Environmental Impact Assessment of Nagmati Dam Project

Gokarneshwor Munucipality-1, Kathmandu,

Bagmati Pradesh

Submitted to:

Government of Nepal

Ministry of Forests and Environment

Singh Durbar

Through:

Government of Nepal

Ministry of Energy, Water Resources & Irrigation

Singh Durbar

Submitted by:

Department of Water Resources and Irrigation

Nagmati Dam Project

Gaurighat, Guheshwori

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Abbreviations and Acronyms

ADB	-	Asian Development Bank
ANCOLD	-	Australian National Committee on Large Dams
BAP	-	Bagmati Action Plan
BCN	-	Bird Conservation Nepalअनब
BOD	-	Biological Oxygen Demand
BRBIP	-	Bagmati River Basin Improvement Project
B.S.	-	Bikram Sambaat
^{0}C	-	Degree Celsius
CBS	-	Centre Bureau of Statistics
CFRD	-	Concrete Faced Rockfill Dam
CITES	-	The Convention on International Trade in Endangered Species
CPUE	-	Catch per Unit Effort
DCC	-	District Coordination Committee
DHI	-	Danish Hydraulics Institute
DHM	-	Department of Hydrology and Meteorology
DIA	-	Direct Impact Area
DNPWC	-	Department of National Park and Wildlife Conservation
DO	-	Dissolved Oxygen
DoED	-	Department of Electricity Development
DoWRI	-	Department of Energy Water Resources and Irrigation
EIA	-	Environmental Impact Assessment
EPA	-	Environment Protection Act
EPR	-	Environment Protection Rules

ESIA	-	Environmental and Social Impact Assessment
ESMP	-	Environmental and Social Management Plan
FSL	-	Full Supply Level
GoN	-	Government of Nepal
GPS	-	Global Positioning System
Ha	-	Hectare
HMG	-	His Majesty's Government
HPCIDBC	-	High Powered Committee for Integrated Development for Bagmati Civilization
ICOLD	-	International Commission on Large Dams
IEE	-	Initial Environmental Examination
IIA	-	Indirect Impact Area
ILO	-	International Labour Organization
IUCN	-	International Union for Conservation of Nature
IWRM	-	Integrated Water Resources Management
Km	-	Kilometer
km^2	-	Square Kilometers
kW	-	Kilo Watt
l/s	-	Liters per Second
M	-	Meter
Mm	-	Millimeter
m^3/s	-	Cubic Meters per Second (cumecs)
mg/l	-	Milligrams per Liter
Mm^3	-	Million Cubic meters

MCM	-	Million Cubic Meters
MDE	-	Maximum Design Earthquake
MoFE	-	Ministry of Forests and Environment
MoUD	-	Ministry of Urban Development
MFSC	-	Ministry of Forest and Soil Conservation
MW	-	Mega Watt
NAPA		National Adaptation Program of Action
NDP		Nagmati Dam Project
NGO	-	Non-Governmental Organization
NTWL	-	Normal Top Water Level
OBE	-	Operating Basis Earthquake
PGA	-	Peak Ground Acceleration
PIU	-	Project Implementation (Irrigation Unit)
PPTA	-	Project Preparatory Technical Assistance
RL	-	Reduced Level
SNNP	-	Shivapuri-Nagarjun National Park
TOR	-	Terms of Reference
UNCED	-	United Nations Conference on Environment and Development
UNDRIP	-	UN Declaration on the Rights of Indigenous Peoples
VDC	-	Village Development Committee
WBM	-	Water Balance Model
WECS	-	Water and Energy Commission Secretariat
WBQM	-	Water Balance and Quality Model
WWTP	-	Waste Water Treatment Plant

कार्यकारी सारांश

१. प्रतिवेदन तयार गर्ने संस्थाको नाम र ठेगाना

१.१ प्रस्तावकको नाम र ठेगाना

यस नागमती बाँध आयोजनाको प्रस्तावक नेपाल सरकार, ऊर्जा, जलस्रोत तथा सिंचाइ मन्त्रालय, जलस्रोत तथा सिंचाइ विभाग, नागमती बाँध आयोजना, ललितपुर रहेको छ। नागमती बाँध आयोजनाको कार्यालय गौरीघाट, गुहेश्वरी, काठमाण्डौंमा स्थापित गरिएको छ। यो आयोजना बागमती नदी जलाधार सुधार आयोजनाको एउटा अङ्गको रूपमा सुख्खा मौसममा बागमती नदीको बहावमा वृद्धि गर्ने उद्देश्य रहेको आयोजना हो। राष्ट्रिय योजना आयोगले यस आयोजनालाई राष्ट्रिय प्राथमिक्ता प्राप्त आयोजनाको रूपमा वर्गीकरण गरेको छ।

१.२ वातावरणीय अध्ययनको औचित्यता

प्रस्तावित नागमती बाँध आयोजना शिवपुरी नागार्जुन राष्ट्रिय निकुञ्ज भित्र कार्यान्वयन गर्न लागिएको हुँदा यो प्रस्ताव नियमावलीको अनुसूची ३(क) "वन क्षेत्र"- १२ "राष्ट्रिय निकुञ्ज, वन्यजन्तु आरक्ष, शिकार आरक्ष क्षेत्रभित्र कार्यान्वयन गरिने प्रस्तावहरू" बमोजिमको प्रस्ताव रहेको र वन तथा वातावरण को च.नं ७६२ मिति २०७८।१।६ को पत्रानुसार तोकिएका शर्त पालना गर्ने गरी प्राप्त अध्ययन सहमति बमोजिम प्रस्तावकले वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदन तयार गरेको छ। यस आयोजना एसियाली विकास बैङ्कको सहयोगमा कार्यान्वयन गरिन लागिएको हुनाले नियमावलीको नियम ७ को उपनियम ८ बमोजिम अङ्ग्रेजी भाषामा तयार गरिएको हो।

१.३ अध्ययनको सिमा

यस वातावरणीय प्रभाव मूल्याङ्कन अध्ययनले जलाशय निर्माणबाट सूक्ष्म जलवायुमा पर्ने सम्भावित असरको अनुमान गर्न सकेको छैन। अनुमान गरिएका अन्य असरहरूका अतिरिक्त बाँध फुटेर हुने सम्भावित असर र असर हुनसक्ने पूर्वानुमानित क्षेत्र र जनसङ्ख्या मात्र यस वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदनमा समावेश गरिएको छ।

२. आयोजनाको जानकारी

यस आयोजनाको बाँध नागमती नदी र बागमती नदीको सङ्गम स्थल भन्दा ३ कि.मि. माथि मुलखर्क गाउँ नजिक गोकर्णेश्वर नगरपालिका वडा नं १, काठमाण्डौं नागमती नदीमा शिवपुरी राष्ट्रिय निकुञ्जको सिमाना भित्र concrete-faced rockfill dam (CFRD) किसिमको निर्माण गरिने छ। बाधँको उचाइ ९४.५ मिटर, लम्बाइ ५५४ मिटर र क्रेष्टमा ७ मिटर चौडाइ हुनेछ। बाँध निर्माणबाट ४८०,४२६ वर्ग मिटरमा फैलिएको पूर्ण आपूर्ति स्तर मा ९४.८४ लाख घनमिटर जल भण्डारण क्षमताको जलाशय निर्माण हुने छ। यसका अतिरिक्त पेनस्टक, पावरहाउस, स्पिल वे, टरवाईन, पुल तथा विद्युत प्रसारण लाईन जस्ता संरचनाहरू निर्माण गरिने छन । आयोजनाका लागि जम्मा ६५.३०४ हेक्टर जमिनको आवश्यकता पर्नेछ जसमध्ये ६२.९७७ हेक्टर स्थायी रुपमा र हेक्टर अस्थायी रुपमा आवश्यक पर्नेछ। निर्माण अवधिमा करीव ३०० कामदारहरु दैनिक रुपमा आवश्यक पर्नेछ। आयोजनाको निर्माण अवधी Defect Liability Period (DLP) सहीत ९ वर्ष रहेको छ।

३. अध्ययन विधि

प्रस्तावित नागमती बाँध आयोजनाको वातावरणीय प्रभाव मूल्याङ्कन, नागमती बाँध आयोजनाको स्वीकृत कार्यसूची, जलश्रोत क्षेत्रका लागि राष्ट्रिय वातावरणीय प्रभाव मूल्याङ्कन निर्देशिका (खेस्रा २०५३), वातावरण

संरक्षण ऐन, २०७६ वातावरण संरक्षण नियमावली, २०७७ (पछिल्लो संशोधन सहित) अनुसार गरिएको छ। यस अध्ययन आयोजनाको प्रत्यक्ष प्रभावित क्षेत्रमा केन्द्रित भएर गरिएको थियो। अध्ययन विधिका रुपमा आयोजना सङ्ग सम्बन्धित प्रकाशित तथा अप्रकाशित प्रतिवेदनहरूको पुनरावलोकन, चेकलिस्ट सर्भेक्षण, मुख्य जानकार व्यक्ति सङ्ग अन्तर्वार्ता, घरधुरि सर्वेक्षण, प्रत्यक्ष अवलोकन, गणना सर्वेक्षण, वायु गुणस्तर मापन, ध्वनि स्तर मापन, नमुना पानी सङ्कलन र प्रयोगशाला परीक्षण, सम्बन्धित सरोकारवालाहरू सङ्ग छलफल जस्ता विधि मार्फत आयोजना क्षेत्रको भौतिक, जैविक, सामाजिक आर्थिक तथा साँस्कृतिक वातावरणको तथ्याङ्क सङ्कलन अध्ययनका क्रममा गरिएको थियो। सार्वजनिक सुनुवाईको क्रममा सङ्कलन गरिएको र ७ दिने सूचना मार्फत प्राप्त राय सुझावलाई संलग्न गरी अन्तिम प्रतिवेदन तयार गरिएको छ।

४. पुनरावलोकन गरिएका नियम तथा कानूनहरु

आयोजनाले नेपालको संविधान, २०७२ को प्रावधान, नेपाल सरकारको विभिन्न क्षेत्रगत नीतिहरु, कानूनहरु र निर्देशिकाहरुलाई आकर्षित गरेको छ जसलाई आयोजना निर्माण गर्ने परिप्रेक्षमा मनन गरिएको छ। सम्बन्धित नेपालको संविधानको धाराहरू, योजना, ऐन, नियम, कार्यनीति, नियमावली, अन्तराष्ट्रिय सन्धि तथा मापदण्डहरु यस प्रतिवेदनको अध्याय चारमा विस्तृत रुपमा उल्लेख गरिएको छ।

५. विद्यमान वातावरणीय अवस्था

५.१ भौतिक वातावरण

आयोजना क्षेत्र समुन्द्री सतह बाट १४१० मिटर देखि १९११ मिटर मा फैलिएको छ। आयोजना क्षेत्रको भू-उपयोग वन क्षेत्र, बुट्यान क्षेत्र, कृषि क्षेत्र र घाँसे मैदानमा विभाजित रहेको छ। भौगोलिक रुपमा आयोजना क्षेत्र फोर हिमाली जियोमर्फिक भागमा रहेको छ। फिलाइट्स, सिस्ट, मार्बलस, क्वार्जाइट्स र निस यस क्षेत्रका मुख्य चट्टान हुन्। खानी तथा भुगर्भ विभाग द्वारा प्रकाशित भुकम्पीय नक्सा अनुसार आयोजना क्षेत्र मध्यम उच्च भूकम्पीय जोखिम क्षेत्रमा रहेको छ। ककनीमा रहेको जल तथा मौसम स्टेशन मौसमी तथ्याङ्क अनुसार आयोजना क्षेत्रको औसत वायु तापक्रम १४.२५ ^{o}C रहेको छ र सुन्दरीजल स्टेशनको १९९४-२०२१ सम्मको दैनिक वर्षा तथ्याङ्क विश्लेषण बाट प्राप्त नतिजा अनुसार यस क्षेत्रको औषत वार्षिक वर्षा २०९५.६० रहेको छ। वायु गुणस्तर र ध्वनिको स्तर अनुगमन अनुसार अनुगमन स्थल तिलगङ्गा/पशुपतिनाथ भन्दा अनुगमन स्थल धापमा वायुको गुणस्तरमा सुधार र ध्वनिको स्तरमा कमि रहेको पाइएको थियो। पानी परीक्षण को नतिजा अनुसार धाप र नागमती नदीको माथिल्लो क्षेत्रमा प्रदुषण रहित गुणस्तरीय पानी रहेको र पशुपतिनाथ मन्दिर क्षेत्र सम्म पुग्दा पानीको गुणस्तरमा क्रमिक रूपमा गिरावट देखिएको छ।

५.२ जैविक वातावरण

प्रस्तावित नागमती बाँध आयोजना शिवपुरी नागार्जुन राष्ट्रिय निकुञ्ज भित्र रहेको छ। यो राष्ट्रिय निकुञ्ज समुन्द्र सतहबाट १००० मिटर देखि २७३२ मिटरमा १५९ वर्ग किलोमिटरमा फैलिएको छ। शिवपुरी नागार्जुन राष्ट्रिय निकुञ्जको व्यवस्थापन योजना (२०१७/१८-२०२१/२२) अनुसार यस निकुञ्जमा २,१२२ प्रजाति भन्दा बढी वनस्पति जसमा १६ स्थानीय प्रजाति रहेका छन्। निकुञ्जमा ३० स्तनधारी प्रजातिको बासस्थान रहेको छ जसमा ४ प्रजाति नेपाल सरकार, राष्ट्रिय निकुञ्ज तथा वन्यजन्तु संरक्षण ऐन, १९७३ अन्तर्गत संरक्षित सूचीमा सूचिकृत, ८ प्रजाति, आइ.यु.सि.एन. को रातो किताब र १२ प्रजाति साइटिस. को अनुसूची (८ प्रजाति अनुसूची क र ४ प्रजाति अनुसूची ख) मा सूचीकृत रहेका छन्।

यस अध्ययनले आयोजनाको बाँध क्षेत्र र नागमती बागमती सङ्गम स्थलमा असला माछा (*Schizothorax richardsonii*) र *Schistura sp.* अभिलेख गरेको छ।

५.३ सामाजिक-आर्थिक तथा साँस्कृतिक वातावरण

नागमती बाँध आयोजना बागमती प्रदेश, काठमाण्डौं जिल्ला, गोकर्णेश्वर नगरपालिका वडा नं १ मा कार्यान्वयन गरिन लागिएको हो। राष्ट्रिय जनगणना २०२१ अनुसार आयोजना प्रभावित क्षेत्र गोकर्णेश्वर नगरपालिका वडा नं १ को जनसङ्ख्या ७८७२ रहेको छ जसमध्ये पुरुष ३८६७ र महिला ४००५ रहेका छन्। आयोजना प्रभावित वडामा जम्मा २०४२ घरधुरि अभिलेख गरिएको थियो जसको औसत घरधुरिको आकार ३.८६ रहेको छ। प्रभावित वडाको लैङ्गिक अनुपात ९६.५५ रहेको छ। आयोजना प्रभावित ३० घरधुरिको जम्मा जनसङ्ख्या १५९ रहेको छ जसमा पुरुष ८५ र महिला ७४ रहेका छन्। प्रभावित घरधुरिको औसत घरधुरि आकार ५.३ र लैङ्गिक अनुपात १.१४ रहेको छ।

६. विकल्पहरुको विश्लेषण

विना आयोजनाको विकल्पलाई अस्विकार गरिएको छ किनकी यसले सुख्खा मौसममा ४५० लिटर प्रति सेकेण्ड को बहाव प्रबाह गरी बागमती नदीको पानीको गुणस्तरमा सुधार गर्ने बागमती नदी जलाधार सुधार आयोजनाको उद्देश्य प्राप्तिमा सहयोग गर्दैन। अध्ययन गरिएका अन्य विकल्पहरू प्राविधिक र आर्थिक दृष्टिले सम्भव नरहेकाले अस्वीकृत गरिएको छ। शिवपुरी नागार्जुन राष्ट्रिय निकुञ्ज भित्र रहने गरी आयोजनाको संरचनागत विकल्पहरूको विश्लेषण पश्चात प्रस्तावित आयोजनाको संरचनाहरूको अवस्थिति र डिजाइन विकल्पलाई वातावरणीय, प्राविधिक र आर्थिक दृष्टिकोणमा उत्म मानिएको छ।

७. वातावरणीय प्रभाव, बढोत्तरी तथा न्यूनीकरणका उपायहरु

अन्य विकास आयोजना जस्तै, यस आयोजनाले पनि विद्यमान प्राकृतिक अवस्थामा दुवै सकारात्मक तथा नकारात्मक असर पार्ने छ।

७.१ सकारात्मक प्रभाव

यस आयोजनाले निर्माणका क्रममा ३०० जनालाइ दैनिक अस्थायी रोजगारीको सृजना हुने, स्थानीय व्यापार व्यवसायमा वृद्धि र आयोजनाले स्थानीय स्तरमा पूर्वाधार तथा सामाजिक सेवाको विकासमा मद्दत पुऱ्याउने छ। आयोजनाको सञ्चालन तथा मर्मत सम्भार चरणमा, बागमती नदीको पानीको गुणस्तर सुधार हुनुको साथै सामजिक तथा साँस्कृतिक कार्यको लागि थप बहाव प्राप्त हुनेछ। साथै आयोजनाले १.८६ मेगावाट जलविद्युत उत्पादन र वर्षायाममा मेलम्चि आयोजना मार्फत काठमाडौं उपत्यका खानेपानी लिमिटेडलाई ४५० लिटर प्रति सेकेण्ड खानेपानी उपलब्ध हुनेछ। आयोजनाको कारण बृद्धि हुने आगन्तुक दस्तुर मार्फत शिवपुरी नागार्जुन राष्ट्रिय निकुञ्जको राजस्व सङ्कलनमा वृद्धि हुनेछ। आयोजना सञ्चालन चरणमा नागमती नदीको एकीकृत जलाधार व्यवस्थापन, बाढी नियन्त्रण, स्थानीय र प्रवासी पन्क्षी प्रजातिलाई वासस्थान, भू-जलाधार पूनर्भरण र जलाशयबाट वायुमण्डलीय कार्बन सञ्चितिकरण मार्फत जलवायु परिवर्तनको प्रभावलाई न्यूनीकरण जस्ता लाभहरू प्राप्त हुने देखिन्छ।

७.२ नकारात्मक प्रभाव

७.२.१ भौतिक वातावरण

आयोजनालाई आयोजना सञ्चालनको प्रयोजनको लागि स्थायी र अस्थायी रुपमा जम्मा ६५.३०४ हेक्टर जमिन आवश्यक्ता पर्नेछ जसले हाल रहेको भू-उपयोगमा परिवर्तन ल्याउने छ। निर्माण सम्बन्धि गतिविधि जस्तै उत्खनन्, ढाल कटान, सम्याउने आदिले स्थानीय भू-वनोटलाई परिवर्तन गर्ने, ढाललाई कमजोर

बनाउने, भू-क्षय बढाउने र नदीको पानीमा धमिलोपना बढाउनेछ। निर्माण कार्य, निर्माण सामग्रीको ढुवानी, उत्खनन्, ड्रिलिङ, ब्लास्टिङ्ग, हेभि इक्विपमेन्टको सञ्चालन, क्रसर सञ्चालन आदि कार्यले वातावरणमा धुवा, धुलो, ध्वनि आदि उत्सर्जनबाट वायु तथा ध्वनि प्रदुषण हुने देखिन्छ। निर्माणजन्य र शिविरको घरेलु फोहोरमैला र ढलको कारण जल र जमिन प्रदुषण हुने सम्भावना रहन्छ। सञ्चालनका क्रममा वातावरणको भौतिक अवयवमा पर्ने असरमा सम्भावित बाँध फुटनाले बाढीबाट तल्लो तटमा हुने क्षति, फोहोरमैला व्यवस्थापन र स्थायी कर्मचारी आवासको ढल व्यवस्थापन सङ्ग सम्बन्धित छन्।

७.२.२ जैविक वातावरण

आयोजनाको लागि कुल ८०,२५८ वटा विभिन्न प्रजातिका रुखहरु कटान गर्नु पर्ने देखिन्छ। स्थानीय जैविक विविधतामा कमि, वन्यजन्तुको वासस्थान विनाश जस्ता प्रभाव आयोजनाबाट जैविक वातावरणमा पर्ने स्थायी प्रभाव रहेको छ। निर्माण गतिविधिले सृजना गर्ने असहज परिस्थितिका कारण वन्यजन्तुको आवागमन, चरन र अन्य व्यवहारमा असर गर्नेछ। आयोजना सञ्चालन अवधिमा बाँध र जलाशयले जमिनी जीवजन्तुहरुलाई पुऱ्याउने रोकावटलाई महत्वपूर्ण नकारात्मक प्रभाव मानिएको छ। आयोजनाको बाँध स्थलको माथिल्लो र तल्लो तट मा भिरोलो क्षेत्र रहेको हुनाले आयोजना सञ्चालनको चरणमा जलिय जीवलाई कुनै नकारात्मक असर पर्ने देखिदैन।

७.२.३ सामाजिक-आर्थिक तथा साँस्कृतिक वातावरण

आयोजनाबाट हुने झण्डै ०.२९५ हेक्टर निजी जमिनको स्थायी अधिग्रहणले ३० घरधुरिहरुलाई प्रत्यक्ष रुपमा प्रभाव पार्दछ । कृषियोग्य जमिनमा संरचना निर्माण गर्नाले त्यसमा हुने उत्पादन घट्नेछ। निर्माणमा काम गर्ने कामदार र अन्य व्यवसायिक अवसरको खोजीमा आउने भिडका कारण स्थानीय सेवासुविधा जस्तै विधालय, स्वास्थ संस्था, खानेपानी वितरण प्रणाली, प्रशासनिक सेवा, सुरक्षा, स्थानीय बजारमा अतिरिक्त दबाव पर्ने देखिन्छ। सञ्चालनका क्रममा निर्माणजन्य रोजगारी र अन्य अवसरको अन्त्यका कारण स्थानीय जनताको आर्थिक गतिविधि प्रभावित हुने देखिन्छ।

८. सकारात्मक प्रभाव बढोत्तरी तथा नकारात्मक प्रभाव न्यूनीकरणका उपायहरू

८.१ सकारात्मक प्रभाव बढोत्तरीका उपायहरू

नागमती बाँध आयोजनाले रोजगारी तथा तालिममा आयोजना प्रभावित परिवार, निम्न आय भएका तथा सिमान्तकृत समुदायलाई प्राथमिक्ता दिनेछ। आयोजनाले उद्यम विकास, पऱ्या-पर्यटन, कृषि सम्बन्धि सिप विकास तालिम आयोजना गर्नेछ। आयोजनालबाट सामुदायिक सहायता कार्यक्रम अन्तर्गत आयोजना लागतको रूपमा छुट्टाइएको ०.५% रकम मार्फत स्थानीय पूर्वाधारको विकास, सामाजिक सेवाको सेवा प्रभाहमा र हाल पानी प्रयोग गरी रहेका तल्लो तट समुदायको पानी प्रयोगको संरचनाको सुधार गर्न मद्दत गरिने छ। आयोजनाले शिवपुरी नागार्जुन राष्ट्रिय निकुञ्जको सुरक्षा र राजश्व सङ्कलनका लागि सुरक्षा पोष्ट र टिकट काउन्टर निर्माण गर्नेछ।

८.२ नकारात्मक प्रभाव न्यूनीकारणका उपायहरू

८.२.१ भौतिक वातावरण

कवुलियतमा लिइएको जमिन, जग्गाधनीलाई पूर्ववत स्थितिमा फिर्ता गरिनेछ। कृषियोग्य जग्गाको माथिल्लो तहको माटो क्षय हुन नदिन त्यसलाई सङ्कलन गरेर सुरक्षित स्थानमा भण्डारण गरिनेछ। भीरको कटाई गर्दा त्यसले थाम्न सक्ने गरी मात्र गरिनेछ। ठाडा र तेर्सा नालाहरुको निर्माण गरी भू-क्षयलाई कम गरिनेछ। निर्माण सामाग्रीको उत्खनन् तथा सङ्कलन गर्दा नदीको स्वरुपलाई हानी नपुऱ्याइ गरिनेछ।

धुलो उड्न नदिन प्रमुख सडक र कार्यस्थलमा पानी छर्किने व्यवस्था मिलाईनेछ। सवारीसाधनको नियमित चेक जाँच गरी त्यसबाट हुने प्रदुषणको सम्बन्धमा आवश्यक कदम चालिनेछ। फोहरमैलालाई त्यसको प्रकार अनुसार छुट्याइ एवं रितले व्यवस्थापन गरिनेछ। कामदारको संख्याको आधारमा चर्पी र पानीको व्यवस्था मिलाइनेछ। निर्माणका क्रममा उत्पादन हुने माटोको पुनः प्रयोग गरिनेछ र बाँकी उचित ढङ्गले व्यवस्थापन गरिनेछ। अस्थायी संरचनाहरु आयोजना सम्पन्न भएपछि हटाइनेछ।

८.२.२ जैविक वातावरण

सरकारी वन क्षेत्र र त्यहाँबाट काटिने रुखको क्षतिपूर्ति प्रचलित कानूनले तोके बमोजिम गरिने छ। काट्नुपर्ने रुखहरुलाई अध्यावधिक गरी, चिन्ह लगाई आवश्यक मात्रामा काटिने छ। सरकारी वनबाट काटिने प्रत्येक रुखको बदलामा २५ वटा स्थानीय प्रजातिका विरुवा वनक्षेत्रको क्षतिपूर्ति वापत दिइएको वा तोकिएको स्थानमा वृक्षारोपण गरिने छ। पकाउने तताउने प्रयोजनको लागि दाउराको प्रयोग कम गर्न कामदारका लागि मट्टीतेल वा ग्यासको व्यवस्था मिलाइनेछ। कामदारलाई चोरी-सिकारी गर्न र वन पैदावारहरुको संकलन गर्न रोक लगाइने छ र यसको व्यवस्था आचार संहिता मार्फत गरिनेछ। बाँधबाट खोलामा १५० लिटर प्रति सेकेण्ड बहाव वातावरणीय प्रवाहको लागि छोडिनेछ र वातावरणीय प्रवाहको कार्यान्वयन कडाईका साथ लागु गरिने छ। शिवपुरी नागर्जुन राष्ट्रिय निकुञ्ज सङ्गको समन्वयमा वन्यजन्तुको वासस्थान पुनर्स्थापन कार्यक्रम सञ्चालन गरिनेछ।

८.२.३ सामाजिक आर्थिक तथा साँस्कृतिक वातावरण

आयोजना प्रभावित परिवारहरुलाई आयोजनाले लिने उनीहरुको जग्गा तथा सम्पतिको लागि समुचित क्षतिपूर्ति दिइनेछ। आयोजना प्रभावित परिवारहरूलाई रोजगारीको अवसरहरु र आयोजनाले सञ्चालन गर्ने विभिन्न किसिमका सिपमुलक तालिमहरुमा पहिलो प्राथमिकता दिइनेछ। भएको बाली नाश हुने अवस्थामा त्यसको प्रचलित बजार मूल्यको आधारमा उचित क्षतिपूर्ति दिइनेछ। स्थानीय सेवा सुविधामा दबाव कम गर्न ठेकेदारले दैनिक उपभोग्य आवश्यकता जस्तै खानेपानी, संचार, बिजुली तथा खाना पकाउने इन्धन आदिको व्यवस्था क्याम्प भित्रै गर्ने छ। निर्माण गतिविधिका कारण कुनै भौतिक संरचनामा क्षति हुन गएमा त्यसको पुननिर्माण वा पुनस्थापना गरिनेछ। प्रभावित क्षेत्रका स्वास्थ्य तथा शिक्षण संस्थाको सुधारको लागि आवश्यक सहयोग प्रदान गरिनेछ। निर्माण चरण पश्चात आर्थिक कृयाकलापमा संलग्न गराउन वैकल्पिक जीविकोपार्जन सम्बन्धिमा विभिन्न तालिमहरु स्थानीयलाई दिइनेछ।

९. वातावरणीय अनुगमन

वातावरणीय अनुगमन योजनामा आयोजनाको निर्माण पूर्व चरण, निर्माण चरण र सञ्चालन चरणमा हुने गतनिविधिहरूलाई अनुगमन गर्न आधार रेखिय अनुगमन, नियमपालक अनुगमन र प्रभाव अनुगमन समावेश गरिएको छ। अनुगमन योजनामा मापन गर्न सकिने सूचक, विधि, समय, स्थान, अनुमानित लागत र जिम्मेवार निकाय प्रस्तुत गरिएको छ।

१०. वातावरणीय व्यवस्थापन योजना

आयोजनाको निर्माण तथा सञ्चालन चक्र बाट उत्पन्न हुने वातावरणीय प्रभावहरूलाई उचित रूपमा सम्बोधन गर्ने र वातावरण व्यवस्थापन योजनामा प्रस्ताव गरिएका उपायहरूको कार्यान्वयन गर्ने प्रमुख दायित्व नागमती बाँध आयोजना व्यवस्थापनको हुनेछ। आयोजनाले डिजाइन अनुगमन र वातावरण व्यवस्थापन योजनाको कार्यान्वयन, अनुगमन, मूल्याङ्कन तथा सूचना प्रवाहको लागि आयोजना व्यवस्थापन तथा सुपरीवेक्षण परामर्शदाता नियुक्त गर्नेछ। आयोजना व्यवस्थापन तथा सुपरीवेक्षण परामर्शदाताले

वातावरण अनुगमन र वातावरण व्यवस्थापन योजनाको कार्यान्वयन सम्बन्धि प्रतिवेदन आयोजनाको निर्माण कार्य सकिएको ३ महिना भित्र नागमती बाँध आयोजनालाई बुझाउने छ। आयोजनाको कुल वातावरणीय लागत, सामुदायिक सहायता कार्यक्रमको लागत सहित ने.रू २४१,१७५,००० (आयोजनामा समावेश लागत बाहेक) रहेको छ।

११. वातावरणीय परीक्षण

यस नागमती बाँध आयोजनाको वातावरणीय परीक्षण आयोजना सञ्चालनको २ वर्ष पुरा भए पश्चात गरिनेछ। वातावरणीय परीक्षणको लागि आवश्यक व्यवस्थापन नेपाल सरकार, वन तथा वातावरण मन्त्रालयले गर्नेछ।

१२. निश्कर्ष तथा प्रतिवद्धता

यस नागमती बाँध आयोजनाको कार्यान्वयनबाट अन्य आयोजना जस्तै विद्यमान प्राकृतिक अवस्था र समाजमा सकारात्मक र नकारात्मक प्रभाव पर्ने देखिन्छ। यस आयोजना कार्यान्वयनबाट पर्ने प्रभावहरूलाई स्थापित विधि र वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदनमा प्रस्ताव गरिएका उपायहरूको कार्यान्वयनबाट सकारात्मक प्रभाव अभिवृद्धि तथा नकारात्मक प्रभाव न्यूनीकरण गर्न सकिनेछ। बागमती नदी जलाधार सुधार आयोजनाको उद्देश्य प्राप्तिका साथै आयोजना कार्यान्वयनबाट प्राप्त दिर्घकालीन फाइदा हुने देखिएकोले यो आयोजना कार्यान्वयन गरिनुपर्ने देखिएको छ। प्रस्तावक यस वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदनमा उल्लेख गरिएको सम्पूर्ण उपाय कार्यान्वयन र आयोजना कार्यान्वयनको चरणमा देखिने अन्य प्रभावहरूलाई समेत उचित विधि मार्फत न्यूनीकरण गर्न प्रतिवद्ध रहेको छ।

Executive Summary

1. Name and Address of the Institution Preparing Report

1.1 Name and Address of the Project Proponent

The proponent of this project is Government of Nepal, Ministry of Energy Water Resources & Irrigation, Department of Water Resources and Irrigation, Nagmati Dam Project, Lalitpur, stationed at Gaurighat, Guheswhori, Kathmandu. This project is one of the components of the Bagmati River Basin Improvement Project (BRBIP) with an objective of enhancing the river flow in Bagmati River over the entire dry season. This project has been classified as National Priority Project by the National Planning Commission.

1.2 Rationale for Conducting Environmental Impact Assessment

The proposed "Nagmati Dam Project" is being implemented within Shivapuri National Park boundary is listed as Schedule 3-(ka) "Forest Sector"-serial no. 12 proposal which states "any proposal proposed to be implemented within the area of National Park, Wildlife Reserve or Hunting Reserve" shall undergo EIA study and the proponent has prepared the Environment Impact Assessment Report according to the conditions stated in the letter (cha no. 762) of Ministry of Forest and Environment dated 2078-01-06. Since, the project is being funded by ADB, this report is prepared in English language pertaining to Rule 7, sub rule 8 of EPR, 2077.

1.3 Limitation of the Study

This EIA study couldn't predict the micro-climatic affect from the creation of reservoir. Apart from the other anticipated impacts, forecast of the possible impacted areas and tentative impacted population along the Bagmati River up to Chobhar from the unprecedented dam failure has only been included in this EIA report.

2. Description of the Project

The Project incorporates construction of a concrete-faced rockfill dam (CFRD) at the Nagmati River near the Mulkharka village of Gokarneshwor Ward no. 1, Kathmandu located at about 2 km upstream from the confluence of Nagmati and Bagmati Rivers inside the Shivpuri Nagarjun National Park boundary. The NDP constitutes of CFRD of height 94.5m, 554m long and crest width of 7m. The construction of dam will create a reservoir expanded in an area of 480,426 m^2 at FSL with a storage capacity of 9.484 Mm^3 at FSL. In addition to these, the infrastructures such as penstock, powerhouse, spillway, turbine, bridge and transmission line will also be constructed. A total of 65.304 ha of land will be required for the project. Of the total, 62.977 ha is permanent land requirement and 2.327 ha is temporarily required. A total of about 300 construction work force is required on daily basis during construction period. The project construction period including Defect Liability Period (DLP) is 9 years.

3. Study Methodology

This Environmental Impact Assessment (EIA) study of Nagmati Dam Project (NDP) has been carried out in accordance to the approved ToR of NDP, National EIA guidelines for water resource sector (Draft 2053), Environment Protection Act (EPA), 2076 and Environment Protection Rules (EPR), 2077 (with latest amendments). The study was conducted focusing the direct impact area of the project. Review of project related published and unpublished documents, checklist survey, KII, household survey, direct observation, census survey, transect survey, air quality monitoring, noise level recording, water sampling and laboratory experiments and consultation with relevant stakeholders was conducted to collect information on physical, biological, socio-economic and cultural environmental parameters within the project area during the study. The received suggestions and concerned from public hearing and 7 days public notice was duly incorporated and final report was prepared.

4. Reviewed Legal aspects and Compliance

A number of provisions of Constitution on Nepal, 2015, over-arching and sectoral policies, legislations, and guidelines of the Government of Nepal are attracted by the project, which have been reviewed in the context of the project development. Related Clause of Constitution of Nepal, 2015, Plans, Acts, Rules, Guidelines, International Conventions and Standards are described in detail in Chapter 4 of the report.

5. Baseline Environment

5.1 Physical Environment

The project area is extended from RL 1410m to RL 1911m from the sea level. The land use pattern is predominated by forest followed by shrub land, cultivated land and grass land respectively. Geologically, the project area lies within the Fore Himalaya Geomorphic Unit. The main rock types in this region are phyllites, schists, marbles, quartzite and gneisses. According to the seismic map published by department of mines and geology, the project is located in high seismic prone zone. According to the climatological records of Kakani Substation of DHM located at Kakani, the average air temperature is 14.25°C. The annual average rainfall derived using daily rainfall data from 1994-2021 of Sundarijal station showed 2095.60 mm. The air quality and sound level monitoring showed improvement in air quality and lowering of sound level moving upstream from monitoring station at Tilganga/Pashupatinath area to monitoring station at Dhap. The results of water testing showed a distinct pattern of relatively unpolluted, good water quality at the upstream sites (Dhap and Nagmati) with progressive deterioration of the water quality down to the Pashupatinath temple area.

5.2 Biological Environment

The proposed Nagmati Dam is located within the Shivapuri-Nagarjun National Park (SNNP), which covers an area of 159 km^2 and an elevation ranging from 1,000 m to 2,732 m above sea level. The SNNP supports a rich floral and faunal diversity, with a number of protected species of mammals, birds and plants. According to the Management Plan of Shivpuri Nagarjun National Park (2017/2019-2021/2022), there are more than 2,122 species of flora of

which 16 of them being endemic flowering plants. The park provides home for 30 species of mammals out of which four species are listed in protected list of Nepal government's National Parks and Wildlife Conservation Act 1973 AD, eight are listed in IUCN Red Data Book and 12 are included in the CITES Appendices (eight in Appendix I and four Appendix II). Snow Trout (*Schizothorax richardsonii*) and *Schistura multifaciata* was recorded in the dam area and at the Bagmati river and Nagmati river confluence.

5.3 Socio-Economic Environment

Nagmati Dam Project lies in the Ward no. 1 of Gokarneshwor Municipality, Kathmandu district, Bagmati Province, Nepal. According to the National Housing and Population Census, 2021, the total population of Gokarneshwor Municipality Ward no. 1 is 7872 out of which male population is 3867 and female population is 4005. The total households recorded is 2042 with average family size of 3.86. The sex ratio is calculated to be 96.55. The total population of the 30 affected households is 159, out of which male population is 85 and female population is 74. The average family size is calculated to be 5.3 with sex ratio 1.14.

6. Alternative Analysis

The no project alternative is rejected as it does not help to meet the desired objective of BRBIP i.e., to improve the Bagmati River water quality through dry season flow of 450 lps. Other alternatives to meet the objective of BRBIP for the improvement of Bagmati River were rejected as they were not feasible technically and economically. The project component alternatives within the SNNP were evaluated and the proposed location and design alternative is considered the best alternative from the environmental, technical and economical perspective.

7. Environmental Impacts of the Proposal

Like any other development projects, this project is also likely to produce both beneficial and adverse impacts on the existing natural settings and society.

7.1. Beneficial Impacts

During construction phase, the project will provide temporary employment opportunities to 300 people, increase in local business and the project will support in th edevelopment of local infrastructures and improvement of social services facilities. During operation and maintenance phase, Bagmati River water quality will be improved and additional water flow will be available for socio-cultural usages. The project will generate 1.86 MW of hydro-energy and provide additional drinking water supply of 450 lps to KUKL through MWSP during monsoon season. SNNP will generate revenue through PES and service charge from the visitors. Benefits such as integrated watershed management of Nagmati River, flood control, habitat for local and migratory bird *sps*, ground water recharge and minimization of climate change impacts through the atmospheric carbon sequestration by the reservoir is expected during the operation phase of the project.

7.2. Adverse Impacts

7.2.1 Physical Environment

A total of 65.304 ha of land will be required permanently and temporarily for the project and will be changed to another land use from project implementation. The construction activities like excavation, slope cutting and grading will lead to changes in local topography, disturbance in the fragile slopes making soil loose eventually causing erosion and siltation of the water body. The construction works, transportation and handling of construction material, excavation, drilling, blasting use of heavy equipment, operation of crushing and batching plant, etc., will emit significant amount of dust and produing noise causing air and noise pollution during construction phase. Solid and liquid waste generated from construction works and camping activities will degrade water quality and pollute land. The impact on physical environment during operation phase is related with the flooding downstream from the potential dam failure, solid waste form permanent office camp and camp wastewater management.

7.2.2 Biological Environment

Altogether 80,258 of trees and poles class of different species will be felled for the project. Reduction in local biodiversity, destruction of terrestrial habitat is envisioned as the permanent impact in biological envrionment due to the clearance activities. Construction disturbances resulting from drilling, blasting and vehicle movement and other related activities would interrupt normal movement, feeding and other activities of wildlife. Obstruction in the movement of terrestrial wildlife due to the dam and reservoir is the major impact on the biological environment anticipated during the operation phase. Since, there is existence of sharp fall upstream and downstream of the dam, impact from the barrier created on the river flow by the dam have no significant adverse impact on the aquatic life from the project in the operation phase.

7.2.3 Socio-Economic and Cultural Environment

The project affects 30 households directly by permanent land acquisition of about 0.295 ha and permanently. Reduction in agricultural production due to construction of infrastructures in the agricultural land. Influx of people in the form of workforce and subsidiary business opportunity seekers will put pressure on the social service institutions such as educational facilities, health services, water supply systems, administrative services, security institutions, local markets and supply institutions. Due to the decline in construction related works, the economic activities of local people will be impacted in operation phase.

8. Beneficial Impacts Augmentation Measures and Adverse Impacts Mitigation Measures

8.1 Beneficial Impacts Augmentation Measures

NDP will give priority to the project affected families (PAFs), poor and disadvantaged group for the employment and trainings related to the skill development. Project will conduct trainings related to entrepreneurship development, eco-tourism, and agriculture to enhance the skill development of the local population. Project will allocate 0.5% of total project cost as community support program cost to support development of local infrastructures and improvement of social services facilities of the project direct impacted area and improvement

of infrastructures of the existing downstream users. Project will construct security post, ticket entry counters for SNNP for security and revenue collection.

8.2 Adverse Impacts Mitigation Measures

8.2.1 Physical Environment

The temporary land will be returned to the owner after proper treatment/rehabilitation. To conserve top soil, the top soil shall be collected and stored in a safe place. Slope of the cutting areas shall be maintained at less than the angle of repose to the extent possible. Both vertical and horizontal drains will be provided to minimize the soil erosion problem. Extraction of quarry materials will be done without affecting the existing river morphology. Water spraying will be carried out and vehicles will comply with the national emission standards and regular (monthly) check-up for maintenance. Wastes will be separated, recycled, reused or disposed as per its type. Camps will be provided with toilet and drinking water facility depending on the number of workforce. Generated spoil will be used as back fill materials as far as possible and remaining spoil will be managed properly in the designated sites. The temporary facilities will be dismantled after construction works are over.

8.2.2 Biological Environment

The forest area and trees felled will be compensated as per the prevailing law. Trees that are likely to be removed shall be counted, marked and harvested with the proper forest techniques. The project will plant at least 25 saplings of locally suitable species for the loss of each tree at the compensated land or site designated for plantation. In order to avoid or minimize potential threat such as illegal cutting and collection of forest products, it is recommended for best utilization of the forest products extracted as a part of site clearance. The proponent will prohibit the project workers from game hunting and poaching and any kind of illegal activities through code of conduct. A minimum of 150 lps of will be released in the dewatered section and the releasing mechanism will be strictly ensured. Wildlife rehabilitation programs will be implemented in coordination with SNNP.

8.2.3 Socio-economic and Cultural Environment

Land equaling the area of forest to be acquired by the project will be bought and handed over to GoN. The Project Affected Families will be provided respectable compensation for the land and property they lose to the project. They will be given primary priority in project related employment opportunities and all types of training opportunities. Standing crop will be compensated as per the local market price. Alternative source of drinking water will be identified and developed for the project. Project will promote alternative livelihood activities by training on improved agriculture and other off-farm activities.

9. Environmental Monitoring

Environmental monitoring plans include the environmental monitoring during preconstruction, construction and operation phases for baseline, compliance and impact monitoring of the project activities. A set of measurable indicators have been selected for the monitoring and the plan includes methods of monitoring, monitoring time, monitoring location, and institution responsible for monitoring along with the costs required for monitoring.

10. Environmental Management Plan

To ensure that the environmental issues of the project development and operation in the project impact areas are properly addressed during the project life cycle, the NDP project management, as the primary responsible institution, will implement the key elements prescribed in the environmental management plan. NDP will appoint PMSC to ensure the designed monitoring plans and environmental management plans are duly implemented, monitored, assessed, evaluated and disseminated to the stakeholders for feedback and improvement. The NDP-PMSC will compile the environmental monitoring and EMP implementation report of the construction phase within 3 months of the construction completion and submit to proponent. Proponent will pass the report to stakeholders to get feedback and provide database of environmental management works of the Proposal for future use. The sum of the environmental cost including community support program cost for the project is estimated as NRs 241,175,000 (excluding the costs included in project cost).

11. Environmental Audit

Environmental audit of NDP will begin after two years of the commencement of the project. The necessary arrangements for this audit will be done by GoN, MoFE.

12. Conclusion and Commitments

Like any other development projects, NDP is also likely to produce both beneficial and adverse impacts on the existing natural settings and society. The positive impacts associated with this project can be enhanced and negative impacts can be minimized/mitigated through the established procedures and implementation of proposed measures in this EIA report. Implementation of this project has associated long term benefits while meeting the desired objective of BRBIP. Therefore, this project should go for the implementation. The proponent is committed in implementing all the measures depicted in this EIA report and also the measures to mitigate the impacts incurred during the project implementation.

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CHAPTER 1 NAME AND ADDRESS OF THE INSTITUTION PREPARING REPORT

1.1 Name and Address of the Proponent

The proponent of this Nagmati Dam Project is: Government of Nepal, Ministry of Energy Water Resources & Irrigation, Department of Water Resources and Irrigation, Nagmati Dam Project, Lalitpur, stationed at Gaurighat, Guheswhori, Kathmandu. This project is one of the components of the Bagmati River Basin Improvement Project (BRBIP) with an objective of enhancing the river flow in Bagmati river through Kathmandu over the entire dry season. GoN-MoEWRI (Minister Level) decided to implement the NDP on 2077-12-12 (March 25, 2021) (Annex 1) and this project has been classified as National Priority Project by the National Planning Commission (Annex 2). The proponent along with the aforementioned objective has planned to generate the 1.86 MW power before releasing the discharge into Bagmati River. The proponent has received letter of reservation of project area for electricity generation survey license (Annex 3). ADB has committed to fund the NDP project. The Aide Memoire from ADB mission to Nepal is attached in Annex 31.

Corresponding Address of the Proponent

Government of Nepal,
Ministry of Energy Water Resources & Irrigation,
Department of Water Resources and Irrigation,
Nagmati Dam Project, Lalitpur, stationed at Gaurighat, Guheswhori, Kathmandu.
Phone Number: 01-4114374
Email: nagmati@dwri.gov.np, brbip.doi@gmail.com

1.2 Name and Address of Consultant Preparing the EIA Report

The Environmental Impact Assessment (EIA) report of Nagmati Dam Project has been prepared by Entura Hydro Tasmania in association with Total Management Solution Pvt. Ltd and is updated by Architect Design and Civil Construction Pvt. Ltd, Kathmadu, Nepal in 2022. The EIA report was prepared and forwarded for approval to the then Ministry of Population and Environment in 2015. This report was prepared and updated in accordance with the newly promulgated EPA, 2076 BS and EPR, 2077 BS incorporating necessary comment/suggestions received from SNNP, DNPWC and Ministry of Forests and Environment by the consultant on behalf of the project proponent.

Corresponding Address of the Consultant

Entura in association with Total Management Service (TMS) Pvt. Ltd.
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1.3 Rationale for Conducting EIA

Environment Protection Act, 2019 and Environment Protection Regulation, 2020 (with amendments) are the statutory environmental legislations of Nepal. Section-3 of EPA, 2019 has provisioned the mandatory requirement of Environmental Assessment of the projects identified by Rule 3 of EPR, 2020. Similarly, Section-8 of EPA has prohibited the implementation of proposal without the approval of Environmental Assessment Report from the concerned agency. Since this proposal is being implemented within the Shivapuri Nagarjun National Park area, as per EPR 2077, Anex -3, ka (10) EIA study is required. This EIA report is prepared in the prescribed format provided in schedule-12 pertaining to Rule 7, sub rule-5 (c) of EPR, 2020 to be submitted to MoFE for approval. The proponent has prepared the report according to the conditions stated in the letter (cha no. 762) of Ministry of Forest and Environment dated 2078-01-06.Since, the project is being funded by ADB, this report is prepared in English language pertaining to Rule 7, sub rule 8 of EPR, 2020.

1.4 Objective of the EIA Study

The main objective of Environmental Impact Assessment is to integrate the physical, biological, social, cultural and environmental concerns into the development process in order to achieve sustainable development in the country. EIA study involving wide range of stakeholders to provide their concerns, comments and suggestions with beneficial impacts enhancement measures and likely adverse impacts mitigation measures in order to make proposal implemented.

Specific objectives of the EIA are as follows:

- To collect baseline data on physical, biological and socio-culture environment of the project area.
- Identify, predict and evaluate both beneficial and adverse impacts of the construction of Nagmati Dam on the physical, biological, socio-economic and cultural aspects of the environment of the proposed area;
- Propose environmental protection measures (benefit augmentation and adverse impacts mitigation measures) along with environmental management plan and monitoring plan and environmental audit requirements with the stakeholder engagement;
- To familiarize various stakeholders with EIA outcomes through public consultation and participation programs and to incorporate their relevant concerns and issues in EIA report;
- To prepare environmental management, monitoring, and auditing plans;
- To provide sufficient information to the decision makers about the possible implications due to implementation of the project to make the final decision for the approval of the project; and
- Identify the residual uncertainties not possible to be resolved by the EIA study, if any.

1.5 Limitation of the Study

This EIA was basically focused to envisage the possible impacts associated with the implementation of the Nagmati Dam project. This EIA study couldn't predict the micro-climatic affect from the creation of reservoir. Also, the Nagmati River is the tributary of Bagmati river which flows along the densely populated area of Kathmandu and Lalitpur Metropolitans within Kathmandu Valley, forecast of the possible impacted areas and tentative impacted population has only been included in this EIA report.

CHAPTER 2 INTRODUCTION OF PROPOSAL

2.1 Background

The Bagmati River Basin (BRB) has a cultural and economic significance to the people of Nepal. The water flowing in the Bagmati River is considered holy and is used for cultural and ritual ceremonies practiced at the many significant temples located along its banks. The river flows through Kathmandu which is the administrative and economic center of the country as well as Nepal's gateway for tourism. It provides most of the city's drinking water in its upper basin, hydropower generation in the middle basin, and large-scale irrigation in the lower basin.

The poor water quality conditions in the Bagmati River and its tributaries are caused by the discharge of untreated or poorly treated domestic sewage, discharge of untreated industrial wastewater and dumping of solid waste then undergoing degradation in the river system. Adding to the water quality problems are the diversion of the flow in the Upper Bagmati for water supply to Kathmandu and water use for irrigation, reducing the water flow and thereby reducing the assimilative capacity of the Bagmati River critically during the dry season. In addition, sand mining takes place in the Bagmati River and its tributaries in the rural sections upstream of Kathmandu and there is settlement encroachment of the river banks in the densely-urbanized sections, downstream. In the Upper Bagmati itself, sand mining is continuing above Gokarna. There are existing regulations preventing sand mining however these are poorly enforced and mining in the other reaches of the Bagmati cause significant degradation of the river channel. These activities are seriously deteriorating the Bagmati River flow and water quality.

The Nagmati Dam Project is a component of the Bagmati River Basin Improvement Project (BRBIP), which has the objective of improving water security and resilience to potential climate change impact in the Bagmati River Basin. The purpose of the Nagmati Dam is to boost the flow in the Bagmati River through Kathmandu over the entire dry season. The intent is to store water during the Monsoon season and release this water downstream to the Bagmati River during the dry season to improve the river water quality through enhanced flow. A feasibility study was carried out by the Danish Hydraulic Institute (DHI) on the proposed Nagmati Dam in 2012 to 2013. This was undertaken as an Asian Development Bank (ADB) Technical Assistance project, TA 8050. Water Balance Modelling undertaken for the Bagmati River Basin by this study assessed the required release from the Nagmati Dam. The aim of this release volume was to fulfil two objectives i) achieving perennial flow and ii) water quality targets at Gokarna and Pashnupatinath, namely a minimum flow target of 200 l/s and a water quality target of at least bathing standard with a minimum reliability of 66%. A second desirable objective in addition to the first, if both economically and technically feasible, is to improve the water quality downstream of Pashnupatinath in synergy with the planned upgraded Guheshwori Waste Water Treatment Plant (WWTP): the river will likely to remain anaerobic even with an upgraded WWTP, and hence continue producing strong odours, unless the WWTP's effluent is significantly diluted with additional oxygenated river flow.

An extended study was conducted for NDP by Entura in 2016. Based on the Water Balance Modelling, the study concluded that to achieve these objectives required a guaranteed 400 l/s flow target in the Bagmati River at Sundarijal. Therefore, the storage volume provided by the Nagmati Dam is expected to provide a 100% reliability for this flow at Sundarijal throughout the entire year, taking into account existing water usage between the Nagmati Dam site and Sundarijal.

A large 90 meter high dam at the Nagmati River was proposed at the preliminary stage of the study, however, after the detail geological, hydrological and existing downstream water consumption, the study suggested a 94.5-meter-high dam at the Nagmati River. As stated in Updated Feasibility Report, given the inconsistency between rainfall and streamflow data for the project area, the long term average flow at the Nagmati Dam site was reduced from 0.9 m^3/s (28 Mm^3/ annum) as per the DHI Feasibility Study Report to 0.7 m^3/s (22 Mm^3/annum), a 22% reduction in flow. The storage model developed by Entura was used to determine the revised storage volume to meet the environmental objectives with this reduced inflow. According to area capacity curve, the storage capacity at RL 1908 m and RL 1871 m works out to be 9.48 Mm^3 and 0.69 Mm3respectively. Accordingly, the live storage is 8.79 Mm^3. The FSL is fixed at EL. 1908m. From the freeboard assessment, it is concluded that the crest level of the dam (including the parapet wall) should at least be RL 1912.60m to account for the required freeboard. The corresponding area of the reservoir for FSL 0f El 1908 is 48.04 ha. The maximum reservoir level is El. 1911.23 which corresponds to an area of about 50.7 ha.

Further, the project also planned to optimize the benefits of the project through generation of 1.86 MW of hydro-energy. The NDP after receiving a request letter from MoWS (Annex 6) to study the feasibility of providing water to KUKL through MWSP during monsoon season, optimized its design in penstock alignment and powerhouse location (NDP, 2022) to provide 450 l/s of water supply to MWSP during monsoon season of each year, generally, June 15 to September 15 (Ashar to Bhadra). The memorandum of understanding (MoU) between MoEWRI, MoUD and MoWS on the water sharing from the development of NDP is attached in Annex 7. The proposed project further aimed to improve watershed condition in the Shivapuri-Nagarjun National Park (SNNP) through its proper management as well as in the Bagmati River catchment area. The total cost of the project as per the DPR report is around NRs 25,079,820,000. These costs includes three different outputs which are dam construction, SNNP watershed management and eco-tourism, and institutional capacity building for dam safety.

2.2 Objectives of the Proposal

The main purpose of the Nagmati Dam project proposal is to augment dry season flows to the Bagmati River, thus improving the quality of the water in the river for both environmental and religious purposes. The objectives are further sub-divided into following:

- To store water during the monsoon season and release the stored water downstream to the Bagmati River throughout the year;
- Improve the river water clarity, odour and visual cleanliness;
- Maintain the water quality at Gokarna and Pashupatinath religious sites with minimum flow of 0.45 m^3/s throughout the year.

- Maintain the all year round a minimum flow based on the ecological environment flow requirement of the Bagmati River;
- Increase benefits from the project by generating hydro-energy from the diverted discharge to the Bagmati River at Sundarijal; and
- Provide the additional drinking water to the Kathmandu Upatyaka Khane Pani Limited through Melamchi Water Supply Project during monsoon season.

2.3 Relevancy of the Project

Bagmati River Basin is considered the most water stressed basin in Nepal. The basin is seeing a decline in water resources availability owing to natural and anthropogenic causes while experiencing significant increases in fresh water demand to meet the expanding population and industrial sector, and demands for irrigated agriculture. The rapid and unplanned expansion of Kathmandu City has placed tremendous pressure on the water resources of the upper BRB. In the absence of appropriate solid waste and waste water management, the river has become the main waste collector drain: it now contains high levels of fecal contamination, pathogenic bacteria, bacteriological and physicochemical pollutants. The absence of pollution safety measures has created serious health hazards to local people, livestock, and aquatic flora and fauna, while its physical deterioration has led to a loss of cultural and recreational amenity for the local communities whom no longer respect or cherish the river environment. Rapid urbanization has also led to increased demands on the valley's water supply distribution. During dry season, around 80% of the upper Bagmati River flow is diverted for domestic use leaving very little flow for irrigation and other sectors including environment. Current utilization of surface water is only 10% as water in rainy season is untapped due to absence of seasonal storage facilities. As a result, municipal authorities, individuals and companies continue to extract groundwater at an unsustainable rate. Ground water extraction is estimated to be 4 to 5 times higher than the natural recharge and the water table has retreated by 35 meters (m) in the last 20 years. The situation is further aggravated by: (i) the conversion of the recharge areas into residential areas, and (ii) upstream catchment degradation. In the Kathmandu valley, the river is biologically dead and made of heavily polluted sewage water that endangers the health of the capital's population and downstream water users. Throughout the basin, frequent floods and river bank erosion are the main threat to infrastructure, agricultural land, people's lives, and their livelihoods.

Therefore, the Bagmati River Basin Improvement Program (BRBIP) seeks to improve the water security and resilience to potential climate change impacts in the Bagmati River Basin. In response to the general public's desire to restore the river environment in Kathmandu Valley and the Government's efforts to mitigate the impact of water-induced disasters in the middle and lower reaches of the Basin, Nagmati Dam Project seems to be vital while meeting the objective. The proposed Nagmati Dam Project is expected to deliver in meeting the objective of BRBIP through "Increased Water Availability in the Basin during the Dry Season" to improve the Bagmati River water quality. In addition to meeting desired objective of BRBIP, this project will have added benefits from the hydro-energy generation as well water supply to MWSP during monsoon season. In this regard, the NDP is relevant and should proceed for implementation.

2.4 Project Description

The proposed Nagmati dam site is located in Gokarneshwor Municipality Ward no. 1 of Kathmandu district. The dam site is located where the Nagmati River enters a narrow and steep sided gorge. At this point, the elevation of the river bed is approximately RL 1,840 m and the contributing catchment area is 12 km^2. The Nagmati dam site is approximately 11 km from the headwaters near Chisapani (the elevation at the catchment divide is 2,320 m), and 2 km upstream of the point where the Nagmati River joins the Bagmati River above Sundarijal. The powerhouse is located at RL 1410m on the left bank of Bagmati River at Sundarijal.

2.4.1 Project Location

The Nagmati Dam Project is located in Gokarneshwor Municipality, Bagmati Province, Nepal. The proposed dam is located at the Nagmati River near the Mulkharka village, Ward no. 1 of Gokarneshwor Municiplaity inside the SNNP. The powerhouse is located in Sundarijal, Ward no. 1 of Gokarneshwor municipality. The administrative location of the project is presented in Figure 2-1 below.

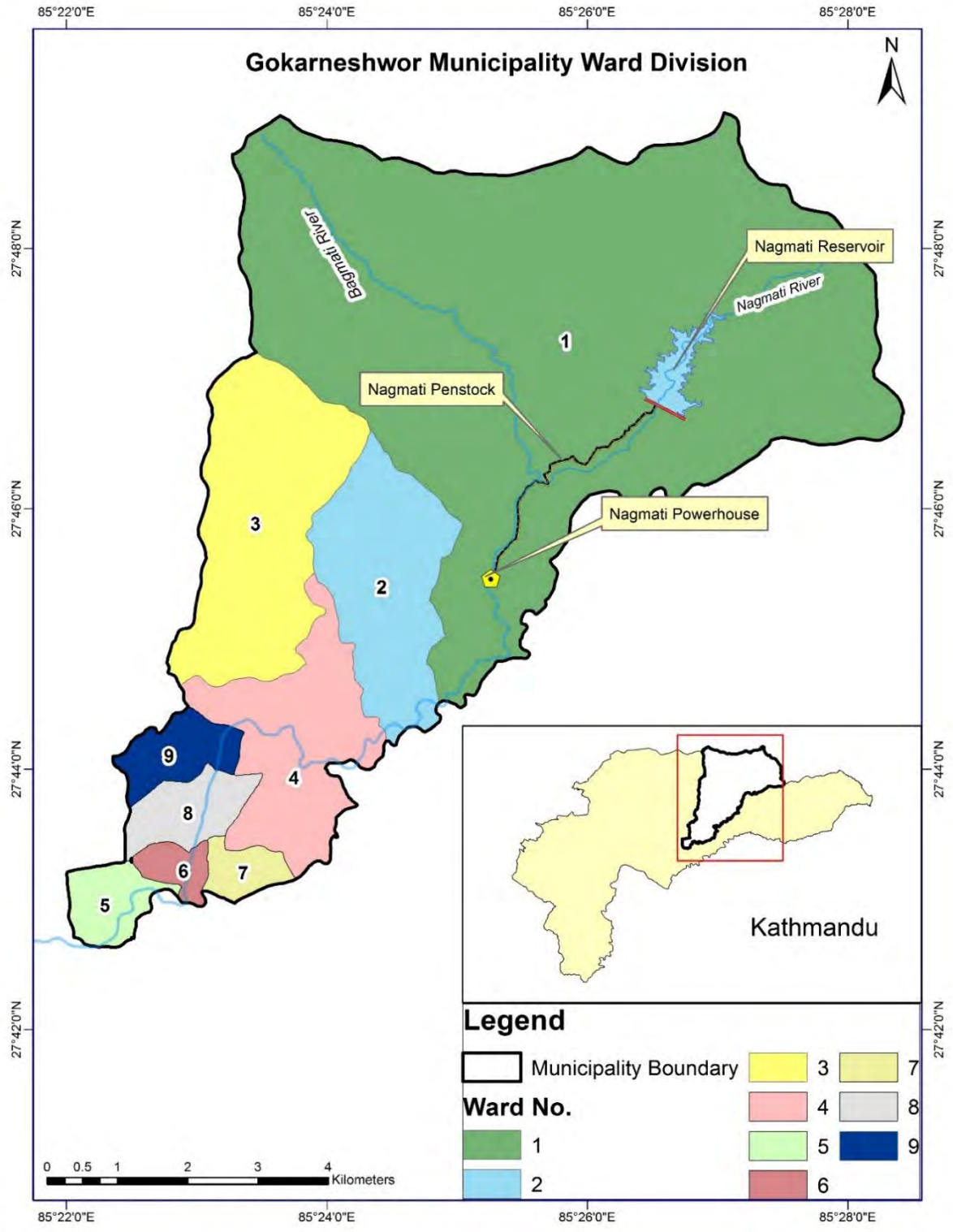

Figure 2-1: Administrative Location of the Project Area

2.4.2 Project Accessibility

The Nagmati Dam and power house is accessible by road. Power house can be reached via black topped road about 12 KM from Ratna Park and it is located next to Melamchi water treatment plant at Sundarijal. Nagmati dam site can be accessed via either the rough vehicle track from Sundarijal through Mulkharka and up alongside the Nagmati River, or the road from Sundarijal around east side of the National Park to Dhap and Chisapani and back down the Dhap-to-Mulkharka vehicle track. The project accessibility is shown in project layout map attached in Annex 9.

2.4.3 Project Components

The NDP constitutes of CFRD of height 94.5m, 554m long and crest width of 7m. The construction of dam will create a reservoir expanded in an area of 480,426 m^2 at FSL with a storage capacity of 9.484 Mm^3 at FSL. A steel penstock pipe of 0.6m diameter and length 2968m before bifurcation is supplied starting from the 2.5 diameter outlet conduit that bifurcates into two 0.4m diameter unit penstocks of 6.25m and 11.63m length to convey design discharge of 450 l/s to the two Pelton turbines at powerhouse. Flow will be discharged into the Bagmati River through MWSP existing cascade canal during dry period and during wet season the discharge of 450 l/s will be supplied to MWSP through existing cascade canal of MWSP from Tail Pool. Map showing the project components is presented in Figure 2-2 and Annex 9.

2.4.3.1 River Diversion

The purpose of river diversion works is to divert the river inflow away from the project construction area, especially from the construction area for the CFRD construction.

River diversion works include construction of upstream and downstream coffer dams and laying of 2.5m diameter concrete encased steel pipe as diversion conduit. The diversion conduit is a 2.5m diameter concrete conduit up to the junction with the conduit coming from the intake after which it is a 2.5m diameter steel lined conduit with a concrete encasement. The diversion conduit is provided with a bell mouth entry and a stoplog gate structure at the upstream end and a valve house at the downstream. River diversion works are designed to cater for 1:10 AEP flood event with a peak flood inflow of 28.12 m^3/s. the upstream invert level of the diversion conduit is set at RL 1842m. The diversion conduit has been aligned close and almost parallel to the Nagmati River on its right bank. The diversion conduit and coffer dams will also be founded on bed rock.

The upstream cofferdam will prevent flooding of the dam area from the headwater upstream of the diversion inlet. The upstream cofferdam is approximately 9m high and will only store approximately 15ML at crest level due to the relatively steep bed slope and confined nature of the river channel. Thus, any failure of the cofferdam will be rapidly attenuated in the river channel downstream of the dam and will have negligible impact at the downstream population locations. A small downstream cofferdam will be provided to prevent flooding of the dam area from tailwater downstream of the diversion outlet. The diversion conduit intake comprises of stoplog arrangement to withstand reservoir head with limited leakage during plugging of the diversion conduit. The diversion plug has been designed to withstand reservoir head corresponding to a maximum water level of RL 1911.23m.

After construction of the Dam the diversion pipe will be converted into emergency outlet pipe.

2.4.3.2 Dam

A Concrete Faced Rockfill Dam (CFRD) of 554m long at the top and crest 7m wide has been proposed. The height above lowest upstream plinth foundation is 77.5m and that from above downstream toe is 94.5m. Top level of dam is at RL 1911.5m. The upstream slopes and downstream slopes is maintained at 1.7H:1V. The CFRD has been designed following the ANCOLD codes for dam design.

Design life of a dam is mainly determined by the sedimentation rate and the design life of structures. Since the sedimentation rate of this dam seems negligible being within the conserved area, the design life is mainly governed by the durability and strength of the dam body and associated structures. In this case the design life of Nagmati dam can be assumed 100 years. The details of design for dam safety and seismic risk in presented in Section 5.1.15 of this EIA report and schematic layout of dam is presented in Annex 9.

2.4.3.3 Reservoir

The construction of dam will create a reservoir expanded in an area of 480,426 m^2 at FSL with a storage capacity of 9.484 Mm^3 at FSL. The storage capacity of the reservoir at MOL is 0.695 Mm^3. The live storage capacity is 8.8 Mm^3 from FSL to MOL and 9.12 Mm^3 from FSL to DSL. The FSL, MFL, MOL and DSL are at RL 1908 m, RL 1911.23 m, 1871 m and 1865.5 m respectively.

2.4.3.4 Spillway

An un-gated ogee crest chute spillway of crest width 20m is proposed on the right bank of the CFRD at crest level of RL 1908 m to provide a safe passage for the flood inflows away from the dam to prevent overtoppling of the dam. Spillway consists of a frontal approach ogee crest leading to a chute, flip bucket and plunge pool. The chute narrows down to 10m width within a horizontal transition length of 50m. The spillway chute channel of 10m width continues downstream of the transition for 194.75m to the lip of the flip bucket, the total plan length being 244.25m. Lip level of the bucket is fixed at RL 1841.61m. An approach channel is provided upstream of the spillway. The chute is provided with 2m high side walls to restrict the flow in the channel and prevent any splashing due to bulking. The flip bucket at the downstream end of the chute will discharge the water into the preformed plunge pool downstream of the CFRD.

2.4.3.5 Water Outlet

The outlet works arrangement includes a 2.5m diameter concrete encased steel conduit connected to the 2.5m diameter diversion conduit 47m (length of the conduit) downstream of the intake with a goose neck connection, so that the remaining downstream segment of the diversion conduit can still be used as the outlet conduit. The diversion conduit will be plugged just upstream of the junction with the outlet conduit to seal the flow from the upstream segment of the diversion conduit permanently. The outlet conduit can also be used as the emergency dewatering outlet for the dam.

Howell-Bunger valve provided at the downstream end of the conduit is operated to restrict the flow velocity in the conduit to 6m/s during emergency lowering of the reservoir. The intake to the outlet conduit has a bell mouth entrance with the invert of RL 1865.5m and has been provided with a trash rack to prevent large size floating debris from entering the intake. Provision of stoplog gate has also been made which could be lowered during low reservoir levels to isolate the pipeline for inspection. The outlet conduit has the same butterfly and fixed cone (Howell-Bunger) valves of 2.5m and 1.5m diameter respectively inside a valve chamber.

a) Penstock Pipe Offtake

Penstock pipe offtake has a 600mm diameter. Penstock pipe supplies a flow of 450 l/s to Nagmati power house. There is a butterfly valve for flow isolation located approximately 230m downstream of the offtake point.

b) Escape Pipe Offtake

Escape pipe offtake has a 400mm diameter and is primarily for riparian releases. Escape pipe has the ability to release additional 450l/s during the penstock/powerhouse maintenance. Escape pipe has a butterfly valve and a globe valve for flow isolation.

2.4.3.6 Penstock

A steel penstock pipe of 0.6m diameter and length 2968m before bifurcation is supplied starting from the 2.5 diameter outlet conduit that bifurcates into two 0.4m diameter unit penstocks of 6.25m and 11.63m length to convey water to the two Pelton turbines. In most of the length, the penstock pipe is buried. The penstock pipe will have varying liner thickness ranging from 8mm to 20mm. In the exposed length, the pipe is carried on saddle supports and anchor blocks. Thrust blocks have been provided in the buried penstocks at bends.

2.4.3.7 Valve House for Penstock

A surface valve house is provided to house the two spherical valves, one each for unit penstock of 0.2m diameter to control the water flow into the powerhouse.

2.4.3.8 Power House

The power house footprint has a length of 22.5m and a width of 15.65m that will be within the MWSP premises. it comprises two machines bays and a service bay. The height of the building has been set as 12.8m above foundation level. The level is 9.9m above the service bay level. The clearance above the crane beam has been kept at 2.7m. The powerhouse will house machine hall, control room, office room, battery room and D.G set room.

2.4.3.9 Turbine

Two horizontal-jet Pelton turbines each with a rated capacity of 1MW will be installed. The level of the center line of the jet of the Pelton turbine is at RL 1410m.

2.4.3.10 Tail Race Channel

The water received from two turbines will be collected in one pool and released to the river or to the treatment plant of Melamchi Water Supply System as agreed mutually.

The major items required to convey the water from powerhouse tailpool to the receiving well or the distribution chamber of the Melamchi water supply treatment plant are the pumps and the delivery pipe.

1. Pumps (450 Ips, 75 kW, Self-Primed/Submersible, Centrifugal Pump)

2. Additional Pipe and Fittings in Powerhouse (75 m long, 450 mm diameter connecting pipe)

2.4.3.11 Access Road

The project needs to upgrade existing 5.737 km long road from Sundarijal upto dam axis. The existing 4m average wide road will be upgraded to 5.5 m wide (excluding drainage and structures). Implementation of project will impound the existing road from Mulkharka to Bhanjyang. The project will construct 4.108 km road of 4.5 m width at the right side of reservoir as the replacement for the existing road that will be inundated after the construction of the dam. This access road at the right side of reservoir will be Feeder Road, Class IV as classified by NRS, 2070. The road from the upstream point of the reservoir (end of the replacement road) to the Bhanjyang will be upgraded and maintainted which is 1.688 km in length. The access roads will be gravel road and will have 1m wide shoulder on both sides with appropriate roadside drainage structures. The road will be rigid pavement as necessary to increase the strength of the road. The project access road is shown in Figure 2-2 and project layout map attached in Annex 9.

The project will construct temporary haul roads, for transporting earth and rockfill for the quarry operation and dam rockfill operation, will be two lane roads, about 10 m wide, with occasional single-lane sections about 5 m wide. They will all be below Full Supply Level (FSL) in the reservoir area. A total length of haul road of about 2.7 km will be required; this includes roads for carting overburden material to spoil disposal areas, but excludes the roads within the quarries. Other temporary access roads will be about 5 m wide, with some narrower sections. As detailed above, most of these will be below FSL in the reservoir area or covered by dam rockfill. A total length of these roads of about 1.1 km will be required. This includes the short temporary road which will be required to access the main site office.

2.4.3.12 Bridge

The project will construct a 8.4 m wide bridge of span 14m adjacent to the existing bridge 5located about 50m upstream from the Bagmati-Nagmati confluence in the Sundarijal Chisapani road.

2.4.4 Power Evacuation

The generated power will be evacuated through one number single circuit 11 kV overhead transmission line to 11kV switchyard located at Sundarijal power station. The generated voltage (3.3kV) will be stepped up to 11 kV by means of 2 nos. of 1.5 MVA, 3.3/11 kV, 3 phase step-up transformer.

The transmission line length is approximately 350m for power evacuation up to Sundarijal and upgradation of existing TL will be carried out from Sundarijal Powerhouse to Chabhil sub station

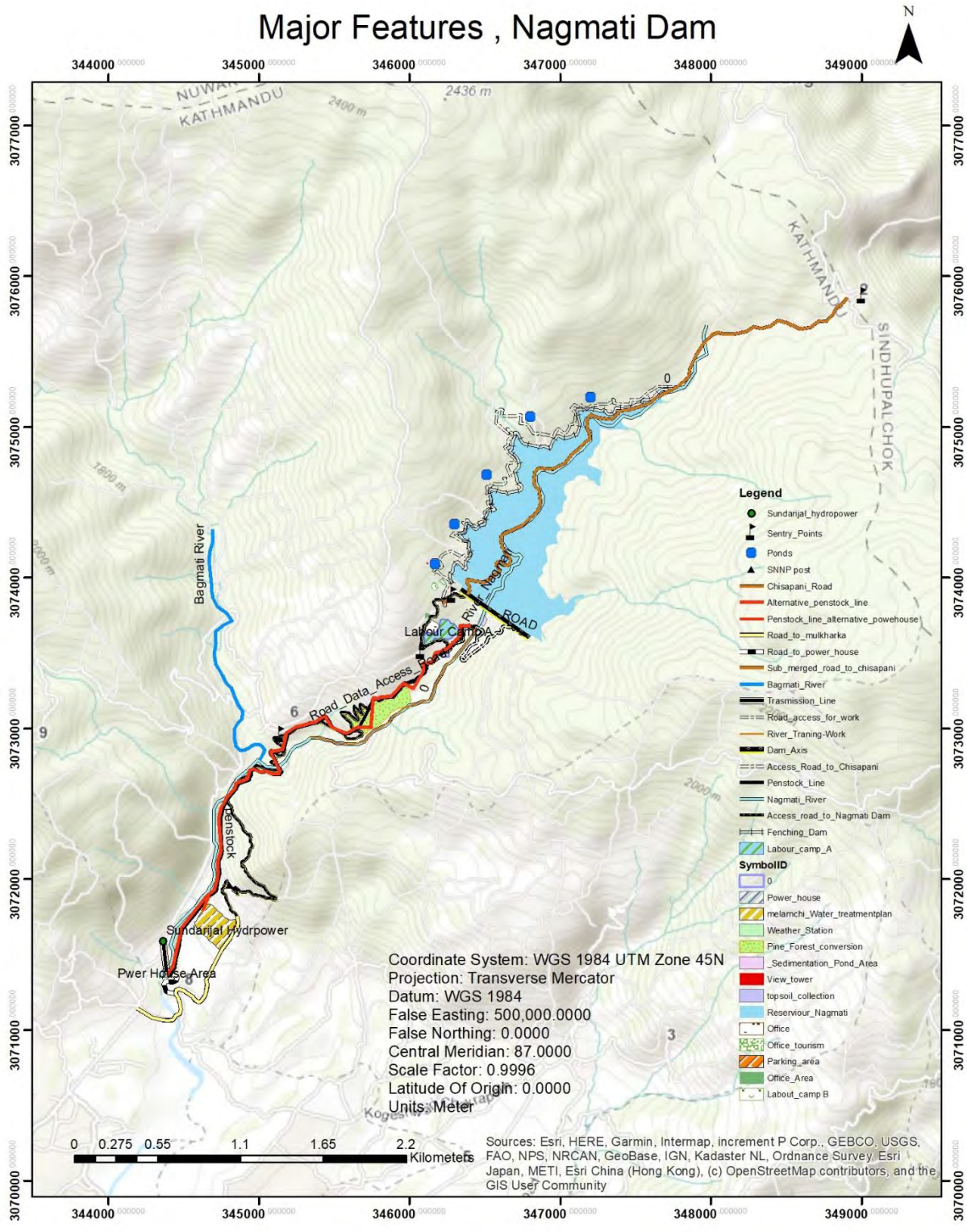

Figure 2-2: Major Features of Nagmati Dam Project

2.4.5 Project Salient Features

The salient features of the Nagmati Dam Project is presented in Table 2-1 below.

Table 2-1: Salient Features of Nagmati Dam Project

Nagmati Dam Project: Salient features	
Location	
Administrative Location	Gokarneshowor Municipality Ward no 1, Kathmandu District, Bagmati Province, Nepal
Location in Protected Area	Shivapuri Nagarjun National Park (SNNP)
Nearest airport	Kathmandu
Hydrology and Design Floods	
River/Stream	Nagmati/ Bagmati
Nagmati catchment area	12 km^2
Design discharge	0.45 m^3/s at the power house for power generation and river flow after tail race, and 0.15 m^3/s at the toe of the dam for eflow
Design flood at dam site (Probable Maximum Flood)	522 m^3/s
Routed flood peak through spillway	232 m^3/s
Diversion flood	28 m^3/s (peak inflow for 1:10 AEP storm event)
River Diversion Arrangement	
Diameter of diversion pipe	2.5 m
Length of diversion pipe	375 m
Invert level	RL 1842.0 m
Top of upstream coffer dam	RL 1850.0 m
Top of downstream coffer dam	RL 1819.0 m
Maximum flow velocity	5.7 m/sec
Note: After construction of the Dam the diversion pipe will be converted into emergency outlet pipe.	
Dam	
Type	Concrete Faced Rockfill Dam (CFRD)
Height above lowest upstream plinth foundation	77.5m

Nagmati Dam Project: Salient features	
Height above downstream toe	94.5m
River bed level at dam site	1817 m
Top level of dam	RL 1911.5 m
Top level of parapet wall on the upstream	RL 1912.6 m
Crest length of dam	554 m
Crest width of dam	7.0 m
U/ s & d/ s slopes	1.7:1
Reservoir	
Full supply level (FSL)	RL 1908.0 m
Maximum reservoir level	RL 1911.23 m
Minimum operating level (MOL)	RL 1871.0 m
Dead storage level (DSL)	RL 1865.5 m
Storage capacity at FSL	9.484 Mm^3
Reservoir area at FSL	480426 m^2
Storage capacity at MOL	0.695 Mm^3
Live storage	8.79 Mm^3 (FSL to MOL) 9.12 Mm^3 (FSL to DSL)
Spillway	
Type	Un-gated Ogee Crest Chute Spillway
Crest level	RL 1908.0 m
Crest length	20.0 m
Length of transition from 20 m to 10 m	50.0 m
Length of chute from spillway crest up to flip bucket	244.3 m (length on plan)
Invert level of flip bucket	RL 1840.0 m
Radius of bucket	12 m
Lip angle	30˚
Lip level	RL 1841.61 m
Emergency Outlet	
Invert level of intake	RL 1865.5 m

Nagmati Dam Project: Salient features	
Shape of intake	Bell-mouth
Length of emergency outlet pipe (2.5m diameter) up to junction with diversion pipe	47 m
Discharge capacity at FSL	112 m^3/s
Valve house for Emergency Outlet	
Type of valve house	Surface
Type and number of valves	Fixed cone (Howell-Bunger) valve x 1 Butterfly valve x 1
Diameter of valves	Fixed cone (Howell-Bunger) valve: 1.5 m Butterfly valve: 2.5 m
Note: The Power Penstock and Escape Pipe take off from the Diversion-cum- Emergency Outlet Pipe on the downstream of the dam.	
Escape Pipe	
Diameter	0.40 m
Maximum discharge	600 l/sec (includes 150 l/sec for riparian use)
Type and number of valves	Globe valve x 1 Butterfly valve x 1
Diameter of valve for regulation of flow	Globe valve: 0.4 m Butterfly valve: 0.4 m
Penstock Pipe	
Type	Surface and buried penstock
Number	One number starting from outlet pipe and bifurcating into two before power house
Diameter before bifurcation	0.6 m, circular shaped
Diameter after bifurcation	0.4 m, circular shaped
Liner thickness	8 mm to 20 mm
Liner material	IS 2062 Grade E 250 B
Length before bifurcation	2968 m
Length of penstocks after bifurcation	6.25 m and 11.63 m
Velocity through Penstock	1.6 m/s

Nagmati Dam Project: Salient features	
Valve House for Penstock	
Type of valve house	Surface
Type of valve	Spherical valve
Number	2 (one each for unit penstock)
Diameter of valve	0.2 m
Power House	
Type	Surface
Gross head	552 m
Rated head	536 m
Centre line of turbines	RL 1410.0 m
Size of power house	22.5 m (L) x 15.65 m (W) x 12.8 m (H)
Rated discharge	0.45 m^3/s
Tail Race Channel	
Type	Concrete, cut and cover type
Length	11.2 m for Unit-1 17.9 m for Unit-2
Size	0.5 m (W) x 0.6 m (H) internal
Maximum tail water level (for 100-year return period flood)	RL 1410m
Turbine	
Turbine type	Horizontal; 2-Jet Pelton turbines
Number	2
Power Generation	
Optimum installed capacity	1.86 MW
Net annual energy after transmission & outage losses	13.13 GWh
Generator's details	Capacity: 3 (180 kW) Diesel
Note: The energy table is added in Annex 11.	
Bridge	
Span	14m

Nagmati Dam Project: Salient features	
Width	8.4 m
Type	RCC
Access road	Sundarijal to dam axis - 5.737 km (upgrade) Right side of Reservoir – 4.108 km (new) Reservoir upstream to Bhanjyang – 1.688 km (upgrade)

Source: Feasibility Study Report of NDP, 2016 and Review of Detailed Design of Penstock Alignment and Powerhouse of NDP, 2022

2.5 Project Requirement

2.5.1 Construction Materials

The dam will be concrete-faced rock fill. Cement concrete intermixed with boulders will be used for the construction of dam and cofferdam. Rebars of different diameters will be used to reinforce the structures. The project access road will be graveled road. Bricks will be used to construct boundary wall. Cement concrete will be prepared mixing aggregates with cement and sand. During the operation of quarry, the project might require to use explosives. This issue had come during the preparation of the Geotechnical Baseline Report and it is evident from the comments made by the then Panel of Experts reviewing the report and from Entura's response that a rockfill dam of Nagmati Project's size cannot be constructed without blasting. The safety measures can be adopted during blasting like controlled blasting, and scheduling blasts during times when noise is less likely to disturb wildlife or people. Additionally, careful planning and design of the blast can help to direct the noise away from sensitive areas. However, alternative methods and technologies will be explored and practiced as far as practicable.

The construction materials required for the project shall be used from local market or from within the country as far as possible. The construction materials required with quantity and probable source is presented in the Table 2-2 below.

Table 2-2: Estimated Construction Material Quantity and Source

S.N.	Construction material	Unit	Quantity	Source
1.	Boulders	M^3	1,672,000	Quarry 1,2 and 3
2.	Gravel for Access Road (Base and Sub-base material)	M^3	33,660	Outsourced from permitted quarry/crusher company
3.	Earth material (if required)	M^3	875,000	Quarry 1,2 and 3, and foundation excavation
4.	Rebar	Ton	3,500	Local market

5.	Cement	Ton	12,900	Local market
6.	Aggregate	M^3	20,000	Quarry/crusher plant
7.	Water stops	M	937	Local market
8.	Brick	M^3	200	Local market
9.	Sand	M^3	10,000	Outsourced from permitted quarry/crusher company
10	Power Gelatin	Ton	1250	Nepal Army/Outsourced from permitted source
11	Detonators	Nos	625000	Nepal Army/Outsourced from permitted source
12	Fuse	M	89000m	Nepal Army/Outsourced from permitted source

Source: Feasibility study report of NDP, 2016

2.5.2 Construction Power

As far as possible, electrical energy will be used in the camps and construction site and workshop supplied by NEA. Electrical line will be extended from the Sundarijal powerhouse upto the dam site to be used during construction and operation and maintenance phase as well. The extension of electrical supply line for the project will be established by NEA. Generator will be used during power cut and for emergency purposes. Petrol and Diesel will be used for the transportation vehicles. Estimated construction power is presented in Table 2-3.

Table 2-3: Estimated Construction Power

S.N.	Energy Type	Numbers/Volume
1.	Generators (Capacity)	3 (180 kW) Diesel
2.	Petrol	600,000 L
3.	Diesel	900,000 L

Source: Estimated by the NDP EIA study team, 2022

2.5.3 Manpower Required

The project requires skilled, semi-skilled and unskilled manpower both for the construction and operation stages. A total of workforce required for construction of the project is about 300 of which 53 are skilled, 65 are semiskilled and rest 182 are unskilled. The estimated manpower is further subdivided into proponent, supervision consultant and contractors team. For the operation 22 full time staffs will be required of which 15 are skilled, 5 are semiskilled and 2 unskilled. The estimated manpower required for the construction and operation stage for the project is presented in Table 2-4 and Table 2-5 below.

a) Construction Stage

Table 2-4: Estimated Manpower for the Construction Stage

S.N.	Manpower	Proponent	Supervision Consultant	Contractor	Mandays
1.	**Skilled**				
a.	Project Chief	1			
b.	Resident Engineer/Civil/Mechanical/Electrical Engineer (20 years-experience)		2	4	
c.	Project Manager/Construction manager/Team Leader		1	1	
d.	Civil Engineer	3	2	4	
e.	Electrical Engineer/Hydropower Engineer	1	1	2	
f.	Mechanical Engineer		1	1	
g.	Engineering Geologist/Senior Geologist	1	1	1	
h.	Environmentalist/Safety Incharge		1	2	
i.	Sociologist		1		
j.	Surveyor		1	1	
k.	Administration and Finance Incharge	2	1	1	
l.	Wildlife biologist/Wildlife expert		1		
m.	Site-supervisor/Overseer/operation incharge	3	5	8	
	Sub-total	**10**	**18**	**25**	**116,070**
2.	**Semiskilled**				
a.	Lab Technician		2	2	
b.	Excavator operators			4	
c.	Foreman			4	
d.	Masons			20	
e.	Batching plant operators			3	
f.	Crusher and Screening plant operators			3	
g.	Batching plant, Crusher and Screening plant and vehicle			3	

S.N.	Manpower	Proponent	Supervision Consultant	Contractor	Mandays
	maintenance mechanics				
h.	Security guards	1		2	
i.	Drivers	3	2	10	
j.	Cook	1	1	4	
	Subtotal	**5**	**5**	**55**	**142,350**
3.	**Unskilled**				
a.	Labors			172	
b.	Office helpers	3	1	6	
	Subtotal	**3**	**1**	**178**	**398,580**
	Total	**18**	**24**	**258**	
	Grand Total	**300**			**657,000**

Source: Estimated by the NDP EIA study team, 2022

b) Operation Stage

Table 2-5: Estimated Manpower for the Operation Stage

S.N.	Manpower	Numbers
a.	**Skilled**	
1	Project Chief	1
2	Civil Engineer	1
3	Geotechnical Engineer	1
4	Electrical Engineer	1
5	Mechanical Engineer	1
6	Overseer (Civil and Electrical)	3
7	Admin/Finance Officer	1
8	Power Plant Operator	2
9	Dam Operators	4
10	Grievance Redressal Officer	1
	Sub-total	**15**
b.	**Semi-skilled**	
1.	Electrical Technician	2
2	Security Guard	1

3	Driver	2
	Sub-total	**5**
c.	**Unskilled**	
1	Office helper	2
	Sub-total	**2**
	Grand Total	**22**

Source: Estimated by the NDP EIA study team, 2022

2.5.4 Land Requirement

For the construction, repair and maintenance of penstock 8m wide land is required. The same land will be used for the electrical transmission line from sundarijal to Dhap dam site. The reservoir will occupy about 50.7 hectares within the SNNP forest area and penstock will be laid on the ground 2968m with width of 8m meant an area of 2.39 ha and mostly under forest. Access road will need about 1.8 ha from Sundarijal up to reservoir. Further, the access road from Mulkharka (dam) to Bhanjyang will occupy about 2.82 ha. Engineers' camp and office building, weather station and spillway as well as parking area and water supply tank will need 1.944 ha permanently. Pipe line will be constructed along the road. Total 65.304 ha land will be needed for acquisition, out of which 62.682 ha will be used permanently and 2.327 ha temporarily. Area out of the reservoir for top soil deposition, labour camps are considered temporary. The component wise land area required for the project with ownership is presented in the Table 2-6 below.

Table 2-6: Land Requirement for the Project

S.N.	Project component/ facilities	Land Required (ha.)	
		Private/ Cultivated land (ha)	Government/ Forested land (SNNP) (ha)
1	**Permanent Land Requirement**		
i.	Reservoir and Dam		50.7
ii.	Penstock	0.111	2.277
iii.	Access Road	0.184	7.914
iv.	Power house		0.161
v.	Office camp		0.52
vi.	Water source (Intake)		0.016
vii.	Weather station		0.1
viii,	Tourism point		0.163
ix.	Parking area		0.11

x.	View point		0.015
xi.	Pond, sedimentation area		0.289
xii.	Camp and office (security office)		0.6
xiii.	Total	0.295	62.682
Total Permanent Land		**62.977**	
2	**Temporary Land Requirement**		
i.	Labor Camp		2.15
ii.	Top soil collection		0.177
	Total	0	2.327
Total Temporary Land		**2.327**	
	Grand Total	0.295	65.009
Total Land Required		**65.304**	

Source: NDP EIA Study, 2022

2.5.5 Project Construction Schedule

The total time needed for the implementation of NDP will be of 9 years that includes 2 years as defect liability period. Before construction works, 2 years time is expected to be required in preparatory works, getting approvals from government and donor, selecting construction contractor, awarding work order. The Project will be started from mid of 2024 AD with forest clearance and access road. Road improvement and construction will be done separately prior to commencement of major project works. Prior to the start of construction works, the project will collect all the required permits and approvals such as EIA study, tree cutting permit and government land use permit. The project will acquire the required private land and simultaneously update the DPR. For the construction works, approximately 7 years period is expected to be needed where construction of the project components such as cofferdams, dam, penstock installation, powerhouse construction, electro-mechanical works, and transmission line will be completed. The project completion and hand over stage is planned to be completed within 2031 AD. The defect notification will be 2 years from the date of handing over to the project by the contractor. The project construction schedule containing the list of activities and time schedule is attached in Annex 10.

2.6 Project Support Facilities

2.6.1 Camp Area

The contractor is responsible for the construction/management of camps for its workforce during the project construction period. It is envisaged that two camps one in dam area and another in powerhouse area is required to house the construction workforce. A temporary construction camp will be constructed near the dam area with consultation with SNNP for which 2 ha land has been allocated near the dam. Since, the powerhouse area is located in the

settlement area, existing private house will be rented for the construction period. Employer will rent the existing private house for its office near the powerhouse area. In addition, there will be a small camp set up for the Owner's Engineer Staff. It may be located next to the powerhouse within the town of Sundarijal. If construction of the water treatment plant there has been completed, then the site of a similar facility for that project could be re-used.

The main Project Office and laboratory are proposed to be located in Mulkharka village. There will also be a small office for the construction of the power station at the power house construction site. Local site buildings for construction workers, small tools and materials, including meal sheds and toilets, will be situated on the platforms on top of Spoil Disposal Areas B and C, also at the foot of the spillway and near the intake structure and also at the power station. Establishment of SNNP post for SNNP, Security post for Nepal Army, Sentry points, ticket counters, tourism infrastructures such as view tower, public toilets and permanent weather station location shall be done by NDP and their establishment location shall be finalized in consultation with SNNP.

2.6.2 Muck Disposal Area/Spoil Disposal Area

Due to the project construction works, it is estimated that a total of 921,068m^3 volume of muck has to be managed in the designated muck disposal area. It estimated that 1,014,188 m^3 volume of muck will be generated from the excavation works out of which 93120 m^3 of muck will be used for backfill (Table 2-7). The project will manage the remaining muck in the areas designated for the project use. The excessive muck can be exported outside SNNP area for infrastructure works. In case of excessive muck, the royalty will be payed to SNNP as per existing law. The project has planned to use some part of all the temporary areas designated for construction material storage, crusher and screening plant, batching plant, camps. The muck stored in these areas will later be used in the rehabilitation of the areas disturbed by construction activities. The proposed areas Area A, Area B, Area C, Area D, Area E, Area F and Area G that will be used for muck disposal is shown in Figure 2-3 and its location with GPS coordinates is presented in the Table 2-8. Further, areas designated for quarries will also be utilized to dispose the generated muck. Apart from Area A, all the proposed muck disposal sites will be inundated by the reservoir after the project operation. For Area A, a bulking factor of 2.5m has been considered for piling up of the muck/spoil. Gabion masonry wall will be constructed with adequate drainage for the stability of Area A muck disposal site. For other muck disposal areas, compaction of the loose materials will be done.

Table 2-7: Estimated Muck Volume

S.N.	Project Component	Unit	Excavation	Backfill	Other use	Volume of muck to be managed	Remarks
1	Coffer Dam	m^3	28,900	23,120	-	5,780	To be managed on Platform-Area G
2	Dam	m^3	666,588	-	-	666,588	To be

S.N.	Project Component	Unit	Excavation	Backfill	Other use	Volume of muck to be managed	Remarks
							managed on Platform-Area G, Area E, Area F and Area C
3	Penstock	m^3	97,650	-	-	97,650	To be managed on Platform-Area G, Area E and Area F
4	Powerhouse	m^3	1,050	-	-	1,050	
5	Access Road	m^3	220,000	70000	-	150,000	To be managed on Platform-Area, Area B, Area D, Area E and Area F
	Total	**m^3**	**1,014,188**	**93,120**	**-**	**921,068**	

Source: Feasibility study report of NDP, 2016

Table 2-8: Proposed Muck Disposal Area Location

S.N.	Description	Location
1.	Muck disposal- Area A	346252.27 E, 3073825.71 N
2.	Muck disposal- Area B	346328.24 E, 3074038.51 N
3.	Muck disposal- Area C	346931.90 E, 3073792.50 N
4.	Muck disposal- Area D	346442.04 E, 3074277.51 N
5.	Muck disposal- Area E	346746.86 E, 3074850.96 N
6.	Muck disposal- Area F	346867.06 E, 3074748.30 N
7.	Muck disposal- Area G	347141.71 E, 3074748.30 N

Source: Feasibility study report of NDP, 2016

2.6.3 Construction Material Storage Yard

The project has proposed two construction material storage yard (Figure 2-3 and Table 2-9). Both of the construction material storage yard is located upstream from the dam axis on either side of the Nagmati River. Construction materials such as Cements, Rebar, Penstock Pipes, construction equipments will be stored in this area. In addition, a separate bunker house will

be constructed to store the explosives in Area C. The explosives will be under the direct supervision of Nepal Army personnel and only authorized person will be allowed to enter the bunker house. Also, this area will house contractor's main workshop including vehicle maintenance. Adjacent to this facility will be the project's general construction store which includes a small building in medium-sized compound. The Contractor will also have workshop within the temporary buildings at the power station site.

Table 2-9: Location of Construction Material and Explosives Storage Yard

S.N.	Description	Location
1.	Construction material storage yard- Area B	346328.24 E, 3074038.51 N
2.	Construction materials and explosives storage yard- Area C	346931.90 E, 3073792.50 N

Source: Feasibility study report of NDP, 2016

2.6.4 Quarry Site

The project has planned to operate three quarry, quarry 1, quarry 2 and quarry 3 respectively. The quarry sites have been proposed about 200m upstream from Dam axis on either bank of Nagmati River (Figure 2-3). The quarry sites have been proposed within the inundated area of the project which later will be converted into reservoir. The volume of quarry material that will be extracted from the quarry sites is estimated to be 2,163,000 m^3. The extracted boulders from the quarry will be used for the rock filling of the dam. Extraction from the quarry will be by mucking using excavators. The volume of extraction from each quarry with its GPS location is presented in Table 2-10 below. After the construction of the dam, the quarry area will submerge forming the reservoir of the project, therefore not requiring any sort of restoration.

Table 2-10: Quarry Area with Volume of Extraction

S.N.	Quarry Area	Unit	Volume of Extraction (m^3)	Location in GPS	Remarks
1.	Quarry 1	m^3	823,000	346802.11 E, 3074292.78 N	Rockfill
2.	Quarry 2	m^3	830,000	346779.29 E, 3074492.53 N	Rockfill
3.	Quarry 3	m^3	510,000	346874.37 E, 3074637.43 N	Rockfill
	Total		**2,163,000**		

Source: Feasibility study report of NDP, 2016

2.6.5 Crusher and Screening Plant

The project has planned to operate a crusher and screening plant to produce the required rockfill materials in the desired shape. Crusher and screening plant will be used for the supply of required materials for the project and shall not be used for any other purposes. Since, the crusher and screening plant site is proposed within the inundated area, the plant site doesn't need restoration. However, a settling pond of capacity 10m^3 will be constructed to settle the waste water generated from washing of quarry materials before releasing it into the river

channel. After the completion of works and before filling up of the reservoir, the site will be cleared up from the plant materials. Harmful and toxic materials such as oil, grease, chemicals, lubricants which are harmful and toxic to the freshwater ecosystem will be cleared from the site. Due consideration shall be given to left the site in natural condition. The proposed location of crusher and screening plant is presented in Figure 2-3 and Table 2-11 below.

2.6.6 Batching Plant

The project has planned to operate a batching plant to produce cement concrete mix required for the project construction. Batching plant will be used for the supply of required cement concrete mix for the project and shall not be used for any other purposes. Since, the batching plant site is proposed within the inundated area, the plant site doesn't need restoration. However, a settling pond of capacity $10m^3$ will be constructed to settle the waste water generated from concrete mix in the batching plant before releasing it into the river channel. After the completion of works and before filling up of the reservoir, the site will be cleared up from the plant materials. Materials such as oil, grease, chemicals, lubricants, cement which are harmful and toxic to the freshwater ecosystem will be cleared from the site. Due consideration shall be given to left the site in natural condition. The proposed location of crusher and screening plant is presented in Figure 2-3 and Table 2-11 below.

Table 2-11: Location of Crusher and Screening Plant and Batching Plant

S.N.	Description	Location
1.	Crusher and Screening Plant-Area E	346746.86 E, 3074850.96 N
2.	Batching Plant- Area D	346442.04 E, 3074277.51 N

Source: Feasibility study report of NDP, 2016

2.6.7 Top Soil Stockpile Area

The project has selected two areas (Figure 2-3) for top soil stockpile and storage. Before the start of construction activities and quarry operation, the top soil of that area will be extracted and stored in the designated area. Slope will be maintained for proper drainage. The proposed location and area of the top soil stockpile area is presented in the Table 2-12 below.

Table 2-12: Top Soil Stockpile Area Location

S.N.	Description	Location
1.	Top soil stockpile area- Area A	346252.27 E, 3073825.71 N
2.	Top soil stockpile area- Area F	346867.06 E, 3074748.30 N

Source: Feasibility study report of NDP, 2016

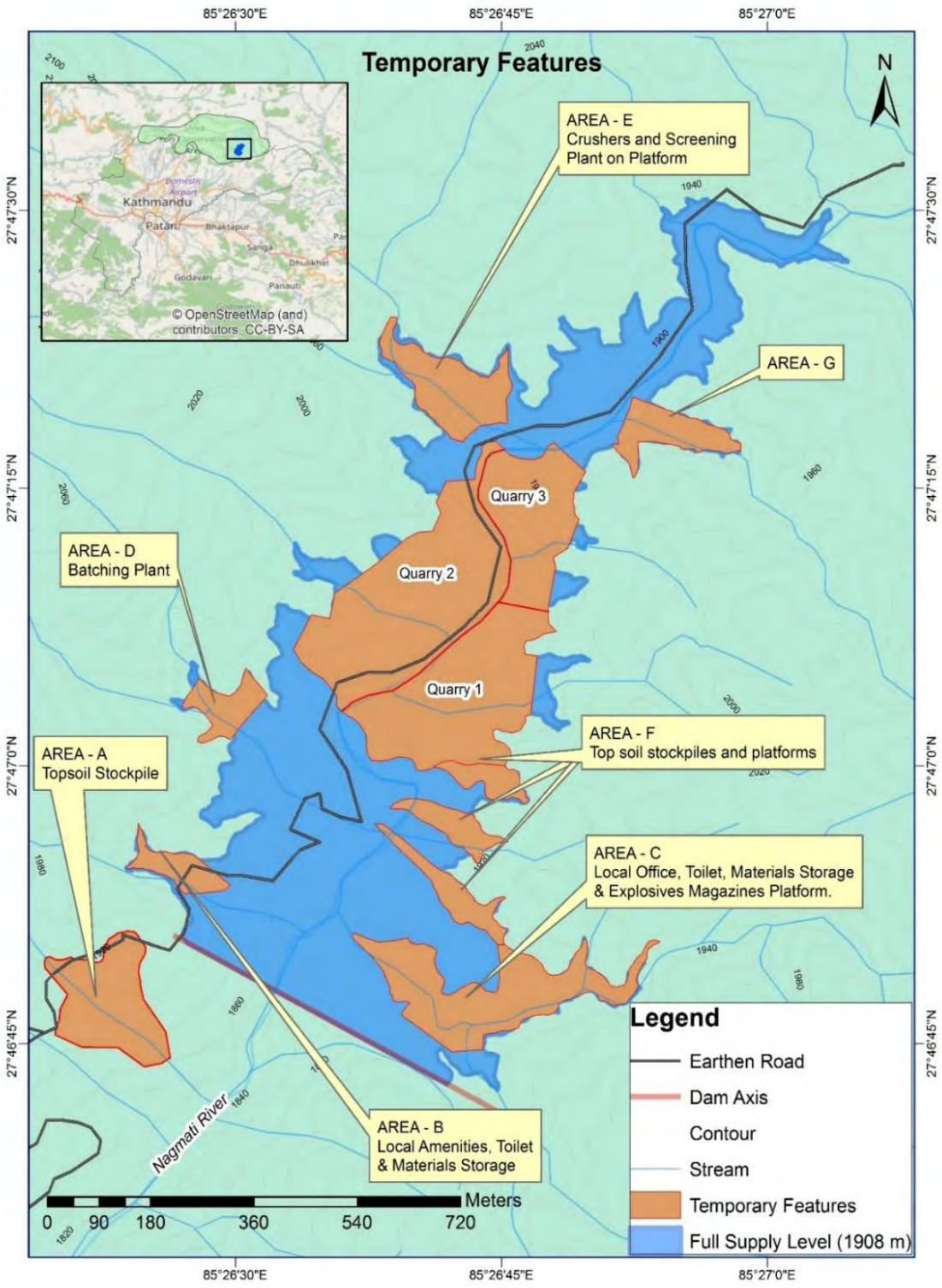

Figure 2-3: Project Proposed Muck Disposal Area Location

Source: Feasibility study report of NDP, 2016

2.7 Project Activities

The project will carry out activities (Table 2-13) that may have adverse environmental consequences during preconstruction, construction and operation phase.

Table 2-13: Project Activities Having Environmental Consequences

Project Activities		
Preconstruction	**Construction**	**Operation**
• Delineation of land area • Survey and pegging • Drilling work for geological investigations • Land acquisition • Tree felling and vegetation clearance	• Site preparation • Drilling and excavation • Blasting • Scaffolding • Muck and spoil disposal • Quarrying and borrow pits • Operation of heavy machinery, parking & movement of vehicles • River diversion for dam construction • Electromechanical works	• Demolition of temporary structures • Repair and maintenance of project structures • River diversion for project operation

2.8 Project Operation Modality

The proposed Nagmati Dam Project is being implemented within SNNP. As per the requirement of the Working Policy on construction and operation of new infrastructures in Protected Area, 2065, the project needs to release 50% of mean monthly discharge of water during the construction and operation period of the project. However, during monsoon season, the flow will be maintained through precipitation and also toppling water flow will be released from Spillway, it is expected that 50% of mean monthly flow will be achieved. Since, the project is also being planned to control downstream flooding and sedimentation, the project will release 150 l/s volume of water throughout its operation period, 150 l/s is considered as environmental release for this project. From the study, 150 l/s environmental release will suffice the required flow to meet the existing downstream water usages. Table 2-14 presents the month wise available mean monthly flow, environmental flow and flow that will be diverted for electricity generation, MWSP during monsoon and release to the Bagmati river channel at Sundarijal.

Table 2-14: Flow Regulation of NDP during Operation

Month	Mean monthly flow of Nagmati river at Dam Site (m^3/s)	Environmental flow D/S release (m^3/s)	Water release to Bagmati River at Sundarijal (m^3/s)	Diverted flow for Energy generation (m^3/s)	Water supply to MWSP during monsoon
Jan	0.10	0.15	0.45	0.45	
Feb	0.08	0.15	0.45	0.45	
Mar	0.08	0.15	0.45	0.45	
Apr	0.10	0.15	0.45	0.45	

Month	Mean monthly flow of Nagmati river at Dam Site (m^3/s)	Environmental flow D/S release (m^3/s)	Water release to Bagmati River at Sundarijal (m^3/s)	Diverted flow for Energy generation (m^3/s)	Water supply to MWSP during monsoon
May	0.21	0.15	0.45	0.45	
Jun	0.59	0.15	0.45	0.45	0.45 (June 15 onwards)
Jul	1.65	0.15	0.45	0.45	0.45
Aug	2.13	0.15	0.45	0.45	0.45
Sep	1.77	0.15	0.45	0.45	0.45 (September 15)
Oct	0.84	0.15	0.45	0.45	
Nov	0.33	0.15	0.45	0.45	
Dec	0.15	0.15	0.45	0.45	

Source: Calculated by EIA Study team, 2022

CHAPTER 3 STUDY METHODOLOGY FOR PREPARING THE EIA REPORT

This chapter outlines the methods adopted and the process followed during field data collection, analysis, and preparation of the report. This EIA study has followed the steps outlined in the Environment Protection Act (1997), Environment Protection Rule (1997), and the National Environmental Impact Assessment Guidelines (1993). However, after the enactment of Environment Protection Act, 2019 and Environment Protection Rules, 2020, the prescribed requirements have been duly considered and followed for the EIA study of this project. The project proponent received permission on 19 April 2021 (2078.1.6 BS) from the MoFE to conduct EIA of Nagmati Dam Project (Annex 5). This EIA report has been updated/prepared according to prescribed format mentioned on Schedule 12 of EPR, 2020 and approved ToR (Annex 4).

The necessary information, issues and potential impacts of the Nagmati Dam within the SNNP were identified, predicted and evaluated in the development of this EIA report. Issues are grouped under physical, biological, and socio-economic and cultural aspects in accordance with the provision of the EPR, 2020. The major steps undertaken in the EIA methodology to accomplish the assignment were:

3.1 Delineation of Impact Area

The impact area of the proposed Nagmati Dam project is delineated on the basis of perceived direct and indirect impacts due to the project activities. The impact area has been classified as Direct Impact Area (DIA), Indirect Impact Area (IIA) and Overall Impact Area (Table 3-1). The overall impact area has been taken where unanticipated impact may happen from the project construction, operation and maintenance. The impact area classification has been elaborated as below:

3.1.1 Direct Impact Area (DIA)

The area likely to be affected by the activities and facilities that are directly owned, operated, or managed by the NDP. The area which will house the project components such as dam, penstock, powerhouse and project support facilities such as muck disposal area, quarry and crusher operating area, construction camp, construction material storage yard etc are considered under the direct impact area.

3.1.2 Indirect Impact Area (IIA)

The area beyond the DIA which are affected due to construction and operation of the project has been considered as the IIA. The area which are affected, due to increased demand of goods and services from the influx of project workforce, disturbance on social, religious and cultural harmony due to the possible conflict between locals and the project workforce, habitat fragmentation etc. For the purpose of the study, area beyond DIA within Gorkarna Municipality has been taken as IIA.

3.1.3 Overall Impact Area

The area within DIA and IIA are considered as the overall impact area. This project is a dam project having reservoir that has the storage capacity of 9.484 Mm^3 of water at full supply

level. Since, the Bagmati River flows along the densely populated areas of Kathmandu and Lalitpur, unanticipated incident such that, sudden failure of dam may release high volume of water in the Bagmati River that may result disaster incidents downstream of the dam flooding the areas near the river banks. Therefore, accounting this rare and unanticipated incident, the wards on either banks of Bagmati River starting from Nagmati Reservoir area up to exit point of Bagmati River at Chobhar, has been considered as Overall Impact Area (OIA) (Figure 3-1).

Table 3-1: Impact Area Delineation of NDP

Impact area	Area description	Administrative Area
Direct Impact Area (DIA)	Proposed Nagmati Dam site area within the SNNP and reservoir area of 50.7 hectare and including penstock alignment along right bank of Nagmati River and left bank of the Bagmati River to powerhouse site on the left bank at Sundarijal; camp sites, borrow area, powerhouse area; existing Sundarijal-Mulkarka-Chispani between Sundarijal and the reservoir area, including relocated vehicle track section of approximately 2 km that will be inundated into reservoir.	Ward No. 1 of Gokarneshwor Municipality
Indirect Impact Area (IIA)	Beyond the direct impact area of project implementation that might inadvertently affected due to project activities.	Gokarneshwor Municipality
Overall Impact Area	The Wards of every local unit lying on both banks of Bagmati river starting from Nagmati Reservoir area upto the exit point of Bagmati river at Chobhar.	Gokarneshwor Municipality, Kageshwori Manohara Municipality, Kirtipur Municipality, Kathmandu Metropolitan, Lalitpur Metropolitan,

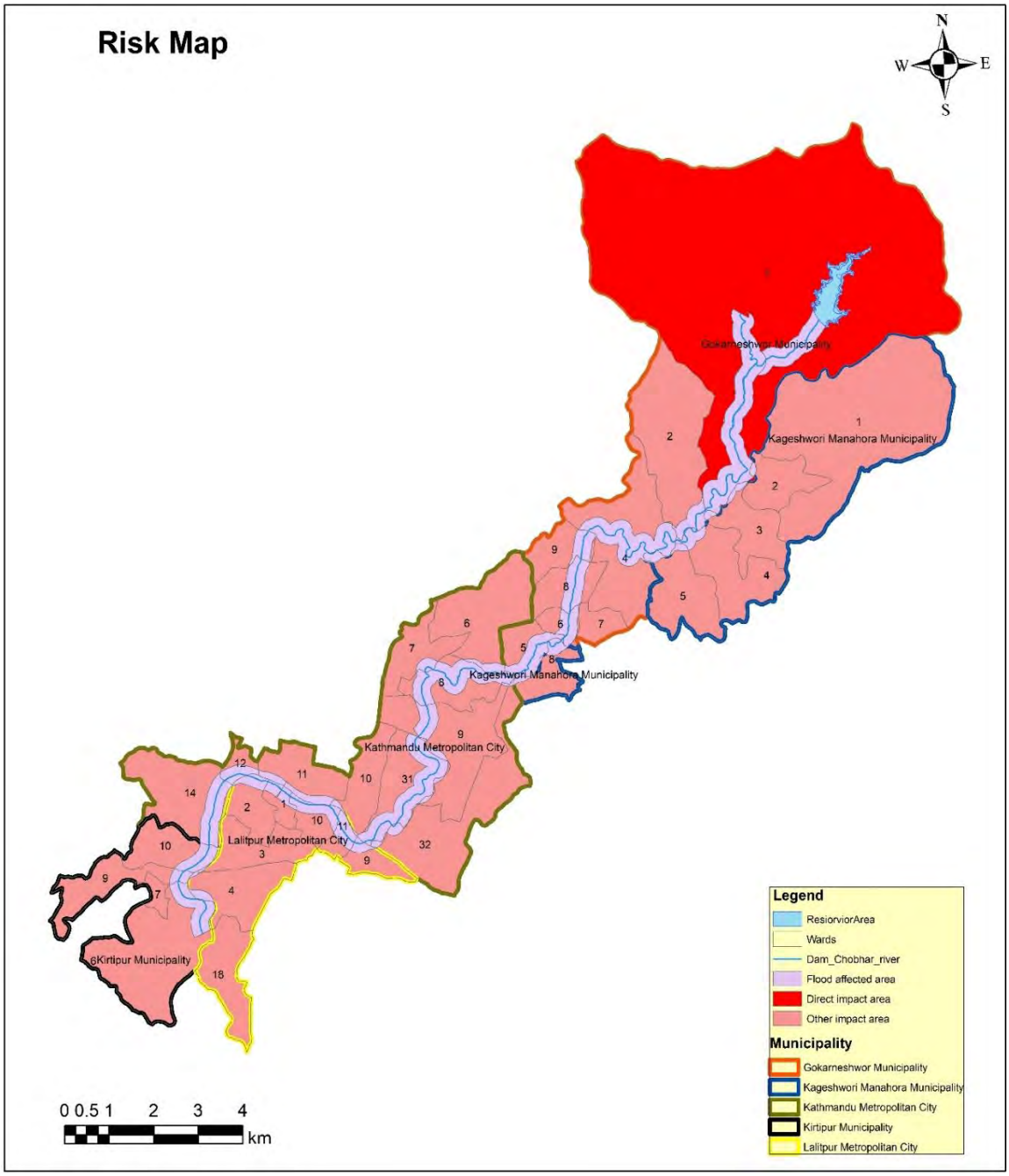

Figure 3-1: Nagmati Dam Project Impact Area in Administrative Map

3.2 Literature review of Relevant Documents and Map Interpretation

During the desk study, published and unpublished documents were reviewed which are relevant for this study purposes, Relevant literature, documents, maps, policies, guidelines and manuals were collected. A desk-based study was carried out to collect and review information regarding the physical, environment, biological, social and cultural environment of the project area, as well as project-related issues and other important issues to be addressed during the EIA studies. The website of the SNNP was visited to understand the biological

environment and values of the conservation area. Other relevant documents were also reviewed to understand the biological environment of the project area and the SNNP.

Other literature reviewed includes:

- All pertinent published and unpublished reports and documents regarding the BRBIP project
- Pre-feasibility study and feasibility study reports of the NDP so far completed
- Survey and design reports including drawings of the proposed NDP
- Prevailing Polices, Acts, Rules, Guidelines, Standards (environmental, water quality, air quality, noise level), Manuals, Conventions etc.

3.3 Key Informant Interview

Local people include those of an older age, SNNP park people, political leaders, social workers etc. have been interviewed to get acquainted with the existing physical, biological and socio-economic condition of the project influenced area and local issues and concerns. The key informants have been an important source of information regarding potential beneficial and adverse environmental impacts with the implementation of the Nagmati Dam project. Checklist and questionnaire used for KII has been included in Annex 12.

3.4 Use of Questionnaire and Checklist for Collecting Data

A set of structured questions was prepared to know the primary information on the physical, biological and socio-economic and cultural environment. Sample of checklist and questionnaire are given in Annex 7. Checklist were prepared to collect and solicit information about landslides, landuse, forest, wildlife, NTFP, religious and cultural sites, etc that existed especially in DIA of the NDP. Checklist and questionnaire used for KII has been included in Annex 12.

3.5 Field Study

Field study was conducted by multi-disciplinary team of experts of concerned subject matter for the collection of primary data and verification of secondary data collected during desk study. The approach included direct observation, measurement, survey, KII, questionnaire and checklist recording to collect of site-specific information. Public consultation meetings with the relevant stakeholders and one public hearing were conducted in the DIA for the collection of opinions, suggestions and recommendations. Details of the methods adopted in order to generate environmental information regarding physical, biological, social and cultural environment of the project area are as follows:

3.5.1 Physical Environment

The information related to the physical environment, such as topographical data, climate data (temperature and rainfall), geological and land stability information, hydrological data, land use pattern and other information concerning physical resources of the project area were taken from the project feasibility study report and detailed project report. Other relevant information, has been derived from available topographical maps, site observations and geological mapping. Site specific photographs, consultation with local communities and inquiries about the history of landslides in the area etc. has also been collected. Air quality,

water quality and noise levels around the Nagmati Dam have been established for baseline information following appropriate scientific methodology. Information on physio-chemical parameters of the Nagmati river water quality have been investigated in order to predict the impacts to propose appropriate mitigation and enhancement measures. Probable seismic hazard and the likely impact downstream due to dam breach and associated mitigation measures have been presented. Land use patterns within the reservoir, along the penstock alignment, and around the powerhouse have been presented. Land area required for the acquisition of the penstock alignment and powerhouse has been estimated, including temporary and permanent land area required for acquisition. The methods adopted to collect the existing baseline information on physical environment is presented in Table 3-2 below and checklist used for field study is attached in Annex 12.

Table 3-2: Summary of Methodology Adopted for Physical Environment Data Collection

SN	Parameter/ Components	Methods used	Source of information/ data	Project components covered
1.	Land Use	• Direct observation • Collection of information from secondary source	Shivapuri Nagarjun National Park Management Paln, 2017-2022 AD	Upstream of Nagmati Dam
2.	Topography	• Direct Observation • Topographical Map of scale 1:25,000, Google maps and GIS maps interpretation	Department of Survey, 1997 (Sheet no.-2785 02 D, 2785 06 A and 2785 06 B)	Project DIA
3.	Geology, Seismicity and soil	• Direct Observation • Collection of relevant information from DPR	Feasibility study of Nagmati Dam Project Seismic Hazard Assessment, 2017	Project Area
4.	Climate/ Meteorology (Temperature and Rainfall)	• Analysis of secondary data from DHM • Temperature data from Tribhuvan International Airport station, Kathmandu (Annex 13) • Rainfall data from Sundarijal Station (Annex 13)	Feasibility study of Nagmati Dam Project	
5.	River	• River discharge data from	Feasibility study	

	hydrology, erosion, sediments and geomorphology	DHM was analysed using data from Bagmati River at Sundarijal Station and Gaurighar Station (Annex 13) • Collection of relevant information from DPR	of Nagmati Dam Project	
6.	Downstream water use and riparian water release	• Study of downstream water usages • Study of minimum riparian water release	Feasibility study of Nagmati Dam Project	
7.	Muck and soil waste management	• Estimation of amount of muck to be generated • Estimation of reuse of muck for construction propose • Estimation of muck to be disposed • Identification and quantification of solid waste generated and its management	Feasibility study of Nagmati Dam Project	
8.	Air quality	• Ambient Air quality monitoring data collection • High volume sampler named Repairable Dust Sampler Modeled No. APM 460 NL, for sampling of PM10, SPM and Lead (Pb) (Specification-Annex 14) • For the sampling of SOx and NOx, Gaseous Sampling Attachment Envirotech APM 411 was used (Specification-Annex 14) • Air quality monitoring locations are provided in Annex 14.	Field data compared with Nepal Ambient Air Quality Standard, 2012	Pashupati, Gorkarna, Sundarijal, Nagmati and Dhap from 21 December to 25 December 2021
9.	Noise level	• Noise level survey monitoring for 24 hours on 1 hour interval using sound pressure level meter for 10 minutes • Sound Pressure level Meter (Monarch 322) (Specification-Annex 14)	Field data compared with Nepal Noise Quality Standard, 2012	Dhap, Nagmati Dam, Sundarijal, Gokarna and Pashupati-Tilganga

		• Calculation of equivalent sound level using standard formula • Noise level measurement locations are provided in Annex 14.		from 21 December to 25 December 2022
10.	Water quality	• Water sampling, laboratory testing and analysis • Sampling locations for collection of water samples are provided in Annex 14.	Measured data compared with relevant Nepal Water Quality Standards	Upstream of dam, dewatered stretch

3.5.2 Biological Environment

Information regarding terrestrial and aquatic flora and fauna of the SNNP and project area has been established for baseline information. The impacts of project construction on the flora and fauna have been identified and predicted in order to propose appropriate mitigation and enhancement measures. Literature has been reviewed in order to understand the flora and fauna of the SNNP and project area. Documentation has been carried out with the information on: (i) forest and vegetation including epiphytic plants in the project area; (ii) wildlife in the project area including mammals, birds, aquatic fauna and impact upon fish with the construction of the project; and (iii) endemic, vulnerable and threatened species in the project area. The checklists used to record field information are attached in Annex 12. Following methods were opted to collect the relevant information.

1) Vegetation and Forest Resources

Vegetation status, forest type, tree loss, medical plants, and non-timber forest products (NTFPs) have been documented in accordance with the established and prevailing requirements and practices.

a. Forest Inventory Design (Tree Enumeration)

The tree enumeration of the remaining reservoir area having tree diameter more than 5 inch in line with rule 89(b) of the Forest Regulations 2079, all trees and poles with a diameter of more than 5 inches dbh in the forest area proposed for the project construction area was completely surveyed and collected data in accordance with Schedule 50 of the same regulations (Note: For the ease of carrying out field enumeration, the already established blocks and plots) was followed to measures the trees. Along with tree measurement, tree having diameter more than 5 inch was tagged with blue color tin plate (with white enamel paint) with tree numbering starting from 31226 (from remaining number of previous work in the same reservoir area). GPS points of the trees (with distance intervals of around 10/10m) was taken for the ease of tree tracking during tree feeling time. The tree class was also be identified in line with forest regulation (Grade 1, 2, 3, 4).

Note: In case of trees that were not reachable for measurement due to difficult terrain, was marked in recording sheet as NR (not reachable), but species name, estimated diameter (dbh) and height was recorded, and reference to nearby tagged tree was recorded in the sheet using

N (A, B..). Here N, refers to tree number of nearby tagged tree. This was applicable to forked trees/poles, to whom we measured it as an individual trees but tagging (metallic plate) was made to a tree, and N (A, B.) was named in the recording sheet.

b. Data collection

While conducting the tree enumeration of the reservoir area, the field register (data collection sheet) was prepared in line with the requirement as mentioned in Forest Regulation (Annex 9), and was reported as per Annex 50 (details in annex 12 of this report). All the field data was digitized, and was further processed to calculate the volume, and other necessary information's. Inside the data collection sheet, the name, diameter, height, tree tagging number, GPS code of each tree was measured and field register was managed. In case of measurement using linear tape in cm/m, the data was further converted into inch and feet during data processing, and report preparation, accordance with template provided by Nagmati Dam Project Office. Latest forest inventory devices was used to measure the tree. Creation of a data entry template with necessary quality controls (as provisioned by Forest Inventory Guideline) to ensure the quality of data, including double entry, invalid values, consistency and range check.

2) Wildlife (Mammals, Birds and Herpetofauna)

To address the intended objectives, scientific techniques like sign survey along transects, bird watching, informal interviews and random surveys have been carried out for the documentation of the mammalian, birds and herpeto-fauna species present in the project area. The valuable ecological habitats of the mammalian, birds and herpeto-fauna species in the project area have been identified. The possible impacts that the implementation (construction and operation) of the proposed project on the mammalian fauna and their habitats have been predicted. The approaches and methodology followed for the study are as follows.

a) Direct Observation

Random line transects were laid in and around the project area in order to observe wildlife. Animals and birds sighted directly were recorded along with their locations (GPS coordinates and elevations). Additionally, the habitat attributes of the area of the sightings are documented, including vegetation types and coverage, proximity from water bodies, aspects, etc.

b) Transect Survey

The research was conducted in twelve transects varying in length between 250-700 m. Ttransects were taken along the walking trail at the three sites. Wild life and Birds sighted were recorded and documented. Transects of the study are presented in figure attached in Annex 15.

c) Signs survey

Animal signs such as footprints, feaces (pellets/scats/droppings), diggings, scents, etc. were observed for the verification of wildlife within the park. Animal signs 5 m left and right along

transects were identified, and associated wild mammals documented. GPS location and habitat attributes were noted for each identified sign.

3) Aquatic Ecology

a) Macro-invertebrates

"Macro-invertebrates Survey of the Upper Bagmati Catchment" conducted for BRBIP EIA, 2013 was considered for the baseline information to be included in this EIA study report. Further, available literatures on macro-invertebrates study proximate to the study area were also extensively reviewed. Considering the detailed macro-invertebrate study conducted by BRBIP for its EIA study, no macro-invertebrate sampling was conducted for this EIA study. The results gathered from the BRBIP EIA, 2013 within and proximate to Nagmati River has been presented in the relevant section

b) Fish survey

"Fish Survey for Environmental Study of the Upper Bagmati River Environment. Bagmati River Basin Improvement Project (BRBIP), 2013" was considered for the baseline information to be included in this EIA study report. Further, other past study on status and abundance of fish in the study area was reviewed. Considering the detailed fish study conducted by BRBIP for its EIA study, no fish sampling was conducted for this EIA study. However, consultation with SNNP officials and locals was conducted to document the presence of fish *sps.*, their abundance and density in the project DIA The results gathered from the BRBIP EIA, 2013 has been presented in the relevant section.

Table 3-3: Summary of Methods used for Baseline Information Collection for Biological Environment

SN	Parameter/components	Methods used	Source of information/data	Project components covered
1.	Vegetation and Forest Resources	• Forest Inventory • Enumeration for Tree loss • Key informant consultation • Review of secondary literatures • Checklist and formats used for field study are attached in Annex 12.	• Field study • SNNP and other published literatures • Draft BRBIP EIA, 2013	Reservoir Dam Penstock Powerhouse Access road Project support facility areas
2.	Non-Timber Forest Product (NTFP) and	• Direct Observation and	• Field study • SNNP and	Project DIA

	other locally useful and commercially important timbers and medicinal plans	recording • Verification and addition of information/data through Key informant consultation • Review of secondary literatures • Checklist and formats used for field study are attached in Annex 12.	other published literatures • Draft BRBIP EIA, 2013	
3.	Wild life, Birds and herpeto-fauna	• Transect survey, sign survey, direct observation • Key Informant Interview • Review of secondary literatures • Checklist and formats used for field study are attached in Annex 12.	• Field study • SNNP and other published literatures • Draft BRBIP EIA, 2013	Project Area
4.	Rare, Endangered, Threatened and Protected Plant and Animal Species	• Transect survey, sign survey, direct observation • Key Informant Interview • Review of secondary literatures • Checklist and formats used for field study are attached in Annex 12.	• Field study • SNNP and other published literatures • Draft BRBIP EIA, 2013 • IUCN Red Book, CITIES, DNPWC published literatures	Project Area

5.	Aquatic Ecology			
a.	Macro-invertebrates	• Review of secondary literatures	• Draft BRBIP EIA, 2013 • Other relevant published literatures	Project DIA along Nagmati River
b.	Fish	• Review of secondary literatures • Consultation with Key Informants	• Draft BRBIP EIA, 2013 • Other relevant published literatures	Project DIA along Nagmati River

3.5.3 Socio-economic and Cultural Environment

Information on socio-economic features of the project including population, ethnic composition, settlement, infrastructure, and market centres and activities has been established. Information regarding tourism and development activity has been included in the report. The methodology to collect these data and information included site visits and observations, literature review, standard questionnaire and checklist. Discussions with SNNP staff, local people of the concerned municipality, and local agencies were also carried out and compiled.

i) Data Collection Methods

To collect the qualitative and quantitative primary data on various domains of socio-economic and cultural environment field study in the project area was conducted. The techniques used for field research included are presented below:

a) Household Survey

A structured questionnaire was designed to collect the information on household size, land holding, economic status, education status, employment, etc. of the PAF. Affected household family/members were interviewed to gather the information. Prior to the survey, orientation was provided to the enumerators. Social expert along with the enumerators conducted the household survey. All the PAF were interviewed during the survey. Sample of the questionnaire used for the HH survey is attached in Annex 14.

b) Key Informant Interview

People having the greater knowledge on the various aspects of the locality were considered key informants and were selected purposively. Key informants were asked about the possible impacts on the existing socio-cultural practices. The interviews were qualitative and open ended. Key informants included Ward-1 chairperson of Gokarna Municipality, School Teacher, and Officials from SNNP (Table 3-4). The interviewer subtly probed the interviewee to elicit information, opinions and experience regarding project related socio-cultural issues and possible impacts. The checklist containing topics/issues or open-ended questions used for the key informant interview is attached in Annex 14.

Table 3-4: List of Key Informants Interviewed

SN	Name of Key Informant	Designation	Address
1	Narayan Shrestha	Ward Chairman, Gokarneshwor Muncipality, Ward-1	Gokarneshwor Muncipality, Ward-1
2	Nima Sherpa	Former President-Sundarijal VDC	Gokarneshwor Muncipality, Ward-1
3	Prakash Karmacharya	Principal-Shree Sundarijal Primary School, Mulkharka	Gokarneshwor Muncipality, Ward-1
4	Birya Bahadur Tamang	President-Sundarijal 4, 5 and 6 Water Supply User Committee	Gokarneshwor Muncipality, Ward-1
5	Anil Tamang	President-School Management Committee, Sundarijal Primary School, Mulkharka	Gokarneshwor Muncipality, Ward-1
6	Sita Tamang	President-Sundarijal-Chisapani-Gosaikunda Construction Development Committee	Gokarneshwor Muncipality, Ward-1
7	Laxman Prasad Poudyal	Chief Warden, SNNP	
8	Shrijana Shrestha	Assistant Warden, SNNP	
9	Shiva Kumar Gaire	Assistant Warden, SNNP	

Source: EIA Field Study, 2021

c) Focus Group Discussion

Group discussion was conducted in the project DIA with the project impacted stakeholders. The participants in the group discussion included family member of the PAF, representatives of the social groups/bodies such as Sundarijal 4, 5 and 6 Water Supply User Committee, Sundarijal-Chisapani-Gosaikunda Construction Development Committee, Teachers of Shree Sundarijal Primary School and representatives from Shivapuri Nagarjun National Park. The study team conducted focus group discussions, at Mulkharka, Gokarneshwor-1 on Magh 3, 2078 BS (January 17, 2022 AD), at Mahankal, Sundarijal, Gokarneshwor-1 on Magh 8, 2078 BS (January 22, 2022 AD) and at SNNP headquarter on March 7, 2022 to disseminate the project information and to collect their concern, opinions, suggestions and demands. Acquisition of land and property by the project infrastructure development such as road, power house, penstock, livelihoods enhancement, use of forest product were the areas/issues of discussion. Details of focus group discussion is attached in Annex 16. Major concern, opinions and suggestions inclusion in this EIA report is presented in the Table 3-6 below.

d) Direct Field Observation

Site observation was made to collect supplementary information on various socio-cultural and economic aspects. This included recording of physical surroundings, religious/cultural

structures and sites, ongoing religious/cultural activities. A market survey was also conducted to gather information of available commodities and their local market price.

Table 3-5: Summary of Methods Used for Baseline Information Collection of Socio-economic and Cultural Environment

SN	Parameter/ components	Methods used	Source of information/ data	Project components covered
1.	Demography	• Review of secondary literatures	• CBS, 2021	Gokarneshwor Municipality
2.	Project Impacted Households	• Household survey	• Field study	Project DIA
3.	Religious, Cultural, Archeological and Historical Information	• Key Informant Interview • Public Consultation • Group Discussion • Review of secondary literatures	• Field study • Published literatures	Project Area
4.	Socio-economic and cultural information of the Project Area	• Key Informant Interview • Public Consultation • Group Discussion • Review of secondary literatures	• Field study • Published literatures	Project Area
5.	Concerns, opinions, suggestions and recommendation of the stakeholders	• Key Informant Interview • Public Consultation • Group Discussion • Public Hearing • 7 days public notice	• Field study	Project DIA

3.6 Data Analysis

Collected data were analyzed with simple method, tabular method, matrix and mathematical calculation and pasted in appropriate places of the EIA report.

3.6.1 Physical Environment

The collected data and information through the literature review and field study on land use, topography, geology, soil, erosion and land stability, geomorphology, climate and hydrology, air quality, water quality, noise level and climate change were collated to generate comprehensive set of databases. Geological map was studied to identify the critical weak geological areas. Erosion and land instability were analysed in terms of geology and geomorphic processes including climatic and hydrological variations to activate the erosion and land instabilities. Climatic and hydrological records were analysed to generate spatial and temporal variations that characterize the area. Recorded air quality and noise level data were

analysed, calculated using standard formula and compared with relevant standards of Nepal. Further, water quality data was also analysed and compared with relevant standards of Nepal to set the baseline environmental condition of the project impact area.

3.6.2 Biological Environment

Collected data was analyzed to acquire the attributes that were required to get further information regarding the volume of trees, poles, firewood as per Forest Regulation 2079. The raw database obtained from the forest enumeration (forest inventory of measured plots within reservoir area) was digited and then analyzed. During the database analysis, various reference documents in line with forest regulation 2079 regarding the formulae and calculation methods was reviewed. After then, the status of forest, tree species, and growing stock was analyzed.

a) Forest Stock

Forest status of the reservoir area was measured by calculating Tree Volume; growing stock of tree & poles was calculated. The allometric equations developed by Sharma and Pukkala (1990) was used for calculating tree, poles, firewood volumes, as mentioned in forest regulation 2079.

b) Forest types

Based on the field information collected through enumeration and GIS analysis, different forest types in the proposed project area was analyzed.

Stem Number

Total stem number of the reservoir area was calculated. The total number of stems in the reservoir area was measured and counted. Tree stem/ha was also calculated for the tree/pole species. Species wise stem/ha was analyzed using Excel sheet developed in accordance with forest regulation 2079.

Tree Stem Volume

$$\ln(v) = a + b * \ln(d) + c * \ln(h)$$

Where In = Natural logarithm to the base 2.71828
v = volume
a, b and c are volume constants,
d = diameter at breast height
h = height of the tree

c) Protected Plants and Animals Species

The data collected on the types of plant species, animal species, birds were compared with the IUCN Red Data list, CITIES and GoN protected species list and presented in the relevant sections of this EIA report.

3.6.3 Socio-economic and Cultural Environment

The data collected through various tools and sources were analyzed using both descriptive and statistical methods. Qualitative data like socio-cultural characteristics, practices, perceptions, concern and suggestions of the stakeholders have been analyzed under appropriate context

under different categories and sub-headings. Quantitative data collected from household survey have been analyzed using MS Office Excel. Necessary tables have been presented in the appropriate sections. National housing and population census published by CBS, 2021 data was used for the analysis of the socio-economic and cultural environment.

3.7 Impact Identification, Prediction and Evaluation

The identified issues have been categorized into beneficial and adverse impacts. Impacts have been rated for their magnitude, extent and duration using appropriate symbols and definitions with due consideration of the National EIA Guideline, 1993. The magnitude of the impact has been further classified into (i) site specific, (ii) local and (iii) regional. The duration of the impact has been further classified into (i) short, (ii) medium-term and (iii) long-term. Scoring for evaluation of the impacts has been carried out as per the EIA Guidelines 1993.

3.8 Public Consultation and Public Hearing

3.8.1 Public Consultation

Formal and informal public consultation were conducted in the Project DIA. Informal consultation with locals were conducted prior to the formal consultation to identify the key stakeholders and actors to explore the various socio-economic, cultural other relevant issues associated with the project implementation. These discussions were helpful to identify the key issues to be discussed during the formal consultation and workout the possible grievance address mechanism. A formal public consultation was organized in Mulkharka, Gokarneshwor-1. The discussion/consultation was mainly focused to identify the issues related to the land acquisition, socio-economic and cultural implications of the project, areas where project should assist, employment opportunities, livelihood enhancement activities and modality of grievance address mechanism. The participants of the formal public consultation meeting is presented in Annex 16.

3.8.2 Public Hearing

A public hearing was organized at Melamchi Water Treatment Plant meeting hall, Sundarijal and second one hearing meeting was held at Mulkharka village on 2078-10-3 (2022-Jan-17) near the Nagmati Dam Reservoir to disseminate the information about the project and possible implications from the project implementations and to collect opinions, suggestions from the public and relevant stakeholders. Prior to the public hearing program, locals and relevant stakeholders were notified through the public notice. Notices were affixed in the community places, Gokarneshwor-1 Ward office and SNNP and Deeds (Muchulka) were also collected (Annex 14). Public hearing notice was played in Kantipur FM to provide information about the public hearing program (Annex 17). Further, public hearing public notice was also published in Kantipur Daily Newspaper, a national daily on Poush 27, 2078 (Annex 17).

A leaflet with project information in Nepali local language was developed, including all the major findings, potential impacts and suggestions as well as mitigation measures. The leaflets were distributed to all concerned stakeholders prior to the public hearing. Further, the study team shared the enhancement measures to intensify the beneficial impacts and mitigative, corrective and compensatory measures to minimize the negative impacts proposed in the EIA

report to the public and relevant stakeholders. The study team in response to the limited presence of stakeholders conducted another public hearing program at Melamchi Sarokar Samiti Office, Sundarijal on Ashoj 30, 2079 BS (October 16, 2022 AD) to address the issues of local affected people. Issues, opinions, suggestions were collected and is addressed in this EIA report in the relevant section. The meeting minutes of the Public Hearing Program is attached in Annex 17.

Table 3-6: Feedbacks/Concern of the Local People and SNNP and Measures Taken to Incorporate the Concerns during Project Implementation

SN	Issues	Key feedback/concern of the community	Measures for the integration of raised issues/concern during project implementation
a.	Private land compensation	Appropriate Compensation should be done within a short timeframe. Cash compensation is preferred, but land can also be alternative compensation. If available land to land compensation at Mahankal or Santari phat (Flat land) is also acceptable. Land should be acquired whole in case of small chank leftover. Building should also be taken over whole if some portion is covered by infrastructure such as road or penstock. Representation of Impacted People while discussion meetings for acquisition of land and property. Road should be constructed as per the heavy vehicle will be used for transportation therefore width of road needs to be determined at this land acquisition stage.	Table 8-4 Pre-construction stage S.N A-1 Section 8.1, Table 8.1, S.N-3
b.	Biodiversity Conservation	Biodiversity conservation program should be implemented by the project.	Section 8.2.2, Table 8-3, S.N A-ii
c.	Employment	Skill improvement trainings for women/girls and special target group. Support to farmers in agricultural seed,	Section 8.1, Table 8-1, S.N A-I, A-2, B-11

		equipment, technology and trainings. Organize a Visit for Male 25 and female 25 members to Ilam district to share ideas of livelihoods enhancement through agriculture development practice.	
d.	Livelihood Support Activities	Local people should be given priority employment should be provided in priority to interested Impacted People when hiring employees for the Nagmati Dam Project.	Section 8.1, Table 8-1, S.N A-I, A-2, B-11
e.	Tourism	Develop an Integrated Eco-tourism Plan of Bagmati Watershed including Nagmati and Dhap Dam. Promote the traditional route to Dhap instead of fire line.	Section 8.1, Table 8-1, S.N B-11
f.	Conflict	Compensation plantation, fencing wall maintenance, mess wire fence construction in coordination with SNNP to reduce Human Wildlife Conflict. Disaster plan in case of dam failure	Section 8.2.2, Table 8-3, S.N A-i Section 14.7.3.3.2
g.	Support to Community structures and services	There should be 6 m road along the penstock near the Melamchi Treatment Plant settlement area. Existing water resource use should not be stopped due to project implementation. Improve trail to Kiriyaputri Ghar (Grave yard building) Install road side lamps along the road in this village.	Section 8.1, Table 8-1, S.N A-7
h.	Monitoring	SNNP requires 1 4WD Scorpio and 5 two wheelers for the monitoring purpose	Section 8.2.2, Table 8-3, S.N A-iii Section 14.5.2, Table 14-5

3.8.3 Days Public Notice

A 7 days public notice was published on 2079-8-25 in accordance with the Annex 10 of EPR to collect written opinions and suggestion on the implementation of this Nagmati Dam

Project. The public notice was affixed in the public places, Gokarneshwor-1 Ward office and SNNP office and Muchulka was collected (Annex 18). Received written opinions and suggestions relevant to the project were addressed and incorporated in the relevant sections of this EIA report.

3.9 Recommendation Letters Collection

Recommendation letters with the concerns and suggestions from Gokarneshwor Municipality, Gokarneshwor Municipality Ward no. 1 and SNNP was collected in the format prescribed in Annex 16 of EPR as per the provision made in rule 8(8) of EPR, 2020 (Annex 19). The concerns and suggestion were addressed and incorporated in this EIA report in relevant sections.

3.10 Draft EIA Report Development

Draft EIA report of Nagmati Dam Project was prepared as per the format for EIA Report preparation on Schedule-12 of the EPR, 2020. All the comments documented during the public hearing, comments, and suggestions received from stakeholders have been incorporated. Scoping document and Terms of Reference for conducting the EIA study of Nagmati Dam Project were followed during the development of draft EIA report. The EIA study is presented in Table 3-7 below.

Table 3-7: EIA Study Team Composition

SN	Name	Degree	Involved EIA/IEE study
1	Sher Singh Thagunna/ EIA Team Leader	Master of Applied Science (Park, Recreation and Tourism)	>10
2	Purusottam Mahat/ Environment	Master (Environmental Management)	>15
3	Alex Singh Thagunna/Civil Engineer	ME (Construction Engineering & Management)	5
4	Mohit Singh Thagunna/Socio-economist	MPhil (Finance)	4
5	Ujwal Maskey/Geologist	Master Geology	3
6	Sewak Bhatta/Environmentalist	Master Environment Science, GIS	1
7	Asha Bhatta/Research Assistant	Bachelor in forestry	0

CHAPTER 4 POLICY, STRATEGY, ACT AND GUIDELINE RELATED TO PROJECT

This Chapter has reviewed relevant policies, acts, regulations, guideline, and other related standards as well as international conventions which have a direct relevance with the proposed Nagmati Dam project construction and operation.

4.1 Constitution of Nepal, 2072 (2015 AD)

Article	Related points
Article 30	Right to clean environment: (1) Every citizen shall have the right to live in a clean and healthy environment. (2) The victim shall have the right to obtain compensation, in accordance with law, for any injury caused from environmental pollution or degradation
Article 51 (g)	**Policy regarding the conservation, management and use of natural resources**: (1) to protect, promote, and make environmental friendly and sustainable use of natural resources, (2) to make multi-purpose development of water resources based on public participation. (5) to conserve, promote, and make sustainable use of, forests, wildlife, birds, vegetation and bio-diversity, by mitigating possible risks to environment from industrial and physical development, while raising awareness of general public about environment cleanliness, (6) to maintain the forest area in necessary lands for ecological balance, (7) to adopt appropriate measures to abolish or mitigate existing or possible adverse environmental impacts on the nature, environment or biological diversity, (8) to pursue the principles of environmentally sustainable development, (9) to make advance warning, preparedness, rescue, relief and rehabilitation in order to mitigate risks from natural disasters.

4.2 Policy, Plan & Strategies

Policy, Plan & Strategies	Article/rule/section and point to be considered during project implementation
National Forest Policy, 2075 (2018 AD)	Aim: strengthen the forest resources, manage forest resource sustainably, increase productivity of forest area/sector and increase overall production from forest. Similarly, to conserve biodiversity, conservation of sources, and equal sharing and distribution of environmental services gained from conservation; to encourage private sector for the development and conservation of forest sector; to reduce the adverse impacts of climate related hazards and enhance climate change adaptation measures and resilience in Nepal.

Working Policy for Construction and operation of physical infrastructures in protected area 2065 (2008 AD)	The working policy mentions that the land of protected area and its buffer zone shall be provided exclusively for the projects with national priority. Government of Nepal, (Ministerial Council) shall decide whether the project is National Priority Project or not. The policy states that the tax for the forest products like soil, sand, gravel, boulders etc. need to be paid to the respective Protect Area office as per the rate declared by Forest Regulation 2051. The policy needs to plant 25 trees for each tree cut by the project as compensatory plantation. The policy requires monitoring from the representative from the respective protected area office to conduct any Construction related works.
Water Resources Policy 2020	Adopted the principles of IWRM and the river basin organizations to advance the management of water resources.
Wetland Policy, 2059 (2003 AD)	Aim: This policy is for planned conservation, maintenance and development of wetlands, while providing support to economic, social and cultural development, wise use of wetlands.
Water Induced Disaster Management Policy, 2059 (2003 AD)	Objectives of: (i) minimizing the loss of public and property related to water induced disaster; (ii) conserving watershed and aquatic ecosystem for the sustainable use of water related infrastructures, (iii) controlling water induced disaster and management of flood affected areas, and (iv) clarifying the role of government and non-government organizations involved in river management activities. The policy has identified five strategic areas for its implementation: (a) emergency protection measures, (b) abatement of water induced disaster, (c) natural resource conservation, (d) utilization of river banks and flood plains, and (e) institutional development.
Solid Waste Management National policy, 2079 BS (2022AD)	Section 9, subsection 9.3: Emphasizes reducing wastes at their very source Section 9, subsection 9.4: Citizen's participation in waste management
Environmental Assessment in the Road Sector of Nepal: A Policy Document, GEU/DOR, January, 2000	Purpose: to guide for Environmental studies of road
Nepal Environmental Policy and Action Plan (NEPAP I and II),	Seeks to: balance development efforts and environmental conservation; Mitigate adverse environment al impacts on development projects and human actions.

1993-1998	
ADB Policy Paper Safeguard Policy Statement, 2009 AD	The (ADB) in its operational policies incorporates: the Involuntary Resettlement Policy (1995), the Policy on Indigenous Peoples (1998), and the Environment Policy (2002). ADB requires to meet emerging environmental and social challenges of development projects ADB supported nations in its developing member countries (DMCs), respond to lessons learned from its experience with its existing safeguard policy Standards. ADB's safeguard policy aims to help developing member countries (DMCs) address environmental and social risks in development projects and minimize and mitigate, if not avoid, adverse project impacts on people and the environment.
National Biodiversity Strategy and Action Plan, 2071-77 BS (2014-20 AD)	A 35-year vision: "conservation of biodiversity for sound and resilient ecosystems and national prosperity". The strategies and associated actions are grouped into the six biodiversity themes and 15 cross-cutting subjects. The six thematic areas are; protected areas, forest outside protected areas, rangelands, wetlands, agriculture and mountains.
Nepal Conservation Strategy, 2044 BS (1988 AD)	This strategy contains various policies of international and national concern. It says "Nation exercises sovereign rights with respect to natural resources contained within the boundaries. It is this principle that gives substance to the concept of national conservation strategies. It also places the prime responsibility for conservation or the wise use of natural resources, upon individual's nations. In addition, the strategy has made various provisions for resource conservation and its utilization in tune with environment friendly manner. It has provision dealing with biological diversity, soil conservation, watershed management, national park, protected areas & wildlife conservation as well as on natural heritage.

4.3 Acts

Acts	Article/rule/section and point to be considered during project implementation
Environment Protection Act, 2076 (2019 AD)	Article 3: Environmental study report to be prepared Article 4: Detailed analysis of alternative to be made Article 5: Scoping and work schedule Article 6: Standards and quality to be maintained Article 7: Environmental study report to be approved:

	Article 10: Environmental management plan
National Parks and Wildlife Conservation Act, 2029 (1973 AD)	Article: 5 (point Ka to ga), Article 10: Protected Wildlife, Article :15 Ka Study permission
CITES Act, 2073 (2017 AD)	Article 1 (2): This Act shall come into enforcement throughout Nepal and shall apply also to persons committing an act that is deemed to be an offence under this Act living anywhere outside Nepal Article 3: Prohibition on Trade or Transaction of Threatened or Vulnerable Wild Fauna or Flora or Specimen thereof Article 20: describes the offences deemed to be committed Article 21: describes the punishment Article 22: The endangered wild fauna or flora or a specimen thereof or other goods related to an offence under this Act or any material, weapon or transport vehicle used in the commission of such offence shall be confiscated
The Water Resources Act, 2049 (1992 AD)	Article 16: Utilization and Acquisition of Other's Land and House: (1) If it is required that the land or house of any person be used or acquired for the purpose of performing any of the following function, the licensee may submit an application to Government of Nepal : (a) For the construction of a dam or barrage, (b) For the construction of canal, ditch or tunnel, (c) For the construction of a water tank on the surface or underground or for laying pipe, (d) For the construction of ponds or installation of a water distributing center, Article 17, 18, 19 and 20.
Aquatic Animals Protection Act, 2016 (1961 AD)	Article 3, 4,5 (A,B), 6, 8
Soil and Watershed Conservation Act, 2039 (1982 AD)	The Soil and Watershed Conservation Act empowers the government to declare any area as a protected watershed to limit degradation of land by floods, water-logging, salinity in irrigated areas and acceleration of siltation in storage reservoirs, and to properly manage the watersheds. The Act of 1982 and its regulations of 1985 together provide the legal basis for managing watersheds. The Act also outlines the essential parameters necessary for proper watershed management (Including both rivers and lakes).
Land Acquisition	Article 3, 5, 6,7,8, 9

Act, 2034 (1977 AD amendment in 1993 AD)	
Forest Act, 2076 (2019 AD)	Article 42 (Point 1 to 8)
Child Labor Prohibition and Regulation Act 2056 (2001 AD)	Article 2 (Ka): refers "Child" to the children below 16 years of age. Article 3 clause 1: any child below the age of 14 years prohibited for labor employment Article 3 clause 2: prohibited to engage children below 16 years in works in risk-prone sectors such as public transportation and construction related works
Plant Protection Act, 2064 (2007 AD)	Section 3: GoN may by notification in Nepal Gazette, impose restriction or condition for the import of plant or plant product.
Solid Waste Management Act, 2068 (2011 AD)	It is expedient to make the management of the solid waste in a systematic and effective way by reducing at its source, re-use, processing or discharge and for maintaining a clean and healthy environment through the reduction of adverse effects that may be caused to the public health and environment by amending and consolidating the law relating to the management of solid waste like most essential services laws.
Labour Act 2074, (2017 AD)	Article 4, 5, Article 28, e
Local Government Operation Act, 2074 (2017 AD)	The act stipulates works, duties and rights of Rural Municipality and Municipality. The point N ga incorporates provision of Forest, wildlife, birds, use of water resources, environment, and biodiversity
Land Use Act, 2076 (2019 AD)	Land has been classified into 10 categories: agricultural; residential; commercial; industrial; mining and mineral; forest; river, stream, pond and wetland; public use; cultural and archaeological and others.

4.4 Rules and Regulations

Rules and Regulations	**Article/rule/section and point to be considered during project implementation**
Forest Regulation,	Section 2 rule 3 -1: Land utilization of national forest shall not be changed

2079 (2022 AD)	Rule 4: cabinet is responsible to provide permission for national forest use Rule 96: the project developer shall be responsible to compensation caused by the development works on project own cost Rule 102: Removal of trees Rule 19: measurement of trees and record that need to remove Schedule 9: volume evaluation Section 12 rule 87: prohibits developers to prepare plan which should fall on national forest
Shivapuri Nagarjun National Park Regulation, 2076 (2019)	Rule 24: states about the use of water resources. The priority has been given to aquatic animal, wildlife, drinking water, hydropower, irrigation and other while using water resources from the national park. Rule 26: states about the fee against use of water resources according to provision made in the annex 7 of regulation. Rule 27: 50% of water should be released. Rule 29: provisioned for monitoring committee and Rule 30: mentioned clearly about works, duties and rights of the committee.
Buffer Zone Management Regulation (1996 AD)	Rule 7: The warden shall have the responsibility for conservation in buffer zone including wildlife, natural resources, biodiversity, forest and development works. Rule 15: Users' committee shall have separate fund. Rule 17: describes prohibited activities within buffer zone Rule 26: describes allocation of expenses for community development
Environment Protection Rules 2077 (2020 AD)	Rule 3: Carryout environment study Rule 4: Scoping Rule 5: ToR Rule 6: Public hearing Rule 7: EIA report preparation Rule 8: EIA report submission for approval Rule 9: EIA report preparation approval
Solid Waste Management Regulation 2070 (2013 AD)	Rule 3 (1) focus to segregate the solid waste from the source and manage by the local body. Rule 3(2) has provisioned the harmful waste/chemical producer to make arrangement of managing such sensitive waste them self.

	Rule 5 (1): no one shall discharge solid waste by mixing harmful, chemical, organic or inorganic waste with other waste
Labor Regulation 2075 (2018 AD)	Section 11 (3): provides the employment contract and the matters to be covered under the employment contract.

4.5 Guidelines/Manuals

Guidelines/ Manuals	Article/rule/section and point to be considered during project implementation
National EIA guidelines, 2050 (1993 AD)	The guideline provides clear directions about the process of conducting EIA. This guideline makes EIA in Nepal legally mandatory and contains process for ensuring public involvement during the preparation of EIA report.
Wildlife-friendly Infrastructure Construction Directives, 2078 (2022AD)	The directives provide guidance for the construction of infrastructures in such a way that the habitat and area of movement of wildlife is friendly to them to reduce the wildlife accidents by making the movement of wildlife secure and thus decreasing the human-wildlifw conflict. Section 5: Discussions to be held and coordiugtion to bc mad Section 7: Dctailed Project Rcport and Cost Estimation to be pfeprugd Chapter 3: Construction of Wildlife-friendly Structures

4.6 Standards

Standards	Article/rule/section and point to be considered during project implementation
National Ambient Air Quality Standards, 2069 (2012 AD)	It requires effective monitoring and collection of 8-hour and 24-hour samples of air pollutants like Total Suspended Particulates (TSP), Particulate Matter (PM_{10} and $PM_{2.5}$), carbon monoxide, lead and ozone levels for at least 347 days out of a 365-day year. It further states that no particular place should fail to monitor air samples for two consecutive days.
Nepal Vehicular Emission Standards, 2057 (2000 AD)	The National Ambient Air Quality Standards, 2003 enforced by GON has set quality standards for seven parameters: TSP, PM10, sulphur dioxide, nitrogen oxide, carbon mono-oxide, lead and benzene for the maintenance of the ambient air quality. The project during its Construction and operation will have to comply with the set standards for the ambient air quality.

National Standard for Sound Quality, 2069 (2012 AD)	National Standard for Sound Quality is established as per Rule 15 of Environmental Protection Rules, 2054. The maximum limit of sound for city and residential area is 55 decibels for daytime and 50 decibels for night hours. Whereas for the industrial area, the maximum limit of sound is 75 decibels for daytime and 70 decibels for night hours. Further, for the peace zone, the maximum limit of sound is 50 decibels for daytime and 40 decibels for night hours.
Nepal Road Standards 2070 (2013 AD)	The NRS 2013 defines the road as per capacity. Administrative classification of roads intends National Highways, Feeder Roads, District Roads and Urban Roads. This forest road is developed for wildlife monitoring and project purposes.
River water quality standard	This section describes the water quality standards to be followed by Water Aid in Nepal and its partner organisations. The standards were adopted predominantly from Nepal's National Drinking Water Quality Standards (2006) and WHO's 'Guidelines for Drinking Water Quality' (2004) were predominantly referred.

4.7 International Conventions and treaties

International Conventions/ Treaties	Article/rule/section and point to be considered during project implementation
Convention on International Trade of Endangered Species of Wild Fauna and Flora (CITES), 1973 AD	Article 14: each contracting party should introduce appropriate procedures requiring environmental impact assessment of its proposed projects that are likely to have significant adverse effects on biological diversity with a view to avoiding or minimizing such effects and, where appropriate, allow for public participation in such procedures
ILO Convention on Indigenous and Tribal People, 1989 AD	Article 15: the rights of the peoples concerned to the natural resources pertaining to their lands shall be specifically safeguarded, Article 16 (2): where the relocation of these peoples is considered necessary as an exceptional measure such relocation shall take place only with their free and inform consent, Article 16 (3): whenever possible these peoples shall have the right to return their traditional land as soon as the grounds for relocation cease to exist. Article 16(5): the persons thus relocated shall be fully

	compensated for any resulting loss or injury
Convention on Biological Diversity, CBD, 1992 A.D	Article 14: urges Parties to introduce appropriate procedures requiring EIA of the proposed project that are likely to have significant adverse effects on biological diversity with a view to avoiding or minimizing such effects and, where appropriate, allow for public participation in such procedures.

4.8 Relevant institutions

The following institutions have responsibilities in relation to the Nagmati Dam project development, implementation, operation and regulation, or are important stakeholders to the project.

1. Ministry of Forests and Environment (MoFE)

MoFE is responsible for managing forest and watershed areas using participatory approach and protection of biodiversity. The Ministry along with its respective departments is the main policy making bodies for forest, watershed and wildlife management as well as environment.

2. Department of National Parks and Wildlife Conservation (DNPWC)

DNPWC is responsible for conservation and management of protected areas including National Parks in the country. DNPWC has implemented the concept of buffer zone management to manage the area (which could be forest area, agriculture land and other land use types) surrounding the national parks by providing certain share from the national park to the user groups of the buffer zone for their local development.

3. Ministry of Energy, Water Resources and Irrigation (MoEWRI)

This ministry is responsible for the overall utilization and management of water resources available in the country for the production of energy. As per the Work Division (Second Amendment) Rules, 2009 of Government of Nepal, MoEWRI has been entrusted with the tasks to: (i) develop policies, plan and implement projects for conservation, regulation and utilization of energy; (ii) conduct survey study of energy and its utilization; (iii) construct, operate and maintain multi-purpose electricity project; and (iv) and other matters related to energy and electricity.

4. Water and Energy Commission Secretariat (WECS)

The WECS was established in 1981 with the primary responsibility to assist Nepal Government, the Ministry of Water Resources and other related agencies in the formulation of policies and planning of projects in the water and energy resources sector. The objectives and mandates of WECS have been revised and modified a number of times since their establishment and currently are: to: (i) formulate and assist in developing policies and strategies in the water resources and energy sector; (ii) provide suggestions, recommendations and guidance in the development of irrigation, hydropower and drinking water projects; (iii) prepare policies and plans related to industrial use of water, flood management, in-land navigation, fisheries and other sectors related with water resources, along with the protection

of the environment relating to the above sectors; and, (iv) act as a documentation centre for all regional water resources and energy related issues.

5. High Powered Committee for Integrated Development of Bagmati Civilization (HPCIDBC)

HPCIDBC was established in 1995 as the Bagmati Area Sewerage Construction and Rehabilitation Project (BASCRP) with the mandate to improve the quality of the river flowing through Pashupatinath. This involved Construction of wastewater interceptors along both sides of the Bagmati River upstream of Guheshwori WWTP to divert waste water and treat it at Guheshwori WWTP developed and operated by HPCIDBC. To date, HPCIDBC has already constructed interceptors from Gokarna to Guheshwori and is now extending the interceptors downstream of Pashupatinath from Tilganga to Minbhavan. HPCIDBC is also undertaking greenbelt works which involves Construction and undertaking of river training, retention wall, and greenbelt and corridor roads.

6. Kathmandu Upatyaka Khanepani Limited (KUKL)

KUKL is a public limited company established under the Company Act (2006) using the public private partnership model. It is responsible for operation and management of water supply and sanitation services in the service area within the valley. KUKL currently provide water services to all the five municipalities and rural municipalities surrounding the municipalities. The municipality include most of the locations (Sundarijal, Nayapati, Gokarneswore, Jorpati) located in the catchment area of upper stretch of Bagmati River Basin. KUKL is not directly involved in the Project, but plays a vital role for the implementation of the improved wastewater treatment in Gokarna and Guheshwori WWTPs .

7. Kathmandu Valley Development Authority (KVDA)

KVDA is an autonomous body established for the purpose of formulating and implementing physical development plans in Kathmandu Valley and thereby makes essential services and facilities available to the public. KVDA is provided with an authority to divide the plan area into different land use and lay down conditions for physical development of the plan area. They also have mandate to formulate and implement necessary projects for proper development and maintenance of any religious, cultural and historical heritage. Another key task of KVDA is to prescribe conditions in respect to Construction and other activities to be undertaken in forests, rivers, and streams, ghats and aquatic areas for conservation of nature and environment in the plan area.

8. Shivpuri Nagarjun National Park (SNNP)

SNNP is directly impacted organization and is equally responsible for the betterment of local people residing in buffer zone. Biodiversity conservation, tourism promotion as well as watershed improvement and likewise fall under the jurisdiction of SNNP for their management. The land use pattern in and around SNNP is predominated by forest followed by shrub land, cultivated land and grass land respectively. The cover of forest land is 118.391 km^2 (74.45%), followed bush/shrub land 32.52 km^2 (20.45%), grassland 5.13 km^2 (3.22%), cultivated land 2.86 Km^2 (1.80 %) and other features such as cliffs, building, pond/ lakes cover holds 0.088 Km^2 (0.055 %) (SNNP, 2017).

SNNP is situated on the northern part of Kathmandu valley and lies about 12 km away from the center of capital city. Before, it was gazetted as the national park, it was managed under the Shivapuri Watershed Development Board, and was later declared as Shivapuri Watershed and Wildlife Reserve. Shivapuri lies in a transition zone between subtropical and temperate climates. The vegetation consists of a variety of natural forest types including pine, oak, rhododendron etc, depending on altitude and aspect. Wildlife found in the park are Himalayan Black bear, leopard, jungle cat, and rhesus monkey. The park is also home to 177 species of birds, including at least 9 threatened species, 102 species of butterflies with a number of rare and endangered species, and 129 species of mushroom.

Shivapuri is one of the important sources of drinking water for Kathmandu Valley where about 30 million liters of water eashday has been tapped from rivers such as the Bagmati, Nagmati, Shyalmati and the Bishnumati as well as from many other smaller streams. From Dhap and Nagmati Dam about 1000 lt/s can be utilized after completion of these two high Dams. Therefore, SNNP plays important role in development Nagmati Dam.

9. Asian Development Bank (ADB)

The project is finance under Asian Development Bank. The modality of assistance is grant and loan including technical assistance. ADB is helping Nepal improve water resources management at the Bagmati River Basin. The project will invest in setting up a river basin organization with the capacity to plan and manage the basin water resources in a fully integrated manner. Other improvements include an upstream water storage dam system to increase the river flow in the dry season and riverbed oxygenation weirs.

10. Nepal Electricity Authority (NEA)

Nepal Electricity Authority is responsible for providing license and overall monitoring of the hydropower activities. NDP will do coordination with NEA for hydropower electricity.

11. Ministry of Urban Development, Ministry of Culture, Tourism & Civil Aviation, Department of Road

Ministry of Urban Development, Ministry of Culture, Tourism & Civil Aviation, Department of Road are also rated as prime stakeholders. Ministry of Urban Development is responsible for coordinating with the Ministries related to Upper Bagmati Basin. Ministry of Culture, Tourism & Civil Aviation is responsible for the conservation of natural, cultural and human resources. Department of road is responsible for ensuring the quality of road as per the existing standards.

CHAPTER 5 EXISTING ENVIRONMENTAL CONDITION OF THE PROJECT AREA

5.1 Physical Environment

5.1.1 Land Use

Table 5-1 shows the land utilization in upper Bagmati Watershed Kathmandu at upstream of Nagmati dam. The land use pattern in and around SNNP is predominated by forest followed by shrub land, cultivated land and grass land respectively. The cover of forest land is 118.391 km^2 (74.45%), followed bush/shrub land 32.52 km^2 (20.45%), grassland 5.13 km^2 (3.22%), cultivated land 2.86 Km^2 (1.80 %) and other features such as cliffs, building, pond/ lakes cover holds 0.088 Km^2 (0.055 %) (SNNP, 2017).

Table 5-1: Land use in Upstream of Nagmati dam

Types of land use	Covered Area (km^2)	Percentage of Covered Area (%)
Forest Area	118.391	74.455
Agriculture	2.86	1.80
Bush/Shrub Land	32.52	20.45
Wetland/others	0.088	0.055
Grassland	5.13	3.22

Source: Shivapuri Nagarjung National Park Management paln, 2017-2022

5.1.2 Topography

The topography of the proposed dam area is a hilly region with slopes ranging from 20º to 55º. The proposed site of the Nagmati Dam is located where the Nagmati River enters a narrow and steep-sided gorge. At this point the elevation of the river bed is approximately 1,830 m and the contributing catchment area is 12 km^2. Figure 5-1 shows the contours around the project site and area.

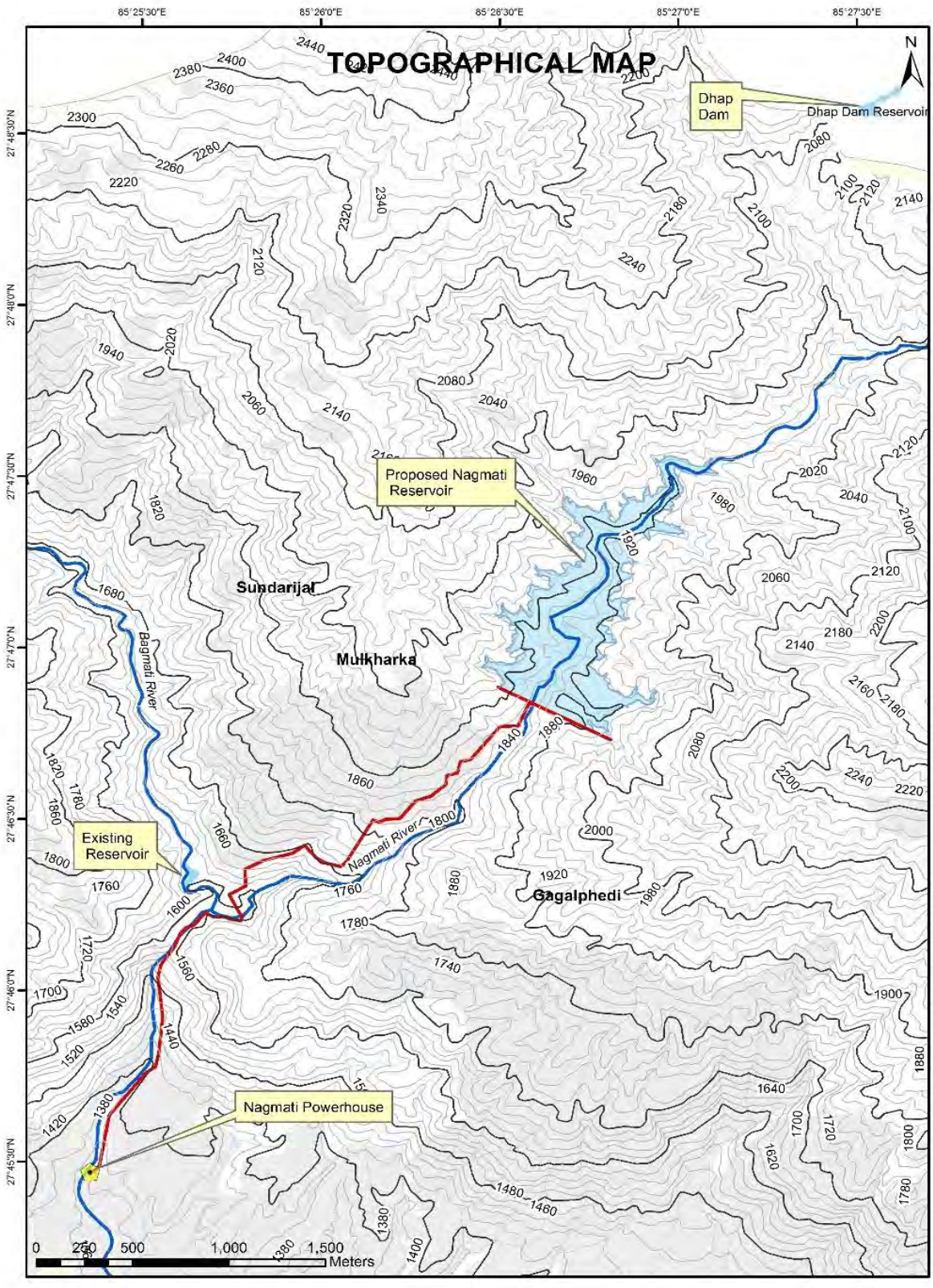

Figure 5-1: Topography of the Project Area

Source: Feasibility study report of NDP, 2016

5.1.3 Catchment

The Nagmati is a spring-fed river that originates in SNNP and is one of the main tributaries of the Bagmati River. The proposed Nagmati Dam is located in the headwaters of the Kathmandu Valley, on the Nagmati River in the Shivapuri-Nagarjun National Park (SNNP) (Figure 5-2). At this point the elevation of the river bed is approximately RL 1,840 and the contributing catchment area is 12 km^2. The Nagmati dam site is approximately 11 km from the headwaters near Chisapani (the elevation at the catchment divide is 2,320 m), and 3 km upstream of the point where the Nagmati River joins the Bagmati River above Sundarijal. While the Dhap dam is about 3.5 km upstream from the Nagamati Dam.

Figure 5-2: Location View of Nagmati Reservoir and Catchment

Source: Hydrological Modelling of Nagmati Dam Project, 2021

5.1.4 Geology

5.1.4.1 Regional Geology

Geological studies were undertaken by DHI for the 2013 draft BRBIP EIA, and supplemented in detail by Entura for the Feasibility Study for the Nagmati Dam project, November 2016. Geological map highlighting the major geology of the project area, after Dhital et. al. 2002 is presented in Figure 5-3. The Kathmandu valley is surrounded by high mountain ranges including Shivapuri (2732 masl) to the North and Phulchwoki (2762 masl) to the South. The valley is composed of Quaternary (Recent and Plio- Pleistocene) sediments overlying Precambrian to Devonian basement rocks. The valley is bounded by faults associated with the Main Central Thrust zone and which separate the Gneiss and Granite complex of the Higher Himalaya Tectonic Zone to the North.

The Quaternary sediments within the Kathmandu valley are mainly lacustrine and fluvial comprising clays, silts, sands and gravels with a thickness in excess of 550 m. The lacustrine sediments were deposited in an ancient lake which occupied the valley from about 2.5 million to 29,000 years ago, and include extensive dark coloured organic clay with fine sands and peats known as the Kalimati Formation which covers the central part of the valley. To the north of the valley, the rising mountains are composed of gneiss and granite of the Sheopuri injection complex and through which rises the upper Bagmati River catchment.

5.1.4.2 Geology of the Project Area

The geology of the Nagmati damsite area is shown on the published 'Engineering and Environmental Geological Map of the Kathmandu Valley, 1:50.000' as within the Sheopuri Gneiss Formation, Precambrian Age (Figure 5-3). The proposed dam site is located within strongly metamorphosed basement rocks of the Higher Himalaya Tectonic Zone. Physiographically the region lies within the Fore Himalaya Geomorphic Unit. The main rock types in this region are phyllites, schists, marbles, quartzite and gneisses. The rocks in the project area are mica gneiss and biotite schist with intrusions of muscovite granite which are intensely weathered at the surface.

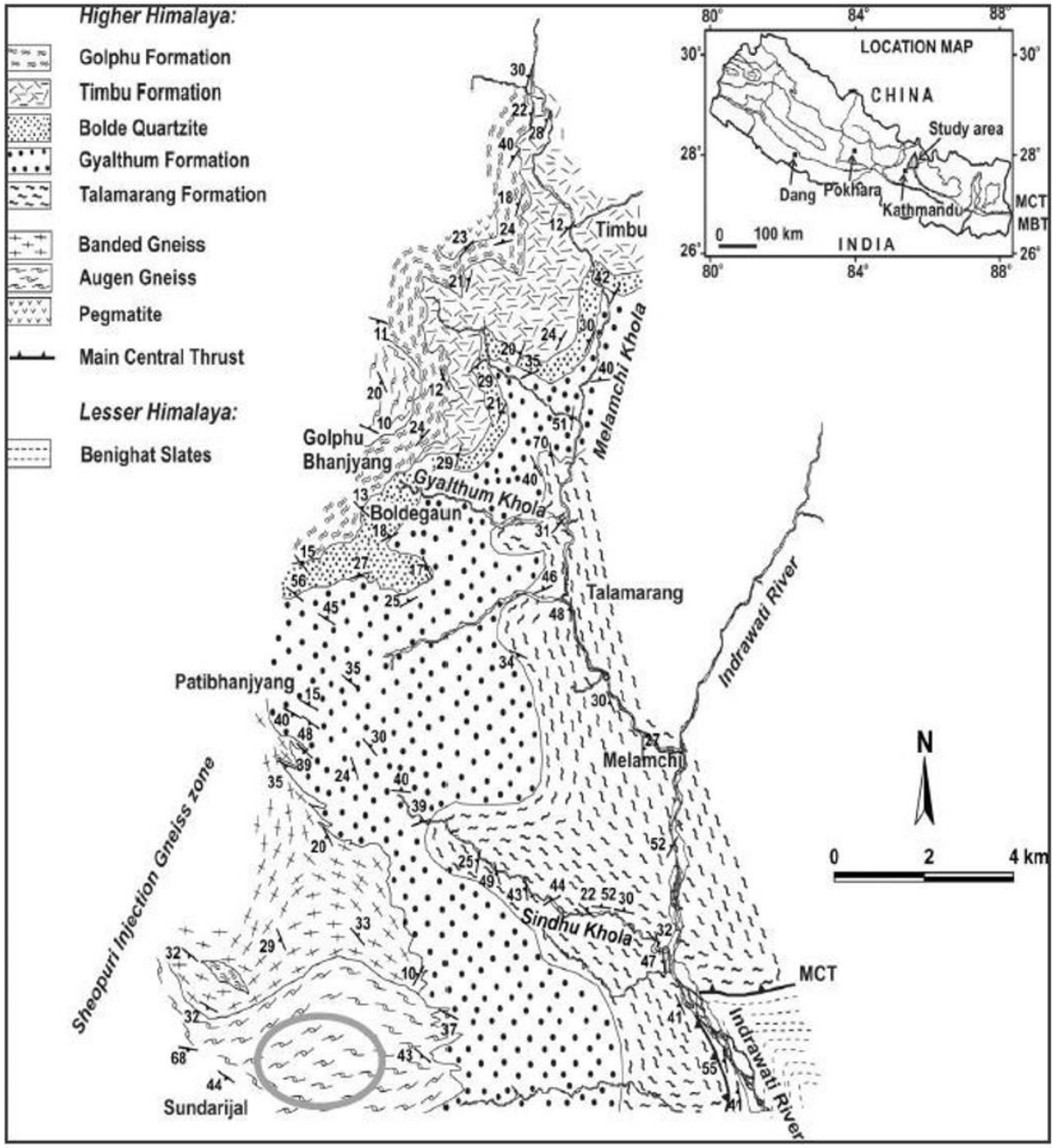

Figure 5-3 : Geology of the project area

Source: Department of Mines and Geology, 1994

5.1.5 Seismicity

The project is located in a tectonically complex area, and the project area is considered as falling in high seismic prone zone (Figure 5-4). Historic seismicity in the region of the proposed Nagmati Dam is lower than in other regions of Nepal. This may be partly because of the relatively short period of earthquake records compared to the recurrence interval of major active faults. The closest significant earthquakes to the site are a magnitude 5.7 earthquake located 56 km from the site that occurred in 1974 and a magnitude 5.8 earthquake located 35

km from the site that occurred in 1997. In April 25, 2015, Kathmandu was devastated by the Nepal or Gorkha earthquake. This 7.8 magnitude earthquake killed more than 9,000 and injured over 23,000. As part of the investigation and detailed design of the the Nagmati Dam, Entura has undertaken a site-specific seismic hazard assessment. This assessment has provided site specific earthquake design loads to be adopted for the Nagmati Dam. This has ensured that the dam is designed for appropriate earthquake loading.

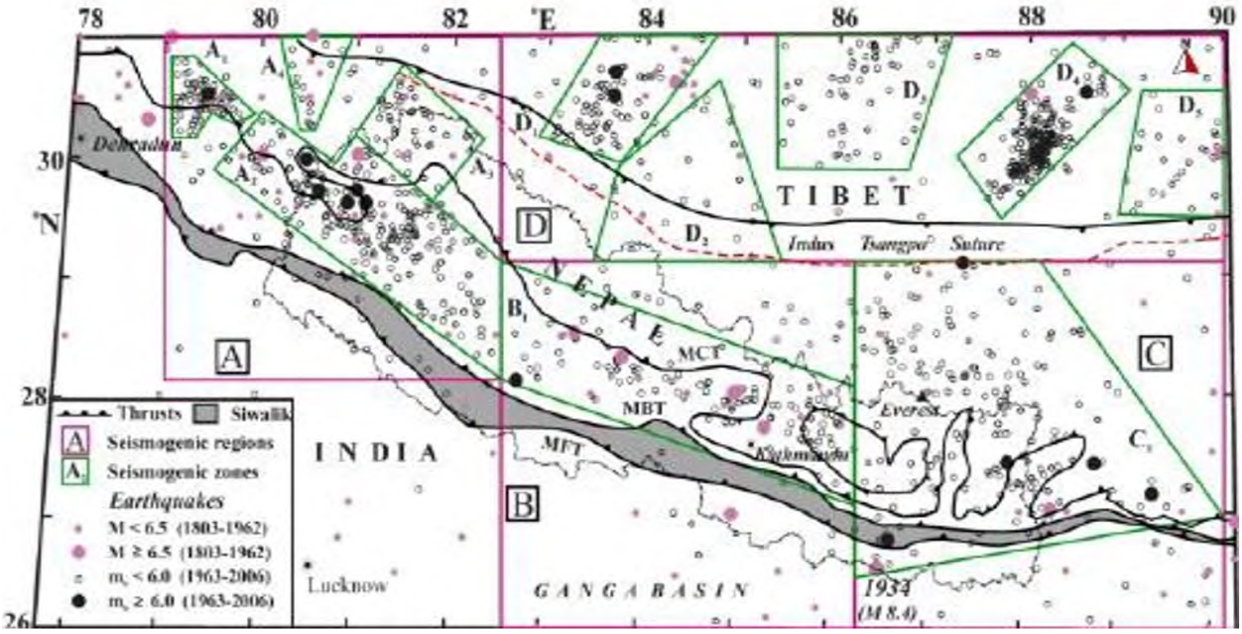

Figure 5-4 : Seismicity map (1803-2006) of Nepal and its adjoining region

Source: Department of Mines and Geology, 2015

5.1.6 Soil

According to the Feasibility Study Report, 2017 of NDP, the soils of the project area were predominantly sandy textured with the textural class "sandy loam" (50-80% sand) being most common, hence the soils support high water infiltration rates and are important for water conservation and ground water recharge. The soils were mostly dark brown to dark grayish brown in colour with low to medium bulk densities and high moisture content due to the time of sampling (shortly after the monsoon season) and proximity to the river.

The soils were mostly acidic in nature with pH values ranging from less than 4 to 6.45, although most sites had pH in the range of 4-5. The total nitrogen statuses of the samples analyzed were mostly moderate to high and correlated with soil organic matter status. Available phosphorus levels were generally low to medium, while exchangeable potassium was highly variable and depended mainly on the rock/mineral types present. Soil organic matter and carbon reflected the land use and vegetation pattern, with forest and grass land sites have high values (3 to 18% SOM; 1.7 to 10.4% SOC) and agricultural areas in the downstream areas having mostly low values (1.3 to 5% SOM; 0.75 to 3% SOC).

5.1.7 Erosion, Sediments and Geomorphology

The dominant soil textures in the Bagmati watershed in SNNP are sandy loams, and loamy, gravely to coarse sands with mica particles. In higher hills and steep slopes in the cultivated and settled areas, because of such soil characteristics, the area is more prone to soil erosion and landslides. Erosion and degradation has already taken place in the region, especially along existing roads. Areas of bank erosion are observable along the road, as well as erosion of the road itself. No major landslip areas were observed.

The Nagmati River at the location of the dam site enters the start of a narrow gorge section with waterfalls, cascades and rapids which continue to the confluence with the Bagmati River. Very large boulders 5 m or more in size occur in the river bed. The area is known locally as 'Nagdaha'. The river section is very narrow and high steep bluffs of hard, fresh to slightly weathered banded gneiss occurs on both abutments. The average right bank abutment slope was measured to be about 50 degrees and the left abutment of the order of 60 degrees.

The Nagmati River generally has a steep bed slope and consists of boulder and cobble sized rocks, interspersed with gravels and sands. Much of the river is inaccessible and difficult to observe and map, although there are some relatively flat and accessible areas near and upstream of the dam site. It was observed that local village people periodically extract sand from the river for local construction in the vicinity of the proposed dam site. They excavate sand from the alluvial deposits and store this in a pile near the banks of the river, and this sediment is then replenished over the wet season and the process is repeated. There is also evidence that the locals extract some of the rock from the river to be used for local construction purposes.

5.1.8 Climate

The climate of the project area from powerhouse to dam area ranges from sub-tropical to temperate. The upper and middle parts of the Bagmati basin (Kathmandu valley and Mahabharat range) have a warm temperate climate. According to the climatological records of Kakani Substation of DHM located at Kakani, the average air temperature is 14.25°C. Similarly, the Annual average maximum temperature is 16.5°C and Annual average minimum temperature is 12.0°C. The data with its source is presented in the Table 5-2 below.

Table 5-2: Hydrological and Meteorological Data

Particulars	Quantity and Unit	Source
Climate of Project Area	Sub-tropical to temperate	SNNP Report
Average Air Temperature	14.25°C	Kakani Substation, DHM
Annual average maximum temperature	16.5°C	Kakani Substation, DHM
Annual average minimum temperature	12.0°C	Kakani Substation, DHM

5.1.9 Rainfall

Majority of the rainfall occurs during the monsoon season in the project area following the pattern of the country. The monsoon season falls during mid-July to mid-September, and about 80% of total annual rainfall occurs during this period. To analyse the rainfall pattern of the study area data from rain-gauge station close to the confluence of the Bagmati and Nagmati rivers, the Bagmati at Sundarijal operated by Department of Hydrology and Meteorology (DHM) was undertaken. The daily rainfall for the period of 1994-2021 has been analysed to calculate the mean monthly rainfall pattern at the Sundarijal station. Based on this analysis, the maximum mean monthly rainfall of 558.85mm has been observed in the month of July and the minimum mean monthly rainfall of 6.35 mm in December. The annual average rainfall is found to be 2095.60 mm. The bar diagram showing the mean monthly rainfall at Sundarijal from 1994-2021 has been presented in the Figure 5-5 below and rainfall data used for analysis in table is attached in Annex 13.

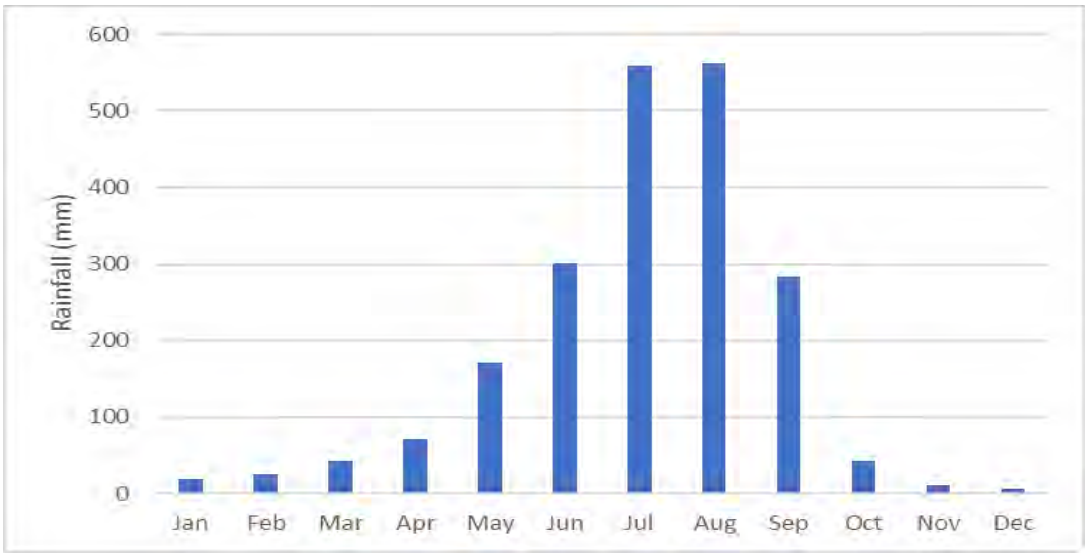

Figure 5-5: Mean monthly rainfall at Sundarijal (1994-2021)

Source: Derived using DHM data from 1994-2021 for EIA study of NDP, 2022

The probable daily rainfall for different return period is also calculated using the rainfall data of Sundarijal station from 1994-2021. The calculated probable daily rainfall with return period in years is presented in the Table 5-3 below. The probable daily rainfall for 2 years is 90.5 mm and that for 100 years is 215.9 mm.

Table 5-3: Probable daily rainfall at Sundarijal

Return period (Years)	Probable daily rainfall (mm)
2	90.5
5	124.1
10	146.3
20	167.6
50	195.2
100	215.9

Source: Derived using DHM data from 1994-2021 for EIA study of NDP, 2022

5.1.10 Hydrology

The region is the origin of some important river systems including Bagmati, Bishnumati, Nagmati, Syalmati, Rudramati, and Yashomati, which are major watersheds. The outflows from the Dhap area create the headwaters of the Nagmati, the main tributary to Bagmati in the SNNP.

5.1.10.1 Long Term Hydrology at Nagmati Dam Site

Long term hydrology of Nagmati River at Nagmati dam site was derived through simulation using SWAT model using hydrological data of Bagmati River at Gaurighat (STN No. 530). The data was calibrated and validated. After the Calibration and Validation of Flow, the SWAT model was run for daily basis calculating the long-term discharge for Nagmati Headworks. The minimum value simulated was 0.011 m^3/s in the month May 2003, whereas the maximum value simulated was 14.42 m^3/s in the month July 2002. The minimum Flow is on February which is 0.15 m^3/s and the maximum flow is 2.53 m^3/s on August. The derived daily average flow at Nagmati dam site is shown in Figure 5-6 below.

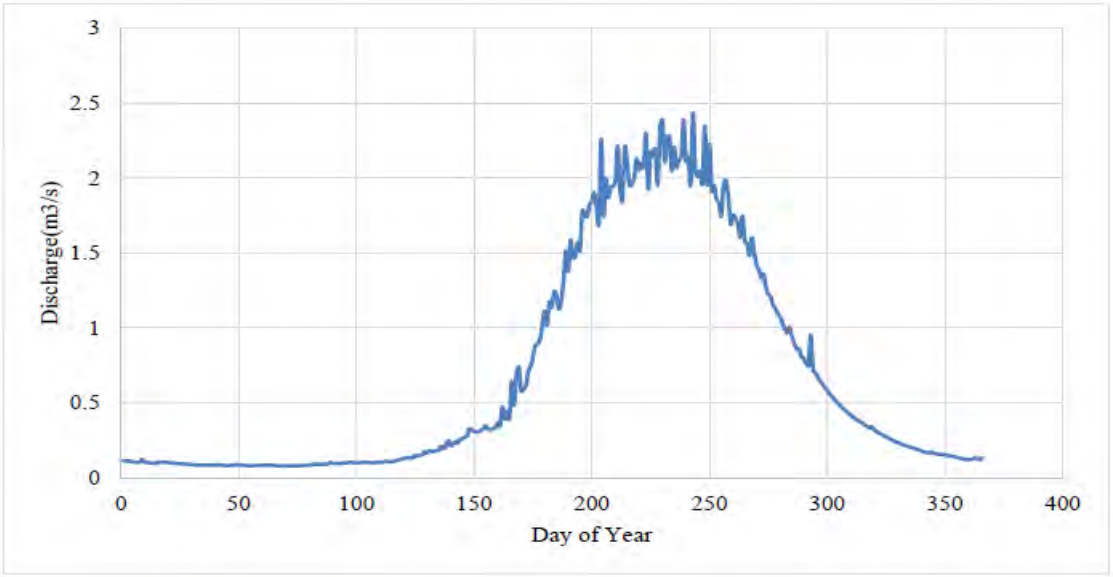

Figure 5-6: Daily average hydrograph at Nagmati dam site

Source: Hydrological Modelling of Nagmati Dam Project, 2021

5.1.10.2 Mean Monthly Flow

Nagmati Dam project (NDP) has recently installed a hydrological station in Nagmati River just downstream of proposed Nagmati dam axis. Discharge data from two hydrological station, one located upstream of the Sundarijal Water Supply Reservoir at Sundarijal (STN No. 505) which monitors both stage and discharge in the Bagmati River and another at Gaurighat (STN No. 530) has been taken. The discharge data of Bagmati River at Sundarijal was available from 1963 AD and at Gaurighat was available from 1993 AD. The calculated mean monthly flow of Bagmati River at the hydrological station considered for deriving mean monthly flow of Nagmati River at dam site and mean monthly flow of Nagmati River at proposed Nagmati dam axis is presented in the Table 5-4 below.

Table 5-4: Mean monthly flow of Bagmati River

Month/ station	Bagmati River at Sundarijal (18 km^2)	Bagmati River at Gauri Ghat (68 km^2)	Nagmati River (12 km^2)
Jan	0.36	0.64	0.19
Feb	0.30	0.61	0.2
Mar	0.26	0.51	0.12
Apr	0.25	0.60	0.11
May	0.33	0.92	0.11
June	0.86	2.13	0.39
July	2.56	7.88	1.54
Aug	3.73	11.3	1.69
Sep	2.91	7.74	1.68
Oct	1.38	3.19	0.64
Nov	0.69	1.41	0.35
Dec	0.46	0.82	0.22
Average	1.17	3.15	0.6

Source: Hydrological Modelling of Nagmati Dam Project, 2021

The mean monthly flow using calculated mean monthly flow of Bagmati River derived for Nagmati River at dam site from SWAT method is presented in the Table 5-5 Below.

Table 5-5: Mean Monthly flows in the Nagmati River at the dam site

Month	Discharge(m^3/s)
Jan	0.10
Feb	0.08
Mar	0.08
Apr	0.10
May	0.21
Jun	0.59
Jul	1.65
Aug	2.13
Sep	1.77
Oct	0.84
Nov	0.33
Dec	0.15

Source: Hydrological Modelling of Nagmati Dam Project, 2021

5.1.10.3 Flow Duration Curve

FDC was plotted for both calibrated and validated data derived for Nagmati River flow at Nagmati dam site (Figure 5-7) derived from long term hydrological data of Bagmati River at Gaurighat (STN No. 530) to evaluate the performance of SWAT model in simulating daily flows at different flow level. The result shows that the model performance is better at both high and low flows leading us to conclusion that the model is reasonably well calibrated for further assessment.

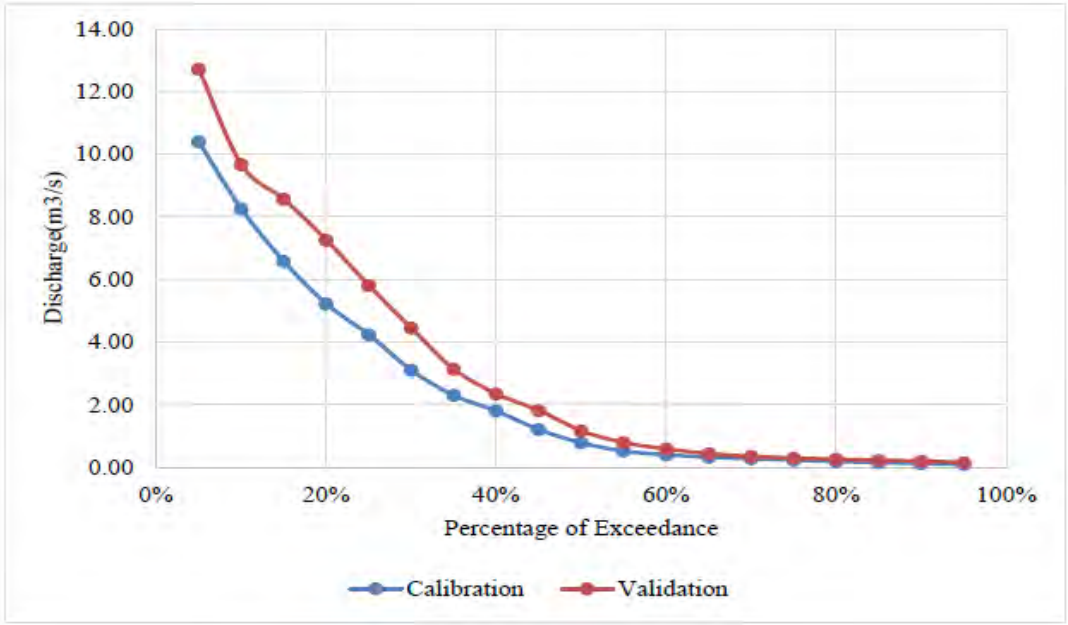

Figure 5-7: Flow duration curve for the Nagmati River

Source: Hydrological Modelling of Nagmati Dam Project, 2021

5.1.10.4 Flood Frequency Analysis

For the construction flood estimates a flood frequency analysis was undertaken for the peak flood flows reported at the gauging station in the Bagmati River at Sundarijal, and this was transposed to the Nagmati River dam site. The results are shown in figure 5-8. The peak flood for 100 years return period was projected at 120 m^3/s.

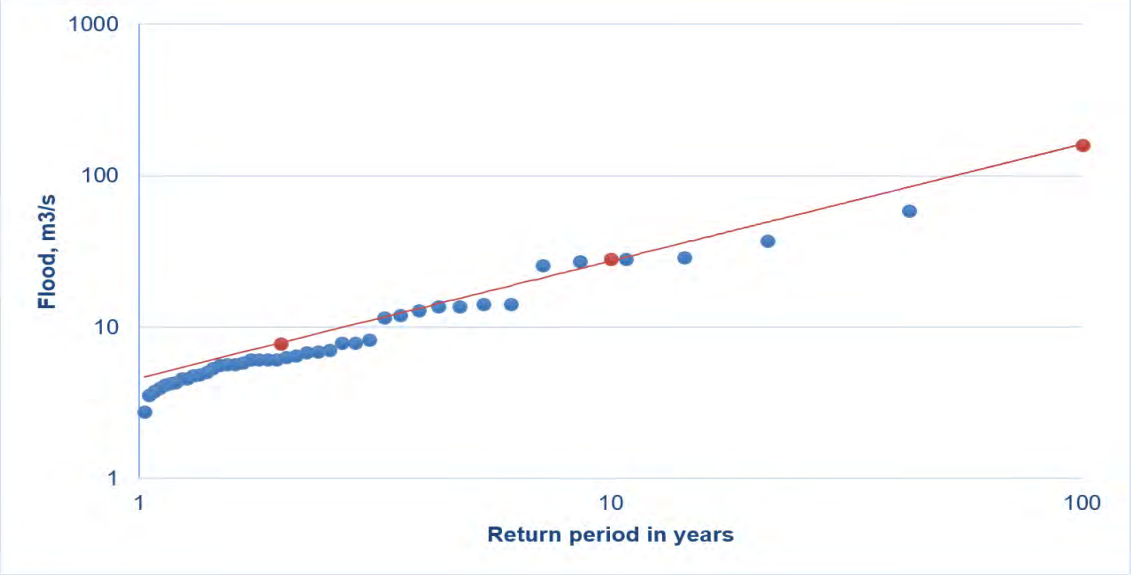

Figure 5-8 : Annual Flood Frequency Analysis for the Nagmati River

Source: Feasibility Study Report of NDP, 2016

5.1.11 Air quality

Air quality monitoring was carried out from 2079/08/05 to 2079/08/08 along the Bagmati at five locations at the Dhap, the Nagmati Dam site, Sundarijal, Gokarna and Pashupati – Tilganga. 24-hour air samples were collected to measure and analyse for Suspended Particulate Matter (SPM), Respirable Suspended Particulate Matter (RSPM), Sulphur Dioxide (SO2), Nitrogen Oxides (NOx) and Lead (Pb). The results are presented in Table 5-6.

Table 5-6: Measured air quality at sites in the Upper Bagmati Basin

Locations	Parameters				
	SPM ($\mu g/m^3$)	RSPM-PM_{10}($\mu g/m^3$)	Sox ($\mu g/m^3$)	NOx ($\mu g/m^3$)	Lead ($\mu g/m^3$)
Tilganga/Pashupatinath	428.01	540.03	<1.0	<1.0	<0.04
Bhawanisthan, Gokarneshwor	268.46	96	<1.0	<1.0	<0.04
Sundarijal	93.31	60.25	<1.0	<1.0	<0.04
Mulkharkha, Near Karma Hotel	70.22	40.15	<1.0	<1.0	<0.04
Dhap	18.73	23.21	<1.0	<1.0	<0.04

Source: Field Survey, 2022

The trend in measured concentrations of particulate matter with high levels at Pashupati going upstream at the sites along the Bagmati/Nagmati Rivers to the expected very low levels in the SNNP at the Dhap.

Overall, the monitored air quality parameters- respirable and non-respirable parameters, including the SOx, NOx and Lead, were found within the Nepal Standards at Sundarijal,

Nagmati and Dhap area. But respirable particulate matter was found above the Nepal Standards at Pashupati area whereas at the Gokarna and Sundarijal site, they were within the Nepal Standards. The Nepal Ambient Air Quality Standard, 2012 is attached in Annex 26. These dust particles were mainly contributed by the vehicular movements and anthropogenic activities at the Pashupati, Gokarna and Sundarijal, whereas in the case of Nagmati and Dhap, it was influenced by the natural state.

5.1.12 Noise Level

Noise level survey monitoring (24 hour on one hour interval) for measurement of Lmax (dBA), Lmin (dBA) and Leq (dBA) were carried out at the same positions as where air quality measurements were done, at the Dhap, the Nagmati Dam site, Sundarijal, Gokarna and Pashupati – Tilganga from 2079/08/05 to 2079/08/08.

The averaged sound pressure level (day and night) of all the five selected points along with number of observations are presented in the Table 5-7. The maximum (at Pashupati) and minimum (at Nagmati) noise level recorded are 87.8 dBA and 41.6 dBA, respectively.

Table 5-7 Average noise level of the sampling points along the Bagmati and Nagmati Rivers

Location	Number of observations	Average sound pressure level		
		Lmax	Lmin	Leq
Pashupati	24	87.8	52.4	65.9
Gokarna	24	82.7	53.4	65.9
Sundarijal	24	73.2	52	59.4
Nagmati Dam site	24	73.4	41.6	54.2
Dhap	24	73.9	45.3	60.1

Source: Field Study, 2022

The maximum sound levels recorded are attributed to vehicular movement. Pashupati, Gokarna and Sundarijal sites have maximum vehicular and human movement compared to the Nagmati Dam site and the Dhap. The results are compared with the National noise level standard, 2012 (Annex 26). The maximum sound pressure level at all the measured sites crossed the prescribed standard. At the Pashupati. Gokarna and Sundarijal sites, the sound pressure was mainly contributed by the vehicular movement along with their pressure horn and some anthropogenic and animal activities. Beside these activities, noise level due to the current of water was also found increasing at the Gokarna site, whereas at the Nagmati and Dhap. It was mainly natural and caused due to sound made by current of Nagmati River, chirping sound of birds and occasional movement of motor bikes and mini trucks.

5.1.13 Water Quality

Data was analysed for a comprehensive range of physio-chemical parameters, pollution indicator parameters (ammonia, nitrate, phosphorus, sulphate, dissolved oxygen, biochemical oxygen demand, total / fecal coliform bacteria), major cations and anions, heavy metals, oil

and grease, detergents, phenolic compounds, cyanide, mercury and selenium (Annex 23). Results were compared with the Nepalese standards (Annex 26).

The results of water testing showed a distinct pattern of relatively unpolluted, good water quality at the upstream sites (Dhap and Nagmati) with progressive deterioration of the water quality down to the Pashupatinath temple area.

Physio-chemical properties are shown in the Table 5-8, pH ranged from 7.1 to 7.7, and odour and taste were considered unobjectionable. Most of the physical, chemical and microbiological properties of the water reflected the elevation/climatic zonation, geology and influence of human populations. Hence, the upstream (headwaters) reaches of Nagmati had low values of temperature. EC, turbidity. TDS, alkalinity and hardness, while these properties gradually increased downstream, with maximum values seen near the Pashupatinath temple.

Pollution indicator parameters are shown in Table 5-8. The values of chemical compounds such as ammonia nitrate and phosphate were low at the upper reaches of Nagmati River, while the highest values were recorded at the Pashupatinath temple. Likewise, biochemical oxygen demand (BOD) and chemical oxygen demand (COD) were low at the upstream sites and higher downstream. Total (TC) and fecal coliform (FC) bacterial presence in the river water also revealed a generally increasing trend from the upstream to the downstream sites, while dissolved oxygen (DO) values where high in unpolluted upstream areas and dropped due to microbial consumption of oxygen in the water at polluted downstream sites.

Table 5-8: Physio-chemical characteristics of sampled water

SN	Site Name	Parameters							
		DO (mg/L)	Ammonia (mg/L)	Nitrate (mg/L)	Phosphate (mg/L)	BOD (mg/L)	COD (mg/L)	T. Coliform (CFU/100ml)	Fecal Coliform (CFU/100ml)
1	Upstream of Proposed Nagmati dam site	8.3	0.03	0.16	0.02	0.6	19	30	7
2	Proposed Nagmati dam site	7.1	0.03	<0.04	0.04	4.8	41	50	20
3	Downstream of proposed Nagmati dam site	8.7	0.04	0.03	0.05	1.2	10	35	22
4	Tap at Mulkharkha	8.6	0.02	<0.04	0.04	1.1	8	37	25
5	Above the powerhouse at Sundarijal	7.8	0.03	0.48	0.01	2.4	13	120	68
6	Adjacent to the Powerhouse site	7.6	0.04	<0.04	0.04	5.4	14	300	201
7	Downstream of Powerhouse	7.6	0.01	0.07	0.03	1.8	23	288	142
8	Near the Bridge	7.6	0.04	0.33	0 04	12.6	12	250	157
9	River adjacent to Gokarna Temple	7.6	1	0.8	0.19	21.6	70	300	78
10	River adjacent to Pashupati Temple	7.5	1.74	0.84	0. 45	31.8	54	300	123

Source: Field study and laboratory experiment, 2022

The concentrations of cations and anions in the Nagmati River primarily reflect the geology and sediment loads. As the dominant rock types in the SNNP area are sandstone and quartzite, which are acidic in nature and resistant or not easily weathered, the cation concentrations low (ranging from 0.3 to 4.0 mg/L) in the upstream areas down to Sundarijal. Downstream from Sundarijal onwards, their concentrations gradually increase, presumably from anthropogenic sources such as agricultural and domestic runoff to high values of Ca. Mg. Na. and K. Of the anions analysed in the river water, fluorine (F-) concentrations were negligible, ranging from not-detected to 0.25 mg/L. Chlorine (Cl-) and sulphate (SO42-) both were low at the upstream reaches and gradually increased downstream to high values. These results are corroborated by the water pH values and the total hardness (TH). The TH values which reflect the concentration of minerals (like calcium and magnesium) in water, steadily increased from 10 mg/L at Nag 02 to 32 mg/L downstream near power station (Table 5-9).

Table 5-9: Chemical Test Results of sampled water

SN	Site Name	Parameters (mg/L)							
		TH	Ca	Mg	Cl	F	SO_4	K	Na
1	Upstream of Proposed Nagmati dam site	<1	<1	<1	21.99	0.04	0.66	1.17	5.14
2	Proposed Nagmati dam site	<1	<1	<1	21.99	<0.02	0.95	1	4.89
3	Downstream of proposed Nagmati dam site	<1	<1	<1	19.99	0.04	1.32	1.34	5.37
4	Tap at Mulkharkha	<1	<1	<1	18.99	<0.05	1.27	1.30	5.2
5	Above the powerhouse at Sundarijal	<1	<1	<1	16.99	0.15	1.64	1.48	5.04
6	Adjacent to the Powerhouse site	<1	<1	<1	15.99	<0.02	2.71	1.72	6
7	Downstream of Powerhouse	<1	<1	<1	12.99	<0.02	3.1	1.86	5.23
8	Near the Bridge	<1	<1	<1	15.99	0.25	2.43	1.79	4.95
9	River adjacent to Gokarna Temple	22	16	4	11.99	0.23	5.51	4.46	11.73
10	River adjacent to Pashupati Temple	22	16	4	25.99	0.14	15.36	7	22.9

Source: Field study and laboratory experiment, 2022

Heavy metals are shown in Table 5-10. The concentrations of heavy metals were below detection for most elements and low for copper, zinc and iron. The value of Al was low in the upper reaches, but gradually increases at down streams. The Pashupatinath temple area exceeded the water quality guidelines standard of 10 mg/L limit for protection of aquatic ecosystems and the 5 mg/L limit for livestock watering. The presence of oil and grease, phenolic compounds and anionic detergent were all below the detection levels and hence negligible in the water samples analysed.

Table 5-10 Heavy Metals in sampled water

SN	Site Name	Parameters (mg/L)									
		Fe	Mn	Cu	Zn	Ni	Cd	Cr	Pb	As	Al
1	Upstream of Proposed Nagmati dam site	0.01	0.02	<0.01	0.06	<0.01	<0.003	<0.01	<0.01	<0.005	0.01
2	Proposed Nagmati dam site	0.01	0.03	0.01	0.12	<0.01	<0.003	<0.01	<0.01	<0.005	0.04
3	Downstream of	0.01	0.02	<0.01	0.06	<0.01	<0.003	<0.01	<0.01	<0.005	0.02

	proposed Nagmati dam site										
4	Tap at Mulkharkha	<0.01	0.01	<0.01	0.08	<0.01	<0.003	<0.01	<0.01	<0.005	<0.01
5	Above the powerhouse at Sundarijal	0.01	0.04	<0.01	0.22	<0.01	<0.003	<0.01	<0.01	<0.005	0.09
6	Adjacent to the powerhouse site	0.01	0.07	<0.01	0.11	<0.01	<0.003	<0.01	<0.01	<0.005	0.02
7	Downstream of Powerhouse	0.01	0.04	<0.01	0.11	<0.01	<0.003	<0.01	<0.01	<0.005	0.02
8	Near the Bridge	0.02	0.05	<0.01	0.66	<0.01	<0.003	<0.01	<0.01	<0.005	0.08
9	River adjacent to Gokarna Temple,	0.02	**0.22**	<0.01	0.13	<0.01	<0.003	<0.01	<0.01	<0.005	0.04
10	River adjacent to Pashupati Temple	0.02	0.13	0.01	0.08	<0.01	<0.003	<0.01	<0.01	<0.005	0.02

NB: ND = Not Detected (Mn <0.05. Cu <0.02. Zn <0.02. Ni <0.02. Cd <0.003. Cr <0.02. Pb <0.01. As <0.005)

Source: Field study and laboratory experiment, 2022

5.1.14 Climate Change

Precipitation, air temperature, evaporation and relative humidity are the important factors for building climate of a particular zone. The characteristics of these parameters are indicative of the climatic changes. It is reported that the General Circulation Models predict a significant increase in monsoon precipitation with an effect of atmospheric greenhouse gases amounting to a 15% increase with double CO_2 concentration and no long-term trend in precipitation is apparent in Nepal. On the other hand, monsoon precipitation in Nepal is found to be related to El Nino and other large scale climatological parameters. Air temperature is the most important single parameter which determines the climatic fluctuations of a location. Analysis of temperature records in Nepal reveals increase in temperature after mid-1970s. From spatial distribution of annual temperature change trends in Nepal from 1977 to 1994. it is estimated that annual rate of increase in temperature around Nagmati area is about +0.07 ˚C per year i.e., 0.7 ˚C per ten years. Its effect on runoff generation would be minimal since there is no snow/ glacial covered area in the project catchment.

Based on the assessment of five GCM models of CMIP6 and SWAT model, Probable Maximum Flood model, hydrological modelling was done which indicates that in future precipitation, temperature, stream flow, percolation and other related aspects will increase.

5.1.15 Seismic Hazard Assessment for Dam Safety

A seismic hazard assessment was conducted for the NDP by the Seismology Research Centre (SRC), a division of ESS Earth Sciences Pty Ltd (ESS). The dam site is in a seismically high-risk location. Dam location, type, design and construction will all need to factor in adequate safety measures for seismic risk. Additionally, communities and assets downstream of the project are at risk if the dam breaks or breaches in any manner. Dam type, design and construction all need to factor in adequate measures for dam break.

During the design phase, the following measures have been undertaken for these risks assessment:

- Detailed geological investigations to confirm acceptability of the dam site
- Dam consequence assessment using dam break analysis
- Design criteria – flood and seismic: based on dam consequence
- Detailed flood hydrology review undertaken
- Detailed site-specific seismic hazard assessment undertaken
- Designed in accordance with current best practice
- Based on these studies and analyses. the Design Criteria adopted are the highest level:
- Earthquake: Design to safely withstand the Seismic Evaluation Earthquake (SEE)
- Flood: Design to safety pass the Probable Maximum Flood (PMF)

The CFRD type of dam is inherently safe against strong earthquake induced shaking, due to the absence of pore pressure in the rockfill and the flat batter of the upstream face. Strong seismic loading results in crest zone deformation, settlement and ravelling. In very strong earthquakes, the concrete face slab may crack and increase leakage through the dam. However, leakage is not a safety issue in a CFRD. For these reasons, the CFRD is considered to have the highest fundamental conservatism against earthquakes, and the same basic design has generally been used in regions of high seismicity as in non-seismic areas. Maximum crest settlement from very severe earthquake loadings would be around 0.6 m and the critical requirement is that the dam has sufficient freeboard for post-earthquake operation. The normal freeboard of 3.5 m provides a more-than-adequate factor of safety. The capability of CFRD which are located in areas of strong seismic activity is demonstrated by the survival of the 156 m high Zipingpu CFRD in the May 2008 Sichuan earthquake (Xu Zeping. 2008). Zipingpu Dam is located 17 km from the epicenter of the magnitude 8.0 earthquake and was subjected to very severe shaking with an acceleration of 2.0 g at the crest. The dam crest settled about 730 mm (0.5%). the horizontal deflection was 180 mm. and there was extensive spalling of concrete at face slab joints but no danger of failure was apparent.

Stability analyses have been undertaken for the CFRD. Analyses have considered stability under both static and OBE and MDE earthquake loading. The results confirm that dam stability meets normally accepted standards (ADB, 2013).

The PGA for Nagmati Dam has been calculated as being 0.82 g for 1 in 475 AEP (10% chance of accidence in 50 years) when considering earthquakes of magnitude Mw 5 and above for bedrock (assuming a Vs30 value of 1000 m/s). This value is well above average by global GSHAP standards, and significantly greater than design earthquake adopted by DHI, which had a PGA of 0.55 g. Therefore, adequate safety measures will be taken while designing the dam in order to ensure the safety of dam. A suite of three time histories has been spectrally matched, using data from the 1978-09-16 Tabas, M7.1 earthquake, the 1999-09-20 Chi-Chi, Taiwan M7.6 earthquake and the 2015-04-25 Gorkha, Nepal M7.8 earthquake. These have been used to assess the likely displacement of the embankment slopes during these extreme earthquakes, to ensure that the dam can withstand these movements. A seismic analysis has been included as part of Entura's November 2016 Feasibility Study, undertaken with the Australian Seismic Research Centre to inform the detailed design.

5.1.16 Water Demand Analysis

Having the reasonably estimated base flow and storage capacity of the Nagmati reservoir, the water demand analysis was performed. The demand analysis was hampered due to lack of spatial and temporal database of water extraction from Bagmati River. The main objective of the reservoir construction is to release fresh water into Bagmati River. However, water supply for drinking purpose is equally important. The reservoir sizing has already been made and designed and thus the storage capacity is fixed, which is about 8.78 MCM of live storage of Nagmati reservoir in its preliminary study. In addition, a smaller reservoir known as Dhap Dam of 1.42 MCM (live storage+spill) capacity in uphill is recently been constructed. However, its reservoir in the existing water regulation/supply/contribution is fairly small. Two alternatives can be possible for the operation of Dhap reservoir: 1) minimum release all round the dry months (i. e. 62lps), and 2) maximum release (i. e. 400 lps) for the 33 days. Alternatively, the Dhap reservoir can be regulated as per the requirement of downstream. In general, Dhap Dam alone could not contribute significantly in the existing drinking water supply system rather it could compensate the environmental flows that keeps the ecosystem of the river system intact. KUKL has been extracting drinking water through diversion from existing mini-hydropower plant at Sundarijal leaving no water in the channel during dry periods, meaning that there is scarcity of drinking water. There are other existing water users downstream from proposed dam such as water mills and Danchi water supply users whose water requirement is fulfilled from Nagmati River (Figure 5-9). Therefore, to fulfill the flow enhancement in the Bagmati River and providing adequate water for the downstream consumptive uses, the capacity of the reservoir is limited and insufficient to meet all the demand especially during the eight dry months (Oct.-May). It is suggested to make available 150lps of water to the existing water supply system at Sundarijal from immediate downstream of Nagmati Dam, available round the year. This will also support the existing system that draws nearly 150lps of water from Nagmati to Bagmati then to the water supply systems. It means that the construction of Nagmati reservoir won't reduce the amount of water in the existing water supply system. Therefore, to provide 150 lps of flow for consumptive purpose, the height of the Nagmati dam has to be extended from 90m high to 94.5m high. This extension of dam height could store 9.484 Mm^3 in the reservoir providing the maximum possible release of 1050 lps (450lps through penstock and 600lps through the emergency outlet) as of the design of the reservoir outlet.

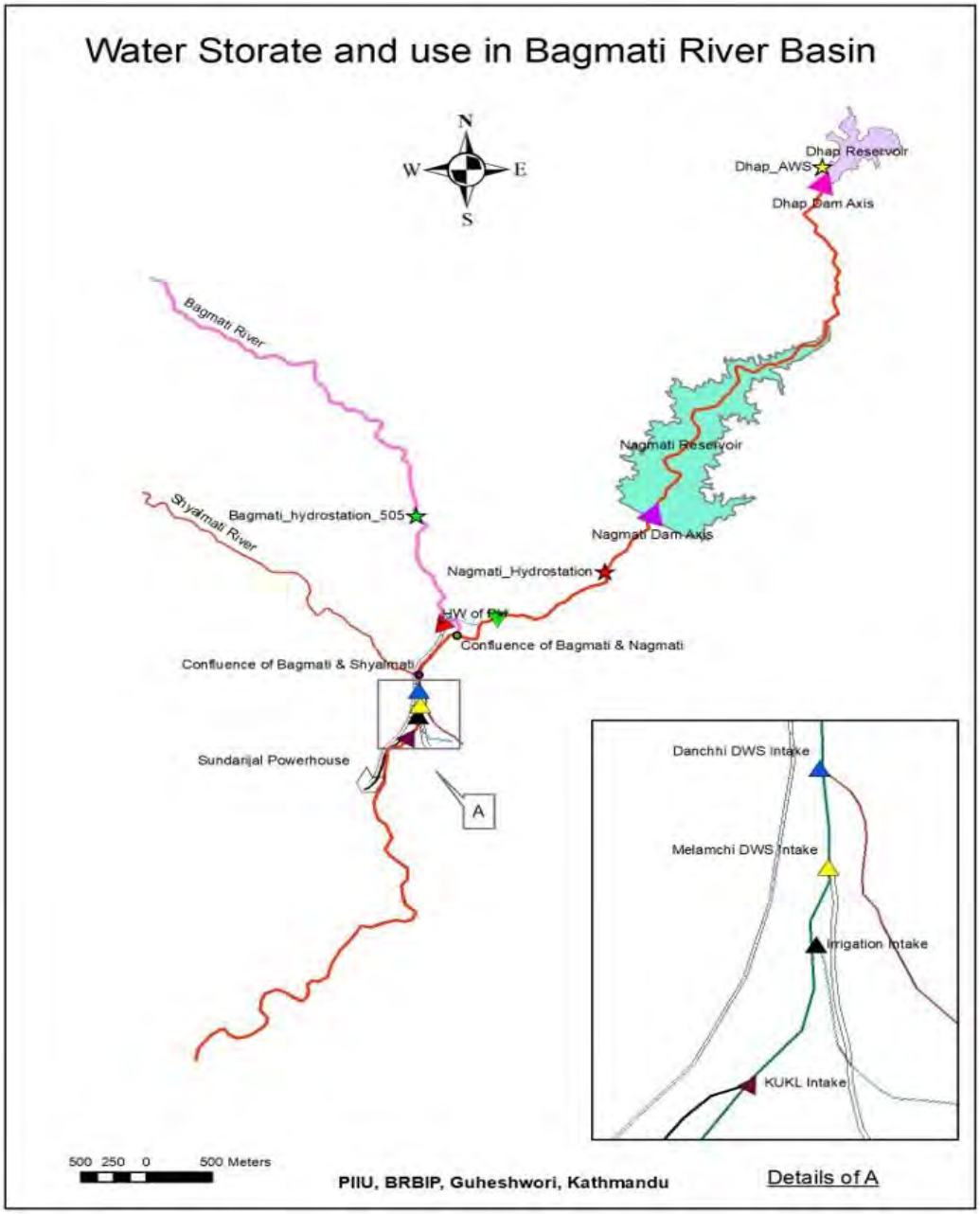

Figure 5-9: Existing water use scenario in Nagmati and Bagmati Rivers

5.2 Biological Environment

5.2.1 Distribution Zones for Biota in the SNNP

The proposed Nagmati Dam is located within the Shivapuri-Nagarjun National Park (SNNP), which covers an area of 159 km^2 and an elevation ranging from 1,000 m to 2,732 m above sea level. The area was declared protected to address problems of soil erosion owing to deforestation, overgrazing and cultivation on steep slopes and consequent issues with the quality and quantity of water supply. Protection of the Shivapuri watershed and wildlife was

initially through declaration as a reserve in 1975, and later as Nepal's 9th National Park in 2002.

The SNNP supports a rich floral and faunal diversity, with a number of protected species of mammals, birds and plants. The floral diversity is quite high in the park due to its location, altitude and climatic variations. The vegetation of the park represents mid-hill flora, fauna and ecosystems in the transition zone between sub-tropical and temperate climate, where the variations are primarily a function of the altitude. There are more than 2,122 species of flora of which 16 of them being endemic flowering plants. Although these endemic plants are available in SNNP, they will not be significantly affected by Nagmati dam which which will occupy only 0.3% area of SNNP area. However, conservation measures will be adopted as provisioned in mitigation measures. Also, about 129 species of mushroom including *Lactarius pleusitides* have been identified in the park.

Forests are one of the major natural resources of the National Park covering more than 70% of the park area. The following Table 5-11 presents the forest habitats and altitudinal distribution of flora and fauna in the SNNP area.

Table 5-11: Latitudinal distribution of flora and fauna in the SNNP

Forest type or habitat	Altitude (m)	Flora	Fauna
Ever green mixed broad-leaved forest	1000-1500	*Schima wallichii* (चिलाउने), *Castonopsis indica (*कटुस*),* *Alnus nepalensis* (उतिस), *Anthosaphalus cadamba* (कदम), *Prunus cerasoides* (पैयु),	Wild boar (*Sus scrofa*) Barking deer (*Muntiacus muntijak*) Rhesus monkey (*Macaca mulatta*) Langur (*Semnopithecus entellus*) Indian hare (*Lepus nigricollis*)
Chir pine forest	1000-1600	*Pinus roxburghii* (खोटे सल्ला), *Castonopsis indica (*कटुस*),* *Myrica esculenta* (काफल), *Pyrus pashia* (मयल)	Wild boar (*Sus scrofa*) Barking deer (Muntiacus muntijak) Rhesus monkey (*Macaca mulatta*) Langur (*Semnopithecus entellus*) Indian hare (*Lepus nigricollis*)
Upper mixed hardwood forest	1500-2700	*Acer* (फिरफिरे), *Aesculus* (पाङर), *Juglans regia* (ओखर), *Betula* (लेक पैयु) *Fraxinus spp* (लाँकुरी) *Alnus nepalensis* (उतिस), *Salix spp.* (वैस) *Quercus spp.* (बाँझ), *Celtis spp*. (खरी)	Himalayan goral (*Nemorhaedus goral*) Himalayan black bear (*Ursus thibetanus*) Yello-throated marten (*Martes flavigula*) Wild boar (*Sus scrofa*)

Forest type or habitat	Altitude (m)	Flora	Fauna
Oak-Rhododendron forest	2300-2700	*Quescus semacarpifolia* (खसु) *Eurya acuminata* (झिगाने), *Ilex dipyrena* (सेतो खसु), *Michelia champaca* (चाँप) *Rhododendron arboreum* (लाली गुराँस) *Symplocos spp.*	Wild boar (*Sus scrofa*) Barking deer (*Muntiacus muntijak*) Porpucine (*Hystrix indica*)

Source: Shivapuri-Nagarjun National Park Management Plan, 2004 (draft)

5.2.2 Flora of the Project Area

The SNNP, climatically falls in the transition zone between sub-tropical to temperate region where mid mountain habitats provide shelters to fauna found in mid-mountain.

The inventory done in the proposed Nagmati dam area, it was observed that the whole forest is in the secondary stage of succession. It was very hard to find the big and/or mature sized trees in the area. Consultation with local residents disclosed that there were not any security check posts in the Shivapuri area during the insurgency period. This led to cutting and felling of big trees. These trees were either used as timber or as fuelwood for alcohol distillation. Considerable numbers of local residents are still involved in distillation. After the restoration of peace, practices of cutting and felling of trees have been stopped.

Quercus glauca (Falat) was the most dominant species of proposed Nagmati dam area with altogether 18851 trees and poles enumerated. *Rhododendron arboretum* (Laligurans), *Symplocos pyrifolia* (Kholme), *Carpinus viminea* (Saur), *Camellia kissi* (Chiyapate) and *Quercus lanata* (Banj) are the major associated species in Nagmati area. Altogether 71 species were recorded during the enumeration across the different study sites. The tree species recorded from the field study is presented in Table 5-12 and Table 5-13 and tree species recorded during enumeration is attached in Annex 22.

Table 5-12: Number of major tree species enumerated at Nagmati dam site

SN	Species Name (Scientific)	Species Name (Local)	Total Number of Species
1	*Quercus glauca*	Falat	18851
2	*Rhododendron arboretum*	Laligurans	8857
3	*Symplocos pyrifolia*	Kholme	6371
4	*Carpinus viminea*	Saur	5770
5	*Camellia kissi*	Chiyapate	4539
6	*Quercus lanata*	Banj	4467
7	*Lyonia ovalifolia*	Angeri	4196
8	*Cleyera japonica*	Baklopaate	3695
9	*Castanopsis tribuloides*	Masure Katus	3082
10	*Rhus wallichii*	Valayo	2318
11	*Myrica esculenta*	Kafal	2254
12	*Lithocarpus elegans*	Arkheulo	1527

SN	Species Name (Scientific)	Species Name (Local)	Total Number of Species
13	*Cinnamomum glanduliferum*	Malagiri	1279
14		Kaulo	1260
15	*Michelia champaca*	Chaap	1251

Source: EIA Field Study, 2023

Table 5-13: List of fruit bearing trees in Nagmati Project Area

S.N.	Common Nepali name	Scientific name	Location
1	Angeri	*Lyonia ovalifolia*	Transect Nos. 3, 4, 5, 6, 7 and 8
2	Dhansingare	*Gaultheria fragrantissima*	Transect Nos. 3, 4 and 6
3	Gurans	*Rhododendron sp.*	Transect Nos. 4, 5, 6, 7 and 8
4	Hinguwa	*Camellia kissi*	Transect Nos. 4, 7 and 8
5	Jamanemandro	*Mahonia napaulensis*	Transect Nos. 3 and 8
6	Jure Kafal	*Eriobotrya dubia*	Transect Nos. 6, 7 and 8
7	Kaulo	*Persea odoratissima*	Transect Nos. 5, 7 and 8
8	Khasru	*Quercus semecarpifoloa*	Transect Nos. 3, 4, 5, 6, 7 and 8
9	Mayal	*Pyrus pashia*	Transect Nos. 3, 4, 5, 6, 7 and 8
10	Rachan	*Daphniphyllum himalense*	Transect Nos. 4, 5 and 7
11	Seto Siris	*Albizia julibrissin var mollis*	Transect Nos. 4 and 7

Source: EIA Field Study, 2022

5.2.3 Wildlife

The Shivapuri Nagarjun National Park harbors fairly common to endangered species of wildlife. They are distributed throughout the area from 1000m to as high as 2700m in the temperate habitat. According to the Management Plan of Shivpuri Nagarjun National Park (2017/2019-2021/2022) the park provides home for 30 species of mammals. Out of which four species are listed in protected list of Nepal government's National Parks and Wildlife Conservation Act 1973 AD, eight are listed in IUCN Red Data Book and 12 are included in the CITES Appendices (eight in Appendix I and four Appendix II). Wildlife recorded in the park includes the Clouded leopard (*Pardofelis nebulosa*), Indian Pangolin (*Manis crassicaudata*), Chinese Pangolin (*Manis pentadactyla*), Leopard cat (*Prionailurus bengalensis*), Asamese Monkey (*Macaca asamensis*), Common leopard (*Panthera pardus*), Ghoral (*Naemorhedus goral),* Himalayan Black Beer (*Ursus thibetanus*), Sambar Deer (*Cervus unicolor*), Jungle Cats (*Felis chaus*), Rhesus Monkey (*Macaca mulata*), Hanuman Langur (*Semnopithecus intellus*), Barking Deer (*Muntiacus muntijak*), Wild pig (*Sus scrofa*), Indian Hare (*Lepus nigricollis*), Martin (*Martes flavigula*), Large Indian Civet (*Viverra zibetha*), Himalayan Palm Civet (*Paguma larvata*), Jackal (*Canis aureus*), Porcupine (*Hystrix brachyuran*), Flying Squirrel (*Callosciurus pygerythrus*) and Mongoose (*Herpestes edwardsii*).

No direct observation of fauna was held during the survey time except barking deer, wild pig, jungle cat and monkey. Also, no new species of wildlife were noted. Ten mammalian species were recorded in the field surveys across the 12 transects, shown in Table-14, of which five

were direct sightings. Three carnivores were recorded in the Nagmati Dam area via animal signs, the Leopard Cat (Prionailurus bengalensis), the Jungle Cat (Felis chaus) and the Large Civet (Viverra zibetha), indicating this is an important wildlife habitat and acts as a corridor for their movement.

During transect survey, Clouded leopard (*Pardofelis nebulosa*) was not observed. Clouded leopard is found in primary evergreen forest, moist subtropical semi-deciduous forest, selectively logged forest, degraded woodland, tall grassland, and marginal scrub forest (Jnawali et al., 2011).

Table 5-14: Wild mammals identified from surveys at the Nagmati Project Area

SN	Scientific names	Common/ Nepali names	Order	Family	Identification	No. of sighting	Location
1	*Dremomys lokriah*	Orange bellied Himalayan Squirrel/ हिमाली बन लोखर्के	Rodentia	Scuridae	V	1	B
2	*Macaca mulatta*	Rhesus Macaque/ रातो बाँदर	Primates	Cercopithecidae	V	>5	B
3	*Munitacus muntjak*	Barking Deer/ रतुवा	Artiodactyla	Cervidae	P, V	3	B, Dh
4	*Lepus nigricollis*	Large Hare/ खैरो खरायो	Lagomorpha	Laporidae	V	2	Dh
5	*Martes flavigula*	Yellow-throated Marten/ मलसाँप्रो	Carnivora	Mustelidae	F. V	2	Dh
6	*Prionailurus bengalensis*	Leopard Cat/ चरी बाघ	Carnivora	Felidae	S	4	N. Dh
7	*Felis chaus*	Jungle Cat/ वन विरालो	Carnivora	Felidae	S	1	N
8	*Panthera pardus*	Common Leopard/ ध्वासे चितुवा	Carnivora	Felidae	S	2	Dh
9	*Viverra zibetha*	Large Civet/ सिभेट	Carnivora	Viverridae	Sc	2	N. Dh
10	*Sus scrofa*	Wild Boar/ बँदेल	Artiodactyla	Suidae	D	>3	Dh

Note: Identification: V=Direct Sighting. P=Pellet. F=Footprint. S=Scat. Sc=Scent. D=Digging; Location: B=Bagmati. N=Nagmati. Dh=Dhap

From the six transects laid in the Nagmati dam area, scats of *Prionailurus bengalensis* and *Felis chaus* and scent of *Viverra zibetha* were recorded in the area confirming the presence of those three carnivores (Table 5-15).

Table 5-15: Scats and scents of wildlife recorded in Nagmati Project Area

Animal	Sign	Location	Elevation	Aspect	Crown cover	Dominant trees	Distance from water
Felis chaus (Jungle Cat/ वन विरालो)	Scat	Transect No. 3	1841 m	SE	Open	Pinus roxburghii. Rhododendron arboreum. Myrica esculenta. etc.	100 m from Nagmati
Prionailurus bengalensis (Leopard Cat/ चरी बाघ)	Scat	Transect No. 4	1856 m	E	4%	Pinus roxburghii. Pyrus pashia. Quercus sp. Gultheria fragrantissima. etc.	20 m
	Scat	Transect No. 6	1921 m	E	28%	Rhododendron arboreum. Quercus sps. Thea sps. Myrica esculenta. etc.	20 m
	Scat with worms	Middle of the road			64%	Rhododendron arboreum. Lyonia ovalifolia. Daphniphyllum himalayensis	20 m
Viverra zibetha (Large Civet/ सिभेट)	Scent	Transect No. 8	1977 m	Ridge. S	85%	Pyrus pashia. Thea sps. Myrica esculenta. etc.	50 m

5.2.4 Herpeto Fauna

The SNNP and BZ have tremendous habitats for common to rare and endangered species of herpetofauna. It represents highly diversified faunal elements of sub-tropical to temperate zone characteristics. The list of herpeto fauna present in the project area is presented in the Table 5-16 below.

Table 5-16: List of the species of herpetofauna recorded from SNNP

S.N.	Species	Common Name	IUCN	CITES
1	*Hoplobatrachus tigerinus*	Indian Bullfrog/भ्यागुतो	LC	II
2	*Ptyas mucosus*	Rat Snake/धामन		II

3	*Naja naja*	Common Cobra/कोब्रा		II
4	*Naja kaouthia*	Monocled Cobra/कोब्रा		II
5	*Ophiophagus Hannah*	King Cobra/कोब्रा		II
6	*Chaparana spp.*	Paa/ पाँ भ्यागुतो		
7	*Varanus bengalensis*	Bengal monitor/ गोहोरो		II

Source: SNNP, 2015

5.2.5 Birds

The SNNP has provided habitat to more than 320 species of birds. This record also includes 117 migratory birds. Among the total species of birds recorded in the park, 120 are wetland dependent, 80 are winter migrants, 6 are summer migrants, 28 are residential and 6 are vagrant (SNNP, 2017). The park is home to 22 globally threatened species such as Slender-billed Vulture, White-rumped Vulture and Red-headed Vulture are listed in endangered category of IUCN. Other common bird species are white backed vulture, Himalayan griffon (Nepali & Suwal, 2007), dark kite, hen harrier, goshawk, sparrow hawk, sikhra, common buzzard, Asian black eagle, steppe eagle (BPP, 1995), magpies, kalij pheasant, leaf birds, flycatcher, bushchat, babblers, cuckoos, bulbul, swift, warblers. Importantly, the Spiny babler (*Turdoides nipalensis*), Wren babbler (*Pnoepyga pusilla*) are the endemic birds found in Shivapuri Nagarjun National Park. Previous studies showed that the SNNP harbors the only endemic species of Nepal, the Spiny babbler.

During the transect survey, the study team recorded 16 bird species from the 12 transects varying in length between 250-700m. Birds were recorded from five transects (Transect no. 3, 4, 5, 6, 7 and 8) set up at Nagmati Dam site. The recorded list of birds is presented in Table 5-17.

Table 5-17 : List of birds recorded in the Nagmati Project Area

SN	Common Name	Nepali Name	Scientific Name	Locations
1	Black Bulbul	Bakhre Jureli	*Hypsipetes leucocephalus*	Transect No. 3
2	Chestnut-bellied Nuthatch	Katuse Matta	*Sitta cinnamoventris*	Transect No. 8
3	Common Hoopoe	Fapre Chara	*Upupa epops*	Transect No. 4
4	Grey Treepie	Pahaadi Kokale	*Dendrocitta formosae*	Transect Nos. 3, 4, 6 and 8
5	Grey-hooded Warbler	Tumulkari Fisto	*Phylloscopus xanthoschistos*	Transect No. 3
6	Himalayan Bulbul	Julphe Jureli	*Pycnonotus leucogenys*	Transect No. 3
7	Hoary-throated Barwing		*Actinodura nipalensis*	Transect No. 3
8	Mountain Bulbul	Kailopete Jureli	*Ixos mcclellandii*	Transect No. 8
9	Oriental Turtle Dove	Tame Dhukur	*Streptopilia orientalis*	Transect No. 3
10	Rufous-bellied Niltava	Niltau	*Niltava sundara*	Transect No. 8
11	Shikra	Shikra	*Accipter badius*	Transect No. 3
12	Striated	Kalki Torigada	*Garrulax striatus*	Transect No. 4

	Laughingthrush			
13	White Wagtail	Seto Tiktike	*Motacilla alba*	Transect No. 7
14	White-tailed Nuthatch		*Sitta himalayensis*	Transect Nos. 4 and 5
15	White-tailed Stonechat	Jhekjhek Jhyapshi	*Saxicola leucura*	Transect No. 8
16	Yellow-breasted Greenfinch	Gajale Pitchari	*Chloris spinoides*	Transect No. 8

Source: F ield Survey, 2022

5.2.6 Protected, endangered and rare species of Flora and Fauna

5.2.6.1 Plants

Protected plant species listed by different organisations are shown in Table 5-18. Altogether seven species of protected species were recorded from the surveyed sites. Out of the seven species Jhyaau *(Lichen spp.) and* Lauth salla *(Taxus wallichiana)* is listed as protected species by GoN.

Table 5-18: Protected, endangered and rare species of different categories

Species	Local Name	IUCN	CAMP	GN	CITES	Local Availability
Asparagus racemosus	Kurilo		V			R
Bergenia ciliate	Pakhanved	T				C
Choerospondias axillaris	Lapsi	R				R
Dioscorea deltoidei	Bhyaakur	T	EN		App II	R
Lichen spp.	Jhyaau			2		C
Orchidaceae	Sungava, Sunakhari	T			App II	C
Pinus roxburghii	Khote salla	LC				A
Rubia manjith	Majitho		V			A
Taxus wallichiana	Lauth salla	E	EN	2	App II	R

Source: Field Study, 2022

Notes: **IUCN**: T = Threatened, R = Rare, LC = Least Concern; **CAMP (Conservation Assessment Management Planning Workshop, 2001):** EN = Endangered, V = Vulnerable; **GoN (Government of Nepal, Forest Regulations 1995, amended in 2001):** 1 = timber trees banned for felling, transportation and export: 2 = banned for export outside the country without processing; **CITES**: App II = Appendix II = species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled; **Local Availability (Observation by vegetation survey team):** A = abundant, C = common, R = rare

5.2.6.2 Mammals

Of the ten-mammal species recorded in the field survey (the full 12 transects), six are protected and threatened wildlife including the three-species recorded in the Nagmati Dam area. These six-protected species are shown in Table 5-19.

Table 5-19: Protected and threatened wildlife recorded in the Nagmati Project Area

S.N.	Scientific name	English name / Nepali name	Protection status		
			GoN	IUCN	CITES
1	*Prionailurus bengalensis*	Leopard cat / Chari bagh	Schedule 1	LC	II
2	*Panthera pardus*	Common leopard / Chituwa		VU	I
3	*Macaca mulata*	Rhesus macaque / Rato bandar		LC	II
4	*Felis chaus*	Jungle cat / Ban Biralo		LC	II
5	*Martes flavigula*	Yellow-throated marten/ Malsapro		LC	III
6	*Viverra zibetha*	Large Indian civet/ Thulo nirbiralo		Vu	III

Note: Y=Protected under NPWC Act. 1973. LC=Least concern. Nt=Near threatened. Vu=Vulnerable; I. II & III = Appendices

Prionailurus bengalensis (Leopard cat/Chari bagh) is the protected wildlife in Nepal under the National Parks and Wildlife Conservation Act 1973. It is found in Shivpuri Nagarjun National Park. It is protected because of its heavy habitat loss and poaching (traded due to its skin and bone). It is listed as a least concern species in the IUCN Red List category and Appendix II of CITES. Nagmati dam may not significantly affect the species as the dam will cover only 0.3% area of SNNP. However, for the conservation of this protected species, conservation measures will be adopted as provisioned in mitigation measures.

Table 5-20 shows the threatened bird species potentially present in the Nagmati area, based on secondary sources. Only one vulnerable species is listed as a nationally threatened bird, the White-tailed Stonechat, which was recorded at the Nagmati Dam site. Of the other 11 threatened bird species listed in the Table 5-20, the Saker Falcon, the Grey-sided Laughingthrush and Blue-winged Laughingthrush are possibly found at the dam site, while the remaining 8 threatened species are not likely to be found here.

Table 5-20: Threatened species of birds in Nagmati Project Area

S. N.	Bird species	Status	Likely in SNNP	Season	Habitat	Nesting season	Food	Likely at Nagmati site
1	Hodgson's Bushchat (*Saxicola insignis*)	Vulnerable (IUCN 2012) and Endangered nationally (BCN and DNPWC 2011)	Yes	Winter visitor for Nepal	Grass land. tall grass and Reeds nearby river	June	Insects and fruits	Least possibility (only single unusual record from Chisapani area which is aerially 4

S. N.	Bird species	Status	Likely in SNNP	Season	Habitat	Nesting season	Food	Likely at Nagmati site
								km far from Nagmati
2	Saker Falcon/ बाज (*Falco cherrug*)	Endangered (IUCN 2012)	Yes	Wintering and passage migrants	Open country	NA	Dove, pigeon, insects. Rodent	Possible
3	White-rumped Vulture/ डंगर गिद्ध (*Gyps bengalensis*)	Critically Endangered (IUCN 2012. BCN and DNPWC 2011)	Yes	Residential (All year)	Open country. Tall tree and human habitation	Oct-April	Scavenger	Least possibility
4	Grey-sided Laughingthrush (*Pterorhinus caerulatus*)	Vulnerable nationally (BCN and DNPWC 2011) Globally Least Concern (IUCN 2012)	Yes	Residential (All year)	Forest and bush	NA	Insects. Fruits	Possible
5	Blue-winged Laughingthrush (*Trochaloptero n squamatus*)	Vulnerable nationally (BCN and DNPWC 2011 and Least Concern (IUCN 2012)	Yes	Residential (All year)	Forest and bush	NA	Insects. Fruits	Possible
6	White-tailed Stonechat (*Saxicola leucuru*)	Vulnerable Nationally (BCN and DNPWC 2011) and Least Concern (IUCN 2012)	Yes (Field survey 2012	Residential (All year)	Grass land	NA	Insects. Fruits	Confirmed at downstream location
7	Brown Wood Owl/ उल्लू (*Strix leptogrammica*)	Vulnerable Nationally (BCN and DNPWC 2011) and	Yes	Residential (All year)	Primary Forest	NA	Rodent. birds and reptiles	Least Possibility

S. N.	Bird species	Status	Likely in SNNP	Season	Habitat	Nesting season	Food	Likely at Nagmati site
		Least Concern (IUCN 2012)						
8	Spot-bellied Eagle Owl/ उल्लू (*Bubo nipalensis*)	Nationally Endangered (BCN and DNPWC 2011) Least Concern (IUCN 2012)	Yes	Residential (All year)	Primary Forest	Dec-March	Rodents. birds and reptiles	Least Possibility
9	Lammergeier Vulture/ हाडफोर (*Gypaetus barbatus*)	Vulnerable Nationally (BCN and DNPWC 2011) and Least Concern (IUCN 2012)	Yes	Residential (All year)	Open country and cliff	NA	Scavenger	Least Possibility
10	Egyptian Vulture/ सेतो गिद्ध (*Neophron percnopterus*)	Vulnerable Nationally (BCN and DNPWC 2011) and Endangered (IUCN 2012)	Yes	Residential (All year)	Open country and cliff	NA	Scavenger	Least Possibility
11	Himalayan Griffon/ हिमाली गिद्ध (*Gyps himalayensis*)	Vulnerable Nationally (BCN and DNPWC 2011) and Least Concern (IUCN 2012)	Yes	Residential (All year)	Open country and cliff	NA	Scavenger	Least Possibility
12	Cinereous Vulture/ राज गिद्ध (*Aegypius monachus*)	Near Threatened (IUCN 2012) and Nationally Endangered (BCN and DNPWC 2011)	Yes	Uncommon winter visitor	Open country	NA	Scavenger	Least Possibility

Source: Based on (BCN and DNPWC 2011) (SNP and BCN 2007)

5.2.7 Aquatic ecology

5.2.7.1 Macroinvertebrates

During the EIA study of BRBIP, a detail study of macroinvertebrates was conducted to document the occurrence of various macro invertebrates in the NDP implementation area. Six sites were investigated in the Nagmati river (Table 5-21). The study revealed that the species diversity and abundances are very high for nearly all aquatic invertebrate groups in addition to algae (all groups) and other aquatic plants. The percentage of individuals and the taxon diversity of Chironomidae further increases (predominantly Orthocladiinae. in quietly flowing reaches Tanytarsini and Chironomini). The net-spinning trichopterans are usually numerous only where suitable current velocities are available whereby Polycentropodidae can appear in large quantities in potamal regions. Macrophytes can cover areas but usually green algae (Chlorophyceae) do not yet appear in large quantities. No aquatic rooted vegetation exists in the river environment at the Nagmati Dam site.

The survey classified the various stretched of the Nagmati to belong to the Environmental Class II (beta-mesosaprobic) with a degree of pollution as 'slightly polluted' (Moog and Sharma, 2001). This shows that the Nagmati River is not in a pristine condition. Despite having a good water quality, the aquatic ecosystem is disturbed by human activity in the catchment.

Table 5-21: Aquatic invertebrates recorded from Nagmati sites in macro-invertebrate study

SN	Order	Family	Subfamily/Genus/species	NAG-01	NAG-02	NAG-03	NAG-04	NAG-05	NAG-06
1	Coleoptera	Elmidae					30	43	253
2	Coleoptera	Gyrinidae			17	68	3	1	1
3	Coleoptera	Dytiscidae		63	4	1			
4	Coleoptera	Psephenidae	*Psephenoidinae*				10	11	28
5	Coleoptera	Psephenidae	*Eubrinae*				2		2
6	Coleoptera	Scirtidae						1	1
7	Coleoptera	Hydrophilidae							1
8	Coleoptera	Hydraenidae				1			
9	Diptera	Simuliidae				1	142	866	211
10	Diptera	Chironomiidae	*Chironominae*	88	355	511	3		4
11	Diptera	Chironomiidae	*Tanypodinae*	193	9	12			
12	Diptera	Chironomiidae	*Orthocladiinae*	7	4			145	6
13	Diptera	Limoniidae					17	43	26
14	Diptera	Athericidae					13	14	39
15	Diptera	Limoniidae	*Hexatoma sp.*				2	28	21
16	Diptera	Chironomiidae	*Diamesinae*				1	37	1
17	Diptera	Tipulidae					5	2	1
18	Diptera	Ceratopogonidae		1		3			2

19	Diptera	blephariceridae	*Horaia sp.*						3
20	Diptera	Tabanidae							1
21	Diptera	Dolichopodidae							1
22	Diptera	Dixidae					1		
23	Diptera	Pediciidae	*Dicranotasp.*				1		
24	Ephemeroptera	Baetidae	*Baetis sp.*				138	367	308
25	Ephemeroptera	Ephemerellidae	*Cicticostella sp.*				77	153	351
26	Ephemeroptera	Betidae	*Baetiella sp.*				3	262	81
27	Ephemeroptera	Heptageniidae	*Epeorus sp.*				69	15	77
28	Ephemeroptera	Heptageniidae	*Iron sp.*				9	6	39
29	Ephemeroptera	Heptageniidae	*Paragnetina sp.*				27		25
30	Ephemeroptera	Ephemerellidae	*Seratella sp.*						29
31	Ephemeroptera	Leptoplebiidae	*Choroterpes sp.*				19		
32	Ephemeroptera	Ephemerellidae	*Notacanthurus sp.*				7	3	2
33	Ephemeroptera	Baetidae	*Acentrella sp.*						6
34	Ephemeroptera	Ephemerellidae	*Uracanthella sp.*						2
35	Ephemeroptera	Ephemerellidae	*Torleya sp.*					2	
36	Ephemeroptera	Ephemeroptera	*Drunella sp.*					1	
37	Haplotaxids	Megascolecidae	*Perionyx fluvialitis*	2				6	1
38	Hemiptera	Aphelocheridae					44	142	26
39	Hemiptera	Notonectidae		67	14	3			
40	Lepidoptera	Pyralidae				1			
41	Megaloptera	Corydalidae						3	3
42	Odonata	Calopterygidae						17	
43	Odonata	Aeshnidae		5		6	2	1	1
44	Odonata	Gomphidae		1			3		
45	Odonata	Epiophlebiidae	*Epiophlebia laiddawi*				2		
46	Odonata	Libellulidae							1
47	Plecoptera	Leuctridae	*Periomyia sp.*				8	63	11
48	Plecoptera	Nemouridae	*Indonemoura sp.*				35	3	21
49	Plecoptera	Perlidae	*Neoperla sp.*				14	4	30
50	Plecoptera	Peltoperlidae	*Peltoperla p.*				2		
51	Plecoptera	Perlidae	*Acroneurinae*					1	
52	Trichoptera	Hydropsychidae	*Ceratopsyche sp.*				396	81	142
53	Trichoptera	Lepidostomatidae	*Lepidostoma sp.*					34	69
54	Trichoptera	Hydroptilidae	*Hydroptila sp.*						41
55	Trichoptera	Rhyacophilidae	*Hyporhyacophila sp.*				4	4	8
56	Trichoptera	Rhyacophilidae	*Himalopsyche sp.*				7	6	3
57	Trichoptera	Psychomyiidae	*Psychomyia sp.*					2	8

58	Trichoptera	Polycentropodidae	*Polycentropus sp.*	9					
59	Trichoptera	Philopotamidae	*Chimarra sp.*				5	2	
60	Trichoptera	Hydropsychidae	*Hydropsyche sp.*					2	1
61	Trichoptera	Phryganeidae						1	

* Relative Abundance of the macroinvertebrates observed (1=very rare. 2=rare. 3=common. 4=abundant. 5=highly abundant)

5.2.7.2 Fish

In two fish collection sites, no fishes were captured. It was reported that a, few days before the survey, someone had poisoned the river to kill fish. There was no fish or signs of fish at all. In the remaining three fish collection sites around the confluence between Nagmati and Bagmati yielded two different species of fish, *Schizothorax richardsonii* and *Schistura multifaciata*. *Schistura beavani* recorded in the 2013 survey was not recorded in this survey. In the two species, four different size cohorts were caught viz. 7mm fry, 12mm, 18mm and 48mm. The presence of multiple size cohorts of the snow trout depicts breeding has occurred in different time frames of the breeding season. This indicates the presence of a healthy brood population around the confluence. This is further evidenced by the presence of milting male snow trout in the location.

5.2.8 Human Wildlife Conflict

The area is the habitat for the Clouded leopard (*Pardofelis nebulosa*), Leopard cat (*Prionailurus bengalensis*), and Common leopard (*Panthera pardus*) which are vector to the humans and domestic animals of the study area. During the key informant consultation with the SNNP officials and local people past incident of confrontation with the above wild species was recorded in the project area. However, in the recent years, no incident of human loss has been recorded due to the direct confrontation with these wild animal species. Since, the project is being implemented within the SNNP, the habitat area of these species, due precaution should be undertaken to prohibit/minimize the issue of human wildlife conflict.

5.3 Socio-economic and Cultural Environment

5.3.1 Project Municipality

Administratively, proposed Nagmati Dam Project lies in the Ward no. 1 of Gokarneshwor Municipality, Kathmandu district, Bagmati Province, Nepal. Gokarneshwar Municipality covers an area of 1.5 sq km and located in the north of the capital Kathmandu. It is established merging Sundarijal, Nayapati, Baluwa, Gokarna and Jorpati VDCs. The center of the municipality has been designated as Jorpati. To the east of this municipality are Kageshwari Manohara municipality and Sindhupalchowk district, Kathmandu municipality on the west, Nuwakot and Sindhupalchowk district on the north and Kathmandu municipality and Kageshwari Manohar municipality on the south.

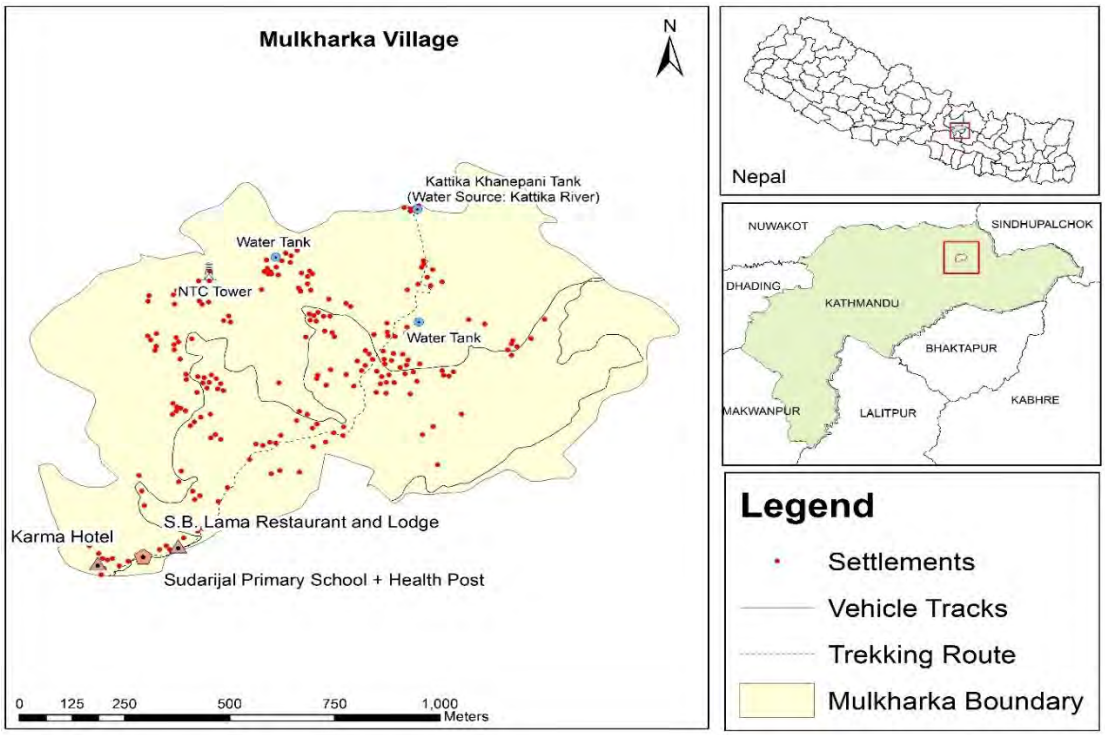

Figure 5-10: Map of Gokarneshwor Municipality Ward no. 1 with Settlements

5.3.1.1 Population and demographics of Gokarneshwor Muncipality

The total population of Gokarneshwor Muncipality as per the National Population and housing Census, 2021 is 149,366 out of which 73235 are males and 76131are females. The total households in the municipality are 39771. The average family size and sex ratio of the municipality are found to be 3.76 and 96.20 respectively (Table 5-22).

Table 5-22: Population and demographic features of the Gokarneshwor Municipality

SN	Demographic Feature	Value
1.	Total Households	39771
2.	Total Population	149366
a.	Male	73235
b.	Female	76131
3.	Average Household Size	3.76
4.	Sex Ratio	96.20

Source: National Population and Housing Census, 2021

5.3.2 Project Impacted Ward

Gokarneshower Municipality is established merging Sundarijal, Nayapati, Baluwa, Gokarna and Jorpati VDCs. Then Sundarijal VDC is now the Gokarneshwor Muncipality Ward no. 1. Therefore, the National Housing and Population Census, 2021 data of Sundarijal VDC has

been used to analyse the population and demographic features of Gokarneshwor Muncipality Ward no. 1.

5.3.2.1 Population and demographic features of Ward no.1 of Gokarneshwor Municipality

According to the National Housing and Population Census, 2021, the total population of Gokarneshwor Municipality Ward no. 1 is 7872 out of which male population is 3867 and female population is 4005. The total households recorded is 2042 with average family size of 3.86. The sex ratio is calculated to be 96.55 (Table 5-23).

Table 5-23: Population and demographic features of the Gokarneshwor Municipality Ward no. 1

SN	Demographic Feature	Value
1.	Total Households	2042
2.	Total Population	7872
a.	Male	3867
b.	Female	4005
4.	Average Household Size	3.86
5.	Sex Ratio	96.55

Source: CBS, 2021

5.3.2.2 Caste/Ethnicity

Tamang, Chettri, Brahmin, Newar, Magar, Gurung and Sherpa are the major castes of the Ward no. 1 Gokarneshwor Municipality. Ward no. 1 comprises diverse ethnic groups such as Newar, Tamang, Gurung, Sherpa, etc. of which Tamang are the dominant ethnic group present in the area (Table 5-24).

Table 5-24: Caste composition of the Gokarneshwor Municipality Ward no. 1

Caste	Total
Kshetri	195
Brahman – Hill	202
Tamang	1345
Newar	212
Gurung	39
Sherpa	26
Others	23
Total	2042

Source: CBS, 2021

5.3.2.3 Language

According to the National Population and Housing Census, 2021, Tamang, Nepali, Newari, Bhojpuri, Sherpa, Hyolmo/Yholmo are the languages spoken in the area. Tamang being the language spoken by most of the population.

5.3.2.4 Education

According to the National Population and Housing Census, 2021, the literacy rate of Gokarneshwor Municipality Ward no. 1 is 81.90%. The male literacy rate is calculated to be 88.58% and that of female is 75.56%. Shree Sundarijal Primary School is situated in the Mulkharka village for primary level of education.

5.3.2.5 Culture and religion

People of the Gokarneshwor Municipality Ward no. 1 follow Hinduism and Buddhism and are living in the harmony. People of this area celebrate Buddha Purnima, Janai Purnima, Gaijatra, Dashain, Tihar, Loshar etc. SNNP has important pilgrimage destinations including NagiGumba, Bagdwar, Bishnudwar, Jamacho and Manichur Mahadev, Kageshwori. Sundarimai, Baudeshwor, Tarkeshow, Pachali Bhairav and other religious destinations. The Locations of cultural and religious significance near to the project area are shown in Figure 5-11.

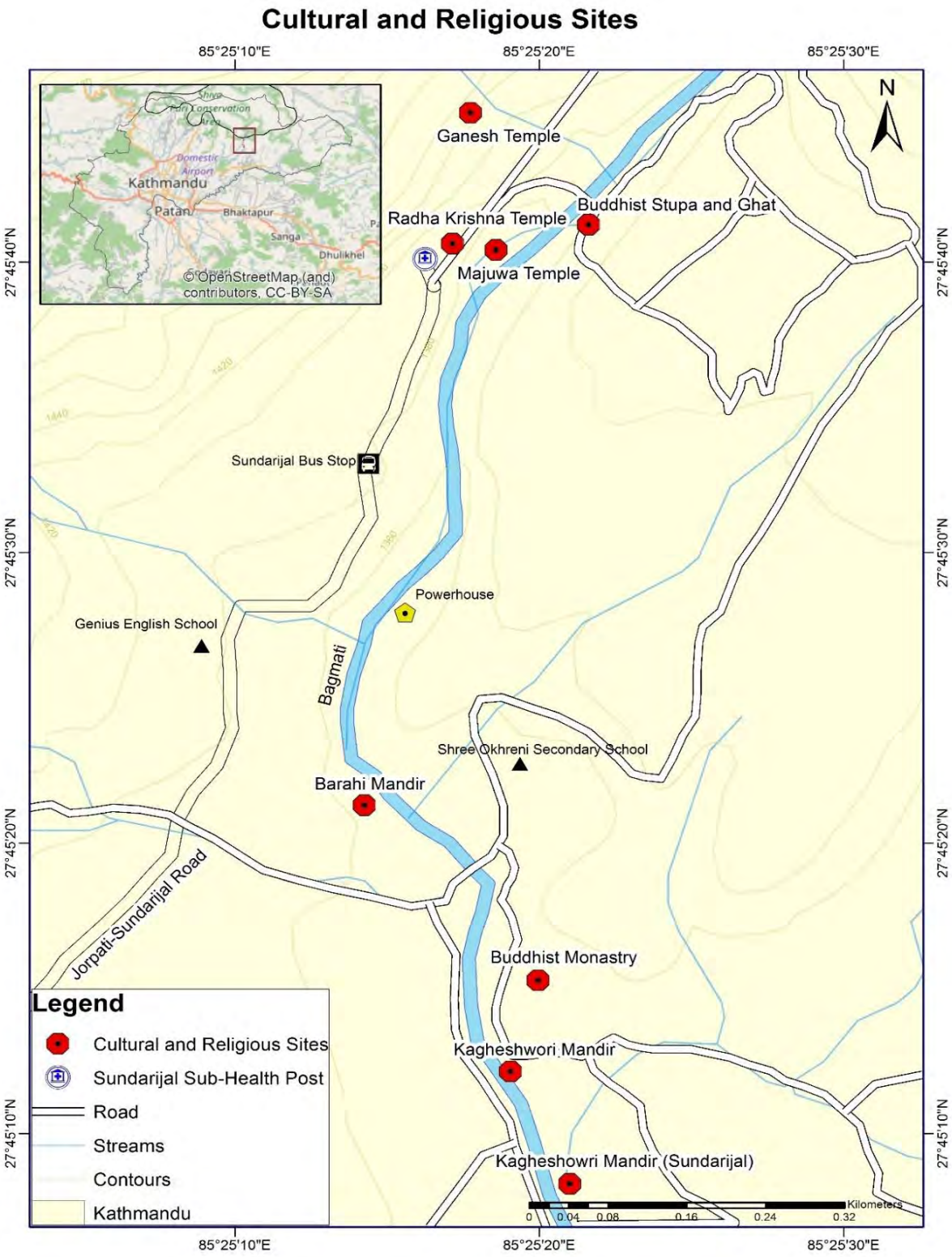

Figure 5-11: Cultural and religious sites within and periphery of the project area

5.3.2.6 Health and Sanitation

During the field study, a health post was recorded at the top storey of Shree Sundarijal Primary School is situated in the Mulkharka village. Further, private clinics and pharmacy were recorded in the Sundarijal area. Nepal Medical College and Teaching Hospital is located about 3 km distance by road from the Sundarijal. Therefore, the project area has good access to the health facilities.

According to the National Population and Housing Census, 2021, most of the household have drinking water facility from tap water followed by spout water for drinking (Table 5-25)

Table 5-25: Main source of drinking water in Gokarneshwor Municipality Ward no. 1

Gokarneshwor Municipality Ward no. 1	Total HHs	Main source of drinking water								
		Tap/piped water (within premise)	Tap/piped water (outside premise)	Tubewell/ handpump	Covered well/kuwa	Uncovered well/kuwa	Spout water	River /stream	Jar/ bottle	Others
Number	2042	774	838	19	33	18	228	0	123	9
Percentage	100%	36.58%	41.04%	0.93%	1.62%	0.88 %	11.16%	0	6.02%	0.44 %

Source: National Population and Housing Census, 2021

According to the National Population and Housing Census, 2021, 99.51% of the total households have the toilet facility and only 0.49% are without toilets in their households (Table 5-26).

Table 5-26: Toilet Facility in Gokarneshwor Municipality Ward no. 1

Gokarneshwor Municipality Ward no. 1	Total HHs	HHs without toilet facility	Households with toilet facility of			
			Flush toilet (public sewerage)	Flush toilet (septic tank)	Pit toilet	Public toilet
Nos.	2042	10	11	1788	231	2
Percentage	100%	0.49%	0.54%	87.56%	11.31%	0.1%

Source: National Population and Housing Census, 2021

5.3.2.7 Energy

According to the National Population and Housing Census, 2021, LP gas is the major source of energy used in the area for cooking purposes followed by firewood (Table 5-27).

Table 5-27: Source of energy for cooking in Gokarneshwor Municipality Ward no. 1

Gokarneshwor Municipality Ward no. 1	Total household	Fuel usually used for cooking						
		Wood/ firewood	Kerosene	LP gas	cow dung	Bio gas	Electricity	Others
Nos	2042	233	0	1801	0	1	2	5
Percentage	100%	11.41%	0	88.2%	0	0.05%	0.097%	0.24%

Source: National Population and Housing Census, 2021

According to the National Population and Housing Census, 2021, almost all the households (99.31%) use electricity as the energy source for lightning (Table 5-28).

Table 5-28: Source of energy for lighting in Gokarneshwor Municipality Ward no. 1

Gokarneshwor Municipality Ward no. 1	Total household	Energy used for lightning				
		Electricity	Kerosene	Bio gas	Solar	Others
Nos	2042	2028	0	0	13	1
Percentage	100%	99.31%	0	0	0.64%	0.05%

Source: National Population and Housing Census, 2021

5.3.2.8 Land use

Table 5-29 shows the land use areas in the Shivapuri watershed and Figure 5-12, show the different land use locations within the project area. Out of the total catchment area in the Shivapuri-Nagarjun National Park (SNNP) about 328.6 ha (9.7%) is covered by agricultural land including settlement areas and the remaining 3057.4 ha (90.3%) is covered by forest. bush areas and wetlands.

Table 5-29 : Land use areas in the Shivapuri watershed

S. No	Land use	Area (ha)	% Coverage
1	Cultivation	328.6	9.70
2	Forest	3055.0	90.23
3	Bush land	2.0	0.06
4	Wetlands	0.57	0.01
	Total	3386.0	100.00

Source: GIS section in Department of Soil Conservation and Watershed Management (DSCWM)

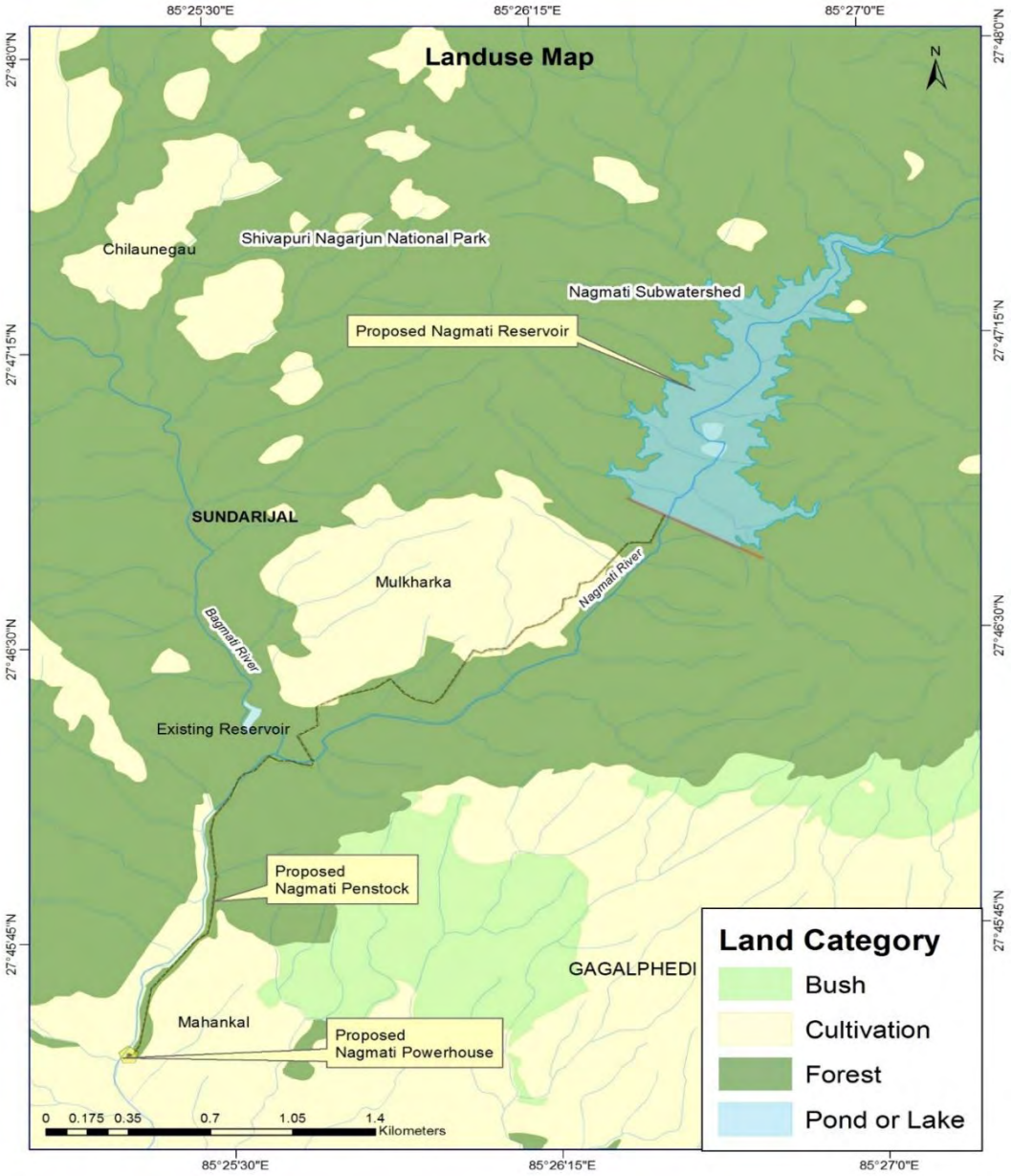

Figure 5-12: Land uses in the Project Area

The northern fringe area of the SNNP is the major recharge zone for the Bagmati River along with its tributaries. The Nagmati, Shyalmati, Bishnumati. Manohara. Dhobikhola. Balkhu and Nakkhu rivers all have their origin in the SNNP. Bagmati watershed is an important source of water in Kathmadu valley and drains through southern flat Terai to India.

5.3.2.9 Existing Water Use

Water uses in the vicinity of the project are summarized in Table 5-30 and data available on withdrawal amounts by Sudarijal and Mahankalchaur water treatment plant is shown in Table 5-31. Important note is that in the driest months, the Sundarijal Water Supply diverts all water from both the Nagmati and Bagmati rivers for drinking water supply purposes, effectively leaving no flow downstream of the diversion weir in the Nagmati River nor

downstream of the Sundarijal Water Supply Reservoir on the Bagmati River. From some 30 years have been used traditionally by the Kageshowri Manohara Drinking Water Supply Committee for managing drinking water from the Bagmati river just above the proposed powerhouse within the project area. Now, a filter plant of 36 lps is under construction. Another water treatment plant has been constructed at Mahankal with a capacity of 2.12 lps. This plant is fed by Shyalmati River. The water users in the river stretch from dam to powerhouse is shown in Figure 5-13.

Table 5-30: Existing water uses in the Nagmati Project Area

Water use	Details
Mulkharka Village domestic use	Kattika water tank established at north of the village, source local tributaries.
Mulkharka Village agricultural use	Rainfed and used from other local tributaries
Water mills on the Nagmati River	Two water mills are located between the dam and Bagmati confluence
Sundarijal water supply reservoir, powerhouse and water treatment plant	300 lbs Water is diverted out of the Nagmati River via a weir approximately 780 m upstream of the confluence of the Nagmati and Bagmati rivers. The diverted water is delivered to the Sundarijal Water Supply Reservoir via a small canal
Irrigation offtakes at the Bagmati River weir at Sundarijal	There is a cluster of small irrigation offtakes that service most of the irrigated area on the left bank of the Bagmati River at Sundarijal.
Domestic water use at Sundarijal	DWS to Danchhi (36 lps) Filter plant Mahankal (2.12 lps) from Shyalmati river Other small systems (unquantified)
Commercial water use at Sundarijal	KUKL has diverted water from JAICA intake (to sundarijal water treatment plant and to Mahankalchaur only in rainy season) and has gained permission for about 1 KW to operate
Water use for Melamchi DWS	During critical period and mainly in monsoon season

Sourcee: Field Study, 2022

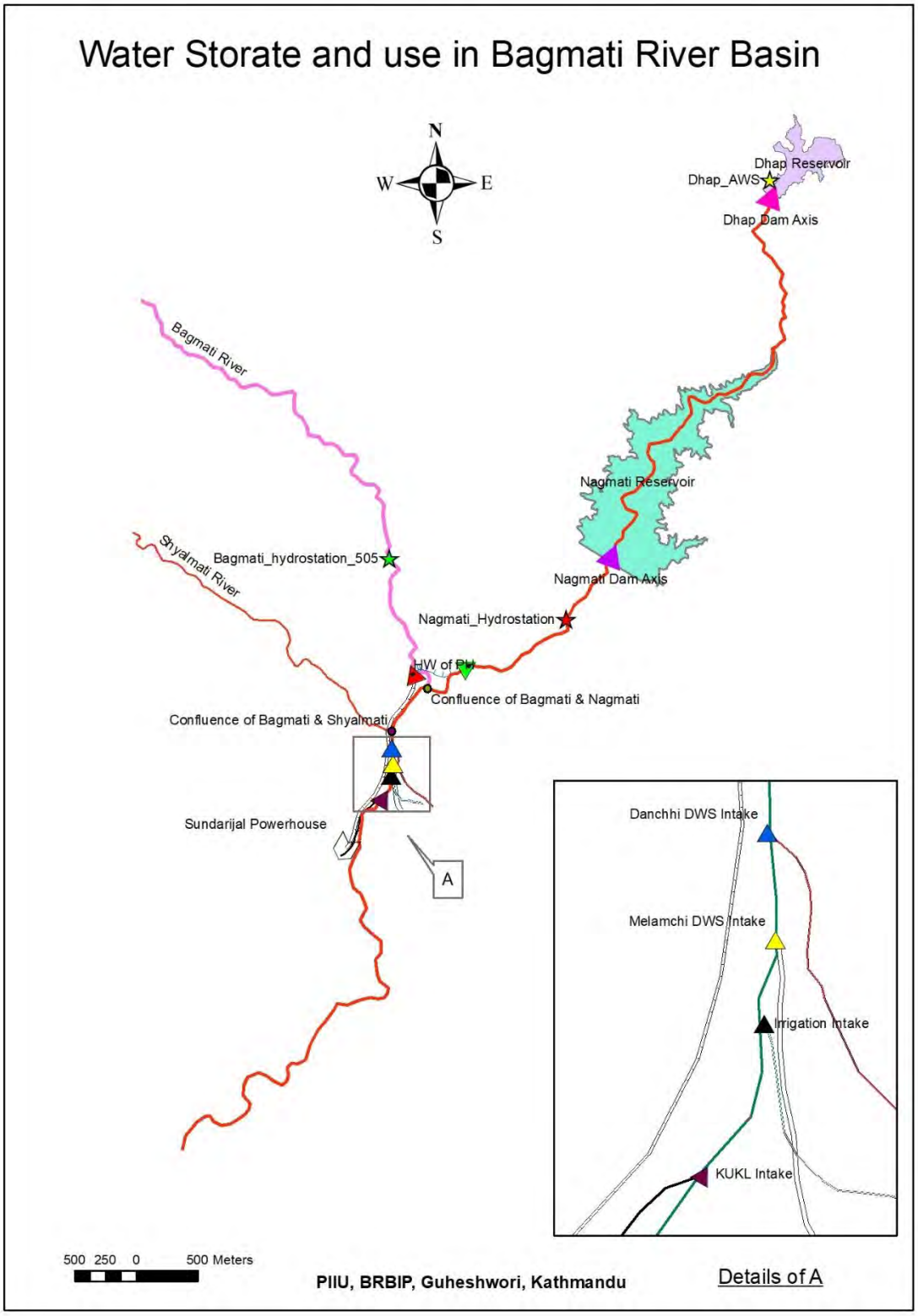

Figure 5-13: Water uses in vicinity of the project

Table 5-31: Sundarijal and Mahankalchaur water treatment plant withdrawals table for the fiscal year 2077/78

Water Use	Average Monthly Withdrawals (Million liters per day)												
	Shrawan	Bhadra	Ashwin	Kartik	Mangsir	Pash	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashar	Daily Average
Sundarijal	16	18	18	18	18	16	16	14	12	12	14	14	15.50
Mahankalchaur	24	24	24	24	24	18	16	14	14	14	16	22	19.50

Source: Annual Report of KUKL, 2079

5.3.2.10 Agriculture

The soil in the Upper Bagmati river basin along the Bagmati River is mostly alluvial deposits which are fertile and suitable for agriculture, with irrigation along the river banks and rain fed agriculture in the higher lands. The crops usually grown in the low lands are paddy during the monsoon season and wheat and potato during the winter and spring seasons. In the higher lands paddy is cultivated where ever possible, otherwise land is cultivated with maize or millet. During the winter and spring seasons the higher lands are usually left fallow. However, in some areas mustard (oilseed) or barley is cultivated. The general cropping pattern in the Upper Bagmati River Basin is presented in Figure 5-14.

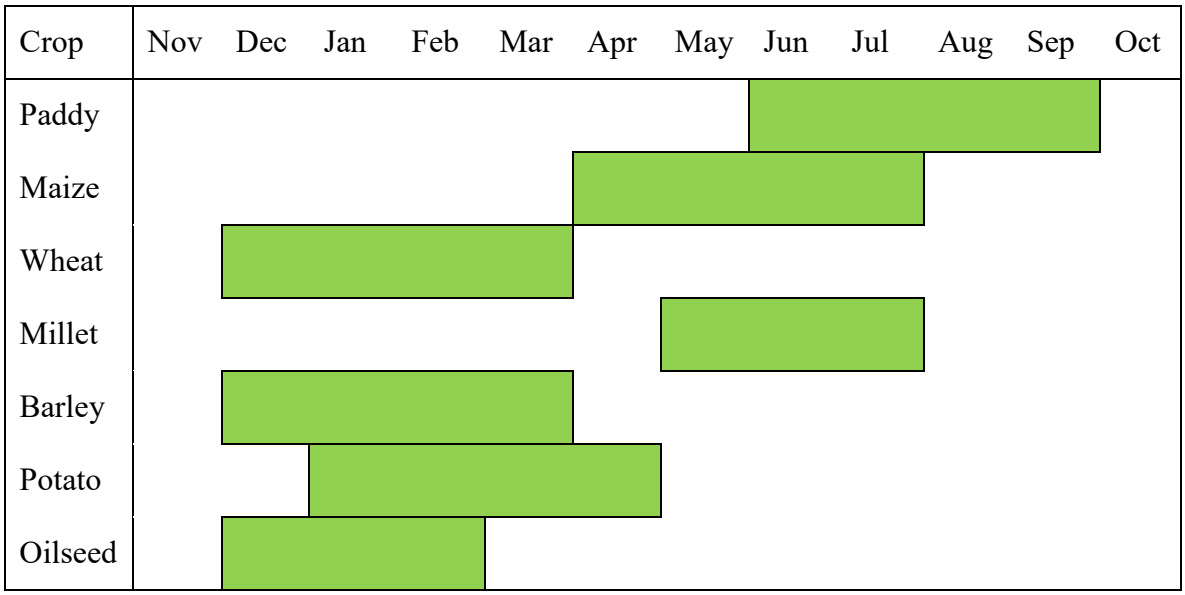

Figure 5-14 : Seasonal cropping patterns in the Upper Bagmati River Basin

Source: Farm Survey for the Feasibility Study on Rehabilitation for Government Developed Irrigation Scheme in Kathmandu Valley. JICA. May 1994

5.3.2.11 Tourism

SNNP is one of the famous destinations for both local and international tourist for hiking, traking, picnic etc. Canyomimg is a courageous game at Sundarijal invites foreigners and Nepalese visitors every year. Visitors use to visit also for cycling from Sundarijal to Chisapani as well as up to Melamchi situated at the norther Sindhupalchowk District. Chisapani has been one of the prominent tourist destinations for sight-seeing of Himalayas, mountains, river valleys, cultivated terraces, beautiful landscape etc. The park brochure lists 12 common routes famous for trekking, of which two originate out of Sundarijal: Sundarijal-Manichur-Jhule-Chisapani and Sundarijal-Mulkharka-Chisapani. Though the promotion of tourism is not the prime objective of this NDP, it is expected that the formation of reservoir will create an aesthetic place as like already in Dhap dam which is attracting tourists for recreational activities, thus increasing number of visitors in the area. This flow of tourist will enhance the economic activities in the area.

5.3.3 Socio-economic Profile of Project Impacted Households

Implementation of the NDP will require the 0.295 ha of private land. All together 30 HHs with 43 land parcels will be impacted by the project. Demographic, economic and cultural information of the impacted HHs were collected through the household survey. Impacted households were identified using Cadastral Map prepared by District Survey Office. List of project affected households with name, area and land parcel number has been attached in Annex 24 and road layout in contour map of Sundarijal is attached in Annex 25.

5.3.3.1 Demography

The total population of the affected 30 households is 159, out of which male population is 85 and female population is 74. The average family size is calculated to be 5.3 with sex ratio 1.14.

5.3.3.2 Caste/Ethnicity and Religion

The 30 impacted households are from there different caste groups. 63.33% of the impacted households are brahmins and chhetris while 36.67% are indignous people (Tamangs, Newars and Sherpas).

5.3.3.3 Education

All the family members above 5 years of the 30 impacted households are literate. However, only 86.79% people of these households has received formal education. Education qualification ranges from lower secondary school to above graduation.

5.3.3.4 Migration

The impacted households responded that some of their family members are temporarily migrated to live in areas near to core Kathmandu city. 50% of the impacted household said their family members own house in Jorpati, Chabahil, Boudha areas.

5.3.3.5 Income and Expenditure

The impacted household has average annual income of NRs. 500,000. The sources of income included government service and foreign employment. The income from agricultural commodities seems insignificant as the production is limited for household consumption only.

5.3.3.6 Occupation

The survey of 30 affected households revealed that most affected households depend on more than one source of income for the fulfilment of their livelihood. The table below shows the occupational status of affected households.

Table 5-32: Occupational status of impacted households

Occupation	Percentage	Population
Agriculture	13.84	22
Busuness	5.66	9
Government service	6.92	11
Foreign employment	8.18	13
Student/Children	27.04	43
Others	10.06	16
House work	11.95	19
Unemployed	16.35	26
Total	100	159

Source: SIA study of NDP, 2023

5.3.3.7 Mode of Compensation

The impacted household are ready to collect land for land compensation in the same area. If land for land compensation is not available, adequate cash compensation should be provided by the NDP to purchase the lost land in the same area.

CHAPTER 6 ALTERNATIVE ANALYSIS

Alternative analysis is considered as a crucial part of EIA study. It involves analysis of alternatives that provide basis for selecting best one alternative among all. The basis for alternative analysis of the proposed Nagmati Dam Project was conducted in the context of achieving the desired objectives listed in Section 2.2 of this EIA report. The primary objective of this project is to augment dry season flows to the Bagmati River, thus improving the quality of the water in the river for both environmental and religious purposes. Thus, this alternative analysis is targeted in comparing the benefits, advantages, detriments from the project implementation versus not implementing the project, identifying possible alternatives of the project itself, location of the project, within or outside of SNNP and project components alternatives. The different alternatives are discussed as in the following:

6.1 "Do nothing" Alternative

The first alternative considered has been the "do nothing" option. Benefits of not implementing project are; i) Government can invest in other projects important than the proposed project; ii) Existing forest ecology will be preserved; iii) Wildlife habitat fragmentation will be prohibited and will be maintained at natural state; iv) Land area required for the project can be used for the future development purposes; v) Loss of trees and forest cover will be prohibited; vi) Project implementation area will be free from air, noise and water pollution resulting from project construction; vii) Densely populated downstream areas along the Bagmati River will be safe from the high flood disasters resulting from the unanticipated dam failure; and viii) Pressure on the existing resources due to the intrusion of more than 300 workforce into the area will be prohibited.

Implementation of the proposed project will enable the enhance flow throughout the year in the Bagmati River improving river water quality for both environmental and religious purposes. The proposed dam of the project will serve to store the monsoon rainfall protecting the downstream urbanized community along the Bagmati River banks from extreme rainfall floods and can serve to provide the drinking water to the ever-increasing population of Kathmandu Valley in a whole. The project has planned to generate 1.86 MW of hydro-energy from the diverted 450 l/s of water from the dam before releasing it into the Bagmati River at Sundarijal. The project will also provide 450 l/s of drinking water to Melamchi Water Supply Plant after generating 1.86 MW hydro-energy during monsoon season. In terms of economic benefits, the project will create employment opportunities for more than 300 skilled, semi-skilled and unskilled workers for seven years enhancing their livelihood. In addition, the formation of reservoir will create additional tourism opportunities to the local peoples. Thus, increasing the economic activities will create additional jobs. Also, the required construction materials for the project will create business opportunities to the local vendors. Further, this project is beneficial in terms of coping with the impacts of climate change.

Possibility of improving water quality of Bagmati River both ecologically significant and religiously usable level without the regular flow from this project seems difficult. Growing population generating additional domestic and industrial/commercial waste water, dumping of human and animal waste into the Bagmati River in the Upper Bagmati Catchment has made difficult to achieve the desired objectives. 100% effective recycling or collection and disposal

of waste water seems unachievable at the present scenario. Therefore, to dilute the increasing water pollutants and to maintain the river water quality both environmentally and religiously significant, implementation of this project is the best alternative. Implementing the proposed mitigative/corrective/compensatory measures proposed in this EIA report for the project construction and operation stages, this project seems feasible with additive benefits from of project implementation. Therefore, "no project option" is discarded.

6.2 Project alternatives

Using a water balance and quality model to account for future developments, the BREMP identified the following alternative measures for flow augmentation in the river to improve its assimilative capacity:

- Construction of other reservoirs in the SNNP
- Inter-basin transfer using water from the Melamchi tunnel
- Reducing withdrawal of water from Sundarjial WTP

Further, during stakeholder's consultations the alternative of building a series 'cascade' of smaller dams instead of the higher Nagmati Dam was suggested. The feasibility of these alternatives is discussed in the following.

6.2.1 Construction of Other New Reservoirs in the SNNP

During the feasibility study, three dam sites on the Bagmati and Nagmati Rivers were considered to be feasible, namely the Dhap Dam, Nagmati Dam and Bagmati Dam shown in figure 6-1. Of these, a 60-m high dam at the Bagmati would provide 2.5 Mm^3 of storage (i.e., about 30% of the storage capacity of 8 Mm^3 needed to meet the downstream flow enhancement target) and its unit cost ($/$m^3$) would be about twice that for Dhap and Nagmati dams. On this basis, a dam at the Bagmati was eliminated from consideration.

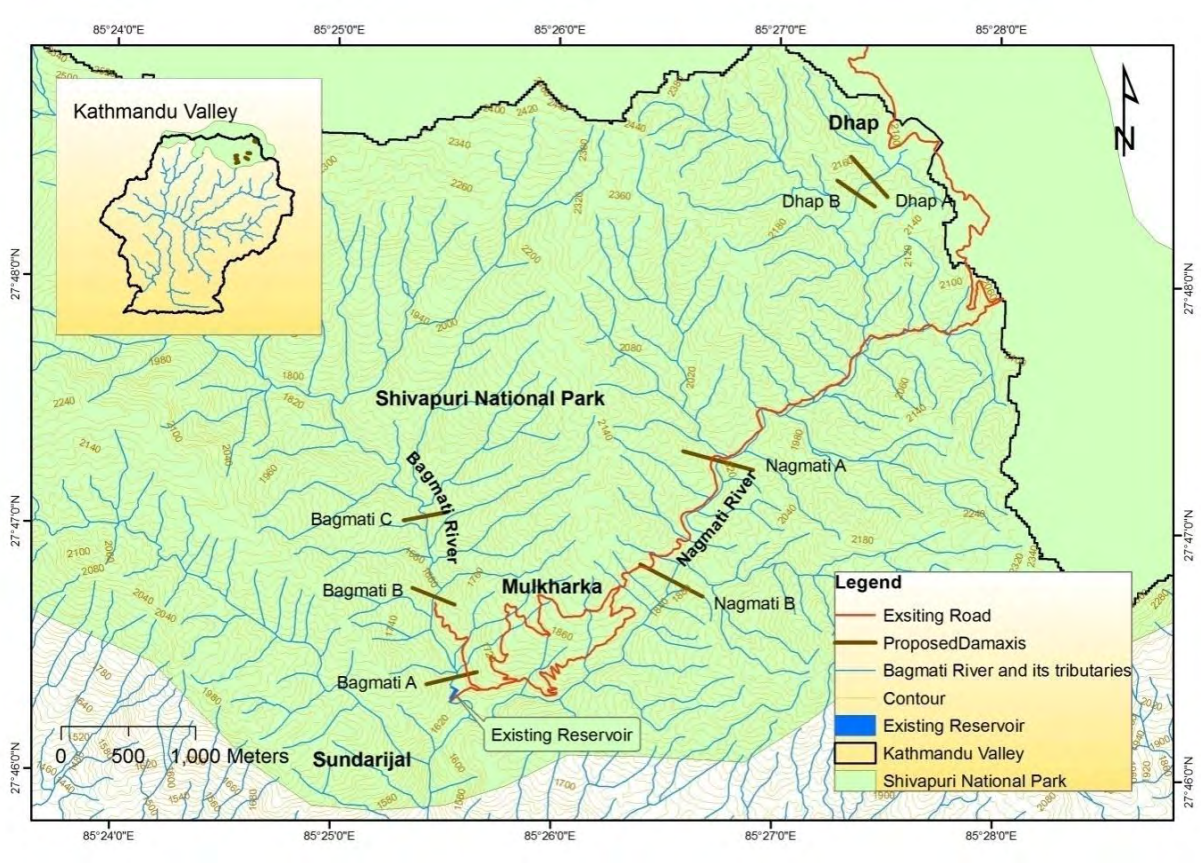

Figure 6-1: Dam options on the Bagmati and Nagmati Rivers

6.2.2 Inter-Basin Transfer Using Water from the Melamchi Tunnel

An alternative to dam construction on the Nagmati or Bagmati rivers is an inter-basin transfer from another river system. Considering the time needed for planning, design and implementation of an inter-basin transfer, the most favourable would be to use of water from the Melamchi Tunnel, if possible.

The Malamchi project involves the construction of approximately 27 km diversion tunnel to divert 170 MLD of raw water from the Melamchi River to the Sundarijal outlet, where the raw water is treated. As the first phase of the WTP project, the detailed design of the WTP capacity has been done for 170 MLD with provision of the future expansion. The plant will be developed in three phases, each of 170 MLD, to build an ultimate WTP capacity of 510 MLD. However, the water demand forecasted by KUKL (Figure 6-2) showed more than 800 MLD daily requirement for the Kathmandu Valley.

However, a major issue that have been identified by the BREMP when developing the basin profile with the stakeholders in terms of water resources management in the Upper Watershed is related to the huge gap between the water demand growth and the decreasing water availability in the Kathmandu Valley. This situation is particularly sharp during the dry season. Figure 6-2 illustrates this issue refers only to the KUKL area which covers approximately 70% of the population of the Kathmandu Valley. If considering the entire

Kathmandu Valley, the gap between water demand and water supply is likely to be even worse.

Even considering that the 3 phases of Melamchi Project is completed on time, an important gap will remain. Because the water scarcity within the Kathmandu Valley will persist after Melamchi becomes operational the likely scenario is that no water will be made available for augmenting the low flow in the Bagmati River during the dry season. Therefore, the alternative of inter-basin transfer was not considered to be feasible in any foreseen future.

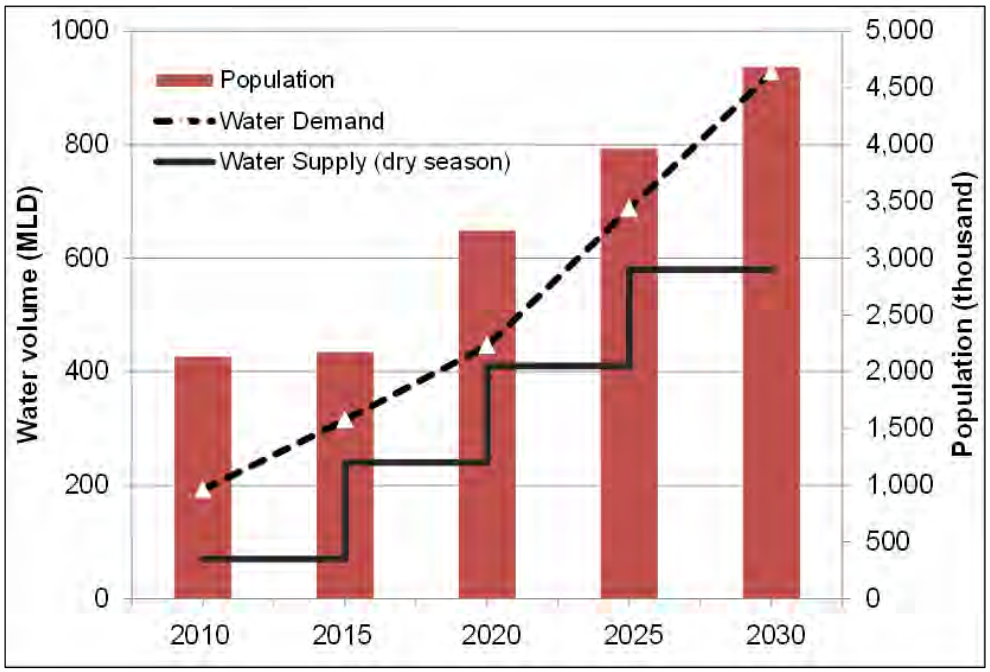

Figure 6-2: Water demand and supply balance projection. KUKL Service Area dry season

6.2.3 Reducing Withdrawal of Water from the Sundarijal WTP

Even considering that the 3 phases of the Melamchi Project are completed on time, an important gap will remain in the supply of drinking water in the Kathmandu Valley. Because the water scarcity within the Kathmandu Valley will persist even after Melamchi Project becomes operational, the likely scenario is that the Sundarijal WTP will continue operating with its current capacity. Therefore, stopping the water diversion from the Bagmati for drinking water is not considered a feasible option in any foreseen future.

6.2.4 A Series of Smaller Dams

In theory, instead of one large dam at Nagmati, a series of smaller-scale dams, forming a cascade could be constructed on the Bagmati and Nagmati Rivers within the SNNP. However, in practice this is not a feasible proposition for the following reasons:

- There are relatively few sections of the two rivers where the river valley narrows sufficiently to provide the topography suited dam Construction (i.e., where the river is wide, damming would require an exorbitantly large dam).

- With respect to topography, the local geological characteristics determine whether a dam is feasible at a given site. A dam may not be feasible where the sides of the valley that form the dam abutments are comprised of highly permeable strata, deeply weathered rock, deep soils, etc., and where the valley slopes in the dam or reservoir area are unstable. In this context, five prospective dam sites were identified on the Bagmati River. However, geological reconnaissance ruled out three of these dam sites due to the sorts of geological constraints referred to above.
- With respect to overall environmental issues, a cascade of dams would require more access roads to be built, disturbance in larger areas of the SNNP, effects on the Bagmati and Nagmati at more sites etc.

6.3 Storage Location Alternatives

6.3.1 Alternative Storage Locations outside the SNNP

The Terms of Reference for the Project PPTA pointed at the possibility of having up to 4 dams in series located at the Mahadev Khola in the Bageshwari Reserved Forest, near Bhaktapur. The heights of the dams could range from 5 to 40 meters and the types of dams to be chosen would dependent on the guidance of the stakeholders and advice of the Dam Specialist. Another alternative dam site outside the SNNP at the Thosne Khola has also been identified. These locations are shown in Figure 6-3.

6.3.1.1 Alternative Reservoirs Located at Mahadev Khola

In relation to the economic justification of the proposed Mahadev Khola dam. a 'yardstick cost' is available from the Stage 1 Melamchi Diversion, the cost of which is approximately USD $1.2 m per MLD, excluding the water treatment and non-infrastructural components. For comparison, the estimated unit cost per MLD delivered by the Mahadev Khola dam would be nearly three times that of Melamchi. Consequently, reservoirs at Mahadev Khola have been found to be economically non-feasible, compared to the cost of water from inter-basin transfer as for the Melamchi Project.

6.3.1.2 Alternative Reservoir Located at Thosne Khola

The Thosne Khola is a river to the south of Kathmandu. It flows west initially and then turns south to join the Bagmati River. The project concept formulated by JWA involved constructing a 120 m high dam on Thosne Khola, with stored water fed north by a 3.9 km long tunnel to the Nakhu Khola. The Nakhu Kola runs in a predominantly northerly direction to reach the Bagmati River at Chobar, 4 km south of central Kathmandu, meaning that water from the Thosne Khola dam could be released into the Nakhu Khola and abstracted to public water supply. The abstraction point would most likely be near its confluence with the Bagmati River albeit needing to be upstream of any significant pollution sources.

An alternative reservoir at Thosne Khola could substitute for the Nagmati dam through a 'water swap'. This would involve Melamchi water taken to boost the dry season flow in the upper Bagmati, and 'replaced' by an equal amount of water from Thosne Khola joining the water supply system from the south.

No re-evaluation has been done of the JWA cost estimate, given that their cost is equivalent to USD $1.89 m per MLD of yield, or 89% higher than the estimated cost-per-MLD of water

from Melamchi Project. Had the Thosne Khola cost been closer to that of Melamchi a review would have been justifiable, but in practice the cost margin is so high that Thosne Khola would not be conomic even if it were possible to identify substantial cost savings.

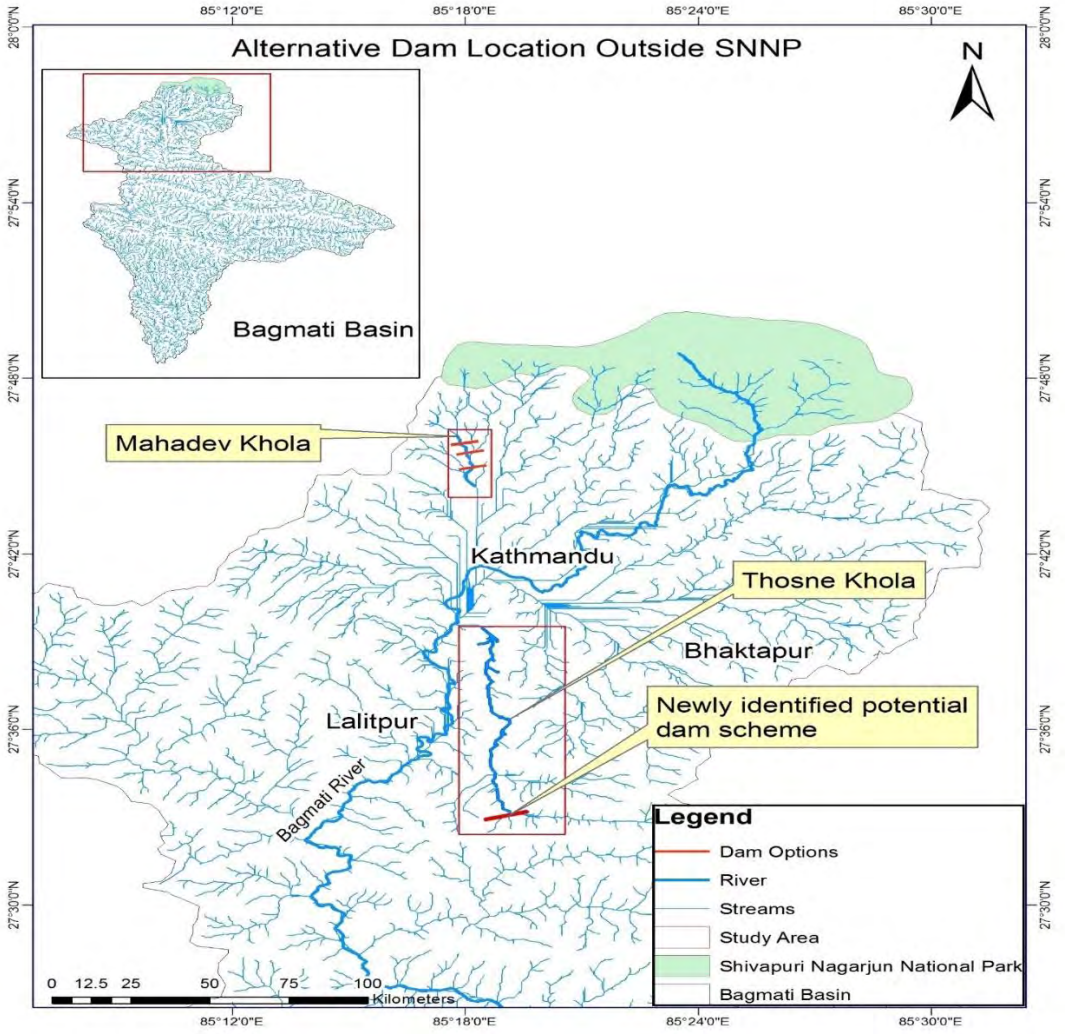

Figure 6-3: Alternative dam storage location options outside the SNNP

6.3.2 Alternative Storage Locations inside the SNNP

Alternative location to Nagmati Dam - During the Inception Phase of the BRBIP PPTA considered two locations for larger dams (one each on the Bagmati and Nagmati). However, these were found to be non-feasible for geotechnical and technical as well as economic reasons. Further, Shyalmati river, one of the tributaries of the Bagmati River does not contain a suitable narrow gorge to construct dam that can provide much water to meet the bathing quality and quantity into Bagmati river as studied by BRBIP PPTA. Also, water resources of Shyalmati have been used for agricultural, drinking water and Canyoning (eco-tourism) purposes. Constructing access road will require to cut a good patch of wildlife habitat. Also, cost of production will be high compare to Nagmati Dam Project.

6.4 Project Components Alternatives

6.4.1 Dam Location Alternatives

Preliminary investigations were carried out in 2012-13 by the DHI consultant under ADB of siting and design options for the Nagmati Dam. The investigations sought to establish the least-cost dam(s) to provide approximately 8 Mm^3 of reservoir storage sufficient to allow a continuous 'environmental flow' release of approximately 400 l/s into the upper Bagmati River throughout the dry season. The study identified two suitable dam locations along the Nagmati river, categorized as Nagmati "A" and Nagmati "B" based upon the site topographic survey and engineering geological reconnaissance (Figure 6-2). The dam sites were assessed for the suitability of construction of concrete-face rockfill dams (CFRDs) suited for the local conditions. Further, feasible access routes for construction works and construction materials transportation were identified and assessed in parallel with the socio-environmental assessments. Apart from the field level assessments, project works required and the estimated costs for the selection of best alternative was conducted.

6.4.1.1 Dam Location Option 1- Nagmati "A"

Nagmati "A" dam option was studied at RL 1940m. The engineering geological reconnaissance found 'fatal flaws' with the Nagmati 'A' dam site. Deeply weathered rock at the abutments and/or unstable slopes in the dam/reservoir making the proposed location unsuitable for the construction and operation of the dam.

6.4.1.2 Dam Location Option 2- Nagmati "B"

Nagmati "B" dam option was studied about 850m downstream from the Nagmati "A" dam option at RL 1911.5m. The Nagmati River at this location, has a narrow gorge section suitable for dam construction. The river section is very narrow and high steep bluffs of hard, fresh to slightly weathered banded gneiss occurs on both abutments. Geologically, the area is less prone to soil erosion as the area falls under forest cover. The engineering geological reconnaissance found suitable geology for the construction of the dam. Preliminary cost estimations, recognizing uncertainties over the topography, geology, etc. found that the unit cost of Nagmati 'B' project is suitable in terms of economic and financial aspects.

6.4.2 Dam Size Alternatives

6.4.2.1 Dam Option 1

This dam option was proposed in the preliminary study of the NDP. In this option required an area of an area of 41.2 ha with a large 90 meter high dam at the Nagmati River was planned to be built to create 41.2 ha area reservoir storing up to 8 Million m^3 of water, sufficient to provide a dry season flow of 400 l/s in Bagmati River downstream of Sundarijal.

6.4.2.2 Dam Option 2

After the subsequent detailed study conducted by Entura in 2016, a dam of 94.5m high at the Nagmati River is proposed for the construction that can store 9.484 Mm^3 volume of water in the created reservoir extended in an area of 50.4 ha, that can provide a dry season flow of 450 l/s in Bagmati River downstream of Sundarijal. An additional 50 l/s dry flow will be available

than Dam Option 1 that can mix the additional discharged pollutants in the Bagmati River channel to improve river water quality.

6.4.3 Access Road alternatives to Powerhouse

There may be road to powerhouse (proposed in private land) that one can be constructed from the eastern side which requires compensation against the acquisition of private land.

The other road could be feasible from western side of powerhouse that doesn't need to acquire private land. This road can be used for transmission alignment to existing powerhouse at the right bank of Bagmati river. With the construction of a bridge over Bagmati river, the route will be of shortest distance and will have a better access to Sundaijal Bus Park.

6.4.4 Penstock Alignment Alternatives

6.4.4.1 Penstock Alignment Option 1

The design discharge is supplied through 0.6m diameter steel penstock of 3600 m length to the power house from the offtake at the 2.5m diameter outlet conduit. The main penstock pipe bifurcates into two 0.4m diameter unit penstocks of 6.25 m and 11.63 m lengths which convey water to the two Pelton turbines each to generate 2.12 MW of hydro enrgy. The penstock pipe passes through river crossings and road crossing at several points and has multiple bends requiring pipe protections.

6.4.4.2 Penstock Alignment Option 2

The required power design discharge is supplied through 0.6m diameter steel penstock of 3790 m length to the power house from the offtake at the 2.5m diameter outlet conduit. The main penstock pipe bifurcates into two 0.4m diameter unit penstocks of 6.25 m and 11.63 m lengths which convey water to the two Pelton turbines to generate 2.21 MW of hydro energy. The penstock pipe passes through river crossings and road crossing at several points and has multiple bends requiring pipe protections.

6.4.4.3 Penstock Alignment Option 3

In this penstock alignment option, the design discharge is supplied through 0.6m diameter steel penstock of 2968m length to the power house from the offtake at the 2.5m diameter outlet conduit. The main penstock pipe bifurcates into two 0.4m diameter unit penstocks of 6.25 m and 11.63 m lengths which convey water to the two Pelton turbines each with a rated capacity of 1 MW each to generate 1.86 MW of hydro energy. Optimization of the penstock alignment length resulted in reduction of penstock alignment length, use of less river crossing, road crossing and pipe protection structures which reduced the overall cost.

6.4.5 Powerhouse Alternatives

6.4.5.1 Powerhouse Option 1

The power station houses two horizontal shaft Pelton turbine with an output of 1039 KW at rated head and directly coupled to the generator. The power house has a tail race channel to let the water coming from the turbines out and into the Bagmati River. The purpose of the tail race channel is to convey the design power discharge after generation from each Pelton turbine smoothly to the Bagmati River.

6.4.5.2 Powerhouse Option 2

The powerhouse option 1 was reviewed and shifted 500 meters upstream of from previous location. The shifting of the powerhouse was due to approach of penstock pipe to the powerhouse crossing through some unstable area which will require more protection works as well as the relocation were done based on the loss of energy, priority of using water and economic analysis. Since the powerhouse option 2 lies 10 meters above the Bagmati river, the provision of the powerhouse flood protection works was removed. This along with removal of previously required protection works along approach of penstock pipe passing through settlement, reduced the cost of powerhouse option 2 in comparison to powerhouse option 1. Furthermore, the location of powerhouse option 2 is more suitable considering the option for pumping of the tail water from the powerhouse on to the Melamchi water supply scheme.

6.5 Comparison of Alternatives

Comparison of alternatives has been presented for the project component alternatives only. Project alternatives and storage location alternatives has already been discussed and presented in the previous sections of this chapter. In the preliminary phase of detailed engineering study, dam option 1, penstock alignment option 1 and powerhouse option 1 was opted and therefore was presented in the approved Scoping and ToR of this NDP. However, after further study, optimization of project components and water requirement for water quality improvement of Bagmati River downstream of Sundarijal and water sharing agreement between MoEWRI, MoUD and MoWS other alternatives were studied. Therefore, three alternatives have been envisaged during the course of detailed engineering study of this NDP (Annex 20). Comparative analysis of these three alternatives in terms of possible beneficial environmental impacts and likely adverse impacts from implementation of each alternative has been presented in Table 6-1 below. Three alternatives are:

I. Alternative 1: Dam Option 1, Penstock alignment Option 1 and Powerhouse Option 1
II. Alternative 2: Dam Option 2, Penstock alignment Option 2 and Powerhouse Option 1
III. Alternative 3: Dam Option 2, Penstock alignment Option 3 and Powerhouse Option 2

Table 6-1: Comparison of Alternatives

Alternative	Beneficial Environmental Impact	Likely Adverse Impact
Alternative 1: Dam Height Option 1, Penstock Alignment Option 1, Powerhouse Option 1		
Design Reservoir • Area - 41.2 ha • Storage Capacity at FSL- 7.8 Mm^3 Dam • Type- CFRD	• Consistent water flow of minimum 0.4m^3/400 l/s in the Bagmati river to maintain the river water quality • Availability of water at religious sites Gokarna, Gujeshwori and Pashupati	• Loss of 41.2 ha of Forest land into reservoir and 2.4 ha of private land into concrete structures • Loss of approximately 19,000 nos. of poles and trees of different tree *sps.* and other vegetation resulting reduction in carbon

Alternative	Beneficial Environmental Impact	Likely Adverse Impact
• Height-90 m • Crest length-554m • Crest Width-7m <u>Penstock</u> • Type- Surface and buried steel Penstock • Length before bifurcation-3,600 m of 0.6 m dia pipe <u>Powerhouse</u> • Type-Surface • Size- 22.5m (L) × 15.65m × 12.8 m (H) • RL- 1398 m • Turbines- Horizontal, 2 Jet Pelton turbines <u>Tailrace Channel</u> • Type- Concrete and cover type • Length- 11.2m for unit 1 and 17.9m for unit 2	for bathing for religious performances • Generation of 1.86 MW of Hydro-energy • Flood control on downstream areas • Employment opportunities to the locals • Creation of habitat for bird *sps.,* migratory bird *sps.* and aquatic plants and animals • Carbon sequestration from the created wetland • Ground water recharge	sequestration from the standing vegetation • Conversion of terrestrial ecosystem into aquatic ecosystem • Wildlife habitat fragmentation due to forest clearance and creation of reservoir disturbing free movement of terrestrial wild animals • Reduction in agricultural production from the private land acquired for the project • Loss of life and livelihoods downstream due to flooding from sudden dam failure triggered by extreme events such as erratic rainfall or earthquake
Project Location Dam is located at RL 1909.5m within SNNP Penstock Alignment passes through SNNP and buffer zone of SNNP upto powerhouse at Sundarijal Powerhouse is planned in the private land in the left bank of Bagmati river at Sundarijal	• Creation of habitat for bird *sps.,* migratory bird *sps.* and aquatic plants and animals within SNNP	• Conversion of terrestrial ecosystem into aquatic ecosystem • Wildlife habitat fragmentation due to forest clearance and creation of reservoir disturbing free movement of terrestrial wild animals • Reduction in agricultural production from the private land acquired for the project
Physical Feature Mountainous, narrow gorge, funnel shaped at the proposed dam location, powerhouse is in gentle sloped land, penstock passes through the gentle to steep slopes	• Project will invest on landslides and erosion control through implementation of bio-engineering practices throughout	• Conversion of existing landscape • Soil erosion, landslides due to instabilities from the construction activities

Alternative	Beneficial Environmental Impact	Likely Adverse Impact
Construction Technology Excavators will be used for mucking of quarry and use of explosives will be avoided to extent possible unless required, crusher plant to produce desired sized boulder and batching plant to prepare the desire concrete mix will be used	• Employment opportunities for the locals and surrounding people of the project area during the construction period	• Change in landscape and instability due to mucking from quarry exaggerating landslides and soil erosion • Air and noise pollution from the construction activities and explosives disturbing the movement of wild animals; • Disturbance to the nearby communities due to the movement of heavy vehicles; • Soil and water pollution from the leakages of lubricants, Mobil, chemicals; • Traffic congestion in the area due to movement of high number of vehicles
Operation Method Discharge of 500l/s of will be released from the dam of which 100 l/s will for riparian release. The discharge of 400l/s will be diverted for hydro-energy generation and will again be released into Bagmati during dry periods.	• Consistent water flow of minimum 0.4m^3/400 l/s in the Bagmati river throughout the year to maintain the river water quality • Availability of water at religious sites Gokarna, Gujeshwori and Pashupati for bathing for religious performances • Generation of Hydro-energy • Flood control on downstream areas	• Loss of life and livelihoods downstream due to flooding from sudden dam failure
Construction Schedule Accomplishment of project in 7-year period		• Landslides, soil erosion may get triggered in the unstable slopes if the construction activities is conducted during wet periods • Debris flood may get trigger due to erratic rainfalls
Raw material	• Increase in economic	• Possible over exploitation of

Alternative	Beneficial Environmental Impact	Likely Adverse Impact
Project requires various construction materials such as Boulders, Gravel, Sand, Cement,	activities due to the supply of project required construction materials by the local vendors	resources due to unplanned extraction for the supply of materials to the project • Future planned projects may be deprived from construction materials
Forest and government land use Approximately 51 ha government land is required permanently which will be converted into reservoir and built-up structures	• Creation of habitat for bird *sps.,* migratory bird sps. and aquatic plants and animals • Carbon sequestration from the created wetland	• Loss of Forest land • Loss of trees and other vegetation resulting reduction of carbon sequestration • Conversion of terrestrial ecosystem into aquatic ecosystem • Wildlife habitat fragmentation due to forest clearance and creation of reservoir disturbing free movement of terrestrial wild animals • Reduction in land area for other future purposes
Adverse Impacts	• Loss of Forest land and private land • Loss of trees and other vegetation • Conversion of terrestrial ecosystem into aquatic ecosystem • Wildlife habitat fragmentation due to forest clearance and creation of reservoir disturbing free movement of terrestrial wild animals • Loss of life and livelihoods downstream due to flooding from sudden dam failure • Soil erosion, landslides due to instabilities from the construction activities • Air and noise pollution from the construction activities and explosives disturbing the movement of wild animals; • Soil and water pollution from the leakages of lubricants, Mobil, chemicals; • Traffic congestion in the area due to movement of high number of vehicles	

Alternative	Beneficial Environmental Impact	Likely Adverse Impact
Alternative 2: Dam Option 2, Penstock Alignment Option 2, Powerhouse Option 1		
Alternative	**Beneficial Environmental Impact**	**Likely Adverse Impact**
<u>Design</u> <u>Reservoir</u> • Area- 480426m^2 • Storage Capacity at FSL- 9.484 Mm^3 <u>Dam</u> • Type- CFRD • Height-94.5m • Crest length-554m • Crest Width-7m <u>Penstock</u> • Type- Surface and buried steel Penstock • Length before bifurcation- 3790m • Diameter-0.6mm • Number thrust blocks- 55 nos. • Number of anchor blocks- 26 nos. • River crossing structures- 1 no. • Road crossing structures- 5 nos. • Head loss-12.03 m <u>Powerhouse</u> • Type-Surface • Size- 22.5m (L) × 15.65m × 12.8 m (H) • RL- 1398 m • Turbines- Horizontal, 2 Jet Pelton turbines • Powerhouse protection- required	• Consistent water flow of minimum 0.45m^3/450 l/s in the Bagmati river to maintain the river water quality • Availability of water at religious sites Gokarna, Gujeshwori and Pashupati for bathing for religious performances • Additional drinking water supply to MWSP during monsoon • Generation of 2.1 MW of Hydro-energy • Flood control on downstream areas • Employment opportunities to the locals • Creation of habitat for bird sps., migratory bird sps. and aquatic plants and animals • Carbon sequestration from the created wetland • Reduction of land area requirement than alternative option 1 due to reduction in penstock alignment length	• Loss of Forest land and private land • Loss of 80,258 nos. poles and trees of different tree species and other vegetation resulting reduction in carbon sequestration from the standing vegetation • Conversion of terrestrial ecosystem into aquatic ecosystem • Wildlife habitat fragmentation due to forest clearance and creation of reservoir disturbing free movement of terrestrial wild animals • Loss of life and livelihoods downstream due to flooding from sudden dam failure

Alternative	Beneficial Environmental Impact	Likely Adverse Impact
• Water pumping to MWSP during monsoon-required Tailrace Channel • Type- Concrete and cover type • Length- 11.2m for unit 1 and 17.9m for unit 2		
Project Location Dam is located at RL 1911.5m within SNNP Penstock Alignment passes through SNNP upto powerhouse Powerhouse is planned in the private land in the left bank of Bagmati river at Sundarijal at RL 1398m	• Creation of habitat for bird *sps.,* migratory bird *sps.* and aquatic plants and animals within SNNP	• Conversion of terrestrial ecosystem into aquatic ecosystem • Wildlife habitat fragmentation due to forest clearance and creation of reservoir disturbing free movement of terrestrial wild animals • Reduction in agricultural production from the private land acquired for the project
Physical Feature Mountainous, narrow gorge, funnel shaped at the proposed dam location, powerhouse is in gentle sloped land, penstock passes through the gentle to steep slopes	• Project will invest on landslides and erosion control through implementation of bio-engineering practices throughout the project construction and operation period	• Conversion of existing landscape • Soil erosion, landslides due to instabilities from the construction activities
Construction Technology excavators will be used for mucking of quarry and use of explosives will be avoided to extent possible unless required, crusher plant to produce desired sized boulder and batching plant to prepare the desire concrete mix will be used	• Employment opportunities for the locals and surrounding people of the project area during the construction period	• Change in landscape and instability due to mucking from quarry exaggerating landslides and soil erosion • Air and noise pollution from the construction activities and explosives disturbing the movement of wild animals; • Disturbance to the nearby communities due to the movement of heavy vehicles; • Soil and water pollution

Alternative	Beneficial Environmental Impact	Likely Adverse Impact
		from the leakages of lubricants, Mobil, chemicals; • Traffic congestion in the area due to movement of high number of vehicles
Operation Method Discharge of 600l/s of will be released from the dam of which 150 l/s will for riparian release. The discharge of 450l/s will be used for hydro-energy generation and will be released into Bagmati during dry periods and will be supplied to MWSP during monsoon.	• Consistent water flow of minimum 0.45m^3/450 l/s in the Bagmati river throughout the year to maintain the river water quality • Availability of water at religious sites Gokarna, Gujeshwori and Pashupati for bathing for religious performances • Additional drinking water supply to MWSP during monsoon • Generation of Hydro-energy • Flood control on downstream areas	• Loss of life and livelihoods downstream due to flooding from sudden dam failure
Construction Schedule Accomplishment of project in 7-year period		Same as alternative 1
Raw material Project requires various construction materials such as Boulders, Gravel, Sand, Cement,	• Increase in economic activities due to the supply of project required construction materials	• Over exploitation of resources due to unplanned extraction for the supply of materials to the project
Forest and government land use Approximately 60 ha government land is required permanently which will be converted into reservoir and built-up structures	• Creation of habitat for bird sps., migratory bird sps. and aquatic plants and animals • Carbon sequestration from the created wetland	• Additional 9 ha forest land is required than alternative 1 • Loss of trees and other vegetation • Conversion of terrestrial ecosystem into aquatic ecosystem • Wildlife habitat

Alternative	Beneficial Environmental Impact	Likely Adverse Impact
		fragmentation due to forest clearance and creation of reservoir disturbing free movement of terrestrial wild animals • Reduction in land area for other future purposes
Adverse Impact	Adverse Impacts are similar to the Alternative 1 with additional loss of poles, trees and ground vegetation from additional 9 ha forest area required for extended reservoir	
Alternative 3: Dam Option 2, Penstock Alignment Option 3, Powerhouse Option 2		
	Beneficial Environmental Impacts	**Likely Adverse Environmental Impacts**
<u>Design</u> Reservoir and dam similar to alternative 2 <u>Penstock</u> • Type- Surface and buried steel Penstock • Length before bifurcation- 2968m • Diameter-0.6mm • Number thrust blocks- 40 nos. • Number of anchor blocks-3 nos. • River crossing structures- 1 no. • Road crossing structures- 3 nos. • Head loss-9.49 m <u>Powerhouse</u> • Type-Surface • Size- 22.5m (L) × 15.65m × 12.8 m (H) • RL- 1410 m • Turbines- Horizontal, 2 Jet Pelton turbines	• Consistent water flow of minimum 0.45m^3/450 l/s in the Bagmati river to maintain the river water quality • Availability of water at religious sites Gokarna, Gujeshwori and Pashupati for bathing for religious performances • Additional drinking water supply to MWSP during monsoon • Generation of 1.86 MW of Hydro-energy • Flood control on downstream areas • Employment opportunities to the locals • Creation of habitat for bird sps., migratory bird sps. and aquatic plants and animals • Carbon sequestration from	Same as alternative 2 with reduction in land area required for penstock alignment and powerhouse

Alternative	Beneficial Environmental Impact	Likely Adverse Impact
• Powerhouse protection- not required • Water pumping to MWSP during monsoon- not required <u>Tailrace Channel</u> • Type- Concrete and cover type Length- 11.2m for unit 1 and 17.9m for unit 2	the created wetland • Reduction in land area requirement compared to alternative option 1 and alternative option 2 • Powerhouse protection- not required • Water pumping to MWSP during monsoon- not required	
Project Location Dam is located at RL 1911.5m within SNNP Penstock Alignment passes through SNNP upto powerhouse Powerhouse is planned within the area of MWSP owned land in the left bank of Bagmati river at Sundarijal	• Same as alternative 1 and 2 with reduction in acquisition of private land required for the powerhouse and penstock alignment	• Same as alternative 1 and 2
Physical Feature Mountainous, narrow gorge, funnel shaped at the proposed dam location, powerhouse is in gentle sloped land, penstock passes through the gentle to steep slopes	Same as alternative 1 and 2	• Same as alternative 1 and 2
Construction Methods excavators will be used for mucking of quarry and use of explosives will be avoided to extent possible unless required, crusher plant to produce desired sized boulder and batching plant to prepare the desire concrete mix will	Same as alternative 1 and 2	• Same as alternative 1 and 2

Alternative	Beneficial Environmental Impact	Likely Adverse Impact
be used		
Operation Method Discharge of 600l/s of will be released from the dam of which 150 l/s will for riparian release. The discharge of 450l/s will be used for hydro-energy generation and will be released into Bagmati during dry periods and will be supplied to MWSP during monsoon.	• Same as alternative 2	• Same as alternative 1 and 2
Construction Schedule Accomplishment of project in 7-year period		Same as alternative 1
Raw material Project requires various construction materials such as Boulders, Gravel, Sand, Cement,	Same as alternative 1 and 2	Same as alternative 1 and 2
Forest and government land use Approximately 62.682 ha government land is required permanently which will be converted into reservoir and built-up structures	Same as alternative 1 and 2 with reduction of 1 ha forest land than alternative 2 due to reduction in penstock alignment	• Same as alternative 1 and 2 • Additional 8 ha forest land is required than alternative 1
Adverse Impacts	Similar to alternative option 1 and 2	

6.6 Cost-benefit analysis of Project Components

A comparative cost-benefit analysis of powerhouse alternatives has been conducted. Since, the penstock alignment option 3 is shorter in length decreasing the installation of number of anchor blocks, thrust blocks and river crossing structures with additional head compared to penstock alignment option 1 and penstock alignment option 2, penstock alignment option 3

has been considered for the cost-benefit analysis of the two powerhouse options. The comparative cost benefit analysis between the powerhouse option 1 and powerhouse option 2 is presented in the Table 6-2 below.

Table 6-2: Cost-benefit analysis of powerhouse options

SN	Description	Option 1	Option 2	Remarks
A.	**Construction Works**			
1.	**Civil works**			
i.	Excavation works for powerhouse including contingency @ 10% and VAT 13%	3,925,476.45	2,241,603.53	
ii.	Protection works for powerhouse (including contingency @ 10% and VAT 13%)	24,378,409.88	4,972,000.00	
	Sub-total	**28,303,886.33**	**7,213,603.53**	
2.	**Hydromechanical works**			
i.	Additional Pipe for Pumping (including contingency @ 5% and VAT 13%)	5,765,832.27	2,882,916.14	
ii.	Water Pump	1,633,283.19	816,641.60	
iii.	Additional Stretch of Pipe from Powerhouse Option 2 to 1	35,242,526.75		
iv.	Truss Structure for river crossing	1,918,350	2,046,240	
	Sub-total	**44,559,992.21**	**5,745,797.74**	**38,814,194.47 additional construction cost for Option 1**
B.	**Land Acquisition**			
i.	Additional Land	180,900,000	-	Not required for

SN	Description	Option 1	Option 2	Remarks
	Requirements			Option 2
	Sub-total	**180,900,000**		**180,900,000 land acquisition cost for Option 1**
	Total (A+B+C)	**253,763,878.54**	**12,959,401.27**	**240,804,477.27 additional construction cost for Option 1 than Option 2**
B.	**Revenue**			
i.	Dry energy revenue	102,842,340	94,018,697	revenue loss from Option 2 (8,823,642.64)
ii.	Wet energy revenue	61,188,319	55,938,498	revenue loss from Option 2 (5,249,820.90)
iii.	Revenue from Melamchi Water Scheme	48,600,000	48,600,000	
	Sub-total	**212,630,659.00**	**198,557,195**	**14,073,464 revenue loss annually from Option 2**
C.	**Operating Cost**			
i.	Pump Operating Cost (NEA Tariff Rate) 375 KWh for option 1 and 75 KWh for option 2	19,689,062.50	14,277,812.50	
	Sub-total	**19,689,062.50**	**14,277,812.50**	**5,411,250 annual operating cost savings from Option 2**

SN	Description	Option 1	Option 2	Remarks
D.	**Net annual benefit**	**6,369,743.48**	**19,097,573.61**	**12,727,830.13 Option 2 has net annual benefit**

(Source: NDP, 2022)

6.7 Cost Benefit Analysis of Project

An economic and financial analysis was carried out as a complementary part to the Updated Feasibility Study of the Nagmati Dam[1]. The purpose of the economic analysis was to determine the economic viability of the proposed Nagmati project with updated outline and costing. The financial analysis was carried out to determine financial feasibility and sustainability of the project components. These analyses were in accordance with ADB's Guidelines for the Economic Analysis of Projects (ADB, 1997).

Economic analysis appraises the project from the point of view of the national economy whilst financial analysis appraises a project from the owner's perspective. The result of the economic analysis is an Economic Rate of Return (EIRR), which is based on incremental economic cash flows, i.e. the difference between "with project" and "without project" cash flows. These streams of cash flows are arrived at by projecting cash flows over the economic life of the project and discounting to their Present Value (PV). The economic cost and benefit streams were estimated for the average expected project life of 40 years. Thus, the economic and financial Project assessment period is from 2022 (after Project implementation) till 2062.

The Economic Internal Rate of Return (EIRR) for the overall Project (Nagmati Dam) was calculated at 17.1% that is greater than the Economic Opportunity Cost of Capital (EOCK) criteria of 12%. Therefore, the project is economically viable.

6.8 Conclusion on alternatives analysis

Comparative analysis of the selected alternatives showed that all three alternatives have more or less similar beneficial and adverse impacts in meeting the primary objective of the project, i.e., to provide continuous flow and to improve the Bagmati River water quality. Alternative 1 requires less forest/government land area under SNNP than alternative 2 and alternative 3, reducing the tree and vegetation loss. However, with increase population, intrusion of additional ground water and disposal of untreated pollutants the river will likely to remain anaerobic even with an upgraded WWTP, and hence continue producing strong odours, unless the WWTP's effluent is significantly diluted with additional oxygenated river flow. Therefore, additional continuous water flow is envisioned to fulfill the desired objective of the project. To fulfill the primary objective, alternative 2 with increased dam height from preliminary 90m high to 94.5m high with reservoir storage of 9.484 Mm^3 extended over 50.7

1 Entura (2016) Economic and Financial Analysis Report, Bagmati River Basin Improvement Project

ha has been proposed that required approximately additional 9 ha of forest land within SNNP than alternative 1. In addition to the supply of continuous flow in the Bagmati River during dry periods and generation of hydro-energy, the project will supply 450 l/s drinking water to MWSP during the wet period enhancing the project benefits. Further, optimization of the project was conducted and alternative 3 is prosed with reduced penstock alignment length and shifting of powerhouse upstream from previously proposed location within MWSP area. Alternative 3 will require less permanent land area, less protection works and has net annual benefit than alternative 2 (Table 6-2).

Since, SNNP is extended over the larger area and the project in coordination with SNNP will implement wildlife habitat restoration programs, the impact on wildlife area is expected to be minimal and for short period. Also, the creation of the reservoir will serve as the habitat for both local and migratory bird species promoting biodiversity of the SNNP. The extension of dam height from 90m to 94.5m requiring additional 9 ha of forest land within SNNP will serve to store additional atmospheric carbon, store additional 1.6 Mm^3 volume of monsoon rainfall that can be used for multiple purposes and also the impacted area downstream from the unprecedented dam failure will likely to be more or less similar, it can be concluded that the rise of 4.5m dam height from its preliminary design of 90m height doesn't pose significant impacts. Therefore, based on the comparative analysis of the selected three alternatives in terms of potential beneficial environmental impacts and likely adverse impacts, alternative 3 is environmentally, technically, as well as economically suitable to achieve the desire objective of the BRBIP compared to alternative 1 and alternative 2.

Having considered all identified options for increasing the storage capacity and increase the water availability in the Upper Bagmati to achieve the objectives set forth in the BREMP, it is concluded there are no feasible alternatives than to establish the Nagmati Dam storage capacity in the SNNP with the selected alternative option 3. Therefore, alternative 3 is recommended for implementation following the National Building Code and internationally followed Codes for dams to achieve the desired objective of BRBIP expediting benefits.

CHAPTER 7 ENVIRONMENTAL IMPACTS OF PROPOSAL

This chapter contains the issues identified during the Scoping and ToR stage of this EIA. In-depth study of the identified issues was conducted and potential environmental impacts were determined and presented in this chapter. The identified environmental impacts were evaluated in terms of magnitude, extent and duration following National EIA Guideline, 1993.

7.1 Potential Beneficial Impacts

Implementation of Nagmati Dam Project is envisioned to have multiple positive impacts. Besides, fulfilling the major objective of improving the water quality of the Bagmati river at environmentally and religiously acceptable level, this project will provide additive benefits of which the major benefits include generation of hydro-energy, supply of additional drinking water supply, flood control and employment generation. The predicted beneficial impacts from the project implementation (project construction and operation stage) are presented as follows:

7.1.1 Construction Stage

7.1.1.1 Employment Generation/Opportunity

The project will require skilled, semi-skilled and unskilled human workforce during the construction of the project. It is anticipated that the project will require about 300 nos. of skilled, semi-skilled and unskilled human workforce generating employment of 766,500 mandays. Most of the labors will come from the neighboring areas, generating substantial employment opportunities to the locals from Sundarijal, Mulkharka and adjoining areas. The earning made from the employment will enhance their economic status hence improving their quality of life. Further, indirect employment opportunities from project support activities such food supply for construction human workforce and development of local market due to influx of additional people may also create additional employment opportunities.

This impact is anticipated to be direct, high in magnitude, local in extent and short term in duration.

7.1.1.2 Increased Economic Activities

The implementation of Nagmati Dam Project will enhance the economic activities in an around the project area. Project will require various types of construction materials such as sand, cement, gravel, aggregates, rebars which are available in the local market. Further, the influx of construction workers will increase demand of local daily consumable goods. The local business persons can take advantages of these new opportunities by expanding their business. Local farmers can benefit from sell of vegetables, poultry and dairy products. As a result of increased economic activities, a significant amount of cash will be in the local economy. The increase in trade and business will create economic opportunities and enhance the economic value of the area and status of the local people.

This impact is anticipated to be indirect, high in magnitude, local in extent and short term in duration.

7.1.1.3 Improved Accessibility

The project will upgrade and construct approximately 11.533 km of access road required for it. The access road of 5.737 km to the dam crest via left abutment from the existing access road from Sundarijal will be upgraded to 5.5 m width and construct the access road of 4.108 km of width of 4.5 m towards Bhanjyang from dam will be constructed which will be the replacement for the existing road that will be inundated after the construction of the dam. Project will upgrade remaining 1.668 km of existing road from dam to Bhanjyang. These access roads will serve to improve the accessibility of the project area reducing time to reach Sundarijal from Mulkharka Village and Chisapani.

This impact is anticipated to be direct, medium in magnitude, site specific in extent and long term in duration.

7.1.1.4 Potential Exposure to New Technology and Technology Transfer

It is expected that highly skilled technical people will gather for the construction of the project to ensure quality of work and efficient execution of the construction works. Local people who will work with these skilled people will get opportunities to learn from them. With the skill learned and experience gained during the construction of the project, local people will be able to get employment in similar projects elsewhere in Nepal and abroad. Local people will obtain technical skills, particularly, in dam construction, vehicle driving works, masonry, gabion wires weaving, construction of dry walls and gabion walls and bioengineering works.

The impact is direct, moderately significant, local extent and long term in duration.

7.1.1.5 Potential Improvement of Local Public Service/Facilities

Additional public services like water supply, health and sanitation (water tap, public toilets etc) will be established in the project area to cater the demand of work force. Besides, the NDP is committed to provide support to Gokarneshwor Municipality in strengthening health facilities, educational institutions such as schools and colleges, public sanitations facilities and community water supply facilities. NDP will support on providing additional health equipment's to local health post and improvement of existing health post structures. NDP will also support for improvement of the existing school structures (i.e., classrooms, library, recreation and sanitation facilities); and, provision of teaching materials and equipment. The water supply established by NDP for the project itself can also be made available for the project affected area, especially for Mulkharka and Sundarijal. In addition, NDP will provide support to the Gokarneshwor Municipality and SNNP for the construction of eco-friendly public toilets. All the programs will be implemented in consultation and close coordination with Gokarneshwor Municipality and SNNP. All these support by the NDP to the project affected municipality will improve the local public services in the project impact area.

The impact will be direct in nature, medium in magnitude, local in extent and long term in duration.

7.1.1.6 Improvement in Livelihood

The influx of construction workers will increase demand of local daily consumable goods. The local business persons can take advantages of these new opportunities by expanding their business. Local farmers can benefit from sell of vegetables, poultry and dairy products. New hotels and tea shops will be opened to cater demands of construction workers. All these activities will contribute for local economy and livelihood improvement.

The impact is indirect, moderate in magnitude, local in extent and short term in duration.

7.1.1.7 Community Support Program

NDP will support the various community programs in the project DIA. The community programs will include but not limited to education support, health sector support, existing drinking water supply rehabilitation support, construction of community infrastructures support such as local road upgrading, bridge construction, school infrastructures, Gumba, Temples and other community-based infrastructures. In addition, project will extensively support for the conservation of local biodiversity. Community support programs will be conducted in co-ordination with Gokarneshwor Municipality and Gokarna Municipality Ward no. 1. A need assessment report shall be submitted to NDP for any community related programs by the Gokarneshwor Municipality and Gokarna Municipality Ward no. 1. Further, programs related to biodiversity conservation will be conducted in close coordination with SNNP. The project has allocated 0.5% of its total project cost for the community support program.

The impact is direct, high in magnitude, local in extent and short term in duration.

7.1.2 Operations Stage

7.1.2.1 Improved River Water Quality

The prime objective of the project is to improve the water quality of Bagmati river at the environmental and religious acceptable limits. After the construction of the project, 0.45 m^3/s of additional discharge will be released into the Bagmati river channel at Sundarijal. This enhanced flow in the Bagmati river downstream of Sundarijal all-round the year could dilute the waste water, improving the river water at the environmental and religious acceptable limits provided direct sewage discharge to the river is completely banned.

This impact is anticipated to be direct, high in magnitude, local in extent and long term in duration.

7.1.2.2 Availability of Water for Socio-Cultural Usages

The prime objective of the NDP is to maintain the water quality at Gokarna and Pashupatinath religious sites exceeding bathing standard with minimum flow of 0.45m^3/s throughout the year. After the operation of the project, it is expected that the religious sites along the Bagmati River such as Pashupatinath, Gujeshwori and Gokarna will have improved water quality for bathing purposes as requested by Pashupati Area Development Trust (Annex 21) to perform Hindu religious rituals. However, in order to achieve river water quality at bathing standard, direct sewarage discharge into the river should be completely banned.

This impact is anticipated to be high in magnitude, local in extent and long term in duration.

7.1.2.3 Generation of Hydro-Energy

The project has planned to multiply the benefits along with achieving its desired primary objective. NDP has planned to generate 1.86 MW of hydro-energy from the discharge/flow used for improving the Bagmati river water quality before releasing it to the Bagmati River. This additional benefit will generate revenue through electrical energy connected to National Grid. Since, the discharge will be fed from reservoir, consistent hydro-energy will be

generated throughout the year and therefore can reduce the energy import from India during dry periods.

This impact is anticipated to be direct, medium in magnitude, local in extent and long term in duration.

7.1.2.4 Supply of Additional Drinking Water to Melamchi Water Supply Project

Melamchi Water Supply Project has been initiated by GoN with assistance from ADB to supply drinking water to Kathmandu Valley. The projected demand for drinking water supply for 2030 is more than 900 MLD and the Melamchi Water Supply Project has been planned for 510 MLD only. Thus, NDP has planned to provide the 0.45 m^3/s (450 l/s) of discharge to Melamchi Water Supply Project during monsoon season for distribution in the Kathmandu Valley after using it to generate the hydo-energy. This project will be helpful in contributing additional drinking water requirement for the Kathmandu Valley during monsoon season. Additionally, this project can also serve to provide vital drinking water to Kathmandu Valley in case of drought triggered by climate change impacts in the near future swaping water during the critical condition of Melamchi and replenish later to the river as compensation.

This impact is anticipated to be direct, moderate in magnitude, regional in extent and long term in duration.

7.1.2.5 Generation of Revenue through Payment for Ecosystem Services Charge to SNNP

Payment for Ecosystem Services (PES) will be implemented according to Constitutinal and relevatnt legal provisions in consultation with relevant stakeholders. NDP will provide 20% of the generated revenue from the hydropower operation and supply of water to KUKL through MWSP to SNNP as per the regulatory provision made in the Rule 26 of SNNP regulation, 2018. Further, SNNP can collect revenue from the ecotourist visiting the reservoir area of the NDP as already experienced after the operation of Dhap dam upstream. SNNP can invest this generated revenue in biodiversity conservation and shivapuri watershed management.

This impact is anticipated to be direct, high in magnitude, local in extent and long term in duration.

7.1.2.6 Integrated Watershed Resource Management

Implementation of the project will be helpful in overall management of Nagmati river watershed, a tributary of Bagmati river. The dam will reduce the erosion and river cutting downstream of the dam area due to the high discharge during monsoon season reducing sediments transport to downstream. Further, multiple usage such as generation of hydro-energy, drinking water supply, carbon sequestration, flood control, ground water recharge will be achieved from the project operation. The reservoir will serve to provide suitable habitat for terrestrial wildlife, locals as well as migratory bird *sps.,* and fish *sps.* In addition, the creation of additional aquatic regime will serve to store carbon as aquatic habitats are important in absorbing huge amounts of carbons playing vital role in reducing the climate change. Further, NDP will allocate budget annually for the biodiversity conservation and river bank protection. The broad-leaved trees will be planted in the 5 ha area near Mulkharka under the pine forest.

The broad-leaved forest helps to reduce pH while pine forest makes the soil acidic. They also help to reduce fire hazard and helps in carbon sequestration.

This impact is anticipated to be direct, high in magnitude, local in extent and long term in duration.

7.1.2.7 Flood Control

The climate change impact study conducted by NDP in the Bagmati watershed above Gaurighat suggested the possibility of increase precipitation in the watershed. The reservoir of the Nagmati Dam Project has the storage capacity of 9.484 Mm^3 volume of water at FSL. Development of 554m long dam can hold Possible Maximum Flood of 522Cu.m/s. This project will serve to control the uncertain flood resulting from the uncertain extreme rainfalls upstream of the reservoir protecting areas downstream from the dam by storing high volume of rainfall water.

This impact is anticipated to be direct, moderate in magnitude, regional in extent and long term in duration.

7.1.2.8 Creation of Wetland

The reservoir of the Nagmati Dam Project will create the wetland habitat providing suitable habitat for terrestrial wildlife, locals as well as migratory bird *sps.,* and fish *sps.* In addition, the creation of additional aquatic regime will serve to store carbon as aquatic habitats are important in absorbing huge amounts of carbons playing vital role in reducing the climate change.

This impact is anticipated to be indirect, moderate in magnitude, Regional in extent and long term in duration.

7.1.2.9 Ground Water Recharge

The accumulation of large volume of water in the reservoir allows percolation of water underground, thus increasing the water table level of the area allowing furture water security in Bagmati River basin. The increase water table allows the flow of water underground to the water springs of the area downstream during dry period. Availability of water supply from the water springs can be used by locals for drinking and agriculture purposes.

This impact is anticipated to be indirect, low in magnitude, local in extent and long term in duration.

7.1.2.10 Employment Opportunity

The project will require project chief, engineers, power plant operators, electrical technicians and other support staffs for the smooth operation and management of the project. It is estimated that 22 full time staff is needed for the project operation and management generating employment opportunities for skilled, semi-skilled and unskilled workforce. Local people will be recruited for administrative and technical work according to their qualifications and skills. These will give permanent income source to some of the local people. In addition, short-term employment for periodic maintenance work will be beneficial for the local unemployed people to supplement their household income. Further, due to the increase

tourism activities due to the reservoir will create indirect employment opportunities from the increase economic activities in the area.

This impact is anticipated to be indirect, low in magnitude, local in extent and long term in duration.

7.1.2.11 Increment in Economic Activities

The objective of the project implementation is not for promotion of tourism in the project area. However, the project area is well known for hiking, bird watching and also is the trekking route to Gosaikunda and Langtang National Park. It is expected that after the completion of the project, the reservoir will increase the tourism activities in the area as the reservoir could serve to habitat migratory bird *sps*, local bird *sps,* and add up the recreational and aesthetic beauty of the area attracting more local and international tourist. This increase tourist mobility will enhance the economic activities of the area. Local people can have income generation through sell of vegetable products, opening of tea shops and small lodges along the route to the reservoir providing additional employment opportunities.

This impact is anticipated to be indirect, low in magnitude, site specific in extent and long term in duration.

7.1.2.12 Generation of Royalty

Revenue generation is directly linked to the economic transaction and overall development of the area. As per the provision in the Intergovernmental Fiscal Agreement Act, 2075, 50% of the total royalty obtained will be allocated to the Government of Nepal, 25% to the concerned state and 25% to the concerned local level.

This additional source of income will encourage local bodies to invest greater amount in the development activities such as health, water supply, education, communication, and transport services.

This is direct impact of low magnitude, regional extent and for long term.

7.1.2.13 Community Support Program

NDP will support the various community programs in the project DIA during its operation. Community support programs will be conducted in co-ordination with Gokarneshwor Municipality and Gokarna Municipality Ward no. 1. A need assessment report shall be submitted to NDP for any community related programs by the Gokarneshwor Municipality and Gokarna Municipality Ward no. 1. Further, programs related to biodiversity conservation will be conducted in close coordination with SNNP.

The impact is direct, moderate in magnitude, site specific in extent and long term in duration.

Table 7-1: Summary of beneficial impact evaluation matrix

Environmental Impacts (Beneficial)	Nature	Magnitude	Extent	Duration	Significance	
Construction Stage						
Employment opportunity	D	H (60)	L (20)	St (05)	85	High
Increased Economic Activities	I	H (60)	L (20)	St (05)	85	High
Improved Accessibility	D	M (20)	SS (10)	Lt (20)	50	Moderate
Potential exposure to new technology and technology transfer	D	Mo (20)	L (20)	Lt (20)	60	Moderate
Potential improvement of public facilities	D	Mo (20)	L (20)	Lt (20)	60	Moderate
Improvement in livelihood	I	Mo (20)	L (20)	St (05)	45	Low
Community support program	D	H (60)	SS (20)	St (05)	85	High
Operation Stage						
Improved river water quality	D	H (60)	L (20)	Lt (20)	100	High
Availability of water for socio-cultural usages	D	H (60)	L (20)	Lt (20)	100	High
Generation of Hydro-Energy	D	Mo (20)	L (20)	Lt (20)	60	Moderate
Supply of additional drinking water to Melamchi Water Supply Project	D	Mo (20)	R (60)	Lt (20)	100	High
Generation of revenue through payment for ecosystem services (PES) charge to SNNP	D	H (60)	L (20)	Lt (20)	100	High
Integrated watershed management	D	H (60)	L (20)	Lt (20)	100	High
Flood control	D	Mo (20)	R (60)	Lt (20)	100	High
Creation of wetland	I	Mo (20)	R (60)	Lt (20)	100	High
Ground water recharge	I	Mo (20)	L (20)	Lt (20)	60	Moderate
Employment opportunity	I	Lo (10)	L (20)	Lt (20)	50	Moderate
Increment in economic activities	I	Lo (10)	SS (10)	Lt (20)	40	Low
Generation of Royalty	D	Lo (10)	R (60)	Lt (20)	90	High
Community support program	D	Mo (20)	SS (10)	Lt (20)	40	Low

Note: *D = Direct & I = Indirect; H = High, Mo = Moderate & Lo = Low; R = Regional, L = Local & SS = Site Specific;* Lt = Long Term, Mt = Medium Term & St = Short Term

7.2 Potential Adverse Impacts

7.2.1 Physical Environment

7.2.1.1 Construction Stage

a) Changes on land use pattern and topography due to muck/spoil disposal, land acquisition and build of structures

The project requires about 65.304 ha of land for the project development on permanent and temporary basis (Table 2-6). The acquired land shall be utilized for various project purposes with obvious effects on the land use pattern and topography of the area.

The private, agriculture and forest land area occupied permanently (62.977 ha) will have a permanent land use change. These areas will be converted into structural sites. About 50.7 ha of forest land will be converted into reservoir and dam area. Quarry operation, crusher plant and batching plant will be installed within the reservoir area. Similarly, forested and private land area will also required for the construction of Penstock, Access Road and permanent camps at dam. About 0.1 ha of land under ownership of MWSP will be changed for powerhouse area. Topographical changes are expected in the areas used for quarry operation and along the dam construction area. Reservoir of about 0.49 km^2 will be formed after dam construction. These topographical changes will remain as permanent change throughout project life and will be the residual impact of the project.

The impact will be direct in nature, high in magnitude, site specific in extent and long term in duration.

b) Change on water & soil quality due to possible spillage/leakage of toxic materials

Haphazard disposal of used lubricants, grease, engine oil, and toxic chemicals and seepage of petroleum products from the bunkers and mechanical yards can have an adverse impact to the receptors (either land or water resources).

The construction equipments and vehicles use large quantities of grease, engine lubricants and other lubricants. Similarly, a number of toxic chemicals are used for enhancing the property of concrete admixtures and water proofing works. Disposal of these materials after use or expiry of the usable date into the water bodies or land will have adverse impacts on the water or soil quality. The seepage of the petroleum products from the storage yards/bunkers of the construction site and the release of these products as mechanical yard wastewater into the water bodies also has the potential of water quality degradation rendering the water unsuitable for consumption at downstream and aquatic life.

Envisaged impacts of such disposal or seepage of the contaminated water or land will be direct in nature, moderate in magnitude, local in extent, short term in duration.

c) Degradation of water quality due to river water diversion, waste water generated from the washing of construction material at crusher plant site and batching plant operation,

Coffer dam and dam foundations lie on the river bed. Hence, any construction on the river bed is going to impinge upon the river water quality and habitat of aquatic life. For the construction of Coffer dam and dam foundations, project has a plan of river water diversion at

construction site; such that the construction works directly don't impinge the flowing river. This river diversion works will have serious implication on the existing water quality during the diversion period and existing aquatic ecology permanently. Similarly, proposed muck/spoil disposal sites are along the Nagmati river bank, mixing up of rainfall water with muck/spoil from the surface runoff during monsoon into the river water can also degrade the river water quality. Also, the waste water generated from the washing of construction materials at crusher plant and waste water released from the batching plant during preparation of concrete mix into the river channel without treatment will have serious implications in the river water quality.

The impact will be direct in nature, moderate in magnitude, site specific in extent and short term in duration.

d) Degradation of local air quality and increase in noise level

Potential of air pollution in the surrounding areas

High volume of particulate emissions will be generated from various excavations, crushing and mixing activities during construction in and around the project site. The movement of vehicles on the earthen road surface is also expected to generate large volumes of particulate emissions. Different factors that determine the amount of dust blown in the atmosphere include type of activity & operational modality of the construction works & vehicles and climatic conditions (dry & wet). The project construction at dam site is devoid from the human settlement, but vehicles playing from the main road to the construction sites, however could impact health of the construction workers, settlements along the project access roads and settlements around the powerhouse due to high suspension dust particles coming from movement of vehicles on earthen road.

The cooking activities in construction & labor camps and combustion from vehicles/machineries will also generate gaseous emissions. These emissions are likely to degrade the ambient air quality of the local surrounding areas significantly.

The impact is direct in nature, moderate in magnitude, site specific in extent and short term in duration.

Potential of noise pollution in the surrounding areas

The construction activity particularly blasting operations, machinery operations and vehicular traffic will enhance the background noise level during the construction period close to the construction sites (quarry sites, batching plants, aggregate crushing plants, powerhouse, dam site, mechanical and equipment yards) and along the vehicular corridors. At the construction site and immediate vicinity, the background noise level is expected to be higher, whereas background noise level is expected to be lower for the nearest community which is about 500 m away from the activity point. Increased short lived peak noise during blasting could be much higher for the nearest community, while the noise level contributed by the vehicular movement along the road corridor could be marginally high.

The impacts of the noise level is expected to be high to the occupational worker which can have implication on their health both by the increased background noise level and the short-lived high pitch noise of blasting and vehicular movements. The communities located at

distance will not feel the impact of the increased background noise, but high pitch short-lived noise may impact the health of the communities particularly the old aged and children.

The impacts will be direct in nature, moderate in magnitude, site specific in extent and short term in duration.

e) Impact due to operation of quarry sites

Large amount of construction materials especially boulders of different sizes are required for the construction of dam. Boulders will be harvested from the proposed quarries. Haphazard quarrying from the river might change the river morphology and river water pathways significantly involving changes in river bank erosion and sedimentation pattern than the existing one. Quarrying at the river banks might involve changes in river water quality particularly in the increase in the sediment load due to river edge falling into the river exaggerating landslides and mass wasting. In addition, use of explosives for quarrying will increase the emission and noise level.

The impact is direct in nature, moderate in magnitude, site specific in extent and short term in duration.

f) Impact due to storage of construction materials

During the construction phase, there will be significant amount of construction materials such as bricks, cement, gravels, aggregates etc around the construction area. The improper storage of these materials in bulk amount impairs aesthetic beauty of the surrounding area in construction site. Further, the haphazard storage of these along the access road and elsewhere will disturb for the movement of workers, people and vehicles.

The impact is direct in nature, low in magnitude, site specific in extent and short term in duration.

g) Damage on infrastructures due to the blasting and use of heavy equipments

The vibrations of blasting might damage structures such as mud mortar houses of the local community if located close to the quarry sites. The settlement closest to the Nagmati dam site is Mulkharka, which lies approximately 300 m to the south-west from the proposed dam site, along the Mulkharka-Chisapani road passing the dam site. Cracks might develop in these houses. Besides, due to the high intensity of vibration and noise during blasting/drilling activities, the nearby rock and slope structures might crack and fall down. However, in case of NDP, since the quarry operation area site is devoid of and far away from human settlement, possibility of such impact to physical structures and houses of local community is not expected. In addition, the vibration created by the movement of heavy vehicles along the access road might impact the settlements along the access road.

The impact is *direct*, *low in magnitude, site specific in extent and short term in duration.*

h) Impact due to improper management of solid and construction waste

The solid waste generated in construction camps that include a range of solid waste from normal household kitchen waste to garden waste, packaging wastes comprising plastics, paper cardboards to other common wastes such as clothes, rubber, leather, glass bottles, broken glass and porcelain, ruptured plastic bottles, buckets. Estimated potential solid waste

generation from the construction camps is 135.6 kg/day (estimated 226 person @ 0.6kg/ppday = 510kg/day). If disposed improperly, this could result in land pollution and degradation of aesthetics in and around the areas of construction camps.

Similarly in the construction sites, cement bags, packaging materials and containers of the equipment, and other materials, small iron pieces, wires, worn out ropes, wood pieces, worn out timbers, used and worn-out vehicle tires, damaged plywood planks are generated as solid waste from construction. Haphazard disposal of these construction wastes will degrade the aesthetics of the surrounding area and cause pollution of river banks and bed. The impact has low magnitude and short term and site specific.

The impact is direct in nature, low in magnitude, site specific in extent and short-term in duration.

i) Impact on slope stability, sedimentation, and soil erosion

Site clearance and construction activities in fragile slope are potential causes that might increase slope instability, erosion and sedimentation particularly in the penstock, spoil disposal, quarry, camp, dam, access road sites due to removal of vegetation and alteration of natural drainage features.

Construction activities will include land excavation, slope cutting, grading, use of heavy equipment etc, which will change the existing slope of land. These activities on slopes may induce slope failure and mass wasting. Similarly, use of explosives for excavation during the quarry will disturb the stable rock and rock fall may occur. Blasting will cause vibrations which may initiate landslides. The clearing activities of forest and agricultural land for the construction of project structures will make the soil surface loose. Thus, soil erosion may occur during the rainy season especially in the steep slopes. The eroded particles may be transported to the river by monsoon runoff and exacerbate sedimentation in river

The impact is direct, moderate magnitude, site specific and short term in duration.

j) Impacts in drainage pattern

Surface drainage changes are expected along the access roads and at the dam site and penstock alignment, muck/spoil disposal areas and crusher and batching plant operation sites. Permanent office and camps site also will alter the natural surface drainages. The change in natural drainages has the potential for water logging and surface erosion. It might also obstruct the water flow from the upslope terrace to the downslope terrace hindering the free flow of water.

The impact will be *direct in nature, moderate in magnitude, site specific in extent and short term in duration.*

k) Impacts on natural spring and other water sources due to dam construction and penstock installation along the penstock alignment

The project area is rich in natural springs. Due to construction of 550m long dam, existing natural springs and other water sources will get blocked from the concrete works. However, since the area is rich in natural springs and the natural water will create its outlet in its own, the impact is minimal. Further, drying up of existing natural spring due to project construction works is not expected. The water source used by Dachi Water Supply Consumer Group lies

50m downstream from the proposed dam. Therefore, at existing condition project construction works doesn't impact existing natural springs and other water sources used for other purposes.

l) Impacts of muck disposal

During the construction of NDP, it is estimated that 1,014,188 m^3 volume of muck is expected to be generated from the excavation works of dam, penstock, powerhouse and access road. Out of the total generated muck, 93,120 m^3 of muck will be used for backfill (Table 2-7). The total estimated volume of 921,068 m^3 of muck has to be managed in the designated muck disposal area. Haphazard disposal of muck in the designated area and elsewhere is of concern related to air pollution, water quality issues, erosion and sedimentation. As the muck disposal site is located in close to embankment area, improper disposal might increase the sediment load in the river and there is a possibility of muck washout during high monsoon floods which could cause the downstream sedimentation and disturbance to the aquatic life.

The envisaged impacts are direct, moderate in magnitude, site specific in extent and short term in duration.

m) Downstream flooding due to the failure of coffer dam

The project has planned to construct two coffer dams for the river diversion during the construction of CFRD. The upstream coffer dam will be constructed at RL 1842m and a small downstream coffer dam will be constructed to prevent flooding of the dam area from tailwater downstream of the diversion outlet. The upper cofferdam is approximately 9m high and will only store approximately 15ML at crest level. In case of extreme events such as erratic rainfalls, high magnitude earthquakes, failure of these coffer dams can cause flooding in the downstream areas impacting life and livelihoods of the people living near the banks of the river channel.

The envisaged impacts are direct, low in magnitude, local in extent and short term in duration.

7.2.1.2 Operation Stage

a) Impacts due to change in water quality in the dewatered stretch

The change in flow during wet season is not considered significant but in dry period the natural flow will be reduced. Since, the NDP will release environmental flow of 150 lps and also the area has few sources of spring water along the reduced water flow stretch that will contribute in enhancing the river flow that will certainly reduce the impact in river water quality from reduced flow. Further, about 1.5km downstream from proposed dam is the confluence of Bagmati river and Nagmati river at Sundarijal Mai Temple, adding additional water in the reduced stretch. Therefore, it is expected that the impact from reduced water flow from the project operation is not significant.

b) Impacts due to modification of landscape

The topography of the project area will be changed since the land use will be changed in the area. The local topography of forested land and agricultural will be replaced by concrete infrastructure of project like dam, powerhouse, and office quarters. There will be change in aesthetic beauty. Also, the cutting of slopes during construction may disturb the fragile slopes accelerating landslides in the operation phase as well impacting the local topography.

The impact will be direct in nature, moderate in magnitude, site specific in extent and long term in duration.

c) Impacts due to increased sedimentation on downstream due to sediment flushing from Reservoir

The Nagmati river is low sediment carrying river. Therefore, sediment flushing from the reservoir is not required. Therefore, impacts from sediment flushing is insignificant.

d) Impacts due to change in micro-climate in reservoir area and de-watered stretch

The creation of reservoir after the construction of the project will alter the micro-climate of the project area. The existing daily rainfall pattern and extreme rainfall incidents might get intensified due to the creation of reservoir as it is expected that the surrounding area near to the lakes receives high rainfall due to high evaporation from the pondage area. In addition, the Dhap dam project is also implemented near to NDP, adding additional evaporation to atmosphere could intensify the extreme rainfall incidents as well as increase the daily rainfall pattern. The dewatered stretch downstream of dam upto the powerhouse will receive 50% less waterflow than the river natural flow could alter the micro-temperature of the section. The impact may be higher to the temperature and high rainfall non-resilient faunal and floral species at the immediate downstream of the weir. Since temperature and rainfall resilience of the existing flora and fauna is not well understood, the degree of impacts could not be predicted. However, it is expected that the microclimatic modifications might cause impacts to some extent on flora and fauna of mostly aquatic origin. Human beings being more resilient to such changes in temperatures, health effects to the public health are not expected.

The impact will be direct in nature, moderate in magnitude, local in extent and long term in duration.

e) Reclamation of the muck disposal area and quarry site area

The project has selected the muck/spoil disposal and quarry area within the impoundment area. The areas used for muck/spoil disposal area and quarry area will be converted into reservoir. Thus, reclamation is not required to the muck/spoil disposal and quarry area operated within the impoundment area. However, muck/spoil disposal area selected outside the impoundment area needs reclamation.

The impact will be direct in nature, moderate in magnitude, site specific in extent and short term in duration.

f) Impact of slope instability

Due to mountainous fragile topography, slope instability and soil erosion are common problem which get accelerated during intense rainfall in monsoon season. The construction of project infrastructure such as dam, penstock, access roads changes the topography. Hence, slope stability is a matter which needs to be taken into account during the operation phase. Change in land use during construction phase may make the steep slope unstable and may accelerate landslides during operation also if not managed properly.

The impact will be direct in nature, low in magnitude, site specific in extent and long term in duration.

g) Impacts due to leakage of oil and grease and other liquid materials

The operation of equipments, machinery and vehicles require grease, engine oil and other lubricants. Haphazard disposal of these materials after use or expiry of the usable date and leakage, seepage and runoff of the petroleum products during handling, during use, after use and storage after expiry of the usable date into the land and water bodies has a long-lasting impact on the soil and water quality.

The impact will be direct in nature, low in magnitude, site specific in extent and long term in duration.

h) Flood outburst due to dam failure

NDP reservoir will hold 9.484 Mm^3 volume of water at FSL. Bagmati river flows through the densely populated urban areas of Kathmandu Valley. The river passes through the areas of Gokarneshwor Municipality, Kathmandu Metropolitan, Lalitpur Metropolitan and Kirtipur Municipality. In addition to the densely populated areas, four major religious sites, Gokarneshwor, Gujeshwori, Pashupatinath and Sankhamul exist in the banks of Bagmati river. These religious sites are the center of religious beliefs to the Hindus attracting devotee from all around the world. Pashupatinath Area is also listed under the UNESCO world heritage sites. Since, Kathmandu Valley is vulnerable to the seismic movement and the area experienced a huge destruction from the recent 7.8 Magnitude earthquake in 2015, failure of the dam exaggerated by the seismic activity cannot be discarded. The dam failure study conducted by ENTURA, 2015 showed that the peak discharge of 3,470 m^3/s will be released from the dam at Sunny Day. The discharge will be 3,470 m^3/s, 2,300 m^3/s, 1,140 m^3/s and 1,130 m^3/s at Sundarijal Bridge, Gokarna Mahadev Temple, Pashupatinath Temple and Sinamangal Road respectively as forecasted from the MIKE HYDRO modelling for Sunny Day Failure (SDF). The time interval to reach the locations from the bottom of dam to the Sinamangal bridge is 0, 0.15 hr, 0.45 hr, 1:30 hr and 1:40 hr respectively. Similarly, the forecasted discharge from the MIKE HYDRO modelling for Probable Maximum Flood Failure (PMFF) at Dam bottom, Sundarijal Bridge, Gokarna Mahadev Temple, Pashupatinath Temple and Sinamangal Road is 5,960 m^3/s, 5,940 m^3/s, 3,680 m^3/s, 1,600 m^3/s and 1,600 m^3/s respectively. The time interval to reach the locations from the bottom of dam to the Sinamangal bridge is 0, 0.08 hr, 0.27 hr, 1:03 hr and 1:12 hr respectively. The areas that could be impacted due to the flooding triggered by dam failure for Sunny Day Failure (SDF) and Probable Maximum Flood Failure (PMFF) is presented in Annex 29. The local units that could be impacted is presented in Figure 3-1.

This uncertain failure of the dam will release 9.484 Mm^3 of water in the Bagmati river channel flooding the areas downstream. The impacts from this unprecedented accident will be devastating posing serious threats to the life and livelihoods of the population downstream of the dam. The tentative population that could be impacted from dam failure would not be less than 500,000 from Nagmati Dam to exit point at Chobhar. The religious sites of significant importance will be inundated from the flooding. Further, the high discharge can change its natural flow channel shifting the existing river channel.

The impact will be direct in nature, high in magnitude, regional in extent and long term in duration.

i) Impacts in physio chemical parameters quality of water downstream of Nagmati dam and point of mixing of discharge release from NDP powerhouse in the Bagmati River at Sundarijal

A study conducted on water quality impact due to the operation of Indrawati Hydropower Project, a RoR project, showed marked increase in temperature, pH, mean conductivity, turbidity at downstream, suspend solids and substantial increment in the physical and chemical qualities of river water in compression to upstream water quality of the river. Total nitrogen was also decreasing in the downstream of the wire site (Bhatt and Khanal, 2011). Similarly, Tomczyk, P and Wiatkowski, M, 2021 also concluded from their research that higher the damming height, high is the impact on physio-chemical parameters of the water. However, both the research found increasing DO level from just below dam to the downstream of the tailrace due to natural aeration of river water. During the operation of NDP, the water quality below the dam could change and can impact the aquatic life.

The impact will be direct in nature, low in magnitude, site specific in extent and long term in duration.

Table 7-2: Summary of adverse impact evaluation matrix for physical environment

SN	Impact	Direct/ Indirect Impact	Magnitude	Extent	Duration	Significance	
A	**Construction Phase**						
a.	Change on land use pattern and topography due to muck disposal, land acquisition and build of structures	D	H (60)	SS (10)	Lt (20)	100	High
b.	Change on water and soil quality due to possible spillage/leakage of toxic materials	D	M (20)	SS (10)	St (05)	35	Low
c.	Degradation of water quality due to river water diversion, waste water generated from the washing of construction material at crusher plant site and batching plant operation	D	M (20)	SS (10)	St (05)	35	Low
d.	Degradation of local air quality and increase in noise level	D	M (20)	SS (10)	St (05)	35	Low
e.	Impact due to operation of quarry site	D	Mo (20)	SS (10)	St (05)	35	Low
f.	Impacts due to storage of	D	Lo (10)	SS	St (05)	25	Low

SN	Impact	Direct/ Indirect Impact	Magnitude	Extent	Duration	Significance	
	construction material			(10)			
g.	Damage on infrastructures due to the blasting and use of heavy equipments	D	Lo (10)	SS (10)	St (05)	25	Low
h.	Impacts due to improper management of solid and construction waste	D	M (20)	SS (10)	St (05)	35	Low
i.	Impacts on slope stability, sedimentation and soil erosion	D	Mo (20)	SS (10)	St (05)	35	Low
j.	Impacts in drainage pattern	D	Mo (20)	SS (10)	St (05)	35	Low
k.	Impacts on natural spring and other water sources due to dam construction and penstock installation along the penstock alignment						Not significant
l.	Impacts of muck disposal	D	Mo (20)	SS (10)	St (05)	35	Low
m.	Downstream Flooding due to the Failure of Coffer Dam	D	Lo (20)	L (20)	St (05)	45	Low
B	**Operation Phase**						
a.	Impacts due to reduction in downstream flow and change in water quality	D	M (20)	L (20)	Lt (20)	60	Moderate
b.	Impacts due to modification of landscape	D	Mo (20)	SS (10)	Lt (20)	50	Moderate
c.	Impacts due to increased sedimentation on downstream due to sediment flushing from Reservoir						Not significant
d.	Impacts due to change in micro-climate in Reservoir Area and De-watered Stretch	D	Mo (20)	L (20)	Lt (20)	60	Moderate
e.	Reclaiming the muck disposal area and quarry site area	D	M (20)	SS (10)	Lt (20)	50	Moderate

SN	Impact	Direct/ Indirect Impact	Magnitude	Extent	Duration	Significance	
f.	Impacts of slope instability	D	Lo (10)	SS (10)	Lt (20)	40	Low
g.	Impacts due to leakage of oil and grease and other liquid materials	D	Lo (10)	SS (10)	Lt (20)	40	Low
h.	Flood Outburst due to Dam Failure	D	H (60)	R (60)	Lt (20)	140	Highly significant
i.	Impacts in physio chemical parameters quality of water downstream of Nagmati dam and point of mixing of discharge release from NDP powerhouse in the Bagmati River at Sundarijal	D	Lo (10)	SS (10)	Lt (20)	40	Low

7.2.2 Biological Environment

7.2.2.1 Construction Stage

a) Loss of vegetation due to the clearance and acquisition of forest land

NDP will clear both the permanently acquired land area and temporarily required land area. NDP will acquire all the required land for its implementation before commencing construction works. Project will require total 65.304 ha of land area out of which 62.977 ha is required permanently and 2.327 ha is temporary. The area of Government forested land of SNNP required permanently is 62.682 ha. The existing land use will be converted into the reservoir and structures, changing the existing landscape of the SNNP area, an area strictly demarcated for wildlife protection and biodiversity conservation. Due to the clearance, standing trees of different species will be lost permanently. From the tree enumeration, 75185 number of poles and 5073 number of trees will be lost. Biodiversity of the cleared area will be lost in addition with the loss of wild life habitat from the forest land acuisition. The number and volume of each tree species that needs to be cleared is attached in the Annex 22. Considering the overall forest area, the clearance activities will be restricted to the limited area compared to larger area of SNNP, the impact is envisioned to be moderate.

The impact is direct, moderate in magnitude, site specific in extent and medium term in duration (It is expected that the compensatory planation will compensate the lost trees after full growth in 20 years).

Table 7-3: Volume of trees and poles in Nagmati Area to be inundated

Particulars	Number	Net Timber Volume (cft)	Net Fuelwood Volume (cft)
Trees (>30 cm DBH)	5073	4,181.24	117,175.27

Poles (10-29.99 cm DBH)	75185	3,115.67	314,942.63
Total	**80258**	**7,296.91**	**432,117.90**

Source: Field Study, 2080

The trees will remain standing above RL 1908 m inside the reservoir area because this area is above the spillway and most of the time this area remains above the water. The trees in the submerged area of quarry site and spoil areas will also remain standing.

b) Loss of biodiversity

Activities like forest clearance and tree falling would account loss of biodiversity. It is estimated that construction of the project would require clearance of 71 types of tree species accounting to the loss of about 80,258 pole and tree class. However, as these species are distributed in wider area in similar ecological zone, the overall impact of site clearance on floral diversity is expected to be minimum.

Given the workforce number and their stay for seven years in the construction sites, it can be projected that firewood requirement would be sufficient to exert pressure on the firewood trees in the surrounding forest. Hence, the loss of floral diversity could be expected. However, as the project area lies in protected area the strict rules are enforced to protect the floral resources and hence firewood collection is not expected to be high.

Moreover, as the forest in the project vicinity and upland areas close to the project are considered rich in NTFP resources of higher value, the workforce and even the local could exploit these resources in free time to maximize the economic gains as the project site itself will provide them a market of high potential. Such activities again can put pressure on the local floral diversity. Besides, activities like forest clearance and tree falling, taping of water for power generation, noise from blasting, vibration created by blast and drill machine will impair habitat quality of the area and thus creates impacts on faunal biodiversity (wildlife) habitat in the area. These activities create migration/displacement of individuals and population of animal and bird species leading to loss of biodiversity in the area during construction period.

The impact will be both direct in nature, low in magnitude, site specific in extent and short term in duration.

c) Wild life habitat fragmentation, birds nesting ground loss and destruction due to forest clearance and construction activities

The project is being implemented within the protected area system. Clearance activities before the commencement of construction activities will deteriorate the existing wildlife habitat. During, the transect survey, occurrence of ten mammal *sps.* (Table 5-14) and 16 bird *sps.* have been recorded in the project area during transect survey (Table 5-17). Also 7 herpeto fauna has been recorded in the SNNP (Table 5-16). Therefore, forest clearance for the required land for the project will deteriorate their existing habitat, feeding, nesting, breeding ground eventually impacting their movement. Further, construction activities in the nearby forested areas may affect the mobility of wild animals. Construction works need the use of heavy equipment, drilling and blasting activities that will produce noise and vibrations. These disturbances will affect the normal mobility, feeding habits of wild animals and birds. The construction activity will disturb the movement of these wild animals and birds as they are noise sensitive.

However, the habitat of the wild life and birds is extended to the larger area the impact is expected to be moderate.

The impact is direct, moderate in magnitude, site specific in extent and short term in duration.

d) Pressure on rare, endemic, endangered, threatened and protected species of both flora and fauna

Tale 5-18, Table 5-19 and Table 5-20 list the presence of rare, endemic, endangered, threatened and protected species of both flora and fauna in the project area. During the clearance activities, the protected flora species will be lost and also due to the project activities like blasting, forest clearance, movement of heavy vehicles etc. these species may be disturbed and migrated for short interval in safer place. Additionally, these species may be affected by the encroachment of construction workers in the forest. Illegal hunting, poaching and harvesting of protected species may occur due to high mobility of people.

The impact will be direct in nature, low in magnitude, site specific in extent and short term in duration.

e) Illegal felling of vegetation, trade of NTFPs, hunting & poaching of wildlife and trade of fish

Forest in the project vicinity and upland area is rich in NTFPs resources of medicinal and higher economic value. NTFPs such as Kurilo (*Asparagus racemosus*), Pakhanved (*Bergenia ciliate*), Lapsi (*Choerospondias axillaris*), Bhyaakur (*Dioscorea deltoidei*), Jhyaau (*Lichen spp.),* Sungava, Sunakhari (*Orchidaceae),* Majitho (*Rubia manjith)* of high economic value are recorded in the project area. The project construction workforce are likely to involve occasionally in collecting and illicit trade of such goods in local market and beyond. If such activities are not restricted, it will put pressure in surrounding forest and contribute to deterioration of forest condition.

Similarly, workers coming from outside the area may be attracted to hunt birds and wild animals during the construction period. Most of the project features fall within the jurisdiction of SNNP and most of the mammals in the project area are protected by law and hunting is prohibited. Also, the occurrence of fish in the project area is sparse, therefore, cases of illegal hunting and poaching and fishing in the area could be insignificant. Such pressure on flora and fauna will be site specific and it is expected to continually decrease after completion of construction.

The impact will be indirect in nature, low in magnitude, local in extent and short term in duration.

f) Disturbance to aquatic species and its habitat due to construction activities

The study on fish indicates existence of two fish species, Snow Trout (*Schizothorax richardsonii*) and Loaches (*Schistura multifaciata*) in the Nagmati river. However, in the Nagmati river stretch between dam and powerhouse only one species Snow Trout (*Schizothorax richardsonii*) was recorded. Excavation, river diversion and concreting works, and disposal of construction spoils, waste water, effluent of oils and grease etc. directly into the river without treatment will affect the fish species including other aquatic species and their habitats. Also, haphazard disposal of construction waste, and excavated materials (e.g., muck) could have direct impact on the aquatic ecosystem. Also, from the study of BRBIP EIA, 2013,

despite having a good water quality, the aquatic ecosystem is already disturbed by human activity in the catchment.

The impact will be direct in nature, high in magnitude, site specific in extent and short term in duration.

g) Impact due to fire hazard on forest resources

In and around the construction area, there will be many types of fuel that create fire hazards, such as slash accumulation of timber cutting, debris accumulation, large accumulation of flammable leaves, dead trees, dry bushes etc., as well as gasoline for vehicles and machinery. Fire might be set accidentally due to inadvertently thrown cigarette stub and left campfire or deliberately by some ruffian. Small fire can turn huge forest fire. Improper garbage disposal and improper storage of inflammable gases and liquids at the construction site can aggravate the situation. If the fire become uncontrollable and expand in wider area it will pose impacts on both vegetation and wildlife inhabit in it. Other losses of forest fire includes natural vegetation and agriculture crops, loss of forest-derived food and income, accelerated soil erosion and sedimentation on water bodies. Smoke and haze cause production of ozone and greenhouse gases.

The impact will be indirect in nature, low in magnitude, local in extent and short term in duration.

h) Human Wild life conflict

The area is the habitat for the Clouded leopard (*Pardofelis nebulosa*), Leopard cat (*Prionailurus bengalensis*), and Common leopard (*Panthera pardus*) which are vector to the humans and domestic animals of the study area. During the key informant consultation with the SNNP officials and local people past incident of confrontation with the above wild species was recorded in the project area. Due to the project activities like blasting, movement of heavy vehicles etc. these species may be frightened and can enter into settlement areas for its safety. During this course, it might attack local and project workers for its safety.

The impact will be indirect in nature, low in magnitude, local in extent and short term in duration.

i) Encroachment in Shivapuri Nagarjun National Park

The project, as far as possible, has minimized land acquisition of the forest areas and has plans and measures to ensure that there is no encroachment of the forest area by the construction workforce employed by the project.

The impact will be indirect in nature, low in magnitude, local in extent and short term in duration.

7.2.2.2 Operation phase

a) Disturbance to movement of fish, aquatic species and its habitat due to obstruction created by the dam

The study on fish indicates the existence of two fish species Snow Trout (*Schizothorax richardsonii*) and *Schistura multifaciata* between the dam area and powerhouse area. Further, their occurrence is sparse in the dam area. This may be due to the steep gradient and sharp fall

upstream and about 30m downstream of the proposed dam area. Therefore, no impact has been envisioned movement of fish species and aquatic species from the obstruction created by the dam. Therefore, no impact from the reduced water flow and dam obstruction has not been envisioned.

The impacts will be direct in nature, low in magnitude, site specific in extent and long term in duration.

b) Change in existing terrestrial ecosystem into aquatic ecosystem and loss of wildlife due to destruction and fragmentation of its habitat

Implementation of NDP will create a reservoir of 0.48 km^2. The area inundated will be converted into aquatic ecosystem from existing terrestrial ecosystem reducing the available terrestrial habitat. Also, this reservoir will fragment the existing wildlife habitat separating the river banks for about 200m upstream from the dam location obstructing the movement of wild mammal animals. Further, loss of wildlife cannot be neglected from the drowning during crossing from the reservoir area which is extended from RL 1871m RL to 1911.23m in height. However, the wild life habitat is extended over a relatively huge area, impact on wild life habitat during operation phase seems low. Thus, habitat destruction and fragmentation is not highly significant.

The impact is direct in nature, expected to be low in magnitude, site specific and long term in duration.

c) Disturbance on movement of animals due to project features

Project features that lie in the forest area may block the occasional passage of wild animals. Infrastructure and facilities such as the access road, penstock alignment, dam, reservoir may interrupt the regular movement of fauna in the impact area. However, the wild life habitat is extended over a relatively huge area, disturbance on movement of animals due to project features during operation phase seems low.

The impact will be direct in nature, low in magnitude, site specific in extent and long term in duration.

d) Pressure on rare, endemic, endangered, threatened and protected species of both flora and fauna

Protected animals reported in the area may be at risk due to their high economic value. No activities affecting protected floral species will be carried out by the project during operation phase. However, project staff and dependants may involve in illicit trade of protected floral and faunal species.

The impact will be indirect in nature, low in magnitude, local in extent and long term in duration.

e) Illegal felling of vegetation, trade of NTFPs, hunting & poaching of wildlife and trade of fish

Although the number of workers will be reduced during the operation phase, there will be mobility of people due to the access road so there may be illegal hunting of wild animals. As some protected animals with high economic value are also recorded in the forest areas, there will be possibility of illegal hunting of the wild animals by project staff. Forest in the project

vicinity and upland area is rich in NTFPs resources of medicinal and higher economic value. The project operation staff and their dependent are likely to involve in collection and illicit trade of such goods in local market and beyond. Also, since the project is within the protected system i.e., within SNNP, fish species is not recorded in huge numbers. Therefore, the issue of fishing and trade of local fish is not relevant for this project.

The impact will be indirect in nature, low in magnitude, local in extent and long term in duration.

f) Human wildlife conflict

The area is the habitat for the Clouded leopard (*Pardofelis nebulosa*), Leopard cat (*Prionailurus bengalensis*), and Common leopard (*Panthera pardus*) which are vector to the humans and domestic animals of the study area. With the restoration of wild habitat, the presence of these wild *sps.* near the dam area might increase and could be threatening to the project operation persons.

The impact will be indirect in nature, low in magnitude, local in extent and long term in duration.

g) Encroachment in Shivapuri Nagarjun National Park

The impact is similar to that described in section 7.2.2.2 construction phase, heading "Encroachment in Shivapuri Nagarjun National Park".

Table 7-4: Summary of Significance of Adverse Impacts on Biological Environment

SN	Impact	Direct/Indirect Impact	Magnitude	Extent	Duration	Significance	
A	**Construction Phase**						
i.	Loss of vegetation due to clearance for the project structures and facilities	D	Mo (20)	SS (10)	Mt (10)	50	Moderate
ii.	Loss of biodiversity	D	Lo (10)	SS (10)	St (5)	25	Low
iii.	Wild life habitat fragmentation and destruction	D	Mo (20)	SS (10)	St (5)	35	Low
iv.	Pressure on rare, endemic, endangered, threatened, and protected species of both flora and fauna due to project activities	D	Lo (10)	SS (10)	St (05)	75	High
v.	Disturbance on the movement of wildlife due to construction activities	D	Mo (20)	L (20)	St (05)	45	Low
vi.	Illegal felling of vegetation, trade of NTFPs, hunting & poaching of wildlife and trade of fish	I	L (10)	L (20)	St (05)	35	Low
vii.	Disturbance to aquatic	D	H (60)	SS (10)	St (05)	75	High

SN	Impact	Direct/Indirect Impact	Magnitude	Extent	Duration	Significance	
	species and its habitat due to construction activities						
viii.	Impact due to fire hazard on forest resources	I	Lo (10)	L (20)	St (05)	35	Low
ix.	Human wildlife conflict	I	Lo (10)	L (20)	St (05)	35	Low
x.	Encroachment in Shivapuri Nagarjun National Park	I	Lo (10)	L (20)	St (05)	35	Low
B	**Operation Phase**						
i.	Disturbance to aquatic species and its habitat due to obstruction created by the weir						Not significant
ii.	Change in existing terrestrial ecosystem into aquatic ecosystem and loss of wildlife due to destruction and fragmentation of its habitat	D	Lo (10)	SS (10)	Lt (20)	40	Low
iii.	Disturbance on movement of animals due to project features	D	Lo (10)	Sp (10)	Lt (20)	40	High
iv.	Pressure on rare, endemic, endangered, threatened and protected species of both flora and fauna	I	Lo (10)	L (20)	Lt (20)	50	Moderate
v.	Illegal felling of vegetation, trade of NTFPs, hunting & poaching of wildlife and trade of fish	I	Lo (10)	L (20)	Lt (20)	50	Moderate
vi.	Human wildlife conflict	I	Lo (10)	L (20)	Lt (20)	50	Moderate
vii.	Encroachment in Shivapuri Nagarjun National Park	I	Lo (10)	L (20)	Lt (20)	50	Moderate

Note: D = Direct, I = Indirect, SS= Site specific, L= Local, R= Regional, St=Short Term, Lt= Long Term, H = High, M=Moderate, Lo= Low

Value in the parenthes are based on neumaric value provided in National Environmental Impact Assessment Guideline, 1993. Priority rank; 1 (sum of numerical value 70 or above) = highly significant; 2 (sum of numerical value 45 - 70) = moderately significant; 3 (sume of numeric value below 45) = low significant.

7.2.3 Socio-economic Environment

7.2.3.1 Pre-Construction Stage

a) Permanent Acquisition of Private Property

NDP will acquire all the required land for its implementation before commencing construction works. Project will require total 65.304 ha of land area out of which 62.977 ha is required permanently and 2.327 ha is temporary. The area under private ownership is 0.295 ha (Table 2-6). Private land with/without houses (Table 7-5) will be lost from 30 HHs due to the land acquisition. These directly affected households who lose their assets due to project activities are termed as Project Affected Family (PAF). None of the affected households will be physically displaced from the project sites as all of the households have either some parcels of remaining land. Further, the private owner will lose their property holding reducing their economic capacity. The ownership details of the private land with land parcel number has been attached in Annex 24.

The impact is direct, high in magnitude, site specific in extent and long term in duration.

Table 7-5: Extent of loss of land by affected HH as a result of NDP implementation

Category of Loss	Number of HH	Percentage of the total HH	Remarks
Land only	19	635	Total no. of land plots = 43
Land with house	8	27%	Cement concrete house
Land with shed/courtyard	3	105	
TOTAL	30	100.00	

Source: SIA Study of NDP, 2023

7.2.3.2 Construction Phase

a) Loss of private land and issue of food security

Project will acquire 0.295 ha of private land is permanently required for the construction of different project structures and facilities. The permanent acquisition of land will reduce the available land for the agriculture production for the impacted hhs. However, the required land is quiet low and impacted HHs have other sources of income for their livelihood. Therefore, envisioned to have low impact.

The impact will be direct in nature, moderate in magnitude, site specific in extent and long term in duration.

b) Loss of trees from private owned land

None of the households will lose any types of privately planted trees as a result of project construction.

c) Pressure on existing water supply systems

The active construction period is 7 years and DLP is proposed 2 years. During active construction period, a total of 300 human resources including technical and non-technical staff will be required. Existing drinking water supply system will face increased pressure due to requirement of additional water supply for the workforce concentrated in the project sites. Since, the headworks area is located far from settlement area and there could be other alternatives water source, drinking water facilities around powerhouse is likely to be affected more.

The impact will be indirect in nature, high in magnitude, local in extent and short term in duration.

d) Impacts on occupational health and safety

The construction activities such as blasting, using heavy equipment and working in the river, steep slopes, may cause accidents and injuries. The most common injuries that might occur are due to accidental falls from scaffoldings or other structures, injuries due to falling objects such as rocks or other construction equipment, collapse of excavations sites, traffic accidents and drowning. The victims will most probably be construction worker although injuries to local people are also possible. Similarly, construction practice without use of Personal Protective Equipments (PPE) like glove, boot and helmet results into the minor accidents. Work related injuries and vehicle accidents are the likely impacts predicted due to implementation of the proposed project.

This impact is expected to be direct, high in magnitude, short-termed in duration and site specific.

d) Pressure on existing infrastructures, facilities such as road, health post, education, health and sanitation facilities, etc

The project areas will experience the sudden increase in population, as more people will migrate in the areas during the project construction period due to jobs and business opportunities. Although, necessary infrastructure will be developed in the camp area, the capacity of existing community infrastructures such as health post, schools may not be sufficient to meet the increased population. Similarly, other infrastructures like drinking water supply health facility will face increased pressure due to demand from workforce concentrated in the project sites. The placement of project structure, facilities and construction of access road may disturb local foot trails, pipes of drinking water supply, trekking/hiking trails etc.

The nature of the impact is both direct/indirect, moderate magnitude, site specific and short term in duration.

e) Sudden increase on economic activities (boom and boost effect)

The increased economic activities and sudden flow of cash as a result of project construction activities may have negative impacts on peoples' livelihood. Large volume of cash flow is likely to escalate the price of commodities whose affect is likely to be greater to the locals

than the newcomers. Similarly, due to availability of other income generating options, local agricultural labors may be diverted towards the project works at the peak farming season, which may cause high demand of labors in agriculture, which will ultimately bring inflation in local agricultural products.

The impact will be indirect in nature, low in magnitude, local in extent and short term in duration.

f) Interference on cultural and traditional practices of the local people due to increased outside project staff and workers

The influx of large numbers of workers and job seekers into the project area is certain to cause major changes in social relationships, and cultural and traditional norms and values. People of diverse culture and attitude will come to project area during the construction phase. The existing culture and traditional practices of the local may not be familiar or similar to the outsiders. Thus, in such circumstances, intentionally or unintentionally outsiders' behaviour may hurt the local people sentiments if they don't follow the traditional culture of the society.

The impact is indirect, local extent, low in magnitude and expected to be short term duration.

g) Impacts on women and children

Involvement of men in project related construction work would increase women's workload. Besides performing household chores, and child rearing and bearing, the women in the project area may need to spend most of the time in farming activities. As a result, women will not have enough time to take good care of children and thus children's nutritional status and general health is likely to suffer. Similarly, due to the increase in availability and consumption of alcohol in the project area, the women are always vulnerable to sexual and physical violence both in work place as well as at home. Similarly, the involvement of the parents in the project may result in increase in workload of the children. Likewise, the direct involvement of the children in the project causes negative consequences effect on education as well as their health.

The impact is indirect, expected to be moderate in magnitude, short term in duration and local in extent

h) Impacts on law and order in the project area due to large work force

Due to the influx of workforce from different places and different ethnic and cultural background there will be possibilities of conflict of interest between the workers and project management and among workers and between outside workers and local communities. Local employment opportunities, information disclosure on wage rate and other benefits, working hours, cultural clash etc are the few examples to escalate conflicts. The situation of law and order will be affected as a result of the possible conflict between local and outsider due to social ills like misbehave by the project workers with local people, alcohol consumption, gambling, prostitutions, women trafficking, and quarrelling between local and outsiders.

The occurrence and significance of the impacts will largely depend on the composition of the work force, the anticipated social disturbances being higher with a more foreign workforce. In any case, *the impact is predicted to be indirect, moderate in magnitude, site specific in extent and for a short in duration.*

i) Impacts of STDs due to outside workers

The influx of large number of people with different social and cultural backgrounds is prominent during construction phase. Outside workers having regular income and being separated from families and working long hours schedule are in search of recreation in the form of alcoholism, gambling, illegal prostitution etc. The outside workforce may introduce transmissible disease of unknown nature to the communities. The mixing of the outside workforce sexually with the local community individuals due to unsafe sexual intercourse may also increase the risks of STD and AIDS/HIV in the community.

The impact will be indirect in nature, moderate in magnitude, site specific in extent and short term in duration.

j) Existing water use rights

The water of Nagmati river has been being utilized for consumptive purpose like drinking, irrigation, micro-hydro and water mills between dam and the powerhouse site (Table 5-30). Thus, water rights issues are significant for this project. However, during construction stage, the existing water use pattern will not be impacted from the NDP. Therefore, during construction stage the water use rights from the NDP is insignificant.

k) Loss of archaeological, religious and culturally important sites, if any

Sundaimai temple and Shiva temple are located within the project DIA. However, no rehabilitation of these sites is required. Therefore, tis impact is insignificant.

l) Impact on existing bridge and in the access road

Movement of many heavy types of equipment will be required for constructing the project structures. These, equipment will be carried to the construction sites through the existing roads and increased number of vehicle movement implifies pressure on existing bridge and high traffic in the access roads. This road and bridge are also used by upstream communities of Mulkharka and Chisapani for their movement. High movement of vehicles and traffic in the access road will might result in bridge collapse and may also hamper free passage of local road users of Mulkharka and Chisapanithat. Further, the existing access road is only 4 m wide which is insufficient for the safe movement of heavy vehicle.

The impact will be direct in nature, medium in magnitude, site specific in extent and short term in duration.

7.2.3.2 Operation phase

a) Loss of agricultural production and local economy

Details have been provided in Section 7.2.3.1 under “Loss of private land and issue of food security”

b) Water diversion and existing water use rights

The water of Nagmati River has been being utilized for consumptive purpose like drinking, irrigation, micro-hydro and water mills between dam and the powerhouse site (Table 5-30 and Table 5-31). The Sundarijal Water Supply diverts all water from both the Nagmati and Bagmati rivers for drinking water supply purposes, effectively leaving no flow downstream of the diversion weir in the Nagmati river nor downstream of the Sundarijal Water Supply

Reservoir on the Bagmati River. From some 30 years have been used traditionally by the Kageshowri Manohara Drinking Water Supply Committee for managing drinking water from the Bagmati river just above the proposed powerhouse within the project area. Now, a filter plant of 36 lps is under construction. In addition, two water mills exist just below 50m downstream from dam location that also requires adequate water flow for its operation. Since, multiple stakeholders are involved in the water use of Nagmati river between the dam and powerhouse site, conflict on water use seems inevitable. Thus, water rights issues are highly significant for this project.

The impact is direct, high in magnitude, local in extent and long term in duration.

c) Safety on movement of people and animals due to sudden change on release of water in downstream of the dam

The likely social impacts of altered river flows below the tailrace outlet are largely related to safety. The safety of all river users is likely to be affected by the variation in river flows below the outlet. Sudden downstream release and therefore rise and widen over a relatively short time. If people are using the river at this time and are unaware of the situation, or if operational routines change without notification, people (in particular children) and animals could be caught in the flow.

The impact is direct, low in magnitude, local in extent and long term in duration.

d) Recession of Local economy and change on people's behavior due to withdrawal of construction work

After the completion of the project many economic activities and opportunities will be withdrawn. Consequently, market areas, houses, hotels, etc. may also get deserted if other economic activities do not fill in the economic activities that prevailed during the construction phase. The reduction in economic activities and associated income will have some impact on local people. The withdrawal or decrease in economic activity during operation and maintenance may affect the lifestyle of the local people. Local people are habitual of more earning and expenses are raise as increase in economic condition of the people during construction period. People will face difficulties to manage the lifestyle.

The magnitude of the impact is predicted to be moderate because some of the economic activities might be continued during operation phase also. The extent is site specific and duration is medium term and indirect in nature.

Table 7-6: Summary of Significance of Adverse Impact on Socio-economic and Cultural Environment

SN	Impact	Direct/Indirect Impact	Magnitude	Extent	Duration	Significance	
A	**Construction Phase**						
i	Loss of private land and issue of food security	D	Mo (20)	SS (10)	Lt (20)	50	Moderate
ii	Loss of trees from private	D	Lo (10)	SS (10)	St (5)	25	Low

	owned land						
iii	Pressure on existing water supply systems	I	H (60)	L (20)	St (05)	85	High
iv	Impacts on occupational health and safety	D	H (60)	SS (10)	St (05)	75	High
v	Pressure on existing infrastructures facilities such as road, health post, education, health and sanitation	I	M (20)	SS (10)	St (05)	35	Low
vi	Sudden increase on economic activities (boom and boost effect)	I	Lo (10)	L (20)	St (05)	35	Low significant
vii	Interference on cultural and traditional practices of the local people due to increased outside project staff and workers	I	Lo (10)	L (20)	St (05)	35	Low significant
viii	Impacts on women and Children	I	M (20)	L (20)	St (05)	45	Moderate
ix	Impacts on law and order in the project area due to large work force	I	M (20)	L (20)	St (05)	45	Moderate
x	Impacts of STD due to outside workforces	I	M (20)	L (20)	St (05)	45	Moderate
xi	Existing water use rights						Insignificant
xii	Loss of archaeological, religious and culturally important sites						Insignificant
xiii	Impact on existing foot trail and wooden brigde in the headworks and pressure on foot trails and movement of people	D	M (20)	Sp (10)	St (05)	35	Low significant
xiv	Losses of private infrastructures and common property resources due to blasting, and use of heavy equipments	D	M (20)	SS (10)	St (05)	35	Low

B	Operation Phase						
i	Loss of agricultural productions and local economy	D	M (20)	L (20)	Lt (20)	60	Moderate
ii	Existing water use rights						Insignificant
iii	Safety on movement of people due to sudden change release of water in downstream of dam						Insignificant
iv	Recession of local economy due to withdrawal of construction work	I	M (20)	Sp (10)	M (20)	50	Moderately significant

Note: D = Direct, ID = Indirect, S= Site specific, L= Local, R= Regional, ST=Short Term, LT= Long Term, H = High, M=Moderate, LO= Low

Value in the parenthes are based on neumaric value provided in National Environmental Impact Assessment Guideline, 1993. Priority rank; 1 (sum of numerical value 70 or above) = highly significant; 2 (sum of numerical value 45 - 70) = moderately significant; 3 (sume of numeric value below 45) = low significant.

7.3 Cumulative Impacts

Dhap dam project is already in operation in the Nagmati river basin upstream of the proposed dam location of NDP. The cumulative impact assessment for the potential dam failure simultaneously from both the project at the same time scenario during the operation stage has been presented. The Dhap Dam is a concrete-faced rockfill dam approved to be built at the headwaters of the Nagmati River, extending and existing dam. The main objective of the Dhap dam is to support the Nagmati Dam in contributing to the BRBIP objective to increase environmental flow in the Bagmati River especially during dry season. The dam will store monsoon rainfall and release them during the non-monsoon season. The Dhap Dam is 24 m high with the reservoir capacity of 1,200,000 m^3. It can provide 40-400 l/s of discharge during dry season from the contributing catchment area of 0.8 km^2. The land use in the catchment feeding the dam lies entirely within the SNNP.

The cumulative impact assessment of other issues has not been documented in this EIA report. Though the dam has been designed following the best engineering design codes for dams, unexpected incident due to seismic movement can trigger simultaneous dam failure. The impacts from the dam failure have been explained in section 7.2.2.2 (h). The cumulative impact from the simultaneous dam failures will be the increase in flooding area downstream due to additional volume of water in the river channel subsequently impacting additional life and livelihoods downstream. Further, the time interval projected for flooding in the

downstream due to NDP dam failure will be reduced, therefore the reaction time to rescue the downstream population will also be reduced.

The impact will be direct in nature, high in magnitude, regional specific in extent and short term in duration.

CHAPTER 8 BENEFICIAL IMPACTS AUGMENTATION MEASURES AND ADVERSE IMPACTS MITIGATION MEASURES

This chapter includes the measures proposed to augment the potential beneficial impacts and mitigate/minimize/compensate the negative impacts. Mitigation is the process of providing solutions to prevent impacts or reduce them to acceptable levels. The objectives of mitigation are to: avoid, minimise or remediate the adverse impacts; and ensure that the residual adverse impacts are kept within acceptable levels.

Mitigation follows a hierarchy of approaches, expressed as "Avoid", "Minimise" and "Mitigate and Compensate". Measures to avoid or prevent negative or adverse impacts are prioritised and where avoidance is not practicable, then minimisation of adverse impacts is sought. Where both avoidance and minimisation are impracticable then mitigation and compensation measures are identified and undertaken commensurate with the project's risks and impacts. Residual impacts are those impacts that remain after all mitigation measures have been implemented and it is for these that compensation measures are often considered to "offset" the impact.

The project proponent ensures to implement the mitigation and enhancement measures illustrated in this section at different phases of project implementation and operation. The proponent understands that any additional measures required to avoid, minimize and compensate the adverse environmental effect unforeseen in this section is also its responsibility.

8.1 Beneficial Impacts

Implementation of NDP will have positive impacts on the local, regional as well as on the context of national development. Besides the benefits from the improvement of Bagmati river water quality, the project will generate employment and other benefits during the construction and operation phases. The identified and predicted beneficial impacts of the project are described below with potential augmentation measures. The proposed augmentation measures are anticipated to intensify the benefits generated through the implementation of NDP into larger area to an extent. The beneficial impacts from the NDP are presented in Table 8-1 with augmentation measures, implementation location of augmentation measures, time of implementation and responsible stakeholder for the implementation of augmentation measures.

Table 8-1: Beneficial Impacts with Enhancement Measures

S.N	Beneficial Impacts	Enhancement measures	Implementation Location	Time	Estimated Cost	Responsibility
A	**Construction phase**					
1	Employment opportunity	Priority to the PAF, poor and disadvantaged people for employment in the project Job related vacancy advertisement in local newspaper; Work related skill training for 100 people of Gokarneshwor Municipality Ward no.1	Project DIA	Before commencement of Construction works	NRs 100,000 for vacancy advertisement NRs 1,000,000 for training program	NDP Contractor
2	Increased Economic Activities	Conduct training on dairy product, poultry/livestock farming, vegetable farming, eco-tourism and furniture making	Project DIA	Within 6 months from the start of construction works	NRs 1,000,000 for training program and livelihood enhancement visit to Ilam	NDP
3.	Improved Accessibility	Construction of new bridge and extension of existing access road Regular maintenance of access roads Allowance of free movement of local communities through the access roads	Project access roads	Within 1 year of the start of work	Included in project cost	NDP Contractor
4	Exposure to new technology and technology transfer	Priority to the project affected families, poor and disadvantaged people for employment in the project; Provision for necessary training to the newly employed workers depending upon their skills and the nature of the work offered	Project DIA	Before commencement of Construction works	Refer S.N. A- 1	NDP Contractor
5	Potential	Allocated budget (0.5% of total project cost)	Project DIA	During	Will be allocated	NDP

S.N	Beneficial Impacts	Enhancement measures	Implementation Location	Time	Estimated Cost	Responsibility
	improvement of public facilities	under Community Support Program (CSP) for maintenance and improvement of health, education, drinking water, irrigation, road, street light installation and forest conservation sector		construction period	from CSP cost as required	
6	Improvement in livelihood	Conduct training on dairy product, poultry/livestock farming, vegetable farming, eco-tourism and furniture making	Refer S.N 1 and S.N 2	During construction period	Refer S.N 1 and S.N 2	NDP
7	Community support program	Allocated budget (0.5% of total project cost) for Community Support Program (CSP)	Refer S.N 5	Refer S.N 5	Refer S.N 5	NDP
	Sub total				**2,100,000**	
B	**Operation Phase**					
1.	Improved river water quality	Release of 0.45 m^3/s of additional discharge into the Bagmati river channel at Sundarijal during dry periods	Bagmati river channel at Sundarijal	Start of project operation	Will be allocated in annual project operation cost	Project operation manager/NDP
2.	Availability of water for socio-cultural usages	Release of 0.45 m^3/s of additional discharge into the Bagmati river channel at Sundarijal during dry periods	Bagmati river channel at Sundarijal	Start of project operation	-	Project operation manager/NDP
3.	Generation of Hydro-Energy	Provision of supply of hydro-energy to project DIA and Gokrneshwor Municipality from the NDP generated energy if possible.	Project DIA	After start of project operation	Will be allocated in annual project operation cost	NDP
4.	Supply of additional drinking water to Melamchi Water Supply Project during monsoon	Provision of drinking water supply to project affected water user committees through MWSP Project will coordinate with MWSP to extend its network to the project affected water user	Project DIA and Water user committee's areas	After start of project operation	Will be allocated in annual project operation cost	NDP

S.N	Beneficial Impacts	Enhancement measures	Implementation Location	Time	Estimated Cost	Responsibility
	season	committe's areas.				
5.	Generation of revenue through payment for ecosystem services (PES) charge to SNNP	Project will provide 20% of the generated revenue to SNNP as provision in SNNP regulation, 2018	SNNP	After start of revenue generation	Will be according to revenue generated	NDP
6.	Integrated watershed management	Project will promote the multiple use of available water; project will invest in biodiversity conservation and reservoir bank protection in coordination with SNNP	Within 1 km radius of project dam	After start of project operation in coordination with SNNP	@ 500,000 for biodiversity conservation awareness programs Will be allocated in annual project operation cost for reservoir bank protection programs	Project operation manager/NDP
7.	Flood control	Project will construct earthquake and extreme events resistance dam to protect downstream communities from flood events Regular maintenance of dam	Dam Area	From day 1 of project operation	Will be allocated in annual project operation cost for reservoir bank protection programs	Project operation manager/NDP
8.	Creation of wetland	Project will implement forest conservation programs in coordination with SNNP and will invest in biodiversity conservation and reservoir bank protection	Within 1 km radius of project reservoir	After start of project operation	Refer S.N B-5	NDP
9.	Ground water recharge	Project will conduct annual study on water springs downstream of the dam. If suitable source is found, the project will support relevant stakeholder for its use.	1km radius downstream of dam	After start of project operation for first five years	Will be allocated in annual project operation cost	Project operation manager/NDP

S.N	Beneficial Impacts	Enhancement measures	Implementation Location	Time	Estimated Cost	Responsibility
10.	Employment opportunity	Preferential priority to the PAF, poor and disadvantaged people for employment in the project Training on dam operation and maintenance	Project DIA	After start of project operation for first two years	NRs 100,000 annually for one training = NRs 200,000 for two trainings	Proponent
11.	Increment in economic activities	Local people will be encouraged to establish enterprises & small cottage industries which uses local resources; Local people will be encouraged to establish business that supply groceries and equipments/goods needs of the project Entrepreneur development trainings to 20 persons annually or livelihood enhancement visit to Ilam Project in coordination with HPCIDBC and SNNP will prepare and integrated eco-tourism plan of Bagmati Watershed including Nagmati and Dhap Dams Project will support Gokarneshwor Municipality and SNNP to promote traditional route to Dhap.	Project DIA	After start of project for first five years	NRs 100,000 annually for one training = 500,000 for five trainings or livelihood enhancement visit to Ilam and other similar districta NRs 2,000,000 for eco-tourism plan preparation of Bagmati Watershed	RM
12.	Generation of Royalty	As per Intergovernmental Fiscal Agreement Act, 2075, 25% of the total royalty will be given to the concern local level Investment in local development activities from the generated royalty by the Gokarneshwor Municipality	Gokarneshwor Municipality	After receival of royalty		Bagmati Province, MoPIT
13.	Community support	Support to the Project DIA communities on infrastructure development, health and education	Project DIA	After start of project operation	1,000,000 annually =	Project operation

S.N	Beneficial Impacts	Enhancement measures	Implementation Location	Time	Estimated Cost	Responsibility
	program	sector strengthening		for first five years depending upon the need assessment	5,000,000	manager/NDP
	Sub total				**NRs 8,200,000**	

8.2 Adverse Impacts

Implementation of any infrastructure project has its associated adverse impacts. NDP is being implemented within the SNNP which is an area designated/delineated for the conservation of biodiversity. Therefore, construction of NDP will pose adverse impacts on the wildlife habitat due to the direct intervention in the protected system. In addition, the area downstream is densely populated Kathmandu Metropolitan. Unanticipated dam failure could result into loss of lives and livelihood along the Bagmati river banks from dam to Bagmati river exit from Kathmandu Valley at Chobhar. During, the preparation of this EIA report, adverse impacts are predicted for pre-construction, construction and operation stages and necessary, practical impact mitigation and minimization measures are proposed to offset/reduce/minimize the adverse impacts of the project implementation. Compensatory measures are proposed for the irreversible impacts. Adverse impacts with potential mitigation measures, implementation location of mitigation measures, time of implementation, cost and responsible authority to implement the measures for physical environment, biological environment and socio-economic and cultural are presented in Table 8-2, Table 8-3 and Table 8-4 below.

8.2.1 Physical Environment

Table 8-2: Adverse Impacts on Physical Environment with Mitigation Measures

SN	Impact	Mitigation measures	Location	Time	Estimated cost	Responsibility
A	**Construction Phase**					
i.	Change on land use pattern and topography due to muck disposal,	Change on land use pattern from permanent build of structures will be residual impact as it is not reversible; Top soil collection, storage and reuse for the restoration	Project Construction and project support	Construction Period	NRs. 2,000,000	NDP

SN	Impact	Mitigation measures	Location	Time	Estimated cost	Responsibility
	land acquisition and build of structures	of temporary land acquired; plantation on the muck disposal area.	facilities area			Contractor
ii.	Change on water and soil quality due to possible spillage/leakage of toxic materials	Avoid spillage while storing, handling and using toxic materials, monitoring of use and leakage of toxic materials; Collection of spillage and careful disposal, strict rules in banning haphazard disposal.	Project Construction and project support facilities area	Construction Period	-	NDP Contractor
iii.	Degradation of water quality due to river water diversion, waste water generated from the washing of construction material at crusher plant site and batching plant operation	Installation of diversion pipe before the construction of coffer dam to allow natural flow of river water; diversion pipes of dia 1.2m will be installed at least 40m upstream and natural river water will be released 30m downstream from the coffer dam construction location to avoid mixing of construction materials with the river water; In the creek bed at the underside of each spoil area will be placed large boulders covered with finer rock, to allow a water passage beneath the spoil fill; Construction of sedimentation ponds of capacity 20 m^3 each at crusher plant and batching pant site to settle the waste water before releasing it into the river channel; Mixing of water pollutant such as cement, oil and other toxic materials into the river water will be avoided.	Coffer dams construction location Crusher plant and batching plant operation site	Construction period of coffer dam	Included in project cost	NDP Contractor
iv.	Degradation of water and air quality and increase in noise level	Restriction on discharge of construction waste to the river water; Development of proper waste disposal system for both solid and liquid waste; construction of double berm and impervious flooring of concrete around the oil and other storage area, monitoring of leaks and seepage; Regular maintenance of engines and machinery, isolation of crushing plants from the settlement, water sprinkling in dusty construction area as and when required, proper disposal of solid waste; Limiting Blasting at night; restriction on use of pressure horn near settlement and wildlife habitat area; proper maintenance of equipment	Project construction and project support facilities area	Construction period	NRs 2,000,000 for OHS training NRs 5,000,000 for regular water sprinkling NRs 1,000,000 for wire fencing in the blasting areas	NDP Contractor

SN	Impact	Mitigation measures	Location	Time	Estimated cost	Responsibility
		and machinery; construction of noise barrier such as thick plywood fence at heavily noisy construction area; installation of crushing plant away from settlement and providing ear plugs to the workers.				
v.	Impact due to operation of quarry site	Quarrying operations in the flood plain will be stripping operation rather than forming a big borrow pit at one location; The quarry operation will not be carried below the flowing water level of the river; piling of quarried materials, will be done on the designated place only; and since the quarry area will be inundated by the reservoir site reclamation will not be conducted.	Project quarry operation area	Construction period	Included in project cost	NDP Contractor
vi.	Impacts due to storage of construction material	Proper storage of construction materials. Re-use and proper disposal of its' remaining.	Project construction material storage yard area	Construction period	-	NDP Contractor
vii.	Damage on infrastructures due to the blasting and use of heavy equipments	Since the quarry area requiring blasting is far from settlement, it is envisioned that there will be no impacts from blasting; limiting blasting at day time only; compensation and repairing of damaged structures; information dissemination regarding timing of blasting	Nearby settlements and settlements along the access road where movement of heavy equipments are required	Construction period	NRs. 2,000,000	NDP Contractor
viii.	Impacts due to improper management of solid, construction and camp waste	Implementation of 4R principle (recognize, reduce, reuse and recycle) for waste management; Proper disposal of generated waste; Strict Prohibition on direct burning of waste and disposal on rivers will be implemented; training to project workforce on solid and construction waste management will be provided within first 3 months of start of construction works; septic tanks will be	Project construction and project support facilities area	within first 3 months of start of construction works	-	NDP Contractor

SN	Impact	Mitigation measures	Location	Time	Estimated cost	Responsibility
		constructed to collect sewerage waste which later will be transported into sewerage treatment plant at Sundarijal				
ix.	Impacts on slope stability, sedimentation and soil erosion	Application of proper bioengineering measures including toe wall, gabion, shotcrete, small civil engineering structures and vegetation; construction of slope protection structures such as revetment walls, benches or terraces riprap and spurs at appropriate location	Project construction, project support facilities area, project access road	Construction period	Included in project cost	NDP Contractor
x.	Impacts in drainage pattern	Material storage and muck disposal will be done only in designated area; Provision of both vertical and horizontal drains in places where natural drainage are disturbed such as project access road, muck disposal area, storage yard, camp area etc.	Project construction area, muck/spoil disposal area, project access roads and project support facilites	Construction period	Included in project cost	NDP Contractor
xi.	Impacts on natural spring and other water sources due to dam construction and penstock installation along the penstock alignment	Recording of potential natural springs and will be used to provide downstream water users for their use; water pipes/construction of storage tank/pond will be used to divert the water from the natural springs.	Dam area and penstock alignment	Construction period	NRs 2,000,000	NDP
xii.	Impacts of muck disposal	Safe disposal of muck; Compaction of loose soil particles and protection structures as per required; Use of muck in construction activities such as back filling, road maintenance, construction of gabion wall, drain ditches around the spoil disposal site and management of disposal site by plantation.	Muck disposal area	Construction period	Included in project cost	NDP Contractor
xiii.	Downstream Flooding due to the Failure of	This is the unanticipated impact as the coffer dams are designed after seismic and structural analysis to resist the	Project DIA and downstream of	Construction	Cost for siren installation is	NDP

SN	Impact	Mitigation measures	Location	Time	Estimated cost	Responsibility
	Coffer Dam	failure triggered by extreme events. However, the project will build mechanism to flow the information to the locals downstream such as installation of siren at Sundarijal and will conduct disaster preparedness trainings to the project DIA local people; Project will allocate emergency response preparedness fund	Sundarijal	period	included in project cost @ NRs 500,000 for disaster preparedness training to local of project DIA	
	Sub total				**14,500,000**	
B	**Operation Phase**					
i.	Impacts due to reduction in downstream flow and change in water quality	Maintaining downstream release or the environmental flow; Detail observation and monitoring for first five years operation period in order to understand downstream water requirements; training for dam gate operators for environmental release.	100m downstream of dam upstream from the Bagmati Nagmati confluence	first five years of operation period	Included in project operation cost	DoWRI-NDP
ii.	Impacts due to modification of landscape	Change in landscape will be residual impact; muck disposed area outside the inundated area will be reclaimed after proper stabilization of land; slope stabilization works implementing bio-engineering in the fragile and disturbed areas induced due to the project activities	Reclamation of muck disposal area will be completed within 6 months from project operation date; slope stabilization works will be conducted throughout the project operation period whenever	Within 6 months of project operation	NRs 2,000,000	DoWRI-NDP

SN	Impact	Mitigation measures	Location	Time	Estimated cost	Responsibility
			required.			
iii.	Impacts due to increased sedimentation on downstream due to sediment flushing from Reservoir	Insignificant				
iv.	Impacts due to change in micro-climate in Reservoir Area and De-watered Stretch	The continuous flow of environmental flow be maintained to minimize the impacts of micro-climatic change	De-watered Stretch downstream of dam	From the day of project operation	-	DoWRI-NDP
v.	Reclaiming the muck disposal area and quarry site area	The temporary land shall be returned to the GoN to the extent possible in the pre-leased state; plantation in the reclaimed area will be conducted.			Refer S.N B-ii	DoWRI-NDP /Contractor
vi.	Impacts of slope instability	Implementation of slope stabilization measures like bio-engineering method to stabilize the slope and to control the soil erosion having fragile geology if any unstable slope developed in project vicinity during operation; To avoid erosion and sedimentation problems, any bare surface will not be left near the project areas; Natural drainage will be maintained as far as possible	Project DIA	When required	Will be included in project operation cost	DoWRI-NDP
vii.	Impacts due to leakage of oil and grease and other liquid materials	All spent grease, engine oil and other lubricants and unused or date expired toxic chemicals will be collected separately in plastic drums and stored in a safe place under the shade; All empty containers of engine lubricants and toxic chemicals will be squeezed and stored in a safe place under the shade; Unused chemicals, spent engine lubricants; grease will be discharged only after approval of the environmental officer and his/her recommendation;	Construction material storage yard	Within 6 months from the start of project operation	NRs 500,000	Proponent

SN	Impact	Mitigation measures	Location	Time	Estimated cost	Responsibility
viii.	Flood Outburst due to Dam Failure	This is the unanticipated impact as the dams are designed after seismic and structural analysis to resist the failure triggered by extreme events. However, the project will build mechanism to flow the information to the locals downstream such as installation of siren at Sundarijal, Gokarna, Pashupatinath, Bagmati Bridge at Sinamangal and Thapathali and will conduct disaster preparedness trainings to the project officials for early response and proper management in disaster condition Project has prepared dam operation and maintenance manual. Summary of schedule duties from dam operation and maintenance manual of NDP is attached in Annex 28. Implementation of emergency response prepared for NDP. Summary is presented in Table 14-13. Emergency response fund allocation	Project DIA along the Nagmati and Bagmati river and downstream from Sundarijal to Bagmati river exit from Kathmandu Valley at Chobhar	Before completion of dam construction and throughout the operation period	Cost for siren installation is included in project cost @ NRs 2,000,000 for disaster preparedness trainings to the project officials for early response and proper management in disaster condition An emergency fund for this extreme event will be allocated by NDP/DoWRI	MoEWRI DoWRI NDP
ix.	Impacts in physio chemical parameters quality of water downstream of Nagmati dam and point of mixing of discharge release from NDP powerhouse in the Bagmati River at Sundarijal	The study conducted by Ling et. al, 2016, Bhatt and khanal, 2011 and Tomczyk, P and Wiatkowski, M, 2021 on changes in physio chemical parameters of water showed improvement in physio chemical water quality parameters descending from dam. Since, the project will release 150 lps of environmental flow from dam and also additional flow will be added in the Nagmati River from its tributaries springs below dam before mixing with Bagmati River near Sundarijal mai Temple, the changes in the physio chemical parameters of river water will be minimal. Further, the NDP will install Pelton Turbine for power generation which doesn't alter the physio chemical	Dewatered stretch and tail water release point of Bagmati River at Sundarijal	Operation period	Included in project monitoring cost during operation period	Operation Manager/NDP

SN	Impact	Mitigation measures	Location	Time	Estimated cost	Responsibility
		properties of the fed water. Also, there is 20m elevation drop between tail-race level and river normal water level providing sufficient for aeration by means of cascade drop therefore maintaining DO. NDP will conduct physio chemical parameters test twice a year (one in wet season and another in month May) to understand the changes in existing river water quality and will provide additional flow if further required for improvement in the dewatered stretch.				
	Sub total				**4,500,000**	
	Total				**19,000,000**	

8.2.2 Biological Environment

Table 8-3: Adverse Impacts on Biological Environment with Mitigation Measures

SN	Impact	Mitigation measures	Implementation Location	Time	Estimated cost	Responsibility
A	**Construction Phase**					
i.	Loss of vegetation due to the clearance and acquisition of forest land	Limiting tree cutting and forest clearance only in the areas required for construction activities. The trees in the submerged area of quarry site and spoil areas will remain standing. The trees above RL 1908 m in the reservoir area will not be cut because this area is above spillway and most of the time this area remains above the water. Compensatory plantation in the ratio 1:25 and maintenance of it for 5 years The broad-leaved trees will be planted in the 5 ha area near Mulkharka under the pine forest. After the completion of extraction, the site will be leveled and reclaimed to suit the landscape preferably by re vegetation; After piling the muck systematically, the temporary land shall be returned to the GoN not less than in the pre-leased state.	Project construction and project support facilities area and access road	Land substitution to SNNP within 2 years from the start of construction works Piling works 1 month prior to the start of construction works Reclamation of temporary forest land within 6 months of the project operation	Project will allocate required cost as per the land replacement cost evaluation committee. NRs. 978,322,500 for plantation (No. of trees = 61*1600+80258*25 = 2104050) NRs 71,562,500 clearance and piling up of felled tress NRs 12,000,000 barbed-wire fencing NRs 19,500,000 for maintenance for 5 years Total of all = 1,081,385,000	Proponent Contractor
ii.	Loss of biodiversity	Tree felling will be limited only in the area required; Provision of alternative energy sources such as LPG/Kerosene; Biodiversity conservation trainings to labors; Biodiversity program implementation in	Project construction area	Within 2 months of the start of construction works	Biodiversity conservation training program for labors NRs 1,000,000 annually during	Proponent/ Contractor

SN	Impact	Mitigation measures	Implementation Location	Time	Estimated cost	Responsibility
		coordination with SNNP			construction period for Biodiversity conservation program implementation in coordination with SNNP	
iii.	Wild life habitat fragmentation and destruction	Tree felling will be limited only to the required forest area; Unnecessary use of blasting and drilling activities will be avoided; project will build temporary pond to provide water for terrestrial wildlife in consultation with SNNP	Project DIA and area of 1km radius from dam axis	After 3 years of start of construction Construction of temporary pond will be completed within 6 months from the date of dam construction works	Lumpsum amount of NRs 200,000 for SNNP to study the habitat fragmentation and destruction due to the project A lumpsum amount of 5,000,000 for the construction of temporary pond	NDP SNNP
iv.	Pressure on rare, endemic, endangered, threatened, and protected species of both flora and fauna due to project activities	Emphasizing protected species for compensatory plantation plan; Restriction on illegal collection, hunting, poaching and trade of NTFPs and wild animals	Project construction area and area within radius of 500m from dam axis	Construction period	Refer S.N A- i and ii	Proponent/Contractor
v.	Illegal felling of vegetation, trade of NTFPs, hunting and	Strict prohibition on hunting, poaching activities and illegal felling of trees around the project area by the	Project construction area and area within	Construction period	Refer S.N A- i and ii	Proponent/Contractor

SN	Impact	Mitigation measures	Implementation Location	Time	Estimated cost	Responsibility
	poaching of wildlife	constructional workers Conduction of environmental awareness and conservation program/campaign	radius of 500m from dam axis			
vi.	Disturbance to aquatic species and its habitat due to construction activities	Preparation of waste management plan regarding the use, storage and disposal of toxic, solid and sanitary waste and materials Installation of water diversion pipe from 50m upstream of dam and coffer dam construction site	Dam construction area and along the Nagmati river upto Bagmati Nagmati confluence	Construction period	Included in project cost for diversion pipe installation	Proponent/Contractor
vii.	Impact due to fire hazard on forest resources	Safe storage of inflammable materials with fire extinguishing equipment facility; public awareness program and firefighting training to construction workers			NRs 150,000 for firefighting training to project officials NRs 5,000,000 for installation of Fire extinguishing equipment	Proponent/Contractor
viii.	Human wildlife conflict	Fencing of construction sites and camp area by barbed wire or stone/brick masonry wall; construction activities on day time only; restriction to project personnel and labors on roaming around the nearby forest area.	Project construction area and within radius of 1km upstream from dam axis	Construction period	Included in project cost	NDP Contractor
ix.	Encroachment in Shivapuri Nagarjun National Park	Dissemination of information to the local authorities and SNNP if found encroachment; prohibition to the construction workforce to enter into the local forest areas for recreation as well as illegal harvesting of forest resources	Project construction area	Construction period	Refer SN A-ii for Biodiversity conservation training program	Proponent/Contractor
	Sub total				**1,092,735,000**	

SN	Impact	Mitigation measures	Implementation Location	Time	Estimated cost	Responsibility
B	**Operation Phase**					
i.	Disturbance to movement of fish, aquatic species and its habitat due to obstruction created by the dam	Not significant				
ii.	Change in existing terrestrial ecosystem into aquatic ecosystem and loss of wildlife due to destruction and fragmentation of its habitat	Change in existing terrestrial ecosystem into aquatic ecosysystem in the inundated area will be the residual impact of this project Tree felling will be limited only to the required forest area; reclamation of habitat loss by developing plantation site and taking care for 5 years; implementation of wildlife habitat restoration programs	Project construction, temporary facilities areas and areas within 1km radius of dam axis	After 1 year of project operation	NRs 7,500,000 (NRs 1,500,000 annually) to study the habitat status of wildlife for five years NRs 20,000,000 (NRs 4,000,000 annually) to implement wildlife habitat restoration programs for 5 years Refer Table 8-3, Construction Phase S.N A-I for cost of maintenance of plantation works for five years	Operation Manager SNNP
iii.	Disturbance on movement of animals due to project features	Risky project structures such as dam area will be fenced to ensure the safe movement of wildlife	Dam area	Before 1 month from the start of project operation	Included in project cost	NDP
iv.	Pressure on rare, endemic, endangered,	Restriction on illegal collection, hunting, poaching and trade of NTFPs and wild animals; organizing the	Project DIA	Operation period	NRs 500,000 for Biodiversity and	Project operation

SN	Impact	Mitigation measures	Implementation Location	Time	Estimated cost	Responsibility
	threatened and protected species of both flora and fauna	awareness program on importance of protected plant and animal species and conservation practices			environment conservation awareness program to local people and operation manpower	manager
v.	Illegal felling of vegetation, trade of NTFPs, hunting & poaching of wildlife and trade of fish	Strict prohibition on hunting, poaching activities and illegal felling of trees around the project area by the operational workers; Conduction of environmental awareness and conservation program/campaign	Project operation area	Operation period	Refer SN-iv	Project operation manager
vi.	Human Wildlife conflict	Fencing of permanent office camp sites in the dam area by barbed wire or stone/brick masonry wall; restriction to project personnel and labors on roaming around the nearby forest area.	Project construction area and within radius of 1km upstream from dam axis	Operation period	Cost for regular fencing maintenance will be included in project operation cost	Project operation manager
vii.	Encroachment in Shivapuri Nagarjun National Park	Dissemination of information to the local authorities and SNNP if found encroachment; prohibition to the operation staffs to enter into the local forest areas for recreation as well as illegal harvesting of forest resources	Project operation area	Operation period	Refer V	NDP Project operation manager
	Sub total				**28,000,000**	
	Total				**1,120,735,000**	

8.2.3 Socio-economic and Cultural Environment

Table 8-4: Adverse Impacts on Socio-economic and Cultural Environment with Mitigation/Compensatory Measures

SN	Impact	Mitigation measures	Implementation location	Time	Estimated cost	Responsibility
A	**Pre-Construction Stage**					
i.	Permanent Acquisition of Private Property	Adequate compensation to the affected parties for permanent land acquisition at the rate fixed by the Compensation Fixation Committee (CFC) formed under the chair of Chief District Officer (CDO) of Kathmandu District; Project will acquire the whole land area in case of small clank is left over; Project will ensure the representation from impacted land owners while fixing the compensation rate for the private land acquisition; Priority to the affected households for employment opportunity	Permanent land acquisition area	Compensation to private land owners will be completed before 1 month of the construction works	NRs 265,779,076 for private property acquisition	DoWRI NDP
	Sub total				**265,779,076**	
B	**Construction Phase**					
i.	Loss of private land and issue of food security	The standing crops in the lands acquired will be compensated from negotiation with the land owners, if these lands have standing crops at the time of land acquisition; The construction of project component and facilities will be conducted in pre acquired land; Additional land or crops if damaged by the project activities, compensation will be paid to the concerned land owners as per the loss.	Permanent and temporary land acquired areas and land areas damaged by project activities	During land acquisition and as required for damages by project activities	NRS. 1,000,000 Contractor will be made responsible for the damages during construction phase	Proponent/Contractor
ii.	Loss of trees from private owned land	Compensation of the trees to the affected households	Permanent and temporary acquired private lands	1 month before the start of construction activities	NRS. 650,000	Proponent

SN	Impact	Mitigation measures	Implementation location	Time	Estimated cost	Responsibility
iii.	Pressure on existing water supply systems	Establishment of separate water supply for Construction activities and camps without disturbing local water supply facilities.	Project camp areas	Within 1 month from the start of the construction activities	Included in project cost	Proponent/Contractor
iv.	Impacts on occupational health and safety	Provision of adequate training on occupational health and safety to all construction workers; Provision of protective clothing such as helmets, boots, gloves, and mask to all construction workers, supervisors, and visitors; Restriction in access to construction sites to the public by fencing and using guards.	Project construction sites	From the day of start of construction activities	Included in project cost	Proponent/Contractor
v.	Pressure on existing infrastructures facilities such as road, drinking water, health post, education, health and sanitation	Local people will be employed in priority basis; Existing local services like drinking water, health service will be strengthen through Community Support Program (CSP); Adequate construction camp will be established.	Project DIA	During construction period when required	Will be allocated from CSP cost (0.5% of total project cost)	Proponent/Contractor
vi.	Sudden increase on economic activities (boom and boost effect)	Organizing awareness campaign in project impact area regarding the negative impacts of increased economic activities and encouraging the people for savings acquired directly/indirectly due to project implementation to control cash flow in the local market.	Project DIA	Before 6 months of construction works completion	-	Proponent/Contractor
vii.	Interference on cultural and traditional practices of the local people due to increased outside project staff and workers	Counseling to workers about local cultures, monitoring of workers behaviors and prohibition of local culture disruption activities, establish recreational facilities/service, support to *Aama Samuha* in preventing anti-social behaviors.	Project DIA	Construction period	-	Proponent/Contractor

SN	Impact	Mitigation measures	Implementation location	Time	Estimated cost	Responsibility
viii.	Impacts on women and Children	Provide employment opportunity to local women, conduct women empowerment activity, avoid child labor and strictly follow the labor act to fix the lower age bar to recruit construction workers.	Project DIA Construction camps	Within 6 months from the start of construction activities	NRs 200,000 for women empowerment trainings	Proponent/Contractor
ix.	Impacts on law and order in the project area due to large work force	The local law and order authorities will be regularly informed about the construction planning and sites of construction works and activities; The construction workforce will be regularly instructed to respect local people and their traditions and culture and not to indulge in any conflict with the local people; Avoid entering into private premises without informing and without the permission of the property owners; Provide opportunity for local people in construction related jobs;	Construction camps and project DIA	Construction period	-	Proponent/Contractor
x.	Impacts of STD due to outside workforces	Preference will be given to the local people in project related jobs and subsidiary opportunities; A strict code of conduct for the workforce will be formulated and enforced. In case any worker is found soliciting prostitution will be penalized and terminated;	Project DIA and construction camps	Construction period	-	Proponent/Contractor
xi.	Existing water use rights	Project will conduct formal discussions with the downstream water users committees and will support in identifying alternative source along with its management.	Downstream of dam in the dewatered stretch and areas of downstream water user committees	Within 3 months of the start of construction period	Will be allocated from CSP cost (0.5% of total project cost)	Proponent
xii.	Loss of archaeological, religious and culturally important sites	Ban on influx of an individual/mission/group of people having intention of influencing the people at the project site pertaining to imposition of some religion, apart	Project DIA and construction camps	Construction period	-	Proponent/Contractor

SN	Impact	Mitigation measures	Implementation location	Time	Estimated cost	Responsibility
		from their traditional religion, with the help of local authority				
xiii.	Impact on existing bridge and in the access road	A new bridge in same location will be constructed by the project and existing access road required for the project will also be upgraded to formation width of 5.5m.	Access road and existing bridge of access road	Within 6 months of start of construction works	Included in project cost	Proponent/Contractor
	Sub total				**1,850,000**	
B	**Operation Phase**					
i.	Loss of agricultural productions and local economy	The project will conduct agricultural training to increase production in remaining land using modern tools, improved variety of seeds and livestock assistance; Skill training, employment and other sources of income will also reduced this impact to acceptable level.	Project DIA	Within 6 months of project operation for first 3 years	NRs.1, 500,000	Proponent
ii.	Water diversion and existing water use right	Project will conduct formal discussions with the downstream water users committees and will support in identifying alternative source along with its management; project will ensure the release of required water from the dam to meet the downstream water users requirements.	Downstream of dam upto powerhouse at Sundarijal and downstream water user committees areas	Operation period	Will be included in annual project implementation budget	Proponent
iii.	Safety on movement of people due to sudden change of release of water in downstream of dam	An early warning system, specifically a siren system will be established to minimize this impact; Early information dissemination mechanism will be established by the proponent to prove early information to downstream communities.	Areas below dam at Sundarijal, Gokarna, Pashupatinath, Bagmati bridge at Tinkune and	Within 1 month of project operation	Included in project operation cost	Proponent

SN	Impact	Mitigation measures	Implementation location	Time	Estimated cost	Responsibility
			Thapathali			
iv.	Recession of local economy due to withdrawal of construction work	The project will give priority to provide employment to local people during operation phase also as far as possible; Encourage the workers to spend their earnings in a proper way from the time of construction; Facilitate the local people to establish small-scale local industries in the area through their earnings.	Project DIA	Within 6 months of project operation	NRs 500,000	Proponent
	Sub total				**2,000,000**	
	Total				**269,629,076**	

CHAPTER 9 ENVIRONMENTAL MONITORING

Environmental monitoring is an essential part of the EIA report to ensure the effectiveness of environmental mitigation measures, compliance with environmental standards and to facilitate any needed project design or operational changes. The major objectives of environmental monitoring are:

- To keep environmental impacts within the limits of standards fixed by legal instrument and to monitor continuously changes in baseline conditions during construction and operation stage.
- To measure the success of compliance of mitigation measures proposed for minimizing the likely environmental impacts, and
- To inform timely about the potential environmental losses.

9.1 Monitoring Agency

Regular monitoring of EMP implementation will be conducted by the implementing agency (internal monitoring) as well as by an independent external monitoring and evaluation organization or individual designated by MoEWRI/MoFE (external monitoring) to verify:

- Project activity comply with environmental laws and the impacts do not exceeds legal standards;
- Actions and commitments described in the EMP are implemented fully on time;
- EMP actions and compensation measures are effective enough to enhance (or at least restore) affected parties and/or environmental components;
- Complaints and grievances lodged by project affected people are followed up and that where necessary, appropriate corrective actions are implemented; and
- If necessary, changes in EMP procedure are made to improve delivery of entitlements to project affected people.

For the NDP, primary monitoring responsibility will rest with the Proponent. The Project Management and Supervision Consultant (PMSC) will be appointed to supervise the project construction woks in environmentally friendly way.

9.1.1 Internal

The internal monitoring will be carried out by Project Management and Supervision Consultant (PMSU) for NDP on a regular basis to assess progress against the schedule of action defined in the EMP. Further the works will also be monitored through Shivapuri Nagarjun National Park (SNNP) and Department of Water Resources and Irrigation (DoWRI). Activities to be undertaken by PMSC for EMP implementation will include;

- Liaison with the EMP implementation team, Land Acquisition Team, construction contractor and project affected communities to review and report progress against the EMP;
- Assess the progress on implementation of action and commitment describe in EMP;
- Verification that agreed measures to restore or enhance affected environmental components are being implemented;

- Identification of any problem, issue or cases related to environmental degradation and hardship of life affected communities resulting from the resettlement process;
- Assess project affected peoples' satisfaction with environmental and resettlement outcomes through informal village head and household interviews;
- Collect record of grievances, and follow-up to check that appropriate corrective action, if required have been undertaken and that outcome are satisfactory; and
- Prepare brief quarterly progress and compliance report for NDP management, external monitoring team, and MoFE.

9.1.2 External

An independent external monitoring and evaluation will be carried out by MoEWRI. A six-monthly review of the EMP implementation will be conducted by MoEWRI. The obtained results and necessary action undertaken to comply the prevailing environmental standards then will be notified to MoFE by MoEWRI in written. External monitoring will be conducted during the implementation period to ensure that the project activity comply with the environmental standards and to check the proper implementation of EMP as well as received grievances are addressed in a prompt manner to resolve the cases or not.

Activities that will be undertaken by the consultants include:

- Review of internal monitoring procedures and reporting to ascertain whether these are being undertaken in compliance with EMP;
- Review of internal monitoring record as a basis for identifying any areas of non-compliance, any recurrent problems, or potentially disadvantaged groups or households;
- Review grievances record for evidence of significant non-compliance or recurrent poor performance in resettlement implementation;
- Discuss with NDP management, PMSU staff, and others involved in land acquisition, compensation disbursement or livelihood restoration to review progress and identify critical issues;
- Survey affected households and enterprises to gauge the extent to which project affected peoples' standard of leaving and livelihood have been restored or enhanced as a result of the project;
- Assess overall compliance with the EMP requirements; and
- Prepare a summary monitoring report for NDP management, MoFE and financing institute on progress of EMP implementation, any issue arising and any necessary corrective actions.

9.2 Types of Monitoring

Three types of monitoring can be applied for environmental monitoring which are as follows:

9.2.1 Baseline Monitoring

Baseline monitoring is required to compile and maintain the database on environmental conditions prior to the project implementation, which is especially important if the project is delayed due to unforeseen circumstances. Such data recorded before the project implementations will facilities comparison of information obtained in monitoring activities

conducted during the project construction. Majority of environmental baseline information have been already enlisted in the EIA study. Thus, these information needs to be incorporated through baseline monitoring once before the commencement of construction works of the project. Baseline information of the parameters to be documented before the commencement of construction works are presented in Table 9-1.

9.2.2 Impact Monitoring

The actual impacts that have occurred due to project implementation should be closely monitored during the construction and operation of the project for the effective implementation of mitigation measures. Moreover, regular meetings should be held with local people to assess the impacts of the project on the community & environment and take note of their concerns. The Ministry of Forests and Environment is main organization to conduct Impact monitoring. The parameters that will be impacted due to the implementation of this project and that has to be monitored during construction and operation stages is presented in Table 9-2.

9.2.3 Compliance Monitoring

Compliance monitoring is essential in order to encourage and promote the proponent to comply with the requirements as listed in the mitigation measures and any condition set forth during the project approval. The compliance monitoring will monitor whether the mitigation measures and environmental enhancement programs recommended in EIA report were actually implemented as designed for the construction and operation phases. The parameters that have to be monitored for the compliance during the project construction and operation is presented in Table 9-3.

Table 9-1: Baseline Monitoring

Parameters	Indicator	Location	Method	Frequency/ schedule	Budget (NRs)	Monitoring Responsibility
Physical Environment						
Slope stability, landslides and soil erosion	Existing number of slope failure landslides/ debris flows/gully formation sites	Dam, powerhouse site, internal access roads, quarry site, penstock alignment and muck/spoil disposal area	Direct observation and mapping in the appropriate scale map	Once/pre-construction phase	500,000	NDP
River hydrology	Monthly flow record	Immediate upstream and downstream of dam upto the powerhouse area	Flow measurement, gauging	Once/Before construction	100,000	NDP
Air Quality	TSP, PM_{10}, $PM_{2.5}$ and dust accumulation in houses and vegetation	In and around construction site and project access road	As per National Ambient Air quality Standards, Nepal, 2012, site observation	Once/ pre-construction phase	250,000	NDP
Noise Quality	Noise level(dBA)	Construction site, project access road, quarry site and nearby settlements	Sound level meter	Once/pre-construction phase	100,000	NDP

Parameters	Indicator	Location	Method	Frequency/ schedule	Budget (NRs)	Monitoring Responsibility
Water Quality	DO, BOD, Turbidity, TDS, TSS, COD , Color, pH, hardness, oil, grease, coliform	Immediate u/s and d/s of proposed dam site and immediate d/s and just upstream of confluence with Bagmati river	Sample collection and laboratory analysis as per Generic Standard Part I: Tolerance Limits for Industrial Effluents to be Discharged into Inland Surface Waters, Nepal, 2003	Once/ pre-construction	500,000	NDP
Land pollution	Open defecation and scattered waste	Project DIA, proposed camp area and nearby forest	Direct observation	Once/pre-construction phase	25,000	NDP
Springs and water source	Number, discharge/uses/ household dependence	200 m stripe of dam area	Field Survey, maps and photographs	Twice; dry and wet season/pre-construction phase	2,000,000	NDP
Conditions of built structures	Cracks on build structure	Houses and build structures nearby construction site	Field Survey, maps and photographs	Once/pre-construction phase	25,000	NDP
Sub-total					**3,500,000**	
Biological environment						
Forest and vegetation	Forest status in terms of vegetation coverage and species	Forests within 0.5 km distance of the dam, penstock alignment, project access road and camp area	Forest sampling and photography from particular location, consultation with SNNP	Once/pre-construction phase	100,000	NDP SNNP

Parameters	Indicator	Location	Method	Frequency/ schedule	Budget (NRs)	Monitoring Responsibility
Wildlife status	Wildlife status in terms of species present and reported, raider wildlife (monkey, jackal, leopard)	Nearby forest	Consultation with locals, SNNP, note season of raiding, frequency of raiding, and the place raided	Once/pre-construction phase	400,000	NDP SNNP
Sub-total					**500,000**	
Socio-economic and cultural environment						
Economic status of project affected Wards	Household income and expenditure pattern of project affected people	Project surrounding settlements and affected Wards	Field observation, social-economic survey, discussions with local people	Once/pre-construction phase	500,000	NDP
Energy use	Fuel wood consumption in HHs, Source of HH energy	Project surrounding settlement and affected Wards	Discussions with local people and energy consumption survey	Once/pre-construction phase	-	NDP
Markets	Number of Hotels/Tea stall and Restaurants	nearby project area	Social survey, site observation	Once/pre-construction phase	-	NDP
Consumer price	Rental for night stay, labor cost/day (male and female) and price of daily consumable local and imported items such as rice, wheat, maize, millet, milk, meat (chicken, mutton, buff), sugar, kerosene, LPG, vegetables, food, etc.	project surrounding settlements	Market survey and documentation	Once/pre-construction phase	-	NDP
Health and sanitation	Common disease, no. of people served by health post, no. of illness, no. of untimely death case due to illness, no. of HHs having toilets, Practice of sanitation (Child defecation, solid waste disposal),	surrounding settlements	Field survey and documentation, Photographs and testing water quality samples as per drinking quality	Once/pre-construction phase	-	NDP

Parameters	Indicator	Location	Method	Frequency/ schedule	Budget (NRs)	Monitoring Responsibility
	Source of water (Piped, springs, river) and quality		standards			
Infrastructure and service delivery centers	Site accessibility, number and types of existing infrastructure facility, existing service centers,	Settlements in project surrounding area	Discussions with the local people and site observation	Once/pre-construction phase	-	NDP
Employment	Number of service holders in the project affected area	Project affected Wards	Socio-economic survey and review of secondary data	Once/pre-construction phase	-	NDP
Agriculture production	Types and quantity of crops grown, crops production rate	Project affected Wards	Social survey, field observation and discussions with the local people	Once/pre-construction	-	NDP
Disadvantaged groups	Employment, economic status, social status, education	Project affected Wards	Social survey and discussion with targeted group	Once/pre-constructio1n	-	NDP
Sub-total					**500,000**	
Total					**4,500,000**	

Table 9-2: Impact Monitoring

Monitoring Issues	Monitoring Indicator	Monitoring Location	Monitoring Method	Monitoring Frequency	Monitoring Cost	Monitoring Responsibility
Construction phase						
Slope stability, landslide and erosion	Newly developed landslides scar/ debris flows/gully formation sites	Dam and powerhouse site, internal access roads,	Field visit and site observation	Twice a year/ During Construction	500,000	NDP-PMSU

Monitoring Issues	Monitoring Indicator	Monitoring Location	Monitoring Method	Monitoring Frequency	Monitoring Cost	Monitoring Responsibility
		quarry site, penstock alignment and muck disposal area				
Air Quality	24 hours TSP and PM 10 (to examine impact on ambient air quality in relation to NAAQS standards	In and around construction site and project access road	As per National Ambient Air Quality Standards, Nepal, 2012	Twice a year (November, April) During Construction	1,000,000	NDP-PMSU
Water Quality	DO, BOD, Turbidity, TDS, TSS, COD , Color, pH, hardness, oil, grease, coliform	Immediate u/s and d/s of proposed intake site and immediate d/s	Sample collection and laboratory analysis as per Generic Standard Part I: Tolerance Limits for Industrial Effluents to be Discharged into Inland Surface Waters, Nepal, 2003	Quarterly During Construction	500,000	NDP-PMSU HPCIDBC
Noise quality	Noise level(dBA)	Construction site, project access road, quarry site and nearby settlements	Sound level meter	Twice a year (November, April) During Construction	100,000	NDP-PMSU
Land pollution	Open defecation and scattered waste	Construction area, proposed camp area and nearby forest	Direct observation	Daily During Construction	-	NDP-PMSU SNNP Gokarneshwor

Monitoring Issues	Monitoring Indicator	Monitoring Location	Monitoring Method	Monitoring Frequency	Monitoring Cost	Monitoring Responsibility
						Municipality Ward no. 1
Springs and water sources	Discharge/second, for the complained spring	Complained springs and water sources within 200 m strip of dam and penstock alignment	Field Survey and documentation in maps and photographs	Immediately after the receiving complaint (monitoring in dry and wet season only) During Construction	100,000	NDP-PMSU SNNP Gokarneshwor Municipality Ward no. 1
Conditions of built structure	Cracks on complained structures	Complained structures nearby construction site	Field Survey and documentation in maps and photographs	Immediately after the receiving complain	100,000	NDP-PMSU Gokarneshwor Municipality Ward no. 1
Forest and vegetation	Forest status in terms of vegetation coverage and species	Forests within 2 km distance of the dam, powerhouse, project access road and camp area	Forest sampling and photography from particular location, consultation with SNNP, DNPWC	Twice a year	100,000	NDP-PMSU SNNP DNPWC
Wildlife	Wildlife status in terms of presence of species Raider wildlife (monkey, beer, jackal, leopard)	Nearby forest and project surrounding area;	Consultation with locals, note season of raiding, frequency of raiding, and the place raided	Twice a year (September and March)	100,000	NDP-PMSU SNNP DNPWC

Monitoring Issues	Monitoring Indicator	Monitoring Location	Monitoring Method	Monitoring Frequency	Monitoring Cost	Monitoring Responsibility
Economic status of project affected Wards	Household income and expenditure pattern of project affected people	Project surrounding settlements and affected Wards	Field observation, social-economic survey, discussions with local people	Once a year	500,000	NDP-PMSU Gokarneshwor Municipality Ward no. 1
Energy Use	Fuel wood consumption in HHs, Source of HH energy	Project surrounding settlement	Discussions with local people and energy consumption survey	Once in a year	-	NDP-PMSU Gokarneshwor Municipality Ward no. 1
Markets	No of hotels/tea stall and restaurants	Settlements nearby project area	Social survey, site observation	Once in a year	-	NDP-PMSU Gokarneshwor Municipality Ward no. 1
Consumer price	Rental for night stay, labor cost/day (male and female) and price of daily consumable local and imported items such as rice, wheat, maize, millet, milk, meat (chicken, mutton, buff), sugar, kerosene, LPG, vegetables, food, etc.	project surrounding settlements	Market survey and documentation	Every month	-	NDP-PMSU Gokarneshwor Municipality Ward no. 1
Health and sanitation	Common disease, no of people visit in the health post, no of illness, no of untimely death case due to illness, no of HH having toilets, Practice of sanitation (Child defecation, solid waste disposal), Source of water (Piped, springs, river) and quality	project surrounding settlements	Field survey and documentation, Photographs and testing water quality samples as per drinking quality standards	Monthly	-	NDP-PMSU Gokarneshwor Municipality Ward no. 1

Monitoring Issues	Monitoring Indicator	Monitoring Location	Monitoring Method	Monitoring Frequency	Monitoring Cost	Monitoring Responsibility
Infrastructure and service delivery centers	Site accessibility, number and types of existing infrastructure facility, existing service centers and pressure on them	Settlements in project surrounding area	Discussions with the local people and site observation	Once a year	-	NDP-PMSU Gokarneshwor Municipality Ward no. 1
Employment	No of service holders in the project affected area	Project affected Ward	Socio-economic survey and review of secondary data	Once a year	-	NDP-PMSU Gokarneshwor Municipality Ward no. 1
Agriculture production	Agriculture land availability, types and quantity of crops grown, crops production rate	Project affected Ward	Social survey, field observation and discussions with the local people	Once in a year	-	NDP-PMSU Gokarneshwor Municipality Ward no. 1
Disadvantaged groups	Employment, economic status, social status, education	Project affected Ward	Social survey and discussion with targeted group	Once a year	-	NDP-PMSU Gokarneshwor Municipality Ward no. 1
Sub total					3,000,000	
	Operation phase					
Slope stability land slide and soil erosion	Newly developed scar of landslide/ slope failure/debris flows/gully formation sites	Dam and reservoir area, powerhouse site,	Direct observation and mapping in the appropriate scale map	Twice a year for first 5 years of operation	Will be included in project	DoWRI-NDP

Monitoring Issues	Monitoring Indicator	Monitoring Location	Monitoring Method	Monitoring Frequency	Monitoring Cost	Monitoring Responsibility
		Penstock alignment, internal access roads, and muck/spoil disposal area			operation cost	
River hydrology	150 lps d/s release from dam	Immediate upstream and downstream of dam and just upstream of the confluence with the Bagmati river.	Flow measurement, gauging	Every month	Will be included in project operation cost	DoWRI-NDP SNNP HPCIDBC
Air Quality	TSP, PM_{10} and dust accumulation in settlements and vegetation	In and around construction site and project access road	As per National Ambient Air quality Standards, Nepal, 2003	Once after operation	500,000	DoWRI-NDP
Noise level	Noise level(dBA)	Dam, project access road, and nearby settlements	Sound level meter (as used during baseline monitoring)	once after operation	50,000	DoWRI-NDP
Water Quality	DO, BOD, Turbidity, TDS, TSS, COD , Color, pH, hardness, oil, grease, coliform	Immediate upstream and downstream of dam and immediate d/s and just upstream and downstream of water discharge point from the powerhouse in the Bagmati river at Sundarijal	Sample collection and laboratory analysis as per Generic Standard Part I: Tolerance Limits for Industrial Effluents to be Discharged into Inland Surface Waters, Nepal, 2003	Twice a year (November, April) for first 5 year	500,000	DoWRI-NDP HPCIDBC

Monitoring Issues	Monitoring Indicator	Monitoring Location	Monitoring Method	Monitoring Frequency	Monitoring Cost	Monitoring Responsibility
Land pollution	Open defecation and scattered waste	Nagmati river and Bagmati river bank upto Sundarijal from dam location, proposed camp area and nearby forest	Direct observation	Once a year for first year	25,000	DoWRI-NDP SNNP HPCIDBC Gokarneshwor Municipality Ward no. 1
Springs and water source	Discharge/second, for the springs monitored in the baseline monitoring	200 m stripe of dam, penstock alignment and project access road	Field Survey and documentation	Once a year in dry season for first 2 years	50,000	DoWRI-NDP SNNP Gokarneshwor Municipality Ward no. 1
Forest and vegetation	Forest status in terms of vegetation coverage, tree density and species	Forests within 2 km distance of the reservoir	Forest sampling and photography from particular location, (place of photo taken and sample plot same as baseline monitoring)	Twice a year for first 2 year (September and March)	500,000	DoWRI-NDP SNNP DNPWC
Wildlife	Wildlife status in terms of presence and siting of species, raider wildlife (monkey, porcupine, jackal, leopard)	Nearby forest	Consultation with locals, note season of raiding, frequency of raiding, and the place raided	Twice a year for first 2 years (September and March)	500,000	DoWRI-NDP SNNP DNPWC
Economic status of project	Household income and expenditure pattern of people in affected settlements and Wards	Project surrounding settlements and	Field observation, social-economic survey,	Once for the first year of	500,000	DoWRI-NDP Gokarneshwor

Monitoring Issues	Monitoring Indicator	Monitoring Location	Monitoring Method	Monitoring Frequency	Monitoring Cost	Monitoring Responsibility
affected Wards		affected Wards	discussions with local people	operation		Municipality Ward no. 1
Markets	No of Hotels/Tea stall and Restaurants	nearby project area	Social survey, site observation	Every month/ for the first year of operation	-	DoWRI-NDP Gokarneshwor Municipality Ward no. 1
Consumer price	Rental for night stay, labor cost/day (male and female) and price of daily consumable local and imported items such as rice, wheat, maize, millet, milk, meat (chicken, mutton, buff), sugar, kerosene, LPG, vegetables, food, rental for night stay etc.	project surrounding settlements	Market survey and documentation	Every month for the first year of operation	-	DoWRI-NDP Gokarneshwor Municipality Ward no. 1
Agriculture production	Agriculture land availability, types and quantity of crops grown, crops production rate	Project affected Wards	Social survey, field observation and discussions with the local people	Once for first year of operation	-	DoWRI-NDP Gokarneshwor Municipality Ward no. 1
Sub total					**2,625,000**	
Total					**5,625,000**	

Table 9-3: Compliance Monitoring

Monitoring Issues	Monitoring Indicator	Monitoring Location	Monitoring Method	Monitoring Frequency	Monitoring cost	Monitoring Responsibility
Pre-construction						
Inclusion of environmental considerations in tender documents and thereafter into the contractors work plan	Written statement in tender document and construction work plan	In tender document	Review of detailed design, specification, tender documents and construction work plan The presence in the contractors work plan of each of the environmental considerations from the tender documents	Once, before approval of tender document	-	MoEWRI DoWRI NDP
Land acquisition and compensation	Land/property acquisition procedure	Affected parties	Discussions with local people and the project management	Once/during land acquisition	500,000	MoEWRI DoWRI DAO, Kathmandu NDP
Permits and approvals	Permits and approvals recipient from concerned legal authority	Project affected area	Compliance with license and permit conditions	Once weekly	-	DoWRI NDP
Sub-total					**500,000**	

Monitoring Issues	Monitoring Indicator	Monitoring Location	Monitoring Method	Monitoring Frequency	Monitoring cost	Monitoring Responsibility
Construction phase						
Environmental flow	River flow variation downstream of dam Average monthly flow of Nagmati river	Downstream of dam upstream of the Bagmati river and Nagmati river confluence	River water measurement and documentation	Daily/weekly/ monthly depending upon the measure	1,000,000	HPCIDBC SNNP NDP-PMSU Contractor
Water quality	Parameters listed in "Tolerance Limits for Industrial Effluents to be Discharged into Inland Surface Waters" 2003 – for compliance	Sanitary discharge of camps after treatment Aggregate washing point discharge after treatment Sample station 500m downstream of dam site	Same methodology used for baseline monitoring	Monthly	500,000	HPCIDBC SNNP NDP-PMSU Contractor
Air Quality	TSP/PM_{10}, CO, CO_2, Nox, Sox Spraying of water regularly on work activity areas as appropriate. Vehicular emission tests as per GON standard Maintenance of the equipment as per specifications	Project Construction area including project access roads and project support facilities	As per Nepal Air Quality Standards, 2012 Nepal Vehicular Emission Standard, 2012	Monthly	2,000,000	NDP-PMSU SNNP Contractor

Monitoring Issues	Monitoring Indicator	Monitoring Location	Monitoring Method	Monitoring Frequency	Monitoring cost	Monitoring Responsibility
Noise level and vibrations	• Monitoring of noise levels in the project construction area, project access road and project support facilities • Maintenance of equipment in accordance with manufacture's specifications. • Traffic movement control and limit on horns • Controlled blasting • Monitoring of vibration levels		As per Nepal Noise Level Standard, 2012 Documentation of impacts on nearby sellements of project DIA	Bi-monthly/monthly depending upon the requirement	1,000,000	NDP-PMSU SNNP Contractor
Water quality in the camps	As per Nepal Drinking Water Quality Standard for compliance	Water supply reservoir and tap of the camps	As per Nepal Drinking Water Quality Standard	Once in Six Months	500,000	NDP-PMSU Contractor
Slope stability	Landslides, mass wasting	project construction area, project access road and project support facilities	Direct observation and documentation	Weekly/monthly depending upon the measure during rainy season	500,000	NDP-PMSU SNNP Contractor, Gokarneshwor Municipality
Erosion and sedimentation	Effectiveness of the controls Fresh soil erosion	project construction area, project access road and project	Direct observation and documentation	Weekly/monthly depending upon the	1,000,000	NDP-PMSU SNNP Contractor

Monitoring Issues	Monitoring Indicator	Monitoring Location	Monitoring Method	Monitoring Frequency	Monitoring cost	Monitoring Responsibility
		support facilities		measure		Gokarneshwor Municipality
Spoil/muck disposal	Reuse of spoil wherever possible (within and outside the project) Adopted mechanism of spoil disposed in the designated area	Spoil disposal sites	Direct observation and documentation	Weekly/monthly depending upon the measure	500,000	NDP-PMSU SNNP Contractor, Gokarneshwor Municipality
Top soil management	Adopted mechanism of top soil management in the designated area	Top soil management sites and construction sites	Direct observation and documentation	Weekly/monthly depending upon the measure	500,000	NDP-PMSU SNNP Contractor Gokarneshwor Municipality
Waste management	Waste material reused and recycled from project construction sites, camps and ancillary sites Management of non – recyclable waste in the designated sites	Project Construction area and Nagmati and Bagmati river banks upto sundarijal	Direct observation and documentation	Weekly/monthly depending upon the measure	500,000	NDP-PMSU SNNP Contractor, Gokarneshwor Municipality
Tree Felling and Vegetation clearance	Permits and approval for tree cutting and vegetation clearance Presence of authorized official during tree cutting and vegetation clearance Number of trees cut at the project site	Area of tree cutting and vegetation clearance required for the project	Direct observation and documentation in presence of legal authority from SNNP	Daily	500,000	NDP-PMSU SNNP Contractor

Monitoring Issues	Monitoring Indicator	Monitoring Location	Monitoring Method	Monitoring Frequency	Monitoring cost	Monitoring Responsibility
	and in the project vicinity Storage of cut trees compliance with the legal requirement					
Aquatic ecology	Fish species and macro-invertebrates density	Sample station 500 m downstream dam site upstream of Bagmati Nagmati confluence	Same procedure followed for baseline monitoring	Quarterly/ one in every season	800,000	HPCIDBC NDP-PMSU SNNP Contractor
Terrestrial ecology	Encroachment on the forested and vegetation area beyond delineated area	Project construction area, project access roads and project support facilities sites	Direct observation and documentation	Monthly	500,000	NDP-PMSU SNNP Contractor
Public and occupational health and safety	Outbreak of epidemic in the village and construction camps. Management of ambulance, first aid, PPE in the construction sites Number of workers reporting sickness, injuries, construction accident and fatal incidents etc.	All surrounding villages and construction sites and camps,	Direct observation, consultation with local people/communities and health workers, managers of camps and construction workforce, health care facilities of the construction camps and sites	Twice a month	500,000	NDP-PMSU Contractor
Traffic and access	Check maintenance records and 'green stickers' Enforcement on speed limits and horn noise levels.	Project access roads	Direct observation and consultation	Monthly	500,000	NDP-PMSU Contractor

Monitoring Issues	Monitoring Indicator	Monitoring Location	Monitoring Method	Monitoring Frequency	Monitoring cost	Monitoring Responsibility
Grievances settlement on social issues	Settlement of cases of disputes	Project DIA	Site observation and discussion with local people	Once a year and when required	200,000	DoWRI NDP-PMSU Contractor Gokarneshwor Municipality
Law and order and security	Theft, burglary, quarrels, social unrest, number of police case etc.	Construction areas, labor camps	Direct observation and consultation with the local communities and affected Wards authority and reports of the construction camp management	Monthly	50,000	NDP-PMSU Contractor Gokarneshwor Municipality Local police station
Sub-total					**11,050,000**	
Operation phase						
Demolition and removal of temporary structures and rehabilitation of the temporary construction sites, muck disposal/topsoil management sites	Effectiveness of rehabilitation measures at sites	All the sites to be rehabilitated identified by this EIA study	Direct supervision and documentation	Daily/weekly/ monthly depending upon the measure till the completion of rehabilitation works	200,000	DoWRI-NDP DNPWC/SNNP MoFE MoEWRI Gokarneshwor Municipality

Monitoring Issues	Monitoring Indicator	Monitoring Location	Monitoring Method	Monitoring Frequency	Monitoring cost	Monitoring Responsibility
Compensatory plantation/revegetation	Effectiveness of compensatory plantation, regeneration status	Compensatory plantation sites	Direct supervision and documentation	Daily/weekly/ monthly depending upon the measure till 5 years from the day of operation	1,000,000	DoWRI-NDP DNPWC/SNNP MoFE Gokarneshwor Municipality
Water quality in the operation camp	As per Nepal Drinking Water Quality Standard	Water supply reservoir and tap of the camps	As per Nepal Drinking Water Quality Standard	Once in six months	Will be allocated in the annual budget of NDP	DoWRI-NDP
Health, sanitation and safety	Number of workers reporting sickness, injuries, accident and fatal incidents etc.	Project area; powerhouse and dam	Site observation and discussion with workers and local people	Once a year	Will be allocated in the annual budget of NDP	DoWRI-NDP
Grievances settlement on social issues	Settlement of cases of disputes	Project DIA	Site observation and discussion with local people	Once a year and when required	Will be allocated in the annual budget of NDP	DoWRI-NDP /MoEWRI/ Gokarneshwor Municipality
Downstream water release as recommended in EIA	Water volume released from the dam and associated structure to downstream	Downstream low flow zone	Discharge measurement at the 100 m downstream of dam	Bi-Monthly (twice a month)	Will be allocated in the annual budget of NDP	DoWRI-NDP

Monitoring Issues	Monitoring Indicator	Monitoring Location	Monitoring Method	Monitoring Frequency	Monitoring cost	Monitoring Responsibility
Sub-Total					**1,200,000**	
Total					**12,750,000**	

CHAPTER 10 ENVIRONMENTAL AUDIT

Environment Protection Act, 2019, Chapter 2, Section 12, the environmental audit of NDP will begin after two years of the completion of the project. The environmental audit will be completed within six of the project operation. The NDP-PIU will make necessary arrangements for this Audit through GON or its nominated auditor.

The role of the environmental auditor is to identify environmental changes arising from the project and to assess the effectiveness of the mitigation measures adopted, suggesting additional measures where appropriate. The environmental auditor needs to record the nature and scale of actual changes to baseline conditions and compare them with the predicted impacts. Where mitigation measures have been adopted, some assessment of their effectiveness must be made. Where measures are inadequate or impacts unforeseen, a strategy for restoration needs to be formulated in consultation with the relevant bodies. It is also essential that the effectiveness of mitigation measures be assessed over time to ensure that temporary stopgap solutions are not employed and that any gradual, but potentially serious, deterioration in environmental quality is detected.

The function of the environmental audit may, therefore, be summarized as follows:

- Verify compliance with the stated mitigation/performance targets
- Verify compliance with relevant environmental legislation
- Ensure minimum human exposure to environmental risk
- Advice on environmental improvements
- Liaise closely with the parties involved in the monitoring process and initiate a counterpart program for the audit to ensure institutionally memory;
- Review the overall success of the project in relation to its environmental goals and suggest where improvements in procedure could be made in the future.

10.1 Types of Environmental Audit

10.1.1 Decision Audit

It examines the effectiveness of the EIA as a decision-making tool.

10.1.2 Implementation Audit

It ensures that approved terms and conditions have been fulfilled.

10.1.3 Performance Audit

It studies the work of agencies associated with proposal management.

10.1.4 Project Impact Audit

It examines environmental changes arising from the proposal implementation.

10.1.5 Predictive Technique Audit

It examines the accuracy and utility of predictive techniques by comparing actual against predicted environmental impacts.

10.1.6 Environmental Impact Assessment (EIA) Procedure Audit

The EIA Procedure Audit examines critically the methods and approaches adopted during the EIA study.

10.2 Institutions/Stakeholders Involved in Environmental Audit

Generally, three stakeholders are involved in environmental audit. They are as follows:

a) Auditor: The institution/stakeholder who will perform the environmental audit.
b) Auditee: The institution/stakeholder who will be audited
c) Third Party: Independent organization/person/consultant appointed either by auditor or auditee to perform environmental audit.

10.3 Types of Audits depending upon the organization/stakeholder involvement

The types of audits depending upon the organization/stakeholder involvement for audit are as follows:

a) Internal Audit
b) External Audit
c) Mandatory Audit
d) Voluntary Audit

10.4 Environmental Audit Report Format

EPR, 2020 has prescribed the format for the Environmental Audit report format which is presented in the Table 10-1 and the checklist to be used for the environmental auditing is presented in Table 10-2 below.

Table 10-1: Repot Format for Environmental Audit

Chapter 1	Executive Summary
Chapter 2	Description of audit works, interviews conducted in the project site, areas of audit and applied methodologies, information/data/particulars related to environmental monitoring and auditing can be included in this chapter.
Chapter 3	Complete decision of auditing
Chapter 4	Recommendations to be complied and corrective task to be followed regarding the project's effective performance
Annex	Concerned data and particulars
Team members for Environmental Auditing	
Expert	Expert related to proposal
	Environmental Expert
	Socio-economic. cultural Expert
	Other experts depending on the nature. magnitude and impacts it causes

Table 10-2: Checklist for Environmental Audit

SN	Particular	Project activity	Expected impact	Actual impact	Mitigation measures	Effectiveness	Informatiom	Source of information
1. Physical Aspect								
1	Air quality							
2	Water Quality							
3	Level pf noise							
4	Land use							
5	Water resource							
2. Biological Aspects								
1	Forest							
2	Vegetation							
3	Wildlife							
4	NTFP							
5	Fish							
6	Threatened species							
3. Socio-economic and cultural aspects								
1	Education							
2	Agriculture							
3	Employment							
4	Migration							

5	Health & sanitation							
6	Aesthetic							
7	Gender issues							
8	Religious & cultural condition							
9	Social condition							

Source: EPR, 2020

10.5 Environmental Auditing Schedule

As per EPR, 2020 environmental audit will be carried out one time after two years of operation of the project.

CHAPTER 11 CONCLUSION AND COMMITMENT

11.1 Conclusion of Study

The NDP will provide substantial environmental benefits and increase water security for the population in the Upper Bagmati Basin. Whilst the extension of the Dhap Dam during Phase I will create the opportunity for achieving bathing water quality standards at temple sites down to Pashupatinath during festivals in the dry season, establishing the Nagmati dam will provide a storage capacity to achieve year-round bathing water quality at the temple sites down to Pashupatinath through the improved water flow. Provided all the sewerage discharging the river will be completely removed and only treated water discharge to the river.

The social and environmental impacts caused by siting, planning, design, pre-construction; construction and operation of the Nagmati project, after mitigation measures are implemented are generally minor. The negative impact from clearing of the trees in the Nagmati reservoir area will be fully compensated through compensatory plantation of trees following GoN rules. The Nagmati project will support SNNP by providing monitoring means such as transportation vehicle and equipment. In addition, watershed improvement support will also be provided.

The EIA study report shows that construction and operation of Nagmati Dam Project will culminate the beneficial impacts in all level such as local, provincial and the national. In addition, pilgrims and tourists will have their higher level of satisfaction as a result of bathing quality and quantity of water in the bagmati river basin. This EIA study has identified, predicted and outlined the beneficial and adverse impacts while the project is executed within the SNNP and downstream.

The beneficial impacts identified from the project are found more significant and important as compared to the adverse impacts. However, the adverse impacts are negligible and for short-term. The adverse impacts of the Nagmati Dam Projects can be prevented or minimized adopting the environmental mitigation measures recommended in this report. Most of the adverse impacts predicted and identified are insignificant to moderately significance and short termed. In addition, the generation of employment, promotion of local market and tourism, development of dam infrastructure will significantly contribute in improving livelihood of the local people. Therefore, it is an appropriate step to establish and operate the project with due consideration and implementation of all the recommended mitigation measures.

The Nagmati Dam Project's EIA is undertaken according to all provisions and and format outlined in Annex 14 of EPR 2020. Hence, there is no need for further study.

11.2 Commitments of the Proponent

The proponent of this Nagmati Dam Project is fully committed to implement recommendations and measures to maximize beneficial impacts as well as timely execute the adverse impacts mitigation measures outlined in this EIA report. Moreover, the proponent will also act and mitigate or compensate any loss from the project implementation that are incurred during the project implementation.

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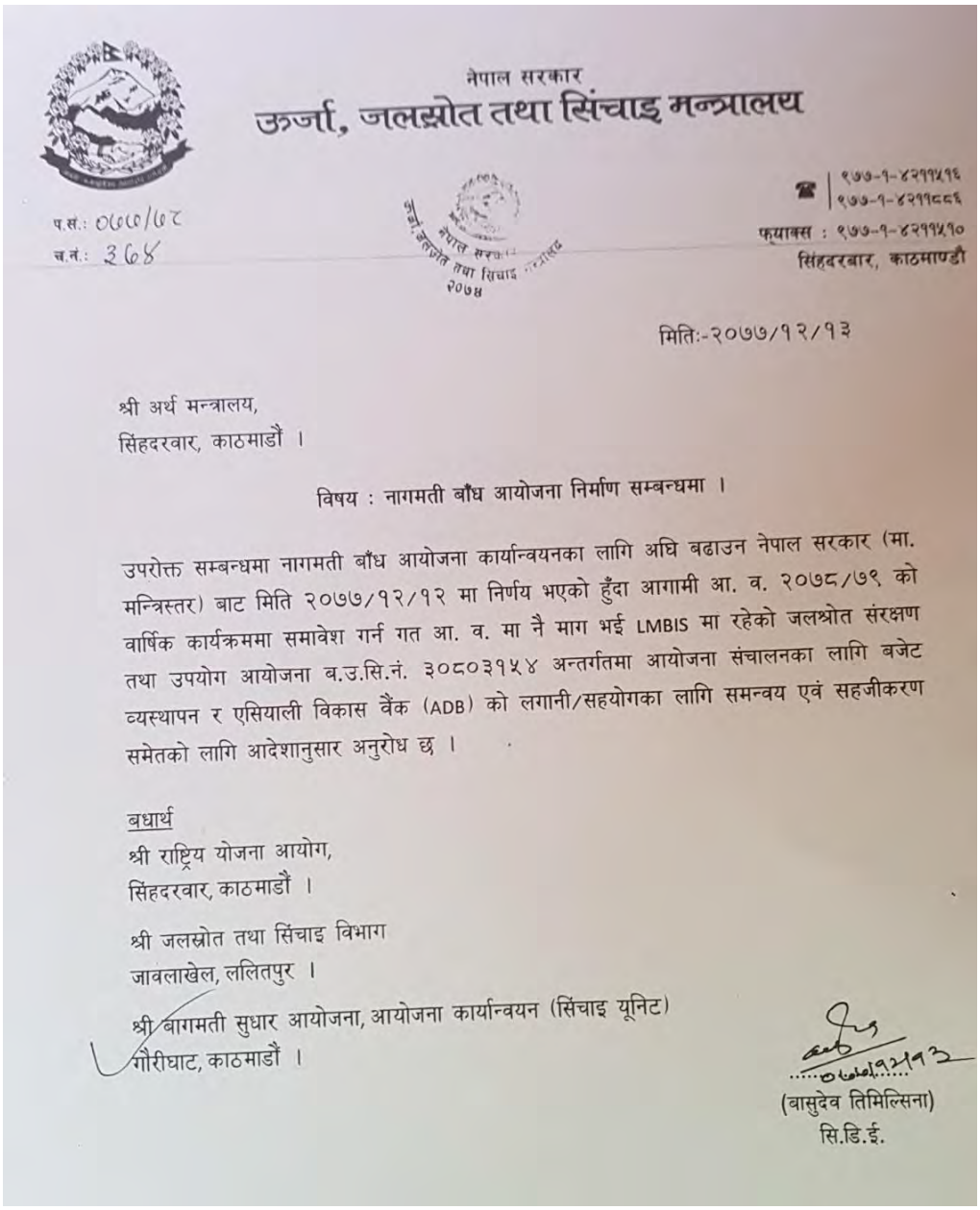
CHAPTER 13 ANNEXES

Annex 1

Government of Nepal-Ministry of Energy, Water Resources and Irrigation (Minister Level) Decision to Implement NDP



नेपाल सरकार
ऊर्जा, जलस्रोत तथा सिंचाइ मन्त्रालय

फोन : ९७७-१-४२११५१६
९७७-१-४२११८८६
फ्याक्स : ९७७-१-४२११५१०
सिंहदरबार, काठमाण्डौं

प.सं.: ०७८०/७८
च.नं.: 368

मिति:-२०७७/१२/१३

श्री अर्थ मन्त्रालय,
सिंहदरवार, काठमाडौं ।

विषय : नागमती बाँध आयोजना निर्माण सम्बन्धमा ।

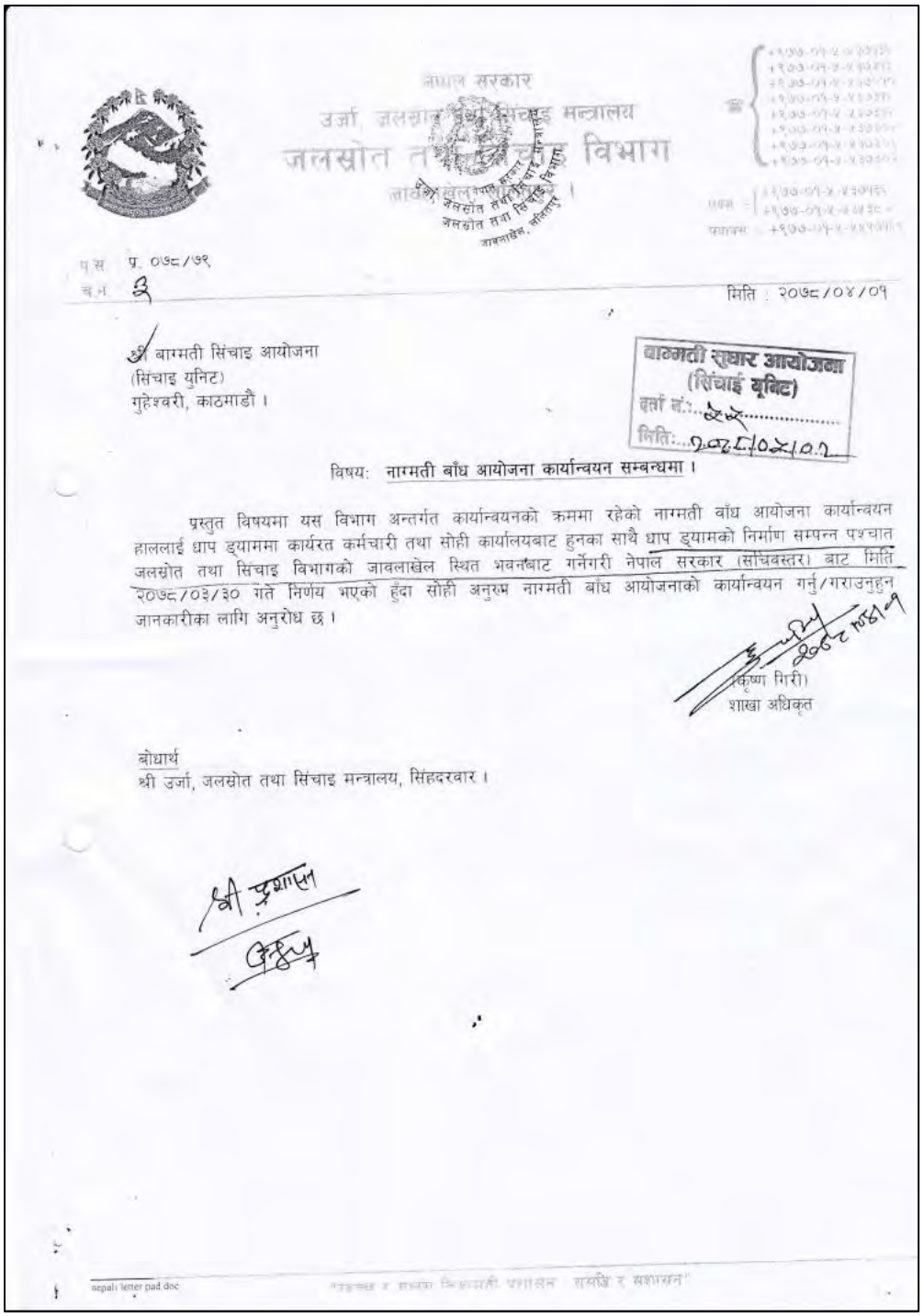
उपरोक्त सम्बन्धमा नागमती बाँध आयोजना कार्यान्वयनका लागि अघि बढाउन नेपाल सरकार (मा. मन्त्रिस्तर) बाट मिति २०७७/१२/१२ मा निर्णय भएको हुँदा आगामी आ. व. २०७८/७९ को वार्षिक कार्यक्रममा समावेश गर्न गत आ. व. मा नै माग भई LMBIS मा रहेको जलश्रोत संरक्षण तथा उपयोग आयोजना ब.उ.सि.नं. ३०८०३१५४ अन्तर्गतमा आयोजना संचालनका लागि बजेट व्यस्थापन र एसियाली विकास बैंक (ADB) को लगानी/सहयोगका लागि समन्वय एवं सहजीकरण समेतको लागि आदेशानुसार अनुरोध छ ।

बधार्थ
श्री राष्ट्रिय योजना आयोग,
सिंहदरवार, काठमाडौं ।

श्री जलस्रोत तथा सिंचाइ विभाग
जावलाखेल, ललितपुर ।

श्री बागमती सुधार आयोजना, आयोजना कार्यान्वयन (सिंचाइ यूनिट)
गौरीघाट, काठमाडौं ।

(बासुदेव तिमिल्सिना)
सि.डि.ई.



नेपाल सरकार
ऊर्जा, जलस्रोत तथा सिंचाइ मन्त्रालय
जलस्रोत तथा सिंचाइ विभाग
जावलाखेल, ललितपुर ।

पत्र सं. प्र. ०७८/७९
च.नं. ३

मिति : २०७८/०४/०१

श्री बाग्मती सिंचाइ आयोजना
(सिंचाइ युनिट)
गुहेश्वरी, काठमाडौं ।

बाग्मती सुधार आयोजना
(सिंचाई यूनिट)
दर्ता नं.: ४४
मिति: २०७८/०४/०२

विषय: नाग्मती बाँध आयोजना कार्यान्वयन सम्बन्धमा ।

प्रस्तुत विषयमा यस विभाग अन्तर्गत कार्यान्वयनको क्रममा रहेको नाग्मती बाँध आयोजना कार्यान्वयन हाललाई धाप ड्यामका कार्यरत कर्मचारी तथा सोही कार्यालयबाट हुनका साथै धाप ड्यामको निर्माण सम्पन्न पश्चात जलस्रोत तथा सिंचाइ विभागको जावलाखेल स्थित भवनबाट गर्नेगरी नेपाल सरकार (सचिवस्तर) बाट मिति २०७८/०३/३० गते निर्णय भएको हुँदा सोही अनुरुप नाग्मती बाँध आयोजनाको कार्यान्वयन गर्नु/गराउनुहुन जानकारीका लागि अनुरोध छ ।

(कृष्ण गिरी)
शाखा अधिकृत

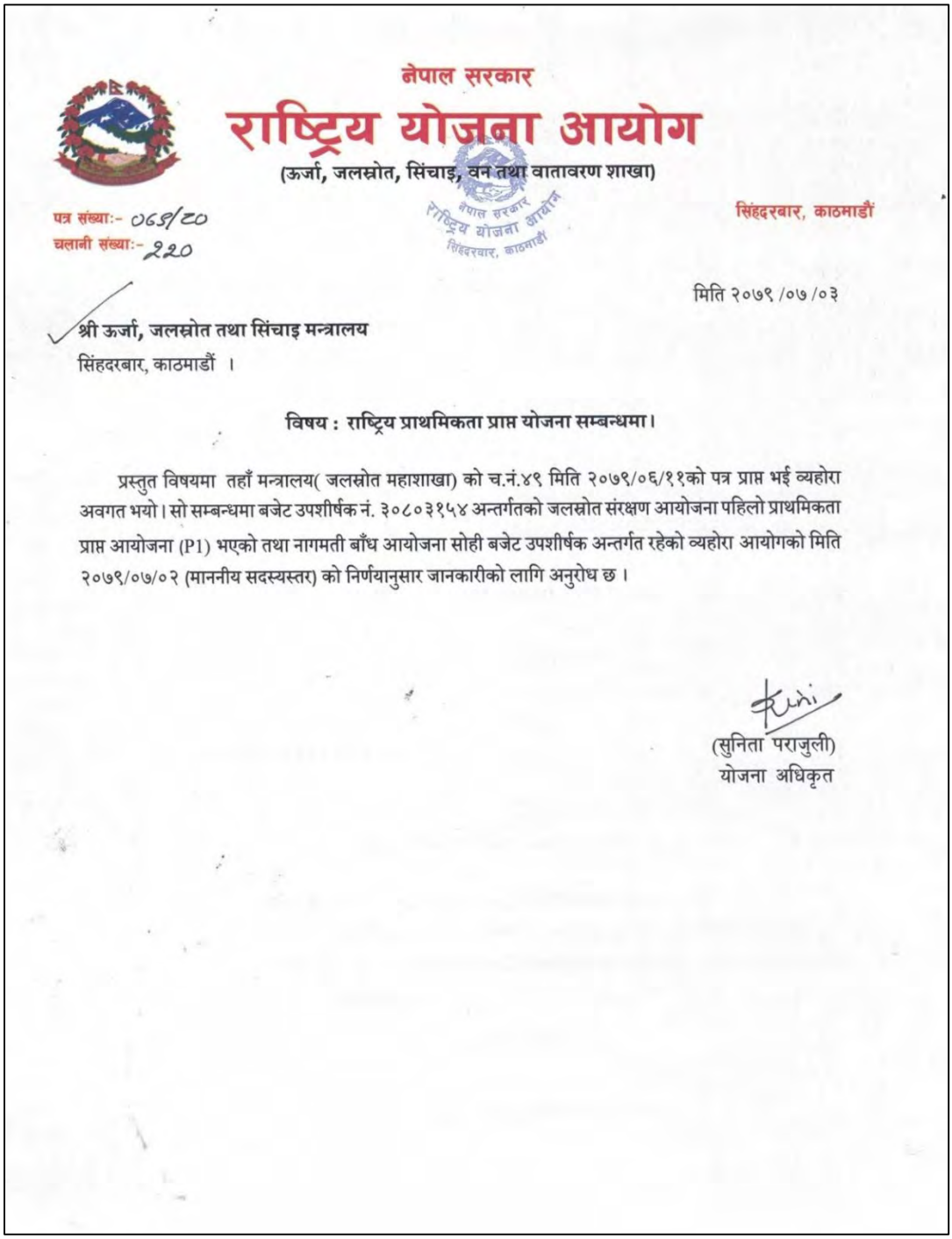
बोधार्थ
श्री ऊर्जा, जलस्रोत तथा सिंचाइ मन्त्रालय, सिंहदरबार ।

श्री प्रशासन

nepali letter pad doc

Annex 2

Declaration of Nagmati Dam Project as National Priority Project



नेपाल सरकार

राष्ट्रिय योजना आयोग

(ऊर्जा, जलस्रोत, सिंचाइ, वन तथा वातावरण शाखा)

पत्र संख्या:- ०६९/८०
चलानी संख्या:- २२०

सिंहदरबार, काठमाडौं

मिति २०७९ /०७ /०३

श्री ऊर्जा, जलस्रोत तथा सिंचाइ मन्त्रालय
सिंहदरबार, काठमाडौं ।

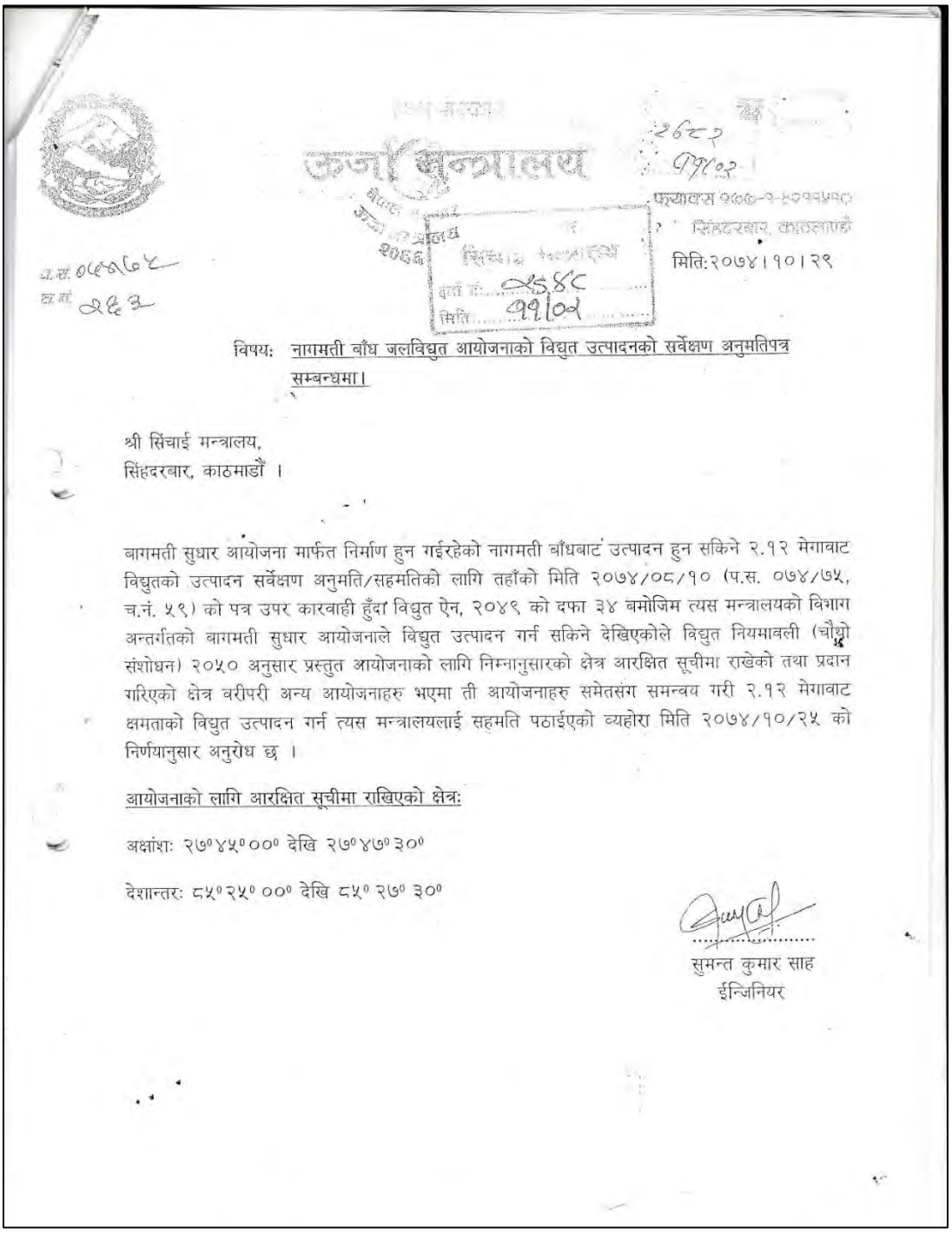
विषय : राष्ट्रिय प्राथमिकता प्राप्त योजना सम्बन्धमा।

प्रस्तुत विषयमा तहाँ मन्त्रालय(जलस्रोत महाशाखा) को च.नं.४९ मिति २०७९/०६/११को पत्र प्राप्त भई व्यहोरा अवगत भयो। सो सम्बन्धमा बजेट उपशीर्षक नं. ३०८०३१५४ अन्तर्गतको जलस्रोत संरक्षण आयोजना पहिलो प्राथमिकता प्राप्त आयोजना (P1) भएको तथा नागमती बाँध आयोजना सोही बजेट उपशीर्षक अन्तर्गत रहेको व्यहोरा आयोगको मिति २०७९/०७/०२ (माननीय सदस्यस्तर) को निर्णयानुसार जानकारीको लागि अनुरोध छ ।

(सुनिता पराजुली)
योजना अधिकृत

Annex 3

Letter from MoEWRI on Electricity Generation Survey License



ऊर्जा मन्त्रालय

फोन नं. ०१-४२०१५८०
सिंहदरबार, काठमाडौं

२०७४

सिंचाई मन्त्रालय
पत्र संख्या: २५४८
मिति: ०१/०८

मिति: २०७४।१०।२९

च.नं. ०७४/७५
पत्र सं. २६३

विषय: नागमती बाँध जलविद्युत आयोजनाको विद्युत उत्पादनको सर्वेक्षण अनुमतिपत्र सम्बन्धमा।

श्री सिंचाई मन्त्रालय,
सिंहदरबार, काठमाडौं ।

बागमती सुधार आयोजना मार्फत निर्माण हुन गईरहेको नागमती बाँधबाट उत्पादन हुन सकिने २.१२ मेगावाट विद्युतको उत्पादन सर्वेक्षण अनुमति/सहमतिको लागि तहाँको मिति २०७४/०८/१० (प.स. ०७४/७५, च.नं. ५९) को पत्र उपर कारवाही हुँदा विद्युत ऐन, २०४९ को दफा ३४ बमोजिम त्यस मन्त्रालयको विभाग अन्तर्गतको बागमती सुधार आयोजनाले विद्युत उत्पादन गर्न सकिने देखिएकोले विद्युत नियमावली (चौथो संशोधन) २०५० अनुसार प्रस्तुत आयोजनाको लागि निम्नानुसारको क्षेत्र आरक्षित सूचीमा राखेको तथा प्रदान गरिएको क्षेत्र बरीपरी अन्य आयोजनाहरु भएमा ती आयोजनाहरु समेतसंग समन्वय गरी २.१२ मेगावाट क्षमताको विद्युत उत्पादन गर्न त्यस मन्त्रालयलाई सहमति पठाईएको व्यहोरा मिति २०७४/१०/२५ को निर्णयानुसार अनुरोध छ ।

आयोजनाको लागि आरक्षित सूचीमा राखिएको क्षेत्र:

अक्षांश: २७°४५°००° देखि २७°४७°३०°

देशान्तर: ८५°२५°००° देखि ८५°२७°३०°

सुमन्त कुमार साह
ईन्जिनियर

Annex 4

Approved Scoping and ToR

नेपाल सरकार

जनसंख्या तथा वातावरण मन्त्रालय

सिंहदरबार, काठमाडौं

वातावरण मूल्याङ्कन शाखा

प.सं.:-

च.नं.:- ४९०

मिति २०७३/०५/१४

श्री सहरी विकास मन्त्रालय,
सिंहदरबार ।

दर्ता नं.: २८
मिति: ०८३/९/२०१७

विषयः क्षेत्र निर्धारण प्रतिवेदन र कार्यसूची स्वीकृत गरिएको बारे ।

तहाँ मन्त्रालयको च.नं. २९७ , मिति २०७३/०१/२० को पत्र साथ प्राप्त नाग्मती नदीमा बाँध निर्माण कार्यको लागि प्रस्तावित आयोजना सम्बन्धमा तयार पारिएको वातावरणीय प्रभाव मूल्याङ्कन (EIA) सम्बन्धी क्षेत्र निर्धारण प्रतिवेदन (SD) तथा कार्यसूचि (TOR) माथी कारवाही हुँदा प्रस्तावकद्वारा पेश गरिएको परिमार्जित प्रस्ताव ,2016 लाई निम्नानुसारका शर्तहरु सहित स्वीकृत गरिएको व्यहोरा नेपाल सरकार (सचिवस्तर) को मिति २०७३/०५/१० को निर्णयानुसार अनुरोध छ

शर्तहरु:

१.EIA अध्ययनको क्रममा कुनै नया/थप सवाल पहिचान हुन आएमा तिनलाई समेत EIA प्रतिवेदनमा सम्बोधन गर्नु पर्नेछ ।

२.कार्यसूचीले औल्याएका सवालहरु अनुसार Impacts र Mitigation measures हरु क्रमबद्ध रुपमा प्रस्तुत गर्नु पर्नेछ ।

३.वातावरण व्यवस्थापन योजनामा सकारात्मक प्रभाव अभिवृद्धि र नकारात्मक प्रभाव निराकरणका उपायहरु के,कहाँ,कसरी,कसले र कहिले गर्ने बारे उल्लेख भएको हुनु पर्नेछ ।

४.आयोजना निर्माणका क्रममा निस्कने Muck र Spoil लाई यथा सम्भव Re-use गर्नु पर्ने नीति EIA प्रतिवेदनमा सम्बोधन गर्नु पर्नेछ ।

५. वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदन तयारीको क्रममा सार्वजनिक सुनवाईमा उठेका सवालहरु र सरोकारवालाको राय सुझावहरुको सम्बन्धमा सरोकारवालाहरुको हस्ताक्षर सहितको माईन्यूटिड प्रतिवेदनमा समावेश भएको हुनु पर्नेछ ।

६. वातावरण व्यवस्थापन योजनाको लागि लाग्ने खर्च स्पष्ट रुपमा छुट्याउनु पर्नेछ ।

७. प्रस्तावीत आयोजना वातावरणीय लगायत सामाजिक तथा आर्थिक हिसाबले उपयुक्त छ,छैन भन्ने विषयको अध्ययनलाई EIA प्रतिवेदनमा समेटनु पर्नेछ ।

८. वातावरणीय अध्ययनको लागि नाग्मती बाँध निर्माण सम्बन्धमा वन तथा भू-संरक्षण मन्त्रालयबाट छुट्टै अध्ययन सहमति लिई कार्य अगाडि बढाउनु पर्नेछ ।

९. वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदन तयारीको क्रममा प्रस्तावीत आयोजनाको विभिन्न अवयवहरु जस्तै reservoir,access road,hydropower works, निर्माण हुने क्षेत्र वरपरका flora र fauna को species diversity,species richness को सम्बन्धमा विस्तृत अध्ययन गरी प्रतिवेदनमा संलग्न गर्नु पर्नेछ ।

१०. प्रतिवेदन तयारीको क्रममा जलविद्युत र बाँधको details / specification जस्तै बाँधको लम्बाई, water ways को dimension,turbines को संख्या power evacuation system र annual energy generation जस्ता सन्दर्भ प्रतिवेदनमा विस्तृत रुपमा उल्लेख हुनु पर्नेछ ।

कार्यालयको ठेगाना: सिंहदरबार, काठमाडौं नेपाल
कार्यालयको टेलिफोन नं.: ४२११७३७, ४२११६४९, ४२११९९६ ४२११९४६, ४२११८९४
फ्याक्स नं.: ४२११५५४
ईमेल: info@mope.gov.np
वेब साईट : www.mope.gov.np

नेपाल सरकार

जनसंख्या तथा वातावरण मन्त्रालय

सिंहदरबार, काठमाडौं

वातावरण मूल्याङ्कन शाखा

प.सं.:-

च.नं.:-

११.प्रतिवेदन तयारीको क्रममा construction material के र कति मात्रामा चाहिने, muck कति मात्रामा generate हुने, कति मात्रामा muck backfilling को लागि प्रयोग हुने, bulking factor compaction, disposal area को.topography जस्ता सन्दर्भ विस्तृत रुपमा प्रतिवेदनमा उल्लेख गर्नु पर्नेछ।

१२. प्रतिवेदनमा seismic hazard assessment को सन्दर्भ विस्तृत रुपमा उल्लेख हुनु पर्नेछ।

१३. प्रतिवेदनमा प्रभावित गा.वि.स./नगरपालिकाको सिफारिस संलग्न गर्दा सार्वजनिक सुनवाईको मिति पश्चातको गर्नु पर्नेछ।

(ईश्वरी दत्त पनेरु)
शाखा अधिकृत

बोधार्थ
श्री बाग्मती सुधार आयोजना,
काठमाण्डौं।

कार्यालयको ठेगाना:
सिंहदरबार, काठमाडौं
नेपाल

कार्यालयको टेलिफोन नं.:
४२११३३७, ४२११६४१, ४२११९९६
४२११९४६, ४२११८९४
४२११५८६, ४२११६९८

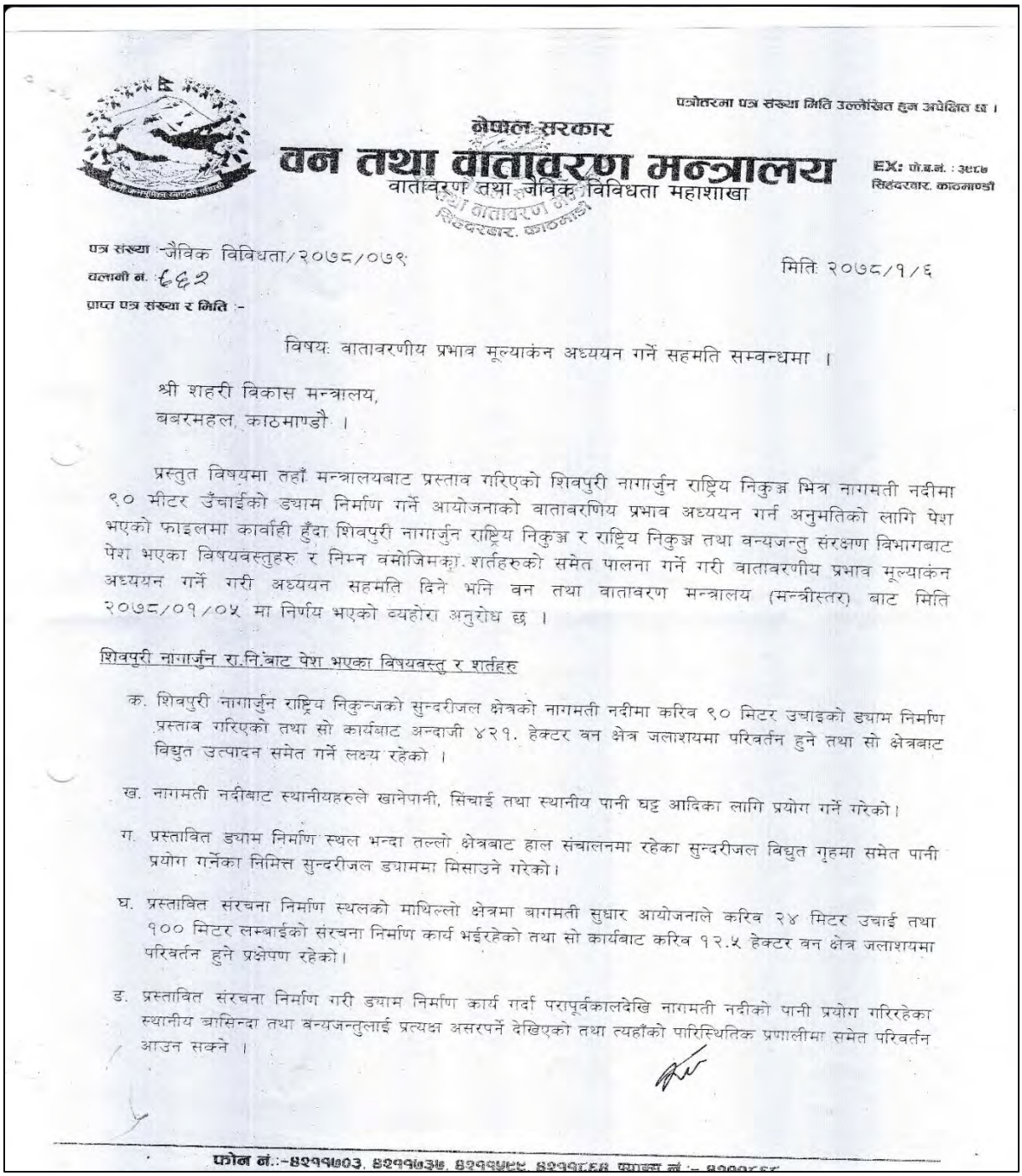
फ्याक्स नं.:
४२११९५४

ईमेल:
info@mope.gov.np

वेब साईट :
www.mope.gov.np

Annex 5

Letter of Consent from MoFE for EIA Study



पत्रोत्तरमा पत्र संख्या मिति उल्लेखित हुन अपेक्षित छ ।

नेपाल सरकार

वन तथा वातावरण मन्त्रालय

वातावरण तथा जैविक विविधता महाशाखा

EX: पो.ब.नं. : ३९८७
सिंहदरबार, काठमाण्डौं

पत्र संख्या :-जैविक विविधता/२०७८/०७९

चलानी नं. ६६२

प्राप्त पत्र संख्या र मिति :-

मिति: २०७८/१/६

विषयः वातावरणीय प्रभाव मूल्याकंन अध्ययन गर्ने सहमति सम्वन्धमा ।

श्री शहरी विकास मन्त्रालय,
बबरमहल, काठमाण्डौं ।

प्रस्तुत विषयमा तहाँ मन्त्रालयबाट प्रस्ताव गरिएको शिवपुरी नागार्जुन राष्ट्रिय निकुञ्ज भित्र नागमती नदीमा ९० मीटर उँचाईको ड्याम निर्माण गर्ने आयोजनाको वातावरणिय प्रभाव अध्ययन गर्न अनुमतिको लागि पेश भएको फाइलमा कार्वाही हुँदा शिवपुरी नागार्जुन राष्ट्रिय निकुञ्ज र राष्ट्रिय निकुञ्ज तथा वन्यजन्तु संरक्षण विभागबाट पेश भएका विषयवस्तुहरु र निम्न वमोजिमका शर्तहरुको समेत पालना गर्ने गरी वातावरणीय प्रभाव मूल्याकंन अध्ययन गर्ने गरी अध्ययन सहमति दिने भनि वन तथा वातावरण मन्त्रालय (मन्त्रीस्तर) बाट मिति २०७८/०१/०५ मा निर्णय भएको व्यहोरा अनुरोध छ ।

शिवपुरी नागार्जुन रा.नि.बाट पेश भएका विषयवस्तु र शर्तहरु

क. शिवपुरी नागार्जुन राष्ट्रिय निकुन्जको सुन्दरीजल क्षेत्रको नागमती नदीमा करिव ९० मिटर उचाइको ड्याम निर्माण प्रस्ताव गरिएको तथा सो कार्यबाट अन्दाजी ४२१. हेक्टर वन क्षेत्र जलाशयमा परिवर्तन हुने तथा सो क्षेत्रबाट विद्युत उत्पादन समेत गर्ने लक्ष्य रहेको ।

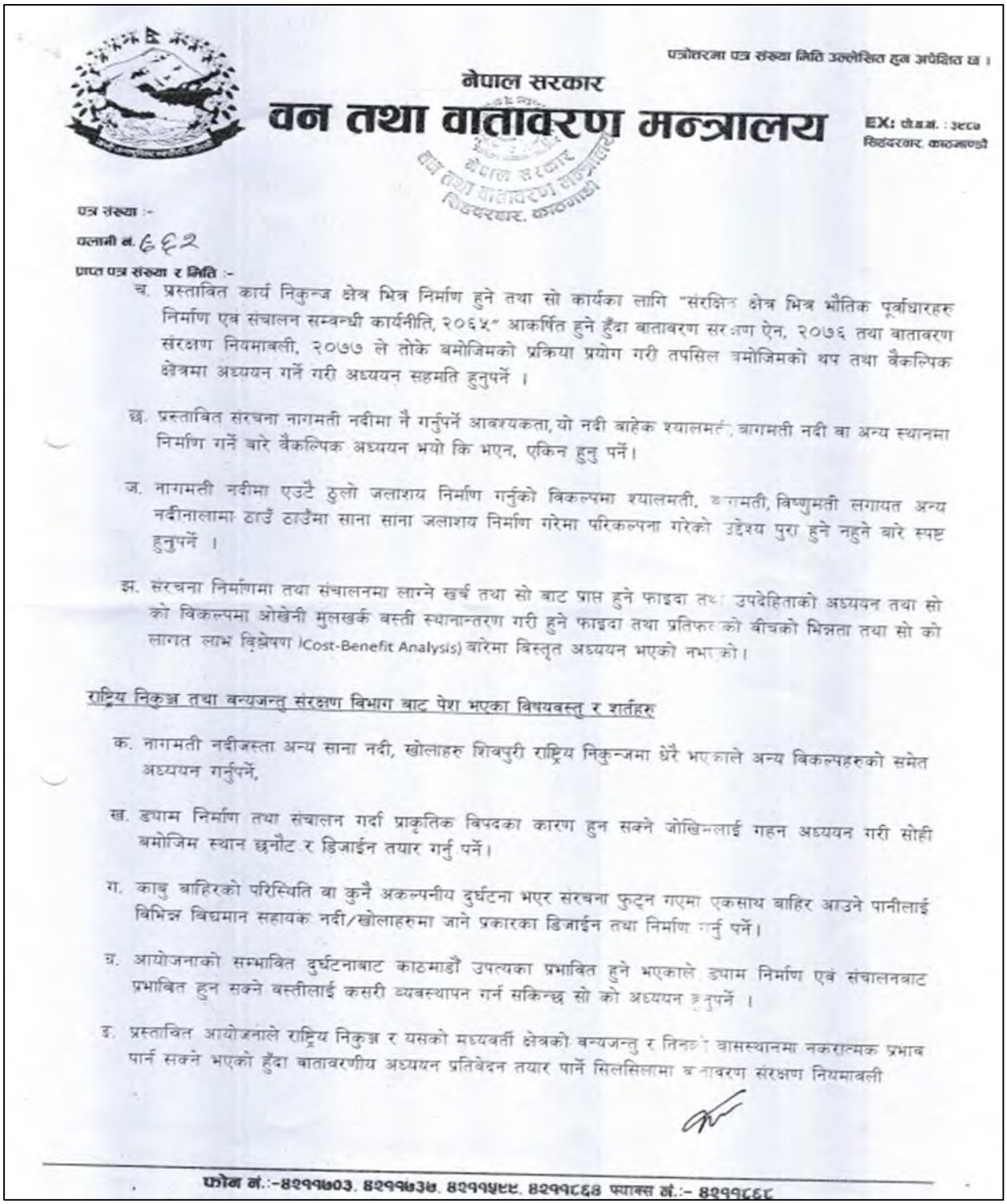
ख. नागमती नदीबाट स्थानीयहरुले खानेपानी, सिंचाई तथा स्थानीय पानी घट्ट आदिका लागि प्रयोग गर्ने गरेको।

ग. प्रस्तावित ड्याम निर्माण स्थल भन्दा तल्लो क्षेत्रबाट हाल संचालनमा रहेका सुन्दरीजल विद्युत गृहमा समेत पानी प्रयोग गर्नेका निमित्त सुन्दरीजल ड्याममा मिसाउने गरेको।

घ. प्रस्तावित संरचना निर्माण स्थलको माथिल्लो क्षेत्रमा बागमती सुधार आयोजनाले करिव २४ मिटर उचाई तथा १०० मिटर लम्बाईको संरचना निर्माण कार्य भईरहेको तथा सो कार्यबाट करिव १२.५ हेक्टर वन क्षेत्र जलाशयमा परिवर्तन हुने प्रक्षेपण रहेको।

ङ. प्रस्तावित संरचना निर्माण गरी ड्याम निर्माण कार्य गर्दा परापूर्वकालदेखि नागमती नदीको पानी प्रयोग गरिरहेका स्थानीय वासिन्दा तथा वन्यजन्तुलाई प्रत्यक्ष असरपर्ने देखिएको तथा त्यहाँको पारिस्थितिक प्रणालीमा समेत परिवर्तन आउन सक्ने ।

फोन नं.:-४२११७०३, ४२११७३४, ४२११५८९, ४२११८६४ फ्याक्स नं :- ४२११८६८



पत्रोत्तरमा पत्र संख्या मिति उल्लेखित हुन अपेक्षित छ ।

नेपाल सरकार

वन तथा वातावरण मन्त्रालय

EX: फो.न.नं. : ३९८७
सिंहदरबार, काठमाण्डौ

पत्र संख्या :-

चलानी नं. ६९२

प्राप्त पत्र संख्या र मिति :-

च. प्रस्तावित कार्य निकुन्ज क्षेत्र भित्र निर्माण हुने तथा सो कार्यका लागि "संरक्षित क्षेत्र भित्र भौतिक पूर्वाधारहरु निर्माण एवं संचालन सम्बन्धी कार्यनीति, २०६५" आकर्षित हुने हुँदा वातावरण सरक्षण ऐन, २०७६ तथा वातावरण संरक्षण नियमावली, २०७७ ले तोके बमोजिमको प्रक्रिया प्रयोग गरी तपसिल बमोजिमको थप तथा वैकल्पिक क्षेत्रमा अध्ययन गर्ने गरी अध्ययन सहमति हुनुपर्ने ।

छ. प्रस्तावित संरचना नागमती नदीमा नै गर्नुपर्ने आवश्यकता, यो नदी बाहेक श्यालमती, नागमती नदी वा अन्य स्थानमा निर्माण गर्ने बारे वैकल्पिक अध्ययन भयो कि भएन, एकिन हुनु पर्ने।

ज. नागमती नदीमा एउटै ठुलो जलाशय निर्माण गर्नुको विकल्पमा श्यालमती, नागमती, विष्णुमती लगायत अन्य नदीनालामा ठाउँ ठाउँमा साना साना जलाशय निर्माण गरेमा परिकल्पना गरेको उद्देश्य पुरा हुने नहुने बारे स्पष्ट हुनुपर्ने ।

झ. संरचना निर्माणमा तथा संचालनमा लाग्ने खर्च तथा सो बाट प्राप्त हुने फाइदा तथा उपदेहिताको अध्ययन तथा सो को विकल्पमा ओखेनी मुलखर्क बस्ती स्थानान्तरण गरी हुने फाइदा तथा प्रतिफल को बीचको भिन्नता तथा सो को लागत लाभ विश्लेषण (Cost-Benefit Analysis) बारेमा विस्तृत अध्ययन भएको नभएको।

<u>राष्ट्रिय निकुञ्ज तथा वन्यजन्तु संरक्षण विभाग बाट पेश भएका विषयवस्तु र शर्तहरु</u>

क. नागमती नदीजस्ता अन्य साना नदी, खोलाहरु शिवपुरी राष्ट्रिय निकुन्जमा धेरै भएकाले अन्य विकल्पहरुको समेत अध्ययन गर्नुपर्ने,

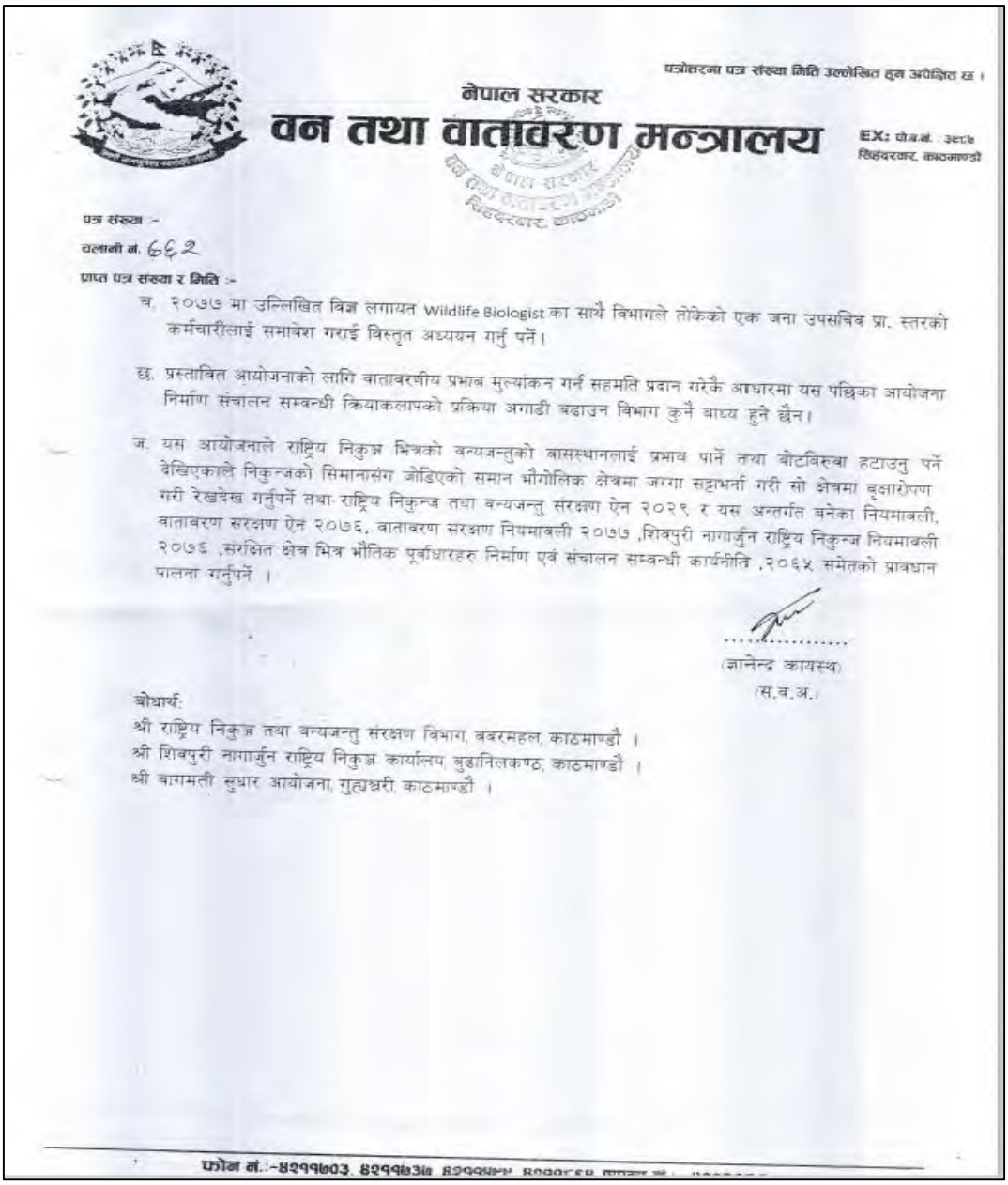
ख. डयाम निर्माण तथा संचालन गर्दा प्राकृतिक विपदका कारण हुन सक्ने जोखिम्लाई गहन अध्ययन गरी सोही बमोजिम स्थान छनौट र डिजाईन तयार गर्नु पर्ने।

ग. काबु बाहिरको परिस्थिति वा कुनै अकल्पनीय दुर्घटना भएर संरचना फुट्न गएमा एकसाथ बाहिर आउने पानीलाई विभिन्न विद्यमान सहायक नदी/खोलाहरुमा जाने प्रकारका डिजाईन तथा निर्माण गर्नु पर्ने।

घ. आयोजनाको सम्भावित दुर्घटनाबाट काठमाडौं उपत्यका प्रभावित हुने भएकाले डयाम निर्माण एवं संचालनबाट प्रभावित हुन सक्ने बस्तीलाई कसरी व्यवस्थापन गर्न सकिन्छ सो को अध्ययन हुनुपर्ने ।

ङ. प्रस्तावित आयोजनाले राष्ट्रिय निकुञ्ज र यसको मध्यवर्ती क्षेत्रको वन्यजन्तु र तिनको वासस्थानमा नकारात्मक प्रभाव पार्न सक्ने भएको हुँदा वातावरणीय अध्ययन प्रतिवेदन तयार पार्ने सिलसिलामा वातावरण संरक्षण नियमावली

फोन नं.:-४२११७०३, ४२११७३७, ४२११५९९, ४२११८६४ फ्याक्स नं.:- ४२११८६९



पत्रोत्तरमा पत्र संख्या मिति उल्लेखित हुन अपेक्षित छ ।

नेपाल सरकार

वन तथा वातावरण मन्त्रालय

EX: पो.ब.नं. ३८८७
सिंहदरबार, काठमाण्डौ

पत्र संख्या :-

चलानी नं. ६६२

प्राप्त पत्र संख्या र मिति :-

च. २०७७ मा उल्लिखित विज्ञ लगायत Wildlife Biologist का सार्थे विभागले तोकेको एक जना उपसचिव प्रा. स्तरको कर्मचारीलाई समावेश गराई विस्तृत अध्ययन गर्नु पर्ने।

छ. प्रस्तावित आयोजनाको लागि वातावरणीय प्रभाव मुल्यांकन गर्न सहमति प्रदान गरेकै आधारमा यस पछिका आयोजना निर्माण संचालन सम्बन्धी क्रियाकलापको प्रक्रिया अगाडी बढाउन विभाग कुनै बाध्य हुने छैन।

ज. यस आयोजनाले राष्ट्रिय निकुञ्ज भित्रको वन्यजन्तुको वासस्थानलाई प्रभाव पार्ने तथा बोटबिरुवा हटाउनु पर्ने देखिएकाले निकुन्जको सिमानासंग जोडिएको समान भौगोलिक क्षेत्रमा जग्गा सट्टाभर्ना गरी सो क्षेत्रमा वृक्षारोपण गरी रेखदेख गर्नुपर्ने तथा राष्ट्रिय निकुन्ज तथा वन्यजन्तु संरक्षण ऐन २०२९ र यस अन्तर्गत बनेका नियमावली, वातावरण संरक्षण ऐन २०७६, वातावरण संरक्षण नियमावली २०७७ ,शिवपुरी नागार्जुन राष्ट्रिय निकुन्ज नियमावली २०७६ ,संरक्षित क्षेत्र भित्र भौतिक पूर्वाधारहरु निर्माण एवं संचालन सम्बन्धी कार्यनीति ,२०६५ समेतको प्रावधान पालना गर्नुपर्ने ।

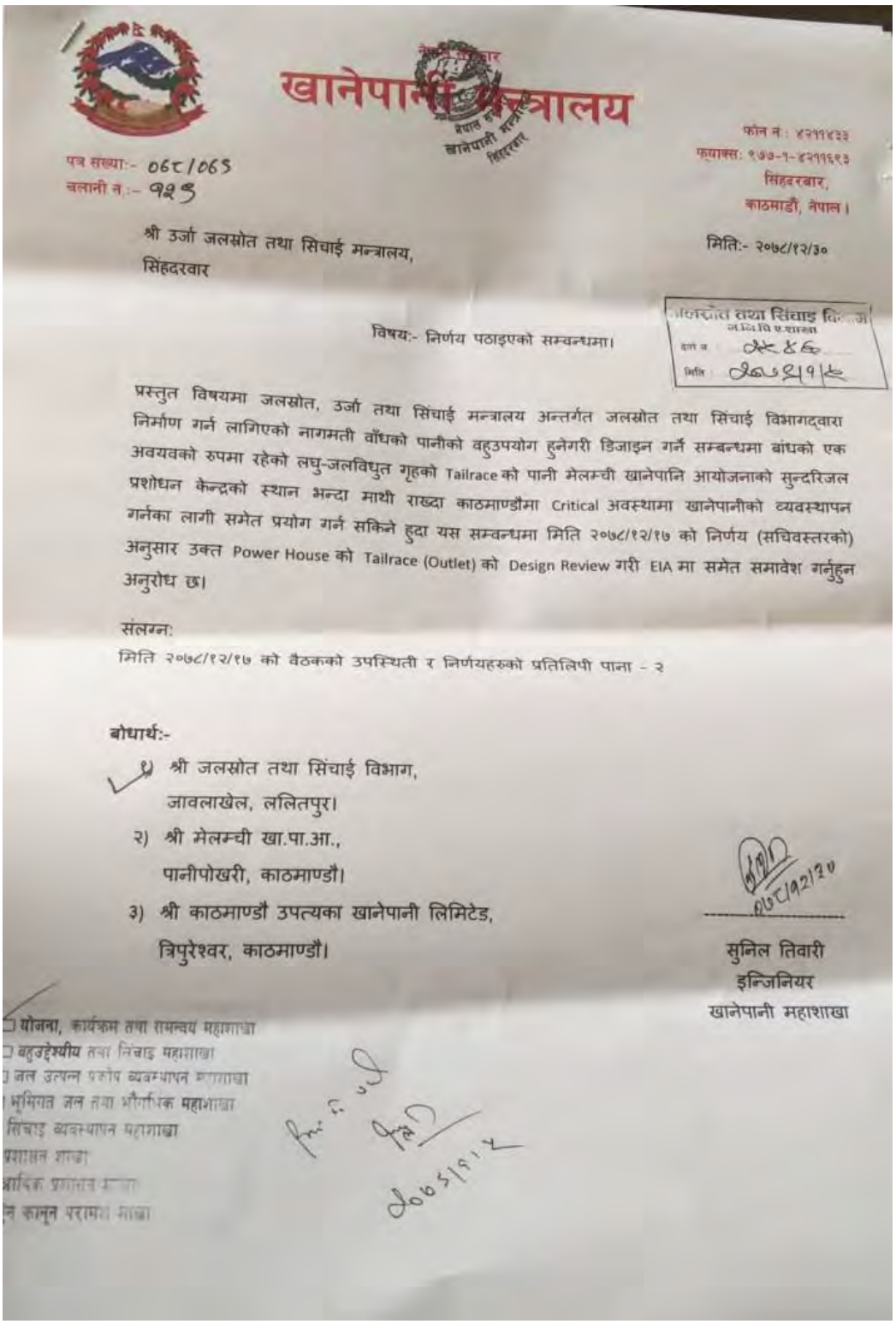
.....
(ज्ञानेन्द्र कायस्थ)
(स.व.अ.)

बोधार्थ:
श्री राष्ट्रिय निकुञ्ज तथा वन्यजन्तु संरक्षण विभाग, बबरमहल, काठमाण्डौ ।
श्री शिवपुरी नागार्जुन राष्ट्रिय निकुञ्ज कार्यालय, बुढानिलकण्ठ, काठमाण्डौ ।
श्री वागमती सुधार आयोजना, गुह्यश्वरी, काठमाण्डौ ।

फोन नं.:-४२११७०३, ४२११७३७, ४२११७१५, ४२११८१६, फ्याक्स नं.: ४२११८२८

Annex 6

Request Letter from MoWS to MoEWRI



खानेपानी मन्त्रालय

फोन नं: ४२११४३३
फ्याक्स: ९७७-१-४२११६९३
सिंहदरबार,
काठमाडौं, नेपाल।

पत्र संख्या:- ०६८/०६९
चलानी नं:- ९२९

मिति:- २०७८/१२/३०

श्री उर्जा जलस्रोत तथा सिंचाई मन्त्रालय,
सिंहदरवार

विषय:- निर्णय पठाइएको सम्बन्धमा।

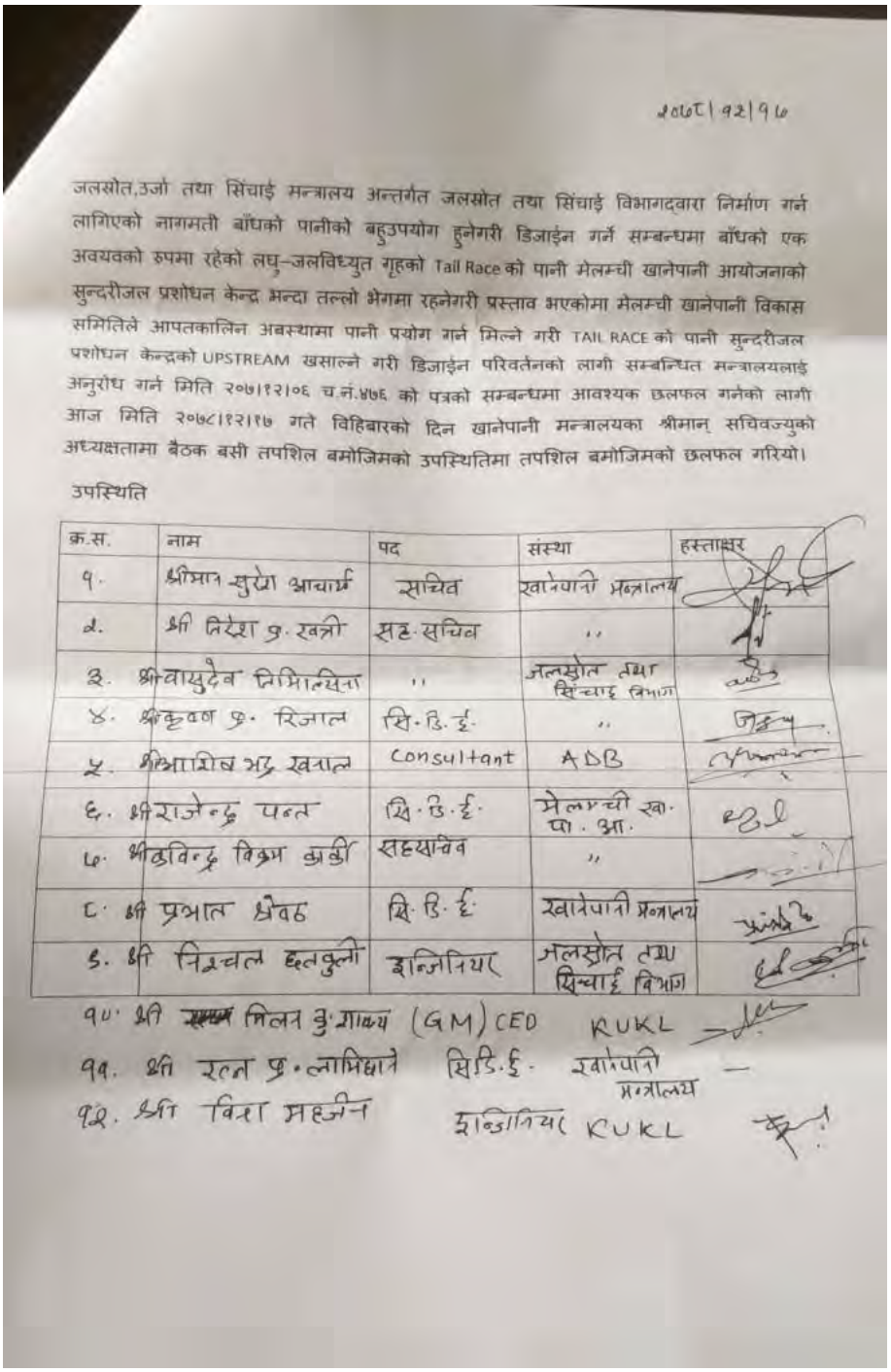
प्रस्तुत विषयमा जलस्रोत, उर्जा तथा सिंचाई मन्त्रालय अन्तर्गत जलस्रोत तथा सिंचाई विभागद्वारा निर्माण गर्न लागिएको नागमती बाँधको पानीको बहुउपयोग हुनेगरी डिजाइन गर्ने सम्बन्धमा बांधको एक अवयवको रुपमा रहेको लघु-जलविद्युत गृहको Tailrace को पानी मेलम्ची खानेपानि आयोजनाको सुन्दरिजल प्रशोधन केन्द्रको स्थान भन्दा माथी राख्दा काठमाण्डौमा Critical अवस्थामा खानेपानीको व्यवस्थापन गर्नका लागी समेत प्रयोग गर्न सकिने हुदा यस सम्बन्धमा मिति २०७८/१२/१७ को निर्णय (सचिवस्तरको) अनुसार उक्त Power House को Tailrace (Outlet) को Design Review गरी EIA मा समेत समावेश गर्नुहुन अनुरोध छ।

संलग्न:
मिति २०७८/१२/१७ को बैठकको उपस्थिती र निर्णयहरुको प्रतिलिपी पाना - २

बोधार्थ:-
१) श्री जलस्रोत तथा सिंचाई विभाग,
जावलाखेल, ललितपुर।
२) श्री मेलम्ची खा.पा.आ.,
पानीपोखरी, काठमाण्डौ।
३) श्री काठमाण्डौ उपत्यका खानेपानी लिमिटेड,
त्रिपुरेश्वर, काठमाण्डौ।

सुनिल तिवारी
इन्जिनियर
खानेपानी महाशाखा

☐ योजना, कार्यक्रम तथा समन्वय महाशाखा
☐ बहुउद्देश्यीय तथा सिंचाइ महाशाखा
☐ जल उत्पन्न प्रकोप व्यवस्थापन महाशाखा
☐ भूमिगत जल तथा भौगर्भिक महाशाखा
☐ सिंचाइ व्यवस्थापन महाशाखा
☐ प्रशासन शाखा
☐ आर्थिक प्रशासन शाखा
☐ कानुन परामर्श शाखा

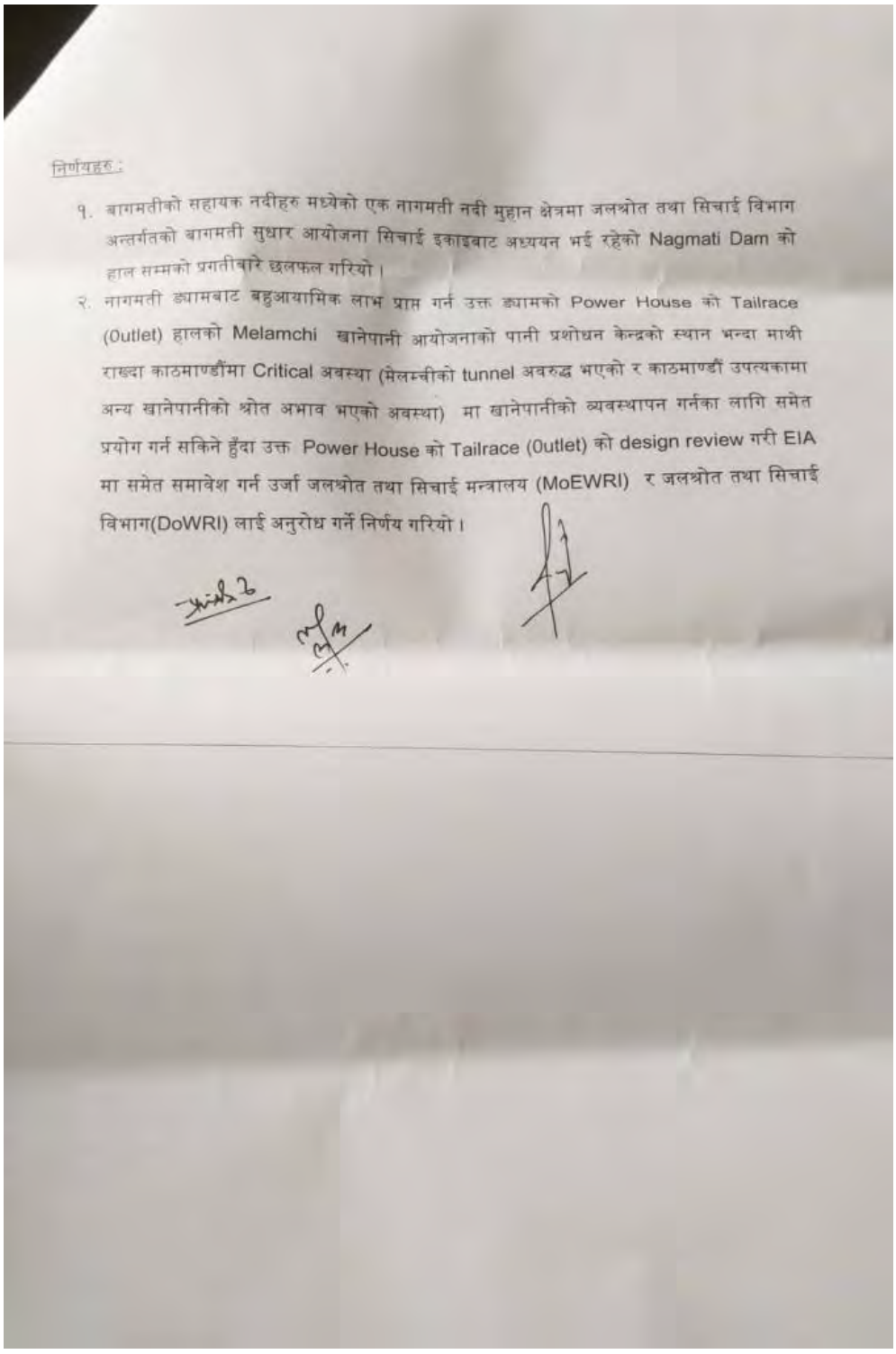


२०७८।१२।१७

जलस्रोत,ऊर्जा तथा सिंचाई मन्त्रालय अन्तर्गत जलस्रोत तथा सिंचाई विभागद्वारा निर्माण गर्न लागिएको नागमती बाँधको पानीको बहुउपयोग हुनेगरी डिजाईन गर्ने सम्बन्धमा बाँधको एक अवयवको रुपमा रहेको लघु–जलविध्युत गृहको Tail Race को पानी मेलम्ची खानेपानी आयोजनाको सुन्दरीजल प्रशोधन केन्द्र भन्दा तल्लो भेगमा रहनेगरी प्रस्ताव भएकोमा मेलम्ची खानेपानी विकास समितिले आपतकालिन अवस्थामा पानी प्रयोग गर्न मिल्ने गरी TAIL RACE को पानी सुन्दरीजल प्रशोधन केन्द्रको UPSTREAM खसाल्ने गरी डिजाईन परिवर्तनको लागी सम्बन्धित मन्त्रालयलाई अनुरोध गर्ने मिति २०७।१२।०६ च.नं.४७६ को पत्रको सम्बन्धमा आवश्यक छलफल गर्नेको लागी आज मिति २०७८।१२।१७ गते विहिबारको दिन खानेपानी मन्त्रालयका श्रीमान् सचिवज्युको अध्यक्षतामा बैठक बसी तपशिल बमोजिमको उपस्थितिमा तपशिल बमोजिमको छलफल गरियो।

उपस्थिति

क्र.स.	नाम	पद	संस्था	हस्ताक्षर
१.	श्रीमान सुरेश आचार्य	सचिव	खानेपानी मन्त्रालय	
२.	श्री निरेश कु. खत्री	सह-सचिव	,,	
३.	श्री वासुदेव निमिल्सिना	,,	जलस्रोत तथा सिंचाई विभाग	
४.	श्री कृष्ण कु. रिजाल	सि. इ. ई.	,,	
५.	श्री आशिष भट्ट खत्राल	Consultant	ADB	
६.	श्री राजेन्द्र पन्त	सि. इ. ई.	मेलम्ची खा. पा. आ.	
७.	श्री ध्रुविन्द्र विक्रम कुवँर	सहसचिव	,,	
८.	श्री प्रभात श्रेष्ठ	सि. इ. ई.	खानेपानी मन्त्रालय	
९.	श्री निश्चल ढुङ्गेल	इन्जिनियर	जलस्रोत तथा सिंचाई विभाग	
१०.	श्री ~~[illegible]~~ मिलन कु. गाछ्यं (GM) CEO		KUKL	
११.	श्री रत्न कु. लामिछाने	सि.इ.ई.	खानेपानी मन्त्रालय	—
१२.	श्री विरा महर्जन	इन्जिनियर	KUKL	



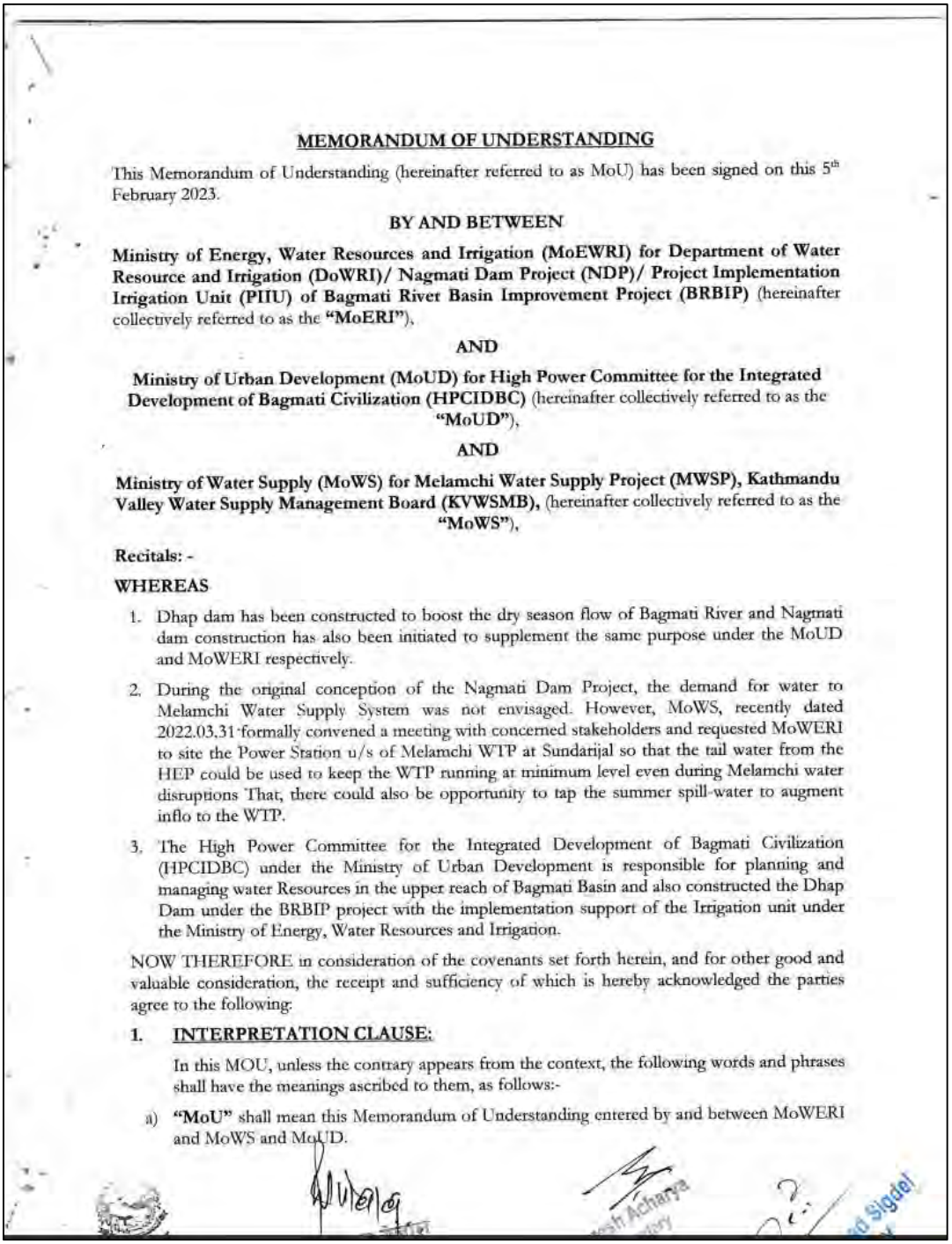
निर्णयहरु :

१. बागमतीको सहायक नदीहरु मध्येको एक नागमती नदी मुहान क्षेत्रमा जलश्रोत तथा सिचाई विभाग अन्तर्गतको बागमती सुधार आयोजना सिचाई इकाइबाट अध्ययन भई रहेको Nagmati Dam को हाल सम्मको प्रगतीबारे छलफल गरियो ।

२. नागमती ड्यामबाट बहुआयामिक लाभ प्राप्त गर्न उक्त ड्यामको Power House को Tailrace (Outlet) हालको Melamchi खानेपानी आयोजनाको पानी प्रशोधन केन्द्रको स्थान भन्दा माथी राख्दा काठमाण्डौंमा Critical अवस्था (मेलम्चीको tunnel अवरुद्ध भएको र काठमाण्डौं उपत्यकामा अन्य खानेपानीको श्रोत अभाव भएको अवस्था) मा खानेपानीको व्यवस्थापन गर्नका लागि समेत प्रयोग गर्न सकिने हुँदा उक्त Power House को Tailrace (Outlet) को design review गरी EIA मा समेत समावेश गर्न उर्जा जलश्रोत तथा सिचाई मन्त्रालय (MoEWRI) र जलश्रोत तथा सिचाई विभाग(DoWRI) लाई अनुरोध गर्ने निर्णय गरियो ।

Annex 7

Memorandum of Understanding between MoEWRI, MoUD and MoWS for Water Use



MEMORANDUM OF UNDERSTANDING

This Memorandum of Understanding (hereinafter referred to as MoU) has been signed on this 5th February 2023.

BY AND BETWEEN

Ministry of Energy, Water Resources and Irrigation (MoEWRI) for Department of Water Resource and Irrigation (DoWRI)/ Nagmati Dam Project (NDP)/ Project Implementation Irrigation Unit (PIIU) of Bagmati River Basin Improvement Project (BRBIP) (hereinafter collectively referred to as the **"MoERI"**),

AND

Ministry of Urban Development (MoUD) for High Power Committee for the Integrated Development of Bagmati Civilization (HPCIDBC) (hereinafter collectively referred to as the **"MoUD"**),

AND

Ministry of Water Supply (MoWS) for Melamchi Water Supply Project (MWSP), Kathmandu Valley Water Supply Management Board (KVWSMB), (hereinafter collectively referred to as the **"MoWS"**),

Recitals: -

WHEREAS

1. Dhap dam has been constructed to boost the dry season flow of Bagmati River and Nagmati dam construction has also been initiated to supplement the same purpose under the MoUD and MoWERI respectively.
2. During the original conception of the Nagmati Dam Project, the demand for water to Melamchi Water Supply System was not envisaged. However, MoWS, recently dated 2022.03.31 formally convened a meeting with concerned stakeholders and requested MoWERI to site the Power Station u/s of Melamchi WTP at Sundarijal so that the tail water from the HEP could be used to keep the WTP running at minimum level even during Melamchi water disruptions That, there could also be opportunity to tap the summer spill-water to augment inflo to the WTP.
3. The High Power Committee for the Integrated Development of Bagmati Civilization (HPCIDBC) under the Ministry of Urban Development is responsible for planning and managing water Resources in the upper reach of Bagmati Basin and also constructed the Dhap Dam under the BRBIP project with the implementation support of the Irrigation unit under the Ministry of Energy, Water Resources and Irrigation.

NOW THEREFORE in consideration of the covenants set forth herein, and for other good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged the parties agree to the following:

1. **INTERPRETATION CLAUSE:**

In this MOU, unless the contrary appears from the context, the following words and phrases shall have the meanings ascribed to them, as follows:-

a) **"MoU"** shall mean this Memorandum of Understanding entered by and between MoWERI and MoWS and MoUD.

b) **"Term"** shall mean the duration of this MOU for which the MOU continues to be valid and binding between the parties.

2. **PURPOSE:**

a) As noted above, the parties agree to share the released water from the existing Dhap dam and proposed Nagmati Dam for various use under their mutual benefit.

b) To maintain Quality standards and desired rate of flow in the river at the upper reach of Bagmati River Basin.

c) To optimize the benefit of the development of Water Resources as per the principle of Integrated Water Resources Management (IWRM) to meet the requirement of all parties under the principle of Shared benefit and risks.

3. **TERM:**

(a) This MoU is effective from the day and date last signed and executed by the duly authorized representatives of the parties to this MoU and shall remain in full force and effect until and unless terminated by each parties.

(b) This MoU may be terminated, without any cause, by either party within six (6) months prior notice, delivered by hand or by registered mail or courier to the respective addresses of the parties.

4. **RIGHTS AND RESPONSIBILITIES OF THE PARTIES:**

4.1 Ministry of Energy, Water Resources and Irrigation/DoWRI/NDP

a) Responsible for the overall planning, Design, Construction, Operation and Maintenance of Nagmati Dam Project and Operation and Maintenance of Dhap Dam Project after its completion.

b) Provide water to the river flow, Melamchi Drinking Water Supply System and any other uses directly from the dam or other project components as agreed between parties or as per the guidelines approved by the concerned authority.

c) Ensure discharge of 450 LPS of water in Bagmati River in dry season.

d) Maintain tail water level at 1410 m if technically feasible.

4.2 Ministry of Urban Development/HPCIDBC

a) Prepare an Integrated Water Resource Management (IWRM) plan for the upper Bagmati Basin in the capacity of River Basin Organization (RBO) as per the formation order of High Power Committee for the Integrated Development of Bagmati Civilization (HPCIDBC) and develop and operate the Decision Support System (DSS) for the implementation and monitoring of the plan.

b) Based on the past water use database and inventory, determine the existing water use right of various users such as Kathmandu Upatyaka Khanipani Limited (KUKL), Melamchi Water Supply Project (MWSP), Sundarijal Hydropower, Danchhi Water Supply System, Irrigation systems etc and monitor the actual use of river water by various users to ensure at least the dam-released flow available in the river.

Suresh Acharya
Secretary

c) Plan, coordinate and manage the restriction of direct sewerage discharge in the river to ensure the bath-able standard quality of water in the river as per the objective of Bagmati River Basin Improvement Project (BRBIP).

4.3 Ministry of Water Supply/MWSDB/ MWSP/KVWSMB/KUKL

a) Responsible for bearing the cost of the entire construction work for delivering water from the tailrace of hydropower of the Nagmati Dam Project to the inlet of the treatment plant of the Melamchi Water Supply System.

b) Provide land required and free access for the construction space that is required for the powerhouse and appurtenant structures to the Nagmati Dam Project at the North -West corner of the Melamchi WTP Complex for shifting the powerhouse to feed water to the Melamchi Water Supply System.

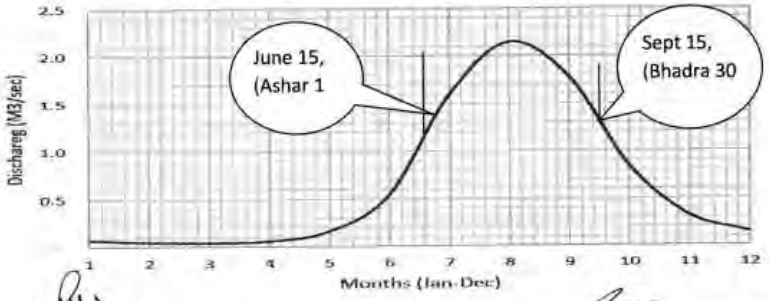
c) Detailed terms and conditions of Water supply service provision to Melamchi Water supply system and associated operation and maintenance cost will be ascertained followed by a separate agreement before the start of operation phase of the Nagmati dam project.

d) Ensure the regulation of abstractions for KUKL/ Melamchi and other drinking water supply systems, if any, from the various reaches of the river such that the releases from the Dhap and Nagmati dams continuously flow in the river to meet the intended purpose of the dams. This provision, however, doesn't affect the pre-dam water use rights of the existing water supply systems.

e) Provide discharge of about 450 lps of water, as and when required, from the tail race of the Nagmati HEP for about 3 months during the monsoon season of each year, generally, June 15 to September 15 (Ashar to Bhadra). As per the hydrological modeling, SWAT generated Hydrograph at the dam site of Nagmati river is presented below. The schedule of release to the drinking water supply system may, however, be changed according to the change in rainfall pattern and the resulting hydrograph, as agreed upon by the parties.

f) The parties can explore the possibility on short term/emergency draw of water from the dam as per point 4.1b above, and later on replenish/compensate that volume with Melamchi water when the diversion resumes.

g) Maintain tail water level at 1410 m if technically feasible.



नेपाल सरकार
सचिव
Suresh Acharya
Secretary

5. **Disputes:**

Any and all claims, disputes, questions or controversies involving the Parties and arising out of or in connection with this MOU, or the execution, interpretation, validity, performance, breach or termination hereof (collectively, "Dispute(s)") will be amicably resolved by the Parties.

6. **AMENDMENT AND MODIFICATION:**

This MOU constitutes a complete and exclusive understanding of the terms between the Parties on the subject hereof and no amendment or modification hereto shall be valid and effective unless in writing and signed by the parties.

7. **APPLICABLE LAW & JURISDICTION:**

This MOU including its subject matter, interpretation, validity, construction and/ or performance and any disputes or claims arising out of or in connection thereof, in all respects shall be governed by and construed in accordance with the laws of Nepal;

8. **SEVERABILITY:**

If any provision of this MOU is held to be invalid or unenforceable for any reason, such invalid or unenforceable provision shall be made ineffective and the remaining provisions will continue in full force without being impaired or invalidated in any way. The Parties agree to replace any invalid provision with a valid provision that most closely approximates the intent and economic effect of the invalid provision.

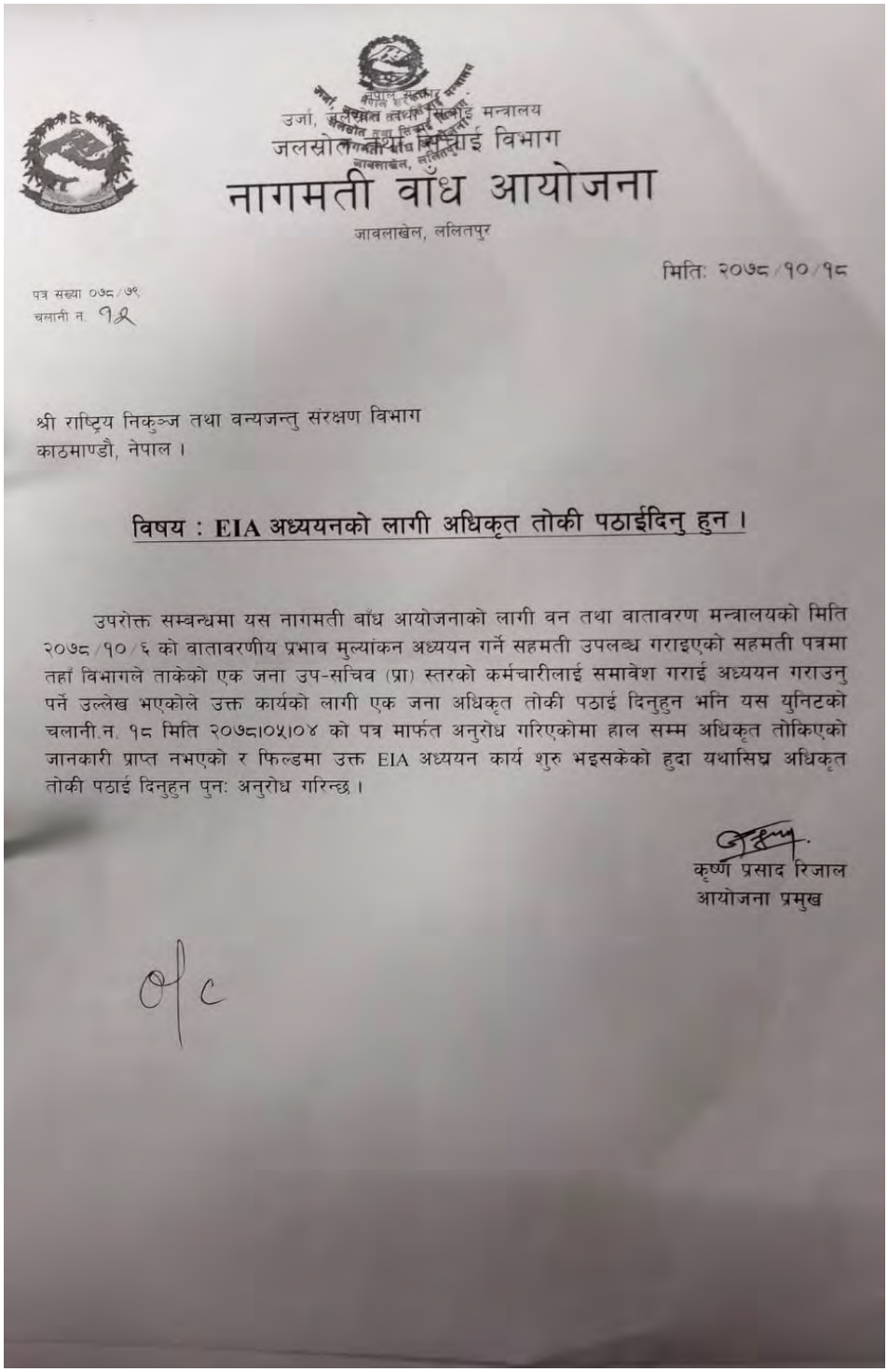
9. **SIGNING OF THE MOU:**

IN WITNESS WHEREOF the Parties hereto have hereunto set their hands and seal the day and year first above written.

On Behalf of MoEWRI	On Behalf of MoU	On Behalf of MoWS
Name: - Gopal Prasad Sigdel	Name: - Suresh Achary	Name: - Mani Ram Gelal
Designation: - Secretary	Designation: - Secretary	Designation: - Secretary
Signature: -	Signature: -	Signature: -
Witness	Witness	Witness
Gopal Prasad Sigdel Secretary	Rabindra Bohara PD, HPCIDBC	Tirtha Prasad Khadka
Suchee1 C Acharya, JG, DWRI		

Annex 8

Letter for the involvement of under secretary from DNPWC



उर्जा, जलस्रोत तथा सिंचाई मन्त्रालय
जलस्रोत तथा सिंचाई विभाग
नागमती बाँध आयोजना
जावलाखेल, ललितपुर

मितिः २०७८/१०/१८

पत्र संख्या ०७८/७९
चलानी नं. १९

श्री राष्ट्रिय निकुञ्ज तथा वन्यजन्तु संरक्षण विभाग
काठमाण्डौ, नेपाल ।

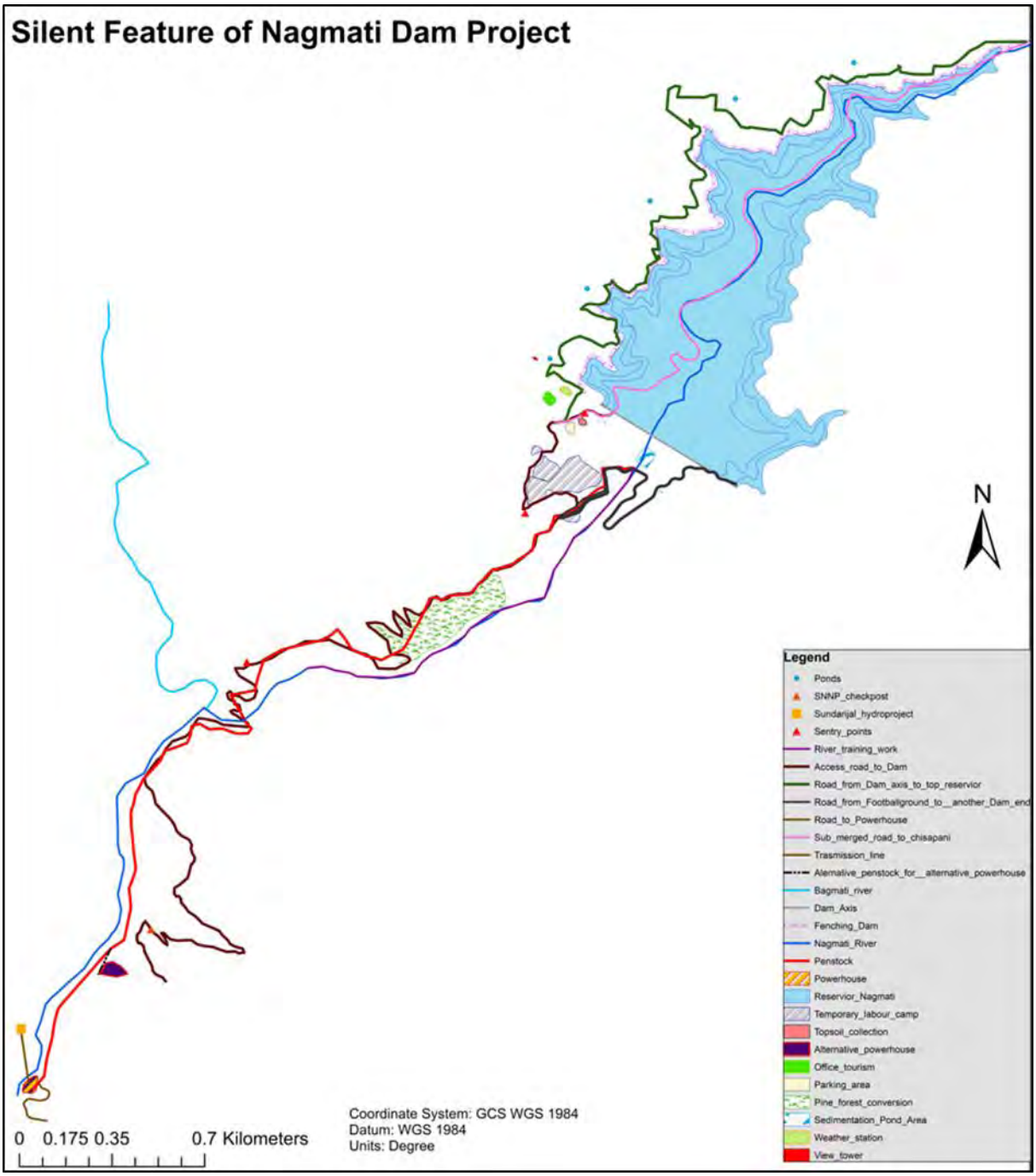
विषय : EIA अध्ययनको लागी अधिकृत तोकी पठाईदिनु हुन ।

उपरोक्त सम्बन्धमा यस नागमती बाँध आयोजनाको लागी वन तथा वातावरण मन्त्रालयको मिति २०७८/१०/६ को वातावरणीय प्रभाव मुल्यांकन अध्ययन गर्ने सहमती उपलब्ध गराइएको सहमती पत्रमा तहाँ विभागले ताकेको एक जना उप-सचिव (प्रा) स्तरको कर्मचारीलाई समावेश गराई अध्ययन गराउनु पर्ने उल्लेख भएकोले उक्त कार्यको लागी एक जना अधिकृत तोकी पठाई दिनुहुन भनि यस युनिटको चलानी.न. १८ मिति २०७८।०५।०४ को पत्र मार्फत अनुरोध गरिएकोमा हाल सम्म अधिकृत तोकिएको जानकारी प्राप्त नभएको र फिल्डमा उक्त EIA अध्ययन कार्य शुरु भइसकेको हुदा यथासिघ्र अधिकृत तोकी पठाई दिनुहुन पुनः अनुरोध गरिन्छ ।

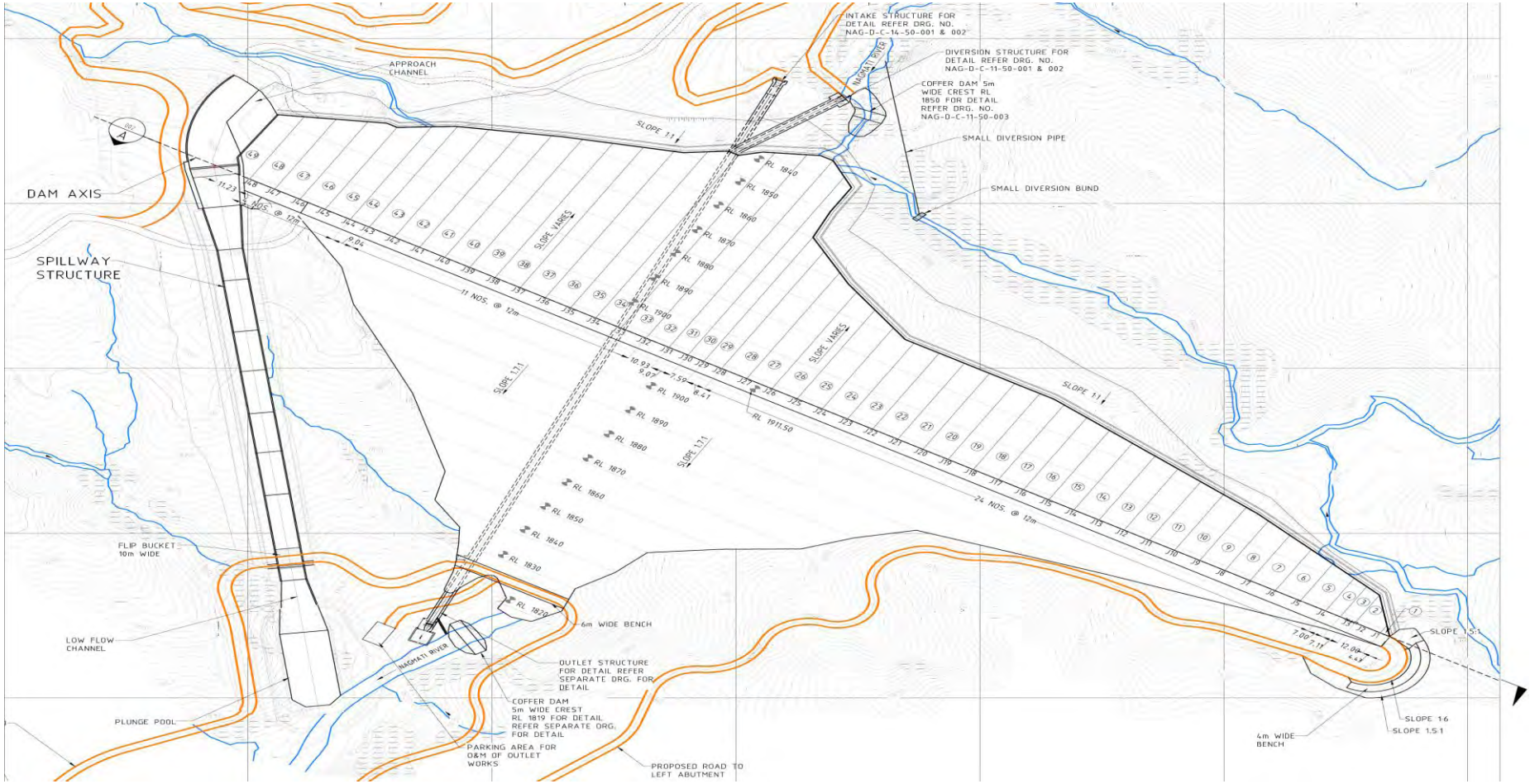
कृष्ण प्रसाद रिजाल
आयोजना प्रमुख

Annex 9

Annex 9.1 Project Layout Maps



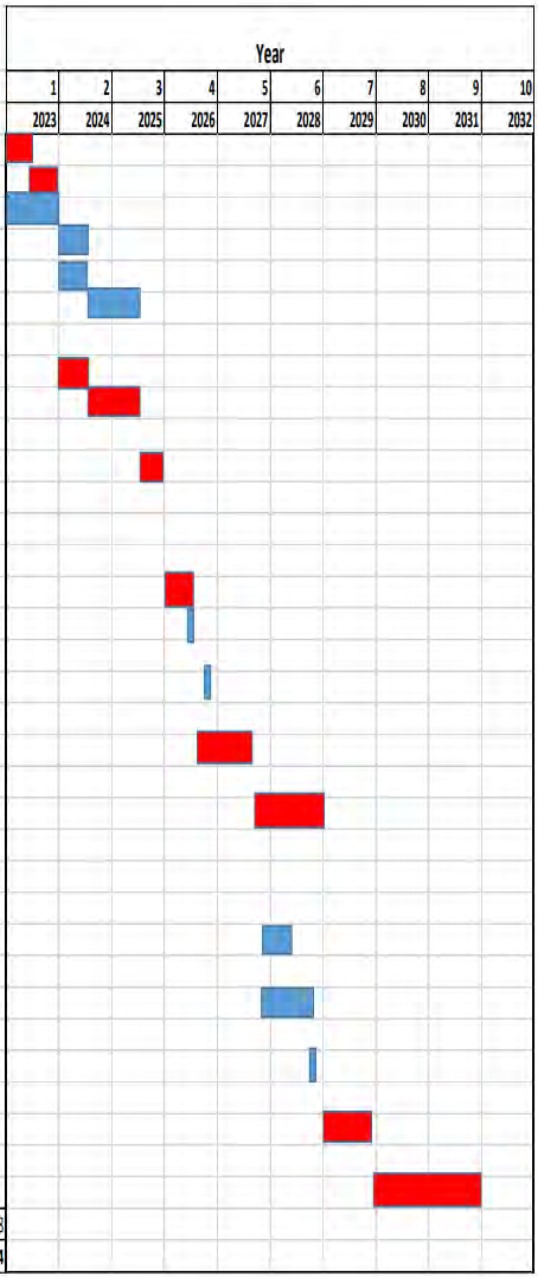
Annex 9.2 Schematic Layout of Dam



Annex 10

Project Construction Schedule

SN	Major Work Activity	Sub Activity	Quantity	Productivity	Duration months	Duration in days	
1	Project preparation works	SIA/EIA Additional Study			6	180	
		EIA/SIA Approval			6	180	
		DPR update/Value Engg. and Approval			12	360	
		Tree cutting permit and land use permit			6	180	
		Private land acquisition			6	180	
2	Road construction + forest	Separate Contract			12	360	
3	Approvals	Govt. /Donor budget approvals			6	180	
4	Procurement	Procuement of Contractor			12	360	
5	Temporary Camp establishment, equipment and foreign materials procurement				6	180	
6	Main Dam						
		Excavation (weathered rock)	376000	1888	6.64	199	
		Excavation rock	71000	1168	2.03	61	
		Plinth concreeting	1600	21.2	2.52	75	
		Dam Body	1617000	3960	13.61	408	
		Face slab concrete	577		18.41	552	
		Upstream Blanket	80850	2000	1.35	40	
7	Penstock Pipe work	Supports, laying, Joining, testing			6	180	
8	Powerhouse construction				12	360	
9	Transmission line				3	90	
7	Impounding and trial run				11	330	
8	Defect Notification Period				24	720	
				Total	172.6	5177	14.38
				Critical	109.66	3290	9.14



Annex 11

Energy Table

Month	No. of days in the month	Flow in the river (m^3/s)	Available flow of power generation (m^3/s)	Turbine discharge	No. of E/M units in operation	Gross head	Headloss	Net head	Combined E/M efficiency
Baishakh	31	0.45	0.45	0.45	2	501.5	9.750308	491.7497	0.85536
Jestha	31	0.45	0.45	0.45	2	501.5	9.750308	491.7497	0.85536
Ashadh	32	0.45	0.45	0.45	2	501.5	9.750308	491.7497	0.85536
Shrawan	31	0.45	0.45	0.45	2	501.5	9.750308	491.7497	0.85536
Bhadra	31	0.45	0.45	0.45	2	501.5	9.750308	491.7497	0.85536
Ashwin	31	0.45	0.45	0.45	2	501.5	9.750308	491.7497	0.85536
Kartik	30	0.45	0.45	0.45	2	501.5	9.750308	491.7497	0.85536
Mangsir	29	0.45	0.45	0.45	2	501.5	9.750308	491.7497	0.85536
Poush	30	0.45	0.45	0.45	2	501.5	9.750308	491.7497	0.85536
Magh	29	0.45	0.45	0.45	2	501.5	9.750308	491.7497	0.85536
Falgun	30	0.45	0.45	0.45	2	501.5	9.750308	491.7497	0.85536
Chaitra	30	0.45	0.45	0.45	2	501.5	9.750308	491.7497	0.85536

Month	Power (KW)	Estimated energy (KWh)	Estimated energy (GWh)	discharge per unit turbine	Monthly Average Dry Energy, (KWh)	Monthly Average Wet Energy, (KWh)	Revenue from Dry Energy, (Nrs.)	Revenue from Wet Energy, (Nrs.)
Baishakh	1856.8	1312415	1.312415	0.225	1312415		16273943	
Jestha	1856.8	1312415	1.312415	0.225	635039.4	677375.3	7874488	4809365
Ashadh	1856.8	1354751	1.354751	0.225		1354751		9618730
Shrawan	1856.8	1312415	1.312415	0.225		1312415		9318145
Bhadra	1856.8	1312415	1.312415	0.225		1312415		9318145
Ashwin	1856.8	1312415	1.312415	0.225		1312415		9318145
Kartik	1856.8	1270079	1.270079	0.225		1270079		9017559
Mangsir	1856.8	1227743	1.227743	0.225	592703.4	635039.4	7349522	4508780
Poush	1856.8	1270079	1.270079	0.225	1270079		15748977	
Magh	1856.8	1227743	1.227743	0.225	1227743		15224011	
Falgun	1856.8	1270079	1.270079	0.225	1270079		15748977	
Chaitra	1856.8	1270079	1.270079	0.225	1270079		15748977	
	Total	**15452625**	**15.45263**				**93968895**	**55908867**

Annex 12

Questionnaires and Checklist Used for the EIA Study

Annex 12.1 Physical Environment

A. Topography/Physiography

1. Study of Topographic maps/ other available maps and identify the ground topographic characteristics of land covered by the proposed Nagmati Dam Project
2. Verify the topographic characteristics of the land in the field
3. Observe key geomorphic features of the ground and the agents that are responsible for moulding the ground geomorphic features
4. If possible classify the ground as per the geomorphic features

B. Climate and Meteorology

1. Study of published data of regarding temperature, rainfall, humidity,
2. If possible classify the climatic zone and its verification
3. Visit the meteorological office of the district and get latest information

C. River Hydrology/ Drainage Pattern

1. Study of Topographic maps/ other available maps and identify the drainage patterns of the Nagmati River
2. Verify the topographic characteristics of the river system/drainage pattern in the field
3. Collect all the available information regarding river hydrology (Max. flow, Min flow, average flow, etc. if available)
4. Collect the available information regarding the quality of river water
5. Investigate flood potential in the river and seasons of occurrence

D. Air Quality

1. Collect any data on air quality of the area from previous literature
2. Investigate on the air polluting activities of the area (traffic, biomass burning, industries, other anthropogenic activities

E. Water Quality

1. Collect data on Nagmati river water from previous monitoring activities if any
2. collect water samples of the Nagmati river for laboratory analysis

F. Erosion and land Stability

1. Investigate dominant erosion features along the proposed project structures
2. Investigate erosion potential of the project area
3. Investigate the erosion features and potentials of the local streams and gullies
4. Investigate land stability problems of the project area and structures

G. Sedimentation

1. Investigate suspended sediment loads in the Nagmati river water in the monsoon period from the previous monitoring data if any

2. Investigate sedimentation problems and quantity of sedimentation in the Nagmati river

H. Land Use

1. Investigate on the land use of the project area from the topo-maps, and other available land use maps
2. Investigate the land use affected by the project structures and subsidiary facilities
3. Investigate on the land use potentials of the area

I. Water Use

1. Identify water sources such as springs, irrigation canal, etc used for drinking water, irrigation, etc by the local communities (Note down name of the springs, irrigation facility and the name of village, community & nos. of HHs using them along with ward numbers

Annex 12.2 Biological Environment

A. FOREST SAMPLING CHECKLIST

Format 1: Data Reporting Template

आयोजनाको नाम: नागमती बाँध आयोजना संरक्षित

क्षेत्रको नाम: शिवपुरी—नागार्जुन राष्ट्रिय निकून्ज

नगरपालिका/गाउँपालिका: गोकर्णेश्वर नगरपालिका

वनको क्षत्रफल:

वन पैदावरको विवरण:

क. रुख (ब्यासः ३० से.मि. भन्दा ठुला)

क्र.स.	प्रजाति	गोलाई इन्च	उचाई (फिट)	प्राप्त हुनसक्ने वन पैदावर		मुल्य	जिपिएस कोअर्डिनेट	कैफियत
				काठ (क्यूफिट)	दाउरा (क्यूफिट)			

ख. बल्लाबल्ली (ब्यासः १० - २९.९ से.मि.
सम्म.)

क्र.स.	प्रजाति	गोलाई इन्च	उचाई (फिट)	प्राप्त हुनसक्ने वन पैदावर		मुल्य	जिपिएस कोअर्डिनेट	कैफियत
				काठ (क्यूफिट)	दाउरा (क्यूफिट)			

ग. लाप्रा र बिरुवा (ब्यासः ४.०४ देखि ९.९
से.मि. सम्म)

क्र.स.	प्रजाति	सङख्या	दाउरा	मुल्य

Format 2: Data collection Template for Tree (>30 cm DBH) and Poles (10-29.9 cm DBH)

आयोजनाको नाम : नागमती बाँध आयोजना

संरक्षित क्षेत्रको नाम : शिवपुरी नागार्जुन राष्ट्रिय निकून्ज

वन पैदावर सर्बेक्षणको विवरण: रुख तथा बल्लाबल्ली

फाराम नं २

नगरपालिका/गाउँपालिका: गोकर्णेश्वर नगरपालिका

वनको क्षत्रफल:

ब्लक नम्बर	प्लट नम्बर	रुख नम्बर	प्रजातिको नाम	गोलाई (से.मि.)	उचाई (मि.)	श्रेणी	जिपिएस कोअर्डिनेट		कैफियत
							Latitude	**Longitude**	

तयार गर्नेः	**रुजु गर्नेः**	**चेक गर्नेः**	**प्रमाणित गर्नेः**
परामर्शदाता प्रतिनिधि	आयोजना प्रतिनिधि बागमती सुधार आयोजना आयोजना कार्यान्वयन ईकाई	रेन्जर शिवपुरी-नागार्जुन राष्ट्रिय निकून्ज कार्यालय	सहायक संरक्षण अधिकृत शिवपुरी-नागार्जुन राष्ट्रिय निकून्ज कार्यालय

Format 3: Data collection Template for Seedlings and Saplings

आयोजनाको नाम : नागमती बाँध आयोजना
नगरपालिका/गाउँपालिका: गोकर्णेश्वर नगरपालिका
संरक्षित क्षेत्रको नाम : शिवपुरी नागार्जुन राष्ट्रिय निकून्ज
वनको क्षत्रफल:
वन पैदावर सर्वेक्षणको विवरण: लाप्रा तथा विरुवा

फाराम नं ३

ब्लक नम्बर	प्लट नम्बर	प्रजातिको नाम	सँख्या	उचाई (मिटर)	कैफियत

तयार गर्ने:
परामर्शदाता प्रतिनिधि

रुजु गर्ने:
आयोजना प्रतिनिधि
वागमती सुधार आयोजना
आयोजना कार्यान्वयन ईकाई

चेक गर्ने:
रेन्जर
शिवपुरी-नागार्जुन राष्ट्रिय निकून्ज कार्यालय

प्रमाणित गर्ने:
सहायक संरक्षण अधिकृत
शिवपुरी-नागार्जुन राष्ट्रिय निकून

B. FIELD CHECKLIST FOR WILDLIFE STUDY

FORMAT– A1

MAMMALS OF THE PROJECT AREA

SN	Common Names	Scientific Names	Status of occurrence			Habitat				Migratory Status/season		Observed Location	Reported location
			Common	Sparse	Rare	F	B	G	A	M/R/V	S		

Note: Habitats = F- forest, B – Bush, G- Open grass land, A – Agricultural land

Migratory status and season = M – Migratory, R = Resident, V = Visitor occasionally, S – migration season

FORMAT-A2

REPTILES AND AMPHIBIANS OF THE PROJECT AREA

SN	Common Names	Scientific Names	Status of occurrence			Habitat				Migratory Status/season		Observed Location	Reported location
			Common	Sparse	Rare	F	B	G	A	M/R/V	S		

Note: Habitats = F- forest, B – Bush, G- Open grass land, A – Agricultural land

Migratory status and season = M – Migratory, R = Resident, V = Visitor occasionally, S – migration season

FORMAT III – A3

BIRDS OF THE PROJECT AREA

SN	Common Names	Scientific Names	Status of occurrence			Habitat				Migratory Status/season		Observed Location	Reported location
			Common	Sparse	Rare	F	B	G	A	M/R/V	S		

Note: Habitats = F- forest, B – Bush, G- Open grass land, A – Agricultural land

Migratory status and season = M – Migratory, R = Resident, V = Visitor occasionally, S – migration season

C. CHECKLIST FOR HABITAT LOSS

1: Loss of Terrestrial Habitat at different Project Components

1(A) : Forest/Shrub/Scrub

SN	Project Component	Animal species in the identified habitat#	Number of habitats affected/ number of active habitat**	State habitat's continuity and connectivity	Number of similar habitats in the surrounding areas	Dominant vegetation type## (evergreen/ deciduous/ mixed/others)	Dominant tree/ vegetation size (dbh)/avg. height(m)	Usage of habitat###	Crown cover (%)	Threat/ conservation status
1	Dam and Reservoir	Local/ Scientific Name								
2	Water Conveyance: Canal/ penstock									
3	Power House									
4	TL/Access Road/ ROW									
5	Substation/ Switchyard									
	Total					Sum				

Note:

** *Give number of both habitats as –*no. of affected / no. of active

 # Identify the listing category (Govt./IUCN/CITES) with ranking for each category: Use different rows for each species

Also give dominant species

Classify as –Active, Temporary and Breeding/Feeding or Hunting/Resting/others.

1(B) : Open Field and others

SN	Project Component	Animal species in the identified habitat#	Number of habitats affected/ number of active habitat	Number of similar habitats in the surrounding areas	Type of open field ##	Dominant plants (dbh)/avg. height(m)	Usage of habitat###
1	Headworks*	Local Name/ (*Scientific Name*)					
2	Water Conveyance: Canal/ penstock						
3	Power House						
4	TL/Access Road/ ROW						

5	Substation/ Switchyard						
	Total				Sum		

Note:

* *Add associated structures at headworks, if required*

\# *Identify the listing category (Govt./IUCN/CITES) with ranking for each category: Use different rows for each species*

\## *Types could be: Plain; Barren; Grassy; If other (specify)*

\### *Classify as –Active, Temporary and Breeding/Feeding or Hunting/Resting/others.*

2 (A): Loss of Aquatic Habitat at different Project Components (*for fish and mammalian species*)

S. N.	Project component	Species in the identified habitat#	Number of habitats affected/number of intact active habitat	Change in water depth (m)		General composition of sub-strate##	Water qualtiy observation ###	State presence and/or absence of benthic macro
		Local Name/ *(Scientific Name)*		Before *	After*			
1	Reservoir							
2	Dam							
3	Dewatered Zone							
4	River Quarry Sites							
5	Spoil Disposal Sites							
	Total					Sum		

Note:

** Give average depth in dry season/wet season as–**dry season depth/wet season depth**, Before and After the Project Construction.*

 # Identify the listing category (Govt./IUCN/CITES) with ranking for each category: Use different rows for each species

Bedrock; Boulder; Cobble; Gravel; Sand; Silt; Clay; or others

Give --Temperature (at what depth); pH; DO; Salinity; Turbidity; Observed Colour.

2(B). List of affected fish species

S. N.	Fish migration Characteristics	Number of fish Species	Fish Species*	Listing of Species**	Other Aquatic Species
1	Resident				
2	Short range migratory				
3	Mid range Migratory				
4	Long range migratory				
	Total	**Sum**			

Note:

** Give both Scientific and Common Name*

*** Identify the listing category (Govt./IUCN/CITES) with ranking for each category: Use different rows for each species*

3 (A): Loss of Bird Habitat at different Project Components

SN	Project Component	Bird species in the identified habitat#	Loss of nesting places	Other available nesting places in the surrounding areas	Dominant vegetation type## (evergreen/ deciduous/ mixed/others)	Tree/ vegetation size (dbh)/avg. height(m)	Usage of habitat ###	Crown cover (%)	Threat/ conservation status
1	Dam and Reservoir	Local Name/ (Scientific Name)							
2	Water Conveyance: Canal/ penstock								
3	Power House								
4	TL/Access Road/ ROW								
5	Substation/ Switchyard								
	Total				Sum				

Annex 12.3 Socio-Economic and Cultural Environment

A. HOUSEHOLD QUESTIONNAIRE

District: Municipality=M Ward No: Village:

Respondent's Name Gender: Age: Cast: Religion:
Occupation: Education: Date:

1. Family Description

SN	Name of Family Member	Age	Gender	Education	Occupation
1					
2					
3					
4					
5					
6					
7					
8					
9					

2. Annual Income and Expenditure NRs…….

Source: ……..

3. Migration

a. How long ago you have been migrated this place? ……..Years/Months

b. From where you reside here? ……..

c. Any member of your family went for earning temporally? If yes:

How Many Members	For how many months	Place of Job

4. Land ownership (Ropani)

S.N	Ownership	Irrigated Land	Non-Irrigated land	Garden	Paster	Other	Total
1	Self-owned						
2	Cultivated other's land						
3	Leased to other						

5. Main agricultural crops and use of crops

Crop	Annual Production (Muri)	Consumed (Muri)	Sell (Muri)
Rice/wheat			
Maize/Millet			
Mustard			
Buck wheat			

Potato			
Others			

6. Production is sufficient for

3 Month ☐ 6 Month ☐

9 Month ☐ 12 Month ☐

Do you sell excess amount of crop? ☐

Do you buy main food crops? ☐

7. How much do you invest for crop production annually?

8. Livestock

Type →	Cattle	Buffalo	Goat	Pig	Chicken	Other	Total
Number							

9. Physical Facility

1. Drinking water: Spring ☐ Riv ☐ Tap ☐ Other ☐

2. (1) How many liters of water you consume per day ? ……..

(2) How many liters you receive per day ? ……..

3. How far is road: 1 km ☐ 2 km ☐ 3 km ☐ 0 km ☐

Toilet Facility: Inside House or Out side House Tick appropriate answer

Garbage/sewrage management ?

10. Main disease ____ ?

1. 2. 3.

11. Communication facility? Source of Energy ?

12. Loss due to Project

1. Land only 2. House. 3. Land, house, other structure too

13. Interest on Compensation type

1. Cash compensation
2. House for house
3. Land for land
4. Do you happy to shift other places

14. Please mention what short of impact you will have due to project components?

15. Propose any measure to apply?

16. Specify benefits when NDP is implemented?

B. FGD CHECKLIST

Location (District, Muni/RM, Ward and Tole /Gaun):
Date:
Facilitator:

- **Project Description** *(Presented by the Facilitator/Researcher)*
- **Profile of the CFUGs/Water Users**
    - Total Number of User member HH and membership Criteria
    - Caste/ethnic and gender composition of the Users
    - Leadership Patterns of the User Committee
    - Overall condition of the forest including types with major species
    - Extraction of forest products (types, quantity per year) and provisions of distribution among members and non-members
    - Level of forest product/ water available and their sufficiency for the local users and alternative mechanisms
    - Main use/purpose of water
    - Extraction of fish and other aquatic lives from the river
    - Spiritual and cultural use and associated values of the river

. 3. **Socioeconomic Profile of the area**
    - Population/demographic features
    - Total HHs
    - Total population
    - Male/Female Ratio
    - Women headed HHs
    - Average Age of marriage and child birth

- Main and Secondary Modes of Livelihood
- Land Ownership Patterns
- Food Sufficiency Level
- Level of Education/ skill & trainings
- Formal Employment
- Health Condition
- Patterns of energy used
    - Cooking
    - Lighting
- Access to other Resources and Assets
    - Safe Drinking Water
    - Toilet
    - School
    - Health Centre
    - Security centre
- Involvement in Public Decision Making

- Ethnic organization
- NGOs
- Political Parties
- Neighborhood

- Access to natural resources
  - Forest/fuel wood/ fodder/timber/NTFPs
  - Animal grazing
  - River/recreation

4. Self-identification

1. Characteristics of Indigenous Peoples (Adhivasi Janajatis)
2. Distinct social, economic, cultural and political institutions
3. Cultural Heritage
   a. Cultural resources- temples, shrines, and sacred elements of the landscape, artifacts and buildings etc.
   b. Archaeological resources-plants and animal remains, burial sites and architectural elements etc.

4. **Attitude toward the Project and Perceived Likely Impacts (high, low or medium**
5. **Mitigation Measures and Modes of Rehabilitation/ or Restoration**
6. **General Perception and Understanding of Local Development Needs/Issues**
7. **Expectations from the Project**
8. **Identification of Needs and their Priority within the Scope of the Project**
9. **Modes of Implementation of Social Development Program**
   - Institutional arrangements
   - Participation and consultation
   - Grievances and hearing mechanism
   - Monitoring and evaluation

List of FGD Participants

Date: ……..

Venue (District, M, Ward and tole/Gaun):

Facilitator:

S.N	Name	Age	Sex	Affiliation	Contact telephone	Signature
1						
2						
3						

C. CHECKLIST FOR ETHNO-BOTANICAL SURVEY

S.N.	Local Name	Use type	Part and mode of use	Remarks

Note: use abbreviation for use type: E - edible, M - Medicine, F – fodder, FW – firewood, T – timber, Fi – fiber, Fe – fence etc.

Annex 13

Temperature, Rainfall and River Data from DHM used for Analysis

a. Temperature Data of Tribhuvan International Airport, Kathmandu

Year	Maximum Temperature												
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Mean
Jan	19.62	17.46	18.86	18.61	20.17	18.25	19.34	18.46	18.11	17.31	19.68	16.86	18.56
Feb	23.75	22.78	23.75	20.86	22.21	23.37	23.73	22.78	20.77	19.66	22.34	18.58	22.05
March	27.00	26.62	28.12	25.77	24.70	26.95	24.10	26.75	25.09	24.71	26.53	28.25	26.22
April	28.67	28.65	29.31	29.61	26.42	31.17	28.18	26.23	27.29	26.95	29.09	30.12	28.47
May	28.89	31.38	30.00	29.73	30.56	28.90	28.15	27.64	30.64	27.89	27.10	28.14	29.09
June	29.42	31.25	29.98	30.51	31.43	29.21	29.90	29.40	30.75	28.39	28.67	28.68	29.80
July	28.62	28.84	29.36	29.56	29.55	28.07	29.30	29.51	28.76	28.04	28.38	29.45	28.95
Aug	29.54	29.50	29.64	29.33	29.11	30.01	29.18	28.75	30.53	29.82	28.18	29.83	29.45
Sep	28.39	29.37	29.81	28.39	29.39	27.94	29.72	29.45	27.44	29.29	28.80	28.73	28.89
Oct	28.06	27.26	26.60	26.45	27.18	27.44	28.04	26.27	26.51	28.69	27.74	26.33	27.21
Nov	22.43	22.49	22.58	21.91	23.59	23.55	23.59	22.68	23.69	23.06	22.55	24.16	22.95
Dec	18.86	19.29	18.79	20.05	18.80	20.76	20.77	18.73	18.08	19.36	18.60		19.28

Source: Department of Hydrology and Meteorology (DHM), 2022

Year	Minimum Temperature												
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Mean
Jan	2.38	2.73	1.59	3.90	4.37	4.00	3.17	3.22	3.57	4.09	4.42	5.52	3.58
Feb	5.28	5.18	6.14	5.64	7.00	6.25	6.82	6.95	6.11	6.53	6.21	5.70	6.15
March	8.85	8.36	10.09	9.14	9.91	10.30	9.42	10.15	8.41	10.21	10.30	12.53	9.80
April	11.95	12.95	12.40	11.88	12.55	14.16	13.39	13.24	13.79	12.54	11.90	16.21	13.08
May	16.17	16.05	17.06	16.42	16.57	16.21	16.01	16.32	15.78	16.00	16.43	17.02	16.34
June	18.99	20.10	20.08	20.08	19.67	19.54	19.59	19.34	19.27	19.53	19.75	19.83	19.65
July	20.46	20.64	20.44	20.87	19.83	20.39	20.37	20.66	20.33	20.48	20.55	20.72	20.48
August	20.00	20.17	20.17	20.60	20.10	20.06	20.39	20.23	20.58	20.65	20.48	20.50	20.33
Sep	19.07	19.03	18.87	19.04	18.87	19.32	19.32	19.20	19.12	19.35	19.24	19.54	19.16
Oct	14.18	12.68	15.95	13.68	13.67	15.47	15.41	12.44	14.92	15.72	16.66	14.85	14.64
Nov	9.46	6.54	7.72	10.12	9.47	8.54	9.00	7.81	11.05	8.05	9.05	11.36	8.88
Dec	4.13	3.99	4.78	4.79	4.32	5.84	5.41	4.31	4.47	4.63	5.45		

Source: Department of Hydrology and Meteorology (DHM), 2022

b. Rainfall Data from Sundarijal Station from 1994-2020

Year	Monthly rainfall (mm)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1994	35.4	24.1	21.6	28.2	262.0	619.3	875.7	878.8	676.2	0.0	19.8	0.0	3441.1
1995	19.6	47.2	42.0	9.6	102.6	326.4	815.0	588.0	357.0	41.0	60.8	0.0	2409.2
1996	73.6	9.2	14.8	51.0	67.6	492.8	680.4	897.8	480.2	64.4	0.0	0.0	2831.8
1997	28.0	8.2	27.4	125.6	113.0	329.0	1176.	752.8	227.0	34.8	47.0	64.4	2933.2
1998	1.8	0.0	97.0	133.4	308.8	440.2	808.0	852.0	203.6	22.4	0.0	0.0	2867.2
1999	6.2	2.2	0.2	19.5	219.2	455.6	822.8	695.8	381.4	194.6	0.0	0.0	2797.5
2000	0.3	2.4	20.4	87.4	343.0	514.1	734.9	706.6	361.7	2.8	0.0	2.0	2775.6
2001	7.0	1.5	12.1	26.8	183.3	420.1	597.9	636.9	124.6	18.0	0.0	0.2	2028.4
2002	37.3	38.1	111.4	90.6	271.2	133.8	536.6	512.4	128.7	47.3	0.4	0.2	1908.0
2003	49.9	64.5	61.7	14.5	29.1	68.8	584.1	549.6	329.8	0.0	0.0	20.4	1772.4
2004	48.9	0.3	31.4	30.3	233.0	101.8	392.2	287.9	183.8	44.9	30.4	0.0	1384.9
2005	93.8	14.6	15.3	11.8	21.7	49.7	190.1	208.6	137.5	146.6	0.0	0.0	889.7
2006	0.0	0.0	37.4	112.6	410.3	257.1	295.8	424.8	181.1	11.2	0.0	22.2	1752.5
2007	0.0	104.7	54.5	154.2	114.7	245.5	428.4	571.5	406.8	30.2	0.0	0.0	2110.5
2008	1.8	0.0	104.8	25.8	111.8	234.9	294.9	321.8	286.2	41.4	0.0	13.2	1436.6
2009	0.0	0.0	17.4	0.0	290.0	92.4	684.9	426.4	326.9	37.3	0.0	0.0	1875.3
2010	0.0	24.7	28.4	79.2	157.5	306.4	407.4	782.2	128.1	52.9	0.0	0.0	1966.8
2011	17.2	61.4	37.3	103.3	246.3	288.5	534.3	605.8	393.3	27.4	24.2	0.1	2339.1
2012	12.5	33.4	27.4	129	82.2	212.5	472.5	590.6	446.4	27.6	4	0	2038.1
2013	10	45.3	7.5	42.5	249.3	370.8	433.7	605.5	163.7	90.3	90.3	6	2114.9
2014	4	16.4	100.6	11.8	51.8	226.2	654.3	531.9	363	69.6	0	17.3	2046.9
2015	2.4	36.4	73.1	57	74.6	216.2	487.9	452.7	172.9	48.8	0	0	1622
2016	0.3	12.8	12	11	157.5	430.5	647.4	243.2	371.9	69.4	0	0	1956
2017	16.4	0	105.4	102.7	159.8	376.8	475.9	461.8	168.9	31.6	3.5	0.1	1902.9
2018	9	0.8	30.4	195.3	211.9	259.5	578.1	902.4	11.4	9.4	0	0	2208.2
2019	26.1	106.7	57.1	114	76.3	214.8	365.4	473.3	430.1	9.3	0	31.6	1904.7
2020	53.3	22.8	45.3	65.8	174.8	430.7	412.4	505.5	258.7	2.7	0	0	1972
Mean	18.72	25.32	43.42	71.25	171.1	301.13	558.85	562.41	283.71	42.55	10.75	6.35	2095.60

c. Average monthly and yearly discharge of Bagmati River at Sundarijal and Gaurighat Station (in m^3/s))

Location: Sundarijal							**Latitude: 27. 46 30**						
River: Bagmati River							**Longitude: 85. 25 40**						
Year	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**Jun.**	**Jul.**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Dec.**	Year
1963	0.221	0.128	0.141	0.191	0.176	0.424	2.04	4.83	2.65	1.1	0.544	0.34	1.07
1964	0.224	0.153	0.124	0.123	0.148	0.284	1.76	3.73	3.6	1.39	0.559	0.411	1.04
1965	0.327	0.261	0.222	0.225	0.209	0.4	1.55	3.26	1.5	0.811	0.557	0.278	0.799
1966	0.246	0.217	0.188	0.162	0.488	1.19	3.11	4.88	3.27	0.963	0.385	0.284	1.28
1967	0.246	0.203	0.192	0.197	0.181	0.387	3.7	4.51	3.24	1.45	0.728	0.403	1.29
1968	0.258	0.197	0.241	0.223	0.181	1.37	4.2	4.72	3.39	1.92	0.614	0.291	1.47
1969	0.204	0.209	0.185	0.174	0.193	0.201	1.32	3.1	2.92	1.29	0.555	0.335	0.891
1970	0.22	0.214	0.203	0.189	0.149	0.447	2.65	4.97	3.15	1.75	0.661	0.384	1.25
1971	0.145	0.111	0.08	0.136	0.14	2.24	2.95	4.27	2.44	0.994	0.56	0.31	1.2

Location:	**Sundarijal**						**Latitude: 27. 46 30**						
River:	**Bagmati River**						**Longitude: 85. 25 40**						
Year	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**Jun.**	**Jul.**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Dec.**	Year
1972	0.283	0.245	0.235	0.197	0.238	0.45	2.45	2.99	2.99	0.994	0.59	0.385	1
1973	0.279	0.245	0.235	0.184	0.238	1.05	2.4	3.25	...	...	0.592	0.302	...
1974	0.241	0.196	0.156	0.103	0.258	0.264	1.98	3.01	3.14	1.79	1.16	0.896	1.1
1975	0.748	0.681	0.688	0.505	0.365	0.708	1.33	1.11	2.63	1.75	0.93	0.722	1.01
1976	0.574	0.444	0.294	0.302	0.68	4.95	5.56	5.83	5.54	1.53	0.459	0.456	2.22
1977	0.385	0.355	0.3	0.374	0.42	1.08	3.26	3.55	2.05	0.897	0.48	0.381	1.13
1978	0.316	0.231	0.259	0.237	0.382	0.606	2.51	5.19	3.39	1.87	0.595	0.241	1.32
1979	0.162	0.104	0.081	0.114	0.128	0.302	2.12	2.64	2.36	1	0.498	0.396	0.825
1980	0.205	0.148	0.106	0.12	0.188	1.55	3.19	2.96	2.86	1.6	0.916	0.62	1.2
1981	0.359	0.261	0.263	0.285	0.45	0.89	2.68	3.27	2.65	1.37	0.778	0.504	1.15
1982	0.342	0.4	0.295	0.478	0.266	0.419	1.55	2.75	3.03	0.978	0.38	0.35	0.937
1983	0.237	0.192	0.173	0.213	0.226	0.309	3.92	5.66	5.7	3	1.19	0.733	1.8
1984	0.573	0.429	0.4	0.397	0.617	1.26	4.71	4.87	4.5	1.18	0.553	0.403	1.66
1985	0.4	0.248	0.206	0.215	0.339	0.561	2.11	2.83	2.98	1.43	0.733	0.475	1.04
1986	0.547	0.462	0.395	0.398	0.429	0.932	3.31	4	3.8	1.64	0.73	0.497	1.43
1987	...	...	0.248	0.215	0.211	0.471	2.8	3.47	2.83	0.894	0.533	0.377	...
1988	0.26	0.189	0.186	0.18	0.31	1.28	3.68	5.04	2.71	1.13	0.636	0.489	1.34
1989	0.45	0.338	0.292	0.227	0.388	0.748	2.63	5.07	3.87	2.11	1.02	0.685	1.48
1990	0.563	0.509	0.474	0.475	0.51	1.76	3.25	3.43	2.88	1.46	0.78	0.458	1.38
1991	0.29	0.241	0.229	0.213	0.231	0.682	1.62	...	...	...	...	...	...
1992	0.296	0.254	0.222	0.202	0.223	0.299	1.11	3.12	3.14	1.18	0.694	0.511	0.937
1993	0.41	0.324	0.276	0.307	0.414	0.796	2.42	3.43	2.26	1.08	0.502	0.366	1.05
1994	...	...	...	...	0.301	1.27	3.47	4.43	3.39	1.47	0.962	0.726	...
1995	0.64	0.627	0.626	0.533	0.629	1.64	3.28	3.66	2.28	1.36	0.641	0.385	1.36
1996	0.337	0.261	0.221	0.216	0.217	0.486	1.95	3.35	2.3	1.47	0.404	0.236	0.954
1997	0.216	0.188	0.141	0.177	0.146	0.48	3.35	2.4	1.68	1.19	0.676	0.478	0.926
1998	0.303	0.253	0.294	0.274	0.362	0.659	2.98	3.98	2.23	1.4	0.765	0.468	1.16
1999	0.292	0.233	0.209	0.21	0.232	0.869	3.04	4.11	3.63	2.18	1.08	0.661	1.4
2000	0.481	0.359	0.296	0.32	0.593	1.34	2.96	3.42	1.91	1.11	0.404	0.331	1.13
2001	0.241	0.143	0.138	0.168	0.643	0.905	2.89	4.41	3.46	1.48	0.903	0.772	1.35
2002	0.768	0.758	0.609	0.3	0.741	1.45	4.12	5.62	2.01	1.18	0.509	0.338	1.53
2003	0.332	0.333	0.3	0.211	0.215	0.429	2.32	3.58	3.46	1.31	0.648	0.391	1.13
2004	0.416	0.353	0.315	0.282	0.292	0.402	1.91	3.75	2.53	1.59	0.826	0.577	1.1
2005	0.524	0.395	0.392	0.372	0.379	0.395	1.13	3.8	2.72	1.44	0.917	0.675	1.09
2006	0.595	0.507	0.502	0.516	0.721	1.22	2.93	4.35	2.86	1.38	0.952	0.734	1.44
2007	0.313	0.299	0.301	0.304	0.446	1.32	2.02	2.28	3.13	1.06	0.745	0.375	1.05
2008	0.295	0.231	0.16	0.126	0.124	0.558	1.67	2.86	1.81	0.774	0.555	0.362	0.794
2009	0.499	0.212	0.133	0.176	0.224	0.219	0.952	2.5	1.46	0.778	0.415	0.328	0.658
2010	0.241	0.221	0.2	0.165	0.184	0.324	1	2.91	2.67	0.876	0.459	0.368	0.802
2011	0.303	0.237	0.174	0.194	0.533	0.927	3.54	4.03	3.5	2.89	1.5	0.538	1.53
2012	0.366	0.325	0.317	0.342	0.273	0.263	1.15	3.83	2.55	1.19	0.608	0.445	0.972
2013	0.376	0.338	0.219	0.21	0.224	0.353	1.61	3.22	1.95	1.1	0.665	0.411	0.89
2014	0.341	0.312	0.256	0.219	0.22	0.429	1.94	2.95	3.2	1.31	0.513	0.407	1.01
2015	0.311	0.298	0.238	0.267	0.591	1.11	1.84	2.67	2.02	1.27	0.623	0.389	0.968

Location: Sundarijal								**Latitude: 27. 46 30**					
River: Bagmati River								**Longitude: 85. 25 40**					
Year	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**Jun.**	**Jul.**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Dec.**	Year
Average	0.357	0.296	0.262	0.253	0.333	0.856	2.56	3.73	2.91	1.38	0.686	0.455	1.17
Location: Gauri Ghat								Latitude: 27 42 35					
River: Bagmati River								Longitude: 85 21 10					
Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year
1991	0.602	0.155	0.182	0.247	0.439	0.804	3.4	6.42	6.9	1.95	0.942	0.711	1.9
1992	0.483	0.245	0.106	0.187	0.326	0.728	2.45	6.05	6.19	2.34	1.31	0.831	1.77
1993	0.41	0.424	0.353	0.576	0.888	1.64	4.97	8.43	4.16	1.93	0.818	0.38	2.08
1994	0.321	0.187	0.079	0.104	0.291	2.16	6.69	12	10.2	2.47	0.991	0.612	3.01
1995	0.319	0.269	0.238	0.232	1.04	4.9	8.39	7.06	4.01	2.18	1.14	0.517	2.52
1996	0.473	0.231	0.208	0.175	0.175	1.53	4.83	11.1	5.91	3.02	1.15	0.593	2.45
1997	0.398	0.289	0.22	0.558	0.356	1.06	8.51	10.9	4.05	1.79	0.852	0.842	2.49
1998	0.379	0.295	0.544	0.601	0.898	1.14	8.14	11.8	5.25	2.35	1	0.47	2.74
1999	0.354	0.32	0.294	0.311	0.433	2.08	7.54	11	6.58	4.83	1.4	0.548	2.97
2000	0.268	0.218	0.183	0.265	1.24	2.64	7.47	11.7	6.17	2.19	0.87	0.699	2.82
2001	0.648	1.55	0.368	0.311	0.6	1.91	7.04	16.1	10.5	5.19	2.2	0.976	3.95
2002	0.758	0.587	0.877	0.925	1.99	2.01	17	22.3	9.33	2.72	0.866	0.3	4.98
2003	1.41	1.56	1.51	1.39	1.16	2.13	13.3	16.9	17.1	4.98	1.77	0.973	5.35
2004	0.716	0.372	0.542	0.683	1.07	1.25	9.15	12	7.43	3.68	1.18	0.549	3.22
2005	0.47	0.239	0.201	0.161	0.155	0.763	3.4	9.68	3.87	1.88	0.622	0.211	1.81
2006	0.088	0.538	0.387	0.615	1.13	1.88	5.73	6.89	5.37	2.22	0.579	0.248	2.14
2007	0.202	...	0.179	0.381	0.843	4.46	8.78	8.11	13.3	3.83	1.78	0.945	...
2008	0.642	0.262	0.46	0.438	0.712	3.88	6.64	10.8	7.33	3.34	1.75	1.01	3.1
2009	0.689	0.372	0.501	0.715	1.25	0.899	8.29	8.33	5.92	3.93	2.29	1.6	2.9
2011	1	1.01	0.918	1.57	2.5	4.37	13.9	13.9	11.5	5.14	2.72	1.62	5.01
2012	1.42	1.55	1.26	1.65	1.03	1.51	9.07	12.4	13.5	3.91	1.93	1.48	4.23
2013	1.33	1.49	0.763	0.701	1.66	3.78	10.2	14.5	7.05	3.71	2.06	1.28	4.04
2014	0.9	0.83	0.778	0.656	0.696	1.61	7.92	9.83	8.66	4.35	2.17	1.45	3.32
2015	1.06	0.921	1.16	1.03	1.16	2.06	6.73	14.9	5.95	2.73	1.57	0.94	3.35
Average	0.638	0.605	0.513	0.604	0.919	2.13	7.88	11.3	7.74	3.19	1.41	0.824	3.13

Annex 14

Air, Noise and Water Sampling Locations and Air and Noise Sampler Specifications

a. Sampling Details for Ambient Air Monitoring with Location

S.N.	Sample Type	Location	Sampling Date	Latitude	Longitude
1.	Air	Tilganga/Pashupatinath	2079/08/05	27°42'26.3"N	85°20'52.4"E
2.		Bhawanisthan, Gokarneshwor	2079/08/06	27°44'17.4"N	85°23'12"E
3.		Sundarijal	2079/08/07	27°45'37.1"N	85°25'16"E
4.		Mulkharkha, Near Karma Hotel	2079/08/08	27°46'20.9"N	85°25'40.2"E
5.		Dhap	2079/08/09	27°46'58.6"N	85°26'38.6"E

b. Sampling Details for Noise Level Measurement with Location

S.N.	Sample Type	Location	Sampling Date	Latitude	Longitude
1.	Noise	Tilganga/Pashupatinath	2079/08/05	27°42’25.7” N	85°20'53.1"E
2.		Bhawanisthan, Gokarneshwor	2079/08/06	27°42’16.9” N	85°23’11.7” E
3.		Sundarijal	2079/08/07	27°45’18.4” N	85°25’38.1” E
4.		Mulkharkha, Near Karma Hotel	2079/08/08	27°46’20.7” N	85°25’40.1” E
5.		Dhap	2079/08/09	27°46’38.4” N	85°26’38.4” E

c. Sampling Details for Water sampling points with Location

S. N.	Sample Type	Location	Sampling Date	Latitude	Longitude	Lab Code
1	Water	Upstream of Proposed Nagmati Dam Site	2079/09/02	27°47'45.30"N	85°27'22.62"E	22/12-871(a)
2		Proposed Nagmati Dam Site	2079/09/02	27°46'59.58"N	85°26'39.24"E	22/12-871(b)
3		Downstream of proposed Nagmati Dam Site	2079/09/02	27°46'29.82"N	85°26'19.56"E	22/12-871(c)
4		Tap at Mulkharkha	2079/09/02	27°46'21.30"N	85°25'41.00"E	22/12-871(j)
5		Above the Powerhouse at Sundarijal	2079/09/03	27°45'43.20"N	85°25'22.80"E	22/12-871(d)
6		Adjacent to the Powerhouse Site	2079/09/03	27°45'28.74"N	85°25'14.70"E	22/12-871(e)
7		Downstream of Powerhouse	2079/09/03	27°45'21.60"N	85°25'15.60"E	22/12-871(f)
8		Near the Bridge	2079/09/03	27°45'14.40"N	85°25'19.20"E	22/12-871(g)
9		River Adjacent to Gokarna Temple,	2079/09/03	27°44'21.30"N	85°23'17.04"E	22/12-871(h)
10		River Adjacent to Pashupati Temple	2079/09/03	27°42'34.26"N	85°20'54.90"E	22/12-871(i)

d. Air Quality Monitoring Instruments with Specification

i) High volume sampler

Specification

Dust Sampler (APM 460 NL)

Flow Rate:	0.9 – 1.4 m^3 /min free flow
Particle Size:	Particles of 10 microns & below collected on Filter Paper holder.
	SPM bigger than 10 microns collected in a separate sampling bottle under the cyclone.
Sampling Time:	28 hours (maximum)
Sampling Time Record:	0 to 9999.99 hrs. recorded on a Time Totalizer.
Automatic Sampling:	24 hrs. programmable timer to automatically shut off the system after preset time interval.
Power Requirement:	Nominal 220 V. Single Phase. 50Hz AC mains supply.
Size & Weight:	430 x 320 x 930mm, 45Kg
Manufactured by:	Envirotech Instruments Pvt. Ltd. India

ii) Gaseous Sampling Attachment Envirotech APM 411

Flow Rate:	0.3 to 3 LPM,
Accuracy:	2% of span.
Flow Control:	Four inlet and one outlet with built in needle valves for flow control of each unit.
Sampling Train:	4 Nos. of 35ml Borosilicate glass impingers.
Size:	240 x 125 x 350mm.
Manufactured by:	Envirotech Instruments Pvt. Ltd. India

Figure: High Volume Sample

Figure: Gaseous Sampling Attachment

e. Sound Level Meter Specification

2.0 Specifications:

Standard Compliance:		IEC651 Type 2, ANSI S1.4 Type 2
Measurement range:		30 - 130dB
Dynamic range:		50 dB
Scale Ranges:	**Low:**	30 - 80dB
	Medium:	50 - 100 dB
	High:	80 - 130 dB
	Auto:	30 - 130 dB
Frequency range:		31.5Hz - 8KHz
Frequency weighting:		A, C
Time weighting:		Fast (125mS), Slow (1 sec.)
Microphone:		1/2 inch electret condenser microphone
Digital display:		4 digits
Resolution:		0.1dB
Update Rate:		0.5 sec.
Analog display:		50 segment bargraph
Resolution:		1dB
Update Rate:		50mS
Accuracy:		±1.5dB (under reference conditions, 94dB @ 1KHz)
Out of Range Indication:		Displays 'OVER' when over range for bargraph scale selected Displays 'UNDER' when under range for bargraph scale selected Displays '-LO.-' when under range by at least 20 dB
MAX/MIN hold:		Maximum and Minimum RMS value hold
Internal memory:		32,000 records
Digital output:		Bi-directional RS232. Software and cable included
AC output:		0 - 1Vrms over scale range selected Approx. 100 Ω output impedance
DC output:		10mV/dB Approx. 1 KΩ output impedance
Power requirement:		9 Volt battery, NEDA 1604 or JIS 006P or IEC 6F22
Battery life:		Approx. 50 hours with alkaline battery. Low battery indication

Operating Conditions:

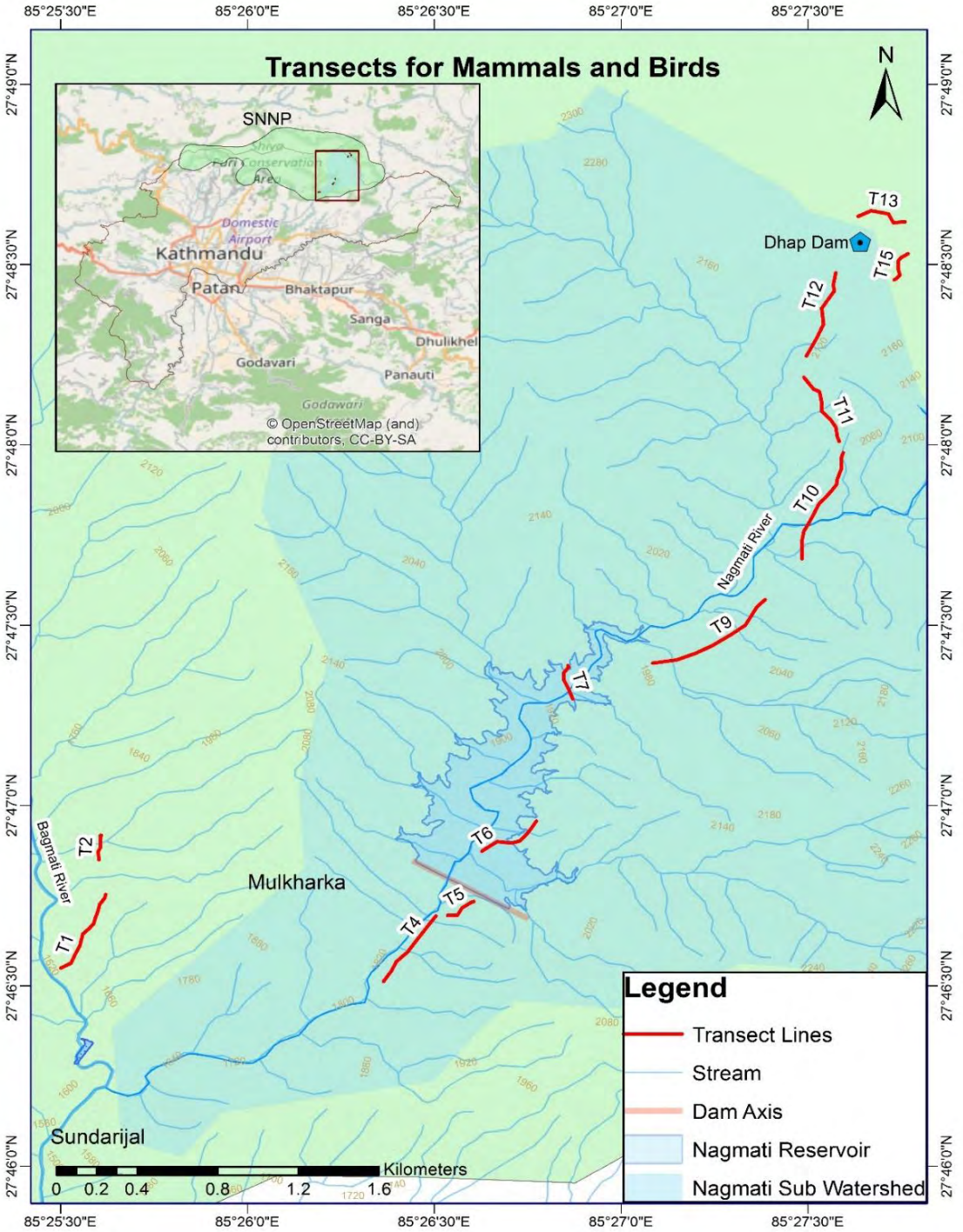
- Operating Temperature and Humidity: 0°C - 40°C (32°F - 104°F); 10 - 90% RH Non-condensing
- Storage Temperature and Humidity: -10°C - 60°C (14°F - 140°F); 10 - 75% RH Non-condensing
- Altitude up to 2000 meters (6500 feet)

Dimensions:	275×64×30mm (10.8×2.5×1.2 in)
Weight:	Approx. 285g (10.0 oz)
Accessories:	Windscreen, Battery, Carrying Case, 3.5mm Plug, Screwdriver, Instruction Manual, Software, RS232 Cable
Option:	AC Adaptor: 9Vdc (8-15Vdc Max.) @ 30mA, 3.5mm (+), 1.35mm (-)

Annex 15

Plots Location for Biological Environment Study

Transects for the field studies of mammals and birds



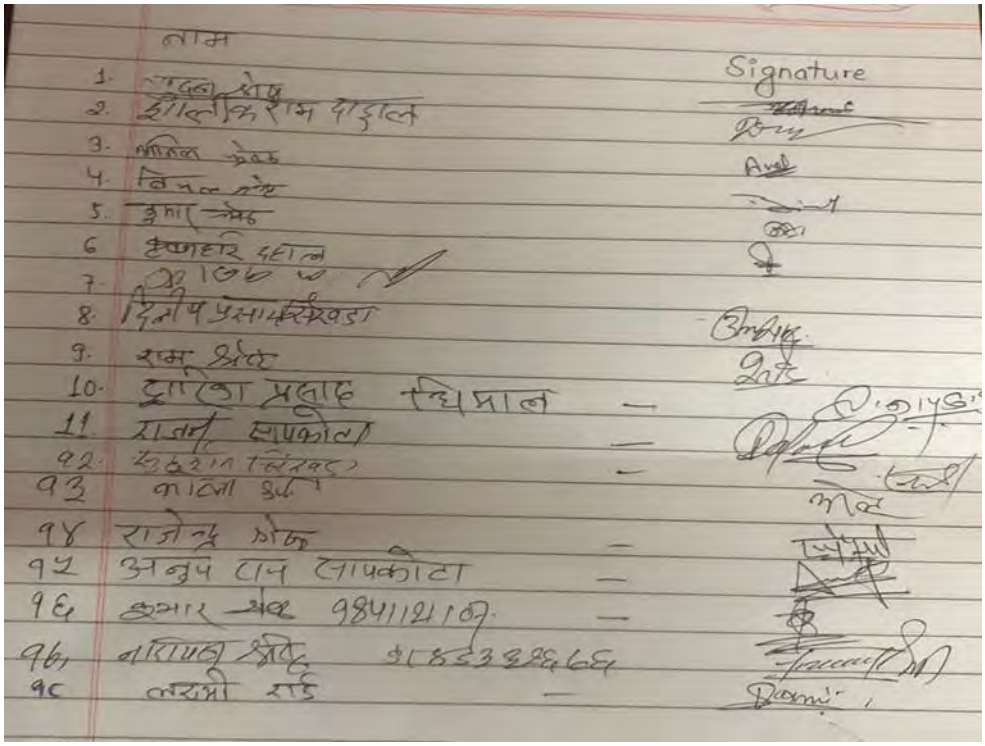
Annex 16

Public Consultation, Stakeholders Consultation, FGD and Meeting Minutes

Table: List of Participants of Public Consultation

SN	Name	Organization	Position	Address
1	Nima Sherpa	Sundarijal VDC	Former President	Gokarneshwor-1, Mulkharka
2	Aambar Lama	Local	-	Gokarneshwor-1, Mulkharka
3	Birya Bahadur Tamang	Sundarijal 4. 5. 6 Water Supply Committee	President	Gokarneshwor-1, Mulkharka
4	Lal Bahadur Tamang	Local		Gokarneshwor-1, Mulkharka
5	Anil Tamang	Shree Sundarijal Primary School	President. School Management Committee	Gokarneshwor-1, Mulkharka
6	Ram Ba. Gurung	Local	Farmer	Gokarneshwor-1, Mulkharka
7	Sita Tamang	Sundarijal-Chisapani-Gosaikunda Construction Development Committee	President	Gokarneshwor-1
8	Durga Lama	Local	Farmer	Gokarneshwor-1
9	Narayan Shrestha	Gokarneshwor Municipality Ward-2	President	Gokarneshwor-1, Mulkharka
10	Dhaba Gyalmu Sherpa	Women Representative		Gokarneshwor-1, Mulkharka
11	Surendra Shrestha	Local		Gokarneshwor-1
12	Binod Lama	Gokarneshwor Municipality Ward-2		Gokarneshwor-1, Mulkharka
13	Saroj Tamang	Local		Gokarneshwor-1, Mulkharka
14	Rajeev Tamang	Local		Gokarneshwor-1, Mulkharka
15	Nobiru Sherpa	Local	Farmer	Gokarneshwor-1, Mulkharka
16	Sunil Tamang	Local	Farmer	Gokarneshwor-1, Mulkharka
17	Som Bahadur Tamang	Local	Farmer	Gokarneshwor-1, Mulkharka
18	Astaman Lama	Local	Farmer	Gokarneshwor-2. Mulkharka
19	Sherbahadur Lama	Local	Farmer	Gokarneshwor-2. Mulkharka
20	Rita Sapkota	Sundarijal Health Post	Auxiliary nurse midwife	Gokarneshwor-3.
21	Lakpa Sherpa	Local		Gokarneshwor-1. Mulkharka
22	Bhairab Prashad Sapkota	Local		Gokarneshwor-1
23	Nhuchedevi Shrestha	Shree Sundarijal Primary School	Teacher	Gokarneshwor-1

List of participants of FGD



Nagmati Dam Project
Focus Group Discussion at Sundarijal
Kathmandu

Nagmati Dam Project/Architect Design and Civil Construction Pvt. Ltd (National Consultant) organizes a Focus group discussion meeting at Sundarijal for people who are expected to be impacted by the Nagmati Dam Project implementation. Sixteen households of Sundarijal will be impacted due to road construction near the Shivapuri Nagarjun National Park boundary (a 9 m width road is proposed). Land and property required to be acquired in order to build access road to reservoir. Penstock site 8m wide will also be acquired and likewise power house needs some land. In this context, a meeting was organized to collect information, opinion about the project and impact on their livelihoods. Participation of Impacted People was as follows:

Public hearing meetings and focus group discussion were held to collect data where impacted people actively participated and provided their valuable concerns and suggestions as following:

Focus Group Discussion – 1

A 9 m width road is proposed to construct at Sundarijal, penstock alignment, powerhouse need to acquire Land and property. In this context, a meeting was organized to collect information, opinion about the project and impact on their livelihoods.

Date: 3.4.2022
Venue: Mahankal, Sundarijal Kathmandu

Participation of Local people of Sundarijal
Representative of Shivapuri Nagarjun National Park
Nagmati Dam Project/Architect Design and Civil Construction Pvt. Ltd

Area of Discussion

- Acquire Land and Property by the Project
- Infrastructure development such as road, power house, penstock
- Livelihoods enhancement

Opinion and suggestion from the participants

Participants at the first glance raised their concern about whether Nagmati Dam Project will metalized? If it is to be implemented when does compensation to the people will be completed?

Concerns and Suggestions

- We are unable to do proper use of land and property due to the dream of Nagmati Dam Project. They said that they are told not to do further strengthen t works such as house construction and other associated works. This situation prevents our self-development.
- Appropriate Compensation should be done within a short timeframe. Cash compensation is preferred, but land can also be alternative compensation.

- If available land to land compensation at Mahankal or Santari phat (Flat land) is also acceptable.
- Land should be acquired whole in case of small chank leftover. Building should also be taken over whole if some portion is covered by infrastructure such as road or penstock.
- Road should be constructed as per the heavy vehicle will be used for transportation therefore width of road needs to be determined at this land acquisition stage.
- There should be 6 m road along the penstock near the Melamchi Treatment Plant settlement area.
- Existing water resource use should not be stopped due to project implementation.
- If possible 10m road is also constructed in the project area.
- Representation of Impacted People while discussion meetings for acquisition of land and property.
- Local people should be given priority employment should be provided in priority to interested Impacted People when hiring employees for the Nagmati Dam Project. Impacted People should be given share of energy as per the existing law.
- CSR: Improve taril to Kiriyaputri Ghar (Grave yard building)
- Install road side lamps along the road in this village.
- Skill improvement trainings for women/girls and special target group.
- Scholarship for students
- Support to farmers in agricultural seed, equipment, technology and trainings.
- Organize a Visit for Male 25 and female 25 members to Ilam district to share ideas of livelihoods enhancement through agriculture development practices.
- Compensation plantation, fencing wall maintenance, mess wire fence construction in coordination with SNNP to reduce Human Wildlife Conflict.
- Disaster plan in case of dam failure.

From FGD meeting we conclude that Local people who are resident of Mahankal Sundarijal are positive to the Nagmati Dam Project. It should be started with proper compensation as possible as early. Traditional use of water resources should not be prohibited from implementation of this project. But delay of implementation will hamper the development of local's wellbeing.

Focus Group Discussion – 2

Date: 2078.12.23
Venue: Mulkharka Gokarneshwor – 1

Participation of Local people of Mulkharka:

Representative of Shivpuri Nagarjun National Park
Buffer Zone representative
Nagmati Dam Project/Architect Design and Civil Construction Pvt. Ltd

Area of Discussion:

- Acquire Land and Property by the Project
- Infrastructure development such as road, power house, penstock
- Livelihoods enhancement

- Use of forest product

Suggestions

1. Beneficial Impacts from the Implementation of Nagmati Dam Project.
   - Graveled road provides access to tourists and villagers throughout the year.
   - Number of trekkers, riders and hikers increases and tourist stay will increase at Mulkharka.
   - Enhance economy of Mulkharka village.
   - Better road access reduces the transportation cost.
   - Improved aquatic habitat offers place to migratory birds.
   - Downstream water regime enhanced result on good status of edible grass, NTFP and other.
2. Likely Adverse Impacts
   - Reduces grazing land.
   - Outsiders pay high cost for land at Mulkharka.
   - Immigration pressure in the National Park.
3. Mitigation Measures

- Resettlement of Mulkharka not only due to construction of the Nagmati Dam Project but other factors are also involved such as Human Wildlife Conflict. Some restriction in the movement at night and use of natural resource and trade, Contamination on drinking water reservoir from human phenomena from Mulkharka.
- Resettlement of Mulkharka is only possible when there is equal Land to Land compensation in the vicinity of Mulkharka or Sundarijal. In addition, households do not have land ownership certificate (but living and cultivate land since long) should also be treated as land and property owner to provide land compensation. Resettlement of Mulkharka could be suitable at nayapati, Baluwa, Dhakal Gaun and Santari area. The resettlement should be done considering social structure, cultural norms, and community background.
- Conduct HWC mitigation activities.
- Create Mulkharka a model tourist village.
- Provide employment opportunities to Mulkharka residents during construction and operation of the Nagmati Dam Project.
- Develop an Integrated Eco-tourism Plan of Bagmati Watershed including Nagmati and Dhap Dam.
- Promote the traditional route to Dhap instead of fire line.
- Potential disaster prone land due to failure of dam for example Migma Sherpa at Mulkharka along the road and penstock pipe alignment should be acquired whole land and provide full compensation.
- Compensation should be appropriate.
- Provide share to locals in Hydropower operation.
- Improvement of tradition trail to village under Corporate Social Responsibility of the project.
- Install improve Water Mill.
- Support to Gumba.
- Support to Health post and School.
- Construct a community hall and Gumba at center of 4, 5, 6 ward of Mulkharka VDC (before).

- Construct a double line Bridge at Nagmati existing small bridge. And if, possible develop black topped road up to Dam Axis.
- Develop a playground in suitable area of Mulkharka.

Protect cultivated area by mesh wire fencing and SNNP's periphery wall should be repaired.

Discussion with SNNP

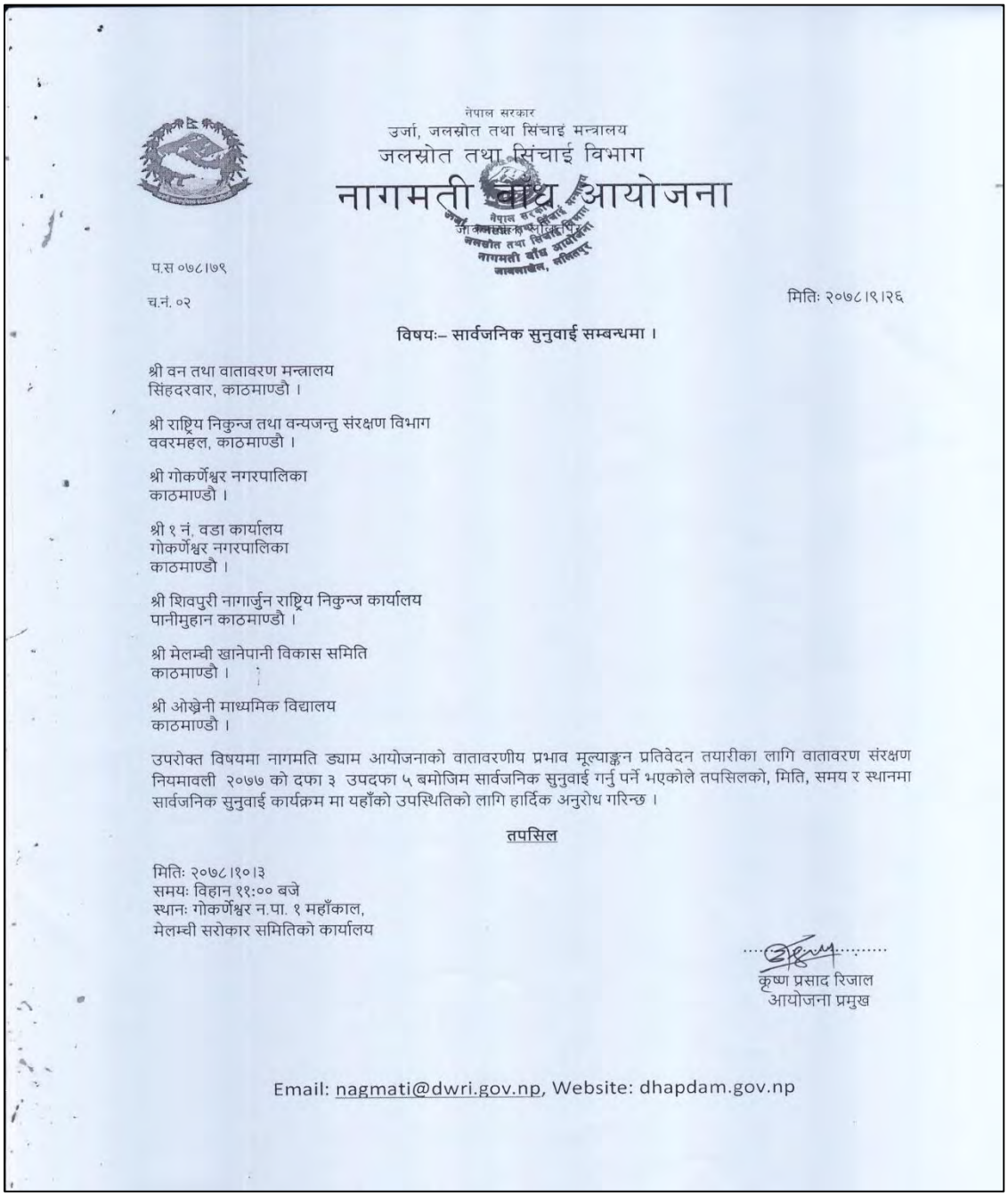
The issues raised by SNNP on 2079/02/18

- Maintenance of fence: 111km wall on either side of Nagamati Dam
- Human-wildlife conflict activities (fencing, alternative cropping, awareness training)
- Monitoring facilities: Office building, staff quarter, strengthening of the national park, strengthening of Sundarijal sector office, relocation of Mulkharka, SNNP post, Security post at Bhanjyang and Mulkharka
- Plantation: an alternative way of the use of plantation costs as the park has not have enough space
- Habitat fragmentation
- Parking near Nagmati dam
- Tourism master plan (integrated tourism) with mitigation (wildlife-friendly infrastructures)
- Fireline (vertical grid) new fire line plus upgrade
- Study of vegetation, birds, and mammal, database preparation training (wildlife handling, rescues boat, net),
- wildlife rescue equipment
- Digital Ticketing
- Dam Exposure visit
- Field level Staff
- Fire extinguishing vehicle way maintain

Annex 17

Public Hearing Notice, Muchulka and Meeting Minutes

a. Muchulka of Public Hearing Notice Affixing



नेपाल सरकार
उर्जा, जलस्रोत तथा सिंचाई मन्त्रालय
जलस्रोत तथा सिंचाई विभाग
नागमती बाँध आयोजना

प.स ०७८।७९

च.नं. ०२

मितिः २०७८।९।२६

विषयः– सार्वजनिक सुनुवाई सम्बन्धमा ।

श्री वन तथा वातावरण मन्त्रालय
सिंहदरवार, काठमाण्डौ ।

श्री राष्ट्रिय निकुन्ज तथा वन्यजन्तु संरक्षण विभाग
ववरमहल, काठमाण्डौ ।

श्री गोकर्णेश्वर नगरपालिका
काठमाण्डौ ।

श्री १ नं. वडा कार्यालय
गोकर्णेश्वर नगरपालिका
काठमाण्डौ ।

श्री शिवपुरी नागार्जुन राष्ट्रिय निकुन्ज कार्यालय
पानीमुहान काठमाण्डौ ।

श्री मेलम्ची खानेपानी विकास समिति
काठमाण्डौ ।

श्री ओखेनी माध्यमिक विद्यालय
काठमाण्डौ ।

उपरोक्त विषयमा नागमति ड्याम आयोजनाको वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदन तयारीका लागि वातावरण संरक्षण नियमावली २०७७ को दफा ३ उपदफा ५ बमोजिम सार्वजनिक सुनुवाई गर्नु पर्ने भएकोले तपसिलको, मिति, समय र स्थानमा सार्वजनिक सुनुवाई कार्यक्रम मा यहाँको उपस्थितिको लागि हार्दिक अनुरोध गरिन्छ ।

तपसिल

मितिः २०७८।९०।३
समयः विहान ११:०० बजे
स्थानः गोकर्णेश्वर न.पा. १ महाँकाल,
मेलम्ची सरोकार समितिको कार्यालय

कृष्ण प्रसाद रिजाल
आयोजना प्रमुख

Email: nagmati@dwri.gov.np, Website: dhapdam.gov.np

उर्जा, जलस्रोत तथा सिंचाई मन्त्रालय
जलस्रोत तथा सिंचाई विभाग
नागमती वाँध आयोजना
जावलाखेल, ललितपुर

प.स ०७८।७९

च.नं. ०२

मितिः २०७८।९।२६

विषयः– सार्वजनिक सुनुवाई सम्बन्धमा ।

श्री धुनधोला जिल्ला अदालत विधालय
ललितपुर

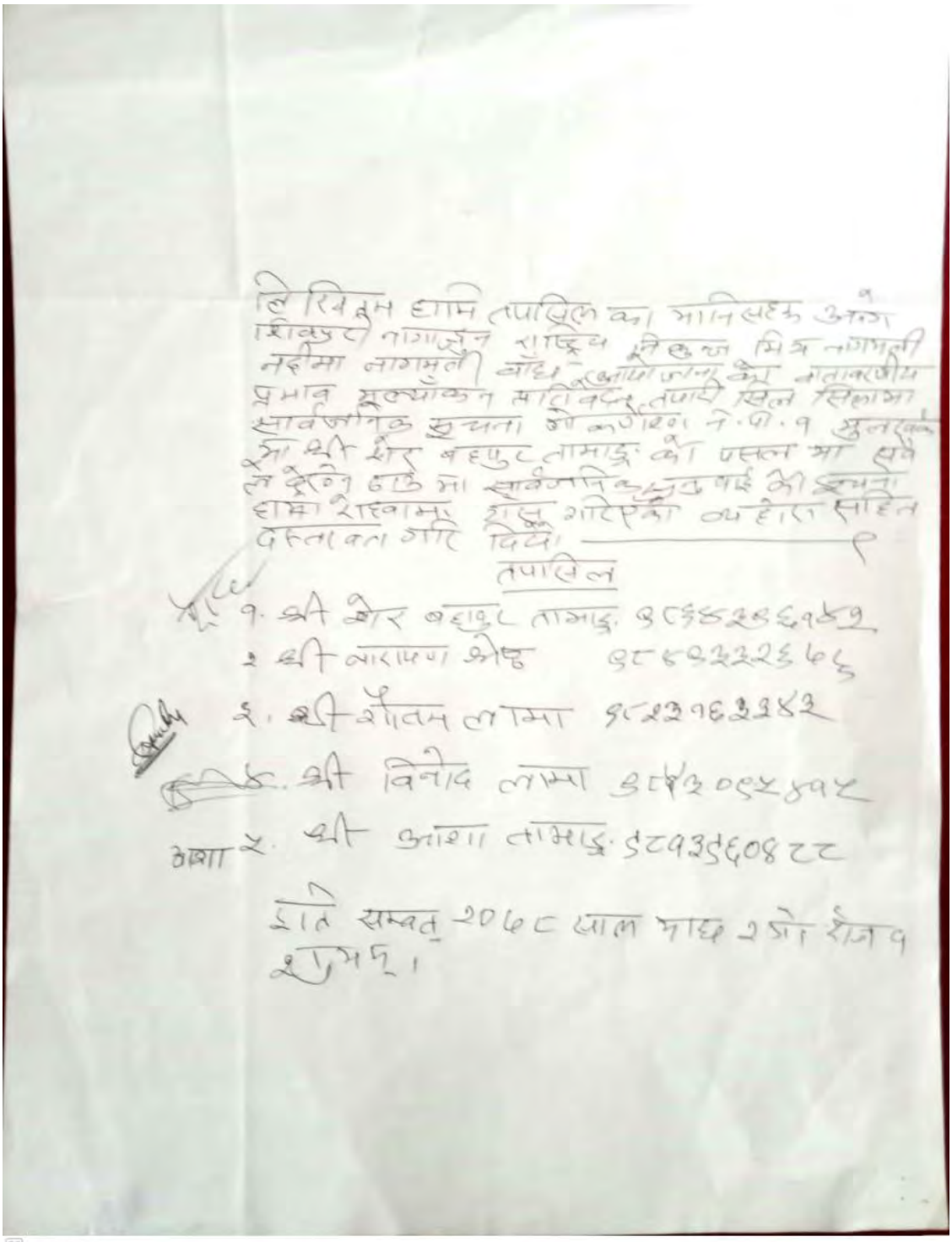
उपरोक्त विषयमा नागमति ड्याम आयोजनाको वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदन तयारीका लागि वातावरण संरक्षण नियमावली २०७७ को दफा ३ उपदफा ५ बमोजिम सार्वजनिक सुनुवाई गर्नु पर्ने भएकोले तपसिलको, मिति, समय र स्थानमा सार्वजनिक सुनुवाई कार्यक्रम मा यहाँको उपस्थितिको लागि हार्दिक अनुरोध गरिन्छ ।

तपसिल

मितिः २०७८।१०।३
समयः विहान ११:०० वजे
स्थानः गोकर्णेश्वर न.पा. १ महाँकाल
मेलम्ची सरोकार समितिको कार्यालय

.....
कृष्ण प्रसाद रिजाल
आयोजना प्रमुख

Email: nagmati@dwri.gov.np, Website: dhapdam.gov.np



लिखितम हामि तपाईलेका मानिसहरु ओम शिवपुरी नागार्जुन राष्ट्रिय निकुञ्ज भित्र नागमती नदीमा नागमती बाँध निर्माण जान्ने बारे वातावरणीय प्रभाव मूल्यांकन गरिदिन तपाई सबैलाई सार्वजनिक सूचना गरी नगरिएमा ने.पी.१ अनुसार श्री शेर बहादुर तामाङ्ग को पक्षमा मात्र हुने गरी निर्णय गर्नु पर्ने जानकारी गराई हामी साक्षीमा राखी गरेको कार्य हेरी सहित दस्तखत गरी दिये।

तपाईलेका

१. श्री शेर बहादुर तामाङ्ग ९८४४२४६१७१
२. श्री नारायण ओझा ९८४९३२३६५
३. श्री गौतम लामा ९८२३१६३३४३
४. श्री विनोद लामा ९८४३०९४५१८
५. श्री आशा तामाङ्ग ९८१३६०४८८

मिति सम्वत् २०६८ साल माघ २४ गते रोज १ शुभम्।

लिखितम् हामी तपसिलमा लेखिएका मानिसहरू आगे शिवपुरी नागार्जुन राष्ट्रिय निकुन्ज भित्र नेपाल सरकार बाट नागमती ड्याम आयोजना कार्यान्वयनको वातावरणीय प्रभाव मूल्याँङ्कन प्रतिवेदन तयारिका सिलसिलामा सार्वजनिक सुनुवाई गर्ने सम्बन्धी सार्वजनिक सूचना मिति २०७८ साल माघ ३ गते सुन्दरिजल, गोकर्णेश्वर नगरपालिका नं. १ मा अवस्थित मेलम्ची सरोकार समितिको कार्यालयमा अध्ययन टोलीका सदस्यले हाम्रो रोहवरमा सार्वजनिक सूचना टाँस गरेकोले यो मुचुल्कामा दस्तखत गरि दियौ ।

तपसिल

सि.नं.	नाम	ठेगाना	पद र संस्था	मोवाइल नं.	दस्तखत
१	दिलीप प्रसाद [illegible]	[illegible]	[illegible] सरोकार समिति	9[illegible]	
२	[illegible]	[illegible]		9[illegible]	
३	नितेश [illegible]	[illegible]		9861505[illegible]	
४	[illegible]	— " —		9841360261	
५	[illegible]	[illegible]		[illegible]	
६	[illegible]	[illegible]		[illegible]	
७	महेश [illegible]	"		9849176051	
८	गोकुल [illegible]	[illegible]	[illegible]	98[illegible]	
९	[illegible]	"	" [illegible]	9[illegible]	
१०.	[illegible]	[illegible]		9[illegible]	

ईति सम्बत् २०७८ साल माघ ..... गते रोज..... शुभम् ।

नागमती ड्याम आयोजनाको वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदन तयारी सम्बन्धी सार्वजनिक सूचना बुझि लिएको प्रमाणित सम्बन्धमा ।

सूचना प्राप्त गर्नेको नाम: पदः कार्यालयको छाप

दस्तखतः मितिः

टंकनाथ घिमिरे
शाखा अधिकृत

नागमती ड्याम आयोजनाको वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदन तयारी सम्बन्धी सार्वजनिक सूचना बुझि लिएको प्रमाणित सम्बन्धमा ।

सूचना प्राप्त गर्नेको नाम: पदः कार्यालयको छाप

दस्तखतः मितिः 2076/09/29

नागमती ड्याम आयोजनाको वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदन तयारी सम्बन्धी सार्वजनिक सूचना बुझि लिएको प्रमाणित सम्बन्धमा ।

सूचना प्राप्त गर्नेको नाम: पदः कार्यालयको छाप

दस्तखतः मितिः 06/9/29

नागमती डयाम आयोजनाको वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदन तयारी सम्बन्धी सार्वजनिक सूचना बुझि लिएको प्रमाणित सम्बन्धमा ।

सूचना प्राप्त गर्नेको नामः देवराज गहतराई पदः अध्यक्षज्यू कार्यालयको छाप

दस्तखतः

मितिः २०८१/०९/१८

श्री ओखनी माध्यमिक विद्यालय सुन्दरीजल २०४९

नागमती डयाम आयोजनाको वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदन तयारी सम्बन्धी सार्वजनिक सूचना बुझि लिएको प्रमाणित सम्बन्धमा ।

सूचना प्राप्त गर्नेको नामः [illegible] पदः कार्यालयको छाप

दस्तखतः

मितिः

नागमती डयाम आयोजनाको वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदन तयारी सम्बन्धी सार्वजनिक सूचना बुझि लिएको प्रमाणित सम्बन्धमा ।

सूचना प्राप्त गर्नेको नामः [illegible] पदः [illegible] कार्यालयको छाप

दस्तखतः

मितिः २०८१०३।१८

वडा सचिव

गोकर्णेश्वर नगरपालिका १ नं. वडा कार्यालय सुन्दरीजल, काठमाडौं नागमती प्रदेश, नेपाल २०७३

नागमती ड्याम आयोजनाको वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदन तयारी सम्बन्धी सार्वजनिक सूचना बुझि लिएको प्रमाणित सम्बन्धमा ।

सूचना प्राप्त गर्नेको नामः [illegible] पदः इन्जिनियर कार्यालयको छाप [illegible]

दस्तखतः [illegible] मितिः २०८/१०/३

नागमती ड्याम आयोजनाको वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदन तयारी सम्बन्धी सार्वजनिक सूचना बुझि लिएको प्रमाणित सम्बन्धमा ।

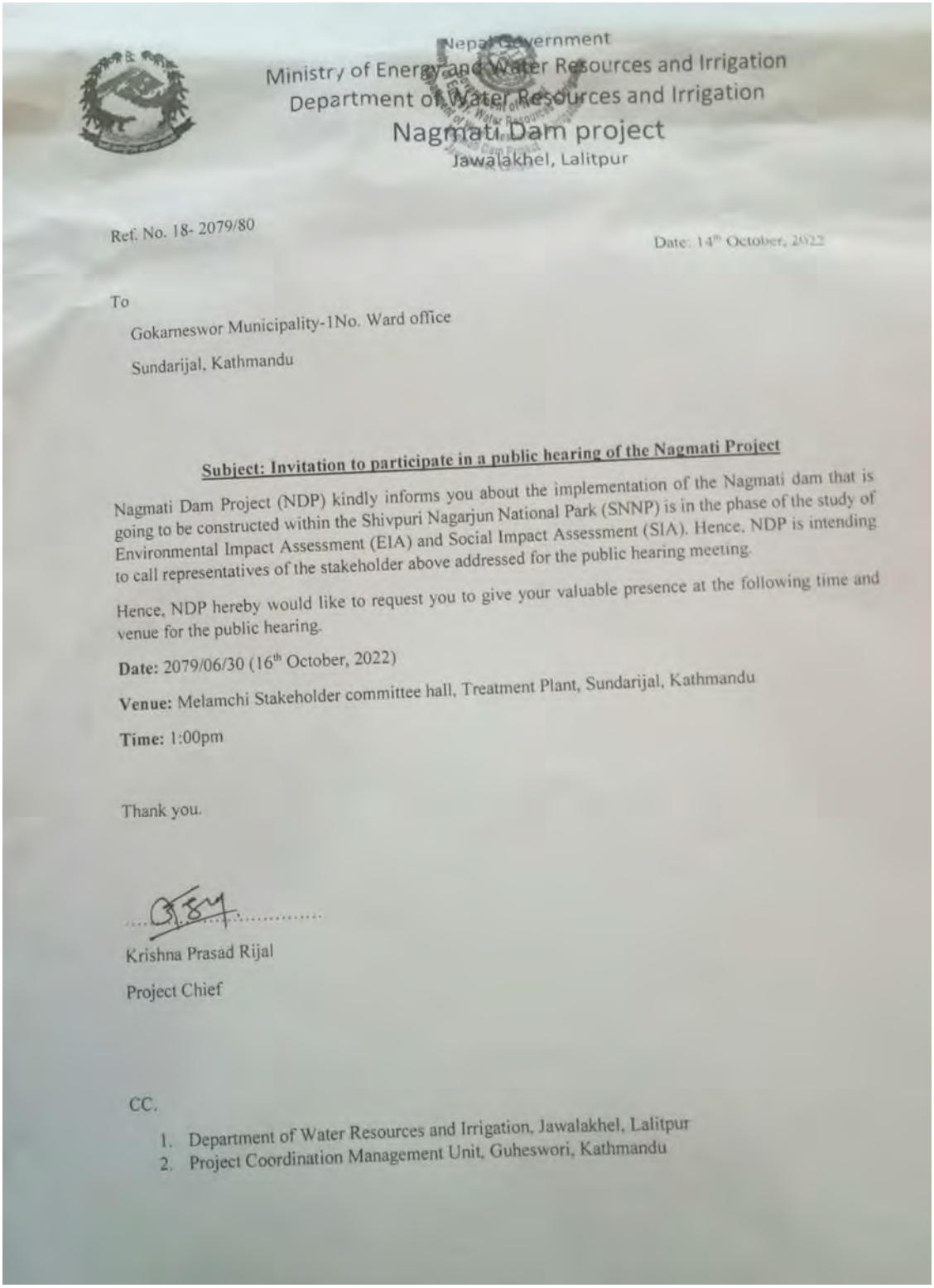
सूचना प्राप्त गर्नेको नामः पदः कार्यालयको छाप

दस्तखतः मितिः

नागमती ड्याम आयोजनाको वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदन तयारी सम्बन्धी सार्वजनिक सूचना बुझि लिएको प्रमाणित सम्बन्धमा ।

सूचना प्राप्त गर्नेको नामः पदः कार्यालयको छाप

दस्तखतः मितिः



Nepal Government
Ministry of Energy and Water Resources and Irrigation
Department of Water Resources and Irrigation
Nagmati Dam project
Jawalakhel, Lalitpur

Ref. No. 18- 2079/80

Date: 14th October, 2022

To

Gokarneswor Municipality-1No. Ward office

Sundarijal, Kathmandu

Subject: Invitation to participate in a public hearing of the Nagmati Project

Nagmati Dam Project (NDP) kindly informs you about the implementation of the Nagmati dam that is going to be constructed within the Shivpuri Nagarjun National Park (SNNP) is in the phase of the study of Environmental Impact Assessment (EIA) and Social Impact Assessment (SIA). Hence, NDP is intending to call representatives of the stakeholder above addressed for the public hearing meeting.

Hence, NDP hereby would like to request you to give your valuable presence at the following time and venue for the public hearing.

Date: 2079/06/30 (16th October, 2022)

Venue: Melamchi Stakeholder committee hall, Treatment Plant, Sundarijal, Kathmandu

Time: 1:00pm

Thank you.

Krishna Prasad Rijal

Project Chief

CC.

1. Department of Water Resources and Irrigation, Jawalakhel, Lalitpur
2. Project Coordination Management Unit, Guheswori, Kathmandu

Nepal Government
Ministry of Energy and Water Resources and Irrigation
Department of Water Resources and Irrigation
Nagmati Dam project
Jawalakhel, Lalitpur

Ref. No. 18- 2079/80

Date: 14th October, 2022

To

World Wildlife Fund (WWF)
Baluwatar, Kathmandu

Bird Conservation Nepal (BCN),
Lazimpat, Kathmandu

Zoological Society of London (ZSL),
Gyaneshwor, Kathmandu

Subject: Invitation to participate in a public hearing of the Nagmati Project

Nagmati Dam Project (NDP) kindly informs you about the implementation of the Nagmati dam that is going to be constructed within the Shivpuri Nagarjun National Park (SNNP) is in the phase of the study of Environmental Impact Assessment (EIA) and Social Impact Assessment (SIA). Hence, NDP is intending to call representatives of the stakeholder above addressed for the public hearing meeting.

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Time: 1:00pm

Thank you.

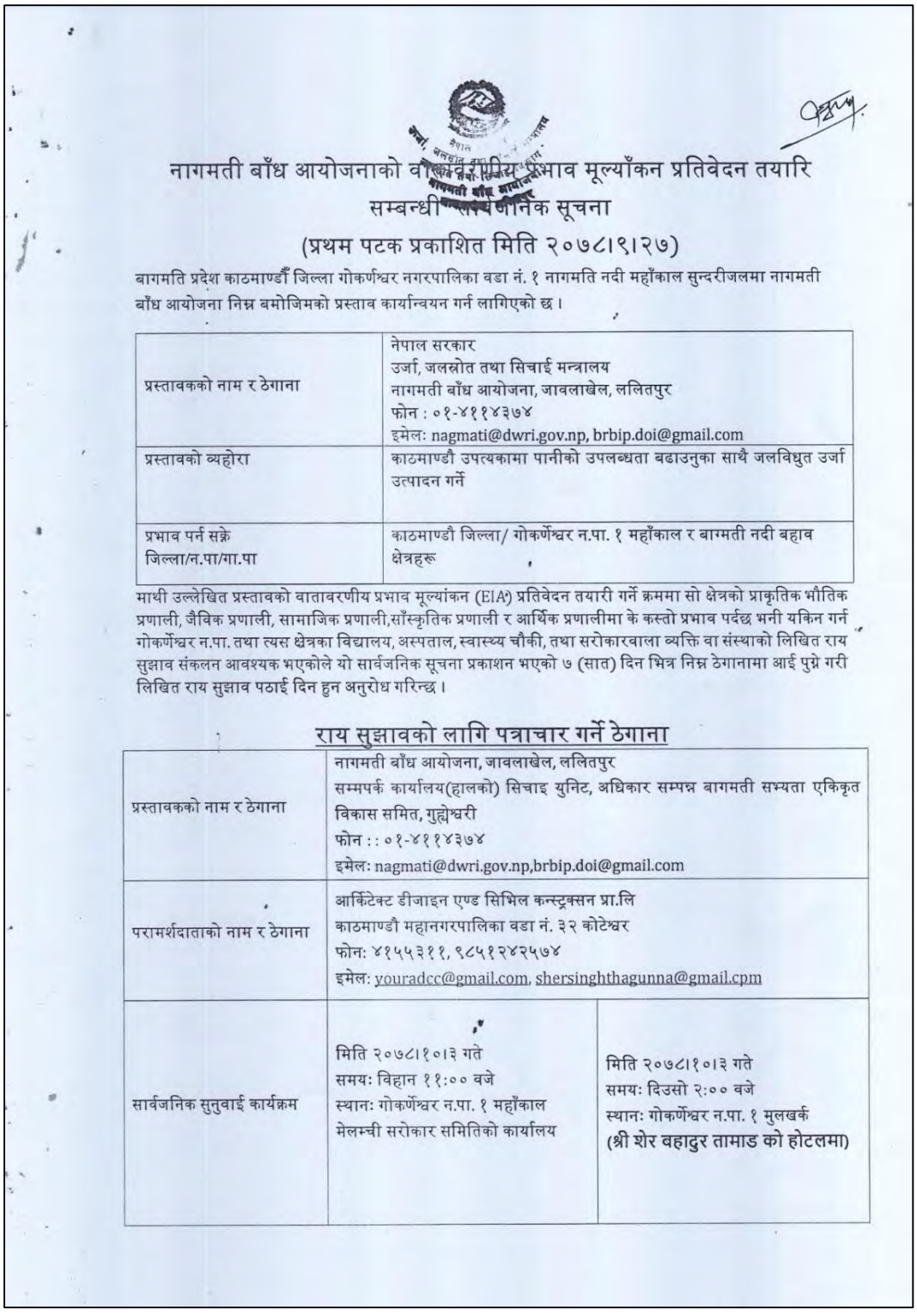
Krishna Prasad Rijal

Project Chief

CC.

1. Department of Water Resources and Irrigation, Jawalakhel, Lalitpur
2. Project Coordination Management Unit, Guheswori, Kathmandu

b. Public Hearing Public Notice



नागमती बाँध आयोजनाको वातावरणीय प्रभाव मूल्याँकन प्रतिवेदन तयारि
सम्बन्धी सार्वजनिक सूचना

(प्रथम पटक प्रकाशित मिति २०७८।९।२७)

बागमति प्रदेश काठमाण्डौँ जिल्ला गोकर्णेश्वर नगरपालिका वडा नं. १ नागमति नदी महाँकाल सुन्दरीजलमा नागमती बाँध आयोजना निम्न बमोजिमको प्रस्ताव कार्यान्वयन गर्न लागिएको छ ।

प्रस्तावकको नाम र ठेगाना	नेपाल सरकार उर्जा, जलस्रोत तथा सिचाई मन्त्रालय नागमती बाँध आयोजना, जावलाखेल, ललितपुर फोन : ०१-४११४३७४ इमेल: nagmati@dwri.gov.np, brbip.doi@gmail.com
प्रस्तावको व्यहोरा	काठमाण्डौ उपत्यकामा पानीको उपलब्धता बढाउनुका साथै जलविधुत उर्जा उत्पादन गर्ने
प्रभाव पर्न सक्ने जिल्ला/न.पा/गा.पा	काठमाण्डौ जिल्ला/ गोकर्णेश्वर न.पा. १ महाँकाल र बाग्मती नदी बहाव क्षेत्रहरू

माथी उल्लेखित प्रस्तावको वातावरणीय प्रभाव मूल्यांकन (EIA) प्रतिवेदन तयारी गर्ने क्रममा सो क्षेत्रको प्राकृतिक भौतिक प्रणाली, जैविक प्रणाली, सामाजिक प्रणाली,साँस्कृतिक प्रणाली र आर्थिक प्रणालीमा के कस्तो प्रभाव पर्दछ भनी यकिन गर्न गोकर्णेश्वर न.पा. तथा त्यस क्षेत्रका विद्यालय, अस्पताल, स्वास्थ्य चौकी, तथा सरोकारवाला व्यक्ति वा संस्थाको लिखित राय सुझाव संकलन आवश्यक भएकोले यो सार्वजनिक सूचना प्रकाशन भएको ७ (सात) दिन भित्र निम्न ठेगानामा आई पुग्ने गरी लिखित राय सुझाव पठाई दिन हुन अनुरोध गरिन्छ ।

राय सुझावको लागि पत्राचार गर्ने ठेगाना

प्रस्तावकको नाम र ठेगाना	नागमती बाँध आयोजना, जावलाखेल, ललितपुर सम्पर्क कार्यालय(हालको) सिचाइ युनिट, अधिकार सम्पन्न बागमती सभ्यता एकिकृत विकास समित, गुह्येश्वरी फोन : : ०१-४११४३७४ इमेल: nagmati@dwri.gov.np,brbip.doi@gmail.com	
परामर्शदाताको नाम र ठेगाना	आर्किटेक्ट डीजाइन एण्ड सिभिल कन्स्ट्रक्सन प्रा.लि काठमाण्डौ महानगरपालिका वडा नं. ३२ कोटेश्वर फोन: ४१५५३११, ९८५१२४२५७४ इमेल: youradcc@gmail.com, shersinghthagunna@gmail.cpm	
सार्वजनिक सुनुवाई कार्यक्रम	मिति २०७८।१०।३ गते समय: विहान ११:०० वजे स्थान: गोकर्णेश्वर न.पा. १ महाँकाल मेलम्ची सरोकार समितिको कार्यालय	मिति २०७८।१०।३ गते समय: दिउसो २:०० वजे स्थान: गोकर्णेश्वर न.पा. १ मुलखर्क (श्री शेर वहादुर तामाड को होटलमा)

नागमती बाँध आयोजनाको वातावरणीय प्रभाव मूल्याँकन प्रतिवेदन तयारी सम्बन्धी सार्वजनिक सूचना

(प्रथम पटक प्रकाशित मिति : २०७८।९।२७)

बागमती प्रदेश काठमाण्डौं जिल्ला गोकर्णेश्वर नगरपालिका वडा नं. १ नागमती नदी महाँकाल सुन्दरीजलमा नागमती बाँध आयोजनामा निम्न बमोजिमको प्रस्ताव कार्यान्वयन गर्न लागिएको छ।

प्रस्तावकको नाम र ठेगाना	नेपाल सरकार उर्जा, जलस्रोत तथा सिचाई मन्त्रालय जलस्रोत तथा सिचाई विभाग नागमती बाँध आयोजना, जावलाखेल, ललितपुर फोन: ०१-४११४३७४, इमेल : nagmati@dwri.gov.np, brbip.doi@gmail.com
प्रस्तावको व्यहोरा	बागमती नदीमा पानीको उपलब्धता बढाउनुका साथै जलविद्युत उर्जा उत्पादन गर्ने
प्रभाव पर्न सक्ने जिल्ला/न.पा./गा.पा	काठमाण्डौं जिल्ला/गोकर्णेश्वर न.पा.१ महाँकाल र बागमती नदी बहाव क्षेत्रहरु

माथी उल्लेखित प्रस्तावको वातावरणीय प्रभाव मूल्यांकन (EIA) प्रतिवेदन तयारी गर्ने क्रममा सो क्षेत्रको प्राकृतिक भौतिक प्रणाली, जैविक प्रणाली, सामाजिक प्रणाली, सांस्कृतिक प्रणाली र आर्थिक प्रणालीमा के कस्तो प्रभाव पर्दछ भनी यकिन गर्न गोकर्णेश्वर न.पा. तथा त्यस क्षेत्रका विद्यालय, अस्पताल, स्वास्थ्य चौकी, तथा सरोकारवाला व्यक्ति वा संस्थाको लिखित राय सुझाव संकलन आवश्यक भएकोले यो सार्वजनिक सूचना प्रकाशन भएको ७ (सात) दिन भित्र निम्न ठेगानामा आईपुग्ने गरी लिखित राय सुझाव पठाई दिनहुन अनुरोध गरिन्छ।

राय सुझावको लागि पत्राचार गर्ने ठेगाना

प्रस्तावकका नाम र ठेगाना	नागमती बाँध आयोजना, जावलाखेल, ललितपुर सम्पर्क कार्यालय (हालको लागि) : सिचाई युनिट, अधिकार सम्पन्न बागमती सभ्यता एकिकृत विकास समिति, गुह्येश्वरी, गौरीघाट, काठमाडौं फोन: ०१-४११४३७४ इमेल:nagmati@dwri.gov.np, brbip.doi@gmail.com
परामर्शदाताको नाम र ठेगाना	आर्किटेक्ट डीजाइन एण्ड सिभिल कन्स्ट्रक्सन प्रा.लि काठमाण्डौं महानगरपालिका वडा नं. ३२ कोटेश्वर फोन:४१५५३११, ९८५१२४२५७४ इमेल: youradcc@gmail.com, shersinghthagunna@gmail.com

c. Letter to Kantipur FM Pvt. Ltd. to Disseminate Public Hearing Program Information

ऊर्जा, जलस्रोत तथा सिंचाई मन्त्रालय
जलस्रोत तथा सिंचाई विभाग
नागमती वाँध आयोजना
जावलाखेल, ललितपुर

पत्र संख्या ०७८ ७९
चलानी नं. ८१८

मिति: २०७८।१०।०२

श्री कान्तिपुर एफ. एम. प्राइभेट लिमिटेड
पुल्चोक, काठमाडौं।

विषय: सार्वजनिक सुनुवाई कार्यक्रमको विज्ञापन सम्बन्धि

उपरोक्त सम्बन्धमा उल्लेखित Script (३५ सेकेण्ड को रेकर्ड), *"शिवपुरी नागार्जुन राष्ट्रिय निकुन्ज भित्र नेपाल सरकार बाट नागमती क्याम आयोजना कार्यन्वयनका लागि प्रस्ताव गरिएकोमा सो को वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन तयारीका लागि यहि माघ ३ गते विहान ११ बजे मेलम्ची सरोकार समितिको कार्यालय, सुन्दरीजल, गोकर्णेश्वर नगरपालिका नं. १ मा संचालन हुने सार्वजनिक सुनुवाई कार्यक्रममा सरोकारवाला व्यक्ति वा संस्था उपस्थित भई आफ्नो राय सुझाव दिन हुन हार्दिक अनुरोध गरिन्छ "* लाई तपसिल बमोजिम तहाको रेडियोमा प्रसारण गरिदिन हुन अनुरोध गर्दछु।

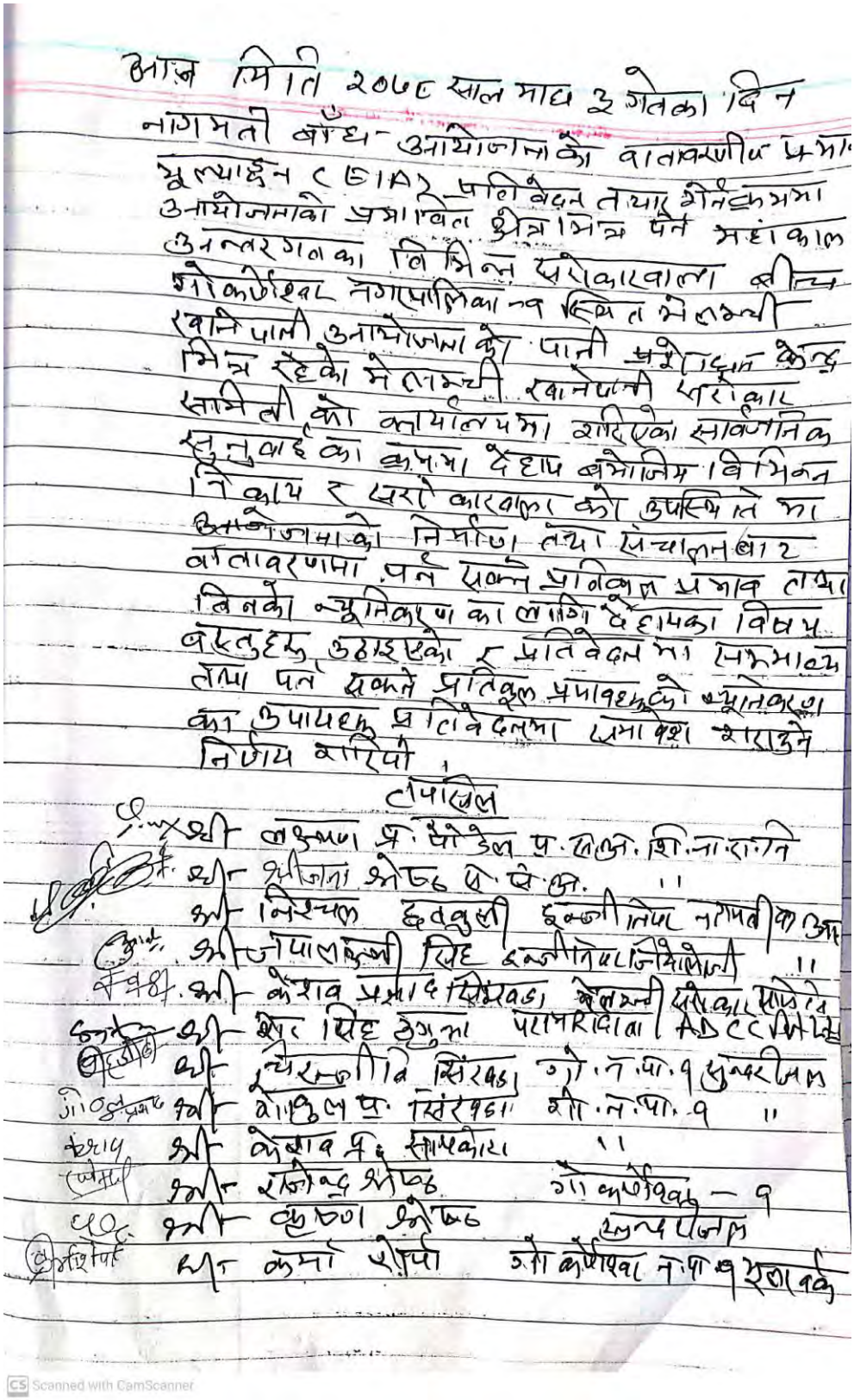
तपसिल,

१.	Loose Advertisement Tariff, 10 am -5pm	1 time
२.	Loose Advertisement Tariff, 5pm- 11pm	1 time
३.	News time, 9 am, Before News	1 time
		Total 3 times

जया लक्ष्मी सिं
इन्जिनियरिङ्ग जियोलोजिस्ट

Email: nagmati@dwri.gov.np, Website: dhapdam.gov.np

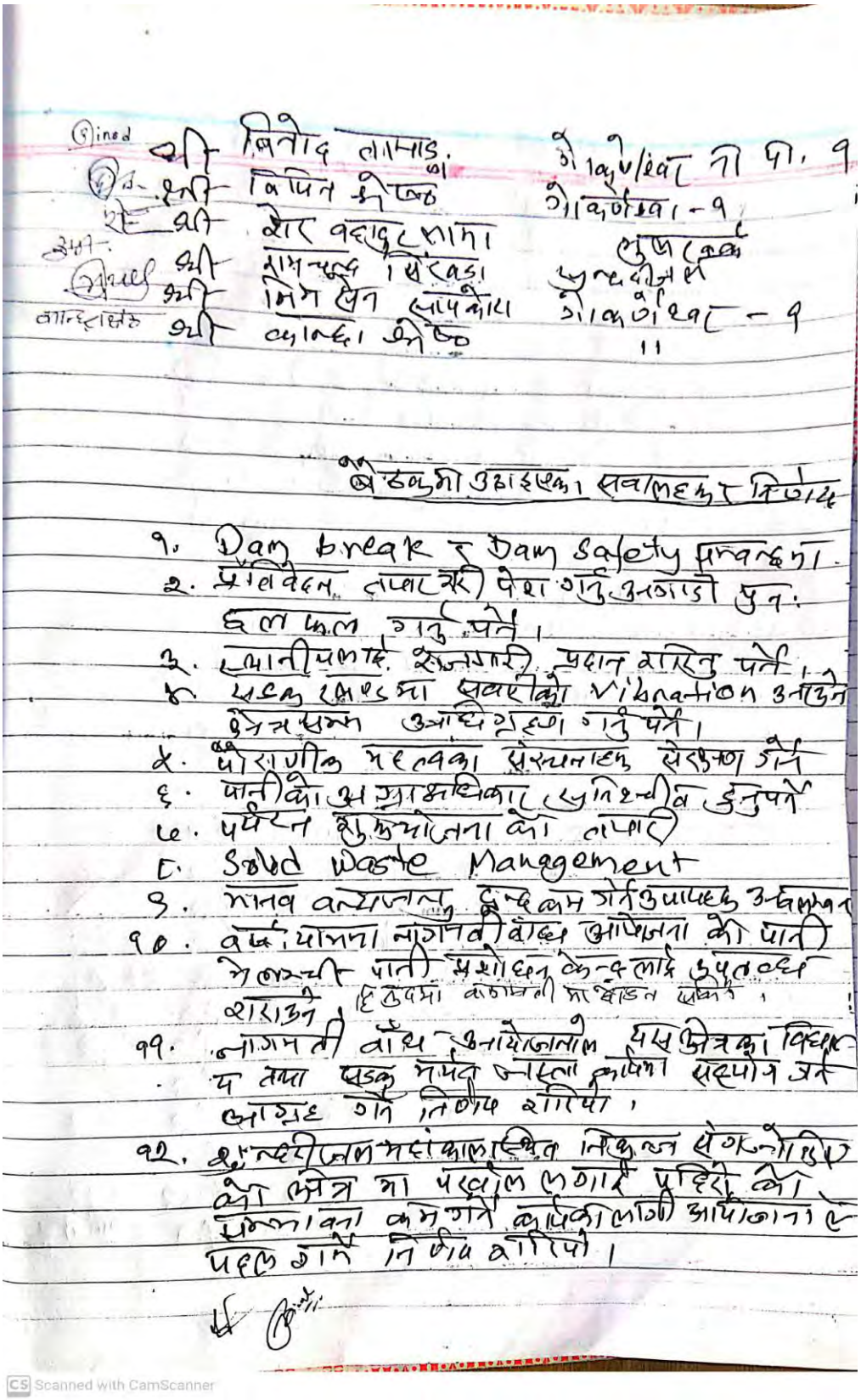
d. Meeting Minutes of Public Hearing



आज मिति २०७८ साल माघ ३ गतेका दिन नागमती बाँध-आयोजनाको वातावरणीय प्रभाव मूल्याङ्कन (EIA) प्रतिवेदन तथा सैनिकमग्ना आयोजनाको प्रभावित क्षेत्र भित्र पर्न सक्ने अन्तरगतका विभिन्न सरोकारवाला व्यक्ति गोकर्णेश्वर नगरपालिका र वरिपरि मेलम्ची खानेपानी आयोजना को पानी प्रशोधन केन्द्र भित्र रहेको मेलम्ची खानेपानी सरोकार समिति को कार्यालयमा शहरिएका सार्वजनिक सुनुवाइको कार्यमा देहाय बमोजिम विभिन्न निकाय र सरोकारवालाको उपस्थितिमा आयोजनाको निर्माण तथा संचालनबाट वातावरणमा पर्न सक्ने प्रतिकूल प्रभाव तथा तिनको न्यूनिकरण का लागि गरिने उपायका विषयमा छलफल गरिएको र प्रतिवेदनमा समावेश गर्नुपर्ने तथा पर्न सक्ने प्रतिकूल प्रभावहरूको न्यूनिकरण का उपायहरू प्रतिवेदनमा समावेश गराउने निर्णय गरियो ।

उपस्थिति

१. श्री लक्ष्मण प्र. पौडेल प्र. हेल्थ. फि. ना. रा. ने
२. श्री प्रतिमा श्रेष्ठ प. से. अ. ।।
३. श्री निश्चल छत्रबुली इन्जीनियर नागपती क्षेत्र
४. श्री जयपालबुली सिंह इन्जीनियर/जियोलोजी ।।
५. श्री केशव प्रसाद सिंहरक्ष खोलसी खानेपानी सरोकार समिति
६. श्री शेर सिंह ठकुरी परामर्शदाता ADCC प्रा.लि.
७. श्री [illegible] सिंहरक्ष गो.न.पा.९ सुन्दरीजल
८. श्री बेलाकुमार सिंहरक्ष गो.न.पा.९ ।।
९. श्री केशव प्र. सापकोटा ।।
१०. श्री रविन्द्र श्रेष्ठ गो.कर्णेश्वर - ९
११. श्री कुलचन्द्र श्रेष्ठ सभापतिज्यू
१२. श्री कमला पौडेल गो.कर्णेश्वर न.पा.९ [illegible]



श्री विनोद लामाछाने
श्री विपिन श्रेष्ठ
श्री शेर बहादुर लामा
श्री रामचन्द्र पौडेल
श्री मिन बहादुर लापचोर
श्री लालबहादुर श्रेष्ठ

बैठकमा उठाइएका सवालहरु विवरण

१. Dam break र Dam safety सम्बन्धमा ।
२. प्रभावित तथा पहिरो पर्ने अनुमानित क्षेत्र अनुसार पर्ने ।
३. स्थानीयबासी रोजगारी प्रदान गरिनु पर्ने ।
४. पहिरो क्षेत्रमा पर्ने Vibration अनुसार क्षेत्रसमय अनुसार हुने ।
५. पोराणीक महत्वका संरचनाहरु संरक्षण गर्ने
६. पानीको अधिकार सुनिश्चित हुनुपर्ने
७. पर्यटन प्रवर्द्धनमा जोड दिने
८. Solid Waste Management
९. मानव बस्तीजान नदिनुपर्ने उपायहरु अवलम्बन
१०. बर्खा यामका नागमती बाँध आयोजना को पानी सञ्चयको पानी प्रशोधन केन्द्रलाई उपलब्ध गराउने, हिउँदमा बगमती सङ्कलन गर्ने ।
११. नागमती बाँध आयोजनाले यस क्षेत्रका विद्यालय तथा पहिरो सम्बेदनशील क्षेत्रमा सचेतना कार्यक्रम गर्ने ।
१२. सुन्दरीजलमा संकलित निकुञ्ज क्षेत्रको क्षेत्र मा पर्ने पहिरो क्षेत्रको सम्भावना कम गर्ने कार्यक्रमलाई आयोजनाले पहिलो गर्ने ।

सार्बजनिक सुनुवाई मुलखर्क

आज मिति २०७८/१०/३ गतेका दिन यस नागमती बाँध आयोजनाको EIA प्रतिबेदन तयार गर्ने क्रममा आयोजनको प्रभावित क्षेत्र भित्र पर्ने मुलखर्क क्षेत्र अन्तर्गतका बिभिन्न सरोकारवालाहरु बिच गोकर्णेश्वर नगरपालिका वार्ड न.१ स्थित मुलखर्क गाउँमा गरिएको सार्बजनिक सुनुवाई का क्रममा देहाय बमोजिमको विभिन्न निकाय र सर्बसाधरणको उपस्थितिमा यस आयोजनाको निर्माण तथा संचालन बाट बाताबरणमा पर्न सक्ने प्रतिकुल प्रभाब तथा त्यसको न्यूनीकरणका लागि देहायका बिषयबस्तु हरु उठाइएको र प्रतिबेदन तयारीका क्रममा सम्भाव्यताका तथा प्रतिकुल प्रभावको पहिचानका आधारमा न्यूनीकरणका उपायहरु प्रतिबेदन मा समाबेश गराउने सहमति गरियो।

उपस्थिति

श्री लक्ष्मण प्रसाद पौड्याल प्रमुख संरक्षण अधिकृत शिवपुरी नागार्जुन रास्ट्रिय निकुन्ज पानिमुहान

श्री श्रीजना श्रेष्ठ संरक्षण अधिकृत शिवपुरी नागार्जुन रास्ट्रिय निकुन्ज पानिमुहान

श्री निश्चल छत्कुली इन्जिनियर नागमती बाँध आयोजना

श्री जया लक्ष्मी सिंह इन्जिनियरिंग जियोलोजिस्ट नागमती बाँध आयोजना

श्री शेर सिंह ठगुन्ना परामर्शदाता

श्री शेर बहादुर लामा मुलअर्क

श्री सजना तामाङ मुलअर्क

श्री कुमार तामाङ मुलअर्क

श्री कर्मा शेर्पा मुलअर्

श्री नारायण श्रेष्ठ मुलअर्क

श्री गौतम लामा मुलअर्क

श्री कान्छ तामाङ मुलअर्क

श्री विनोद लामा मुलअर्क

श्री हिरा फामा मुलअर्क

श्री आशा लामा मुलअर्क

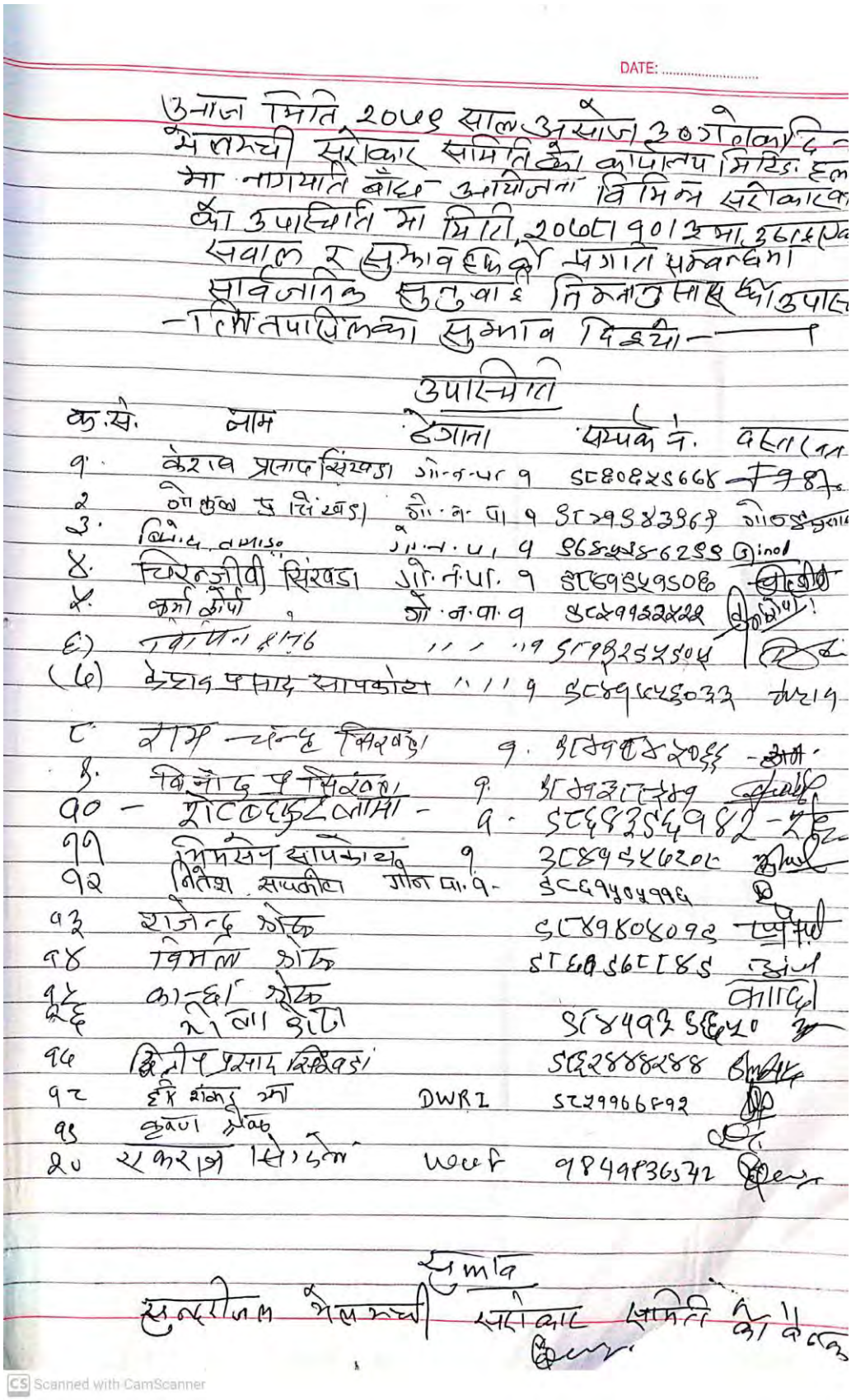
मुलखर्क स्थित सर्वसधारण बाट उठाइएका सवालहरु तथा निर्णय

- इयाम निर्माण अगावै पहुँच सडक बनाउनु पर्ने।
- प्राथामिक बिध्यालय लाइ सहयोग गर्नुपर्ने।
- स्थानीयलाई रोजगारी प्रदान गरिनु पर्ने।
- Social Walfare का कार्यहरु गरिनु पर्ने ।
- चिसापानी जाने छोटो रुटको बाटो कायम हुनुपर्ने
- पर्यटन गुरुयोजना को तयारी।
- इयामको तल्लो तटीय क्षेत्रको जोखिमयुक्त जग्गा अधिग्रहण गरिनु पर्ने।
- साँस्कृतिक जेगेर्ना गर्ने कार्य अन्तर्गत गुम्बा मठ मन्दिर स्तुपाहरु मर्मत सम्भार गर्नु पर्ने।
- आयोजना समयमै कार्यान्वयन हुनु पर्ने।
- स्थानीय कामदारलाई पहिलो प्राथमिकता दिनु पर्ने।
- Dam Safety को सुनुश्चितता।
- Hydropower को share स्थानीयलाई दिनु पर्ने।
- Social Development का कार्यहरु स्थानीय सरकार तथा स्थानीय संस्था मार्फत गरिनुपर्ने।
- स्थानीय पुर्बाधार विकास।
- बस्ति स्थान्तरण।

निर्णय १. मुफखर्क नजिकै जलाशय निर्माय हुने र बढ्दो पर्यटन को प्रत्यक्ष प्रभाव समेत यस गाउँलाई पर्ने हुँदा शिवपुरी नागार्जुन राष्ट्रिय निकुन्जका लागि एक Integrated Eco-tourism Development Plan तयार गरि प्रभाव कम गर्न सहयोग गर्ने ।

निर्णय २. यस गाउँमा रहको स्कूल र धार्मिक गुम्बाको निर्माणमा सहयोग गर्न अनुरोध गर्ने ।

निर्णय ३. मुलखर्कमा रहेका भित्रि सडकहरूको स्तरोन्ति गर्ने ।



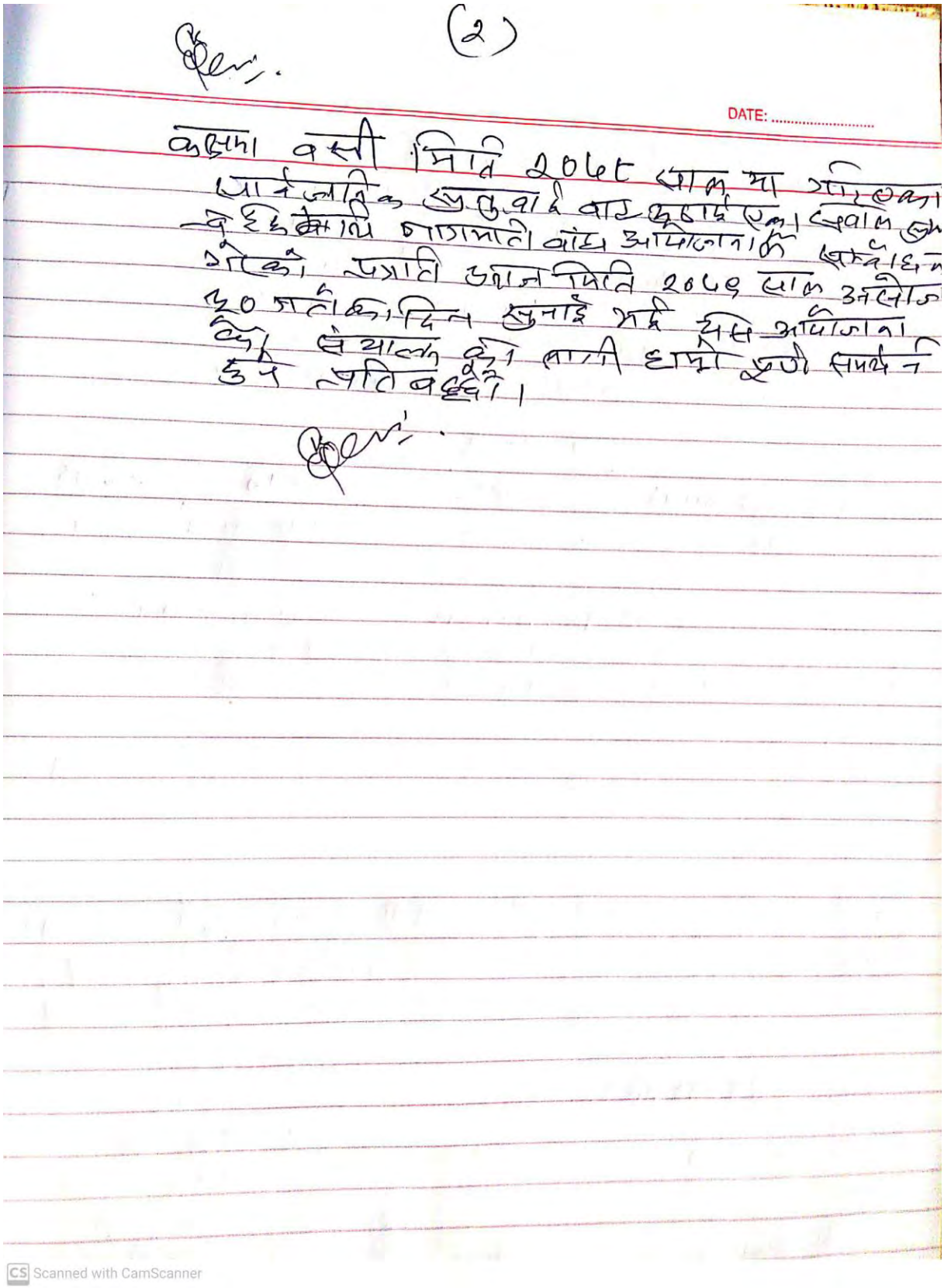
उनाज मिति २०६९ साल असोज ३० गते शनिवार दि
मेलम्ची सरोकार समितिको कार्यालय, मिडिल हल
मा नागमति बाँध आयोजना विभिन्न सरोकारव
को उपस्थिति मा मिति २०६८।९०।३ मा बहसको
सवाल र सुझाव हकिको प्रगति सम्बन्धमा
सार्वजनिक सुनुवाई तिमनाथ साह को उपस्थि
तिमा पारित को सुझाव दिइयो ।

उपस्थिति

क.से.	नाम	हैसियत	सम्पर्क नं.	दस्तखत
१.	केशव प्रसाद सिंखडा	गो.न.पा. १	9CE80825668	
२	गोकुल प्र सिंखडा	गो.न.पा. १	9CE9883967	
३.	[illegible]	गो.न.पा. १	9CE9883962	
४.	चिरन्जीवी सिंखडा	गो.न.पा. १	9CE9952950	
५.	कृष्ण कोर्पा	गो.न.पा. १	9CE9922222	
६)	[illegible]	" " १	9CE9825404	
(६)	केशव प्रसाद सापकोटा	" " १	9CE9CE50333	
८	राम चन्द्र सिंखडा	१	9CE9[illegible]	
९.	विनोद प्र सिंखडा	१	9CE9[illegible]	
१०	[illegible]	१	9CE9[illegible]	
११	[illegible]	१	9CE9[illegible]	
१२	नितेश सापकोटा	गोन पा. १	9CE9[illegible]	
१३	राजेन्द्र श्रेष्ठ		9CE9804809E	
१४	विमला श्रेष्ठ		9CE9[illegible]	
१५	कान्छा श्रेष्ठ			
१६	[illegible]		9CE9[illegible]	
१५	दिनेश प्रसाद सिंखडा		9CE9[illegible]	
१८	हरि शंकर [illegible]	DWRI	9CE9[illegible]	
१९	कृष्ण श्रेष्ठ			
२०	[illegible]	WUF	9849836372	

सुझाव

सुन्दरीजल मेलम्ची सरोकार समिति को तर्फ



(2)

DATE: .....

बक्सपा वस्ती मिति 2064 साल मा गठन भएका
प्रा.वि.ले. प्रत्युवाद वाट कुहार्ड एवं खुवाल
वृक्षारोपण नागमती बांध आयोजनाको प्रस्ताव
गरेको प्रगति जानकारी मिति 2069 साल असोज
२० गते का दिन सुनाई भई यस आयोजना
को संचालन हुँदा बाकी हाम्रो तर्फ सम्पर्क
हुन प्रतिबद्धता।

e. Previous Public hearings (2074 BS)

नेपाल सरकार
सिंचाइ मन्त्रालय
सिंचाइ विभाग
बागमती सुधार आयोजना
आयोजना कार्यान्वयन (सिंचाइ यूनिट)
गुहेश्वरी, गौरीघाट, काठमाडौं

प.सं.:- 063/68
च.नं.:- ५८०

मितिः- २०७४/०२/१७

श्री वन तथा भु-संरक्षण मन्त्रालय
सिंहदरबार काठमाण्डौं ।

विषय : नागमती बाँध परियोजनाको वातावरणीय प्रभाव मूल्याङ्कन सम्बन्धि सार्वजनिक सुनुवाई ।

महोदय,

उपरोक्त विषयमा वातावरण संरक्षण ऐन,२०५३ अनुसार निम्न मिति तथा स्थानमा नागमती बाँध परियोजनाको वातावरणीय प्रभाव मूल्याङ्कन सम्बन्धि सार्वजनिक सुनुवाई हुने जानकारी गराउँदै तहाँको उपस्थितिको लागि यसै पत्रमार्फत हार्दिक निमन्त्रणा गर्दछु ।

सार्वजनिक सुनुवाई हुने स्थान :
श्री सुन्दरीजल प्रा.वि.को प्राङ्गण, मूलखर्क, गोकर्णेश्वर न. पा. वडा नं १
समय : बिहान ११ बजे
मिति : वि. सं. २०७४/०२/२८ (ई. सं. २०१७ जुन ११)

आशिष भद्र खनाल
इकाई प्रमुख

नेपाल सरकार
सिंचाइ मन्त्रालय
सिंचाइ विभाग

बागमती सुधार आयोजना

आयोजना कार्यान्वयन (सिंचाइ यूनिट)
गुहेश्वरी, गौरीघाट, काठमाडौं

प.सं.:- 062/68
च.नं.:- ५८७

मिति:- २०७४/०२/१७

श्री वन विभाग,
बबरमहल, काठमाण्डौं ।

विषय : नागमती बाँध परियोजनाको वातावरणीय प्रभाव मूल्याङ्कन सम्बन्धि सार्वजनिक सुनुवाई ।

महोदय,

उपरोक्त विषयमा वातावरण संरक्षण ऐन,२०५३ अनुसार निम्न मिति तथा स्थानमा नागमती बाँध परियोजनाको वातावरणीय प्रभाव मूल्याङ्कन सम्बन्धि सार्वजनिक सुनुवाई हुने जानकारी गराउँदै तहाँको उपस्थितिको लागि यसै पत्रमार्फत हार्दिक निमन्त्रणा गर्दछु ।

सार्वजनिक सुनुवाई हुने स्थान :
श्री सुन्दरीजल प्रा.वि.को प्राङ्गण, मूलखर्क, गोकर्णेश्वर न. पा. वडा नं १
समय : बिहान ११ बजे
मिति : वि. सं. २०७४/०२/२८ (ई. सं. २०१७ जुन ११)

आशिष भद्र खनाल
इकाई प्रमुख

नेपाल सरकार
सिंचाइ मन्त्रालय
सिंचाइ विभाग

बागमती सुधार आयोजना

आयोजना कार्यान्वयन (सिंचाइ यूनिट)
गुहेश्वरी, गौरीघाट, काठमाडौं

प.सं.:- 062/68
च.नं.:- ९८७

मिति:-....२०७४/०२/१७....

श्री राष्ट्रिय निकुन्ज तथा वन्यजन्तु संरक्षण विभाग,
बबरमहल, काठमाण्डौं ।

विषय : नागमती बाँध परियोजनाको वातावरणीय प्रभाव मूल्याङ्कन सम्बन्धि सार्वजनिक सुनुवाई ।

महोदय,

उपरोक्त विषयमा वातावरण संरक्षण ऐन,२०५३ अनुसार निम्न मिति तथा स्थानमा नागमती बाँध परियोजनाको वातावरणीय प्रभाव मूल्याङ्कन सम्बन्धि सार्वजनिक सुनुवाई हुने जानकारी गराउँदै तहाँको उपस्थितिको लागि यसै पत्रमार्फत हार्दिक निमन्त्रणा गर्दछु ।

सार्वजनिक सुनुवाई हुने स्थान :
श्री सुन्दरीजल प्रा.वि.को प्राङ्गण, मूलखर्क, गोकर्णेश्वर न. पा. वडा नं १
समय : बिहान ११ बजे
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ओशिष भद्र खनाल
इकाई प्रमुख

नेपाल सरकार
सिंचाइ मन्त्रालय
सिंचाइ विभाग

नागमती सुधार आयोजना

आयोजना कार्यान्वयन (सिंचाइ यूनिट)
गुहेश्वरी, गौरीघाट, काठमाडौं

प.सं.:- 062/68
च.नं.:- ९८७

मिति:-.....२०७४/०२/१७..

श्री शिवपुरी-नागार्जुन गण्डुय निकुन्ज कार्यालय,
पानी मुहान, बुढानिलकण्ठ, काठमाण्डौं ।

विषय : नागमती बाँध परियोजनाको वातावरणीय प्रभाव मूल्याङ्कन सम्बन्धि सार्वजनिक सुनुवाई ।

महोदय,

उपरोक्त विषयमा वातावरण संरक्षण ऐन,२०५३ अनुसार निम्न मिति तथा स्थानमा नागमती बाँध परियोजनाको वातावरणीय प्रभाव मूल्याङ्कन सम्बन्धि सार्वजनिक सुनुवाई हुने जानकारी गराउँदै तहाँको उपस्थितिको लागि यसै पत्रमार्फत हार्दिक निमन्त्रणा गर्दछु ।

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श्री सुन्दरीजल प्रा.वि.को प्राङ्गण, मूलखर्क, गोकर्णेश्वर न. पा. वडा नं १
समय : विहान ११ बजे
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आशिष भद्र खनाल
इकाई प्रमुख

नेपाल सरकार
सिंचाइ मन्त्रालय
सिंचाइ विभाग

बागमती सुधार आयोजना

आयोजना कार्यान्वयन (सिंचाइ यूनिट)
गुहेश्वरी, गौरीघाट, काठमाडौं

प.सं.:- 062/68
च.नं.:- 9CD

मिति:-.....२०७४/०२/१७....

श्री अधिकार सम्पन्न बागमती साझेदारी एकीकृत विकास समिति,
गुहेश्वरी, काठमाण्डौं ।

विषय : नागमती बाँध परियोजनाको वातावरणीय प्रभाव मूल्याङ्कन सम्बन्धि सार्वजनिक सुनुवाई ।

महोदय,

उपरोक्त विषयमा वातावरण संरक्षण ऐन,२०५३ अनुसार निम्न मिति तथा स्थानमा नागमती बाँध परियोजनाको वातावरणीय प्रभाव मूल्याङ्कन सम्बन्धि सार्वजनिक सुनुवाई हुने जानकारी गराउँदै तहाँको उपस्थितिको लागि यसै पत्रमार्फत हार्दिक निमन्त्रणा गर्दछु ।

सार्वजनिक सुनुवाई हुने स्थान :
श्री सुन्दरीजल प्रा.वि.को प्राङ्गण, मूलखर्क, गोकर्णेश्वर न. पा. वडा नं १
समय : बिहान ११ बजे
मिति : वि. सं. २०७४/०२/२८ (ई. सं. २०१७ जुन ११)

आँशिष भद्र खनाल
इकाई प्रमुख

नेपाल सरकार
सिंचाइ मन्त्रालय
सिंचाइ विभाग

बागमती सुधार आयोजना

आयोजना कार्यान्वयन (सिंचाइ यूनिट)
गुहेश्वरी, गौरीघाट, काठमाडौं

प.सं.:- 063/68
च.नं.:- ९८०

मिति:-....२०७४/०२/१७....

श्री मिरा मेयर ज्यू ।

गोकर्णेश्वर नगरपालिका

विषय : नागमती बाँध परियोजनाको वातावरणीय प्रभाव मूल्याङ्कन सम्बन्धि सार्वजनिक सुनुवाई ।

महोदय,

उपरोक्त विषयमा वातावरण संरक्षण ऐन,२०५३ अनुसार निम्न मिति तथा स्थानमा नागमती बाँध परियोजनाको वातावरणीय प्रभाव मूल्याङ्कन सम्बन्धि सार्वजनिक सुनुवाई हुने जानकारी गराउँदै यहाँको उपस्थितिको लागि यसै पत्रमार्फत हार्दिक निमन्त्रणा गर्दछु ।

सार्वजनिक सुनुवाई हुने स्थान :
श्री सुन्दरीजल प्रा.वि.को प्राङ्गण, मूलखर्क, गोकर्णेश्वर न. पा. वडा नं १
समय : बिहान ११ बजे
मिति : वि. सं. २०७४/०२/२८ (ई. सं. २०१७ जुन ११)

आशिष भद्र खनाल
इकाई प्रमुख

नेपाल सरकार
सिंचाइ मन्त्रालय
सिंचाइ विभाग

बागमती सुधार आयोजना

आयोजना कार्यान्वयन (सिंचाइ यूनिट)
गुहेश्वरी, गौरीघाट, कमठमाडौं

प.सं.:- 062/68
च.नं.:- 900

मिति:-.....२०७४/०२/१७..

श्री उप-मेयर ज्यू !

गोकर्णेश्वर नगरपालिका

विषय : नागमती बाँध परियोजनाको वातावरणीय प्रभाव मूल्याङ्कन सम्बन्धि सार्वजनिक सुनुवाई

महोदय,

उपरोक्त विषयमा वातावरण संरक्षण ऐन,२०५३ अनुसार निम्न मिति तथा स्थानमा नागमती बाँध परियोजनाको वातावरणीय प्रभाव मूल्याङ्कन सम्बन्धि सार्वजनिक सुनुवाई हुने जानकारी गराउँदै यहाँको उपस्थितिको लागि यसै पत्रमार्फत हार्दिक निमन्त्रणा गर्दछु ।

सार्वजनिक सुनुवाई हुने स्थान :
श्री सुन्दरीजल प्रा.वि.को प्राङ्गण, मूलखर्क, गोकर्णेश्वर न. पा. वडा नं १
समय : बिहान ११ बजे
मिति : वि. सं. २०७४/०२/२८ (ई. सं. २०१७ जुन ११)

आशिष भद्र खनाल
इकाई प्रमुख

नेपाल सरकार
सिंचाइ मन्त्रालय
सिंचाइ विभाग
बागमती सुधार आयोजना
आयोजना कार्यान्वयन (सिंचाइ यूनिट)
गुहेश्वरी, गौरीघाट, काठमाडौं

प.सं.:- 063/064
च.नं.:- 90

मिति:-.....२०७४/०२/१७..

श्री वडा अध्यक्ष ज्यू !
गोकर्णेश्वर न.पा. वडा नं-१

विषय : नागमती बाँध परियोजनाको वातावरणीय प्रभाव मूल्याङ्कन सम्बन्धि सार्वजनिक सुनुवाई ।

महोदय,

उपरोक्त विषयमा वातावरण संरक्षण ऐन,२०५३ अनुसार निम्न मिति तथा स्थानमा नागमती बाँध परियोजनाको वातावरणीय प्रभाव मूल्याङ्कन सम्बन्धि सार्वजनिक सुनुवाई हुने जानकारी गराउदै यहाँको उपस्थितिको लागि यसै पत्रमार्फत हार्दिक निमन्त्रणा गर्दछु ।

सार्वजनिक सुनुवाई हुने स्थान :
श्री सुन्दरीजल प्रा.वि.को प्राङ्गण, मूलखर्क, गोकर्णेश्वर न. पा. वडा नं १
समय : बिहान ११ बजे
मिति : वि. सं. २०७४/०२/२८ (ई. सं. २०१७ जुन ११)

आशिष भद्र खनाल
इकाई प्रमुख

नेपाल सरकार
सिंचाइ मन्त्रालय
सिंचाइ विभाग

बागमती सुधार आयोजना

आयोजना कार्यान्वयन (सिंचाइ यूनिट)
गुहेश्वरी, गौरीघाट, काठमाडौं

प.सं.:- 063/68
च.नं.:- 907

मिति:-.....२०७४/०२/१७..

आदरणीय वडा सदस्यज्यूहरु !
गोकर्णेश्वर न.पा. वडा नं - १

विषय : नागमती बाँध परियोजनाको वातावरणीय प्रभाव मूल्याङ्कन सम्बन्धि सार्वजनिक सुनुवाई।

महोदय,

उपरोक्त विषयमा वातावरण संरक्षण ऐन,२०५३ अनुसार निम्न मिति तथा स्थानमा नागमती बाँध परियोजनाको वातावरणीय प्रभाव मूल्याङ्कन सम्बन्धि सार्वजनिक सुनुवाई हुने जानकारी गराउँदै यहाँको उपस्थितिको लागि यसै पत्रमार्फत हार्दिक निमन्त्रणा गर्दछु।

सार्वजनिक सुनुवाई हुने स्थान :
श्री सुन्दरीजल प्रा.वि.को प्राङ्गण, मूलखर्क, गोकर्णेश्वर न. पा. वडा नं १
समय : विहान ११ बजे
मिति : वि. सं. २०७४/०२/२८ (ई. सं. २०१७ जुन ११)

आशिष भद्र खनाल
इकाई प्रमुख

नेपाल सरकार
सिंचाइ मन्त्रालय
सिंचाइ विभाग

बागमती सुधार आयोजना

आयोजना कार्यान्वयन (सिंचाइ यूनिट)
गुहेश्वरी, गौरीघाट, काठमाडौं

प.सं.:- 062/68
च.नं.:- १८०

मिति:-.....२०७४/०२/१७...

आदरणीय सम्पूर्ण राजनितीक दलका प्रतिनिधिज्यूहरु ।

गोकर्णेश्वर नगरपालिका

विषय : नागमती बाँध परियोजनाको वातावरणीय प्रभाव मूल्याङ्कन सम्बन्धि सार्वजनिक सुनुवाई ।

महोदय,

उपरोक्त विषयमा वातावरण संरक्षण ऐन,२०५३ अनुसार निम्न मिति तथा स्थानमा नागमती बाँध परियोजनाको वातावरणीय प्रभाव मूल्याङ्कन सम्बन्धि सार्वजनिक सुनुवाई हुने जानकारी गराउँदै यहाँको उपस्थितिको लागि यसै पत्रमार्फत हार्दिक निमन्त्रणा गर्दछु ।

सार्वजनिक सुनुवाई हुने स्थान :
श्री सुन्दरीजल प्रा.वि.को प्राङ्गण, मूलखर्क, गोकर्णेश्वर न. पा. वडा नं १
समय : विहान ११ बजे
मिति : वि. सं. २०७४/०२/२८ (ई. सं. २०१७ जुन ११)

आशिष भद्र खनाल
इकाई प्रमुख

नेपाल सरकार
सिंचाइ मन्त्रालय
सिंचाइ विभाग
बागमती सुधार आयोजना
आयोजना कार्यान्वयन (सिंचाइ यूनिट)
गुहेश्वरी, गौरीघाट, काठमाडौं

प.सं.:- 063/64
च.नं.:- 960

मिति:- २०७४/०२/१७

श्री जन सङ्ख्या तथा वातावरण मन्त्रालय,
सिंहदरबार काठमाण्डौं ।

विषय : नागमती बाँध परियोजनाको वातावरणीय प्रभाव मूल्याङ्कन सम्बन्धि सार्वजनिक सुनुवाई ।

महोदय,

उपरोक्त विषयमा वातावरण संरक्षण ऐन,२०५३ अनुसार निम्न मिति तथा स्थानमा नागमती बाँध परियोजनाको वातावरणीय प्रभाव मूल्याङ्कन सम्बन्धि सार्वजनिक सुनुवाई हुने जानकारी गराउँदै तहाँको उपस्थितिको लागि यसै पत्रमार्फत हार्दिक निमन्त्रणा गर्दछु ।

सार्वजनिक सुनुवाई हुने स्थान :
श्री सुन्दरीजल प्रा.वि.को प्राङ्गण, मूलखर्क, गोकर्णेश्वर न. पा. वडा नं १
समय : बिहान ११ बजे
मिति : वि. सं. २०७४/०२/२८ (ई. सं. २०१७ जुन ११)

अशिष भद्र खनाल
इकाई प्रमुख

11 copies. Received
Uttam Khadgi
12/.

Annex 18

7 days Public Notice and Muchulka

a. Muchulka of 7 days Public Notice

नेपाल सरकार
वन तथा वातावरण मन्त्रालय
राष्ट्रिय निकुञ्ज तथा वन्यजन्तु संरक्षण विभाग
शिवपुरी नागार्जुन राष्ट्रिय निकुञ्ज कार्यालय
पानीमुहान, कनेडीमाण्डौ

फोन नं ०१-४३७०३४४, ०१-४३७४८३०

पत्र संख्या: ०७९/८०
चलानी नं.: ३९८

मिति: २०७९/८/२५

विषयः सूचना टाँस गरिएको बारे ।

श्री नागमती बाँध आयोजना,
जावलाखेल, ललितपुर ।

प्रस्तुत विषयमा तहाँ आयोजनाको प.स. ०७९/८० च.नं. २४ मिति २०७९।०८।२५ को पत्र मार्फत प्राप्त भएको नगमती बाँध आयोजनाको वातावरणीय प्रभाव मुल्यांकन प्रतिवेदन तयारीको निम्ति प्रकाशित ७ दिने सार्वजनिक सूचना यस कार्यालयको सूचना पाटिमा मिति २०७९/८/२५ गते टाँस गरिएको व्यहोरा अनुरोध छ ।

२०७९/८/२५

लक्ष्मण प्रसाद पोख्रेल
प्रमुख संरक्षण अधिकृत
रा.प. द्वितिय (प्रा.)

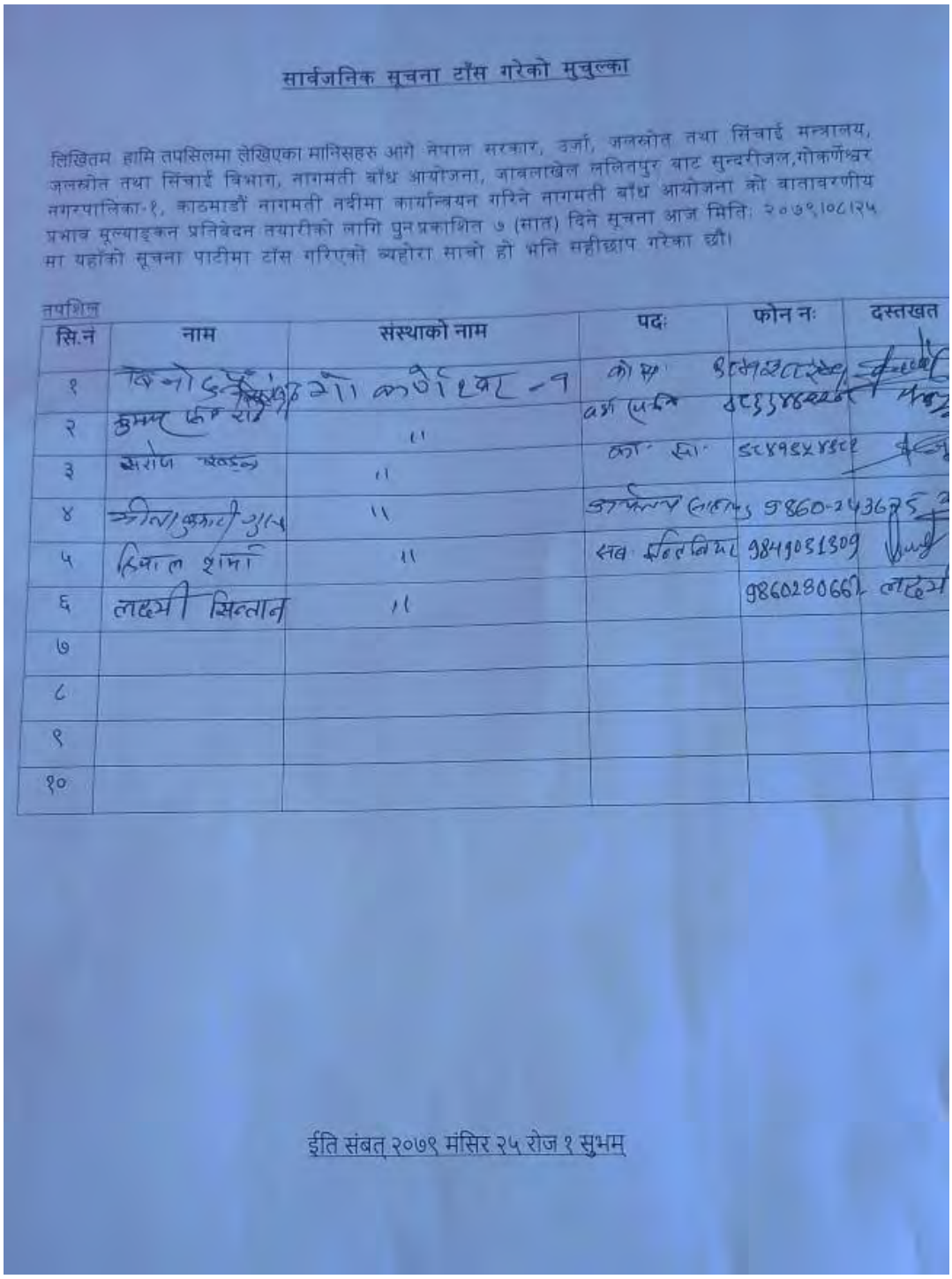
सार्वजनिक सूचना टाँस गरेको मुचुल्का

लिखितम हामि तपसिलमा लेखिएका मानिसहरु आगे नेपाल सरकार, उर्जा, जलस्रोत तथा सिंचाई मन्त्रालय, जलस्रोत तथा सिंचाई विभाग, नागमती बाँध आयोजना, जावलाखेल ललितपुर बाट सुन्दरीजल,गोकर्णेश्वर नगरपालिका १, काठमाडौं नागमती नदीमा कार्यान्वयन गरिने नागमती बाँध आयोजना को वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदन तयारीको लागि पुनःप्रकाशित ७ (सात) दिने सूचना आज मिति २०७९।०८।२५ मा यहाँको सूचना पाटीमा टाँस गरिएको व्यहोरा साचो हो भनि सहीछाप गरेका छौ।

तपशिल

सि.न	नाम	संस्थाको नाम	पद	फोन नं	दस्तखत
१	दिनराज ढकाल	डाटेकनो प्रा. लि.	प्रोजेक्ट	9851068936	
२	प्रतीक्षा किट	"	"	9843520280	
३	राम व लामा	"	"	9841385110	
४	राजेन्द्र सिरुवा	"	"	9841536705	
५	सन्जय पौज्यत	"	"	9828822550	
६	पमुना मार्की	"	"	9841570920	
७					
८					
९					
१०					

ईति संवत् २०७९ मंसिर २५ रोज १ सुभम्



सार्वजनिक सूचना टाँस गरेको मुचुल्का

लिखितम हामि तपसिलमा लेखिएका मानिसहरु आगे नेपाल सरकार, उर्जा, जलस्रोत तथा सिंचाई मन्त्रालय, जलस्रोत तथा सिंचाई विभाग, नागमती बाँध आयोजना, जावलाखेल ललितपुर बाट सुन्दरीजल,गोकर्णेश्वर नगरपालिका-१, काठमाडौं नागमती नदीमा कार्यान्वयन गरिने नागमती बाँध आयोजना को वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदन तयारीको लागि पुनःप्रकाशित ७ (सात) दिने सूचना आज मिति: २०७९।०८।२५ मा यहाँको सूचना पाटीमा टाँस गरिएको व्यहोरा साचो हो भनि सहीछाप गरेका छौ।

तपशिल

सि.नं	नाम	संस्थाको नाम	पदः	फोन नः	दस्तखत
१	विनोद [illegible]	गोकर्णेश्वर -१	को.प.	[illegible]	
२	कुमार [illegible]	"	अ.प्र.ति	[illegible]	
३	[illegible]	"	का. स.	[illegible]	
४	[illegible]	"	[illegible]	9860-243675	
५	[illegible]	"	[illegible]	9841081809	
६	लक्ष्मी सिन्तान	"		9860280662	
७					
८					
९					
१०					

इति संवत् २०७९ मंसिर २५ रोज १ सुभम्

b. Copy of Published Notice in National Newspaper

नेपाल सरकार
ऊर्जा, जलस्रोत तथा सिंचाई मन्त्रालय
जलस्रोत तथा सिंचाई विभाग
नागमती बाँध आयोजना
जावलाखेल ललितपुर

नागमती बाँध आयोजनाको वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदन तयारी सम्बन्धी सार्वजनिक सूचना

पुन प्रकाशित मिति २०७८।०८।२५

नेपाल सरकार, ऊर्जा, जलस्रोत तथा सिंचाई मन्त्रालय, जलस्रोत तथा सिंचाई विभाग, नागमती बाँध आयोजना, जावलाखेल ललितपुर द्वारा सुन्दरीजल, गोकर्णेश्वर नगरपालिका-१, काठमाडौं, नागमती नदीमा निम्न बमोजिमको प्रस्ताव कार्यान्वयन गर्न लागिएको छ।

प्रस्तावकको नाम र ठेगाना	नेपाल सरकार ऊर्जा, जलस्रोत तथा सिंचाई मन्त्रालय जलस्रोत तथा सिंचाई विभाग नागमती बाँध आयोजना, जावलाखेल ललितपुर हाल गुह्येश्वरी, काठमाडौं फोन: ०१-४११४३७४ इमेल nagmati@dwri.gov.np, brbip.doi@gmail.com
प्रस्तावको व्यहोरा	प्रस्तावित नागमती बाँध आयोजनाको मुख्य उद्देश्य नागमती नदीमा बाँध निर्माण गरी मुख्य मौसममा नागमती नदीमा पानीको उपलब्धता बढाउनका साथै २१२ मेघावाट जलविद्युत उर्जा उत्पादन गर्नु रहेको छ। आयोजनाको मुख्य विवरण निम्नानुसार छ। • बाँध: ९४.५ मि. उचाइ, ५५४ मि. क्रेस्ट लम्बाइ र ७ मिटर क्रेस्ट चौडाई • जलाशय: पूर्ण आपूर्ति स्तरमा ९०.४८४ लाख घन मिटर भण्डारण क्षमता रहेको ४८.०४ हेक्टरमा फैलिएको • पेनस्टक: ०.६ मिटर व्यासको बाइफर्केशन पूर्व ३९.४३८८ मि. र बाइफर्केशन पश्चात ०.४ व्यासको ६.२५ मि. र ११.६३ मि. लम्बाइको २ एकाइ रहने • विद्युतगृह: सतही किसिमको २२.५ मि. लम्बाइ र १५.६५ मि. चौडाई क्षेत्रफलमा निर्माण हुने • आवश्यक जग्गा क्षेत्रफल • सरकारी वन क्षेत्र: ६१.४६१ हे. • निजी: करिब १.२९२ हे.
प्रभाव पर्ने जाने जिल्ला/न.पा	काठमाण्डौ जिल्ला/गोकर्णेश्वर नगरपालिका वडा नं. १

माथि उल्लेखित प्रस्तावको वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदन (EIA) तयारीको क्रममा सो क्षेत्रको प्राकृतिक भौतिक प्रणाली, जविक प्रणाली, सामाजिक प्रणाली, सांस्कृतिक प्रणाली र आर्थिक प्रणालीमा के कस्तो प्रभाव पर्दछ भनि यकिन गर्न गोकर्णेश्वर नगरपालिका, शिवपुरी-नागर्जुन राष्ट्रिय निकुञ्जी तथा त्यस क्षेत्रका विद्यालय, अस्पताल, स्वास्थ्य चौकी तथा सरोकारवाला व्यक्ती वा संस्थाको लिखित राय सुझाव लिन आवश्यक भएकोले यो सार्वजनिक सूचना प्रकाशित भएको मितिले ७ (सात) दिनभित्र निम्न ठेगानामा आई पुग्ने गरी लिखित राय सुझाव उपलब्ध गराई दिन हुन अनुरोध गरिन्छ।

राय सुझावको लागि पत्राचार गर्ने ठेगाना:

प्रस्तावकको नाम र ठेगाना	नागमती बाँध आयोजना, जावलाखेल ललितपुर, हाल गौरिघाट, गुह्येश्वरी फोन: ०१-४११४३७४ इमेल:nagmati@dwri.gov.np, brbip.doi@gmail.com
परामर्शदाताको नाम र ठेगाना	आर्किटेक्ट डीजाइन एण्ड सिभिल कन्स्ट्रक्सन प्र. लि., कोटेश्वर फोन : ०१-४१५५३११ इमेल : youradcc@gmail.com

नेपाल सरकार

नेपाल सरकार
उर्जा, जलस्रोत तथा सिंचाई मन्त्रालय
जलस्रोत तथा सिंचाई विभाग
नागमती बाँध आयोजना
जावलाखेल ललितपुर

नागमती बाँध आयोजनाको वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदन तयारी सम्बन्धी सार्वजनिक सूचना

पुनःप्रकाशित मिति २०७९।०८।२५

नेपाल सरकार, उर्जा, जलस्रोत तथा सिंचाई मन्त्रालय, जलस्रोत तथा सिंचाई विभाग, नागमती बाँध आयोजना, जावलाखेल ललितपुर द्वारा सुन्दरीजल, गोकर्णेश्वर नगरपालिका-१, काठमाडौं, नागमती नदीमा निम्न बमोजिमको प्रस्ताव कार्यान्वयन गर्न लागिएको छ।

प्रस्तावकको नाम र ठेगाना	नेपाल सरकार उर्जा, जलस्रोत तथा सिंचाई मन्त्रालय जलस्रोत तथा सिंचाई विभाग नागमती बाँध आयोजना, जावलाखेल ललितपुर हाल गुह्येश्वरी, काठमाडौं फोन: ०१-४११४३७४ इमेल:nagmati@dwri.gov.np, brbip.doi@gmail.com
प्रस्तावको व्यहोरा	प्रस्तावित नागमती बाँध आयोजनाको मुख्य उद्देश्य नागमती नदीमा बाँध निर्माण गरी सुख्खा मौसममा बागमती नदीमा पानीको उपलब्धता बढाउनका साथै २.१२ मेघावाट जलविद्युत उर्जा उत्पादन गर्नु रहेको छ। आयोजनाको मुख्य विवरण निम्नानुसार छ। • बाँध: ९४.५ मि. उचाइ, ५५४ मि. क्रेस्ट लम्बाइ र ७ मिटर क्रेस्ट चौडाई • जलाशय: पूर्ण आपूर्ति स्तर मा ९०.४८४ लाख घन मिटर भण्डारण क्षमता रहेको ४८.०४ हेक्टर मा फैलिएको • पेनस्टक: ०.६ मिटर व्यासको बाइफर्केशन पूर्व ३९४३.८८ मि. र बाइफर्केशन पश्चात ०.४ व्यासको ६.२५ मि. र ११.६३ मि. लम्बाइको २ एकाइ रहने • विद्युतगृह: सतही किसिमको २२.५ मि. लम्बाइ र १५.६५ मि. चौडाई क्षेत्रफलमा निर्माण हुने • आवश्यक जग्गा क्षेत्रफल ○ सरकारी वन क्षेत्र: ६१.५६१ हे. ○ निजी: करिब १.२९२ हे.
प्रभाव पर्ने जाने जिल्ला न.पा	काठमाण्डौ जिल्ला गोकर्णेश्वर नगरपालिका वडा नं. १

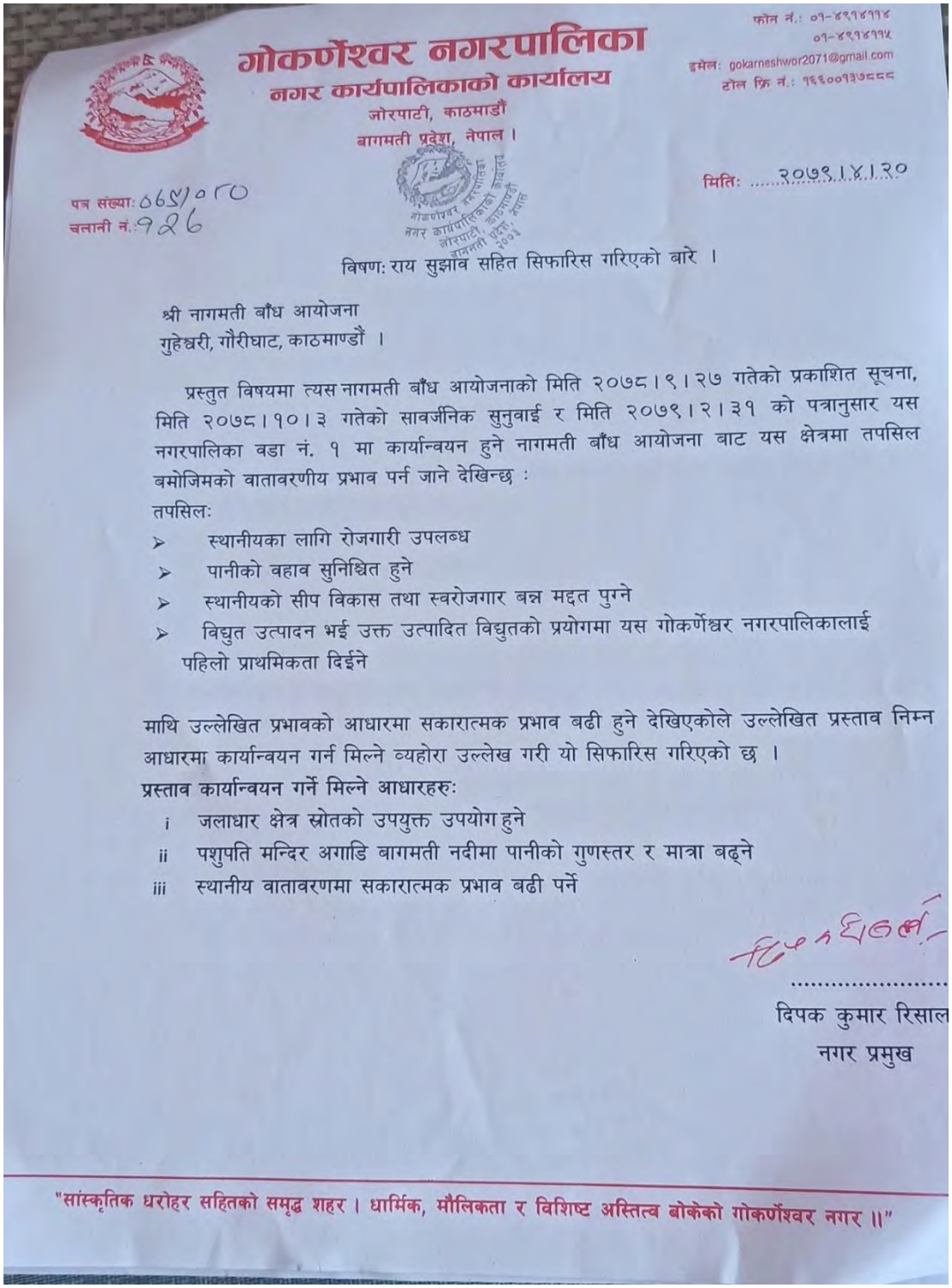
माथि उल्लेखित प्रस्तावको वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदन (EIA) तयारीको क्रममा सो क्षेत्रको प्राकृतिक भौतिक प्रणाली, जबिक प्रणाली, सामाजिक प्रणाली, साँस्कृतिक प्रणाली र आर्थिक प्रणालीमा के कस्तो प्रभाव पर्दछ भनि यकिन गर्न गोकर्णेश्वर नगरपालिका, शिवपुरी नागर्जुन राष्ट्रिय निकुञ्ज तथा त्यस क्षेत्रका विद्यालय, अस्पताल, स्वास्थ्य चौकी तथा सरोकारवाला व्यक्ती वा संस्थाको लिखित राय सुझाव लिन आवश्यक भएकोले यो सार्वजनिक सूचना प्रकासित भएको मितिले ७ (सात) दिनभित्र निम्न ठेगानामा आई पुग्ने गरी लिखित राय सुझाव उपलब्ध गराई दिन हुन अनुरोध गरिन्छ । राय सुझावको लागि पत्राचार गर्ने ठेगाना:

प्रस्तावकको नाम र ठेगाना	नागमती बाँध आयोजना, जावलाखेल ललितपुर, हाल गौरिघाट, गुह्येश्वरी फोन: ०१-४११४३७४ इमेल:nagmati@dwri.gov.np, brbip.doi@gmail.com
परामर्शदाताको नाम र ठेगाना	आर्किटेक्ट डीजाइन एण्ड सिभिल कन्स्ट्रक्सन प्र. लि., कोटेश्वर फोन : ०१-४१५५३११ इमेल : youradcc@gmail.com

Annex 19

Recommendation Letters from Concerned Stakeholders

a. Recommendation Letter from Gokarneshwor Municipality



गोकर्णेश्वर नगरपालिका
नगर कार्यपालिकाको कार्यालय
जोरपाटी, काठमाडौं
बागमती प्रदेश, नेपाल ।

फोन नं.: ०१-४९१४११४
०१-४९१४११५
इमेल: gokarneshwor2071@gmail.com
टोल फ्रि नं.: १६६००१३७८८८

पत्र संख्या: ०६५/०८०
चलानी नं.: ९२६

मिति: २०७९।४।२०

विषय: राय सुझाव सहित सिफारिस गरिएको बारे ।

श्री नागमती बाँध आयोजना
गुहेश्वरी, गौरीघाट, काठमाण्डौं ।

प्रस्तुत विषयमा त्यस नागमती बाँध आयोजनाको मिति २०७८।९।२७ गतेको प्रकाशित सूचना, मिति २०७८।१०।३ गतेको सावर्जनिक सुनुवाई र मिति २०७९।२।३१ को पत्रानुसार यस नगरपालिका वडा नं. १ मा कार्यान्वयन हुने नागमती बाँध आयोजना बाट यस क्षेत्रमा तपसिल बमोजिमको वातावरणीय प्रभाव पर्न जाने देखिन्छ :

तपसिलः

- स्थानीयका लागि रोजगारी उपलब्ध
- पानीको वहाव सुनिश्चित हुने
- स्थानीयको सीप विकास तथा स्वरोजगार बन्न मद्दत पुग्ने
- विद्युत उत्पादन भई उक्त उत्पादित विद्युतको प्रयोगमा यस गोकर्णेश्वर नगरपालिकालाई पहिलो प्राथमिकता दिईने

माथि उल्लेखित प्रभावको आधारमा सकारात्मक प्रभाव बढी हुने देखिएकोले उल्लेखित प्रस्ताव निम्न आधारमा कार्यान्वयन गर्न मिल्ने व्यहोरा उल्लेख गरी यो सिफारिस गरिएको छ ।

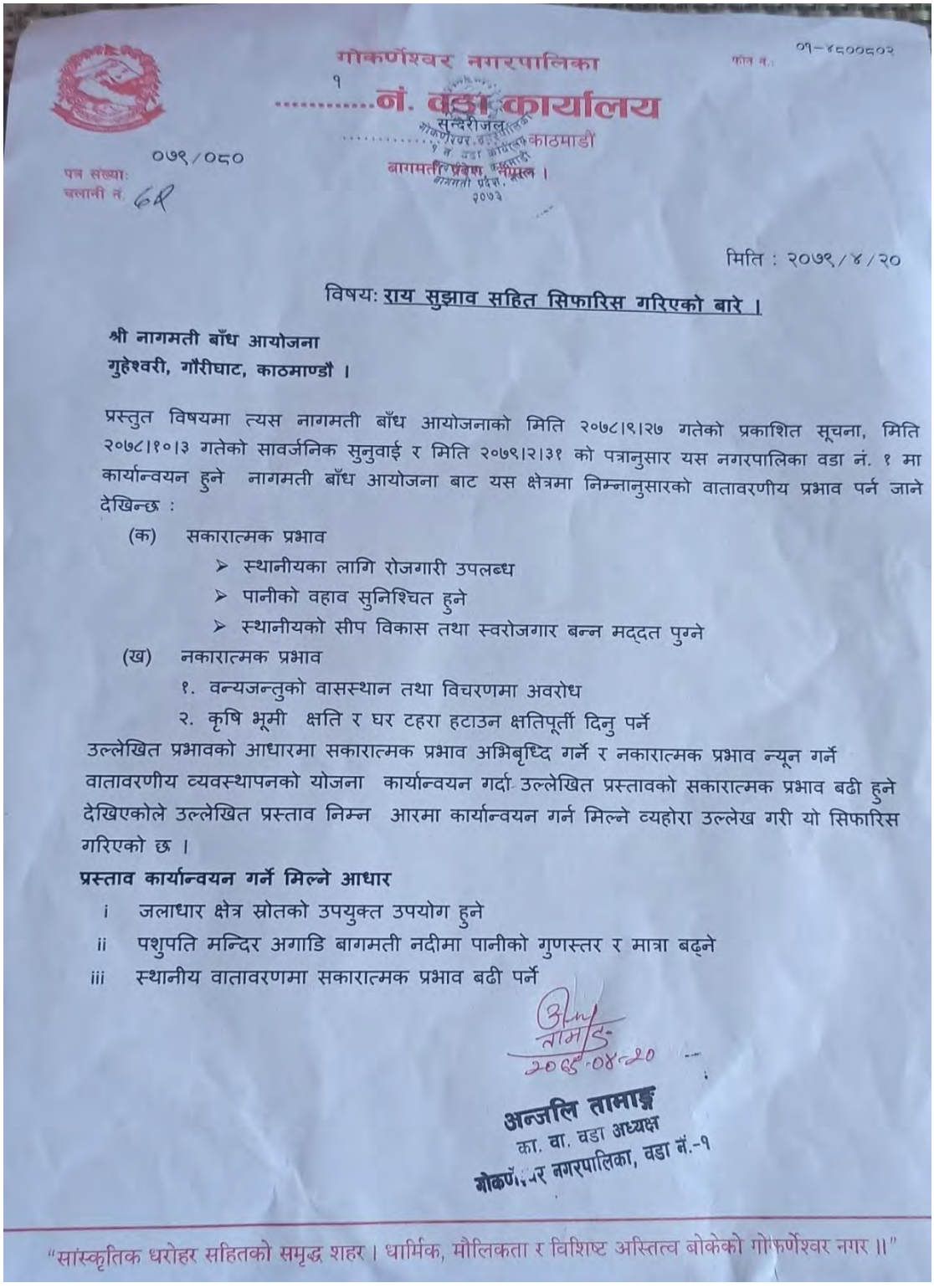
प्रस्ताव कार्यान्वयन गर्ने मिल्ने आधारहरुः

i. जलाधार क्षेत्र स्रोतको उपयुक्त उपयोग हुने
ii. पशुपति मन्दिर अगाडि बागमती नदीमा पानीको गुणस्तर र मात्रा बढ्ने
iii. स्थानीय वातावरणमा सकारात्मक प्रभाव बढी पर्ने

.....
दिपक कुमार रिसाल
नगर प्रमुख

"सांस्कृतिक धरोहर सहितको समृद्ध शहर । धार्मिक, मौलिकता र विशिष्ट अस्तित्व बोकेको गोकर्णेश्वर नगर ॥"

b. Recommendation Letter from Gokarneshwor Municipality Ward no. 1



गोकर्णेश्वर नगरपालिका
१ नं. वडा कार्यालय
सुन्दरीजल, काठमाडौं
बागमती प्रदेश, नेपाल ।

फोन नं.: ०१-४६००८०२

पत्र संख्या: ०७९/०८०
चलानी नं. 68

मिति : २०७९/४/२०

विषय: राय सुझाव सहित सिफारिस गरिएको बारे ।

श्री नागमती बाँध आयोजना
गुहेश्वरी, गौरीघाट, काठमाण्डौ ।

प्रस्तुत विषयमा त्यस नागमती बाँध आयोजनाको मिति २०७८।९।२७ गतेको प्रकाशित सूचना, मिति २०७८।१०।३ गतेको सार्वजनिक सुनुवाई र मिति २०७९।२।३१ को पत्रानुसार यस नगरपालिका वडा नं. १ मा कार्यान्वयन हुने नागमती बाँध आयोजना बाट यस क्षेत्रमा निम्नानुसारको वातावरणीय प्रभाव पर्न जाने देखिन्छ :

(क) सकारात्मक प्रभाव
- स्थानीयका लागि रोजगारी उपलब्ध
- पानीको वहाव सुनिश्चित हुने
- स्थानीयको सीप विकास तथा स्वरोजगार बन्न मद्दत पुग्ने

(ख) नकारात्मक प्रभाव
१. वन्यजन्तुको वासस्थान तथा विचरणमा अवरोध
२. कृषि भूमी क्षति र घर टहरा हटाउन क्षतिपूर्ती दिनु पर्ने

उल्लेखित प्रभावको आधारमा सकारात्मक प्रभाव अभिबृध्दि गर्ने र नकारात्मक प्रभाव न्यून गर्ने वातावरणीय व्यवस्थापनको योजना कार्यान्वयन गर्दा उल्लेखित प्रस्तावको सकारात्मक प्रभाव बढी हुने देखिएकोले उल्लेखित प्रस्ताव निम्न आरमा कार्यान्वयन गर्न मिल्ने व्यहोरा उल्लेख गरी यो सिफारिस गरिएको छ ।

प्रस्ताव कार्यान्वयन गर्ने मिल्ने आधार

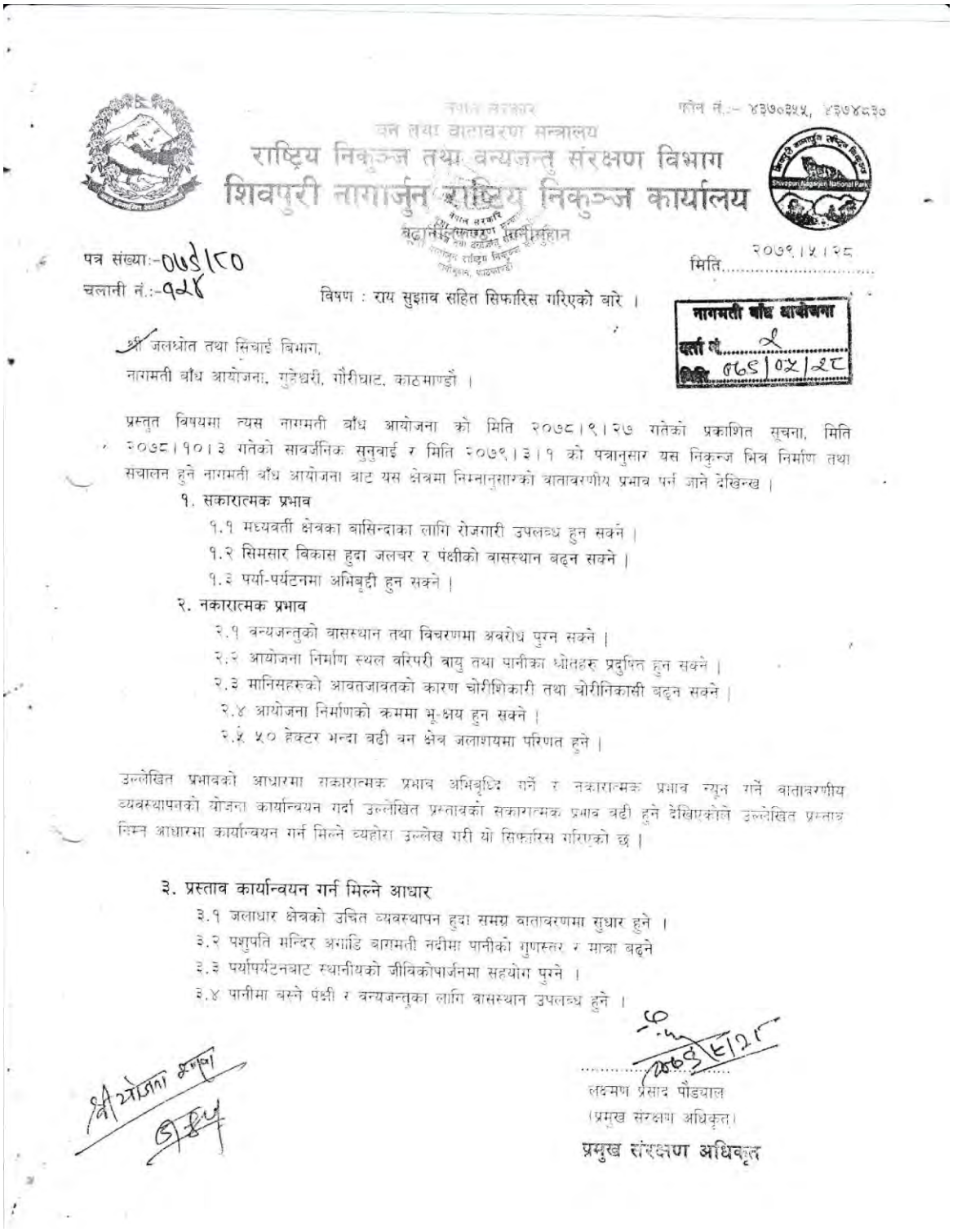
i जलाधार क्षेत्र स्रोतको उपयुक्त उपयोग हुने
ii पशुपति मन्दिर अगाडि बागमती नदीमा पानीको गुणस्तर र मात्रा बढ्ने
iii स्थानीय वातावरणमा सकारात्मक प्रभाव बढी पर्ने

२०७९-०४-२०

अन्जलि तामाङ
का. वा. वडा अध्यक्ष
गोकर्णेश्वर नगरपालिका, वडा नं.-१

"सांस्कृतिक धरोहर सहितको समृद्ध शहर । धार्मिक, मौलिकता र विशिष्ट अस्तित्व बोकेको गोकर्णेश्वर नगर ।।"

c. Recommendation Letter from Shivapuri Nagarjun National Park



नेपाल सरकार
वन तथा वातावरण मन्त्रालय
राष्ट्रिय निकुञ्ज तथा वन्यजन्तु संरक्षण विभाग
शिवपुरी नागार्जुन राष्ट्रिय निकुञ्ज कार्यालय

फोन नं.:- ४३७०२५५, ४३७४८३०

पत्र संख्या:-०७९/८०
चलानी नं.:-९२४

मिति: २०७९।४।२८

विषय : राय सुझाव सहित सिफारिस गरिएको बारे ।

नागमती बाँध आयोजना
पत्रा नं. २
मिति ०७९/०४/२८

श्री जलश्रोत तथा सिंचाई विभाग,
नागमती बाँध आयोजना, गुदेश्वरी, गौरीघाट, काठमाण्डौं ।

प्रस्तुत विषयमा त्यस नागमती बाँध आयोजना को मिति २०७८।९।२७ गतेको प्रकाशित सूचना, मिति २०७८।१०।३ गतेको सार्वजनिक सुनुवाई र मिति २०७९।३।१ को पत्रानुसार यस निकुञ्ज भित्र निर्माण तथा सचालन हुने नागमती बाँध आयोजना बाट यस क्षेत्रमा निम्नानुसारको वातावरणीय प्रभाव पर्न जाने देखिन्छ ।

१. सकारात्मक प्रभाव
- १.१ मध्यवर्ती क्षेत्रका बासिन्दाका लागि रोजगारी उपलब्ध हुन सक्ने ।
- १.२ सिमसार विकास हुदा जलचर र पंक्षीको बासस्थान बढ्न सक्ने ।
- १.३ पर्या-पर्यटनमा अभिबृद्दी हुन सक्ने ।

२. नकारात्मक प्रभाव
- २.१ वन्यजन्तुको बासस्थान तथा विचरणमा अवरोध पुरन सक्ने ।
- २.२ आयोजना निर्माण स्थल वरिपरी वायु तथा पानीका श्रोतहरु प्रदुषित हुन सक्ने ।
- २.३ मानिसहरुको आवतजावतको कारण चोरीशिकारी तथा चोरीनिकासी बढ्न सक्ने ।
- २.४ आयोजना निर्माणको क्रममा भू-क्षय हुन सक्ने ।
- २.५ ५० हेक्टर भन्दा बढी वन क्षेत्र जलाशयमा परिणत हुने ।

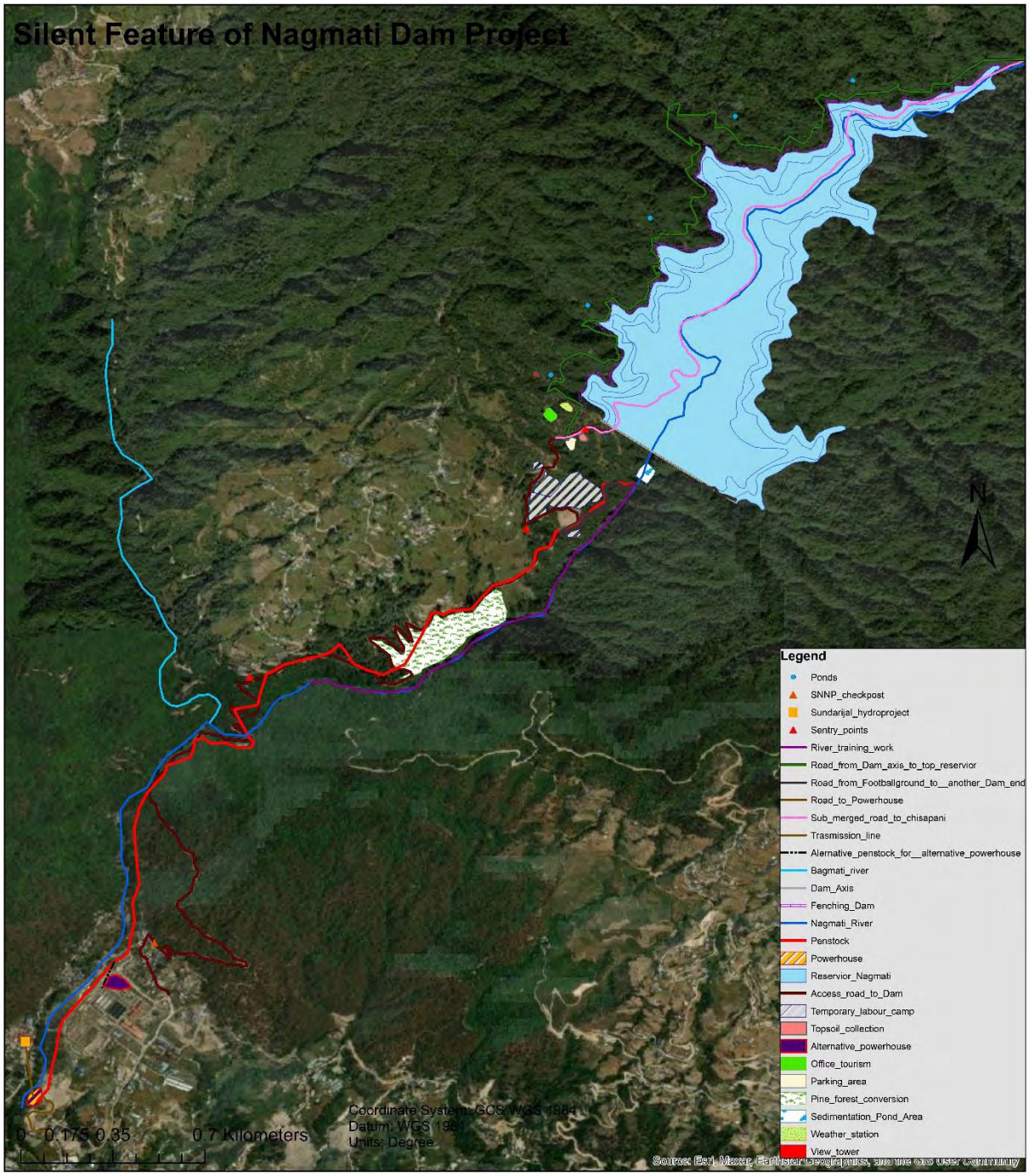
उल्लेखित प्रभावको आधारमा सकारात्मक प्रभाव अभिबृद्दि गर्ने र नकारात्मक प्रभाव न्यून गर्ने वातावरणीय व्यवस्थापनको योजना कार्यान्वयन गर्दा उल्लेखित प्रस्तावको सकारात्मक प्रभाव बढी हुने देखिएकोले उल्लेखित प्रस्ताव निम्न आधारमा कार्यान्वयन गर्न मिल्ने व्यहोरा उल्लेख गरी यो सिफारिस गरिएको छ ।

३. प्रस्ताव कार्यान्वयन गर्न मिल्ने आधार
- ३.१ जलाधार क्षेत्रको उचित व्यवस्थापन हुदा समग्र वातावरणमा सुधार हुने ।
- ३.२ पशुपति मन्दिर अगाडि बागमती नदीमा पानीको गुणस्तर र मात्रा बढ्ने
- ३.३ पर्यापर्यटनबाट स्थानीयको जीविकोपार्जनमा सहयोग पुरने ।
- ३.४ पानीमा बस्ने पंक्षी र वन्यजन्तुका लागि बासस्थान उपलब्ध हुने ।

२०७९।४।२८
लक्ष्मण प्रसाद पौडयाल
(प्रमुख संरक्षण अधिकृत)
प्रमुख संरक्षण अधिकृत

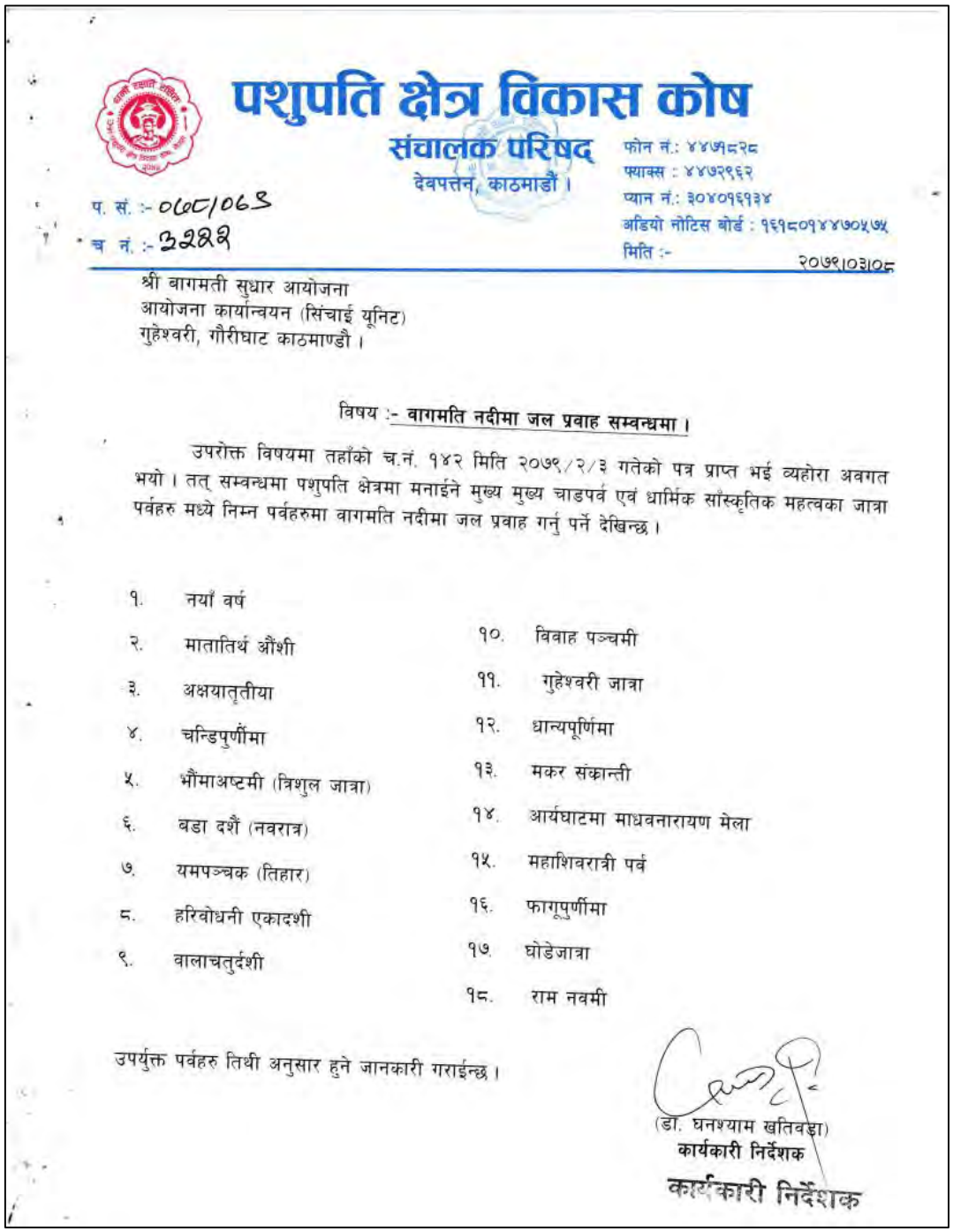
Annex 20

Project Alternatives Layout Map



Annex 21

Letter from Pashupati Area Development Trust for River Water Flow



पशुपति क्षेत्र विकास कोष
संचालक परिषद
देवपत्तन, काठमाडौं ।

फोन नं.: ४४७८२८
फ्याक्स : ४४७२९६२
प्यान नं.: ३०४०१६१३४
अडियो नोटिस बोर्ड : १६१८०१४४७०५७५
मिति :- २०७९।०३।०८

प. सं. :- ०७८/०७९
च नं. :- ३२२२

श्री बागमती सुधार आयोजना
आयोजना कार्यान्वयन (सिंचाई यूनिट)
गुहेश्वरी, गौरीघाट काठमाण्डौ ।

विषय :- **बागमति नदीमा जल प्रवाह सम्बन्धमा ।**

उपरोक्त विषयमा तहाँको च.नं. १४२ मिति २०७९/२/३ गतेको पत्र प्राप्त भई व्यहोरा अवगत भयो । तत् सम्बन्धमा पशुपति क्षेत्रमा मनाईने मुख्य मुख्य चाडपर्व एवं धार्मिक सांस्कृतिक महत्वका जात्रा पर्वहरु मध्ये निम्न पर्वहरुमा बागमति नदीमा जल प्रवाह गर्नु पर्ने देखिन्छ ।

१. नयाँ वर्ष
२. मातातिर्थ औंशी
३. अक्षयातृतीया
४. चन्डिपुर्णीमा
५. भौंमाअष्टमी (त्रिशुल जात्रा)
६. बडा दशैं (नवरात्र)
७. यमपञ्चक (तिहार)
८. हरिवोधनी एकादशी
९. बालाचतुर्दशी
१०. विवाह पञ्चमी
११. गुहेश्वरी जात्रा
१२. धान्यपूर्णिमा
१३. मकर संक्रान्ती
१४. आर्यघाटमा माधवनारायण मेला
१५. महाशिवरात्री पर्व
१६. फागूपुर्णीमा
१७. घोडेजात्रा
१८. राम नवमी

उपर्युक्त पर्वहरु तिथी अनुसार हुने जानकारी गराईन्छ ।

(डॉ. घनश्याम खतिवडा)
कार्यकारी निर्देशक
कार्यकारी निर्देशक

Annex 22

List of Tree *sps.* to be Felled with Volume

Table: List of tree and pole species to be felled

SN	*Species Name (Scientific)*	Species Name (Local)	Total Number of Species	Net Timber Volume (cft)	Volume of Fuelwood (cft)
1	*Ilex dipyrena*	Seto Khasru	106	14.61	475.13
2	*Albizia chinensis*	Sirish	279	73.95	2,502.34
3	*Alnus nepalensis*	Uttis	581	719.21	8,613.91
4	*Camellia kissi*	Chiyapate	4539	14.08	11,400.87
5	*Carpinus viminea*	Saur	5770	338.35	29,662.33
6	*Castanopsis tribuloides*	Masure Katus	3082	318.03	16,084.15
7	*Choerospondias axillaris*	Lapsi	1	-	50.71
8	*Cinnamomum glanduliferum*	Malagiri	1279	414.43	9,222.68
9	*Cleyera japonica*	Baklopaate	3695	-	12,175.17
10	*Daphniphyllum himalense*	Rakchan	328	44.75	2,032.01
11	*Engelhardia spicata*	Mauwa	15	-	75.70
12	*Eriobotrya elliptica*	Maya	179	7.93	646.14
13	*Eugenia jambolana*	Jamun	7	-	23.44
14	*Eurya acuminata*	Jhingane	676	8.62	2,358.22
15	*Eurya cerasifolia*	Thulo Jhingane	5	-	22.49
16	*Ficus neriifolia*	Dudhilo	9	-	30.54
17	*Fraxinus floribunda*	Lakuri	411	60.70	2,033.23
18	*Ilex dipyrena*	Chotro	4	-	6.39
19	*Ilex excelsa*	Punwale	780	115.10	4,246.63
20	*Ilex species*	Pahale	4	-	17.72
21	*Lindera pulcherrima*	Kharane	3	-	10.50
22	*Lithocarpus elegans*	Arkheulo	1527	203.52	8,292.34
23	*Lyonia ovalifolia*	Angeri	4196	3.48	14,034.03
24	*Mahonia nepaulensis*	Jamane Madro	3	-	5.01
25	*Michelia champaca*	Chaap	1251	841.26	15,019.89
26	*Michelia kisopa*	Lek Chaap	345	303.91	3,620.44
27	*Myrica esculenta*	Kafal	2254	29.83	9,570.50
28	*Myrsine semiserrata*	Desi Kalikath	62	-	128.91
29	*Myrsine species*	Seti Kath	98	6.62	370.88
30	*Neolitsea pallens*	Neolitsea	72	32.26	363.63
31	*Others*	Paheli	662	56.49	3,105.22
32	*Others*	Banse	3	-	25.22
33	*Persea duthiei*	Ban Kaulo	1019	220.85	5,758.97
34	*Persea odoratissima*	Seto Kaulo	123	2.84	685.61
35	*Pinus roxburghii*	Khote Salla	286	656.11	3,771.73
36	*Pinus wallichiana*	Sallo	14	7.56	90.53
37	*Prunus cerasoides*	Paiyun	242	42.03	1,268.99
38	*Prunus cornuta*	Lek Aaru	2	-	5.64
39	*Pyrularia edulis*	Aamphi	3	-	7.64
40	*Pyrus pashia*	Ban Mel	213	0.91	947.36
41	*Quercus glauca*	Falat	18851	1,787.48	87,238.19
42	*Quercus lamellosa*	Dharis	103	16.89	834.14
43	*Quercus lanata*	Banj	4467	420.34	35,560.12
44	*Quercus semecarpifolia*	Khasru	99	3.65	1,511.69
45	*Rhododendron arboretum*	Laligurans	8857	145.74	82,367.11
46	*Rhus javanica*	Bhakimlo	417	48.18	2,334.97
47	*Rhus wallichii*	Valayo	2318	18.20	8,545.93

SN	*Species Name (Scientific)*	Species Name (Local)	Total Number of Species	Net Timber Volume (cft)	Volume of Fuelwood (cft)
48	*Saurauia napaulensis*	Gagan Rukh	1	-	3.07
49	*Schima wallichii*	Chilaune	490	82.92	2,204.87
50	*Symplocos pyrifolia*	Kholme	6371	125.15	24,689.01
51	*Symplocos ramosissima*	Dabdabe	125	-	512.51
52	*Taxus wallichiana*	Lauth Salla	63	6.87	328.09
53	*Viburnum mullaha*	Laure Rukh	4	-	12.95
54		Gaayo	4	-	6.93
55		Hade Bir	14	-	95.53
56		Kali Mel	497	-	2,570.65
57		Kalo Kaulo	25	-	145.27
58		Kanike	745	3.99	2,229.40
59		Kaulo	1260	55.53	6,871.43
60		Kharej	3	-	7.41
61		Lankuri	1	-	4.03
62		Lek Dabdabe	180	4.84	833.16
63		Lisse	24	-	124.09
64		Mel	425	-	1,356.04
65		Ban Chutro	7	-	18.78
66		Chinde	3	-	9.61
67		Maine Kada	50	-	206.10
68		Phirphire	3	-	12.14
69		Si Si	435	13.89	1,644.67
70		Sano Jhingane	24	-	56.47
71		Tejpat (Malagiri)	264	25.82	1,020.71
Total			**80258**	**7296.91**	**432117.90**

Annex 23

Laboratory Test Reports of Collected Water Samples

Soil Water and Air Testing Labaratories Pvt. Ltd.
VAT No: 605928743
Tel: +977-01 4249480
Email: swatlab2017@gmail.com
PO Box: 25752, Kathmandu, Nepal
Sisir Marga 11, Babarmahal, Kathmandu, Nepal

SWAT/F/C/04
Version no: 01
Issue no: 02
Revision no: 03
Effective date: 2021/08/01

WATER ANALYSIS REPORT

Name of Client:	Bagmati River Basin Improvement Project	**Lab Code:**	22/12-871(a)
Collector:	Aalekh Bhattarai	**Location:**	Upstream of Proposed Nagmati dam site
Source:	Water	**Sampled By:**	Aalekh Bhattarai
Longitude:	85°27'22.62"E	**Latitude:**	27°47'45.30"N
Sampling Date/Time:	2022/12/17,12:30 P.M.	**Test Performance Date:**	2022/12/18-2022/12/29
Receipt Date:	2022/12/18	**Issued Date:**	2023/01/02

Parameters	Results	Unit	NDWQS	Method
Physical				
Color	0	TCU	5 (10)	2120 B. APHA 23rd edition
Electrical Conductivity	20	µS/cm	1500 (max)	2510 B. APHA 23rd edition
pH	7.1	-	6.5-8.5	4500 H+ B. APHA 23rd edition
Temperature	9.9	°C	-	-
Taste and Odour	unobj	-	-	-
Total Solids	40	mg/L	3000	2540 B. APHA 23rd edition
Total Dissolved Solids	28	mg/L	1000	2540 C. APHA 23rd edition
Turbidity	<0.1	NTU	5 (15)	2130 B. APHA 23rd edition
Chemical				
Ammonia	0.03	mg/L	1.5	4500 NH_3 F. APHA 23rd edition
Dissolved Oxygen	8.3	mg/L	-	DO Meter
Biochemical Oxygen Demand	0.6	mg/L	500	5210 B, APHA 23rd edition
Chemical Oxygen Demand	19	mg/L	-	5220 B., APHA 23rt edition
Chloride	21.99	mg/L	250	4500-Cl- B. APHA 23rd edition
Nitrate	0.16	mg/L	50	4500 NO_3^- B. APHA 23rd edition
Total Alkalinity	14	mg/L	2000	2320 B., APHA 23rd edition
Total Hardness	<1	mg/L as $CaCO_3$	500	2340 C. APHA 23rd edition

Analyzed and Checked By

Authorized By
Er. Lokesh Sapkota

SWAT/F/C/04
Version no: 01
Issue no: 02
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Effective date: 2021/08/01

Soil Water and Air Testing Labaratories Pvt. Ltd.
VAT No: 605928743
Tel: +977-01 4249480
Email: swatlab2017@gmail.com
PO Box: 25752, Kathmandu, Nepal
Sisir Marga 11, Babarmahal, Kathmandu, Nepal

Parameters	Results	Unit	NDWQS	Method
Calcium	<1	mg/L	200	3500-Ca D. APHA 23rd edition
Magnesium	<1	mg/L	-	-
Sodium	5.14	mg/L	-	3500-Na APHA 23rd edition
Potassium	1.17	mg/L	-	3500-K B., APHA 23rdedition
Sulphate	0.66	mg/L	250	4500-SO_4^{2-}. E. APHA 23rd edition
Orthophosphate	0.02	mg/L	-	4500-P E., APHA 21st edition
Residual Chlorine	<0.04	mg/L	0.1-0.2***	4500-Cl B. APHA 23rd edition
Arsenic*	<0.005	mg/L	0.05	Arsenic Test Kit
Iron	0.01	mg/L	0.3 (3)	3500-Fe B. APHA 23rd edition
Manganese**	0.02	mg/L	0.2	3111B. APHA 23rd edition
Fluoride**	<0.05	mg/L	0.5-1.5***	4500 F-D. APHA 23rd edition
Cadmium**	<0.003	mg/L	0.003	3111B. APHA 23rd edition
Chromium**	<0.01	mg/L	0.05	3111B. APHA 23rd edition
Lead**	<0.01	mg/L	0.01	3111B. APHA 23rd edition
Zinc**	0.06	mg/L	3	3111B. APHA 23rd edition
Copper**	<0.01	mg/L	1	3111B. APHA 23rd edition
Aluminium**	<0.01	mg/L	0.2	3500-Al B. APHA 23rd edition
Nickel	<0.01	mg/L	-	-
Microbiology				
Total Coliform *	**30**	CFU/100 mL	0	9222 B., APHA 23rd edition
Faecal Coliform*	**7**	CFU/100 mL	0	9222 D., APHA 23rd edition

NDWQS=National Drinking Water Quality Standard (2062)
Note: The integrity of the sample and results are dependent on the quality of sampling. The results refer only to the parameters tested of the samples provided/collected for analysis.
*These parameters are not within the scope of Nepal Standard
**These parameters are outsourced to another Laboratory.
***These values show lower and upper limits
Remarks: Except for Total Coliform and Faecal Coliform, all observed values of other tested parameters are found to be within the limit of NDWQS 2062.

Analyzed and Checked By

Authorized By
Er. Lokesh Sapkota

SWAT/F/C/04
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Tel: +977-01 4249480
Email: swatlab2017@gmail.com
PO Box: 25752, Kathmandu, Nepal
Sisir Marga 11, Babarmahal, Kathmandu, Nepal

WATER ANALYSIS REPORT

Name of Client:	Bagmati River Basin Improvement Project	**Lab Code:**	22/12-871(b)
Collector:	Aalekh Bhattarai	**Location:**	Proposed Nagmati dam site
Source:	Water	**Sampled By:**	Aalekh Bhattarai
Longitude:	85°26'39.24"E	**Latitude:**	27°46'59.58"N
Sampling Date/Time:	2022/12/17,1:40 P.M.	**Test Performance Date:**	2022/12/18-2022/12/29
Receipt Date:	2022/12/18	**Issued Date:**	2023/01/02

Parameters	Results	Unit	NDWQS	Method
Physical				
Color	0	TCU	5 (10)	2120 B. APHA 23rd edition
Electrical Conductivity	20	µS/cm	1500 (max)	2510 B. APHA 23rd edition
pH	7.4	-	6.5-8.5	4500 H+ B. APHA 23rd edition
Temperature	10.4	°C	-	-
Taste and Odour	Unobj	-	-	-
Total Solids	26	mg/L	3000	2540 B. APHA 23rd edition
Total Dissolved Solids	24	mg/L	1000	2540 C. APHA 23rd edition
Turbidity	<0.1	NTU	5 (15)	2130 B. APHA 23rd edition
Chemical				
Ammonia	0.03	mg/L	1.5	4500 NH_3 F. APHA 23rd edition
Dissolved Oxygen	7.1	mg/L	-	DO Meter
Biochemical Oxygen Demand	4.8	mg/L	500	5210 B, APHA 23rd edition
Chemical Oxygen Demand	41	mg/L	-	5220 B., APHA 23rd edition
Chloride	21.99	mg/L	250	4500-Cl- B. APHA 23rd edition
Nitrate	<0.04	mg/L	50	4500 NO_3^- B. APHA 23rd edition
Total Alkalinity	12	mg/L	2000	2320 B., APHA 23rd edition
Total Hardness	<1	mg/L as $CaCO_3$	500	2340 C. APHA 23rd edition

Analyzed and Checked By

Authorized By
Er. Lokesh Sapkota

The report shall not be reproduced except in full, without approval of the laboratory.

SWAT/F/C/04
Version no: 01
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VAT No: 605928743
Tel: +977-01 4249480
Email: swatlab2017@gmail.com
PO Box: 25752, Kathmandu, Nepal
Sisir Marga 11, Babarmahal, Kathmandu, Nepal

Parameters	Results	Unit	NDWQS	Method
Calcium	<1	mg/L	200	3500-Ca D. APHA 23rd edition
Magnesium	<1	mg/L	-	-
Sodium	4.89	mg/L	-	3500-Na APHA 23rd edition
Potassium	1	mg/L	-	3500-K B., APHA 21st edition
Sulphate	0.95	mg/L	250	4500-SO_4^{2-}. E. APHA 23rd edition
Orthophosphate	0.04	mg/L	-	4500-P E., APHA 21st edition
Residual Chlorine	<0.04	mg/L	0.1-0.2***	4500-Cl B. APHA 23rd edition
Arsenic*	<0.005	mg/L	0.05	Arsenic Test Kit
Iron	0.01	mg/L	0.3 (3)	3500-Fe B. APHA 23rd edition
Manganese**	0.03	mg/L	0.2	3111B. APHA 23rd edition
Fluoride**	<0.05	mg/L	0.5-1.5***	4500 F-D. APHA 23rd edition
Cadmium**	<0.003	mg/L	0.003	3111B. APHA 23rd edition
Chromium**	<0.01	mg/L	0.05	3111B. APHA 23rd edition
Lead**	<0.01	mg/L	0.01	3111B. APHA 23rd edition
Zinc**	0.12	mg/L	3	3111B. APHA 23rd edition
Copper**	<0.01	mg/L	1	3111B. APHA 23rd edition
Aluminium**	<0.01	mg/L	0.2	3500-Al B. APHA 23rd edition
Nickel	<0.01	mg/L	-	-
Microbiology				
Total Coliform *	**50**	CFU/100 mL	0	9222 B., APHA 23rd edition
Faecal Coliform*	**20**	CFU/100 mL	0	9222 D., APHA 23rd edition

NDWQS=National Drinking Water Quality Standard (2062)
Note: The integrity of the sample and results are dependent on the quality of sampling. The results refer only to the parameters tested of the samples provided/collected for analysis.
*These parameters are not within the scope of Nepal Standard
**These parameters are outsourced to another Laboratory.
***These values show lower and upper limits
Remarks: Except for Total Coliform and Faecal Coliform, all observed values of other tested parameters are found to be within the limit of NDWQS 2062.

Analyzed and Checked By

Authorized By
Er. Lokesh Sapkota

SWAT/F/C/04
Version no: 01
Issue no: 02
Revision no: 03
Effective date: 2021/08/01

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PO Box: 25752, Kathmandu, Nepal
Sisir Marga 11, Babarmahal, Kathmandu, Nepal

WATER ANALYSIS REPORT

Name of Client:	Bagmati River Basin Improvement Project	**Lab Code:**	22/12-871(c)
Collector:	Aalekh Bhattarai	**Location:**	Downstream of Proposed Nagmati Dam site
Source:	Water	**Sampled By:**	Aalekh Bhattarai
Longitude:	85°26'19.56"E	**Latitude:**	27°46'29.82"N
Sampling Date/Time:	2022/12/17,3:10 P.M.	**Test Performance Date:**	2022/12/18-2022/12/29
Receipt Date:	2022/12/18	**Issued Date:**	2023/01/02

Parameters	Results	Unit	NDWQS	Method
Physical				
Color	0	TCU	5 (10)	2120 B. APHA 23rd edition
Electrical Conductivity	20	µS/cm	1500 (max)	2510 B. APHA 23rd edition
pH	7.3	-	6.5-8.5	4500 H+ B. APHA 23rd edition
Temperature	10.3	°C	-	-
Taste and Odour	unobj	-	-	-
Total Solids	38	mg/L	3000	2540 B. APHA 23rd edition
Total Dissolved Solids	30	mg/L	1000	2540 C. APHA 23rd edition
Turbidity	0.13	NTU	5 (15)	2130 B. APHA 23rd edition
Chemical				
Ammonia	0.04	mg/L	1.5	4500 NH_3 F. APHA 23rd edition
Dissolved Oxygen	8.7	mg/L	-	DO Meter
Biochemical Oxygen Demand	1.2	mg/L	500	5210 B, APHA 23rd edition
Chemical Oxygen Demand	10	mg/L	-	5220 B., APHA 23rt edition
Chloride	19.99	mg/L	250	4500-Cl- B. APHA 23rd edition
Nitrate	<0.04	mg/L	50	4500 NO_3^- B. APHA 23rd edition
Total Alkalinity	12	mg/L	2000	2320 B., APHA 23rd edition
Total Hardness	<1	mg/L as $CaCO_3$	500	2340 C. APHA 23rd edition

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Parameters	Results	Unit	NDWQS	Method
Calcium	<1	mg/L	200	3500-Ca D. APHA 23rd edition
Magnesium	<1	mg/L	-	-
Sodium	5.37	mg/L	-	3500-Na APHA 23rd edition
Potassium	1.34	mg/L	-	3500-K B., APHA 21st edition
Sulphate	1.32	mg/L	250	4500-SO_4^{2-}. E. APHA 23rd edition
Orthophosphate	0.05	mg/L	-	4500-P E., APHA 21st edition
Residual Chlorine	<0.04	mg/L	0.1-0.2***	4500-Cl B. APHA 23rd edition
Arsenic*	<0.005	mg/L	0.05	Arsenic Test Kit
Iron	0.01	mg/L	0.3 (3)	3500-Fe B. APHA 23rd edition
Manganese**	0.02	mg/L	0.2	3111B. APHA 23rd edition
Fluoride**	<0.05	mg/L	0.5-1.5***	4500 F-D. APHA 23rd edition
Cadmium**	<0.003	mg/L	0.003	3111B. APHA 23rd edition
Chromium**	<0.01	mg/L	0.05	3111B. APHA 23rd edition
Lead**	<0.01	mg/L	0.01	3111B. APHA 23rd edition
Zinc**	0.06	mg/L	3	3111B. APHA 23rd edition
Copper**	<0.01	mg/L	1	3111B. APHA 23rd edition
Aluminium**	<0.01	mg/L	0.2	3500-Al B. APHA 23rd edition
Nickel	<0.01	mg/L	-	-
Microbiology				
Total Coliform *	**35**	CFU/100 mL	0	9222 B., APHA 23rd edition
Faecal Coliform*	**22**	CFU/100 mL	0	9222 D., APHA 23rd edition

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**These parameters are outsourced to another Laboratory.
***These values show lower and upper limits
Remarks: Except for Total Coliform and Faecal Coliform, all observed values of other tested parameters are found to be within the limit of NDWQS 2062.

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WATER ANALYSIS REPORT

Name of Client:	Bagmati River Basin Improvement Project	**Lab Code:**	22/12-871(d) (S_4)
Collector:	Aalekh Bhattarai	**Location:**	Above the powerhouse at Sundarijal
Source:	Water (S_4)	**Sampled By:**	Aalekh Bhattarai
Longitude:	85°25'22.80"E	**Latitude:**	27°45'48.20"N
Sampling Date/Time:	2022/12/17,5:00 P.M.	**Test Performance Date:**	2022/12/18-2022/12/29
Receipt Date:	2022/12/18	**Issued Date:**	2023/01/02

Parameters	Results	Unit	NDWQS	Method
Physical				
Color	0	TCU	5 (10)	2120 B. APHA 23rd edition
Electrical Conductivity	30	µS/cm	1500 (max)	2510 B. APHA 23rd edition
pH	7.4	-	6.5-8.5	4500 H+ B. APHA 23rd edition
Temperature	10.4	°C	-	-
Taste and Odour	unobj	-	-	-
Total Solids	82	mg/L	3000	2540 B. APHA 23rd edition
Total Dissolved Solids	42	mg/L	1000	2540 C. APHA 23rd edition
Turbidity	**20.15**	NTU	5 (15)	2130 B. APHA 23rd edition
Chemical				
Ammonia	0.03	mg/L	1.5	4500 NH_3 F. APHA 23rd edition
Dissolved Oxygen	7.8	mg/L	-	DO Meter
Biochemical Oxygen Demand	2.4	mg/L	500	5210 B, APHA 23rd edition
Chemical Oxygen Demand	13	mg/L	-	5220 B., APHA 23rt edition
Chloride	19.99	mg/L	250	4500-Cl- B. APHA 23rd edition
Nitrate	0.08	mg/L	50	4500 NO_3^- B. APHA 23rd edition
Total Alkalinity	24	mg/L	2000	2320 B., APHA 23rd edition
Total Hardness	<1	mg/L as $CaCO_3$	500	2340 C. APHA 23rd edition

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Parameters	Results	Unit	NDWQS	Method
Calcium	<1	mg/L	200	3500-Ca D. APHA 23rd edition
Magnesium	<1	mg/L	-	-
Sodium	5.04	mg/L	-	3500-Na APHA 23rd edition
Potassium	1.48	mg/L	-	3500-K B., APHA 21st edition
Sulphate	1.64	mg/L	250	4500-SO_4^{2-}. E. APHA 23rd edition
Orthophosphate	0.01	mg/L	-	4500-P E., APHA 21st edition
Residual Chlorine	<0.04	mg/L	0.1-0.2***	4500-Cl B. APHA 23rd edition
Arsenic*	<0.005	mg/L	0.05	Arsenic Test Kit
Iron	0.01	mg/L	0.3 (3)	3500-Fe B. APHA 23rd edition
Manganese**	0.04	mg/L	0.2	3111B. APHA 23rd edition
Fluoride**	<0.05	mg/L	0.5-1.5***	4500 F-D. APHA 23rd edition
Cadmium**	<0.003	mg/L	0.003	3111B. APHA 23rd edition
Chromium**	<0.01	mg/L	0.05	3111B. APHA 23rd edition
Lead**	<0.01	mg/L	0.01	3111B. APHA 23rd edition
Zinc**	0.22	mg/L	3	3111B. APHA 23rd edition
Copper**	<0.01	mg/L	1	3111B. APHA 23rd edition
Aluminium**	<0.01	mg/L	0.2	3500-Al B. APHA 23rd edition
Nickel	<0.01	mg/L	-	-
Microbiology				
Total Coliform *	**120**	CFU/100 mL	0	9222 B., APHA 23rd edition
Faecal Coliform*	**68**	CFU/100 mL	0	9222 D., APHA 23rd edition

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Remarks: Except for Turbidity, Total Coliform and Faecal Coliform, all observed values of other tested parameters are found to be within the limit of NDWQS 206

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WATER ANALYSIS REPORT

Name of Client:	Bagmati River Basin Improvement Project	**Lab Code:**	22/12-871(e)
Collector:	Aalekh Bhattarai	**Location:**	Adjacent to the powerhouse site
Source:	Water	**Sampled By:**	Aalekh Bhattarai
Longitude:	85°25'19.20"E	**Latitude:**	27°45'14.40"N
Sampling Date/Time:	2022/12/18,7:00 A.M.	**Test Performance Date:**	2022/12/18-2022/12/29
Receipt Date:	2022/12/18	**Issued Date:**	2023/01/02

Parameters	Results	Unit	NDWQS	Method
Physical				
Color	0	TCU	5 (10)	2120 B. APHA 23rd edition
Electrical Conductivity	50	µS/cm	1500 (max)	2510 B. APHA 23rd edition
pH	7.5	-	6.5-8.5	4500 H+ B. APHA 23rd edition
Temperature	11.2	°C	-	-
Taste and Odour	unobj	-	-	-
Total Solids	74	mg/L	3000	2540 B. APHA 23rd edition
Total Dissolved Solids	8	mg/L	1000	2540 C. APHA 23rd edition
Turbidity	**20.30**	NTU	5 (15)	2130 B. APHA 23rd edition
Chemical				
Ammonia	0.04	mg/L	1.5	4500 NH_3 F. APHA 23rd edition
Dissolved Oxygen	7.6	mg/L	-	DO Meter
Biochemical Oxygen Demand	5.4	mg/L	500	5210 B, APHA 23rd edition
Chemical Oxygen Demand	14	mg/L	-	5220 B., APHA 23rt edition
Chloride	15.99	mg/L	250	4500-Cl- B. APHA 23rd edition
Nitrate	<0.04	mg/L	50	4500 NO_3^- B. APHA 23rd edition
Total Alkalinity	32	mg/L	2000	2320 B., APHA 23rd edition
Total Hardness	<1	mg/L as $CaCO_3$	500	2340 C. APHA 23rd edition

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Parameters	Results	Unit	NDWQS	Method
Calcium	<1	mg/L	200	3500-Ca D. APHA 23rd edition
Magnesium	<1	mg/L	-	-
Sodium	6	mg/L	-	3500-Na APHA 23rd edition
Potassium	1.72	mg/L	-	3500-K B., APHA 21st edition
Sulphate	2.71	mg/L	250	4500-SO_4^{2-}. E. APHA 23rd edition
Orthophosphate	0.04	mg/L	-	4500-P E., APHA 21st edition
Residual Chlorine	<0.04	mg/L	0.1-0.2***	4500-Cl B. APHA 23rd edition
Arsenic*	<0.005	mg/L	0.05	Arsenic Test Kit
Iron	0.01	mg/L	0.3 (3)	3500-Fe B. APHA 23rd edition
Manganese**	0.07	mg/L	0.2	3111B. APHA 23rd edition
Fluoride**	<0.05	mg/L	0.5-1.5***	4500 F-D. APHA 23rd edition
Cadmium**	<0.003	mg/L	0.003	3111B. APHA 23rd edition
Chromium**	<0.01	mg/L	0.05	3111B. APHA 23rd edition
Lead**	<0.01	mg/L	0.01	3111B. APHA 23rd edition
Zinc**	0.11	mg/L	3	3111B. APHA 23rd edition
Copper**	<0.01	mg/L	1	3111B. APHA 23rd edition
Aluminium**	<0.01	mg/L	0.2	3500-Al B. APHA 23rd edition
Nickel	<0.01	mg/L	-	-
Microbiology				
Total Coliform *	**300**	CFU/100 mL	0	9222 B., APHA 23rd edition
Faecal Coliform*	**201**	CFU/100 mL	0	9222 D., APHA 23rd edition

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**These parameters are outsourced to another Laboratory.
***These values show lower and upper limits
Remarks: Except for Turbidity, Total Coliform and Faecal Coliform, all observed values of other tested parameters are found to be within the limit of NDWQS 2062.

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WATER ANALYSIS REPORT

Name of Client:	Bagmati River Basin Improvement Project	**Lab Code:**	22/12-871(f)
Collector:	Aalekh Bhattarai	**Location:**	Downstream of Powerhouse
Source:	Water	**Sampled By:**	Aalekh Bhattarai
Longitude:	85°25'15.60"E	**Latitude:**	27°45'21.60"N
Sampling Date/Time:	2022/12/18, 6:00 A.M.	**Test Performance Date:**	2022/12/18-2022/12/29
Receipt Date:	2022/12/18	**Issued Date:**	2023/01/02

Parameters	Results	Unit	NDWQS	Method
Physical				
Color	0	TCU	5 (10)	2120 B. APHA 23rd edition
Electrical Conductivity	50	µS/cm	1500 (max)	2510 B. APHA 23rd edition
pH	7.6	-	6.5-8.5	4500 H+ B. APHA 23rd edition
Temperature	10.6	°C	-	-
Taste and Odour	unobj	-	-	-
Total Solids	94	mg/L	3000	2540 B. APHA 23rd edition
Total Dissolved Solids	56	mg/L	1000	2540 C. APHA 23rd edition
Turbidity	**20.81**	NTU	5 (15)	2130 B. APHA 23rd edition
Chemical				
Ammonia	0.01	mg/L	1.5	4500 NH_3 F. APHA 23rd edition
Dissolved Oxygen	7.6	mg/L	-	DO Meter
Biochemical Oxygen Demand	1.8	mg/L	500	5210 B, APHA 23rd edition
Chemical Oxygen Demand	23	mg/L	-	5220 B., APHA 23rt edition
Chloride	12.99	mg/L	250	4500-Cl- B. APHA 23rd edition
Nitrate	0.07	mg/L	50	4500 NO_3^- B. APHA 23rd edition
Total Alkalinity	26	mg/L	2000	2320 B., APHA 23rd edition
Total Hardness	<1	mg/L as $CaCO_3$	500	2340 C. APHA 23rd edition
Calcium	<1	mg/L	200	3500-Ca D. APHA 23rd edition

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Parameters	Results	Unit	NDWQS	Method
Magnesium	<1	mg/L	-	-
Sodium	5.23	mg/L	-	3500-Na APHA 23rd edition
Potassium	1.86	mg/L	-	3500-K B., APHA 21st edition
Sulphate	3.1	mg/L	250	4500-SO_4^{2-}. E. APHA 23rd edition
Orthophosphate	0.03	mg/L	-	4500-P E., APHA 21st edition
Residual Chlorine	<0.04	mg/L	0.1-0.2***	4500-Cl B. APHA 23rd edition
Arsenic*	<0.005	mg/L	0.05	Arsenic Test Kit
Iron	0.01	mg/L	0.3 (3)	3500-Fe B. APHA 23rd edition
Manganese**	0.04	mg/L	0.2	3111B. APHA 23rd edition
Fluoride**	<0.05	mg/L	0.5-1.5***	4500 F-D. APHA 23rd edition
Cadmium**	<0.003	mg/L	0.003	3111B. APHA 23rd edition
Chromium**	<0.01	mg/L	0.05	3111B. APHA 23rd edition
Lead**	<0.01	mg/L	0.01	3111B. APHA 23rd edition
Zinc**	0.11	mg/L	3	3111B. APHA 23rd edition
Copper**	<0.01	mg/L	1	3111B. APHA 23rd edition
Aluminium**	<0.01	mg/L	0.2	3500-Al B. APHA 23rd edition
Nickel	<0.01	mg/L	-	-
Microbiology				
Total Coliform *	**288**	CFU/100 mL	0	9222 B., APHA 23rd edition
Faecal Coliform*	**142**	CFU/100 mL	0	9222 D., APHA 23rd edition

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*These parameters are not within the scope of Nepal Standard
**These parameters are outsourced to another Laboratory.
***These values show lower and upper limits
Remarks: Except for Turbidity Total Coliform and Faecal Coliform, all observed values of other tested parameters are found to be within the limit of NDWQS 2062.

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WATER ANALYSIS REPORT

Name of Client:	Bagmati River Basin Improvement Project	**Lab Code:**	22/12-871(g)
Collector:	Aalekh Bhattarai	**Location:**	Near the Bridge
Source:	Water	**Sampled By:**	Aalekh Bhattarai
Longitude:	85°25'14.70"E	**Latitude:**	27°45'28.74"N
Sampling Date/Time:	2022/12/18, 8:00A.M.	**Test Performance Date:**	2022/12/18-2022/12/29
Receipt Date:	2022/12/18	**Issued Date:**	2023/01/02

Parameters	Results	Unit	NDWQS	Method
Physical				
Color	0	TCU	5 (10)	2120 B. APHA 23rd edition
Electrical Conductivity	40	µS/cm	1500 (max)	2510 B. APHA 23rd edition
pH	7.7	-	6.5-8.5	4500 H+ B. APHA 23rd edition
Temperature	10.8	°C	-	-
Taste and Odour	unobj	-	-	-
Total Solids	84	mg/L	3000	2540 B. APHA 23rd edition
Total Dissolved Solids	44	mg/L	1000	2540 C. APHA 23rd edition
Turbidity	**22.06**	NTU	5 (15)	2130 B. APHA 23rd edition
Chemical				
Ammonia	0.04	mg/L	1.5	4500 NH_3 F. APHA 23rd edition
Dissolved Oxygen	7.6	mg/L	-	DO Meter
Biochemical Oxygen Demand	12.6	mg/L	500	5210 B, APHA 23rd edition
Chemical Oxygen Demand	12	mg/L	-	5220 B., APHA 23rt edition
Chloride	15.99	mg/L	250	4500-Cl- B. APHA 23rd edition
Nitrate	0.33	mg/L	50	4500 NO_3^- B. APHA 23rd edition
Total Alkalinity	34	mg/L	2000	2320 B., APHA 23rd edition
Total Hardness	<1	mg/L as $CaCO_3$	500	2340 C. APHA 23rd edition

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Parameters	Results	Unit	NDWQS	Method
Calcium	<1	mg/L	200	3500-Ca D. APHA 23rd edition
Magnesium	<1	mg/L	-	-
Sodium	4.95	mg/L	-	3500-Na APHA 23rd edition
Potassium	1.79	mg/L	-	3500-K B., APHA 21st edition
Sulphate	2.43	mg/L	250	4500-SO_4^{2-}. E. APHA 23rd edition
Orthophosphate	0.04	mg/L	-	4500-P E., APHA 21st edition
Residual Chlorine	<0.04	mg/L	0.1-0.2***	4500-Cl B. APHA 23rd edition
Arsenic*	<0.005	mg/L	0.05	Arsenic Test Kit
Iron	0.02	mg/L	0.3 (3)	3500-Fe B. APHA 23rd edition
Manganese**	0.07	mg/L	0.2	3111B. APHA 23rd edition
Fluoride**	<0.05	mg/L	0.5-1.5***	4500 F-D. APHA 23rd edition
Cadmium**	<0.003	mg/L	0.003	3111B. APHA 23rd edition
Chromium**	<0.01	mg/L	0.05	3111B. APHA 23rd edition
Lead**	<0.01	mg/L	0.01	3111B. APHA 23rd edition
Zinc**	0.11	mg/L	3	3111B. APHA 23rd edition
Copper**	<0.01	mg/L	1	3111B. APHA 23rd edition
Aluminium**	<0.01	mg/L	0.2	3500-Al B. APHA 23rd edition
Nickel	<0.01	mg/L	-	-
Microbiology				
Total Coliform *	**250**	CFU/100 mL	0	9222 B., APHA 23rd edition
Faecal Coliform*	**157**	CFU/100 mL	0	9222 D., APHA 23rd edition

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Note: The integrity of the sample and results are dependent on the quality of sampling. The results refer only to the parameters tested of the samples provided/collected for analysis.
*These parameters are not within the scope of Nepal Standard
**These parameters are outsourced to another Laboratory.
***These values show lower and upper limits
Remarks: Except for Turbidity, Total Coliform, Feacal Coliform, all observed values of other tested parameters are found to be within the limit of NDWQS 2062.

Analyzed and Checked By

Authorized By
Er. Lokesh Sapkota

SWAT/F/C/04
Version no: 01
Issue no: 02
Revision no: 03
Effective date: 2021/08/01

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Sisir Marga 11, Babarmahal, Kathmandu, Nepal

WATER ANALYSIS REPORT

Name of Client:	Bagmati River Basin Improvement Project	**Lab Code:**	22/12-871(h)
Collector:	Aalekh Bhattarai	**Location:**	River Adjacent To Gokarna Temple
Source:	Water	**Sampled By:**	Aalekh Bhattarai
Longitude:	85°23'17.04"E	**Latitude:**	27°44'21.30"N
Sampling Date/Time:	2022/12/18, 9:10 A.M.	**Test Performance Date:**	2022/12/18-2022/12/29
Receipt Date:	2022/12/18	**Issued Date:**	2023/01/02

Parameters	Results	Unit	NDWQS	Method
Physical				
Color	0	TCU	5 (10)	2120 B. APHA 23rd edition
Electrical Conductivity	120	µS/cm	1500 (max)	2510 B. APHA 23rd edition
pH	7.3	-	6.5-8.5	4500 H+ B. APHA 23rd edition
Temperature	13.6	℃	-	-
Taste and Odour	unobj	-	-	-
Total Solids	258	mg/L	3000	2540 B. APHA 23rd edition
Total Dissolved Solids	80	mg/L	1000	2540 C. APHA 23rd edition
Turbidity	**92.64**	NTU	5 (15)	2130 B. APHA 23rd edition
Chemical				
Ammonia	1.0	mg/L	1.5	4500 NH_3 F. APHA 23rd edition
Dissolved Oxygen	7.6	mg/L	-	DO Meter
Biochemical Oxygen Demand	21.6	mg/L	500	5210 B, APHA 23rd edition
Chemical Oxygen Demand	70	mg/L	-	5220 B., APHA 23rt edition
Chloride	11.99	mg/L	250	4500-Cl- B. APHA 23rd edition
Nitrate	1.0	mg/L	50	4500 NO_3^- B. APHA 23rd edition
Total Alkalinity	62	mg/L	2000	2320 B., APHA 23rd edition
Total Hardness	22	mg/L as $CaCO_3$	500	2340 C. APHA 23rd edition

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Parameters	Results	Unit	NDWQS	Method
Calcium	16	mg/L	200	3500-Ca D. APHA 23rd edition
Magnesium	4	mg/L	-	-
Sodium	11.73	mg/L	-	3500-Na APHA 23rd edition
Potassium	4.46	mg/L	-	3500-K B., APHA 21st edition
Sulphate	5.51	mg/L	250	4500-SO_4^{2-}. E. APHA 23rd edition
Orthophosphate	0.19	mg/L	-	4500-P E., APHA 21st edition
Residual Chlorine	<0.04	mg/L	0.1-0.2***	4500-Cl B. APHA 23rd edition
Arsenic*	<0.005	mg/L	0.05	Arsenic Test Kit
Iron	0.02	mg/L	0.3 (3)	3500-Fe B. APHA 23rd edition
Manganese**	**0.22**	mg/L	0.2	3111B. APHA 23rd edition
Fluoride**	<0.05	mg/L	0.5-1.5***	4500 F-D. APHA 23rd edition
Cadmium**	<0.003	mg/L	0.003	3111B. APHA 23rd edition
Chromium**	<0.01	mg/L	0.05	3111B. APHA 23rd edition
Lead**	<0.01	mg/L	0.01	3111B. APHA 23rd edition
Zinc**	0.13	mg/L	3	3111B. APHA 23rd edition
Copper**	<0.01	mg/L	1	3111B. APHA 23rd edition
Aluminium**	<0.01	mg/L	0.2	3500-Al B. APHA 23rd edition
Nickel	<0.01	mg/L	-	-
Microbiology				
Total Coliform *	**300**	CFU/100 mL	0	9222 B., APHA 23rd edition
Faecal Coliform*	**78**	CFU/100 mL	0	9222 D., APHA 23rd edition

NDWQS=National Drinking Water Quality Standard (2062)
Note: The integrity of the sample and results are dependent on the quality of sampling. The results refer only to the parameters tested of the samples provided/collected for analysis.
*These parameters are not within the scope of Nepal Standard
**These parameters are outsourced to another Laboratory.
***These values show lower and upper limits
Remarks: Except for Turbidity, Manganese, Total Coliform, and Faecal Coliform all observed values of other tested parameters are found to be within the limit of NDWQS 206

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WATER ANALYSIS REPORT

Name of Client:	Bagmati River Basin Improvement Project	**Lab Code:**	22/12-871(i)
Collector:	Aalekh Bhattarai	**Location:**	River adjacent to Pashupati Temple
Source:	Water	**Sampled By:**	Aalekh Bhattarai
Longitude:	85°20'54.90"E	**Latitude:**	27°42'34.26"N
Sampling Date/Time:	2022/12/18,10:40 A.M.	**Test Performance Date:**	2022/12/18-2022/12/29
Receipt Date:	2022/12/18	**Issued Date:**	2023/01/02

Parameters	Results	Unit	NDWQS	Method
Physical				
Color	0	TCU	5 (10)	2120 B. APHA 23rd edition
Electrical Conductivity	200	µS/cm	1500 (max)	2510 B. APHA 23rd edition
pH	7.3	-	6.5-8.5	4500 H+ B. APHA 23rd edition
Temperature	15.2	°C	-	-
Taste and Odour	unobj	-	-	-
Total Solids	204	mg/L	3000	2540 B. APHA 23rd edition
Total Dissolved Solids	132	mg/L	1000	2540 C. APHA 23rd edition
Turbidity	**42.68**	NTU	5 (15)	2130 B. APHA 23rd edition
Chemical				
Ammonia	**1.74**	mg/L	1.5	4500 NH_3 F. APHA 23rd edition
Dissolved Oxygen	7.5	mg/L	-	DO Meter
Biochemical Oxygen Demand	31.8	mg/L	500	5210 B, APHA 23rd edition
Chemical Oxygen Demand	54	mg/L	-	5220 B., APHA 23rt edition
Chloride	25.99	mg/L	250	4500-Cl- B. APHA 23rd edition
Nitrate	1.74	mg/L	50	4500 NO_3^- B. APHA 23rd edition
Total Alkalinity	84	mg/L	2000	2320 B., APHA 23rd edition
Total Hardness	22	mg/L as $CaCO_3$	500	2340 C. APHA 23rd edition
Calcium	16	mg/L	200	3500-Ca D. APHA 23rd edition

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Parameters	Results	Unit	NDWQS	Method
Magnesium	4	mg/L	-	-
Sodium	22.9	mg/L	-	3500-Na APHA 23rd edition
Potassium	7	mg/L	-	3500-K B., APHA 21st edition
Sulphate	15.36	mg/L	250	4500-SO_4^{2-}. E. APHA 23rd edition
Orthophosphate	0.45	mg/L	-	4500-P E., APHA 21st edition
Residual Chlorine	<0.04	mg/L	0.1-0.2***	4500-Cl B. APHA 23rd edition
Arsenic*	<0.005	mg/L	0.05	Arsenic Test Kit
Iron	0.02	mg/L	0.3 (3)	3500-Fe B. APHA 23rd edition
Manganese**	0.13	mg/L	0.2	3111B. APHA 23rd edition
Fluoride**	<0.05	mg/L	0.5-1.5***	4500 F-D. APHA 23rd edition
Cadmium**	<0.003	mg/L	0.003	3111B. APHA 23rd edition
Chromium**	<0.01	mg/L	0.05	3111B. APHA 23rd edition
Lead**	<0.01	mg/L	0.01	3111B. APHA 23rd edition
Zinc**	0.08	mg/L	3	3111B. APHA 23rd edition
Copper**	<0.01	mg/L	1	3111B. APHA 23rd edition
Aluminium**	<0.01	mg/L	0.2	3500-Al B. APHA 23rd edition
Nickel	<0.01	mg/L	-	-
Microbiology				
Total Coliform *	**300**	CFU/100 mL	0	9222 B., APHA 23rd edition
Faecal Coliform*	**123**	CFU/100 mL	0	9222 D., APHA 23rd edition

NDWQS=National Drinking Water Quality Standard (2062)
Note: The integrity of the sample and results are dependent on the quality of sampling. The results refer only to the parameters tested of the samples provided/collected for analysis.
*These parameters are not within the scope of Nepal Standard
**These parameters are outsourced to another Laboratory.
***These values show lower and upper limits
Remarks: Except for Turbidity, Ammonia Total Coliform and Faecal Coliform, all observed values of other tested parameters are found to be within the limit of NDWQS 2062.

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WATER ANALYSIS REPORT

Name of Client:	Bagmati River Basin Improvement Project	**Lab Code:**	22/12-871(j)
Collector:	Aalekh Bhattarai	**Location:**	Tap at Mulkharka
Source:	Water	**Sampled By:**	Aalekh Bhattarai
Longitude:	85°25'41.00"E	**Latitude:**	27°46'21.30"N
Sampling Date/Time:	2022/12/17,4:00 A.M.	**Test Performance Date:**	2022/12/18-2022/12/29
Receipt Date:	2022/12/18	**Issued Date:**	2023/01/02

Parameters	Results	Unit	NDWQS	Method
Physical				
Color	0	TCU	5 (10)	2120 B. APHA 23rd edition
Electrical Conductivity	30	µS/cm	1500 (max)	2510 B. APHA 23rd edition
pH	7.2	-	6.5-8.5	4500 H+ B. APHA 23rd edition
Temperature	10.2	℃	-	-
Taste and Odour	unobj	-	-	-
Total Solids	36	mg/L	3000	2540 B. APHA 23rd edition
Total Dissolved Solids	27	mg/L	1000	2540 C. APHA 23rd edition
Turbidity	0.11	NTU	5 (15)	2130 B. APHA 23rd edition
Chemical				
Ammonia	0.02	mg/L	1.5	4500 NH_3 F. APHA 23rd edition
Dissolved Oxygen	8.6	mg/L	-	DO Meter
Biochemical Oxygen Demand	1.1	mg/L	500	5210 B, APHA 23rd edition
Chemical Oxygen Demand	8	mg/L	-	5220 B., APHA 23rt edition
Chloride	18.99	mg/L	250	4500-Cl- B. APHA 23rd edition
Nitrate	<0.04	mg/L	50	4500 NO_3^- B. APHA 23rd edition
Total Alkalinity	14	mg/L	2000	2320 B., APHA 23rd edition
Total Hardness	<1	mg/L as $CaCO_3$	500	2340 C. APHA 23rd edition
Calcium	<1	mg/L	200	3500-Ca D. APHA 23rd edition

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Parameters	Results	Unit	NDWQS	Method
Magnesium	<1	mg/L	-	-
Sodium	5.2	mg/L	-	3500-Na APHA 23rd edition
Potassium	1.30	mg/L	-	3500-K B., APHA 21st edition
Sulphate	1.27	mg/L	250	4500-SO_4^{2-}. E. APHA 23rd edition
Orthophosphate	0.04	mg/L	-	4500-P E., APHA 21st edition
Residual Chlorine	<0.04	mg/L	0.1-0.2***	4500-Cl B. APHA 23rd edition
Arsenic*	<0.005	mg/L	0.05	Arsenic Test Kit
Iron	<0.01	mg/L	0.3 (3)	3500-Fe B. APHA 23rd edition
Manganese**	0.01	mg/L	0.2	3111B. APHA 23rd edition
Fluoride**	<0.05	mg/L	0.5-1.5***	4500 F-D. APHA 23rd edition
Cadmium**	<0.003	mg/L	0.003	3111B. APHA 23rd edition
Chromium**	<0.01	mg/L	0.05	3111B. APHA 23rd edition
Lead**	<0.01	mg/L	0.01	3111B. APHA 23rd edition
Zinc**	0.08	mg/L	3	3111B. APHA 23rd edition
Copper**	<0.01	mg/L	1	3111B. APHA 23rd edition
Aluminium**	<0.01	mg/L	0.2	3500-Al B. APHA 23rd edition
Nickel	<0.01	mg/L	-	-
Microbiology				
Total Coliform *	**37**	CFU/100 mL	0	9222 B., APHA 23rd edition
Faecal Coliform*	**25**	CFU/100 mL	0	9222 D., APHA 23rd edition

NDWQS=National Drinking Water Quality Standard (2062)
Note: The integrity of the sample and results are dependent on the quality of sampling. The results refer only to the parameters tested of the samples provided/collected for analysis.
*These parameters are not within the scope of Nepal Standard
**These parameters are outsourced to another Laboratory.
***These values show lower and upper limits
Remarks: Except for Total Coliform and Faecal Coliform, all observed values of other tested parameters are found to be within the limit of NDWQS 2062.

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Annex 24

List of project Affected Households with Name, Area and Land Parcel Number

Gokarneshwor Municipality Ward No 1 (Existing sundarijal VDC ward no 7 & 8)

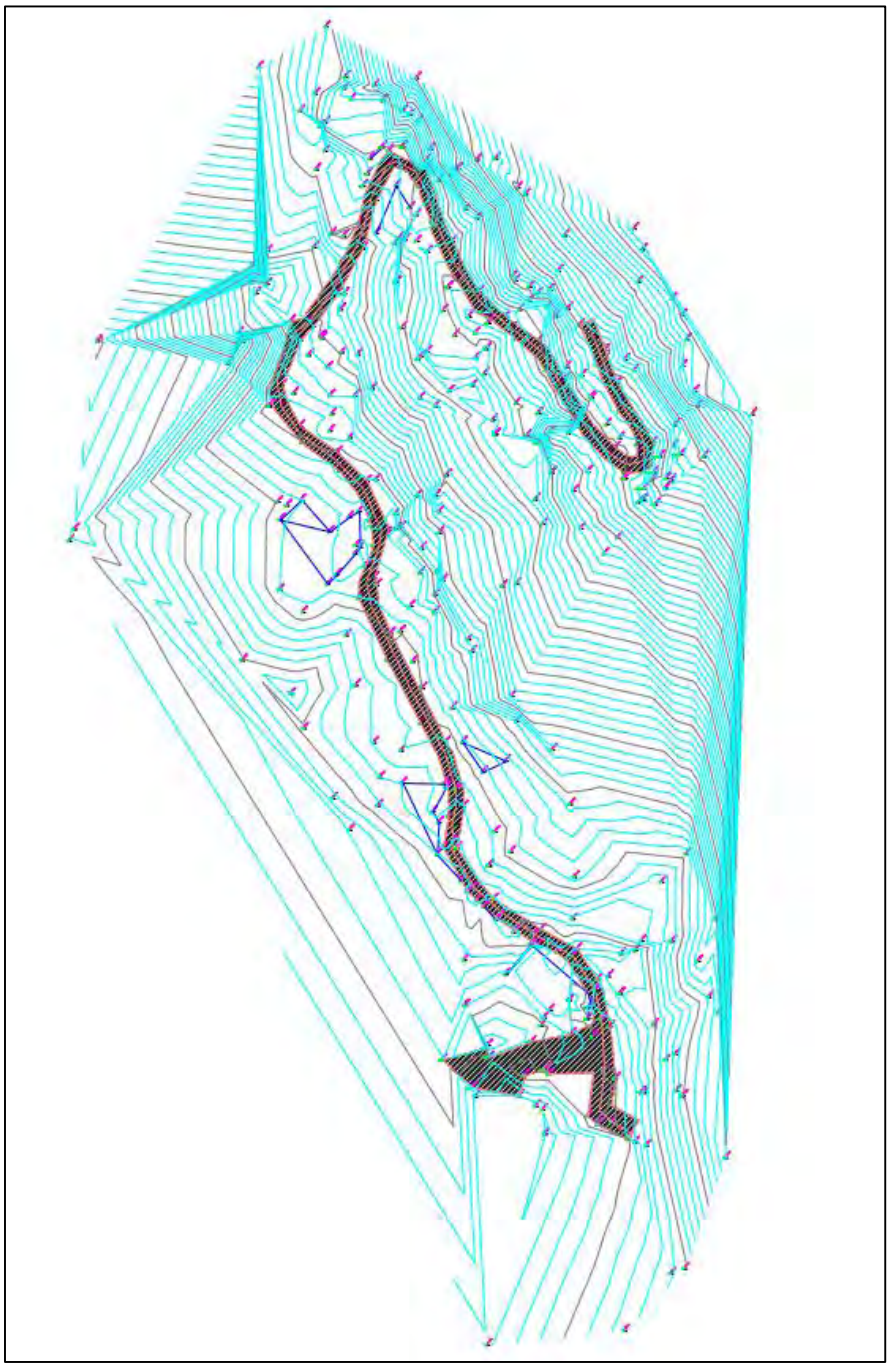
S. N.	Name	Ward No.	Parcel No.	Total land (sq. m)	Land for compensation (sq. m)	Remarks
1	Ambika Subedi	7	92	317.95	103.62	Land only
2	Diwang Dahal	7	67	95.38	15.28	Land only
2	Bimala Dahal	7	66	95.38	14	Land only
2	Sangita Dahal	7	65	95.38	15	Land only
2	Sangita Dahal	7	131	47.69	10	Land only
2	Sangita Dahal	7	132	238.46	66.24	Land only
3	Nima Tamang	7	13	413.34	51.56	Land only
4	Jayanti Dahal	7	72	373.59	64.12	Land + House
5	Narayan Pd. Simkhada	7	7	3847.28	111.7	Land only
5	Narayan Pd. Simkhada	8 (ka)	16	238.46	65.59	Land only
6	Dorje & Saili Tamang	7	156	317.95	40.77	Land + House
7	Sharmila Chaulagai	7	163	667.7	13.11	Land only
8	Bhola Shrestha	7	165	254.36	39.28	Land only
9	Kancha Shrestha	7	125	1160.54	115.72	Land only
10	Rajendra & Rajkumar Shrestha	7	2	381.55	71.96	Land + House
10	Rajendra & Rajkumar Shrestha	8 (ka)	328	629.95	91.39	Land only
10	Rajendra & Rajkumar Shrestha	8 (ka)	24	492.83	95.29	Land only
11	Ram Shrestha	7	1	479	140.64	Land only
11	Ram Shrestha	8 (ka)	25	365.65	45.64	Land only
12	Laxman Tamang	7	157	317.95	4.36	Land only
13	Bhola Pd. Simkhada	7	86	357.70	57.29	Land only
14	Bhimsen Pd. Sapkota	8 (ka)	422	286.16	35.02	Land + House
15	Putali Simkhada	8 (ka)	288	596.16	55.14	Land only
16	Goma Dhimal	8 (ka)	376	278.21	50.32	Land + House
17	Dilip Pd. Simkhada	8 (ka)	11	238.46	8.88	Land + House

S. N.	Name	Ward No.	Parcel No.	Total land (sq. m)	Land for compensation (sq. m)	Remarks
18	Maiya & Chiranjivi Simkhada	8 (ka)	12	572.32	22.78	Land + House
18	Maiya & Chiranjivi Simkhada	8 (ka)	14	174.87	100.21	
18	Maiya & Chiranjivi Simkhada	8 (ka)	295	347.76	48.6	Land only
19	Krishna Hari Dahal	8 (ka)	15	238.46	69.35	Land only
19	Krishna Hari Dahal	8 (ka)	18	492.83	16.65	Land only
20	Sudarshan Simkhada	8 (ka)	407	256.35	30.53	Land + Shed
20	Sudarshan Simkhada	8 (ka)	411	286.16	37.37	Land only
21	Kancha & Hasta Bd Shrestha	8 (ka)	26	222.56	46.74	Land only
22	Keshab Pd. Sapkota	8 (ka)	421	127.18	29.91	Land + House
23	Sange Sherpini/Mendo Sherpa	4 (kha)	48	5150.9	479.5	Land only
24	Binod Simkhada	8 (ka)	401	476.93	121.12	Land only
25	Ramesh Pd. Simkhada	8 (ka)	396	190.77	101	Land + Courtyard
26	Rabi/Ganesh Shrestha	8 (ka)	347	476.93	176.96	Land only
27	Chandramaya Gole/Pabitra Tamang	8 (ka)	341	190.75	19	Land only
28	Srihari Simkhada	8 (ka)	397	190.77	82.95	Land only
28	Srihari Simkhada	8 (ka)	389	317.95	52.3	Land + Courtyard
29	Kamala Simkhada	8 (ka)	398	190.77	52.85	Land only
30	Gokul Simkhada	8 (ka)	400	516.68	78	Land only

Note: 30 Household and 43 land plots

Annex 25

Road Layout in Contour Map of Sundarijal



Annex 26

Relevant Standards of Nepal

a. Water quality standards as per WHO, Nepal Standard and Aquatic Ecology Health Standard (AEHS)

Parameter	Unit	WHO GV	Nepal Standard (2022)	AEHS (From World Bank)
Color	TCU	-	5(15)	-
Electrical Conductivity	µS/cm	-	1500	-
pH	-	6.5 - 9.2	6.5 - 8.5	6.5-8.5
Temperature	℃	-	-	-
Taste and Odor	-	unobj	unobj	-
Total Solids	mg/L	-	3000	-
Total Dissolved Solids	mg/L	1,500	1000	1000
Turbidity	NTU	-	5(10)	-
Ammonia	mg/L	-	1.5	0.02
Dissolved Oxygen	mg/L	-	-	6
Biochemical Oxygen Demand	mg/L	4	-	4
Chemical Oxygen Demand	mg/L	-	-	-
Chloride	mg/L	600	250	500
Nitrate	mg/L	-	50	20
Total Alkalinity	mg/L	-	2000	-
Total Hardness	mg/L	-	500	-
Calcium	mg/L	-	200	-
Magnesium	mg/L	-	-	-
Potassium	mg/L	-	-	-
Sulphate	mg/L	400	250	500
Residual Chlorine	mg/L	0.0	0.10-0.50	-
Arsenic	mg/L	0.01	0.05	-
Iron	mg/L	-	0.3(3)	-
Manganese	mg/L	0.5	0.2	-
Fluoride	mg/L	1.5	0.50-1.50	1.0
Cadmium	mg/L	0.003	0.003	0.005
Chromium	mg/L	0.05	0.05	0.05
Lead	mg/L	0.01	0.01	0.05
Zinc	mg/L	-	3	-
Copper	mg/L	2	1	-
Aluminum	mg/L	-	0.2	-
Nickel	mg/L	0.02	-	-
Total Coliform	CFU/100 mL	Nil	Nil	-

WHO GV: World Health Organization Guideline Value 2017 update
Unobj: Non Objectionable

b. Guideline Values of Ambient air Quality According to WHO and National Ambient Air Quality Standards

Parameters	WHO Guideline 2021	National Ambient Air Quality Standards for Nepal, 2012
Particulate Matter (PM_{10})	45 (µg/m^3), 24-hour average 15 (µg/m^3), annual average	120 (µg/m^3), 24-h average
Total Suspended Particulate (TSP)	-	230 (µg/m^3), 24-h average
Nitrogen dioxide (NO_2)	25 (µg/m^3), 24-hour average 10 (µg/m^3), annual average	80 (µg/m^3), 24-hour average 40 (µg/m^3), annual average
Sulfur dioxide (SO_2)	40 (µg/m^3), 24-hour average	70(µg/m^3), 24-hour average 50 (µg/m^3), annual average
Lead	0.5(µg/m^3), annual average	0.5 (µg/m^3), annual average

c. Limit of sound pressure level according to Ministry of Forest and Environment Sound Level Limit, 2069

Area	Day Limit (dB)	Night Limit (dB)
Industrial Area	75	70
Commercial Area	65	55
Rural Residential Area	45	40
Urban Residential Area	55	50
Mixed Residential Area	63	55
Peace Zone	50	40

(Ref: A Collection of related information and Environmental Standard, Government of Nepal)

d. Soil Guideline Value (SGV)

Heavy Metals	WHO/FAO, mg/kg	CLEA 2009, mg/kg
Iron (Fe)	50000	-
Manganese (Mn)	2000	-
Copper (Cu)	100	-
Zinc (Zn)	300	-
Cadmium (Cd)	3	150
Nickel (Ni)	50	130
Lead (Pb)	100	310
Aluminium (Al)	-	-
Arsenic (As)	20	40

Annex 27

Construction/Operation Management Plans

Table: Construction/operation Impact Management Plan

SN	Activities	Timing of Actions	Location	Responsibilities
A	***Soil erosion, landslide and sedimentation control plan***			
1	Disturb as little ground area as possible, stabilize these areas as soon as possible, control drainage through the area, and trap sediment onsite. Install erosion control barriers around perimeter of cuts, disposal pits and roadways	Pre-construction/ Construction phase	All project sites	Contractor
2	Prepare and use topsoil management plan to collect fertile top soil before construction begin and use for later rehabilitation work	Pre-construction, construction phase	As appropriate in quarry and muck disposal sites	Contractor
3	Slope works and earth excavation works will be conducted in such a way that minimizes exposure of the soil surface both in terms of area and duration.	Construction phase	All project area	Contractor
4	Apply erosion control measures before the rainy season begins, preferably immediately following construction. Install erosion control measures as each construction site is completed.	Construction phase	Active construction	Contractor
5	In all construction sites, install sediment control structures where needed to slow or redirect runoff and trap sediment until vegetation is re-established. Sediment control structures include windrows of slash, rock beams, sediment catchment basins, straw bales, brush fences, and	Construction phase	Active construction	Contractor
6	All surface excavation above 3m vertical height will be excavated through benching	Construction	All project sites	Supervising engineer/Contractor
7	Control water flow through construction sites or disturbed areas with ditches, berns, check structures, live grass barriers, and rock.	Construction	All project sites	Contractor
8	All project facility sites (camps, mechanical yards, storage facilities, muck disposal sites etc.) will have temporary drainage facilities to collect and discharge the runoff water safely to the natural water bodies.	Construction	All project facility sites	Contractor
9	The access roads will be provided permanent side drain structures to collect water from the upslope area. The collected water of the side drains will be discharged to suitable natural waterway to avoid upstream and downstream erosion	Construction	All project sites	Contractor

SN	Activities	Timing of Actions	Location	Responsibilities
11	Access roads across agricultural fields, provisions will be made to drain the slope water to the down slope agricultural land such that the water required for irrigation is not blocked with prior consultation and agreement with farmers	Construction	Access roads across agricultural fields	Contractor
12	Cleaning of the road side drains and other drainage structures regularly once before the onset of monsoon, twice during monsoon and once after the monsoon such that the drains are maintained to operate as designed and are not filled with the sediments derived from the side slopes	Construction	Access roads and drainages in other areas	Contractor
13	Water will be sprayed as needed on earthen roads, cuts, and fill materials and stockpiled soil to reduce wind induced erosion and dirt	Construction/ operation	Access road	Contractor
14	Large changes in the landscape from quarries, spoil tips, etc. will be landscaped and replanted, both to reduce erosion problems and to reduce the visual impact of construction	Construction	All project sites	Contractor/PMSU
15	Erosion control measures will be maintained until vegetation is successfully re-established.	Construction/ operation	All project sites	Contractor/PMSU
16	Monitoring of related activities	Pre-construction, construction/ operation	All project sites as designated	PMSU/ Operation Manager
B	***Particulate emission and dust pollution abatement***			
17	Minimize production of dust and particulate materials at all times , to avoid impacts on surrounding communities	Construction phase	All project site	Contractor
18	Place screens around construction areas to minimize dust proliferation, paying particular attention to areas close to local communities	Construction phase	All project site	Contractor
19	Spray water as needed on dirt roads, cut areas and soil stockpiles or fill material, Spraying will be carried out in dry and windy days, at least twice a day (morning and afternoon). The frequency of spraying near local communities will be increased as needed.	Pre-construction/construction/operation	Dusty construction sites and roads	Contractor, Operation manager
20	The aggregate crushing sites and active construction sites will also be sprinkled regularly by water as to the requirement on the advice of supervising engineers	Construction period	Aggregate crushing site, and active construction site	Contractor
21	Pave access roads with gravel in sections which near the communities and other sensitive receptors to reduce generation of air-born dust	Construction/operation	Access roads	Contractor, operation manager

SN	Activities	Timing of Actions	Location	Responsibilities
22	All persons at the construction sites, engineers and supervisors will be provided with Personal Protective Equipments-PPE (air masks, helmets and safety goggles as per OHS guideline) and provided OHS training at regular interval (once in 6 months)	Pre-construction, construction, operation period	All construction sites	Contractor , NDP Management
23	Ensure adequate maintenance of all vehicles, and machinery. Construction plant/vehicles and machinery that generate serious air pollution and those which are poorly maintained will not be allowed on site	Pre-construction/construction	All project sites	Contractor
24	Monitoring of implementation of above activities	Pre-construction, construction and operation	All project sites	PMSU
C	***Noise pollution abatement***			
25	Maintain established speed limit for all construction related traffic on project access road	Pre-construction/construction	All project access road	Contractor
26	Maintain on-site vehicle speeds at or below 30kph	Pre-construction, construction, operation period	All project area	Contractor, Operation manager
27	Operation of noise generating construction activities in the day time zone as far as possible	Pre-construction, Construction period	All camps and active construction sites	Contractor
28	Prohibition in the blowing of horns in critical stretches close to villages and near the school area along the road	Pre-construction, Construction and operation period	Settlements and school areas	Contractor, operation manager
29	To the extent possible, maintain noise level associated with all machinery and equipment at permissible level	Pre-construction/construction/operation	All project area	Contractor
30	Fitting of noise reducing equipments in the ventilators compressors and diesel generator sets	Pre-construction, Construction period	Ventilator, Compressors and diesel generator sets	Contractor

SN	Activities	Timing of Actions	Location	Responsibilities
31	In sensitive areas (including residential neighborhoods, hospitals, rest homes, schools, etc.) more strict noise abatement measures may need to be implemented to prevent undesirable noise levels.	Pre-construction/construction	All project area	Contractor
32	Concrete batching plants, generators and other equipment will be carefully placed as far away from local communities to reduce noise impacts from these machines	Construction	All construction site	Contractor
33	Temporary noise barriers will be installed at the appropriate locations to avoid nighttime noise impacts,	Construction	All noisy construction sites	Contractor
34	Notification boards will be posted at all construction sites providing information about the project, as well as contact information about the site managers, environmental staff, telephone numbers and other contact information so that any affected people can have a channel to voice their concerns and suggestions	Construction phase	All noisy construction sites	Contractor
35	People living within potentially impacted areas will be notified ahead of time of the length and noise intensity of the proposed nighttime construction.	Construction period	All noisy construction site	Contractor
	Prepare construction equipment and vehicle maintenance plan to ensure avoidance of unnecessary noise creation during construction and vehicle movement	Pre-construction, construction and operation period	For all construction site	Contractor/NDP operation manager
36	Monitoring of implementation of above activities	Pre-construction, construction and operation period	All project site	PMSU
D	***Blasting management plan***			
37	If possible avoid blasting, otherwise warn local communities and/or residents that could be disturbed by noise and vibration generating from blasting	Construction (prior to blasting period)	Blasting area	Contractor
38	Prohibit blasting within 100 m of sensitive areas including residential, schools etc.	Construction period	All project area	Contractors
39	Blasting will not be carried out in adverse weather condition	Construction period	All project area	
40	Before blasting is carried out, a detailed survey will be conducted at nearby communities to evaluate the degree of impacts due to the blasting activity (e.g. possible damage to structures or infrastructure due to vibration, effects on	Construction period	Settlement/structures around the blasting area	Contractor, PMSU

SN	Activities	Timing of Actions	Location	Responsibilities
	animals, local residents, etc.			
41	No blasting will be allowed during nighttime unless prior approval is obtained from the concern authority	Construction period	All project site	Contractor
42	All persons will be at least 200m away from the blasting point	Construction period(during blasting time)	All blasting areas	Contractor
43	Monitoring of implementation of above activities	Construction period	Specified area	PMSU
E	***Handling of toxic and hazardous materials***			
44	All spent grease, diesel and Mobil and unused or date expired toxic chemicals will be collected separately in plastic drums and stored in a safe place under the shade.	Construction period	All specified construction area	Contractor
45	All empty containers of grease, diesel, Mobil, and toxic chemicals will be squeezed and stored in a safe place under the shade.	Construction period	All specified construction area	Contractor
46	Unused chemicals, diesel, spent Mobil; grease will be discharged only after approval of the project environmental officer and his/her recommendation. Project area does not have a sanitary landfill in the nearby locality. The environmental officer in coordination with the contractor will identify some secured sites or will arrange disposal in sanitary landfill elsewhere depending upon the volume and toxicity of the waste.	Construction period	All specified construction area	Contractor
	Petroleum bunkers will be placed in a separate, concrete bunded area with a facility of oil and grease separator.			
F	***Earthwork, cut and fill slope management***			
47	All earthwork will be properly controlled, especially during the rainy season	Construction	All project sites	Contractor
48	Maintain stable cut and fill slopes at all times and cause the least possible disturbance to areas outside the prescribed limits of the works	Construction	All project sites	Contractor
46	In order to protect any cut or fill slopes from erosion, cut off drains and toe-drains will be provided at the top and bottom of slopes and be planted with grass or other plant cover. Cut off drains should be provided above high cuts to minimize water runoff and slope erosion	Construction	All project sites	Contractor
47	Any excavated cut or unsuitable material will be disposed off in designated disposal areas as agreed to by the Environmental Supervisor	Construction	Muck disposal sites	Contractor
48	Monitoring of above activities implementation	Construction	Specified area	PMSU

SN	Activities	Timing of Actions	Location	Responsibilities
G	***Stockpiles and borrow pits management***			
49	Prepare overall Stockpile and Borrow Pits Management Plan for the total work. Operation of a new borrowing area, on land , in a river, or in an existing area, will be subject to prior approval of the Environmental Supervisor	Pre-construction/construction	All designated sites	Contractor
50	Avoid borrowing where it interface with natural drainage pattern	Construction	All borrow pit area	Contractor
51	Crushing plant will not be located adjacent to environmentally sensitive areas such as steep slopes, erosion prone area, or to existing settlements and be operated with adequate dust control device	Construction	All crushing plants	Contractors
52	Limit extraction of material to approved and demarcated borrow pits	Construction period	All borrow pits	Contractor
53	The rock or gravel taken from a river will not disturb the river flow, or damage or undermine the river banks.	Construction	River banks	Contractor
54	Stockpile topsoil prior to opening borrow pit and spread back the topsoil over the borrow area and maintain uniform surface with adequate slope for drainage	Construction	Borrow pit	Contractor
55	It will be ensure that all borrow pits used are left in an appropriate condition with stable side slopes, re-established of vegetation, restoration of natural water courses, avoidance of flooding of the excavated areas wherever possible so no stagnant water bodies are created	Construction	Borrow pits	Contractor
56	Once the job is completed all construction generated debris will be removed from the site to an approved disposal location	Construction	All construction sites	Contractor
57	Monitoring of above activities implementation	Pre-construction and construction	As specified	PMSU
H	**Construction waste and muck disposal**			
58	Establish and enforce daily site clean-up procedure, including maintenance of adequate	Construction	All project sites	Contractor, Environmental

SN	Activities	Timing of Actions	Location	Responsibilities
	disposal facilities for construction debris			Supervisor
59	Muck and debris generated from the construction activities will be suitably reused, to the best extent possible. The disposal of remaining muck/debris will be carried out only in a designated site without impacting forest, natural drainage, settlements, agriculture land and environmentally sensitive area.	Construction	All construction and disposal sites	Contractor, Environmental Supervisor
60	Prior to start of muck disposal, make a plan for muck disposal plan, incorporating the most suitable stabilization techniques and get approval from environmental supervisor	Construction	Muck disposal site	Contractor
61	Stabilize spoil disposal sites to avoid erosion by landscaping and plantation	Construction	Muck disposal sites	Contractor
62	Monitoring of related activities implementation	Pre-construction/ construction /operation	All project sites as designated	PMSU, Operation Manager
I	**Water and land pollution abatement**			
62	Construction sites and workers camps at headworks, and powerhouse will be equipped with runoff drainages/ditches and safety tanks during construction period and later improvised to suit to the local conditions in the operation period as permanent network OR will be safely closed. The runoff water collected will be safely discharged to the natural water bodies.	Construction Period	All construction sites	Contractor
63	All drainage networks at the construction sites and camp areas, spoil disposal sites etc. will be maintained and kept functional at all times	Construction, operation Period	All project sites	Contractor, Operation management
64	All project facility sites (camps, mechanical yards, storage facilities, muck disposal sites etc.) will be facilitated with temporary drainage facilities to collect and discharge the runoff water after required treatment (sedimentation and oil and grease removal) safely to the natural water bodies.	Pre-construction, Construction period	All camp and facility sites	Contractor
65	The quarry operation will not be carried below the flowing water level of the river	Construction period	Quarry site	Contractor

SN	Activities	Timing of Actions	Location	Responsibilities
66	Flood plain quarrying will be carried out only in the dry season i.e from November through May only	Construction period	Quarry site	Contractor
67	Construction waste such as cement and concrete slurry will not be discharged to the river water.	Construction period	Headwork, powerhouse	Contractor
68	The tunnel seepage water discharges will be collected in settling tanks/ponds outside the portal areas in a suitable location for sedimentation and treatment before final discharge (minimum water retention time of the tanks will be 2 hours)	Construction period	Tunnel discharge points	Contractor
69	The water discharged from aggregate washing plant will be collected in settling tanks/ponds at suitable location for sedimentation and treatment (minimum water retention time of the tanks will be 2 hours)	Construction period	Aggregate waste water discharge point	Contractor
70	All spent Grease and Mobil and unused or date expired toxic chemicals will be collected separately in plastic drums and stored in a safe place under the shade	Pre-construction, Construction /operation	All construction sites, camps and other facility sites/operation	Contractor /Operation manager
71	All containers of the Grease, Mobil, and toxic chemicals will be punctured and stored in a safe place under the shade	Pre-construction, Construction /operation	All construction sites, camps and other facility sites powerhouse	Contractor /Operation manager
72	The unused chemicals, spent Mobil, Grease etc. will discharged only with the approval of the project environment and community development unit	Pre-construction, Construction period and operation period	All construction sites, camps and other facility sites	Contractor /Operation manager
73	The petroleum bunkers will be placed in a separate area in a concrete bounded area with the facility of oil and grease separator	Pre-construction, Construction period	Storage yards	Contractor
74	The waste water from the mechanical yards will be collected in a separate area. The water will be treated for the oil and grease and then released into the water bodies.	Construction period	Mechanical yard waste water discharge point	Contractor
75	Provisioning of adequate toilet facilities will be made in the camps and active construction sites.	Pre-construction,	All camps and active	Contractor

SN	Activities	Timing of Actions	Location	Responsibilities
	The toilet waste of the camps will be drained to a single treatment facility in each camp. The treated water will only be released to the nearby area.	Construction period	construction sites	
76	Open defecation will be prohibited in and around the construction sites, camp sites and in the river bank area. Hoarding sign boards will be placed in the construction camps, and active construction sites.	Pre-construction, Construction period	In areas surrounding the construction sites	Contractor
78	A solid waste collection and storage system will be established in all the construction related camps and construction sites. The collected waste will be segregated as to the property of the waste as degradable, glass, metals, plastics, cloths and leather etc. and will be stored in separate bounded areas. These materials will be disposed as to the recommendations and approval of the project environment and community development unit	Pre-construction, Construction /operation	All camps and active construction sites/Operation camps	Contractor/ Operation Manager
19	Garbage containers of adequate size will be placed at critical places in the construction related camps and construction sites. The garbage will be collected daily for segregation and storage as outlined above	Pre-construction, Construction, Operation	All camps and active construction sites/Operation camp	Contractor /Operation Manger
80	Monitoring of above activities implementation	Pre-construction, Construction, Operation	As designated	PMSU
J	***Terrestrial ecosystem management plan***			
81	Provision of kerosene/LPG to the outside workforce for cooking	Pre-construction, construction	Construction workers of all project sites	Contractor
82	Provision for camp lodging to the outside workforce with a common LPG cooking facility	Pre-construction, construction	All outside construction workers camp	Contractor
83	Prohibition on the sale and purchase of the local NTFP, wildlife products in the camps	Pre-construction, construction and operation	All project locations	PMSU, Contractor, Operation Manager
84	Prohibition in roaming in the local forest area by	Pre-	Surrounding	PMSU,

SN	Activities	Timing of Actions	Location	Responsibilities
	the outside workforce	construction, construction and operation	areas of project site	Contractor, Operation Manager
85	Clearing of the forest vegetation as to the requirement of project structures and facilities only	Construction	All permanently occupied forest areas	PMSU, Contractor
86	Clearing of the forest vegetation and stockpiling the vegetation products before handover:	Construction	All permanently occupied forest areas	PMSU, Contractor
87	Compensatory plantation as per the Work Procedure Regarding Use of National Forest Area for Projects of National Priority, 2074 (plantation in 1:25 ratio of felled trees) and management of plantation site for 5 years	Construction and Operation	Areas as designated by the District Forest Office	NDP Management
88	Lease Compensation to the Forest Land Area	Construction and Operation	All permanently occupied forest areas	NDP Management, Operation Manager
89	Technical and Financial assistance to the affected forest user groups	Construction	Project affected community forest and leasehold forest	PMSU
90	Inform in time to the local authorities, Ward chairperson, DNPWC office, ACAP and the forest range post office, if it finds the forest area is encroached close to the construction site	Construction	Surrounding forests of the project site	PMSU
91	Assist the local authorities in the protection works of the forest areas close to the construction sites.	Construction	Surrounding areas of the project site	PMSU
92	Placed hording boards at critical location of the access road as the preventive actions to control the forest fire	Construction	Surrounding areas of the project site	PMSU
93	Organize public awareness programs to prevent the forest fires in the local area	Construction	Surrounding areas of the project site	Contractor/ PMSU
94	Regularly inform project workers not to throw lighted cigarette tips in the forest areas and not to use forest area as picnic spots	Construction	Surrounding areas of the project site	Contractor/ PMSU

SN	Activities	Timing of Actions	Location	Responsibilities
95	Compliance and impact monitoring of the related activities as per monitoring plan	Construction/operation	All sites as designated	PMSU /Operation Manager
K	***Aquatic Environment Management Plan***			
96	Implementation of the activities of Water and land pollution abatement	Pre-construction, Construction and operation	All project sites	PMSU, Contractor
97	Prohibition on the discharge of muck/spoil into the river bed and aggregate mining on the wet river channel	Construction	All construction and quarry	Contractor
98	Design and build a structure in intake to ensure release of 50% of the mean monthly flow in downstream low flow zone	Design, construction and operation phase	Barrage	Design and Supervising engineer, operation manager
99	Assist the local communities for the improvement of onsite sanitation management on regular basis	Construction, Operation	Project surrounding settlements	PMSU, Operation manger
L	***Public and Occupational Health and Safety Plan***			
100	Prepare and enforce a occupational health and safety plan to address matters regarding the health and safety of construction/operation workers and project staff	Pre-construction/construction/operation	All project sites	Contractor/operation manager
101	Protection of every person (workers and local people including pedestrian) and nearby property from construction related accident	Pre-construction, construction	All project sites	Contractor
102	Prepare maximum permissible vehicular speed on each section of the road	Pre-construction, construction/operation	Project access road	Contractor/operation manager
103	Place signs around the construction areas to facilitate traffic movement, provide direction to various components of the works, and provide safety advice and warnings.	Construction	Access road and construction sites	Contractor
104	Appropriate danger signs in all active construction sites work areas as to the degree of risk in the site	Construction	All active construction sites	Contractor

SN	Activities	Timing of Actions	Location	Responsibilities
105	Fencing of all construction sites and restriction on entry to the outsiders others than authorized person	Construction	All active construction sites	Contractor
106	Be responsible for any damage to local roads and bridges due to the transportation of excessive loads and repair such damage	Construction	Access road	Contractor
107	In school area use traffic safety personnel to direct traffic during school hours	Construction	Access road	Contractor
108	Conduct safety training for construction workers prior to beginning works	Construction/operation	Access road	Contractor/operation manager
109	Insurance of workers	Pre-construction/operation	All workers	Contractor/operation manager
110	Regular trainings to operation staffs as required on occupation health and safety issues and preparedness along with emergency drills	Operation Period	All operation staffs and workers	Operation Manager
111	Provide personal protective equipments and clothing (gloves, goggles, respirators, dust masks, hard hats, steel toed boots, etc.) for workers and enforce their use	Construction/operation	All project sites	Contractor/operation manager
112	Suspend all works during heavy rains or emergencies of any kind	Construction/operation	All project sites	Contractor/operation manager
113	Screening of all workers health on recruitment and annually	Construction/operation	All construction workers	Contractor/operation manager
114	Provision of health checkups to the local public	Construction	People of surrounding settlement	Contractor, PMSU
115	Establish facilities for early diagnosis and treatment of patients with the disease	Construction, operation	All project sites	Contractor, operation manager
116	Collecting and testing of sputum of individuals who are at risk for Tuberculosis(TB) infection	Construction, operation	All project sites	Contractor, operation manager
117	Storing sufficient medicines and transfusion fluids for treatment of respiratory infection, food poisoning and diarrhea	Construction, operation	All project sites	Contractor, operation manager

SN	Activities	Timing of Actions	Location	Responsibilities
118	Develop solution for mass outbreaks of food poisoning	Construction, operation	All project sites	Contractor, operation manager
119	Periodic monitoring of kitchen hygiene and sanitary condition in the camp	Construction/operation	Camps canteen and project sites	Contractor, operation manager
120	Implementation of a disease control and pest management measures in camp area	Construction/operation	All camp area	Contractor, operation manager
121	Implementation of a program for the detection and screening of sexually transmitted infectious, especially with regard to HIV/AIDS, amongst workers	Construction/operation	All camp area	Contractor, operation manager
122	Establish a medical center at the main construction camp for the diagnosis and treatment of communicable disease, simple medical complaints, and the handling of medical emergencies and accidents	Construction	Major camp	Contractor, PMSU
123	Ensure availability of subsidiary treatment or first aid post staff by either a trained nurse or a locally trained personnel in all small construction camp, as required	Construction	Small construction camps	Contractor, PMSU
124	Provide appropriate information and education to the workforce on basic personal hygiene, prevention of disease, including respiratory disease, vector-born disease, diarrhea, STDs like HIV/AIDS, tuberculosis etc.	Construction	All construction camps	Contractor
125	Provision for adequate disposal of medical waste from the clinics and from any other activities undertaken by the medical staff	Construction	All construction camps	Contractor
126	Water supply facility with a treatment unit	Construction	All project camps	Contractor
127	Establishment and construction waste and garbage collection system and management	Construction	All active construction sites	Contractor
128	Monitoring of compliance and impact related to the above as activities	Pre-construction	Areas as designated	PMSU

Annex 28

Summary of Dam Operation Manual

Table: Nagmati Dam Operation and Maintenance Manual- Summary of Schedule Duties

Scheduled duty	Location/ Drawing number	Number of units present	Inspection frequency	Equipment necessary/ Personnel	Purpose
DAM					
Vegetation management	Crest, Downstream Face, Abutment and Toe	N/A	Inspect as part of the routine inspection; remove vegetation if >0.3m in height	Cutter/ Poison	Excessive vegetation greater than 1m in height may obscure a defect that may be observed during a routine inspection
Routine inspection	Dam	N/A	Daily	Designated Operator(s)	Identification and reporting of deficiencies by visual observation of the dam
Annual dam safety inspection	Dam and surrounds	N/A	Annual	Dams Engineer	Identification and reporting of deficiencies by visual observation with recommendations for corrective actions
Comprehensive surveillance review	Dam and surrounds	N/A	• After first filling (within six months of construction) • Every 5 years	Expert Team	Identification of deficiencies by a thorough onsite inspection and evaluating surveillance data
Safety review	Dam and surrounds	N/A	Not more than 20 years	Expert Team	A report assessing the safety of a dam and recommending if any remedial or maintenance work is necessary.
Special inspections	Dam and surrounds	N/A	Unusual events (e.g. heavy flood and earthquake)	Dams Engineer	Assess the condition of the dam urgently after an unusual event
INSTRUMENTATION & MONITORING					
Rainfall		1	• Daily (manual) • Telemetry (once every day)	Rainfall gauge (telemetered)	Rainfall vs measured reservoir level and seepage, flood loading trigger
Survey	NAG-D-C-12-54-001	37	• Baseline at the end of dam construction • On first filling • Six months after construction for five years • Annually thereafter	Survey Equipment	Settlement and lateral deformations of the crest
Perimetric joint meters	NAG-D-C-12-54-001	4	• Baseline at the end of dam construction	Joint Meters	Monitor that the total displacement is within the range to which the

Scheduled duty	Location/ Drawing number	Number of units present	Inspection frequency	Equipment necessary/ Personnel	Purpose
			• On first filling • Six months after construction • Annually thereafter		waterstops can accommodate without rupture.
Inclinometer	NAG-D-C-12-54-001	1	• Baseline at the end of dam construction • On first filling • Six months after construction • Annually thereafter	Inclinometer probe	Face slab deformations
Foundation piezometers	NAG-D-C-12-54-001	8	• Baseline at the end of dam construction • On first filling • Quarterly	Piezometer probe	Uplift pressure
Seismic strong motion detection system		2	• Telemetry (continuously)	Seismic strong motion detectors/ Dam Safety Engineer	Earthquake loading trigger, dam safety inspection
V-notch weirs	NAG-D-C-12-54-001 NAG-D-C-12-54-003	3	• Daily (all 3 weirs) • Telemetry of V-notch weir at dam toe (every 15 minutes)	V-notch weirs	To Monitor: • Seepage around the outlet works. • Seepage through the face and/or plinth. • Piping beneath the plinth (through grout curtain). • Seepage through the spillway foundation.
Settlement cells	NAG-D-C-12-54-001	3	• During construction • After major events like earthquake	Settlement cells probe	To measure and monitor dam settlement during construction
Concrete stress meters	NAG-D-C-12-54-001	4	• Baseline at the end of dam construction • On first filling • Six months after construction • Annually thereafter	Two-axis stress meters/probe	To monitor the stress levels in the face slab and the risk of cracking
STORAGE					
Storage level (telemetered)		1	15 minutes	Telemetry equipment	Information of the loadings on the dam
Storage level		1 set	Daily	Gauge boards	Information of the

Scheduled duty	Location/ Drawing number	Number of units present	Inspection frequency	Equipment necessary/ Personnel	Purpose
(manually read)					loadings on the dam
SPILLWAY					
Spillway drains	NAG-D-C-13-52-003	1 set	Yearly	Pump, hoses and ladders	Inspection needed for the stability of chute. If blocked should be cleaned by flushing, rodding or other appropriate means
Aeration vents	NAG-D-C-13-52-005	2	Yearly	Pump, hoses and ladders	Inspection needed for the stability of chute concrete. If blocked should be cleaned by flushing, rodding or other appropriate means.
PUBLIC SAFETY AND HEALTH					
Signage	Local Area		Routine inspection	Dam Operator(s)	Check for damaged or vandalised signs. Signs help the public identify hazardous areas.

Annex 29

Projected Impacted Areas from Flooding due to Dam Failure Extracted from NDP Dam Safety Emergency Management Plan

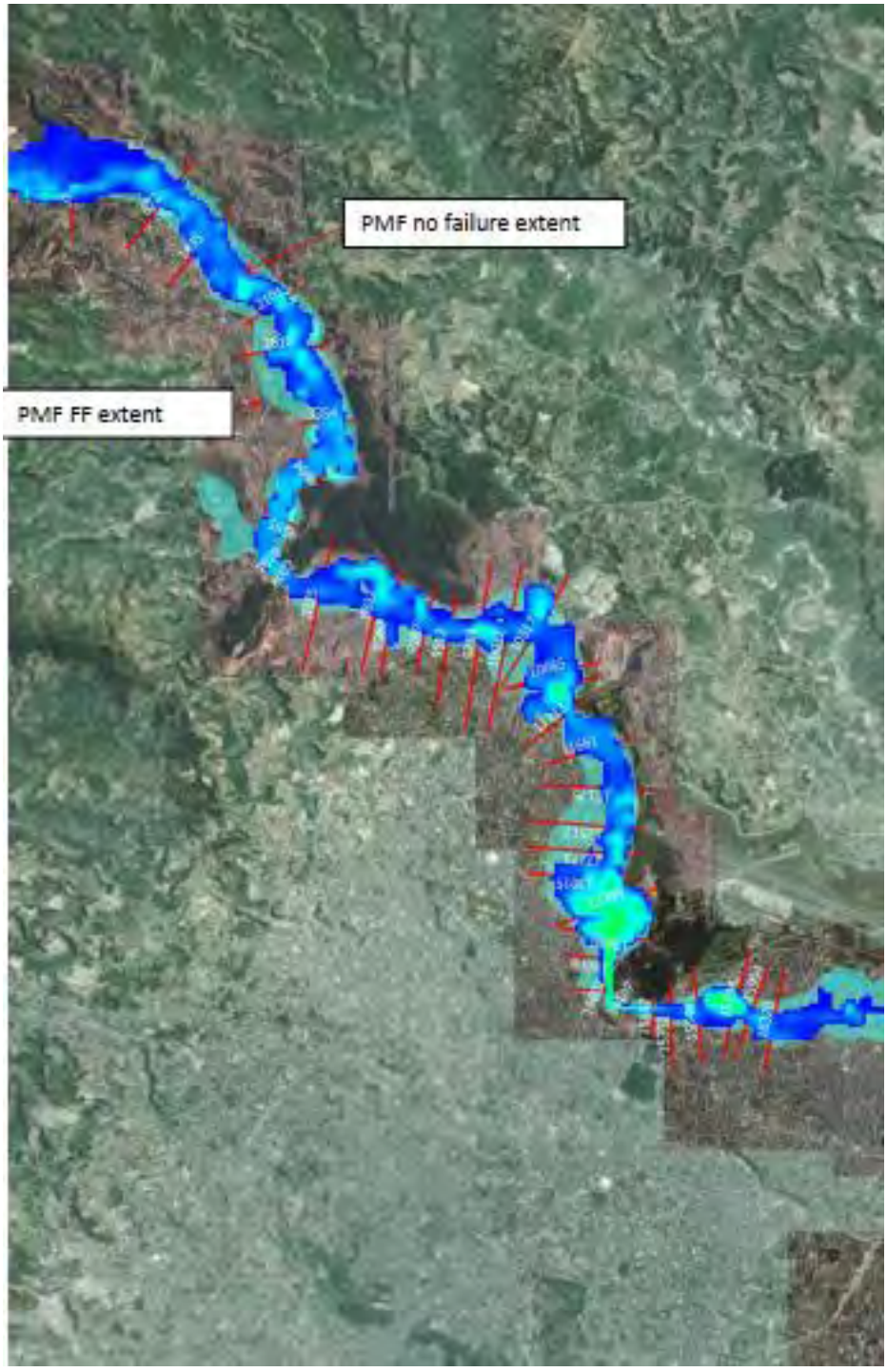


Figure: Nagmati Dam PMF FF – Comparison of HEC-RAS 2D flood extents prior to arrival of dam break flood wave and the maximum dam break flood extent

Annex 30

Declaration from NDP and EIA Study Team

a. Declaration from NDP

Government of Nepal
Ministry of Energy, Water Resources and Irrigation
Department of Water Resources and Irrigation
Nagmati Dam Project
Jawalakhel, Lalitpur

Proponent's Declaration

Title of the EIA project:

Environmental Impact Assessment Report of Nagmati Dam Project (Update- 2023)

Shivpuri Nagarjuna National Park, Gokarneshwor Municipality Ward No. 1 Mulkharka-Sundarijal

Kathmandu.

Name and Address of the Proponent

Department of Water Resources and Irrigation,
Nagmati Dam Project, Lalitpur
Presently Situated at Gaurighat, Guheswhori, Kathmandu.
Phone Number: 01-4114374
Email: nagmati@dwri.gov.np, brbip.doi@gmail.com

On behalf of the Department of Water Resources and Irrigation, Nagmati Dam Project, I declare the following:

We have gone through the content of this EIA report that the multidisciplinary study team has prepared professionally by employing methodologies and the findings are correct to the best of my knowledge. The team shall be accountable for technical study, whereas the vendor shall be responsible for any misleading information in any part of this report.

.....
Krishna Prasad Rijal
Project Director

Email: brbip.doi@gmail.com, Website: https://dhapdam.gov.np

b. Declaration from EIA Study Team

ARCHITECT DESIGN & CIVIL CONSTRUCTION PVT. LTD.
Phone: 01 4155311, Address: Kathmandu-32, Koteshwor, Nepal
Email: youradcc@gmail.com

Declaration

Title of the EIA project:
Environmental Impact Assessment Report of Nagmati Dam Project (Update)
Shivapuri Nagarjun National Park, Gokarneshwor Municipality Ward No. 1 Mulkharka-Sundarijal
Kathmandu.

Name and Address of the Proponent
Department of Water Resources and Irrigation,
Nagmati Dam Project
Lalitpur, Situated at Gaurighat, Guheswhori, Kathmandu.
Phone Number: 01-4114374, Email: nagmati@dwri.gov.np, brbip.doi@gmail.com

We declare the following:
We have updated/prepared systematically this/EIA Report using acceptable methodologies. Findings are correct and have not been altered in any manner. We shall be accountable for any misleading information in any part of this report.

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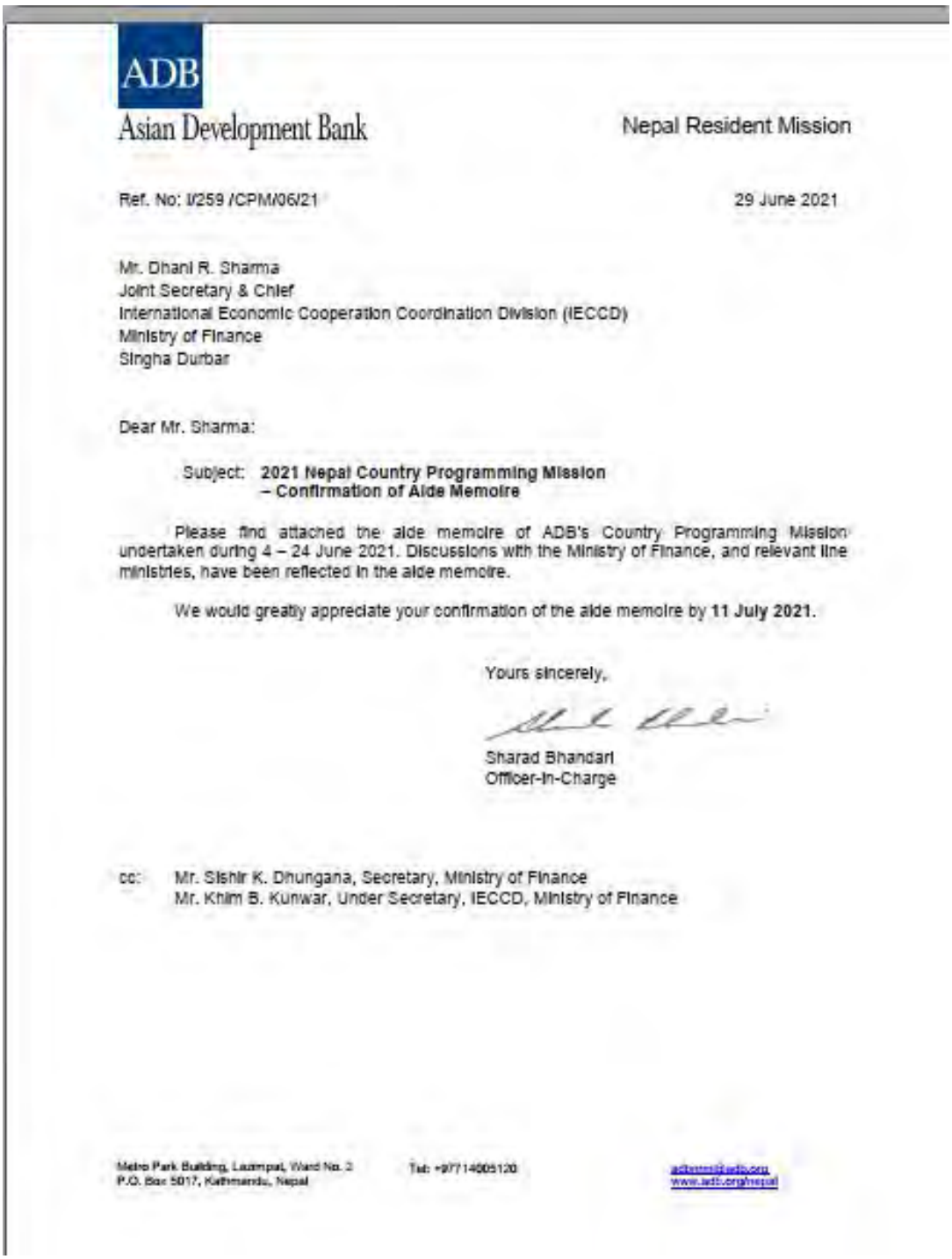
Annex 31

ADB Aide Memoire for NDP



ADB
Asian Development Bank

Nepal Resident Mission

Ref. No: I/259 /CPM/06/21

29 June 2021

Mr. Dhani R. Sharma
Joint Secretary & Chief
International Economic Cooperation Coordination Division (IECCD)
Ministry of Finance
Singha Durbar

Dear Mr. Sharma:

Subject: **2021 Nepal Country Programming Mission – Confirmation of Aide Memoire**

Please find attached the aide memoire of ADB's Country Programming Mission undertaken during 4 – 24 June 2021. Discussions with the Ministry of Finance, and relevant line ministries, have been reflected in the aide memoire.

We would greatly appreciate your confirmation of the aide memoire by **11 July 2021**.

Yours sincerely,

Sharad Bhandari
Officer-In-Charge

cc: Mr. Sishir K. Dhungana, Secretary, Ministry of Finance
Mr. Khim B. Kunwar, Under Secretary, IECCD, Ministry of Finance

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20. The Mission briefed the Ministry of Energy, Water Resources, and Irrigation (MOEWRI-Irrigation) on the proposed pipeline for 2021–2024 that currently includes (ii) Nagmati Dam Development Project (NDDP) as standby 2024.

ADB NEPAL RESIDENT MISSION

19 November 2021

Mr. Ishwori Prasad Aryal
Joint Secretary & Chief
International Economic Cooperation and Coordination Division
Ministry of Finance

Dear Mr. Aryal,

Subject: NEP: Proposed Mechanized Irrigation Innovation Project —Consultation Mission (8–17 November 2021)

Please find attached the aide memoire of the above mission that was fielded from 8 to 17 November 2021. This summarizes the Mission's finding and agreements including those discussed during the wrap up meeting.

We would be grateful for government's review and confirmation of the aide memoire by **15 December 2021**.

Yours sincerely,

Arnaud Caucnois
Country Director

cc: Mr. Sagar K. Rai, Secretary, MOEWRI
Mr. Susheel Chandra Acharya, Director General, DWRI
Mr. Dipendra Laudari, Project Director MIIP, DWRI
Mr. Dilli Raj Lekhak, Under Secretary, IECCD, MOF

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63. Nagmati Dam Development Project (NDDP). The proposed GoN-ADB pipeline for 2021-2024 includes the Nagmati Dam Development Project as standby for approval in 2024 for $110.

Annex 32

Comments and Suggestions from MoFE and its incorporation in EIA Report

Table: EIA Study Consent Conditions from MoFE and its Incorporation in EIA Report

SN	Comments	Place of incorporation	Response from the Proponent
A.	**Concerns and Comments of SNNP**		
1	The area of 42.1 ha forest area of SNNP in Sundarijal area will be converted into reservoir from the construction of 90 high dam in Nagmati River. The project also aimed to generate hydro electricity	Section 2.1, Paragraph 5	Difference in figure 90 and 94.5m is due to the discrepancy in preliminary and detailed design. The design optimization carried out based on the detailed topography and hydrology of the site provoked the change in the height of the dam.
2.	The Nagmati River water is being used for drinking water, irrigation, water mill by the locals	Section 2.8; Section 5.1.16	The project will release 150 l/s flow as an environmental flow to fulfill the existing downstream water usage
3.	There is existing river water usage by Sundarijal Powerhouse diverting water into the Sundarijal dam downstream of proposed dam	Section 2.8; Section 5.1.16	The project will release 150 l/s flow as an environmental flow to fulfill the existing downstream water usage
4.	Construction of proposed dam will directly impact the ancestral water users of Nagmati River and wildlife with possibility of change in existing ecosystem	Section 8.2.2, Table 8-3	The impact from possible conversion of existing terrestrial ecosystem into aquatic ecosystem of the inundated area from the reservoir is the residual impact of the project
5.	The proposed project is being constructed within National Park attracting "Work Policy on Construction and Operation of Physical Infrastructure within the Conservation Area, 2065". Therefore, the consent on EIA study should be provided in line with the process provisioned in EPA, 2076 and EPR, 2077 with alternative area study	Chapter 6	The EIA study was conducted following all the legal provisions and alternative analysis was also conducted
6.	As an alternative to constructing a single large reservoir on the Nagmati River, it should be cleared that constructing small reservoirs in rivers such as Shyalmati, Bagmati, Bishnumati or on any other location has been envisaged or not.	Chapter 6	The alternative analysis conducted showed that the proposed project is the best option for fulfilling the desired objective
7	Study on the cost of construction and operation of the structure, its benefit and utilization study and the difference between the benefits and returns of relocating Okhreni and Mulkharka settlements in its alternative, and detailed study of cost-benefit analysis to be confirmed.	Public hearing	During the public consultation conducted for the EIA study, the locals of the Okhreni and Mulkharka were not willing to get relocated from their motherland. Therefore, the study on cost-benefit analysis for relocation was not conducted
B.	**Concerns and Comments of DNPWC**		
1	There are many tributaries like Nagmati tributary within SNNP, so that other tributaries also need to be studied as	Chapter 6	Some alternatives have been assessed

SN	Comments	Place of incorporation	Response from the Proponent
	alternative;		
2	The risk of natural disaster during the construction and operation of dam should be studied intensively and site selection and design should be prepared accordingly;	Section 5.1.15; Section 7.2.1.1; Section 7.2.1.2; Section 8.2.1, Table 8-2; Section 14.7.3.3.2,; Annex 27 and 28	Seismic analysis for dam break, emergency response plan for dam failure, dam operation and maintenance manual developed
3	The design and construction should be done in such a way that the gush of water that comes out from dam break due to unforeseen disaster or uncontrollable condition should flow through numerous existing tributaries;	Section 5.1.15,	Dam has been designed following the ANCOLD codes for larger dams. Since, Bagmati River is the major river flowing through the Kathmandu Valley where other tributaries mix, diverting flood water into other tributaries seems unachievable
4	As the Kathmandu Valley will be affected by the probable disaster of the project, a study should be carried out on how to manage the settlements that may be affected by the construction and operation of the dam.	Section 8.2.1, Table 8-2; Section 14.7.3.3.2; Annex 28 and 27	Dam Safety Emergency Management Plan and Dam operation and maintenance manual prepared
5	The proposed project may have negative impact on wildlife and its habitat within national park and buffer zone therefore while preparing EIA report, detailed study should be carried out including expert as mentioned in the EPR, 2020 (2077), wildlife biologist and a technical undersecretary appointed by department;		Detailed study has been carried out according to schedule 13 of EPR 2020 In addition, international experts have been employed by ADB to guide this report
6	The department will not be obliged to proceed the process of construction and operation on the basis of consent given to EIA for the proposed project;		Condition
7	This project will impact the wildlife habitat and needs the clearance of vegetation, the project should provide equal area adjacent to SNNP boundary in the similar geographical region. Also, the project should carry plantation work in the provided area and shall follow the provisions made in DNPWC Act, 2029 and regulations formed under it, EPA, 2076, EPR, 2077, SNNP regulation, 2076 and Work Policy on Construction and Operation of Physical Infrastructure within the Conservation Area, 2065.	Section 8.2.2, Table 8-3	Condition

Annex 33

Comments and Suggestions from DoWRI and its incorporation in EIA Report

Table: Specific Comments of DoWRI and Responses

SN	Comments from DWRI	Responses
1	The cover page is not according to format recommended in EPR 2077, remove the name of consulting firm, update (Month, year BS)	The cover page is arranged as per the schedule 12, format of EPR 2020 and name of the consultant is removed from the cover page as suggested
2	Remove the page of revision history	Removed as suggested
3	Clearly define (I) objective of the proposal (II)Rational for conducting EIA Study (iii) relevancy of the project	i The objectives of the proposal is presented in section 2.2 of EIA report. ii Rational for conducting EIA Study is stated in section 1.3 of EIA report. iii Relevancy of the project is clearly stated in 2.3 which is based on EPR 2077 as suggested
4	If construction is an objective of the proposal, detailed plan should be included.	Project Construction Schedule is presented in section 2.5.5 as suggested
5	Include summary of the cost for each activity and total project cost	Presented in Table 2-1 as suggested
6	Is construction of bridge a component the project, if yes, include detailed cross section	Presented in section 2.4.3.12 with dimensions as suggested
7	Letter of consent for EIA study, approval of SD/ToR not found in the report	Letter of consent for EIA study is provided in Annex 5 and letter of approval of SD/ToR of NDP is provided in Annex 4
8	Address the comments/suggestions given by SNNP and DNPWC and attach matrix in the annex	Comments/suggestions received from MoFE/ DNPWC/SNNP is addressed in relevant sections of this EIA report and Matrix is included in Annex 32
9	Public hearing notice does not contain adequate information as mentioned in the EPR	Public Hearing notice is prepared as Sample given in EPR 2077 Annex 10
10	Please include document of proof for the sources such as FM/websites used for dissemination of information for the public hearing.	Letter from NDP to Kantipur FM to play the Public Hearing notice is attached in Annex 17 and Public notice was also published on https://dhapdam.gov.np/news-detail/16/
11	The date of Mulkharka of Public hearing notice is after the date of public notice.	7 days public notice for collection of opinions/suggestions from the stakeholders is republished after muchulka collection and is attached in Annex 18 as suggested
12	Minutes of public hearing, recommendation letters are not found in the report	Minutes of the public hearing is attached in Annex 17 and recommendation letters from relevant stakeholders is attached in Annex 19 as suggested
13	The muchulka for public notice (2nd notice) for comments and suggestions by stakeholders not found in the submitted report. Please complete the process as per EPR 2077 rule 7 (sub-rule 2, 3, 4) and Rule 8, 9 and 10.	Refer SN 11
14	The land use category of all the proposed project should be defined and quantified along with	Land requirement table with ownership is provided in Table 2-6,

SN	Comments from DWRI	Responses
	vegetation to be removed along with coordinates of trees that need to be removed	Project component wise tree removal with nos. and volume is presented in Table 7-3, species wise trees to be removed is provided in Annex 22
15	The quantification of above ground biomass (tree wood volume) should be presented as recommended in Forest Rule 2079. Enumeration of tree, pole and sapling should be incorporated in the annex of the report.	Refer 14
16	Based on topography, Geology and seismicity analysis, a paragraph should be written in alternative analysis for the design adopted for safety of dam structural analysis report should be included in the baseline.	Seismic Risk Analysis was conducted for dam design considering the topography, geology and seismicity and is provided in Section 5.1.16 Section 6.4.1 for Dam location alternatives
17	In the assessment of climate change, the report infers runoff due tormenting snow as major causative factors, how about attention if discharge due to erratic rainfall, disaster risk reduction in case of dam failure is not assessed, disaster management plan should be incorporated.	Presented in Section 14.7.3.3.2
18	The baseline survey was conducted in 2012 any primary information older than 2 years need to be reviewed	Revised information has been provided in the relevant sections
19	As per EPR 2077 rule 8 sub-rule 11, and EIA report must be prepared and submitted within two years of approval of SD/ToR, there seems to be delay of 10 years.	The EIA report was submitted at MOFE in 2017 within two years of approval of ToR and the approval process is ongoing continuously till date .MOFE has given permission to continue the study along with the comments of DNPWC and SNNP on 19-05-2021 which are incorporated in this report. The two years period counts from the date of permission issued by the MOFE. (Rule 9 sub rule 9)
20	Since the proposal's FIA/IIA lies completely in ward no 1 of Gokarneshwor Municipality, only information related to project and ward no 1 should be included	Information of Gokarneshwor Ward no. 1 has been presented in Section 5.3.2 as suggested
21	Environment Management Plan should be based on baseline information, impact on environment and the plan should be prepared in the format prescribed in EPR 2077	EMP has been prepared based on baseline information as per prescribed format by the EPR 2077 and is provided in chapter 14 of EIA report.
22	Site specific and practical mitigation/enhancement measures should be worked out.	Site specific and practical mitigation/enhancement measures have been worked out and presented in Chapter 8 of the report.
23	Approximate value for loss of land and properly should be proposed in environment management plan.	Approximate value for loss of land and properly has been calculated and presented in Table 8-4 and Table 14-4 in the report
24	Please go through the report other comments/suggestions marked for changes/corrections in particular sections.	The comments/suggestions made in the report has been revised/corrected as needed in the necessary sections

PHOTOS

Public consultation at Mahankal, Sundarijal

Public consultation at Mulkharka

CHAPTER 14 ENVIRONMENT MANAGEMENT PLAN

The Environmental Management and Mitigation Plan (EMMP) has been prepared in the format prescribe in EPR, 2020. The EMMP consist of proposed measures to augment the potential beneficial impacts and minimize/mitigate/compensate the potential adverse impacts. The prepared EMMP consist of activities to be performed, methods to perform the activities, activities implementation location, time of implementation, responsible stakeholder to perform the activities, estimated cost and the organization/stakeholder to monitor and evaluate the overall activities. The EMMP for potential beneficial impacts and potential adverse impacts on physical, biological and socio-economic and cultural environment during pre-construction, construction and operation stages are presented in the Table 14-1, Table 14-2, Table 14-3 and Table 14-4 below.

14.1 Environment Management Plan for Beneficial Impacts

Table 14-1: EMMP Matrix for Beneficial Impacts

SN	Beneficial Impacts	Enhancement measures	What	Where	Methods	When	Who	Estimated Manpower, Budget and Time	Monitoring and Evaluation
A	**Construction phase**								
1	Employment opportunity	Priority to the PAF, poor and disadvantaged people for employment in the project	Work related skill training such as dam construction, vehicle driving works, masonry, gabion wires weaving, construction of dry walls and gabion walls and bioengineering works, JCB operator, vehicle maintenance, electrical works etc. by professionals in coordination with Gokarneshwor Municipality	Project DIA	Job related vacancy advertisement in local newspaper; Selection of trainee in coordination with Gokarneshwor Municipality Ward no. 1 office Priority to PAF, poor and disadvantaged people	Before commencement of Construction works	NDP / PMSU Contractor	Total 10 trainers NRs 1,000,000 1 month training as per the demand	MoFE MoEWRI DoWRI Gokarneshwor Municipality
2	Increased Economic	Creating entrepreneurship	Training on dairy product,	Project DIA	Selection of trainee in	Within 6 months from	NDP /	Total 10 trainers	MoFE

SN	Beneficial Impacts	Enhancement measures	What	Where	Methods	When	Who	Estimated Manpower, Budget and Time	Monitoring and Evaluation
	Activities	opportunities for PAF, poor and disadvantaged people to gather benefits from the increased economic activities	poultry/livestock farming, vegetable farming, professional cooking, vehicle maintenance, mobile maintenance, tourist guide trainings by expert trainers		coordination with Gokarneshwor Municipality Ward no. 1 office Priority to PAF, poor and disadvantaged people	the start of construction works	PMSU	NRs 1,000,000 1 month training as per the demand	MoEWRI DoWRI Gokarneshwor Municipality
3.	Improved Accessibility	Construction of new bridge and extension of existing access road	Project will construct a new bridge to replace the existing bridge and will extend the existing wide access road into formation width of 5.5m.	Project access roads	Project will contract the construction contractor	Within 1 year from the start of construction works of bridge and road extension	NDP Contractor	Total 25 manpower that includes skilled, semiskilled and unskilled Included in project cost 1 year from the start of construction works	DoWRI NDP PMSU
4	Exposure to new technology and technology transfer	Priority to the project affected families, poor and disadvantaged people for employment in the project;	Refer S.N A-1	Refer S.N A-1	Refer S.N A-1	Refer S.N A-1	Refer S.N A-1	Refer S.N A-1	Refer S.N A-1
5	Potential improvement of	Allocated budget (0.5% of total project cost) under Community	Support to health post, school,	Project DIA and downstream	Need assessment of the health post,	Within 1 month from the start of	NDP PMSU	5 manpower Will be allocated	MoFE MoEWRI

SN	Beneficial Impacts	Enhancement measures	What	Where	Methods	When	Who	Estimated Manpower, Budget and Time	Monitoring and Evaluation
	public facilities	Support Program (CSP) for maintenance and improvement of health, education, drinking water, irrigation, bridge and forest conservation sector	construction of bridge demanded by the locals, water source identification and management for drinking, irrigation and other use as per need of downstream communities	water user's areas	schools, existing water requirements and assessing potential water sources to meet the requirement; consultation with local stakeholders in coordination with Gokarneshwor Municipality Ward no. 1 office	construction works		from 0.5% of CSP cost	DoWRI Gokarneshwor Municipality
6	Improvement in livelihood	Refer S.N A-1 and S.N A-2	Refer S.N A-1 and S.N A-2	Refer S.N A-1 and S.N A-2	Refer S.N A-1 and S.N A-2	Refer S.N A-1 and S.N A-2	Refer S.N A-1 and S.N A-2	Refer S.N A-1 and S.N A-2	Refer S.N A-1 and S.N A-2
7	Community support program	Allocated budget (0.5% of total project cost) for Community Support Program (CSP)	Refer S.N A-5	Refer S.N A-5	Refer S.N A-5	Refer S.N A-5	Refer S.N A-5	Refer S.N A-5	Refer S.N A-5
B	**Operation Phase**								
1.	Improved river water quality	Release of 0.45 m^3/s of additional discharge into the Bagmati river	Release of 0.45 m^3/s of additional discharge into	Bagmati river channel at Sundarijal	Project operation modality	Start of project operation	NDP	Will be allocated in annual project operation cost	MoEWRI, DoWRI

SN	Beneficial Impacts	Enhancement measures	What	Where	Methods	When	Who	Estimated Manpower, Budget and Time	Monitoring and Evaluation
		channel at Sundarijal	the Bagmati river during dry periods						BRBIP
2.	Availability of water for socio-cultural usages	Release of 0.45 m^3/s of additional discharge into the Bagmati river channel at Sundarijal	Release of 0.45 m^3/s of additional discharge into the Bagmati river during dry periods	Bagmati river channel at Sundarijal	Project operation modality	Start of project operation	NDP	Will be allocated in annual project operation cost	MoEWRI, DoWRI BRBIP
3.	Generation of Hydro-Energy	Provision of supply of hydro-energy to project DIA and Gokrneshwor Municipality from the NDP generated energy if possible;	Coordination with MoEWRI, DoWRI, NEA for energy distribution from the project and energy use price reduction	Project DIA	Coordination with MoEWRI, DoWRI, NEA	After start of project operation	NDP	Will be allocated in annual project operation cost	MoEWRI DoWRI
4.	Supply of additional drinking water to Melamchi Water Supply Project during monsoon Season	Provision of drinking water supply to project affected water user committees through MWSP Project will coordinate with MWSP to extend its network to the project affected water user committee's areas; Project will allocate some part of revenue	Project will coordinate with MWSP to extend its network to the project affected water user committee's areas	Project DIA and Water user committee's areas	coordinate with MWSP and KUKL	After start of project operation	NDP	Will be allocated in annual project operation cost	MoEWRI, MoWS DoWRI

SN	Beneficial Impacts	Enhancement measures	What	Where	Methods	When	Who	Estimated Manpower, Budget and Time	Monitoring and Evaluation
		generated through water supply to Melamchi for local development							
5.	Generation of revenue through payment for ecosystem services (PES) charge to SNNP	Project will provide 20% of the generated revenue to SNNP as provision in SNNP regulation, 2018				Throughout the NDP operation	NDP	Will be according to revenue generated	MoEWRI MoWS MoFE DNPWC SNNP
6.	Integrated watershed management	Project will promote the multiple use of available water; project will invest in biodiversity conservation and reservoir bank protection in coordination with SNNP.	Biodiversity conservation programs and Reservoir bank protection	Within 1 km radius of dam	Biodiversity conservation awareness programs on biodiversity Implementation of reservoir bank protection programs	After start of project operation	NDP	@ 500,000 for biodiversity conservation awareness programs Will be allocated in annual project operation cost for reservoir bank protection programs	MoFE, DNPWC, SNNP
7.	Flood control	Project will construct earthquake and extreme events resistance dam to protect downstream communities from	Regular Maintenance of Dam	Dam Area	Daily checkup of dam structures	From day 1 of project operation	NDP	Will be allocated in annual project operation cost for reservoir bank protection	MoEWRI, DoWRI

SN	Beneficial Impacts	Enhancement measures	What	Where	Methods	When	Who	Estimated Manpower, Budget and Time	Monitoring and Evaluation
		flood events						programs	
8.	Creation of wetland	Project will implement forest conservation programs in coordination with SNNP and will invest in biodiversity conservation and reservoir bank protection	Biodiversity conservation programs and reservoir bank protection programs	Within 1 km of project DIA	Biodiversity conservation awareness programs on biodiversity Implementation of reservoir bank protection programs	After start of project operation	NDP	Refer S.N B-5	MoFE, DNPWC, SNNP
9.	Ground water recharge	Project will conduct annual study on water springs downstream of the dam. If suitable source is found, the project will support relevant stakeholder for its use.	Annual water spring study downstream of dam	2km radius downstream of dam	Direct field study	After start of project operation for first five years	NDP	Will be allocated in annual project operation cost	MoFE, DNPWC, SNNP
10.	Employment opportunity	Preferential priority to the PAF, poor and disadvantaged people for employment in the project	Training on dam operation and maintenance	Project DIA	Skilled development trainings to 20 persons Selection of trainee in coordination with Gokarneshwor Municipality Ward no. 1	After start of project operation for first two years	NDP	@ NRs 100,000 annually for one training	MoEWRI DoWRI

SN	Beneficial Impacts	Enhancement measures	What	Where	Methods	When	Who	Estimated Manpower, Budget and Time	Monitoring and Evaluation
					office Priority to PAF, poor and disadvantaged people				
11.	Increment in economic activities	Local people will be encouraged to establish enterprises & small cottage industries which uses local resources; Promotion of eco-tourism	Skilled development trainings to 10 persons annually Preparation of eco-tourism plan of Bagmati Watershed	Project DIA Bagmati Watershed including Nagmati and Dhap Dams	Entrepreneur development trainings to 20 persons annually Selection of trainee in coordination with Gokarneshwor Municipality Ward no. 1 office Priority to PAF, poor and disadvantaged people Promotion of eco-tourism activities in coordination with SNNP	After start of project for first five years One year before the start of project operation	NDP	@ NRs 100,000 annually for one training NRs 2,000,000 for eco-tourism plan development	MoEWRI HPCIDBC DoWRI SNNP Gokarneshwor Municipality

SN	Beneficial Impacts	Enhancement measures	What	Where	Methods	When	Who	Estimated Manpower, Budget and Time	Monitoring and Evaluation
12	Generation of Royalty	As per Intergovernmental Fiscal Agreement Act, 2075, 25% of the total royalty will be given to the concern local level The local level will be encouraged to invest additional funding available from the royalty in local development	Investment in local development activities from the generated royalty by the Gokarneshwor Municipality	Gokarneshwor Municipality	Local Infrastructure development and strengthening of basic facilities such as health, education, water supply	After receival of royalty	Gokarneshwor Municipality	Will be allocated depending upon the received royalty	MoEWRI Bagmati Province, MoPIT
13	Community support program	Support to the Project DIA communities on infrastructure development, health and education sector strengthening	Support on infrastructure development, health and education sector strengthening	Project DIA	Local Infrastructure development and strengthening of basic facilities such as health, education, water supply as per the need assessment	After start of project operation for first five years depending upon the need assessment	NDP	Will be allocated in annual project operation cost	Gokarneshwor Municipality

14.2 Environment Management Plan for Physical Environment

Table 14-2: EMMP Matrix for Adverse Impacts on Physical Environment

SN	Adverse Impacts	Mitigation measures	What	Methods	Where	When	Who	Estimated Manpower, Budget and Time	Monitoring and Evaluation
A	**Construction Phase**								
i.	Change on land use pattern and topography due to muck disposal, land acquisition and build of structures	Change on land use pattern from permanent build of structures will be residual impact as it is not reversible; Top soil collection, storage and reuse for the restoration of temporary land acquired; plantation on the muck disposal area.	Top soil collection, storage and reuse for the restoration of temporary land acquired; plantation on the muck disposal area.	Top soil collection in designated site Piling up of muck in the designated site Plantation of suitable vegetation	Project Construction and project support facilities area	Construction period	Contractor	Included in project cost	MoEWRI DoWRI NDP SNNP Gokarneshwor Municipality
ii.	Change on water and soil quality due to possible spillage/leakage of toxic materials	Avoid spillage while storing, handling and using toxic materials, monitoring of use and leakage of toxic materials; Collection of spillage and careful disposal, strict rules in banning haphazard disposal.	Training to workforce and handling and using of toxic materials and disposal in environmentally friendly manner	Training to workforce on handling and using of toxic materials and disposal along with solid waste management in environment	Project Construction and project support facilities area	Within 1 month of Construction Period	Contractor	2 trainers for each training NRs. 200,000 Annually	MoEWRI DoWRI NDP SNNP Gokarneshwor Municipality

SN	Adverse Impacts	Mitigation measures	What	Methods	Where	When	Who	Estimated Manpower, Budget and Time	Monitoring and Evaluation
				ally friendly manner					
iii.	Degradation of water quality due to river water diversion	Installation of diversion pipe before the construction of coffer dam to allow natural flow of river water; diversion pipes will be installed at least 40m upstream and 30m downstream from the coffer dam construction location to avoid mixing of construction materials with the river water; Mixing of water pollutant such as cement, oil and other toxic materials into the river water will be avoided.	Installation of diversion pipe before the construction of coffer dam to allow natural flow of river water	Best engineering practice	Coffer dams construction location	Construction period of coffer dam	Contractor	Included in project cost	NDP
iv.	Degradation of water and air quality and increase in noise level	Restriction on discharge of construction waste to the river water; Development of proper waste disposal system for both solid and liquid waste; construction of double berm and impervious flooring of concrete around the oil and other storage area, monitoring of leaks and	Waste management system setup and operation Water sprinkling in dusty construction area and along the project access roads for two times a day	Training on occupational health and safety to workforce Regular water sprinkling in dust blow areas	Project construction and project support facilities area	Construction period	PMSU/ Contractor	NRs 2,000,000 for PPE equipments and training NRs 5,000,000 for regular water sprinkling NRs 500,000	NDP Gokarneshwor Municipality Nepal Army in case of blasting

SN	Adverse Impacts	Mitigation measures	What	Methods	Where	When	Who	Estimated Manpower, Budget and Time	Monitoring and Evaluation
		seepage; Regular maintenance of engines and machinery, isolation of crushing plants from the settlement, water sprinkling in dusty construction area as and when required, proper disposal of solid waste; Limiting Blasting at night only; restriction on use of pressure horn near settlement and wildlife habitat area; proper maintenance of equipment and machinery; construction of noise barrier such as thick plywood fence at heavily noisy construction area; installation of crushing plant away from settlement and providing ear plugs to the workers.	regularly Mandatory rules for following occupational health and safety measures and distribution of mask and ear plugs to workforce	Fencing of blasting areas Prior information dissemination before blasting activities and prohibition of access to blasting area other than authorized personnel.				for wire fencing in the blasting areas	
v.	Impact due to operation of quarry site	Quarrying operations in the flood plain will be stripping operation rather than forming a big borrow pit at one location; The quarry operation will not	Quarry operation on designated site Storage of quarry materials on designated place	Quarry operation and storage of materials on designated	Project quarry operation area	Construction period	Proponent/ Contractor	Included in project cost	

SN	Adverse Impacts	Mitigation measures	What	Methods	Where	When	Who	Estimated Manpower, Budget and Time	Monitoring and Evaluation
		be carried below the flowing water level of the river; piling of quarried materials, will be done on the designated place only; and since the quarry area will be inundated by the reservoir site reclamation will not be conducted.		site only Prohibition of access on quarry operation site to unauthorized personnel					
vi.	Impacts due to storage of construction material	Proper storage of construction materials. re-use and proper disposal of its' remaining.	Storage, use, re-use of construction material and proposer disposal of its remaining	Designated place allocation for construction material storage Practice of Waste management system	Project construction material storage yard area	Construction period	Proponent/ Contractor	Included in project cost	NDP Gokarneshwor Municipality
vii.	Damage on infrastructures due to the blasting and use of heavy equipments	Since the quarry area requiring blasting is far from settlement, it is envisioned that there will be no impacts from blasting; limiting blasting at day time only; compensation and repairing of damaged	Blasting in quarry operation sites will be conducted only on day time	Blasting in quarry operation sites will be conducted only on day time Information	Nearby settlements and settlements along the access road where movement of heavy	Construction period	Proponent/ Contractor	NRs. 2,000,000	NDP Gokarneshwor Municipality

SN	Adverse Impacts	Mitigation measures	What	Methods	Where	When	Who	Estimated Manpower, Budget and Time	Monitoring and Evaluation
		structures; information dissemination regarding timing of blasting		dissemination of blasting to the people present in the construction area	equipments are required				
viii.	Impacts due to improper management of solid and construction waste	Implementation of 4R principle (recognize, reduce, reuse and recycle) for waste management; Proper disposal of generated waste; Strict Prohibition on direct burning of waste and disposal on rivers will be implemented; training to project workforce on solid and construction waste management will be provided within first 3 months of start of construction works	Implementation of 4R principle (recognize, reduce, reuse and recycle) for waste management; Proper disposal of generated waste	Training to workforce on waste management handling	Project construction and project support facilities area	within first 3 months of start of construction works	Proponent/ Contractor	Refer SN A-ii	NDP Gokarneshwor Municipality
ix.	Impacts on slope stability, sedimentation and soil erosion	Application of proper bioengineering measures including toe wall, gabion, shotcrete, small civil engineering structures and vegetation; construction of	bioengineering measures including toe wall, gabion, shotcrete, small civil engineering	Bioengineering with small civil engineering structures	Project construction, project support facilities area, project access	Construction period	Contractor	5,000,000	NDP Gokarneshwor Municipality

SN	Adverse Impacts	Mitigation measures	What	Methods	Where	When	Who	Estimated Manpower, Budget and Time	Monitoring and Evaluation
		slope protection structures such as revetment walls, benches or terraces riprap and spurs at appropriate location	structures and vegetation; construction of slope protection structures such as revetment walls, benches or terraces riprap and spurs at appropriate location		road				
x.	Impacts in drainage pattern	Material storage and muck disposal will be done only in designated area; Provision of both vertical and horizontal drains in places where natural drainage are disturbed such as project access road, muck disposal area, storage yard, camp area etc.	Provision of both vertical and horizontal drains in places where natural drainage are disturbed	Site observation and management of drainages for natural flow as required	Project construction area, muck/spoil disposal area, project access roads and project support facilities	Construction period	Contractor	Included in project cost	NDP Gokarneshwor Municipality
xi.	Impacts on natural spring and other water sources due to dam construction and penstock installation along the penstock alignment	Recording of potential natural springs and will be used to provide downstream water users for their use; water pipes will be used to divert the water from the natural springs.	Recording of potential natural springs and will be used to provide downstream water users for their use; water pipes will be used to divert	Site observation of potential natural springs and other water sources and construction	Dam area and penstock alignment	Construction period	Contractor	2,000,000	NDP Gokarneshwor Municipality Downstream water

SN	Adverse Impacts	Mitigation measures	What	Methods	Where	When	Who	Estimated Manpower, Budget and Time	Monitoring and Evaluation
			the water from the natural springs.	of appropriate civil engineering structures					user committees
xii.	Impacts of muck disposal	Safe disposal of muck; Compaction of loose soil particles and protection structures as per required; Use of muck in construction activities such as back filling, road maintenance, construction of gabion wall, drain ditches around the spoil disposal site and management of disposal site by plantation.	Disposal at designated site only; Reuse and construction of appropriate civil engineering structures Management of drainage for natural flow Plantation	Disposal at designated site only; Reuse and construction of appropriate civil engineering structures Management of drainage for natural flow Plantation	Muck disposal area	Construction period	Contractor	5,000,000	NDP Gokarneshwor Municipality
xiii	Downstream Flooding due to the Failure of Coffer Dam	This is the unanticipated impact as the coffer dams are designed after seismic and structural analysis to resist the failure triggered by extreme events. However, the project will build mechanism to flow	Information flow to downstream communities; Emergency evacuation of the communities along the Nagmati	Installation of siren at Sundarijal Disaster preparedness trainings to the project	Project DIA along the Nagmati and Bagmati river	Before completion of coffer dam construction	Proponent	Cost for siren installation is included in project cost @ NRs 500,000 for disaster	MoEWRI DoWRI Gokarneshwor Municipality

SN	Adverse Impacts	Mitigation measures	What	Methods	Where	When	Who	Estimated Manpower, Budget and Time	Monitoring and Evaluation
		the information to the locals downstream such as installation of siren at Sundarijal and will conduct disaster preparedness trainings to the project DIA local people.	and Bagmati river	DIA local people				preparedness training to local of project DIA	
B	**Operation Phase**								
i.	Impacts due to reduction in downstream flow and change in water quality	Maintaining downstream release or the environmental flow; Detail observation and monitoring for first five years operation period in order to understand downstream water requirements; training for dam gate operators for environmental release.	Maintaining downstream release or the environmental flow; Detail observation and monitoring for first five years operation period	Downstream water requirement study Training for dam gate operators for environmental release.	100m downstream of dam upstream from the Bagmati Nagmati confluence	first five years of operation period	NDP	Will be included in project operation cost	MoEWRI DoWRI SNNP Gokarneshwor Municipality
ii.	Impacts due to modification of landscape	Change in landscape will be residual impact; muck disposed area outside the inundated area will be reclaimed after proper stabilization of land; slope stabilization works implementing bio-engineering in the fragile	Bio-engineering in the fragile and disturbed areas induced due to the project activities	Implementation of bioengineering technique with small civil engineering structures	Reclamation of muck disposal area will be completed within 6 months from project operation	Within 6 months of project operation	NDP	NRs 2,000,000	MoEWRI DoWRI SNNP Gokarneshwor Municipality

SN	Adverse Impacts	Mitigation measures	What	Methods	Where	When	Who	Estimated Manpower, Budget and Time	Monitoring and Evaluation
		and disturbed areas induced due to the project activities			date; slope stabilization works will be conducted throughout the project operation period whenever required.				
iii.	Impacts due to increased sedimentation on downstream due to sediment flushing from Reservoir	Insignificant							
iv.	Impacts due to change in micro-climate in Reservoir Area and De-watered Stretch	The continuous flow of environmental flow will be maintained to minimize the impacts of micro-climatic change	Continuous flow of environmental flow	Continuous flow of environmental flow	De-watered Stretch downstream of dam	From the day of project operation	NDP	-	MoEWRI DoWRI SNNP Gokarneshwor Municipality
v.	Reclaiming the muck disposal area	The temporary land shall be returned to the GoN to the extent possible in the pre-leased state; plantation	plantation in the reclaimed area will be conducted	plantation in the reclaimed	Muck disposal area	Within 6 months from	Contractor	Refer S.N B-ii	MoEWRI DoWRI

SN	Adverse Impacts	Mitigation measures	What	Methods	Where	When	Who	Estimated Manpower, Budget and Time	Monitoring and Evaluation
		in the reclaimed area will be conducted.		area will be conducted.		project operation			SNNP NDP Gokarneshwor Municipality
vi.	Impacts of slope instability	Implementation of slope stabilization measures like bio-engineering method to stabilize the slope and to control the soil erosion having fragile geology if any unstable slope developed in project vicinity during operation; To avoid erosion and sedimentation problems, any bare surface will not be left near the project areas; Natural drainage will be maintained as far as possible	Implementation of slope stabilization measures like bio-engineering method to stabilize the slope and to control the soil erosion having fragile geology Natural drainage will be maintained as far as possible	Implementation of slope stabilization measures like bio-engineering method to stabilize the slope and to control the soil erosion having fragile geology Natural drainage will be maintained as far as possible	Unstable slope within project construction area and support facilities	When necessary	NDP	Will be included in project operation cost	MoEWRI DoWRI SNNP Gokarneshwor Municipality
vii.	Impacts due to leakage	All spent grease, engine oil and other lubricants and	Storage of toxic	Storage of	Construction	Within 6	Contractor	NRs 500,000	MoEWRI

SN	Adverse Impacts	Mitigation measures	What	Methods	Where	When	Who	Estimated Manpower, Budget and Time	Monitoring and Evaluation
	of oil and grease and other liquid materials	unused or date expired toxic chemicals will be collected separately in plastic drums and stored in a safe place under the shade; All empty containers of engine lubricants and toxic chemicals will be squeezed and stored in a safe place under the shade; Unused chemicals, spent engine lubricants; grease will be discharged only after approval of the environmental officer and his/her recommendation	chemicals will be collected separately in plastic drums and stored in a safe place under the shade	toxic chemicals will be collected separately in plastic drums and stored in a safe place under the shade and discharge only after approval of the environmental officer and his/her recommendation	material storage yard	months from the start of project operation			DoWRI SNNP NDP Gokarneshwor Municipality
viii.	Flood Outburst due to Dam Failure	This is the unanticipated impact as the coffer dams are designed after seismic and structural analysis to resist the failure triggered by extreme events. However, the project will build mechanism to flow the information to the locals downstream such as	Information flow to downstream communities; Emergency evacuation of the communities along the Nagmati and Bagmati river	Installation of siren at Sundarijal, Gokarna, Pashupatinath, Bagmati Bridge at Sinamangal and Thapathali	Project DIA along the Nagmati and Bagmati river and downstream from Sundarijal to Bagmati river exit from	Before completion of coffer dam construction	DoWRI NDP	Cost for siren installation is included in project cost An emergency fund for this extreme event will be allocated by	OPMCM MoD MoHA MoEWRI MOCTCA DAO Kathmandu

SN	Adverse Impacts	Mitigation measures	What	Methods	Where	When	Who	Estimated Manpower, Budget and Time	Monitoring and Evaluation
		installation of siren at Sundarijal, Gokarna, Pashupatinath, Bagmati Bridge at Sinamangal and Thapathali and will conduct disaster preparedness trainings to the project officials Emergency response fund allocation		Disaster preparedness trainings to the project officials	Kathmandu Valley at Chobhar			MoEWRI/DoWRI	DAO, Lalitpur Kathmandu Metropolitan Police Lalitpur Metropolitan Police Kathmandu Metropolitan, Lalitpur Metropolitan, Kageshwori Manohara Municipality Gokarneshwor Municipality
ix.	Impacts in physio chemical parameters quality of water downstream of Nagmati dam and point of mixing of discharge release from NDP	Project will release 150 lps of environmental flow from dam Project will conduct physio chemical parameters test twice a year (one in wet season and another in month May) to understand	Flow measurement below dam to ensure the release of 150 lps of environmental flow	Direct flow measurement and water analysis	Dam, dewatered stretch and mixing point of tail water from NDP powerhouse	Throughout the operation period For water analysis twice a	NDP	Will be included in annual operation cost of NDP	MoEWRI MoFE DNPWC DoWRI

SN	Adverse Impacts	Mitigation measures	What	Methods	Where	When	Who	Estimated Manpower, Budget and Time	Monitoring and Evaluation
	powerhouse in the Bagmati River at Sundarijal	the changes in existing river water quality and will provide additional flow if further required for improvement in the dewatered stretch.	Water sampling and laboratory testing of the water samples		to Bagmati River at Sundarijal	year for first five years of project operation			SNNP HPIDIC

14.3 Environment Management Plan for Biological Environment

Table 14-3: EMMP Matrix for Adverse Impacts on Biological Environment

SN	Impact	Mitigation measures	What	Methods	Where	When	Who	Estimated Manpower, budget and time	Monitoring and Evaluation
A	**Construction Phase**								
i.	Loss of vegetation due to the clearance and acquisition of forest land	Project will provide land area equal to acquired government land near to the project area/similar geographical location or provide the amount equivalent to cost of the government land to the Government as per the rules set in Forest Act, 2076 and Forest Regulation, 2079	Land substitution to SNNP Piling up of cut trees and handing over to SNNP Compensatory plantation in the ratio 1:25 and maintenance of it for 5 years Land to SNNP will	Land substitution to SNNP adjacent to SNNP boundary Piling up of cut trees and handing over to SNNP Compensatory	Project DIA Project construction and project support facilities area and access road	Land substitution to SNNP within 2 years from the start of construction works Piling works 1 month prior to the	NDP Contractor	Cost for government land substitution will be allocated as per the amount fixed by land replacement compensation committee	MoFE MoEWRI DNPWC DoWRI SNNP

SN	Impact	Mitigation measures	What	Methods	Where	When	Who	Estimated Manpower, budget and time	Monitoring and Evaluation
		Limiting tree cutting and forest clearance only in the areas required for construction activities; Compensatory plantation in the ratio 1:25 and maintenance of it for 5 years The trees in the submerged area of quarry site and spoil areas will remain standing. The trees above RL 1908 m in the reservoir area will not be cut because this area is above spillway and most of the time this area remains above the water. After the completion of extraction, the site will be leveled and reclaimed to suit the landscape preferably by re vegetation; After piling the muck systematically, the temporary land shall be returned to the GoN not less than in the pre-leased state.	be made available within 2 years of start of construction works Reclamation of temporary forest land	plantation in the ratio 1:25 in the place proposed by SNNP Provision of cost for maintenance for 5 years to SNNP Organizing forest conservation program in Project DIA Reclamation of temporary forest land after completion of construction works		start of construction works Reclamation of temporary forest land within 6 months of the project operation		Cost for tree plantation included in project cost	

SN	Impact	Mitigation measures	What	Methods	Where	When	Who	Estimated Manpower, budget and time	Monitoring and Evaluation
ii.	Loss of biodiversity	Tree felling will be limited only in the area required; The trees in the submerged area of quarry site and spoil areas will remain standing. Trees above RL 1908 m in the reservoir area will not be cut; Provision of alternative energy sources such as LPG/Kerosene; Hunting and roaming around the forest area by the labors will be prohibited; Biodiversity conservation trainings to labors	Provision of alternative energy sources such as LPG/Kerosene in the camps Biodiversity conservation trainings to labors	Provision of alternative energy sources such as LPG/Kerosene in the camps Biodiversity conservation trainings to labors	Project construction area	Within 2 months of the start of construction works	NDP Contractor	NRs 500,000 for biodiversity conservation training program for labors NRs 2,000,000 for Biodiversity program implementation in coordination with SNNP	DoWRI SNNP
iii.	Wild life habitat fragmentation and destruction	Tree felling will be limited only to the required forest area; Unnecessary use of blasting and drilling activities will be avoided; project will build temporary pond to provide water for terrestrial wildlife in consultation with SNNP	Tree felling will be limited only to the required forest area; Unnecessary use of blasting and drilling activities will be avoided	Tree felling will be limited only to the required forest area; Unnecessary use of blasting and drilling activities will be avoided	Project construction area	Construction period Construction of temporary pond will be completed	PMSU Contractor	Lumpsum amount of NRs 2,000,000 for SNNP to study the habitat fragmentation and destruction A lumpsum amount of 5,000,000 for the construction of	DoWRI NDP/PMSU SNNP

SN	Impact	Mitigation measures	What	Methods	Where	When	Who	Estimated Manpower, budget and time	Monitoring and Evaluation
						within 6 months from the date of dam construction works		temporary pond	
iv.	Pressure on rare, endemic, endangered, threatened, and protected species of both flora and fauna due to project activities	Emphasizing protected species for compensatory plantation plan; Restriction on illegal collection, hunting, poaching and trade of NTFPs and wild animals	Emphasizing protected species for compensatory plantation plan; Restriction on illegal collection, hunting, poaching and trade of NTFPs and wild animals Biodiversity conservation trainings to labors	Biodiversity conservation trainings to labors	Project construction area and area within radius of 500m from dam axis	Construction period	PMSU Contractor	Refer S.N A-ii	DoWRI NDP/PMSU SNNP
v.	Illegal felling of vegetation, trade of NTFPs, hunting and poaching of wildlife	Strict prohibition on hunting, poaching activities and illegal felling of trees around the project area by the constructional workers	Conduction of environmental awareness and biodiversity conservation program/campaign	Conduction of environmental awareness and biodiversity conservation program/campaign	Project construction area and area within radius of 500m from dam axis	Construction period	PMSU Contractor	NRs 500,000 for environmental awareness and biodiversity conservation program/campaign	DoWRI SNNP
vi.	Disturbance to aquatic species and its habitat due to construction	Preparation of waste management plan regarding the use, storage and disposal of toxic, solid	Implementation of waste management plan	Training to workforce on waste management	Dam construction area and along the	Construction period	PMSU Contractor	Included in project cost for diversion pipe	DoWRI SNNP

SN	Impact	Mitigation measures	What	Methods	Where	When	Who	Estimated Manpower, budget and time	Monitoring and Evaluation
	activities	and sanitary waste and materials; Installation of water diversion pipe from 50m upstream of dam and coffer dam construction site		Installation of water diversion pipe from 50m upstream of dam and coffer dam construction site	Nagmati river upto Bagmati Nagmati confluence			installation	
vii.	Impact due to fire hazard on forest resources	Safe storage of inflammable materials with fire extinguishing equipment facility; public awareness program and firefighting training to construction workers	Storage of inflammable materials with fire extinguishing equipment facility	public awareness program and firefighting training to construction workers	Project construction area	Construction period	PMSU Contractor	NRs 150,000 for firefighting training NRs 2,500,000 for Fire extinguishing equipment	NDP DoWRI SNNP
viii.	Human wildlife conflict	Fencing of construction sites and camp area by barbed wire or stone/brick masonry wall; construction activities on day time only; restriction to project personnel and labors on roaming around the nearby forest area.	Fencing construction/installation Construction activities only on sunlight Restriction to roam on nearby forest	Fencing construction/installation Construction activities scheduling Implementation of code of conduct to project personnel	Project construction area and within radius of 1km upstream from dam axis	Construction period	PMSU Contractor	Cost for regular maintenance of fencing will be included in project operation cost	NDP SNNP
ix.	Encroachment in	Dissemination of	Information	Monthly	Project	Construction	PMSU	S.N A- ii	NDP

SN	Impact	Mitigation measures	What	Methods	Where	When	Who	Estimated Manpower, budget and time	Monitoring and Evaluation
	Shivapuri Nagarjun National Park	information to the SNNP authorities if found encroachment; prohibition to the construction workforce to enter into the forested areas of SNNP for recreation as well as illegal harvesting of forest resources	dissemination to the SNNP authorities on encroachment Restriction of labors on entering into forested areas outside of project construction area.	meeting with SNNP authorities Biodiversity conservation training program	construction area	period	Contractor		DoWRI SNNP
B	**Operation Phase**								
i.	Disturbance to movement of fish, aquatic species and its habitat due to obstruction created by the dam	Not significant							
ii.	Change in existing terrestrial ecosystem into aquatic ecosystem and loss of wildlife due to destruction and fragmentation of its habitat	Tree felling will be limited only to the required forest area; reclamation of habitat loss by developing plantation site and taking care for 5 years	Reclamation of habitat loss area by plantation taking care for 5 years	Plantation in the reclaimed area by local species	Project construction, temporary facilities areas and areas within 1km radius of dam axis	After 1 year of project operation and for 5 years	Project operation manager SNNP	NRs 7,500,000 (NRs 1,500,000 annually) to study the habitat status of wildlife Refer Table 14-2, Construction Phase S.N A-I for cost of maintenance of plantation	DNPWC NDP

SN	Impact	Mitigation measures	What	Methods	Where	When	Who	Estimated Manpower, budget and time	Monitoring and Evaluation
								works for five years	
iii.	Disturbance on movement of animals due to project features	Risky project structures such as dam area will be fenced to ensure the safe movement of wildlife	Fencing in an around dam location area	Fencing with barbed wire or stone masonry wall	Dam area	Before 1 month from the start of project operation	Project operation manager NDP	Included in project cost	DNPWC NDP SNNP
iv.	Pressure on rare, endemic, endangered, threatened and protected species of both flora and fauna	Restriction on illegal collection, hunting, poaching and trade of NTFPs and wild animals; organizing the awareness program on importance of protected plant and animal species and conservation practices	Restriction on illegal collection, hunting, poaching and trade of NTFPs and wild animals Biodiversity conservation awareness program to local people and operation manpower	Biodiversity conservation awareness program to local people and operation manpower	Project DIA	Operation period	Project operation manager	NRs 500,000 for Biodiversity conservation awareness program to local people and operation manpower	DoWRI NDP/PMSU SNNP
v.	Illegal felling of vegetation, trade of NTFPs, hunting & poaching of wildlife and trade of fish	Strict prohibition on hunting, poaching activities and illegal felling of trees around the project area by the operational workers	Conduction of environmental awareness and biodiversity conservation program/campaign	Conduction of environmental awareness and biodiversity conservation program/campaign	Project operation area	Operation period	Project operation manager	NRs 500,000 for environmental awareness and biodiversity conservation program/campaign	DoWRI SNNP
vi.	Human Wildlife conflict	Fencing of permanent office camp sites in the dam area by barbed wire or	Fencing construction/installation	Fencing construction/installation	Project operation area at dam	Operation period	Project operation manager	Cost for fencing is included in	NDP SNNP

SN	Impact	Mitigation measures	What	Methods	Where	When	Who	Estimated Manpower, budget and time	Monitoring and Evaluation
		stone/brick masonry wall; restriction to project personnel and labors on roaming around the nearby forest area.	Restriction to roam on nearby forest	Implementation of code of conduct to project personnel	and within radius of 1km upstream from dam axis			project operation cost	
vii.	Encroachment in Shivapuri Nagarjun National Park	Dissemination of information to the SNNP authorities if found encroachment; prohibition to the construction workforce to enter into the forested areas of SNNP for recreation as well as illegal harvesting of forest resources	Information dissemination to the SNNP authorities on encroachment Restriction of labors on entering into forested areas outside of project construction area.	Monthly meeting with SNNP authorities Biodiversity conservation awareness program	Project operation area at dam and within radius of 1km upstream from dam axis	Operation period	Operation manager	NRs 500,000 for Biodiversity conservation awareness program for first five years of project operation	NDP DoWRI SNNP

14.4 Environment Management Plan for Socio-economic and Cultural Environment

Table 14-4: EMMP Matrix for Adverse Impacts on Socio-economic and Cultural Environment

SN	Impact	Mitigation measures	What	Methods	Where	When	Who	Estimated cost	Monitoring and Evaluation
A	**Pre-Construction Stage**								
1.	Permanent Acquisition	Adequate compensation to the affected parties for	Compensation to private land	Compensation	Project permanent	Compensation to private	PMSU	NRs	MoEWRI

SN	Impact	Mitigation measures	What	Methods	Where	When	Who	Estimated cost	Monitoring and Evaluation
	of Private Property	permanent land acquisition; Priority to the affected households for employment opportunity	at the rate fixed by land acquisition committee formed under chairmanship of CDO, Kathmandu; Employment related skill training to PAF	through bank Employment related skill training to PAF	land required areas	land owners will be completed before 1 month of the construction works	NDP CDO, Kathmandu Gokarneshwor Municipality	265,779,076 for private property acquisition; included in project cost NRs. 2,000,000 for livelihood rehabilitation	MoLMCPA DoWRI NDP
B	**Construction Phase**								
1.	Loss of private land and issue of food security	The standing crops in the lands acquired will be compensated from negotiation with the land owners, if these lands have standing crops at the time of land acquisition; The construction of project component and facilities will be conducted in pre acquired land; Additional land or crops if damaged by the project activities, compensation will be paid to the concerned land	Compensation to standing crops of the private land with negotiation with the land owners Compensation to damaged land or crops by the project activities	Budget allocation for the compensation of standing crops and distribution of the compensation to affected parties	Permanent and temporary land acquired areas and land areas damaged by project activities	During land acquisition and as required for damages by project activities	PMSU for standing crop loss Contractor for damages caused by project activities	NRS. 1,000,000 NRs. 1,000,000	NDP Gokarneshwor Municipality

SN	Impact	Mitigation measures	What	Methods	Where	When	Who	Estimated cost	Monitoring and Evaluation
		owners as per the loss.							
2.	Loss of trees from private owned land	Compensation of the trees to the affected households	Compensation of felled trees to the affected households	Marking and numbering individual trees; market rate survey of felled trees; compensation to affected households after negotiation	Permanent and temporary acquired private lands	1 month before the start of construction activities	PMSU	NRS. 650,000	NDP Gokarneshwor Municipality DFO
3.	Pressure on existing water supply systems	Establishment of separate water supply for Construction camps without disturbing local water supply facilities.	Provision of separate water supply facility for the project	Identification of water source and management	Project camp areas	Within 1 month from the start of the construction activities	PMSU Contractor	Included in project cost	NDP
4.	Impacts on occupational health and safety	Provision of adequate training on occupational health and safety to all construction workers; Provision of protective clothing such as helmets, boots, gloves, and mask to all construction workers, supervisors, and visitors; Restriction in access to construction sites to the	Provision of adequate training on occupational health and safety to all construction workers; Provision of protective clothing such as	Mandatory use of PSE to all the personnel in the working site Strict implementation of OSH plan	Project construction sites	From the day of start of construction activities	Contractor	Included in project cost	PMSU NDP

SN	Impact	Mitigation measures	What	Methods	Where	When	Who	Estimated cost	Monitoring and Evaluation
		public by fencing and using guards.	helmets, boots, gloves, and mask to all construction workers, supervisors, and visitors; Restriction in access to construction sites to the public by fencing and using guards.						
5.	Pressure on existing infrastructures facilities such as road, drinking water, health post, education, health and sanitation	Local people will be employed in priority basis; Existing local services like drinking water, health service will be strengthened through Community Support Program (CSP); Adequate construction camp will be established.	Skill development related to project for locals Strengthening of local community infrastructures	Organizing of training to locals for skill development Strengthening of local community infrastructures in coordination with Gokarneshwor Municipality Ward no. 1	Project DIA	During construction period when required	PMSU	Will be allocated from CSP cost (0.5% of total project cost)	NDP Gokarneshwor Municipality
6.	Sudden increase on economic activities (boom and boost	Organizing awareness campaign in project impact area regarding the	Organizing awareness	Organizing awareness campaign for	Project DIA	Before 6 months of construction	PMSU	NRs 500,000	NDP Gokarneshw

SN	Impact	Mitigation measures	What	Methods	Where	When	Who	Estimated cost	Monitoring and Evaluation
	effect)	negative impacts of increased economic activities and encouraging the people for savings acquired directly/indirectly due to project implementation to control cash flow in the local market.	campaign	locals of project DIA		works completion			or Municipality
7.	Interference on cultural and traditional practices of the local people due to increased outside project staff and workers	Counseling to workers about local cultures, monitoring of workers behaviors and prohibition of local culture disruption activities, establish recreational facilities/service, support to *Aama Samuha* in preventing anti-social behaviors.	Awareness trainings to labors Implementation of code of conduct to the labors	Organizing awareness training to labors	Project DIA	Construction period	PMSU Contractor	NRs 500,000	NDP Gokarneshwor Municipality Local Police Station
8.	Impacts on women and Children	Provide employment opportunity to local women, conduct women empowerment activity, avoid child labor and strictly follow the labor act to fix the lower age bar to recruit construction workers.	Training on project related employment skill development to women Strictly prohibition of child labor	Organizing employment related skill development training focusing women of project DIA Maintaining personal	Project DIA Construction	Within 6 months from the start of construction activities Construction	PMSU	NRs 200,000	NDP Gokarneshwor Municipality

SN	Impact	Mitigation measures	What	Methods	Where	When	Who	Estimated cost	Monitoring and Evaluation
				record with age of each labor	camps	period	Contractor		
9.	Impacts on law and order in the project area due to large work force	The local law and order authorities will be regularly informed about the construction planning and sites of construction works and activities; The construction workforce will be regularly instructed to respect local people and their traditions and culture and not to indulge in any conflict with the local people; Avoid entering into private premises without informing and without the permission of the property owners; Provide opportunity for local people in construction related jobs;	Strict implementation of code of conduct to labors	Recording of arguments, physical disputes to nearest police station	Construction camps and project DIA	Construction period	Contractor	-	PMSU NDP Gokarneshwor Municipality Local police station
10.	Impacts of STD due to outside workforces	Preference will be given to the local people in project related jobs and subsidiary opportunities; A strict code of conduct for the workforce will be	Employment opportunities to locals Strict implementation of code of	Strict implementation of code of conduct to labors	Project DIA and construction camps	Construction period	Contractor	-	PMSU NDP Gokarneshwor

SN	Impact	Mitigation measures	What	Methods	Where	When	Who	Estimated cost	Monitoring and Evaluation
		formulated and enforced. In case any worker is found soliciting prostitution will be penalized and terminated;	conduct to labors						Municipality Local police station
11.	Existing water use rights	Project will conduct formal discussions with the downstream water user committees and will support in identifying alternative source along with its management.	Discussions with downstream water user committees Identification of alternative water sources and its management	Organizing stakeholders consultation Allocating budget for management of downstream water use	Downstream of dam in the dewatered stretch and areas of downstream water user committees	Within 3 months of the start of construction period	PMSU NDP	Will be allocated from CSP cost (0.5% of total project cost)	Gokarneshwor Municipality HPCIDBC
12.	Loss of archaeological, religious and culturally important sites	Ban on influx of an individual/mission/group of people having intention of influencing the people at the project site pertaining to imposition of some religion, apart from their traditional religion, with the help of local authority	Strict implementation of code of conduct to labors	Strict implementation of code of conduct to labors	Project DIA and construction camps	Construction period	Contractor	-	PMSU NDP Gokarneshwor Municipality Local police station
13.	Impact on existing bridge and in the access road	A new bridge in same location will be constructed by the project	Construction of new bridge and upgrading of	Construction of new bridge and upgrading	Access road and existing bridge of	Within 6 months of start of	NDP	Included in project cost	DoWRI Gokarneshwor

SN	Impact	Mitigation measures	What	Methods	Where	When	Who	Estimated cost	Monitoring and Evaluation
		and existing access road required for the project will also be upgraded to formation width of 5.5m.	existing access road to 5.5m formation width	of existing access road to 5.5m formation width	access road	construction works			Municipality
B	**Operation Phase**								
i.	Loss of agricultural productions and local economy	The project will conduct agricultural training to increase production in remaining land using modern tools, improved variety of seeds and livestock assistance; Skill training, employment and other sources of income will also reduced this impact to acceptable level.	agricultural training to increase production in remaining land using modern tools, improved variety of seeds and livestock assistance; Skill training, employment and other sources of income	Trainings of skill development to PAFs	Project DIA	Within 6 months of project operation	Operation Manager	NRs. 500,000	DoWRI NDP
ii.	Water diversion and existing water use right	Project will conduct formal discussions with the downstream water users committees and will support in identifying alternative source along with its management; project will ensure the release of required water	discussions with the downstream water users committees and will support in identifying alternative	Stakeholder consultation and construction of required infrastructures for the management	Downstream of dam upto powerhouse at Sundarijal and downstream water user committees	Operation period	Operation Manager	Will be included in annual project implementation budget	DoWRI NDP

SN	Impact	Mitigation measures	What	Methods	Where	When	Who	Estimated cost	Monitoring and Evaluation
		from the dam to meet the downstream water users requirements.	source along with its management; project will ensure the release of required water from the dam to meet the downstream water users requirements.	of reduced water	areas				
3.	Safety on movement of people due to sudden change release of water in downstream of dam	An early warning system, specifically a siren system will be established to minimize this impact; Early information dissemination mechanism will be established by the proponent to prove early information to downstream communities.	An early warning system, specifically a siren system will be established; Early information dissemination mechanism will be established	Installation of siren and information flow mechanism to downstream communities	Areas below dam at Sundarijal, Gokarna, Pashupatinath, Bagmati bridge at Tinkune and Thapathali	Within 1 month of project operation	Operation Manager NDP	Included in project operation cost	MoEWRI MoCTCA DoWRI DAO, Kathmandu DAO Lalitpur Kathmandu Metropolitan Police Lalitpur Metropolitan Police

SN	Impact	Mitigation measures	What	Methods	Where	When	Who	Estimated cost	Monitoring and Evaluation
4.	Recession of local economy due to withdrawal of construction work	The project will give priority to provide employment to local people during operation phase also as far as possible; Encourage the workers to spend their earnings in a proper way from the time of construction; Facilitate the local people to establish small-scale local industries in the area through their earnings.	Organizing awareness campaign	Organizing awareness campaign for locals of project DIA	Project DIA	Within 6 months of project operation	Project operation manager	NRs 500,000	NDP Gokarneshwor Municipality

14.5 Environmental Enhancement, Mitigation, Monitoring and Management Cost

14.5.1 Cost for Environmental Enhancement and Mitigation

SN	Enhancement/Mitigation Measures	Estimated Cost (NRs)	Remarks
A	**Beneficial Impacts**		
A1	**Construction Phase**		
1.	Vacancy announcement in local newspaper	100,000	
2.	Work related skill training for 100 people of Gokarneshwor Municipality Ward no.1	1,000,000	
3.	Training on dairy product, poultry/livestock farming, vegetable farming, eco-tourism and furniture making	1,000,000	
4.	Construction of new bridge and extension of existing access road regular maintenance of access roads	-	Included in project cost
5.	Higher education/short courses for NDP and SNNP personnel	15,000,000	
6.	Community Support Program cost (0.5% of total project cost) for improvement of education, health, community infrastructures, local roads, street lights, exposure visit to tourist places and enterprises & small cottage industries sites	10,000,0000	
A2	**Operation Stage**		
1.	Biodiversity conservation awareness programs	500,000	
2.	Training on dam operation and maintenance for employment in the project	200,000	
3.	Entrepreneur development trainings to 20 persons annually	500,000	
4.	Community Support Program cost for improvement of education, health, community infrastructures	5,000,000	
	Sub-total	**123,300,000**	
B	**Physical Environment**		
B1	**Construction Phase**		
1.	Reclaiming of the temporary used land, muck disposal area and plantation	2,000,000	

SN	Enhancement/Mitigation Measures	Estimated Cost (NRs)	Remarks
2.	Construction of sedimentation ponds of capacity 20 m^3 each at crusher plant and batching pant site	-	Included in project cost
3	OHS training for labors for the use of PPE	2,000,000	
4.	Regular water sprinkling along the access roads and dusty construction area	5,000,000	
5.	wire fencing in the blasting areas	1,000,000	
6.	Piling up and storage of quarry materials at designated place	-	Included in project cost
7.	Damage on infrastructures due to the blasting and use of heavy equipments	2,000,000	
8.	Construction of septic tanks to collect sewerage waste and its transportation to sewerage treatment plant at Sundarijal	-	Included in project cost
9.	Bioengineering measures including toe wall, gabion, shotcrete, small civil engineering structures and vegetation; construction of slope protection structures such as revetment walls, benches or terraces riprap and spurs at appropriate location	-	Included in project cost
10.	Construction of drainage system along the project access road, at muck disposal area, storage yard, camp area and construction area	-	Included in project cost
11.	Recording of potential natural springs around dam area and along the penstock alignment	2,000,000	
12.	siren installation downstream of the dam	-	Included in project cost
13.	Disaster preparedness training to local of project DIA	500,000	
B2	**Operation Phase**		
1.	Slope stabilization works implementing bio-engineering in the fragile and disturbed areas induced due to the project activities	NRs 2,000,000	
2.	Implementation of slope stabilization measures like bio-engineering method to stabilize the slope and to control the soil erosion having fragile geology if any unstable slope developed in project vicinity during operation	-	Will be included in project operation cost
3.	Collection and storage of grease, engine oil and	500,000	

SN	Enhancement/Mitigation Measures	Estimated Cost (NRs)	Remarks
	other lubricants and unused or date expired toxic chemicals in plastic drums		
4.	Disaster preparedness trainings to the project officials for early response and proper management in disaster condition	2,000,000	
5.	An emergency fund in case of dam failure for rehabilitation and compensation to the affected parties		Will be allocated by GoN, MoEWRI
6.	Physio Chemical parameters of Nagmati	-	Included in monitoring cost
	Sub Total	**17,000,000**	
C	**Biological Environment**		
C1	**Construction Phase**		
1.	Compensation for loss of government land as per forest act, 2076 and forest regulation, 2079	-	Will be included in project cost
2.	Compensatory plantation of 1,000,000 seedlings/saplings at 1:25 ratio	-	Will be included in project cost
3.	Clearance and stockpiling of the felled forest products	-	Will be included in project cost
4.	Forest and biodiversity conservation training programs to labors	500,000	
5.	Maintenance and looking after of compensatory plantation area for 5 years	-	Included in project cost
6.	Biodiversity conservation program implementation in coordination with SNNP	1,000,000	
7.	Study cost for the habitat fragmentation and destruction due to the project to SNNP	2,000,000	
8.	Construction of temporary ponds for providing water to terrestrial wild animals	5,000,000	
9.	Installation of Fire extinguishing equipment	5,000,000	
10.	Firefighting training to project officials	150,000	

SN	Enhancement/Mitigation Measures	Estimated Cost (NRs)	Remarks
11.	Fencing of construction sites and camp area by barbed wire or stone/brick masonry wall		Included in project cost
C2	**Operation Phase**		
1.	Habitat status of wildlife after NDP operation for SNNP for five years	7,500,000	
2.	Implementation of wildlife habitat restoration programs for SNNP for five years	20,000,000	
3	Biodiversity and environment conservation awareness program to local people and operation manpower	500,000	
4	Fencing of permanent office camp sites in the dam area by barbed wire or stone/brick masonry wall		Included in project operation cost
	Sub-Total	**41,650,000**	
D	**Socio-economic and Cultural Impacts Mitigation**		
D1	**Pre-construction Phase**		
1.	Compensation for loss of private land		The amount is included in the Project Cost
2.	Implementation of livelihood rehabilitation programs to PAFs	2,000,000	
D2	**Construction Phase**		
1.	Compensation for loss of crop production (one time compensation during permanent acquisition of land)	1,000,000	
2.	Compensation for loss of trees from private land	650,000	
3.	Establishment of separate water supply for Construction activities and camps		
4.	women empowerment trainings	200,000	
D3	**Operation Phase**		
1.	Agricultural training on use of modern tools, provision on improved variety of seeds and livestock assistance for first 3 years of project	1, 500,000	

SN	Enhancement/Mitigation Measures	Estimated Cost (NRs)	Remarks
	operation to PAFs		
2.	Facilitation trainings and program to the local people to establish small-scale local industries	500,000	
	Sub-Total	**4,350,000**	
	Grand Total	**186,800,000**	

14.5.2 Cost for Environment Monitoring

Summary of environmental monitoring cost is provided in the Table 14-5 below.

Table 14-5: Summary of Environmental Monitoring Cost

S.N.	Environmental Monitoring	Estimated Cost
1.	Baseline Monitoring	4,500,000
2.	Impact Monitoring	5,625,000
3.	Compliance Monitoring	12,750,000
4.	Support to SNNP	
	a. 2 4WD Scorpio and 10 two wheelers to SNNP with fuel and maintenance cost for monitoring works as requested by SNNP	17,000,000
	b. 2 Security posts for monitoring (Deurali and Mahankal)	15,000,000
	Total	**54,875,000**

SNNP Cost Centre

Permanent organization and positions for the proposed two posts should be created through and under the forest line ministry, till then Nagmati Dam Project will support for the minimum requirements through the provisional sum for SNNP support. A separate cost centre at the SNNP will be provided during the implementation through MOFE in consultation with development partner. The higher educztion/short courses and the support to SNNP cost which includes the two security posts and the transportation mentioned above will be included in SNNP cost centre.

14.5.3 Environmental Management Cost

The environmental management cost for staff and consultants of the Environmental Support Unit of the Project Management Office is already included in the civil management cost of the project costs.

14.6 Summary of Environmental Mitigation, Monitoring and Management Cost

Table 14-6 presents the summary of the project environmental costs including the cost included in project cost.

Table 14-6 Summary of the Project Environmental Management Costs

SN	Particulars	Cost (NRs)	% of Total Cost
1	Environmental Enhancement and Mitigation Cost	186,300,000	0.74%
2	Environmental Monitoring Cost	54,875,000	0.22%
Total Environmental Management Cost (Excluding the cost included in the project cost)		**241,175,000**	**0.96%**

14.7 Environmental Management Activities and Action Plans

14.7.1 Implementing Organs

14.7.1.1 Project Stakeholders and their Roles and Responsibilities for Environmental Management

Key stakeholders including NDP, to be involved directly and indirectly in the environment management of the project are:

i. Ministry of Forests and Environment (MoFE);
ii. Ministry of Energy, Water Resources and Irrigation (MoEWRI);
iii. High Powered Commission for Integrated Development of Bagmati Civilization (HPCIDBC);
iv. Department of Water Resources and Irrigation (DoWRI)
v. Department of National Parks and Wildlife Conservation (DNPWC);
vi. Shivapuri Nagarjun National Park (SNNP);
vii. The Proponent-Nagmati Dam Project (NDP)
viii. Project Management and Supervision Consultant (PMSC);
ix. Construction Contractor (CC);
x. Affected Ward-Gokarneshwor Municipality Ward no. 1, Gokarneshwor Municipality, District Coordination Committee of Kathmandu and Lalitpur and District Administration Office, Kathmandu and Lalitpur;
xi. Non-government Organizations (NGOs), Community Based Organizations (CBOs) etc.

The main roles and responsibilities of different parties in the various phases of project development are briefly presented in Table

Table 14-7: Roles and Responsibilities of the Stakeholders

Organizations	Responsibilities	Schedule
Executing Agency (Ministry of Energy. Water Resources and Irrigation)	-Review of the project design. construction and operation activities against approved EIA and EMP measures and national environmental standards	At least once a year during construction
	-Auditing of project general performance during operation phases	Every two years in the operation stage.

Organizations	Responsibilities	Schedule
Ministry of Forests and Environment	-Approving EIA and EMP measures, following national environmental standards and license conditions.	Prior to construction
	-Provide permits for admission and the construction works. including operation of quarry/borrow sites and watershed activities in the SNNP	Prior to. and during construction
DNPWC/SNNP	-Approval of permits for pre-construction activities and permit for staff to enter the SNNP -Approval of permits for construction activities and works in the SNNP -Provide recommendation letter to EIA document	Prior to construction
DoWRI/NDP for the dam design, construction. operation and maintenance of the dam; High Powered Commission for Integrated Development for Bagmati Civilization for the Upper Bagmati river training and beautification works.	-Ensure that the EIA and EMP measures are incorporated in the final project design.	Prior to contract award.
	-Assist contractors in acquire necessary permits and approval for project construction and operation.	Before construction.
	-Ensure that the project construction activities are in accordance with the EMP and other GON legislative requirements.	During construction.
	-Implementation of repair and maintenance of project components including environmental safeguards	During operation.
	-Monitoring and record keeping regarding environmental measures and impacts	During operation
	-Ensure public consultation. participation and involvement in all phase of project implementation	Project period
Project Management and Supervision Consultant (PMSC)	-Oversee environmental mitigation measures as per EIA and EMP are incorporated into the final design. Update the EMP as required during detailed design.	During final design
	-Supervision and impact and compliance monitoring of the construction contractor's activities and environmental mitigation measures as per EMP and provisions of inspection reports.	As per EMP

Organizations	Responsibilities	Schedule
	Conduct environmental monitoring and prepare periodic monitoring reports for submission to ADB and MOFE	As per EMP
	-Assist IA in the implementation and supervision of environmental compensation and enhancement programs and their monitoring and auditing.	As per EMP
	-Ensure all the plans prepared as required and as mentioned in EIA in order to safeguard environment of the SNNP	Prior to construction
	-Ensure public (Locals) participation and involvement in project construction	Construction period (Contractor)
	-Ensure construction contractors follow worker's safety rules and regulations	Construction period
Construction Contractor	-Acquire necessary permits and approval for project construction; entrance to SNNP; and operation.	Before construction.
	-Prepare a detailed Construction EMP (CEMP/EMAP) before construction and get it approved from PMSU. -Implement mitigation measures as specified in the CEMP/EMAP updated by the PMSU as necessary during detailed design.	As per EMP during construction
	-Monitoring and record keeping of environmental mitigation measures	As per EMP during construction
	-Implementation of the corrective actions as recommended by the supervising consultants	As per EMP during construction
	-Ensure public participation and involvement in project construction	Construction stage
Independent Environment Monitoring Consultant	- Review safeguards documents including EIA and EMP and request changes if and when required	Project Period
	- Oversee and periodically monitor Contractor's implementation of the EMP and review control procedures carried out by PMSU and PIUs.	Project Period
	-Review environmental impacts of project	Project Period

Organizations	Responsibilities	Schedule
	interventions and monitor progress with regards to environmental targets and indicators	
	Review reports and report to EA through the PMSU/Project Director on EMP efficiency. contractors' performance and announce corrections needed	Project Period
Affected Ward-Gokarneshwor Municipality Ward no. 1, Gokarneshwor Municipality, DCC of Kathmandu, NGOs and CBOs.	Monitor that the environmental mitigation measures and enhancement measures are implemented in all stages of the project as per EMP	Project Period
MoHA, DAO, Kathmandu and Lalitpur	Lead and Coordinate rescue, rehabilitation and resettlement of affected population by the flooding from dam break	Project Operation/Emergency Cases

To effectively integrate the various stakeholders of Environmental Management of NDP an institutional framework for different phases of project development and implementation is established. The objective of the institutional framework is to establish linkages of the various stakeholders such that project activities are taken forward through a linear command and control, while inputs from the various stakeholders are taken and internalized in the project implementation at various levels of the institutions.

14.7.1.2 Institutional Arrangement

The environmental management framework during construction is based on and integral with the overall project management framework for the project.

The project will be implemented by the Ministry of Energy. Water Resources and Irrigation as the Executing Agency. The Department of Water Resources and Irrigation (DoWRI) is the Implementing Agency (IA) for dams in the SNNP. Upon completion of construction of the NDP, the operation, management and maintenance will be carried out by the office under DoWRI.

The Nagmati Dam will be built through construction contract/s. The implementation of the EMP will be the responsibility of the NDP involving construction contractor/s. The construction contractor/s will be responsible for implementing mitigation requirements as mentioned in the construction specifications. The NDP will consult DCC, Gokarneshwor Municipality, Gokarneshwor Municipality Ward no. 1, DAO, SNNP as necessary. Majority of staff will be appointed or deputed on the leadership of the Project Chief/Director for NPD from Government and from the DoWRI (Table 14-8). The organizational chart for execution of environmental management is resented in Figure 14-1.

Table 14-8: Project Management Staffing for NDP from Government/DoWRI

Project Chief/Director				
Planning, Design and Research Section	**Procurement and Contract Management Section**	**Monitoring and Quality Control Section**	**Social and Environmental Section**	**Administration/ Account Section**
Senior Engineer -1	Senior Engineer -1	Senior Engineer -1	Senior Engineer -1	Administrator (Na.Su) -1
Sub-Engineer-1	Sub-Engineer-1	Engineering Geologist-1	Senior Association Organizer-1	Accountant-1
		Sub-Engineer-1	Sub-Engineer-1	Support staffs -5
			Environment specialist and Sociologist will be supported from the DWRI	

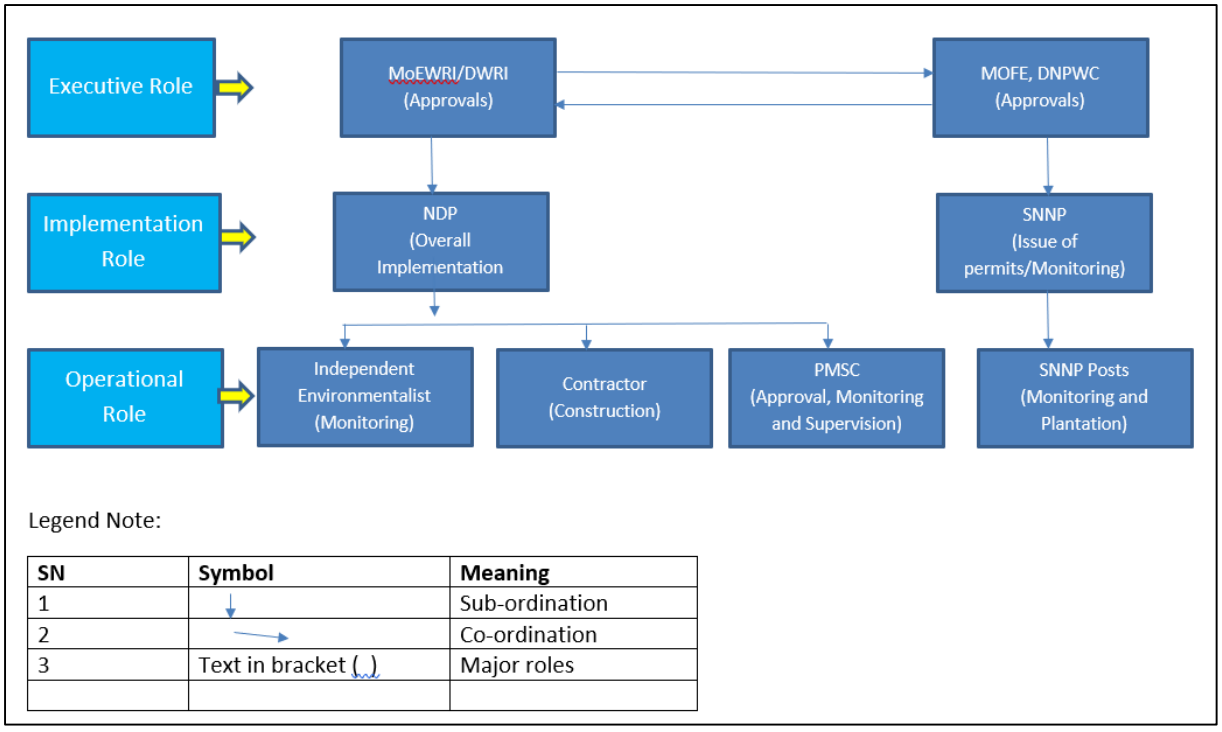

Figure 14-1: Organization Chart of NDP for Environment Management

A Project Management and Supervision Consultancy (PMSC) will support the Project Chief/Director of the NDP, and provide training to the Government staff in the project. Construction activities will be overseen by the NDP supported by the PMSC.

Staffing for the PMSC is shown in Table 14-9. Tentative staffing of Project Management and Supervision Consultant (PMSC) team will include an Environmental Safeguard Specialist and a Social Safeguard Specialist in order to safeguard construction works of the Nagmati Dam. The PMSC will be responsible to monitor and supervise dam construction works and its associated structures including the access road. The PMSC will also be responsible to monitor and supervise safety works carried out by the construction contractor during construction. and monitor actual impacts within the SNNP during the time of construction.

The PMSC environment specialist will support the NDP environmentalist in the implementation of the ESMP. The PMSC environmental specialist will provide training in environmental monitoring, evaluation and assessment to the staff. This will consist on on-the-job-training to the Safeguard and M&E Unit staff. Specific and technical short-term courses will be given to NDP staff, other relevant staff in DoWRI. Besides, the PMSC environmentalist will support in EIA monitoring, evaluation and reporting to senior level staff, also to make them aware and familiar with the EIA procedures requirements and their importance.

Table 14-9: Project Management and Supervision Consultant staffing

<table>
<tr><td colspan="5">Team Leader</td></tr>
<tr><td colspan="5">Deputy Team Leader</td></tr>
<tr><td>RE- Civil</td><td>RE- Dam / Design Specialist</td><td>Environmental Safeguard Specialist</td><td rowspan="3">Social Safeguard / Public Relation Specialist</td><td>Account and Finance Officer</td></tr>
<tr><td>IOW-Civil</td><td>IOW-Dam</td><td rowspan="2">Environmental Specialist/ Watershed/Protected Area Management Specialist</td><td rowspan="2">Junior Finance Officer</td></tr>
<tr><td>Junior Engineer</td><td>Junior Engineer</td></tr>
<tr><td colspan="5">Admin Officer</td></tr>
</table>

There will be three supporting environmental staffs under PMSC for monitoring. Evaluation, and construction supervision as well as to fulfil all the EIA requirements ensuring proper implementation of mitigation measures during the time of construction. The proposed environmental staffs under EMP are Environmental Safeguard Specialist. Environmental Specialist/Watershed/Protect Area Management Specialist and Social Safeguard Specialist will be responsible to fulfil all the EIA requirements. Social Safeguard Specialist will further be responsible to settle all the social issues and any unforeseeable issues encountered during the time of construction.

14.7.1.3 Monitoring/auditing and Keeping Performance Record and Reporting Requirements

To demonstrate compliance with the environment health and safety management, the proponent will instruct the construction contractors through supervising engineer to maintain daily records of his/her mitigation implementation and monitoring works at its office during the construction phase. Apart from this, contractors will keep records of the employment of the project PAF, local area people, Nepali and foreigner and will submit such records to the Supervising Engineers every month. Similarly records of occupational health will also be documented submitted to Supervising Engineer every month. Besides, records of instructions,

trainings, and land area rented with agreements will also be submitted to the Supervising Engineers regularly. Similarly, the NDP-PMSC will maintain all the records of felled trees, land area acquired, and expenses of land acquisition, resettlement and rehabilitation and other environmental enhancement programs implemented.

The NDP-PMSC will carry out monitoring/auditing works of the activities of the construction contractors. The retrievable records of contractors will be kept by the NDP-PMSC and forwarded to the project engineer. NDP-PMSC in coordination with the Supervising Engineer will fix dates for monthly meetings on Environmental management, and Health and safety with the contractor. Such meetings will be chaired by Supervising Engineers, while the Environment Manager of unit will also be present in the meeting. Environmental Manger will brief on the project performance related to environment and social issues and flag issues to be resolved in the construction sites with recommendations on corrective actions. The corrective actions and reporting will have the followings:

- Identification of incidences of non-compliance
- In case of non-compliance, identification of responsible person of the proponent/contractor to take necessary actions
- Recommend actions for compliance with specific timelines for compliance and person responsible for compliance

The meetings deliberation and agreements with the contractors will be recorded and signed for future actions. As per the requirement, the environmental manager will send the corrective actions to be taken by the contractor through supervising engineer.

The bi-monthly reports produced by the NDP-PMSC will be distributed to the concerned stakeholders for their comments and suggestions.

The NDP-PMSC will compile the environmental monitoring/auditing report of the construction phase within 3 months of the construction completion and submit to proponent. Proponent will pass the report to stakeholders to get feedback and provide database of environmental management works of the Proposal for future use.

In the operation phase, the Operation Manager, will keep records of the mitigation and monitoring as required at site office. Once a year, the Operation Manager will prepare a compiled report of the project operation. The report will be passed to the concerned stakeholders for comments and suggestions. The operation management office will carry out any recommendations and suggestion of the concerned stakeholders.

14.7.2 Contractor's Responsibility for Environmental and Social Compliance as per EMP

The contractor is responsible to prepare the following plans as stipulated in EMP and its subsequent obligations under each plan. The plans will be inclusive in a broader Environmental Management and Execution Plan (EMEP) of contractor to be submitted by the contractor to the client. The project management will include the above provision in the contract document as priority clause for compliance and costing as required. The EMEP will

be approved prior to the implementation of contractor's mitigation obligations or as per deadline highlighted in the contract document.

The contractor should prepare EMEP and submitted to the engineer or NDP management within 60 days of mobilization of the contract.

The plans to be submitted by the contractor in EMEP includes:

- Construction camps management plan,
- Temporary land acquisition plan,
- Air, water, land and noise pollution abatement plan,
- Terrestrial and aquatic ecology management plan,
- Soil erosion, landslide, and sedimentation control plan,
- Blasting management plan,
- Stockpile and borrow pits management plan,
- Construction waste and muck/spoil management plan,
- Public and occupational health and safety plan,
- Environmental awareness and training plan,
- Accident and emergency management plan,
- Traffic and access management plan,
- Site restoration plan,
- Complain handling plan

The implementation modality of above plans will be clearly mentioned by the contractor in EMEP.

The implementation modality will include the organizational structure of EMEP implementers, timeframe, methods, monitoring and reporting mechanisms.

The minimum obligation of the contractor to be included in each of the specified plans will be as per the basis features of plans discussed above and mitigation section of the EIA report and should include details of actions, timing of action and redress mechanism in the event of failure to comply with the actions. List of construction/operation management plan is attached in Annex 26.

14.7.3 Environment Management Action Plans

As an environmental management actions, a number of management plans will be implemented throughout pre-construction, construction and operation phase of the project which includes Permits and Approval Plan, Construction Camp Management Plan, Construction/operation Impact Management Plan, Resettlement and Rehabilitation Plan, Environment Awareness and Training Plan, Accident and Emergency Management Plan, Traffic and Access Management Plan, Complain Handling Plan, Site Restoration Plan etc.

14.7.3.1 Permits and Approval Plan

The objective of permits and approvals is to comply with the government legislative requirement/procedure and to keep cordial relationships with the project stakeholders.

There are a number of legislative requirements which demands prior permits and approvals from the concerned government agencies to commence the work. Besides, for the smooth operation of project construction and operation works some activities would require general consensus of the project affected families and/or project area communities. In these cases project management should take prior permits and approvals or consensus of the people or individuals before the start of the activities. The project should ensure that all the permits and approval or consensus of the general public is taken before the start of the activities. The permits and approval or consensus required for the project are presented in Table 14-10 below.

Table 14-10: Permits and Approval Plan

SN	Required Permits and Approval	Agency from where permits and approval or consensus required	Implementation Time in project lifecycle	Responsibility
1	EIA Approval and Issuance of construction license	Ministry of Forests and Environment and Department of Electricity Development, Ministry of Energy Water Resources and Irrigation	Pre-construction	NDP Management
2	Tree clearing from SNNP forests	SNNP, DNPWC, MoFE	Pre-construction	NDP Management
3	Permanent/temporary land (public) acquisition	Chief District Officer, Kathmandu	Pre-construction	NDP Management
4	Permanent/temporary land(private) acquisition	Landowners	Pre-construction	NDP Management
5	Entry to private land and property, if required	Landowners	Construction	Contractor
6	Relocation/disturbance/obstruction to infrastructure such as foot trails, irrigation facilities, water supply facilities, telephone lines, electricity lines etc.	Affected parties/individuals/Ward Offices	Construction	NDP Management Contractor

All approval and permits will be procured at least a week before the start of pre-construction and construction works by the environment stakeholders as listed in the table above. The permits and approval will be documented and recorded in the Project information center at the site.

14.7.3.2 Construction Camps Management Plan

The objective of construction camp management plan is to help address potential negative impacts on local communities through the introduction of approximately 830- person construction work force. Besides, the construction preparation activities at the site; establishment of various camps for the engineers/contractors/workers; storage and mechanical yard have lasting consequences in local environment and society. Therefore, the project

proponent/construction contractor will implement a series of activities related to the management of construction workforce and camp as given in the Table 14-11 below.

It is therefore, planning for traffic management (on site and along the road corridor) and management of construction camps and storage facilities (fuel, hazardous materials, and explosives) are very crucial on the overall environmental management plan. A proper and sensible planning at this stage will avoid likely environmental and social adverse consequences. The highlights of construction camps and traffic management plan are presented in Table 14-11.

Table 14-11: Construction Camps Management Plan

SN	Activities	Timing of Actions	Responsibilities
A	***General management requirement***		
1	Pre-information to the local area people on the start date of project preparation works and the range of activities to be undertaken	Pre-construction (Start of construction preparation at site)	NDP Management
2	Whenever possible, recruit locally available workforce, provide appropriate training as necessary	Pre-construction (At least 15 days prior to start of construction work)	Contractor
3	Address and manage potential ethnic tensions between workers and the local communities, increase risk of prostitution and communicable disease, theft, drug and alcohol abuse, market distortion due to temporary inputs of local economy and other local tensions such as unemployment, ethnicity and divergent cultural values	Throughout the construction period	Contractor
4	Site clearance and construction plan for construction camps (engineer, contractor, labor force, mechanical yards, long term storage facilities for lubricants, fuel, and explosives etc) with plans to save top soil for later use	Pre-construction (Start of construction preparation at site)	Contractor
5	Checking and approval of plan (check landscape harmony, adequacy of space, room size, ventilation system, fire hazard equipment placements, toilets, water supply system, communication systems, medical facilities, drainage system, common cooking and dining space, sewage treatment system, recreational facilities, solid waste collection and storage facilities, top soil excavation, and storage area for later use, muck placement site for later final disposal in muck spoil disposal sites, fencing, hoarding board placement sites etc.)	Pre-construction (Start of construction preparation at site)	Supervising engineer PMSU
6	Provide adequate and suitable facilities for washing cloths and utensils for the use of contract labor employed therein	Throughout the construction period	Contractor
7	Provide suitable, safe and comfortable accommodation for the workforce	Throughout the construction	Contractor
8	Provide adequate lavatory facilities (toilets and washing area) for the number of workers expected on site, plus visitors. Toilet facilities should be provided with adequate supplies of clean and potable water and soap. Separate and adequate bathing facilities for the use of male and female workers	Throughout the construction	Contractor

SN	Activities	Timing of Actions	Responsibilities
9	Provide recreational facilities to the workers in the camp area	Throughout the construction	Contractor
10	Provide safe potable water for food preparation, drinking and bathing	Throughout the construction	Contractor
11	Establish a method and system for temporary storage and disposal of recycling of all solid waste generated by the labor camp	Throughout the construction	Contractor
12	Provide alternate fuel source for cooking or heating in any labor camp or base camp and do not allow the use of fuel wood from local forest	Throughout the construction	Contractor
13	Ensure the storage of diesel fuel and lubricants are not located within 50 m of watercourses and operated so that no pollutants enter into the watercourse, either overland or through groundwater seepage, especially during the period of rain.	Throughout the construction	Contractor
14	Locate concrete batching plant at least 200m away of any residence	Throughout the construction	Contractor
15	Provide medical and first aid facilities at each camp area	Throughout the construction	Contractor
16	Proper disposal of medical waste	Throughout the construction	Contractor
B.	***Security:*** *Security measures will be in place to ensure the safe and secure running of the camp and its residence.*		
17	Provide access to construction camp only for residing workforce and construction camp employees and develop provision for prior approval from the camp manager for visitor access to the construction camp	Throughout the construction	Contractor
18	Provision for adequate, day-time night-time lighting	Throughout the construction	Contractor
19	Provision and installation in all buildings of firefighting equipment and portable fire extinguisher	Throughout the construction	Contractor
C	***Maintenance of camp facilities:*** *Maintenance of camp facilities will be done to ensure that the construction camp and its facilities will be organized and maintained to acceptable and appropriate standard*		
20	Establish a designated camp cafeteria under strict sanitary and hygiene conditions	Throughout the construction	Contractor
21	Establish designated meal time, rest time, recreational hours	Throughout the construction	Contractor
22	Adequate lighting in latrine and urinals and maintain clean sanitary condition in all times	Throughout the construction	Contractor
23	Provide clean water in the latrine all the times through tap or storage in drums	Throughout the construction	Contractor
24	Provision for complain register to receive and respond to complaints from the construction camp residents regarding facilities and service provided	Throughout the construction	Contractor
Δ	**Code of conduct (Behavior):** A major concern during a construction of the project is the potentially negative impact of the workforce interaction with local communities. For that reason, a Code of Conduct will be establish to		

SN	Activities	Timing of Actions	Responsibilities
	outline the importance of the appropriate behavior, drug and alcohol abuse, and compliance with relevant laws and regulations. Each employee will be informed of the code of conduct and bound by it while in the employee of the client or its contractors. The code of conduct will address, but not limited wthin the following measures;		
25	Workers and subcontractors abide by the laws and regulation of Nepal	Throughout the construction	Contractor, NDP Management
26	Prohibit illegal substances, weapons, firearms, pornographic materials, gambling, alcohol and drug abuse	Throughout the construction and operation	Contractor, NDP Management
27	Prohibit hunting and trading of wild animals	Throughout the construction and operation	Contractor, NDP Management
28	Prohibit disrespecting local customs and traditions	Throughout the construction and operation	Contractor, NDP Management
29	Prohibit smoking and sexual harassment in workplace	Throughout the construction and operation	Contractor , NDP Management
30	Take disciplinary action for those who don not comply with code of conduct, or the rules, regulation and procedures implemented at the camp	Throughout the construction and operation	Contractor , NDP Management

The contractor will be responsible for the preparation of plan immediately after the contract award and site inspection. The plans will be checked to the adequacy as per the minimum requirements for the management of construction camps management and will be approved by the supervising engineers and the environmental officer before the start of the work. All plan documents will be kept in retrievable form by the project management office. One copy of the document will be at the Project Information Office. All data as per the plan will be kept in retrievable form by the contractor at its site office and will regularly furnish the information as demanded by the Supervising engineer and project environmental officer. For the operation phase, the project operation manager will prepare the plan and implement the plan and keep records of the implementation as required by the plan at retrievable form and present the report when demanded by the NDP management or the external auditor.

14.7.3.3 Other Management Plan

In order to implement the project in environmentally and socially sensible manner, apart from environment management plan mention above, the project proponent and the construction contractor is responsible for preparing the following plans:

14.7.3.3.1 Compensatory Plantation Plan

The objective of this plan is to ensure the effective implementation of the compensatory planation to compensate the tree loss due to project implementation. The project will ensure the effective regeneration/afforestation from the compensatory plantation. The compensatory plantation will be conducted in the similar geographical and climatic area as per as possible. The plantation area will be managed in negotiation with SNNP and DNPWC. An MOU will

be made between project and SNNP regarding to this provision.Compensatory plantation plan with allocated cost with implementation responsibility is presented in the Table 14-12 below.

Table 14-12: Compensatory Plantation Plan

SN	Actions	Timing of Action	Allocated cost	Responsibility
1	Tree cutting and plantation	Pre-construction (6 months before construction)	NRs. 978,322,500	NDP Management in co-ordination with SNNP and DNPWC
2	Identification and finalization of the plantation area	Pre-construction (2 months before construction)	NRs 1,000,000 barbed-wire fencing	NDP Management in negotiation with SNNP and DNPWC
3	Clearance and stockpiling of felled trees	Pre-construction (1 month before construction)	NRs. 2,000,000	PMSU coordination with SNNP
4	Selection of the locally suitable tree species for the plantation	Construction Stage (2 months after construction works started)	-	PMSU coordination with SNNP
5	Plantation of the locally suitable tree species in the selected area	Construction Stage (4 months after construction works started)	-	PMSU in coordination with SNNP
6	Appointment of Heralu for 5 years to take care the plantation area	Construction Stage (4 months after construction works started)	NRs 18,000,000	PMSU
7	Handing over of plantation area to SNNP	5 years after the completion of plantation work	-	NDP management in coordination with concerned parties

14.7.3.3.2 Dam Safety Emergency Management Plan

The NDP has prepared dam safety emergency management plan (DSEMP) in case of unanticipated dam failure. The objective of this plan is to enable responsible personnel to:

- Identify conditions which could endanger the integrity of Nagmati Dam which require immediate action;
- Prescribe procedures which should be followed by Department of Irrigation personnel to respond to, monitor, respond and mitigate these emergency conditions at the dam, and
- Provide timely warning to and liaison with appropriate emergency management agencies for their implementation of protection measures for downstream communities.

The Nagmati Dam DSEMP achieves these aims by:

- Establishing a chain of responsibility.
- Setting up effective communication channels, and
- Getting the right people to the right place at the right time.

This DSEMP is designed to provide high level guidance to enable those with responsibilities under the Plan to use their own experience and judgement to best manage the emergency

response. It does not contain detailed contingency actions to mitigate identified failure modes at the dam. It applies to possible, suspected and actual dam safety emergencies involving Nagmati Dam, and outlines 'who does what, when, where and how' during a dam safety emergency. Summary of possible actions with potential responsible person/organization for emergency response in the event of dam failure has been provided in Table 14-13 below.

Table 14-13: Dam Safety Emergency Management Plan

SN	Actions	Timing of Actions	Responsibility
1.	Prepare a 'Dam Safety Message' with all known information about the emergency, emphasising the magnitude of the situation. Notify relevant stakeholders of dam safety emergency management plan to trigger relevant emergency responses: Notify Kathmandu Metropolitan Police Radio Room of dam safety emergency to trigger relevant emergency responses: - Fax/email 'Dam Safety Message'. - Phone to confirm receipt of message.	Immediately after the start of dam failure event	Project Operation Manager/Emergency Event Manager/DoWRI-NDP
2.	Implement relevant emergency responses in accordance with the emergency procedures and in accordance with the advice from the Emergency Event Manager. Responses may include: - Preparedness, evacuations and road & bridge closures.	Within 15 minutes of the start of dam failure even	Kathmandu Metropolitan Police
3.	Communicate with the Government Ministers and Officials and the media Implement 'National Disaster Response Framework 2013'		
4.	an Emergency Operations Centre (EOC) in Department of Irrigation office in Jawalakhel, and ensure that all communication channels are open – landline phones, mobile phones, hand held radios, fax and emails. Maintain a presence at the Emergency Operations Centre for the duration of the dam safety emergency (where appropriate). Maintain a formal 'Event Log' of the entire dam safety emergency including communications, information received, actions carried out and decisions made.	Within 30 minutes of the start of dam failure event	Incident Management Team District Disaster Relief Committee Central Natural Disaster Relief Committee Kathmandu Metropolitan Office Kathmandu Metropolitan Police Radio Room Civil Military Coordination Centre Armed Police Force Chief – Gokarneshwor Municipality

SN	Actions	Timing of Actions	Responsibility
			Chief – Kathmandu Metropolitan City Department of Hydrology and Meteorology (if flood related) Department of Mines and Geology (if earthquake related) Other External Organisations as required
5.	Continue to communicate with the relevant authorities as required throughout the dam safety event to provide updates on site conditions.	Immediately after the start of dam failure event	
6.	Mobilise and instruct the Incident Management Team to develop an 'Action Plan' to detail how the dam safety emergency will be managed.	Within 1 hour of start of the dam failure event	
7.	Complete a 'Status Report' at regular intervals throughout the dam safety emergency, in particular following dam inspections by the Field Personnel, significant changes in the incident or decisions made. Use judgement to determine the appropriate frequency of reporting on the condition of the dam.	Within 1 month from the dam failure event	
8.	Allocate Budget for the rehabilitation and resettlement of the impacted population	Should be included in Project operation for early preparedness	

14.7.3.3.3 Resettlement and Rehabilitation (R&R) Plan

The objective of this plan is to ensure that the effects of acquiring land, property and community resources acquisition on the livelihood of the affected parties and individuals are addressed adequately and in time prior to the start of the project construction in an amicable and conducive environment with mutual consensus and agreement. Any grievances of the affected parties will be handled to the satisfaction of the affected parties or individuals through proper information sharing. The main elements of the R&R Plan are presented in Table 14-14.

Table 14-14: Resettlement and Rehabilitation (R&R) Plan

SN	Actions	Timing of Action	Responsibility
1	Identification of the owners of the land and private properties , land plot numbers and re-verification of landownership or parties traditionally using land	Pre-construction (6 months before construction)	NDP Management in co-ordination with concern parties

	without land certificates, if any		
2	Decision on compensation and rehabilitation packages in policy compliance with R&R report of the project	Pre-construction (4 months before construction)	NDP Management in negotiation with affected parties
3	Award of compensation and rehabilitation packages to the affected parties and individuals	Pre-construction (3 months before construction)	NDP Management
4	Evacuation of the owners from the land, if any	Pre-construction (At least three months will be given to the affected parties to remove their belongings if any)	NDP Management in co-ordination with local government bodies
5	Handling of grievances of the affected parties and individuals	During land/property acquisition and construction	NDP Management/ PMSU
6	Monitoring of the implementation of R&R	Pre-construction and construction	PMSU

The R&R plans will be prepared by the NDP management at least three months before the start of land and property acquisition. All the documents will be public disclosed. A copy of the report will be placed at the Information Center at the site and can be access in request by concern parties.

14.7.3.3.4 Environmental Awareness and Training Plan

The objective of the environmental awareness and training plan is to make aware and educate the project management team, engineers, supervisors, contractors and the workforce on the environmental issues of the project on how each individual could contribute in the upkeep of the environmental resources of the project area. Besides, the trainings will also focus on the key responsibilities of the individuals involved in project management for environmental related decision making on implementation, monitoring, reporting and corrective actions.

Since environmental management is a continuous process, apart from the general training to the managers and engineers of project management and contractors, a trainers training will be provided to the section heads responsible of the PMSU. The contractor in co-ordination with the PMSU will organize awareness and training program to the staff: sub-contractors and key representatives of the contractors on environmental legislation, approvals and permits and environmental issues and measures to abate the negative impacts during the respective period.

The training will also focus on the Operational Health and Safety (OHS), emergency response measures, reporting and complaint handling procedures and other safety measures to be adopted during the construction period. The Environmental awareness and Training Plan is presented in Table 14-15.

Table 14-15: Environmental Awareness and Training Plan

SN	Actions	Target Groups	Timing of Action	Responsibility
1	Orientation and Environmental Training related to NDP including OHS	Project decision Making Contractor Management Team	Pre-construction	PMSU in co-ordination with environmental consultant
2	Orientation and Environmental Trainers Training related to NDP with focus on mitigation and monitoring	Representative of the contractor and PMSU	Pre-construction	NDP Management in co-ordination with environmental

	actions (EMP Implementation) including OHS requirements			consultant
3	Orientation and Environmental training to the project operators on oil handling, storage, and recycling, occupational health and safety, and emergency preparedness	Project operation team	At the beginning of the operation phase	NDP Management in co-ordination with the electro-mechanical contractor and environmental consultant

The environmental awareness and trainings will be provided at least a month before the start of the actual construction works. For the operation phase such training will be provided before the handover of the electromechanical facilities to the NDP management. All training materials and the staffs taking training will be documented and a copy of the document will be kept in the public information center in the respective office at the site.

14.7.3.3.5 Accident and Emergency Management Plan

The Accident and Emergency Management Plan need to be prepared to handle unforeseen events during emergency operations. This emergency management plan highlights some key feature of the emergency preparedness in the event of such unforeseen events (Table 14-16).

Table 14-16: Accident and Emergency Management Plan

SN	Activities	Timing of Actions	Location	Responsibilities
1	Prepare and submit accident and emergency management plan to be adopted including emergency response method to PMSU for approval	Pre-construction (at least a month before starts of construction work)		Contractor
2	Approval on such plan with or without modification	Pre-construction		PMSU
3	Provision of helipad for emergency evacuation of injured or other people	Pre-construction	Construction site	Contractor
4	Establish and operate health clinic/dispensary within the camps. Ensure health service facilities are equipped with sufficient capacity to serve the maximum workforce size and are maintained in good and clean order by the appointed authorized medical doctors and health workers	Construction	Construction site	Contractor
5	Proper implementation of OHS plan, Public and Occupational Health and Safety Plan	As designated in the plan	As designated in the plan	Contractor, operation manager
6	Provision of standby ambulance to evacuate the injured at the earliest to project site hospital	Construction	Powerhouse and headwork area	Contractor
7	Provision of stabilizing equipments and facilities to the injured before he/she could be moved to the nearest hospital with good	Construction	Project Hospital, Health care facility	Contractor

	facilities			
8	Provision of medical stock particularly for water borne diseases to tackle the epidemic in the camp or in the villages surrounding the project site	Construction	Construction site health camp	Contractor
9	Provision of firefighting equipment and regular fire fighting trainings and drills at least once in six months	Construction, operation	Construction site/ powerhouse area	Contractor, Operation Manager
10	Provision of sirens to inform the people of the emergencies (fire hazards, blasting operations, chemical hazard, traffic accidents, earthquake etc.) and drill operations	Construction, operation	Powerhouse, camp sites, Headworks, Tunnel portals	Contractor, Operation Manager
11	Emergency preparedness training and on drill operation (floods, release of water from dam, epidemic outbreak, earthquake etc.) at least every 6 months	Construction, Operation	All project site/ powerhouse and headwork and dewatered stretch	Contractor, Operation Manager
12	Warning signs, symbols, notices will be used for restricted access to the main dam and critical structures. Dedicated human resource including security force will be employed.	Operation	Construction site	Operation Manager
13	Monitoring of the above activities	Construction, Operation	As designated	PMSU/ Operation Manager

14.7.3.3.6 Traffic and Access Management Plan

There is an increased risk of accidents due to increased traffic during the construction phase. The Contractor will arrange special provision of traffic management and road safety measures to avoid traffic congestion and road accidents during construction. The plan will include activities presented in the Table 14-17.

Table 14-17: Traffic and Access Management Plan

SN	Activities	Timing of Actions	Responsibilities
1	Identification and preparation of sites for the parking of the project vehicles (off the road site)	Pre-construction (Start of construction preparation at site)	Contractor in coordination with PMSU
2	Preparation of a Guideline for construction vehicle operation (speed, use of horn, parking on the road and off the road etc.) and meet pollution criteria green stickers, Transport Emergencies, timing of movement, traffic personel deployment	Pre-construction (Start of construction preparation at site)	Supervising engineer , PMSU
3	Speed bumps to limit the vehicle speed in the school and market areas	Pre-construction (Start of construction preparation at	Supervising engineer , PMSU

SN	Activities	Timing of Actions	Responsibilities
		site)	
4	Warning signals at appropriate locations	Pre-construction (Start of construction preparation at site)	Supervising engineer , PMSU
5	Training to the drivers involve in construction works to avoid and take precautions on vehicular accidents	Construction	Contractor
6	Awareness program related to road safety and vehicular accidents to the local communities	Construction	Contractor
7	Regular maintenance of access road up to the standards required for compliance of environmental limits of air pollution and noise and vibration levels	Construction	Contractor
8	Monitoring of compliance of above activities	Pre-construction and construction	PMSU

The PMSU will monitor on the implementation of traffic and access management plan and guide the Contractor through the project office to adopt the measures accordingly.

14.7.3.3.7 Site restoration plan

The primary objective of the plan is to rehabilitate the affected land area, facilities, construction sites, muck/spoil disposal sites, quarry sites, storage and mechanical yards, temporary camp sites, solid and liquid waste storage and treatment sites etc once the construction works and its utility for the construction period is over in the designated site. This activity is envisaged to clean up the pollution created by the construction activities on land, water and air and help to restore the general aesthetic of the area similar to pre-construction period. The key highlights of the plan are presented in Table 14-18.

Table 14-18: Site Restoration Plan

SN	Activities	Timing of Actions	Location	Responsibilities
1	Prepare a site restoration plan including landscaping re-vegetation plan particularly for those locations where severe or high landscape and visual impact are expected	Pre-construction/ construction	All impaired sites	Contractor, PMSU
2	Rehabilitate the excavated slopes of the construction areas using appropriate bio-engineering, plantation/vegetation	Post-Construction	Access roads, penstock area, powerhouse, tailrace	Contractor
3	Rehabilitate the drainage networks as to the requirement (some area might need strengthening while in some it might have to demolished completely to give the land and drainage to natural condition)	Post-Construction	Access roads, camps, storage area, powerhouse, muck and spoil disposal sites etc	Contractor

SN	Activities	Timing of Actions	Location	Responsibilities
4	Demolish all unnecessary structures, their foundations, and clean up and reclaim the sites to pre-construction phase	Post-construction	Temporary residential camps, storage and mechanical yards, batching plant, aggregate crushers, and washing plants, waste water treatment sites and aggregate washout discharges etc.	Contractor
5	Rehabilitate the muck disposal site with proper drainage facility as per approved plan. Use the saved top soil on the top of the muck sites to develop the land in an usable land for afforestation/ or other purpose as per the recommendation of the PMSU	Post-Construction	Muck disposal site	Contractor
6	Rehabilitate quarry and borrow pits area in such that puddles and depressions are not left out	Post-construction	Quarry area	Contractor
7	Remove oil and fuel container contaminated and buried in waste disposal area			
8	Landscape all affected area and cover with grasses and vegetation as appropriate without delay	Post-construction	All affected area	Contractor
9	Clean up of all sites and dispose excess materials properly	Post-construction	All project area	Contractor
10	Properly cover and effectively sealed off all soak pits and septic tanks	Post-construction	All soak pits and septic tanks	Contractor
11	Handover the temporary land acquired sites to the respective owner and get a certificate of handover for submission to PMSU	Post –construction	Quarry Area /Labor camps	Contractor

The site restoration with the above provisions will be prepared by the contractor including the provisions listed in the mitigation chapter in EIA and agreement with the private parties by the contractor at least a year before the closer of the construction works. The environmental officer will review and approve the document with needed changes. This document will be placed in the public information center as reference document for monitoring.

14.7.3.3.8 Disaster Risk Management/Reduction Plan

The Disaster Risk Management/Reduction Plan (**Table 14-19**) need to be prepared to reduce the damage caused by natural hazards like earthquakes, floods, droughts etc., through an ethic of prevention. Disasters often follow natural hazards. A disaster's severity depends on how

much impact a hazard has on society and the environment. For the effective protection of the dam, Dam Safety Emergency Management Plan, Dam Safety Surveillance Manual and Dam Operation and Maintrnance Manual have been prepared and accordingly foolowed.

Table 14-19: Disaster Risk Management/Reduction Plan

SN	Activities	Timing of Actions	Location	Responsibilities
1	Prepare and submit disaster risk management/reduction plan to be adopted including emergency response method to PMSU for approval	Pre-construction (at least a month before starts of construction work)		Contractor
2	Approval on such plan with or without modification	Pre-construction		PMSU
3	Provision of helipad for emergency evacuation of injured or other people during disaster	Pre-construction	Construction site	Contractor
4	Ensure health service facilities are equipped with sufficient capacity and are maintained in good and clean order by the appointed authorized medical doctors and health workers	Construction	Construction site	Contractor
5	Provision of standby ambulance to evacuate the injured at the earliest to project site hospital during disaster	Construction	Powerhouse and headwork area	Contractor
6	Provision of stabilizing equipment and facilities to the injured before he/she could be moved to the nearest hospital with good facilities	Construction	Project primary care unit, Health care facility	Contractor
7	Provision of firefighting equipment and regular fire fighting trainings and drills at least once in six months	Construction, operation	Construction site/ powerhouse area	Contractor, Operation Manager
9	Provision of sirens to inform the people of the emergencies in disaster (flood hazards, fire hazards, earthquake, chemical hazard, etc.)	Construction, operation	Powerhouse, camp sites, Dam,	Contractor, Operation manager
10	Emergency preparedness training and on drill operation (floods, release of water from dam, epidemic outbreak, earthquake etc.) at least every 6 months	Construction, Operation	All project site/ powerhouse and dam and dewatered stretch	Contractor, Operation Manager
11	Monitoring of the above activities	Construction, Operation	As designated	PMSU/ Operation Manager

14.7.3.3.9 Complaint Handling Plan

The project company will establish complain handling procedures to allow Project Affected Persons (PAPs) to appeal any disagreeable decisions, practices and activities arising from compensation for land and assets. There is the potentiality for many types of complains: complains related to land/property loss, complains related to compensation or entitlement and complains related to environment. During construction, the contractor will promptly inform the complaints received from individuals or communities or institutions in written or verbal to

the liaison officer, for necessary actions. Complaints received during the period must record and maintained in a separate book with the following details:

- Nature and type of complaints,
- Type of communication (written or verbal),
- Date and time of complainant, and
- Name and address of the complainer.

The Grievance Redressal Mechanism for land/property loss and compensation or entitlement will be based on Land Acquisition Act, 2034 (1977 AD amendment in 1993 AD). During the project construction, the representative of NDP will collect grievances of the workers and bring it to the NDP for the resolution of the grievances. A more deatiled grievance redressal mechanism will be institutionalized during the construction period.

Grievance Redressal Mechanism for the complain of local people