curious about what ***amount of water*** that will pass through the river once the Project has been constructed.	As per Georgian standards there must be a 95% insurance of at minimum 24 hour water flow in rivers; aquatic ecology and water resource users (irrigation, fish farms) requirements will be assessed in determining a suitable environmental flow. Environmental flows for all dams shall be calculated during ESIA process.	Chapter 10 discusses environmental flows
		One stakeholder was interested to know how **sediment transport** issue has been solved.	According to the feasibility study cleaning of stored water in the dams will be done during times when there is an abundance of water. Dams stop working; all shields of the dams will open up and they will flush away all of the build up of sediment, which will pass through the dam.	Chapter 9 is the water resources and water use Chapter.

Location / Date	Attendees	Summary of Issues raised by stakeholders	AGL Response at Scoping Exhibition	Location in ESIA Report
		One stakeholder wanted to know what kind of ***materials will be used for the tunnels***.	Tunnels will be strengthened with reinforced-concrete. Decisions on the construction of the tunnels will be solved with consideration of the type of rock in the tunnel and the route and will be decided during the preparation stage of the Project.	Section 2.6 covers the criteria set up for tunnel design
		One stakeholder was curious to know whether any other company could ***block the construction*** of the Project.	There has been an Agreement formed between the Government and AGL regarding implementation of the Project, so no other company's involvement will affect the execution of the Project.	Chapter 1 the Project introduction discusses the main parties involved in the preparation of the Project (Chapter 1.3).
		One stakeholder asked what amount of ***river water by percentage will stay*** in river bed in Shuakhevi Municipality. This is very important for the population especially in hot summer days and water mills are constructed on the river.	Calculations will assess aquatic ecology and water resource user (irrigation, fish farms) requirements. It is important as well for maintaining water consumption conditions; river usage as a recreation source will be considered as well.	Chapter 10 discusses environmental flows
Keda Settlement (Keda; Makhuntseti; Bzubzu; Pirveil Maisi; Dandalo) (Keda Municipality) 20th of July, 2011 (time 11:00)	Keda Municipality Governor; Representatives from Mott MacDonald, and Gamma Consulting; (52 additional attendees including the Keda Community Attorney; governor of Keda village; governor of Akutsi Village; chairman of the municipal community committee; various council members.	One stakeholder requested to know what the ***expected height*** of Dandalo dam is.	Dandalo dam will be 13 m high; refinement of the dam parameters will be carried out during the detailed engineering design.	Section 2.5 has a description of the headworks for all three schemes
		One stakeholder asked what ***issues related to roads***.	According to standards of international financial organizations, the investing company has to ensure improvement of the roads, used for implementation of its activities and provide for traffic safety. AGL will take into consideration implementation of rehabilitation works on local roads (where it will be necessary). In addition, permanent and temporary roads will be installed, for use during the cascade construction and operation phases.	Chapter 13 discusses Transport and Traffic issues, and Section 7.4.1.3 – 7.4.1.5 include social impacts of reconstructing and rehabilitating local roads
		One stakeholder wanted to know if local populations would be ***offered preferential tariffs.***	Tariffs are determined by the State, i.e. the National Energy Regulatory Commission and therefore the investor can not decide such matters. The investment company will take an active part in local social programs. Similar programs are planned in coordination with the local municipality.	Section 7.5.3.1 covers recommendations on community investments.
		One stakeholder wanted to know how the water from ***Dandalo reservoir will flow***: through an open channel, pipes or a tunnel.	Water from Dandalo reservoir will flow through a derivation tunnel.	Section 2.5 has a description of the headworks for all three schemes and Section 2.6 covers the criteria set up for tunnel design
		One stakeholder wanted to know	Compensation amounts will be paid to the private and legal persons	Chapter 7 the social impact

Location / Date	Attendees	Summary of Issues raised by stakeholders	AGL Response at Scoping Exhibition	Location in ESIA Report
		on what basis ***compensation*** amounts will be paid? Some land parcels have been already registered, some have not.	whose own land or property that is damaged or lost in the Project implementation process. Land and real property prices will be determined according to the tariffs, arranged by Georgian legislation. Pre-defined and realistic market prices will be considered, when individual contracts with local residents are made. Georgian legislation does not provide compensation payments for unregistered land parcels. According to environmental and social policies of international financial institutions (WB, EBRD, EFC) compensation is to be paid for all the property, which is used by a person and his livelihood. In accordance with the policy of these organizations, compensation will be issued for unregistered plots as well, provided that the owner proves that this land is the source of his income, and is used for its intended purpose.	assessment includes information on population resettlement.
		One stakeholder wanted to know approximately how many ***land parcels*** will be ***flooded***.	At present areas have been specified, which are expected to be flooded by the water from the reservoirs. The number of parcels and their owners will be identified precisely after the detailed engineering design and accurate specifications of the dams are available; we will provide you with additional information about it at future consultations.	Chapter 7 the social impact assessment includes information on population resettlement.
		One stakeholder wanted to know if there was any risk of the villagers being ***physically resettled***.	Physical resettlement of villages will not be an issue, but resettlement of separate families may be necessary. Some land parcels may not be covered by the reservoir water, but it can come so close to these parcels that it will be impossible to reduce direct or indirect impacts and resettlement will be needed. An accurate list of residents, subject to physical or economical resettlement, can only be provided after preparation of the detailed engineering design.	Chapter 7 the social impact assessment includes information on population resettlement.
		One stakeholder wanted to know what measures are planned to prevent **landslides** in respect of the reservoir slopes.	The investor company has taken into consideration that the mountainous Adjara region is sensitive to landslides and erosion, and therefore it plans to carry out detailed engineering - geological and topographic - studies. At present such works are being implemented and the future dam site locations will be selected on the basis of obtained conclusions. From numerous methods of landslide and erosion prevention on the reservoir banks (installation of concrete coverings at the reservoir slopes, slope reinforcement, etc.) the best will be selected based on the engineering - geological study of specific areas.	Chapter 11 discusses geology, landslides and seismic risks and also includes information on erosion
		A stakeholder wanted to know where they can check for information on ***agricultural land parcels***, located in the Project	To organize the study and implementation of resettlement issues the investor has hired an experienced company - "Geographic"; its experts will hold individual negotiations with each family and only on the basis of mutual agreements land parcels or other real estate will be acquired.	Chapter 7 the social impact assessment includes information on population resettlement.

Location / Date	Attendees	Summary of Issues raised by stakeholders	AGL Response at Scoping Exhibition	Location in ESIA Report
		impacted zone.		
		A stakeholder wanted to know when the ***predicted start date*** was for Project construction.	According to plan commencement of construction shall be possible in the second half of 2012, and before that the design and preparatory work will be carried out.	Chapter 6 discusses future project activities. The SEP, which is available from the Project website (www.adjaristsqali.com), discusses activities in greater detail.
Khelvarchauri Municipality (Acharisckali community village) 20th of July, 2011 (time 15:00)	Representatives from Mott MacDonald and Gamma Consulting; (23 additional attendees).	One stakeholder asked if the construction of the dam was intended to take place within the community territory.	No dams or reservoirs are intended to be constructed within the Adjaristsqali community territory. An underground equalizing reservoir and underground power house will be installed in the vicinity of Chorokhi and Adjaristsqali River's confluence, at the left bank slope of Adjaristsqali River. A service tunnel portal and water diversion tunnel portal will come to the ground level.	Section 2.5 has a description of the headworks for all three schemes
		One stakeholder identified that the communities were primarily interested in ***how safe the environment*** in which they live will be after the construction. What should be the distance between the power plant and the local population residence? Local people are not aware of the technical issues, but we want our children to have healthy and clean environment.	Within Adjaristsqali community area, namely at the left bank slope of Adjaristsqali River confluence a power unit for the fourth stage of the cascade will be installed. According to the TFR (technical feasibility report) the power house will be installed under the ground, so no protective zone will be required. The power substation will be located above the ground, and its right of way will not exceed 50-100 m (depending on the power substation capacity). If we consider the distance between the Project site and a populated area, there will be practically no risk of negative impacts on residents' health and safety.	Chapter 7.4.3.1 and 7.4.2.3 cover community health and safety during the construction phase and operation phase respectively. Section 7.5 provides mitigation measures for any possible negative impacts.
		One stakeholder noted that they are clear that the Project is necessary and should be constructed, but wanted to know what will happen to this area. Is it true that there will be ***no water left in the river***?	According to the Georgian environmental law and international environmental standards, mandatory ecological flow should be considered for every specific dam. Along with the water volume, needed for existence of the biological environment also the water volume, needed for water consumers downstream of the dam will be considered during the ecological flow calculation. Based on the practice adopted in Georgia, ecological flow makes 10% of an average long-term consumption of 95% supply, to which the water volume, needed for functioning of water consumers downstream of the dam should be added. Although the river water level will reduce significantly, the environmental flow will be maintained, as well as water from the estuaries, that conflux	Chapter 10 discusses environmental flows

Location / Date	Attendees	Summary of Issues raised by stakeholders	AGL Response at Scoping Exhibition	Location in ESIA Report
			with Adjaristsqali River in the dam downstream along Bzubzu village. It is an important impact, but our goal is to minimize the impact, which, in this case, can be achieved through implementation of systematic ecological flow control.	
		One stakeholder asked how far ***the river level will rise*** within the village of Adjaristsqali.	The river level will not rise on the Adjaristsqali River. The Project construction project on Chorokhi River is planned by another company and AGL has nothing to do with this Project. According to our information, the maximum reservoir water level of Chorokhi River HPPs second stage (Khelvachauri 1 HPP) will be 41 meters above sea level, which will not cause flooding of agricultural or residential land parcels.	Chapter 10 discusses environmental flows
		A stakeholder asked whether the construction will ***impact the village water supply***, which is provided by natural sources.	The Adjaristsqali Project's 4th stage water diversion tunnel will be installed on the left river bank deep inside the mountain. According to preliminary data, the tunnel installation depth and its profile will have no impact on groundwater.	Chapter 9 discusses water resources and water quality.
		One stakeholder asked if there was any ***risk of damage for buildings/facilities*** during the construction - especially during the tunnels' construction and if there is any risk of landslides there.	Construction works within the Adjaristsqali community area will not damage buildings/facilities or create landslides. The tunnels will be constructed by means of a tunnelling machine and the blast hole drilling method may be used only for the underground power house construction. Therefore, negative impacts are considered to be minimal.	Chapter 11 discusses geology, landslides and seismic risks and also includes information on erosion
		One stakeholder asked ***how far away*** the reservoir should be located ***from populated areas*** according to the law and legislation.	This question relates to the HPPs construction project on Chorokhi River, which is not part of this Project. A safe distance between the reservoir edge and residential zones should be calculated during the elaboration process of Chorokhi River HPPs Construction Project ESIA, and this will depend on the reservoir capacity, surface area and other specific conditions.	Section 4.2 contains the national legislation that is relevant to the ESIA.
		One stakeholder asked if the Project would lead to ***air pollution***.	No negative impact on air quality is to be expected during the Project operation phase. In this regard, some impact is possible during the plant construction process, which will be associated with construction equipment and transportation operations.	Chapter 15 of the EIA discusses air quality.

Table B.2: Community and Village Consultation Meetings[2]

Location / Date	Attendees	Summary of Issues raised by stakeholders	AGL Response at Scoping Exhibition	Location in ESIA Report
Didachara community village (Khulo Municipality) 19th of July, 2011 (time 17:00)	Authorized person of Didachara Local Community; authorized person's apparatus employees; Population of villages of Didachara local community and other interested persons; Representatives from Mott MacDonald and Gamma Consulting (23 additional village members).	Many stakeholders raised concerns over potential impacts the Project could have on the frequency of ***environmental hazards*** such as landslips and erosion.	Clean Energy Group is currently carrying out detailed geological-engineering surveys of the Project territory. The survey results will evaluate existing geological risks in the area of Didachara village. Decisions about the implementation of Project activities, in regards to possible environmental hazards, will be made in relation to the findings of the geological-engineering surveys. A second meeting will be held with stakeholders to disclose the findings of the ESIA prior to submission of the report. At this meeting information will be presented on the survey results and any design decisions. We can say in advance that the surface area of the cascade mirror will be small and correspondingly no important climate changes will be expected.	Chapter 11 discusses geology, landslides and seismic risks and also includes information on erosion
		One stakeholder was curious of who would be responsible if a ***landslide or erosion*** process took place?	If erosion or landslides occur that are directly connected to implementation of the planned activity, the Company responsible for this activity shall be liable. Before commencement of the Project a detailed investigation and study of areas sensitive to landslides and erosion shall be carried out and specific prevention measures will be prepared. Effectiveness of prevention measures will be discussed during the ESIA process; and only afterwards a final decision about Project implementation will be made.	Chapter 11 discusses geology, landslides and seismic risks and also includes information on erosion
		One stakeholder asked whether ***local roads*** were going to be reconstructed / improved during the course of the Project?	According to the feasibility study for the Project, in Khulo Municipality at the confluence of the Adjaristsqali and Ghorjomi rivers, construction of a high dam is planned, which will cause water to cover the existing road. Therefore before commencement of the Project works, a new road will be constructed as well as reconstruction and/or rehabilitation of the existing roads.	Chapter 13 discusses Transport and Traffic issues, and Section 7.4.1.3 – 7.4.1.5 include social impacts of reconstructing and rehabilitating local roads
		One stakeholder wanted clarification about what is meant by "***permanent fragmentation*** of habitat. If it is only relating to animals.	In this case we are talking about fragmentation of animal habitats which may happen during construction and operation of linear structures (roads, tunnels etc.) in this case fragmentation of habitats shall be directly connected with construction of the cascade.	Chapter 8 discusses ecology and biodiversity with Section 8.5 assessing aquatic impacts and Section 8.4 assessing terrestrial impacts.

[2] Further details are included in the Stakeholder Engagement Plan (SEP) presented in ESIA Volume IV.

Location / Date	Attendees	Summary of Issues raised by stakeholders	AGL Response at Scoping Exhibition	Location in ESIA Report
		One stakeholder wanted clarification on what was meant by the ***"spread of infectious diseases***?"	There is a possibility that migrant workers from outside the region will bring with them infectious diseases that are not prevalent in the local population.	Chapter 7 covers the spread of infectious diseases, including prevalence in Georgia (7.3.9.1), and possible impacts and mitigation measures (7.4.3.1 and 7.5.2.3)
		One stakeholder identified that the village was quite important and famous for its ***historical-cultural heritage*** and wanted confirmation that these monuments shall remain undamaged.	The preliminary design shows that no monuments of cultural heritage face any direct negative impact. The indirect impact assessment issues shall be studied during a process of the ESIA and in case of necessity will be defined with corresponding mitigation measures.	Chapter 17 discusses places of cultural heritage and whether they will be affected or not by the Project.
		One stakeholder wanted to know whether the ***grievance form*** was available on the webpage.	An informational booklet and the SEP were provided that contain contact information of the Public Relations Specialist from AGL and the Company's webpage. The SEP also contains a grievance submission form. Grievances and statements can also be submitted verbally. Clean Energy Invest wishes to carry out processes clearly and openly.	Grievance forms were made available during the meeting and will be available at future meetings. Grievances can also be submitted on the Project website and verbally.
		One stakeholder was curious as to ***when construction would begin***.	If everything carries on according to plan commencement of construction shall be possible in the second half of 2012.	Construction is still scheduled to take place in the second half of 2012
		One stakeholder requested that ***local populations are employed*** by the Project.	As per AGL social policy majority of nonqualified manpower shall be employed from a local population; besides there will be selected qualified manpower as well and further on training shall be applied.	Section 7.4 discusses the possible employment opportunities for local people in the construction phase (Section 7.4.1.1) and in the operational phase (Section 7.4.2.1).
Chvana community village (Shuakhevi	Chvana community representative Representatives from Gamma and	One stakeholder was concerned that the earthworks associated with the new project would cause vibrations which will lead to ***landslides***.	Detailed engineering-geological and geodetic survey works are ongoing in the design area. Based on the survey results basic design solutions and preventive measures against development of dangerous geological processes will be determined.	Chapter 11 discusses geology, landslides and seismic risks and also includes information on erosion

Location / Date	Attendees	Summary of Issues raised by stakeholders	AGL Response at Scoping Exhibition	Location in ESIA Report
Municipality) 19th of July, 2011 (time 13:00)	Clean Energy Group; (16 additional village members).	One stakeholder, on behalf of the village, said that they would like to know, if there will be any negative ***ecological impacts*** and what the recommendations are to prevent them.	Such conclusions and recommendations will be prepared during the ESIA elaboration and presented at the next consultation meeting. The scoping report was presented, which includes a preliminary assessment of impacts, expected during the Project construction and operation phases. Detailed study and analysis of the impact of specific factors will take place during the ESIA elaboration; based on relevant calculations, scale and character of the expected impact. Further, the impact minimization, and if necessary, compensatory measures will be determined for environmental and social damage.	Chapter 8 covers ecology and biodiversity.
		One stakeholder wanted to know what ***tunnelling methods*** are being planned, boring or explosion.	Tunnelling will be done by means of a tunnelling machine.	Section 2.6 covers the criteria set up for tunnel design
		One stakeholder was curious to know what ***height the dams*** will be.	Construction of a low-threshold dam (not higher than 4-5 m) is planned on Chvana River.	Section 2.5 has a description of the headworks for all three schemes
		One stakeholder wanted to know whether the ***residents*** living along the Vanistskali River were going to be impacted by the Project / within the ***Project impact area***.	These residents are not likely to be in the direct impact zone of the Project. More precise information about this will be able after elaboration of the detailed engineering.	Chapter 7 the social impact assessment includes information on population resettlement.
		One stakeholder raised concerns that there is a problem with ***legalization and registration of agricultural land*** and homesteads in the community.	AGL will assist local residents by registration of land parcels within the Project impacted area, and later acquire these parcels.	Chapter 7 the social impact assessment includes information on population resettlement.
		Two stakeholders raised concerns that their municipality is ***land-poor***; and asked of local residents potentially face ***risks of resettlement***. One stakeholder identified that 6 families live within 500m from the water intake- and asked if they would potentially be facing the ***risk of resettlement***.	Issues of physical resettlement of the population living in Chvana community villages have not been discussed at this stage. After the detailed engineering design is completed, locations and exact parameters of the power plant infrastructure objects will be verified, whereupon, together with stakeholders, physical or economic resettlement issues will be discussed in more detail. The headworks construction and operation will not have a direct impact on these residents. Indirect impacts will be determined during the ESIA elaboration, based on the headworks detailed engineering design.	Chapter 7 the social impact assessment includes information on population resettlement.

Location / Date	Attendees	Summary of Issues raised by stakeholders	AGL Response at Scoping Exhibition	Location in ESIA Report
		One stakeholder wanted to know what the ***electricity tariffs*** would be.	The electricity tariffs are determined by the State, i.e. the National Energy Regulatory Commission and therefore the investor can not decide such matters. The investor company, according to its social policy, will take an active part in implementation of social programs in the villages, located in the Project impacted zone.	Section 7.5.3.1 covers recommendations on community investments.
		One stakeholder raised the point that many local residents have ***beehives*** and asked what impact the power plant construction might have on this activity.	Planned activities not are not expected to affect the beekeeping development.	Chapter 7 will discuss impacts on livelihoods and Chapter 8 discusses ecology and biodiversity
		One stakeholder asked whether there is a threat of ***groundwater and spring damage*** during the tunnelling by drilling or drilling and blasting works.	Underground water-bearing layers may quite possibly get bisected during the tunnelling; hence, certain hydrological changes are expected to occur. Considering the tunnelling depths, significant impacts on groundwater surface outcrop are not expected.	Section 9.3.3 discusses groundwater and springs. Section 9.3.2 discusses surface water hydrology.
Zomleti community village (Shuakhevi Municipality) 19th of July, 2011 (time 13:00)	Authorised representative of Zomleti community; Representatives from Mott MacDonald and Gamma Consulting; (36 additional attendees).	Several stakeholders raised concerns over the potential link the Project could have to future ***landslide hazards***. - "Our area is eroded, will construction lead to landslides?" - "will underground explosions cause landslides?" - "if the tunnel construction vehicles cause vibrations, this may lead to landslides"	Exploitation of water reservoirs may cause intensification of erosion and landslides; during preparation of the cascade working draft and ESIA process, prevention measures shall be adopted; including: strengthening the slopes of water reservoirs, providing concrete screens on the slopes etc. Tunnel construction is planned using a special tunnel construction vehicle; drilling and explosion methods shall not be applied. No risk of landslides has been predicted as a result of an explosion. While using modern tunnel construction technology and per technical specifications there is no risk of intensification of landslides.	Chapter 11 discusses geology, landslides and seismic risks and also includes information on erosion
		One stakeholder was interested to know when ***Project construction*** was due to take place.	In compliance with the plan represented in the scoping report. The ESIA process shall finish in Spring of 2012; and mobilization works for the construction may start in Autumn of 2012.	Construction is still scheduled to take place in the second half of 2012
		One stakeholder was concerned about the threat caused by ***temporary roads*** – "Most dangerous are the temporary roads – first it is made and after it is left as it is – because of un-maintained road soil erosion will	Road construction during the construction phase shall be done as per the Project documentation, and erosion and landslide prevention measures will be considered. The majority of the roads constructed during Project implementation shall be used later for access to the cascade. The operator company will be held responsible for proper maintenance of the roads.	Section 13 discusses Transport and Traffic issues, and Section 7.4.1.3 – 7.4.1.5 include social impacts of reconstructing and rehabilitating local roads

Location / Date	Attendees	Summary of Issues raised by stakeholders	AGL Response at Scoping Exhibition	Location in ESIA Report
		develop."		
		One stakeholder wanted to know whether this Project could potentially be ***linked to climate change***. "Recently ecological conditions have been vastly changed in our area; we cannot get the same harvest we had, some of the species do not exist at all. Will Project implementation be connected to climate change?	Possible negative impacts will be assessed during the preparation of the ESIA. The areas of the water reservoir surfaces will be small and no important climate changes are expected.	Chapter 16 provides information on greenhouse gases and climate change adaptation
		One stakeholder was interested to know whether there would be additional ***consultation opportunities***.	According to the International Financial Organizations (in this case the International Financial Corporation), ESIA policy as well as per Georgian Environmental legislation – a second stakeholder meeting should take place after the preparation of the ESIA and following publication of information in a newspaper about the public discussion. As activity implementation Company AGL and Consulting Companies we are in charge of providing complete information which represents subjects of interest for you. Contact information is given in an informational booklet which has been distributed among you.	The next stakeholder meeting is scheduled for Stakeholder Engagement Plan, available from the Project website (www.adjaristsqali.com), discusses future public consultations.
		One stakeholder was concerned that the Project (particularly during the construction of tunnels) could ***impact the quality of local drinking water***.	During the tunnel construction process the possibility of ground water crossing is quite realistic. Although considering that the tunnels will be mainly located at a great depth, the possibility of impacts on natural springs is lessened.	Chapter 9 includes information on water resources and water quality.
Oladauri community villages (Shuakhevi Municipality) 19th of July, 2011 (time 13:00)	Authorised community representative; Representatives from Gamma Consulting and Clean Energy Group; (21 additional attendees mainly from the Oladauri village).	Several stakeholders raised concerns over what changes the Project was going to bring to ***local road networks***.	The tunnel construction will require transportation services and therefore, rehabilitation of existing roads will certainly be provided, where necessary.	Chapter 13 discusses Transport and Traffic issues, and Section 7.4.1.3 – 7.4.1.5 include social impacts of reconstructing and rehabilitating local roads
		One stakeholder wanted to know when ***construction was expected to begin***.	It will be possible to begin the Project construction works in the second half of 2012.	Chapter 6 discusses future Project activities. The SEP, available from the Project website (www.adjaristsqali.com), discusses future consultations in detail

Location / Date	Attendees	Summary of Issues raised by stakeholders	AGL Response at Scoping Exhibition	Location in ESIA Report
		One stakeholder wished to know what the planned ***installation depth*** was for future tunnels.	Topographical surveying and engineering-geological research are currently being implemented, which will provide a basis for the tunnel data, routes, and installation depth. We can presume that tunnels will be at a depth that will virtually eliminate any risk of negative impacts on the local population.	Section 2.6 covers the criteria set up for tunnel design
		One stakeholder wished to know what will be the ***total number of hydro power stations.***	According to preliminary designs, construction and operation of 4 stages of the Project is intended.	Section 2.7 discusses the power house design for the entire Project.
		A few stakeholders wanted to know whether ***local people would be employed*** during the construction and operation stages of the Project. Also, they requested that young educated people are included also as many are currently unemployed.	According to the social policy of AGL company, they will employ the maximum number of local residents as possible for the Project construction and operation phases. Only highly qualified specialists, that can not be found locally, will be invited from outside. AGL intends to implement a special program for local residents to find the required specialists among them, and provide further training.	Section 7.4 discusses the possible employment opportunities for local people in the construction phase (Section 7.4.1.1) and in the operational phase (Section 7.4.2.1).
		A stakeholder wanted to know whether the Project would bring any benefits to the local area, such as ***reduced electricity costs***.	Electricity Tariffs are determined by the State, i.e. the National Energy Regulatory Commission and therefore the investor can not decide such matters. The investment company will take an active part in local community social programs; priority issues for these programs will be determined in coordination with the local municipality council.	Section 7.5.3.1 covers recommendations on community investments.
		A stakeholder wanted to know what the ***future capacity*** of the plant is expected it be?	According to the preliminary design solutions the Project capacity will be 175-300 MW. The total capacity of the Project, as well as power output of each specific power plant will be specified during the detailed engineering design.	Section 2.4 provides the layout of the cascade scheme and the capacity of each scheme.
		A stakeholder had concerns about the ***river running dry***. They identified this as a priority area to the local villagers and wanted to make sure the foreign investor had this issue at the heart also.	According to the Georgian environmental law and international environmental standards, mandatory ecological flow should be considered during water intakes from a river. Ecological flow is calculated under consideration of the water volume, necessary for existence of the biological environment and the water volume, needed for unhindered functioning of water consumption in the dam downstream. Considering the abovementioned, ecological flow in the dam downstream will be systematically provided during the dam operation phase.	Chapter 10 discusses environmental flows
		Stakeholder stressed that they hoped that all potential issues will be explored properly, so that there is no threat for us in the future.	Any economic activity is associated with some environmental impacts. It will also be true in this instance, but our goal is to reduce the negative impact to the minimum possible and increase potential positive impacts on the local population. This is the purpose of this meeting: to get the maximum information from you about the current state and public opinion.	The ESIA has been prepared to consider possible issues and provide mitigation measures if necessary.

Location / Date	Attendees	Summary of Issues raised by stakeholders	AGL Response at Scoping Exhibition	Location in ESIA Report
Merisi community villages (Keda Municipality) 20th of July, 2011 (time 11:00)	Representatives from Gamma Consulting and Mott MacDonald; (23 additional attendees)	One stakeholder asked how long the Project would ***take to implement***.	According to the feasibility report, the project implementation will require approximately 4.0-5.0 years.	Chapter 6 discusses future Project activities. The SEP, available from the Project website (www.adjaristsqali.com), discusses future activities in greater detail
		One stakeholder asked if there will be a ***hydrological regime*** included in the Project.	According to the Georgian environmental law and international environmental standards, maintenance of a mandatory ecological flow should be considered for of each individual dam. Along with the water volume, needed for the existence of the biological environment also the water volume, needed for functioning of water consumers downstream from the dam will be considered during the ecological flow calculation. Based on the practice adopted in Georgia, ecological flow makes 10% of an average long-term consumption of 95% supply, to which the water volume, needed for functioning of water consumers downstream of the dam should be added.	Chapter 10 discusses environmental flow.
		One stakeholder wanted to know whether ***local labour resources*** will be used during the construction and operation phases.	According to the social policy of AGL, they will employ the maximum number of local residents as possible during the Project construction and operation phases. A special program has been developed to select appropriate specialist among the local residents, who will be trained and employed at the both stages of the Project. Only highly qualified specialists, that can not be found locally, will be invited from outside.	Section 7.4 discusses the possible employment opportunities for local people in the construction phase (Section 7.4.1.1) and in the operational phase (Section 7.4.2.1).
		One stakeholder wanted to know the specifics of size and design of the ***tunnel***.	According to preliminary calculations, the tunnel will be 8.0-8.5 meters in diameter, depending on the type of rocks and the tunnelling machine diameter. Exact parameters of the tunnels will be determined during the detailed engineering design.	Section 2.6 covers the criteria set up for tunnel design
		One stakeholder asked if the ***tunnel*** will be used for ***water retention***.	A tunnel may be pressurized or non-pressurized. In this case the tunnel will be non-pressurized. Therefore it will be used only for water transportation.	Section 2.6 covers the criteria set up for tunnel design
		One stakeholder stressed that it should be noted that the ***fish farm at Goderdzistskali*** River is a really prosperous and promising business. The farm should not be closed down	The Project operator-company is obliged to permanently maintain the ecological flow downstream from the dam. The ecological flow must provide the water volume, needed to operate the fish farm. Hence, the fish farm should not be closed. The issue will be further studied during the ESIA preparation and we will provide you with the results by our next meeting.	Chapter 10 discusses the environmental flow

Location / Date	Attendees	Summary of Issues raised by stakeholders	AGL Response at Scoping Exhibition	Location in ESIA Report
		One stakeholder noted that there was a period last year, when the river ran dry so that even hens could cross it. If there will be ***increased water shortages*** again, the village will have to use the river water.	The ecological flow volume to be maintained downstream of the dam will be determined in the ESIA preparation process. The Project operator shall ensure that the ecological flow is permanently maintained. In periods of water shortages the power plant shall be stopped and the entire river flow shall be passed through the dam downstream.	Chapter 10 discusses the environmental flow
Kvatia Meeting – (Khulo Municipality) 02 September 2011	Representatives from Gamma Consulting and Mott MacDonald; (20 additional attendees)		Detailed Meeting Minutes are not currently available for Kvatia Community.	

Table B.3: Summaries Consultation Responses

Stakeholder Group	Khulo Municipality			Shuakhevi Munici-pality				Keda Municipality		Khelvar-chauri Munici-pality		
Stakeholder Bodies	Khulo Municipality	Didachara Village	Lekanashvilebi Villages (Diakonidzee; Duadzeebi; Tsifnari)	Schuakhevi Munici-pality	Chvana Village	Zamleti Village	Oladauri Village	Keda Settlement (Keda; Makhuntseti; Bzubzu; Pirveil Maisi; Dandalo)	Merisi Village	Adjaristsqali Village	Sindieti and Adjaris Agmarti	TOTAL
Issues Raised												
Environmental hazards – landslips and erosion?	1	4		1	1	4		1		1		**13**
Impacts on local road network / improvements?	1	1				1	2	1				**6**
Start/completion date?	1	1				1	1	1	1			**6**
Energy tariffs for local people?	1				1		1	1				**4**
The provision of local jobs?		1		1			1		1			**4**

Ecological / environmental flow?				2			1		1			**4**
Impact on groundwater / springs / Drinking water?					1	1				1		**3**
Loss of private land?	1								2			**3**
Dam height /length / depth concerns					1			1	1			**3**
More public consultation opportunities?	1					1						**2**
Effect on local cultural heritage/historical buildings?		1		1								**2**
Concerns about land registration					1			1				**2**
Local flooding threats?					1			1				**2**

Number of HPPs planned for / future capacity?							2					**2**
Effects on local irrigation / agriculture?	1											**1**
Spread of disease?		1										**1**
Where to find grievance form		1										**1**
Effect on Black Salmon migration				1								**1**
Effect on existing HPP?				1								**1**
Other companies influencing whether Project goes ahead?				1								**1**
What are tunnels going to be constructed from?				1								**1**

What tunnelling method is going to be used?					1							**1**
Impact on local bee industry					1							**1**
Impacts on climate change?						1						**1**
Want young people to be included within the consultation process							1					**1**
Want thorough assessments							1					**1**
Issues of compensation								1				**1**
Physical resettlement								1				**1**
Information on land parcels								1				**1**
Concerns over changes to hydrological regime									1			**1**

Impact on local fish farming?									1			**1**
Air Quality Impacts										1		**1**

B.2. Summary of Private Meetings and Workshops

Table B.4: Private Meetings and Workshops

Location and Date	Attendees	Summary of issues raised by stakeholders	AGL Response at Scoping Exhibition	Location in ESIA Report
Batumi (1st of September, 2011)	Deputy Minister of Finance and Economy of AAR (Grigol Tsamalashvili); IFC (International Finance Corporation), Chief Specialist of Environmental Protection (Akira Tanabe); Association "Flora and Fauna" (Archil Guchmanidze); AAR Environment and Natural Resources Departmen (Nugzar Papunidze); Wildlife Protection Society "Chobi" (Isolda Machutadze); The Georgian Green Movement, Guria regional coordinator (Manana Gogzhadze); The Georgian Green Movement, co-chair (Nino Chkhobadze); NGO "Green Alternative" (David Chipashvili); Shota Rustaveli State University (Sasha Khorava); AAR State Committee Member (Shota Paghava); The Georgian Green	What methods will be used for calculating the ***ecological flow***?	The ecological flow downstream of the designed dams shall be calculated under consideration of the practice, adopted in Georgia, as well as international standard requirements. The ecological flow will provide water volumes, required for existence of the biological environment and functioning of water consumers downstream of the dam.	Chapter 10 discusses ecological flow
		Will ***another meeting*** be held when the scoping report is completed?	Stakeholder meetings will be held after scoping report disclosure, as well as after disclosure of the preliminary ESIA; after disclosure meetings with NGOs will take place.	Chapter 6 discusses future Project activities. The SEP, available from the Project website (www.adjaristsqali.com), discusses future consultations in greater detail.
		Who will be the ***operating company*** of the power plants?	The Project will be the operated by the AGL's subsidiary company - Adjara Energy Georgia.	Chapter 1 the Project introduction discusses the main parties involved in the preparation of the Project (Section 1.3).
		What is to be expected in terms of ***population resettlement***?	Identification of the Project impacted land parcels is finished. After verifying the final designs it will be possible to determine the number of affected land parcels more accurately and detect the number of residents, who will be subject to physical or economic resettlement. According to preliminary data, only a few households will be affected by physical resettlement.	Chapter 7 the social impact assessment includes information on population resettlement.
		How do you calculate the ***ecological flow***? At 10%? There are different methods and you should select the best approach.	The ecological flow will be calculated using international standard methods and will take into account local specifics, in particular: the ecological flow will be calculated under consideration of water volumes, necessary for existence of the biological environment and the functioning of water consumers downstream of the dam.	Chapter 10 discusses ecological flow
		What ***type*** of ***dam*** *will be* constructed by this Project?	According to the Feasibility Report, the Project intends to construct 4-5 RC dams of differing heights (from 15-4 m), and the rest will be low-threshold dams (4-5 m).	Section 2.5 has a description of the headworks for all three schemes
		How far is the ***ecological flow*** calculation method acceptable for Skhalta region?	Ecological flow will be calculated according to international standards and will take into account local specifics. The ecological flow for each specific dam and weir will be calculated considering local conditions.	Chapter 10 discusses ecological flow

Location and Date	Attendees	Summary of issues raised by stakeholders	AGL Response at Scoping Exhibition	Location in ESIA Report
	Movement (Kote Burjanadze); The Georgian Green Movement expert (Zaza Kvantaliani); The Georgian Green Movement (Madonna Pirvelashvili); "Adjar Energy 2007" company, Assistant PR Manager (Sophio Varshalomidze); Representatives from Gamma Consulting and Clean Energy Group.	Will ***residential areas*** become ***flooded*** according to the new Project scheme?	According to the current designs, no flooding of residential areas will occur, but some agricultural, household and commercial lands will be flooded. Resettlement will take place and several households and individuals will be subject to resettlement. AGL has completed the parcel identification and after the final designs are completed, the resettlement processes will begin.	Section 2.5 has a description of the headworks for all three schemes
		Will the ***geology, and possibility of landslides*** *in the area* be considered?	Engineering-geological, topographic-geodetic and seismic surveys of the Project area are being carried out; all landslide zones will be explored the design solutions will be adopted based on results of these studies.	Chapter 11 presents information on geology, seismology and landslides.
		Will the Machakhela River water get ***redirected***?	To ensure water supply of the Project's 4th step (Chorokhi HPP), it is intended that Machakhela River water be diverted to Adjaristsqali River gorge. For this purpose a dam and a diversion tunnel will be constructed on Machakhela River. An implementation decision for this part of the Project will be based on the preliminary design survey results.	Chapter 9 discusses water resources and water quality and includes information on sediment.
		How many hydro power plants will there be? Will all of the water be transported through the tunnel?	According to the Feasibility Report, a 4 stage cascade will be constructed, and derivation will be performed by means of a tunnel. The final decision will be made after completion of the preliminary design research.	Chapter 2 gives an overall description of the Project.
		The tunnel system is quite good, but it is a ***seismically sensitive region***.	The tunnels and power plants will be designed taking into account the preliminary design survey results. Currently, the engineering-geological, topographic-geodetic and seismic surveys are being carried out.	Chapter 11 presents information on geology, seismology and landslides.
		How are the ***existing water flows determined***? How many turbines will there be?	During the design of correction of the rivers, water and solid sediment volumes are estimated by identification of long-term measurement data from the already existing hydropower stations. If such data are not available, the flows will be determined using the analogue method. AGL has begun observing the river flows and a team of English and Georgian hydrologists have been work on the designs.	Chapter 10 discusses environmental flows and Chapter 2.5 discusses the headworks of the schemes including the turbines.
		To date 40 years old turbines are operating at the Ats-HPP their ratio does not meet modern requirements. Is it planned to ***replace the turbines*** with new models?	The Atsi-HPP is the property of another company and it has no connection with the AGL Project.	This is not part of the ESIA scope.
		Is it possible to reflect in the report the importance of the	Gamma Consulting company has a team of specialists that will prepare a separate document about possible adverse impacts on	Chapter 9 discusses water resources and water quality

Location and Date	Attendees	Summary of issues raised by stakeholders	AGL Response at Scoping Exhibition	Location in ESIA Report
		Adjaristsqali River for the ***transport of solid sediment to the Black Sea***? The Chorokhi River is even more important. This issue should be given a separate chapter in the ESIA.	the sea coastline development by the Chorokhi River confluence. Sediments, transported by the Adjaristsqali River, play a very small part in the sea coastline development at Chorokhi River marine confluence and their influence is mainly related to the operation of existing dams on the territory of the Turkish Republic.	and includes information on sediment.
		The possible impact on ***fish*** is quite serious, especially the impacts on Salmon.	Gamma Consulting's ichthyologist, provided with guidance from Mott MacDonald specialists, is studying the ichthyofauna baseline conditions. For the ichthyofauna in general, as well as for the Black Sea Salmon appropriate mitigation measures will be elaborated, including development of salmon farming for its artificial reproduction.	Information on fish species can be found in Chapter 8 which discusses ecology and biodiversity and possible impacts can also be found in Chapter 10 which discusses environmental flows.
		There is an evaluation of water run off in the Caucasus region that was prepared in April (2011) by the UNCC. It suggests that river water will be significantly reduced in the future. The people involved in climate change should see this report.	Thank you for your information. We will surely take into account materials, provided by this document, when elaborating the assessment of possible climate changes.	Chapter 9 discusses water resources and water quality.
		The most significant impact of this Project is the ***impact on biodiversity***. Therefore, we request that as soon as the biological part, i.e. flora and fauna, is completed, and the final location of the infrastructure is specified, a discussion of this chapter is arranged.	The investor would not oppose this suggestion of additionally discussions with non-governmental organizations. It would be better if all the problematic issues are discussed intensively. A meeting should be held after the disclosure of the preliminary ESIA report, which we will discuss with you.	Information ecology and biodiversity can be found in Chapter 8 which discusses ecology and biodiversity and possible impacts can also be found in Chapter 10 which discusses environmental flows.
		What research has been undertaken to examine ***the ichthyofauna***? And who is undertaking this survey? When will these materials be available for review?	The study was carried out by reviewing the existing literature sources. An ichthyologist is currently carrying out field work (which includes control fishing, interviewing local fishers, identification of species according to standard methods, etc.). The research is carried out by an ichthyologist from Gamma Consulting, Mr. Archil Partsvania, under guidance from Mott MacDonald specialists. The materials will be available for review in the preliminary ESIA report, which will be disclosed so that people can comment on it. In addition we will introduce you the research materials and receive your comments and suggestions.	Information ecology and biodiversity can be found in Chapter 8 which discusses ecology and biodiversity and possible impacts can also be found in Chapter 10 which discusses environmental flows.

Location and Date	Attendees	Summary of issues raised by stakeholders	AGL Response at Scoping Exhibition	Location in ESIA Report
		Why was Adjaristsqali River gorge chosen? This is an area susceptible to ***landslides*** with unique biodiversity, especially at Shuakhevi high conservation forest grove. In addition, presumably climate change is anticipated. Is a map of landslide areas provided?	According to the energy policy of the Georgian government, the utilization process of existing hydro potential has begun in the country. Adjaristsqali River is very important in terms of the hydro-energy potential and the Project construction will be implemented sooner or later anyway. Our main goal is to implement the Project under consideration of environmental and social risks. Lower-risk areas should be selected for installation of the Project facilities/communications and mitigation measures should be implemented to minimize the negative impacts. Identification of the areas, sensitive to landslides and erosion will include pre-design research (engineering geology, topography (topo-geodesy) and seismic surveys); after their completion it will be possible to identify the zones at risk of landslides and develop maps accordingly.	Chapter 11 presents information on geology, seismology and landslides.
		Shuakhevi region, in particular the Chirukhistsqali River gorge is very important in terms of ***eco-tourism***. Will the hydropower facilities prevent the development of tourism in this region?	Impacts on the region's tourism potential should be reviewed during the ESIA preparation, as the tourism is important to the Adjara region. If the Project goes to plan and the necessary mitigation measures are considered, neither Chirukhistsqali River gorge eco-touristic potential nor the region's tourism development in general will be negatively impacted. Tourism infrastructure development can include the possibility of the reservoirs being used for recreation purposes.	Section 7.3.13 describes tourism and recreation

Table B.5: Summary of NGO Comments

NGOs, Batumi	"Green Alternative"	Shota Rustaveli State University	AAR government committee	Georgian Green Movement, co-chair	Association "Flora and Fauna"	Wildlife Protection Society "Chobi"	TOTAL
Spokesperson	David Chipashvili	Sasha Khorava,	Shota Pagava	Nino Chkhobadze	Archil Guchmanidze	Isolda Machutadze	
Issues Raised							
Ecological / environmental flow?	2	1 (for Skhalta region)	1				**4**
Concerns on loss of biodiversity		1		1		1 (especially the unique high conservation forest grove in Shuakhevi)	**3**
Environmental hazards – landslips and erosion?		1	1			1	**3**
More public consultation opportunities?	1						**1**
Local flooding threats?		1					**1**
Effect on Black Salmon migration				1			**1**
Effect on existing HPP?			1				**1**
Impacts on climate change?						1	**1**
Physical resettlement	1						**1**
HPP operator?	1						**1**
Type of dam?		1					**1**
How many HPP planned for?			1				**1**
Sediment/ coastline impacts				1			**1**

Information to be included within final ESIA – Caucasus (elaborated by UNCC)					1		**1**
Concerns over the ichthyofauna					1		**1**
River redirection (Machakhela)		1					**1**
Eco-Tourism						1	**1**

B.3. Photographs of Public Consultations

B.3.1. Municipality Consultation Meetings

Figure B.1: Khulo District Consultation

Source: GAMMA

Figure B.2: Shuakhevi District Consultation

Source: GAMMA

Source: GAMMA

Figure B.3: Keda Community Consultation

Source: GAMMA

Source: GAMMA

Figure B.4: Khelvarchauri Municipality Consultation

Source: GAMMA

Source: GAMMA

Source: GAMMA

B.3.2. Community / Village Consultation Meetings

Figure B.5: Chvana Community Consultation

Source: GAMMA

Source: GAMMA

Figure B.6: Zamleti Community Consultation

Source: GAMMA

Source: GAMMA

Figure B.7: Oladauri Community Consultation

Source: GAMMA

Source: GAMMA

Figure B.8: Merisi Community Consultation

Source: GAMMA

Source: GAMMA

Figure B.9: Kvatia Community Consultation

Source: GAMMA

Source: GAMMA

B.3.3. Public Meetings and Workshops

Figure B.10: Batumi – ESIA Inception (Scoping) Stakeholder Interviews with NGOs

Source: GAMMA

Figure B.11: Batumi – ESIA Inception (Scoping) Stakeholder Interviews with NGOs

Source: GAMMA

Appendix C. Social Impact Assessment

C.1. Overall List of Villages Affected

Table C.1: Overall List of Affected Villages

Municipality	Village	Affected by Footprint and Construction of Infrastructure (main feature listed)	Downstream of dams – reduced flow and sediment flushing / overflow issues	Reservoir	Other buildings / adits
Shuakhevi Scheme					
Khulo	Ianobadzeebi/Iakobadzeebi	Didachara Dam Site	Downstream and close to Didachara Dam	Didachara	
	Gelabadzeebi	Didachara Dam Site		Didachara	
	Didachara	Didachara Dam Site		Didachara	Construction Adit
	Diakonidzeebi	Didachara Dam Site			
	Govgadzeebi	Didachara Dam Site	Downstream and close to Didachara Dam		
	Ghurta			Didachara	
	Paksadzeebi			Didachara	
	Tispnari/Tsifnari	Skhalta Dam Site		Skhalta	
	Zegardani	Skhalta Dam Site	Downstream and close to Skhalta Dam		
	Tsablana	Skhalta Dam Site	Downstream and close to Skhalta Dam		
	Kinchauri	Skhalta Dam Site	Downstream and close to Skhalta Dam		
	Skhalta	Skhalta Dam Site			
	Kvatia			Skhalta	
	Bakhmaro	Transfer Tunnel from Chirukhistsqali-Didachara			
	Gochajikhaishi	Transfer Tunnel from Chirukhistsqali-Didachara			
	Duadzeebi	Headrace Tunnel from Didachara - Shuakhevi	Downstream and close to Didachara Dam		Construction Adit
	Dekanashvilebi	Headrace Tunnel from Didachara-Shuakhevi	Downstream and close to Didachara Dam		
	Khulo (town)	Headrace Tunnel from Didachara-Shuakhevi	Downstream and close to Didachara Dam		

Municipality	Village	Affected by Footprint and Construction of Infrastructure (main feature listed)	Downstream of dams – reduced flow and sediment flushing / overflow issues	Reservoir	Other buildings / adits
Khulo	Octomberi	Headrace Tunnel from Didachara-Shuakhevi	Downstream and close to Didachara Dam		
	Vashlovani	Headrace Tunnel from Didachara-Shuakhevi			
	Tkhiladziri	Headrace Tunnel from Didachara-Shuakhevi			
	Okruashvilebi		Downstream and close to Didachara Dam		
	Elidzeebi		Downstream and close to Didachara Dam		
	Ganakhleba		Downstream and close to Didachara Dam		
	Chao		Downstream and close to Didachara Dam		
	Tago		Downstream and close to Didachara Dam		
	Kedlebi		Downstream and close to Didachara Dam		
	Cheri		Downstream and close to Skhalta Dam		
	Gurdzauli		Downstream and close to Skhalta Dam		
	Dzmagula		Downstream and close to Skhalta Dam		
	Purtio		Downstream and close to Skhalta Dam		
Shuakhevi	Makhalakidzeebi	Chirukhistsqali Dam Site	Downstream and close to Chirukhistsqali Dam		
	Kobalta	Chirukhistsqali Dam Site			
	Gori	Chirukhistsqali Dam Site			
	Paposhvilebi	Chirukhistsqali Dam Site	Downstream and close to Chirukhistsqali Dam		

Municipality	Village	Affected by Footprint and Construction of Infrastructure (main feature listed)	Downstream of dams – reduced flow and sediment flushing / overflow issues	Reservoir	Other buildings / adits
Shuakhevi	Oladauri	Chirukhistsqali Dam Site	Downstream and close to Chirukhistsqali Dam		
	Nigazeuli	Headrace Tunnel from Didachara- Shuakhevi			Adit 1.1
	Chanchkhalo	Headrace Tunnel from Didachara- Shuakhevi			Adit 1.1
	Skhepi/Skhefi	Headrace Tunnel from Didachara- Shuakhevi			Adit 2.2
	Shuakhevi (town)	Headrace Tunnel from Didachara- Shuakhevi			
	Ternali	Headrace Tunnel from Didachara- Shuakhevi			
	Kidisubani	Shuakhevi Powerhouse		Khichauri	
	Beselashvilebi	Shuakhevi Powerhouse			
Koromkheti Scheme					
Shuakhevi	Takidzeebi	Chvanistsqali Dam Site	Downstream and close to Chvanistsqali Dam		
	Tsivadzeebi	Chvanistsqali Dam Site			
	Khichauri	Khichauri Dam Site	Downstream and close to Khichauri Dam		
	Akhaldaba	Khichauri Dam Site		Khichauri	
	Zedakana	Khichauri Dam Site			
Keda	Jalabashvilebi	Khichauri Dam Site		Khichauri	
	Kokotauri		Downstream and close to Khichauri Dam		Project Headquarters
	Merisi	Akavreta Dam site			
	Sikhalidzeebi	Akavreta Dam site	Downstream and close to Khichauri Dam		
	Inasharidzeebi	Akavreta Dam site	Downstream and close to Khichauri Dam		
	Medzibna	Akavreta Dam site			
	Gundauri	Akavreta Dam site			

Municipality	Village	Affected by Footprint and Construction of Infrastructure (main feature listed)	Downstream of dams – reduced flow and sediment flushing / overflow issues	Reservoir	Other buildings / adits
Keda	Silibauri	Akavreta Dam site			
	Tskhemlara	Akavreta Dam site			
	Koromkheti	Koromkheti Power Cavern			
	Dzentsmani	Koromkheti Power Cavern			
	Kveda Agara	Koromkheti Power Cavern			
	Pirveli Maisi	Koromkheti Power Cavern			
	Kolotauri	Koromkheti Power Cavern			
	Gogiashvilebi	Tunnel Khichauri-Akavreta			
	Tskhmorisi	Tunnel Khichauri- Akavreta			Akavreta Adit
	Sabaduri	Tunnel Khichauri- Akavreta			
	Dzneladzeebi	Tunnel Khichauri - Akavreta			
	Kharaula	Tunnel Khichauri - Akavreta			
	Oktomberi/Oqtomberi	Tunnel Khichauri -Koromkheti			
	Shevaburi	Tunnel Khichauri -Koromkheti			
	Ortsva	Tunnel Khichauri -Koromkheti			
	Baladzeebi		Downstream and close to Khichauri Dam		
	Dandalo		Downstream and close to Khichauri Dam		Project Headquarters
	Gegelidzeebl		Downstream and close to Khichauri Dam		
	Akho		Downstream and close to Khichauri Dam		
Khertvisi Scheme					
Keda	Kveda Bzubzu	Downstream and close to Khertvisi Dam	Khertvisi		Downstream and close to Khertvisi Dam
	Kveda Makhuntseti		Khertvisi		
	Namlisevi	Downstream and close to Khertvisi Dam			Downstream and close to Khertvisi Dam

Municipality	Village	Affected by Footprint and Construction of Infrastructure (main feature listed)	Downstream of dams – reduced flow and sediment flushing / overflow issues	Reservoir	Other buildings / adits
Keda	Uchkhiti	Downstream and close to Khertvisi Dam			Downstream and close to Khertvisi Dam
	Milisi	Downstream and close to Khertvisi Dam			Downstream and close to Khertvisi Dam
	Kosopeli	Downstream and close to Khertvisi Dam			Downstream and close to Khertvisi Dam
	Chalakhmela	Downstream and close to Khertvisi Dam			Downstream and close to Khertvisi Dam
	Dologani	Downstream and close to Khertvisi Dam			Downstream and close to Khertvisi Dam
Khelvachauri	Maghlakoni				
	Acharistsaghmarti				
	Shushaneti				
	Sindieti	Downstream and close to Machakela Dam			Downstream and close to Machakela Dam
	Tskhemlara				
	Khertvisi				
	Acharistskali				
	Machakhela				
	Kibe				
	Kedkedi	Downstream and close to Machakela Dam			Downstream and close to Machakela Dam

C.2. Dam Break Analysis Summary

C.2.1. General

Dam break analysis has been carried out for Didachara, Skhalta, Khichauri, and Khertvisi dams which are all defines as 'large dams' by ICOLD (height greater than 15m and / or storage greater than 3 Mm^3).

The purpose of the analysis was twofold: firstly to examine the potential impact of a breach for emergency preparedness planning and secondly to assess whether the flood design criteria adopted for these dams may be reduced as a result of the impact of a breach having no material affect on the downstream area, although for the purposes of the study reduction was not considered.

C.2.2. Methodology

The dam break analysis was undertaken using HEC-RAS 4.1.0 one dimensional hydrodynamic model in order to determine the downstream water levels with and without a breach, and hence determine the impact of a breach in terms of the additional area being inundated.

The topographic data for the model were based on the Digital Elevation Model (DEM). Cross sections were extracted from the DEM at around 500 m spacings for the relevant river reach to develop the model. To provide a stable model additional interpolated cross sections were inserted at around 100 m spacings.

Two breach scenarios were considered:

- breach due to flood flows, and
- overtopping due to a landslide into the reservoir.

The flood flows hydrograph for routing down the downstream valley was based on two components:

- Hydrological flood
- Breach hydrograph

Both the Probable Maximum Flood (PMF) and 0.01% (1 in 10,000 year) flood were considered. The flood hydrographs were based on the hydrographs developed during hydrological analysis using the SCS software.

Breach Hydrograph

The breach hydrograph was developed based on the method identified by Froehlich (1995). The following summarises the calculations:

1. Derive initial estimate of peak flow (Q_p) and time to peak (t_p) from:

$$Q_p = FOS.\left[0.607(V_w^{0.295} H_w^{1.24})\right]$$ (Froehlich, 1995)

$$t_p = 120 H_w$$ (Brown & Gosden, 2004)

Where:

Q_p = peak breach outflow (m^3/s)

t_p = time to peak breach outflow (s)

FOS = factor of safety, equal to 1.50. Factor of safety is to be applied to the Froehlich (1995) equation, to ensure an upper bound peak discharge estimate based on the error bounds presented in Froehlich (1995).

H_w = height of water (m) in the reservoir at the time of failure above the final bottom elevation of the breach. For the "credible upper case" scenario assume entire height of dam is breached, assuming water level is 0.5m above dam crest level.

V_w = reservoir volume (m^3) at time of dam failure. For the "credible upper case" scenario assuming top water level is 0.5m above dam crest level.

2. Derive initial estimate of time to end of hydrograph (t_e). Calculate t_e such that area under hydrograph (i.e. total breach volume) is equal to the assumed reservoir volume at time of breach V_w, assuming a triangular-shaped breach hydrograph:

$$t_e = \frac{2V_w}{Q_p}$$

3. Modify hydrograph if t_e, calculated in Step 2, is less than $2t_p$ by:

Keeping Qp constant, set t_e to $2t_p$ and reduce t_p so that total breach outflow is equal to the reservoir volume (V_w):

$$t_p = \frac{V_w}{Q_p}$$

If to meet the condition above, t_p has to be reduced to less than $40H_w$, set t_p to $40H_w$ and reduce Q_p until total breach outflow is equal to the reservoir volume (V_w).

This hydrograph was then added to the flood hydrograph assuming that the dam breach peak occurs at the flood peak flow giving the maximum flood flows.

Landslide Hydrograph

The landslide hydrograph was developed by assuming a land slip the size of the reservoir occurred over a 5 minute period. It was also assumed that half the reservoir volume was routed down the valley. As such the peak flow was equal to:

$$Q_p = \frac{V_w}{2x5x60}$$

The data was then combined and the flood hydrograph routed using HEC-RAS to develop water levels at each cross section. These water levels were then used to develop the flood extents shown in the flood mapping.

C.2.3. Didachara Dam

C.2.3.1. Breach due to Flood Flows

Figure C.1 shows the hydrographs for the PMF, the breach hydrograph and the combined hydrograph for Didachara Dam. Figure C.2 shows the equivalent hydrographs for the 0.01% (1 in 10,000 year) flood.

Figure C.1 Didachara Dam – PMF, Breach and Combined Flood Hydrographs

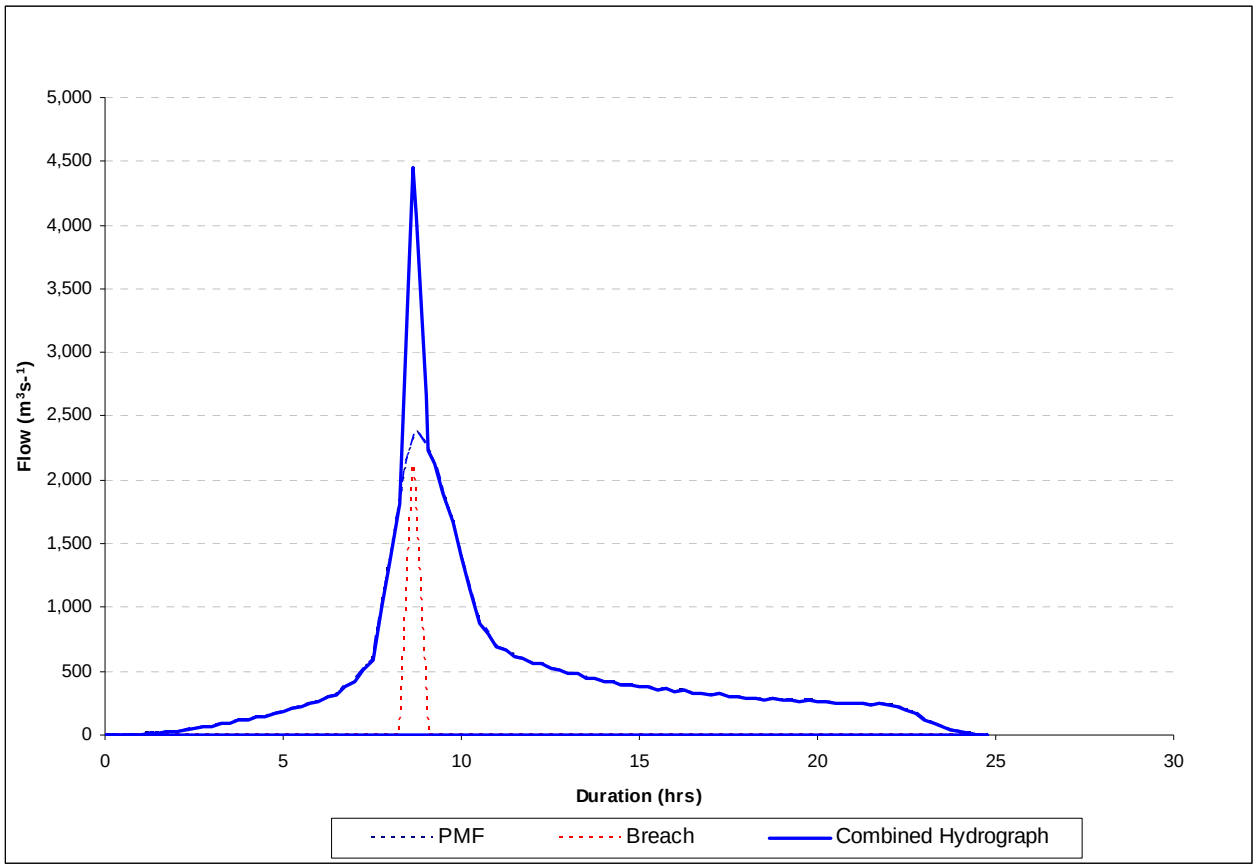
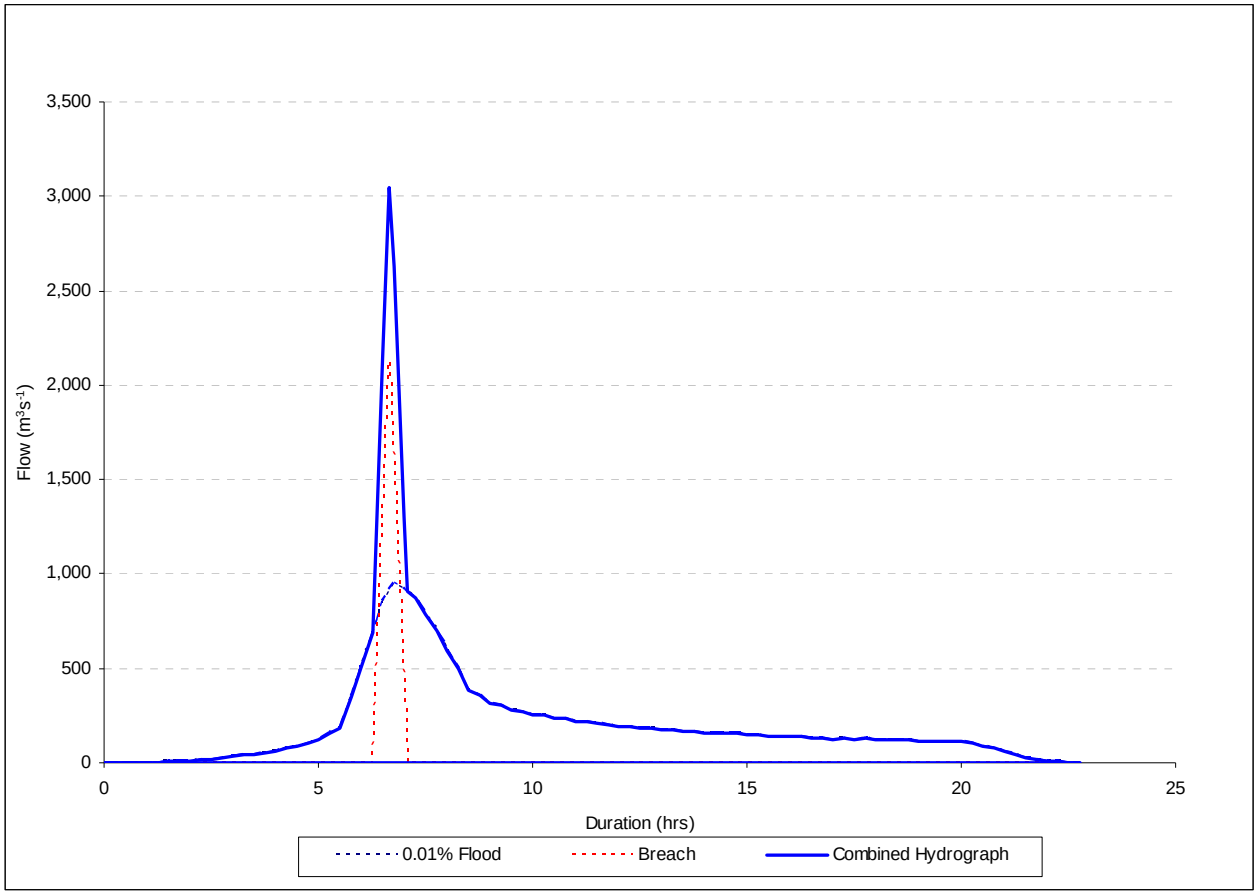


Figure C.2: Didachara Dam – 0.01% Flood, Breach and Combined Flood Hydrographs



A comparison of the peak flows and flood volumes is given in Table C.2.

Table C.2: Didachara Dam – Breach due to Flood Flows

	0.01% (1 in 10,000 year) Flood	PMF	Breach
Peak flow (m^3/s)	950	2,390	2,129
Flood volume (million m^3)	15.9	39.1	3.2

While the increase in peak flows for a breach scenario is significant, the additional flood volume is so limited that the flood extents for the PMF with / without a breach are only appreciably different for the first 6.5 km downstream of the dam. Thereafter there is no tangible difference. Differences in the flood extents for the 0.01% flood with / without breach are appreciable only for the first 8.5 km downstream of the dam. There are no people living within the additional areas that would be inundated so there is no additional risk to the population.

C.2.3.2. Overtopping from Landslide

The peak flows and flood volumes for the scenario where the dam is overtopped due to a landslide into the reservoir are given in Table C.3 below.

Table C.3: Didachara Dam – Overtopping due to Landslide into Reservoir

	Overtopping due to Landslide
Peak flow (m^3/s)	4,389
Flood volume (million m^3)	1.3

The peak flow is similar to the combined impact of the PMF and the Breach measured for the flood flow (Table C.2), and therefore the initial flood in the event of a landslide would not exceed that of a PMF event. However, the extent of the potential impact caused by the landslide would be significantly less due to the flood volume being considerably lower, 1.3 million m^3 in event of a landslide compared to 42.3 million m^3 in the event of PMF. All dams included in the Project have been designed with potential landslide risks taken into consideration. The impact of a landslide displacing the entire volume of the reservoirs has been considered and impacts assessed to be significantly less than that of PMF event, such that no additional risk is posed to areas than would be the case in event of a significant flood.

C.2.4. Skhalta Dam

C.2.4.1. Breach due to Flood Flows

Figure C.3 shows the hydrographs for the PMF, the breach hydrograph and the combined hydrograph for Skhalta Dam. Figure C.4 shows the equivalent hydrographs for the 0.01% (1 in 10,000 year) flood.

Figure C.3: Skhalta Dam – PMF, Breach and Combined Flood Hydrographs

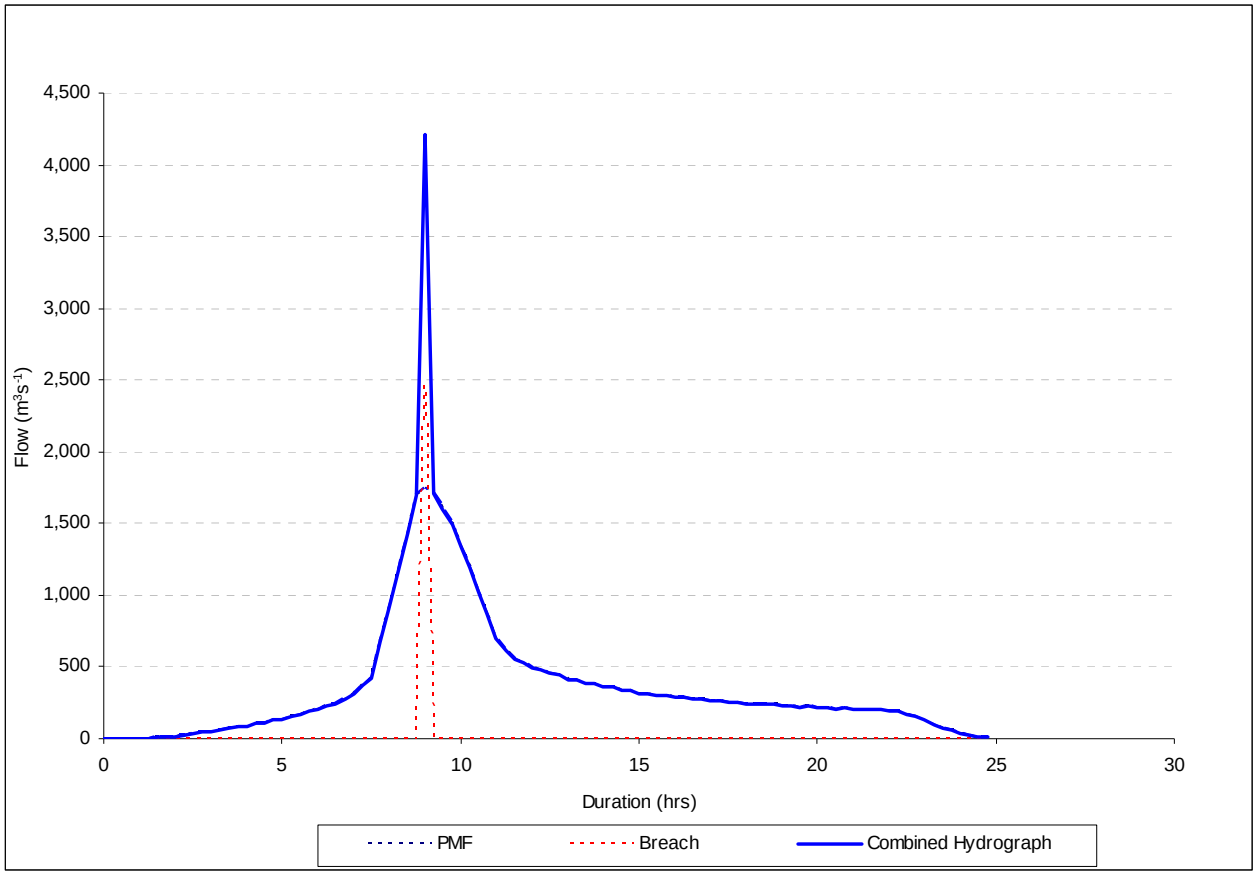
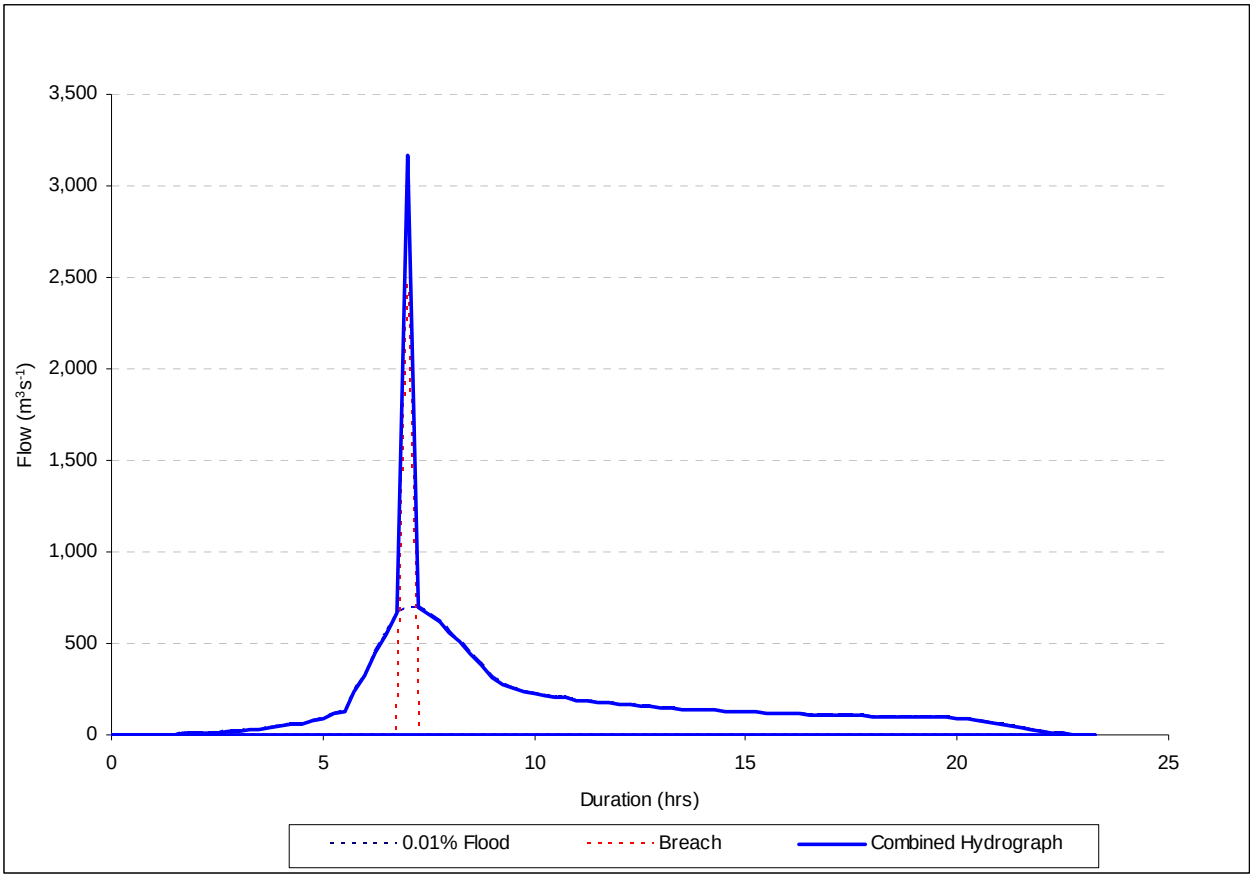


Figure C.4: Skhalta Dam – 0.01% Flood, Breach and Combined Flood Hydrographs



A comparison of the peak flows and flood volumes is given in Table C.4 below.

Table C.4: Skhalta Dam – Breach due to Flood Flows

	0.01% (1 in 10,000 year) Flood	PMF	Breach
Peak flow (m^3/s)	700	1,750	2,466
Flood volume (million m^3)	13.2	32.2	2.2

While the increase in peak flows for a breach scenario is significant, the additional flood volume is so limited that the flood extents for the PMF with / without a breach are only appreciably different for the first 5 km downstream of the dam. Thereafter there is no tangible difference. Differences in the flood extents for the 0.01% flood with / without breach are appreciable only for the first 8 km downstream of the dam. There are no people living within the additional areas that would be inundated so there is no additional risk to the population.

C.2.4.2. Overtopping from Landslide

The peak flows and flood volumes for the scenario where the dam is overtopped due to a landslide into the reservoir are given in Table C.5 below.

Table C.5: Skhalta Dam – Overtopping due to Landslide into Reservoir

	Overtopping due to Landslide
Peak flow (m^3/s)	3,217
Flood volume (million m^3)	1.1

The peak flow is similar to the combined impact of the PMF and the Breach measured for the flood flow (Table C.4), and therefore the initial flood in the event of a landslide would not exceed that of a PMF event. However, the extent of the potential impact caused by the landslide would be significantly less due to the flood volume being considerably lower, 1.1 million m^3 in event of a landslide compared to 44.4 million m^3 in the event of PMF. All dams included in the Project have been designed with potential landslide risks taken into consideration. The impact of a landslide displacing the entire volume of the reservoirs has been considered and impacts assessed to be significantly less than that of PMF event, such that no additional risk is posed to areas than would be the case in event of a significant flood.

C.2.5. Khichauri Dam

C.2.5.1. Breach due to Flood Flows

Figure C.5 shows the hydrographs for the PMF, the breach hydrograph and the combined hydrograph for Khichauri Dam. Figure C.6 shows the equivalent hydrographs for the 0.01% (1 in 10,000 year) flood.

Figure C.5: Khichauri Dam – PMF, Breach and Combined Flood Hydrographs

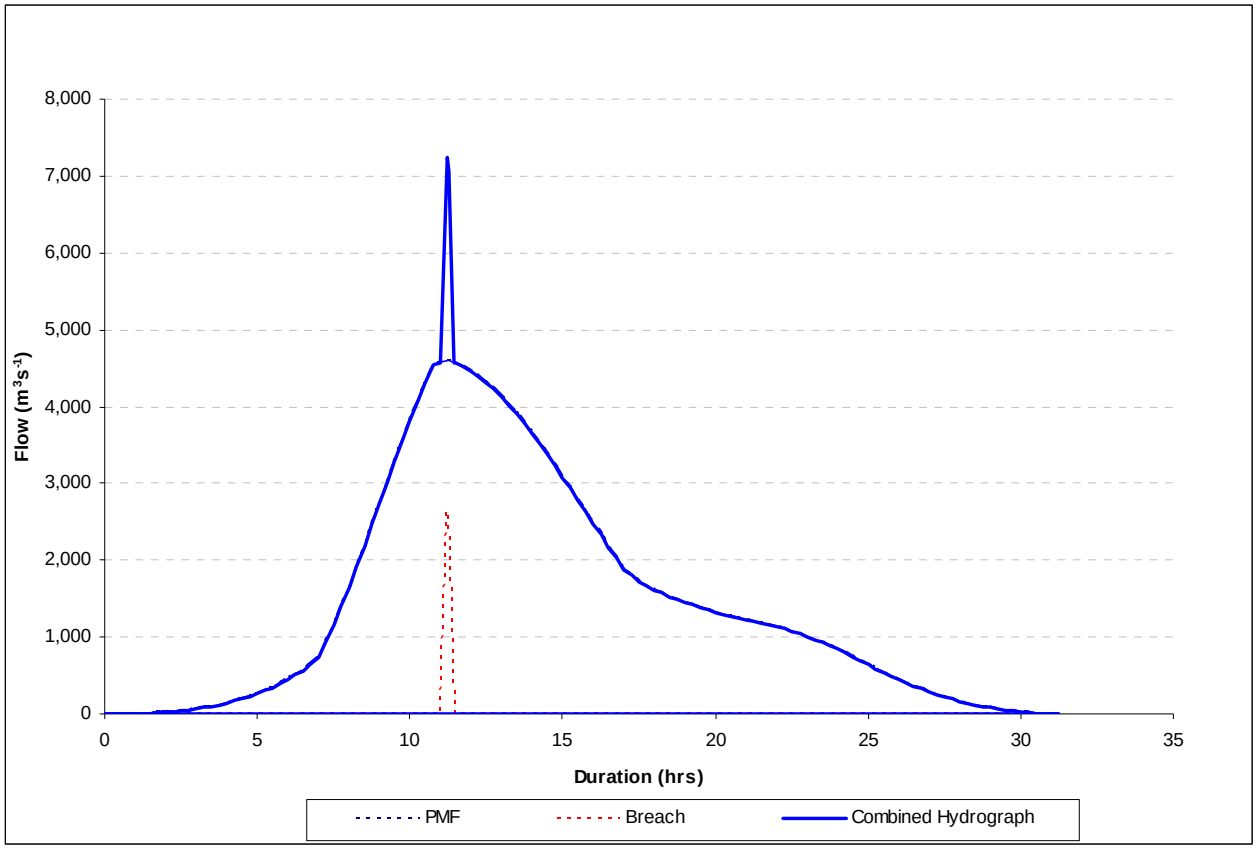
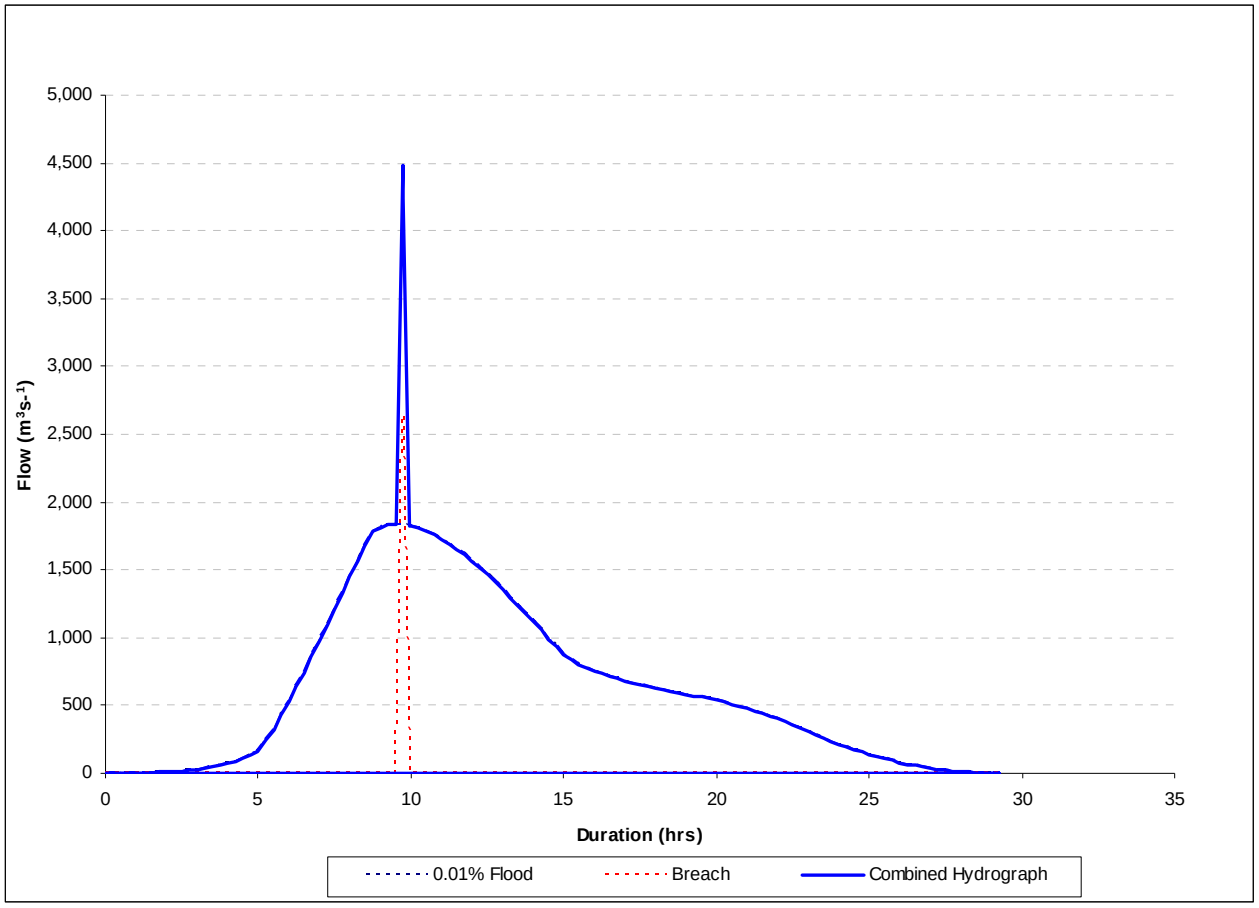


Figure C.6: Khichauri Dam – 0.01% Flood, Breach and Combined Flood Hydrographs



A comparison of the peak flows and flood volumes is given in Table C.6 below.

Table C.6: Khichauri Dam – Breach due to Flood Flows

	0.01% (1 in 10,000 year) Flood	PMF	Breach
Peak flow (m^3/s)	1,840	4,600	2,649
Flood volume (million m^3)	66.2	160.0	2.2

While the increase in peak flows for a breach scenario is significant, the additional flood volume is so limited that the flood extents for the PMF with / without a breach are only appreciably different for the first 4.0km downstream of the dam. Thereafter there is no tangible difference. Differences in the flood extents for the 0.01% flood with / without breach are appreciable only for the first 4.5km downstream of the dam. There are no people living within the additional areas that would be inundated so there is no additional risk to the population.

C.2.5.2. Overtopping from Landslide

The peak flows and flood volumes for the scenario where the dam is overtopped due to a landslide into the reservoir are given in Table C.7 below.

Table C.7: Khichauri Dam – Overtopping due to Landslide into Reservoir

	Overtopping due to Landslide
Peak flow (m^3/s)	3,708
Flood volume (million m^3)	1.1

The peak flow is significantly less than combined impact of the PMF and the Breach measured for the flood flow (Table C.6), and therefore the initial flood in the event of a landslide would not exceed that of a PMF event. Therefore, the extent of the potential impact caused by the landslide would be significantly less due to the flood volume being considerably lower, 1.1 million m^3 in event of a landslide compared to 162.2 million m^3 in the event of PMF. All dams included in the Project have been designed with potential landslide risks taken into consideration. The impact of a landslide displacing the entire volume of the reservoirs has been considered and impacts assessed to be significantly less than that of PMF event, such that no additional risk is posed to areas than would be the case in event of a significant flood.

Khertvisi Dam

C.2.5.3. Breach due to Flood Flows

Figure C.7shows the hydrographs for the PMF, the breach hydrograph and the combined hydrograph for Khertvisi Dam. Figure C.8 shows the equivalent hydrographs for the 0.01% (1 in 10,000 year) flood.

Figure C.7: Khertvisi Dam – PMF, Breach and Combined Flood Hydrographs

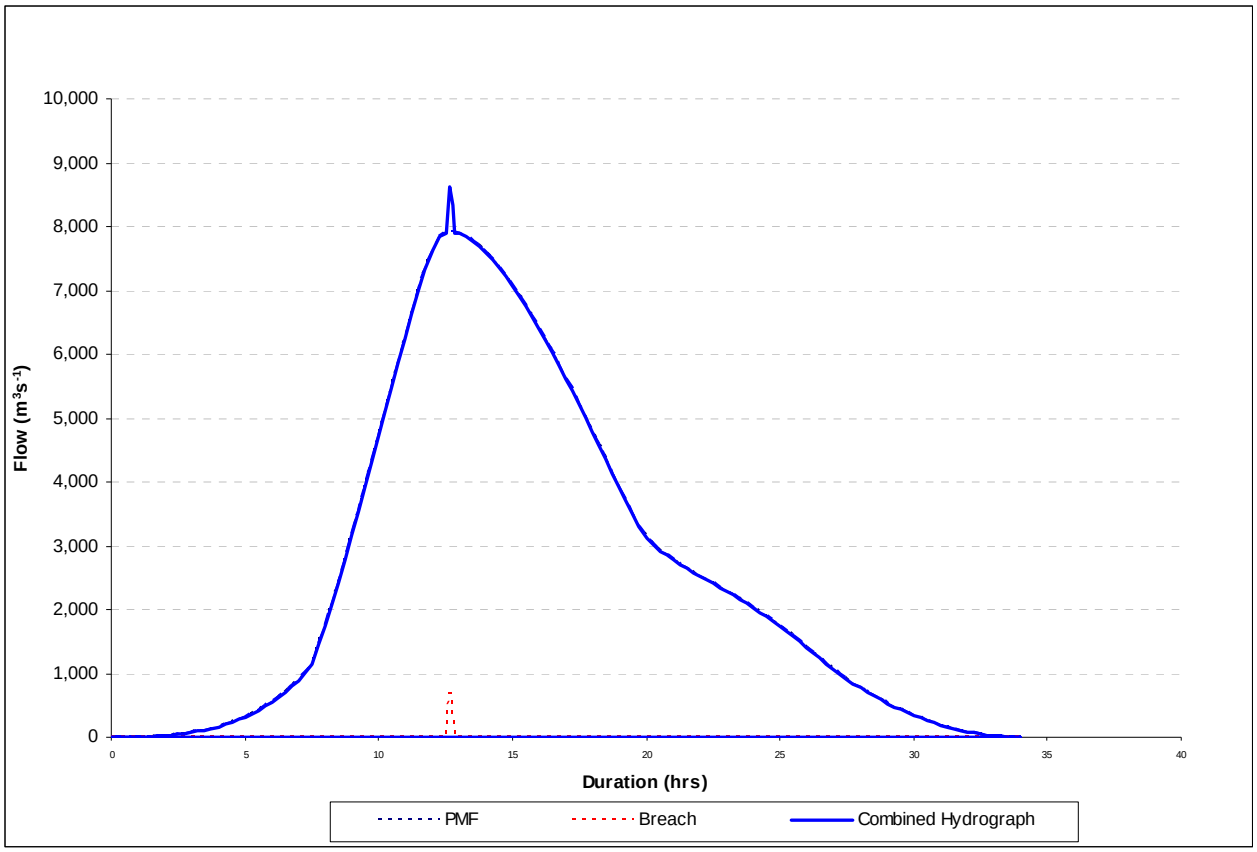
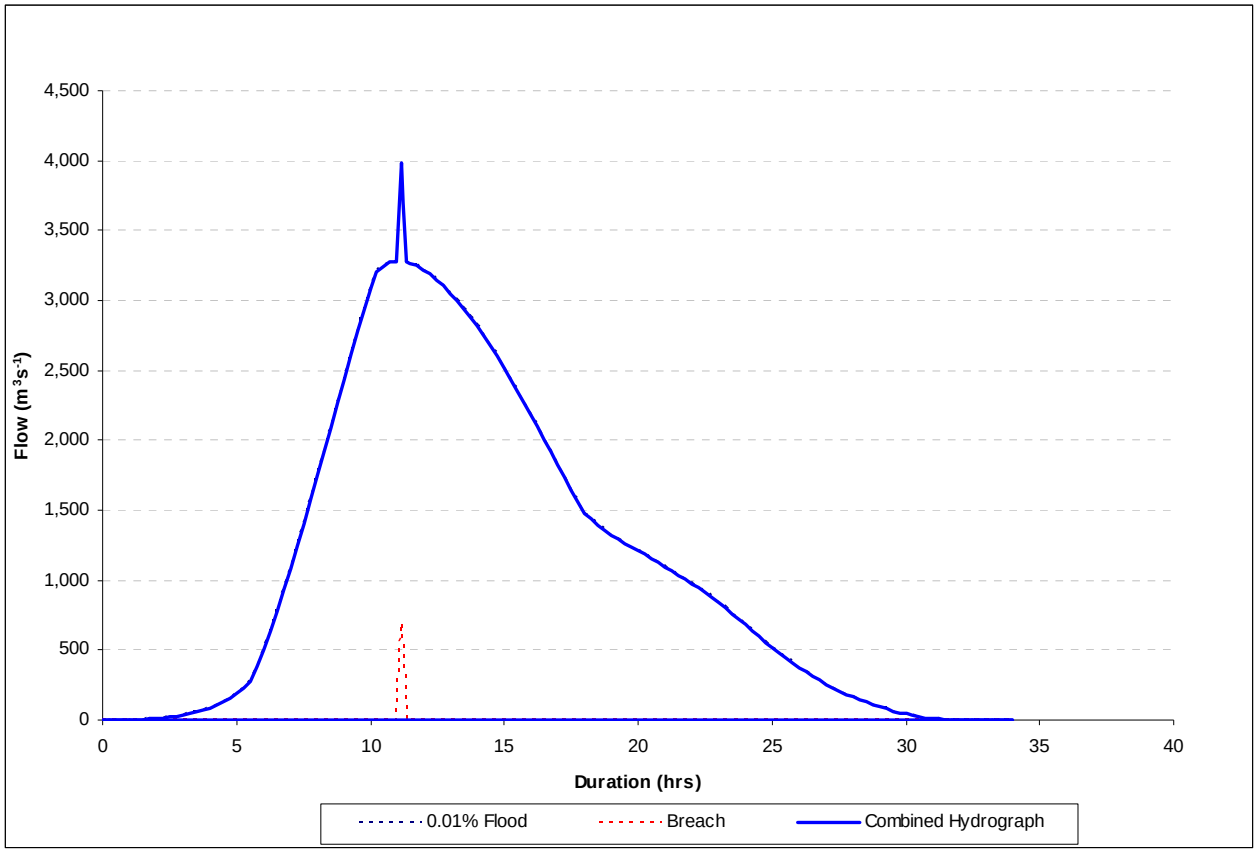


Figure C.8: Khertvisi Dam – 0.01% Flood, Breach and Combined Flood Hydrographs



A comparison of the peak flows and flood volumes is given in Table C.8 below.

Table C.8: Khertvisi Dam – Breach due to Flood Flows

	0.01% (1 in 10,000 year) Flood	PMF	Breach
Peak flow (m^3/s)	3,280	7,920	699
Flood volume (million m^3)	134.0	315.5	0.4

The increase in peak flows for a breach scenario is small and the additional flood volume is so limited that the flood extents for the PMF with / without a breach are not appreciably different. Similarly the flood extents for the 0.01% flood with / without breach are not appreciably different.

C.2.5.4. Overtopping from Landslide

The peak flows and flood volumes for the scenario where the dam is overtopped due to a landslide into the reservoir are given in Table C.9 below.

Table C.9: Khertvisi Dam – Overtopping due to Landslide into Reservoir

	Overtopping due to Landslide
Peak flow (m^3/s)	623
Flood volume (million m^3)	0.2

The peak flow is significantly less than combined impact of the PMF and the Breach measured for the flood flow (Table C.8), and therefore the initial flood in the event of a landslide would not exceed that of a PMF event. Therefore, the extent of the potential impact caused by the landslide would be significantly less due to the flood volume being considerably lower, 0.2 million m^3 in event of a landslide compared to 315.9 million m^3 in the event of PMF. All dams included in the Project have been designed with potential landslide risks taken into consideration. The impact of a landslide displacing the entire volume of the reservoirs has been considered and impacts assessed to be significantly less than that of PMF event, such that no additional risk is posed to areas than would be the case in event of a significant flood.

C.2.6. Summary of Dam Break Analysis

The dam break analysis for Didachara, Skhalta and Khichauri dams shows that there is no significant impact from a dam breach over and above the impact that would be anticipated for either the PMF or the 0.01% (1in 10,000 year) flood event.

There are no people living within the additional areas that would be inundated so there is no additional risk to the population. As such, consideration could be given to reducing the spillway design criteria at the design stage.

The dam break analysis for Khertvisi dam shows that there is no significant impact from a dam breach over and above the impact that would be anticipated for either the PMF or the 0.01% (1in 10,000 year) flood event.

As such, the selection of the Design Flood as the 1% flood (1 in 100 year) and the Safety Check Flood as the 0.1% flood (1 in 1,000 year) in line with ICOLD guidelines for a low dam with little storage appear reasonable.

These results also indicate that there is no necessity to consider the impact on the Chorokhi River.

Appendix D. Ecology and Biodiversity

D.1. Flora and Vegetation Report (Gamma, 2011)

D.1.1. Introduction

This report details the findings of the literature review and field work undertaken to survey the flora and vegetation within the corridor of the proposed Adjaristsqali Hydropower Cascade Project, in particular to identify sensitive communities and habitats.

The botanic description of the territories within the Project impact zone is based on a detailed review of the literature and unpublished data, as well as on own experience and knowledge. At the same time, it should be stated that special field studies will have to be carried out to obtain more detailed information in order to fill existing information gaps (white spots) and provide the basic materials for an Environmental and Social Impact Assessment (ESIA) of the Project planning and construction activities from a botanical view point. Hence, the negative and residual impacts predicted during the Project construction activities on the flora and vegetation of the affected areas has to be confirmed through further surveys.

Within the Project impact zone a great number of communities and species of differing conservation value (Georgian Red List-GRL, GRDB, endemic, rare) as well as economic plants (medicinal, aromatic, wild fruits, fibres, rootcrops, ornamental, beverages, timber, fuel wood, forage (fodder) and pasture, wild relatives of crop species, etc.), are represented.

In addition to endangered species and sensitive habitats having varying conservation values, special attention is given to forested areas, and the urgent necessity to mitigate the residual impact on forest ecosystems is emphasised. In cases where a residual impacts are identified in these areas, compensation measures should be undertaken which cover the rehabilitation/restoration of the equivalent forest habitats.

D.1.2. Legal Framework

Existing environmental legislation in Georgia is based on internationally recognised principles and criteria, which provide an effective basis for the environmental impact assessment.

Georgia's general wild flora and fauna conservation measures are regulated by several legislative acts adopted by the Georgian Parliament in 1994-20011. In this context it is crucial Decree N303 of May 2, 2006 of the President of Georgia, "On Approval of the Red List of Georgia" (Endangered Species List).

Table D.1: Main Environmental Laws of Georgia

Law	Date of Implemetation
Law on Protection of Flora from Harmful Organisms	12.10.1994
The Constitution of Georgia	24.08.1995
Law on Protected Area System	07.01.1996
Law on Normative Acts	29.10.1996
Law on Environmental Protection	10.12.1996
Law on Wildlife	26.12.1996
Law on State Ecological Expertise	01.01.1997
Law on Environmental Permits	01.01.1997
Law on Creation and Management of the Kolkheti Protected Areas	09.12.1998

Law	Date of Implemetation
Law on Changes and Amendments into the Law on Protection of Flora from Harmful Organisms	16.04.1999
The Forest Code	22.06.1999
National Environmental Action Plan of Georgia	19.06.2000
Law on Melioration of Lands	16.10.2000
Law on Special Preservation of State Forest Fund and the Plantation within the Tbilisi City and Neighbouring Territories	10.11.2000
Law on explanation of Borjomi-Kharagauli National Park	28.03.2001
Law on Red Data List and Red Data Book of Georgia	06.06.2003
Law on State Control of Nature Protection	23.06.2005
Law on Red Data List of Georgia	6.04.2003

Source: Gamma

The following Multilateral International Conventions and Agreements related to nature conservation and biodiversity have been enforced in Georgia:

- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES 1975; universal);
- Convention on Biological Diversity (CBD 1992; universal);
- European Union Habitats Directives (1992; regional);
- Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat--Ramsar Convention (1975; universal);
- Convention concerning the Protection of the World Cultural and Natural Heritage (World Heritage Convention; 1972; universal);
- United Nations Framework Convention on Climate Change (UNFCC 1994; universal) and (Kyoto Protocol adopted 1997; universal);
- Convention on the conservation of European Wildlife and natural Habitats (Bern Convention 1979); and
- European Landscape Convention 2000.

D.1.3. Methodological and Conceptual Issues (Approaches) Concerning Flora/Vegetation Description and Identification for Project Impact on Ecosystems and Habitats

Ecosystems along the Project impact zone are usually characterized in terms of habitat/vegetation types, such as those identified in Ketskhoveli (1960), Nakhutsrishvili (1999), Kvachakidze (1996), etc. Species composition within different ecosystems and habitats are determined through the study of bibliographic data and carrying out field surveys.

According to our research, several plant species (vascular mainly) are represented along the Project impact zone. However, as stated by Morris (1995) “in principle, assessment of the flora should include all vascular plants, bryophytes, lichens, algae (including stoneworts) and fungi, although the importance of the groups varies in different communities”. Nonetheless, vascular plants are considered to be the main indicator of terrestrial ecosystems, e.g. all forms of life in a given landscape.

As mentioned above, in addition to endangered plant species and sensitive habitats which have different conservation values, special attention is paid to forested areas, including artificial forest plantations. This is on the grounds that forests are considered as special environmental protection areas, unique, and one of the most important ecosystems with high ecological, aesthetic, cultural, historical and geological properties

(Harcharik, 1997; Isik et al., 1997). In other words, “forests are more valuable as forests than under some other forms of land use” (Harcharik, 1997), and “people are making greater demands on forests for recreation, pleasure, scenery and conservation of biological diversity” (Lanly, 1997).

It is acknowledged that within project impacted areas, it is practically impossible to reinstate and maintain former natural forested territories as they were prior to construction. Consequently, it is recommended that Forest eco-compensation programmes (Forest offset) or offset other ecosystems/plant communities are implemented in order to mitigate residual impacts associated with Project construction activities.

Detrimental impacts to the protection of biodiversity, protected areas and forestry have to be reduced to the absolute minimum and unavoidable residual environmental damages have to be offset by an eco-compensation scheme. In particular the impacts on forest ecosystems have to be evaluated and offset by adequate mitigation and eco-compensation measures with the goal to restore the equivalent forest habitat.

In this context, the calculation of damages to forest ecosystems by the Project construction activities according to the “none-net loss”, “net gain principle” and “habitat hectare” approach is recommended in order to define the exact ratio for forest eco-compensation based upon modern methodologies and international best practice.

The habitat hectare scoring method is a common approach to determine the value of vegetation in non-monetary units. The environmental proxy used i.e. the “currency” in which the value of vegetation is expressed is the “habitat hectare”. The habitat score is derived by assessing a number of site-based habitat and landscape components against a pre-determined ‘benchmark’. Benchmarks have to be defined for different ecological vegetation classes (EVCs).

habitat area [ha] x habitat score = habitat-hectares

This method serves to assess a number of site-based habitat and landscape components against a pre-determined ‘benchmark’ relevant to the vegetation type being assessed. Benchmarks have to be defined for different ecological vegetation classes (EVC). The benchmark for each EVC has to describe the average characteristics of mature and apparently long undisturbed biodiversity and native vegetation occurring in the bioregions in which habitats shall be assessed. The notion of mature and apparently long undisturbed benchmark is relative to the EVC; e.g. a forest benchmark can be based on the average for stands of 200 year old trees with no signs of significant anthropogenic disturbance. Each EVC must contain a range of information required for carrying out a habitat hectare scoring exercise. When carrying out a habitat hectare scoring exercise a habitat score indicating the quality of the vegetation relative to the EVC benchmark is assigned to each of the areas assessed. Multiplying the habitat score by the habitat area (in hectares) allows determining the quality of vegetation. Whereby units of “habitat hectares” are used as a common measuring rod to compare the relative value of different ecosystems within one EVC. The habitat hectare exercise foresees an *in-situ* assessment of natural vegetation to collect a range of visually assessed information of several vegetation components across the habitat zone. The vegetation components that have to be included and assessed depend on the eco-region specific ecosystem composition.

In a second step the visually assessed information on the vegetation components is analysed and used to calculate the habitat score for the area.

The components of the habitat score can be weighted. The Australian State Government of Victoria, Department of Sustainability and Environment, which is a worldwide leading institution in applying the habitat hectare approach, use the following components and weights:

Table D.2: Components and weightings of the habitat score in Victoria, Australia

	Component	Max. value (%)
Site condition	Large trees	10
	Tree (canopy) cover	5
	Understorey (non-tree) strata	25
	Lack of weeds	15
	Recruitment	10
	Organic litter	5
	Logs	5
Landscape context	Patch size*	10
	Neighbourhood*	10
	Distance to core area*	5
	Total	**100**

*Components may be derived with assistance from maps and other (e.g. GIS) information sources.

D.1.4. Overview of Flora and Vegetation in Project Corridor

Adjara vegetation is fairly diverse, which is determined by the different natural conditions of the area as well as a complex history of flora and vegetation development. Adjara, as many researchers have indicated, is the richest province of Kolkheti relict flora. The majority of the elements typical for Kolkheti flora are found in the region. Moreover, there are additional relict species which grow only within Adjara, i.e. – Medvedev's birch, ground laurel – *Epigaea gaulterioides*, etc. The elements of European forest flora are abundantly mixed with Kolkheti vegetation.

The Adjara flora, as all vegetation typical for mountainous countries, is characterised with vertical belting. According to Ketskhoveli (1959), the following belts are prominent in the area: 1) Hydrophytic grass and humid forests with natural climbers – 0-250 m above the sea level; 2) Forests with evergreen Colchic understory and natural climbers – from 150-250 m to 450-500 m above the sea level; 3) Middle mountain belt with a couple of sub-belts – from 500 m to 2,000 m above the sea level; and 4) High mountainous, sub-alpine and alpine belts. The above belts are characterised by different vegetation, which is briefly discussed below.

Adjara lowland – is a coastal line located within the southern end of Kolkheti lowland. The width of the area fluctuates within 2-5 km from Kobuleti, becoming even narrower to the south and the foothills which directly follow the seaside. The latter part of Adjara is prominent for the large amounts of precipitation. The seeping of precipitation occurs only in the upper layers of ground due to high level of water. This results in a lack of flow or only a slight flow of precipitation from the surface. These conditions, in addition to many other factors, have lead to bogging across the major part of Kolkheti lowland.
The mentioned Adjara lowland, generally as the lowest part of Kolkheti lowland, was covered with forested marshes, grass and sphagnum wetland vegetation. These types of vegetation are developed on the wetland meadow, peat-boggy, bog-slit and boggy podzol soils. The majority, especially forested wetlands, is at present dried and plantations of tea and other technical crops are cultivated.

Forested marshes were more abundant in the mentioned vegetation complexes. Only fragments of these forests have been preserved on small areas. Alder - *Alnus barbata*, is dominant in this forests. Caucasian wingnut – *Pterocarya pterocarpa* and in relatively dry areas - hornbeam (*Carpinus caucasica*) and Imeretian oak (*Quercus imeretina*) are also present. The understory is commonly formed by buckthorn (*Frangula alnus*), hawthorn (*Crataegus microphylla*), cranberry (*Viburnum opulus*), etc. At some areas with thinned forests, blackberry and lianas (such as greenbrier (*Smilax excelsa*), silk vine (*Periphloca graeca*), wild grape (*Vitis silvestris*), ivy (*Hedera colchica*), etc.) have become dominant.

Alder formations are found mainly on humid ground, although it is undeveloped in greatly bogged areas. Alder formations are rich with grass synusias formed by typical components of bog vegetation, such as: Imeretian sedge, wetland iris, sedges, cattails, etc. Alder formations with fern, mixed grass and mosses occupy less area. Alder formations with rhododendron are even less abundant on relatively drier areas. The mentioned alder species occurs more or less abundantly in Adjara lowland and middle mountain forests, i.e. hornbeam and beech formations up to 1,500 m above the sea level and at some areas – especially in the upper zone of its development it forms co-dominant cenoses with mountain alder (*Alnus incana*) on small areas.

Fairly diverse leaved forests were abundant in Adjara lowland and foothills. At present only their fragments remain on relatively small areas. Such forests are formed by hornbeam, Imeretian oak, ash (Fraxinus excelsior), Khertvisi oak (Quercus hartvissiana), elm (Ulmus elliptica), lime (Tilia caucasica), persimmon (Diospyros lotus), at some areas – by beech, chestnut, etc. These forests are characterized with well developed understory, which at some areas is formed by deciduous shrubbery: pontic azalea (Rhododendron luteum), buckthorn (Rhamnus imeretina), spindle tree (Evonymus latifolia), bladder nut (Staphylea colchica, St. pinnata), hazel nut (Corylus avellana, C. pontica), etc. and at some areas – by evergreen understory, such as: holly (Ilex colchica), rhododendron (Rhododendron ponticum), Colchic holly (Ruscus hypophyllum), etc. In these forests, especially – within lowlands liana vegetation is also abundant – Colchic ivy, silk vine, wild grape and greenbrier. In some thinned areas, the vegetation is so abundant, that access is impossible. The described forests are located up to 500 m above the sea level.

The intact nature of Adjara Colchic forests has been disrupted. They are either cut or transformed into arable land. Even if forests remain, they are re-established on forest clearings, because growth is very intensive on the lowland of the Western Georgia. Alder and hornbeam should be especially noted in this term. According to Ketskhoveli (1959), the grass vegetation of such forests is fairly diverse, ferns and forb grasses are especially abundant.

Georgian oak forests do not occur in Adjara. It is substituted with Tchorokhi oak (*Quercus dscorochensis*). The forests with Tchorokhi oak dominance are spread on dry slopes of Adjaristsqali and Tchorokhi ravines. The major part of these forests is very thinned and, as a rule, trimmed. Due to hay lack the population uses woody fodder for livestock feeding. These forests resemble Georgian oak forests spread in Kolkheti in structure, but, according to Kolakovski (1961), Minor Asian xerophyle species occur in its structure. Fragments of mountain xerophyle oak forests are represented in these oak forests – among others tragacant astragal was found.

The area above described vegetation belongs to the middle montane zone, which altitudes according to Ketskhoveli (1959) range from 500 m to 2,150 m above sea level (asl). This zone is very rich with plant communities reflected in occurrence of the numerous tree and shrub species as a result of diverse ambient conditions and impacts of human's economic activities.

The landscape importance of this zone is associated with the beech forests, however, as pointed by Dolukhanov (1957), beech forests are common in the middle montane zone, but do not exist in the areas where annual precipitation is less than 500 mm. The principal coenotype of this formation can be found from seaside to subalpine zone, although based on Gulisashvili (1955), altitudinal zone of the beech forests with high productivity beech stands is extended from (900) 1,000 m to 15,000 (1,600) m asl, while according to Dolukhanov (1957), the optimal distribution area of beech forests is limited within the altitudinal range of 800-1,300 m asl. This forest type is characterized by absolute domination of the principal coenotype, though it is not seldom that in the phytocoenosis the major species is admixed with hornbeam, wych elm, chestnut – particularly in the lower montane zone, lime-tree, etc. The beech often forms co-dominated phytocoenosis with spruce and fir.

Beech forests with evergreen understory are widely distributed around Adjar highlands. Such forests are typical for the entire Kolkheti and are mainly associated with humid areas. The understory is formed by Pontic rhododendron (*Rhododendron ponticum*), Black Sea holly (*Ilex colchica*), cherry-laurel (*Laurocerasus officinalis*), in some areas – by *Rhododendron ungernii, etc*. The wet territories also host the beech forests with fern understory. In this type of beech forests the live cover is formed by ferns *Matteuchia struchiopteris, Athyrium filix-femina, Driopteris filix-mas,* sometimes by *Phyllitis scolopendrium,* etc. The later species which are abundant are also found in other types of beech forests, though their share in the phytocoenosis is minor.

On the less humid slopes, the complex of foregoing type beech forests comprises beech shrubs. In these forests the understory are formed by deciduous bushes, e.g. yellow azalea (*Rhododendron luteum*), Caucasian whortleberry (*Vaccinium arctostaphyllos*), common hazel (*Corylus avellana*), some blackberry species, etc. Such beech forests have well-developed herbaceous sinusia. This sinusia, as well as the deciduous beech shrublands in general, are richer in terms of species composition comparing to the other beech forest types. Beech forests are also floristically quite rich with tall herbaceous vegetation and fescue (*Festuca montana*) understories. These two forest types are developed in the different ecological environments, although both of them are of minor importance in Adjarian beech forest landscapes.

The beech forests, with dead ground cover, are quite widely distributed in Adjara, as well as around entire West Georgia. In such beech forests, according to Kolakovski (1961), other tree species have only minor shares, while bushes and herbs almost do not exist. Based on Dolukhanov (1938), this type beech forest provides the most favourable ecological conditions for growth and development of the beech, and is characterized by high productivity. In general lianas are seldom met in such environments; however some liana species, e.g. Colchic ivy, are permanent components of the beech forests.

Hornbeam forests are often found in combination with beech formations, particularly in the lower part of beech distribution area, approximately up to 1,100 m asl. Individual hornbeams admixed to the beech forest may be met even at higher altitudes. The hornbeam stands develop in the various edaphic conditions. For example, on the lowland hornbeam grows in the podzol soils, and in other areas such as the humus-rich carbonate and brown forest soils. Structurally and floristically, hornbeam forests are similar to the beech ones and comprise the analogous forest types, but are developed over significantly smaller areas. In Adjara, as well as around the entire West Georgia, hornbeam forests are often replaced with black alder stands mainly due to human's economic activities. The alder is extensively propagated after felling of the hornbeam forests, which often results in the formation of the mixed alder and hornbeam stands.

According to the accessible data (Ketskhoveli, 1935, 1959; Dolukhanov, 1953; Kolakovski, 1961; Gulisashvili, 1964; Jorbenadze, 1969), in Adjara, and particularly in its beech and hornbeam formation, the

smaller areas are occupied with the chestnut forests. Here it should be noted that with lower abundancy, the chestnut is represented in almost all forest types developed at the foothills and within the middle montane zone. The forests of the later zone is characterised with occurrence of the yew (*Taxus baccata*), which usually belongs to the understory.

The coniferous forests are extensively distributed in Adjara within the altitudinal range from 900 m to 2,000 m, although the pine forests are also found at significantly lower elevations, over the southern slopes of lower reaches of Adjaristsqali River. Adjarian pine forests are distributed fragmentally and are formed with domination of *Pinus kochiana*. The pine forests have open canopies, and thus shrub and herbaceous synusiae are well established. The forests which have closed canopies are formed by spruce (*Picea orientalis*) and fir (*Abies nordmanniana*), and therefore, in these forests shrub and herbaceous understories are seldom. Typologically, such forest type is associated with beech forests. The fir, in combination with the beech, often forms co-dominant coenoses, which are quite common in the Adjarian highlands. Other coniferous forests which extend over larger areas are represented by pure spruce, spruce-and-fir and pure fir stands. In Adjara, such coenoses are mainly found at the upper tree line.

Specific scrubs named by locals as “Shqeriani” are established in some valleys of Adjara which are elevated higher than 1,000 m above sea level. This scrub type was first described by Golitsin (1939, 1948), and afterwards a respective term was established in the botanical references. Such phytocoenoses are created with participation of tertiary relics of Colchic flora, e.g. cherry-laurel, Pontic rhododendron (*Rhododendron ponticum*), Medvedev’s birch (*Betula medwedewi*), *Rhododendron ungernii,* Pontic oak (*Quercus pontica*), *Epigaea gaulterioides*, bilberry, azalea, holly, viburnum, broom, etc. Due to closed pattern of the shrub canopy, the herbaceous cover is weakly developed, however ferns are quite abundant.

Golitsin considers such scrub type to be constituent of original as well as relic phytocoenosis due to co-occurrence of the tertiary relicts, and especially of epigea. At the same time, he negates Sinskaya’s (1933) opinion that such scrubs had an anthropogenic origin and were developed over the former distribution areas of the burnt forests. Ketskhoveli (1959) considers Sinskaya’s opinion more accurate and states that the majority of the scrubs constitute the forest elements including epigea, which according to Shishkin (1930) is a typical component of the understory of Lazistan’s beech forests. Furthermore, Ketskoveli (1959) notes that Shqeriani has been distributed on Adjara-Imerety Range, slopes of Mt. Lomi and in the valleys of Nenskra, Nakra and other rivers of Upper Svaneti. After destruction of the forests in these areas, the bushes forming the understory remained, which were further enforced in to such an extent that it made impossible for the regeneration of the major forest species.

The area above the forests described previously is occupied by a subalpine zone, which has an upper boundary which elevates in average up to 2,200-2,300 m asl. These areas represent the formation of meadows, scrubs and subalpine forests. Similar to the entire Georgian highlands, two forest types – crook-stem and sparse forests - are distributed throughout this area of Adjara. Here sparse forests are mainly formed by red-bud maple (*Acer trautvetteri*), birch (*Betula litwinowii*), etc. In these forests the area between scarcely grown trees is covered with herbs and the ground surface is mainly tussocked. In Adjara the subalpine sparse forests are seldom and mainly are of secondary origin.

The crook-stem forests are more common in Adjara, and in general, are distributed over the north and west slopes, mainly in areas with deep and long-lasting snow cover. This type of forest is mainly formed by the foregoing birch species, mountain-ash, and some species of willow gene, etc. Synusiae of herbaceous and shrub plants are well-developed. Among the shrubs, the principal species is Georgian snow rose (*Rhododendron caucasicum*), while the herbaceous synusia is mainly composed of tall herbaceous plants.

In line with the entire West Georgia, in Adjara the crook-stem forests are often formed by beech. Similar types of crook-stem birch forests also develop, although more common are beech forests with herbaceous understory, where live ground cover is composed of herb and fern synusiae. These beech forests are so distinguished from the middle montane zone, which some researchers, e.g. Dolukhanov (1957), consider to be an entirely independent formation.

In West Georgia, and particularly in Adjara and Guria, crook-stem forests are also formed by Medvedev's birch and Pontic oak. However, such forests are mainly distributed within the middle montane zone. This type forest is distinguished with evergreen shrub sinusia, in subalpine zone – with domination of Georgian Snow Rose (*Rhododendron caucasicum*), and at lower areas – with participation of Pontic rhododendron, cherry-laurel, ilex, etc.

Most parts of subalpine forests in the Adjara highland have been felled and secondary meadows have been developed on these former forested areas. This is one of the reasons why the upper forest boundary in this part of Georgia is ended with spruce and fir forests. Restoration of subalpine forests is a necessity. Their agricultural value is obviously high, because this type or forest protects forests located low down from avalanches, as well as providing important protection of the soil and the enhancing the regulation of water regimes.

Rhododendron scrubs formed by *Rhododendron caucasicum* are well-developed in the subalpine forest complex, as well as within the alpine zone, particularly on the slopes with north and west aspects. These habitats are associated with the mountain peat soils. Rhododendron scrubs are relatively homogenous and poor in terms of species composition. This stems from the specific coenotic structure of rhododendron scrubland. The floristic components of this formation comprise whortleberry (*Vaccinium myrtillus*), red bilberry (*V. vitis-idaea*), *Oxalis acetosella*, and numerous other species including ferns and lichens. The rhododendron scrubs mainly grow on considerably steep slopes, however more seldom, e.g. at some sections of Arsiani Range, they are found on the plain terrain in the form of specific type rhododendron scrubs, which are termed in the references (K. Kimeridze, 1969) as Peat and Hilly Rhododendron Scrubland. This vegetation is associated with the areas of deep and long-lasting snow cover. The subalpine zone also hosts fragmentally distributed juniper shrubs, which according to available information (Ketskhoveli, 1935; Nizharadze, 1948, etc.) are derivatives of the pine forest.

Another characteristic component of Adjarian highland flora is represented by tall herbaceous plants. Abundance of this vegetation is associated with the favourable environmental conditions reflected in the moist humus-rich and thick soils, as well as the soil's optimal thermal regime during vegetation season. Usually such herbs grow within formation of subalpine forests and rhododendron scrubs, as well as in upper montane zone in a form of independent synusia. Quite often the tall herbaceous plants are of poli-dominant nature and comprise *Heracleum sosnowskyi, Campanula lactiflora, Delphinium flexuosum, Inula grandiflora, Doronicm macrophyllum, Senecio platyphyloides, Pyretrum macrophyllum, Aconitum nasutum*, etc. This vegetation is mainly composed of dicotyledons, while monocotyledons, and particularly representatives of grass and sedge genes, are found very seldom. Therefore, as a rule, the ground cover is not tussocked.

Despite an abundance of the phytomass, the tall herbs are useless for haying and grazing, but may be used for preparation of silo that awards this vegetation an agricultural importance. The tall herbaceous vegetation of this type is also rich with medical, technical and decorative plants.

The herbaceous plants mainly grow on subalpine meadows, which are of wider distribution around this zone. This type of vegetation, as well as the mountain meadows in general, is characterised by diverse typology and rich composition of species. However, due to long term use of these areas for grazing and resulting extensive loads, the native vegetation is altered and is represented by types formed in result of pastoral digression. On Arsiani Range mainly are distributed matgrass and bentgrass along with poli-dominant thin herbaceous meadows with Alchemilla and other species. The described forms are developed on mountain-meadow tussock soils. On Shavsheti Range and humid slopes of Adjara-Guria Range are quite widely distributed the broad-leave herb and grass meadows. In addition, similar meadows are extended over the smaller areas of Arsiani Range, mainly in combination with forests, at the upper tree line. Such meadows are characterised by slightly tussoked secondary mountain-meadow soils.

D.1.5. Detailed Description of Flora and Vegetation at Study Locations

A detailed botanical study was carried out within the corridor of proposed hydropower cascade on the Adjaristsqali River. As a result of this study, potential impacts on flora and fauna within the project corridor and adjacent areas during were identified for during the Project construction and operation phases. In addition, various vegetation species of conservation value (Red Book, Red List, endemic, rare) distributed within the project impact area were identified as being at risk, including the economically valuable plants. The following information collected during the study will be further replenished during the pre-construction botanical studies.

Plot No. 1

GPS coordinates N $41^0$34’02.9’’/E $042^0$15’16.1’’, 828 m asl; slope gradient 15^0, Dolabigele River - left tributary of Chikhuristskali River; downstream of village of Karapeti; man-made walnut plantation. Medium conservation value habitat. Tree storey is represented by the following species: *Juglans regia, Alnus barbata, Picea orientalis, Carpinus caucasica.* The following shrub species are present: *Crataegus microphylla, Rubus sanguineus, Hedera colchica*. From the herbaceous species, the following plants are present: *Fragaria vesca, Sanicula europaea, Bellis perenis, Poa* sp., *Cyclamen vernum, Salvia glutinosa, Cynoglossum officinale, Tamus communis, Phyllitis scolopendrium, Asplenium trichomanes.*

Plot No.1: Artificial Walnut Plantation

Source: Gamma

Plot No. 2

Plot No.2: Left riverbank; liana-rich mixed deciduous forest with admixed spruce trees are visible at the right bank. GPS coordinates N $41^0$34'08.4''/E $042^0$15'14.7'', 870 m asl; slope gradient – 25^0.. Dolabigele River - left tributary of the Chirukhistsqali River, downstream of village of Karapeti. Degraded (due to felling) spruce forest. Medium conservation value habitat. Tree canopy cover – 30%; herbaceous plants cover – 40%. The following tree species are represented: *Picea orientalis, Carpinus caucasica, Alnus barbata, Salix caprea*. The herbaceous plants include *Pteridium tauricum.*

Plot No. 2: Liana-rich mixed deciduous forest with admixed spruce trees

Source: Gamma

Plot No. 3

GPS coordinates N $41^0$34'19.5''/E $042^0$17'34.8'', 864 m asl; Low conservation value habitat. Alder forest is developed downstream of village of Paposhvilebi.

Plot No.3: Alder Forest

Source: Gamma

Source: Gamma

Plot No. 4

Plot No.4: Downstream of village of Paposhvilebi; proposed access road to Plot No.8; GPS coordinates N $41^0$34'18.9''/E $042^0$17'26.7'', 843 m asl; Medium conservation value habitat composed of degraded (due to felling) spruce forest with admixed *Quercus dschorochensis, Fagus orientalis, Ulmus glabra, Carpinus caucasica. Quercus dschorochensis* - perimeter at the breast height (PBH) 70cm, height (h) – 20m; *Picea orientalis* – PBH=40cm, h=12m.

Plot No.4: Holly (Ilex colchica)

Source: Gamma

Source: Gamma

Plot Np.4: Pontic rhododendron (*Rhododendron ponticum*)

Source: Gamma

Plot No. 5

Village of Chvana; junction of Baratauli and Chvana valleys; GPS coordinates N 41^{0}40'33.7''/E 042^{0}09'40.8'', altitude 488 m asl; Medium conservation value habitat. The floodplain is occupied by liana-rich mixed deciduous forest, including the following plant species: *Acer campestre, Ulmus glabra, Picea orientalis, Alnus barbata, Salix alba, Tilia caucasica, Quercus dschorochensis, Ficus carica, Robinia pseudoacacia, Juglans regia, Pyrus caucasica, Sambucus nigra, Hedera colchica, Smilax excelsa, Petasites hybridus, Sambucus ebulus, Vinca herbacea, Calystegia sylvatica, Phyllitis scolopendrium, Pteridium tauricum*, etc.

Plot No.5: Liana-rich mixed deciduous Forest

Source: Gamma

Source: Gamma

Plot No.5: Liana-rich mixed deciduous Forest

Source: Gamma

Source: Gamma

Plot No.5: Liana-rich mixed deciduous Forest

Source: Gamma

Plot No. 6

Plot No.6: Dandalo – riverside terrace floodplain; oaks are seen on the opposite bank. GPS coordinates N 41^{0}38’45.1’’/E 042^{0}06’03.6’’, 468 asl; Low conservation value habitat.

Plot No.6: Riverside Terrace; oak forest in the background)

Source: Gamma

Source: Gamma

Plot No. 7

Plot No.7: Dam site; extended from village of Pirveli Maisi downstream to Makhuntseti; GPS coordinates N $41^0$35'05.0''/E $042^0$53'22.8'', 449 asl; Law conservation value habitat.

Plot No.7: Alder Forest

Source: Gamma

Plot No.8

GPS coordinates N $41^0$34'41.3''/E $041^0$53'17.7'', 220 asl; slope gradient 35^0. Village of Khokhona surrounds. Chestnut forest with mixed cherry-laurel. High conservation value habitat. Tree storey comprises the following species: *Castanea sativa, Acer campestre, Alnus barbata*. *Castanea sativa* – PBH=80 cm, h=14 m; *Acer campestre* – PBH=50 cm, h=12 m; *Alnus barbata* – PBH=30 cm, h=12 m; Shrub species include *Laurocerasus officinalis, Rhododendron ponticum, Staphylea colchica, Ilex colchica. Staphylea colchica*'s height is 5 m, *Ilex colchica*'s – 3 m. Herbaceous cover comprises *Smilax excelsa, Hedera colchica, Phyllitis scolopendrium, Asplenium trichomanes.*

Plot No.8: Chestnut Forest with admixed cherry-laurel

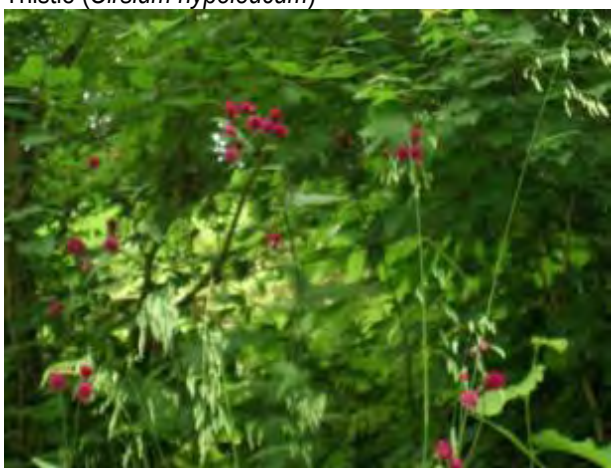
Source: Gamma

Source: Gamma

Plot No.8: Colchic bladdernut (*Staphylea colchica*)

Source: Gamma

Thistle (*Cirsium hypoleucum*)



Source: Gamma

Plot No.8: Bride's feathers (*Aruncus vulgaris*)

Source: Gamma

Plot No.9:

GPS coordinates N 41^{0}30'50.1''/E 041^{0}46'26.8'', 135 asl; Machakhela River Dam. Treeless riverside terrace and adjoined agricultural landscape. Low conservation value habitat.

Plot No:9: Riverside terrace – agricultural landscape

Source: Gamma

Plot No.10

GPS coordinates N 41030'43.3''/E 041045'59.7'', 123 m asl; Low conservation value habitat. Located within the immediate vicinity of the dam site, at the left bank of Machakhela River, upstream of artificial canal. Degraded (due to felling) alder forest mixed with cherry-laurel, lime-tree, hornbeam and maple. Herbaceous cover is formed by the following species: *Vinca herbacea, Phyllitis scolopendrim, Sanicula europaea, Pteridium tauricum, Ranunculus sp., Urtica dioica, Driopteris filix-mas, etc. From shrub species should be noted Rubus sanguineus, Coryllus avellana and Lonicera caucasica.*

Plot No.10: Degraded alder forest with a mix of cherry-laurel and hornbeam

Source: Gamma

Source: Gamma

Plot No.11

At village of Oqtomberi; confluence of Akavreta and Medzibnis Gele rivers; GPS coordinates N 41034’54.9’’/E 041058’04.9’’, altitude - 250 m asl; High conservation value habitat. Mixed deciduous forest. Slope gradient – 300, aspect – North-West. Trees and shrubs include chestnut, alder, maple, Pontic rhododendron , hazel, cherry-laurel, *Hedera colchica, Aristolochia pontica, Tamus communis, Arum albispathum, Oxalis acetosella, Phyllitis scolopendrium, Driopteris filix-mas, Pteris cretica, etc. The spruce trees rarely grow in the liana-rich mixed deciduous forest on the right riverbank.*

Plot No.11: Pontic birthwort (*Aristolochia pontica*)

Source: Gamma

Mixed deciduous forest with Colchic understory

Source: Gamma

Plot No.11: Colchis ivy (*Hedera colchica*)

Source: Gamma

Alder Forest

Source: Gamma

Plot No.12

Village of Chanchuriskhevi surrounds, GPS coordinates N 41034’34.1’’/E 042021’56.5’’, 792 m asl; Pontic rhododendron scrub (Rhododendron ponticum), height of scrub 3m, canopy cover – 90%. High conservation value habitat. Slope gradient – 400, aspect – North-West.

Plot No.12: Pontic rhododendron scrub (*Rhododendron ponticum*)

Source: Gamma

Source: Gamma

Plot No.12: Mixed deciduous forest with Pontic rhododendron understory

Source: Gamma

Source: Gamma

Plot No.13:

Village of Chanchuriskhevi surrounds, GPS coordinates N 41^{0}34'33.8''/E 042^{0}21'58.5'', 764 m asl; Medium conservation value habitat. Slope – 30^0, aspect – North-West; Degraded spruce forest; the following plants form the tree storey: *Picea orientalis* – PBH=70 cm, h=14 m, *Populus tremula* – PBH=30 cm, h=10 m; *Alnus barbata* – PBH=30 cm, h=8 m, *Corylus avellana* – h=5 m, *Thelycrania australis* – h=3 m. The following shrubs are observed: *Laurocerasus officinalis* – h=3 m, *Viburnum opulus* – h=1.5m, *Rhododendron ponticum* – h= 2 m, *Ilex colchia* – h= 1,5m. Herbaceous cover is composed of the following species: *Hedera colchica, Convolvulus arvensis, Driopteris filix-mas, Polypodium vulgare*.

Plot No.13: Degraded spruce forest

Source: Gamma

Plot No.14:

Confluence of Didadjaristskali and Adjaristsqali Rivers downstream of Didachara village. GPS coordinates N 41^{0}39'28.8''/E 042^{0}21'01.7''; altitude - 748 m asl; Low conservation value habitat. Vegetation of the riverside terrace consists of *Salix alba, Robinia pseodocacia* and *Alnus barbata.*

Plot No.14: Riverside terrace vegetation with participation of willow, Robinia pseudoacacia (black locust) and

Source: Gamma

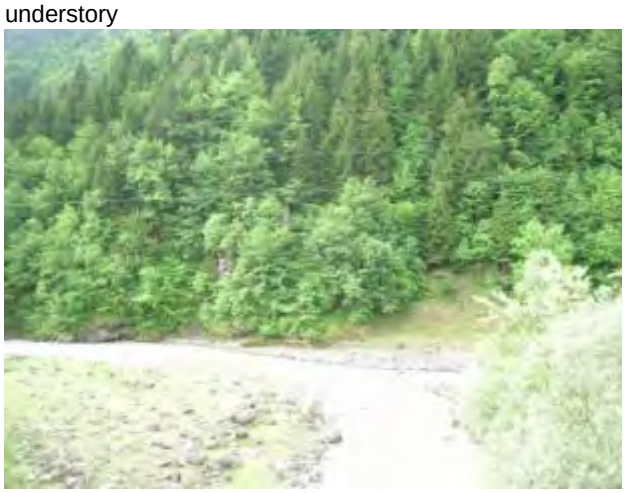
Source: Gamma

Riverside terrace vegetation with participation of willow, Robinia pseudoacacia (black locust) and alder

Source: Gamma

The mixed deciduous forest (supposedly including Chorokhi oak) with admixed spruce trees is visible on the opposite riverside. As the aspect is north, Colchic understory should also exist there. From the remote observation, the opposite riverside seems to be of high sensitivity.

Plot No.14: Mixed deciduous Forest with Colchic understory



Source: Gamma

Source: Gamma

Plot No.14: Mixed deciduous Forest with Colchic understory

Source: Gamma

Riverside alder forest

Source: Gamma

Plot No.15

GPS coordinates N 41032’32.9’’/E 041043’09.2’’, 54 m asl; Confluence of rivers Chirockhi and Adjaristsqali. Riverside terrace. During high flow the floodplain is inundated and, supposedly, water level rises over the slope to up to 3 m in height. The species observed include Alnus barbata and Salix alba. Low conservation value habitat.

Plot No.15: Riverside terrace with alder and willow trees

Source: Gamma

Source: Gamma

Plot No.16

GPS coordinates N 41032'14.1''/E 041043'12.3'', 34 m asl; right bank of Chorokhi River. Fragment of hornbeam-chestnut forest is visible downstream of the alignment, at the right riverbank. Slope – 450. Castanea sativa – PBH=50 cm, h=20 m; Carpinus caucasica – PBH=60 cm, h=20 m. Hedera colchica, Pteridium tauricum, Phyllitis scolopendrium, Polipodium vulgare. At the right riverbank, on the riverside rocky terrace, grow Alnus barbata, Robinia pseudoacacia, Salix alba. Medium conservation value habitat.

Plot No.16: Hornbeam and chestnut forest

Source: Gamma

Source: Gamma

Plot 16: Riverside Terrace with alder forest and agricultural landscape

Source: Gamma

Source: Gamma

Plot No.17

GPS coordinates N 41030’52.6’’/E 041042’55.1’’, 62 m asl; Right bank of Chorokhi River, at village of Kirnati. Alnus barbata, corn fields and pastures are observed on the riverside terrace. At higher elevation, near alignment, there is a developed population of Digitalis schiscKini. Low conservation value habitat.

Plot No.17: Foxglove (Digitalis schischkinii)

Source: Gamma

Population of (Digitalis schischkinii)

Source: Gamma

Plot No.17: Riverside Terrace with alder forest and agricultural landscape

Source: Gamma

Plot No.18

GPS coordinates N 41037’36.0’’/E 042014’54.0’’, 576 m asl; village of Zamleti, right bank of Adjaristsqali River, potential dam site. Aspect – East; slope gradient – 600-800. Oak forest (Quercus dschorochensis) – PBH=20 cm, h=7 m (min); PBH=80 cm, h=12 m (max). The similarly inclined slope covered by pine and spruce forest (Pinus kochiana, Picea orientalis) can be observed at the opposite riverbank. High conservation value habitat.

Plot No.18:Hop-hornbeam (Ostrya carpinifolia)

Source: Gamma

Plot No18:Elm-leaved sumach (Rhus coriaria)

Source: Gamma

Plot No.18: Oak forest (Quercus dschorochensis)

Source: Gamma

Plot No.18: Pine and spruce forest

Source: Gamma

Plot No.18: Chorokhi Oak (Quercus dschorochensis)

Source: Gamma

Plot No.18:Oak forest (Quercus dschorochensis)

Source: Gamma

Plot No.18: Amaracus rotundifolius

Source: Gamma

Plot No.18:Amaracus rotundifolius – population

Source: Gamma

Plot No.18:Hop-hornbeam(Ostrya carpinifolia)

Source: Gamma

Plot No.18:Hop-hornbeam (Ostrya carpinifolia)

Source: Gamma

Plot No.19

GPS coordinates N 41037’17.0’’/E 042015’49.8’’, 504 m asl; left bank of Adjaristsqali River; at Phurtio Bridge. The flood plain may be extended up to this plot. Aspect – North-East; slope – 250. Oak and hornbeam forest; PBH – 1 m, height – 25 m (max); PBH – 30 cm, height – 15 m (min). The following species are also found at the same location: Carpinus caucasica, Acer campestre, Fraxinus oxycarpa, Crataegus sp., Mespilus germanica, Robinia pseudoacacia, Prunus divaricata. On the edges of the forest the following herbaceous species are growing: Pteridium tauricum, Eupatorium cannabinum, Sambucus ebulus, Arctium lappa, Helleborus caucasicus, Fragaria vesca, Cicerbita macrophylla, Digitalis schischkinii,

Campanula cordifolia, etc. At village of Zomleti, along the road descending towards Phurtio Bridge, grows Amaracus rotundifolius. High conservation value habitat.

Plot No.19: Campanula cordifolia

Source: Gamma

Plot No.19:Cicerbita macrophylla

Source: Gamma

Plot No.19: Foxglove (Digitalis schischkinii)

Source: Gamma

Plot No.19:Oak and hornbeam forest with Hartvisian oak (Quercus hartwissiana)

Source: Gamma

Plot No.19:Oak and hornbeam forest with Hartvisian oak (Quercus hartwissiana)

Source: Gamma

Plot No.20

GPS coordinates N 41035’08.4’’/E 041053’22.7’’, 163 m asl; right bank of Adjaristsqali River; village of Pirveli Maisi. Older dam site on the riverside terrace; on the rocky riverbank; major tree vegetation is composed of alder (Alnus barbata). Low conservation value habitat.

Plot No.20:Riverside terrace with alder forest

Source: Gamma

D.1.6. Senstive Areas

After the completion of a detailed botanical survey of the planned Project corridor identification and detailed characteristics of sensitive areas have been conducted. Thus, proceeding from the literature sources review and field surveys the following moderate and high sensitive areas have been identified.

High sensitive areas:

- Plot No.8: GPS coordinates N 41034'41.3''/E 041053'17.7'', 220 m asl; slope gradient 350. Village of Khokhona surrounds. Chestnut forest with mixed cherry-laurel. High conservation value habitat. Tree storey is comprised of the following species: Castanea sativa, Acer campestre, Alnus barbata. Castanea sativa – PBH=80 cm, h=14 m; Acer campestre – PBH=50 cm, h=12 m; Alnus barbata – PBH=30 cm, h=12 m; Shrub species include Laurocerasus officinalis, Rhododendron ponticum, Staphylea colchica, Ilex colchica. Staphylea colchica's height is 5 m, Ilex colchica's – 3 m. Herbaceous cover comprises Smilax excelsa, Hedera colchica, Phyllitis scolopendrium, Asplenium trichomanes.
- Plot No.11; At village of Oqtomberi; confluence of Akavreta and Medzibnis Gele Rivers; GPS coordinates N 41034'54.9''/E 041058'04.9'', altitude - 250 m asl; High conservation value habitat. Mixed deciduous forest. Slope gradient – 300, aspect – North-West. Trees and shrubs include chestnut, alder, maple, Pontic rhododendron , hazel, cherry-laurel, Hedera colchica, Aristolochia pontica, Tamus communis, Arum albispathum, Oxalis acetosella, Phyllitis scolopendrium, Driopteris filix-mas, Pteris cretica, etc. The spruce trees rarely grow in the liana-rich mixed deciduous forest on the right riverbank.
- Plot No.12: village of Chanchuriskhevi surrounds, GPS coordinates N 41034'34.1''/E 042021'56.5'', 792 m asl; Pontic rhododendron scrub (Rhododendron ponticum), height of scrub 3m, canopy cover – 90%. High conservation value habitat. Slope gradient – 400, aspect – North-West.
- Plot No.14: Confluence of Didadjaristskali and Adjaristsqali Rivers downstream of Didachara village. GPS coordinates N 41039'28.8''/E 042021'01.7''; altitude - 748 asl;
- The mixed deciduous forest (supposedly including Chorokhi oak) with admixed spruce trees is visible on the opposite riverside. As the aspect is north, Colchic understory should also exist there. From the remote observation, the opposite riverside seems to be of high sensitivity.
- Plot No.18: GPS coordinates N 41037'36.0''/E 042014'54.0'', 576 m asl; village of Zomleti, right bank of Adjaristsqali River, potential dam site. Aspect – East; slope gradient – 600-800. Oak forest (Quercus dschorochensis) – PBH=20 cm, h=7 m (min); PBH=80 cm, h=12 m (max). The similarly inclined slope covered by pine and spruce forest (Pinus kochiana, Picea orientalis) can be observed at the opposite riverbank. High conservation value habitat.
- Plot No.19: GPS coordinates N 41037'17.0''/E 042015'49.8'', 504 m asl; left bank of Adjaristsqali River; at Phurtio Bridge. The flood plain may be extended up to this plot. Aspect – North-East; slope – 250. Oak and hornbeam forest; PBH – 1 m, height – 25 m (max); PBH – 30 cm, height – 15 m (min). The following species are also found at the same location: Carpinus caucasica, Acer campestre, Fraxinus oxycarpa, Crataegus sp., Mespilus germanica, Robinia pseudoacacia, Prunus divaricata. On the edges of the forest are growing the following herbaceous species:-Pteridium tauricum, Eupatorium cannabinum, Sambucus ebulus, Arctium lappa, Helleborus caucasicus, Fragaria vesca, Cicerbita macrophylla, Digitalis schischkinii, Campanula cordifolia, etc. At village of Zomleti, along the road descending towards Phurtio Bridge grows Amaracus rotundifolius. High conservation value habitat.

Moderate sensitive areas:

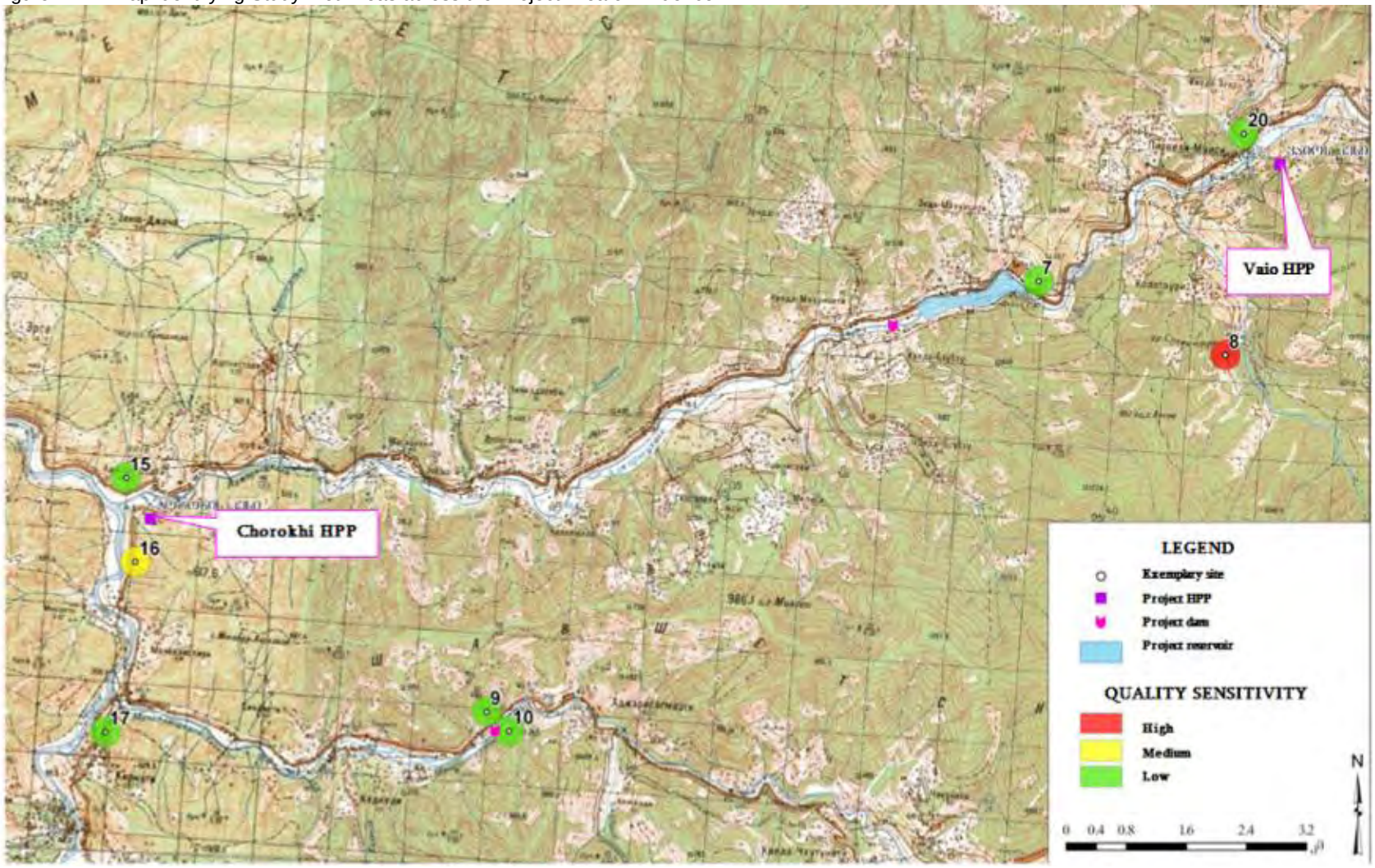
- Plot No.1 GPS coordinates N 41034'02.9''/E 042015'16.1'', 828 m asl; slope gradient 150, Dolabigele River - left tributary of Chikhuristskali River; downstream of village of Karapeti; man-made walnut plantation. Medium conservation value habitat. Tree storey is represented by the following species: Juglans regia, Alnus barbata, Picea orientalis, Carpinus caucasica. From shrubs are growing the following species: Crataegus microphylla, Rubus sanguineus, Hedera colchica.From the herbaceous plants are developed the following species: Fragaria vesca, Sanicula europaea, Bellis perenis, Poa sp., Cyclamen vernum, Salvia glutinosa, Cynaglossum officinale, Tamus communis, Phyllitis scolopendrium, Asplenium trichomanes.
- Plot No.2: Left riverbank; liana-rich mixed deciduous forest with admixed spruce trees is visible at the right bank. GPS coordinates N 41034'08.4''/E 042015'14.7'', 870 m asl; slope gradient – 250.

Dolabigele River - left tributary of Chikhuristskali River, downstream of village of Karapeti. Degraded (due to felling) spruce forest. Medium conservation value habitat. Tree canopy cover – 30%; herbaceous plants cover – 40%. The following tree species are represented: Picea orientalis, Carpinus caucasica, Alnus barbata, Salix caprea. The herbaceous plants include Pteridium tauricum.

- Plot No.4: Downstream of village of Paposhvilebi; proposed access road to Plot No.8; GPS coordinates N 41034'18.9''/E 042017'26.7'', 843 m asl; Medium conservation value habitat composed of degraded (due to felling) spruce forest with admixed Quercus dschorochensis, Fagus orientalis, Ulmus glabra, Carpinus caucasica. Quercus dschorochensis - perimeter at the breast height (PBH) 70 cm, height (h) – 20 m; Picea orientalis – PBH=40 cm, h=12 m.

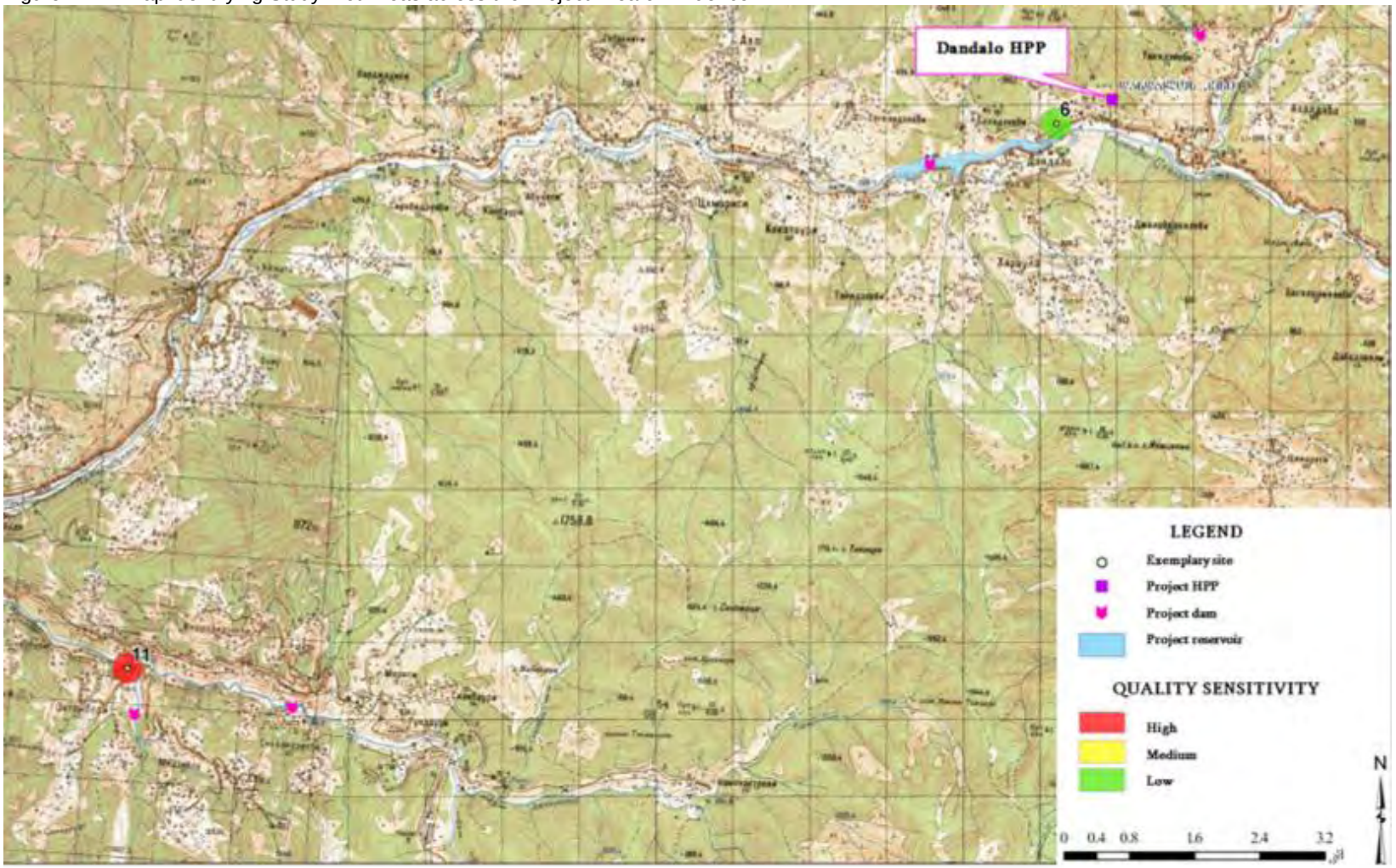
- Plot No.5: Village of Chvana; junction of Baratauli and Chvana valleys; GPS coordinates N 41040'33.7''/E 042009'40.8'', altitude 488 m asl; Medium conservation value habitat. The floodplain is occupied by liana-rich mixed deciduous forest including the following plant species: Acer campestre, Ulmus glabra, Picea orientalis, Alnus barbata, Salix alba, Tilia caucasica, Quercus dschorochensis, Ficus carica, Robinia pseudoacacia, Juglans regia, Pyrus caucasica, Sambucus nigra, Hedera colchica, Smilax excelsa, Petasites hybridus, Sambucus ebulus, Vinca herbacea, Calystegia sylvatica, Phyllitis scolopendrium, Pteridium tauricum, etc.
- Plot No.13: village of Chanchuriskhevi surrounds, GPS coordinates N 41034'33.8''/E 042021'58.5'', 764 m asl; Medium conservation value habitat. Slope – 300, aspect – North-West; Degraded spruce forest; the following plants form the tree storey: Picea orientalis – PBH=70 cm, h=14 m, Populus tremula – PBH=30 cm, h=10 m; Alnus barbata – PBH=30 cm, h=8 m, Corylus avellana – h=5 m, Thelycrania australis – h=3 m. The following shrubs are observed: Laurocerasus officinalis – h=3m, Viburnum opulus – h=1.5m, Rhododendron ponticum – h=2 m, Ilex colchia – h=1.5 m. Herbaceous cover is composed of the following species: Hedera colchica, Convolvulus arvensis, Driopteris filix-mas, Polypodium vulgare.
- Plot No.16: GPS coordinates N 41032'14.1''/E 041043'12.3'', 34 m asl; right bank of Chorokhi River. Fragment of hornbeam-chestnut forest is visible downstream of the alignment, at the right riverbank. Slope – 450. Castanea sativa – PBH=50cm, h=20m; Carpinus caucasica – PBH=60 cm, h=20 m. Hedera colchica, Pteridium tauricum, Phyllitis scolopendrium, Polipodium vulgare. At the right riverbank, on the riverside rocky terrace grow Alnus barbata, Robinia pseudoacacia, Salix alba. Medium conservation value habitat.

Figure D.1: Map identifying Study Plot Areas across the Project Area of Influence



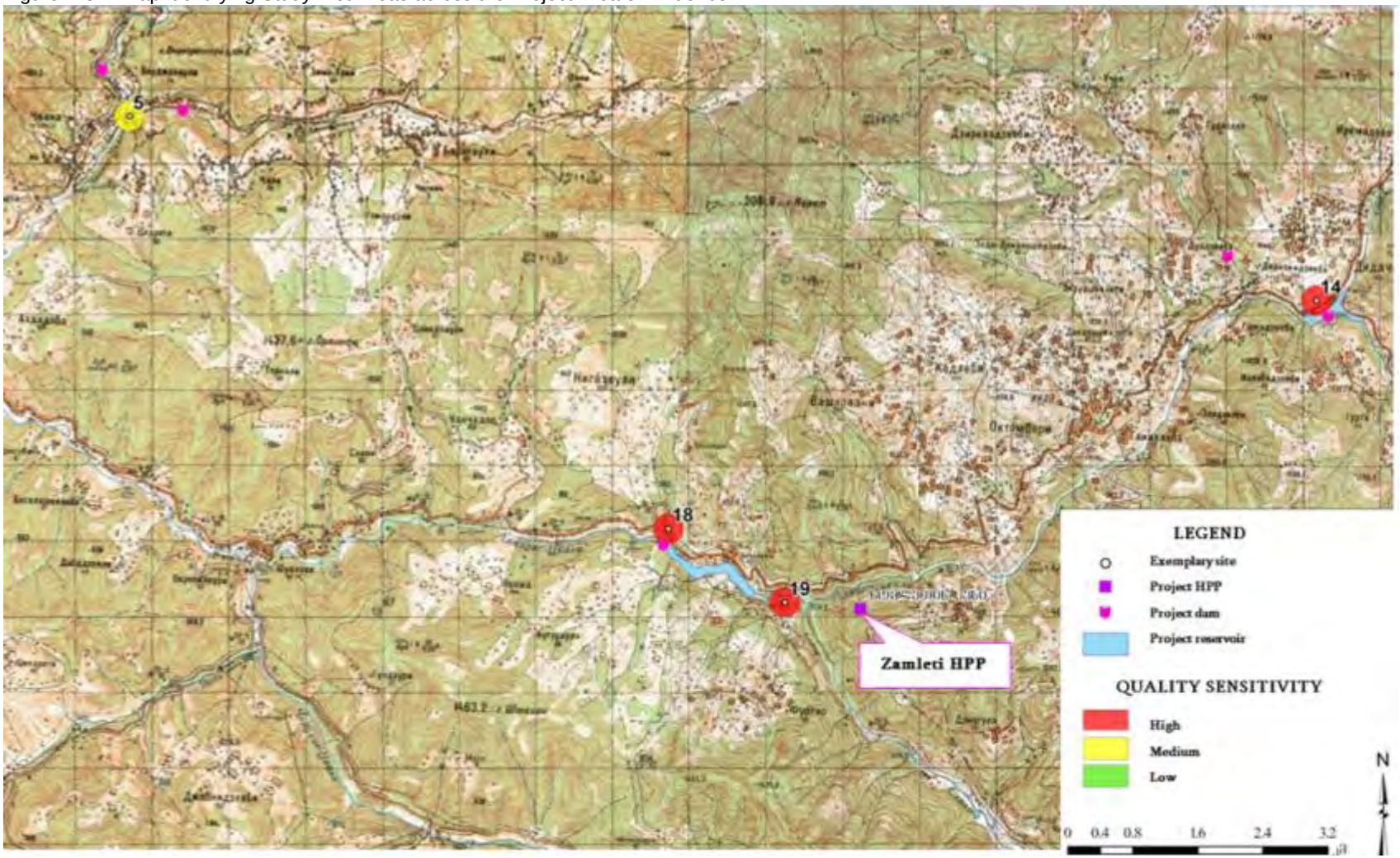
Source: Gamma

Figure D.2: Map identifying Study Plot Areas across the Project Area of Influence



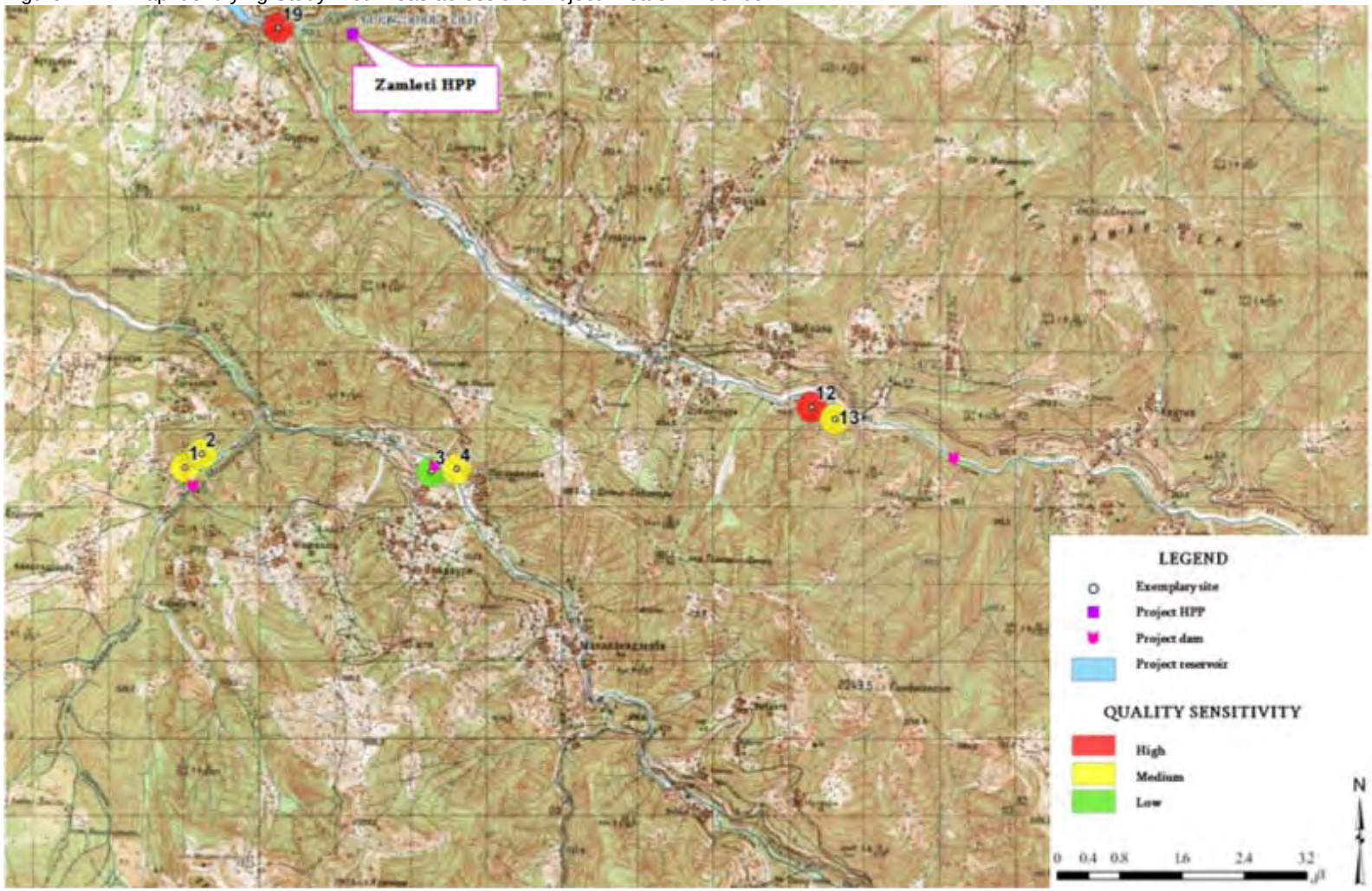
Source: Gamma

Figure D.3: Map identifying Study Plot Areas across the Project Area of Influence



Source: Gamma

Figure D.4: Map identifying Study Plot Areas across the Project Area of Influence



Source: Gamma

D.1.7. Georgia Red List Species Occurring within the Proposed Project Corridor

It should be mentioned that the Georgia Red List, which includes 56 species of vegetation, is not complete and is currently undergoing modifications. In particular, the herbaceous plants are being identified according to IUCN categories (identification of categories of their current state and conservation status). After extrapolation of the aforementioned data the number of Georgia Red List species may significantly increase.

After the completion of the detailed field botanical survey 6 plant species included in Georgia Red List were identified in the designed Project zone of influence: Castanea sativa Mill., Juglans regia L., Ostrya carpinifolia Scop., Quercus hartwissiana Stev., Staphylea colchica Stev., Ulmus glabra Hudds. List and status of the plant species included in Georgia Red List identified in the designed Project corridor are the following:

The species listed under the EU Habitats Directive are not distributed in Project impact Zone.

№	Latin Name	English Name	Category of State and Protection Status	GPS Coordinates
		Angiosperms		
1	*Castanea sativa* Mill.	Common chestnut	VU	N41^{0}34’41.3’’/E 041^{0}53’17.7’’, 220 m asl, slope gradient 35^0; N41^{0}34’54.9’’/E 041^{0}58’04.9’’, 250 m asl; N41^{0}32’14.1’’/E 041^{0}43’12.3’’, 34 m asl.
2	*Juglans regia* L.	English walnut	VU	N41^{0}34’02.9’’/E 042^{0}15’16.1’’, 828 m asl, slope gradient 15^0; N41^{0}40’33.7’’/E 042^{0}09’40.8’’, 488 m asl.
3	*Ostrya carpinifolia* Scop.	European hop hornbeam	EN	N41^{0}37’36.0’’/E 042^{0}14’54.0’’, 576 m asl.
4	*Quercus hartwissiana* Stev.	Hartvisian oak	VU	N41^{0}37’17.0’’/E 042^{0}15’49.8’’, 504 m asl.
5	*Staphylea colchica Stev.*	Colchic bladderrnut	VU	N41^{0}34’41.3’’/E 041^{0}53’17.7’’, 220 m asl, slope gradient 35^0.
6	*Ulmus glabra* Hudds.	Elm	VU	N41^{0}34’18.9’’/E 042^{0}17’26.7’’, 843 m asl; N41^{0}40’33.7’’/E 042^{0}09’40.8’’, 488 m asl.

After the completion of pre-construction botanical survey the presented Georgian Red List species number shall presumably expand according to the presence of their populations in the Project corridor.

Besides the above-mentioned, populations of some rare, endangered and vulnerable species are present within the Project corridor: Lauricerasus officinalis, Hedera colchica, Vinca herbacea, Digitalis schisckinii, Helleborus caucasicus (threatened species), Tilia caucasica, Quercus dschorochensis, Pyrus caucasica, Fraxinus oxycarpa, Lonicera caucasica, Amaracus rotundifolius (rare species), Ficus carica (endangered species). Populations of species protected by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES 1975; universal) Cyclamen vernum are also located within the Project corridor. After the completion of pre-construction botanical survey the presented rare species list shall presumably expand according to the presence of their populations in the project corridor.

D.1.8. Construction and Operational Mitigation Measures

A detailed Botanical assessment should be conducted before beginning project construction activities, which will additionally reveal high conservation value species populations on project areas,. In addition, an assessment of potential negative impacts of construction and operation phases on flora and vegetation for the Project areas should be identified and adequate conservation/reinstatement and compensation measures should be elaborated. A relevant Biorestoration specification plan, Compensation plan and Biodiversity monitoring/ management plan for the botanical component as well as Rare species conservation plan should be prepared. Baseline description/information will serve as basis against which the rate and character of complex ecological reinstatement (vegetation cover reinstatement) of project post-construction areas can be monitored and Biodiversity (Botanical component) monitoring should be carried out.

After the identification of endemic, rare and endangered plant species populations in project impact zone, relevant mitigation measures should be elaborated to undertake necessary steps to ensure protection, conservation and sustainable development of endangered populations, which are directly impacted by the Project construction activities.

To ensure species conservation, translocation of live plants to conservation centers and plant propagation from seeds collected in the wild should be carried out. As the translocation of plants is always associated with high risk, seed propagation should be used as well in order to increase chances of success and propagate enough seedlings for consequent reintroduction.

Plants translocated from their wild habitat and grown from seeds will form living collections at the proposed conservation centers. Once the Project construction phase is finished, translocated plants and those grown from seeds should be reintroduced, in their wild habitat or in relevant adjacent habitats in order to restore the wild populations existing prior to project clearance.

On sites affected by Project construction, it can be practically impossible to reinstate and maintain former natural stands in the state before construction. Consequently, it is recommended that Forest eco-compensation programmes (Forest offset) or offset other ecosystems/plant communities are implemented to mitigate residual impacts caused by the Project construction activities.

Detrimental impacts to the protection of biodiversity, protected areas and forestry have to be reduced to the absolute minimum and unavoidable residual environmental damages have to be offset by an eco-compensation scheme. In particular the impacts on forest ecosystems have to be evaluated and offset by adequate mitigation and eco-compensation measures with the goal to restore the equivalent forest habitat.

In this context the calculation of damages to forest ecosystems by the Project construction activities according to the “none-net loss”, “net gain principle” and “habitat hectare” approach is recommended to define the exact ratio for forest eco-compensation based upon modern methodologies and international best practice.

The habitat hectare scoring method is a common approach to determine the value of vegetation in non-monetary units. The environmental proxy used i.e. the “currency” in which the value of vegetation is expressed is the “habitat hectare”. The habitat score is derived by assessing a number of site-based habitat and landscape components against a pre-determined ‘benchmark’. Benchmarks have to be defined for different ecological vegetation classes (EVCs).

habitat area [ha] x habitat score = habitat-hectares

Since Georgia does not systematically apply to hábitat-hectare approach, EVCs and benchmarks had to be identified based upon information on representative sample plots contained in the planned Project ESIA.

Calculation of damage on the environment should be conducted according to the following document: Ministerial Order on the Endorsement of the Calculation Methodology for the Damage on the Environment, N2 2 February 2011, Tbilisi.

In case the planned project construction requires the cutting down of trees, the said action cannot be acknowledged as a part of the Environment Impact Assessment document. However, this is the point at which further relationships and correspondence between the Client and the Ministry of Energy and Natural Resources and the Ministry of Environment Protection should be maintanced, where all relevant procedures set in the present legislation should be foreseen. As soon as the Environment Impact Assessment report is approved, the list of works to be carried out must be developed specifying the volume of the wood to be cut, and the detailed inventory of the area under the state forest fund must be ensured.

Extraction of Plant Species Included in Red List of Georgia (Endangered) from the Natural Environment

The law of Georgia on the Red List of Georgia and Red Data Book identifies the exceptional cases, when plants included in Red List of Georgia could be extracted from the environment, namely:

a. According to the Article 24 – “Extraction of Endangered Wild Plants or their Parts (from the Natural Environment)”: Extraction of endangered wild plants or their parts (from the natural environment) is allowed only in the below exceptional cases:
b. Restoration and propagation in natural conditions (cultivation);
c. Cultivation in dendrological and botanical gardens and parks;
d. For economic purposes to cultivate in artificial conditions (only if the wild plant is cultivated artificially);
e. For scientific purposes;

f. If the damage of the endangered wild plant or its parts is caused by entomic pests and phyto diseases and their presence in natural environment poses the threat of spreading entomic pests/phyto diseases and the extraction from the natural environment is the only means against entomic pests/phyto diseases – in this case the basis of the review of the issue of the extraction (from the natural environment) of the endangered wild plant or its parts by the Ministry of the Environment Protection of the Georgia is the summary presented to the Ministry by the joint commission of Legal Entity Public Law – Vasil Gulisashvili Institute of Forestry, Legal Entity or Public Law– Levan Kanchaveli Institute of Plant Protection and Legal Entity of Public Law– Tbilisi Botanical Garden and Botanical Institute. Upon the discussion of the summary the Ministry is entitled to decide on the extraction of plants from the natural environment; and
g. During the construction of object and infrastructure of special state significance – during the mentioned activities plant species included in the Red List are extracted from the natural environment only if the Ministry of Environment Protection of Georgia decides to extract plant species included in the Red List from the natural environment. The Ministry of the Environment Protection could be appealed to make the above decision by the Ministry determined by the law of Georgia on “the Structure, Incumbency and Rule of Conduct of the Government of Georgia”.

Change of Category of Forestry Fund

The rule and procedures of the change of category of the State Forest Fund are implemented according to the rule of conduct approved by the order of the Minister of the Environment Protection and Natural Resources N5 (15th February, 2010) on “the Rule of Assigning Category of Special Purpose to State Forest Fund”.

The above mentioned rule regulates the issues of use of forests for special purpose within the State Forest Fund territory. Territory of State Forest Fund, which is issued into special purpose-specific use, is automatically assigned the category of special purpose of the State Forest Fund.

The decision on the assignment of special forest use right within the State Forest Fund, as well as special tree felling, was made by the Ministry of the Environment Protection and Natural Resources upon agreement with other interested agencies, except for the cases as stipulated by Part 3, Article 33 of the Forest Code of Georgia (on the latter the decision is made by the Government of Georgia, while this part of the Forest Code implies the following: any change, which is aimed at the decrease of the State Forest Fund, should be well-grounded. In case of special tree felling on slopes of 35 degrees or more, inclination wood processing is possible only during the construction of an object of especial state significance. Wood processing on slopes of inclination from 30 to 35 degrees is allowed only after special research and if forest restoration measures are introduced in parallel to wood processing). However, there has been a reorganisation of the mentioned Ministry this function was assigned to the Ministry of Energy and Natural Resources, in the structure of which Forestry Agency was included. As the respective changes on separation of incumbency have not yet been implemented in the legislation of Georgia, the below mentioned “Ministry” and Agency responsible for this specific issues presumably imply the Ministry of Energy and Natural resources.

Forest use with special purpose is implemented for the below purposes:

a) Construction, reconstruction (rehabilitation) or uninstallation of hydro systems, pipelines, roads, communications and power transmission communications, channels;

b) During the implementation of anti-fire measures and elimination of results of flood and other xtreme situations;
c) If a threat of restriction of functioning or damage to any infrastructure or its separate elements exists;
d) During fossil/minerals use; and
e) During the reconstruction (rehabilitation) of monument of cultural heritage.

An entity interested in special forest use applies to the appropriate Ministry. This Ministry sends the application and supplemented documents to the bodies with the right of State Forest Fund management for approval. In case of positive response the Ministry sends the full documentation (in cases of activity determined by Sub-Paragraphs “a”, “d” and “e” indicated above) to the Ministry of Economy and Sustainable development of Georgia and the Ministry of Culture and Monuments Protection of Georgia for approval and if positive response is given by these Ministries, it starts the procedure of the review of the application and relative documentation. Only in cases stipulated by Sub-Paragraphs “b” and “c” the decision is based upon the proposal of the body with the right of state forestry management.

For the assignment of right of special forestry use within the State Forest Fund the application should: in case of activities as stipulated by Sub-Paragraphs “a”, “d” and “e” comply with the requirements identified by Article 78 of the General Administrative Code of Georgia. It should also contain the following list of supplemented documents:

1. The motivation of the necessity of special forestry use, its goal and term;
2. For Legal Entities of Private Law and individual entrepreneurs – statement from the register of entrepreneurs and non-profit (non-commercial) legal entities, for physical persons – copy of the personal ID card of Georgian citizen or passport, for Legal Entity of Public Law – authenticated copy of founding documents;
3. Precise measuring drawing of the area selected for special forestry use in UTM coordinate system. The drawing should be authenticated by the executor of the measuring drawing;
4. Copy of the document (if applicable), according to which and proceeding from the determined activity, the implementation of special forestry use is necessary or/and needed;
5. Rationale of the necessity of tree felling; and
6. Information on the presence of the species protected by the Red List within the selected area.

In cases where an activity is covered by Sub-Paragraphs “b” and “c” above, the proposal of the body with Forest Fund management right should be supplemented with the following:

1. Rationale of the necessity of the special forestry use;
2. Rationale of the necessity of tree felling; and
3. Information on the presence of the species protected by the Red List within the selected area.

In cases where an activity is covered by Sub-Paragraph “c”, additional information on the number of trees to be felled according to the species should be provided. In cases where an activity is covered by Sub-Paragraph “d” – a copy of the license for fossil/minerals extraction, and in cases where the activity is determined by Sub-Paragraph “e” – a consent of the Ministry of Culture and Monuments Protection.

In case of a decision on special forestry use within the State Forest Fund, the respective individual administrative-legal act of the Minister is issued. On the bases of this act, the body with the right of State Forest Fund management signs a special forestry use agreement with the stakeholder (except for cases

identified by Sub-Paragraphs “b” and “d”) and delivers the territory selected for special forestry use with the act of delivery-acceptance. In case of the expiry of the term of the agreement (or termination) the forest user returns the territory selected for special forestry use to the incumbent body with the act of delivery-acceptance.

If wood processing is required during special forestry use, the trees to be felled are marked by the stakeholder and assigned by the body with the right of State Forest Fund management.

In cases stipulated by Sub-Paragraphs “b” and “c” and after the issuing of the above mentioned act the body with the right of Forest Fund management implements the special forestry use and records the felled arborescent/wood resources and passes them to the Legal Entity of Public Law of the Ministry – Forestry Agency for further realisation purpose and with the act of delivery-acceptance. If the special forestry user is the Legal Entity of Public Law of the Ministry – Forestry Agency, it records the felled arborescent/wood resource and implements its realisation according to the rules as stipulated by the legislation.

Exclusion of the Forest Fund

Exclusion from the Forest Fund is conducted according to the resolution of the Government of Georgia (13th August, 2010) N240 on “the rule of identification of the State Forest Fund boundary”.

The aim of the rule is to determine legal relationships connected with the identification of the boundaries of the State Forest Fund. It does not spread over the legal relationships connected with the identification of borders of the Protected Areas of the State Forest Fund.

The borders of State Forest Fund are set by the Government of Georgia through sub-legal normative act, which was proposed in the form of draft resolution of the identification of borders of the Stat Forest Fund by the Ministry of Environment Protection and Natural Resources of Georgia. However, after the reorganisation of the mentioned Ministry this function was assigned to the Ministry of Energy and Natural Resources, in the structure of which Forestry Agency was included. As respective changes on separation of incumbency have not yet been implemented in the legislation of Georgia, the below mentioned “Ministry” and Agency responsible for this specific issues presumably imply the Ministry of Energy and Natural Resources.

The below are entitled to raise the issue of the increase or decrease of the State Forest Fund area before the mentioned Ministry:

a) Ministries identified by the law of Georgia on “the Structure, Incumbency and Rule of Conduct of the Government of Georgia”;

b) Government of the Autonomous Republics;

c) Tbilisi City Hall;

d) State assignee – Governor; and

e) As well as the ministry based upon its own initiative.

The appeal should indicate the need (necessity) of increase or decrease of the State Forest Fund area, purpose and supplemented with cadaster measuring drawing (with digital version) of the respective area.

The Ministry submits the presented documentation, according to the rule determined by the General Administrative Code of Georgia, for approval to the below agencies:

a) Ministry of Economy and Sustainable Development of Georgia;

b) Ministry of Culture and Monuments Protection of Georgia; and

c) If needed, to other interested administrative body.

After the receipt of consent from the above mentioned administrative bodies the Ministry submits the prepared material to the Government of Georgia for decision making.

With the aim of precise identification of the contour of the new border of the State Forest Fund the state body of the State Forest Fund management facilitates:

a. Study of the existing information on the State Forest Fund (planning-cartographic and cadastre material, land use plans, existing material of inventory (or forest inventory), topographic maps and other documentation which could be used for project preparation)
b. Request and study of the information related to the border of the adjacent owner (among these – information in Public Register);
c. Determination or/and specification of the border contour of the territory (line) based upon respective material; and
d. Preparation of all the documentation required for the registration of State Forest Fund in Public Register.

The Ministry submits the mentioned documentation to the Government of Georgia for decision making.

After the decision has been made by the Government of Georgia on the identification of border of the State Forest Fund, the Ministry submits the corresponding documentation to Legal Entity of Public Law-National Agency of Public Register of the Ministry of Justice of Georgia for registration purpose in the Public Register.

In addition, the Ministry is entitled to appeal to the Government of Georgia on identification of borders of separate areas within the State Forest Fund with the purpose of their further registration in the Public Register.

The border line of the State Forest Fund (contour) should be determined via respective technologies (Geo-Information System) and on the basis of ortho-photo-plan and other evidence (in state coordinate system – WGS-84/UTM).

D.1.9. References

Akhlkatsi, M., Kimeridze, M., Lorenz, R., Kuenkele, S., Mosulishvili, M. 2003. Diversity and Conservation of Georgian Orchids. Tbilisi.

Akhalkatsi, M. 2010.Habitats of Georgia. Tbilisi.

Bitsadze, M., Rukhadze, A. (2001). "Gadashenebis piras mkofi veluri faunisa da floris sakheobebit saertashoriso vachrobis shesakheb konventsiis" (CITES) danartebshi shetanili sakartvelos veluri faunisa da floris saxeobebi. (The species of wild flauna and flora of Georgia in the appendix lists of the Convention on International Trade in Endangered Species of the Wild Fauna and Flora (CITES). Tbilisi.

Braun-Blanquet, J. 1964. Pflanzensoziologie, Grundzüge der Vegetationskunde, 3rd ed. Springer, Wien-New York.

Canter L.W. 1996. Environmental impact assessment. 2nd ed. McGraw-Hill. New York, London, Tokyo, Toronto.

Cherepanow S.K. 1981. Vascular plants of the USSR. Nauka, Leningrad.

Convention on Biological Diversity. 1995. UNEP. Switzerland (Russian version).

Council of Europe. Convention on the conservation of European wildlife and natural habitats. Bern, 19.09.1979.

Dolukhanov A.G. 1989. Vegetation of Georgia. 1. Forest vegetation of Georgia. Metsniereba, Tbilisi (in Russian).

Flora of Georgia. 1941-1952. 1-8. Georgian Acad. Sci. Publ., Tbilisi (in Georgian).

Flora of Georgia. 1970-2000. 1-13. Metsniereba, Tbilisi (in Georgian).

Forest Code of Georgia. 2000. Tbilisi.

Georgian law on Protected territories system adopted by Parliament of Georgia (March 7 1996). Normative Acts of Parliament of Georgia, Tbilisi, 2000, 10-17 (in Georgian).

Groombridge B. (ed.). 1992. Global biodiversity: Status of the Earth's Living Resources. Chapman & Hall, London, 47-52.

Grossheim, A.A. 1946. Rastitel'nye resursy Kavkaza (Plant resources of the Caucasus). Publish. Academy of Sciences of Azerbeijan, Baku.

Grossheim, A.A., Sosnovski, D.I. 1928. Opyt botaniko-geographichaskogo raionirovania Kavkazskogo kraia. (Botanical-gaographic classification of the Caucasus region). Proceed. Polytechnic Univ. Tbilissi, V. 3.

Grebenshchikov O.S. 1965. Geobotanic Dictionary. Russian-English-German-French. Nauka, Moscow.

Gulisashvili V.Z. 1964. Natural zones and Natural-historical oblasts of Caucasus. Nauka, Moscow (in Russian).

Harcharik D.A. 1997. The future of world forestry. Unasylva 190/191, 48, 4-8.

Hilton-Taylor, C. (compiler). 2000. 2000 IUCN Red List of Threatened Species. IUCN, Gland, Switzerland and Cambridge, UK.

Identification guide to plants of Georgia. 1969. 2. Georg. Acad. Sci. Publ., Tbilisi (in Georgian).

Isik K., Yaltirik F., Akesen A. 1997. The interrelationship of forests, biological diversity and the maintenance of natural resources. Unasylva 190/191, 48, 19-29.

IUCN. 2001. IUCN Red List Categories and Criteria: Version 3.1. IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK.

IUCN. 2003. 2003 IUCN Red List of Threatened Species. [web application]. Available at www.iucnredlist.org. (Accessed: 27 September 2004).

IUCN 2004. 2004 IUCN Red List of Threatened Species. [web application]. Available at: http://www.iucnredlist.org.

IUCN Red List Guidelines 2004 [web application]. Available at: http://www.iucnredlist.org.

Ivaniashvili M. 2000. International Environmental Law in biological diversity. Meridiani, Tbilisi (in Georgian).

Karagöz Gursel. 2001. Introductory country reports. Turkey. In: Borelli S., Kremer A.,

Geburek T., Paule L., Lipman E. (compilers). Report of the Third EUFORGEN Meeting on Social Broadleaves, 22-24 June 2000, Borovets, Bulgaria. International Plant Genetic Resources Institute, Rome, Italy, 11-22.

Ketskhoveli N.N. 1957. Zones of cultivated plants in Georgia. Metsniereba. Tbilisi.

Ketskhoveli N.N. 1959. Map of vegetation of Georgia. An Annex to the book “Vegetation

cover of Georgia”. Tbilisi.

Ketskhoveli N.N. 1960. Vegetation cover of Georgia. Metsniereba, Tbilisi.

Ketskhoveli N.N. (ed.) 1977. Protect wild and cultivated plants of Georgian SSR. Georg. Acad. Sci. Pulb., Tbilisi (in Georgian, Russian).

Kikava G., Chkhetiani I., Jugheli N., Todua V. 1997. The wild fruits of Georgia. Tbilisi.

Kikodze D., Kvachakidze R., Nakhutsrishvili G. 1997. Georgian botanical diversity. Flora. In: Georgian Biodiversity Country Study Report. UNEP, NACRES, Ministry of Environment of Georgia. Tbilisi, 34-45.

Kimeridze, K. 1966. Kavkasiashi chaobis mcenareulobis gavrcelebis kanonzomierebis sakitkhisatvis. (Distribution pattern of wetland vegetation in Caucasus). Bull. Georg. Acad. Scien. 43, 2:234-245.

Kimeridze, K. 1975. Sakartvelos mtianetis kolboxovani islianebi. (Tufted sedge wetlands of mountains of Georgia). Bull. Geor. State Museum. 28-a.

Kvachakidze R. 1996. The geobotanical regioning of Georgia. Metsniereba, Tbilisi (in Georgian).

Kvachakidze, R. 1996. Sakartvelos geobotanikuri daraioneba (Determination of geobotanical regions in Georgia). Metsniereba. Tbilisi.

Kvachakidze R. 2001. Forests of Georgia. Tbilisi (in Georgian).

Lanly J.-P. 1997. World forest resources: situation and prospects. Unasylva 190/191, 48, 9-18.

Makashvili A. 1995. The Trees and Bushes of Georgia (edited by G. Nakhutsrishvili and N. Zazanashvili). WWF, Tbilisi.

Morris P. 1995. Ecology overview. EIA. 197-225.

Morris P., Thurling D., Shreeve T. 1995. Terrestrial ecology. EIA, 227-241.

Mosyakin S.L., Fedoronchuk M.M. 1999. Vascular plants of Ukraine. A nomenclatural

checklist. Kiev.

Nakhutsrishvili G. 1999. The Vegetation of Georgia. Braun-Blanquetia, 15, 1-74.

Nakhutsrishvili G. 2000. Georgia's basic biomes. Biological and Landscape Diversity of

Georgia. WWF, BMZ, Tbilisi, 43-68 (in Georgian, English).

Northen H.T. 1968. Introductory plant science. Third ed. The Ronald Press Company, New York.

Raven P.H., Evert R.F., Eichhorn S.E. 1986. Biology of plants. Worth Publ., New York.

Red Data Book of the Georgian SSR. 1982. Sabchota Sakartvelo, Tbilisi (in Georgian).

Red Data Book of the USSR (1984), Moscow.

Red List of Endangered Species of Georgia. 2003. Legisl. Proc. 3, Order N76, GSS Codex, GSS code-www.gss-ltd.com.

Red List of Georgia. 2006. Internet version, order.

Rote Liste gefährdeter Pflanzen Deutschlands. 1996. Schriftenreihe für Vegetationskunde, Heft 28, Bundesamt für Naturschutz, Bonn-Bad Godesberg.

Sakhokia M.F. 1961 (ed.). Botanical excursions over Georgia. Tbilisi.

Shanshiashvili P. 1998. Developing the system of Georgia's protected territories. Bull. of the

Centre for Strategic Researches and Development (Tbilisi). No 16, 2-23.

The 2000 IUCN red list of threatened species. 2000 UNEP, WCMC.

WDPA Consortium. 2004. 2004 World Database on Protected Areas. IUCN-WCPA and UNEP-WCMC, Gland, Switzerland, Washington, DC, USA and Cambridge, UK.

Zazanashvili N., Sanadiradze G. 2000. The system of protected areas of Georgia at the junction

of 20th – 21th centuries. Biological and Landscape Diversity of Georgia. WWF, BMZ. Tbilisi, 251-276 (in Georgian and English).

Zazanashvili N. 1997. Protected areas of Georgia: Present and future. WWF. Tbilisi (in Georgian).

D.2. Study Report for Fauna (Gamma, 2011)

D.2.1. Introduction

This report is based on detailed literature reviews and the results of field works and field surveys which were previously carried out but still remain unpublished (May 25-29 and September 8-12, 2011). The main goal of the field surveys carried out was to determine which areas within the Project impact zone were inhabited by important species.

Special attention is made in this report to the habitat types, species and habitats protected by Georgian and international agreements (the Red List species, species protected by the Bonn Convention etc.), other animals of a high conservation value to local communities, as well as the species or potential interest to tourists.

D.2.2. Legal Basis

Georgian environmental protection legislation is based on internationally existing concepts and criteria, and represents a good base for an Environmental Impact Assessment (EIA).

The EIA is based on the following Georgian laws and international standards:

D.2.2.1. Law of Georgia on Protection of the Environment (framework law)

The law regulates legal relationships between the state authority bodies and physical persons/legal entities in the scope of environmental protection and consumption of natural resources within the whole territory of Georgia, including its territorial waters, airspace, continental shelf and special economic zones.

The law concerns environmental education, environmental management, economic sanctions, licensing, standards, environmental impact assessment and related issues. The law considers various aspects of ecosystem protection, protected areas, global and regional environmental management, protection of the ozone layer, biodiversity and the Black Sea; as well as issues relating to international cooperation.

The main goals of the law are:
- To support the promotion of biological diversity;
- The conservation of the country-specific, rare, endemic and endangered species of flora and fauna;
- Marine environmental protection; and
- The provision of ecological balance.

The law defines the "Biological Diversity Conservation Principle", which means that a proposed activity should not lead to irreversible degradation of the biodiversity.

The law defines general rules for wildlife and wild plant protection, namely:
- In order to maintain the self-reproduction of wild plant and animal resources and biodiversity conservation, their extraction from the environment is strictly limited and subject to licensing;
- any activities that could damage wildlife, plants, habitats, reproduction areas and migration routes are prohibited;

- in Georgia wild plant and animal protection and consumption rules are established by the legislation;
- endangered wild animals and plants are registered in the "Red List" and "Red Book" of Georgia; and
- any activities regarding wild animals and plants, registered in the "Red List" and "Red Book" of Georgia are prohibited, including: hunting, trade, catching, cutting, mowing, (except in special cases), which decrease the plant and animal number, deteriorates their habitats and living conditions.

Article 40 of the law identifies categories of protected areas, including: reserves, national parks, natural monuments, preserves, protected landscapes and multiple use areas. Existence of categories – biosphere reserves, world heritage sites, wetlands of international importance - in the international network of protected areas is allowed in Georgia. According to the law, the protected areas are established by the Parliament decision.

According to the article 56 of the law, “an international treaty or agreement, if it does not violate the Georgian Constitution, takes juridical precedence over the country-internal normative acts."

D.2.2.2. Law of Georgia on Protected Areas

This law categorises protected areas (including national parks, state reserves, managed reserves, multipurpose areas etc.) and defines activities which are permitted within their boundaries. Activities are permitted only according to the purpose of the area, area legislation, requirements set out in individual regulations and protected area management plans, as well as international agreements and conventions, signed by Georgia. The law provides restrictions to prevent the over consumption of natural resources in national parks and other protected areas. In general, within the protected territories it is prohibited:

- To damage or modify natural ecosystems;
- To destroy natural resources for use or other purposes;
- To seize, damage or disturb natural ecosystems and species;
- To pollute the environment;
- To introduce alien and exotic species of living organisms;
- To import into the territory explosive or poisonous materials; and
- To carry out any other activities, specially restricted by the management plan of the protected area.

Law of Georgia on Animal Wildlife Protection

The animal protection legislation of Georgia is based on Georgian Constitution, international treaties and agreements, laws on environmental protection and the system of protected areas. It is also based on a range of normative acts that are subject to legislation in the field of wildlife, its habitat protection and animal wildlife use.

The law provides protection and restoration of the wildlife and its habitats; conservation of species diversity and genetic resources; sustainability and creating conditions for sustainable development, taking into account interests of the future generations; and it also considers legislative provision of the state regulation, regarding animal protection and animal wildlife consumption.

D.2.2.3. Law of Georgia on the Red List and Red Book (2003)

This law regulates legislative relations in the Red List of Georgia and Red Book of Georgia elaboration field, endangered species protection and consumption sphere, with the exception of issues related to

legislative aspects of international trade with endangered animals and plants, which, in frames of Georgian Legislation, are regulated by the convention on “International Trade with Flora and Fauna Species, Endangered by Extinction”, issued on 3.03.1973 in Washington.

The main objectives of the law are:
- Providing protection and recovery for endangered species registered on Georgian territory;
- Conservation of species diversity and genetic resources;
- Sustainability; creation of conditions for their sustainable development by elaboration of the Red List and Red Book of Georgia; and
- Legislative regulation of the endangered species protection and consumption issues, under consideration of the present and future generations’ interests.

D.2.2.4. Order of the President of Georgia (May 2, 2006) №303 “About Georgian Red List Approval”

This Order approves the list of endangered plant and animal species, registered on the territory of Georgia.

D.2.2.5. Forest Code of Georgia

This Code regulates spheres related to functions and use of forest, including protection, management of water catchments basin, wood production, etc. It allows for private ownership of forest and commercial woodcutting. According to the document, the Forest Department of Georgia does not execute commercial woodcutting itself, but controls and manages these operations and grants this function to private enterprises. However, the Forest Department carries responsibility over sanitary woodcutting and forest management. According to the Code, the Ministry of Environment Protection delegated to the Department a right for issuance of a woodcutting license. The Forest Code sets categories of protected forests, including those regulating soil and catchments basins, riparian and sub-alpine forest zones, floral species of the Red List, etc. The Forest Code is a framework law and requires the execution of detailed regulations.

D.2.2.6. Basic International Conventions and Multilateral Agreements, Signed by Georgian Government

These International Conventions include the following:
- Convention on World Heritage Protection (signed 04.11.1992);
- Convention on Biological Diversity (CBD), 1992 (signed 02.06.1994);
- Convention on Conservation of Migratory Species (CMS), Bonn, 1979 (ratified 11.02.2000);
- Convention on Wetland Protection (Ramsar Convention 1971) (ratified 30.04.1996);
- Agreement on Chiropteran Protection in Europe (EUROBATS), (ratified 21.12.2001);
- Agreement on African - Eurasian Migratory Water Birds Protection (AEWA) (Georgia joined 1.05.2001); and
- Convention on Conservation of European Wildlife and Natural Habitats (Bern Convention, 1982) (ratified 30.12.2008).

There are 137 species, protected through the legislation in Georgia. Together with the species, protected by international conventions, their number reaches 200. Most of these are listed in the International Red List (Red Data List of IUCN), the Red List of Georgia and in the Conventions’ appendices.

D.2.3. Field Study Methodology

D.2.3.1. Mammals Study Methodology

Large and medium-sized mammals are recorded by their footprints in 1-5 km routes and transects, as well as visually, in the daytime and at night. Species' composition and number of small mammals are determined by standard methods of trap-lines (by means of live catching traps). By these means, a percentage outcome of species that are found in the traps (per 100 trap-days), is determined; a relative number of animals in the small mammals' complex are detected. In order to determine a mole existence, ground diggings are registered.

Chiropterans are registered during long term observations in routes, as well as in transect, forests, lanes, separate trees, underground hideouts, buildings and reservoir banks. Chiropterans are registered both visually and by means of ultrasonic detectors - Pettersson D 200 and Pettersson D 240. Existence of large numbers of a specific species within a small area indicates potential presence of a colony. In this case the colony is registered and its approximate size is detected.

D.2.3.2. Bird study methodology

Birds are observed in routes, transects and registration sectors. Legally protected species and their nests, and concentration areas are also registered and marked on the map as areas important for the species. Number of birds is detected by various standard methods (separate methods for lowland and mountainous landscapes); species are also detected by bird voices in forests.

D.2.3.3. Reptiles and Amphibians Study Methodology

Reptiles and amphibians are registered in transects, hideouts and reservoirs.

D.2.4. Geography and Landscape of Adjaristsqali River Basin Middle and Downstream

In Zoogeography terms the South Caucasus belongs to the Mediterranean Basin sub-region of the Palaearctic eco-region. Adjaristsqali River is located in the Caucasus region of the Mediterranean Basin (Vereshchagin 1959; Gadjiev1986). In Physical-geographical terms Adjaristsqali River basin lies in Adjara-Imereti sub-region of the small Caucasus (Ukleba 1981). It includes two landscape types – secondary fields (cornfields, gardens, settlements) and leaf forest with evergreen subforests. The secondary fields' ecosystem is quite degraded, which has resulted in there being species present which are usual for open landscapes and atypical for Adjara forest zone.

The area, impacted by the designed Adjaristsqali River Hydropower Cascade construction phase, directly includes Adjaristsqali, Chorokhi, Machakhela, Skhalta and Akavreta River gorges. The Chvanistskali, Shavitkistskali, Chirukhistskali, Mopdunistskali, Gorjomistskali rivers, as well as many small and nameless rivers and streams, will also be located in the Project zone of influence.

If the anthropogenic landscapes are rich in cultivated and invasive plants, the forested areas are mainly covered by Colchic endemic species. Basically there are: beech, hornbeam, chestnut, oak, maple, persimmon and etc. Fir, pine are present in Shuakhevi and Khulo municipalities. The region is rich in bushes, which include Azalea, box-tree, Cherry-laurel, blackberry etc.

The survey area comprises twelve major sectors, among them:

I – Adjaristsqali and Chorokhi River confluence, Adjaristsqali left bank;

II- Machakhela River, Adjaris Agmarti village adjacent area;

III-IV – Adjaristsqali HPP vicinity. Pirveli Maisi village, Makhuntseti HPP headwork adjacent area;

V - Akavreta River (the river has a confluence with Adjaristsqali River within Keda municipality area), Shevaburi village;

VI – Dandalo village. Keda-Shuakhevi highway section;

VII – Chvana River gorge, vicinity of Chvana and Varjanauli villages;

VIII – Zamleti HPP site and Adjaristsqali River adjacent section from Skhalta River confluence to up- and down-steam;

IX – Adjaristsqali River left tributary - Skhalta River, between Tsablana and Tsifnara villages;

X-XI – Chirukhistskali River near Oladauri village, and its tributary - Modunistskali River; and

XII – Didachara village, Gorjomistskali River.

D.2.5. Species Detected in the Project Area, Protected by International Conventions and Georgian Law (Desk-Based Review of Results)

Land vertebrate species that are listed in the Red List of Georgia and inhabit the middle and downstream of Adjaristsqali River basin, are listed below. The mentioned species may potentially inhabit the designed HPP Cascade consruction impact zone (Table D.3).

Table D.3: Animal Species, registered in the Project impact zone according to literature Sources

№	Latin Name	Georgian Name	English Name	Status	IUCN Status*
		Mammals/Vertebrates			
1	*Lutra lutra*	წავი	Common Otter	VU	
2	*Ursus arctos*	მურა დათვი	Brown Bear	VU	
3	*Lynx lynx*	ფოცხვერი	European Lynx	VU	
4	*Sciurus anomalus*	კავკასიური ციყვი	Caucasian squirrel	VU	
		Birds			
5	Neophron percnopterus	ფასკუნჯი	Egyptian Vulture	*VU*	*EN*
6	Aquila chrysaetus	მთის არწივი	Imperial Eagle	*VU*	
7	Aquila heliaca	ბეგობის არწივი	Golden Eagle	*VU*	*VU*
8	Aquila clanga	მყივანი არწივი	Spotted Eagle	*VU*	*VU*
9	Accipiter brevipes	ქორცქვიტა	*Levant Sparrowhawk*	*VU*	
10	Falco biarmicus	წითურთავა ბარი	*Lanner Falcon*	*VU*	

11	*Falco cherrug*	გავაზი	Saker Falcon	CR	
12	*Falco vespertinus*	თვალშავი	Red-footed Falcon	EN	
13	*Buteo rufinus*	ველის კაკაჩა	Long-legged Buzzard	VU	
14	*Buteo lagopus*	ფეხებანჯგვლიანი კაკაჩა	Rough-legged Buzzard	VU	
15	*Athene noctua*	ჭოტი	Little Owl	VU	
16	*Tadorna ferruginea*	წითელი იხვი	Ruddy Shelduck	EN	
Reptiles					
17	*Darevskia clarkorum*	თურქული ხვლიკი	Clark's Lizard	EN	EN
18	*Vipera kaznakovi*	კავკასიური გველგესლა	Caucasus viper	EN	EN
Amphibians					
19	*Mertensiella caucasica*	კავკასიური სალამანდრა	Caucasian salamander	VU	VU

* - only endangered statuses are indicated (VU-vulnerable, EN – endangered, CR – critically endangered)

According to reference data, of the 4 mammal types listed in the Red Book, only otter is noted along Adjaristsqali River, and is quite itself quite rare here - mainly due to lack of food sources (fish), which is caused by unauthorised catches and fish poaching (fishing with electric wiring and using toxic substances). According to the local population information, bear and lynx are met within the project impact zone in every Municipality that is crossed by Adjaristsqali River; though, as per literature sources, they are registered only in Shuakhevi and Khulo Municipalities. Caucasian squirrel is known only from Khelvachauri and Khulo Municipalities, which indicates a poor survey of the species in the region.

Data about birds is more complete. Birds of prey mainly appear during migration flights in Khelvachauri and Keda Municipalities. Among the 10 species of vermin enlisted in the Red Book, 7 (namely Golden Eagle, Spotted Eagle, Levant Sparrow Hawk, Lanner Falcon, Red-footed Falcon, Long-legged Buzzard), 2 (namely Saker Falcon and Rough-legged Buzzard) may theoretically appear at the tributaries of Chorokhi and Adjaristsqali Rivers, though such cases have not been registered here yet. Imperial Eagle is recorded only in Khulo and Shuakhevi Municipalities. The Egyptian Vulture is very rare for this region as it is a migratory type of bird, which entered the mentioned zone just for food, and nests in the territory of Goderdzi Pass, which is not included in the region of our interest. Little Owl was not registered in Adjaristsqali River gorge, but seldom met in the marine coastal regions, as a rare nesting or wintering species. Ruddy Shelduck species are seldom wintering or migrant species here. The bird migration corridor is usually very narrow in Batumi, and migratory birds are very rarely met in Adjara's mountainous part, and even then only up to Keda settlement, but not higher. This is why numerous migratory birds are met in the vicinity of Chorokhi and Adjaristsqali Rivers' confluence and in Keda settlement. However, during the nesting period they have not been witnessed in these areas.

Only two legally protected reptile species, Clark's Lizard and Caucasian viper, are not registered in Adjaristsqali River gorge, though the first one is noticed in Charnali River gorge and Mtirala Mountain, and the second one – in the seacoast areas. It is possible however that both species are present within the Project impact zone and may be witnessed at a later date. Caucasian Salamander was witness during the survey (1996) in the Chorokhi and Adjaristsqali River confluence area, in the Kveda Makhuntseti village, and also at Goderdzi pass. However, the species distribution has not been sufficiently studied.

Georgia is a signatory to the Bonn Convention "On Protection of migratory species," and the "Treaty on Protection of European Chiropteran"- EUROBATS. Georgia, in accordance with these agreements, shall protect 19 bat species which have been detected in this area and its vicinity (Table D.4).

Table D.4: Protected Bt Species

№	Latin Name	Georgian Name	English Name	Local Status	IUCN and European Status*
1	Rhinolophus ferrumequinum	დიდი ცხვირნალა	Greater Horseshoe Bat		
2	Rhinolophus hipposideros	მცირე ცხვირნალა	Lesser Horseshoe Bat		
3	Rhinolophus euryale	სამხრეთული ცხვირნალა	Mediterranean Horseshoe Bat	GRL**	EU
4	Rhinolophus mehelyi	სათვალიანი ცხვირნალა	Mehely's Horseshoe Bat	GRL	EU, IUCN
5	Myotis blythii	წვეტყურა მღამიობი	Lesser Mouse-eared Bat		
6	Myotis mystacinus	ულვაშა მღამიობი	Whiskered Bat		
7	Myotis nattereri	ნატერერის მღამიობი	Natterer's Bat		
8	Myotis emarginatus	სამფერი მღამიობი	Geoffroy's Bat		
9	Myotis daubentonii	წყლის მღამიობი	Daubenton's Bat		
10	Nyctalus lasiopterus	გიგანტური მეღამურა	Giant Noctule Bat		
11	Nyctalus leisleri	მცირე მეღამურა	Lesser Noctule Bat		
12	Nyctalus noctula	წითური მეღამურა	Common Noctule		
13	Eptesicus serotinus	მეგვიანე ღამურა	Serotine Bat		
14	Pipistrellus pipistrellus	ჯუჯა ღამორი	Common Pipistrelle		
15	Pipistrellus pygmaeus	პაწია ღამორი	Soprano Pipistrelle		
16	Pipistrellus nathusii	ტყის ღამორი	Nathusius's Pipistrelle		
17	Hypsugo savii	სავის ღამორი	Savi's Pipistrelle		
18	Plecotus auritus	რუხი ყურა	Brown Big-eared Bat		
19	Vespertilio murinus	ჩვეულებრივი ღამურა	Frosted Bat		

* - all species have a status vulnerable (VU), therefore it is not indicated

** - (GRL) Georgian Red List, (EU) European Red list, (IUCN) International Red List

Chiropterans, inhabiting Adjaristsqali River middle- and downstream, protected by the Bonn Convention

No legally protected bat species have been identified within the discussed area; however, the Adjaristsqali and Chorokhi River gorges have not been fully studied. The only species, earlier described by us in this region, was Brown Big-eared Bat, caught in Merisi village (Keda municipality). All other catches were made by us near Kveda Makhuntseti and Adjarisagmarti villages, during our earlier studies.

All waterfowl and water adjacent inhabiting birds in Georgia are protected by the agreement on African - Eurasian Migratory Waterfowl and Wetland Bird Protection. There are only a few such birds in the Adjaristsqali basin; however they have still been included within the following list (Table D.5).

Table D.5: Species found in the target area, protected by the agreement on Africa – Eurasian Migratory Waterfowl

№	Latine Name	Georgian Name	English Name
1	Podiceps auritus	წითელყელა მურტალა	Slavonian Grebe
2	Pelecanus crispus	ხუჭუჭა ვარხვი	Dalmatian Pelican
3	Nycticorax nycticorax	ღამის ტანჩა	Black-crowned Night Heron
4	Ardeola ralloides	ყვითელი ყანჩა	Scuacco Heron
5	Bubulicus ibis	ეგვიპტური ყანჩა	Cattle Egret
6	Egretta alba	დიდი თეთრი ყანჩა	Great White Egret
7	Ardea purpurea	წსრცი ყანჩა	Purple Heron
8	Anser fabalis	მეკალოე ბატი	Bean Goose
9	Anser anser	რუხი ბატი	Greylag Goose
10	Tadorna ferruginea	წითელი იხვი	Ruddy Shelduck
11	Tadorna tadorna	ამლაყი იხვი	Common Shelduck
12	Anas penelope	თეთრშუბლა იხვი	Eurasian Wigeon
13	Anas strepera	რუხი იხვი	Gadwall
14	Anas platyrhinchos	გარეული იხვი	Mallard
15	Milvus migrans	ძერა	Black Kite
16	Circus aeruginosus	ჭაობის ბოლობეჭედა	Eurasian Marsh Harrier
17	Pandion haliaetus	შაკი	Osprey
18	Porzana porzana	ქათამურა	Spotted Crake
19	Crex crex	ღალღა	Corncrake
20	Charadrius dubius	მცირე წინტალა	Little Ringed Plover
21	Gallinago gallinago	ჩიბუხა	Common Snipe
22	Tringa ochropus	შავი ჭოვილო	Green Sandpiper
23	Actitis hypoleucos	მებორნე	Comon Sandpiper
24	Larus ridibundus	ჩვეულევრივი თოლია	Black-headed Gull
25	Larus genei	წვრილნისკარტა თოლია	Slender-billed Gull
26	Larus armenicus	სომხური თოლია	Armenian Gull
27	Larus cacchinans	ყვითელფეხა თოლია	Yellow-legged Gull
28	Riparia riparia	მენაპირე მერცხალი	Sand Martin

None of the above listed animals are considered endangered either by the European, or by international Red List.

From these birds only Little Ringed Plover, Common Sandpiper, Green Sandpiper and seagulls nest or inhabit Adjaristsqali River gorge. It has also been identified that sand martin nest within this area, however, this is a very rare occurrence. All others, even Eurasian Marsh Harrier (nesting in the most of Georgian area), are migratory or flown-in birds.
According to the studied literature and surveys carried out, a total of 229 vertabrate species were recorded within the Project target area. This includes 61 species which are legally protected by Georgian legislation

and international conventions, and also 20 which are Caucasian endemic or subendemic species. See Table D.6.

Table D.6: Total number, endemism and protected status of vertebrates, distributed in the target area

Class	Total Quantity of Species	Legally Protected Species	Endemic and Sub-endemic Species
Amphibians	5	1	2
Reptiles	14	0	5
Birds	148	37	1
Mammals	62	23	12
Total	**229**	**61**	**20**

D.2.6. Outcomes of the Field Survey Works

D.2.6.1. Survey Results of 2011

Some animals, typical for the survey area, met overall:

Mammals - East European hedgehog (*Erinaceus concolor*), Caucasian mole (*Talpa caucasica*), a Levant Mole (*Talpa levantis*), Gueldenstaedt's Shrew (Crocidura gueldenstaedtii)), Natterer's bat (*Myotis nattereri*), Common Noctule (*Nyctalus noctula*), Common Pipistrelle (*Pipistrellus pipistellus*), lesser common field mouse (*Sylvaemus uralensis*), Caucasian forest mouse (*Sylvaemus fulvipectus*), Asianic forest mouse (*Sylvaemus mystacinus*), Major's Pine Vole (*Terricola majori*), least weasel (*Mustela nivalis*), red fox (*Vulpes vulpes*), golden jackal (*Canis aureus*). Major's Pine Vole and Forest Mouth identification was carried out upon their holes in tree roots and their vicinity.

Birds - Northern Goshawk (*Accipiter gentilis*), Common Buzzard (*Buteo buteo*), Common Wood Pigeon (*Columba palumbus*), Common Cuckoo (*Cuculus canorus*), Tawny Owl (*Stris aluco*), Boreal Owl (*Aegolius funereus*), Eurasian Crag Martin or just Crag Martin (Ptyonoprogne rupestris), Black Woodpecker (*Dryocopus martius*), Black Woodpecker (*Dendrocopoc major*), Green Woodpecker (*Picus viridis*), Tree Pipit (*Anthus trivialis*), White Wagtail (*Motacilla alba*), Grey Wagtail (*Motacilla cinerea*), Eurasian Wren (*Troglodytes troglodytes*), Dunnock (*Prunella modularis*), European Robin (*Erythacus rubekula*), Common Redstart (*Phoenicurus phoenicurus*), Common Blackbird (*Turdus merula*), Song Thrush (*Turdus philomelos*), Mistle Thrush (*Turdus viscivorus*), Blackcap (*Sylvia atrikapilla*), Greenish Warbler (*Phylloscopus nitidus*), Goldcrest (*Regulus regulus*), Long-tailed Tit (*Aegithalos caudatus*), Great Tit (*Parus major*), Coal Tit (*Parus ater*), Blue Tit (*Parus coeruleus*), Eurasian Nuthatch (*Sitta europaea*), Eurasian Treecreeper (*Certhia familiaris*), Eurasian Jay (*Garrulus glandarius*), Hooded Crow (*Corvus cornix*), Common Raven (*Corvus corax*), Chaffinch (*Fringilla coelebs*), Eurasian Siskin (*Carduelis spinus*), European Goldfinch (*Carduelis carduelis*), European Greenfinch (*Carduelis chloris*), Common Crossbill (*Loxia curvirostra*), Eurasian Bullfinch (*Pyrrhula pyrrhula*);

Reptiles met most frequently: Georgian Lizard (*Darevskia rudis*) and Red-Belied Lizard (*Darevskia parvula*), often found Slow Worms (*Anguis colchica, A. fragilis)*.

Amphibians met frequently: European Green Toad (*Bufo viridis*), Caucasian Toad (*Bufo verrucozissimus*), Marsh Frog (*Rana ridibunda*) Long-legged Wood Frog (*Rana macrocnemis*), European tree frog (*Hyla arborea*).

It has to be taken into account that no Black Woodpecker (*Dryocopus martius*), Common Crossbill (*Loxia curvirostra*), Eurasian Bullfinch (*Pyrrhula pyrrhula*), Eurasian Jay (*Carduelis spinus*) and Goldcrest (*Regulus regulus*) were found during the surveys within the low lying sectors (50-300 m). However, Black Woodpecker and Eurasian Jay can be identified here within winter months.

According to the information provided from local residents', as well as the results of our researches and colleagues, Common Otter (Lutra lutra), European Lynx (Lynx lynx), Brown Bear (*Ursus arctos*), Wolf (*Canis*), Fox (*Vulpes*) are found in the target area. Also, the Caucasian squirrel (*Sciurus anamalus*) has been witnessed here.

From this point onwards, the abovementioned species will not be specially mentioned by description within the specific sections.

During May 25-29 and September 8-12 2011, a series of field surveys were carried out in order to detect the current condition of land mammals within the Project zone of influence. A range of land mammals species were identified.

Section №1 - 25.05.2011. The confluence of Adjaristsqali and Chorokhi Rivers, Adjaristsqali River left bank. Greenwood were identified on the slopes - beech, hornbeam, chestnut, oak and etc, shrubs are growing, a steep slope is at some distance. In additon to the bird species listed in the general table, Caspian yellow-legged (*Larus cacchinans*), Armenian (*Larus armenicus*) and Slender-billed (*Larus genei*) Gulls were identified. Chiroptera species were witnessed here: Greater Horseshoe Bat (*Rhinolophus ferrumequinum*), Lesser Mouse-eared Bat (*Myotis blythii*), Daubenton's Bat წყლის მღამიობი (*Myotis daubentonii*), Lesser Noctule Bat (*Nyctalus leisleri*), Serotine Bat (*Eptesicus serotinus*). According to local residents, bear (*Ursus arctos*) has been witnessed here in winter.

Section №2. Machakhela River, Adjarisagmarty village adjacent territory. Machakhela HPP. Village, greenwood on the slopes - beech, hornbeam, chestnut, oak and etc, shrubs are growing. The river gorge is wider by the dam. In addition to the birds and reptiles listed in the the general table, *Charadrius dubius* and Greenish Warbler *(Phylloscopus trochiloides)* were found there. Greater and Lesser Horseshoe Bat *(Rhynolophus ferrumequinum, Rhynolophus hipposideros)* were detected in the former military facilities near the village. In addition to the baseline species, there were *Myotis mystacinus / brandtii, Eptesicus serotinus, Vespertilio murinus* near Machakhela River.

Section №3-4. Makhunceti HPP vicinity. Pirveli Maisi village, the Adjaristsqali HPP headwork. Road on the right bank of Adjaristsqali River, on the left slope - greenwood, village and agriculture land. Besides the bird and reptile species, listed in the general table, there were found 2-3 Caspian Gulls (*Larus cachinnans*), Accipiter nisus, Charadrius dubius, Nyctalus noctula, Nyctalus leisleri, Myotis mystacinus/brandti/aurascens, Eptesicus serotinusi.

Section №5. Akavreta River (the river has a confluence with Adjaristsqali River within Keda municipality area), Shevaburi village. A well developed grove, mainly greenwood on the slopes - beech, alder-tree, chestnut, walnut; agriculture fields. In addition to the birds listed in the general table, *Tringa ochropus* and Greenish Warbler *(Phylloscopus trochiloides)* were found there. The river water is clear and fish are met there, among them: brown trout *(Salmo trutta)*, Spirlin- ray-finned fish (*Alburnoides bipunctatus fasciatus)*. Local residents have no information about the Common Otter (*Lutra lutra).* From chiroptera there was *Nyctalus lasiopterus*. Colchis Slow worm *(Anguis colchica)* was detected there.

Section №6. Dandalo village, of Keda-Shuakhevi highway sector. The river meanders quite far from the road. There are small grove fragments, artificial plantation of acacia and open sites, an erosive rock. In addition to the birds, listed in the general table there are met: red-backed shrike *(Lanius colurio)*, swallow - mainly Eurasian Crag Martin or just Crag Martin (*Ptyonoprogne rupestris*) and house martins *(Delichon urbica)*. Chiroptera noted: *Myotis mystacinus/brandti/aurascens*, *Eptesicus serotinusi* and *Nyctalus leisleri*. Reptiles: *Platyceps najadum*.

Section №7. Chvana River gorge, in the vicinity of Chvana and Varjanauli villages. Mixed forest: oak, hornbeam, maple, beech, fir-tree, pine. The village sectors are spread throughout the surrounding area; this is where the confluence of Nagvarevistskali and Vanistsqali Rivers is located (from this location and downstream, the river is called Chvanistsqali). Natural vegetation is found in an around the village area. According to locals residents, there are a significant number of jackals (which often steal hens), and Grey wolf *(Canis lupus*), and , seldomly European hare (Lepus europaeus) are found also. From Chiropterans, *Eptesicus serotinus* were found. In addition to the bird's general list, Greenish Warbler *(Phylloscopus trochiloides)* were identified. Our colleagues have also identified *Elaphe longissima*.

Section №8. 26.05.2011 Zomleti HPP and Adjaristsqali River adjacent section, from Skhalta River confluence area up- and downstream. The river gorge is deep, almost canyon-like downwards from the Suakhevi-Khulo road. Rocky and erosive slopes along the road, steep rocks in the lower part, mixed forested in the upper side with dominating oak and hornbeam. The river left bank is forested nearly from the water edge, mainly fir-pine with some greenwood species. A dead jackal was seen in this section, but no other larger mammals were detected. During the September research, *Sciurus anomalus* were detected. In addition to the birds species listed in the general table, House martin *(Delichon urbica)* were also identified.

Section №9. 26.05.2011 Adjaristsqali River left tributary - Skhalta River, between Tsablana and Tsifnara villages. Very steep slopes with mixed forests: fir-tree, pine, oak, hornbeam and beech, in streams' vicinity - alder-tree. In 1989 a large landslide occurred in this area, which blocked the river. The river flows through the accumulated mass through a narrow gorge. Within the landslide deposit on the left bank of the river there is a pine grove, boulders and stones spread across it. The right bank area adjacent is overgrazed and partially deforested through cuttings. In the river upstream, the gorge is relatively broad, the river is branched. From the bank edge, a forest grows up the inclined slopes.

With regards to mammals, Radde's Shrew (*Sorex raddei*), European Pine Marten (*Martes martes*) were identified. Through inerviews with locals' it was discovered that there is Euroasian Otter (Lutra lutra), Brown Bear (Ursus arctos), and European Roe Deer *(Capreolus capreolus*) within the Project impact zone. Chiropterans found included whiskered/Brandt's Myotis (*Myotis mystacinus/brandti/aurascens*), Common Noctule (Nyctalus noctula) and Lesser Horseshoe (*Rhinolphus hipposideros*). With regards to reptiles, *Anguis fragilis* was detected. This section is rich in animal variety and number.

Section №10-11. Chirukhistsqali River near Oladauri village, and its tributary Modunistskali River. The first point (near Oladauri village): the slopes are settled on both sides, there are pastures, haylofts, and arable lands. There also remains some small fragments of mixed forest and fir groves.

With regards to mammals, marten (*Martes sp)*, and European Roe Deer (*Capreolus capreolus*) were identified; Chiropterans found included whiskered/Brandt's Myotis (*Myotis mystacinus/brandti/aurascens*), *Nyctalus leisleri,* and *Hypsugo savii.* With regards to birds, common forest species were identified, as well

as Barn Swallow (*Hirundo rustica*), red-backed shrike (*Lanius colurio*), House Sparrow (*Passer domesticus*), and Common Sandpiper (*Actitis hypoleucos*).

At the second point, a fir-pine forest is present at Modunistskali River left bank; the dike adjacent slope consists of cut secondary bushwood (nuts, blackberry and etc.); and there is protected forest also present on the right slope. The mammals witnessed included: brown bear (*Ursus arctos*), Common Wild Boar *(Sus scrofa)*, European Roe Deer (Capreolus capreolus), presumably Euroasian Otter (Lutra lutra) and European Lynx (Lynx lynx). With regards to birds, the following were found: common wild species and White-throated Dipper (*Cinclus cinclus*) at the river, in river effluents on the Shavsheti range northern slopes there are met Caucasian grouse *(Lyrurus mlokosiewiczi)*. Similar to section №9, this section is also characterised by a variety of animals.

Section №12. 28.05.2011 Didadjara village, Ghorjomistskali River. Mixed forest on the slopes, haylofts on the right side, the gorge is narrowing. Willow, alder-tree, and acacia are growing along the river; oak, hornbeam, fir-tree are met in the forest. In addition to the bird species listed in the general table, Common Rosefinch *(Carpodacus erythrinus)*, and red-backed shrike (*Lanius colurio*) were witnessed. There are also many jackals (*Canis aureus*) located within the area. European Badger *(Meles meles)* and wildcat *(Felis sylvestris*) tracks were also found, as well as a European Badger hole. Chiropterans identified included the whiskered/Brandt's Myotis (*Myotis mystacinus/brandti/aurascens*). Reptiles detected included the *Darevskya derjugini* as well as lizards of the same genus. This particular area is rich in animals.

The surveys carried out show that the study areas are mainly anthropogenically impacted, but natural landscapes are located in their close vicinity. Hence, almost all sites are of moderate, higher than moderate, and high environmental sensitivity and are characterised by a high variety and high number of fauna species (Table D.7).

Table D.7: Quantities of Fauna Species across Project Sectors

Sector	Number of species
№1 - Adjaristsqali and Chorokhi River confluence	56+8=64
№2 - Machakhela River, Adjaris Agmarti village adjacent area	56+7=63
№3-4 - Makhuntseti HPP headwork adjacent area; Pirveli Maisi village	56+6=62
№5 - Akavreta River near Skhalidzeebi village (Shevaburi vill. vicinity)	56+3=59
№6 - Dandalo village. Keda-Shuakhevi highway section	61+6=67
№7 - Chvana River gorge, vicinity of Chvana and Varjanauli villages	61+5=66
№8 - Zomleti HPP, from Skhalta River confluence	61+2=63
№9 - Skhalta River, between Tsabla and Tsifnara villages	61+9=70
№10-11 - Chirukhistskali River near Oladauri village, and its tributary-Modunistskali River	61+14=75
№12 - Didadjara village, Gorjomistskali River	61+7=68

The first figure in the column "number of species" indicates the number of animals that are found overall, the second number is the number of animals which have been seen additionally, or were identified as present by local residents.

Table D.7 shows that the number of species is similar across all sites, however, the number of animals varies significantly between each. Sections of particular interest are:

- №2 Machakhela River gorge - the number of animals is high; species diversity is also high; in addition its sensitivity will eventually increase as a protected area is planned to be created here. Significant mitigation measures will be necessary on Machakhela since a dam will be constructed by Adjarisagmarti village, and also, the river will be flooded at the confluence as a result of the planned dam construction on Chorokhi River;
- № 5 Akavreta River gorge - a relatively low number of species, but a high number of animals, especially birds;
- №9 Skhalta River gorge between the villages of Tsablana and Tsipnara - species diversity is high (the second highest among the sectors), and also a high number of animals present. In addition, the importance of this particular sector will increase due to the presence of protected species such as otter and bear;
- №10-11 Chirukhistsqali River gorge - has the highest number of species and animals. It is also noteworthy that there are legally protected species, such as otters, bear and lynx in this area. Also notable, *Hypsugo Savii* inhabit this area, which is quite unusual for a forest zone. Interestingly, *Lyrurus mlokosiewiczi* is present in Modunistskali River effluent vicinity, which is surprising considering the river is short, only 7-8 km;
- № 12 - Ghorjomistskali River downstream - this area is the third richest in species diversity and has one of the highest numbers of animals. This is the most endangered location within the survey, as the highest dam shall be constructed here, which could have a negative impact on the animal populations. It is also at risk considering that this area is located between two active anthropogenesis sectors – the highway and Didadjara village; in case of a flooding the sector will lose its natural landscape. Hence, the highest mitigation measures should be provided here;

Noteworthy the stations № 1 - the Adjaristsqali and Chorokhi River confluence and № 6 - Dandalo, where the number of species is high - though numerous are the species, atypical for a high forest zone, forest species are rather seldom.

The complete list of the animals, typical for Adjaristsqali, Chorokhi and Machakhela River gorges is provided in Table D.8 below.

Table D.8: Species Located within the Project Area (excluding an 8 km coastline)

№	Species Latin Name	Khelvachauri Municipality	Qeda Municipality	Shukhevi Municipality	Khulo Municipality
		Mammals			
1.	Erinaceus concolor	+		+	+
2.	Talpa caucasica #	+		+	+
3.	Talpa levantis #	+			
4.	Sorex raddei #	+	+	+	
5.	Sorex satunini #				+
6.	Sorex volnuchini #		+		
7.	Neomys teres #	+			
8.	Crocidura gueldenstaedti	+	+	+	
9.	Crocidura leucodon	+			
10.	Rhinolophus ferrumequinum *	+			
11.	Rhinolophus hipposideros *	+			
12.	Myotis blythi *	+			
13.	Myotis nattereri *	+	+	+	+
14.	Myotis mystacinus/brandtii/aurascens *	+	+	+	
15.	Nyctalus lasiopterus *		+		
16.	Nyctalus noctula *	+	+	+	+
17.	Nyctalus leisleri *	+	+	+	
18.	Eptesicus nilssonii *	+			

19.	Eptesicus serotinus *		+		
20.	Pipistrellus pipistrellus *	+	+	+	+
21.	Pipistrellus pygmaeus *				
22.	Pipistrellus nathusii *	+	+	+	+
23.	Hypsugo savii *			+	
24.	Plecotus auritus *		+		
25.	Vespertilio murinus *	+			
26.	Lepus europaeus	+	+	+	+
27.	Sciurus anomalus	+			+
28.	Sciurus vulgaris			+	+
29.	Glis glis		+	+	+
30.	Dryomys nitedula	+	+	+	+
31.	Cricetulus migratorius *			+	+
32.	Prometheomys schaposchnikovi * #			+	+
33.	Clethrionomys glareolus ponticus * #			+	+
34.	Arvicola terrestris	+		+	
35.	Chionomys nivalis			+	
36.	Chionomys gud #			+	
37.	Chionomys roberti #	+		+	+
38.	Terricola majori	+	+	+	+
39.	Terricola daghestanicus #				+
40.	Microtus arvalis			+	+
41.	Sylvaemus uralensis	+		+	+
42.	Sylvaemus fulvipectus	+			+
43.	Sylvaemus ponticus #	+			+
44.	Sylvaemus mystacinus	+	+	+	+
45.	Mus musculus	+	+	+	+
46.	Rattus rattus	+	+	+	
47.	Rattus norvegicus	+	+		
48.	Nyctereutes procyonoides				+
49.	Canis aureus	+	+	+	+
50.	Canis lupus			+	+
51.	Vulpes vulpes	+	+	+	+
52.	Ursus arctos *			+	+
53.	Martes martes			+	+
54.	Martes foina			+	+
55.	Mustela nivalis	+	+	+	+
56.	Meles meles	+	+	+	+
57.	Lutra lutra *	+	+	+	+
58.	Felis silvestris			+	+
59.	Lynx lynx *			+	+
60.	Sus scrofa	+	+	+	+
61.	Capreolus carpeolus		+	+	+
62.	Rupicapra rupicapra *			+	+
		Birds			
63.	Podiceps auritus *		+		
64.	Pelecanus crispus *	+			
65.	Nycticorax nycticorax *	+			
66.	Ardeola ralloides *	+	+	+	+
67.	Bubulicus ibis *	+			+
68.	Egretta alba *			+	+
69.	Ardea purpurea *		+	+	+
70.	Anser fabalis *	+	+		+
71.	Anser anser *	+		+	+
72.	Tadorna ferruginea *	+			
73.	Tadorna tadorna *		+	+	+
74.	Anas penelope *		+	+	+
75.	Anas strepera *		+		+
76.	Anas platyrhinchos *		+		+
77.	Pernis apivorus	+	+		
78.	Milvus migrans *	+	+		

79.	Neophron percnopterus *	+	+		
80.	Circaetus gallicus	+	+		
81.	Circus aeruginosus *	+	+		
82.	Circus cyaneus	+	+		
83.	Circus macrourus	+	+		
84.	Circus pygargus	+	+		
85.	Accipiter gentilis	+	+	+	+
86.	Accipiter nisus	+	+		
87.	Accipiter brevipes *	+	+		
88.	Buteo buteo	+	+	+	+
89.	Buteo rufinus *	+	+		
90.	Aquila pomarina	+	+		
91.	Aquila clanga *	+	+		
92.	Aquila nipalensis	+	+		
93.	Aquila heliaca *	+	+		
94.	Aquila chrysaetos *			+	+
95.	Hieraeetus pennatus	+	+		
96.	Pandion haliaetus *	+	+		
97.	Falco naumanni *	+	+		
98.	Falco tinnunculus	+	+		
99.	Falco vespertinus *	+	+		
100.	Falco columbarius	+	+		
101.	Falco subbuteo	+	+		
102.	Falco peregrinus brookei	+	+		
103.	Coturnix coturnix	+	+	+	+
104.	Porzana porzana *	+	+		
105.	Crex crex *	+	+		
106.	Charadrius dubius *	+	+		
107.	Gallinago gallinago *	+	+		
108.	Scolopax rusticola *	+	+		+
109.	Tringa ochropus *	+	+		
110.	Actitis hypoleucos *	+	+	+	
111.	Larus ridibundus *	+	+	+	+
112.	Larus genei *	+			
113.	Larus armenicus *	+			
114.	Larus cacchinans *	+	+	+	+
115.	Columba livia	+	+	+	+
116.	Columba oenas	+	+	+	+
117.	Columba palumbus	+	+	+	+
118.	Cuculus canorus	+	+	+	+
119.	Otus scops	+	+		
120.	Bubo bubo				+
121.	Strix aluco	+	+	+	+
122.	Asio otus	+	+	+	
123.	Aegolius funereus			+	+
124.	Apus apus	+	+	+	+
125.	Merops apiaste	+	+	+	+
126.	Upupa epops	+	+		+
127.	Jynx torquilla		+		
128.	Picus viridis	+	+	+	+
129.	Dryocopus martius		+	+	+
130.	Dendrocopos major	+	+	+	+
131.	Dendrocopos medius	+	+	+	+
132.	Dendrocopos leucotos	+		+	+
133.	Dendrocopos minor	+	+	+	+
134.	Lullula arborea	+	+	+	+
135.	Alauda arvensis	+	+		
136.	Riparia riparia *	+	+	+	
137.	Ptyonoprogne rupestris	+	+	+	+
138.	Hirundo rustica	+	+	+	+
139.	Delichon urbica	+	+	+	+

140.	Anthus campestris	+	+		
141.	Anthus trivialis	+	+	+	+
142.	Anthus pratensis	+	+		
143.	Anthus spinoleta			+	+
144.	Motacilla alba	+	+	+	+
145.	Motacilla cinerea	+	+	+	+
146.	Motacilla flava	+	+	+	
147.	Cinclus cinclus	+	+	+	+
148.	Troglodytes troglodytes	+	+	+	+
149.	Prunella modularis	+	+	+	+
150.	Erithacus rubecula	+	+	+	+
151.	Luscinia luscinia	+	+	+	+
152.	Luscinia megarhynchos	+	+	+	+
153.	Luscinia svecica	+	+	+	+
154.	Phoenicurus phoenicurus	+	+	+	+
155.	Saxicola rubetra	+	+	+	
156.	Saxicola torquata	+	+	+	+
157.	Oenanthe oenanthe	+	+	+	
158.	Monticola saxatilis				+
159.	Monticola solitaries				+
160.	Turdus torquatus			+	
161.	Turdus pilaris	+	+		
162.	Turdus iliacus	+	+	+	
163.	Turdus merula	+	+	+	+
164.	Turdus philomelos	+	+	+	+
165.	Turdus viscivorus	+	+	+	+
166.	Cettia cetti	+	+		
167.	Sylvia atricapilla	+	+	+	+
168.	Sylvia communis	+	+	+	
169.	Sylvia curruca	+	+	+	
170.	Sylvia nisoria	+	+	+	
171.	Phylloscopus lorenzii #	+	+	+	+
172.	Phylloscopus nitidus	+	+	+	+
173.	Phylloscopus trochiloides	+	+	+	+
174.	Phylloscopus trochilus	+	+	+	
175.	Regulus ingicapillus	+	+	+	+
176.	Regulus regulus	+	+	+	+
177.	Ficedula albicollis	+	+		
178.	Ficedula parva	+	+		
179.	Ficedula semitorquata	+	+	+	
180.	Muscicapa striata	+	+	+	+
181.	Aegithalos caudatus	+	+	+	+
182.	Parus ater	+	+	+	+
183.	Parus caeruleus	+	+	+	
184.	Parus major	+	+	+	+
185.	Sitta europea	+	+	+	+
186.	Sitta krueperi	+	+	+	+
187.	Certhia brachydactila	+	+	+	
188.	Certhia familiaris	+	+	+	+
189.	Oriolus oriolus	+	+		
190.	Lanius collurio	+	+	+	+
191.	Lanius minor	+	+		+
192.	Garrulus glandarius	+	+	+	+
193.	Nucifraga cariocatactes		+		
194.	Corvus frugilegus	+	+	+	+
195.	Corvus cornix	+	+	+	+
196.	Corvus corax	+	+	+	+
197.	Sturnus vulgaris	+	+	+	+
198.	Passer domesticus	+	+		
199.	Fringilla coelebs	+	+	+	+
200.	Serinus pusillus			+	+

201.	Carduelis cannabina	+	+	+	+
202.	Carduelis carduelis	+	+	+	+
203.	Carduelis chloris	+	+	+	+
204.	Carduelis spinus		+	+	+
205.	Loxia curvirostra		+	+	+
206.	Carpodacus erythrinus		+		+
207.	Pyrrhula pyrrhula		+	+	+
208.	Coccothraustes coccothraustes	+	+	+	
209.	Emberiza cia		+	+	+
210.	Miliaria calandra	+	+	+	
		Reptiles			
211.	Anguis colchica		+		
212.	Anguis fragilis				+
213.	Lacerta strigata		+		
214.	Lacerta media		+		
215.	Darevskia derjugini #				+
216.	Darevskia parvula #	+	+	+	+
217.	Darevskia rudis #	+	+	+	+
218.	Darevskia valentine #			+	
219.	Darevskia armeniaca #			+	
220.	Natrix natrix	+	+	+	
221.	Coronella austriaca	+			
222.	Coluber najadum	+		+	
223.	Elaphe longissima			+	+
224.	Vipera transcaucasiana	+			
		Amphibians			
225.	Mertensiella caucasica *#	+	+		
226.	Bufo viridis	+	+	+	+
227.	Bufo verrucosissimus #	+	+		+
228.	Rana ridibunda	+	+		
229.	Rana macrocnemis			+	+

D.2.7. Sensitive Areas and Risk Factors

Forested sections that directly border areas next to flooding or the dam sections, or are directly flooded, can be assumed as sensitive areas within the designed Adjaristsqali Hydropower Cascade construction zone. The cascade and dam inlet and outlet construction areas are sensitive as well, as their construction is associated with deforestation. Sections: № 2, 5, 9, 10-11, 12 are characterised by high sensitivities, previously mentioned. In these sections, flooding is not likely to exceed 5-10m in height; so, damage to the fauna should not be considerable. However, small sized reservoirs may attract birds and otters leaving in the water close vicinities.

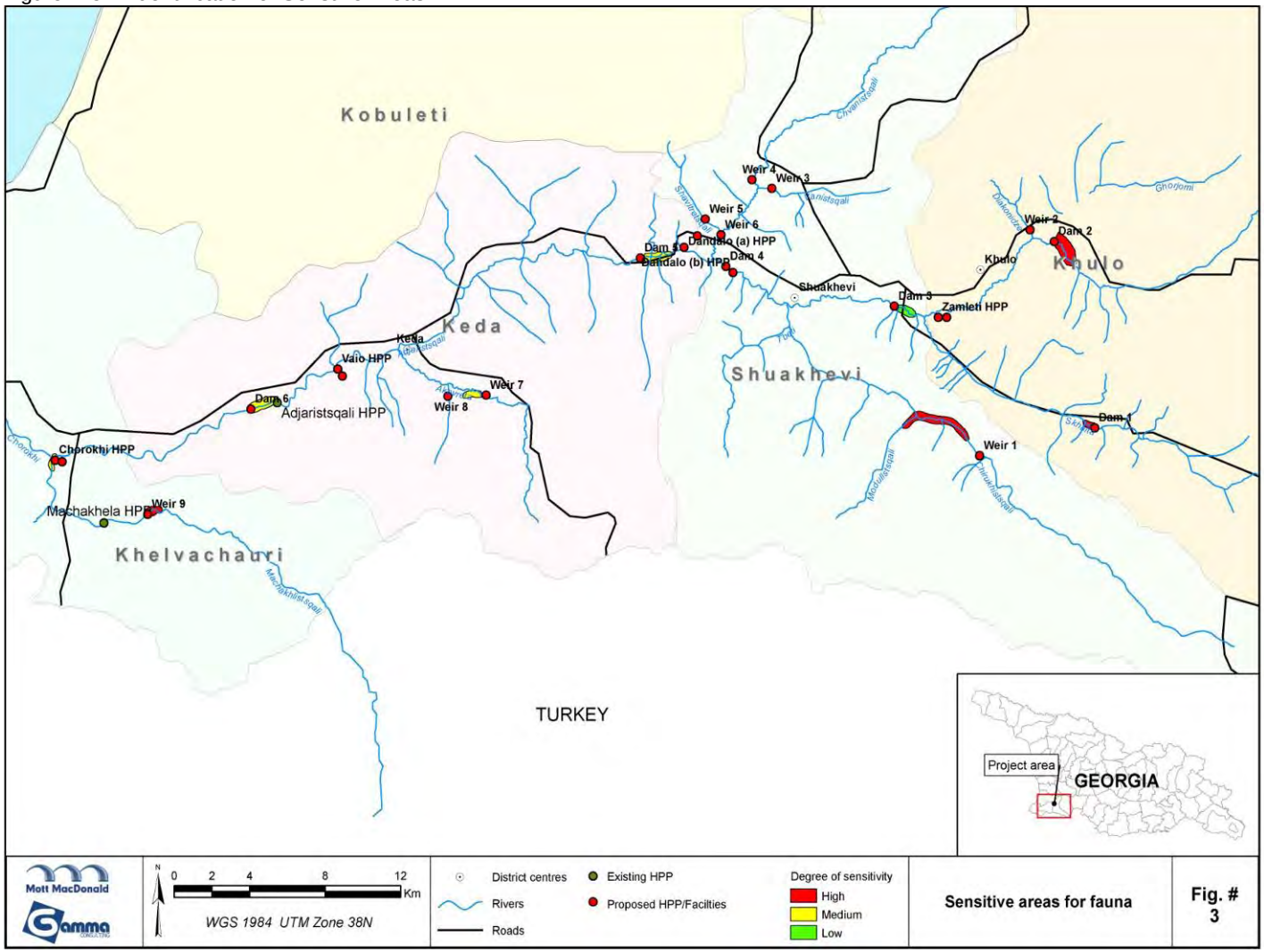
In tailrace of the dam, where water flow currently amounts to 10%, riverbed fauna complexes will be significantly changed, especially animals' quantity, which will fall due to low amount of water. In lower parts, the forest structure will be changed - it will become thinner and forestless zones will increase. Due to these changes, the number of the species which are characteristic for open landscapes will increase, changing the fauna present within the Adjaristsqali River and valley considerably. For example, a few species that inhabit areas adjacent to the water will completely disappear, as the small isles that they inhabited will become easily accessible to predators.

As a result of flooding, birds' and mammals' coverts will be destroyed on the following sections: № 2, 12 and partially № 3 (right side), as well as faunistic complexes on the whole flooded area. Forest and water adjacent complexes completely differ from forest complexes with its variety types. Hence implementation of mitigation measures will be necessary to eliminate catastrophic changes. Unfortunately no mitigation

measures can be implemented in shallow water sections in order to control fauna condition except annual monitoring, and in case of strong violation, emergency measures must be taken. Monitoring must be carried out for all sensitive areas in order to control biodiversity conditions.

As a result of flooding, birds' and mammals' coverts will be destroyed in the sections № 2, 12 and partially № 3 (right side), as well as faunistic complexes in the whole flooded area. The forest and water adjacent complexes completely differ from the forest complexes themselves, through their variety of species. Hence, implementation of mitigation measures will be necessary to eliminate such catastrophic changes. Unfortunately, no mitigation measures, except annual monitoring, can be implemented in the future shallow water sections, in order to control the fauna condition and in case of strong violations take emergency measures. Monitoring must be carried out in all sensitive areas to control the biodiversity state. Sensitive areas identified within the Project area can be found in Figure D5.

Figure D.5: Identification of Senstive Areas



Source: Gamma

Fauna research team:

a. Alexander Bukhnikashvili – head of the zoologists team, expert of mammals;
b. Gia Edisherashvili - ornithologist;
c. David Bekoshvili – herpetologist.

D.3. Fish Survey Report (Gamma, 2011)

D.3.1. Introduction

According to the signed agreement and TOR the main objectives of the field survey were:

- Identification of available species;
- Determination of their status – mainstream, rare or protected;
- Identification of potential significant sensitive habitats (e.g. spawning and nursery sites) - the main rivers and tributaries, if any;
- Identification of the presence of ecologically important fish habitats within the footprint of the dams and weirs; and
- Assessment of potential impact of the scheme on fish within the main rivers and tributaries

The survey can be divided into two stages:

Desktop Review	information gathering, collation and analysis of the baseline data, familiarisation with the project scheme; planning the survey; mobilisation
Field survey	Ground proofing of information available by the end of the stage 1. This includes: walkover and survey of the sites; interviews with local fishermen; identification of key sensitive sections; identification of the needs of subsequent studies based on information obtained by the end of the stage 2.

D.3.2. Legislative and Policy Context

The main environmental legislation and policies relevant to the development include: International policies and legislation include:

- EU Water Framework Directive
- EU Fisheries Directive
- EU Common Fisheries Policy
- Convention on the Protection of the Black Sea against Pollution, signed in Bucharest in 1992
- Convention on Biodiversity (CBD) (1994)
- Bucharest Convention on Protection of the Black Sea against Pollution (1994)
- Fishing Vessels on the High Seas (Compliance Agreement) (1994)
- United Nations Convention on the Law of the Sea (UNCLOS) (1996)
- Ramsar Convention on Wetlands (1996)
- Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) (1996)
- Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) (2000)
- Convention on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS) (2001).

In addition, Georgia has ratified one international fisheries agreement that implements several provisions of UNCLOS, i.e. the Compliance Agreement which is approved by the FAO Conference in 1993 and entered into force in 2003 aim to respond about depletion of fish stocks in the high seas as a result of increasing Illegal, Unreported and Unregulated (IUU) fishing addressing the problems of "reflagging" and "flag of convenience" practices caused by vessels. In the same context, Georgia has not ratified the Agreement for the Implementation of the Provisions (UNCLOS) relating to the Conservation and

Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (UN Fish Stocks Agreement) (UN - Division for Ocean Affairs and Law of the Sea, 2008).

As a member of the Food and Agriculture Organization of the United Nations (FAO), has agreed to the Code of Conduct for Responsible Fisheries. Georgia has aimed to be a member of relevant regional and international fisheries bodies such as General Fisheries Commission for the Mediterranean (GFCM), the European Inland Fisheries Advisory Committee (EIFAC), Network of Aquaculture Centers in Central and Eastern Europe (NACEE) and the Black

Sea Fisheries Commission, to be established under the Convention for Fisheries and Conservation of Living Resources of the Black Sea (The Commission on the Protection of the Black Sea Against Pollution, 2008).

At present Georgia has no fisheries law. Recently, however, it has pursued various legal and administrative initiatives that have resulted in the adoption of a number of laws and regulations that address the fishery sector in various aspects including:

- The Georgian Constitution (1995, as amended)
- The Veterinary Law (1995, as amended)
- The Law on Protected Areas (1996)
- The Law on the Protection of the Environment (1996)
- The Law on Promoting and Ensuring Investment Activity (1996)
- The Law on Environmental Permit (1996)
- The Law on Wildlife (1996)
- The Law on Water (1997)
- The Marine Code (1997)
- The Law on the Privatization of State Property (1997)
- The Law on Maritime Areas (1998)
- The Law on Standardization (1999)
- The Law on General Procedures for Granting Business Licenses and Permits (2002, as amended in 2004)
- The Sanitary Code (2003, as amended).

At the very beginning of the twenty-first century the MoA started to prepare a new law on fisheries for Georgia. Governmental approval of this law was expected to take place in coming years, after which a number of regulations under the law will still need to be produced. In case of fishery statistics, there are several collection programs for fishery data.

D.3.3. Survey Methodology

D.3.3.1. Desktop Review - Information gathering, collation and analysis of the baseline data, familiarisation with the project scheme; planning the survey; mobilisation

Date: 1 July - 20 August, 2011

Task: Desk top studies. Collation of available data (scientific and reference materials, reports, etc.).

Construction and operation activities relating to the proposed development can have impacts on ecological features beyond the confines of the project footprint. Following XXXIEEM guidance, fish and associated

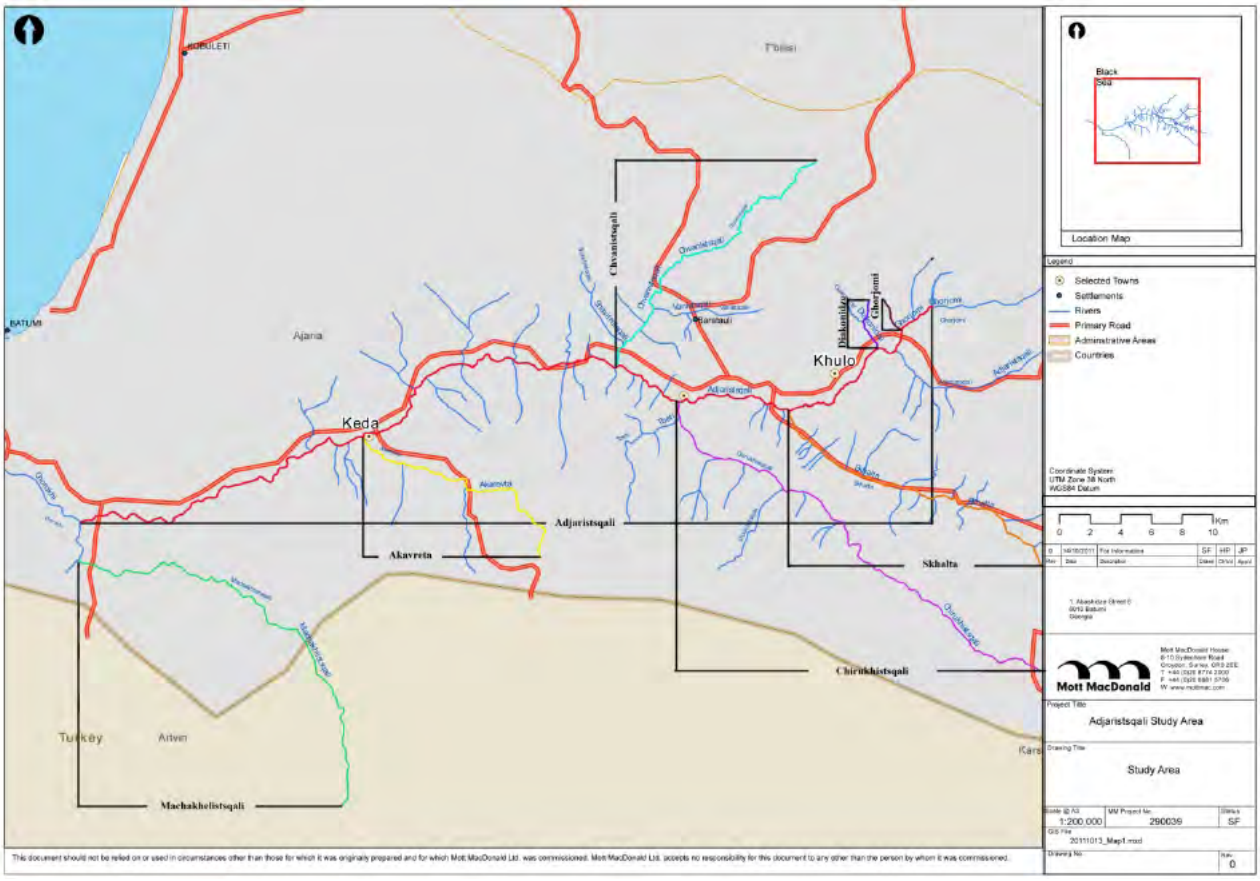
habitats and species occurring within the ZoI were investigated. The potential zone of influence for the proposed development was defined as follows:

- Areas directly within the footprint for the proposed development and access;
- Areas where there is a risk of habitat disturbance, alteration in water quality and flow regime as well as noise and vibration during construction and/or operation.

For this assessment, the following AoI was considered appropriate:

The Adjaristsqali River from its confluence with the Choroki to its confluence with the Ghorjomi River, in addition the following tributaries are effected by the scheme, the Machakhlistsqali River, Akraveta River, Chirukhistsqali River, Chvanistsqali River, Skhalta River, and Diakonidze River.

Figure D.6: Project Area of Influence



Source: Mott MacDonald

A desk based study was undertaken to gather information on the ecological requirements of various fish species present in Georgia. The following databases and online resources were researched:

- Fishbase Web Site
- The IUCN database
- "Red Book" and "Red List" of Georgia http://red_list.ge/, http://moe.gov.ge/index.php?sec_id=47&lang_id=ENG

- Checklist of fishes of Georgia
  http://www.main.ge/zoology/files/publications/checklists/Checklist%20of%20fishes%20of%20Georgia.pdf

In addition, key reports reviewed related to this scheme included:

1. saqarTvelos cxovelTa samyaro; 4 tomi, rbiltanianebi(mtknari wylisa da xmeleTis moluskebi), damdgari wyalsatevebis datotvilulvaSiani da niCabfexiani kibosnairebi, Tevzebi; gamomcemloba mecniereba, 1973

2. elaniZe r.,md. Woroxis qvemo dinebis Tevzebi, saqarTvelos Sida wyalsatevebis hidrobiologia da iqTiologia, nakveTi 1, 1964 w.

3. mesxiZe j., md.aWariswylis da misi DSenakadebis iqTiofaunis SeswavlisaTvis, rusTavelis saxelobis baTumis ped.institutis Sromebi, t.9,1962w.

4. demetraSvili m. saqarTvelos mtknari wylebis sarewao Tevzebi. saq. ssr.mecn. akademiis gamomcemloba. Tbilisi. 1963 w.

5. SarvaSidze v. saqarTvelos Tevzebi (sarkvevi). Gamomcemloba “ganaTleba”. Tbilisi. 1982 w.

6. გორაძე რ. (დისერტაცია) Savi zRvis oraguli **Salmo trutta labrax Pallas** statusi, bioekologia, konservaciisa da menejmentis strategia ბათუმი, 2009

7. Гогмачидзе Т.М., Джанашвили А.Г., Месхидзе Ж.Х. и др. – Фауна Аджарии (позвоночные). Изд. «Сабчота Аджара», Батуми, 1979

8. Гогмачидзе Т.М. К изучению гидрофауны реки Чорохи и её притоков. Тез. 1 Республиканской научной конференции биологов, ГССР, Кутаиси, 1979, с. 59 – 61

9. Бурчуладзе О.Г., Горадзе Р.Ч., Цинцадзе З.А. 1974. Материалы по характеристике лососевых в бассейне рек Аджарской АССР. Тр.Груз.отд. ВНИРО, Батуми, т.16. с.45 55.

10. Веселов Е.А. 1977. Определитель пресноводных рыб фауны СССР. М. ,,Просвещение”. 138 с.

11. Месхидзе Д.Х., Бурчуладзе О.Г. 1982. Рыбы черноморского побережья Грузии. Изд. ,,Сабчота Аджара”. Батуми, 114.с.

12. Эланидзе Р.Ф. 1983. Ихтиофауна рек и озер Грузии семейство Salmonidae лососевие. Институт зоологии АН ГССР. Тбилиси: Мецниереба.320 с.(с.38 55).

13. Эланидзе Р.Ф., Деметрашвили М.Г., Бурчуладзе О.Г., Курашвили Б.Е. 1970. Рыбы пресных вод Грузии (атлас). «Мецниереба».. Тбилиси. 114 с.

D.3.4. Field Survey - Field Work, Ground proofing for Information available from Desk Study

Date: 25 August – 3 September 2011

Task: This include: walkover and survey of the sites within the AoI; interviews with local fishermen; identification of key sensitive sections; identification of the needs of subsequent studies based on information obtained by the end of the stage 2.

D.3.4.1. Walk Over

Using the River Adjaristsqali energetic potential usage scheme plan, the main rivers and tributaries were divided into separate sampling reaches, with each reach encompassing one dam or one weir. A walkover survey was then undertaken to identify suitable survey sites that encompass a range of different habitats available for fish as well as the identification of sensitive sections, these included:

- Shallow stony water riffles for fish that need flowing water
- Fast flowing rapids for fish needing oxygen rich water
- Marginal vegetation with overhang that acts as a cover for smaller species
- Deeper flowing channels for potentially some larger fish
- Deeper slack water pool margins for other fish
- Identification of key sensitive sections (i.e. spawning sites).

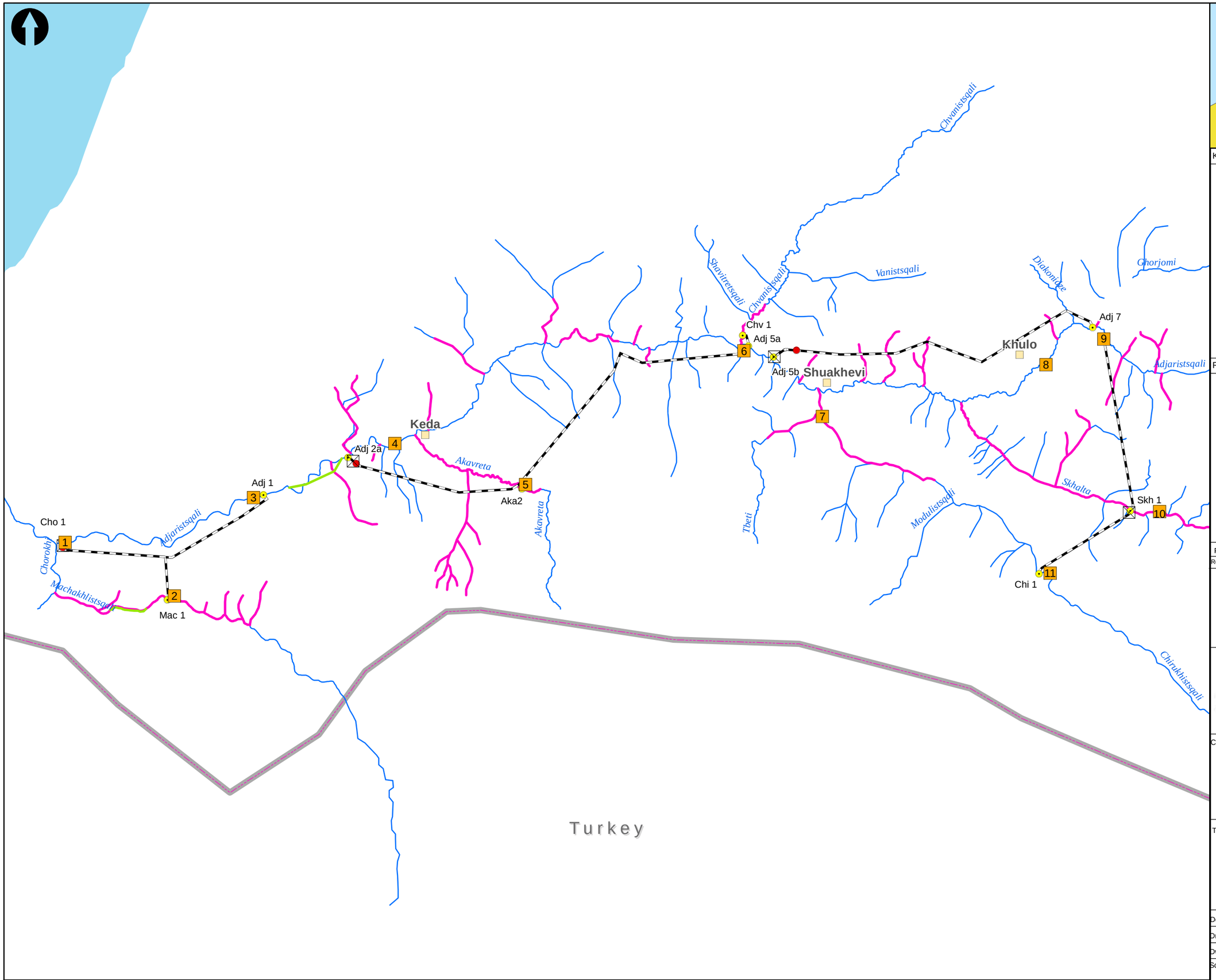
D.3.4.2. Fish Surveys

Fish Surveys

A total of 11 sites were selected with a range of different morphological conditions so as to detect as many fish species as possible. Figure D7 shows the location of the fish and zoo-benthos sampling points.

Ichthyology and zoo benthos samples (prey for fish) were taken using established techniques (Spork *et al*., 2006), these included gill nets, landing nets, throwing nets, fishing rods and dragnets for fingerlings. Fish were sorted according to species and counted. The relative numbers were expressed as the number of fish caught per one meter of net, in case of the dragnets used for fingerlings – per 1 m^3, in case of use of throwing nets – per each 1 m^2 of the river bottom. Various keys were used to identify the fish species.

Zoo-benthos samples were obtained using established techniques with approximately two to three samples collected within each river section and within a 0.25 m^2 area. Organisms were sorted into taxonomic groups, subsequently counted and weighed.



Key to symbols

- Field survey points
- Power House
- Surge Shaft
- Nodes
- Selected Towns
- Fish spawning areas
- Rivers
- Existing Tunnel
- Proposed Tunnels
- Country Boundary

Reference drawings

0 2 4 6 8 km

Coordinate System:
UTM Zone 38 North
WGS84 Datum

Rev	Date	Description	Drawn	Ch'k'd	App'd
P1	14/03/2012	For Information	LC	RM	JP

Mott MacDonald
Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

GEG GROSS ENERGY GROUP Engineering & Consulting

DOLSAR Engineering Ltd

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi
Georgia

Title

Adjaristsqali Hydropower Cascade
ESIA Report
Fish Spawning Areas

Designed				Eng Check	
Drawn	LC			Coordination	
Dwg check	RM			Approved	JP

Scale @ A3	Status	Rev
1:180,000	INF	P1

Drawing Number
MMD-290039-MNC-GEN-01-101

Interviews with Fishermen

Local fishermen were interviewed to obtain further information on the fish present (e.g. general species including any rare, protected and/or migratory species), preferred areas, as well as identification of any known sensitive areas (e.g. spawning sites). These interviews would also provide information on how socio-economically important fishing is to the local community. Fishers were provided with a map showing the location of the proposed development and were asked to clearly mark on the preferred areas for certain species (including upper and lower territorial limits) and sensitive areas.

Local fishermen were then interviewed using a questionnaire. Each fisherman was interviewed separately with to avoid "too much imagination". The information obtained was believed to be reliable, if it was confirmed by more than three fishermen. The field survey time coincided with the fishing ban period (May-August), nevertheless 20 fishermen were interviewed.

The questionnaire used is provided in Appendix D4.

D.3.5. Aquatic Baseline

D.3.5.1. Physical Environment

The Adjaristsqali River originates from the western slope of the northern part of Arsiani Range at 2,435 m height. It joins the Chorokhi River from the right; 1 km downstream is Khertvisi village.

The length of the river is 90 km, head 2,397 m, average inclination – 26.6%, catchment area 1,540 km^2, average elevation 1,400 m. The river basin includes 988 rivers with total length 2,165 km. The main tributaries are: Satsikhuri (length 14 km), Skhalta (length 29 km), Chirukhistskali (length 32 km), Chvanistskali (length 21 km), and Akaverta (length 19 km).

The river basin has an asymmetric shape and is located on the western part of South Georgian Plateau within Adjara region. The basin is confined by Chakvi, Adjara-Imereti, Arsiani and Shavsheti watersheds. Average width of the basin is 25 km, maximal – 50 km. The landform in the boundaries of the river basin is mountainous, strongly divided. In the upper reaches, up to the Akavreta River, deep sharply split gorges are found. Beds of the tributaries are narrow and sharp, sometimes with precipitous banks.

D.3.6. Ichthyofauna of the Adjara Region

D.3.6.1. General Distribution of Ichthyofauna

In the Adjara region, the ichthyofauna diversity is determined by the physical/geographical and climatic conditions of the area. In the Adjara region, 47 species and 17 families have been recorded which includes freshwater and anadromous fish species. The ichthyofauna community is considered to be diverse but with a low abundance.

None of the species is abundant enough to be important for commercial fishing, however, amateur, subsistence fishing is rather popular.

Within the Area of Influence, 18 species belonging to five families which include the salmonids Salmonidae, gobies Gobiidae, freshwater eels Anguillidae loaches Cobitidae carps Cyprinidae are present. Protected species potentially present within the ZoI include the black sea salmon S*almo labrax*, sea trout/brown trout *Salmo trutta* and Colchic khramulya *Capoeta sieboldii* and the European eel *Anguilla Anguilla.*

Black Sea Salmon - Salmo labrax (Pallas,1814)

Source: Gamma

Colchic Khramulya - Capoeta sieboldii (Steindachner, 1864)

Source: Gamma

Anguilla anguilla (Linnaeus, 1758) - European Eel

Source: Gamma

Appendix D3 shows the full species list for those fish present in the Adjara region and those within the ZoI.

Further information on the location of these fish species in the Adjaristsqali River and its tributaries and whether they are rheophillic (current loving) or liphophillic (slow flowing or stagnant waters containing submerged vegetation) or whether they are simply passing through the area is also provided in Table D.10.

Table D.9: Location of Fish Species and Environmental Groups in the Adjaristsqali River and Tributaries

Taxonomic Group	Environmental Group	1. Adjaristsqali and Chorokhi confluence	2. Machakhlistsqali	3. Adjaristsqali Makhuntseti	4. Adjaristsqali Tega bridge	5. Akavreta	6. Chvanistsqali and Adjaristsqali confluence	7. Chirukhistsqali	8. Adjaristsqali (near Khulo)	9. Ghorjomistskali and Adjaristsqali confluence	10. Skhalta	11. Chirukhistsqali (2)	Information source
*Salmo trutta / Sea Trout, Brown trout	F.R.	-	+	-	-	+	+	-	In tributaries	-	In tributaries	+	ch
Salmo labrax Black sea salmon	Pas.	-	+	-	-	-	-	-	-	-	-	-	i
Ponticola constructor Caucasian Goby	F.R.	+	-	+	-	-	+	+	-	-	-	+	i
*Anguilla anguilla European Eel	Pas.	+	-	-	-	-	-	-	-	-	-	-	i
Squalius cephalus orientalis Caucasian Chub	F.R.	+	-	+	-	-	+	+	-	-	-	+	ch
Gobio gobio lepidolaemus n. caucasicus Gudgeon	F.R.	+	+	+	+	+	+	+	+	+	+	+	ch
Luciobarbus escherichii Colchic Barbel	F.R.	+	+	+	+	+	+	+	+	+	+	+	ch
Capoeta sieboldii *Colchic Khramulya	F.R.	+	+	+	-	-	-	+	-	-	-	+	i
Capoeta tinca Anatolian Khramulya	F.R.	+	+	+	-	-	+	-	+	-	+	+	ch
Alburnus derjugini Colchic Bleak	F.L.	+	-	-	-	-	-	-	-	-	-	-	i
Alburnoides	F.L.	+	+	+	+	+	+	+	+	+	+	+	ch

Taxonomic Group	Environmental Group	1. Adjaristsqali and Chorokhi confluence	2. Machakhlistsqali	3. Adjaristsqali Makhuntseti	4. Adjaristsqali Tega bridge	5. Akavreta	6. Chvanistsqali and Adjaristsqali confluence	7. Chirukhistsqali	8. Adjaristsqali (near Khulo)	9. Ghorjomistskali and Adjaristsqali confluence	10. Skhalta	11. Chirukhistsqali (2)	Information source
fasciatus Rock minnow													
Phoxinus colchicus Colchic Minnow	F.L.	+	-	-	+	+	-	+	-	+	+	+	ch
Rhodeus colchicus Colchic Bitterling	F.L.	+	+	+	+	-	+	-	-	+	-	+	ch
Rutilus rutilus Roach	F.L.	+	+	+	+	+	+	+	+	+	+	+	ch
Chondrostoma colchicum Colchic Nase	F.L.	+	+	+	-	-	+	+	-	-	-	+	ch
Cobitis satunini Satunini Loach	F.L.	+	_	_	_	_	-	+	-	-	-	_	i
Nemacheilus angorae Angora loach	F.L.	+	+	+	+	+	+	+	+	+	+	+	i

Source: GAMMA

The density of fish inhabiting the surveyed rivers was shown to vary dramatically and was dependent on water flow, with rheophillic species favouring areas of high flow. Fish surveys recorded gudgeon, colchic barbel, minnows and the Angora roach at all of the survey sites. In relation to the location of the protected fish species, surveys indicated the following:

- The Black Sea Salmon *Salmo labrax* used to migrate or, as mentioned by some interviewees – permanently live in the Machakhlistsqali River;
- Sea/brown trout are present in the tributaries of the Skhalta and Khikhanistskali, Chvanistsqali and Adjaristsqali confluence, Machakhlistsqali, Akavreta and Chirukhistsqali (2)
- Colchic Khramulya are present in the Chirukhistsqali, Adjaristsqali Makhuntseti, Adjaristsqali and Chorokhi confluence, Machakhlistsqali and Chirukhistsqali (2) sites.
- European eel at the Adjaristsqali and Chorokhi confluence.

Interviews with fishermen revealed, their catch tends to be dominated by Colchic barbel and chub throughout the catchment and in areas of low flow minnows and Khramulya, dominated the catch. At an elevation of 800 m to 1,500 m, in the mountainous areas and the upper reaches of the tributaries, the brown/sea trout is present. Whereas Colchic barbel and other species are not observed above 1,000 m,

the remaining species belonging to the Cyprinidae family tended to be located at 700-800 m above sea level.

D.3.6.2. Sensitive Areas

During the field surveys fry schools were detected in the tributaries of the Adjaristsqali. Fry species detected included roach, European bitterling *Rhodeus amarus*, rock minnow, Caucasian chub and colchic minnow. In autumn these species move into the Adjaristsqali River. The presence of these species indicates a favourable habitat for fry to thrive. However, according to the interviews, quantitatively the fish stock over the last period of time has decreased. The interviewees link this fact with regulation of the flow, in particular in the Chorokhi. Up stream spawning migration into the Adjaristsqali River and then into its tributaries occurs when and by which species and then there is migration downstream during continuous rainfall into the Adjaristsqali River or the Chorkhi River.

The time of spawning and migration (upstream and downstream) varies among the various species and is presented in Figure D7.

D.3.6.3. Fish Prey

Most of the surveyed rivers have biotopes which is suitable for aquatic life. In most of the rivers there are lots of suitable areas for different fish species to undergo offspring fattening. Although, as the local fishers noted, motherfish shoals of the main game-fish species migrate to the upper part of Adjaristsqali or its main tributaries (Skhalta, Chirukhistskali, Chvanistskali, Akavreta).

For most species, inhabiting the studied rivers, the fattening period begins presumably in April, when water temperature reaches steady +7 - +9 ° C. Reophilic fish species feeding intensity in the vegetative period is high, which is indicated by their intestine filling average index. The highest levels of intestine filling were characteristic for the Colchic Barbel, Caucasian Anchovy, Khramulya, Minnow and Roach Intestine filling levels of Chvanistskali and Khikhanistskali tributaries (Zortikhevi stream, Saskikhevi and Guldida streams) inhabiting trout were also quite high.

Overall, feed composition of the fish species described in the surveyed rivers contained 43 groups of feed subjects which included animal, vegetable, periphyton and detritus. The vegetative components were represented by diatoms and green algae and plants seeds. Animal feed was diverse and included infusorians, various groups of worms, jointed legged animals, as well as adult fish and whitebait.

For the fish inhabiting the surveyed rivers, it is apparent that they not only use autochthonic components of the river ecosystem - hydrobionts – as food, but also consume terrestrial invertebrates found in water. Representatives of 17 such alloctonic groups were found in the studied fish feed groups, such as ants, lepidopterous insects, spiders and others. Feed composition of various fish species contained seven to thirty-two feed subject groups. The diet of trout and barbel was found to be the most diverse.

D.3.6.4. Fisheries

There is an insufficient quantity of fish for a commercial fishery to operate, however, an amateur fishery exists which is of recreational importance and most of the fish caught are sold on the roadside or are delivered to local restaurants. Fishing techniques include so called screens and throw fish nets. Fishing is general practice in all rivers within the AoI, however several priority sections were identified, these included:

1. The Adjaristsqali River from junction with the Chorokhi River to Adjaristsqali HPS river tributary;

2. The Adjaristsqali River from Adjaristsqali HPS to the Akavreta river tributary

3. The Adjaristsqali River from village Dandalo to the Chvanistsqali river tributary and The Cvanistskali River 3 km upstream the junction with the Adjaristsqali;

4. The Adjaristsqali river from the Chvanistsqali river tributary to the Chirukhistsqali river tributary and The Chirukhistsqali river 2.5 km upward from the junction with the Adjaristsqali river;

5. The Adjaristsqali River from junction with the Diakonidze River

6. The Adjaristsqali River near the bridge Tega

7. The Skhalta River near bridge

8. The Khikhanistskali river by village Kvatia

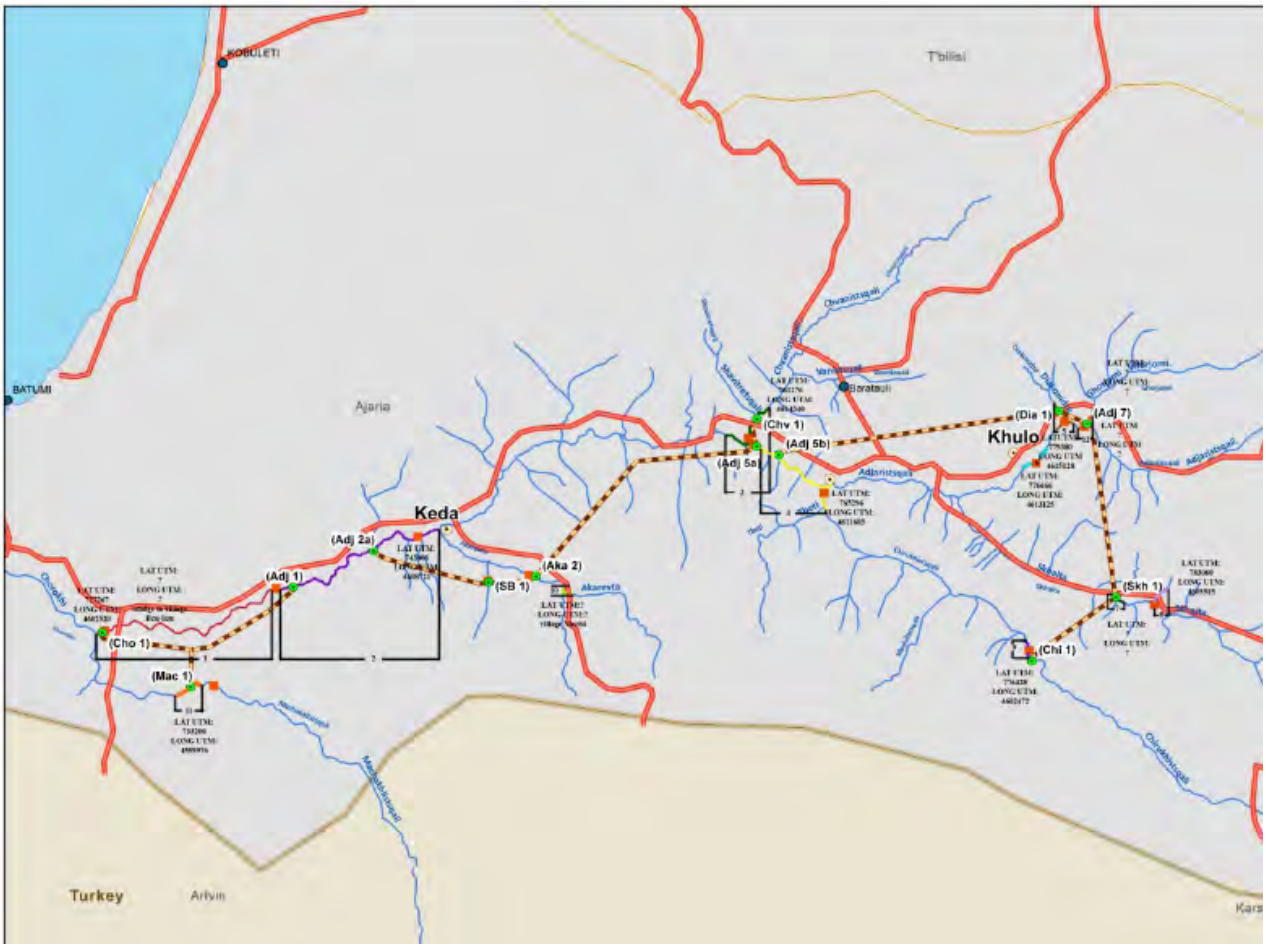
9. The Chirukhistsqali river by HPP

10. The Akavreta river by village Merisi

11. The Machakhelistskali river by village Adjaristsklis agmarti

12. The Ghorjomi river the junction with the Adjaristsqali river

Figure D.8: Priority Fishing Areas along the Adjaristsqali River



Source: Mott MacDonald

In these sections “free fishing” regime is common practice, this means that any fisherman can catch fish in that particular location. However, the situation is different for trout fishing. Trout mostly dwells in the upper reaches of the Adjaristsqali tributaries or in small rivers (secondary tributaries) that join the latter. The village communities along these streams strictly protect the trout resources in “their territories” and do not welcome “strangers”. Selling of trout was not detected; it is used within the community.

The fishermen revealed that they catch 3.7 kg of fish per day which mostly consist of Black sea chub, Caucasian chub, Anatolian khramulya, Colchic barbel, Colchic nase, Colchic bleak, Roach, Royal fish, also Brown trout, Black Sea Salmon and eel. The average price of fish is 7 GEL per 1 kg.

During the Interviews many of the fishermen confirmed presence of such protected and migratory species, as European Eel and Black Sea Salmon in Adjaristsqali River and its tributaries, as well as in Machakhlistsqali River. Also the presence of protected fish species - Brown Trout and Colchic Khramulya was confirmed.

The fishermen noted that throughout its flow Adjaristsqali River is important for providing different fish species with feed and other resources. Furthermore, it was noted that during the spawning period the fish

enter upper sections of Adjaristsqali River, as well as Adjaristsqali tributaries, which confirms importance of Adjaristsqali main tributaries for fish spawning.

The local communities are concerned about the future of the fish resources with consideration of potential impact of the planned development on the fish stocks/availability. Fishing is a part of the local culture, subsistence fishing - important for the local economy.

The field surveys also revealed that a number of fish (trout) farms were operating within the ZoI. For example, in the Keda municipality in particular, more than 50 small, medium and large fish farms are rearing rainbow trout (Oncorhynchus mykiss (Walbaum 1792)). The owners and the staff expressed their concern about the future of this business - both water availability and its physical and chemical characteristics were considered as a crucial issue.

Table D.10: List of Existing Trout Farms

№	Name of Farm	Address	GIS Points (Coordinates)
		Keda District	
1	i.e.Otar Nakashidze	Akho vil.	0255075 4616219
2	i.e. Otar Bolcvadze	Akho vil.	0255182 4616335
3	i.e. Malkhaz Beridze	Akho vil.	0255184 4616382
4	i.e.Nuri Beridze	Akho vil.	0255114 4616257
5	i.e.Ramaz Baladze	Akho vil.	0254942 4611688
6	i.e. Murman Beridze	Akho vil.	0255017 4616018
7	i.e. Amiran Bolkvadze	Gobroneti vil.	0754315 4614921
8	i.e. Merab Jabnidze	Zvare vil.	0748331 4612681
9	i.e.Koba Jabnidze	Zvare vil.	0747870 4612487
10	i.e.Ilia Jabnidze	Zvare vil.	0747867 4612523
11	i.e. Tariel Kobuladze	Zvare vil.	0747602 4612647
12	i.e. Raul Jabnidze	Zvare vil.	0747713 4611255
13	i.e. Merab Kobuladze	Zvare vil.	0747596 4612631
14	i.e. Shalva Kobuladze	Zvare vil.	0747525 4612640
15	i.e. Shukri Jabnidze	Zvare vil.	0747669 4612639
16	i.e. Murman Kobuladze	Zvare vil.	0746963

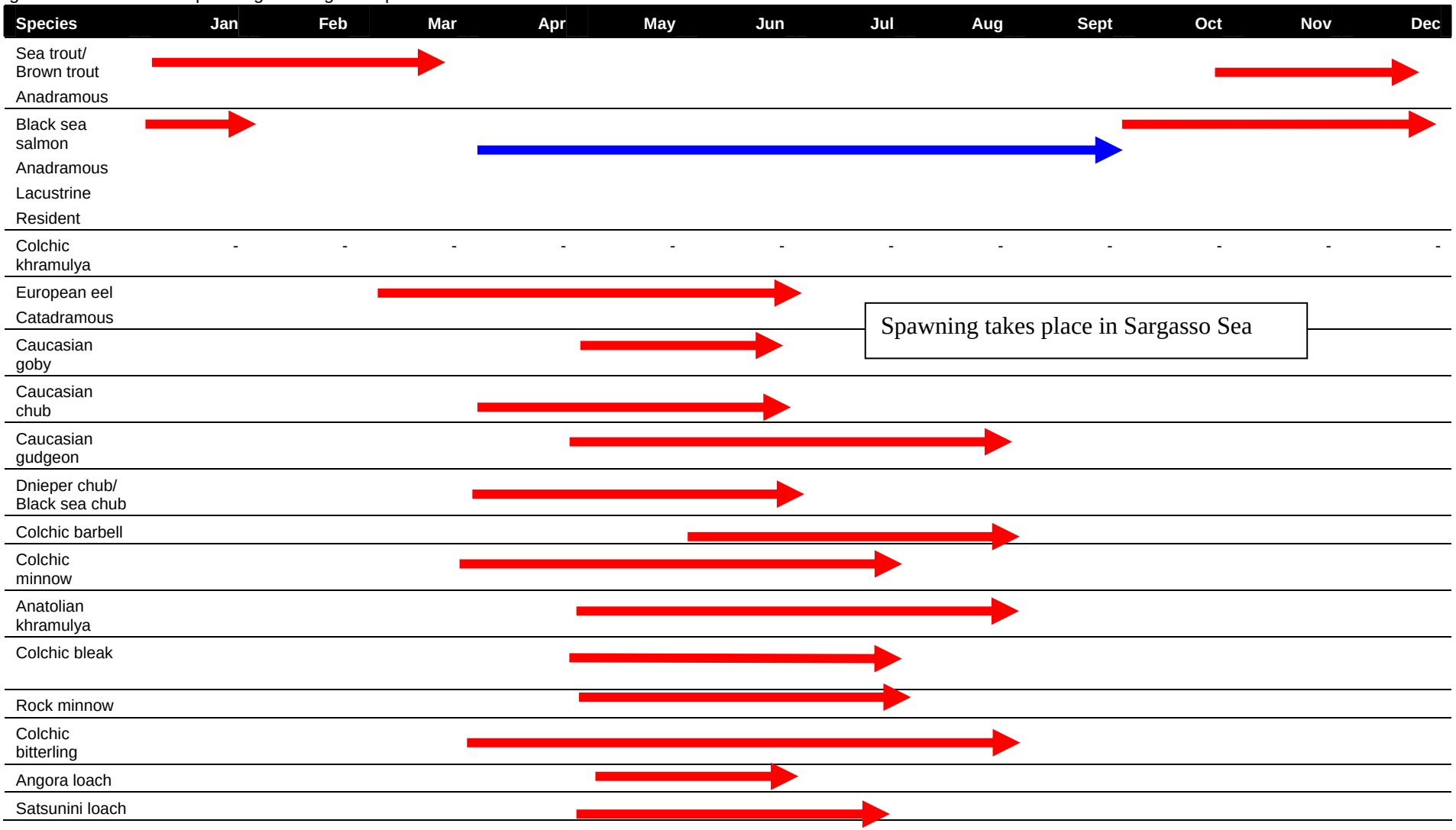
№	Name of Farm	Address	GIS Points (Coordinates)
			4613074
17	i.e. Gala Gogitidze	Zvare vil.	0746913 4613049
18	i.e. Badri Gogitidze	Zvare vil.	074771 4612664
19	i.e. Mirian Gogitidze	Zvare vil.	0746726 4613340
20	i.e.Ilia Gogitidze	Zvare vil.	0746851 4613096
21	i.e. Remzi Kobuladze	Zvare vil.	0748540 4613511
22	i.e.Mirali Beridze	Zvare vil.	0746936 4613055
23	‘Sakalchala” Ltd.	Pirveli Maisi vil.	0741237 4608172
24	i.e.Jumber Devadze	Agara vil.	0741395 4609767
25	i.e. Malkhaz Devadze	Agara vil.	0741394 4609701`
26	i.e. Tengiz Tebidze	Agara vil.	0740799 4612596
27	i.e. Bichiko Devadze	Agara vil.	0741352 4610078
28.	i.e.Merab Devadze	Agara vil.	0741241 4610428
29.	i.e.Nadim Devadze	Agara vil.	0741724 4609271
30.	i.e. Giorgi Dumbadze	Kolotauri vil.	0740637 4607027
31.	i.e.Zaur Makharadze	Kolotauri vil.	0741459 4605638
32.	i.e. Indira Surmanidze	Dzencmani vil.	0743676 4607889
33.	i.e. Raul NakaShidze	Dzencmani vil.	0743652 4607940
34.	i.e. Nazim Chkheidze	Dzencmani vil.	0743265 4607882
35.	i.e. Shita Surmanidze	Dzencmani vil.	0743837 4608635
36.	“ Akavreta 2007” Ltd.	Oktomberi vil.	0746509 4607883
37.	i.e. Merab Gorgadze	Oktomberi vil.	0746663 4606594
38.	i.e.Merab Dumbadze	Medzibna vil.	0747512 4606113

№	Name of Farm	Address	GIS Points (Coordinates)
39.	i.e. Gela Koncelidze	Kvashta vil.	0748343 4612925
40.	i.e. Geno Gatenadze	Kvashta vil.	0748519 4612962
41.	i.e. Nodar Gatenadze	Kvashta vil.	0748610 4612964
42.	i.e. Djumber Gatenadze	Kvashta vil.	0748638 4612919
43.	i.e.Djumber Makhachadze	Kvashta vil.	0747983 4612189
44.	i.e. Levan Sirabidze	Kvashta vil.	0749601 4612363
45.	i.e. Nugzar Bolkvadze	Coniarisi vil.	025130 4614651
46.	i.e. Mamuka Papunidze	Coniarisi vil.	0251812 4616094
47.	i.e. Malkhaz Beridze	Coniarisi vil.	0251339 4615054
48.	i.e. Minuchar Beridze	Coniarisi vil.	0251230 4614455
49.	i.e. Zaza Bolkvadze	Coniarisi vil.	0251326 4615069
50.	i.e. Tamaz Beridze	Coniarisi vil.	0251085 4615292
51.	i.e. David Bolkvadze	Coniarisi vil.	0251161 4615188
52.	i.e. Gocha Papunidze	Coniarisi vil.	0251775 4616197
53.	i.e. Zura Makaradze	Coniarisi vil.	0251603 4610506
54.	i.e. Jemal Baramidze	Coniarisi vil.	0251433 4616670
55.	i.e. Ciala Gogitidze	Coniarisi vil.	0749548 4618010
56.	i.e. Avto Bolkvadze	Coniarisi vil	0749476 4618184
		Shuakhevi District	
1	i.e. Jemal Khujadze	Uchamba vil.	0260796 4608711
2	i.e. Mamuka Beridze	Uchamba vil.	0261910 4608162
3	i.e. Varshanidze	Samoleti vil.	0261869 4608206
4	i.e.Mevlud Churkvaidze	Samoleti vil.	0261900 4608553

№	Name of Farm	Address	GIS Points (Coordinates)
5	i.e. Shalva Turmanidze	Gogadzeebi vil.	0263143 4604342
6	i.e. Tamaz Tavdgiridze	Jabnidzeebi vil.	0262037 4609017
		Khulo District	
1	i.e. Nugzar Solomonidze	Diakonidzeebi vil.	0278219 4615419
2	i.e. Suliko Bolkvadze	Uchkho vil.	0276440 4617916

Source: Gamma

Figure D.9: Indicative spawning and migration periods based on available literature



Anadramous fish which spend most of their lives in the sea and migrate to fresh water to breed.

Key	
Spawning	
Downstream migration	
Upstream migration	

Source: Gamma

D.3.7. References

1. И.Ф. Правдин – Руководство по изучению рыб (преимущественно пресноводных); Изд. «Пищевая промышл.», Москва, 1966 г.

2. О.А. Котляр – Методы рыбохозяйственных исследований (Ихтиология); Рыбное; 2004 г.

3. А.Ф.Коблицкая – Определитель молоди пресноводных рыб – Изд. «Лёгк. И Пищев. Промышленность»; Москва; 1981 г.

4. Е.А. Зиновьев, С.А. Мандрица – Методы исследования пресноводных рыб – Пермь; 2003 г.

5. Н.И. Чугунова – Руководство по изучению возраста и роста рыб

6. В.Л. Брюзгин – Методы изучения роста рыб по чешуе, костям и отолитам

7. Типовые методики исследования продуктивности видов рыб в пределах их ареалов

8. .Е.Д. Васильева – Рыбы Чёрного моря: Определитель морских, солоноватоводных, эвригалинных и проходных видов с цветными иллюстрациями,

собранными С.В. Богородским – Изд. «ВНИРО», Москва, 2007 г.

9. Биологические методы исследования водоёмов в Финляндии – Под редакц.: Марья Руоппа и Пертти Хейнонен; Хельсинки 2006 г.

10. Методическое пособие по изучению питания и пищевых отношений рыб в естественных условиях

11. Определитель пресноводных беспозвоночных России и сопредельных территорий – Под общ. Редакцией С.Я. Цалолихина 6 Томов – Издательство

«Наука», Москва, 2004 г.

12. Полевой определитель планктона – Зоологический институт АН СССР; Москва, 1972 г.

13. О.Е. Тивяшова - Сбор и обработка зоопланктона в рыбоводных водоёмах (методическое пособие с определителем основных пресноводных видов);

Ростов на Дону, 2009 г.

14. Б.Б. Намсараев и др. – Полевой практикум по водной микробиологии и гидрохимии – Улан уде 2006 г.

15. Полевой определитель пресноводных беспозвоночных – Составители А. Полоскин, В. Хаитов, Москва; 2006 г.

16. Ари Мякеля и др. Полевые работы в исследованиях водоёмов (методическое пособие для специалистов по отбору проб) – Хельсинки, 2000 г

17. Н.А. Мягков – Атлас – определитель рыб ; Изд. «Просвещение» Москва 1994 г.

18. F. Richard Hauer & Gary A. Lamberty Methods in stream ecology – Elsevier Inc., 2007

19. Todd Hatfield at all. Guidelines for the collection and analysis of fish and fish habitat data for the purpose of assessing impacts from small hydropower projects in British Columbia, 2007

20. Adam Lewis at all. Assessment Methods for Aquatic Habitat and Instream Flow Characteristics in Support of Applications to Dam, Divert, or Extract Water from Streams in British Columbia, 2004

D.4. Fishermen Survey Questionnaire

Date of survey		
Location	District:	Place:
Name of fisherman		
Where does fishing? (The interviewer should present a map to the fisher and subsequently clearly mark the locations on the map)		
The main rivers or tributaries?		
Does fishing daily or seasonal?		
How many fishers catch fish on this Chapter?		
What fishing techniques are used?		
Is the fishing recreational and/or commercial?		
Which species are targeted by the fishers? (The interviewer does not enumerate of fish species. The fisherman should name fish species himself. The interviewer should convert common name to full species name)		
Which other fish species are present? (The interviewer does not enumerate of fish species. The fisherman should name fish species himself. The interviewer should convert common name to full species name)		
Is the fisherman aware about of any protected or rare fish species being present? (The interviewer does not enumerate of fish species. The interviewer can supply photographs of rare or protected species potentially present. The fisherman should name fish species himself. The interviewer should convert common name to full species name.)		
Does the river contain any migratory species and if so, when have he observed the various species moving upstream/downstream? (The interviewer does not enumerate of fish species. The fisherman should name fish species himself. The interviewer should convert common name to full species name)		
Is he aware of any sensitive sites (e.g. spawning and nursery grounds) in the area and if so where are they located? (The interviewer should present a map to the fisher and subsequently clearly mark the locations on the map)		

D.5. Fish Species Present

Table D.11: Species Present in Adjara Region and Within the ZoI

Scientific Name (Family, species)	Georgian Name	English Name	Present in the Zone of Influence
Acipenser sturio	ფორონჯი	European Sturgeon*	No
Acipenser stellatus	ტარაღანა	Starry Sturgeon*	No
Acipenser persicus colchicus	კოლხური ზუთხი	Colchic strurgeon*	No
Huso huso	სვია	Beluga Strurgeon*	No
Fam. Salmonidae	ოჯ. ორაგულისებრნი	Fam. Salmons	
Salmo labrax	შავი ზღვის ორაგული	Black Sea Salmon	Yes
Salmo trutta	ნაკადულის კალმახი	Sea trout, Brown trout	Yes
Oncorhynchus mykiss	ცისარტყელა კალმახი	Rainbow Trout	?
Fam. Petromyzontidae	ოჯ. სალამურასებრნი	Fam. Lampreys	
Eudontomyzon mariae	სალამურა	Ukrainian Brook Lamprey	No
Fam. Gobiidae	ოჯ. ღორჯოსებრნი	Fam. Gobies	
Neogobius melanostomus	შავპირა ღორჯო	Round Goby	No
Neogobius fluviatilis	მექვიშია ღორჯო	Monkey Goby	No
Neogobius ratan	ღორჯო-რატანი	Ratan Goby	No
Ponticola constructor	მდინარის ღორჯო	Caucasian Goby	Yes
Proterorhinus marmoratus	მილცხვირა ღორჯო	Tubenose Goby	No
Neogobius gymnotrachelus	ყელტიტველი ღორჯო	Racer Goby	No
Fam Percidae	ოჯ. ქორჭილასებრნი	Fam. Perches	
Perca fluviatilis	ქორჭილა	Perch	No
Fam. Pleuronectidae	ოჯ. მდინარის კამბალასებრნი	Fam. Flounders	
Platichthys flesus	კამბალა-გლოსა	Flounder	No
Fam. Esocidae	ოჯ. წერისებრნი	Fam. Pikes	
Esox lucius	წერი	Pike	No
Fam.Siluridae	ოჯ. ღლავისებრნი	Fam. Sheatfishes	
Silurus glanis	ღლავი (ლოქო)	Wels Catfish	No
Fam. Anguillidae	ოჯ. გველთევზასებრნი	Fam. Freshwater Eels	
Anguilla anguilla	ევროპული გველთევზა	European Eel	Yes
Fam. Atherinidae	ოჯ. ათერინასებრნი	Fam. Silversides	
Atherina boyeri pontica	შავი ზღვის ათერინა	Black Sea Sandsmelt	No
Fam. Moronidae	ოჯ. ლავრაკისებრნი	Fam. Basses	
Dicentrarchus labrax	ლავრაკი	Bass	No
Fam. Syngnathidae	ოჯ. ნემსთევზასებრნი	Fam. Pipefishes	
Syngnathus abaster	ნემსთევზა	Black Sea Pipefish	No
Fam. Poeciliidae	ოჯ. გამბუზიასებრნი	Fam. Livebearers	

Scientific Name (Family, species)	Georgian Name	English Name	Present in the Zone of Influence
Gambusia affinis	გამბუზია	Mosquitofish	No
Fam. Mugilidae	ოჯ. კეფალსიებრნი	Fam. Mullets	
Mugil cephalus	კეფალი	Flat-Headed Mullet	No
Mugil soiuy	პილენგასი	So-iuy Mullet	No
Liza aurata	ოქროსფერი კეფალი	Golden Mullet	No
Fam. Cobitidae	ოჯ. ხლაკუნასებრნი	Fam. Loaches	
Cobitis satunini	ხლაკუნა (გველანა)	Satunini Loach	Yes
Nemacheilus angorae	ანგორული გოჭალა	Angora Loach	Yes
Fam. Gasterosteidae	ოჯ. სამეკალასებრნი	Fam. Sticklebacks	
Gasterosteus aculeatus	სამეკალა	Three-Spined Stickleback	No
Fam. Cyprinidae	ოჯ. კობრისებრნი	Fam. Carps	
Cyprinus carpio	გოჭა (კობრი)	Carp	No
Carassius carassius	კარასი	Crucian Carp	No
Rutilus rutilus	ნაფოტა	Roach	Yes
Rutilus frisii	შავი ზღვის ნაფოტა	Black Sea Roach	No
Squalius cephalus orientalis	კავკასიური ქაშაპი	Caucasian Chub	Yes
Petroleuciscus borysthenicus)	ჯუჯა ქაშაპი	Black sea Chub	Yes
Phoxinus colchicus	კოლხური კვირჩხლა	Colchic Minnow	Yes
Scardinius erythrophthalmus	ფარფლწითელა	Rudd	No
Tinca tinca	გუწუ (ლოქორია)	Tench	No
Chondrostoma colchicum	კოლხური ტობი	Colchic Nase	Yes
Gobio caucasicus	დასავლეთ ამიერკავკასიური ციმორი	Gudgeon	Yes
Luciobarbus escherichii	კოლხური წვერა	Colchic Barbel	Yes
Capoeta sieboldii	კოლხური ხრამული	Colchic Khramulya	Yes
Capoeta tinca	ანატოლიური ხრამული	Anatolian Khramulya	Yes
Alburnus derjugini	კოლხური თრისა (ელავი)	Colchic Bleak	Yes
Alburnoides fasciatus	ფრიტა	Rock minnow	Yes
Vimba vimba	ვიმბა	Zahrte	No
Rhodeus amarus	ტაფელა	Bitterling	No
Rhodeus colchicus	კოლხური ტაფელა	Colchic Bitterling	Yes

D.6. Result of Fish Surveys

1. The European Eel – single specimens are found. Information about eels was obtained from local fishers. Four out 20 interviewed fishers, independently noted that they caught eels in Adjaristsqali (three Fishers) and Machakhela (one fisher). Each of them notes that it is a quite rarity to have caught an eel, and one of the fishers said that eels can be found in Adjaristsqali just once in every 3 years.

2. Rock minnow – this species was detected during fish surveys at control fishing points. This species was relatively abundant throughout the ZoI (50 specimens per 100 m of the net) except for the upstream areas, where the average relative number is two specimens per 100 m of net.

3. Colchic Barbel – found at all control fishing points. Average relative number is 15 specimens per 100 m of net.

4. Colchic Minnow – was detected at numerous points during the fish surveys. Interviews with the fishers indicated that maximum numbers are observed in summer low-water periods. In is fairly common in some areas, with average relative number of up to 70 specimens / 1 m^3.

5. Caucasian Chub – is common in the Adjaristsqali River and interviewed fishers confirmed this species is found everywhere in rivers' middle and downstream. However, during the fish surveys this species was only recorded in the middle and downstream points of Adjaristsqali River. The Average relative number is four specimens per 100 m of net.

6. Gudgeon – is a common species and was detected at all survey sites. The average relative number is 10 specimens per 100 m of the net.

7. Colchic Bitterling – present in a limited number of biotopes, although it is common in certain habitats. Average relative number is 6 specimens per 100 m of net.

8. Colchic Nase – present in a limited number of biotopes. Average relative number is 7 specimens per 100 m of net.

9. Royal fish – interviews indicated that this fish is rare and only local populations are numerous. Not detected during the fish surveys.

10. Black Sea Salmon – according to interviews with fishers, this species is present in the Chorokhi and Adjaristsqali Rivers' confluence and in Machakhela River. Local fishers indicate this species is present in the Machakhela during the whole year. Not detected during fish surveys.

11. Sea Trout/ Brown trout – found in the Adjaristsqali tributaries' and upper reaches. The average relative number, in the upstream areas of the larger Adjaristsqali tributaries, is five specimens per 100 m of net whereas in the smaller tributaries, two specimens per 100 m of net was recorded. According to interviews with the fishermen, this is the only species in the river effluents and is quite numerous.

D.7. Ecological Requirements of Fish

Table D.12: Ecological Requirements of Fish

Fish Species	Habitat	Upstream migration	Spawning and Fry Stage	Downstream migration	General Information
Sea trout/Brown trout *Salmo trutta* Anadramous Georgian Red List Status Vulnerable IUCN Red List Least concern, population trend unknown	Present in cold streams, rivers and lakes. Sea and lake trout forage in pelagic and littoral habitats, sea trout mostly remain close to coast, not very far from estuary of natal river. Within the ZoI, the sea trout/brown trout at found at high elevations above 800 m. Brown trout need cover even a weed bed affords some protection. Over hanging bank sides and vegetation, even bridges are a favourite. Trout feed on a wide variety of insects both aquatic and terrestrial which is brought by currents. Being territorial as adult trout may feed at the same place on the same food for hours. Brown trout are considered to be one of the most adaptable species. Like the salmon the brown trout can migrate to the sea (anadromous) Unlike the salmon not all brown trout bother to migrate, the majority live out their whole life cycle in fresh water. Only in the last century was it realised	Dependent on age, sex and river. Whitling (a young full trout during its second season) start to migrate in July –September to lower reaches of river to over winter or mature and then migrate to upper reach spawning sites. Anadromous adults which may have spent 18 months at sea may migrate in May and enter rivers until late October. Within the ZoI, adult trout remain at high elevations with upstream and downstream migration occurring in the upper reaches of the tributaries.	Resident trout usually spawn for the first time at 2-3 years and spawn for 2-3 seasons. Spawning starts between late October and March, but usually in November to December. These eggs vulnerable to spates and washout, low oxygen levels and pollution Spawning habitat includes rivers and streams with swift water into gravel. The eggs hatch 3 to 5 months after spawning and is dependent on the temperature of the water i.e.hatching quicker in warmer water. Newly hatched trout are called alevins and they carry their yoke sac with them and are dependent on this for sustenance. In good conditions this stage will last for about 20 days during which time the alevins hide in gravel. At the end of this stage, when the yoke sac has been absorbed the alevins become fry and are about an inch long. The fry usually emerge between March (Spain) and July (Finland). The fry will move, usually downstream, to find food. Where they end up is the main factor in their	Smoltification is usually complete at 2-3 years and increases with latitude. All juveniles have the ability to smolt and start to migrate. Smolts tend to start to migrate downstream in April- May when temperature ranges between 5-11^{o}C, migration rises as water levels rise along with increased turbidity. If migration is impossible, smolts may interrupt migration and become resident again. In some small, summer dry streams all migrate whereas in others none seem to migrate. Migration for this species stays upstream at high elevations.	Oxygen levels, temperature and sediments are probably the most important factors. Trout need 6 ppm of dissolved oxygen for good growth, which is high. Temperatures above 20-21^{o}C are lethal to trout (and warm water contains less oxygen). Trout will tolerate acidity levels of a pH down to 4.5. In the UK there are very few waters with such acidity, but in Scandinavia thousands of lochs and streams are now devoid of trout due to acid rain.

Fish Species	Habitat	Upstream migration	Spawning and Fry Stage	Downstream migration	General Information
	that the Brown Trout and the Sea Trout are the same species. Exactly why some brownies become sea trout is unclear. Certainly the rivers of the west coast of Scotland produce more sea trout. This may be because they are generally poorer in terms of nutrient (spate rivers). So the trout may be looking for more food. Rivers which produce a lot of juveniles may also stimulate a return to the sea since adult trout are territorial.		development. Both sexes survive spawning and anadramous trout migrate back to sea or lake in Autumn or overwinter in rivers.		
Black sea salmon *Salmo labrax* Anadramous Lacustrine Resident Georgian Red List Status Endangered IUCN Red List Least concern, population trend unknown.	Present at sea, along coasts at depths of up to 50 m. Migrates to up hill streams. Resident populations in streams and uppermost reaches with fast current, cold clear water and stone or gravel bottoms. Within the ZoI this species has only been recorded in the Machakhela river.	At the start of a cold spring, migration is observed, usually in June and July. For instance in spring 2004, the spawning migration lasted until 15 July due to the low thermal conditions of the river. However, migration starts in the river when the sea temperature in the coastal area ranges from 8-8.5^{0}C. A sharp increase in seawater temperature urges the salmon towards the river. In Abkhazia salmon concentrate near the river mouths and upstream migration is observed when water temperature in the sea and the river delta range from 11-16^{0}C and 8-10^{0}C respectively. In other sections of the Black Sea coastline, migration starts at 11-17^{0}C	Spawning starts from October-January. Start and end of spawning migrations is dependent on the sea and river temperatures. This species has a homing ability to return to its place of birth. They spawn in upper reaches with fast current. The large rivers originating from high mountains, with more than 1500 km2 catchment area, average annual flow exceeding 100 m/sec (eg. Chorokhi river) and the medium rivers with catchment area 1000-1500 km^2, average annual flow 5-50 m/sec (e.g. Machakhela River) and important for the existence and reproduction of salmon. The small rivers with	After their fist year in freshwater, the young salmon are called post yearling parr. Parrs can live in rivers and streams for 2-4years and then smoltify and migrate to sea or mature in freshwater. In the UK this occurs in May to June. Salmon may then spend one or more years at sea before returning to their home river to spawn.	

Fish Species	Habitat	Upstream migration	Spawning and Fry Stage	Downstream migration	General Information
		(sea) and 9-11^{0}C (rivers). By the end of migration period, the sea water temperature increases to 20-24^{0}C, seldom 25^{0}C, while river temperature reaches 12-14^{0}C. For Abkhazian section – the temperature ranges from 20-24^0 and 10-12^{0}C respectively. Massive migration of salmon is mostly related to the summer high water period. In Georgian rivers salmon migrates upstream mostly at night, during the high water and flash flood periods, when the water is muddy. At this time, they use their maximal speed for moving up to find the new whirlpools for feeding which occurs from April 10 to 15 September. Swners can be found in whirlpool of the river until the water temperature starts to fall. At the first signal, the fish rapidly moves up to the spawning areas, located upstream.	catchment area 50-100 km2, average annual flow 5 m/sec (eg. Dgamishi, Korolistskali, Tkhilnaristskali, Jochostskali and Boloko rivers) are important for reproduction, feeding the fries, silvering and movement to the sea. Results of the surveys (R. Goradze et al) proved that for salmon the most important small river in the region is Boloko, one of left tributaries of the Chorokhi River. Mortality of salmon in the early life stages is usually high due to natural predation and human-induced changes in habitat, such as siltation, high water temperatures, low oxygen concentration, loss of stream cover, and reductions in river flow		
European eel *Anguilla anguilla* Catadromous IUCN Red List Critically Endangered. Population declining	Eels are found in all types of benthic habitats from small streams to shores of large rivers and lakes. Naturally only occurs in water bodies that are connected to the sea; elsewhere they are stocked. Present on the bottom, under stones, in mud or in crevices. The European eel population as a whole has	Elvers (small eels), enter the estuaries and colonize the continental waters. Young eels spend their growing period in freshwater, males for 6-12 years, females for 9-20 years, before ending their metamorphosis.	Amphihaline species, which migrates to the depths of the Sargasso Sea to spawn. Spawning takes place in late winter and spring in the Sargasso Sea.	At the end of their growth period, they become sexually mature and the eels migrate to the sea where they inhabit deep waters. Eels sexually mature at 20-25°C. Migration to sea and gameotgenesis occurs at temperatures ranging from 0-30°C. Recent genomic DNA studies have shown that the European Eel exhibits non-random mating and restricted gene flow among eels from different	The fishing stock is currently outside safe biological limits and current fisheries unsustainable. Europe has issused a Regulation requiring all member states to produce eel management plans and have the objective to permit the escapement to the sea of at least 40% of silver eel biomass.

Fish Species	Habitat	Upstream migration	Spawning and Fry Stage	Downstream migration	General Information
	declined in most areas.			locations exists.	Threats include the bioaccumulation of pollutants, dams (blocking migration routes and from mortality in turbines
Colchic khramulya *Capoeta sieboldii* Georgian Red List status Vulnerable Not on IUCN Red List	Found in rivers at higher in the lower reaches in the Adjaristsqali and its tributaries. Usually associated with fast flows and cold water. Other literature has indicated that khramulas are typical inhabitants of slow-flowing and stagnant waters, and feed on algae and detritus.		Spawns in May-August.		
Caucasian goby *Ponticola constructor* IUCN Red List Least Concern	Freshwater, in a wide variety of flowing waters from cold hills to foot hill streams. Never found in brackish water. Locally abundant in suitable habitats and has no known threats.		Reproduction from May to June, spawn on bottom side of stones. Release up to 250-1500 eggs.		
Caucasian chub *Squalis cephalus orientalis* Not on IUCN Red List	Present in all Georgian rivers and adjoining lakes as well as reservoirs. Can be found in upstream areas of rivers, along with Barbel. Accustomed to water temperature of 32 – 35^{0}C. Feeds on benthos and algae, partly fish and frogs, spawn.		Spawns from April to July. Spawns up to 150 thousand eggs, 1.5 mm in diameter; spawn is yellowish, sticky, sticks to algae and objects. Young fish hatch in 7 – 10 days		No commercial value but forms part of sport and recreational fisheries
Dnieper chub/Black sea chub *Petroleuciscus borysthenicus* IUCN Red List least	Freshwater; brackish; benthopelagic species which inhabits lowland rivers, lower reaches of montane rivers, limans, lakes, deltas, backwaters		Spawns in April-June at 12-28°C, in 0.1-1.0 m deep clear water, over sandy or slightly muddy bottom. Females lay 2-3 portions of adhesive eggs on and amidst aquatic plants		Sharp decline of some populations is due to drainage of flood-plains and channelization of river beds

Fish Species	Habitat	Upstream migration	Spawning and Fry Stage	Downstream migration	General Information
concern, trend unknown	with moderate to no current. Prefers to stay in warm water with temperatures up to 30-32°C, on sand and mud bottom. Occurs in shallow places with slow current along banks, in backwaters, in small lakes and similar calm-water sites. Can tolerate slightly brackish water and low oxygen concentrations. Does not undertake migration but moves to deeper places in winter.		each spawning period.		
Colchic minnow *Phoxinus colchicus* IUCN Red List, least concern, population trend unknown	Present in a wide range of cold and well oxygenated habitats from small, fast-flowing streams to large rivers. Associated with salmonid fishes or cyprinids of barbel zone. Gregarious and rheophilic species.		Spawns from April to July. Spawns over clean gravel areas in flowing water. Spawns in shoals, fractional spawner, females deposit the sticky eggs deep into clean gravel.		
Caucasian gudgeon *Gobio lepidolaemus caucasicus* Not on IUCN Red List	Inhabits freshwater, in rivers reaches high upstream. Prefers slow river shallows with small river branches. Feeds on plankton, benthos and partly algae.		Spawns from May till end of August. Spawns three times and can release up to 1000 – 12000 eggs.		
Colchic barbel *Luciobarbus escherichii* Not on IUCN Red List	In freshwater habitats, along with khramulya and present in the high upstream areas in the lower trout zone. Mainly inhabits rivers and accustomed to calm water. In winter inhabits caves of		Spawns from June to the end of August. In Prefers fast, clean stony - sandy river bottoms, for feeding and spawning. Spawns twice in river shallows. Can release 2-15,000 eggs in rivers, and in lakes - 4-30,000. Spawn at temperatures of 12-18^{o}C.		

Fish Species	Habitat	Upstream migration	Spawning and Fry Stage	Downstream migration	General Information
	river shores and bottom holes.		Young fish hatch in one week.		
Anatolian khramulya *Capoeta tinca* Not on IUCN Red List	Present upstream in high river reaches, along with Barbus, in lower sections of trout sectors. Usually present in fast flowing cold water. Can be bred in lakes and ponds.		Spawns from May to August, and is dependent on the surrounding temperature Reach sexual maturity from 2 – 3 years.		No commercial value
Colchic bleak *Alburnus derjugini* Not on IUCN Red List	Inhabits preferably shallow, silty and stony-sandy river sectors.		Spawns in May – July.		
Rock minnow *Alburnoides fasciatus* Not on IUCN Red List	Inhabits mainly shallow, slow river sectors with small branches. This species can also be found in lakes.		Spawns in May – end of July. Can release 2,000 – 6,000 eggs.		
Colchic bitterling *Rhodeus colchicus* Not on IUCN Red List	Most abundant in still or slow-flowing water with dense aquatic vegetation and sand-silty bottom. Present in lowland ponds, canals, slow-flowing rivers, backwaters and oxbows.		Spawns in April-August. Spawns for the first time at one year old. Most individuals do not survive their first reproduction and populations fluctuate greatly over the years.		
Angora loach *Nemacheilus angorae / Oxynoemacheilus angorae* IUCN Red List, data deficient.	Inhabits shallow stony sandy substrates rich in vegetation (e.g. branches). Can be found on the shores of lakes.		Spawns in May - June, with up to 1,000 – 2,500 eggs released.		
Satsunini loach *Cobitis satunini*	A freshwater fish which inhabits rivers, lakes coastal zones. Present in		Spawns in May – July, Spawning numbers can reach 500 – 2,000. Sexual		No commercial value.

Fish Species	Habitat	Upstream migration	Spawning and Fry Stage	Downstream migration	General Information
Not on IUCN Red List	the sandy – stony shallows where there are small branches. This species prefers stagnant to slowly running waters with a sandy or silty substrate.		maturity reached by 3 – 4 years.		
Colchic nase *Chondrostoma colchium* Not on IUCN Red List	The Colchic nase is a pure riverine fish that prefers a slow current and pebble bottom overgrown with algae to feed on.		It does not migrate, but spawns in the shallowest areas of streams and rivers. It spawns much earlier than the barbels, from March to early May at temperatures between 12 and 15		

D.8. Composition of Fish Prey

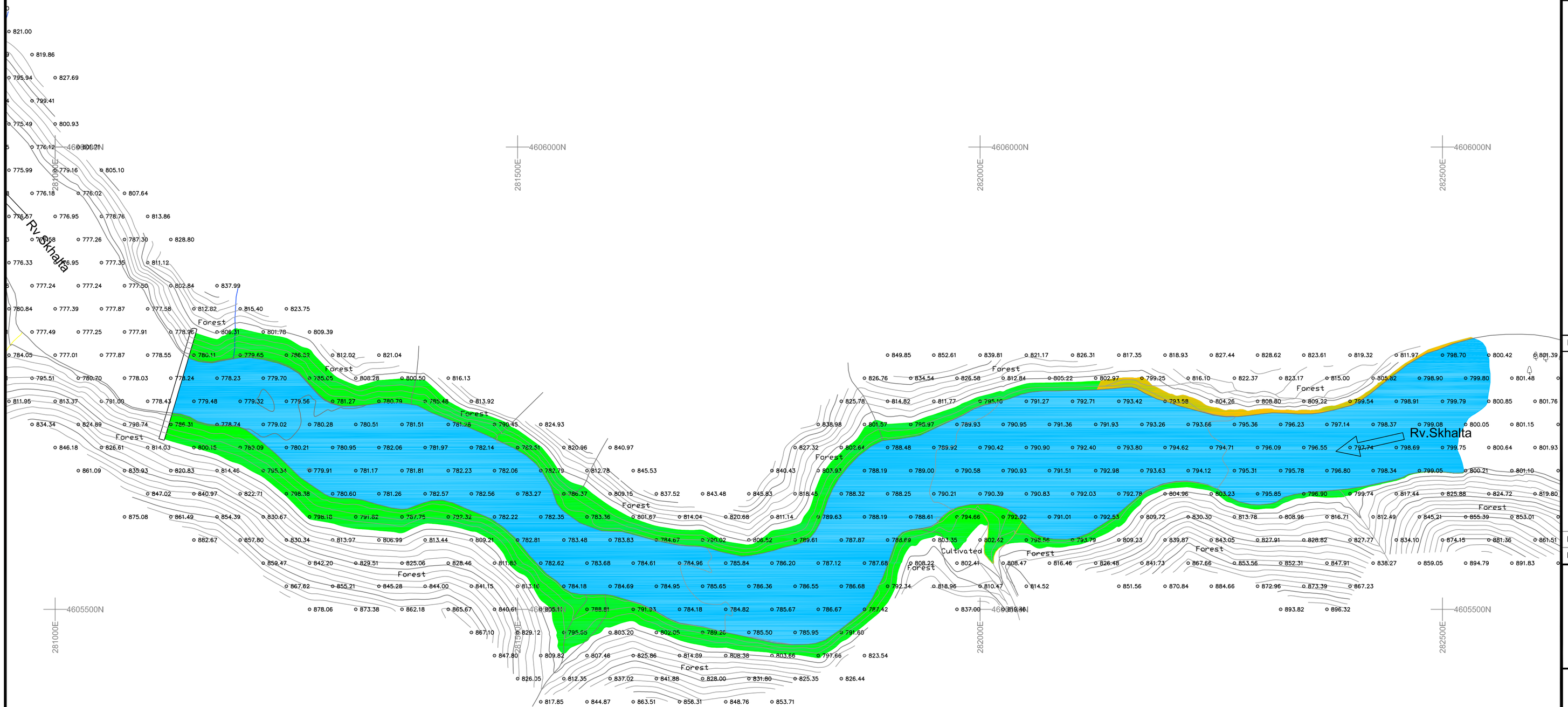
Table D.13: Composition of Fish Feed

Feed subject	Trout	Colchic Barbel	Gudgeon	Caucasian Chub	Khramulya	Schneider	Colchic Minnow	Goby
Chlorophyta	-	+	+	-		+	-	-
Bacillariophyta	+	+	+	-	-	+	-	-
Plant seeds	+	-	+	-	+	-	-	-
Ciliophora	-	+	+	-	-	-	-	-
Plathelmintes	-	-	+	+	+	-	-	-
Oligochaeta	+	+	+	-	+	+	+	+
Rotatoria	-	-	+	-	-	-	-	-
Nematoda	+	+	+	+	+	+	+	+
Arthropoda ov.	-	-	+	-	-	-	-	-
Arthropoda pup.	+	+	+	-	-	+	+	-
Myriapoda	-	-	-	-	-	-	+	-
Arachnida	+	+	-	-	-	-	-	-
Hydrocarina	+	-	+	-	-	-	-	-
Phyllopoda	+	-	-	-	-	-	-	+
Cladocera	-	+	+	-	+	+	-	+
Copepoda	-	+	+	-	-	-	-	+
Amphipoda	+	+	+	-	-	+	-	+
Isopoda	+	-	-	-	-	-	-	-
Dermaptera	+	+	-	-	-	-	-	+
Ephemeroptera, im.	+	-	+	-	-	-	-	+
Ephemeroptera, lrv.	+	+	+	-	+	+	+	+
Plecoptera, im.	-	-	-	-	-	-	+	-
Plecoptera, lrv.	+	-	+	-	-	+	+	-
Hemiptera	+	-	-	-	-	-	-	-
Orthoptera	+	-	-	-	-	-	-	-
Odonata, lrv.	+	-	-	-	-	-	-	-
Coleoptera, im.	+	+	+	-	-	+	+	-
Coleoptera, lrv.	+	+	-	-	-	+	-	-
Hymenoptera	+	-	+	-	-	-	-	-
Vespoidea	+	-	-	-	-	-	-	-
Formicoidea	+	+	+	+	-	+	+	-
Diptera, im.	+	+	+	-	+	+	+	-
Diptera, lrv.	+	+	-	+	-	-	-	-
Brachycera, lrv.	+	+	+	-	-	-	+	-
Nematocera, im.	+	+	+	-	-	-	+	-
Nematocera, lrv.	+	+	+	+	+	+	+	+
Trichoptera, lrv.	+	+	+	-	-	+	+	+
Trichoptera, im.	+	-	-	-	-	-	-	-

Feed subject	Trout	Colchic Barbel	Gudgeon	Caucasian Chub	Khramulya	Schneider	Colchic Minnow	Goby
Lepidoptera, lrv.	+	+	+	-	-	+	-	-
Pisces	+	-	-	-	-	-	-	-
Detritus(Детрит)	-	+	+	+	+	+	-	-
Periphyton(Периф итон)	+	+	+	+	+	+	-	-
Total groups	32	24	28	7	10	18	14	11
Note: ov., - egg; for amphibious insects: im., - grownup insects, larv., - larves								

D.9. Submerged Land Use Maps

NORTH



Notes

Key to symbols

- RIVERBED AREA (145,476m²)
- FOREST AREA (49,656m²)
- VEGETATION & GRASSLAND AREA (2,487m²)
- TREE
- SPOT HEIGHT

Reference drawings

MMD-290039-MNC-SHU-04-125

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	24.01.12	AK	PRELIMINARY ISSUE	HW	VH

Mott MacDonald

Victory House
Trafalgar Place
Brighton, BN1 4FY
United Kingdom
+44 (0)1273 365000
+44 (0)1273 365100
www.mottmac.com

Gamma CONSULTING

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi Georgia

Title

Adjaristsqali Hydropower Cascade
Skhalta Reservoir
Submerged Land Use

Designed	JG	J.Glass	Eng check	HW	H.White
Drawn	AK	A.King	Coordination	VH	V.Hovland
Dwg check	JG	J.Glass	Approved	VH	V.Hovland

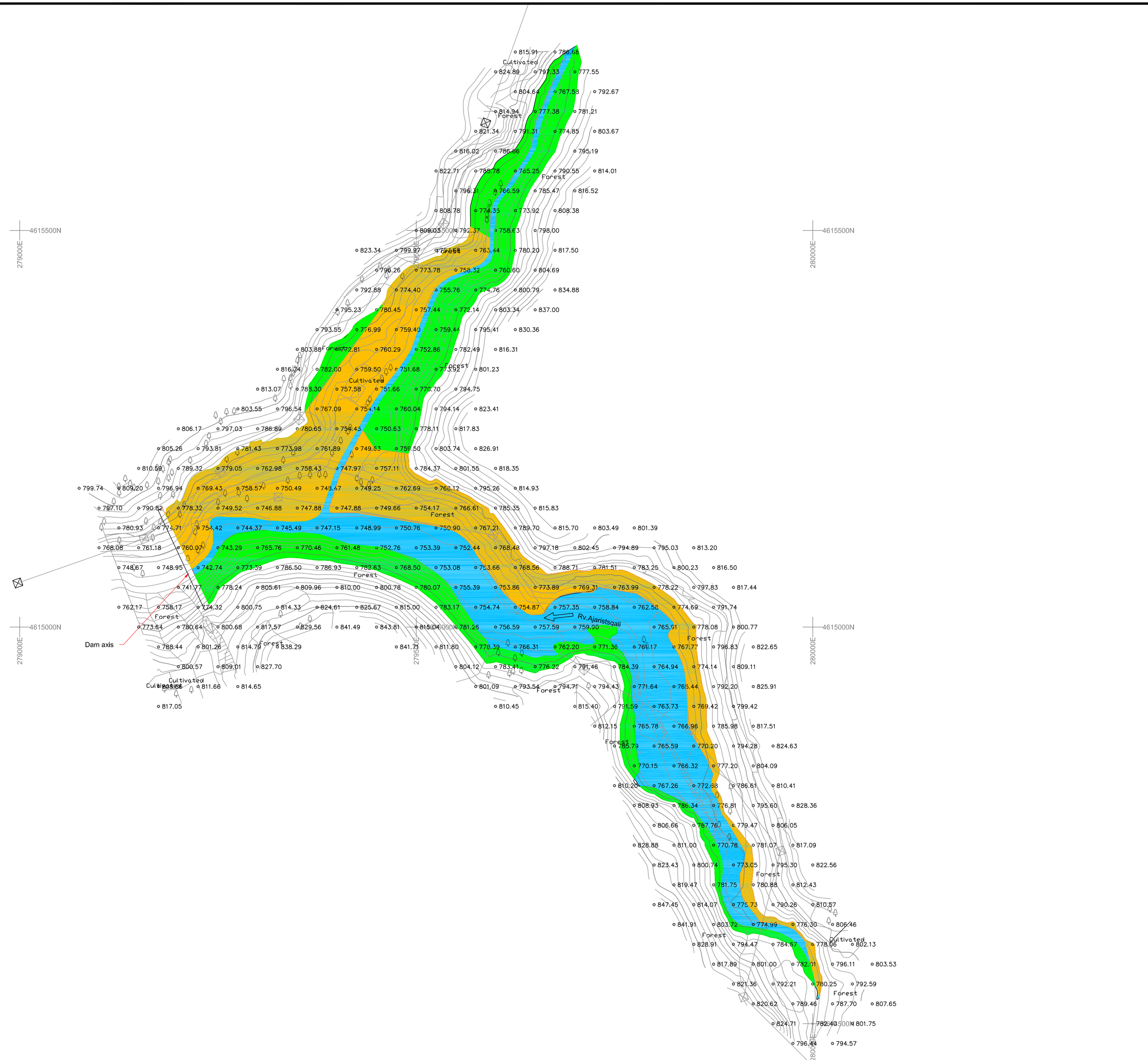
Scale at A1	Status	Rev
As Shown	PRE	P1

Drawing Number

MMD-290039-MNC-SHU-07-007

C:\Users\kin23165\Desktop\Work Temp\MMD-290039-MNC-SHU-07-007.dwg Jan 25, 2012 - 4:31PM kin23165

NORTH



0 1:2.5 125mm 250mm

Notes

Key to symbols

- RIVERBED AREA (53,163m²)
- FOREST AREA (48,000m²)
- VEGETATION & GRASSLAND (66,475m²)
- TREE
- SPOT HEIGHT

Reference drawings

MMD-290039-MNC-SHU-04-135

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	24.01.12	AK	PRELIMINARY ISSUE	HW	VH

Mott MacDonald

Victory House
Trafalgar Place
Brighton, BN1 4FY
United Kingdom
+44 (0)1273 365000
+44 (0)1273 365100
www.mottmac.com

Gamma CONSULTING

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi Georgia

Title

Adjaristsqali Hydropower Cascade
Didachara Reservoir
Submerged Land Use

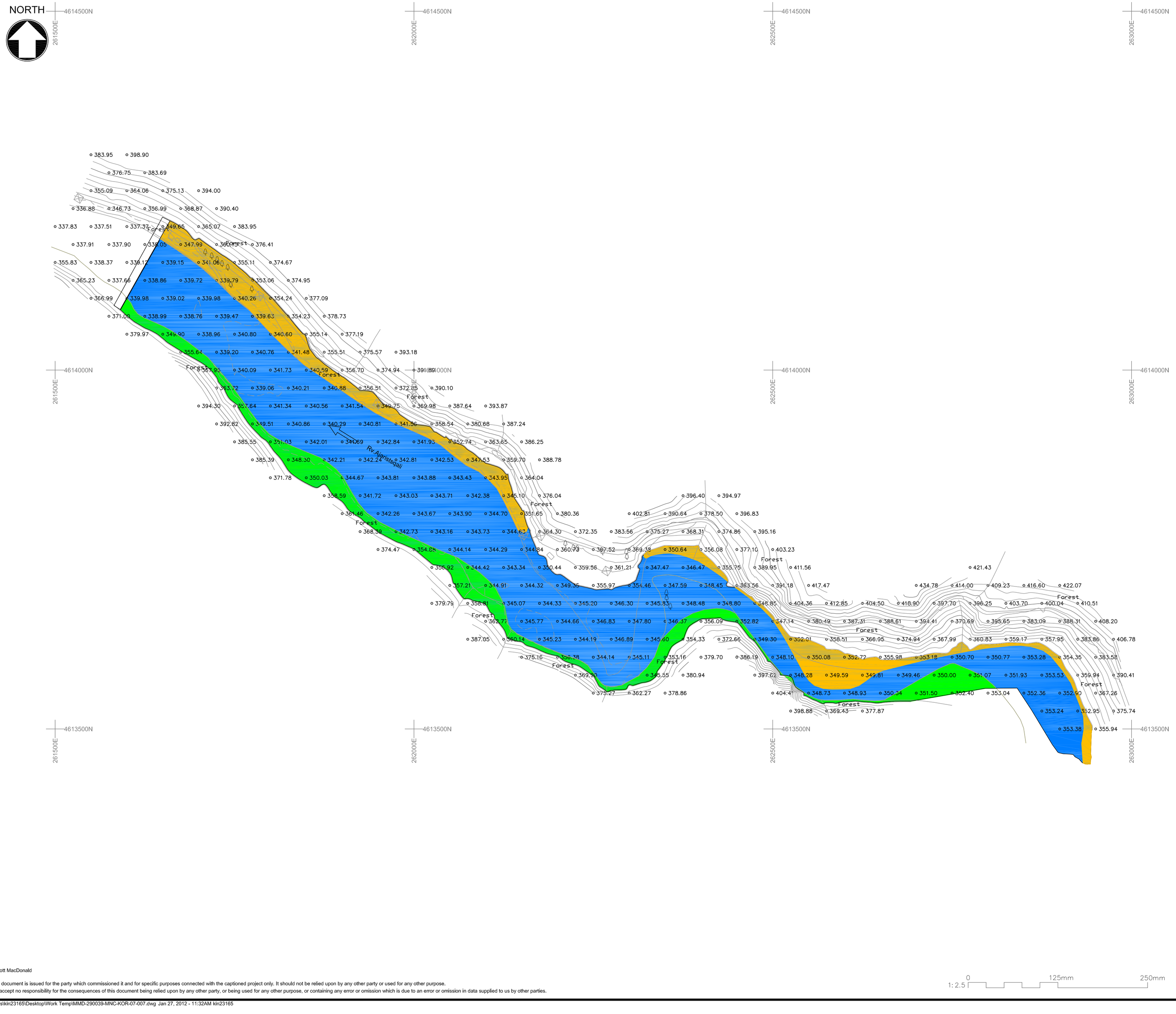
Designed	JG	J.Glass	Eng check	HW	H.White
Drawn	AK	A.King	Coordination	VH	V.Hovland
Dwg check	JG	J.Glass	Approved	VH	V.Hovland

Scale at A1	Status	Rev
As Shown	PRE	P1

Drawing Number

MMD-290039-MNC-SHU-07-008

C:\Users\kin23165\Desktop\Work Temp\MMD-290039-MNC-SHU-07-008.dwg Jan 25, 2012 - 4:34PM kin23165



Notes

Key to symbols

- RIVERBED AREA (124,680m²)
- FOREST AREA (22,017m²)
- VEGETATION & GRASSLAND AREA = (25,280m²)
- TREE
- SPOT HEIGHT

Reference drawings

MMD-290039-MNC-KHU-04-315

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	24.01.12	AK	PRELIMINARY ISSUE	HW	VH

Mott MacDonald
Victory House
Trafalgar Place
Brighton, BN1 4FY
United Kingdom
+44 (0)1273 365000
+44 (0)1273 365100
www.mottmac.com

Gamma CONSULTING

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi Georgia

Title

Adjaristsqali Hydropower Cascade
Khichauri Reservoir
Submerged Land Use

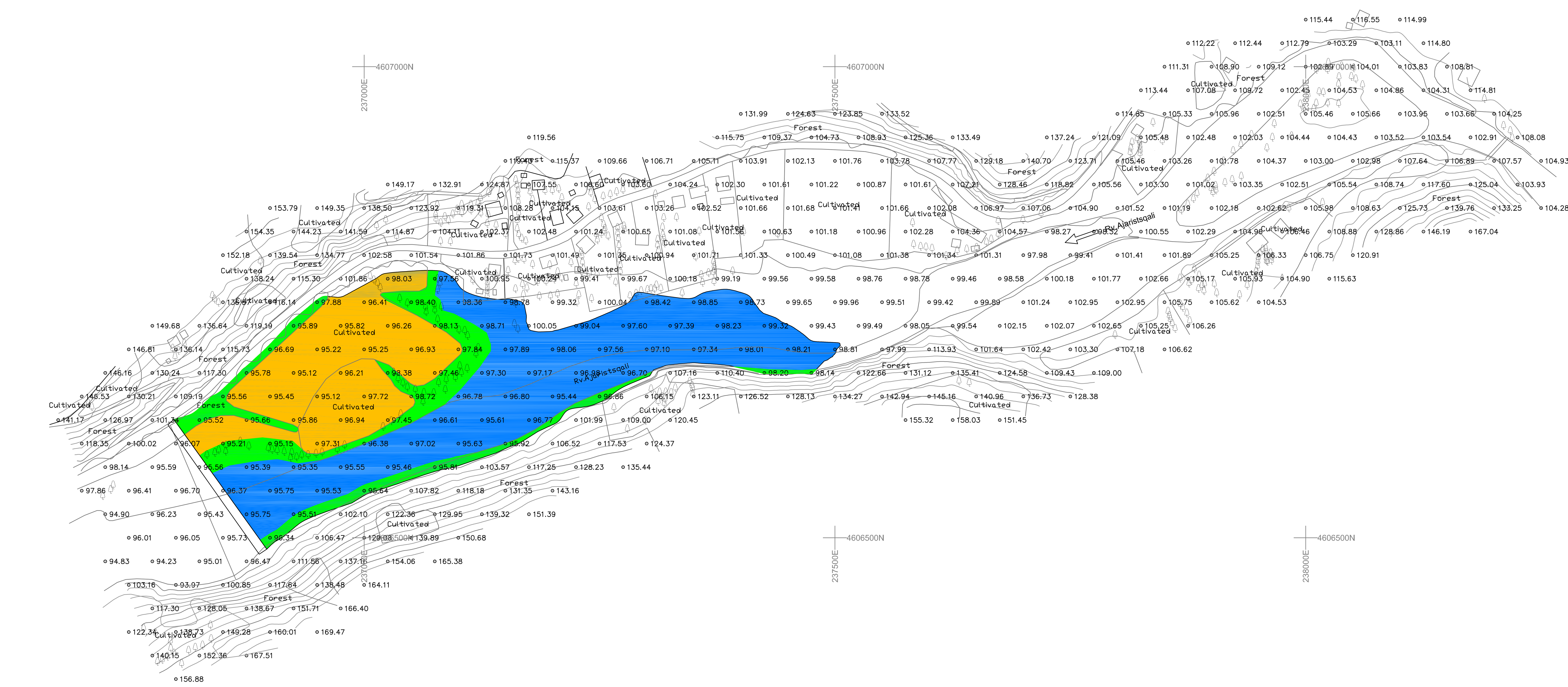
Designed	JG	J.Glass	Eng check	HW	H.White
Drawn	AK	A.King	Coordination	VH	V.Hovland
Dwg check	JG	J.Glass	Approved	VH	V.Hovland

Scale at A1	Status	Rev
As Shown	PRE	P1

Drawing Number
MMD-290039-MNC-KOR-07-007

1: 2.5 0 125mm 250mm

C:\Users\kin23165\Desktop\Work Temp\MMD-290039-MNC-KOR-07-007.dwg Jan 27, 2012 - 11:32AM kin23165



Notes

Key to symbols

- RIVERBED AREA (41,440m²)
- FOREST AREA (15,738m²)
- VEGETATION & GRASSLAND AREA (27,746m²)
- TREE
- SPOT HEIGHT

Reference drawings

MMD-290039-MNC-KHU-04-315

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	24.01.12	AK	PRELIMINARY ISSUE	HW	VH

Mott MacDonald

Victory House
Trafalgar Place
Brighton, BN1 4FY
United Kingdom
+44 (0)1273 365000
+44 (0)1273 365100
www.mottmac.com

Gamma CONSULTING

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi Georgia

Title

Adjaristsqali Hydropower Cascade
Khertvisi Reservoir
Submerged Land Use

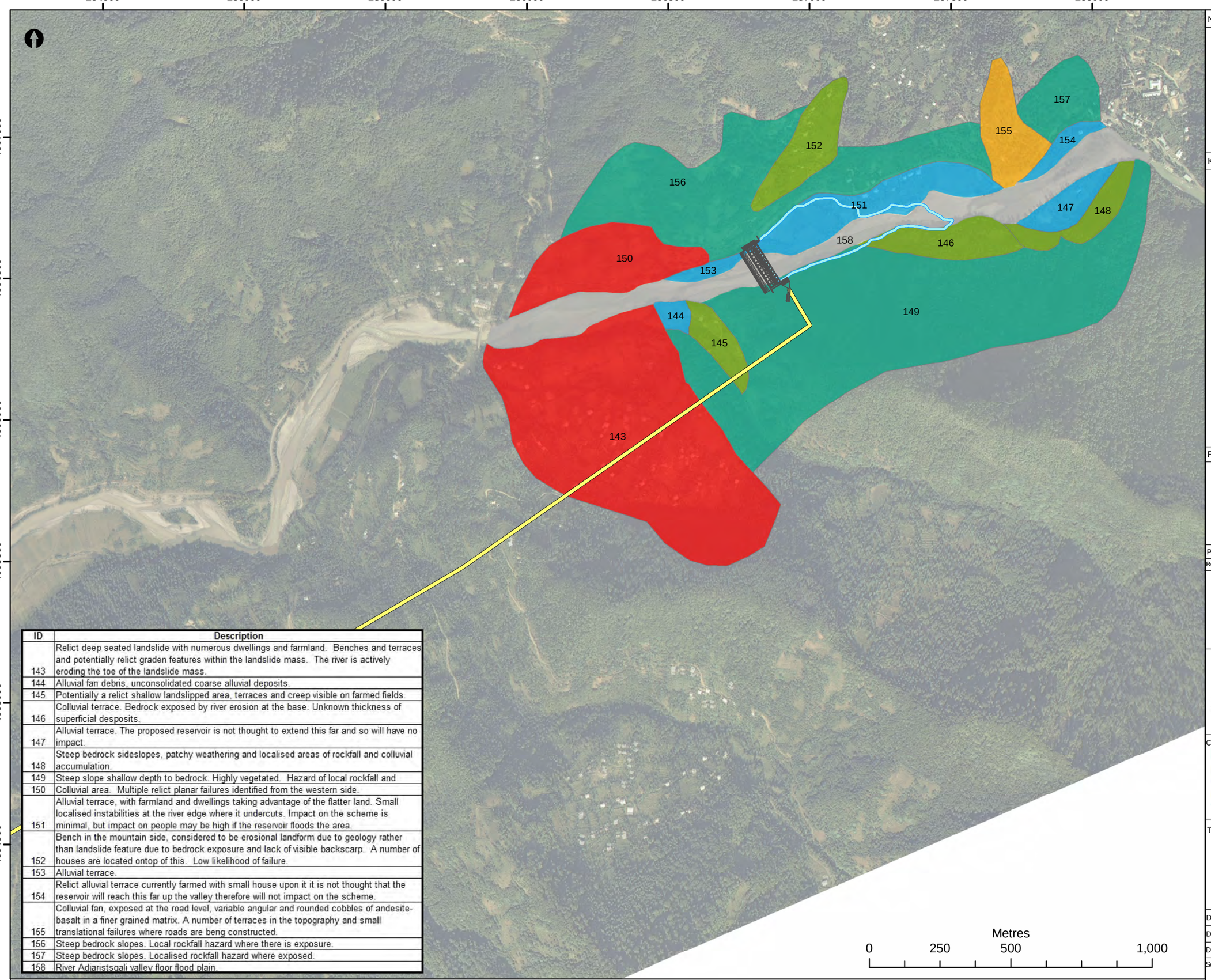
Designed	JG	J.Glass	Eng check	HW	H.White
Drawn	AK	A.King	Coordination	VH	V.Hovland
Dwg check	JG	J.Glass	Approved	VH	V.Hovland

Scale at A1: As Shown | Status: PRE | Rev: P1

Drawing Number: MMD-290039-MNC-KHE-07-006

Appendix E. Geology, Landslides and Seismic Risks

E.1. Landslide Hazard Maps



ID	Description
143	Relict deep seated landslide with numerous dwellings and farmland. Benches and terraces and potentially relict graden features within the landslide mass. The river is actively eroding the toe of the landslide mass.
144	Alluvial fan debris, unconsolidated coarse alluvial deposits.
145	Potentially a relict shallow landslipped area, terraces and creep visible on farmed fields.
146	Colluvial terrace. Bedrock exposed by river erosion at the base. Unknown thickness of superficial desposits.
147	Alluvial terrace. The proposed reservoir is not thought to extend this far and so will have no impact.
148	Steep bedrock sideslopes, patchy weathering and localised areas of rockfall and colluvial accumulation.
149	Steep slope shallow depth to bedrock. Highly vegetated. Hazard of local rockfall and
150	Colluvial area. Multiple relict planar failures identified from the western side.
151	Alluvial terrace, with farmland and dwellings taking advantage of the flatter land. Small localised instabilities at the river edge where it undercuts. Impact on the scheme is minimal, but impact on people may be high if the reservoir floods the area.
152	Bench in the mountain side, considered to be erosional landform due to geology rather than landslide feature due to bedrock exposure and lack of visible backscarp. A number of houses are located ontop of this. Low likelihood of failure.
153	Alluvial terrace.
154	Relict alluvial terrace currently farmed with small house upon it it is not thought that the reservoir will reach this far up the valley therefore will not impact on the scheme.
155	Colluvial fan, exposed at the road level, variable angular and rounded cobbles of andesite-basalt in a finer grained matrix. A number of terraces in the topography and small translational failures where roads are beng constructed.
156	Steep bedrock slopes. Local rockfall hazard where there is exposure.
157	Steep bedrock slopes. Localised rockfall hazard where exposed.
158	River Adjaristsqali valley floor flood plain.

Notes

1. The hazard rating is calculated based upon impact rating vs likelihood rating (the ratings are described in full in the report).
2. Coordinate System: UTM Zone 38 North, WGS84 Datum
3. Structures and tunnels shown are feasibility design stage

Key to symbols

Likelihood – of the scheme construction / operation to cause mass movement	Impact of mass movement on the scheme / population: Low	Medium	High
Low	1	2	3
Medium	2	3	4
High	3	4	5

Tunnel Alignments

Reservoir Extent

Reference drawings

-MMD-290039-MNC-KHE-03-301-P1 Khertvisi Scheme Headrace Tunnel Alignment and Long Section

-MMD-290039-MNC-KHE-03-302-P1 Khertvisi Scheme Machakhlistsqali transfer tunnel alignment and long section

Rev	Date	Description	Drawn	Ch'k'd	App'd
P1	15/01/12	Preliminary Issue	SF	AD	PJP

Mott MacDonald
Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

GEG GROSS ENERGY GROUP Engineering & Consulting

DOLSAR Engineering Ltd

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi
Georgia

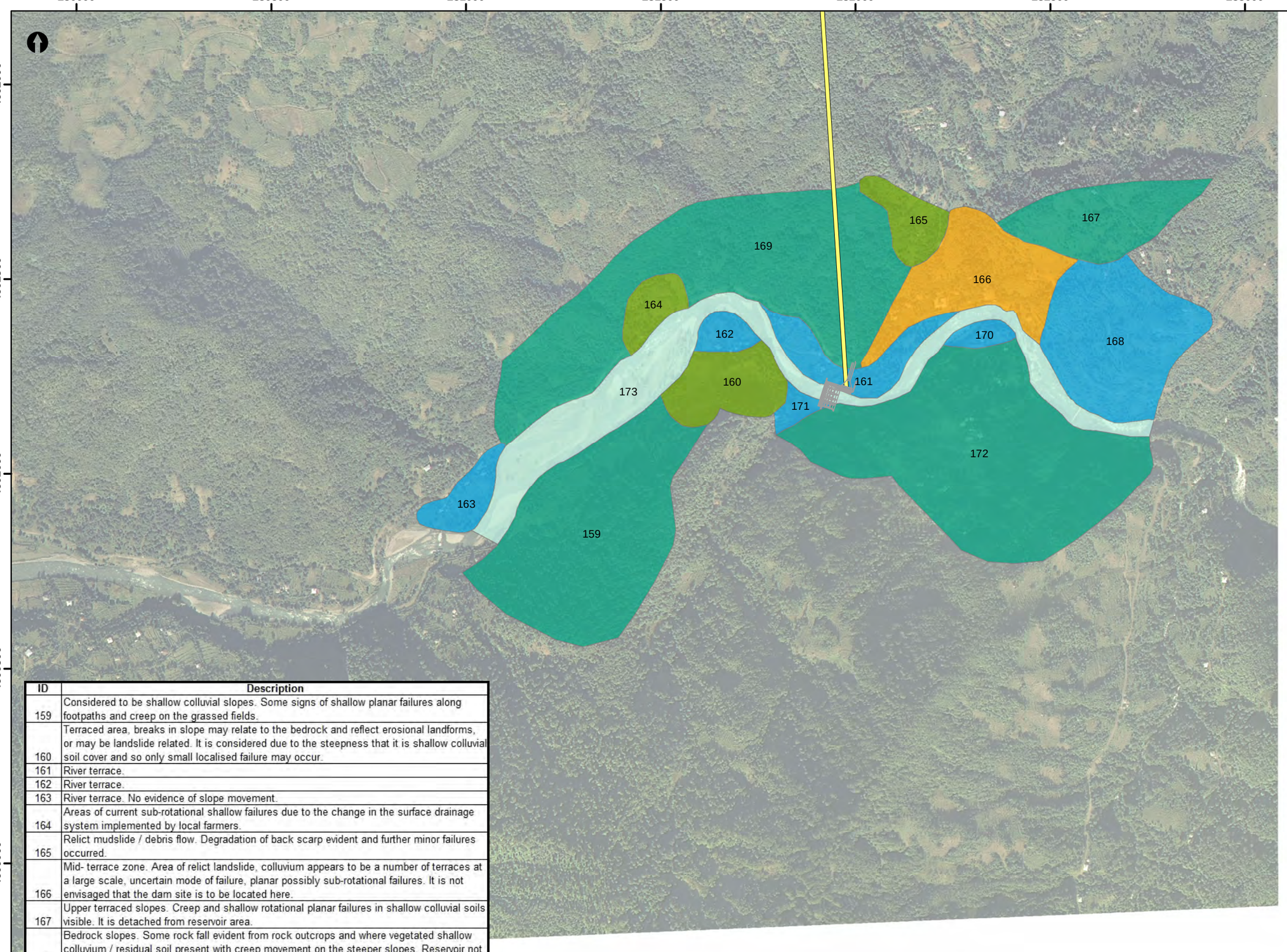
Title

Adjaristsqali Hydropower Cascade
Feasibility Study
Khertvisi Dam and Intake
Landslide Hazard Mapping

Designed	LB		Eng Check	AD	
Drawn	SF		Coordination	LB	
Dwg check	AD		Approved	PJP	

Scale @ A3: 1:12,500
Status: PRE
Rev: P1

Drawing Number: MMD-290039-MNC-KHE-02-312



ID	Description
159	Considered to be shallow colluvial slopes. Some signs of shallow planar failures along footpaths and creep on the grassed fields.
160	Terraced area, breaks in slope may relate to the bedrock and reflect erosional landforms, or may be landslide related. It is considered due to the steepness that it is shallow colluvial soil cover and so only small localised failure may occur.
161	River terrace.
162	River terrace.
163	River terrace. No evidence of slope movement.
164	Areas of current sub-rotational shallow failures due to the change in the surface drainage system implemented by local farmers.
165	Relict mudslide / debris flow. Degradation of back scarp evident and further minor failures occurred.
166	Mid- terrace zone. Area of relict landslide, colluvium appears to be a number of terraces at a large scale, uncertain mode of failure, planar possibly sub-rotational failures. It is not envisaged that the dam site is to be located here.
167	Upper terraced slopes. Creep and shallow rotational planar failures in shallow colluvial soils visible. It is detached from reservoir area.
168	Bedrock slopes. Some rock fall evident from rock outcrops and where vegetated shallow colluvium / residual soil present with creep movement on the steeper slopes. Reservoir not envisaged to extend this far.
169	Bedrock slopes with colluvial soil covering, vegetated with pine and deciduous trees. Some colluvial soil build up. Creep observed in curved tree trunks.
170	Areas of river terraces (no landslide hazard).
171	Alluvial material.
172	Shallow depth to bedrock. Some benches observed, potentially accumulation of colluvium at the foot of the slopes.
173	River Machakhlistsqali valley floor. Alluvial deposits.

Metres
0 250 500 1,000

Notes

1. The hazard rating is calculated based upon impact rating vs likelihood rating (the ratings are described in full in the report).
2. Coordinate System: UTM Zone 38 North, WGS84 Datum
3. Structures and tunnels shown are feasibility design stage

Key to symbols

		Impact of mass movement on the scheme / population		
		Low	Medium	High
Likelihood – of the scheme construction / operation to cause mass movement	Low	1	2	3
	Medium	2	3	4
	High	3	4	5

Tunnel Alignments

Reservoir Extent

Reference drawings

-MMD-290039-MNC-KHE-03-301-P1 Khertvisi Scheme Headrace Tunnel Alignment and Long Section

-MMD-290039-MNC-KHE-03-302-P1 Khertvisi Scheme Machakhlistsqali transfer tunnel alignment and long section

Rev	Date	Description	Drawn	Ch'k'd	App'd
P1	15/01/12	Preliminary Issue	SF	AD	PJP

Mott MacDonald
Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

GEG GROSS ENERGY GROUP Engineering & Consulting

DOLSAR Engineering Ltd

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi
Georgia

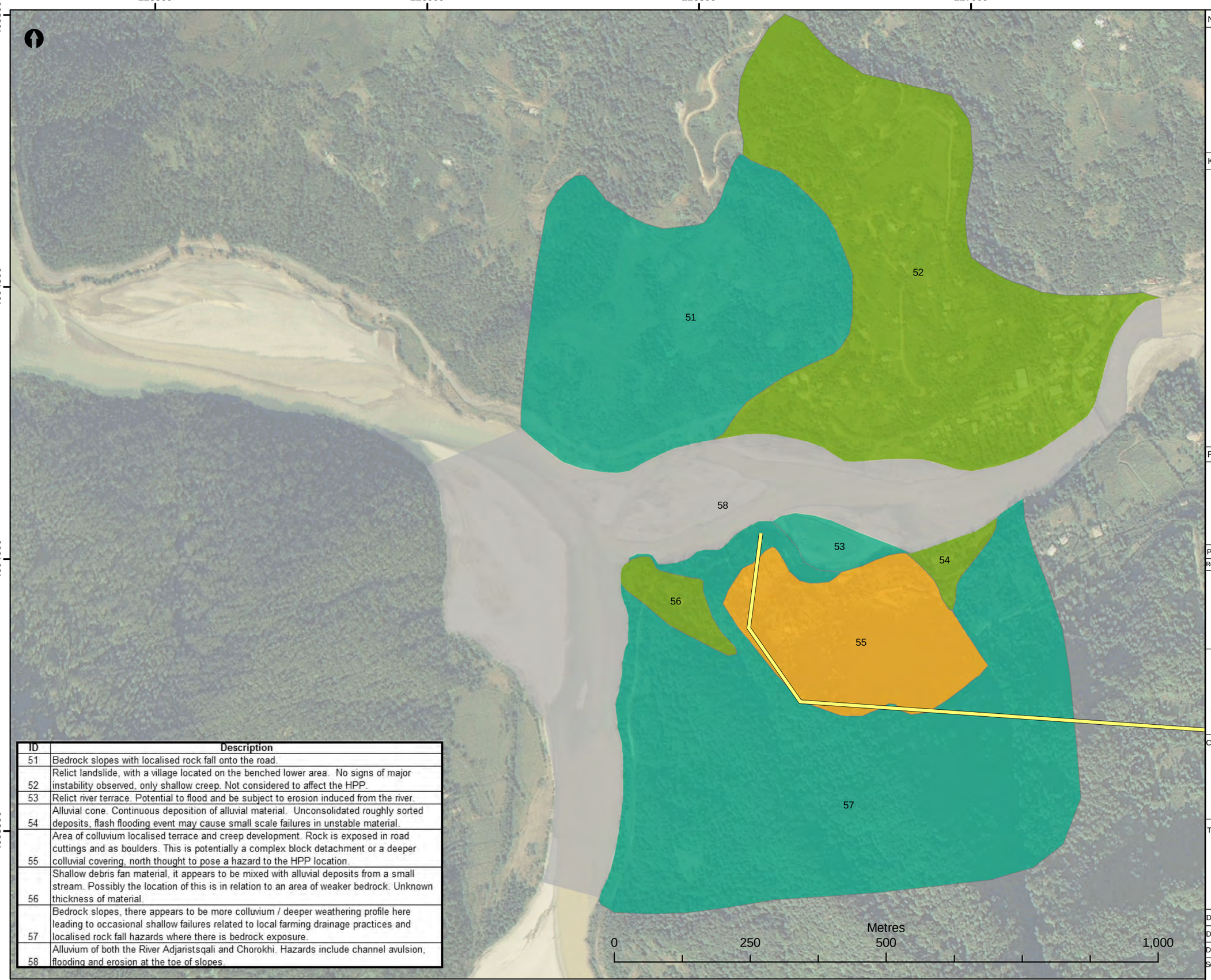
Title

Adjaristsqali Hydropower Cascade
Feasibility Study
Machakhlistsqali Weir and Intake
Landslide Hazard Mapping

Designed	LB		Eng Check	AD	
Drawn	SF		Coordination	LB	
Dwg check	AD		Approved	PJP	

Scale @ A3: 1:10,000
Status: PRE
Rev: P1

Drawing Number: MMD-290039-MNC-KHE-02-322



ID	Description
51	Bedrock slopes with localised rock fall onto the road.
52	Relict landslide, with a village located on the benched lower area. No signs of major instability observed, only shallow creep. Not considered to affect the HPP.
53	Relict river terrace. Potential to flood and be subject to erosion induced from the river.
54	Alluvial cone. Continuous deposition of alluvial material. Unconsolidated roughly sorted deposits, flash flooding event may cause small scale failures in unstable material.
55	Area of colluvium localised terrace and creep development. Rock is exposed in road cuttings and as boulders. This is potentially a complex block detachment or a deeper colluvial covering, north thought to pose a hazard to the HPP location.
56	Shallow debris fan material, it appears to be mixed with alluvial deposits from a small stream. Possibly the location of this is in relation to an area of weaker bedrock. Unknown thickness of material.
57	Bedrock slopes, there appears to be more colluvium / deeper weathering profile here leading to occasional shallow failures related to local farming drainage practices and localised rock fall hazards where there is bedrock exposure.
58	Alluvium of both the River Adjaristsqali and Chorokhi. Hazards include channel avulsion, flooding and erosion at the toe of slopes.

Notes

1. The hazard rating is calculated based upon impact rating vs likelihood rating (the ratings are described in full in the report).
2. Coordinate System: UTM Zone 38 North, WGS84 Datum
3. Structures and tunnels shown are feasibility design stage

Key to symbols

Likelihood – of the scheme construction / operation to cause mass movement	Impact of mass movement on the scheme / population: Low	Medium	High
Low	1	2	3
Medium	2	3	4
High	3	4	5

Tunnel Alignments

Reference drawings

-MMD-290039-MNC-KHE-03-301-P1 Khertvisi Scheme Headrace Tunnel Alignment and Long Section

-MMD-290039-MNC-KHE-03-302-P1 Khertvisi Scheme Machakhlistsqali transfer tunnel alignment and long section

Rev	Date	Description	Drawn	Ch'k'd	App'd
P1	15/01/12	Preliminary Issue	SF	AD	PJP

Mott MacDonald
Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

GEG GROSS ENERGY GROUP Engineering & Consulting

DOLSAR Engineering Ltd

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi
Georgia

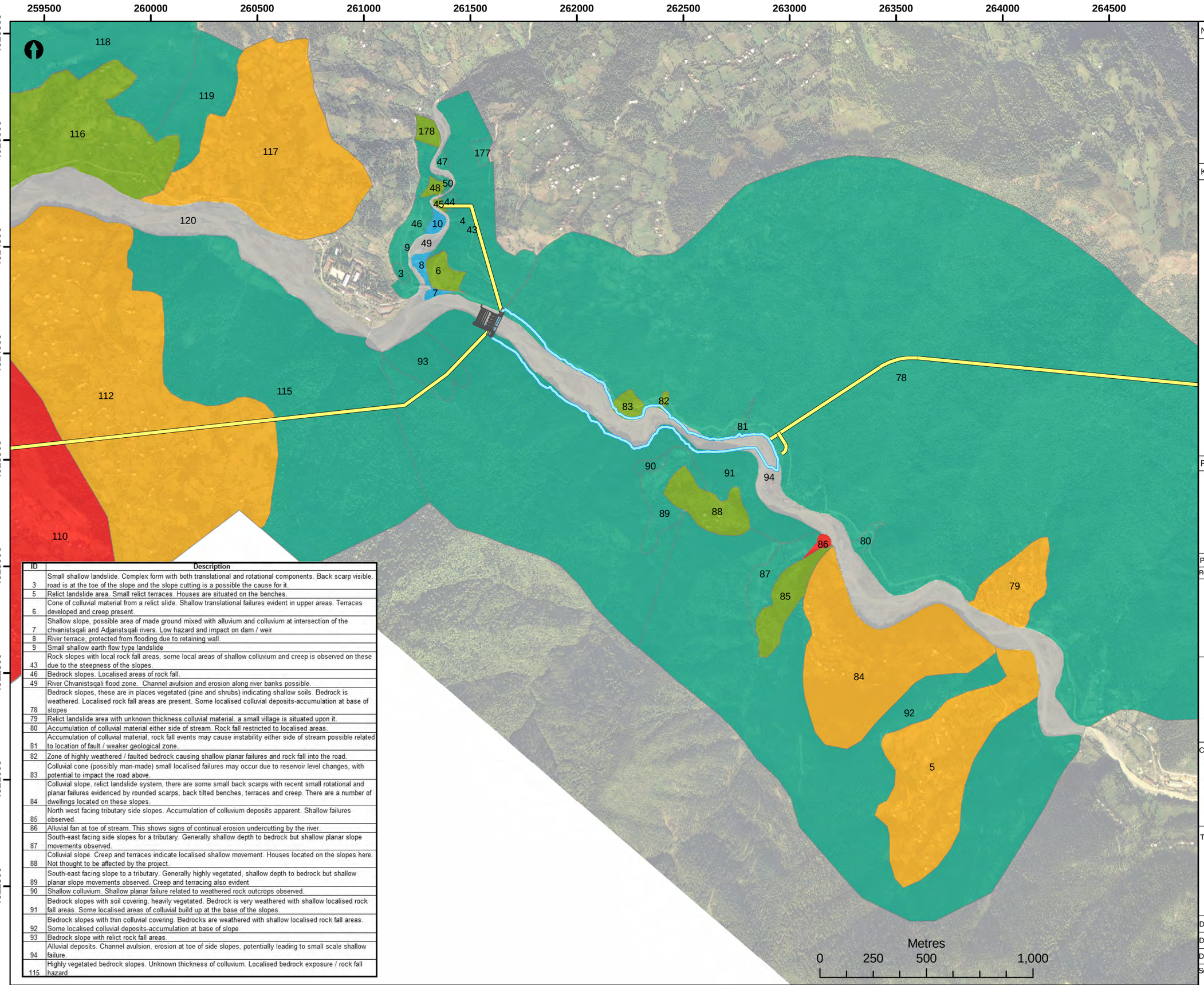
Title

Adjaristsqali Hydropower Cascade Feasibility Study
Khertvisi Hydro Powerplant and Tailrace Landslide Hazard Mapping

Designed	LB		Eng Check	AD	
Drawn	SF		Coordination	LB	
Dwg check	AD		Approved	PJP	

Scale @ A3: 1:6,500
Status: PRE
Rev: P1

Drawing Number: MMD-290039-MNC-KHE-02-332



ID	Description
3	Small shallow landslide. Complex form with both translational and rotational components. Back scarp visible. road is at the toe of the slope and the slope cutting is a possible the cause for it.
5	Relict landslide area. Small relict terraces. Houses are situated on the benches.
6	Cone of colluvial material from a relict slide. Shallow translational failures evident in upper areas. Terraces developed and creep present.
7	Shallow slope, possible area of made ground mixed with alluvium and colluvium at intersection of the chvanistsqali and Adjaristsqali rivers. Low hazard and impact on dam / weir
8	River terrace, protected from flooding due to retaining wall.
9	Small shallow earth flow type landslide
43	Rock slopes with local rock fall areas, some local areas of shallow colluvium and creep is observed on these due to the steepness of the slopes.
46	Bedrock slopes. Localised areas of rock fall.
49	River Chvanistsqali flood zone. Channel avulsion and erosion along river banks possible.
78	Bedrock slopes, these are in places vegetated (pine and shrubs) indicating shallow soils. Bedrock is weathered. Localised rock fall areas are present. Some localised colluvial deposits-accumulation at base of slopes
79	Relict landslide area with unknown thickness colluvial material, a small village is situated upon it.
80	Accumulation of colluvial material either side of stream. Rock fall restricted to localised areas.
81	Accumulation of colluvial material, rock fall events may cause instability either side of stream possible related to location of fault / weaker geological zone.
82	Zone of highly weathered / faulted bedrock causing shallow planar failures and rock fall into the road.
83	Colluvial cone (possibly man-made) small localised failures may occur due to reservoir level changes, with potential to impact the road above.
84	Colluvial slope, relict landslide system, there are some small back scarps with recent small rotational and planar failures evidenced by rounded scarps, back tilted benches, terraces and creep. There are a number of dwellings located on these slopes.
85	North west facing tributary side slopes. Accumulation of colluvium deposits apparent. Shallow failures observed.
86	Alluvial fan at toe of stream. This shows signs of continual erosion undercutting by the river.
87	South-east facing side slopes for a tributary. Generally shallow depth to bedrock but shallow planar slope movements observed.
88	Colluvial slope. Creep and terraces indicate localised shallow movement. Houses located on the slopes here. Not thought to be affected by the project.
89	South-east facing slope to a tributary. Generally highly vegetated, shallow depth to bedrock but shallow planar slope movements observed. Creep and terracing also evident
90	Shallow colluvium. Shallow planar failure related to weathered rock outcrops observed.
91	Bedrock slopes with soil covering, heavily vegetated. Bedrock is very weathered with shallow localised rock fall areas. Some localised areas of colluvial build up at the base of the slopes.
92	Bedrock slopes with thin colluvial covering. Bedrocks are weathered with shallow localised rock fall areas. Some localised colluvial deposits-accumulation at base of slope
93	Bedrock slope with relict rock fall areas.
94	Alluvial deposits. Channel avulsion, erosion at toe of side slopes, potentially leading to small scale shallow failure.
115	Highly vegetated bedrock slopes. Unknown thickness of colluvium. Localised bedrock exposure / rock fall hazard

Notes

1. The hazard rating is calculated based upon impact rating vs likelihood rating (the ratings are described in full in the report).
2. Coordinate System: UTM Zone 38 North, WGS84 Datum
3. Structures and tunnels shown are feasibility design stage

Key to symbols

		Impact of mass movement on the scheme / population		
		Low	Medium	High
Likelihood – of the scheme construction / operation to cause mass movement	Low	1	2	3
	Medium	2	3	4
	High	3	4	5

Tunnel Alignments

Reservoir Extent

Reference drawings

-MMD-290039-MNC-KOR-03-202-P1-Koromkheti Scheme Headrace Tunnel (option 2 TBM/D&B) Tunnel alignment and long section

-MMD-290039-MNC-KOR-03-205-P1-Koromkheti Scheme Chvanistsqali transfer alignment and long section

Rev	Date	Description	Drawn	Ch'k'd	App'd
P1	13/01/12	Preliminary Issue	SF	AD	PJP

Mott MacDonald
Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

GEG GROSS ENERGY GROUP Engineering & Consulting

DOLSAR Engineering Ltd

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi
Georgia

Title

Adjaristsqali Hydropower Cascade Feasibility Study
Khichauri Dam and Reservoir Landslide Hazard Mapping

Designed	LB		Eng Check	AD	
Drawn	SF		Coordination	LB	
Dwg check	AD		Approved	PJP	

Scale @ A3	Status	Rev
1:16,500	PRE	P1

Drawing Number
MMD-290039-MNC-KOR-02-212

260500 261000 261500 262000

4615000

4614500

4614000

ID	Description
3	Small shallow landslide. Complex form with both translational and rotational components. Backscarp visible. road is at the toe of the slope and the slope cutting is a possible cause for it.
4	Weathered bedrock visible in a dry gorge. Undercutting by river erosion and atmospheric effects is causing localised rock fall, minimal impact.
6	Cone of colluvial material from a relict slide. Shallow translational failures evident in upper areas. Terraces developed and creep present.
7	intersection of the chvanistsqali and Adjaristsqali rivers. Low hazard and impact on dam / weir.
8	River terrace, protected from flooding due to retaining wall.
9	Small shallow earth flow type landslide.
10	River terrace, protected from flooding due to retaining wall.
43	Rock slopes with local rock fall areas, some local areas of shallow colluvium and creep is observed on these due to the steepness of the slopes.
44	Area of colluvium, potentially a relict landslide. Terracing evident and a recently active shallow small mudslide is observed. Impact of this is not thought to be high due to relatively shallow colluvium deposits.
45	Shallow colluvial slope large boulders toe of the slope. hazard of rock fall / slope failure. erosion of toe may impact slope above.
46	Bedrock slopes. Localised areas of rock fall.
47	Relict river terrace / flood plain. Rock fall debris on upper surface. River is undercutting the southern side causing some small localised failures into the river.
48	Slope has number of springs along it, channels diverted by the farmer. Surface colluvial material, creep and shallow rotational failures observed also bedrock exposed indicating shallow thickness.
49	River Chvanistsqali flood zone. Channel avulsion and erosion along river banks possible.
50	River flood plan area. Flat marshy potentially organic rich compressible ground.
91	shallow localised rock fall areas. Some localised areas of colluvial build up at the base of the slopes.
94	Alluvial deposits. Channel avulsion, erosion at toe of side slopes, potentially leading to small scale shallow failure.
177	Lack of vegetation and shallow terraces and creep developed indicating shallow colluvium.
178	Colluvial accumulation possible related to the road construction, unknown thickness. Creep evident on grassy surface.

Metres
0 125 250 500

This document should not be relied on or used in circumstances other than those for which it was originally prepared and for which Mott MacDonald Ltd. was commissioned. Mott MacDonald Ltd. accepts no responsibility for this document to any other than the person by whom it was commissioned.

Notes

1. The hazard rating is calculated based upon impact rating vs likelihood rating (the ratings are described in full in the report).
2. Coordinate System: UTM Zone 38 North, WGS84 Datum
3. Structures and tunnels shown are feasibility design stage

Key to symbols

Likelihood – of the scheme construction / operation to cause mass movement	Impact of mass movement on the scheme / population: Low	Medium	High
Low	1	2	3
Medium	2	3	4
High	3	4	5

Tunnel Alignments

Reservoir Extent

Reference drawings

-MMD-290039-MNC-KOR-03-202-P1-Koromkheti Scheme Headrace Tunnel (option 2 TBM/D&B) Tunnel alignment and long section

-MMD-290039-MNC-KOR-03-205-P1-Koromkheti Scheme Chvanistsqali transfer alignment and long section

Rev	Date	Description	Drawn	Ch'k'd	App'd
P1	13/01/12	Preliminary Issue	SF	AD	PJP

Mott MacDonald
Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

GEG GROSS ENERGY GROUP Engineering & Consulting

DOLSAR Engineering Ltd

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi
Georgia

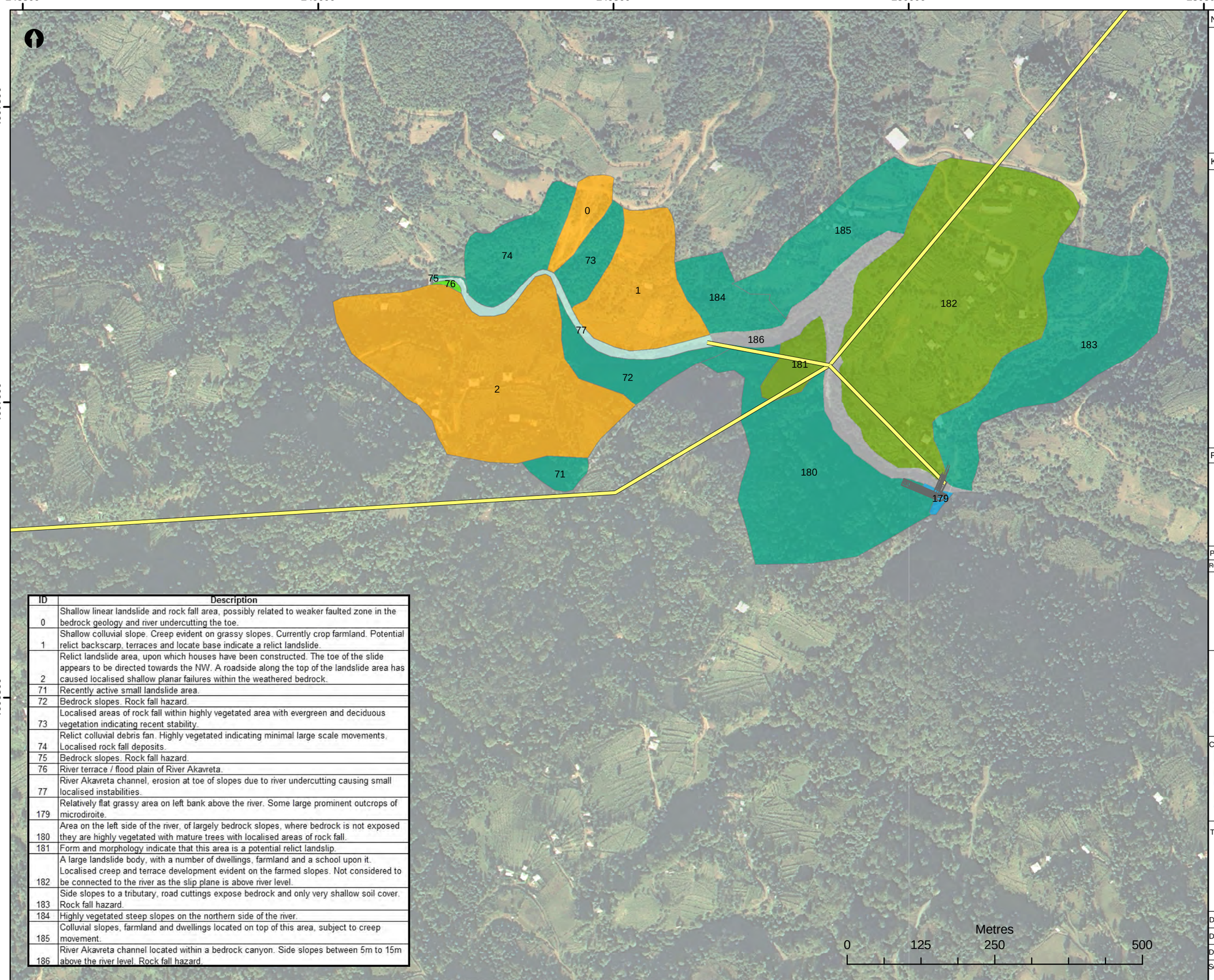
Title

Adjaristsqali Hydropower Cascade Feasibility Study Chvanistsqali Weir Landslide Hazard Mapping

Designed	LB		Eng Check	AD	
Drawn	SF		Coordination	LB	
Dwg check	AD		Approved	PJP	

Scale @ A3: 1:5,503
Status: PRE
Rev: P1

Drawing Number: MMD-290039-MNC-KOR-02-222



ID	Description
0	Shallow linear landslide and rock fall area, possibly related to weaker faulted zone in the bedrock geology and river undercutting the toe.
1	Shallow colluvial slope. Creep evident on grassy slopes. Currently crop farmland. Potential relict backscarp, terraces and locate base indicate a relict landslide.
2	Relict landslide area, upon which houses have been constructed. The toe of the slide appears to be directed towards the NW. A roadside along the top of the landslide area has caused localised shallow planar failures within the weathered bedrock.
71	Recently active small landslide area.
72	Bedrock slopes. Rock fall hazard.
73	Localised areas of rock fall within highly vegetated area with evergreen and deciduous vegetation indicating recent stability.
74	Relict colluvial debris fan. Highly vegetated indicating minimal large scale movements. Localised rock fall deposits.
75	Bedrock slopes. Rock fall hazard.
76	River terrace / flood plain of River Akavreta.
77	River Akavreta channel, erosion at toe of slopes due to river undercutting causing small localised instabilities.
179	Relatively flat grassy area on left bank above the river. Some large prominent outcrops of microdiroite.
180	Area on the left side of the river, of largely bedrock slopes, where bedrock is not exposed they are highly vegetated with mature trees with localised areas of rock fall.
181	Form and morphology indicate that this area is a potential relict landslip.
182	A large landslide body, with a number of dwellings, farmland and a school upon it. Localised creep and terrace development evident on the farmed slopes. Not considered to be connected to the river as the slip plane is above river level.
183	Side slopes to a tributary, road cuttings expose bedrock and only very shallow soil cover. Rock fall hazard.
184	Highly vegetated steep slopes on the northern side of the river.
185	Colluvial slopes, farmland and dwellings located on top of this area, subject to creep movement.
186	River Akavreta channel located within a bedrock canyon. Side slopes between 5m to 15m above the river level. Rock fall hazard.

Notes

1. The hazard rating is calculated based upon impact rating vs likelihood rating (the ratings are described in full in the report).
2. Coordinate System: UTM Zone 38 North, WGS84 Datum
3. Structures and tunnels shown are feasibility design stage

Key to symbols

Likelihood – of the scheme construction / operation to cause mass movement	Impact of mass movement on the scheme / population: Low	Medium	High
Low	1	2	3
Medium	2	3	4
High	3	4	5

Tunnel Alignments

Reference drawings

-MMD-290039-MNC-KOR-03-202-P1-Koromkheti Scheme Headrace Tunnel (option 2 TBM/D&B) Tunnel alignment and long section

-MMD-290039-MNC-KOR-03-205-P1-Koromkheti Scheme Chvanistsqali transfer alignment and long section

Rev	Date	Description	Drawn	Ch'k'd	App'd
P1	13/01/12	Preliminary Issue	SF	AD	PJP

Mott MacDonald
Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

GEG GROSS ENERGY GROUP Engineering & Consulting

DOLSAR Engineering Ltd

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi
Georgia

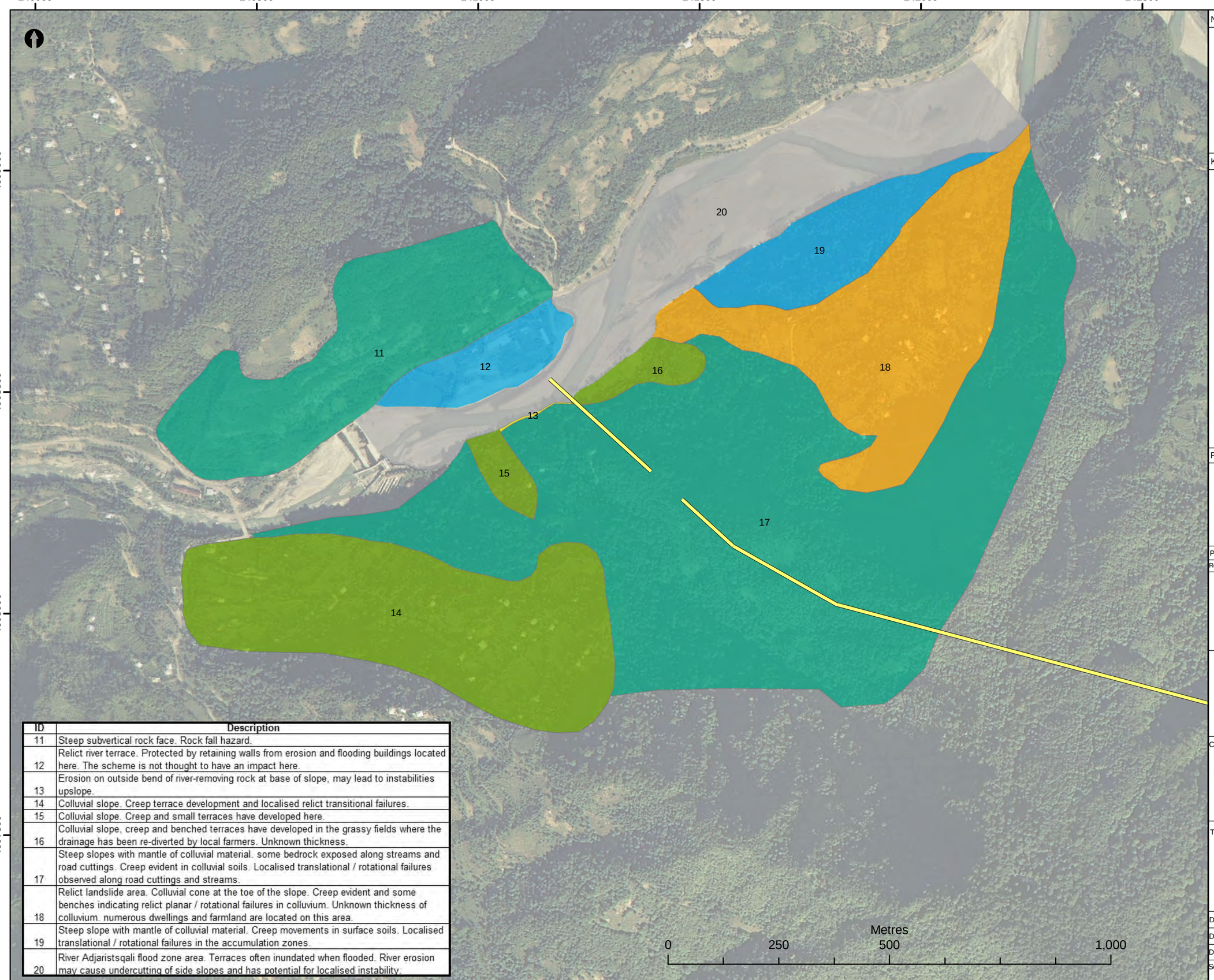
Title

Adjaristsqali Hydropower Cascade Feasibility Study Akavreta Weir Landslide Hazard Mapping

Designed	LB		Eng Check	AD	
Drawn	SF		Coordination	LB	
Dwg check	AD		Approved	PJP	

Scale @ A3	Status	Rev
1:6,000	PRE	P1

Drawing Number
MMD-290039-MNC-KOR-02-232



ID	Description
11	Steep subvertical rock face. Rock fall hazard.
12	Relict river terrace. Protected by retaining walls from erosion and flooding buildings located here. The scheme is not thought to have an impact here.
13	Erosion on outside bend of river-removing rock at base of slope, may lead to instabilities upslope.
14	Colluvial slope. Creep terrace development and localised relict transitional failures.
15	Colluvial slope. Creep and small terraces have developed here.
16	Colluvial slope, creep and benched terraces have developed in the grassy fields where the drainage has been re-diverted by local farmers. Unknown thickness.
17	Steep slopes with mantle of colluvial material. some bedrock exposed along streams and road cuttings. Creep evident in colluvial soils. Localised translational / rotational failures observed along road cuttings and streams.
18	Relict landslide area. Colluvial cone at the toe of the slope. Creep evident and some benches indicating relict planar / rotational failures in colluvium. Unknown thickness of colluvium. numerous dwellings and farmland are located on this area.
19	Steep slope with mantle of colluvial material. Creep movements in surface soils. Localised translational / rotational failures in the accumulation zones.
20	River Adjaristsqali flood zone area. Terraces often inundated when flooded. River erosion may cause undercutting of side slopes and has potential for localised instability.

Notes

1. The hazard rating is calculated based upon impact rating vs likelihood rating (the ratings are described in full in the report).
2. Coordinate System: UTM Zone 38 North, WGS84 Datum
3. Structures and tunnels shown are feasibility design stage

Key to symbols

		Impact of mass movement on the scheme / population		
		Low	Medium	High
Likelihood – of the scheme construction / operation to cause mass movement	Low	1	2	3
	Medium	2	3	4
	High	3	4	5

Tunnel Alignments

Reference drawings

-MMD-290039-MNC-KOR-03-202-P1-Koromkheti Scheme Headrace Tunnel (option 2 TBM/D&B) Tunnel alignment and long section

-MMD-290039-MNC-KOR-03-205-P1-Koromkheti Scheme Chvanistsqali transfer alignment and long section

Rev	Date	Description	Drawn	Ch'k'd	App'd
P1	13/01/12	Preliminary Issue	SF	AD	PJP

Mott MacDonald
Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

GEG GROSS ENERGY GROUP Engineering & Consulting

DOLSAR Engineering Ltd

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi
Georgia

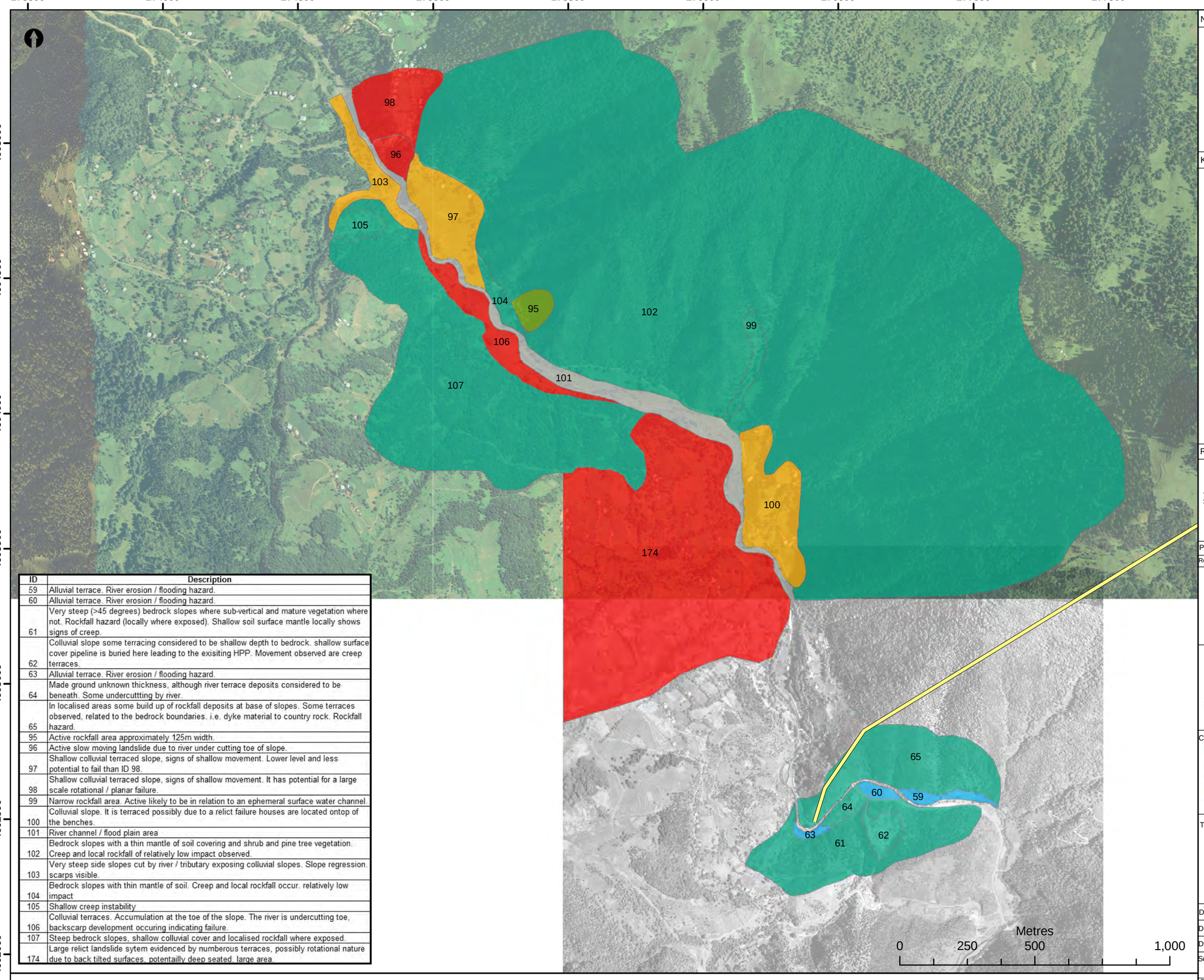
Title

Adjaristsqali Hydropower Cascade Feasibility Study
Koromkheti Hydro Powerhouse Landslide Hazard Mapping

Designed	LB		Eng Check	AD	
Drawn	SF		Coordination	LB	
Dwg check	AD		Approved	PJP	

Scale @ A3: 1:8,000
Status: PRE
Rev: P1

Drawing Number: MMD-290039-MNC-KOR-02-242



ID	Description
59	Alluvial terrace. River erosion / flooding hazard.
60	Alluvial terrace. River erosion / flooding hazard.
61	Very steep (>45 degrees) bedrock slopes where sub-vertical and mature vegetation where not. Rockfall hazard (locally where exposed). Shallow soil surface mantle locally shows signs of creep.
62	Colluvial slope some terracing considered to be shallow depth to bedrock. shallow surface cover pipeline is buried here leading to the exisiting HPP. Movement observed are creep terraces.
63	Alluvial terrace. River erosion / flooding hazard.
64	Made ground unknown thickness, although river terrace deposits considered to be beneath. Some undercutttting by river.
65	In localised areas some build up of rockfall deposits at base of slopes. Some terraces observed, related to the bedrock boundaries. i.e. dyke material to country rock. Rockfall hazard.
95	Active rockfall area approximately 125m width.
96	Active slow moving landslide due to river under cutting toe of slope.
97	Shallow colluvial terraced slope, signs of shallow movement. Lower level and less potential to fail than ID 98.
98	Shallow colluvial terraced slope, signs of shallow movement. It has potential for a large scale rotational / planar failure.
99	Narrow rockfall area. Active likely to be in relation to an ephemeral surface water channel.
100	Colluvial slope. It is terraced possibly due to a relict failure houses are located ontop of the benches.
101	River channel / flood plain area
102	Bedrock slopes with a thin mantle of soil covering and shrub and pine tree vegetation. Creep and local rockfall of relatively low impact observed.
103	Very steep side slopes cut by river / tributary exposing colluvial slopes. Slope regression. scarps visible.
104	Bedrock slopes with thin mantle of soil. Creep and local rockfall occur. relatively low impact
105	Shallow creep instability
106	Colluvial terraces. Accumulation at the toe of the slope. The river is undercutting toe, backscarp development occuring indicating failure.
107	Steep bedrock slopes, shallow colluvial cover and localised rockfall where exposed.
174	Large relict landslide sytem evidenced by numberous terraces, possibly rotational nature due to back tilted surfaces, potentailly deep seated, large area.

Notes

1. The hazard rating is calculated based upon impact rating vs likelihood rating (the ratings are described in full in the report).
2. Coordinate System: UTM Zone 38 North, WGS84 Datum
3. Structures and tunnles are shown are feasiblity design stage

Key to symbols

Likelihood – of the scheme construction / operation to cause mass movement	Impact of mass movement on the scheme / population: Low	Medium	High
Low	1	2	3
Medium	2	3	4
High	3	4	5

Tunnel Alignments

Reference drawings

- MMD-280039-MNC-SHU-03-101-P1 Shuakhevi Scheme Headrace Tunnel Alignment and long section
- MMD-280039-MNC-SHU-03-104-P1 Shuakhevi Scheme Shuakhevi transfer tunnels - alignment and long sec

Rev	Date	Description	Drawn	Ch'k'd	App'd
P1	13/01/12	Preliminary Issue	SF	AD	PJP

Mott MacDonald
Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

GEG GROSS ENERGY GROUP Engineering & Consulting

DOLSAR Engineering Ltd

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi
Georgia

Title

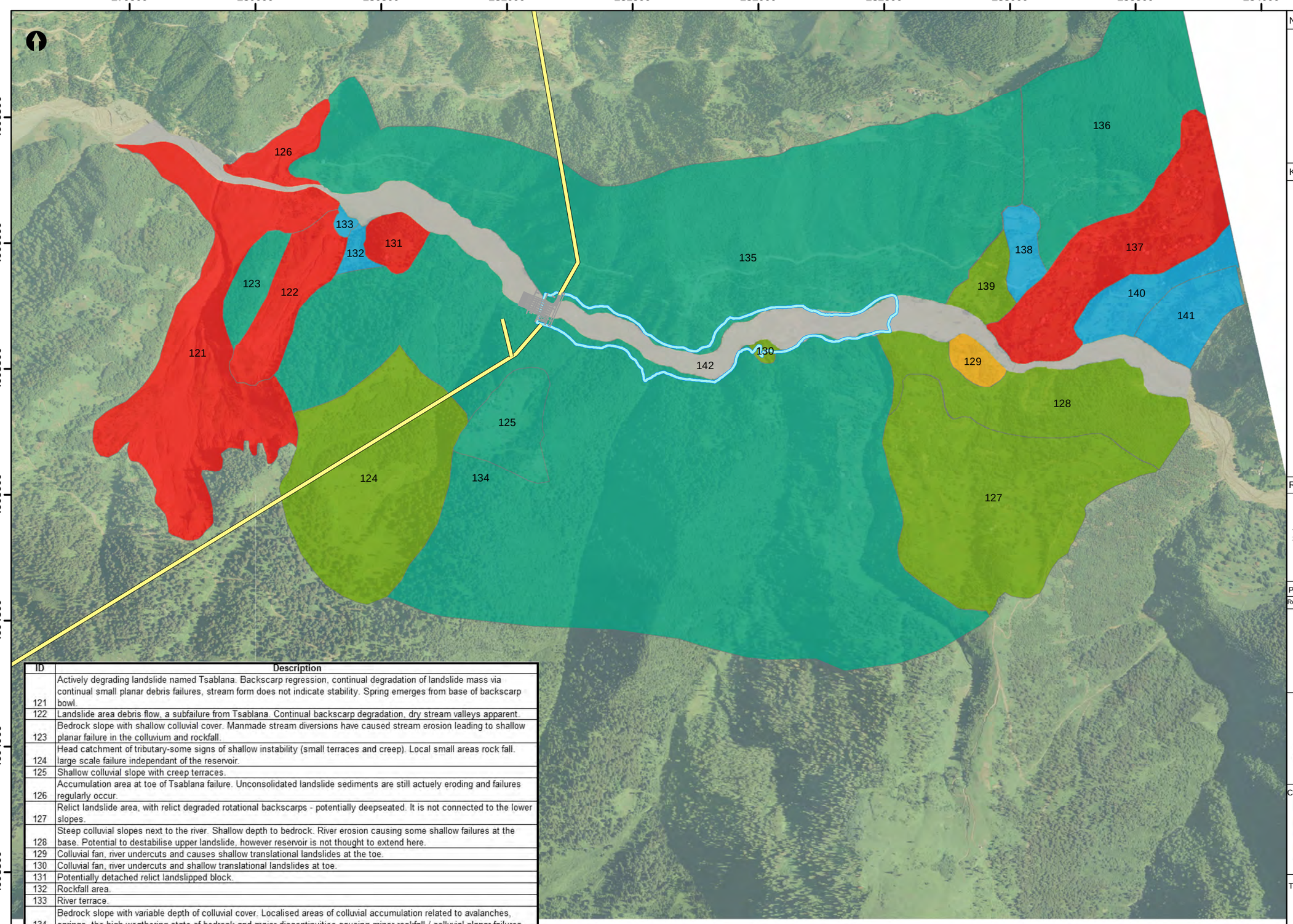
Adjaristsqali Hydropower Cascade Feasibility Study
Chirukhistsqali Weir and Intake Landslide Hazard Mapping

Designed	LB		Eng Check	AD	
Drawn	SF		Coordination	LB	
Dwg check	AD		Approved	PJP	

Scale @ A3: 1:13,000
Status: PRE
Rev: P1
Drawing Number: MMD-290039-MNC-SHU-02-112

279500 280000 280500 281000 281500 282000 282500 283000 283500 284000

4606500 4606000 4605500 4605000 4604500 4604000 4603500 4603000



ID	Description
121	Actively degrading landslide named Tsablana. Backscarp regression, continual degradation of landslide mass via continual small planar debris failures, stream form does not indicate stability. Spring emerges from base of backscarp bowl.
122	Landslide area debris flow, a subfailure from Tsablana. Continual backscarp degradation, dry stream valleys apparent.
123	Bedrock slope with shallow colluvial cover. Manmade stream diversions have caused stream erosion leading to shallow planar failure in the colluvium and rockfall.
124	Head catchment of tributary-some signs of shallow instability (small terraces and creep). Local small areas rock fall. large scale failure independant of the reservoir.
125	Shallow colluvial slope with creep terraces.
126	Accumulation area at toe of Tsablana failure. Unconsolidated landslide sediments are still actuely eroding and failures regularly occur.
127	Relict landslide area, with relict degraded rotational backscarps - potentially deepseated. It is not connected to the lower slopes.
128	Steep colluvial slopes next to the river. Shallow depth to bedrock. River erosion causing some shallow failures at the base. Potential to destabilise upper landslide, however reservoir is not thought to extend here.
129	Colluvial fan, river undercuts and causes shallow translational landslides at the toe.
130	Colluvial fan, river undercuts and shallow translational landslides at toe.
131	Potentially detached relict landslipped block.
132	Rockfall area.
133	River terrace.
134	Bedrock slope with variable depth of colluvial cover. Localised areas of colluvial accumulation related to avalanches, springs, the high weathering state of bedrock and major discontinuities causing minor rockfall / colluvial planar failures.
135	Bedrock slopes (south facing) with localised areas of rockfall. Planar failure dominates-due to dicontinuity orientations.
136	Area of rockfall. Thick vegetated tallus slope.
137	Relict landslide / debris flow. Kvatia Villige is located upon it. It is thought to be at the end of the scheme, but there are signs of planar instability along the roads cut into the toe of the landslide body.
138	Area of active terrace movement, considered to be shallow depth to bedrock, not directly affected by reservoir extent.
139	Paleo-planar landslide area. considered to be shallow and only shallow instability evidenced on the slope creep.
140	Bedrock slopes (south facing) localised areas of rockfall. Some dwellings from Katvia Village are located on this.
141	Recent shallow movement evidenced by surface creep terraces. Probably thin depth to bedrock.
142	Skhalta River Valley.

Metres
0 250 500 1,000

Notes

1. The hazard rating is calculated based upon impact rating vs likelihood rating (the ratings are described in full in the report).
2. Coordinate System: UTM Zone 38 North, WGS84 Datum
3. Structures and tunnles are shown are feasiblity design stage

Key to symbols

Likelihood – of the scheme construction / operation to cause mass movement	Impact of mass movement on the scheme / population: Low	Medium	High
Low	1	2	3
Medium	2	3	4
High	3	4	5

Tunnel Alignments

Reservior Extent

Reference drawings

- MMD-280039-MNC-SHU-03-101-P1 Shuakhevi Scheme Headrace Tunnel Alignment and long section
- MMD-280039-MNC-SHU-03-104-P1 Shuakhevi Scheme Shuakhevi transfer tunnels - alignment and long sec

Rev	Date	Description	Drawn	Ch'k'd	App'd
P1	13/01/12	Preliminary Issue	SF	AD	PJP

Mott MacDonald
Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

GEG GROSS ENERGY GROUP Engineering & Consulting

DOLSAR Engineering Ltd

Client

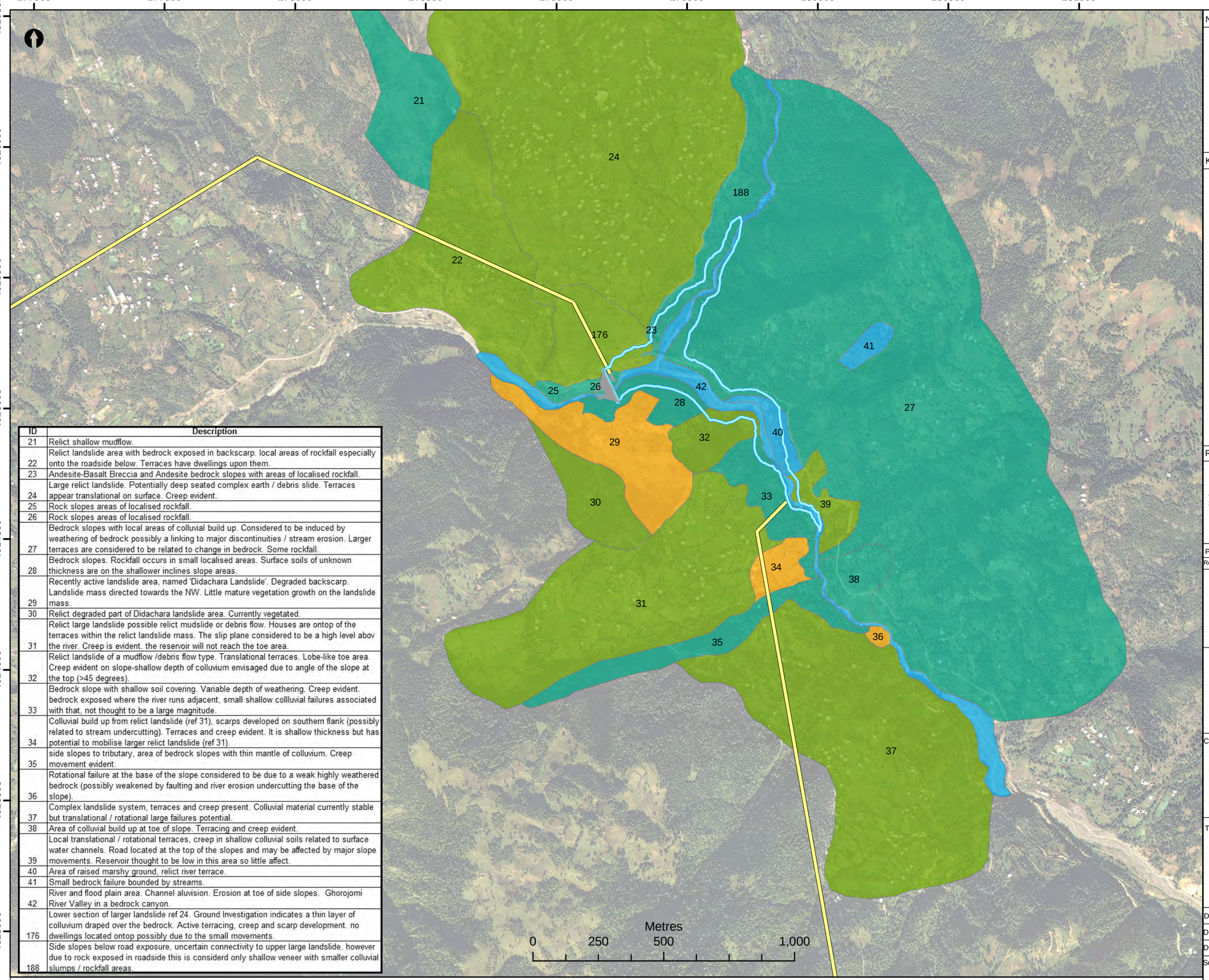
Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi
Georgia

Title

Adjaristsqali Hydropower Cascade
Feasibility Study
Skhalta Dam and Reservior
Landslide Hazard Mapping

Designed	LB		Eng Check	AD	
Drawn	SF		Coordination	LB	
Dwg check	AD		Approved	PJP	
Scale @ A3	1:15,000	Status	PRE	Rev	P1

Drawing Number
MMD-290039-MNC-SHU-02-122



ID	Description
21	Relict shallow mudflow.
22	Relict landslide area with bedrock exposed in backscarp. local areas of rockfall especially onto the roadside below. Terraces have dwellings upon them.
23	Andesite-Basalt Breccia and Andesite bedrock slopes with areas of localised rockfall.
24	Large relict landslide. Potentially deep seated complex earth / debris slide. Terraces appear translational on surface. Creep evident.
25	Rock slopes areas of localised rockfall.
26	Rock slopes areas of localised rockfall.
27	Bedrock slopes with local areas of colluvial build up. Considered to be induced by weathering of bedrock possibly a linking to major discontinuities / stream erosion. Larger terraces are considered to be related to change in bedrock. Some rockfall.
28	Bedrock slopes. Rockfall occurs in small localised areas. Surface soils of unknown thickness are on the shallower inclines slope areas.
29	Recently active landslide area, named 'Didachara Landslide'. Degraded backscarp. Landslide mass directed towards the NW. Little mature vegetation growth on the landslide mass.
30	Relict degraded part of Didachara landslide area. Currently vegetated.
31	Relict large landslide possible relict mudslide or debris flow. Houses are ontop of the terraces within the relict landslide mass. The slip plane considered to be a high level abov the river. Creep is evident. the reservoir will not reach the toe area.
32	Relict landslide of a mudflow /debris flow type. Translational terraces. Lobe-like toe area. Creep evident on slope-shallow depth of colluvium envisaged due to angle of the slope at the top (>45 degrees).
33	Bedrock slope with shallow soil covering. Variable depth of weathering. Creep evident. bedrock exposed where the river runs adjacent, small shallow collluvial failures associated with that, not thought to be a large magnitude.
34	Colluvial build up from relict landslide (ref 31), scarps developed on southern flank (possibly related to stream undercutting). Terraces and creep evident. It is shallow thickness but has potential to mobilise larger relict landslide (ref 31).
35	side slopes to tributary, area of bedrock slopes with thin mantle of colluvium. Creep movement evident.
36	Rotational failure at the base of the slope considered to be due to a weak highly weathered bedrock (possibly weakened by faulting and river erosion undercutting the base of the slope).
37	Complex landslide system, terraces and creep present. Colluvial material currently stable but translational / rotational large failures potential.
38	Area of colluvial build up at toe of slope. Terracing and creep evident.
39	Local translational / rotational terraces, creep in shallow colluvial soils related to surface water channels. Road located at the top of the slopes and may be affected by major slope movements. Reservoir thought to be low in this area so little affect.
40	Area of raised marshy ground, relict river terrace.
41	Small bedrock failure bounded by streams.
42	River and flood plain area. Channel aluvision. Erosion at toe of side slopes. Ghorojomi River Valley in a bedrock canyon.
176	Lower section of larger landslide ref 24. Ground Investigation indicates a thin layer of colluvium draped over the bedrock. Active terracing, creep and scarp development. no dwellings located ontop possibly due to the small movements.
188	Side slopes below road exposure, uncertain connectivity to upper large landslide. however due to rock exposed in roadside this is considerd only shallow veneer with smaller colluvial slumps / rockfall areas.

Notes

1. The hazard rating is calculated based upon impact rating vs likelihood rating (the ratings are described in full in the report).
2. Coordinate System: UTM Zone 38 North, WGS84 Datum
3. Structures and tunnels shown are feasibility design stage

Key to symbols

Likelihood – of the scheme construction / operation to cause mass movement	Impact of mass movement on the scheme / population: Low	Medium	High
Low	1	2	3
Medium	2	3	4
High	3	4	5

Tunnel Alignments

Resevior Extent

Reference drawings

- MMD-280039-MNC-SHU-03-101-P1 Shuakhevi Scheme Headrace Tunnel Alignment and long section
- MMD-280039-MNC-SHU-03-104-P1 Shuakhevi Scheme Shuakhevi transfer tunnels - alignment and long sec

Rev	Date	Description	Drawn	Ch'k'd	App'd
P1	13/01/12	Preliminary Issue	SF	AD	PJP

Mott MacDonald
Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

GEG GROSS ENERGY GROUP Engineering & Consulting

DOLSAR Engineering Ltd

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi
Georgia

Title

Adjaristsqali Hydropower Cascade Feasibility Study
Didachara Dam and Intake Landslide Hazard Mapping

Designed	LB		Eng Check	AD	
Drawn	SF		Coordination	LB	
Dwg check	AD		Approved	PJP	

Scale @ A3	Status	Rev
1:13,500	PRE	P1

Drawing Number
MMD-290039-MNC-SHU-02-132

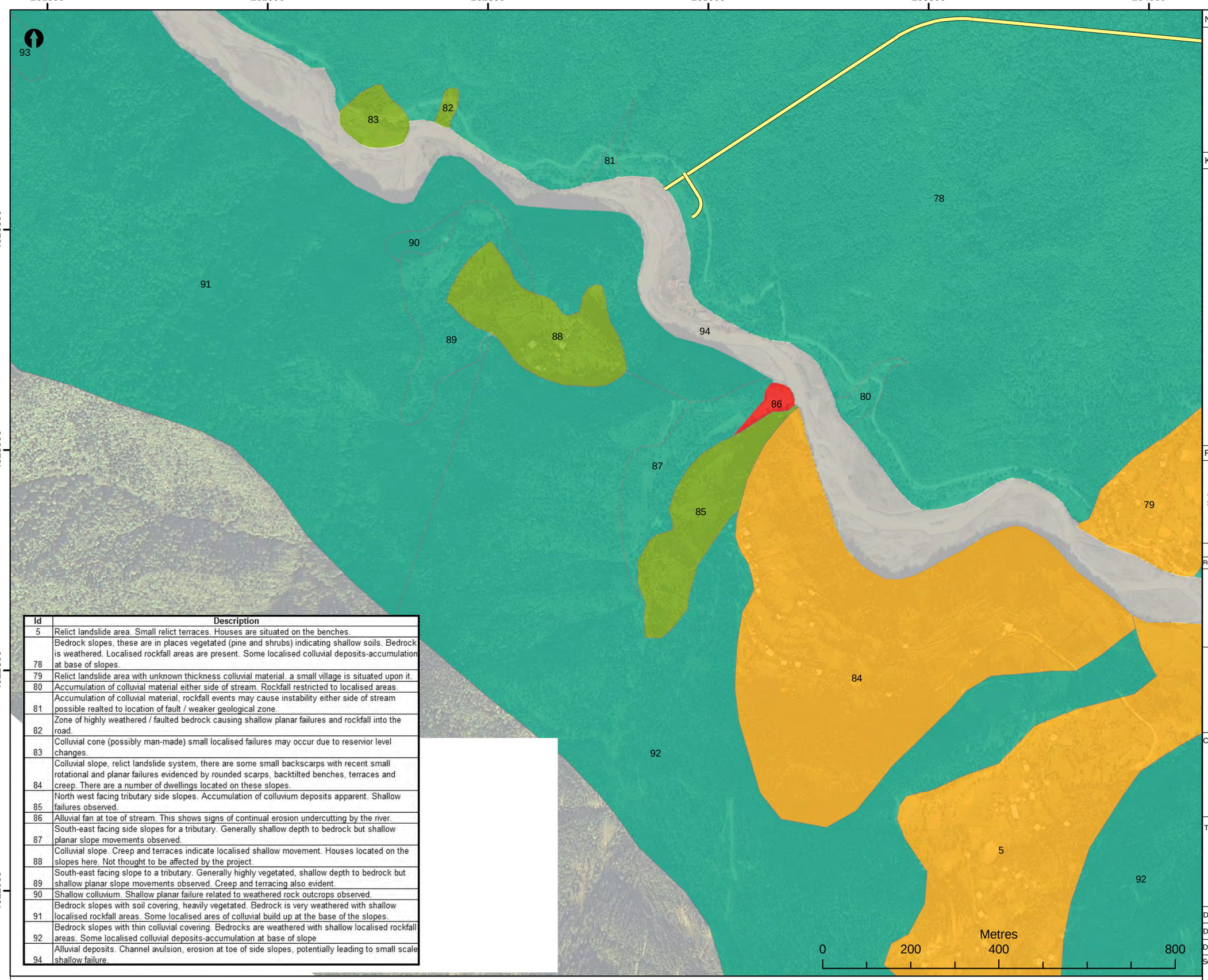
261500 262000 262500 263000 263500 264000

4613500

4613000

4612500

4612000



Id	Description
5	Relict landslide area. Small relict terraces. Houses are situated on the benches.
78	Bedrock slopes, these are in places vegetated (pine and shrubs) indicating shallow soils. Bedrock is weathered. Localised rockfall areas are present. Some localised colluvial deposits-accumulation at base of slopes.
79	Relict landslide area with unknown thickness colluvial material. a small village is situated upon it.
80	Accumulation of colluvial material either side of stream. Rockfall restricted to localised areas.
81	Accumulation of colluvial material, rockfall events may cause instability either side of stream possible realted to location of fault / weaker geological zone.
82	Zone of highly weathered / faulted bedrock causing shallow planar failures and rockfall into the road.
83	Colluvial cone (possibly man-made) small localised failures may occur due to reservior level changes.
84	Colluvial slope, relict landslide system, there are some small backscarps with recent small rotational and planar failures evidenced by rounded scarps, backtilted benches, terraces and creep. There are a number of dwellings located on these slopes.
85	North west facing tributary side slopes. Accumulation of colluvium deposits apparent. Shallow failures observed.
86	Alluvial fan at toe of stream. This shows signs of continual erosion undercutting by the river.
87	South-east facing side slopes for a tributary. Generally shallow depth to bedrock but shallow planar slope movements observed.
88	Colluvial slope. Creep and terraces indicate localised shallow movement. Houses located on the slopes here. Not thought to be affected by the project.
89	South-east facing slope to a tributary. Generally highly vegetated, shallow depth to bedrock but shallow planar slope movements observed. Creep and terracing also evident.
90	Shallow colluvium. Shallow planar failure related to weathered rock outcrops observed.
91	Bedrock slopes with soil covering, heavily vegetated. Bedrock is very weathered with shallow localised rockfall areas. Some localised ares of colluvial build up at the base of the slopes.
92	Bedrock slopes with thin colluvial covering. Bedrocks are weathered with shallow localised rockfall areas. Some localised colluvial deposits-accumulation at base of slope
94	Alluvial deposits. Channel avulsion, erosion at toe of side slopes, potentially leading to small scale shallow failure.

Notes

1. The hazard rating is calculated based upon impact rating vs likelihood rating (the ratings are described in full in the report).
2. Coordinate System: UTM Zone 38 North, WGS84 Datum
3. Structures and tunnels shown are feasibility design stage

Key to symbols

		Impact of mass movement on the scheme / population		
		Low	Medium	High
Likelihood – of the scheme construction / operation to cause mass movement	Low	1	2	3
	Medium	2	3	4
	High	3	4	5

Tunnel Alignments

Reference drawings

- MMD-280039-MNC-SHU-03-101-P1 Shuakhevi Scheme Headrace Tunnel Alignment and long section
- MMD-280039-MNC-SHU-03-104-P1 Shuakhevi Scheme Shuakhevi transfer tunnels - alignment and long sec

Rev	Date	Description	Drawn	Ch'k'd	App'd
P1	13/01/12	Preliminary Issue	SF	AD	PJP

Mott MacDonald
Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

GEG GROSS ENERGY GROUP Engineering & Consulting

DOLSAR Engineering Ltd

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi
Georgia

Title

Adjaristsqali Hydropower Cascade
Feasibility Study
Shuakhevi Hydro Powerhouse
Landslide Hazard Mapping

Designed	LB		Eng Check	AD	
Drawn	SF		Coordination	LB	
Dwg check	AD		Approved	PJP	

Scale @ A3: 1:8,000
Status: PRE
Rev: P1

Drawing Number: MMD-290039-MNC-SHU-02-142

Appendix F. Traffic and Transportation

F.1. Shuakhevi Scheme – Bridges and Pipe Bridges

Table F.1: Existing Bridges and Pipe Bridges

№	Name	Location	Structure Type	Approx. capacity (t)	Length (m)	Width (m)	Note
State highway (S-1)							
1	Bridge	River Jochostsqali	Reinforced Concrete	50	25	8	
2	Pipe bridge	Unnamed Tributary	Reinforced Concrete	50	2	8	
3	Pipe bridge	Unnamed Tributary	Reinforced Concrete	50	6	8	
4	Pipe bridge	Unnamed Tributary	Reinforced Concrete	50	5	8	
5	Pipe bridge	Unnamed Tributary	Reinforced Concrete	50	3	8	
6	Bridge	Unnamed Tributary	Reinforced Concrete	50	40	8	
7	Bridge	River Qrughelistsqali	Reinforced Concrete	50	5	8	
8	Bridge	River Adjaristsqali	Reinforced Concrete	30	90	4	May require rehabilitation
9	Bridge	River Kveda Bzana	Reinforced Concrete	50	30	8	
10	Pipe bridge	Unnamed Tributary	Metal	50	-	10	
11	Bridge	River Bzana	Reinforced Concrete	50	26	8	
12	Bridge	River Adjaristsqali	Mixed Construction	10	145	3	May require rehabilitation
13	Pipe bridge	Unnamed Tributary	Reinforced Concrete	50	-	10	
14	Pipe bridge	Unnamed Tributary	Reinforced Concrete	50	-	10	
15	Bridge	River Babuchoghlebi	Reinforced Concrete	50	20	10	
16	Bridge	River Adjaristsqali	Reinforced Concrete	50	75	5	May require rehabilitation
17	Bridge	Unnamed Tributary	Reinforced Concrete	50	5	8	
18	Overhead Road	River Adjaristsqali	Reinforced Concrete	50	155	8	
19	Bridge	River Adjaristsqali	Mixed Construction	30	85	5	
20	Bridge	River Kalaskuri	Reinforced Concrete	50	20	8	
21	Bridge	River Adjaristsqali	Reinforced Concrete	10	56	3	May require rehabilitation
22	Bridge	Unnamed Tributary	Reinforced Concrete	50	25	8	
23	Pipe bridge	Unnamed Tributary	Reinforced	50	19	8	

№	Name	Location	Structure Type	Approx. capacity (t)	Length (m)	Width (m)	Note
			Concrete				
24	Pipe bridge	Unnamed Tributary	Reinforced Concrete	50	5	8	
25	Pipe bridge	Unnamed Tributary	Reinforced Concrete	50	5	8	
26	Bridge	Unnamed Tributary	Reinforced Concrete	50	30	8	
27	Pipe bridge	Unnamed Tributary	Reinforced Concrete	50	3	8	
28	Pipe bridge	Unnamed Tributary	Reinforced Concrete	50	3	8	
29	Pipe bridge	Unnamed Tributary	Reinforced Concrete	50	7	8	
30	Pipe bridge	Unnamed Tributary	Reinforced Concrete	50	7	8	
31	Bridge	River Tsoniarisi	Reinforced Concrete	50	42	8	
32	Bridge	Unnamed Tributary	Metal	10	15	4	May require rehabilitation
33	Pipe bridge	Unnamed Tributary	Reinforced Concrete	10	5	4	May require rehabilitation
34	Pipe bridge	Unnamed Tributary	Reinforced Concrete	10	5	4	May require rehabilitation
35	Pipe bridge	Unnamed Tributary	Reinforced Concrete	10	5	4	May require rehabilitation
36	Bridge	Unnamed Tributary	Reinforced Concrete	10	12	5	May require rehabilitation
37	Bridge	River Adjaristsqali	Metal	12	48	5	May require rehabilitation
38	Bridge	River Adjaristsqali	Reinforced Concrete	50	82	10	
39	Pipe bridge	Unnamed Tributary	Reinforced Concrete	10	8	6	May require rehabilitation
40	Bridge	Unnamed Tributary	Mixed Construction	50	24	8	May require rehabilitation
41	Bridge	River Posadanistsqali	Reinforced Concrete	50	15	8	
42	Bridge	Unnamed Tributary	Reinforced Concrete	50	24	8	
43	Bridge	Unnamed Tributary	Reinforced Concrete	50	75	8	
44	Bridge	Unnamed Tributary	Reinforced Concrete	10	8	6	May require rehabilitation
45	Bridge	River Chvanistsqali	Reinforced Concrete	50	40	8	
46	Pipe bridge	Unnamed Tributary	Reinforced Concrete	50	3	7	
47	Pipe bridge	Unnamed Tributary	Reinforced Concrete	50	3	7	
48	Pipe bridge	Unnamed Tributary	Reinforced	50	3	7	

№	Name	Location	Structure Type	Approx. capacity (t)	Length (m)	Width (m)	Note
			Concrete				
49	Pipe bridge	Unnamed Tributary	Reinforced Concrete	15	12	7	May require rehabilitation
50	Bridge	River Chanchkhalostsqali	Reinforced Concrete	15	23	7	May require rehabilitation
51	Bridge	River Adjaristsqali	Metal	2	22	3	
52	Pipe bridge	River Tskhramukhlistsqali	Reinforced Concrete	15	10	7	May require rehabilitation
53	Pipe bridge	Unnamed Tributary	Reinforced Concrete	15	4	7	May require rehabilitation
54	Pipe bridge	Unnamed Tributary	Reinforced Concrete	25	5	7	
55	Pipe bridge	Unnamed Tributary	Reinforced Concrete	15	5	7	May require rehabilitation
56	Pipe bridge	Unnamed Tributary	Reinforced Concrete	15	5	7	May require rehabilitation
57	Pipe bridge	Unnamed Tributary	Reinforced Concrete	15	5	7	May require rehabilitation
58	Pipe bridge	Unnamed Tributary	Reinforced Concrete	15	5	7	May require rehabilitation
59	Pipe bridge	Unnamed Tributary	Reinforced Concrete	15	5	7	May require rehabilitation
60	Bridge	River Adjaristsqali	Mixed Construction	2	45	2	
61	Bridge	River Diakonisdzeebistsqali	Reinforced Concrete	25	10	7	May require rehabilitation
62	Bridge	River Ghorjomitsqali	Reinforced Concrete	50	60	8	Will be flooded
State Highway (S-77)							
1	Bridge	River Chirukhistsqali	Reinforced Concrete	15	50	4	May require rehabilitation
2	Bridge	River Chirukhistsqali	Metal	6	20	3	May require rehabilitation
3	Bridge	River Modulistsqali	Metal	3	18	3	May require rehabilitation
4	Bridge	River Chirukhistsqali	Metal	4	36	4	May require rehabilitation
5	Bridge	River Chirukhistsqali	Metal	10	24	4	May require rehabilitation
State Highway (S-75)							
1	Bridge	River Skhalta	Metal	25	23	4	May require rehabilitation
2	Bridge	River Skhalta	Metal	10	16	3	May require rehabilitation
3	Bridge	River Skhalta	Reinforced Concrete	10	3	4	May require rehabilitation
4	Pipe bridge	River Skhalta	Reinforced Concrete	3	7	4	May require rehabilitation
5	Bridge	River Skhalta	Reinforced	7	8	4	May require

№	Name	Location	Structure Type	Approx. capacity (t)	Length (m)	Width (m)	Note
			Concrete				rehabilitation
6	Pipe bridge	River Skhalta	Metal	7	24	3	May require rehabilitation
7	Bridge	River Skhalta	Reinforced Concrete	7	30	3	May require rehabilitation

Table F.2: New Bridges and Pipe Bridges

№	Location	Type of Bridge/Pipe Bridge	Approx. Span (m)	Estimated High Flood Level (m)
1	Approx. 910 m u/s of Didachara dam axis	70R	60.0	787.5
2	Chirukhistsqali Weir	70R	40	918.0
3	Approx. 50 m d/s of Adit 1 portal	70R	50	725.0
4	Approx. 50 m d/s of Adit 2 portal	70R	62.5	705.0

F.2. Koromkheti Scheme – Bridges and Pipe Bridges

Table F.3: Existing Bridges and Pipe Bridges

№	Name	Location	Structure Type	Approx. capacity (t)	Length (m)	Width (m)	Note
State highway (S-1)							
1	Bridge	River Jochostsqali	Reinforced Concrete	50	25	8	
2	Pipe bridge	Unnamed Tributary	Reinforced Concrete	50	2	8	
3	Pipe bridge	Unnamed Tributary	Reinforced Concrete	50	6	8	
4	Pipe bridge	Unnamed Tributary	Reinforced Concrete	50	5	8	
5	Pipe bridge	Unnamed Tributary	Reinforced Concrete	50	3	8	
6	Bridge	Unnamed Tributary	Reinforced Concrete	50	40	8	
7	Bridge	River Qrughelistsqali	Reinforced Concrete	50	5	8	
8	Bridge	River Adjaristsqali	Reinforced Concrete	30	90	4	May require rehabilitation
9	Bridge	River Kveda Bzana	Reinforced Concrete	50	30	8	
10	Pipe bridge	Unnamed Tributary	Metal	50	-	10	
11	Bridge	River Bzana	Reinforced Concrete	50	26	8	
12	Bridge	River Adjaristsqali	Mixed Construction	10	145	3	May require rehabilitation
13	Pipe bridge	Unnamed Tributary	Reinforced Concrete	50	-	10	
14	Pipe bridge	Unnamed Tributary	Reinforced Concrete	50	-	10	
15	Bridge	River Babuchoghlebi	Reinforced Concrete	50	20	10	
16	Bridge	River Adjaristsqali	Reinforced Concrete	50	75	5	May require rehabilitation
17	Bridge	Unnamed Tributary	Reinforced Concrete	50	5	8	
18	Overhead Road	River Adjaristsqali	Reinforced Concrete	50	155	8	
19	Bridge	River Adjaristsqali	Mixed Construction	30	85	5	
20	Bridge	River Kalaskuri	Reinforced Concrete	50	20	8	
21	Bridge	River Adjaristsqali	Reinforced Concrete	10	56	3	May require rehabilitation
22	Bridge	Unnamed Tributary	Reinforced Concrete	50	25	8	
23	Pipe bridge	Unnamed Tributary	Reinforced	50	19	8	

№	Name	Location	Structure Type	Approx. capacity (t)	Length (m)	Width (m)	Note
			Concrete				
24	Pipe bridge	Unnamed Tributary	Reinforced Concrete	50	5	8	
25	Pipe bridge	Unnamed Tributary	Reinforced Concrete	50	5	8	
26	Bridge	Unnamed Tributary	Reinforced Concrete	50	30	8	
27	Pipe bridge	Unnamed Tributary	Reinforced Concrete	50	3	8	
28	Pipe bridge	Unnamed Tributary	Reinforced Concrete	50	3	8	
29	Pipe bridge	Unnamed Tributary	Reinforced Concrete	50	7	8	
30	Pipe bridge	Unnamed Tributary	Reinforced Concrete	50	7	8	
31	Bridge	River Tsoniarisi	Reinforced Concrete	50	42	8	
32	Bridge	Unnamed Tributary	Metal	10	15	4	May require rehabilitation
33	Pipe bridge	Unnamed Tributary	Reinforced Concrete	10	5	4	May require rehabilitation
34	Pipe bridge	Unnamed Tributary	Reinforced Concrete	10	5	4	May require rehabilitation
35	Pipe bridge	Unnamed Tributary	Reinforced Concrete	10	5	4	May require rehabilitation
36	Bridge	Unnamed Tributary	Reinforced Concrete	10	12	5	May require rehabilitation
37	Bridge	River Adjaristsqali	Metal	12	48	5	May require rehabilitation
38	Bridge	River Adjaristsqali	Reinforced Concrete	50	82	10	
39	Pipe bridge	Unnamed Tributary	Reinforced Concrete	10	8	6	May require rehabilitation
40	Bridge	Unnamed Tributary	Mixed Construction	50	24	8	May require rehabilitation
41	Bridge	River Posadanistsqali	Reinforced Concrete	50	15	8	
42	Bridge	Unnamed Tributary	Reinforced Concrete	50	24	8	
43	Bridge	Unnamed Tributary	Reinforced Concrete	50	75	8	
44	Bridge	Unnamed Tributary	Reinforced Concrete	10	8	6	May require rehabilitation
45	Bridge	River Chvanistsqali	Reinforced Concrete	50	40	8	
State Highway (S-74)							
1	Bridge	River Adjaristsqali	Reinforced Concrete	50	100	10	
2	Bridge	River Akavreta	Metal	10	35	4	May require rehabilitation

№	Name	Location	Structure Type	Approx. capacity (t)	Length (m)	Width (m)	Note
3	Pipe bridge	Unnamed Tributary	Reinforced Concrete	5	3	3	May require rehabilitation
4	Bridge	River Akavreta	Metal	5	20	3	May require rehabilitation
5	Bridge	Unnamed Tributary	Metal	5	10	3	May require rehabilitation
6	Bridge	Unnamed Tributary	Metal	5	6	3	May require rehabilitation
7	Bridge	River Akavreta	Metal	5	24	3	May require rehabilitation
8	Bridge	River Akavreta	Metal	-	20	1.5	May require rehabilitation

Table F.4: New bridges and Pipe Bridges

№	Location	Type of Bridge/Pipe Bridge	Approx. Span (m)	Estimated High Flood Level (m)
1	Approx. 255m d/s of Akavreta Dam	70R	46.8	350.5
2	Approx. 700m d/s of Adit 5	70R	37.5	304.5
3	Outlet Portal	70R	25.0	155.5

F.3. Khertvisi Scheme – Bridges and Pipe Bridges

Table F.5: Existing Bridges and Pipe Bridges

№	Name	Location	Structure Type	Approx. capacity (t)	Length (m)	Width (m)	Note
State highway (S-1)							
1	Bridge	River Jochostsqali	Reinforced Concrete	50	25	8	
2	Pipe bridge	Unnamed Tributary	Reinforced Concrete	50	2	8	
3	Pipe bridge	Unnamed Tributary	Reinforced Concrete	50	6	8	
4	Pipe bridge	Unnamed Tributary	Reinforced Concrete	50	5	8	
5	Pipe bridge	Unnamed Tributary	Reinforced Concrete	50	3	8	
6	Bridge	Unnamed Tributary	Reinforced Concrete	50	40	8	
7	Bridge	River Qrughelistsqali	Reinforced Concrete	50	5	8	
8	Bridge	River Adjaristsqali	Reinforced Concrete	30	90	4	May require rehabilitation
9	Bridge	River Kveda Bzana	Reinforced Concrete	50	30	8	
10	Pipe bridge	Unnamed Tributary	Metal	50	-	10	
11	Bridge	River Bzana	Reinforced Concrete	50	26	8	
12	Bridge	River Adjaristsqali	Mixed Construction	10	145	3	May require rehabilitation
13	Pipe bridge	Unnamed Tributary	Reinforced Concrete	50	-	10	
14	Pipe bridge	Unnamed Tributary	Reinforced Concrete	50	-	10	
15	Bridge	River Babuchoghlebi	Reinforced Concrete	50	20	10	
State Highway (S-74)							
1	Bridge	River Adjaristsqali	Metal	10	50	4	May require rehabilitation
2	Pipe bridge	Unnamed Tributary	Reinforced Concrete	25	2	5	May require rehabilitation
3	Pipe bridge	Unnamed Tributary	Stone	30	4	5	May require rehabilitation
4	Pipe bridge	Unnamed Tributary	Stone	60	3	5	May require rehabilitation
5	Bridge	Unnamed Tributary	Reinforced Concrete	30	6	6	May require rehabilitation
6	Bridge	River Machakhlistsqali	Mixed Construction	10	50	6	
7	Bridge	Unnamed Tributary	Mixed Construction	10	4	4	May require rehabilitation

№	Name	Location	Structure Type	Approx. capacity (t)	Length (m)	Width (m)	Note
8	Pipe bridge	Unnamed Tributary	Mixed Construction	10	4	4	May require rehabilitation
9	Pipe bridge	Unnamed Tributary	Mixed Construction	10	4	4	May require rehabilitation
10	Pipe bridge	Unnamed Tributary	Mixed Construction	10	4	4	May require rehabilitation
11	Pipe bridge	Unnamed Tributary	Reinforced Concrete	10	4	4	May require rehabilitation
12	Bridge	River Machakhlistsqali	Metal	15	30	4	May require rehabilitation
13	Pipe bridge	Unnamed Tributary	Reinforced Concrete	10	5	4	May require rehabilitation
14	Bridge	River Machakhlistsqali	Mixed Construction	12	40	4	

Table F.6: New Bridges and Pipe Bridges

№	Location	Type of Bridge/Pipe Bridge	Approx. Span (m)	Estimated High Flood Level (m)
1	Approx. 210 m d/s of Khertvisi dam axis	70R	25.0	92.5
2	Approx. 72 m d/s of Machakhlistsqali dam axis	70R	approx. 125.0	100.5

Appendix G. Greenhouse Gas Emissions

Table G.1: Emissions Factors to Calculate CO_2e

Item	Emission Factor	Emission Factor Unit	Source
Concrete	0.1	$kgCO_2e/t$	IFC CEET
	1.2	$kgCO_2e/kg$	ICE v2
	1.59	$kgCO_2e/£$	Defra
Electrical Equipment	53	$kgCO_2e/£$	Defra
Cement	235	$kgCO_2e/t$	IFC CEET
PVC	520	$kgCO_2e/t$	IFC CEET
	1.13	$kgCO_2e/£$	Defra
Steel	2.89	$kgCO_2e/kg$	ICE V2
	4.11	$kgCO_2e/£$	Defra
Stainless Steel	6.15	$kgCO_2e/kg$	ICE v2
Construction	0.54	$kgCO_2e/£$	Defra
Clay	1.89	$kgCO_2e/£$	Defra
Rigid Truck	1.15928	$kgCO_2e/veh\ km$	Defra
Private Passenger Car	0.20510	$kgCO_2e/veh\ km$	Defra
Quarry Stone	0.003	$kgCO_2e/kg$	IFC CEET
Formwork	1.1	$kgCO_2e/kg$	ICE v2

Appendix H. Cultural Heritage and Archaeology

H.1. Cultural Heritage Monuments Table

Table H.1: Cultural heritage Data

MM ref	Grid Ref UTM Zone 38N WGS84	Description	Date	Adjara Municipality	Scheme Phase	Source	Designation
1	227815, 4606318	Khertvisi (Zedobani) Winepress	AD XI century	Khelvachauri	Khertvisi - III	CHPAA	-
2	227837, 4603664	Khertvisi Winepress and Marani (location for storing wine in special pitchers)	AD XI-XIII Centuries	Khelvachauri	Khertvisi – III	CHPAA	-
3	226191, 4601323	Gvara castle. Gvara Fortress is situated at the merging of the rivers Chorokhi and Machakhela, 300m far from the mouth. It is built on a rocky hill. Most of its walls are destroyed except the south-western and northern-western ones. Their maximal height is 5-6m. Conducted researched works proved that the fortress had been built during the 6th-7th centuries there. It was restored later in the 9th-13th centuries. Due to its advantageous location the fortress had played actual role in controlling roads from the sea to Klarjeti and Artanuji.	AD I-III Centuries	Khelvachauri	Khertvisi – III	CHPAA	-
4	234672, 4600290	Tskhemlara Arch Bridge was over the River Machakhela, 7-8km far from Village Adjaristsqali, which is situated along the Batumi-Khulo highway. The bridge served local population in Village Tskhemlara before constructing a motorway bridge in 60's of 20th century. The bridge is 19.6m length, and its walking area is 22m length. It is 1.6m width in the centre, and 5.3m height. Half-oval arch bridge is quite narrow and was used for walking. One can see the second layer of stones, thus its original face is lost. In 2008 the bridge was restored and rehabilitated.	Late Middle Ages	Khelvachauri	Khertvisi – III	CHPAA	-
5	234432, 4600468	Tskhemalaras winepress and Marani (location for storing wine in special pitchers)	AD XI-XII centuries	Khelvachauri	Khertvisi – III	CHPAA	-
6	252505, 4614301	Djame in Abukeda village	XIX century	Keda	Koromkheti -II	Gamma Consulting/Site Survey	Local importance monument
7	255188, 4614928	Djame in Akho village	Later Middle Ages	Keda	Koromkheti –II	Gamma Consulting/Site Survey	National importance monument
8	256954, 4615546	Tower ruin	Later Middle Ages	Keda	Koromkheti –II	Gamma Consulting/Site Survey	Local importance monument

MM ref	Grid Ref UTM Zone 38N WGS84	Description	Date	Adjara Municipality	Scheme Phase	Source	Designation
9	256974, 4615546	Djame	XIX century	Keda	Koromkheti –II	Gamma Consulting/Site Survey	Local importance monument
10	245819, 4610723	Djame	XIX century	Keda	Koromkheti –II	Gamma Consulting/Site Survey	Local importance monument
11	259126, 4614617	Dandalo Bridge	Xi-XII century	Keda	Koromkheti –II	Gamma Consulting/Site Survey	National importance monument
12	259126, 4614617	Kavianis (Khitchauri) Fortress located in Dandalo village “Kilivake”	Later Middle Ages	Keda	Koromkheti –II	Gamma Consulting/Site Survey	National importance monument
13	259126, 4614617	Dandalo remains located at the end of the village, 250m away from the left bank of the Adjaristsqali river	Later Middle Ages	Keda	Koromkheti –II	Gamma Consulting/Site Survey	National importance monument
14	228474, 4604624	Djame, Dologani village	XIX/XX century	Khelvachauri	Khertvisi – III	Gamma Consulting/Site Survey and CHPAA	Local importance monument
15	250581, 4615015	Djame, Varjanisi village	XIX century	Keda	Koromkheti –II	Gamma Consulting/Site Survey	Local importance monument
16	236514, 4604809	Djame, Zeda Bzubzu village	XIX century	Keda	Khertvisi – III	Gamma Consulting/Site Survey	Local importance monument
17	238025, 4608172	Tower, Zeda Makhuntseti village	Middle Ages	Keda	Khertvisi – III	Gamma Consulting/Site Survey	Local importance monument
18	244048, 4610179	Fortress, Zendidi village	Later Middle Ages	Keda	Koromkheti –II	Gamma Consulting/Site Survey	Inserted in category of stationary cultural monuments of National importance
19	244048, 4610179	Church, Zendidi village	High Middle Ages	Keda	Koromkheti –II	Gamma Consulting/Site Survey	Local importance monument
20	246931, 4612150	Tower, Zesofeli village (south-west)	Middle Ages	Keda	Koromkheti –II	Gamma Consulting/Site Survey	Local importance monument
21	244048, 4610179	Fortress Ruin, Zendidi village	High Middle Ages	Keda	Koromkheti –II	Gamma Consulting/Site Survey	Local importance monument
22	247812, 4613053	Tower, Zvare village (central road)	Later Middle Ages	Keda	Koromkheti –II	Gamma Consulting/Site Survey	Local importance monument

MM ref	Grid Ref UTM Zone 38N WGS84	Description	Date	Adjara Municipality	Scheme Phase	Source	Designation
23	247812, 4613053	Djame, Zvare village	1834	Keda	Koromkheti –II	Gamma Consulting/Site Survey	Local importance monument
24	249167, 4612474	Djame, Kvashta village	XIX century	Keda	Koromkheti –II	Gamma Consulting/Site Survey	Local importance monument
25	256107, 4613600	Djame, Kokotauri village	XIX century	Keda	Koromkheti –II	Gamma Consulting/Site Survey	Local importance monument
26	256107, 4613600	Kokotauri village (yard of Mamuladzeebi), Winepress	Later Middle Ages	Keda	Koromkheti –II	Gamma Consulting/Site Survey	Local importance monument
27	240623, 4607165	Djame, Kolotauri village	XIX century	Keda	Shuakhevi –I	Gamma Consulting/Site Survey	Local importance monument
28	234959, 4603973	Medrese (madrasah), Milisa village	XIX century	Keda	Khertvisi – III	Gamma Consulting/Site Survey	Local importance monument
29	247710, 4605767	Tskaro, Medzibna village (possibly the same as MM 54)	XX century	Keda	Koromkheti –II	Gamma Consulting/Site Survey	Local importance monument
30	246353, 4606346	Remains of Sharvashidzeebi house, Oqtomberi village		Keda	Koromkheti –II	Gamma Consulting/Site Survey	Local importance monument
31	246353, 4606346	Winepress located at the end of Oqtomberi village, just outside the settlement	Later Middle Ages	Keda	Koromkheti –II	Gamma Consulting/Site Survey	Local importance monument
32	240031, 4608791	Tsivasula Fortress, around Pirveli Maisi village	Middle Ages	Keda	Koromkheti –II	Gamma Consulting/Site Survey	National importance monument
33	240031, 4608791	“Mitsis Khidi”, around Pirveli Maisi village	Middle Ages	Keda	Koromkheti –II	Gamma Consulting/Site Survey	National importance monument
34	233404, 4603062	Djame, Uchkhiti village	Middle Ages	Khelvachauri	Khertvisi - III	Gamma Consulting/Site Survey	Local importance monument
35	236268, 4606070	Bridge, Kveda Makhuntseti village	IX-X century	Keda	Khertvisi – III	Gamma Consulting/Site Survey	National importance monument
36	236268, 4606070	Djame, Kveda Makhuntseti village	XIX century	Keda	Khertvisi-III	Gamma Consulting/Site Survey	Local importance monument
37	254079, 4614022	Bridge, Tskhomorisi village	Later Middle Ages	Keda	Koromkheti –II	Gamma Consulting/Site Survey	National importance monument

MM ref	Grid Ref UTM Zone 38N WGS84	Description	Date	Adjara Municipality	Scheme Phase	Source	Designation
38	254081, 4614022	Djame, Tskhomorisi village	XIX century	Keda	Koromkheti –II	Gamma Consulting/Site Survey	Local importance monument
39	243176, 4608536	Fortress, located north-east of Dzetsmani village	Middle Ages	Keda	Koromkheti –II	Gamma Consulting/Site Survey	National importance monument
40	243176, 4608536	Djame, Dzetsmani village	XIX century	Keda	Koromkheti –II	Gamma Consulting/Site Survey	Local importance monument
41	251566, 4616674	Bridge, Tsoniarisi village	Later Middle Ages/ IX – X centuries	Keda	Koromkheti –II	Gamma Consulting/Site Survey	National importance monument
42	251566, 4616674	Djame, Tsoniarisi village	XIX century	Keda	Koromkheti –II	Gamma Consulting/Site Survey	Local importance monument
43	230898, 4605408	Djame, Chinkadzeebi village	XIX century	Keda	Khertvisi – III	Gamma Consulting/Site Survey	Local importance monument
44	247200, 4609476	Bridge over Adjaristsqali river at Akutsa village	Later Middle Ages	Keda	Koromkheti –II	Gamma Consulting/Site Survey	National importance cultural heritage monument
45	234963, 4604125	Mosque at Milisi village, possibly the same as MM28	XIX century	Keda	Khertvisi –II	CHPAA	-
46	239983, 4607896	Cave, Kolotauri village	VIII – IV century BC/Neolithic	Keda	Koromkheti –II	CHPAA	-
47	240019, 4608007	Tower, Kolotauri village	XII-XIII centuries	Keda	Koromkheti –II	CHPAA	-
48	240853, 4608821	Tsivasula castle. Tsivasula Fortress is built in 12th-13th cc. It is situated 0.5km far from the central highway where Sagoreti and Adjara rivers merge. The fortress area is 400m. Its main function used to control roads throughout Acharistskali and Agaristskali valleys. A legend says the fortress name is given in honour of its owner the Tsivadzes family. Same as MM 32.	XII-XIII centuries	Keda	Koromkheti –II	CHPAA	-
49	240232, 4609294	Bridge at Sagoreti village. Sagoreti Bridge is situated in village Sagoreti, Keda Municipality, on the right tributary of the river Agaristskali on the river Chanchakheti. The bridge is 16m long and 2.6m width. The pier is built in natural cliff, which is 4.64m	XI-XII centuries	Keda	Koromkheti –II	CHPAA	-

MM ref	Grid Ref UTM Zone 38N WGS84	Description	Date	Adjara Municipality	Scheme Phase	Source	Designation
		height from water surface. The pier itself is 1.16m height and 2.62m width. An oval arch made of clean cut stones was based onto the pier. The arch itself consists of two parts, i.e. the construction itself and fence. The nearby area is covered with cut stones. Sagoreti Bridge has more developed constructing techniques than other bridges. It is very similar to Makho Bridge. Sagoreti Bridge is supposed to be dated back to mid centuries.					
50	243149, 4608877	Winepress at Koromkheti	XI-XIII centuries	Keda	Koromkheti –II	CHPAA	-
51	243728, 4608354	Castle at Dzetsmani, possibly the same as MM39	XII-XIII centuries	Keda	Koromkheti –II	CHPAA	-
52	244224, 4610219	Castle at Zendidi village. Possibly same as MM18	XVII-XIX centuries	Keda	Koromkheti –II	CHPAA	-
53	246269, 4607673	Winepress at Oqtemberi village. Probably same as MM31	XI-XIII centuries	Keda	Koromkheti –II	CHPAA	-
54	248138, 4606492	Spring, probably same as MM29.	XX century	Keda	Koromkheti –II	CHPAA	-
55	282123, 4599182	Darchidzeebi village “Kalaboni”, Fortress	Later Middle Ages	Shuakhevi	Shuakhevi –I	Gamma Consulting/Site Survey	Local importance monument
56	263662, 4618158	Varjanauli village, Bridge	Later Middle Ages	Shuakhevi	Shuakhevi –I	Gamma Consulting/Site Survey	National importance monument
57	267808, 4611503	Remains of church of Nenia, located at the end of Nenia village (yard of R. Kamadadze)	Later Middle Ages	Shuakhevi	Shuakhevi –I	Gamma Consulting/Site Survey	Local importance monument
58	271842, 4611845	Phurtio bridge near Zamleti village	XI-XII centuries	Shuakhevi	Shuakhevi –I	Gamma Consulting/Site Survey	National importance monument
59	272688, 4607781	Remains of church of Phurtio located on the left bank of Skhaltistskali river, at the end of Phurtio village	XI-XII centuries	Shuakhevi	Shuakhevi –I	Gamma Consulting/Site Survey	National importance monument
60	272688,	Remains of Phurtio located on north-east direction from the	Antic period	Shuakhevi	Shuakhevi	Gamma	Local importance

MM ref	Grid Ref UTM Zone 38N WGS84	Description	Date	Adjara Municipality	Scheme Phase	Source	Designation
	4607781	village centre, at the beginning of village forest			–I	Consulting/Site Survey	monument
61	270020, 4613610	Fortress, Nigazeuli village	Later Middle Ages	Shuakhevi	Shuakhevi –I	Gamma Consulting/Site Survey	Local importance monument
62	278641, 4607310	Former church of Tsablana. The monument is located in the village Tsablana of the Shuakhevi municipality,12 km away from the center	Later Middle Ages	Khulo	Shuakhevi –I	Gamma Consulting/Site Survey	-
63	258236, 4613773	Fortress, Takidzeebi village	Later Middle Ages	Keda	Shuakhevi –I	Gamma Consulting/Site Survey	Local importance monument
64	260917, 4614544 9	Khichauri fortress	Later Middle Ages	Shuakhevi	Koromkheti –II	Gamma Consulting/Site Survey	Local importance monument
65	261992, 4610395	Tsinareti fortress located on the gorge of Mareti river left tributary –Uchamba, at the left side of Shuakhevi-Tsinareti road.	Later Middle Ages	Shuakhevi	Shuakhevi –I	Gamma Consulting/Site Survey	Local importance monument
66	265033, 4616830	Chvani bridge, located on Chvanistsqali river, at the end of Chala village 6.8 km far from Khichauri borough	1780. CHPAA dates this as XI-XIII centuries	Shuakhevi	Shuakhevi –I	Gamma Consulting/Site Survey & CHPAA	Local importance monument
67	265318, 4610699	Oqropilauri village. There is a fortress in village Okropelauri, 2km far from Shuakhevi regional center. The fortress is supposed to be built in 11th-12th cc and is called “Tamari Fortress” or “Uchamba Fortress” by locals. It has much in common with Darchidzeebi Fortress architecture. The both are considered to be dated back to one and the same period since served to protect one and the same valley. The fortress consists of two parts and one tower. There used to be a connecting wall between the first and the second parts, but the wall is destroyed.	XI-XIII centuries	Shuakhevi	Shuakhevi –I	CHPAA	-
68	272043, 4611367	Furtio Bridge is situated at the beginning of Acharistskali Valley in village Furtio. The bridge used to connect Skhaltistskali and Acharistskali valleys. The valley has had advantageous geographic location. It was the shortest way from Ardagan and Akhaltsikhe to the Black Sea coastline. Nowadays the bridge is greatly damaged. The main part is 135m length and 2.35m	IX-X centuries	Shuakhevi	Shuakhevi –I	CHPAA	-

MM ref	Grid Ref UTM Zone 38N WGS84	Description	Date	Adjara Municipality	Scheme Phase	Source	Designation
		width. Tedo Sakhokia gives rather interesting description of the bridge underling high professionalism of the constructor choosing rocky cliff area for the bridge basements thus providing its strength for many centuries to come. Probably same as MM58 but this is attributed a different date.					
69	270621, 4614221	Selim Khimshiashvili Castle. Nigazeuil village. Same as MM61?	Late Middle Ages	Shuakhevi	Shuakhevi –I	CHPAA	-
70	284391, 4613170	Djame, Beghleti village	Late Middle Ages	Khulo	Shuakhevi –I	Gamma Consulting/Site Survey	National importance monument
71	278071, 4615634	Diakonidzeebi village Fortress	Middle Ages	Khulo	Shuakhevi –I	Gamma Consulting/Site Survey	Local importance monument
72	279186, 4616092	Djame, Didajara village	Later Middle Ages	Khulo	Shuakhevi –I	Gamma Consulting/Site Survey	National importance monument
73	285867, 4603970	Church, Vernebi village	High Middle Ages	Khulo	Shuakhevi –I	Gamma Consulting/Site Survey	Local importance monument
74	296950, 4601890	Khikhiani fortress located in Skhalta-Khikhanistskali river heads, one of the branches of Arsiani range, on 2635 m.a. s.l.	XI-XII centuries	Khulo	Shuakhevi –I	Gamma Consulting/Site Survey	Local importance monument
75	277582, 4614809	Bridge, Okruashvilebi village	Later Middle Ages	Khulo	Shuakhevi –I	Gamma Consulting/Site Survey	National importance monument
76	277415, 4606141	Skhalta Monastery Complex, In Skhalta River gorge	Middle Ages	Khulo	Shuakhevi –I	Gamma Consulting/Site Survey	National importance monument The monument is protected in Adjara.
77	289248, 4602239	Khikhadziri fortress	Middle Ages	Khulo	Shuakhevi –I	Gamma Consulting/Site Survey	National importance monument
78	289248, 4602239	Remains of church of Khikhadziri. Ruins of church are located on the left tributary of Khikhanistskali River, 200 far from the centre of Khikhadziri village	Middle Ages	Khulo	Shuakhevi –I	Gamma Consulting/Site Survey	Local importance monument
79	214339, 4608066	Gonio Castle. The oldest data about Gonio belongs to Plinus Secundus (1st c AD). The fortress is mentioned as Apsaros throughout special scientific literature.	I century AD	Khelvachauri	Khertvisi – III	Gamma Consulting/Site Survey/ CHPAA	-

MM ref	Grid Ref UTM Zone 38N WGS84	Description	Date	Adjara Municipality	Scheme Phase	Source	Designation
		In the 2nd century there used to be a Roman fortress town. Due to its strategic location empires of Rome, Byzantine and later city-republics of Italy (Genoa and others) were interested in Gonio fortress during the mid centuries. From 1547 to 1878 Gonio was invaded by the Ottomans, and then given to Russia according to St. Stefen's Agreement. Existence of dune type settlement dated back to the 5th c BC has special scientific value. There is also the iron and metallurgic center of ancient Colchida nearby Gonio area.					
80	237557, 4598955	No description available – will not be impacted by scheme	-	Khelvachauri	Khertvisi – III	Gamma Consulting/Site Survey	-
81	234648, 4600220	Same as MM4.	Late Middle Ages	Khelvachauri	Khertvisi – III	Gamma Consulting/Site Survey	-
82	223808, 4617736	Settlement at Batumi.	Prehistoric to modern	Khelvachauri	Khertvisi – III	Gamma Consulting/Site Survey	-
83	225393, 4599842	Maradidi mosque	XIX century	Khelvachauri	Khertvisi – III	Gamma Consulting/Site Survey/ CHPAA	-
84	222357, 4605697	Makho Bridge is built over the River Makhostskali, in village Makho. The bridge has oval shape that makes it differ from Dandalo Bridge, which has slopped arch. The bridge is 15.8m length, 2m width in the center and 2.14m to the ends. It is 3.6 heights from the river bottom to the arch. Its arrow is 3.2m and railing is 0.5m in width. The bridge is greatly damaged and it is impossible to determine the exact height. Its pairs are 0.68m. The bridge is built with well-cut quadrics, and edges with lime stones.	XI-XII century	Khelvachauri	Khertvisi – III	Gamma Consulting/Site Survey/ CHPAA	-
85	225792, 4602593	No description available – will not be impacted by scheme	-	Khelvachauri	Khertvisi – III	Gamma Consulting/Site Survey/ CHPAA	-

H.2. Walkover Survey Photographs

MM4 Bridge near Tskhemlara village

MM31 Winepress in October village

MM35 Bridge in Makhuntseti village

MM58 and MM 68 Bridge near Phurtio village

MM66 Historical bridge near Chvani village

MM67 Fortress of Queen Tamar in Shuakhevi Municipality

MM74 Fortress near Khikhani village

MM 79 Gonio fortress, eastern view

MM79 Gonio Fortress, western view

Appendix I. References

I.1. Ecology and Biodiversity

Froese, R. and D. Pauly. Editors. 2011.FishBase.World Wide Web electronic publication. www.fishbase.org, version (08/2011).

Unknown a (2004-2011),Brown Trout fish identification, its habitats, characteristics, fishing methods. All Fishing Guide Http://www.allfishingbuy.com/Fish-Species/Trout-Brown.htm.

Unknown author b Sea Trout Biology (undated) http://www.seatroutfishing.net/seatrout.htm

Paul Fishlock (2011). Brown Trout (*Salmo trutta*). http://www.fishingnet.com/brown_trout.htm, Downloaded 10/11/2011.

McAdam, D.S.O., N.R. Liley, and E.S.P. Tan (1999) Comparison of reproductive indicators and analysis of the reproductive seasonality of the tinfoil barb, Puntius schwanenfeldii, in the Perak River, Malaysia. ENVIRONMENTAL BIOLOGY OF FISHES 55:369-380

Cowx, I.G., Noble, R.A., Harvey, J.P., Nunn, A.D., Bolland, J.D., Walton, S and Peirson, G. (undated). Flow Requirements of non-salmonids. University of Hull International Fisheries Institute.

FEOW Freshwater Ecoregions of the World. 433: Western Transcaucasia http://www.feow.org/ecoregion_details.php?eco=433

I.2. Environmental Flows

Acreman M. and M. Dunbar (2004) Defining environmental river flow requirements – a review. Hydrology and Earth Sciences 8(5): 861-876.

Acreman 2007 M. Guidance on environmental flow releases from impoundments to implement the water framework directive. Sniffer Project WFD82.

Acreman M., J. Aldrick, C. Binnie, A. Black, I. Cowx, H.Dawson, M. Dunbar, C. Extence, J. Hannaford, A. Harby, N. Holmes, N. Jarrit, G. Old, G. Peirson, J. Webb and P. Wood (2009). Environmental flows from dams: the water framework directive. Engineering Sustainability 162:13-22.

Alfredsen K., A, Harby. T. Linnansaari, and U. Egedal 2001 Development of an inflow controlled environmental flow regime for a Norwegian River. River Research and Applications

Arthington A.H., Bunn S.E., Poff N.L. & Naiman R.J. (2006) The challenge of providing environmental flow rules to sustain river ecosystems. Ecological Applications, 16, 1311–1318.

Borsányi P., Alfredsen K., Hardby A., Ugedal O & Kraxner C. (2004) A meso-scale habitat classification method for production modelling of Atlantic salmon in Norway. Hydroécologie Appliqué, Tome 14:119-138.

Cowx I. G., R. A. Noble, A. D. Nunn, J. P. Harvey, R. L. Welcomme (2004) Flow level Criteria for Coarse Fish and Conservation Species. Report for the Environment Agency, Science Report SC02011/SR, Bristol, 166p.

Cowx I. G., R. A. Noble, J.P. Harvey, A.D. Nunn, J. D. Bolland, S. Walton and G. Peirson (2010) Flow requirements of non-salmonids. Presentation at the *Conference Manging River Flows for Salmonids,* York, January 2010.

Dyson , M., Bergkamp, G., Scanlon, J. (2003). Flow. The Essentials of Environmental Flows. IUCN, Gland, Switzerland and Cambridge, UK. xiv + 118 pp.

Gordon, N. D. McMahon, T. A., Finlayson, B.L., Gippel, C. J. and Nathan, R. J. 2004, Stream hydrology: an introduction for ecologists, 2nd edn, John Wiley and Sons Ltd, West Sussex.

Hardby A., J-M Olivier, S. Merigoux & E. Malet (2007) A Mesohabitat method used to assess minimum flow changes and impacts on the invertebrate and fish fauna in the Rhone River France. River Research Applications 23:525-543.

Poff N. L, JD. Llan, M. B. Bain, J. R. Karr, K. L. Prestegaard, B. D. Ritcher, R. E. Sparks and J. C. Stromberg (1997) The natural Flow Regime. A paradigm for river conservation and restoration. BioScience, 47 (11): 769-784.

Poff N.L., Allan J.D., Bain M.B., Karr J.R., Prestegaard K.L., Richter B.D., Sparks R.E. & Stromberg J.C. (1997) The natural flow regime. BioScience, 47, 769–784.

Poff N.L., Richter B.D., Arthington A.H. et al. (2010) The ecological limits of hydrologic alteration (ELOHA): a new framework for developing regional environmental flow standards. Freshwater Biology, 55, 147–170.

Poff N. L.and J.K.H. Zimmerman (2010). Ecological responses to altered flow regimes: a literature review to inform the science and management of environmental flows. Freshwater Biology 55:194-205.

Ritcher B. D., A. T. Warner, J. L. Meyer and K. Lutz (2006) A collaborative and adaptive process for developing environmental flow recommendations. River Research and Applications 22:297-318.

Tharme R.E. & King J.M. (1998) Development of the Building Block Methodology for Instream Flow Assessments and Supporting Research on the Effects of Different Magnitude Flows on Riverine Ecosystems. Report to Water Research Commission, 576/1/98, Cape Town

I.3. Geology, Landslides and Seismic Risks

Yilmaz, A. et al (2000) Structural correlation of the southern Transcausacus (Georgia)-Eastern Pontides (Turkey). Geological Society Special Publications. v. 173 p171-182

Bazhenov., M. L and Burtman., V.S (2002). Eocene paleomagnetism of the Caucasus (southwest Georgia): oroclinal bending in the Arabian syntaxis. Tectonophysics no.344. pp 247-259

I.4. Cultural Heritage and Archaeology

Suny, R. G. 1994 *The Making of the Georgian Nation: Second Edition* Indiana University Press

Brand, D. 1994 *Georgia in Antiquity: A History of Colchis and Transcaucasion Iberia 550 BC- AD 562* Clarendon Press, Oxford

Mongait, A. L. 1955 Trs Thompson, M.W. 1961 *Archaeology in the USSR*

Taylor, P. M, Polglase, C.R., Museijibli, N., Koller, J. M., Johnson, T. A. *AGT – Ancient Heritage in the BTC-SCP Pipelines Corridor Azerbaijan-Georgia-Turkey* Website: agt.si.edu accessed 05/01/2012

www.bilkent.ed.tr/~arkeo/newsletter2/newsle29.html *The Georgian-Canadian Excavations at Ats'quri in South-Western Georgia* accessed 05/01/2012

www.batumiairport.com accessed 05/01/2012

Adjara Website: wn.com/adhara accessed 05/01/2012

Anon 2011 'Adjara – on the Shore of the Hospitable Sea' *Modi 5* published 18/07/11