Council for Development and Reconstruction

Greater Beirut Water Supply Augmentation Project Environmental and Social Impact Assessment

Final Environmental and Social Impact Assessment

Volume 2 of 2

L12002-0100D - August 2014

dar al-handasah
shair and partners

Greater Beirut Water Supply Augmentation Project
Environmental and Social Impact Assessment

APPENDIX A

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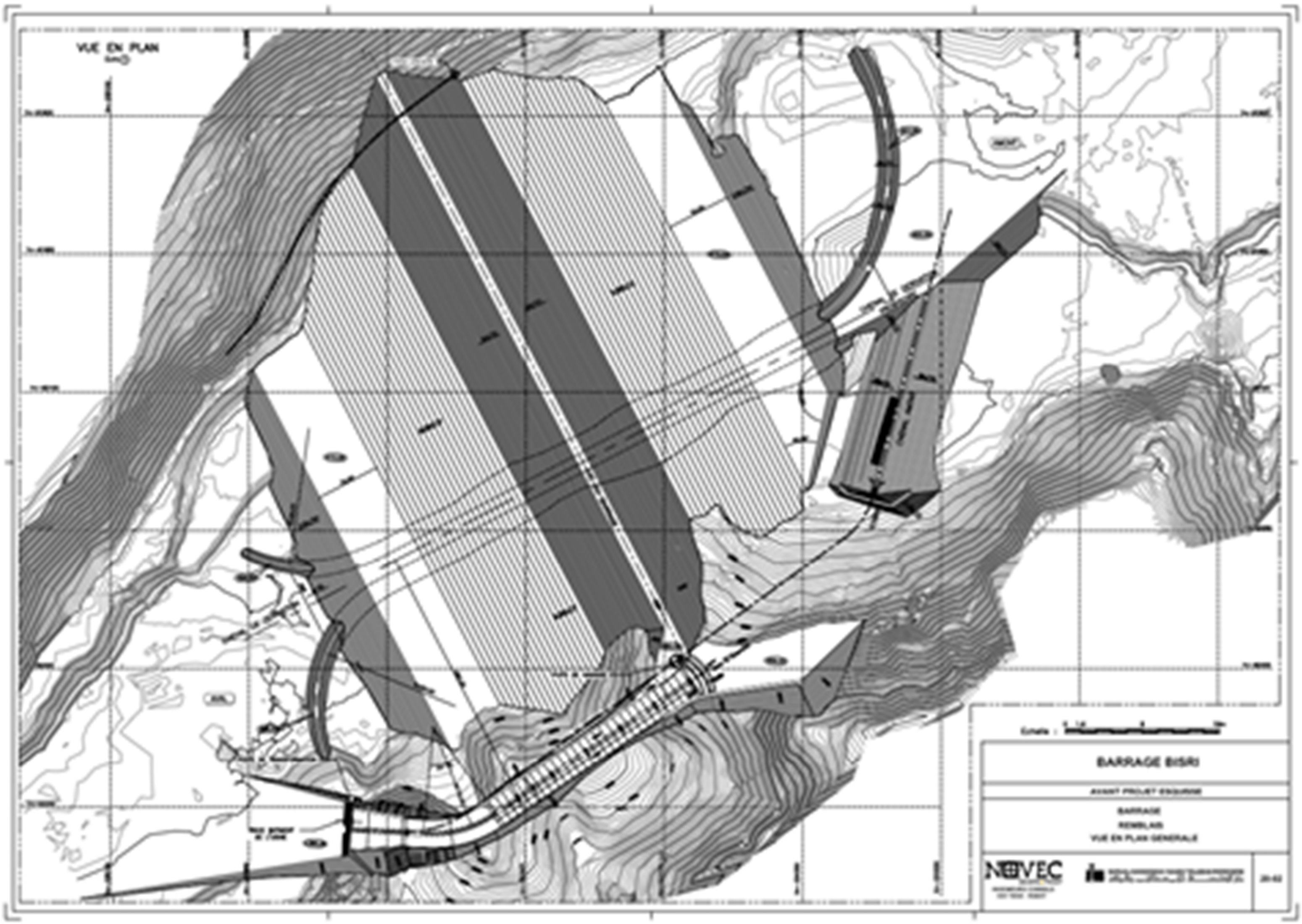
APPENDIX B

DAM DESIGN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BARRAGE
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VUE EN PLAN GENERALE
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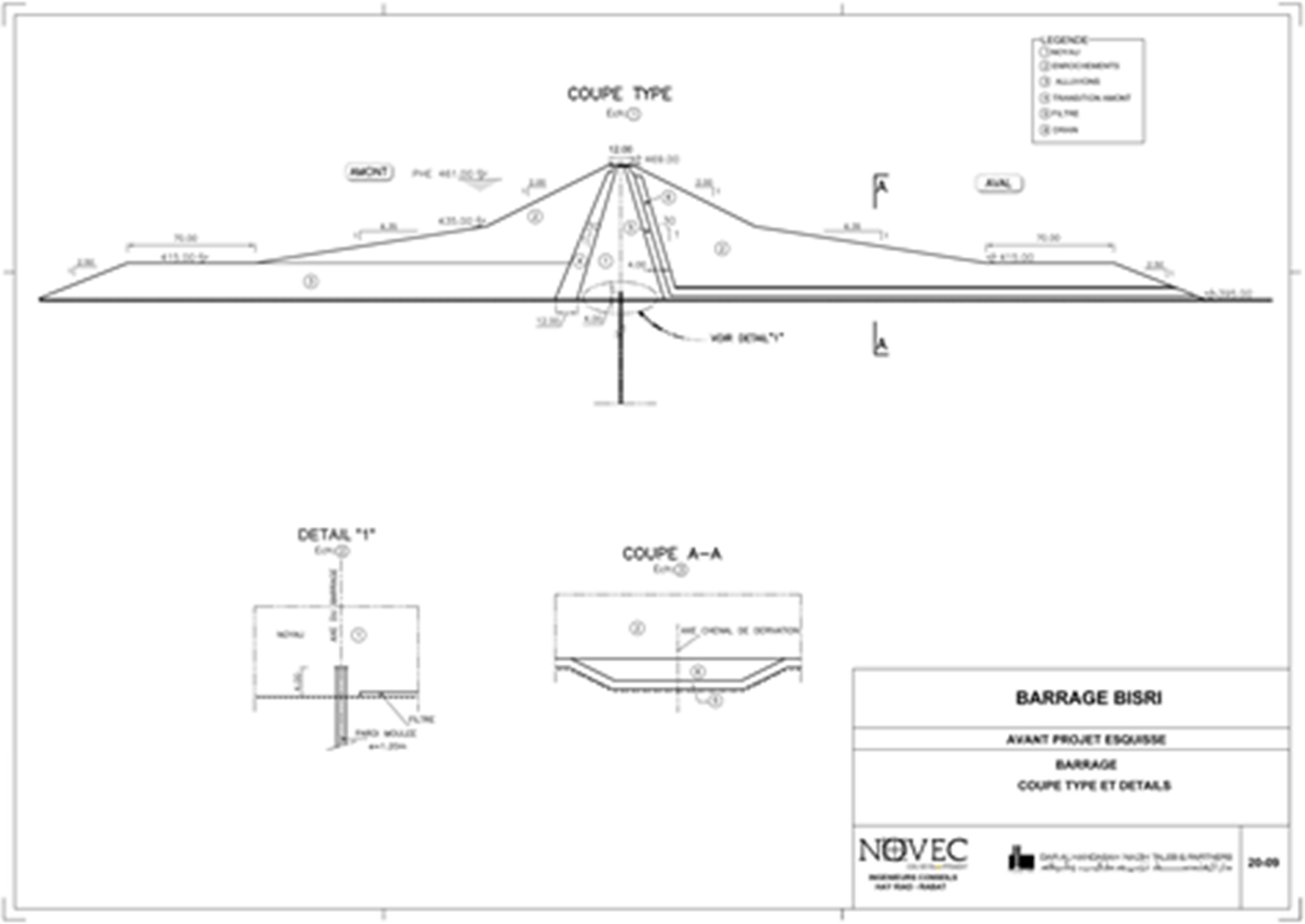
COUPE TYPE
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DETAIL "1"
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FILTRE
AXE CHENAL DE DERIVATION
BARRAGE BISRI
AVANT PROJET ESQUISSE
BARRAGE
COUPE TYPE ET DETAILS
NOVEC
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APPENDIX C

Unofficial Translation of Law NO. 8633 of august 2012

FUNDAMENTALS OF ENVIRONMENTAL IMPACT ASSESSMENT

2012

Fundamentals of Environmental Impact Assessment (EIA)

Based on Law No. 216 dated 2 April 1993 (establishment of the Ministry of Environment), specially the first article thereof;

Based on Law No. 690 dated 26 August 2005 (defining the role and organization of the Ministry of Environment), particularly paragraph 27 of article 2 and paragraph 5 of article 6 thereof;

Based on Law No. 444 dated 8 August 2002 (Environment Protection), specially Article 23 thereof;

Based on Decree No. 2275 dated 15/6/2009 (organizing the units of the Ministry of Environment, defining their roles, structure, and conditions of recruitment for some positions), in particular paragraph 2 of Article 25 thereof;

Based on the proposal of the Minister of Environment;

After consultation with State Advisory Board;

After the approval of the Council of Ministers on ….

The following has been decreed:

Chapter 1

Preliminary Provisions

Article 1: Objective

This decree aims at setting forth rules that should be observed in the environmental impact assessment (EIA) of public and private projects to avoid potential environmental impacts at building, operating and decommissioning these projects.

Article 2: Definitions

Terms and phrases set forth below, as used in this Decree, shall have the following meanings:

Environment: The sum of natural surroundings (physical, chemical and biological) and the social surroundings where all organisms live, interact with each other and with their surroundings.

Environmental Impact Assessment: Assessment of the likely environmental consequences of a proposed project, and determination of necessary measures for mitigating negative environmental consequences and increasing positive impact on the environment and natural resources before approving or disapproving the project.

Environmental Results: Implications of the project on the environment at its building, operation, and decommissioning.

Initial Environmental Examination: A preliminary study to capture potential environmental impact of a project in order to determine whether conducting an EIA study is necessary for the project.

Environmental Management Plan: A group of impact mitigation measures, monitoring and control tools, and institutional procedures taken during building, operating, or decommissioning a project, with a view to eliminating or mitigating negative environmental effects to locally acceptable levels, if any, or to UN standards. The "environmental management plan" shall be deemed to be an integral part of the EIA report and the report of the Initial Environmental Examination.

EIA Scoping: An interaction process among the project owner, official departments and the affected public to identify (1) limits of the EIA study; (2) significant issues; (3) necessary information for report preparation; (4) significant implications that should be examined.

The Project: The building and other construction works that may have significant impact on the environment.

Any interferences with the natural surroundings, including those containing extractive activities or addition to natural resources, which may have major effects on the environment as a result of their building, operation or decommissioning.

Significant Impact: To determine the significance of the impact, the following factors should be taken into consideration: type of the impact; its magnitude, nature, scope, timing and duration; likelihood of occurrence; and its implications.

Project owner: The natural or moral person from the private sector requesting a license to establish his project.

Licensing: The basic decision made by official departments and/or a license receipt allowing the project owner to embark on establishing or operating the proposed project.

Official Department: Public departments and/or public institutions, municipalities and/or municipal unions.

Annex 1: List of projects that duly require an EIA study.

Annex 2: List of projects that require an "initial environmental examination"; except projects located within an area listed in Annex 3 or projects which may have a significant impact on such areas, as these projects shall be subjected to "EIA" studies.

Annex 3: List of Lebanese environmentally sensitive areas where no project is allowable.

Annex 4: EIA classification form to be filled in by project owner, and according to which the Ministry of Environment classifies the project.

Annex 5: List of potential parties involved.

Annex 6; Statement of information required for the "initial environmental examination" report.

Annex 7: Statement of information required for the EIA scoping report.

Annex 8: Statement of information required for the EIA report.

Annex 9: Diagram of the EIA system.

Article 3: Project Scope

(1) It is prohibited to submit a project proposal to competent official departments in a piecemeal fashion that precludes the accurate classification of the project. In this case, the "initial environmental examination" or the "EIA" study of a piecemeal project shall be deemed to be null and void.

(2) The provisions of this decree shall apply to any modification, addition, expansion, rehabilitation or decommissioning - of any existing licensed private project or any approved public project - which may result in significant environmental consequences.

Chapter 2

Phases of Environmental Impact Assessment (EIA)

Article 4: Fundamentals of Requesting the EIA Approval

(1) Project owner will submit an application to the official department concerned inquiring about the classification of his project according to the form shown in Annex 4 together with supporting documents required by the Ministry of Environment. The official department will register the application and refer it to the Ministry of Environment, except what falls in the domain of the industrial licensing committees at the Ministry of Industry and health councils in the governorates where applicable rules are observed.

(2) The official department concerned will request a statement for the Ministry of Environment on the classification of its project or a project implemented on its behalf in accordance with the form shown in Annex 4 together with supports documents required by the Ministry of Environment.

Article 5: Project Classification

(1) Subject to paragraph 1 of Article 4, upon receiving the proposed project classification request as per the standard format and supporting documents, the Ministry of Environment shall verify whether the project falls in the domain of Annex 1 or Annex 2 or is located in an area listed in Annex 3, in addition to the likelihood of a significant impact on that area.

(2) The Ministry of Environment shall advise the competent official department and project owner of the classification decision within 15 days from the date of the registration of the classification request:

A. If the proposed project falls in the domain of Annex 1, it will be subjected to an "EIA" study according to information contained in Annex 8.

B. If the proposed project falls in the domain of Annex 2, it will be subjected to an "initial environmental examination" as per information contained in Annex 6.

C. If the proposed project is classified in the domain of item "B" of this paragraph and located in an area listed in Annex 3, or it may have a significant environmental impact on that area, the project will be subjected to an EIA study.

D. If the project does not fall in the domain of Annex 1 or Annex 2 but located in an area listed in Annex where it may have a significant environmental impact, it will be subjected to an 'initial environmental examination".

E. If the Ministry of Environment does not respond with the prescribed time limit, the project owner and the official department concerned may proceed with the completion of the project file in a way that does not contradict items (A), (B), (C), and (D) of this paragraph.

(3) Based on an informed review during the period mentioned above, the Minister of Environment may request an initial environmental report or an EIA report on the project regardless of its classification in accordance with paragraphs 1 and 2 of this article.

Article 6: Initial Environmental Examination

(1) If the proposed project requires an initial environmental examination, the project owner shall prepare and submit to the Ministry of Environment an initial environmental examination report on the project as per information contained in Annex 6. The Ministry will review and evaluate the report within 30 days from the date of receiving the report, and declare its position as follows:

A. Advising the project owner to prepare an EIA report if its evaluation of the initial environmental examination report demonstrates that the proposed project may significantly have a negative impact on the environment due to building, operating or decommissioning the project. If the project pertains to the private sector, the decision of the Ministry of Environment will be communicated to the official department concerned.

B. Advising the project owner that his project does not require an EIA study as its evaluation of the initial environmental examination report has shown that the project is not likely to have a significant negative impact on the environment, on the condition that he adheres to the mechanism of the environmental management plan in accordance with Article 11 of this decree. If the project pertains to the private sector, the decision of the Ministry of Environment will be communicated to the official department concerned.

C. Advising the project owner to correct some information or provide the missing data. The Ministry should declare its position regarding the submitted additional information within 30 days from the date of receiving such information.

D. If the Ministry of Environment does not respond within the time limit mentioned above, the project owner and the official department concerned may consider that the project does not require an EIA study, and they may proceed with the completion of the project file.

(2) The mechanism of the review mentioned in paragraph 2 of this article shall be determined by virtue of a decision of the Minister of environment.

(3) The official department concerned will issue a license of a private project base on the Ministry of Environment’s decision regarding the initial environmental examination of the project according to paragraph1 of this article, except in cases referred to in item (D) of the same paragraph.

(4) Any official department will not embark on building or operating its proposed project before the Ministry of Environment declares its position regarding the initial environmental examination of the project in accordance with paragraph 1 of this article, except in cases defined in item (D) of the same paragraph.

Article 7: EIA Scoping

(1) If the proposed project requires an EIA study, the project owner shall, in coordination with the Ministry of Environment, identify the EIA scope of the project as per information contained in Annex 7.

(2) On advising the project owner that his project requires an EIA study, the Ministry of Environment will require that he informs the parties involved, identified by the Ministry based on the list contained in Annex 5 in coordination with the project owner. The stamp seal of the official departments concerned and the date of registration on a special document shall deemed to be a proof of informing these parties by the project owner.

(3) Once advised, the municipality (or the governor or commissioner in case there is no municipalities) where the project will be located, should immediately advertise the project to inform the public. The advertisement should be placed on a public

bulletin board and at the location of the project for a period of 15 days. The advertisement should include information that the project requires an EIA study and seeking feedback from the public. The municipality will inform the Ministry of Environment of the commencement date of the advertisement. If the municipality is late in publishing the advertisement, the Ministry of Environment order placing adhesive advertisements by the mayor or other public officials.

(4) The Ministry of Environment will give the public a chance to provide feedback to the Ministry or the official department concerned within one month from the date of the advertisement publication. All remarks and feedback will be communicated to the project owner after being sorted out and evaluated during the review of the EIA report, and after the Ministry of Environment declares its position in accordance with Article 10 of the decree.

(5) The project owner shall submit to the Ministry of Environment a report pertaining to the EIA scoping of the project including attachments of the remarks communicated to him, all incoming comments, the original minutes of public dialogue meetings or the minutes of bilateral meetings with the parties involved.

(6) Within a period of 15 days from receiving the report of EIA scoping, the Ministry of Environment shall declare its position thereon and communicate it to the project owner. Its position will either be an approval of the report or approval pending specific modifications or requesting additional information. The Ministry shall declare its position regarding any submitted additional information within 15 days from the date of receiving such information.

(7) If the Ministry of Environment does not respond during the period mentioned above, project owner may consider that the EIA scoping report has been approved, and he undertakes to use it while preparing the EIA report.

(8) Upon the request of the project owner, the Ministry of Environment shall arrange for a meeting to discuss its remarks and decisions. The Ministry will invite any person or institution to attend the meeting, as appropriate.

(9) The EIA scoping report will be made available to the public and the parties concerned.

Article 8: Preparation of the EIA Report

(1) The project owner will be responsible for the application of the EIA scoping report. This shall include the preparation of the EIA report and submitting it to the Ministry of Environment according to information contained in Annex 8.

(2) The project owner is also responsible, according to the provisions of this decree, for handling any environmental impact not contained in the EIA scoping report but has been revealed during the phases of studying the project.

Article 9: Review of the EIA Report

(1) The Ministry of Environment shall review the EIA report and its conformity to the EIA scoping report approved within two months from the date of receiving the EIA report. If the EIA report does not conform to the approved EIA scoping report, and if the project owner does not conduct the additional studies referred to in paragraph 2 of Article 8, he will be requested to correct the information or provide the missing data and resubmit the report. The Ministry shall review the additional or corrected information within a period not exceeding two months from the date of receiving such information.

(2) If the Ministry of Environment does not respond with the time limit prescribed above, the project owner and the official department concerned may consider that the EIA report is approved, and they may proceed with the completion of the project file.

(3) The mechanism of the review, mentioned in paragraph 1 of this article, will be identified by virtue of a decision of the Minister of Environment.

Article 10: Position of the Ministry of Environment Regarding the EIA Report

(1) After reviewing the final copy of the EIA report, the Ministry of Environment will declare its position regarding the report, either with approval or conditional approval or rejection with explanation.

(2) The Ministry’s position shall be communicated to project owner and the official department concerned if the project is pertaining to the private sector. Such position will be made available to the public and the parties involved, but this right does not include access to information relating to intellectual or industrial property or to any details of the finances of the project. The Ministry’s position will also be communicated to the municipality concerned to be published on the public bulletin board for a period of 15 days.

(3) The official department concerned shall issue a license of the private project in light of the position of the Ministry of Environment regarding the EIA report, except cases identified in paragraph 2 of Article 9 of this decree.

(4) Any official department will not embark on building or operating its proposed project before the Ministry of Environment declares its position regarding the initial environmental examination of the project, except cases identified in paragraph 2 of Article 9 of this decree.

Article 11: Environmental Management of the Project, and Subsequent Monitoring for Project Commencement

(1) The project owner undertakes to observe the mechanism of "environmental management plan" during the building, operations, and decommissioning works.

(2) The Ministry of Environment will monitor the application of the mechanism of the environmental management plan of the project during the building, operations, and decommissioning works.

(3) The project owner shall be responsible, according to the provisions of this decree, for handling any environmental impact not contained in the EIA report, or mistakenly estimated, but has been revealed during the works of building, operating, and decommissioning.

Article 12: Information Publication

The public and the parties involved have the right to see the final EIA report or the initial environmental examination report and the relevant report of the Ministry of Environment, but this right does not include access to information relating to intellectual or industrial property or to any details of the finances of the project.

Article 13: Validity of the Report

The report issued by the Ministry of Environment on the EIA study and/or the initial environmental examination shall be valid for two years in case of the non-commencement of the implementation of the project.

Upon the lapse of this period, the project owner has to advise the Ministry of Environment of his wish to follow through with the project. The Ministry will, then, verify if there are any new elements requiring a new EIA study or an initial environmental examination.

Article 14: Objections and Reviews

(1) The project owner, parties involved, stakeholders and the public have the right to submit written objections to positions of the Ministry of Environment specified in Article 10. These objections should be submitted within 15 days from the date of declaring the Ministry's position. The Ministry shall consider these objections within 15 days from the date they have been received. Objections submitted after the period prescribed in the paragraph shall not be accepted. If the objectioner, within the period mentioned above, does not receive a response from the Ministry regarding the objections, this shall mean that these objections are not accepted by the Ministry.

(2) If any official department objects to the positions of the Ministry of Environment, stipulated in Articles 6, 7, 10, and 15 of this decree, such objections shall be presented to the Council of Ministers for decision.

Article 15: Contraventions and Penalties

(1) In case the project owner contravenes the provisions of this decree, he will be subjected to the provisions of Chapter 6 – especially article 58 – of Law No. 444 dated 8/8/ 2002 (Environment Protection).

(2) The application of the provisions of Chapter 6 of Law No. 444 dated 8/d/2002 (Environment Protection) shall not preclude requiring the project owner, in case of the non-commencement of the implementation of the project, to prepare an EIA study or an initial environmental examination of the project, or oblige him, in case he has embarked on the implementation of the project, to prepare, at least, the **environmental management plan** of the project in accordance with the provisions of this decree.

Article 16: Cost of Reviewing the EIA Study and the Initial Environmental Examination

(1) In accordance with the provisions of Article 23 of Law No. 444 dated 8/8/2002 (Environment Protection), the project owner shall, on being advised of the classification of his project, pay fees amounting to LL 250000 for a project requiring an initial environmental examination and the sum of LL 500000 for a project requiring an environmental impact assessment.

(2) According to the provision of Article 23 of Law No. 444 dated 8/8/2002 (Environment Protection), the project owner whose private project requires an EIA study, shall deposit at the Ministry of Environment a guarantee representing an initial percentage of 0.05% of the value of the project according to the value he submitted in Annex 4, and this will take place on the commencement of identifying the EIA scoping of the project. This guaranteed will cover the cost of reviewing the EIA study if the Ministry of Environment needs the assistance of a specialized expert. The guarantee is refundable according to reimbursement conditions and by virtue of an explained decision of the Ministry of Environment.

(3) As regards projects submitted by official departments and requiring an EIA study, these departments undertake to observe, within the project budget, the coverage of the study review cost and the payments.

(4) Compensations of employees of the Ministry of Environment assigned to review the initial environmental examination reports and the EIA reports in accordance with Articles 6 and 9 of this decree shall commensurate with the overtime as per applicable regulations.

Chapter 3

Miscellaneous General Provisions

Article 17: Transitional Provisions

If public departments or institutions have prepared EIA studies which are approved by recognized international organizations or studies prepared by these recognized international organization, these studies shall be referred to the Ministry of Environment to declare its position thereon in accordance with Article 10 of this decree.

Article 18: Effective Date of the Decree

This Decree shall come into force on the date of its publication in the Official Gazette.

Issued by President of the Republic Baabda on ------

Prime Minister

Minister of Finance

Minister of Environment

Annex 1: Projects that duly require an EIA study

1. Irrigation and drainage:
   - Building dams, man-made lakes and pools/ponds
   - Irrigation projects for area exceeding 500 hectares
2. Drinking water:
   - Building dams, reservoirs, pools and man-made lakes
   - Water desalination plants
   - Integrated projects for drinking water supply
3. Wastewater:
   - Establishment of wastewater treatment plants
   - Drainage channels into the sea
   - Integrated projects for wastewater
4. Solid waste:
   - Establishing centers for the management, treatment, and discharge of the various sold waste
5. Agriculture and forestry:
   - Preparing land for farming, include leveling, clearing, reclaiming, and using chemicals in agricultural activity
   - Deforestation projects
6. Building roads, bridges, railway lines, and tunnels
7. Airports and harbors
8. Power generation and supply:

- Power generating stations
- Power transformation stations

9. Oil and gas:
    - Installation of pipelines on/off the beaches
    - Excavation and extraction of oil and gas
    - Oil refineries
    - Oil platforms
    - Oil tanks
10. Mines, sanders, stone mills, sand sucking
11. Building hospitals
12. Tourism and recreation projects
    - Establishing skiing centers
13. Land reclamation
14. River and sea public properties
15. Inland and marine fisheries
16. Zoo building
17. Factories:
    - Construction of industrial areas
    - Industries included in the table below:

ISIC	Description
D	Industry
15	Food industry (heading)
1511	Fresh and preserved meat. Including slaughterhouse
1512	Poultry meat – fresh and preserved, slaughterhouses
1571	Poultry fodder manufacture
1583	Sugar hot/cold
19	Leather industry:
1910	clean, dye, process, iron (and other works)
21	Paper industry (heading)
2111	Wood pulp
23	Petroleum and coal (heading)
2320	Petroleum refined products, refineries
24	Chemical industries (heading)
2411	Industrial gases capacity= more than 10 tons units/day Various gas factories
2414	Various organic chemicals
2415	Fertilizer and nitrogen compounds
2416	Raw plastic material
2420	Insecticides and other agricultural chemical products. See decrees on Agriculture
2430	Paints, varnishes, printing ink production
2461	Explosives (see Law of Ministry of the Interior for explosives)
26	Building material (heading)
2651	Soil blocks – industry
2652	Limestone – industry
2653	Gypsum
2680	Other mining products (non-metal) – not previously specified
27	Raw mineral industry (heading)
2710	Manufacture of iron, steel and metal mixture
2721	Cast iron pipes and accessories (working space = + 1000 M2)
2722	Steel pipes and accessories (working space= + 1000 M2)
2733	Non-alloy iron and steel products (working space = + 1000 M2)
2735	Iron and steel alloys (working space =+ 1000 M2)
2741	Precious metals (Capacity = - 1000 ton/year; and + 1000 ton/year)
2742	Aluminum casting
2743	Lead and zinc products
2744	Copper products (capacity = + 1000 ton/year)
2745	Other nonferrous metals (capacity= +1000 ton/year)
29	Manufacture of machinery (heading)
2960	Weapons and ammunition
31	Various machines and electrical equipment (heading)
3140	Compounds, batters of preliminary cells
34	Transport-related industry (heading)
3410	Car manufacturing
35	Transport (heading)
3511	Ships
37	Remanufacturing (heading)
3710	Remanufacture of paints
3720	Reuse of non-metal waste

Annex 2: Projects that duly require an initial environmental examination report

1. Irrigation and drainage:
- Irrigation projects if space exceed 100 hectares
2. Drinking water:
- Water treatment plants
3. Wastewater:
- Sanitary sewage networks
4. Agriculture and forestry:
- Reforestation projects
5. Road and transport:
- Building agricultural roads
- Multi-storey parking
- Terminals
6. Power generation and distribution:
- Distribution lines of electrical power(high voltages)
7. Oil and gas:
- Stations for distributing petroleum derivatives
8. Cars:
- Garages with car painting facility
- Car decommissioning
- Neglected car warehouses
9. Tourism and recreation projects:
- Any tourism and recreation project, including hotels, marine complexes, parks and protected areas
10. Housing projects:
- High towers (+15 storeys)
- Housing complexes
11. Farms (classified in the first and second categories)
12. Warehouses of hazardous material
13. Factories:
- Industries included in the table below:

ISIC	Description
D	Industry
15	Food industry (heading)
1511	Fresh and preserved meat (excluding poultry and slaughterhouses)
1512	Poultry meat – fresh and preserved excluding slaughterhouses
1513	Processing all kinds of meat products
1520	Fish products
1531	Processed potato
1532	Fruit and vegetable juice (decree No. 108/83)
1533	Processed and preserved vegetable and fruit – not previously specified, capacity = + 25000 ton/year)
1541	Raw oils and fats (vegetable, animal)
1542	Purified oils and fats (vegetable and animal)
1551	Milk derivatives (between one and 2.5 tons/day, capacity = + 2.5 ton/day)
1552	Ice cream and frozen products ready for consumption (between one and 2.5 tons/day, capacity = + 2.5 ton/day)
1561	Grain mill products (capacity = - 5 ton/hour/ + 5 ton/hour)
1562	Starch and starch products (capacity = - 5 ton/hour/ + 5 ton/hour)
1571	Processed fodder for poultry (vegetable, animal; mix)
1572	Processed food for domestic animals
1589	Other food products
1591	Distilled alcoholic drinks (capacity = + 10000 litres/year, bottled)
1592	Ethyl alcohol
1593	Alcoholic drinks (capacity = + 10000 litres/year, bottled)
1596	Beer
1598	Mineral water, non-alcoholic beverages (see decree No. 108/83)
16	Tobacco products (heading)
1600	Tobacco products (cigarettes, not cigars)
17	Textile products (heading)
1710	Textile and threads, weaving and wool manufacture (power= engines of + 25 kilowatts) Use of chemicals and flammable material (whitening, dyeing, steam broiler)
1720	Textile cloth (sewing), (power= engines of + 25 kilowatts) Use of chemicals and flammable material (whitening or dyeing)
1730	Complementary textile services (whitening or dyeing), other services
1771	Socks and pantyhose (sewed or tight)- (power= engines of 25 kilowatts) Use of chemicals and flammable material (whitening, dyeing, steam broiler)
19	Leather industry (heading)
1930	Various shoes (not including leather manufacturing, (power= engines of +35 kilowatts) Manufacture of shoe accessories from plastics and chemical compounds
20	Furniture and wood industry (heading)
2010	Sawed or scrap wood (power =+ 100 kilowatts) Use of dissolvent material
2020	Compression wood or opposite wood logs or fiber etc (power= + 100 kilowatts) Use of dissolvent material
2030	Carpentry (installation and joining), (power= + 100 kilowatts)
2040	Wooden containers (power= + 100 kilowatts)

2051	Other wood products (power = + 100 kilowatts)
21	Paper industry (heading)
2112	Paper and cartoon paper (w/without use of chlorine material)
22	Publishing, printing and advertisement (heading)
2211	Books, printing, printing and dried in air and fire
24	Chemical industry (heading)
2412	Dyeing
2430	Paints, varnishes, other paints, printing ink A mix of paint and ink
2441	Basic medical products (see Decree 83/105)
2442	Pharmaceuticals (see Decree 83/105)
2451	Soap, detergents, polishing, sanitizers
2452	Perfume and ornaments
2462	Glue and gelatin (from raw animal materials and without them)
2464	Photography chemicals
2466	Other chemicals – not previously specified
25	Rubber and plastic (heading)
2511	Rubber tyres and pipes
2512	Remanufactures rubber tyres and pipes
2513	Other rubber products
2521	Plastic plates, pipes and plastic casting
2522	plastic products for packing
2523	Plastic clothing
2524	Other plastic material
26	Building material (heading)
2611	Surface glass (power= +100 kilowatts)
2612	Surface glass fabrication (power= + 100 kilowatts)
2613	Void glass (power= + 100 kilowatts)
2615	Fabricated glass of different kinds including technical glass equipment (power = + 100 kilowatts)
2621	Domestic appliances and ceramic tiles (power = + 100 kilowatts)
2622	Ceramic sanitary ware
2624	Artistic ceramic products
2626	Thermal ceramics
2630	Ceramic tiles and bottles
2640	Tile, stone, brick products made of dried mud
2661	Cement blocks (w/without compressors and cement vibrating equipment)
2662	Gypsum products
2663	Bricks for mixture (capacity = 50 ton/day)
2666	Other gypsum and cement brick products
2680	Other mining non-metal products (not previously specified – without asbestos)
2681	Sand scratchers
2682	Other mining non-metal products – not previously specified
27	Raw metal industry (heading)
2721	Pipes and accessories of cast iron (working space = + 500 m2; and a range between 500 and 1000 m2)
2722	Steel pipes and accessories (working space = + 500 m2; and a range between 500 and 1000 m2)
2731	Cold iron products (working space = + 1000 m2)

2732	Cold galvanized thin plates (working space = + 1000 m2)
2733	Non alloy iron and steel products (working space = +500 m2), (working space between 500 and 1000 m2)
2734	Metal rail (working space = 1000 m2)
2735	Iron alloys and iron/steel alloys (working space + 500 m2; and between 500 and 1000 m2)
2744	Brass products (capacity = + 1000 ton/year)
2745	Other nonferrous metal products (capacity = + 1000 ton/year)
2751	Iron casting services
2753	Light metal casting services
2754	Other no ferrous metal casting services
28	Metal and electrical technical products (heading)
2851	Metal painting treatment services (electrical – non electrical)
2873	Wire products w chemical insulators
2875	Other fabricated metal products – not previously specified
29	Machinery industry (machines) (heading)
2911	Engines and turbines (except aviation, cars, revolving engines)
2912	Pumps and compressors
2913	Valves and taps
2914	Carrier, machine tooth, pushing tools
2921	Burners and incinerators
2922	Lifting and handling equipment
2923	Non domestic cooling and ventilation equipment
2924	Tools and equipment for different uses – not previously specified
2931	Agricultural tractors
2932	Other machinery for agriculture and forestry
2940	Mechanical tools
2951	Tools for metal works
2952	Equipment for mining and building
2954	Machines for textile, clothing, and leather works
2956	Machines for various purposes – not previously specified
2971	Domestic electrical appliances (capacity = + 50 ton/year)
30	Computer and office equipment (heading)
3001	Production of office equipment
3002	Production of computers
31	Production of various electrical machines and equipment (heading)
3110	Electric engines, generators, transformers
3130	Wires and cables insulated
3150	Lighting bulbs and equipment
3161	Electrical equipment for engines and cars- not previously specified
3162	Various electrical equipment – not previously specified
32	Audio-visual equipment (video) and communication industry (heading)
3210	Valves, electronic pipes, other electronic elements
3230	Recording telecasters and related products
33	Medical and optical equipment (heading)
3310	Medical and surgical equipment
3340	Optical and photographic equipment
34	Transport- related industry (heading)
3420	Manufacture of wagons; seats for cars, trucks, and trailers
3430	Parts and accessories for cars and their engines (capacity= + 50 ton/year;

	capacity = + 50 ton/year)
35	Transport (heading)
3550	Other transportation means – not previously specified
36	Various tools and fitting industry (heading)
3615	Furniture (with sponge manufacture), (capacity = + 50 ton/year)
3622	Jewelry and related arts – not previously specified (capacity = + 50 ton/year)
3640	Sporting equipment and supplies Use of chemicals or flammable material
3650	Toys Use of chemicals or flammable material
3663	Other manufactured products – not previously specified

Annex 3: Environmentally Sensitive Areas

1. Areas classified, by virtue of laws or decrees, as specifically protected areas, or natural environment protected areas, or natural forests or wetlands or important areas of birds or public gardens or natural scenery sites or touristic and historic sites and/or archaeological locations or river banks or springs or holy places.
2. Areas that are home of endangered species (animal and plants).
3. Watersheds
4. Sea beaches, river waterways, and springs
5. Public land

Annex 4: EIA Classification Model

1. Name of the project
2. Project owner:
   - Name:
   - Address:

❑ Tel number: ❑ Fax:

❑ Email:

3. Type of the project:

❑Public ❑Agricultural :

❑Private ❑Industrial (specify the ISIC number):

❑ ❑ Tourism (specify):

❑Services (specify):

❑Others:

4. Nature of the project:

❑New Project ❑Existing project or holder of a license or approved

- ❑ Modification
- ❑ Addition
- ❑ Expansion
- ❑ Rehabilitation
- ❑ Closure

5. Project Objectives:
6. Estimated cost of the project:
   - Construction
   - Preparations
7. Project time schedule

	commencement	End
Planning and designs	....	....
Construction		
operation		

8. Map showing project location – scale 1/20,000 (attached)
9. Other documents attached

Note: the Ministry of Environment may request other documents as per the nature of the project.

The EIA classification decision

(To be filled by the Ministry of Environment)

Annex 5: List of Potential Parties Involved

1. All ministries concerned.
2. Public institutions concerned, for example, Higher Council for Planning and Development; Investment development Authority of Lebanon; and the National Council for Scientific Research.
3. Municipal authorities and the local department responsible for organization.
4. Local non-government environmental societies (duly established).
5. Affected individuals and groups.
6. Universities and research centers concerned.
7. Any society, trade-union or association interested in the project, e.g. the Association of Lebanese Industrialists

Annex 6: Statement of information required for the "initial environmental examination" report

The initial environmental examination report should include the following information (not necessarily in this order):

1. Executive summary.
2. Table of contents
3. Introduction: defining the project, the project owner, the person of office conducting the initial environmental examination, as well as a brief explanation of the type, size and location of the project.
4. Policy, legal and administrative frameworks: an investigation of the enforceable regulations, principles, and standards observed by the environment sector at the local and national levels, laws governing the sector under which the project is included. The information should address specifying the official department concerned, and its potential at the local and national levels.
5. Description of the proposed project: description of project components, the relevant maps according to the appropriate scale and photos, information of project location, comprehensive design, size, capacity, work program, services, the duration of operation, etc.
6. Description of the surrounding environment of the project: gathering and evaluation basic information of environmental characteristics of the study location (physical, chemical, biological, social and economic environment) taking into consideration any expected modifications before the commencement of the project or any likely changes in future.
7. Potential environmental impact of the project: identification, estimation, and assessment of all potential effects of the project on the environment (physical, chemical, biological, social and economic consequences) whether positive or negative, direct or indirect, over the short or long term.
8. Environmental management plan: this paragraph summarizes a group of impact mitigation measures, monitoring and control tools, and institutional procedures taken during building, operating, or decommissioning a project, with a view to eliminating or mitigating negative environmental effects to locally acceptable levels, if any, or to global standards. This paragraph should include the estimated cost of the environmental management plan.
9. Conclusion
10. Annexes:

- Summary of project documents.
- Tables and information statements
- List of scientific and non-scientific references used

- List of the names of who prepared the initial environmental examination report (individuals and institutions).

Note: The Ministry of Environment has the right to modify items required in this annex in accordance with environmental essentials that are applicable to standards and role of the project. Special consideration is given to the application of article 12 "Information Publication".

Annex 7: Statement of information required for the EIA scoping report

1. Introduction: This paragraph defines the objective of the EIA scoping report, the project under stud, in addition to explanation of the EIA executive measures.
2. Background information: This paragraph includes relevant information about potential parties conducting the EIA study, a synopsis of the basic content of the proposed project, a statement of the importance of the project, its objectives, the implementing office, and a summary of the history of the project, the alternatives and related projects. Reference will be made to any projects planned or currently implemented in the same area since they could be competing with the project under consideration in terms of resources.
3. Objectives: This paragraph identifies the EIA scope, and discusses its timing in view of the phases of preparing, designing and implementing the project.
4. EIA requirements: This paragraph sets forth any regulations and guidelines organizing the EIA implementation. It defines the content of the EIA scoping report.
5. Study area: This paragraph shows the boundaries of the area covered by the study for the purposes of environmental impact assessment. And if there is a neighboring or far away area that should be studied in terms of the potential consequences of implementing or managing this project, such area should be included in the EIA scoping report.
6. Scope of work: In some cases, knowing clearly the tasks of the project owner facilitates defining them full in the EIA scoping report. However, in other cases, there is a need to carry out specialized field studies or forming models in order to assess the consequences of the proposed project, and at that point, the project owner is required to define these certain tasks in detail. The scope of work include the following points:

6.1 Policy, legal and administrative frameworks: an investigation of the enforceable regulations, principles, and standards observed by the environment sector at the local and national levels (the study sets forth the known considerations, and the project owner is requested to verify the existence of any other considerations), laws governing the sector under which the project is included. The information should address specifying the official department concerned, and its potential at the local and national levels.

6.2 Assistance in coordinating among official departments and public participation: Assistance in cording the study with official departments, seeking feedback of local NGOs and groups affected by the project, and keeping the minutes of meetings, other activities, communications, comments and how to act regarding them (The EIA scoping report identifies the types of activities such as the meeting on work scoping attended by stakeholders, briefing sessions at the environment sector for project employees, supporting consultants of the environment sector, public seminars etc)>

6.3 Description of the proposed project: Description of project components, the relevant maps according to the appropriate scale and photos, information of project location, comprehensive design, size, capacity, work program, services, the duration of operation, etc.

6.4 Description of the surrounding environment of the project: gathering and evaluation basic information of environmental characteristics of the study location (physical, chemical, biological, social and economic environment) taking into consideration any expected modifications before the commencement of the project or any likely changes in future.

6.5 Potential environmental impact of the project: It should be distinguished between positive and negative effect, direct and indirect impact, short term and long term impact. Permanent unavoidable consequences should be identified, as well as defining universal and cross border effects. Project owner should describe estimation means and techniques used in assessing the impact of the project on the environment. The scope and quality of available information will be determined, together with an explanation of significant information gaps and uncertainties regarding the assessment of the potential impact of the proposed project. It is advisable to review the conditions of some planned studies in order to obtain the missing information. This paragraph should list the possible mitigation measures per each impact and recommend the most effective and low cost measures.

6.6 Analysis of project alternatives: preliminary description of alternatives studied during the preparation of the proposed project and listing other alternatives that can achieve the same objectives. The concept of these alternatives generally include the selection of project site, its designs and technology, construction methods and the stages, and the operation and maintenance procedures. A preliminary comparison will be made among these alternatives in terms of potential environmental effects, their costs relative to the capital and operation, adequacy of local conditions, institutional requirements, training needs, and monitoring and control requirements. It should, as much as possible, identify the preliminary cost and profits of all alternatives, as well as the estimated cost of mitigation measure. The alternation regarding the no implementation of the project should also be included to clarify environmental conditions “AS IS” without the project.

6.7 Environmental management plan:

- Mitigation measures for negative impact
- Monitoring and control plan
- Institutional capacity development plan to implement recommendations contained in the EIA report.

The project owner should prepare a detailed environmental management plan including mitigation measures for all negative consequences, monitoring and control program, the needs of workers and institutions to apply these measures. The cost of this plan should also be identified, including compensations for those affected by impact that will not be mitigated.

7. The Report: The EIA report should be brief addressing only major environmental issues. The body text should focus on investigation results, the conclusion, practical recommendations supported by summaries of the gathered information, and any approved references to explain and interpret such information. The detailed or unclear information is not appropriate in the body text, and should be presented in the annexes or in a separate document. The same thing applies to unpublished documents used in the EIA study and they should be grouped in an annex.

The EIA report must include the following:

- Executive summary
- Table of contents
- Introduction
- Policy, legal and administrative frameworks
- Public participation
- Description of the proposed project
- Description of the surrounding environment of the project
- Potential environmental impact of the project
- Analysis of project alternatives
- Environmental management plan
- Conclusion
- Annexes – minutes of public participation sessions
- Summary of project documents
- Tables and information statements
- List of relevant reports
- List of scientific and nonscientific references used
- List of the names of who prepared the EIA report (individuals and institutions)

Note: The Ministry of Environment has the right to modify items required in this annex in accordance with environmental essentials that are applicable to standards and role of the project. Special consideration is given to the application of article 12 "Information Publication".

Annex 8: Statement of information required in the EIA report

The EIA report should include the following information (not necessarily in this order):

1. Executive summary.
2. Table of contents
3. Introduction
   - Objective and rationale of the project:

- Definition of the project and the project owner
- Brief description of the type, size and location of the project
- Importance of the project to the country

   - The EIA scoping, which include the person or the agency that prepared the study

4. Policy, legal and administrative frameworks:
   - Official department concerned, its capabilities at local and national levels
   - Environmental legislation, other regulations related to the environment, the policy observed in the country
   - Environmental requirements for any of the parties participating in financing the project
   - Applicable Environmental agreements or treaties the country have joined
5. Public participation:
   - Official agencies
   - NGOs
   - Groups affected by the project
6. Description of the proposed project:
   - Type of the project
   - Location of the project: maps showing the project site and its impact
   - Size of the project, including the related activities
   - Proposed program for construction and operation
7. Description of the surrounding environment of the project:

   7.1 Physical and chemical environment:

   - Topographical and geological aspects, and the impact of earthquakes and other hazards
   - Study of surface and underground water
   - Measuring sea and coasts
   - Available means of discharging polluted water, and the quality of water
   - Surround air quality, sources of air pollution

- Climate and weather service
- Noise

7.2 Biological environment:

- Vegetation and animal life
- Fish and water living creatures
- Rare or endangered species
- Sensitive areas (forests, protected areas, natural parks, etc)

7.3 Socio-economic environment:

- Demographics (population, social fabric, employment, income distribution, customs and traditions, people expectations etc)
- Development activities (infrastructure, industry, agriculture, institutions, tourism, recreation etc)
- Land use
- Traffic
- Public health
- Historic and archaeological heritage
- Aesthetic values
- Culture and civilization values (customs and tradition, aspirations)

8. Potential environmental impact of the project:

8.1 Physical and chemical environments

8.2 Biological environment

8.3 Social and economic environment

9. Preliminary analysis of project alternatives:

- Non establishment of the project
- Alternative projects with same objectives
- Same project with different technologies
- Comparing various environmental and economic potentials

10. Environmental management plan:

a. Negative impact mitigation program:

- Summary of significant environmental consequences
- Technical detail of each mitigation measure (applicable to which impact, the conditions of their application, designs, detailed fittings and operational procedures)
- Potential environmental effects of these measures
- Linkage between these measures and other mitigation programs
- Cost of negative impact mitigation program

b. Monitoring and control program:

- Specific technical detail of control means (control standards, control techniques, periodicity of the required control, control location, measurement procedures, keeping and analyzing information, and emergency measures)
- Reporting and report submission
- Detailed budget, acquisition program and the required supplies
- Cost of monitoring and control program

c. Institutional capacity development program:

- Detailed description of institutional procedures required for the above environmental measures (responsibility for implementing mitigation measures and control/follow up procedures etc).
- Technical assistance programs
- Acquisitions and supplies
- Organizational changes
- Cost of institutional capacity development program

11. Conclusion:

- Net profit justifying the establishment of the project
- Explanation of how to mitigate negative impact
- Prior preparations for following up control and supervision

12. Annexes:

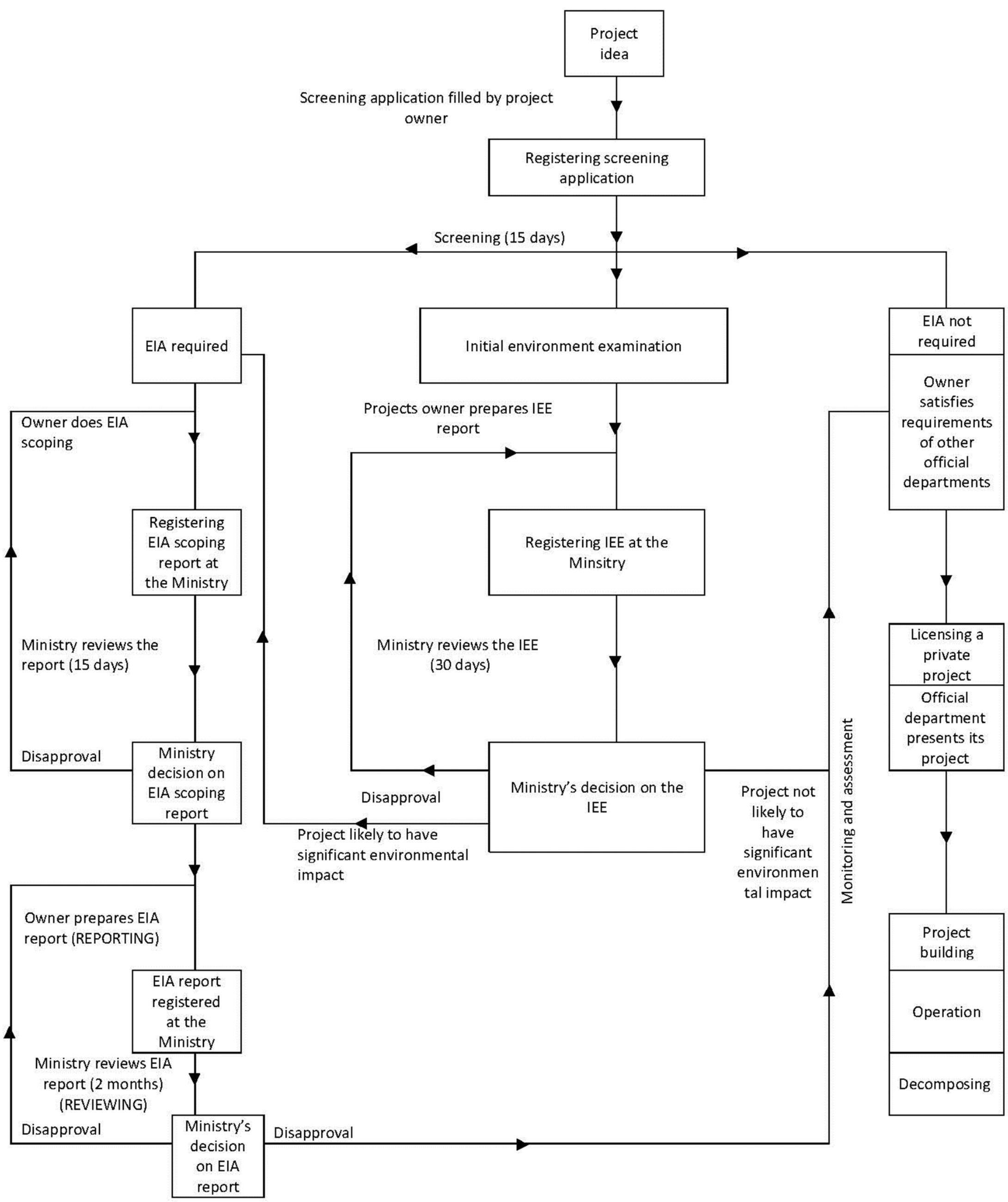
- Minutes of public participation
- Summary of project-related documents
- Tables and information statements
- List of related reports
- List of scientific and nonscientific references used
- List of the names of who prepared the EIA report (individuals and agencies)

Note: The Ministry of Environment has the right to modify items required in this annex in accordance with environmental essentials that are applicable to standards and role of the project. Special consideration is given to the application of article 12 “Information Publication”.

Annex 9: Diagram of the EIA System

Annex 9: Diagram of the EIA System

Diagram of the EIA System



Contents

Appendix D

PHYSICAL CULTURAL RESOURCES PLAN

Introduction and Background

The ESIA documented the need to address the need for rescue archaeology in the Bisri valley as a result of the project. Consequently, the Physical Cultural Resources Plan detailed below was developed and will guide the implementation of agreed arrangements for the full, effective and sustainable implementation of rescue archaeology, relocation of the Mar Moussa church as well as establish acceptable procedures to deal with eventual "Chance Find Procedures". The action plan below has been agreed between the DGA, CDR and other stakeholders and will be updated throughout project implementation as required.

Part a - Rescue Archaeology – Data Collection and Assessment

The Physical Cultural Resources Plan for rescue archaeology on the project was based on the findings of a widely referenced study on the Bisri valley (provided in Appendix J): Building on detailed archaeological field survey work undertaken in 2005, a field based survey update of archaeological and historical sites of the site of the dam and impoundment area, and sites of all associated facilities was undertaken in 2008 by partnership between the General Directorate of Antiquities and the Polish Center of Archaeology at the University of Warsaw. The Polish Center of Archaeology at the University of Warsaw is a widely established institution with demonstrated experience in archaeology of the Middle East.

Rescue Archaeology – Physical Cultural Resources Mitigation

The field survey was jointly issued by the General Directorate for Antiquities (housed within the Ministry of Culture) and by the Polish Center for Archaeology. As a jointly issued report, the field survey and its major findings are therefore endorsed by DGA, which is the only agency in Lebanon with authority to undertake rescue archaeology. The field survey results are provided in Appendix I above and are disclosed as part of this ESIA.

The field survey and associated report focused on the need to (i) undertake rescue archaeology of certain particularly important archeological relics in parallel with dam construction and (ii) to prevent looting of archaeological remains. Mitigation measures include the implementation of a Rescue Archaeology Plan for the Bisri valley and the installation of security and protective facilities around ongoing (open) digs.

The rescue archaeology will be undertaken by a team of specialists that will be appointed by DGA and will be recruited and financed by CDR. as DGA is the only Government agency with the authority to implement any rescue archaeology in Lebanon; this is the common and established procedure that is in line with Lebanese laws and regulations on archaeology.

For the actual rescue works, these will be undertaken by the dam contractors as part of the works contract. A specific line item in the Bill of Quantities (BOQ) will be dedicated to rescue archaeology and will be supervised by the DGA-appointed team of specialists.

To address the looting risk, areas will be fenced off and security personnel hired in the event of increased risk of looting or during periods of low activity on site.

Mitigating Activity	Responsibility	Estimated Cost (USD)
Establish rescue archaeology team of specialists	DGA to appoint specialists, CDR to recruit them.	120,000
Implement rescue archaeology works as required by DGA	Archeology specialists	500,000
Install fencing and security as required to prevent looting	Dam works contractor as per the guidance of the archeology team	10,000

Part B - Mar Moussa Church – Data collection, assessment and endorsement

Specific date regarding Mar Moussa church is limited. The assessment thus relied primarily on field surveys and extensive consultations with communities and religious authorities (primarily the Maronite Diocese) to discuss options for the dismantling and reconstruction of the church, which has high cultural value to local communities. It is important to note that the church is not original construction. Nonetheless, it holds significant cultural importance to local communities and will thus be dismantled and reconstructed at a site that is not submerged. No graveyards were identified as part of the survey work in this area.

Mar Moussa Church – Physical Cultural Resources Mitigation

The Mar Moussa Church will be dismantled and relocated to a site at a higher elevation that has been considered in detail (and compared to 3 other options) and has been agreed upon by all stakeholders. The estimated cost of the dismantling and reconstruction of the church is 2 million USD and will be implemented by the dam works contractor and financed by the project through CDR. Specific line items in the works contract Bill of Quantities (BOQ) will be added to reflect this line of work. The Maronite Diocese will appoint a representative to oversee the implementation of works. The dismantling and relocation of the church will use international best practice standards for World Heritage sites and naturally protected areas.

Mitigating Activity	Responsibility	Estimated Cost (USD)
Dismantle and reconstruct Mar Moussa church	Works contractor under guidance from the Diocese representative	2,000,000
Expropriate land for Mar Moussa church relocation	CDR	500,000
Planned transfer ceremony	Diocese	N/A
Ad hoc monitoring	Diocese	N/A

Part C - Chance Find Procedures

The following chance find procedures will be included in the contract documents of the works contractor and will guide the implementation of any ad hoc rescue archaeology that may arise in the case of chase funds:

The Contractor shall take note that the Directorate General of Antiquities of the Ministry of Culture (DGA) is to be afforded the opportunity to monitor work in the vicinity of known and suspected archaeological sites. As such, the Contractor shall grant access for DGA representatives to all parts of the project site throughout the period of construction. In this respect, the term archaeological site shall refer to all cultural property of an archaeological or historic interest to the DGA.

The DGA shall be considered the Utility Owner of all the sites having declared or suspected archaeological value whether they are found on private or on public property, within or outside the Right of Way.

Prior to commencing work, the Contractor shall prepare a checklist of actions his Foremen and workers shall follow in the event they unearth unrecorded archaeological remains. The list shall be vetted by the DGA and will include contact details for the local DGA Inspector and relevant Construction Management staff. Copies of the list will be circulated to all Discipline Managers, Shift Leaders and Foremen, and posted in places such as Site Offices, Time Keepers Offices and Messes.

Prior to any work on or in the vicinity of known archaeological sites, the Contractor shall coordinate with the Engineer and DGA representatives to ensure adequate measures as specified by DGA are taken to protect these sites.

All known or newly discovered archaeological sites shall be ‘off-limits’ to construction crews, whether on or off duty, except with the express permission of the Engineer. Such permission will only be given where access is needed for site protection or to ensure public and/or worker’s safety.

The Contractor shall make provision in his work program to accommodate the requirements for DGA inspection of any archaeological sites encountered during construction.

If new archaeological remains are discovered during execution for the Works, the Contractor shall immediately inform the DGA and the Engineer. In all such cases, the Contractor shall adjust and/or reschedule his activities in the vicinity of such sites, and/or use other sources of materials if the site falls within a borrow area or quarry, to allow the DGA to carry out surveys and emergency salvage excavations. Work in the vicinity of remains investigated by DGA shall not recommence until written permission to do so has been granted by the DGA.

With regard to the relevant clauses of the Conditions of Contract, no extension of time or payment of costs will be granted for adjusting the sequence of work. The Engineer will only grant an extension where work is suspended as a result of archaeological investigation.

The Contractor's liability in respect of archaeological sites extends to damage by construction workers, on or off duty, the reparation of which shall be undertaken at the Contractor's cost. Repeated violation of sites by workers shall render the Contractor liable for the erection of a fence around the site at his own cost

APPENDIX E

GEOLOGICAL AND GEOTECHNICAL REVIEW REPORT

APPENDIX E GEOLOGICAL AND GEOTECHNICAL REVIEW REPORT

Geotechnical Review Report for Bisri Dam

Table of Content

Table of Figures

Technical Overview of Bisri Dam

The referenced documents relating to this technical review include the following:

1- Design of Bisri Dam: Updated Feasibility Report. Dar Al-Handasah (Nazih Taleb and Partners) for CDR. January 2011 (R1).
2- Bisri Dam Project Feasibility Study. ECI and Dar Al-Handsah (Nazih Taleb and Partners) for CDR, April 1995. 3 volumes - Main Report, Appendices A-D, and Appendix E (R2).

In the following, a description of the findings of these reports is stated, followed by relevant comments.

A. Previous ground investigations and shortcomings

1. Prefeasibility studies and field investigation were performed by the USBR in the 1954, 1974.
2. Another study with accompanying subsurface investigations was performed by ONL during the period between 1974 and 1978.
3. In early 1980's and middle 1990's, Dar Al Handasah Nazih Taleb-ECI (ECIDAH), performed feasibility studies and investigations for the Bisri Dam Project. The 2011 feasibility study is an updated version of the 1995 study.
4. The engineering properties of the valley floor deposits, as summarized from the reported previous studies and investigations are summarized as follows (R2):
    a. The surficial alluvial soils are 2-3m thick normally, but may reach about 30m depth under the active river channel. They have the following characteristics:
        - The relative densities of the upper alluvial sediments -sand, gravels and cobble deposits ranged between 25 to 75%.
        - The fine grained soils fine sands and silty sand) have relative densities ranging between 25 to 70%, with the majority less than 40%.
    b. The investigation results showed that the clayey soils at depth lack the required strength to support the embankment loads, and need to be treated. Consolidation could be enhanced by wick drain installation, and stabilizing berms would account for better safety factors.
    c. The lacustrine clay deposits underlying the surficial sediments were tested and their properties summarized in the following extract:

Property	USBR 1952-1954 Study Low(s)	USBR 1952-1954 Study Range or Average	USBR 1952-1954 Study High(s)	ONL 1975-1978 Study Low(s)	ONL 1975-1978 Study Range or Average	ONL 1975-1978 Study High(s)	ECIDAH 1982-1984 Study Low(s)	ECIDAH 1982-1984 Study Range or Average	ECIDAH 1982-1984 Study High(s)
LL	-	66 57 - 68	74	36, 45	47 - 60.5 53.5	-		40.5 - 58.3 52.2	61.4
PI	26, 29	36 32 - 39	43	14	23 - 35 29.5	38	13.1	18.2 - 30.5 25.7	32.5
wn (%)	27.7	36.6 31.6 - 40.6	42, 42.1	24, 26, 27.5	34.2 - 46.2 41.0	47.5, 48.2, 49.3	-	30.7 - 43.0 37.3	-
LI	-	0.12 - 0.42	-	0.08, 0.17	0.30 - 0.84	0.9, 0.99	0.15, 0.19, 0.21, 0.25	0.28 - 0.55	0.76, 0.79, 1.1
Sand (%)	-	0 - 10	-	-	0 - 5	-	-	0 - 6	-
Silt (%)	-	56 - 70	-	-	42 - 65	-	-	43 - 65	-
Clay (%)	-	30 - 44	-	20, 20, 23	28 - 50	54, 59	12, 22, 25	35 - 55	-
γ d	-	1.237 - 1.440	-	-	1.150 - 1.500	-	-	1.200 - 1.392	-
γ m	-	1.730 - 1.920	-	-	1.675 - 1.890	-	-	1.760 - 1.900	-
Su	-	0.6 - 1.70	-	-	-	-	-	-	-
c(UU)	-	-		0.04	0.1 - 1.0 (15 Tests)	2.4		0.7 (1 Test)	-
ϕ (CD)	-	-			25° - 31.5° (4 Tests)				
Consolidation					(21 Tests)			(5 Tests)	
Cc					0.17 - 0.40			0.325 - 0.44	
Cr								0.025 - 0.09	
Pp (t/m^2)								100 - 145	
O.C.R.								2 - 4.5	

ECI
A DIVISION OF
FREDERIC R. HARRIS
ENGLEWOOD, COLORADO USA

DAR AL HANDASAH NAZIH TALEB & PARTNERS

BISRI DAM
FEASIBILITY STUDY
LABORATORY TEST RESULTS
SUMMARY

FIGURE 5-5

ACCURVE SPW / KAS

3/06/95

C1-Comments:

1- *The joint line surveys were missing from the reported geological study done. Given the nature of the formations, and the structural setting of the area under investigation, a detailed reporting of the joints and fractures is required for a better understanding of the local geology.*
2- *Geophysical surveys by seismic refraction are required to identify the variation in bedrock surface under the river bed at the dam location.*
3- *One noticeable comment is the undifferentiated reporting of the Jurassic succession in (R2), knowing the variable nature of the different (rock) formations making up this Upper Jurassic sequence.*

B. Catchment geology

The project watershed area covers around 215 km^2, mostly draining the western slope of the Jabal el Barouk and Jabal Niha Mountains which rise to elevations higher than 1900 m asl.

The stratigraphy of the catchment basin covers the geologic succession from the Middle Jurassic rocks to the recent Quaternary Deposits.

Upstream from the reservoir, on the western flank of Mount Lebanon, the Bisri River is incised into sedimentary rocks of the Cretaceous and Jurassic sequences. The Cenomanian Sannine Limestone Formation (C4) has a widespread extent and consists of well stratified, fractured, karstic, interbedded limestones, dolomites, and marls. In the canyons and escarpments, the calcareous rocks and argillaceous and marly sandstones of the Lower Cretaceous (Aptien Formation-C2b &C2a) are exposed. The cliff-forming rocks of the Mdairej Formation (C2b) are karstic, while the underlying Abeih Formation (C2a) is mostly clastic and made up of sandstone and alternating marls and grades upwards into limestones. The highest part of the catchment area is underlain by Jurassic dolomite and limestone rocks with volcanic horizons, chert nodules, and interbedded basalts.

From the higher elevations of the drainage basin, the river slopes steeply to the alluvial valley which will constitute the reservoir of the proposed dam. The valley floor occurs at an elevation of about400m asl.

C. Dam site and reservoir geology

The proposed dam will stretch more than 700 meters across the valley and stand about 70 meters above river level. The Nahr Bisri follows a sinuous course meandering with a sandy bed, cutting through old floodplain and terrace deposits. The present floodplain and active river deposits have a maximum thickness of 30 meters in the main channel section. These deposits overlie up to 90 meters of lake deposits which formed as a result of the large landslide at Anane (about three kilometers downstream from the axis).
The outcrops at the site area include geologic formations extending from Jurassic to Quaternary (see attachments 1&2). The left abutment is essentially comprised of the Chouf Sandstone Formation (C1; see Figure 1). This formation is varicolored sandstone,

generally fine grained, and friable. Sometimes it contains ferruginous zones, lignite, and pyrite in addition to thin argillaceous and clay-marl lenses.

Figure 1: The sandstone strata of the Chouf Sandstone Formation (C1) exposed along the cut face of a quarry on the left bank of the Bisri River and proposed dam reservoir.

During a previous investigation (1982), two adits were excavated for distances 210 and 215 meters into the C1 formation. Both adits encountered rather friable rock with some more sound zones with much evidence of past sliding events. The adits also indicated that close to the dam axis, the depth of slide is less than 10m. At other locations in the reservoir, large scale slides were also reported.

The J6-J7 formation (undifferentiated on geologic map) is represented by beige limestone which is hard, locally karstic, sometimes fractured, sandy, and rarely dolomitic. The J5 is a sandy, dolomitic hard limestone with some chalcopyrite. It is moderately karstic, contains some chert and ranges in color from chocolate brown to olive. Overlying the reported Roum Fault contact are the 90 m-thick succession of old alluvium, lake, and river deposits.

On the right abutment side of the main river fault, the succession follows younger formations (see attachment 3). The Lower Aptien Abeih Formation (C2a) comprises limestone and marl containing pisolites. This formation is sandy, multicolored but generally grayish white. It is fine grained, friable at places, contains some lignite, some oolites and a few orbitulinas. It also contains some argillaceous layers.

Overlying the C2a is the Upper Aptien Mdairej (C2b) which is beige to slightly reddish limestone. This formation is karstic. Above the C2b lies the Albien Hammana Formation (C3) which forms the upper part of the right abutment. This formation is a combination of beige limestone, brown marly limestone, and sandy limestone. It is moderately soft rock and is highly fractured. In addition, the lower part of the Sannine Formation (C4) covers a part of the hillside on the right abutment. This formation consists of beige, karstic, sometimes dolomitic, fractured, and well bedded strata (see Figure 2).

Figure 2: Photo of the right bank of the Bisri River where the Lower Cretaceous sequences are exposed. The limestone strata occupy the top of the hillside. The agricultural terrains in the foreground are underlain by the Quaternary river and lake deposits. Photo taken facing eastwards.

The stratigraphy in the reservoir consists mainly of Lower Cretaceous Chouf Sandstone Formation (C1) which is friable sandstone with marl and argillaceous interbeds and some lignite layers. Close to the dam site, a sequence of interbedded limestones and marls of the Albien (C3), Upper Aptien (C2b) and Lower Aptien (C2a) extends from dam axis upstream for about 1.7 km on the right abutment side. The right wall of the reservoir also contains certain slide areas in the Chouf Sandstone Formation.

The left side of the reservoir is essentially composed of the Chouf Sandstone Formation except for a limited exposure of the Mdairej Formation (C2b) along the Ouadi Bhannine. Localized landslides can be seen in the Chouf Sandstone Formation along the left reservoir side.

The river and lake deposits of the Quaternary unconformably overlie the Jurassic and Cretaceous outcrops. The upper river deposits consist of a mixture of sand, silt, gravel, and cobbles. Very little clay was found. In contrast, the underlying lake deposits are nearly all highly plastic clayey silts or silty clays. The lake deposits are often interstratified with sandy lenses or zones of different thicknesses.

The geologic structure at the dam site includes a combination of faulting, folding and slides. The faults appear to be high angle to vertical normal faults that essentially trend nearly north-south and nearly east-west. The boreholes drilled indicated the occurrence of a number of minor faults.

Two major faults intersect the area of the dam, and pass at close proximity of the dam axis. The first one is the Roum Fault, trending northwards, enters into the Nahr Bisri valley about 1.5 km southwest of Dam Axis. The second major fault (the Qalaat el Hambra Fault) strikes east-west on the right abutment side and trends across the river towards the left abutment upstream of the dam axis. The major landslide (downstream along the right bank) is believed to have occurred along this fault. Jointing, fracturing and fissuring are also encountered in the different formations exposed.

Borings along the dam axis, going from the left towards the right abutment, encountered a succession of older beds of the Jurassic formations (J7- J6) abruptly superposed against the Lower Cretaceous Abeih Formation (C2a). The Jurassic succession must have been uplifted by a major fault which has caused this considerable displacement of both Jurassic and Cretaceous formations. The report interprets this fault to be the Roum Fault (see attachment 3).

C2-Comments:

1- *The reports (R1 &R2) acknowledge the complex geologic setting of the proposed dam. In addition, the karstic nature of the exposed limestone formations is also indicated. In this respect, the right abutment of the dam, in addition to the right bank of the river represent substantial leakage potential, especially that fracturing and jointing characterize the outcropping limestone strata.*
2- *Given that the rockmass is fractured and fissured, and the exposed rocks at the left abutment are detrital and granular, the continuous erosive action of water, coupled with the structural setting will definitely make the rocks exposed at the dam site, and the reservoir susceptible to erosion. The presence of several landslides at the right and left banks of the river inside the reservoir area, in addition to the eboulis and sedimentary deposits along the course of the Bisri*

River course, require a detailed evaluation of these features and their effect on the water body of the reservoir.

3- *Karstic formations and karsts in general offer unique conditions resulting in uncertainties. The karstic nature of the terrain should be carefully studied and evaluated in relation to the tectonic setting of the reservoir and its water-tightness.*

D. Fault activity and seismic risk

The major structural and tectonic considerations reported in the reviewed documents are as follows:

1. The major structures affecting the dam site in this tectonic unit are the Roum Fault (flexure) and the Yammouneh Fault.

2. The closest surface trace of the Roum Fault to the Bisri dam site is located about 2 km southwest of the dam site. However, it appears that the fault continues within the Bisri River Valley (covered by alluvial deposits) to the vicinity of proposed dam axis.

3. The closest trace of Yammouneh Fault is approximately 10 km east of the site.

4. The Anti-Lebanon Range located about 25 km east of the Bisri dam site. The major faults of this tectonic unit are the Rachaya and the Serghaya Faults.

5. The Rachaya Fault is located 28 km east of the Bisri dam site.

6. The Serghaya Fault is located 40 km east of the Bisri dam site.

7. There are two notable earthquakes with magnitude 8.3 recorded in 1201 and 1759. Both earthquakes centers lies within a circle of 75 km from the site and both resulted in considerable casualties and a tsunami event.

8. On March 16 1956, a magnitude 6.0 earthquake occurred 4 km east of the proposed dam Axis causing 136 deaths and destroying 6000 houses. This event possibly occurred along the Roum Fault.

9. Most of the faults within the project area are considered to be active. Accordingly, the reported seismic design criteria is summarized in the following table:

Criteria	Source	
	Roum	**Yammouneh**
Length, km	50	600-1000
Distance from dam site (km)	2	10
MCE Magnitude	7.3	8.5
Bracketed Duration (sec)	20	45
Peak Ground Accelerations at Dam site		
Horizontal	0.70g	0.55g
Vertical	0.47g	0.37g

C3-Comments:

1- *The widespread extent of faulting and fracturing causes the development of secondary discontinuities in rocks that further dislocate and decrease their structural integrity. The permeability of the rockmass is thus increased and the potential of leakage from the water reservoir is enhanced.*

2- *The reports (R1&R2) acknowledge the seismic nature and activity of the area under study and neighboring areas (regional scale). However, no dedicated Seismotectonic study was done for the Bisri Dam.*

3- *A major risk is stated in the report (R2) whereby the Roum Fault and/or other associated faults pass under the dam axes. Roum Fault is a highly active fault and the source of earthquakes. For that purpose, a detailed field campaign in addition to a Seismotectonic study is mandatory. The occurrence of such a fault under the dam axis, if proven, places a severe constraint on the dam feasibility and a high risk on downstream developments in case of dam rupture.*

4- *The reservoir area as observed during our site visit is characterized by block tectonics rendering the prediction of the hydrogeological regime under water load very complex and with high degree of uncertainty (see Figure 3).*

Figure 3: View form the dam axis looking downstream (facing WSW). The area is characterized by the movement of tectonic blocks to accommodate prevailing structural elements such as faults.

E. Dam type, location and stability

1. The Bisri Dam Project is located on the Bisri River, approximately 17 km inland from the sea and 30 km southeast of Beirut.
2. The Bisri dam site is situated in a wide valley with moderately sloping abutment walls.
3. The reservoir for the proposed Bisri Dam extends about 4 km upstream of the adopted dam axis on the Bisri River and then branches out along both the Nahr Barouk towards the north and the Ouadi Bhannine towards the south.
4. The Dam Characteristics are reported as follows:
    a. Type of Dam is a zoned earth embankment dam with an RCC section as the spillway.
    b. Maximum Dam Height: 74 meters.
    c. Streambed Elevation: 395m.
    d. Dam Crest Elevation: 469m.

e. Spillway Elevation: 461m.
f. Dam Crest Length: 790 meters (RCC section 70meters long)
g. Crest width: 10 meters.
h. Upstream and downstream dam slopes are 2.5H: 1V.
i. Freeboard: 8 meters.
j. Storage Volume: 128 Mm3.
k. Dead Volume: 8 Mm3.

5. At the proposed dam location, the Bisri River is actively cutting through floodplain and terrace deposits. The following was reported regarding the riverine deposits:
    a. The present floodplain and active river deposits have a maximum thickness of 30 meters in the main channel section.
    b. These deposits are composed of silt, sand, gravel and cobbles. They overlie up to 90 meters of lake deposits which are generally highly plastic clayey soils with occasional sandy lenses of variable thicknesses.
6. The earth embankment comprises seven zones and has the following reported characteristics:
    a. The shell and transition zones are provided on the upstream side of the dam and are followed by a core sloping upstream from the center of the dam.
    b. The filter and chimney drain with transition and shell zones are located directly downstream of the core.
    c. The upstream face of the embankment will be covered entirely with riprap as a slope protection measure. The average thickness of the riprap is around 1m.
    d. The interface with the RCC section will be constructed by continuing the upstream shell and transition zones of the embankment across the upstream face of the RCC. A slope of 0.25H:1V was adopted for the interface wall.
    e. The loading conditions, minimum factors of safety, and the results are summarized in the following table:

Stability Analyses Cases and Results					
Loading Condition	**Foundation Clay**		**Factors of Safety**		**Remarks**
	f	**r_u**	**Minimum Required**	**Actual**	
End of Construction	20°	0.5	1.3	1.3	Upstream and downstream
Steady State Seepage	20°	0.5	1.5	2.2	Upstream only
Rapid Drawdown	20°	-	1.2	1.6	Upstream only

f= angle of friction; **r_u** = pore pressure ratio

    f. The materials properties for the reported stability analyses undertaken at the feasibility level are summarized in the following:

Zone	**Angle of Friction ø**	**Cohesion kg/cm2**	**Moist Density (t/m3)**
Shell	42°	0	2.14
Transition	38°	0	2.1
Filter/Drain	37°	0	2.18
Core	0 and 20°*	0 and 0.7*	1.67
Foundation Alluvium	35°	0	1.9
Foundation Clay	20°	0.7 and 1.4*	1.75

* Post consolidation strength resulting from embankment construction

7. Stability considerations for the design of the proposed dam include the following:
    a. Potential liquefaction of dam foundation soils. For that purpose, 60 samples were tested, and the results indicate that the clays do not appear to be liquefiable. (To be verified during upcoming investigations)
    Moreover, the granular bed-load deposits have been evaluated as prone to potential liquefaction. Proposed possible remedial measures include removal or in-situ densification to provide stability/safety during a seismic event.
    b. Fault rupture/movement under foundations: The report predicted a possibility of 3m vertical movement. A horizontal slippage of equal amount should be considered also for safety purposes.
    c. The deformation of the embankments: The estimated maximum amount of settlement for the Bisri Dam crest (by using an empirical relationship between settlement, earthquake magnitude, and peak ground acceleration, during a MCE event occurring at the Roum or Yammouneh Faults) will be in the order of 5m. The feasibility report adopts a settlement of 6m.
    d. Potential cracking: The report refers for the left abutment area in this respect. More specifically, a transverse crack is expected to develop where the surface of the rock foundation changes from gentler to steeper slopes.
8. The reported foundation design considerations are summarized as follows:
    a. Wick drains and stabilizing berms (at upstream and downstream embankment toe areas) to achieve adequate clay drainage and strength beneath and beyond the embankment section for end of construction stability. Surcharge and stability berms will be constructed for that purpose.
    b. Densification of the surface alluvial deposits through vibro-compaction.
    c. In the abutment areas, and where the embankment is placed on rock, the foundation rockmass should be fresh to slightly weathered rock.
    d. The foundation for the core will be excavated to controlled slopes in both the longitudinal and transverse directions. Slopes in the downstream direction will be limited to 1.5H: 1 V.

e. Beneath the core in the rock abutment zones, all open cracks or joints will be scaled using slush grout or shotcrete.
f. The core material of the right abutment will be constructed above a reinforced concrete slab anchored to the (limestone) bedrock. This slab will serve as the concrete grout cap for consolidation grouting.
g. Beneath the shells, areas of erodible rock will be covered by suitable filters and drains.
h. Monitoring of the dam site will be ensured by the following instrumentations/ measurements (during and after construction):
   i. Piezometers
   ii. Settlements
   iii. Inclinometers
   iv. Movement monitors (survey monuments)
   v. Seismographs
   vi. Seepage (when feasible)
i. The embankment drainage will be done through a combination of chimney drain and a blanket drain. The RCC section will include a vertical drain drilled down into the rockmass foundation.

9. Dam site Water-tightness and seepage considerations. The foundation conditions along the proposed dam axis are reported to have significant variations in permeability and leakage conditions, mainly resulting from the prevailing geologic conditions (lithology and structures). The following considerations were reported:
   a. The left abutment sandstone layers exhibit high permeability intervals within the rockmass. Of importance also is the eventual saturation and weakening of the sandstone rocks along fractures resulting in erosion and potential material losses.
   b. The lacustrine clays occur with intercalations of sandy and silty layers that might reach a thickness of 3m. These clays have been scoured and incised by the coarser granular alluvial deposits of the river channel (which are considered to be permeable). Permeability reported for the intercalations ranged between 10^{-4} cm/s for the slightly clay sand horizons, to 10^{-5}cm/s for the layered silt and silty clay intercalations. The consolidation tests carried on the lacustrine clay samples resulted in an average value of 10^{-8}cm/s.
   c. The deep lacustrine clays are underlain by a stratum of old alluvium and rock debris (possible colluvium). These deposits range between 2 to 15m (as evidenced from borehole logs). This stratum yielded variable permeability results ranging from as low as 2-4 LU to as high as 425 LU.

d. The boreholes drilled along the right abutment resulted in the total loss of drilling water. It is to be noted that karstic limestones strata extend to 1.7km upstream into the reservoir along the right abutment.
e. The proposed seepage control measures include:
    i. A plastic concrete slurry wall is recommended for the left abutment. The slurry wall would fully penetrate the sandstone formation and embed into the underlying limestone formation.
    ii. The seepage control along the RCC spillway section would encompass a 3-line curtain with one line grouted from outside the RCC section (at the RCC upstream face) while the other two lines will be grouted from within a gallery running parallel to the upstream face and accessible via a vertical shaft or an access parallel to the diversion conduit.
    iii. The valley fill deposits might cause severe leakage losses, especially along the deeper old alluvium and rock debris. For that purpose a deep cut off wall is adopted. This cutoff will consist of a slurry trench with plastic concrete backfill embedded 5 m into rock.
    iv. The right abutment will be treated by grouting. The clay core of the embankment will be established over a concrete grout cap anchored into the limestone bedrock. Consolidation grouting will be performed down to a depth of 8 meters under the full extent of the grout cap and a three-line curtain will be installed to a depth of 50 m. A clay blanket will be established from the embankment core beneath and to 5 m beyond the upstream embankment section. The blanket will extend from elevation 460m on the right abutment down to about elevation 415m (about 45m deep) and will be anchored into the relatively impermeable upper terrace lacustrine deposits.
f. Additional seepage control measures will be required along the exposed face of the limestone formation overlying the Mdairej Formation cliffs. These measures include a synthetic geo-membrane pinned to the exposed rock surface. The full extent of the synthetic liner will be confirmed during the final design studies.
g. Since the left bank of the reservoir is mostly made up of sandy rocks and intersected by a series of faults, the rockmass is weakened and potential rockmass sliding may be expected. Moreover, steeply sloping surfaces may require additional stability measures.

C4-Comments:

1- *For the purpose of preventing the separation of the clay core from the RCC abutment under seismic loading, the detail of the joint between RCC and clay* *core should be carefully studied. Should there be a risk of breaching, then the clay core must be continuous along the complete length of the dam, and the spillway should be constructed as a separate structure.*

2- *The alluvial clay deposits must be treated by vertical drains or stone columns during construction in order to allow for dissipation of pore water pressure caused by the dam load and for the major part of settlement to occur during the period of construction.*

3- *The clay core should be constructed of plastic clay such that it can sustain deformation without the risk of cracking under the effect of vertical differential settlement.*

4- *The clay core should be wide enough such that it maintains its integrity under the effect of seismic loading or fault movement, if the latter is of tolerable magnitude.*

5- *The cost of treatment of the foundation of the dam should be carefully evaluated in subsequent phases of study considering the various geotechnical issues commented above.*

6- *The grouting of the bedded limestone on the right abutment cannot eliminate the water leakage through it especially that the limestone is dipping steeply into the abutment. On the other hand the construction of a liner such as a geo-membrane over the limestone has a main disadvantage: leakage will occur through the limestone strata under the level of the river bed. Also, from our experience, a clay liner would be at the risk of failure by piping erosion.*

7- *The study of the dam requires a detailed risk identification and assessment in order to decide how the dam design can further proceed.*

8- *Consideration should be given to relocating the dam axis further upstream, beyond the karstic limestone encountered on the right abutment.*

F. Spillway type and location

1. The spillway, including the crest structure, will be constructed as an RCC section integrated along the left side of the zoned-earth embankment (see attachment 4). The crest will be an ungated 65m long concrete dam with crest invert at Elevation 456m.
2. The RCC will be located on sound rock and constructed at the same time as the embankment. Given the large concrete mass and shape, the RCC section is essentially considered stable.
3. The spillway consists of an ungated crest structure with a sloping, stepped, discharge channel with energy dissipation by means of a stilling basin.
4. A conventional stilling basin will be located at the downstream end of the chute with riprap downstream of the stilling basin in the discharge channel for a length of 50 m.

C5-Comment: as explained above, the interface between the proposed RCC section and fill material is critical and necessitates for safety reasons a detailed study; should the interface cause a failure risk, then the spillway should be constructed as a separate structure from the dam body; the latter would cause an increase in the cost of the spillway. In any case, the reviewer recommends a separate spillway structure.

G. Diversion structures-tunnels

1. During construction, diversion of the river through the dam site will be accomplished with a combination of cofferdam and conduit along the left bank of the dam.
2. The diversion structures are designed to protect the embankment construction against a flood of 440m³/s with a return interval of 25 years. The diversion structures will consist of a cut and cover concrete conduit located on rock under the dam embankment and RCC section.
3. The cofferdam will have a crest at Elevation 418m.
4. The outlet works shall be combined with the diversion canal. In addition, it will be used for access for maintenance from the downstream end.

C6-Comment: In the proposed design, the system of diversion is placed within the RCC spillway. However the feasibility of the latter should be re-evaluated in terms of the behavior of the joint between clay core and RCC considering two critical factors: high vertical settlements of the foundation and high seismic loads.

H. Dam constructability and duration

The different aspects and considerations for the constructability of the dam are summarized as follows:

1. A period of 3 months has been allocated to accomplish the initial mobilization of personnel and equipment to the dam site.
2. The main access route to the project will be from Saida, through Lebaa to the Bisri village. A 12 m wide, unpaved road will be constructed from Bisri to the left abutment dam crest, continuing to the campsite location approximately 1 km upstream.
3. Before the construction of dam facilities, the existing river channel will be straightened and shaped so as to contain the stream flow in the minimum possible space, and maximize the area available for the improvements of the dam foundations.
4. Care of water during construction of other facilities will involve conventional sumping, sloping, and pumping of seepage and runoff water to maintain the work areas in acceptably dry conditions.
5. Construction of the upstream cofferdam is the first critical activity to be undertaken. Materials for the cofferdam fills will come from required excavations and from borrow areas developed in the valley upstream from the dam.
6. Commencement of the open cut excavation for the diversion conduit can begin at an early stage of construction.
7. Upon diversion of the stream through the conduit, the foundation treatment in the old riverbed will proceed to completion. A certain amount of fill placement will be permitted during the foundation treatment phase because of the need to have all areas of the dam footprint loaded at approximately the same rate.
8. A separate rock quarry will be required to produce the volumes of transition and shell materials called for by the design.
9. The intake tower facilities may be started as soon as the diversion conduit construction passes the intake location. Second stage concreting for the tunnel plug and for the gate chamber will be coordinated following installation of the stop logs.
10. Construction of the structures and installation of the gates and valves at the outlet of the conduit will take place after flow has been stopped and the reservoir impoundment has commenced.
11. For the Roller Compacted Concrete (RCC), a separate materials production operation in the alluvium borrow area upstream from the dam has been anticipated to prepare the fill materials. This will involve cone-crushers, screen decks, and conveyors to prepare and stockpile a sufficient volume to avoid unnecessary interruptions during placement.

12. Shell and riprap material will be quarried from the exposed limestone cliffs nearby.
13. The core zone will be constructed by the "Wet Core" method, as the natural moisture content of the clayey deposits are 8-12% greater than the optimum moisture content.
14. The reported schedule of works indicates a construction period of 3 years.

C7-Comments: the proposed completion date is unrealistic; it is expected that the dam construction requires at least a five years duration. The construction schedule should take into consideration:

- *The delays caused by the wet season.*
- *The extensive foundation treatment works as well as their cost*

I. Concluding Statements

1. The findings of the submitted feasibility study and annex reports are summarized as follows:
    a. The complex geologic and structural setting of the proposed dam was highlighted. In addition, the different geologic formations exposed at the dam axis and reservoir were described.
    b. The feasibility reports indicate that karstic formations are exposed along the right bank/abutment that will require treatment. In fact a complex treatment for the purpose of water tightness of the different elements of the dams, in addition to the stability of the dam is proposed.
    c. The reports offer a regional tectonic overview of the dam area, stating the different structural/tectonic elements of influence, in addition to the seismic criteria required for the design.
    d. The design considerations, such as the potential for transverse cracking of the embankment during severe earthquakes have been addressed.
    e. The reported foundations treatment methods proposed include complex and delicate measures including concrete slurry walls, three line grout curtains, consolidation grouting, stabilizing berms, and vibro compacting to treat and mitigate potential leakage, liquefaction of foundation soils, fault rupture under the foundations, and the potential deformation of the embankment.
    f. The dam body material, in addition to the spillway, temporary water diversion and outlet structures were also presented in the submitted reports.

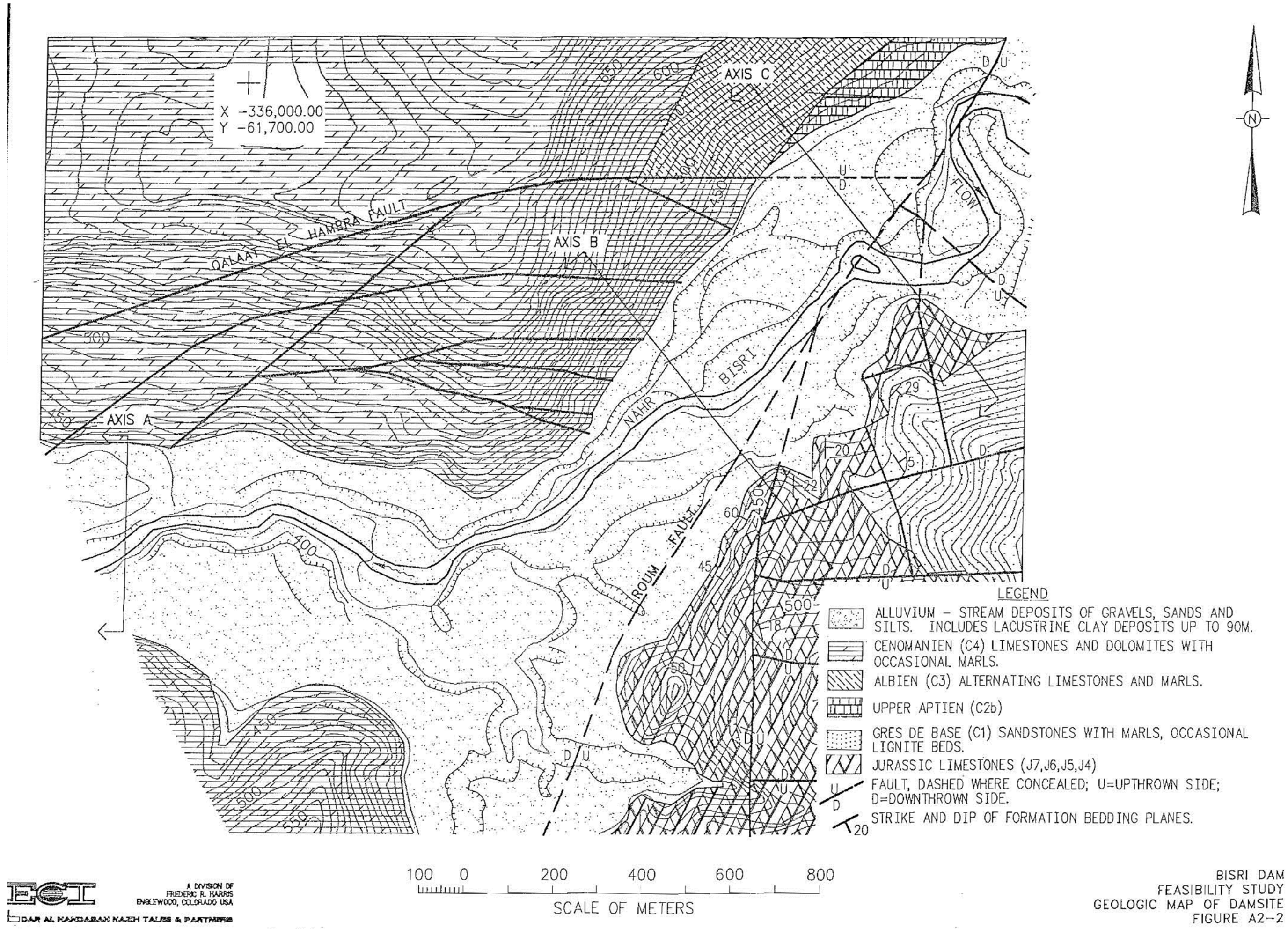
g. The different aspects of the constructability of the dam were also addressed.

2. Our comments on the submitted feasibility study and annexed reports are summarized as follows:
   a. The reported subsurface investigations have yielded data on the geotechnical parameters. However, geophysical surveys to identify the variation in the bedrock surface under the river bed are required. This will shed more light also on the nature and extent of the reported Roum Fault under the dam site.
   b. A joint line survey is required to better understand the jointing and discontinuities orientation in combination with the main faults in the dam area, especially that the structural context of the proposed dam is one of active deformation and block tectonics, as evidenced from the site visit and topography of the area under investigation.
   c. It is noted that the karstic limestone formations exposed along the right bank of the dam site present a potential of leakage as they are fractured. In addition, karstic terrains offer unique conditions resulting in uncertainties. As such, the permeability and water tightness assessments should be carefully revised and reassessed.
   d. Since the report acknowledges the seismic nature and activity of the dam site area, a dedicated Seismotectonic study is mandatory. This study will further shed light on the different structural components of influence to the dam design/stability and will ascertain the extent of the Roum Fault or a branch of it underneath the dam site.
   e. The effects of landslides on the waters of the reservoir should be carefully evaluated and reassessed.
   f. For the purpose of preventing separation of the clay core from the proposed RCC abutment under seismic loading, the feasibility of the joint between the RCC clay core should be carefully evaluated.
   g. The grouting of the bedded limestone on the right abutment cannot eliminate the water leakage through it. On the other hand the construction of a liner such as a geo-membrane over the limestone has a main disadvantage: leakage would continue to occur in the limestone beds under the level of the river bed.
   h. Consideration should be given to relocating the dam axis further upstream beyond the karstic limestone encountered on the right bank.

i. The proposed completion date proposed is unrealistic; it is expected that the dam construction requires at least five years taking into consideration the delay caused by the wet seasons and the extensive foundation treatment works.

j. The study of the dam requires a detailed risk identification and assessment in order to decide how the dam design can further proceed.

ATTACHMENTS



Attachment 1 : **geologic map of the proposed dam site as reported in the feasibility study (R2).**

Attachment 2 : Geologic Map of the Dam Reservoir Area as Reported in the Feasibility Study (R2).

1

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3

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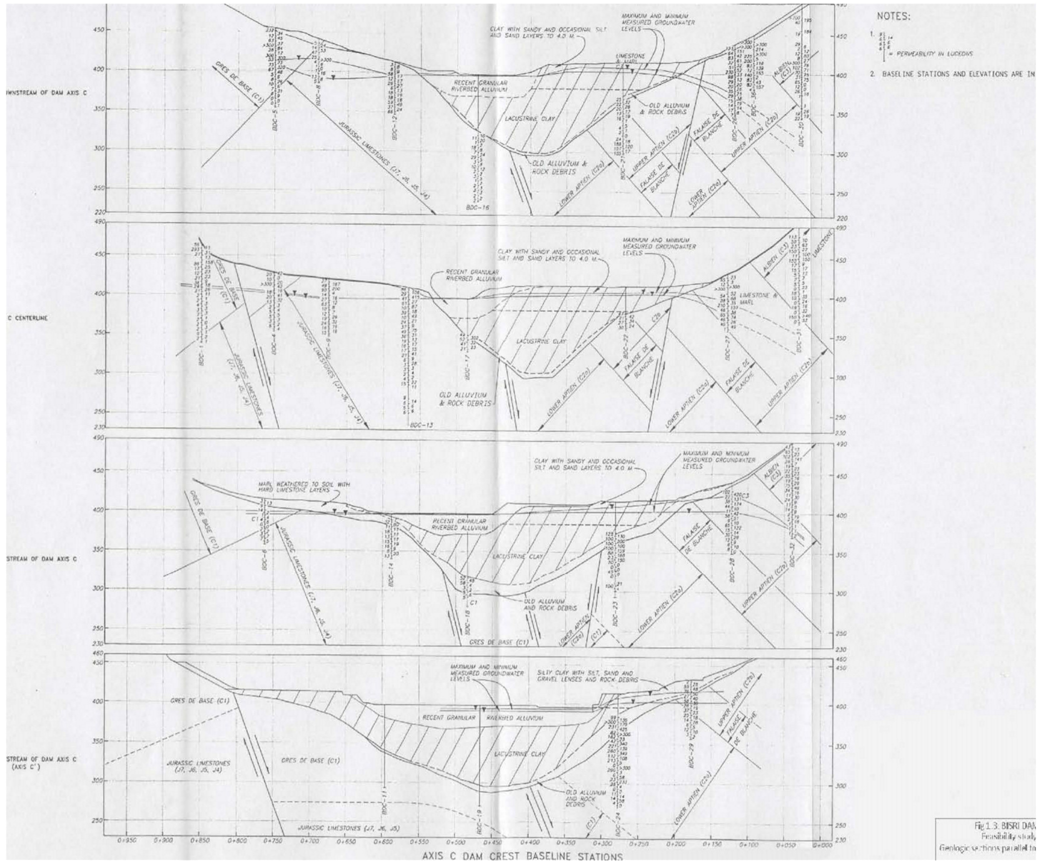
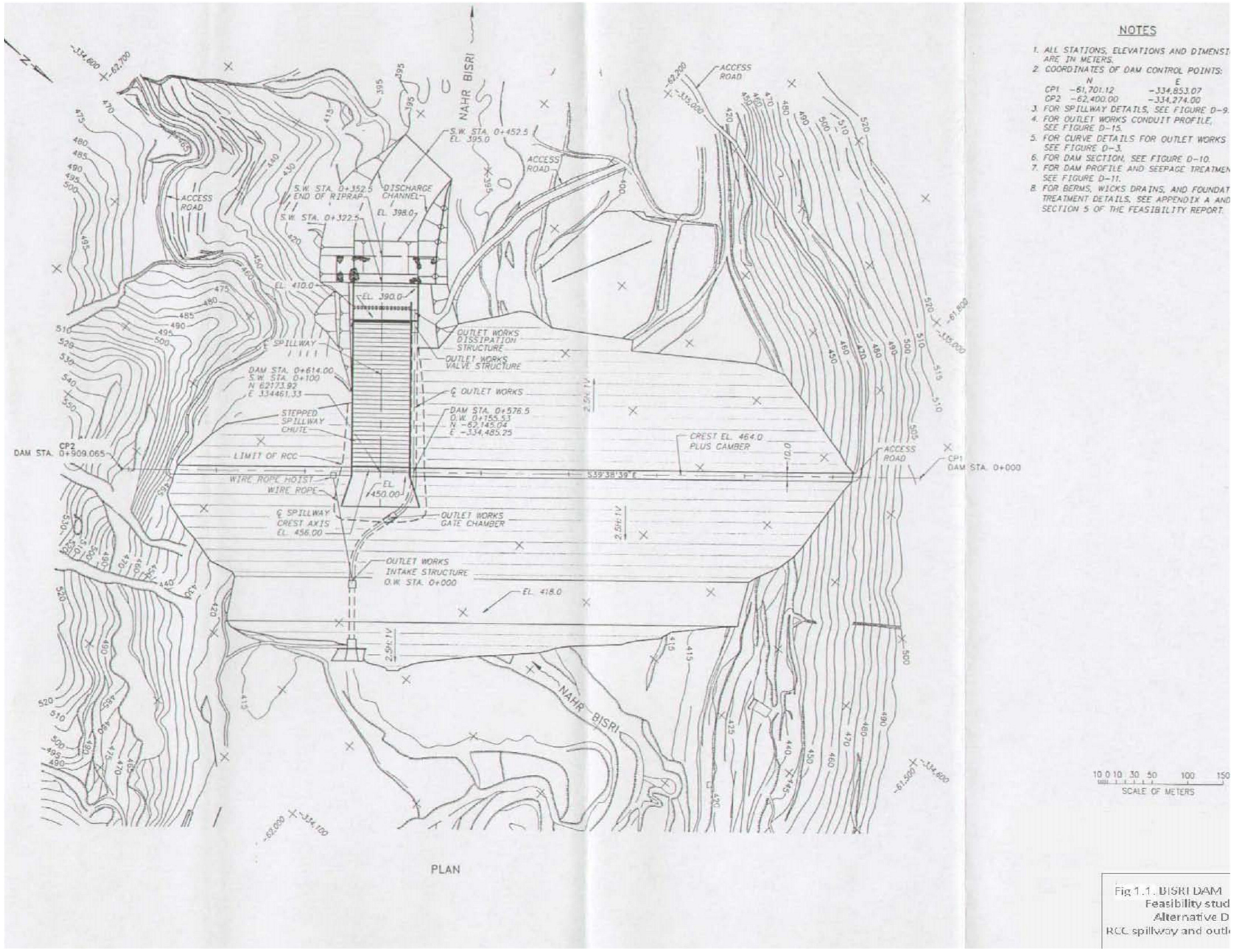


Attachment 3: The Different Geologic Profiles as Reported in (R1&R2) along the Dam Axis Centreline (2), Downstream of Dam Axis (1), and Upstream of the Dam Axis (3 &4).



Attachment 4: A Layout Plan Showing the Proposed Dam Structure Along with the RCC Spillway as Reported in the Feasibility Study Reported in (R1&R2).

APPENDIX F

WATER QUALITY

Appendix F1: AUB sampling at Bisri Bridge

Date	20/04/10	27/04/10	04/05/10	11/05/10	18/05/10	05/04/11	12/04/11	19/04/11	26/04/11	22/06/12
Temperature	19.6	14.1	17.5	18.6	20.5	16.1	19.2	13.1	16.2	
Color	17	3	5	4	4	19	15	14	6	22
Turbidity	5.05	1.37	1.15	2	1.11	5	3	4	2	2.4
Conductivity	428	446	465	518	534	451	482	448	468	383
Acidity as $CaCO_3$	10	5	5		5	10	5	10	5	
Total Alkalinity as $CaCO_3$	155	175	175		180	140	145	140	150	
pH at 20°C	7.51	7.57	7.88		7.81	7.84	7.86	7.99	7.95	7.89
Calcium hardness as $CaCO_3$	180	190	200		200	200	200	190	190	181
Magnesium hardness as $CaCO_3$	35	50	35		40	40	40	45	50	61
Total hardness as $CaCO_3$	215	240	235	5	240	240	240	235	240	242
Chlorides Cl^-	10	10	15	180	20	12.5	12.5	12.5	12.5	14.6
Sulfates SO_4^{2-}	40	39	37	7.81	45	35	36	34	35	29
Phosphates as P	0.04	0.06	0.05	210	0.07	0.03	0.03	0.03	0.11	0.10
Phosphorus as P_2O_5	0.06	0.08	0.07	40	0.09	0.05	0.04	0.04	0.13	
Dissolved Iron Fe^{2+}	0.06	0.09	0.09	250	0.13	0.18	0.13	0.13	0.12	
Ammonia Nitrogen as NH_4^+	0.36	0.32	0.33	25	0.35	0.19	0.24	0.37	0.33	0.09
Nitrites as NO_2^-	0.049	0.045	0.043	42	0.079	0.042	0.039	0.045	0.072	0.036

Date	20/04/10	27/04/10	04/05/10	11/05/10	18/05/10	05/04/11	12/04/11	19/04/11	26/04/11	22/06/12
Nitrates as NO_3^-	8.85	8.35	8.41	0.05	7.97	8.41	7.02	7.52	8.41	7.2
Dissolved oxygen as O_2 (23°C)	4	5	5	0.07	6	5	6	5	5	
TDS as Nalco	216	225	235	262	270	228	243	226	236	192
Mineralization Virtual	306	319	333	371	382	323	345	320	335	
CO_2	9	10	4	5	5	4	3	3	3	
Fluorides	0.15	0.21	0.43	0.05	0.35	0.09	0.11	0.12	0.09	0.30
Manganese Total	0.04	0.05	0.08	0.08	0.02	na	na	na	na	3.4
Sulphide	0.002	0.004	0.001	0.001	0.001	0.005	0.006	0.006	0.003	
BOD_5	21	21	0.2							<2
COD						3	4	17	12	<2
Coliform Bacteria (at 37°C) U.F.C./100ml	14407	8419	8710	11278	34420	39230	20300	25100	22000	>500
Thermo Tolerant Coliform (at 44°C) U.F.C./100ml	12650	7560	7835	6645	14370	24150	5540	4980	13240	
Escherichia coli	545	1160	870	760	1400	1720	1320	660	4760	284

Appendix F2: AUB Sampling at Bisri Bridge for BMLWE

Parameter	07/12/11	21/12/11	04/01/12	25/01/12	01/02/12	15/02/12	29/02/12	14/03/12	28/03/12	11/04/12	25/04/12	09/05/12
Water Temp. (°C)	12.8	13.5	14.1	12.5	11.2	14.3	9.3	12.8	14.2	16.0	18.6	20.7
DO (mg/L)	9.38	9.84	9.11	8.18	9.41	8.11	9.19	8.58	8.24	8.9	8.99	9.6
TOC (mg/L)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BOD_5 (mg/L)	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
COD (mg/L)	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Cyanide (mg/L)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Iron (mg/L)				<0.25							<0.25	
Manganese (mg/L)				<0.25							<2.0	
Arsenic (µg/L)				<1							<2.0	
Cadmium (µg/L)				<0.25							<0.25	
Chromium (µg/L)				<1							<1.0	
Copper (µg/L)				3.2							<1.0	
Lead (µg/L)				<1							<1.0	
Selenium (µg/L)				<2							<2.0	
Antimony (µg/L)				<2							<2.0	

Parameter	07/12/11	21/12/11	04/01/12	25/01/12	01/02/12	15/02/12	29/02/12	14/03/12	28/03/12	11/04/12	25/04/12	09/05/12
Barium (µg/L)				25							24	
Berylium (µg/L)				3							na	
Mercury (µg/L)				<1							<0.5	
Thallium (µg/L)				<2							<2	

Appendix F3: Dar Sampling for ESIA (Oct 2012)

Sampling Point	BW 1	BW 1	BW 2	BW 3	BW 4	BW 5
Date	22/06/12	03/10/12	03/10/12	03/10/12	03/10/12	03/10/12
Turbidity	2.4	1.1	1.1	0.64	1.0	0.75
Conductivity	383	537	590	576	461	324
Color	22	6	19	9	40	15
pH at 20°C	7.89	7.66	7.77	7.73	8.11	8.08
Carbonate Alkalinity as $CaCO_3$		0	0	0	0	0
Bicarbonate Alkalinity as $CaCO_3$		246	235.4	231.2	234	240
Calcium Hardness as $CaCO_3$	181	na				
Magnesium Hardness as $CaCO_3$	61	na				
Total hardness as $CaCO_3$	242	254	346	342	276	254
Calcium		7504	104.7	105.4	81	78.6
Magnesium		1601	20.6	19.2	18	14.0
Sulphate SO_4^{2-}	29	45	144	146	45	28
Nitrate as NO_3^-	7.2	6.5	10.6	10.7	9.6	8.9

Sampling Point	**BW 1**	**BW 1**	**BW 2**	**BW 3**	**BW 4**	**BW 5**
Date	**22/06/12**	**03/10/12**	**03/10/12**	**03/10/12**	**03/10/12**	**03/10/12**
Nitrate-Nitrogen		1.5	2.4	2.4	2.2	2.0
Nitrite as NO_2^-	0.036	0.057	0.020	0.020	0.035	0.022
Nitrite-Nitrogen		0.017	0.006	0.006	0.011	0.007
Ammonia		0.16	<0.09	<0.09	<0.09	<0.09
Ammonia Nitrogen as NH_4^+	0.09	0.13	<0.09	<0.09	<0.09	<0.09
Ortho-Phosphate		0.09	0.39	0.28	0.29	0.41
Total Phosphorus	0.10	0.11	0.19	0.17	0.17	0.22
Chlorides Cl^-	14.6	24.2	37.4	37.6	36.6	32.8
Fluorides	0.30	0.32	0.45	0.56	0.52	0.52
BOD_5	<2	<2	<2	<2	<2	<2
COD	<2	<2	<2	<2	<2	<2
TOC		<0.5	<0.5	<0.5	<0.5	<0.5
Cyanide		<0.005	<0.005	<0.005	<0.005	<0.005
TDS	192	267	295	288	231	212
TSS		13.2	10	4.7	12.8	5.2
Arsenic		<2	<2	<2	<2	<2
Cadmium		<0.25	<0.25	<0.25	<0.25	<0.25
Chromium		<1	<1	<1	<1	<1
Copper		<1	<1	<1	<1	<1
Iron		<0.25	<0.25	<0.25	<0.25	<0.25
Lead		<1	<1	<1	<1	<1
Manganese	3.4	<2	<2	<2	<2	<2
Selenium	3.4	<2	<2	<2	<2	<2
Barium	0.008	0.012	0.014	0.016	0.006	0.005
Thallium	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002

Sampling Point	BW 1	BW 1	BW 2	BW 3	BW 4	BW 5
Date	**22/06/12**	**03/10/12**	**03/10/12**	**03/10/12**	**03/10/12**	**03/10/12**
Mercury	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Beryllium	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Antimony	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Faecal coliforms	284	203	312	343	>500	>500
Total Coliforms	>500	>500	>500	>500	>500	>500
Gamma-BHC (Lindane) ug/l		0.01	0.02			
Dieldrin ug/l		0.02				0.05

Conductivity in µS/cm; pH in PH units; OGP pesticides in µg/l. All other determinations in mg/l.

Appendix F4: Certificate of test for 5 Samples taken by DAR for ESIA (Oct 2012)

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CERTIFICATE OF TEST

Requested by: **Dar Al-Handasah (c/o Elie Abou Rejaili) (Shair and Partners)**	Date	**11/10/2012**
	Your Ref.	**R -22626-W**
	Our Ref.	

Nature of Test:

Sample ID: **BW 1**
Date Received: **03/10/2012**

Turbidity (NTU)	**1.1**
Conductivity (µSiemens/cm at 25°C)	**537**
Apparent Color (Pt-Co units)	**6**
pH (pH Units 25°C)	**7.66**
Hydroxide Alkalinity (mg/L as $CaCO_3$)	**0**
Carbonate Alkalinity (mg/L as $CaCO_3$)	**0**
Bicarbonate Alkalinity (mg/L as $CaCO_3$)	**246**
Total Hardness (mg/L as $CaCO_3$)	**254**
Calcium (mg/L Ca^{2+})	**75.4**
Magnesium (mg/L Mg^{2+})	**16.1**
Sulfate (mg/L SO_4^{2-})	**45**
Nitrate (mg/L NO_3^-)	**6.5**
Nitrate-Nitrogen (mg/L NO_3^-N)	**1.5**
Nitrite (mg/L NO_2^-)	**0.057**
Nitrite- Nitrogen (mg/L NO_2^-N)	**0.017**
Ammonia (mg/L NH_3)	**0.16**
Ammonia-Nitrogen (mg/L NH_3^-N)	**0.13**
Ortho-Phosphates (mg/L o-PO_4^{3-})	**0.09**
Total Phosphorus (mg/L P)	**0.11**
Chlorides (mg/L $C1^-$)	**24.2**
Fluoride (mg/L F^-)	**0.32**

All tests are performed in accordance to the "Standard Methods for the Examination of Water and Wastewater", 22nd Edition, 2012 as approved by the American Public Health Association, the American Water Works Association, and the Water Environment Federation unless otherwise noted.

George M. Ayoub, Ph.D.
Professor of Civil & Environmental Engineering

AMERICAN UNIVERSITY of BEIRUT Department of Civil and Environmental Engineering Engineering Service Laboratories
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CERTIFICATE OF TEST

Requested by: Date

Dar Al-Handasah (c/o Elie Abou Rejaili)
(Shair and Partners)

Your Ref. **11/10/2012**

Our Ref. **R -22626-W**

Nature of Test:

Sample ID: **BW 1**
Date Received: **03/10/2012**

Biochemical Oxygen Demand (mg/L BOD_5)	< 2
Chemical Oxygen Demand (mg/L O_2)	< 2
Total Organic Carbon (mg/L C)	< 0.5
Cyanide (mg/L CN^-)	< 0.005
Total Dissolved Solids (mg/L 25 °C)	267
Total Suspended Solids (mg/L)	13.2
Arsenic (µg/L)	< 2.0
Cadmium (µg/L)	< 0.25
Chromium (µg/L)	< 1.0
Copper (µg/L)	< 1.0
Iron (mg/L)	< 0.25
Lead (µg/L)	< 1.0
Manganese (µg/L)	< 2.0
Selenium (µg/L)	< 2.0
Fecal Coliforms (CFU/100ml)	203
Total Coliforms (CFU/100ml)	~>500

All tests are performed in accordance to the "Standard Methods for the Examination of Water and Wastewater", 22nd Edition, 2012 as approved by the American Public Health Association, the American Water Works Association, and the Water Environment Federation unless otherwise noted.

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Environment Core Laboratory Test Report Reference no:ECL121004-547-BW 1
Page 2 of 5

Organochlorine Pesticides Profile:

Analysis	MDL	Sample BW 1 Result (R)	Method	UR	EPA / WHO MCL	MOH MCL
Alpha-BHC	0.01 ug/L	<0.01 ug/L	EPA 608/508.1M	NE	NA	NA
Gamma-BHC (Lindane)	0.01 ug/L	0.01 ug/L	EPA 608/508.1M	NE	0.2 ug/L	0.2 ug/L
Beta-BHC	0.01ug/L	<0.01ug/L	EPA 608/508.1M	NE	NA	NA
Heptachlor	0.01 ug/L	<0.01 ug/L	EPA 608/508.1M	R±40% of R	0.4 ug/L	NA
Delta-BHC	0.01 ug/L	<0.01 ug/L	EPA 608/508.1M	NE	NA	NA
Aldrin	0.01 ug/L	<0.01 ug/L	EPA 608/508.1M	R±41% of R	0.03ug/L(Aldrin/Dieldrin)	0.02ug/L (Aldrin+ Dieldrin)
Heptachlor Epoxide	0.01 ug/L	<0.01 ug/L	EPA 608/508.1M	R±42% of R	0.2 ug/L	NA
Endosulfan I	0.02 ug/L	<0.02 ug/L	EPA 608/508.1M	R±35% of R	NA	NA
4,4' DDE	0.02 ug/L	<0.02 ug/L	EPA 608/508.1M	NE	NA	NA
Dieldrin	0.02 ug/L	0.02 ug/L	EPA 608/508.1M	R±26% of R	0.03ug/L(Aldrin/Dieldrin)	0.02ug/L (Aldrin+ Dieldrin)
Endrin	0.02 ug/L	<0.02 ug/L	EPA 608/508.1M	R±29% of R	0.2 ug/L	NA
4,4'DDD	0.06 ug/L	<0.06 ug/L	EPA 608/508.1M	NE	NA	NA
Endosulfan II	0.02 ug/L	<0.02 ug/L	EPA 608/508.1M	R±35% of R	NA	NA
4,4'DDT	0.06ug/L	<0.06ug/L	EPA 608/508.1M	R±43% of R	NA	NA
Endrin Aldehyde	0.06 ug/L	<0.06 ug/L	EPA 608/508.1M	NE	NA	NA
Endosulfan Sulfate	0.06 ug/L	<0.06 ug/L	EPA 608/508.1M	NE	NA	NA

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Environment Core Laboratory Test Report Reference no:ECL121004-547-BW 1
Page 3 of 5

Volatiles Organic Compounds:

Analysis	MDL (ug/L)	Sample BW 1 Result (R) (ug/L)	Method	UR	EPA / WHO MCL	MOH MCL
Benzene	1	<1	EPA 524.2/602M	R ± 51% of R	5 ug/L	NA
Bromobenzene	1	<1	EPA 524.2/602M	R ± 13% of R	NA	NA
Bromochloromethane	1	<1	EPA 524.2/602M	R ± 24% of R	NA	NA
Bromodichloromethane	1	<1	EPA 524.2/602M	R ± 10% of R	NA	NA
Bromoform	1	<1	EPA 524.2/602M	R ± 20% of R	NA	NA
n-Butyl Benzene	1	<1	EPA 524.2/602M	R ± 19% of R	NA	NA
tert Butyl Benzene	1	<1	EPA 524.2/602M	NE	NA	NA
sec Butyl Benzene	1	<1	EPA 524.2/602M	R ± 15% of R	NA	NA
Carbon tetrachloride	1	<1	EPA 524.2/602M	R ± 12% of R	5 ug/L	NA
Chlorobenzene	1	<1	EPA 524.2/602M	R ± 57% of R	100 ug/L	NA
Chloroform	1	<1	EPA 524.2/602M	R ± 27% of R	100#	100
4-Chlorotoluene	1	<1	EPA 524.2/602M	R ± 13% of R	NA	NA
2-Chlorotoluene	1	<1	EPA 524.2/602M	R ± 18% of R	NA	NA
1,2-Dibromo-3-chloropropane	1	<1	EPA 524.2/602M	R ± 57% of R	DBCP: 0.2 ug/L	NA
Dibromochloromethane	1	<1	EPA 524.2/602M	R ± 23% of R	NA	NA
1,2-Dibromoethane	1	<1	EPA 524.2/602M	R ± 31% of R	NA	NA
Dibromomethane	1	<1	EPA 524.2/602M	R ± 24% of R	NA	NA
1,3-Dichlorobenzene	1	<1	EPA 524.2/602M	R ± 16% of R	NA	NA
1,2-Dichlorobenzene	1	<1	EPA 524.2/602M	R ± 25% of R	600 ug/L	NA
1,4-Dichlorobenzene	1	<1	EPA 524.2/602M	R ± 16% of R	75	NA
1,1-Dichloroethane	1	<1	EPA 524.2/602M	R ± 24% of R	NA	NA
1,2-Dichloroethane	1	<1	EPA 524.2/602M	R ± 30% of R	NA	NA
cis-1,2-Dichloroethene	1	<1	EPA 524.2/602M	R ± 39% of R	NA	NA
trans-1,2-Dichloroethene	1	<1	EPA 524.2/602M	R ± 13% of R	NA	NA
1,1-Dichloroethene	1	<1	EPA 524.2/602M	R ± 11% of R	5 ug/L	NA
1,2-Dichloropropane	1	<1	EPA 524.2/602M	R ± 19% of R	5 ug/L	NA
1,3-Dichloropropane	1	<1	EPA 524.2/602M	R ± 39% of R	5 ug/L	NA
2,2-Dichloropropane	1	<1	EPA 524.2/602M	R ± 26% of R	5 ug/L	NA
1,1-Dichloropropene	1	<1	EPA 524.2/602M	R ±27% of R	NA	NA
cis-1,3-Dichloro-1-propene	1	<1	EPA 524.2/602M	NE	NA	NA

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Environment Core Laboratory Test Report Reference no: ECL121004-547-BW 1
Page 4 of 5

Analysis	MDL (ug/L)	Sample BW 1 Result (R) (ug/L)	Method	UR	EPA / WHO MCL	MOH MCL
trans-1,3-Dichloro-1-propene	1	<1	EPA 524.2/602M	NE	NA	NA
Ethylbenzene	1	<1	EPA 524.2/602M	NE	700 ug/L	NA
Hexachlorobutadiene	1	<1	EPA 524.2/602M	NE	NA	NA
Isopropylbenzene	1	<1	EPA 524.2/602M	NE	NA	NA
p-Isopropyltoluene	1	<1	EPA 524.2/602M	NE	NA	NA
Methylene Chloride	1	<1	EPA 524.2/602M	NE	NA	NA
Naphtalene	1	<1	EPA 524.2/602M	NE	NA	NA
n-Propyl Benzene	1	<1	EPA 524.2/602M	NE	NA	NA
Styrene	1	<1	EPA 524.2/602M	NE	100	NA
1,1,1,2-Tetrachloroethane	1	<1	EPA 524.2/602M	NE	NA	NA
1,1,2,2-Tetrachloroethane	1	<1	EPA 524.2/602M	NE	NA	NA
Tetrachloroethene	1	<1	EPA 524.2/602M	NE	5 ug/L	NA
Toluene	1	<1	EPA 524.2/602M	NE	1000 ug/L	NA
1,2,3-Trichlorobenzene	1	<1	EPA 524.2/602M	NE	NA	NA
1,2,4-Trichlorobenzene	1	<1	EPA 524.2/602M	NE	NA	NA
1,1,1-Trichloroethane	1	<1	EPA 524.2/602M	NE	200 ug/L	NA
1,1,2-Trichloroethane	1	<1	EPA 524.2/602M	NE	5 ug/L	NA
Trichloroethene	1	<1	EPA 524.2/602M	NE	NA	NA
1,2,3-Trichloropropane	1	<1	EPA 524.2/602M	NE	5 ug/L	NA
1,2,4-Trimethylbenzene	1	<1	EPA 524.2/602M	NE	NA	NA
1,3,5-Trimethylbenzene	1	<1	EPA 524.2/602M	NE	NA	NA
o-Xylene	1	<1	EPA 524.2/602M	NE	1000@	NA
m-Xylene	1	<1	EPA 524.2/602M	NE	1000@	NA
p -Xylene	1	<1	EPA 524.2/602M	NE	1000@	NA

= MCL shown is for the total of these four compounds
@ = MCL shown is for total Xylene's
All detected analytes referred to as "Detected" were between instrument detection limit (0.1 µg/L) and the limit of quantification (1 µg/L).The qualified results represent values determined at levels where the true value of the measured chemical cannot be quantified with a high degree of confidence. The data user may consider these qualified results as estimates when making project decisions.

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1902

Environment Core Laboratory Test Report Reference no:ECL121004-547-BW 1
Page 5 of 5

Metal Analysis:

Analysis as Total per metal	MDL (mg/L)	Sample BW 1 Result (R) mg/L	Method	UR	EPA / WHO MCL	MOH MCL
Barium	0.002	0.012	EPA200-7/8 M	R ±11% of R	2.0 mg/L	0.5 mg/L
Thallium	0.002	<0.002	EPA200-7/8 M	R ±19% of R	0.002 mg/L	NA
Antimony	0.002	<0.002	EPA200-7/8 M	R ±26% of R	NA	NA
Beryllium	0.002	<0.002	EPA200-7/8 M	R ±13% of R	0.004 mg/L	NA
Mercury	0.0005	<0.0005	EPA200-7/8 M	R ±27% of R	0.002 mg/L	0.05 mg/L

Retention of Samples: Samples are discarded one week after delivery of report.
Contact Information: For administrative information, complaints or any other queries, Mrs. Asma Bazzi, EVL Administrator, can be reached at 01-350000, extension 5204, or by email at ab19@aub.edu.lb or by fax: 01-370845.

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Z. HAB
Dr. Zuheir Habbal
Director of Clinical Chemistry Laboratory
Director of Environment Core Laboratory

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CERTIFICATE OF TEST

Requested by: **Dar Al-Handasah (c/o Elie Abou Rejaili)**
(Shair and Partners)

Date **11/10/2012**

Your Ref. **R -22626-W**

Our Ref.

Nature of Test:

Sample ID: **BW 2**
Date Received: **03/10/2012**

Turbidity (NTU)	**1.1**
Conductivity (μSiemens/cm at 25°C)	**590**
Apparent Color (Pt-Co units)	**19**
pH (pH Units 25°C)	**7.77**
Hydroxide Alkalinity (mg/L as $CaCO_3$)	**0**
Carbonate Alkalinity (mg/L as $CaCO_3$)	**0**
Bicarbonate Alkalinity (mg/L as $CaCO_3$)	**235.4**
Total Hardness (mg/L as $CaCO_3$)	**346**
Calcium (mg/L Ca^{2+})	**104.7**
Magnesium (mg/L Mg^{2+})	**20.6**
Sulfate (mg/L SO_4^{2-})	**144**
Nitrate (mg/L NO_3^-)	**10.6**
Nitrate-Nitrogen (mg/L NO_3^-N)	**2.4**
Nitrite (mg/L NO_2^-)	**0.020**
Nitrite- Nitrogen (mg/L NO_2^-N)	**0.006**
Ammonia (mg/L NH_3)	**< 0.09**
Ammonia-Nitrogen (mg/L NH_3^-N)	**< 0.09**
Ortho-Phosphates (mg/L o-PO_4^{3-})	**0.39**
Total Phosphorus (mg/L P)	**0.19**
Chlorides (mg/L $C1^-$)	**37.4**
Fluoride (mg/L F^-)	**0.45**

All tests are performed in accordance to the "Standard Methods for the Examination of Water and Wastewater", 22nd Edition, 2012 as approved by the American Public Health Association, the American Water Works Association, and the Water Environment Federation unless otherwise noted.

George M. Ayoub, Ph.D.
Professor of Civil & Environmental Engineering

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CERTIFICATE OF TEST

Requested by: | Date

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Your Ref. **11/10/2012**

Our Ref. **R -22626-W**

Nature of Test:

Sample ID: **BW 2**
Date Received: **03/10/2012**

Biochemical Oxygen Demand (mg/L BOD_5)	**< 2**
Chemical Oxygen Demand (mg/L O_2)	**< 2**
Total Organic Carbon (mg/L C)	**< 0.5**
Cyanide (mg/L CN^-)	**< 0.005**
Total Dissolved Solids (mg/L 25 °C)	**295**
Total Suspended Solids (mg/L)	**10**
Arsenic (µg/L)	**< 2.0**
Cadmium (µg/L)	**< 0.25**
Chromium (µg/L)	**< 1.0**
Copper (µg/L)	**< 1.0**
Iron (mg/L)	**< 0.25**
Lead (µg/L)	**< 1.0**
Manganese (µg/L)	**< 2.0**
Selenium (µg/L)	**< 2.0**
Fecal Coliforms (CFU/100ml)	**312**
Total Coliforms (CFU/100ml)	**~>500**

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1902

Environment Core Laboratory Test Report Reference no:ECL121004-547-BW 2
Page 2 of 5

Organochlorine Pesticides Profile:

Analysis	MDL	Sample BW 2 Result (R)	Method	UR	EPA / WHO MCL	MOH MCL
Alpha-BHC	0.01 ug/L	<0.01 ug/L	EPA 608/508.1M	NE	NA	NA
Gamma-BHC (Lindane)	0.01 ug/L	0.02 ug/L	EPA 608/508.1M	NE	0.2 ug/L	0.2 ug/L
Beta-BHC	0.01ug/L	<0.01ug/L	EPA 608/508.1M	NE	NA	NA
Heptachlor	0.01 ug/L	<0.01 ug/L	EPA 608/508.1M	R±40% of R	0.4 ug/L	NA
Delta-BHC	0.01 ug/L	<0.01 ug/L	EPA 608/508.1M	NE	NA	NA
Aldrin	0.01 ug/L	<0.01 ug/L	EPA 608/508.1M	R±41% of R	0.03ug/L(Aldrin/Dieldrin)	0.02ug/L (Aldrin+ Dieldrin)
Heptachlor Epoxide	0.01 ug/L	<0.01 ug/L	EPA 608/508.1M	R±42% of R	0.2 ug/L	NA
Endosulfan I	0.02 ug/L	<0.02 ug/L	EPA 608/508.1M	R±35% of R	NA	NA
4,4' DDE	0.02 ug/L	<0.02 ug/L	EPA 608/508.1M	NE	NA	NA
Dieldrin	0.02 ug/L	<0.02 ug/L	EPA 608/508.1M	R±26% of R	0.03ug/L(Aldrin/Dieldrin)	0.02ug/L (Aldrin+ Dieldrin)
Endrin	0.02 ug/L	<0.02 ug/L	EPA 608/508.1M	R±29% of R	0.2 ug/L	NA
4,4'DDD	0.06 ug/L	<0.06 ug/L	EPA 608/508.1M	NE	NA	NA
Endosulfan II	0.02 ug/L	<0.02 ug/L	EPA 608/508.1M	R±35% of R	NA	NA
4,4'DDT	0.06ug/L	<0.06ug/L	EPA 608/508.1M	R±43% of R	NA	NA
Endrin Aldehyde	0.06 ug/L	<0.06 ug/L	EPA 608/508.1M	NE	NA	NA
Endosulfan Sulfate	0.06 ug/L	<0.06 ug/L	EPA 608/508.1M	NE	NA	NA

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Page 3 of 5

Volatiles Organic Compounds:

Analysis	MDL (ug/L)	Sample BW 2 Result (R) (ug/L)	Method	UR	EPA / WHO MCL	MOH MCL
Benzene	1	<1	EPA 524.2/602M	R ± 51% of R	5 ug/L	NA
Bromobenzene	1	<1	EPA 524.2/602M	R ± 13% of R	NA	NA
Bromochloromethane	1	<1	EPA 524.2/602M	R ± 24% of R	NA	NA
Bromodichloromethane	1	<1	EPA 524.2/602M	R ± 10% of R	NA	NA
Bromoform	1	<1	EPA 524.2/602M	R ± 20% of R	NA	NA
n-Butyl Benzene	1	<1	EPA 524.2/602M	R ± 19% of R	NA	NA
tert Butyl Benzene	1	<1	EPA 524.2/602M	NE	NA	NA
sec Butyl Benzene	1	<1	EPA 524.2/602M	R ± 15% of R	NA	NA
Carbon tetrachloride	1	<1	EPA 524.2/602M	R ± 12% of R	5 ug/L	NA
Chlorobenzene	1	<1	EPA 524.2/602M	R ± 57% of R	100 ug/L	NA
Chloroform	1	<1	EPA 524.2/602M	R ± 27% of R	100#	100
4-Chlorotoluene	1	<1	EPA 524.2/602M	R ± 13% of R	NA	NA
2-Chlorotoluene	1	<1	EPA 524.2/602M	R ± 18% of R	NA	NA
1,2-Dibromo-3-chloropropane	1	<1	EPA 524.2/602M	R ± 57% of R	DBCP: 0.2 ug/L	NA
Dibromochloromethane	1	<1	EPA 524.2/602M	R ± 23% of R	NA	NA
1,2-Dibromoethane	1	<1	EPA 524.2/602M	R ± 31% of R	NA	NA
Dibromomethane	1	<1	EPA 524.2/602M	R ± 24% of R	NA	NA
1,3-Dichlorobenzene	1	<1	EPA 524.2/602M	R ± 16% of R	NA	NA
1,2-Dichlorobenzene	1	<1	EPA 524.2/602M	R ± 25% of R	600 ug/L	NA
1,4-Dichlorobenzene	1	<1	EPA 524.2/602M	R ± 16% of R	75	NA
1,1-Dichloroethane	1	<1	EPA 524.2/602M	R ± 24% of R	NA	NA
1,2-Dichloroethane	1	<1	EPA 524.2/602M	R ± 30% of R	NA	NA
cis-1,2-Dichloroethene	1	<1	EPA 524.2/602M	R ± 39% of R	NA	NA
trans-1,2-Dichloroethene	1	<1	EPA 524.2/602M	R ± 13% of R	NA	NA
1,1-Dichloroethene	1	<1	EPA 524.2/602M	R ± 11% of R	5 ug/L	NA
1,2-Dichloropropane	1	<1	EPA 524.2/602M	R ± 19% of R	5 ug/L	NA
1,3-Dichloropropane	1	<1	EPA 524.2/602M	R ± 39% of R	5 ug/L	NA
2,2-Dichloropropane	1	<1	EPA 524.2/602M	R ± 26% of R	5 ug/L	NA
1,1-Dichloropropene	1	<1	EPA 524.2/602M	R ±27% of R	NA	NA
cis-1,3-Dichloro-1-propene	1	<1	EPA 524.2/602M	NE	NA	NA

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Page 4 of 5

Analysis	MDL (ug/L)	Sample BW 2 Result (R) (ug/L)	Method	UR	EPA / WHO MCL	MOH MCL
trans-1,3-Dichloro-1-propene	1	<1	EPA 524.2/602M	NE	NA	NA
Ethylbenzene	1	<1	EPA 524.2/602M	NE	700 ug/L	NA
Hexachlorobutadiene	1	<1	EPA 524.2/602M	NE	NA	NA
Isopropylbenzene	1	<1	EPA 524.2/602M	NE	NA	NA
p-Isopropyltoluene	1	<1	EPA 524.2/602M	NE	NA	NA
Methylene Chloride	1	<1	EPA 524.2/602M	NE	NA	NA
Naphtalene	1	<1	EPA 524.2/602M	NE	NA	NA
n-Propyl Benzene	1	<1	EPA 524.2/602M	NE	NA	NA
Styrene	1	<1	EPA 524.2/602M	NE	100	NA
1,1,1,2-Tetrachloroethane	1	<1	EPA 524.2/602M	NE	NA	NA
1,1,2,2-Tetrachloroethane	1	<1	EPA 524.2/602M	NE	NA	NA
Tetrachloroethene	1	<1	EPA 524.2/602M	NE	5 ug/L	NA
Toluene	1	<1	EPA 524.2/602M	NE	1000 ug/L	NA
1,2,3-Trichlorobenzene	1	<1	EPA 524.2/602M	NE	NA	NA
1,2,4-Trichlorobenzene	1	<1	EPA 524.2/602M	NE	NA	NA
1,1,1-Trichloroethane	1	<1	EPA 524.2/602M	NE	200 ug/L	NA
1,1,2-Trichloroethane	1	<1	EPA 524.2/602M	NE	5 ug/L	NA
Trichloroethene	1	<1	EPA 524.2/602M	NE	NA	NA
1,2,3-Trichloropropane	1	<1	EPA 524.2/602M	NE	5 ug/L	NA
1,2,4-Trimethylbenzene	1	<1	EPA 524.2/602M	NE	NA	NA
1,3,5-Trimethylbenzene	1	<1	EPA 524.2/602M	NE	NA	NA
o-Xylene	1	<1	EPA 524.2/602M	NE	1000@	NA
m-Xylene	1	<1	EPA 524.2/602M	NE	1000@	NA
p -Xylene	1	<1	EPA 524.2/602M	NE	1000@	NA

= MCL shown is for the total of these four compounds
@ = MCL shown is for total Xylene's
All detected analytes referred to as "Detected" were between instrument detection limit (0.1 µg/L) and the limit of quantification (1 µg/L).The qualified results represent values determined at levels where the true value of the measured chemical cannot be quantified with a high degree of confidence. The data user may consider these qualified results as estimates when making project decisions.

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Metal Analysis:

Analysis as Total per metal	MDL (mg/L)	Sample BW 2 Result (R) mg/L	Method	UR	EPA / WHO MCL	MOH MCL
Barium	0.002	0.014	EPA200-7/8 M	R ±11% of R	2.0 mg/L	0.5 mg/L
Thallium	0.002	<0.002	EPA200-7/8 M	R ±19% of R	0.002 mg/L	NA
Antimony	0.002	<0.002	EPA200-7/8 M	R ±26% of R	NA	NA
Beryllium	0.002	<0.002	EPA200-7/8 M	R ±13% of R	0.004 mg/L	NA
Mercury	0.0005	<0.0005	EPA200-7/8 M	R ±27% of R	0.002 mg/L	0.05 mg/L

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CERTIFICATE OF TEST

Requested by: **Dar Al-Handasah (c/o Elie Abou Rejaili)**
(Shair and Partners)

Date **11/10/2012**

Your Ref. **R -22626-W**

Our Ref.

Sample ID: **BW 3**

Nature of Test: **Date Received:** **03/10/2012**

Turbidity (NTU)	**0.64**
Conductivity (µSiemens/cm at 25°C)	**576**
Apparent Color (Pt-Co units)	**9**
pH (pH Units 25°C)	**7.73**
Hydroxide Alkalinity (mg/L as $CaCO_3$)	**0**
Carbonate Alkalinity (mg/L as $CaCO_3$)	**0**
Bicarbonate Alkalinity (mg/L as $CaCO_3$)	**231.2**
Total Hardness (mg/L as $CaCO_3$)	**342**
Calcium (mg/L Ca^{2+})	**105.4**
Magnesium (mg/L Mg^{2+})	**19.2**
Sulfate (mg/L SO_4^{2-})	**146**
Nitrate (mg/L NO_3^-)	**10.7**
Nitrate-Nitrogen (mg/L NO_3^-N)	**2.4**
Nitrite (mg/L NO_2^-)	**0.020**
Nitrite- Nitrogen (mg/L NO_2^-N)	**0.006**
Ammonia (mg/L NH_3)	**< 0.09**
Ammonia-Nitrogen (mg/L NH_3^-N)	**< 0.09**
Ortho-Phosphates (mg/L o-PO_4^{3-})	**0.28**
Total Phosphorus (mg/L P)	**0.17**
Chlorides (mg/L Cl^-)	**37.6**
Fluoride (mg/L F^-)	**0.56**

All tests are performed in accordance to the "Standard Methods for the Examination of Water and Wastewater", 22nd Edition, 2012 as approved by the American Public Health Association, the American Water Works Association, and the Water Environment Federation unless otherwise noted.

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Faculty of Engineering and Architecture
Department of Civil and Environmental Engineering

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قسم الهندسة المدنية والبيئية

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Civil Engineering Service Laboratories | مختبرات الهندسة المدنية

CERTIFICATE OF TEST

Requested by: Date

Dar Al-Handasah (c/o Elie Abou Rejaili)
(Shair and Partners)

Your Ref. **11/10/2012**

Our Ref. **R -22626-W**

Nature of Test:

Sample ID: **BW 3**
Date Received: **03/10/2012**

Biochemical Oxygen Demand (mg/L BOD_5)	**< 2**
Chemical Oxygen Demand (mg/L O_2)	**< 2**
Total Organic Carbon (mg/L C)	**< 0.5**
Cyanide (mg/L CN^-)	**< 0.005**
Total Dissolved Solids (mg/L 25 °C)	**288**
Total Suspended Solids (mg/L)	**4.7**
Arsenic (µg/L)	**< 2.0**
Cadmium (µg/L)	**< 0.25**
Chromium (µg/L)	**< 1.0**
Copper (µg/L)	**< 1.0**
Iron (mg/L)	**< 0.25**
Lead (µg/L)	**< 1.0**
Manganese (µg/L)	**< 2.0**
Selenium (µg/L)	**< 2.0**
Fecal Coliforms (CFU/100ml)	**343**
Total Coliforms (CFU/100ml)	**~>500**

All tests are performed in accordance to the "Standard Methods for the Examination of Water and Wastewater", 22nd Edition, 2012 as approved by the American Public Health Association, the American Water Works Association, and the Water Environment Federation unless otherwise noted.

George M. Ayoub, Ph.D.
Professor of Civil & Environmental Engineering

AMERICAN UNIVERSITY of BEIRUT Department of Civil and Environmental Engineering Engineering Service Laboratories
الجامعة الأميركية في بيروت المختبرات الهندسية

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Environment Core Laboratory Test Report Reference no:ECL121004-547-BW 3
Page 2 of 5

Organochlorine Pesticides Profile:

Analysis	MDL	Sample BW 3 Result (R)	Method	UR	EPA / WHO MCL	MOH MCL
Alpha-BHC	0.01 ug/L	<0.01 ug/L	EPA 608/508.1M	NE	NA	NA
Gamma-BHC (Lindane)	0.01 ug/L	<0.01 ug/L	EPA 608/508.1M	NE	0.2 ug/L	0.2 ug/L
Beta-BHC	0.01ug/L	<0.01ug/L	EPA 608/508.1M	NE	NA	NA
Heptachlor	0.01 ug/L	<0.01 ug/L	EPA 608/508.1M	R±40% of R	0.4 ug/L	NA
Delta-BHC	0.01 ug/L	<0.01 ug/L	EPA 608/508.1M	NE	NA	NA
Aldrin	0.01 ug/L	<0.01 ug/L	EPA 608/508.1M	R±41% of R	0.03ug/L(Aldrin/Dieldrin)	0.02ug/L (Aldrin+ Dieldrin)
Heptachlor Epoxide	0.01 ug/L	<0.01 ug/L	EPA 608/508.1M	R±42% of R	0.2 ug/L	NA
Endosulfan I	0.02 ug/L	<0.02 ug/L	EPA 608/508.1M	R±35% of R	NA	NA
4,4' DDE	0.02 ug/L	<0.02 ug/L	EPA 608/508.1M	NE	NA	NA
Dieldrin	0.02 ug/L	<0.02 ug/L	EPA 608/508.1M	R±26% of R	0.03ug/L(Aldrin/Dieldrin)	0.02ug/L (Aldrin+ Dieldrin)
Endrin	0.02 ug/L	<0.02 ug/L	EPA 608/508.1M	R±29% of R	0.2 ug/L	NA
4,4'DDD	0.06 ug/L	<0.06 ug/L	EPA 608/508.1M	NE	NA	NA
Endosulfan II	0.02 ug/L	<0.02 ug/L	EPA 608/508.1M	R±35% of R	NA	NA
4,4'DDT	0.06ug/L	<0.06ug/L	EPA 608/508.1M	R±43% of R	NA	NA
Endrin Aldehyde	0.06 ug/L	<0.06 ug/L	EPA 608/508.1M	NE	NA	NA
Endosulfan Sulfate	0.06 ug/L	<0.06 ug/L	EPA 608/508.1M	NE	NA	NA

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Environment Core Laboratory Test Report Reference no:ECL121004-547-BW 3
Page 4 of 5

Analysis	MDL (ug/L)	Sample BW 3 Result (R) (ug/L)	Method	UR	EPA / WHO MCL	MOH MCL
trans-1,3-Dichloro-1-propene	1	<1	EPA 524.2/602M	NE	NA	NA
Ethylbenzene	1	<1	EPA 524.2/602M	NE	700 ug/L	NA
Hexachlorobutadiene	1	<1	EPA 524.2/602M	NE	NA	NA
Isopropylbenzene	1	<1	EPA 524.2/602M	NE	NA	NA
p-Isopropyltoluene	1	<1	EPA 524.2/602M	NE	NA	NA
Methylene Chloride	1	<1	EPA 524.2/602M	NE	NA	NA
Naphtalene	1	<1	EPA 524.2/602M	NE	NA	NA
n-Propyl Benzene	1	<1	EPA 524.2/602M	NE	NA	NA
Styrene	1	<1	EPA 524.2/602M	NE	100	NA
1,1,1,2-Tetrachloroethane	1	<1	EPA 524.2/602M	NE	NA	NA
1,1,2,2-Tetrachloroethane	1	<1	EPA 524.2/602M	NE	NA	NA
Tetrachloroethene	1	<1	EPA 524.2/602M	NE	5 ug/L	NA
Toluene	1	<1	EPA 524.2/602M	NE	1000 ug/L	NA
1,2,3-Trichlorobenzene	1	<1	EPA 524.2/602M	NE	NA	NA
1,2,4-Trichlorobenzene	1	<1	EPA 524.2/602M	NE	NA	NA
1,1,1-Trichloroethane	1	<1	EPA 524.2/602M	NE	200 ug/L	NA
1,1,2-Trichloroethane	1	<1	EPA 524.2/602M	NE	5 ug/L	NA
Trichloroethene	1	<1	EPA 524.2/602M	NE	NA	NA
1,2,3-Trichloropropane	1	<1	EPA 524.2/602M	NE	5 ug/L	NA
1,2,4-Trimethylbenzene	1	<1	EPA 524.2/602M	NE	NA	NA
1,3,5-Trimethylbenzene	1	<1	EPA 524.2/602M	NE	NA	NA
o-Xylene	1	<1	EPA 524.2/602M	NE	1000@	NA
m-Xylene	1	<1	EPA 524.2/602M	NE	1000@	NA
p -Xylene	1	<1	EPA 524.2/602M	NE	1000@	NA

#	= MCL shown is for the total of these four compounds
@	= MCL shown is for total Xylene's

All detected analytes referred to as "Detected" were between instrument detection limit (0.1 µg/L) and the limit of quantification (1 µg/L).The qualified results represent values determined at levels where the true value of the measured chemical cannot be quantified with a high degree of confidence. The data user may consider these qualified results as estimates when making project decisions.

النتائج في هذا التقرير تتعلق فقط بالفحوصات التي تم اجرائها على العينات التي سُلمت إلى المختبر
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Environment Core Laboratory Test Report Reference no:ECL121004-547-BW 3

Metal Analysis:

Analysis as Total per metal	MDL (mg/L)	Sample BW 3 Result (R) mg/L	Method	UR	EPA / WHO MCL	MOH MCL
Barium	0.002	0.016	EPA200-7/8 M	R ±11% of R	2.0 mg/L	0.5 mg/L
Thallium	0.002	<0.002	EPA200-7/8 M	R ±19% of R	0.002 mg/L	NA
Antimony	0.002	<0.002	EPA200-7/8 M	R ±26% of R	NA	NA
Beryllium	0.002	<0.002	EPA200-7/8 M	R ±13% of R	0.004 mg/L	NA
Mercury	0.0005	<0.0005	EPA200-7/8 M	R ±27% of R	0.002 mg/L	0.05 mg/L

Retention of Samples: Samples are discarded one week after delivery of report.
Contact Information: For administrative information, complaints or any other queries, Mrs. Asma Bazzi, EVL Administrator, can be reached at 01-350000, extension 5204, or by email at ab19@aub.edu.lb or by fax: 01-370845.

For further technical information, Ms. Carol Sukhn, EVL supervisor, can be reached at extensions 4845, 4849 or 4860, or by email at cs02@aub.edu.lb. Dr. Zuheir Habbal, EVL Technical Director, can be reached at extensions 5163 or 5220 or by email at mh03@aub.edu.lb. Thank you for using the Analytical Chemistry Laboratory at AUB.

AMERICAN UNIVERSITY OF BEIRUT MEDICAL CENTER
ENVIRONMENT CORE LABORATORY

Z. HAB
Dr. Zuheir Habbal
Director of Clinical Chemistry Laboratory
Director of Environment Core Laboratory

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CERTIFICATE OF TEST

Requested by: **Dar Al-Handasah (c/o Elie Abou Rejaili) (Shair and Partners)**

Date **11/10/2012**

Your Ref. **R -22626-W**

Our Ref.

Sample ID: **BW 4**
Date Received: **03/10/2012**

Nature of Test:		
	Turbidity (NTU)	**1.0**
	Conductivity (µSiemens/cm at 25°C)	**461**
	Apparent Color (Pt-Co units)	**40**
	pH (pH Units 25°C)	**8.11**
	Hydroxide Alkalinity (mg/L as $CaCO_3$)	**0**
	Carbonate Alkalinity (mg/L as $CaCO_3$)	**0**
	Bicarbonate Alkalinity (mg/L as $CaCO_3$)	**234**
	Total Hardness (mg/L as $CaCO_3$)	**276**
	Calcium (mg/L Ca^{2+})	**81**
	Magnesium (mg/L Mg^{2+})	**18**
	Sulfate (mg/L SO_4^{2-})	**45**
	Nitrate (mg/L NO_3^-)	**9.6**
	Nitrate-Nitrogen (mg/L NO_3^-N)	**2.2**
	Nitrite (mg/L NO_2^-)	**0.035**
	Nitrite- Nitrogen (mg/L NO_2^-N)	**0.011**
	Ammonia (mg/L NH_3)	**< 0.09**
	Ammonia-Nitrogen (mg/L NH_3^-N)	**< 0.09**
	Ortho-Phosphates (mg/L o-PO_4^{3-})	**0.29**
	Total Phosphorus (mg/L P)	**0.17**
	Chlorides (mg/L Cl^-)	**36.6**
	Fluoride (mg/L F^-)	**0.52**

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Date **11/10/2012**

Your Ref. **R -22626-W**

Our Ref.

Sample ID: **BW 4**

Nature of Test: **Date Received:** **03/10/2012**

Biochemical Oxygen Demand (mg/L BOD_5)	**< 2**
Chemical Oxygen Demand (mg/L O_2)	**< 2**
Total Organic Carbon (mg/L C)	**< 0.5**
Cyanide (mg/L CN^-)	**< 0.005**
Total Dissolved Solids (mg/L 25 °C)	**231**
Total Suspended Solids (mg/L)	**12.8**
Arsenic (µg/L)	**< 2.0**
Cadmium (µg/L)	**< 0.25**
Chromium (µg/L)	**< 1.0**
Copper (µg/L)	**< 1.0**
Iron (mg/L)	**< 0.25**
Lead (µg/L)	**< 1.0**
Manganese (µg/L)	**< 2.0**
Selenium (µg/L)	**< 2.0**
Fecal Coliforms (CFU/100ml)	**~>500**
Total Coliforms (CFU/100ml)	**~>500**

All tests are performed in accordance to the "Standard Methods for the Examination of Water and Wastewater", 22nd Edition, 2012 as approved by the American Public Health Association, the American Water Works Association, and the Water Environment Federation unless otherwise noted.

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Environment Core Laboratory Test Report Reference no:ECL121004-547-BW 4
Page 2 of 5

Organochlorine Pesticides Profile:

Analysis	MDL	Sample BW 4 Result (R)	Method	UR	EPA / WHO MCL	MOH MCL
Alpha-BHC	0.01 ug/L	<0.01 ug/L	EPA 608/508.1M	NE	NA	NA
Gamma-BHC (Lindane)	0.01 ug/L	<0.01 ug/L	EPA 608/508.1M	NE	0.2 ug/L	0.2 ug/L
Beta-BHC	0.01ug/L	<0.01ug/L	EPA 608/508.1M	NE	NA	NA
Heptachlor	0.01 ug/L	<0.01 ug/L	EPA 608/508.1M	R±40% of R	0.4 ug/L	NA
Delta-BHC	0.01 ug/L	<0.01 ug/L	EPA 608/508.1M	NE	NA	NA
Aldrin	0.01 ug/L	<0.01 ug/L	EPA 608/508.1M	R±41% of R	0.03ug/L(Aldrin/Dieldrin)	0.02ug/L (Aldrin+Dieldrin)
Heptachlor Epoxide	0.01 ug/L	<0.01 ug/L	EPA 608/508.1M	R±42% of R	0.2 ug/L	NA
Endosulfan I	0.02 ug/L	<0.02 ug/L	EPA 608/508.1M	R±35% of R	NA	NA
4,4' DDE	0.02 ug/L	<0.02 ug/L	EPA 608/508.1M	NE	NA	NA
Dieldrin	0.02 ug/L	<0.02 ug/L	EPA 608/508.1M	R±26% of R	0.03ug/L(Aldrin/Dieldrin)	0.02ug/L (Aldrin+Dieldrin)
Endrin	0.02 ug/L	<0.02 ug/L	EPA 608/508.1M	R±29% of R	0.2 ug/L	NA
4,4'DDD	0.06 ug/L	<0.06 ug/L	EPA 608/508.1M	NE	NA	NA
Endosulfan II	0.02 ug/L	<0.02 ug/L	EPA 608/508.1M	R±35% of R	NA	NA
4,4'DDT	0.06ug/L	<0.06ug/L	EPA 608/508.1M	R±43% of R	NA	NA
Endrin Aldehyde	0.06 ug/L	<0.06 ug/L	EPA 608/508.1M	NE	NA	NA
Endosulfan Sulfate	0.06 ug/L	<0.06 ug/L	EPA 608/508.1M	NE	NA	NA

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Environment Core Laboratory Test Report Reference no:ECL121004-547-BW 4
Page 3 of 5

Volatiles Organic Compounds:

Analysis	MDL (ug/L)	Sample BW 4 Result (R) (ug/L)	Method	UR	EPA / WHO MCL	MOH MCL
Benzene	1	<1	EPA 524.2/602M	R ± 51% of R	5 ug/L	NA
Bromobenzene	1	<1	EPA 524.2/602M	R ± 13% of R	NA	NA
Bromochloromethane	1	<1	EPA 524.2/602M	R ± 24% of R	NA	NA
Bromodichloromethane	1	<1	EPA 524.2/602M	R ± 10% of R	NA	NA
Bromoform	1	<1	EPA 524.2/602M	R ± 20% of R	NA	NA
n-Butyl Benzene	1	<1	EPA 524.2/602M	R ± 19% of R	NA	NA
tert Butyl Benzene	1	<1	EPA 524.2/602M	NE	NA	NA
sec Butyl Benzene	1	<1	EPA 524.2/602M	R ± 15% of R	NA	NA
Carbon tetrachloride	1	<1	EPA 524.2/602M	R ± 12% of R	5 ug/L	NA
Chlorobenzene	1	<1	EPA 524.2/602M	R ± 57% of R	100 ug/L	NA
Chloroform	1	<1	EPA 524.2/602M	R ± 27% of R	100#	100
4-Chlorotoluene	1	<1	EPA 524.2/602M	R ± 13% of R	NA	NA
2-Chlorotoluene	1	<1	EPA 524.2/602M	R ± 18% of R	NA	NA
1,2-Dibromo-3-chloropropane	1	<1	EPA 524.2/602M	R ± 57% of R	DBCP: 0.2 ug/L	NA
Dibromochloromethane	1	<1	EPA 524.2/602M	R ± 23% of R	NA	NA
1,2-Dibromoethane	1	<1	EPA 524.2/602M	R ± 31% of R	NA	NA
Dibromomethane	1	<1	EPA 524.2/602M	R ± 24% of R	NA	NA
1,3-Dichlorobenzene	1	<1	EPA 524.2/602M	R ± 16% of R	NA	NA
1,2-Dichlorobenzene	1	<1	EPA 524.2/602M	R ± 25% of R	600 ug/L	NA
1,4-Dichlorobenzene	1	<1	EPA 524.2/602M	R ± 16% of R	75	NA
1,1-Dichloroethane	1	<1	EPA 524.2/602M	R ± 24% of R	NA	NA
1,2-Dichloroethane	1	<1	EPA 524.2/602M	R ± 30% of R	NA	NA
cis-1,2-Dichloroethene	1	<1	EPA 524.2/602M	R ± 39% of R	NA	NA
trans-1,2-Dichloroethene	1	<1	EPA 524.2/602M	R ± 13% of R	NA	NA
1,1-Dichloroethene	1	<1	EPA 524.2/602M	R ± 11% of R	5 ug/L	NA
1,2-Dichloropropane	1	<1	EPA 524.2/602M	R ± 19% of R	5 ug/L	NA
1,3-Dichloropropane	1	<1	EPA 524.2/602M	R ± 39% of R	5 ug/L	NA
2,2-Dichloropropane	1	<1	EPA 524.2/602M	R ± 26% of R	5 ug/L	NA
1,1-Dichloropropene	1	<1	EPA 524.2/602M	R ±27% of R	NA	NA
cis-1,3-Dichloro-1-propene	1	<1	EPA 524.2/602M	NE	NA	NA

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Page 4 of 5

Analysis	MDL (ug/L)	Sample BW 4 Result (R) (ug/L)	Method	UR	EPA / WHO MCL	MOH MCL
trans-1,3-Dichloro-1-propene	1	<1	EPA 524.2/602M	NE	NA	NA
Ethylbenzene	1	<1	EPA 524.2/602M	NE	700 ug/L	NA
Hexachlorobutadiene	1	<1	EPA 524.2/602M	NE	NA	NA
Isopropylbenzene	1	<1	EPA 524.2/602M	NE	NA	NA
p-Isopropyltoluene	1	<1	EPA 524.2/602M	NE	NA	NA
Methylene Chloride	1	<1	EPA 524.2/602M	NE	NA	NA
Naphtalene	1	<1	EPA 524.2/602M	NE	NA	NA
n-Propyl Benzene	1	<1	EPA 524.2/602M	NE	NA	NA
Styrene	1	<1	EPA 524.2/602M	NE	100	NA
1,1,1,2-Tetrachloroethane	1	<1	EPA 524.2/602M	NE	NA	NA
1,1,2,2-Tetrachloroethane	1	<1	EPA 524.2/602M	NE	NA	NA
Tetrachloroethene	1	<1	EPA 524.2/602M	NE	5 ug/L	NA
Toluene	1	<1	EPA 524.2/602M	NE	1000 ug/L	NA
1,2,3-Trichlorobenzene	1	<1	EPA 524.2/602M	NE	NA	NA
1,2,4-Trichlorobenzene	1	<1	EPA 524.2/602M	NE	NA	NA
1,1,1-Trichloroethane	1	<1	EPA 524.2/602M	NE	200 ug/L	NA
1,1,2-Trichloroethane	1	<1	EPA 524.2/602M	NE	5 ug/L	NA
Trichloroethene	1	<1	EPA 524.2/602M	NE	NA	NA
1,2,3-Trichloropropane	1	<1	EPA 524.2/602M	NE	5 ug/L	NA
1,2,4-Trimethylbenzene	1	<1	EPA 524.2/602M	NE	NA	NA
1,3,5-Trimethylbenzene	1	<1	EPA 524.2/602M	NE	NA	NA
o-Xylene	1	<1	EPA 524.2/602M	NE	1000@	NA
m-Xylene	1	<1	EPA 524.2/602M	NE	1000@	NA
p -Xylene	1	<1	EPA 524.2/602M	NE	1000@	NA

= MCL shown is for the total of these four compounds
@ = MCL shown is for total Xylene's
All detected analytes referred to as "Detected" were between instrument detection limit (0.1 µg/L) and the limit of quantification (1 µg/L).The qualified results represent values determined at levels where the true value of the measured chemical cannot be quantified with a high degree of confidence. The data user may consider these qualified results as estimates when making project decisions.

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Environment Core Laboratory Test Report Reference no:ECL121004-547-BW 4
Page 5 of 5

Metal Analysis:

Analysis as Total per metal	MDL (mg/L)	Sample BW 4 Result (R) mg/L	Method	UR	EPA / WHO MCL	MOH MCL
Barium	0.002	0.006	EPA200-7/8 M	R ±11% of R	2.0 mg/L	0.5 mg/L
Thallium	0.002	<0.002	EPA200-7/8 M	R ±19% of R	0.002 mg/L	NA
Antimony	0.002	<0.002	EPA200-7/8 M	R ±26% of R	NA	NA
Beryllium	0.002	<0.002	EPA200-7/8 M	R ±13% of R	0.004 mg/L	NA
Mercury	0.0005	<0.0005	EPA200-7/8 M	R ±27% of R	0.002 mg/L	0.05 mg/L

Retention of Samples: Samples are discarded one week after delivery of report.
Contact Information: For administrative information, complaints or any other queries, Mrs. Asma Bazzi, EVL Administrator, can be reached at 01-350000, extension 5204, or by email at ab19@aub.edu.lb or by fax: 01-370845.

For further technical information, Ms. Carol Sukhn, EVL supervisor, can be reached at extensions 4845, 4849 or 4860, or by email at cs02@aub.edu.lb, Dr. Zuheir Habbal, EVL Technical Director, can be reached at extensions 5163 or 5220 or by email at mh03@aub.edu.lb. Thank you for using the Analytical Chemistry Laboratory at AUB.

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Z. HABBAL
Dr. Zuheir Habbal
Director of Clinical Chemistry Laboratory
Director of Environment Core Laboratory

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CERTIFICATE OF TEST

Requested by: **Dar Al-Handasah (c/o Elie Abou Rejaili) (Shair and Partners)**

Date **11/10/2012**

Your Ref. **R -22626-W**

Our Ref.

Nature of Test:
Sample ID: **BW 5**
Date Received: **03/10/2012**

Turbidity (NTU)	0.75
Conductivity (µSiemens/cm at 25°C)	423
Apparent Color (Pt-Co units)	15
pH (pH Units 25°C)	8.08
Hydroxide Alkalinity (mg/L as $CaCO_3$)	0
Carbonate Alkalinity (mg/L as $CaCO_3$)	0
Bicarbonate Alkalinity (mg/L as $CaCO_3$)	240
Total Hardness (mg/L as $CaCO_3$)	254
Calcium (mg/L Ca^{2+})	78.6
Magnesium (mg/L Mg^{2+})	14.1
Sulfate (mg/L SO_4^{2-})	28
Nitrate (mg/L NO_3^-)	8.9
Nitrate-Nitrogen (mg/L NO_3^-N)	2.0
Nitrite (mg/L NO_2^-)	0.022
Nitrite- Nitrogen (mg/L NO_2^-N)	0.007
Ammonia (mg/L NH_3)	< 0.09
Ammonia-Nitrogen (mg/L NH_3^-N)	< 0.09
Ortho-Phosphates (mg/L o-PO_4^{3-})	0.41
Total Phosphorus (mg/L P)	0.22
Chlorides (mg/L Cl^-)	32.8
Fluoride (mg/L F^-)	0.52

All tests are performed in accordance to the "Standard Methods for the Examination of Water and Wastewater", 22nd Edition, 2012 as approved by the American Public Health Association, the American Water Works Association, and the Water Environment Federation unless otherwise noted.

George M. Ayoub, Ph.D.
Professor of Civil & Environmental Engineering

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CERTIFICATE OF TEST

Requested by: Date

Dar Al-Handasah (c/o Elie Abou Rejaili)
(Shair and Partners)

Your Ref. **11/10/2012**

Our Ref. **R -22626-W**

Nature of Test:

Sample ID: **BW 5**
Date Received: **03/10/2012**

Biochemical Oxygen Demand (mg/L BOD_5)	**< 2**
Chemical Oxygen Demand (mg/L O_2)	**< 2**
Total Organic Carbon (mg/L C)	**< 0.5**
Cyanide (mg/L CN^-)	**< 0.005**
Total Dissolved Solids (mg/L 25 °C)	**212**
Total Suspended Solids (mg/L)	**5.2**
Arsenic (μg/L)	**< 2.0**
Cadmium (μg/L)	**< 0.25**
Chromium (μg/L)	**< 1.0**
Copper (μg/L)	**< 1.0**
Iron (mg/L)	**< 0.25**
Lead (μg/L)	**< 1.0**
Manganese (μg/L)	**< 2.0**
Selenium (μg/L)	**< 2.0**
Fecal Coliforms (CFU/100ml)	**~>500**
Total Coliforms (CFU/100ml)	**~>500**

All tests are performed in accordance to the "Standard Methods for the Examination of Water and Wastewater", 22nd Edition, 2012 as approved by the American Public Health Association, the American Water Works Association, and the Water Environment Federation unless otherwise noted.

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Environment Core Laboratory Test Report Reference no:ECL121004-547-BW5
Page 2 of 5

Organochlorine Pesticides Profile:

Analysis	MDL	Sample BW 5 Result (R)	Method	UR	EPA / WHO MCL	MOH MCL
Alpha-BHC	0.01 ug/L	<0.01 ug/L	EPA 608/508.1M	NE	NA	NA
Gamma-BHC (Lindane)	0.01 ug/L	<0.01 ug/L	EPA 608/508.1M	NE	0.2 ug/L	0.2 ug/L
Beta-BHC	0.01ug/L	<0.01ug/L	EPA 608/508.1M	NE	NA	NA
Heptachlor	0.01 ug/L	<0.01 ug/L	EPA 608/508.1M	R±40% of R	0.4 ug/L	NA
Delta-BHC	0.01 ug/L	<0.01 ug/L	EPA 608/508.1M	NE	NA	NA
Aldrin	0.01 ug/L	<0.01 ug/L	EPA 608/508.1M	R±41% of R	0.03ug/L(Aldrin/Dieldrin)	0.02ug/L (Aldrin+ Dieldrin)
Heptachlor Epoxide	0.01 ug/L	<0.01 ug/L	EPA 608/508.1M	R±42% of R	0.2 ug/L	NA
Endosulfan I	0.02 ug/L	<0.02 ug/L	EPA 608/508.1M	R±35% of R	NA	NA
4,4' DDE	0.02 ug/L	<0.02 ug/L	EPA 608/508.1M	NE	NA	NA
Dieldrin	0.02 ug/L	0.05 ug/L	EPA 608/508.1M	R±26% of R	0.03ug/L(Aldrin/Dieldrin)	0.02ug/L (Aldrin+ Dieldrin)
Endrin	0.02 ug/L	<0.02 ug/L	EPA 608/508.1M	R±29% of R	0.2 ug/L	NA
4,4'DDD	0.06 ug/L	<0.06 ug/L	EPA 608/508.1M	NE	NA	NA
Endosulfan II	0.02 ug/L	<0.02 ug/L	EPA 608/508.1M	R±35% of R	NA	NA
4,4'DDT	0.06ug/L	<0.06ug/L	EPA 608/508.1M	R±43% of R	NA	NA
Endrin Aldehyde	0.06 ug/L	<0.06 ug/L	EPA 608/508.1M	NE	NA	NA
Endosulfan Sulfate	0.06 ug/L	<0.06 ug/L	EPA 608/508.1M	NE	NA	NA

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1902

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Page 3 of 5

Volatiles Organic Compounds:

Analysis	MDL (ug/L)	Sample BW 5 Result (R) (ug/L)	Method	UR	EPA / WHO MCL	MOH MCL
Benzene	1	<1	EPA 524.2/602M	R ± 51% of R	5 ug/L	NA
Bromobenzene	1	<1	EPA 524.2/602M	R ± 13% of R	NA	NA
Bromochloromethane	1	<1	EPA 524.2/602M	R ± 24% of R	NA	NA
Bromodichloromethane	1	<1	EPA 524.2/602M	R ± 10% of R	NA	NA
Bromoform	1	<1	EPA 524.2/602M	R ± 20% of R	NA	NA
n-Butyl Benzene	1	<1	EPA 524.2/602M	R ± 19% of R	NA	NA
tert Butyl Benzene	1	<1	EPA 524.2/602M	NE	NA	NA
sec Butyl Benzene	1	<1	EPA 524.2/602M	R ± 15% of R	NA	NA
Carbon tetrachloride	1	<1	EPA 524.2/602M	R ± 12% of R	5 ug/L	NA
Chlorobenzene	1	<1	EPA 524.2/602M	R ± 57% of R	100 ug/L	NA
Chloroform	1	<1	EPA 524.2/602M	R ± 27% of R	100#	100
4-Chlorotoluene	1	<1	EPA 524.2/602M	R ± 13% of R	NA	NA
2-Chlorotoluene	1	<1	EPA 524.2/602M	R ± 18% of R	NA	NA
1,2-Dibromo-3-chloropropane	1	<1	EPA 524.2/602M	R ± 57% of R	DBCP: 0.2 ug/L	NA
Dibromochloromethane	1	<1	EPA 524.2/602M	R ± 23% of R	NA	NA
1,2-Dibromoethane	1	<1	EPA 524.2/602M	R ± 31% of R	NA	NA
Dibromomethane	1	<1	EPA 524.2/602M	R ± 24% of R	NA	NA
1,3-Dichlorobenzene	1	<1	EPA 524.2/602M	R ± 16% of R	NA	NA
1,2-Dichlorobenzene	1	<1	EPA 524.2/602M	R ± 25% of R	600 ug/L	NA
1,4-Dichlorobenzene	1	<1	EPA 524.2/602M	R ± 16% of R	75	NA
1,1-Dichloroethane	1	<1	EPA 524.2/602M	R ± 24% of R	NA	NA
1,2-Dichloroethane	1	<1	EPA 524.2/602M	R ± 30% of R	NA	NA
cis-1,2-Dichloroethene	1	<1	EPA 524.2/602M	R ± 39% of R	NA	NA
trans-1,2-Dichloroethene	1	<1	EPA 524.2/602M	R ± 13% of R	NA	NA
1,1-Dichloroethene	1	<1	EPA 524.2/602M	R ± 11% of R	5 ug/L	NA
1,2-Dichloropropane	1	<1	EPA 524.2/602M	R ± 19% of R	5 ug/L	NA
1,3-Dichloropropane	1	<1	EPA 524.2/602M	R ± 39% of R	5 ug/L	NA
2,2-Dichloropropane	1	<1	EPA 524.2/602M	R ± 26% of R	5 ug/L	NA
1,1-Dichloropropene	1	<1	EPA 524.2/602M	R ±27% of R	NA	NA
cis-1,3-Dichloro-1-propene	1	<1	EPA 524.2/602M	NE	NA	NA

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Page 4 of 5

Analysis	MDL (ug/L)	Sample BW 5 Result (R) (ug/L)	Method	UR	EPA / WHO MCL	MOH MCL
trans-1,3-Dichloro-1-propene	1	<1	EPA 524.2/602M	NE	NA	NA
Ethylbenzene	1	<1	EPA 524.2/602M	NE	700 ug/L	NA
Hexachlorobutadiene	1	<1	EPA 524.2/602M	NE	NA	NA
Isopropylbenzene	1	<1	EPA 524.2/602M	NE	NA	NA
p-Isopropyltoluene	1	<1	EPA 524.2/602M	NE	NA	NA
Methylene Chloride	1	<1	EPA 524.2/602M	NE	NA	NA
Naphtalene	1	<1	EPA 524.2/602M	NE	NA	NA
n-Propyl Benzene	1	<1	EPA 524.2/602M	NE	NA	NA
Styrene	1	<1	EPA 524.2/602M	NE	100	NA
1,1,1,2-Tetrachloroethane	1	<1	EPA 524.2/602M	NE	NA	NA
1,1,2,2-Tetrachloroethane	1	<1	EPA 524.2/602M	NE	NA	NA
Tetrachloroethene	1	<1	EPA 524.2/602M	NE	5 ug/L	NA
Toluene	1	<1	EPA 524.2/602M	NE	1000 ug/L	NA
1,2,3-Trichlorobenzene	1	<1	EPA 524.2/602M	NE	NA	NA
1,2,4-Trichlorobenzene	1	<1	EPA 524.2/602M	NE	NA	NA
1,1,1-Trichloroethane	1	<1	EPA 524.2/602M	NE	200 ug/L	NA
1,1,2-Trichloroethane	1	<1	EPA 524.2/602M	NE	5 ug/L	NA
Trichloroethene	1	<1	EPA 524.2/602M	NE	NA	NA
1,2,3-Trichloropropane	1	<1	EPA 524.2/602M	NE	5 ug/L	NA
1,2,4-Trimethylbenzene	1	<1	EPA 524.2/602M	NE	NA	NA
1,3,5-Trimethylbenzene	1	<1	EPA 524.2/602M	NE	NA	NA
o-Xylene	1	<1	EPA 524.2/602M	NE	1000@	NA
m-Xylene	1	<1	EPA 524.2/602M	NE	1000@	NA
p -Xylene	1	<1	EPA 524.2/602M	NE	1000@	NA

= MCL shown is for the total of these four compounds
@ = MCL shown is for total Xylene's
All detected analytes referred to as "Detected" were between instrument detection limit (0.1 µg/L) and the limit of quantification (1 µg/L).The qualified results represent values determined at levels where the true value of the measured chemical cannot be quantified with a high degree of confidence. The data user may consider these qualified results as estimates when making project decisions.

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Environment Core Laboratory Test Report Reference no:ECL121004-547-BW5
Page 5 of 5

Metal Analysis:

Analysis as Total per metal	MDL (mg/L)	Sample BW 5 Result (R) mg/L	Method	UR	EPA / WHO MCL	MOH MCL
Barium	0.002	0.005	EPA200-7/8 M	R ±11% of R	2.0 mg/L	0.5 mg/L
Thallium	0.002	<0.002	EPA200-7/8 M	R ±19% of R	0.002 mg/L	NA
Antimony	0.002	<0.002	EPA200-7/8 M	R ±26% of R	NA	NA
Beryllium	0.002	<0.002	EPA200-7/8 M	R ±13% of R	0.004 mg/L	NA
Mercury	0.0005	<0.0005	EPA200-7/8 M	R ±27% of R	0.002 mg/L	0.05 mg/L

Retention of Samples: Samples are discarded one week after delivery of report.
Contact Information: For administrative information, complaints or any other queries, Mrs. Asma Bazzi, EVL Administrator, can be reached at 01-350000, extension 5204, or by email at ab19@aub.edu.lb or by fax: 01-370845.

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Appendix F5: Greater Beirut Water Supply Project- Independent Water Quality Review

Windsor Sung, Ph.D, PE
Program Manager, Massachusetts Water Resources Authority
Lecturer, Massachusetts Institute of Technology

Memo

To: Claire A. Kfouri

From: Windsor Sung

Date: November 26, 2012

Re: Greater Beirut Water Supply Project – Independent Water Quality Review

---

Summary

Water quality data from Joun, Bisri (Awali river), Anane and Qaraoun (Karoun) Reservoirs were reviewed. These were collected from December 2011 to November 2012 and includes 24 rounds of physical, chemical and microbiological data; 3 rounds of metals and organics.

Though the results show contamination from farming and industrial activities, in particular at Qaraoun Reservoir, the water quality at Joun Reservoir, where the water treatment plant intake will be located, is characteristic of river waters moderately impacted from human activities. Many of these waters have been used as a source for potable water and do not present any unusual challenge to conventional water treatment technologies.

Water at Joun Reservoir is relatively hard (due to calcium and magnesium). It has a fair amount of solids and bacterial loading. The data collected during this period was compared to the results reviewed by Bartram and LoBuglio[1] (April 2010 to April 2011). The results of that study remain valid and there is no indication that water quality has deteriorated from April 2011 to November 2012.

A conventional water treatment plant, which comprises the treatment processes included in the treatment plant of the Greater Beirut Water Supply Project, will treat the water from Joun Reservoir to international drinking water standards.

In particular, it is recommended that Granular Activated Carbon (GAC) be substituted for anthracite in the filtration step. Ozonation followed by GAC filtration will help to lower nitrite levels and mitigate against the low levels of organics. An optimum pH for residual disinfection and to minimize calcium scale formation potential should also be investigated during the design phase. Every effort should be made to protect the watershed from further contamination.

---

[1]Bartram, Jamie and Joseph LoBuglio. Greater Beirut Water Supply Project: Independent Technical Review of Source Water Quality. Final Report. Chapel Hill, NC: The Water Institute at the University of North Carolina, 31 May 2011

These recommendations have been discussed with the design engineer and have been accepted by the implementing government agency and Project Management Unit.

Date Reviewed and Observations

Physical, chemical and microbiological results from Joun, Bisri (Awali River), Anane and Qaraoun (Karoun) Reservoirs were reviewed. 24 rounds of analysis were collected every 2 weeks starting on 8 December 2011 and continued through 20 November 2012[2]. In addition there were 18 rounds of sampling for BOD, COD, CN, DO and TOC.

Qaraoun Reservoir has the highest values of COD and TOC, followed by Anane and then Joun Reservoir with Bisri having the lowest level. The organic analysis (discussed later) also followed this trend. On the other hand, color, turbidity hardness and total suspended solids were higher for Joun and Bisri Reservoirs than Anane and Qaraoun. These parameters showed large seasonal variability with 2 high episodes in February. The smaller variability of these parameters for Anane and Qaraoun is likely due to reservoir size.

Nitrite at Joun, Anane and Qaraoun Reservoirs are elevated and is a contaminant of concern. However, ozone followed by GAC filtration should be able to treat this. Bisri has low nitrite but is elevated for bacterial load (total and fecal coliform, and E coli). While bacterial loads are high, conventional water treatment followed by chlorine disinfection should provide 4 log removal and inactivation.

Three rounds of metal analysis conducted on 25 February 2012, 25 April 2012 and 18 July 2012 from the same 4 sources were reviewed. Only barium and beryllium were detected with regularity and these were at very low levels. Most heavy metals are associated with particulates and conventional water treatment with coagulation/flocculation/settling followed by filtration is very effective in lowering particulates. Thus metal contamination should not be a concern.

Three rounds of organics analysis conducted on 28 January 2012, 21 July 2012 and 13 October 2012 from the same 4 sources were reviewed. Compounds that were detected include polynuclear aromatic hydrocarbons (PAH), phthalates (plasticizers), pesticides, chloro-benzenes, trihalomethanes and xylenes. Of these compounds, typically Qaraoun Reservoir shows the highest concentration of detects and has more compounds detected. Xylenes were detected at the highest concentration of 11 mg/L at Joun Reservoir on 21 July 2012. These chemicals are indicative of farming and industrial contamination. Conventional water treatment, such as that included in the Greater Beirut Water supply treatment plant, can mitigate against many of these compounds, especially since ozone treatment and carbon filtration are part of the original conceptual design. Pollution prevention always remains preferred over treatment. Therefore watershed protection and source water control is imperative.

All the data has been entered into a master spreadsheet to facilitate additional analysis by interested parties. Box and whisker plots (Figures 1- 27) have been produced for aid in visual comparison of water quality by source. Some key water quality parameters are presented as time series plots in Figures 28 – 33. High values of particulates were associated with February and March 2012 and most likely rain related. High nitrite values were observed in July and August 2012.

In conclusion, the water from Joun Reservoir, which will be used as the influent to the water treatment plant in the Greater Beirut Water Supply Project, is of a quality that is treatable by the conventional water treatment technologies in the treatment plant design.

[2] Data from 28 March 2012 was missing

Disclaimer

The statements above are my personal professional opinions and do not reflect official views of Massachusetts Institute of Technology or Massachusetts Water Resources Authority.

References

1. Greater Beirut Water Supply Project Project Appraisal Document
2. Bartram, Jamie and Joseph LoBuglio. *Greater Beirut Water Supply Project: Independent Technical Review of Source Water Quality. Final Report.* Chapel Hill, NC: The Water Institute at the University of North Carolina, 31 May 2011
3. Montgomery Watson Harza (MWH) Conceptual Design for the GBWSP Water Treatment Plant

Figures

The following figures compare the four water quality sources as a series of box and whisker plots. The middle line in the box is the median value, and the top and bottom boxes are the 25th and 75th percentile values. The top and bottom "whiskers" are 1.5 times the IQR above the third quartile value and 1.5 times IQR below the first quartile value. IQR is the difference between the third and first quartile. Red asterisks are used to denote outliers and these are values greater than or less than the top and bottom whiskers.

It should be noted that these are raw water values. Typical water treatment can remove 1.5 to 2 logs of physical parameters (93 to 99% removal) and up to 4 logs of microbiological counts (99.99%). For example, the median color of Joun Reservoir water was 16.6 (average of 74), it could easily be treated to less than 5 color units. Similarly for turbidity and suspended solids.

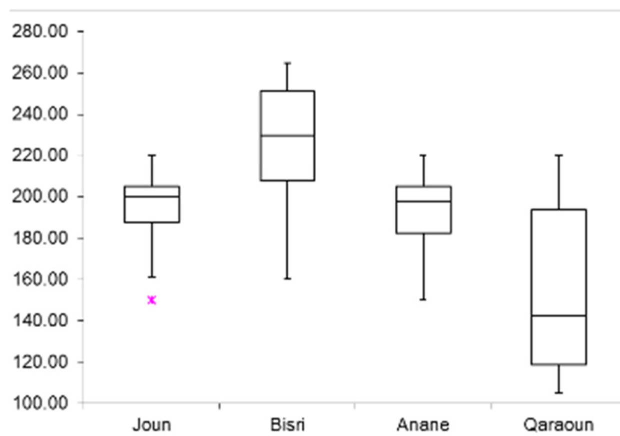

Figure 1 **Total Alkalinity (mg/L as $CaCO_3$)**

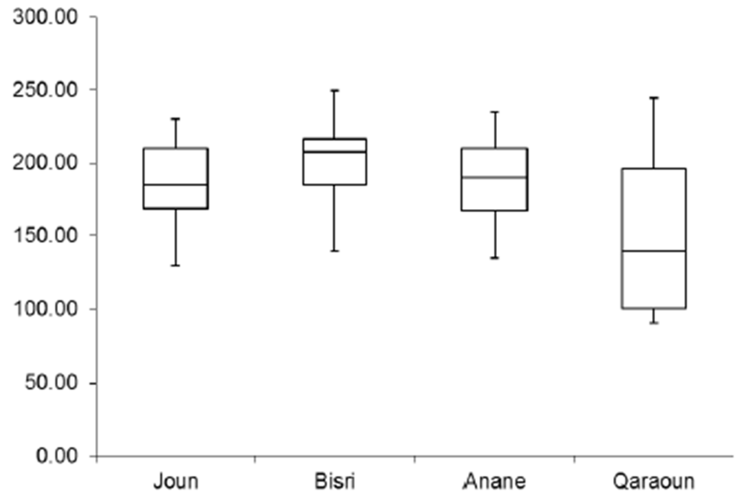

Figure 2 Calcium Hardness (mg/L as $CaCO_3$)

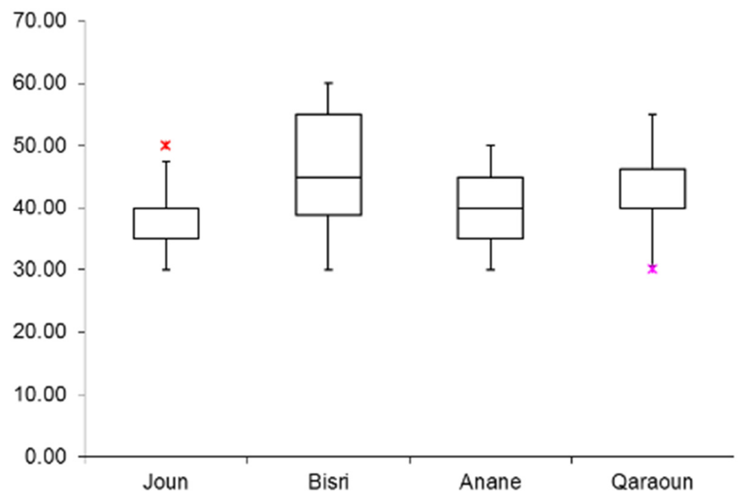

Figure 3 Magnesium Hardness (mg/L as $CaCO_3$)

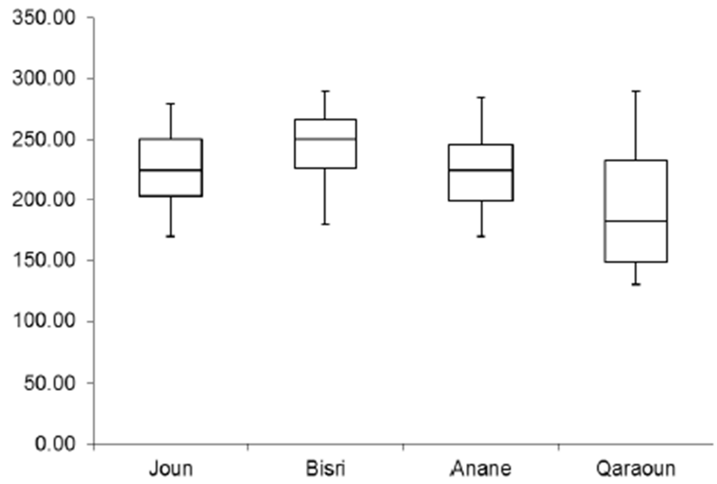

Figure 4 Total Hardness (mg/L as $CaCO_3$)

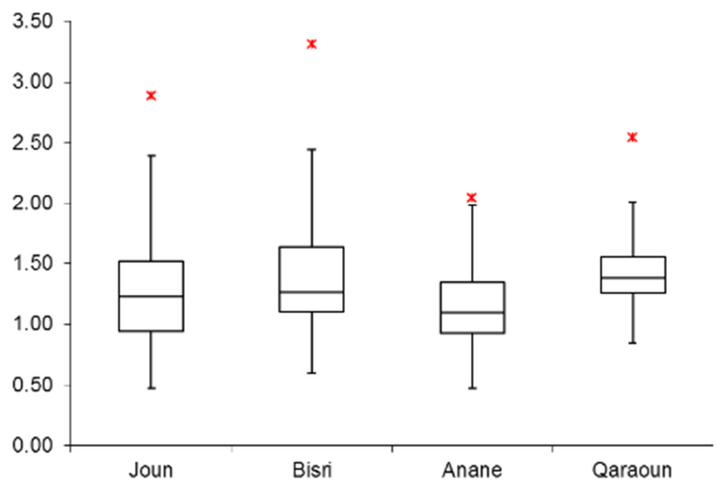

Figure 5 Log_{10} Color (TCU)

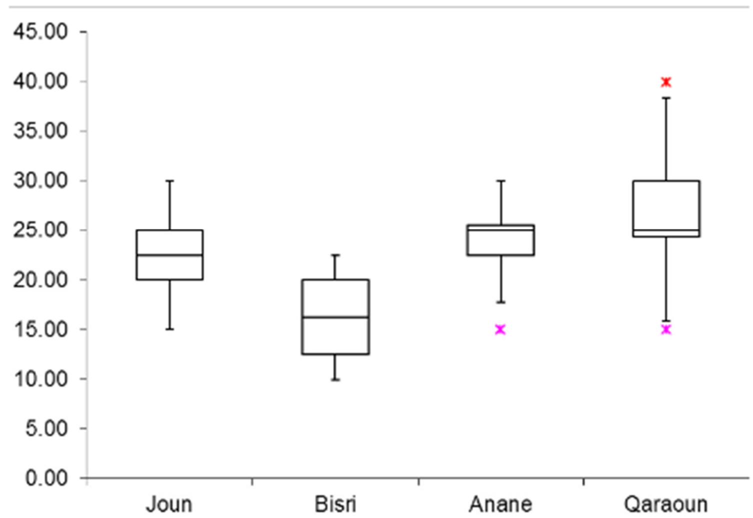

Figure 6 Chloride (mg/L)

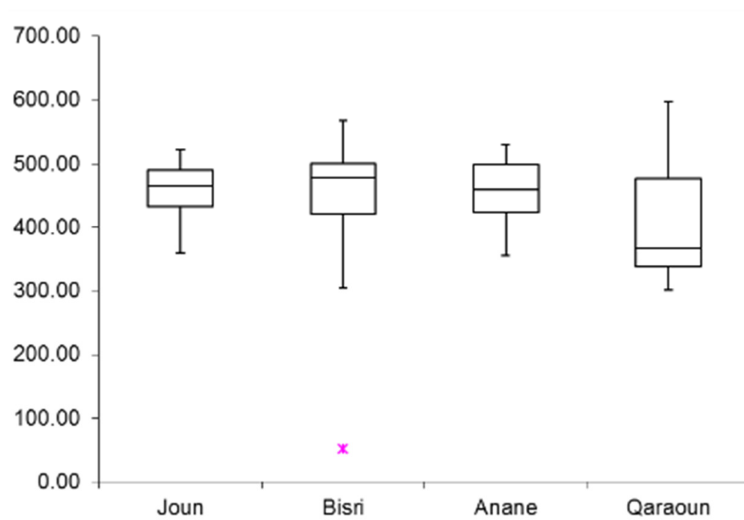

Figure 7 Conductivity (µS/cm)

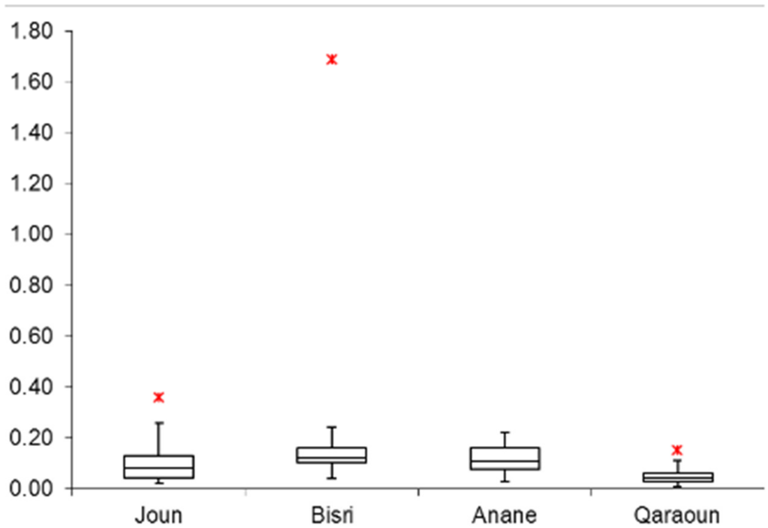

Figure 8 Ferrous Iron Fe^{2+} (mg/L)

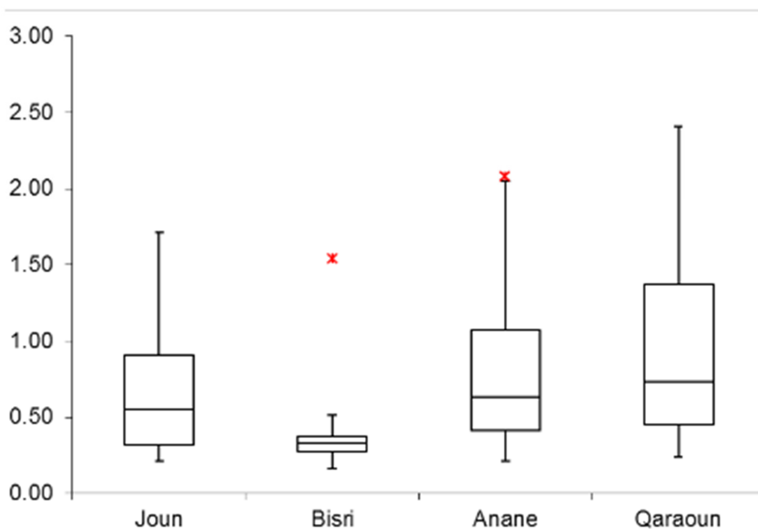

Figure 9 Ammonium Ion NH_4^+ (mg/L)

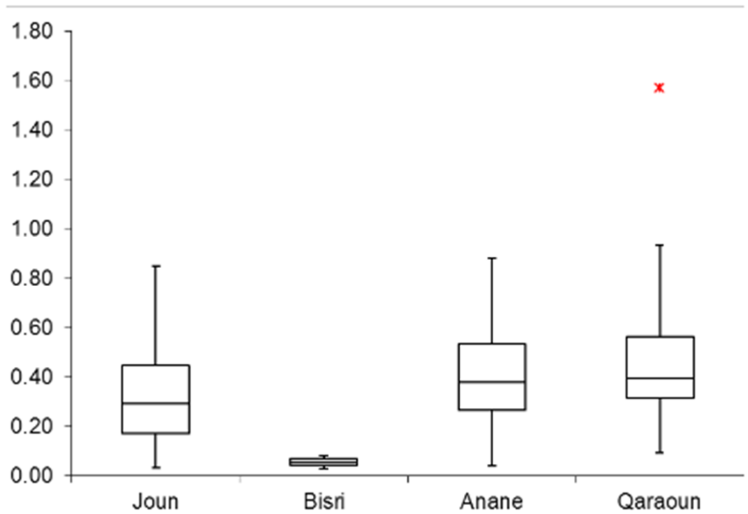

Figure 10 Nitrite NO_2^- (mg/L)

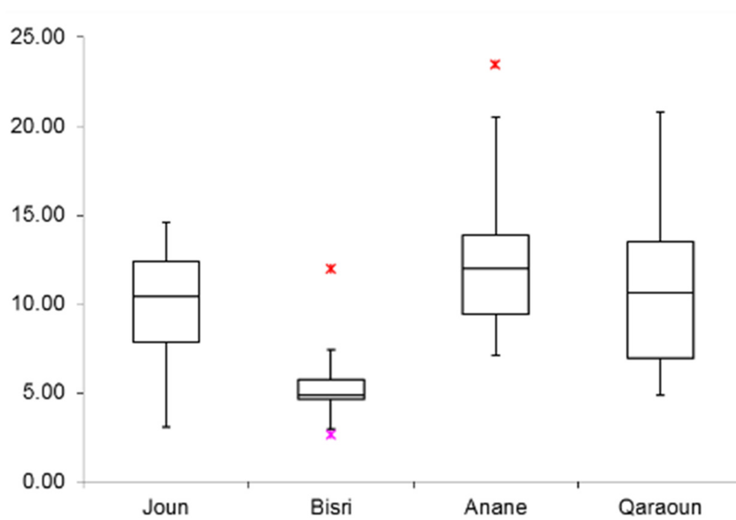

Figure 11 Nitrate NO_3^- (mg/L)

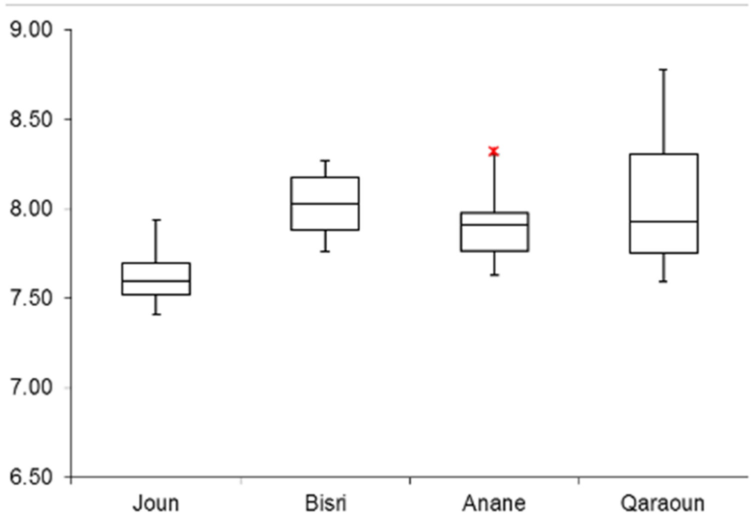

Figure 12 pH

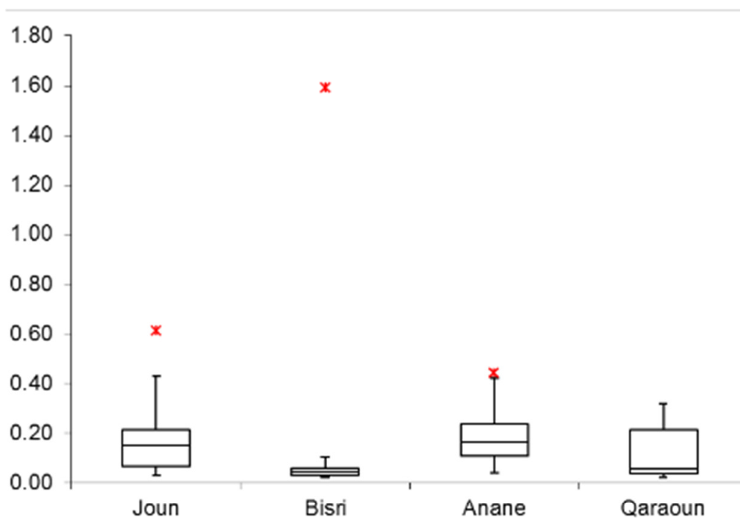

Figure 13 Phosphorus (mg/L)

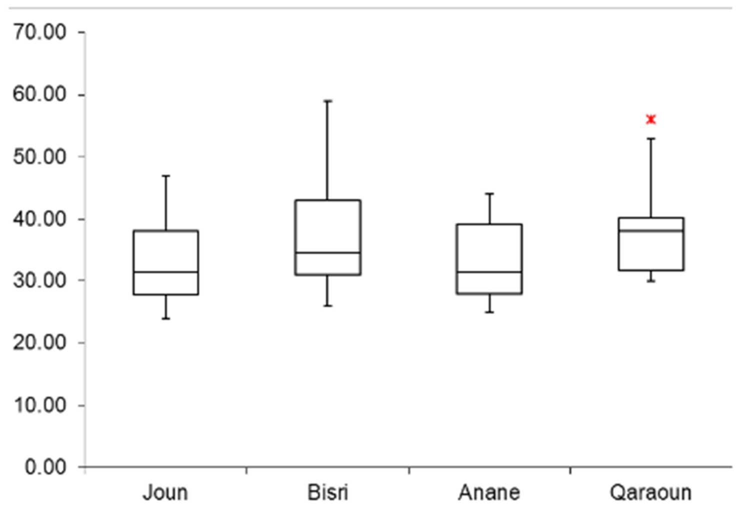

Figure 14 Sulfate (mg/L)

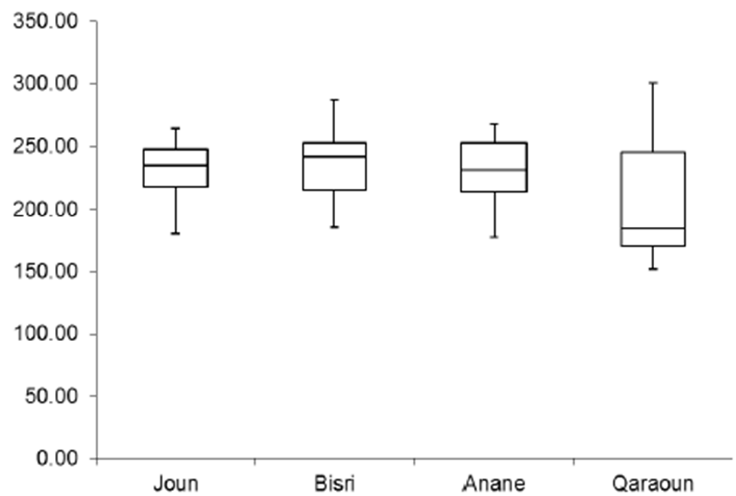

Figure 15 Total Dissolved Solids (mg/L as NaCl)

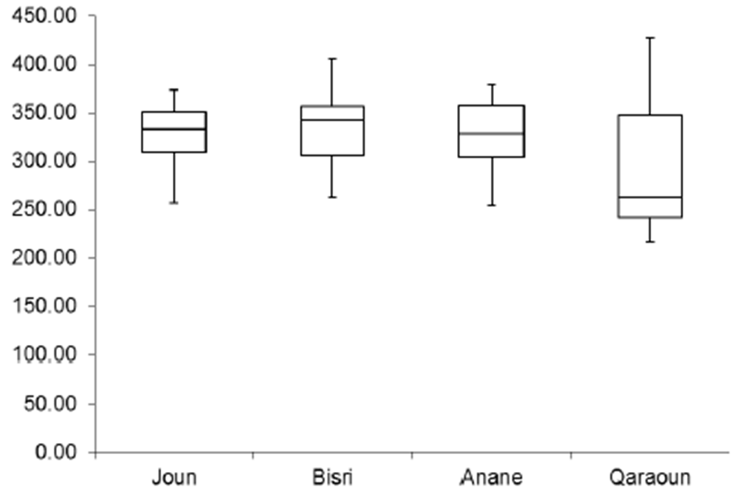

Figure 16 **Virtual Mineralization (mg/L)**

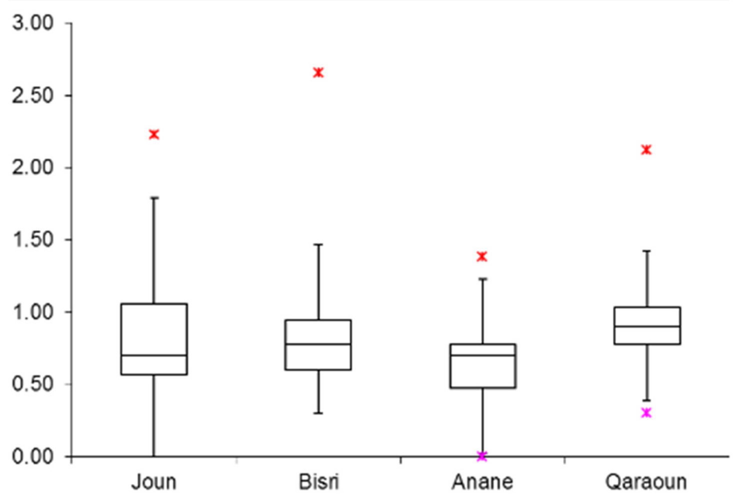

Figure 17 **Log_{10} Total Suspended Solids (mg/L)**

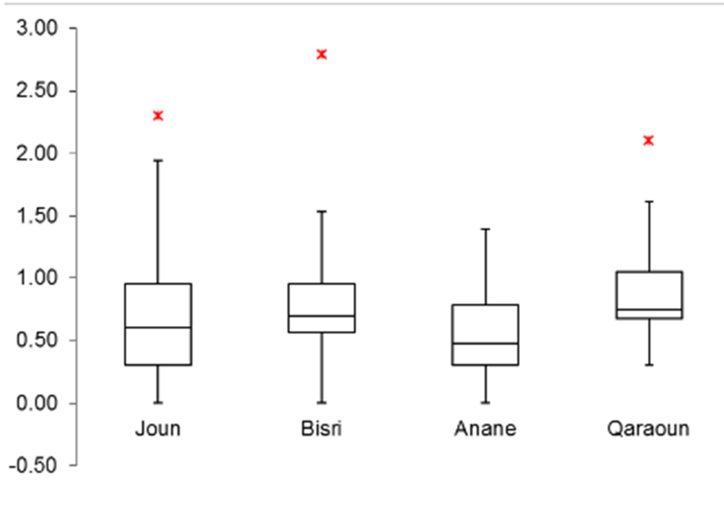

Figure 18 Log$_{10}$ Turbidity (NTU)

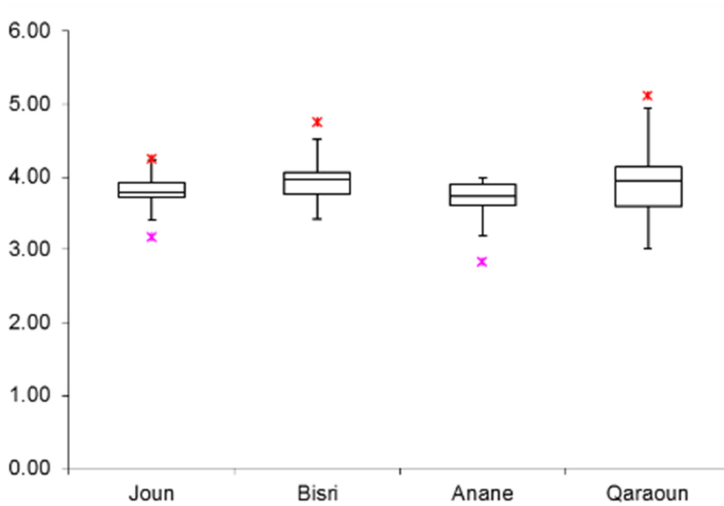

Figure 19 Log$_{10}$ Total Coliform (CFU/100mL)

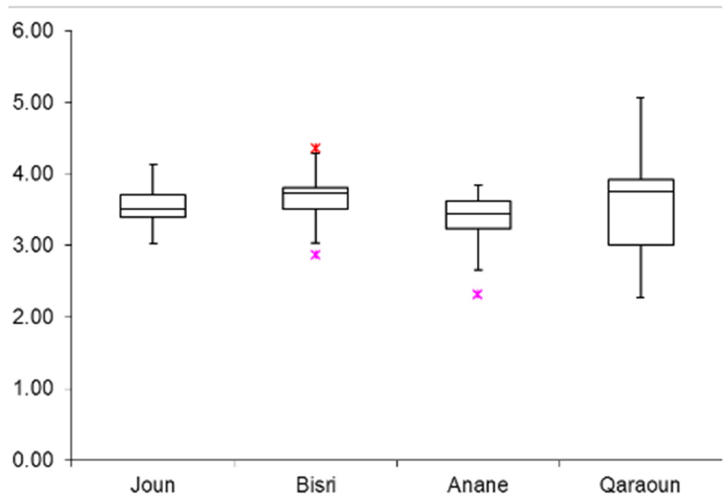

Figure 20 **Log_{10} Thermal Tolerant Total Coliform (CFU/100mL)**

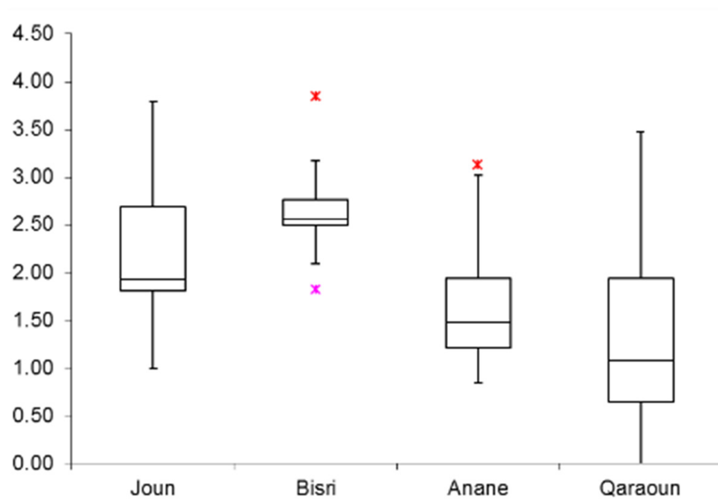

Figure 21 **Log_{10} Escherichlia Coli (CFU/100mL)**

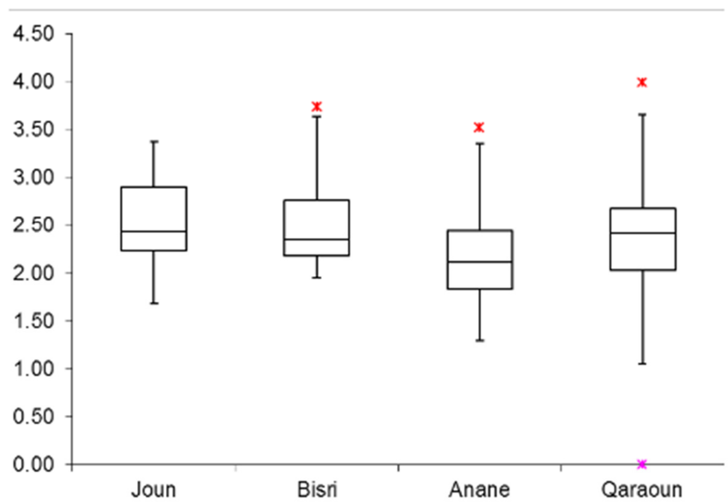

Figure 22 Log$_{10}$ Citrobacter Freundi (CFU/100mL)

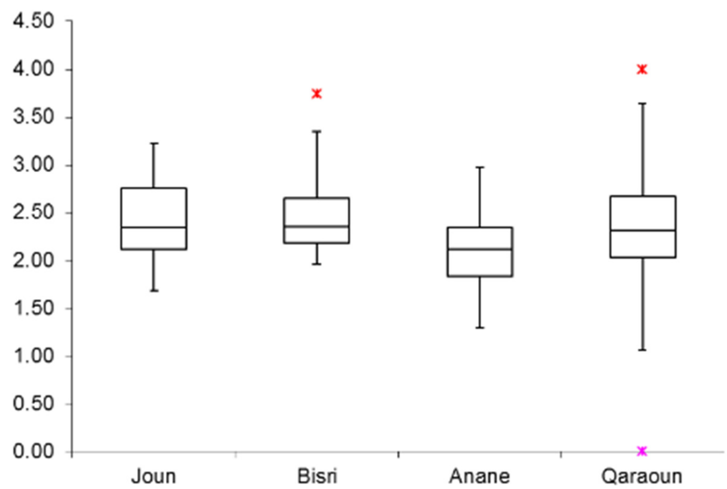

Figure 23 Log$_{10}$ Enterobacter Cloacae (CFU/100mL)

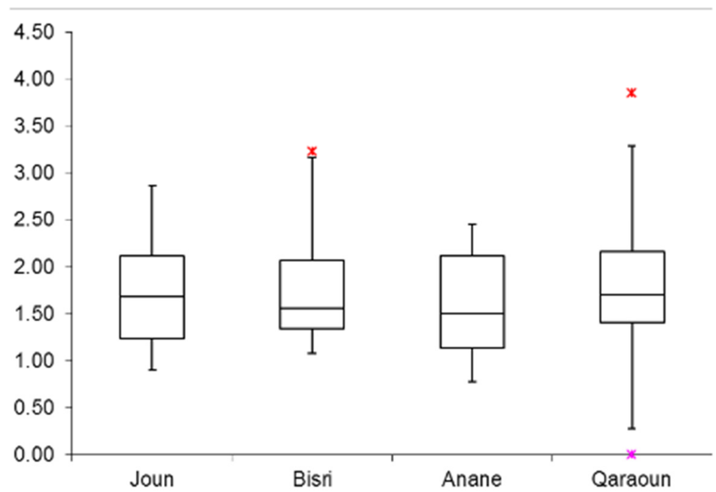

Figure 24 **Log_{10} Kleb. Pneum. Ozaenae (CFU/100mL)**

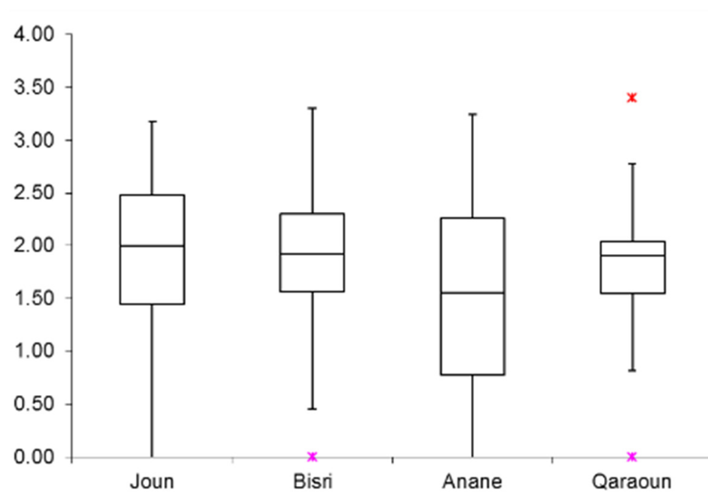

Figure 25 **Log_{10} Chryseomonas Luteola (CFU/100mL)**

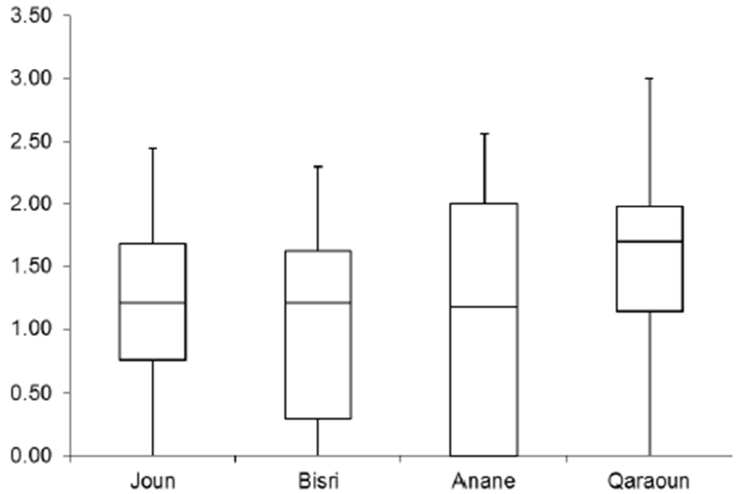

Figure 26 Log$_{10}$ Non fermenter spp (CFU/100mL)

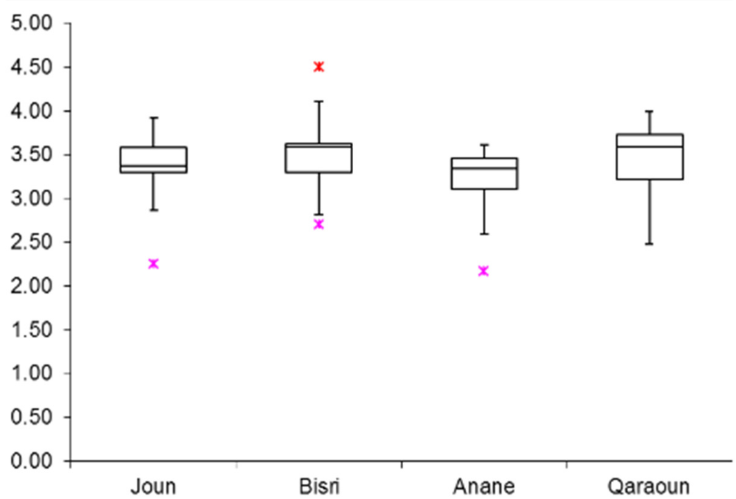

Figure 27 Log$_{10}$ Flavi. Oryzihabitans (CFU/100mL)

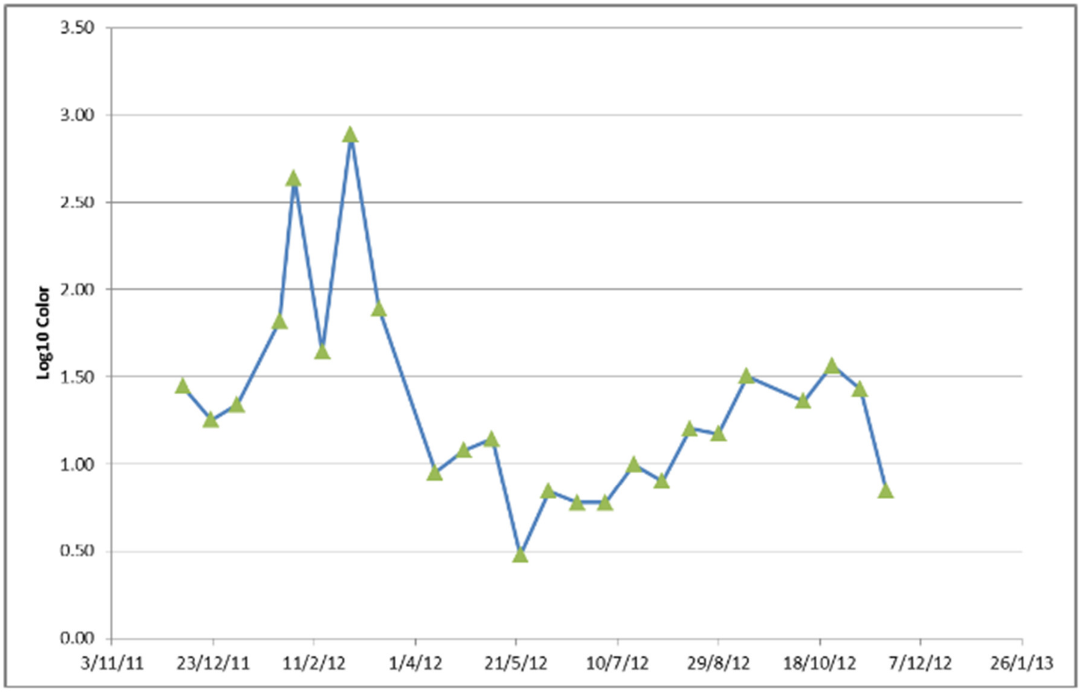

Figure 28 Time variation of Log_{10} Color at Joun Reservoir

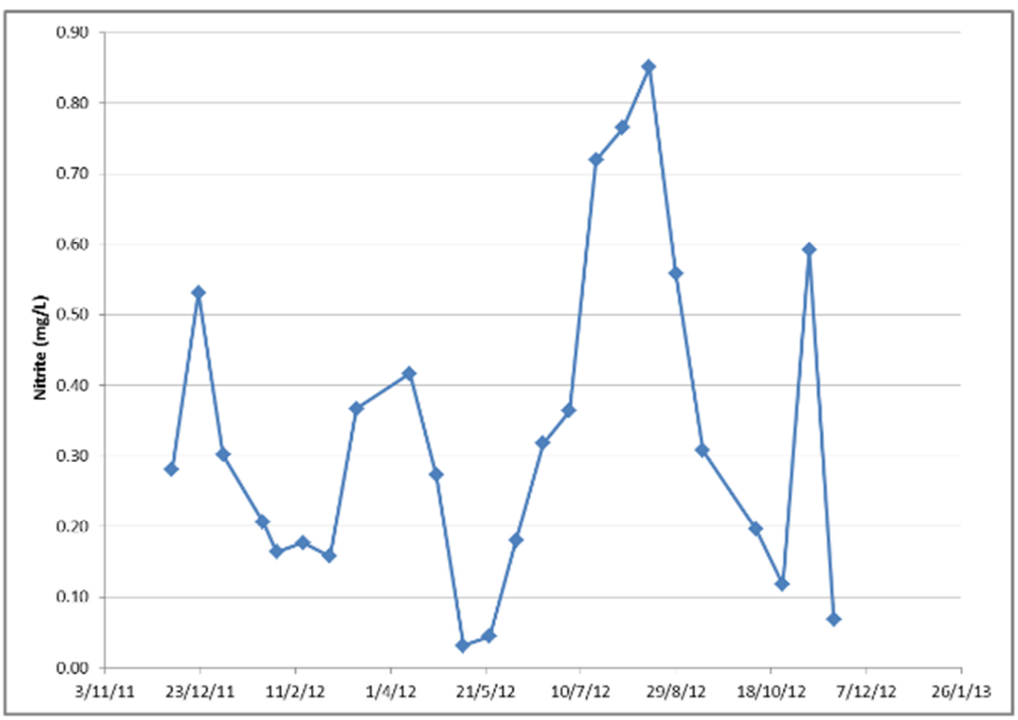

Figure 29 Time variation of Nitrite at Joun Reservoir

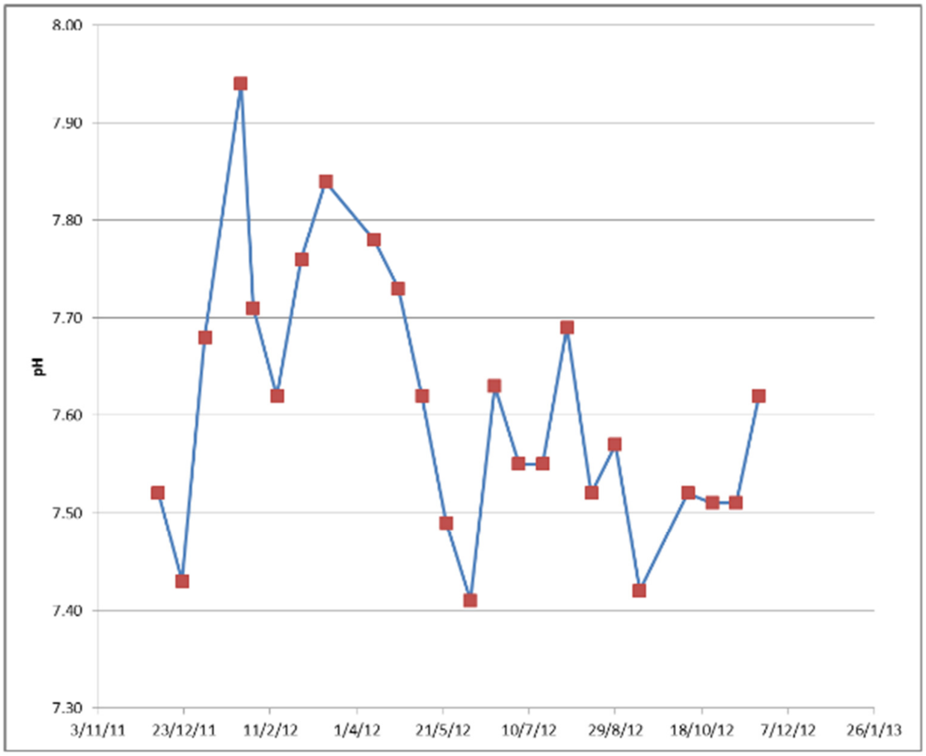

Figure 30 Time variation of pH at Joun Reservoir

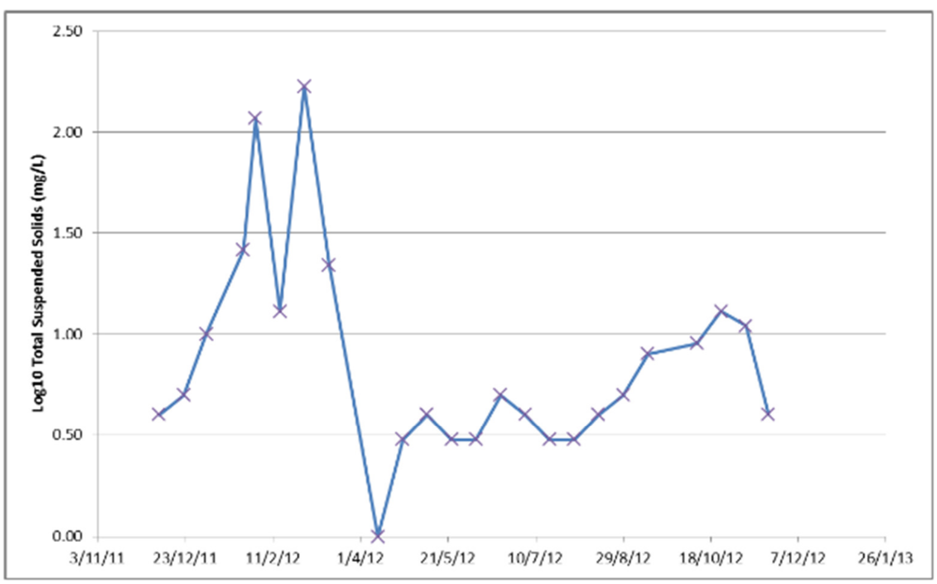

Figure 31 Time variation of Log_{10} Total Suspended Solids at Joun Reservoir

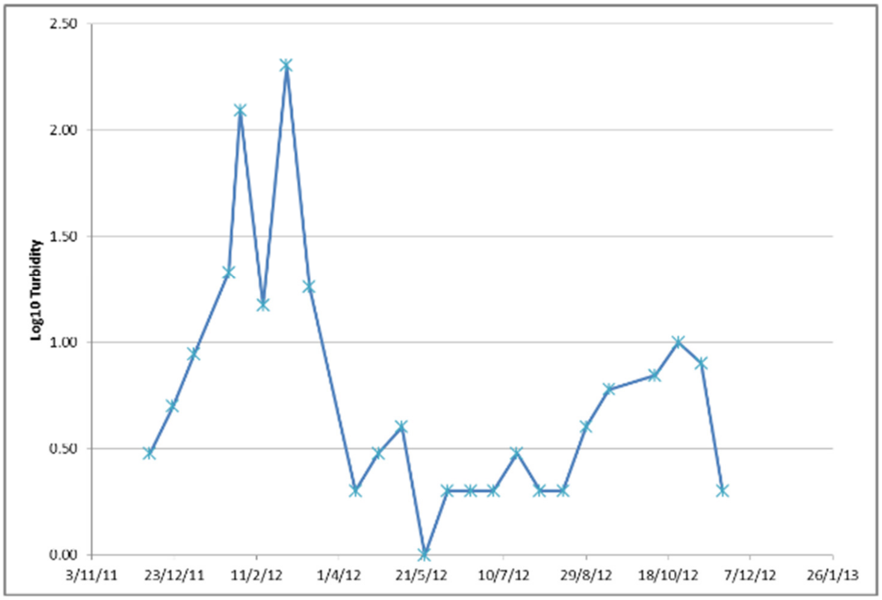

Figure 32 Time variation of Log_{10} Turbidity at Joun Reservoir

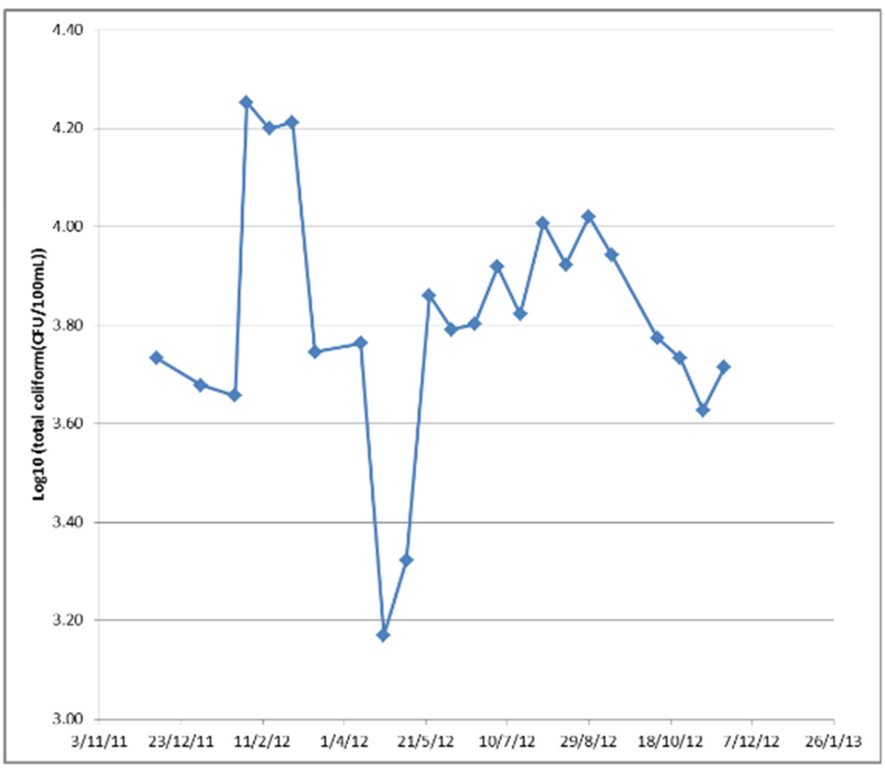

Figure 33 Time variation of Log_{10} Total Coliform at Joun Reservoir

APPENDIX G

Biodiversity Action Plan [1]

[1] This Appendix replaces Appendix G – Ecological Assessment Report – included in the ESIA disclosed on May 30, 2014.

Aims and Objectives of the Biodiversity Action Plan

A Biodiversity Action Plan (BAP) is a plan which includes a set of actions that lead to the conservation or enhancement of biodiversity for a specific site or project. The Biodiversity Management Plan (BMP) forms part of the BAP and provides the delivery mechanism for actions given within it. Specifically the BAP and BMP are needed to ensure that the Project:

- Implements the mitigation, compensation and biodiversity protection measures within the ESIA;
- Complies with national legislation/policy requirements; and
- Complies with international environmental requirements and best practice, including the World Bank Safeguards Policies and the Equator Principles.

The aim of the BAP is to achieve no net biodiversity loss as a result of the Project by ensuring that the biodiversity is protected and enhanced where possible. The BAP has been developed in consultation with stakeholders, conservation NGO's and biodiversity experts and confirms that appropriate measures are in place to be successfully implemented.

The objectives of the BAP are to:

- Review existing biodiversity baseline information for the project area identified within the ESIA and to undertake further detailed biodiversity monitoring surveys;
- Implement a consultation process with relevant stakeholders and biodiversity experts to inform priorities and actions for biodiversity conservation;
- Identify priorities and actions for biodiversity conservation, in consultation with stakeholders and biodiversity experts;
- Determine actions to be undertaken within a BMP to benefit biodiversity; and
- Establish a monitoring and evaluation program for biodiversity allowing for the success of the BAP interventions to be assessed.

This BAP includes short to long-term biodiversity conservation actions as well as on-site mitigation measures linked to the construction and operation activities of the Water Supply Augmentation Project. The on-site mitigation measures will be implemented through the BMP which is incorporated within this document. Implementation of the BMP will be monitored by the independent ESMP Supervision Consultant and by the independent Environment and Social Panel of Experts.

The biodiversity baseline, conservation actions and mitigation in this BAP supplement the information in the ESIA. This latter document also includes actions required under an Environmental and Social Management Plan (ESMP) which covers environmental measures that are relevant to the protection of biodiversity. Additional conservation opportunities/actions have also been identified during the BAP process, following a review of the Project and consultation with the site team and local conservation NGO's. The conservation objectives and actions in this BAP have been developed to ensure the systematic implementation of the mitigation hierarchy i.e. avoid, reduce (minimise) and remedy (restore) (see Figure 1). This will allow for the careful management of risk and the best possible outcomes for the project and local communities, without compromising the health, function and integrity of the ecological system.

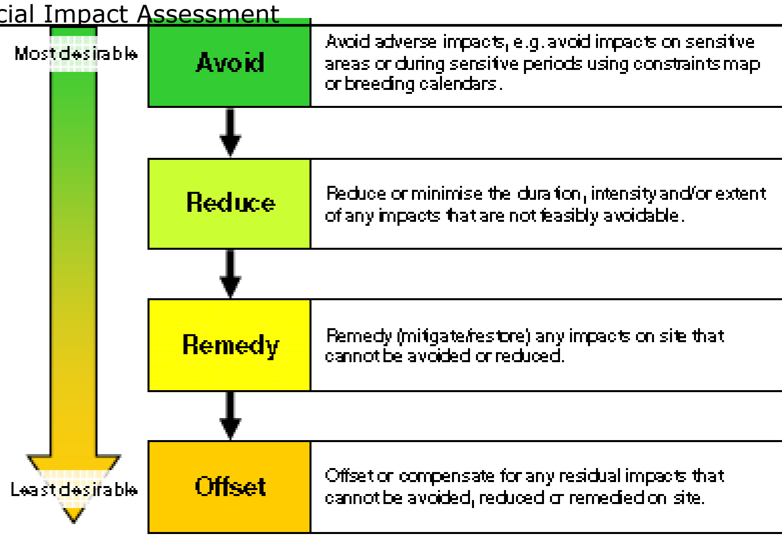

Figure 1: Mitigation Hierarchy

Formulation of the Project BAP

The development of the BAP follows the IFC Guidance Note 6 (IFC, 2012b) and the Cross-Sector Biodiversity Initiative Guidance tool published by the International Petroleum Industry Environmental Conservation Association (IPIECA, 2013). The IPIECA guidance is for the oil and gas industry, but it is the only detailed BAP guidance available and is relevant to many other project types, including water supply projects (see Figure 2).

A BAP is a process from which a document is formulated through the review of previous studies and from consultation with local stakeholders. The ESIA is part of this process in that the ecological assessments of the ESIA provide the baseline upon which the BAP objectives and conservation priorities are based. In accordance with IPIECA guidance best practice, a BAP should thus include eight specific tasks:

- Task 1: Determination of the legal, regulatory, planning, permitting & third party requirements;
- Task 2: Desktop assessment of the project;
- Task 3: Baseline survey of the biodiversity;
- Task 4: Biodiversity impact assessment;
- Task 5: Preparation of the BAP;
- Task 5.1 Establishment of priorities for conservation;
- Task 5.2 Identification of conservation actions;
- Task 6: Implementation of the BAP;
- Task 7: Monitoring, evaluation and improvement; and
- Task 8: Reporting, communication and verification of BAP performance.

Consultations with Stakeholders and Biodiversity Experts

Overview

Stakeholder consultation is an integral component in the formulation of a BAP and is essential to engage with stakeholders to gather opinions on how to complement and coordinate actions. A number of stakeholders were consulted as part of the ESIA. Additional consultation was undertaken for the BAP to: (i) Update the biodiversity baseline (and likely impacts if required); and (ii) Identify the priorities for biodiversity conservation and develop the conservation actions.

Key Stakeholders

Key stakeholders consulted as part of the preparation of the BAP and BMP are (i) local communities and villages within the project and surrounding areas; (ii) government departments and ministries; (iii) academia and (iv) local Lebanese conservation NGO's. The BAP and BMP will be monitored through the environment and social specialists on the project management unit (PMU), independent ESMP supervision consultant and the independent environment and social panel of experts.

Study Area

The geographical scope of the BAP encompasses (i) the upstream catchment of the Bisri river; (ii) the construction area of the dam including the buffer zone; (iii) the downstream river stretch and estuary and (iv) the buffer zone around the downstream river stretch, see Figure 2.

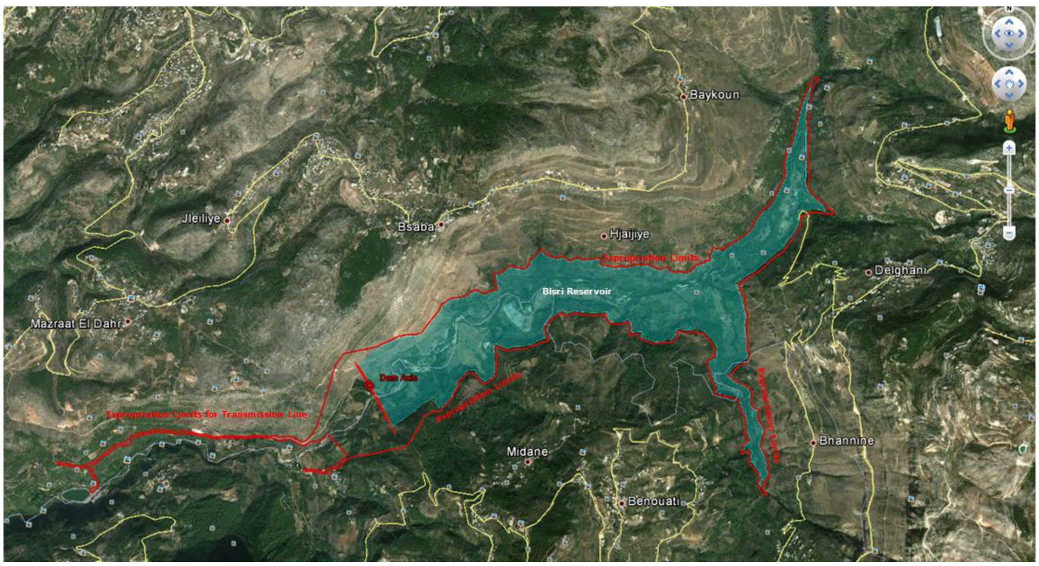

Figure 2: Bisri Dam Project

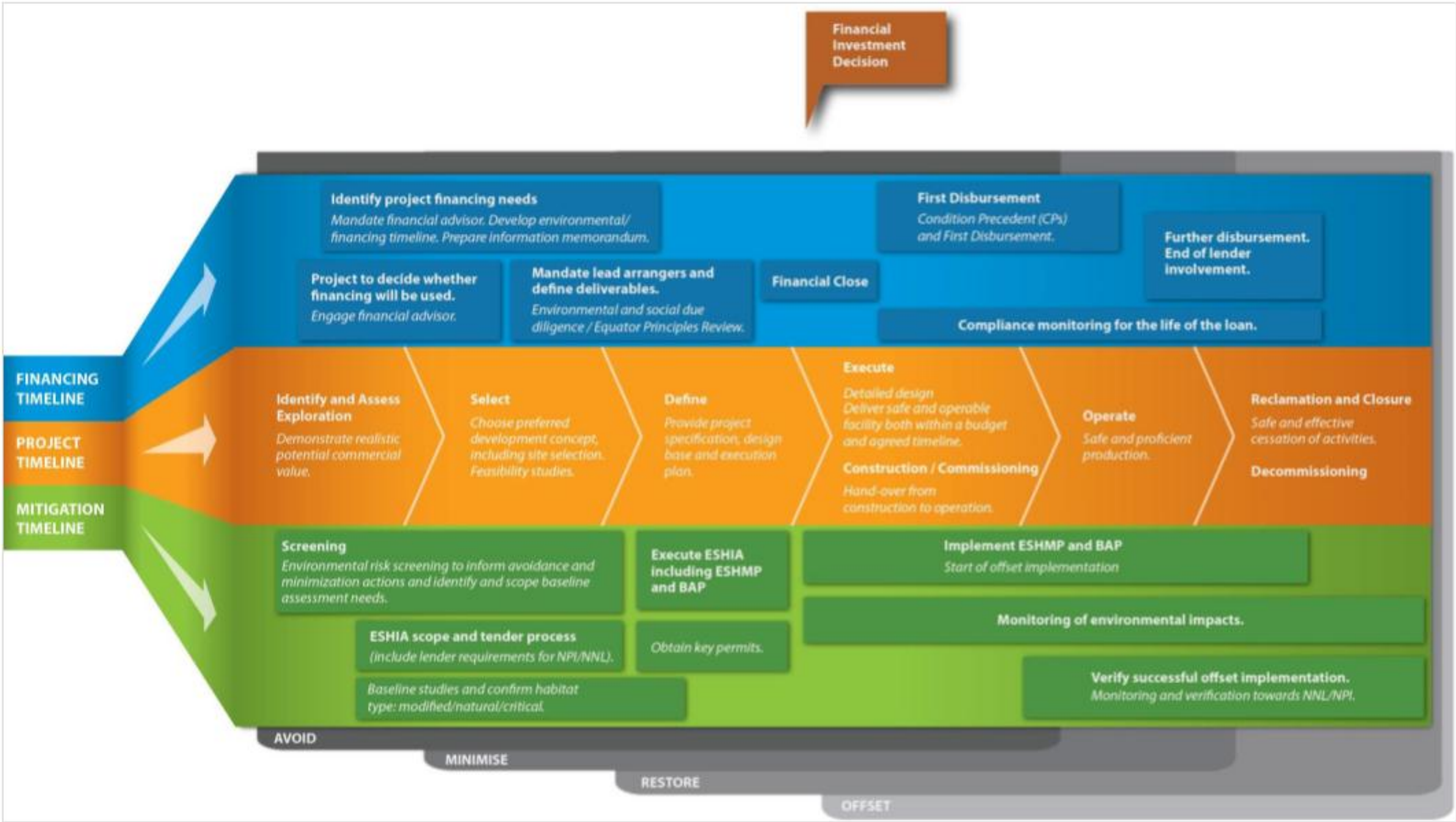

Figure 3: Illustrative Alignment of Project Financing, Project and Mitigation Timelines (Cross Sector Biodiversity Initiative, 2013)

Task 1: Legal and Regulatory Requirements

International Legislation and Policy

The following international laws and conventions have been ratified by Lebanon and are of relevance to this Project:

- Convention on International Trade in Endangered Species of Wild Fauna and Flora (1973);
- United Nations (UN) Framework Convention on Climate Change; and
- UN (Rio) Convention on Biological Diversity (1992)

National Legislative and Policy Framework

Lebanon's Ministry of Environment Decree on ESIA requires a project proponent to undertake an Environmental Impact Assessment where it is considered that the project has the potential to result in potential significant environmental or social impacts.

Planning and Permitting Requirements

A detailed ecological impact assessment was completed for the Project as part of the ESIA. This document identified a number of mitigation and compensation measures which were necessary to ensure that there would be no net loss in biodiversity. This included the creation of a BAP and BMP in order to ensure that mitigation and compensation measures are fully and properly implemented, with stakeholder consultation, to meet conservation goals and objectives.

The BAP and BMP supplements and updates the information included in the ESIA to reflect the refinement and development of the Project design, the additional biodiversity baseline information collected since September 2013, and to include further assessment, mitigation and conservation actions, where necessary, to comply with IFC PS6 (IFC, 2012a, 2012b).

Table 1 below summarizes the likely significant direct and indirect impacts of the Project as identified in the ESIA. The table presents sensitive habitats and protected species that have been identified or are known to likely occur within the wider Project Area, which may be affected by the Project and the types of impacts that may occur.

Table 1: Key likely significant impacts on ecological features during construction and operation

	Project Biodiversity Risk	Key likely impacts (C=construction impacts, O=operation impacts)
Flora	Ccontrol of water flooding may lead to destruction of important plant species and disturbance imposed within the demographic structure of riparian forest	C= Permanent habitat loss from construction of site infrastructure; noise and light disturbance from construction; increased pressure from human activities, such as forest management, logging and hunting due to improved access. O= Disturbance from site staff and vehicles; physical barriers to movement across site roads; light disturbance at well pads from occasional night work
Fish	Reduced volumes of year-round river inflow and outflow, and possibility of water contamination with sewage or polluted water will deteriorate the environmental conditions of various fish species and/or block reproduction	C & O
	Reduction in water flow downtream of Bisri river may impact local freshwater blenny fish.	C&O
Amphibians and Reptiles	Risk of sudden reduction in water availability to hamper viability of amphibians and reptiles	C & O
	Reduction in water availability will impact the environmetnal conditions of the populations of the Bufo cf bufo ("Common European toad"), whose habitat appears to consist mostly of rocky terrain and riparian trees	C & O
Birds	Disturbance to natural environment may lead to a reduction in bird colonies	C & O
Mammals	Fragmentation of natural environment as a result of dam construction may obstruct mammal routes and expose animals to drowning and other risks	C & O

A note on environmental flow calculations

Using the Q95 percentile of the river flow duration curve, accounting for four ecological elements that are the river physical characteristics, fisheries, macrophytes and macroinvertebrates, the Flow-Duration-Analysis for Bisri River estimated the base flow to be 0.3 and 0.45 m^3/s for winter and summer, respectively. The estimated environmental flows should only be used to sustain freshwater and estuarine ecosystems and the human livelihoods that depend on these ecosystems. Other components of environmental flows are also to be considered, such as; the small and larger flood flows and the special purpose flow.

There is no one single method that is recommended and applicable worldwide in determining the Environmental Flows for any given river stream. There are number of methods depending on specific sites requirements and conditions. According to the U.K Resource Assessment and Management RAM[2] framework, a more realistic Environmental Flow could be obtained by combining between the flow and ecology of a given river. Other than the hydrologic properties of the river stream, the river physical characteristics and ecological features, such as fishery, Macrophytes and macro-invertebrates, were accounted for in determining Bisri river Environmental Flows. As such, the Q95 percentile, of the river flow duration curve, was applied[3] to quantify the flow that will be needed to prevent the loss of natural ecosystem because of the dam.

As such, the Q95 percentile yields a river base flow of 400 liters per second (lps), of which, about 25% could be abstracted, totaling the 100 lps, while the balance of 300 lps flow has to be maintained running into the river course as Environmental Flow. Whilst the latter Environmental flow has to be maintained into the river stream all year round, there should be a provision for additional 150 lps flow, starting the month of April and all way through the dry year months until October, to cope with the irrigation needs downstream the dam.

The project Environmental Flow, as described in the ESIA, will be monitored over the first 5 years of dam operation and will be adjusted accordingly as needed to preserve the site natural ecosystem and social services.

Task 2: Third Party Requirements

The Project is required to meet the international standards of the World Bank Group, including IFC Standards and World Bank Policy 4.01 on Natural Habitats.

Task 3: Biodiversity Baseline for Priority Habitats and Species

Desktop Study

A desk study was undertaken as part of the ESIA. Species of conservation importance were determined from the International Union for Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Species (http://www.iucnredlist.org), refereed journal and national expert knowledge.

Field surveys

[2] RAM is intended as a default methodology in the absence of other more sophisticated and extensive data requiring techniques
[3] The Essentials of Environmental Flows. Dyson & Bergkamp and Scanlon 2003 – Gland Switzerland IUCN

A detailed site-specific biodiversity survey was undertaken by Dar El Handassah Shaer (DAS) in August 2013 and to IFC standards, covering all major taxa, including amphibians, reptiles and macro-invertebrates, as well as more specific location and habitat usage information for flora, mammals, birds and fish, including:

- Flora and vegetation survey (including habitat mapping);
- Invertebrates
- Fish
- Reptile and amphibian surveys
- Bird survey
- Mammal survey;

A detailed assessment of habitat conditions was also undertaken in order to assess the suitability of the habitats within the Study Area to support endangered species.

The survey determined, as described below, that the project would not cause significant conversion to critical natural habitats.

Plant Survey

The flora cover was assessed to draw the ecological profile of the plant cover, its status and the impact of the dam on it. A rapid inventory was conducted to identify existing species and their status (rare, endangered, iconic …). Walking transects were identified to obtain an understanding of the vegetation communities in the area, to identify community boundaries, to record species present, and to determine the potential distribution of threatened species (Plate 1). Transects were assigned to cover the different habitats, topographic diversity, and variety of vegetation communities mapped from aerial photos.

Fish and Macroinvertebrates

Electrofishing was used to survey fish and macroinvertebrates. Electrofishing is a common method used for catching fish for surveying and monitoring purposes. The fishing device emits an electric current through the water, stunning fish and making them easy to capture (Cowx, 1990; Cowx and Lamarque, 1990). Carefully regulated amperages of currents used allowed the fish to be stunned effectively without damaging their muscles, vertebrae and spinal nerves. This is a non-selective method of capture that provides a broad overview of the fish fauna living in the surveyed water body.

Amphibians and Reptiles

Amphibians and reptiles were conducted on two intervals days and nights focusing on the water bodies, the riparian habitats and their peripheries. Observing and studying the potential habitats and observations of active animals was the only method for the animals that are active in warmer seasons.

Ornithology Survey

To assess the impact on the avian species, the 20-minute point-count method was used, whereby all species noted during this time period are recorded at different places and different times in the most characteristic habitats of a given area This method is semi-quantitative and changes in abundance of a species are estimated by changes in the frequency of this species over a series of point counts. Frequencies could be mathematically transformed into densities through the use of some statistical rules.

Camera trapping and field surveys

Terrestrial mammal species were surveyed using two approaches, direct and indirect, were used to monitor mammals. Indirect approach was conducted during day time through diurnal walking surveys, where opportunistic observations of secondary signs such as tracks, footprints, fur and scats detected were recorded. Moreover, caves and dens were inspected for bats, animal signs and animal remains. The direct approach was conducted in two ways night surveys commenced using a 4x4 vehicle and a powerful spot light (1-1.5 million candle power) to illuminate animals once their eye-shine at two different times before or after midnight. The second approach through camera-trap surveys. 18 camera traps were placed within the Study Area, at least 100 meters from one another. The cameras were sited so as to cover a combination of habitat types and location within the study area.

Habitats of Conservation Value

A detailed description of the habitats within the Project footprint and surrounding area to 5 kilometers is provided in the ESIA. The main habitats of conservation value are: (i) the riparian habitat and (ii) the Mediterranean ecosystem habitat.

Flora of Conservation Value

Approximately 50 plants were identified in Bisri, of which 11 are of conservation value. Important plant species were identified among which Ricotia lunaria (L.) DC. (endemic at the national scale), Orchis anatolica Boiss., Orchis morio L., Orchis papilionaceae L., Orchis pyramidalis M. Bieb., Orchis romana subsp. libanotica Mt., Orchis tridentata Scop., Ornithogalum umbellatum L. and Fritillaria libanotica (Boiss.).

Species Scientific Name	Species Scientific Name
1. *Acer syriacum Boiss*. & Gaill.	2. *Nerium oleander* L.
3. *Adiantum capillus-veneris* L.	4. *Onosma frutescens* Lam.
5. *Ajuga orientalis* L.	6. *Orchis anatolica* Boiss.
7. *Alnus orientalis* Decne.	8. *Orchis morio* L.
9. *Anemona coronaria* L.	10. *Orchis papilionaceae* L.
11. *Arceuthos drupacea*(Labill.) Ant. & Ky.	12. *Orchis pyramidalis* M. Bieb.
13. *Arum hygrophylum* Boiss.	14. *Orchis romana* subsp. *libanotica* Mt.
15. *Asparagus acutifolius* L.	16. *Orchis tridentata* Scop.
17. *Asperula sp.*	18. *Ornithogalum umbellatum* L.
19. *Asphodellus microcarpus* Salzm. & Viv.	20. *Oxalis per-caprae* L.
21. *Bellevalia latifolia* Ten.	22. *Pinus brutia* Ten.
23. *Bellis sylvestris* Cirillo.	24. *Pinus pinea* L.
25. *Calycotome villosa* (Vahl) Link.	26. *Pistacia palaestina* Boiss.
27. *Ceratonia siliqua* L.	28. *Phillyrea media* L.
29. *Cercis siliquastrum* L.	30. *Platanus orientalis* L.
31. *Cistus creticus* Sibth. & Sm.	32. *Pteridium aquilinum* (L.) Kuhn.
33. *Cyclamen persicum* Sibth. & Sm.	34. *Quercus calliprinos* Webb.
35. *Cupressus sempervirens* L.	36. *Quercus infectoria* Oliv.

37. *Fritillaria libanotica* (Boiss.) Baker	38. *Ricotia lunaria* (L.) DC.
39. *Gallium sp.*	40. *Ruscus aculeatus* L.
41. *Hyacinthus orientalis* L.	42. *Salix libani* Bornm
43. *Iris histrio* Reichb.	44. *Salix* sp.
45. *Lathyrus hierosolymitanus* Boiss. & Bl.	46. *Smilax aspera* L.
47. *Laurus nobilis* L.	48. *Allium neapolitanum* Cyr.
49. *Lavendula stoechas* L.	50. *Tamarix* sp.
51. *Lupinus digitatus* Forsk.	52. *Tamus communis* L.
53. *Muscari comosum* (L.) Mill.	54. *Valeriana dioscoridis* Sibth. & Sm.

Fish

Five fish species and one crab were present in Awali River, out of which three deserve special attention as listed below. These are the Freshwater blenny, the European eel, and the Middle Eastern Green carp. No exotic fish or macroinvertebrates were captured.

Species	Family
Salaria fluviatilis (Asso, 1801)	Blenniidae
Anguilla anguilla (Linnaeus, 1758)	Anguillidae
Capoeta damascina (Valenciennes, 1842)	Cyprinidae
Pseudophoxinus kervillei (Pellegrin, 1911)	Cyprinidae
Oxynoemacheilus leontinae (Lortet, 1883)	Balitoridae
Potamon potamios (Olivier, 1804)	Potamidae

Amphibians and Reptiles

None of the species of snakes and lizards in that basin are known to be endangered or endemic. Most of these species are quite common in the surrounding areas and many parts of the country. There are no apparent impacts on these species due to the dam construction. In this survey, emphasis was placed on species that might be affected or impacted directly or indirectly by changes in the aquatic habitat to the dam construction. The species most like to be impacted are listed below. The impact on the species could be in terms of changes in habitat, breeding sites and food sources.

(T = Threatened, E = Endemic, R = Rare, and C = Common. The type of impact might be: HT= general habitat, BR=breeding habitat, FD=food requirements.)

Species	Common name	Picture	**Status**				Type of Impact		
			T	E	R	C	HT	BR	FD
Natrix tessellata	Water snake					+	+		?

Pelophylax bedriagae	Marsh frog					+	+	+	?	
Pelobates syriacus	Eastern or Syrian spadefoot				+		+	+	?	
Bufo viridis	Green toad					+		+	?	
Bufo cf. *bufo*	European common toad			+	+		+	+	?	
Hyla savignyi	tree frog					+	+	+	?	
Salamandra infraimmaculata	salamander					+	+	+	?	

Triturus vittatus	Newt				+				

Birds of Conservation Value

Thirty two (32) bird species were observed during the surveys. Of the observed birds, four are threatened (White storks, Lesser Spotted Eagle, White Pelicans that are of passage only, and Short-toed Eagle that is of wide range of action (within and beyond the limits of the site). Hence their conservation depends on areas other than Bisri Site. The Bisri area is not considered critical to the migratory routes of these threatened bird species.

Mammals of Conservation Value

The field survey on mammals for Bisri site revealed the presence of 17 mammal species belonging to 14 families. Mammals of conservation value are identified below:

List of mammal species present on the three sites (R= recorded, E = Expected, c= common, r = rare, endemic or endangered on the National level)

Family	Species	Scientific Name	Awali River
Erinaceidae	Hedgehog	*Erinaceus concolor*	R, r
Miniopteridae	European Free-tailed bat	*Tadarida teniotis*	R, r
Vespertilionidae	Common pipistrelli	*Pipistrellus Pipistrellus*	R, c
	Khul’s pipistrelle	*Pipistrellus kuhli ikhawanius*	R, c
Rhinolophidae	Lesser horseshoe	*Rhinolophus hipposideros*	R, c
	Greater horseshoe bat	*Rihnolophus ferrumequinum*	R, c
Canidae	Jackal	*Canis aureus syriacus*	R, c
	Fox	*Vulpus vulpus palaestina*	R, c
Mustelidae	Pine Martin	*Martes foina syriaca*	R, c
	Badger	*Meles meles canescens*	E, r
	Otter	*Lutra lutra*	E, r
Hyaenidae	Striped hyaena	*Hyaena hyaena syriaca*	R, c
Felidae	Wild cat	*Felis silvestris tristrami*	R, r
Suidae	Wild boar	*Sus scrofa lybicus*	R, c
Sciuridae	Squirrel	*Sciurus anomalus syriacus*	E, c
Hystricidae	Porcupine	*Hystrix indica indica*	R, c
Spalacidae	Moles	*Spalax leucodon ehrenbergi*	R, c
Muridae	House mouse	*Mus musculus praetextus*	R, c
	Rats	*Rattus rattus*	R, c
	Field mouse	*Apodemous mystacinus*	R, c

Microtinae (Subfam.)	Voles	*Microtus sp.*	E, c

Biodiversity Action Plan

Overview

This section sets out the proposed actions to be undertaken for the habitats and species of conservation value identified above with the aim of achieving 'no net loss' to biodiversity in accordance with IFC PS6 (IFC, 2012a).

These actions have been developed for each priority biodiversity feature, or groups of features, to ensure the systematic implementation of the mitigation hierarchy i.e. avoid, reduce (minimize), and remedy (restore) as outlined in Figure 1. This will allow for the careful management of risk during construction and operation, and the best possible outcomes for the Project and local communities without compromising the health, function and integrity of the ecological system.

A summary of the objectives is provided in Table 6 below, with details of the actions below.

Table 6: Summary of action plan objectives.

During Construction	
1	Conduct further biodiversity surveys and prepare a detailed map of the habitats of conservation value before construction starts
2	Inform construction staff on the habitats of conservation value and notable plant species prior to the start of construction
3	Plan starting time for major construction works and activities to avoid disturbance of critical species
4	Clearly mark areas to be cleared during construction and fencing of critical flora
5	Translocation of critical endangered flora in area to be cleared prior to the start of construction
6	Establish corridors for crossing to avoid fragmentation of habitats prior to the start of construction
7	Methodical clearance of forested areas to allow natural dispersal of wildlife into adjacent habitat
8	Reduce hunting and logging in areas opened up through the creation of new or improved access roads
9	Reduce and prevent mortality of wildlife from collision from vehicles
10	Prevent pollution from construction waste to reach habitats
11	Light control within Project Area to minimize disturbance to critical species
12	Avoid noise pollution (blasting) at times critical for bird nesting
During Operation	
13	Maintain connectivity and habitats downstream of dam through minimum flow releases
14	Operation of reservoir to avoid water level fluctuation in spring to preserve critical habitats

The actions may partly overlap with the actions of other environmental and social plans and the execution of the BAP should be coordinated with other plans during implementation.

Action 1: Conduct further biodiversity surveys and prepare a detailed map of the habitats of conservation value prior to the start of construction					
Target	To improve and refine the knowledge of biodiversity conducted during the ESIA				
Indicator	Number of survey reports, Finalized map of critical habitats				
Mitigation Hierarchy	**Avoid**	**Reduce**	**Remedy**	**Offset**	**Other**
Start	Before the onset of the construction				
End	On yearly bases over 5 years after construction				
Frequency	Continuous during first year of construction				
Brief description: Extended biodiversity surveys guided by already conducted work in the ESIA. Preparation of detailed map of critical habitats.					
Responsible: Project Developer					

Action 2: Inform construction and operation staff (including contractors) on the habitats of conservation value and notable plant species prior to the start of construction					
Target	To raise awareness of wildlife plant and habitat in the project area				
Indicator	Number of staff and contractors reached through site induction and training; number of posters at site offices				
Mitigation Hierarchy	**Avoid**	**Reduce**	**Remedy**	**Offset**	**Other**
Start	Start of construction				
End	End of construction				
Frequency	During staff induction; continuous during construction and operation				
Brief description: Construction and operational staff will be informed about the areas supporting habitats and species of conservation value, why these features are important and what activities are/are not permitted in these areas.					
Responsible: Biodiversity specialist, Works Contractor					

Action 3: Plan starting time for major construction works and activities to avoid disturbance of critical species					
Target	To avoid and reduce disturbance of wildlife during critical seasons				
Indicator	Start dates of major new construction activities				
Mitigation Hierarchy	**Avoid**	**Reduce**	**Remedy**	**Offset**	**Other**
Start **End** **Frequency**	Start of construction End of construction At start of major activities during construction				
Brief description: Planning of major construction activities, especially those that have large areal influence, should be done to as much as possible avoid disturbance of critical species. Special attention shall be taken to hibernating mammals during winter and nesting birds and breeding amphibians during spring.					
Responsible: Works Contractor as advised by Project Biodiversity Management Specialist					

Action 4: Clearly mark areas to be cleared during construction and fencing of critical flora prior to the start of construction					
Target	To raise awareness affected areas during construction and to protect endangered flora				
Indicator	Meters of fence established, number of signs and demarcations				
Mitigation Hierarchy	**Avoid**	**Reduce**	**Remedy**	**Offset**	**Other**
Start **End** **Frequency**	Start of construction Six months after start of construction At start of construction				
Brief description: Demarcation of all areas to be cleared during construction. Install fencing around essential vegetation close to construction sites. Signs that will inform that these are sensitive environmental areas shall be attached to the fence.					
Responsible: Works Contractor – as advised by Project Biodiversity Management Specialist					

Action 5: Translocation of endangered flora in area to be cleared prior to the start of construction					
Target	To create alternative habitats for endangered flora to be affected by construction				
Indicator	Number of plants translocated				
Mitigation Hierarchy	**Avoid**	**Reduce**	**Remedy**	**Offset**	**Other**
Start **End** **Frequency**	Before start of construction Start of construction Once before construction start				
Brief description: Translocation of nationally endemic species with critical conservation status such as Orchis, Fritillaria, Omithogalum, Hyacinthus, ferns and other species must be done before the construction of the dam. Should if possible be made at end of summer during the dormant stage of the plants in question.					
Responsible: Project Developer, as advised by Project Biodiversity Management Specialist					

Action 6: Establish corridors for crossing to avoid fragmentation of habitats prior to the start of construction					
Target	To avoid and reduce fragmentation of habitats				
Indicator	Number of square meters of corridors established				
Mitigation Hierarchy	**Avoid**	**Reduce**	**Remedy**	**Offset**	**Other**
Start **End** **Frequency**	Start of construction Six months after start of construction At start of construction				
Brief description: Construct corridors for mammals and amphibians for strategic crossing points					
Responsible: Works Contractor – as advised by Project Biodiversity Management Specialist					

Action 7: Methodical clearance of forested areas to allow natural dispersal of wildlife into adjacent habitat					
Target	To avoid damage to wildlife in forested areas to be cleared				
Indicator	Clearance plans and reports				
Mitigation Hierarchy	**Avoid**	**Reduce**	**Remedy**	**Offset**	**Other**
Start **End** **Frequency**	Start of construction Six months after start of construction At start of construction				
Brief description: To conduct clearance in a structured and planned way to allow escape routes out of the area. Avoid clearance during breeding season in spring.					
Responsible: Works Contractor					

Action 8: Reduce hunting and logging in areas opened up through the creation of new or improved access roads					
Target	To avoid damage to critical habitat and species in project area				
Indicator	Number of road gates established, Number of signs				
Mitigation Hierarchy	**Avoid**	**Reduce**	**Remedy**	**Offset**	**Other**
Start **End** **Frequency**	Start of construction End of operations Continuous during construction and operations				
Brief description: To install road gates for access roads to avoid other than necessary transport for construction and operation work, and for local population. Awareness campaigns among construction and operation staff, and local communities, and setting up of signs to enforce illegal hunting and logging.					
Responsible: Works Contractor and Dam Operator					

Action 9: Reduce and prevent mortality of wildlife from collision from vehicles					
Target	To restrain speed limits at low levels and to avoid unnecessary driving during darkness to avoid collisions with wildlife				
Indicator	Levels of speed limit, Number of speed limit and warning signs				
Mitigation Hierarchy	**Avoid**	**Reduce**	**Remedy**	**Offset**	**Other**
Start **End** **Frequency**	Start of construction End of operations Continuous during construction and operations				
Brief description: Setting of low speed limits for access and construction roads. Planning of transport to avoid driving in darkness. Clear demarcation of speed limits and warning for wildlife collisions.					
Responsible: Works Contractor and Dam Operator					

Action 10: Prevent pollution from construction waste to reach habitats					
Target	To avoid damage to habitats in project area by construction waste pollutions				
Indicator	Meters of drainage work to prevent waste water and solid waste seepage to escape, regular monitoring of waste water				
Mitigation Hierarchy	**Avoid**	**Reduce**	**Remedy**	**Offset**	**Other**
Start **End** **Frequency**	Start of construction End of operations Continuous during construction and operations				
Brief description: Planning and construction of solid waste dumps and waste water treatment to avoid spillage or seepage to natural habitats. Construction of drainage around severe pollution risks to ensure polluted water is contained and treated. Monitoring of water discharging from construction sites and permanent site.					
Responsible: Works Contractor and Dam Operator					

Action 11: Light control within Project Area to minimize disturbance to critical species					
Target	To avoid and reduce disturbance of nocturnal wildlife from construction lights				
Indicator	Number of lights used during nighttime				
Mitigation Hierarchy	**Avoid**	**Reduce**	**Remedy**	**Offset**	**Other**
Start **End** **Frequency**	Start of construction End of operations Continuous during construction and operations				
Brief description: Planning of construction and operation work to minimize as much as possible work during darkness. Efficient use of construction lights.					
Responsible: Works Contractor and Dam Operator as advised by Project Biodiversity Management Specialist					

Action 12: Avoid noise pollution (blasting) at times critical for wild life					
Target	To avoid and reduce disturbance of nesting birds				
Indicator	Reported time for blasting				
Mitigation Hierarchy	**Avoid**	**Reduce**	**Remedy**	**Offset**	**Other**
Start **End** **Frequency**	Start of construction End of operations Continuous during construction				
Brief description: Plan and execute blasting to avoid timing during peaks of the breeding season (April-July) and during sunrise and sunset. Preferably do blasting at same time every day.					
Responsible: Works Contractor as advised by Project Biodiversity Management Specialist					

Action 13: Maintain connectivity and habitats downstream of dam through minimum environmental flow releases					
Target	To preserve habitats for flora and fauna, and fish migration in downstream reaches				
Indicator	Monitored flows downstream of dam				
Mitigation Hierarchy	**Avoid**	**Reduce**	**Remedy**	**Offset**	**Other**
Start **End** **Frequency**	At start of reservoir filling End of operations Continuous start of filling to end of operations				
Brief description: To construct dam to allow continuous minimum flow releases and to ensure operation rules to follow such releases.					
Responsible: Works Contractor and Dam operator, biodiversity specialist.					

Action 14: Operation of reservoir to avoid water level fluctuation in spring to preserve critical habitats for species					
Target	To enable and facilitate reproduction of amphibians (Bufo cf Bufo) upstream of Bisri dam				
Indicator	Water level records				
Mitigation Hierarchy	**Avoid**	**Reduce**	**Remedy**	**Offset**	**Other**
Start **End** **Frequency**	Dam commissioning End of operations Continuous during operation				
Brief description: Establish operating rules for dam releases to maintain the Bisri reservoir as high as possible, and avoid releases giving rapid water level fluctuations, during the reproduction period of the Bufo cf Bufo (April-May).					
Responsible: Dam Operator, as advised by Project Biodiversity Management Specialist					

Biodiversity Management Plan

The BAP will be implemented through the BMP summarized in Figure 4 below and the ESMP. The BMP will focus on three key areas: biodiversity monitoring and socialization.

- **Biodiversity Monitoring**

Biodiversity monitoring will be undertaken over a minimum of five years to incorporate the pre-construction, construction and operational phases of the Project. The aims of the surveys will be to assess the impacts of the development and will use the Before-After-Control-Impact (BACI) approach. The methodology to be used will be scientifically robust and repeatable. The surveys will be carried out in collaboration with biodiversity experts/NGOs.

A Rapid Ecological Assessment to provide additional baseline prior to the commencement of works at the project site in was undertaken by Dar El Handassah Shaer (see Appendix A). This assessment was designed to be repeated during the post-construction surveys following the same and other updated methodology.

- **Socialisation**

A socialisation programme will implemented covering two aspects: 1) staff/contractor induction and training; 2) local community engagement.

Staff/contractor induction and training

Inductions and training will be undertaken with all staff and contractors to raise awareness of the ecological issues affecting the Project and to implement any obligations outlined below. This will be achieved through the following:

- **Training for all existing staff and contractors working on the Project**: Group sessions will be organised in order to train all existing staff and contractors working on the Project. The delivery method will be through to approaches i) a PowerPoint presentation followed by a question and answer session, ii) hands on through field or site visits. Due to the large number of staff working on the Project and the requirement to maintain continuous construction work on site, the training will be undertaken over a series of events. The content and delivery will be determined through consultation with the external ecological consultants, the Site Construction Manager and biodiversity experts/NGOs.
- **Future inductions for all new staff and contractors working on the Project**: Following completion of the training events, all new site staff and contractors will be made aware of ecological issues via the existing site induction system. This is currently implemented through a PowerPoint presentation conducted by the Site Construction Manager. Additional slides will be prepared for inclusion in this presentation the external ecological consultants and biodiversity experts/NGOs. In addition to onsite training.
- **Awareness raising posters and information at the site office:** will be achieved through the placement of literature at the Bisri site office

Local community engagement and awareness raising

Socialisation through local community engagement will be carried out within the villages in the catchment of the Project. The aims of the events will be to: 1) raise awareness of the conservation value of the Bisri river and catchment; 2) encourage local people not to hunt Threatened species in the forest or to clear areas by logging and the application of sustainable hunting and logging when necessary; and 3) communicate developments within the Project relevant to the local communities.

Key Project Staff

External Ecological/Social Consultant
Overall ecological and social coordination for the implementation of the BAP and BMP will be undertaken by an external ecological/social consultant. Additional support will be given for the preparation of the ESMP, mapping and socialisation program as well as other duties as necessary.

Biodiversity experts
The biodiversity monitoring surveys, expert stakeholder advice and assistance with the implementation of the socialisation programme will be undertaken by biodiversity experts.

Site Construction Manager
The overall implementation of the BAP and BMP on site will be undertaken by the Site Construction Manager

HSE Manager
The implementation of site measures will be delegated as determined by the Site Construction Manager to the Health, Safety and Environment Manager.

	Project Biodiversity Risk	Key likely impacts (C=construction impacts, O=operation impacts)	Recommended Mitigating Measure	Responsible Party	Estimated Cost (USD)
Flora	Ccontrol of water flooding may lead to destruction of important plant species and disturbance imposed within the demographic structure of riparian forest		Translocation of endemic and species with critical conservation status such as Orchis sp., Fritillaria sp., Ornithogalum sp., Hyacinthus sp., ferns and other species must be done before the construction of the dam and the inundation of downstream areas	CDR and Dam Operator	N/A
		C= Permanent habitat loss from construction of site infrastructure; noise and light disturbance from construction; increased pressure from human activities, such as forest management, logging and hunting due to improved access.	Implement environmental flows to reduce the disturbance intensity	Dam Operator (BMLWE)	N/A
		O= Disturbance from site staff and vehicles; physical barriers to movement across site roads; light disturbance at well pads from occasional night work	Install fencing around trees and patches of vegetation close to construction zones	Works Contractor	10,000
			Signs indicating the area is a "sensitive environmental area" will be clearly and securely affixed to the fencing	Works Contractor	N/A
Fish	Reduced volumes of year-round river inflow and outflow, and possibility of water contamination with sewage or polluted water will deteriorate the environmental conditions of various fish species and/or block reproduction	C & O	Ensure connection of water between dam and downstream water resources.	Dam Operator (BMLWE)	N/A
	Reduction in water flow downtream of Bisri river may impact local freshwater blenny fish.	C&O	Maintain environmental flow as designed	Dam Operator (BMLWE)	N/A
Amphibians and Reptiles	Risk of sudden reduction in water availability to hamper viability of amphibians and reptiles	C & O	Schedule filling of the dam during the October - July season to minimize disruptions to breeding season. Schedule site clearance works during non-vulnerable periods	Dam Operator (BMLWE)	N/A
	Reduction in water availability will impact the environmetnal conditions of the populations of the Bufo cf bufo ("Common European toad"), whose habitat appears to consist mostly of rocky terrain and riparian trees	C & O	Implement a construction site drainage system to reduce pollution to water resources	Works Contractor	Included in construction contract estimate
			Operate dam to maintain water levels as long as possible to optimize breeding and spawning seasons	Dam Operator (BMLWE)	N/A
			Install reptile-proof fencing to prevent *Bufo cf bufo* from returning or accessing the most hazardous parts of the construction site	Works Contractor as advised by Biodiversity Management Specialist	10,000
Birds	Disturbance to natural environment may lead to a reduction in bird colonies	C & O	Schedule any required blasting during the day	Works Contractor	N/A
			Tree clearance to avoid spring nesting seasons	CDR	N/A
Mammals	Fragmentation of natural environment as a result of dam construction may obstruct mammal routes and expose animals to drowning and other risks	C & O	Fence exposed edges and install bushy hedges along exposed roads	Works Contractor as advised by Biodiversity Management Specialist	N/A
			Construct crossing points for strategic animal crossings	Works Contractor as advised by Biodiversity Management Specialist	N/A

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Annex A: Ecological Assessment

LEBANON WATER SUPPLY AUGMENTATION PROJECT

PRE-DAM CONSTRUCTION

ECOLOGICAL ASSESSMENT SERVICES

for

AWALI/BISRI RIVER

Submitted to
Dar Al Handasa
Shair and Partners

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List of Plates

List of Figures

List of Tables

1. INTRODUCTION

Due to the increased attention given to the concept of nature conservation in Lebanon, several national action plans and strategies were developed, among which biodiversity conservation principles are being prioritized through the Environmental Impact Assessment (EIA) (Article 4-Code of the Environment Law 444/2002). However, EIA in Lebanon is in its first stages. According to the Ministry of Environment, the decree concerning EIAs was recently approved by the Council of Ministers under the number 8633/2012 and FEA under the number 8213/2012. EIA Decree aims to identify keys to assess the environmental impact of public and private projects in order to avoid significant environmental damage that may result from such projects.

On the international level, Lebanon is now member in several international conventions and agreements on the conservation of nature. Most notably, are the Ramsar Convention, the Convention on Biological Diversity (CBD), and lately Convention on International Illegal Trade with Endangered Species (CITES) and the Intergovernmental Platform for Biodiversity and Ecosystem Services (IPBES).

Lebanon is a water-rich country compared to Jordan, Palestine or Syria. However, because of limited and contradictory data, it is difficult to accurately assess the availability of water resources as well as water consumption in Lebanon. In 2005, the FAO estimated water withdrawal at 1.31 billion m^3 or about 63% of economically exploitable water resources. Sixty percent (60%) of this water went to agricultural usage, 29% for domestic usage and 11% for industrial use. Moreover, only part of the flooded water from rivers can be captured in dams, while most of the groundwater flows unused to the sea.

Throughout the history of the world, dams and reservoirs have been successfully constructed across rivers to collect and store vast amounts of water and then manage releases to make daily river flows to support civilization in water supply, irrigation and flood control. However, large-scale reservoir construction will have varied impacts, including both positive and negative aspects.

Currently, in Lebanon, a pilot dam project is being considered on Awali River, South of Lebanon, aiming at the utilization of the large quantities of water that are being wasted to the sea. The dam project involves the construction of a freshwater reservoir to provide potable water to a wide range of inhabitants. Legal procedures require the preparation of an environmental impact assessment for the proposed dam project which might have adverse effects on the environment. EIA plays an important role in predicting the environmental, social, economical, and cultural consequences, along with evaluating the mitigation plans for any adverse impacts resulting from the proposed activity.

The current study focuses on evaluating biodiversity of the Awali River site, highlight environmental concern that might arise upon implementation of the dam project on existing biodiversity and recommend mitigation measures to decrease the impact of the dam on biodiversity. A rapid flora and fauna assessment was conducted and the findings were analyzed taking into account the basics of the Code of Environment of Lebanon (Law 444/2002), to assess potential impact of the proposed project on the natural environment and consider mitigation measures to minimize the expected environmental damage resulting from the proposed project implementation.

2. OBJECTIVES

The second phase of the pre-dam construction ecological assessment services for the Lebanon Water Supply Augmentation Project aims at drawing the ecological profile of Awali River in South Lebanon, assessing the conservation values of flora and fauna diversity; as well as the vegetation formation. This will lead to identifying the risks of dam construction on the environment and local communities, to defining ways to mitigate the effects of dam construction, and to ensuring the implementation of integrated ecosystem approach combined with sustainable development. However, due to the short time period, the report focuses on building up a groundwork database on biodiversity in the project site, defining threats and proposes mitigation measures. The second phase aims at:

1- Conducting a rapid field survey of flora and fauna in the proposed project site
2- Identifying and listing major flora and fauna species and their status
3- Identifying potential threats from the proposed project
4- Recommending mitigation measures to enhance the project acceptability by maximizing the benefits while minimizing adverse impacts on biodiversity

3. METHODS

3.1. Plant Survey:

The flora cover was assessed to draw the ecological profile of the plant cover, its status and the impact of the dam on it. A rapid inventory was conducted to identify existing species and their status (rare, endangered, iconic …). Walking transects were identified to obtain an understanding of the vegetation communities in the area, to identify community boundaries, to record species present, and to determine the potential distribution of threatened species (Plate 1). Transects were assigned to cover the different habitats, topographic diversity, and variety of vegetation communities mapped from aerial photos.

Plate 1. Walking transects for flora identification

Information and location of plant species and their habitats were recorded during transect walks. This information was used to assist in identifying the presence of vegetation communities, determining vegetation boundaries, assessing the homogeneity of the study area, and determining the required number of plots.

3.1.1. Field survey

Vegetation communities were randomly assessed in both the thermo-Mediterranean (0-500m) and part of the Eu-Mediterranean in Bisri. Field visit were performed during a very short period in spring 2012 and the first week of November. The number of visits during spring was limited as they aimed to develop preliminary study to estimate the conservation value of the three sites namely Bisri, Dammour and Ibrahim River. While during autumn very few species are expected to be in bloom.

3.1.2. Site diagnosis and analysis

The impact of the dam construction on the vegetation communities in the riparian ecosystem was rapidly identified. Species of special concerns surveyed during very short visit in the spring was defined based on the national assessment.

3.2. Fish and Macro Invertebrates

Electrofishing is a common method used for catching fish for surveying and monitoring purposes. The fishing device emits an electric current through the water, stunning fish and making them easy to capture (Cowx, 1990; Cowx and Lamarque, 1990). Carefully regulated amperages of currents used will allow the fish to be stunned effectively without damaging their muscles, vertebrae and spinal nerves. This is a non-selective method of capture that provides a broad overview of the fish fauna living in the surveyed water body. It is very efficient and suitable for running and still waters. It can be used to make total population estimates for a given stretch of river using multiple catch techniques (Hill et al., 2005).

Plate 2. Survey of the ichthyofauna using electro-fishing method conducted at Bisri (Awali River) Site.
Field expeditions to Awali River were carried out in 2012 (Plate 2). The river had also been extensively surveyed between year 2007 and 2008 (Bariche, unpublished data). A backpack electric fishing device was used. Electrofishing was carried out by chest wading and the small streams were fished on foot. Electrofishing was performed with minimum voltage and avoiding contacts between the fish and the anode, in a manner that minimizes harm to the fish. Stream segments were sampled systematically, moving the anode continuously through the water. All captured fish were handled properly for identification. They were released afterwards into the water at the location of capture and some specimens were kept as voucher specimens. They were preserved and stored in the collections of the Natural History Museum of the American University of Beirut (AUBNHM).

3.3. Herpetofauna (Amphibians and Reptiles) Survey

Amphibians and reptiles were conducted on two intervals days and nights focusing on the water bodies, the riparian habitats and their peripheries (Plate 3). Compiling previous knowledge, observing and studying the potential habitats and observations of active animals was the only method for the animals that are active in warmer seasons. Emphasis was made on the species richness and on rough estimations of the areas of activity and breeding habitats. Specimens collected for species encountered and was preserved and deposited at AUBNHM.

Plate 3. Survey of reptiles and amphibians conducted at Bisri (Awali River) Site

3.4. Ornithology Survey

From an ornithological point of view, the implementation of the Bisri Environment Impact Assessment project requires a methodology that is necessary to be undertaken in order to reach the objectives.
To assess the impact on the avian species, the 20-minute point-count method is used, whereby all species noted during this time period are recorded at different places and different times in the most characteristic habitats of a given area (Ramadan-Jaradi, 1975; Blondel *et al*. 1981; Ramadan-Jaradi, 1984). This method is semi-quantitative and changes in abundance of a species are estimated by changes in the frequency of this species over a series of point counts. Frequencies could be mathematically transformed into densities through the use of some statistical rules. This task is easier when the study is undertaken in line-transects within quadrates (Ramadan-Jaradi & Ramadan-Jaradi, 2002) (Figure 1).

Plate 4. Capturing birds by camera for later identification.

Limitations of the method and alternatives: on days of heavy raptor or stork movement, it was necessary on occasion to estimate the number of birds passing. At other times, birds are individually counted. In addition, some birds were identified through capture with camera from a distance (Plate 4). Single-shelf mist-nets for species identification were not used due to the familiarity of the expert with the birds of Lebanon.
The remaining required knowledge about species status and trends are retrieved from the past experience of the expert, from the records and from literature when available.

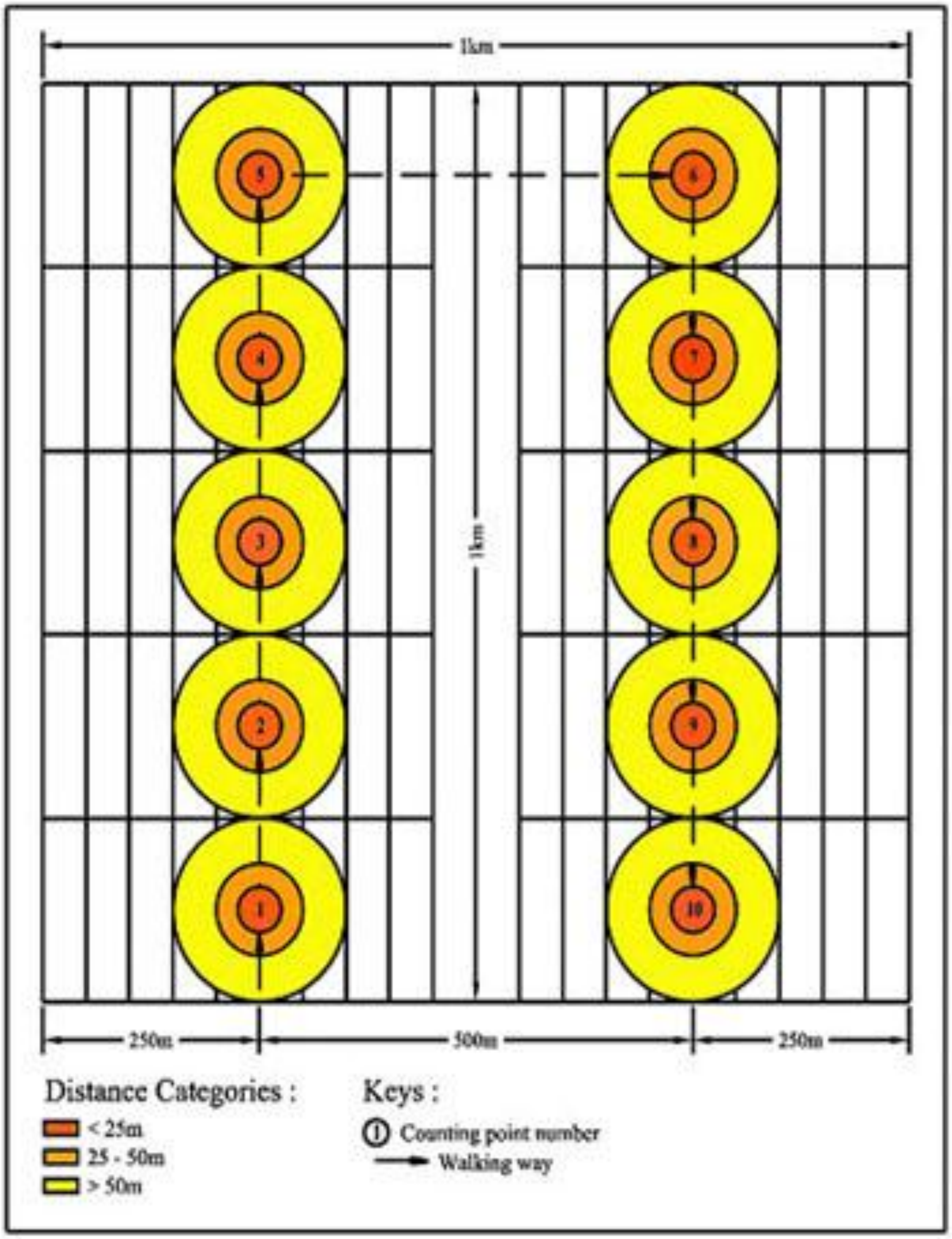


Figure 1. Point counts combined with transects.

3.5. Mammal Survey:

Most mammals are highly persecuted by humans. To avoid such a threat, they became nocturnal, which renders surveying and monitoring mammals a hard task, requiring many techniques and hi-tech equipment Two approaches, direct and indirect, were used to monitor mammals. Indirect approach was conducted during day time through diurnal walking surveys, where opportunistic observations of secondary signs such as tracks, footprints, fur and scats detected were recorded. Moreover, caves and dens were inspected for bats, animal signs and animal remains. Diurnal surveys were conducted between 09:00 and 17:00. Walking was at a slow pace and noise kept to a minimum. Periodical stops for periods of at least five minutes to assess the surroundings and to allow the disturbance caused by the movement of people through the forest to pass.

The direct approach was conducted in two ways night surveys and photo-trapping to obtain data on the more secretive and nocturnal species. Night surveys commenced using a 4x4 vehicle at two different times before or after midnight and lasted between two to three hours. A powerful spot light (1-1.5 million candle power) was used to illuminate animals once their eye-shine had been detected to help with the identification. The pace was slow to increase the chances of sighting the animals.

Photo-trapping equipment to survey mammals consisted of seven pre-baited active and passive remote camera traps, triggered by both heat and motion, were tied to a tree 40-60cm above ground (Plate 5). The cameras were programmed to take photographs 24hours/day with a 2-minute interval between photos, and to record date and time on each photograph. Sites for camera trapping were chosen randomly to cover different habitats, topographies and landscapes. Baits were placed on the ground 3m away from the camera trap. The bait consisted of animal leftovers from butcheries, fruits, domestic refuse and corn.

Data describing each direct and indirect animal sign was recorded. Data recorded included the place where the sign was encountered and in which habitat type was found. Moreover, photos from the camera traps were downloaded to a computer for future analysis.

Plate 5. Camera traps used in surveying mammals and the bait used at Bisri site.

4. RESULTS

4.1. Flora Survey

4.1.1. Description of the site

The area reflects mosaics of ecological niches for various vegetation formation and agricultural fields with various hedges type such as cyprus and casuarina trees. The composition of the vegetation is typical to South/South East and North/North East plants associations. The former represents bushy type vegetation reflecting past uses of the forests with agricultural terraces. The latter mingles trees association of Calabrian pine, stone pine, oak, hawthorn, laurel, pistachio, juniper, carob, etc. with bushes formations and herbaceous vegetations. The valley is home to agricultural fields, riverside plant formations and islands of patches of natural vegetation and alien tree species such as willow, alder, tamarisk, Oriental plane, Cyprus, stone pine and casuarina. Three types of vegetation are identified:
Type 1. River course vegetation formations: Trees observed are *Platanus orientalis* L., *Salix libani* Bornm., *Alnus orientalis* Decne with associated shrubs and herbaceous plants (Plate 6).

Plate 6. River course vegetation along Awali River

Type 2. Hillside North/North East dominated by associations of plant populations of *Pinus brutia* Ten., *Pinus pinea*, *Quercus calliprinos* Oliv., Quercus infectoria, *Laurus nobilis L. and Pistacia paleastina* Boiss (Plate 7) .

Plate 7. Associations of plant populations.

Type 3. South/South East similar to the previous type. It was formed by denser bush-like formations.

4.1.2. Vegetation survey

An approximate number of 50 plants were identified in Bisri (Table 1). Important plant species were identified among which *Ricotia lunaria* (L.) DC. being endemic at the national scale , *Orchis anatolica* Boiss., *Orchis morio* L., *Orchis papilionaceae* L., *Orchis pyramidalis* M. Bieb., *Orchis romana* subsp. *libanotica* Mt., *Orchis tridentata* Scop., *Ornithogalum umbellatum* L. and *Fritillaria libanotica* (Boiss.) Baker. (Fig. 1-5).

Table 1. List of plant surveyed in Bisri region during spring and autumn 2012.

Species Scientific Name	Species Scientific Name
55. *Acer syriacum Boiss*. & Gaill.	56. *Nerium oleander* L.
57. *Adiantum capillus-veneris* L.	58. *Onosma frutescens* Lam.
59. *Ajuga orientalis* L.	60. *Orchis anatolica* Boiss.
61. *Alnus orientalis* Decne.	62. *Orchis morio* L.
63. *Anemona coronaria* L.	64. *Orchis papilionaceae* L.
65. *Arceuthos drupacea*(Labill.) Ant. & Ky.	66. *Orchis pyramidalis* M. Bieb.
67. *Arum hygrophylum* Boiss.	68. *Orchis romana* subsp. *libanotica* Mt.
69. *Asparagus acutifolius* L.	70. *Orchis tridentata* Scop.
71. *Asperula sp.*	72. *Ornithogalum umbellatum* L.
73. *Asphodellus microcarpus* Salzm. & Viv.	74. *Oxalis per-caprae* L.
75. *Bellevalia latifolia* Ten.	76. *Pinus brutia* Ten.

77. *Bellis sylvestris* Cirillo.	78. *Pinus pinea* L.
79. *Calycotome villosa* (Vahl) Link.	80. *Pistacia palaestina* Boiss.
81. *Ceratonia siliqua* L.	82. *Phillyrea media* L.
83. *Cercis siliquastrum* L.	84. *Platanus orientalis* L.
85. *Cistus creticus* Sibth. & Sm.	86. *Pteridium aquilinum* (L.) Kuhn.
87. *Cyclamen persicum* Sibth. & Sm.	88. *Quercus calliprinos* Webb.
89. *Cupressus sempervirens* L.	90. *Quercus infectoria* Oliv.
91. *Fritillaria libanotica* (Boiss.) Baker	92. *Ricotia lunaria* (L.) DC.
93. *Gallium sp.*	94. *Ruscus aculeatus* L.
95. *Hyacinthus orientalis* L.	96. *Salix libani* Bornm
97. *Iris histrio* Reichb.	98. *Salix* sp.
99. *Lathyrus hierosolymitanus* Boiss. & Bl.	100. *Smilax aspera* L.
101. *Laurus nobilis* L.	102. *Allium neapolitanum* Cyr.
103. *Lavendula stoechas* L.	104. *Tamarix* sp.
105. *Lupinus digitatus* Forsk.	106. *Tamus communis* L.
107. *Muscari comosum* (L.) Mill.	108. *Valeriana dioscoridis* Sibth. & Sm.

Besides wild plants Marj Bisri is rich with its fruit trees mainly citrus trees, greenhouses of roses and strawberry, and commercial lawn grass plots.

Fig. 1.Orchis papilionaceae L.

Fig.2. Orchis morio L..

Fig. 3. Orchis romana subsp. *libanotica* Mt.

Fig. 4. Orchis tridentata Scop.,

Fig. 5. Fritillaria libanotica (Boiss.) Baker

4.2. Fish and Macro Invertebrates Survey

Five fish species and one crab were present in Awali River, out of which three deserve special attention (Table 2). These are the Freshwater blenny, the European eel, and the Middle Eastern Green carp. No exotic fish or macroinvertebrates were captured.

Table 2. Fish species recorded from Awali River

Species	Family
Salaria fluviatilis (Asso, 1801)	Blenniidae
Anguilla anguilla (Linnaeus, 1758)	Anguillidae
Capoeta damascina (Valenciennes, 1842)	Cyprinidae
Pseudophoxinus kervillei (Pellegrin, 1911)	Cyprinidae
Oxynoemacheilus leontinae (Lortet, 1883)	Balitoridae
Potamon potamios (Olivier, 1804)	Potamidae

4.2.1. Freshwater blenny:

Biology: Salaria fluviatilis (Asso, 1801) is a small freshwater blenny that lives in river estuaries (Plate 8). The fish resides in lakes and streams with moderate current and has a clear preference to stone bottoms. It is a territorial species that can live up to 5 years. It feeds on insects, crustaceans, and fry. It reproduces during spring in Lebanon.

Plate 8. The Freshwater blenny *Salaria fluviatilis*

Conservation status: According to the IUCN, the Freshwater blenny is not currently considered threatened around the Mediterranean Sea. However, populations have declined considerably in recent years in its area of distribution.

The Freshwater blenny has completely disappeared from most rivers in Lebanon. This is mainly because of habitat alteration, river drying up due to of water diversion, drought, and pollution. The presence of habitat suitable for its larvae is very important for the survival of the species. Two small populations seem to be confined to the lower parts of Awali River and Damur River, living only in the last few hundred meters of freshwater close to the estuary. This makes the population (< 100 individuals) currently existing in Awali River critically endangered.

4.2.2. European eel:

Biology: The European eel *Anguilla anguilla* (Linnaeus, 1758) is a catadromous fish; that resides in freshwater most of its life and migrates to spawn at sea. Upon sexual maturity, adults migrate from the river to the Mediterranean Sea, and then to the Atlantic Ocean where they reproduce. Larvae drift back in the Atlantic using the Gulf Stream current, metamorphose into young eels (elvers), and go upstream to the rivers in the North eastern Atlantic Ocean and the Mediterranean Sea (Plate 9). The species lives in all types of habitats from small streams to large lakes. It reproduces between March and July in the Atlantic Ocean (Sargasso Sea) and feeds on a wide variety of benthic organisms.


Plate 9. The European eel *Anguilla anguilla.* Adult (left) and larvae (right) (source internet)

Conservation status: The species has a high commercial importance in Europe and around the Mediterranean. European eels are sharply declining worldwide, mainly because of overfishing. It has been recently considered as critically endangered by the IUCN.

In Lebanon, this eel is found in all rivers connected to the sea with running waters. Water diversion for agricultural, industrial, or domestic use and heavy chemical pollution are the main cause of its decline.

4.2.3. Middle Eastern Green carp:

Biology: Capoeta damascina (Valenciennes, 1842) is a very common carp occurring in most rivers, streams, and lakes of the Levant, Mesopotamia, and parts of southern Turkey. The fish is present in all rivers (inland and coastal) of Lebanon, as well as the Quaraoun and the Chouan dam (Plate 10). It can be found in various types of water currents and substrates. It is a bottom fish feeding mainly on algae, invertebrates and detritus. It reproduces in small streams where it deposits its eggs on gravel.

Plate 10. The Middle Eastern Green carp *Capoeta damascina*

Conservation status: The Middle Eastern Green carp is a least concern species. It is common wherever it occurs and can withstand poor water conditions and high levels of pollution. It is commonly targeted by Lebanese anglers for consumption and has a local commercial importance.

4.2.4. Minnow and Loach:

The two remaining fish species present in Awali River are a minnow *Pseudophoxinus kervillei* and a loach *Oxynoemacheilus leontinae* (Plate 11). The two species are common wherever they occur and their biology is completely unknown.


Biology: Potamon potamios (Olivier, 1804) is a freshwater crab living in the eastern Mediterranean, from the Sinai to South Anatolia and Greece. It is found in almost all rivers and water bodies of Lebanon (Plate 12). It is a scavenger that complements its diet on invertebrates as well as tadpole and fish. Its biology has not been studied.

Plate 12. The freshwater crab *Potamon potamios*

*Conservation status:*The species is widespread and can tolerate a wide range of habitats. It does not seem to be endangered.

4.3. Herpetological (Amphibians and Reptiles)

Various species of reptiles are found in the Bisri basin. None of the species of snakes and lizards in that basin are known to be endangered or endemic. Most of these species are quite common in the surrounding areas and many parts of the country. There are no apparent impacts on these species due to the dam construction. In this survey, emphasis was placed on species that might be affected or impacted directly or indirectly by changes in the aquatic habitat to the dam construction. The species most like to be impacted are listed in Table 3. The impact on the species could be in terms of changes in habitat, breeding sites and food sources

Table 3. A list of the reptiles and amphibians that might be impacted by the Bisri dam. The status of the species might be: T = Threatened, E = Endemic, R = Rare, and C = Common. The type of impact might be: HT= general habitat, BR=breeding habitat, FD=food requirements.

Species	Common name	Picture	**Status**				Type of Impact		
			T	E	R	C	HT	BR	FD

Natrix tessellata	Water snake					+	+		?
Pelophylax bedriagae	Marsh frog					+	+	+	?
Pelobates syriacus	Eastern or Syrian spadefoot				+		+	+	?
Bufo viridis	Green toad					+		+	?
Bufo cf. *bufo*	European common toad			+	+		+	+	?
Hyla savignyi	tree frog					+	+	+	?
Salamandra infraimmaculata	salamander					+	+	+	?

Triturus vittatus	Newt				+				

4.4. Bird survey

The Point counts, which involved recording all birds seen and heard at selected locations, were used to generate a species list. The list is inclusive of resident and migrant birds. A total of 23 points (each point 50 m ≤distance) were located randomly across the site. Point Counts were done in the mornings (sunrise to 10 am), in April-May 2012 and in the peak of the silent breeding season for most birds (June 2012), as at this time many of the birds are not vocal (G. Ramadan-Jaradi, *pers. comm*); and in September-October 2012 during the autumnal passage of the migrants. Bird distribution and habitat usage varies throughout the property, with an average of 11 individuals per point count (min = 4: max = 19).
Thirty two (32) species were observed during the surveys (Table 1). Of the observed birds, 4 are forest dependent and may reappear in the riparian areas above and below Bisri site: Wren [figure 1], Jay [Figure 2], Chaffinch [Figure 3] and Blackbird [Figure 4].

 Figure 1: Winter Wren	 Figure 2: Eurasian Jay

Figure 3: Chaffinch

Figure 4: Eurasian Blackbird

Species that tolerate high disturbance were found across the site, particularly in the overgrown pastures or where human agglomeration is found. These included the Graceful Prinia (Figure 5), Sparrow (Figure 6), Hooded Crow (Figure 7) and Bulbul (Figure 8).

Several birds common to the region were spotted in the site (Table 4). Birds like Graceful Prinia (*Prinia gracilis*), Jay (*Garrulus glandarius*), Hooded Crow (*Corvus cornix*), Wren (*Troglodytes troglodytes*), Sparrow (*Passer domesticus*),

Figure 5: Graceful Warbler

Figure 6: House Sparrow

Figure 7: Hooded Crow

Figure 8: White Spectacled Bulbul

Swift (*Apus apus*) and Lesser White Throat (*Sylvia curruca*) were frequently spotted during the visits to the area. A few other bird species were reported by the inhabitants of the area but not observed by us, such as Lesser Kestrel (*Falco naumannii*), Black Redstart (*Phoenicurus ochruros*), Masked Shrike (*Lanius collurio*), and Barn Owl (*Tyto alba*). The villagers also reported a few other species but due to various inconsistent local names, these could not be properly identified. However, our field visits during October cumulated the total number of birds from 28 to 32 species where 24 of them are common and none of them is endemic. Four are threatened (White storks, Lesser Spotted Eagle, White Pelicans that are of passage only, and Short-toed Eagle that is of wide range of action (within and beyond the limits of the site). Hence their conservation depends on areas other than Bisri Site.

Figure 9: White Storks

Figure 10: Lesser Spotted Eagle

Figure 11: White Pelican

Figure 12: Short-toed Eagle

Table 4. Birds of Bisri Village site. R= resident, PM= passage migrant, WV= winter visitor, SB= summer breeder, and ?= uncertain status. T= threatened, E= endemic, R= rare, and C= Common.

	Species	*Scientific name*	Status	T	E	R	C
1	Bulbul	*Pycnonotus xanthopygos*	R				+
2	Graceful Warbler	*Prinia gracilis*	R				+
3	Common Chiffchaff	*Phylloscopus collybita*	SB, PM, WV				+
4	Chaffinch	*Fringilla coelebs*	R, PM, WV				+
5	Winter Wren	*Troglodytes troglodytes*	R				+
6	Blackbird	*Turdus merula*	R				+
7	Eurasian Jay	*Garrulus glandarius*	R				+
8	Great Tit	*Parus major*	R				+
9	European Greenfinch	*Carduelis chloris*	R				+
10	Blackcap	*Sylvia atricapilla*	SB, PM, WV				+
11	Sardinian Warbler	*Sylvia melanocephala*	R, PM, WV				+
12	Lesser Whitethroat	*Sylvia curruca*	SB, PM, ?wv				+
13	White Storks	*Ciconia ciconia*	PM	+			+
14	Pelican	*Pelecanus onocrotalus*	PM	+			+
15	Short-toed Snake Eagle	*Circaetus gallicus*	SB, PM	+		+	
16	Long-legged Buzzard	*Buteo rufinus*	R, PM, WV				+
17	Hooded Crow	*Corvus cornix*	R				+
18	Palestine Sunbird	*Cinnyris osea*	R, wv			+	
19	European Goldfinch	*Carduelis carduelis*	R, WV, pm				+
20	House Sparrow	*Passer domesticus*	R				+
21	Swift	*Apus apus*	SB, PM				+
22	Lesser Spotted Eagle	*Aquila pomarina*	PM				+

23	Black headed Bunting	*Emberiza melanocephala*	SB				+
24	Corncrake	*Crex crex*	pm	+		+	
25	Black Kite	*Milvus milvus*	PM				+
26	Steppe Buzzard	*Buteo vulpinus*	PM				+
27	Hoopoe	*Upupa epops*	R, SB			+	
28	White Wagtail	*Motacilla alba*	PM, WV				+
29	Steppe Buzzard	*Aquila nipalensis*	pm			+	
30	Levant Sparrowhawk	*Accipiter brevipes*	PM				+
31	European Sparrowhawk	*Accipiter niseus*	PM			+	
32	Marsh Harrier	*Circus aeroginosus*	PM			+	

From the list above, the four threatened species are:

English name	Short-toed Eagle	
Scientific name	*Circaetus gallicus*	
Distribution	All over Lebanon where thermals are well formed	
Status	Breeding in small numbers in montane areas, especially at Charquieh (Ramadan-Jaradi & Ramadan-Jaradi 1999), hills above Aammiq, Dalhoun and Arz el Shouf (Ramadan-Jaradi *et al* 2004). It is also a widespread and common passage migrant over much of the country, early March–late April (most first half of April) and early September–late October. First recorded by Tristram (1864) and first confirmed breeding recorded at Charquieh in 1996 by Ramadan-Jaradi & Ramadan-Jaradi (1999).	
English name	White Stork	
Scientific name	*Ciconia ciconia*	
Distribution	All over Lebanon where thermals are formed and in wetlands	
Status	Abundant and regular on both passages, but generally commoner in spring over the whole country, but occurs principally over coastal plains (*e.g* in early March–late June, a maximum of 10000 recorded on 9 April 2000 over Dalhoun) and over Beqaa Valley, where in autumn occurs early August–late October (MR-J). Largest flocks usually appear following periods of hot easterly winds. Very few oversummer June-July. First recorded in 1948 (West 1954).	

English name	White Pelican	
Scientific name	*Pelecanus onocrotalus*	
Distribution	All over Lebanon where thermals are well formed and in wetlands	
Status	Common regular passage migrant at both seasons with flocks of up to 1000 birds near coasts, at Aammiq and Qaraoun, and over mountains up to 1800m asl. Occurs mid-February–early June and early September–late November, principally on Palm Islands. First recorded by Tristram (1882).	
English name	Corncrake	
Scientific name	*Crex crex*	
Distribution	In wetlands: Coastal and inlands	
Status	An uncommon passage migrant over Lebanon in mid-August–late October and early March–late May (Ramadan-Jaradi *et al* 2004). Regular in May and beginning of June on Palm Islands (Ramadan-Jaradi & Ramadan-Jaradi 2001), with peaks of up to six birds. An isolated record at Tyre Coast on 6 December 2003 was exceptional (Ramadan-Jaradi *et al* 2005). First recorded in 1824 (Hemprich & Ehrenberg 1833)	

4.5. Mammal Survey

The rapid field survey on mammals for Bisri site revealed the presence of 17 mammal species belonging to 14 families (Table 5). Four species including badgers, otters, squirrels, and voles are expected to exist (Table 5). In addition to wild mammals domestic mammals like goats, cows, dogs and cats were also encountered. Moreover, within the dam site there is a small private zoo that houses lions, tigers, lamas, deer, hyaenas, a fox, some farm animals, and a chimp

Out of the 21 species of mammals, one species, which is the hedgehog [Figure 1] is dependent on forests, farmlands, gardens and orchards. In addition, 3 bat species: the European free tailed bat [Figure 2], lesser horseshoe [Figure 3], and greater horseshoe [Figure 4], hunt along open woodland, woodland edges and paths as well as hedgerows.

Figure 1: Hedgehog

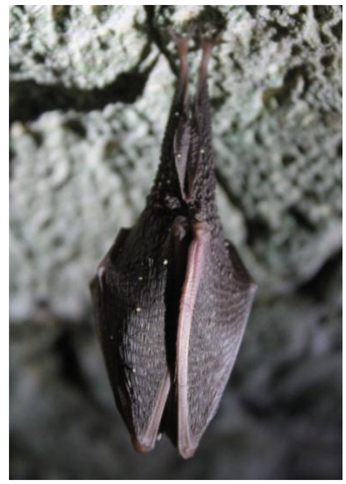


Figure 2: Lesser horseshoe bat

Figure 3: Greater horseshoe bat

Figure 4: Eurasian free tailed bat

Most other species can tolerate high disturbance and are referred to as urban wildlife; these included the common pipistrelle [Figure 5], Khul’s pipistrelle [Figure 6], jackals [Figure 7], foxes [Figure 8], pine martins [Figure 9], wild boar [Figure 10], house mice, rats, and field mice.


Figure 5: Common pipistrelle bat


Figure 6: Khul's pipistrelle bat


Figure 7: Jackal


Figure 8: Red fox


Figure 9: Pine martin


Figure 10: Wild boar

Several mammals which are common to the region were spotted in the site, such as wild cats [Figure 11], striped hyaenas [Figure 12], porcupine [Figure 13], and moles [Figure 14].


Figure 11: Wild cat


Figure 12: Striped hyaena


Figure 13: Porcupine


Figure 14: Mole rat

Finally, two other mammal species which are dependent on the riparian ecosystem are expected to be present: the otter *Lutra lutra* an amphibian mammal that was recorded in Moukhtara (Tohme and Tohme 1985) and documented in Ammique Wetland and Anjar (personal observation) and voles, which are another riparian ecosystem inhabitants, that usually inhabit river banks.

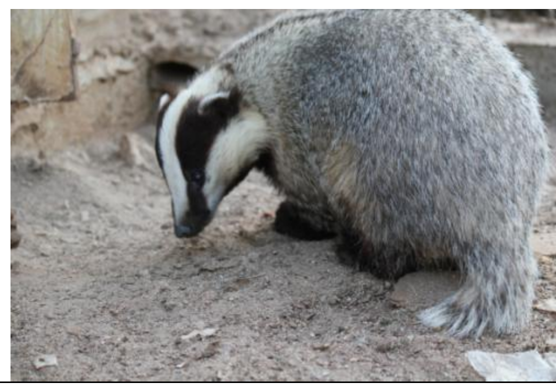
Table 5. List of mammal species present on the three sites (R= recorded, E = Expected, c= common, r = rare, endemic or endangered on the National level)

Family	Species	Scientific Name	Awali River
Erinaceidae	Hedgehog	*Erinaceus concolor*	R, r
Miniopteridae	European Free-tailed bat	*Tadarida teniotis*	R, r
Vespertilionidae	Common pipistrelli	*Pipistrellus Pipistrellus*	R, c
	Khul's pipistrelle	*Pipistrellus kuhli ikhawanius*	R, c
Rhinolophidae	Lesser horseshoe	*Rhinolophus hipposideros*	R, c
	Greater horseshoe	*Rihnolophus ferrumequinum*	R, c

	bat		
Canidae	Jackal	*Canis aureus syriacus*	R, c
	Fox	*Vulpus vulpus palaestina*	R, c
Mustelidae	Pine Martin	*Martes foina syriaca*	R, c
	Badger	*Meles meles canescens*	E, r
	Otter	*Lutra lutra*	E, r
Hyaenidae	Striped hyaena	*Hyaena hyaena syriaca*	R, c
Felidae	Wild cat	*Felis silvestris tristrami*	R, r
Suidae	Wild boar	*Sus scrofa lybicus*	R, c
Sciuridae	Squirrel	*Sciurus anomalus syriacus*	E, c
Hystricidae	Porcupine	*Hystrix indica indica*	R, c
Spalacidae	Moles	*Spalax leucodon ehrenbergi*	R, c
Muridae	House mouse	*Mus musculus praetextus*	R, c
	Rats	*Rattus rattus*	R, c
	Field mouse	*Apodemous mystacinus*	R, c
Microtinae (Subfam.)	Voles	*Microtus sp.*	E, c

From the list above, the five rare species are:

English name	**Hedgehog**	
Scientific name	*Erinaceus europaeus concolor*	
Distribution	The hedgehog was first reported by Lewis et al. (1967). Tohme and Tohme (1985) gave a detailed description and distribution of the species in Lebanon. The hedgehogs are reported from Hadath, Kfarchima, Bsaba, Ibrahim River, Saida, Jaj, Laqlouq, Baalbek, Zahleh, Chmistar, Sarafand, Tamnine Tahta, Barouk, Mokhtara, Rihane, Jezzine, Tyre, Koura, Farayya.	
Status	This species was common in Lebanon, especially in the coastal plain. However, at present the species is endangered due to excessive use of pesticide, unintentional killing during hibernation and road kills. Its habitat does not apparently exceed 2.5 hectares.	
Habitat	The Hedgehog suitable habitats where insects and invertebrates are abundant. This reveals its economic importance besides their presence is a bio-indicator for unpolluted habitat. Dumps are excellent source of food for hedgehogs besides cultivated or semi-desert areas. They are also found in Pine and olive groves as well as in forest edges, gardens and parks.	

English name	**European Free-Tailed bat**	
Scientific name	*Tadarida teniotis*	
Distribution	The European free tailed bat was first reported by Harrison (1962), Tohme and Tohme (1985), and Horacek et al 2008. This species was reported from Faraya, the coastal zone, and from northern part of the Beka'a valley.	
Status	This species is threatened in Lebanon due to habitat destruction excessive use of pesticide.	
Habitat	The European free tailed bat inhabits narrow and inaccessible rock cervices. It roosts in large colonies in narrow cervices in the chalk cliffs Their feeding habit (feeding on insects) as well gives them an economic importance as well a major role in the ecosystem.	
English name	**Eurasian Badger**	
Scientific name	*Meles meles canescens*	
Distribution	It was reported by Lewis et al. 1968 and By Tohme and Tohme (1985) in several areas of Mount Lebanon and East Beqa'a. It was also reported in Ehden and Tannourine Reserve (Abi-Said 2008) and lately in Jabal Moussa Biosphere Reserve (Abi-Said 2010a,b).	
Status	Badgers are endangered in Lebanon due to persecution by human.	
Habitat	Badgers occur in woods, open areas, orchards and vine yards.	

English name	**Wild cat**	
Scientific name	*Felis silvestris tristrami*	
Distribution	This species was reported by Tohme and Tohme (1985). Several personal observations between 1995-2005 in Ehden, Tannourine and AlShouf Reserves besides East Beqa'a as well in Jabal Moussa Biosphere Reserve in 2009. They were reported in most reserves as well as non protected areas, at the coastal areas and East Beqa'a.	
Status	Endangered species due to cross breeding with domestic cats	
Habitat	Wild cats are nocturnal animals that inhabit steppes, hills, valleys, forests, and rocky areas.	
English name	**Common Otter**	
Scientific name	*Lutra lutra seistanica*	
Distribution	The otters were reported by Lewis et al, 1968 and Tohme and Tohme 1985. Their distribution is limited to wetlands and some rivers in Lebanon. However, they face several threats due to conflict with fisheries, dryness of wetlands, and killing by humans. They were reported from Ammique, Kfarzabad, AlAssi river, Jisr AlQadi, AlDamour river and AlMoukhtara river which is an extension of Bisri.	
Status	This species is endangered in Lebanon due to hunting and drying of wetlands.	
Habitat	The otters are very tolerant of where they live, in environments ranging from lakes and bogs to rivers and little from sea level up into the highest mountains. Otters could be found anywhere as long as there is water, sufficient food and away from human disturbance and persecution.	

5. IMPACT ON THE BIODIVERSITY

5.1. Impact on Flora

5.1.1. Loss of habitat

As vegetation is concerned, it is expected that the loss of part of the riparian vegetation will occur because of the inundation of the site resulting from dam construction. Though patches of the riparian vegetation will remain outside the dam construction site, the colonization of tree species on the banks of the dam is expected. If significant impacts on valuable habitats or species are unavoidable, detailed botanical surveys would be required. These may involve targeted searches for protected species and/or those identified as species of significant nature conservation value in either a Species Action Plan or Local Biodiversity Action Plan. Where a habitat of potential nature conservation value is identified, more detailed quadrate-based surveys may be required.

5.1.2. Loss of species

It was not possible to undertake a full survey of the plant species thriving in the site because of the time when the final decision given on the selection of the site. Though through observations during the autumn and the rapid assessment performed during the spring, it expected that the site is shelter to more than 250/300 species including riparian plant and low altitude plant species. Though the species identified are found in other places and they are expected to be found at higher altitude in the region.

5.2. Impact on Fish and Macro invertebrates

The construction of the dam at the level of Bisri will significantly reduce the water flow downstream, to the Awali River estuary. This will certainly affect the Freshwater blenny population surviving in the lower course of the river. The construction of the dam will not pose a direct threat to the European eels present in the river. It is expected that the Middle Eastern Green carp will find the dam a suitable habitat and a large population is expected to quickly establish. The species will certainly have a local commercial importance. Furthermore, the presence of this herbivore will be valuable to the new ecosystem that will be created with the construction of the dam.
Both the minnow *P. kervillei* and the loach *O. leontinae* will probably not be negatively affected by the presence of the dam. On the contrary, they may thrive in large numbers and have a significant role in the newly formed ecosystem. *Pseudophoxinus kervillei* may have commercial importance locally.

5.3. Impact on Herpatofauna (Amphibians and Reptiles)

The impacts of the dam on each species could be upstream or downstream and could affect the general habitat requirements, breeding habitats, food requirements and vulnerability to predators. Some species could be negatively impacted and some could be positively affected.

5.3.1. Upstream Impact:

a. General Habitat: the habitats will be flooded and destroyed and all the species will be pushed into new habitats that might not be suitable. The established riparian habitats that includes *Platanus* (and similar) trees, reed beds and other habitats of the river's wetted zone. The fluctuating levels of the artificial lake will inhibit the formation of a littoral zone which is part of the general habitat. All species will be affected especially *Bufo bufo*.

b. Breeding Habitat: All the amphibian species require shallow aquatic habitats for breeding with slow water flow rates. This will only be found on the peripheral (coastal) zones of the resulting lake. These zones will suffer from fluctuating levels from season to season or from year to year. Considering that the breeding period involves several stages, namely, mate attraction (advertising), mating, egg stage and larval stages (e.g. tadpoles), the breeding process might practically involve several weeks. If the fluctuation occurs during the breeding season (March-June), it would affect one or more of these stages. All amphibian species will be affected

c. Food Source: All the amphibian species are insectivorous feeding on invertebrates. These are affected by riparian and shallow water (littoral) habitats. It is not certain how long it will take these invertebrates to reach the levels of abundance as those before the dam. All species will be affected.

5.3.2. Down Stream Impact:

a. General Habitat: The regulated river flow might benefit the riparian vegetation in some locations normally subjected to flooding and might harm it in other locations where the water flow is normally limited in pre-dam days. All species will be affected.

b. Breeding Habitat: The regulated river flow below the dam might provide suitable habitats for breeding that were not available in pre-dam days. The danger lies when the flow reaches levels that will lead to the disappearance of suitable aquatic habitats. All amphibian species will be affected.

c. Food Source: There is uncertainty about the effect of the dam on the invertebrate fauna of the river itself or that of the riparian zone. All species will be affected.

The upper level of the resulting lake might reach the lower regions of the Moukhtara River where there are populations of the rare species *Bufo* cf *bufo* whose habitat, based on current knowledge is very specialized consisting mostly of rocky terrain and riparian trees. This habitat will be flooded and destroyed.

5.4. Impact on Birds

5.4.1. Impact of noise on wildlife

The project area is inhabited by several species of wild animals and birds. Harm to animals is difficult to quantify since laboratory studies are often quite dissimilar to the real situation. Nevertheless, certain effects are obvious. In the case of short-term noises, e.g. construction, the animals may simply vacate the area. Their return depends on the nature of the project. The response of animals varies from species to species; from almost no reaction, to no tolerance of the sound. The long term noises originating due to blasting, hydraulic drills, vehicular noise and loading of vehicles may result in disappearance of some of the species of birds and animals from the area. However, some fauna may get used to the noise and stay. The level of impact will be more apparent if a survey is conducted on regular intervals such as either quarterly or bi-annually to understand the variations in the population of different species.
Some birds will be driven away permanently from nesting areas as a result of a project that brings a human population into the area (e.g. Long-legged Buzzard), whereas others do not seem to be affected at all (e.g. Graceful Warbler).

5.4.2. Loss of habitat

The project and various other activities will also affect the habitat of established species. Although, the project area itself is a very small portion of the general landscape, but the transport roads within the site and from the main road to the site, all become part of the project area and will result in disturbance and fragmentation of the habitat.
The project activity will also affect birds. Some species will desert the site like the Short-toed Eagle and Long-legged Buzzard for a more safe area. The other birds are considered banal species and may remain in the site with smaller numbers and in fragmented areas.

5.5. Impact on Mammals

The dam will certainly have an effect on mammal species during the construction phase; however, after the completion of the dam mammals' species will adapt to the dam presence and adjust their behavior accordingly, despite obstructing their dispersal route at some point. Moreover, the dam might attract other kinds of species like bats, shrews and otters who favor such habitat. The principal impacts of the project on individual mammal species depend on the ecology and behavior of the species in question. All animals, regardless of their behavior, will be subject to a degree of habitat fragmentation. Smaller mammals such as the shrew and squirrel will tend to have smaller home ranges, and will therefore be susceptible to both habitat loss and fragmentation. Larger or more mobile species may find their territories and key habitats fragmented by this dam, but are less likely to experience significant habitat loss. Mortality of species, both during the construction and operational phases of the project, should also be considered particularly, for those species with large home ranges that will tend to seek to cross roads more often.

6. MITIGATION MEASURES

Mitigation starts with minimizing disturbance through limited access to the area, minimize habitat alteration and land leveling as possible along with their natural vegetation, avoid direct persecution of animal species, and provide necessary training and awareness for project employee

6.1. Flora

Dams' downstream effects on riparian forests are strongly affected by the character and magnitude of adjustment of the fluvial-geomorphic system. The geology, hydrology, climate, and management have a direct influence on the ability of the fluvial system to adjust to dam-induced changes, as well as on the character and magnitude of that adjustment. The major concern for the vegetation and flora diversity is the control of water flooding, niches destruction of important plant species and the disturbance to the riparian forest age structure and sex ration of some tree species. The timing of the implementation of the mitigation strategies for managing impacts to flora can be divided into activities that will be undertaken during the pre-construction, construction and post construction phases of the project. Consequently, the suggested mitigation measures are the following:

1- Fluvial adjustment must be anticipated along alluvial channels where dams alter downstream hydrology and/or sediment load. This is important to give room for the colonization of tree species expected to occur along the banks of the lake.
2- The management strategies of river ecosystem among which riparian forest must focus on simulation of natural hydrographs especially the restoration of flooding frequency
3- The sex ratio of dioecious species such as populous and salix must be monitored to ensure the re-establishment of the tree populations.
4- Translocation of Orchis sp., Fritillaria sp., Ornithogalum sp., Hyacinthus sp., ferns and other species must be done before the construction of the dam and the inundation of downstream areas.
5- Management practices of the dam must foresee steps to reduce the disturbance intensity in order to increase biodiversity in the newly established river banks and lake formation.
6- Measures should also be undertaken to ensure that existing micro-climatic conditions in habitats supporting communities or species of nature conservation importance are maintained.
7- Individual trees and patches of vegetation to be retained close to busy construction zones will be fenced. The location of fencing will be approved by a plant ecologist. Signs indicating the area is a "sensitive environmental area" will be clearly and securely affixed to the fencing.
8- A qualified ecologist will audit the clearing of vegetation during construction of the project and will quantify the area of the dam vegetation community cleared for the biodiversity strategy.

9- Mature citrus and stone fruit trees are hard to be transplanted. Consequently, the orchards in Marj Bisri will be lost. This loss has to be accounted for during planning and implementation of the project.

10- The green houses in Marj Bisri could be relocated with their plants with no actual loss.

6.2. Fish and Macro invertebrates

Since the dam is an artificial newly formed ecosystem, it will be highly advisable from an aquatic scientist's point of view to have:

1- Clearly defined boundaries

2- A year-round regular river inflow and outflow

3- Shallow vegetated areas

4- Minimum human disturbance

Continuously running unpolluted water would help preventing the complete disappearance of the species. It is of high importance that

1- Freshwater keeps running between the dam and the sea in order not to hamper the eels from migrating back and forth and,

2- one or more fish-passes that connect the river to the dam are built, allowing the fish to enter and leave the dam (Figure 2). The presence of this species in the dam will result in adding a significant commercial value.

Figure 2. Different types of passes suitable for the freshwater eel (source Internet)

6.2.1. Fish introduction:

The introduction of exotic species such as carps, trouts, bass, tilapias, and mosquitofish is not recommended. Various studies have shown that the presence of these introduced species negatively affects the native fauna and the ecology of the dam. If introduction is deemed profitable, a full ecological impact assessment by an aquatic ecologist should precede it.

6.3. Herpetofauna (Amphibians and Reptiles)

Amphibians are water dependent animals hence the following mitigation measures have to be taken into consideration to insure their persistence.

1. Water flow downstream should always be maintained at levels that do not harm the riparian vegetation or destroy general and breeding habitats.
2. Breeding habitats on the lake peripheries should be evaluated regularly and alternative habitats should be created. One measure that would benefit not only the amphibian species but many other plants and animals, is to create artificial wetlands in the areas at the edge and/or surrounding the artificial lake whereby water levels are kept there at constant permanent or semi-permanent levels especially during the breeding season. This will allow the establishment of permanent shallow littoral zones that will become home to various plant and animal species.

3. Measures should be taken to avoid drying-out amphibian breeding sites through local disruptions to hydrology.
4. Pollution of amphibian breeding sites should also be prevented, by the sensitive design of construction site drainage and the implementation of pollution control measures.
5. The installation of reptile-proof fencing to prevent reptiles from returning or accessing to the most hazardous parts of the construction site should also be considered.
6. The seasonal programming of site clearance works should also be reviewed, to avoid the hibernation period during which aggregations of torpid reptiles could be encountered that would not have the ability to escape the works.

6.4. Birds

Birds are very sensitive group of animals and can be easily disturbed. Hence, disturbance by dam construction might have a negative impact on their status. The following mitigation measures should be considered

1. Noise creating sources should be properly lined and secured. The compressor and generator have been installed in a properly constructed room, which should be enough to filter out most of the noise. However, if that is not enough, other lining options should be explored, such as a clay liner inside and outside the room.
2. Blasting should be kept to a minimal and scheduled during the daytime.
3. Transport related noise should be kept to minimal through the optimum use of vehicles and proper vehicle maintenance.
4. No exotic bird species should be introduced to the wilderness of the site without guidance from a natural resourced approved specialist.
5. No hunting will be allowed in the site for any reason, especially that the hunting is not allowed by the Law 580/04 within 500 meters from any human agglomeration.
6. Proper guidance to be taken from a wildlife expert on occasions when wildlife is noticed within or near the site.
7. There is a need to maintain the Oak (*Quercus calliprinus*) in some stands to maintain the population of Jay that is known for its benefits to ecosystems.
8. The Bruti Pine (*Pinus brutia*) is a flammable tree and easily infested by the Processionary caterpillar. Subsequently, it should be managed to avoid natural fire near houses and to reduce the allergic impact of the caterpillar. Its management should be accompanied with the introduction of Cuckoo that eats the poisonous caterpillar.

9. Wherever possible, undertake vegetation clearance outside the bird nesting season March to August inclusive.

6.5. Mammals:

The diverse life-cycles, behavior, and habitat requirements of the different mammal species found in Lebanon, require effective mitigation, compensation and enhancement measures to be designed on a species-specific and also site- and project-specific basis. It is important to take measures to avoid impacts on habitats likely to be of particular value to mammal species of nature conservation importance wherever possible. Where valuable habitats or other important sites for mammals (e.g. places of shelter, or key foraging resources) cannot be avoided, appropriate mitigation measures should be designed and implemented.

1- Where impacts associated with fragmentation are expected, mitigation may include the provision of safe crossing points to enable dispersal and maintain links between otherwise fragmented populations. Such crossing points may take the form of pipes, culverts, tunnels and bridges with associated mammal-resistant fencing to ‘funnel’ animals towards these structures.
2- Mammal-resistant fencing along with appropriate hedgerow treatments should be used as a barrier to guide animals towards safe crossing points and to prevent animals from straying onto the carriageway, reducing the risk of mammal mortality.
3- The visual deterrents such as roadside reflectors may also be installed to discourage animals, in particular, from approaching the carriageway, although the effectiveness of such measures is questionable and should only be used in areas where only occasional interaction between mammals and roads are expected.
4- Habitat and/or species translocation should be considered as a last resort where it is not possible to avoid impacts on a sensitive habitat or species.
5- Concerning the two dairy farms present within the site could be relocated easily. As for the the private zoo, it has to be managed in different ways depending on the animal species in question. For example the chimp and the wild carnivores like tigers and lions have to be returned to their country of origin or sent to other sanctuaries since Lebanon is not a suitable habitat for them. However, Lebanese wild carnivores like the hyaenas and foxes could be reintroduced to the Lebanese wilderness with no problems because of their opportunistic feeding behavior. Deer and other herbivore could be maintained in a suitable place as these are semi-domestic animals.

6.6. General mitigation

1. There should be maximum recruitment of labor from the site and its neighboring areas to make them feel part of the project. Recruitment of labor from down country should be avoided.
2. Since women have a very significant role to play in the protection of biodiversity, they should be kept informed of the project through regular meetings or through the labors within the community.
3. Contact between the outsiders and the community should be kept to a minimal to avoid any conflict.
4. The community should abide by its agreement with the local authority to provide full protection to the wildlife and other natural resources.
5. Regular monitoring of the biodiversity should be undertaken.
6. Minimize greenhouse gas releases from reservoirs by minimizing the flooding of land in general and forests in particular.

7. CONCLUSION

In the planning, implementation and operation of projects, the conservation of the quality of environment and the ecological balance should be of primary consideration. The adverse impact, on the environment should be minimized and should be off-set by adequate compensatory measures. Moreover, building a dam, sacrificing nature does not solve the challenges of overconsumption, over-pollution, and under-distribution. World Commission on Dams (WCD) 2000 reported “dams have made an important and significant contribution to human development, and benefits derived from them have been considerable. But in too many cases an unacceptable, and often unnecessary and high price has been paid to secure those benefits, especially in social and environmental terms, by people displaced, by communities downstream, by taxpayers, and by the natural environment.”

Lebanon which is rich in its natural resources, face on the other hand lack of efficient environmental management causing an alarming degradation in those resources, and therefore, resulting in deforestation, soil erosion, water-resources’ pollution, marine habitat destruction, and air pollution. . Hence, the adoption of appropriate EIA procedures will undoubtedly bring about necessary and innovative measures towards environmental protection, particularly after much environmental degradation during nearly two decades of civil unrest. Water pollution control measures may be needed to improve reservoir water quality. Fishing regulation is often essential to maintain viable populations of commercially valuable species, if effectively implemented; watershed management can minimize sedimentation and extend a reservoir’s useful physical life. Finally, demands are increasing every year for water while resources are becoming more and more limited, combined with the pollution of water which has had many adverse effects on the environment, growth and economy of many countries.

Hence, improving irrigation methods, wise use of water, and efficient water transport are of utmost importance to be implemented.

In conclusion, protecting biodiversity of a project area is in the interest of all the stakeholders of a project. The biodiversity protection cannot be achieved without the support of the community, as is evident from this project. Proper cooperation between community and the project proponent can help in protecting the biodiversity of an area. Efforts should be made to incorporate BIA in all EIAs since this is one tool, which has proven successful in minimizing the impacts on biodiversity.

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APPENDIX H

PRELIMINARY REPORT OF POLISH – LEBANESE EXPEDITION TO THE ESHMOUN VALLEY (WADI BISRI)

ESHMOUN VALLEY

PRELIMINARY REPORT ON THE SECOND SEASON OF THE SURVEY, 2005

Krzysztof Jakubiak, Michał Neska

The second season of the Polish-Lebanese survey[1] of the upper part of the Auali (Eshmoun) river valley commenced on September 1, 2005. Fieldwalking was completed by the end of the month. The area covered this year extended from where the survey had finished last year at a point west of Marmousa Chapel to the convents of Deir es-Saide and Deir er-Rabbat near Joun. Several places surveyed last year were rechecked owing to new information about the existence of rock-cut tombs collected in the last days of the first season of fieldwalking. Another pursuit was to explain the total absence of surface finds in the vicinity of the Roman temple at Bisri, tentatively attributed to river erosion.

The actual surveying was divided into two zones, the bottom of the valley being fieldwalked by one group and the slopes by another one, the latter team having to deal with heavy bush cover, which hardly made the prospection easy. The following report is by necessity brief and presents only the most important observations made during the survey.

1 The Polish team included the present writers co-directing the effort, accompanied by Mrs. Olga Wasilewska, Mrs. Zofia Zakrzewska, Mr. Maciej Mielecki and Mr. Piotr Witkowski, archaeologists; and Mr. Maciej Krajcarz, geologist. The Lebanese team headed by Mr. Asa'ad Seif, who is also Project Director on the Lebanese side, included Dr. Corine Yazbek, archaeologist; Mr. Abdallah Ala'Eddine, ceramologist; and Mr. Wissam Khalilin, archaeologist. Sedimentologist and speleologist Dr. Fadi Nader, Director of the Institute of Geology of the American University of Beirut, kindly consulted our findings.
The project is grateful to Mr. Frédéric Husseini, Director General of Antiquities in Lebanon, for permission to continue the survey and for his unfailing support at every step of the project.

ESHMOUN

LEBANON

MODERN STRUCTURES

Only six stone cottages of recent date were located this year, compared to at least 27 last year. These rectangular constructions were built of stone blocks, in one case (site 45, cf. map in *Fig. 1*) taking advantage of the steep rock valley slope, approximately 4 m above the modern road. Another house observed in Bisri village (site 60) was located almost on top of the mountain peak where the modern village is located. Several other severely destroyed structures, possibly dwellings, were recorded in Bisri. Unlike these first two buildings, the ones from sites 62 and 66 had vaulted substructures. The house from site 62 is one of the best preserved of its kind, permitting observations concerning the interior layout. In no. 66, lime mortar was observed bonding the stones, the first case of mortar bonding to be recorded during the survey. The remaining two stone houses located this year were found on sites 48 and 49.

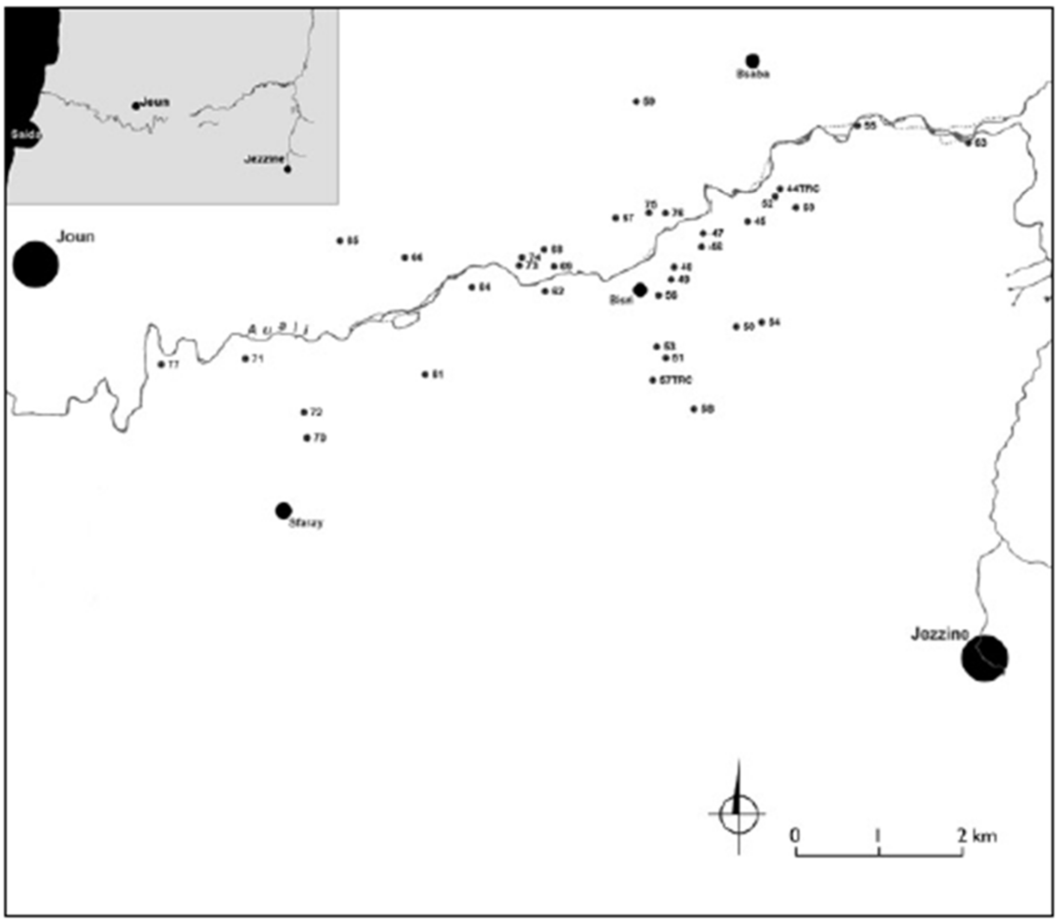

Fig. 1. Map of the surveyed area in the Auali (Eshmoun) Valley, 2004-2005 (Drawing P. Witkowski)

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ARCHAEOLOGICAL SITES

The oldest of the archaeological sites discovered this year have been attributed tentatively to the Pre-pottery Neolithic period. The first of two such sites (no. 68; N 33°35'01.9"; E 35°31'36.6"; 493 m a.s.l.) was localized on the northern slopes of the valley above El Kherbe village. A concentration of flint material was observed, approximately 1.5 ha in area, but no traces of any constructions or related material except for some modern ceramics. Considering the size of the site, it could be interpreted as a village or big workshop. The other site with abundant flint material (no. 77; N 33°34'14.9", E 35°28'40.9", 211 m a.s.l.) was found on the southern slopes of the valley. It covered about half a hectare. The surface collection included several potsherds.

One Chalcolithic or Bronze Age settlement was also localized on the southern valley slopes. The site (no. 59; N 33°35'59.4"; E 35°32'17.9"; 659 m a.s.l.) lies on a jutting rise west of El Baabe village. A modern villa with swimming pool erected on the spot has all but obliterated the ancient remains and more testing will be needed (possibly during the next season) to confirm the presence of the site.

Rock cut tombs, nine in all, were identified on five different sites (nos 46, 51, 55, 70, 72). The sepulchers were either chamber tombs with niches for burials or rock-cut pits for single burials. All were of the Roman period, most likely from the 3rd-4th century AD judging by the overall shape and cutting technique.

Site 46 (N 33°35'03.9", E 35°32'49.2"; 438 m a.s.l.). Two chamber tombs. The western of the two [*Fig. 2*] had a square entrance with the sides recessed to fit a closing slab. The entrance was set inside a recessed frame with vaulted top and a step threshold. Inside the chamber there were two burial niches, one opposite the entrance and another one to the right. The niches were cut as arcosolia with arched vaults.

The other tomb was prepared for four internments [cf. *Fig. 2*]. The entrance was again of square shape. One burial niche was located to the left of the entrance, two others to the right and the fourth further to the back of the chamber. The ground plan of the tombs could not be documented because of the thick accumulations inside the chambers.

Site 51 (N 33°34.2' 21.0"; E 35°32' 33.3"; 539 m a.s.l.). Similar tomb located near the modern road, cut not in the valley slopes as is the rule, but in a freestanding grey rock. The entrance was generally rectangular in shape with recesses for the closing slab. Inside the chamber were two burial niches with vaulted tops. Stones and earth accumulated inside the tomb precluded full documentation.

Site 55 (N 33°35' 47.6", E 35°34' 19.5"; 432 m a.s.l.). Three tombs, each with several burial niches, located on the southern slopes of the valley. In each of the tombs several places for sarcophagi were localized. On the wall of one of the tombs, just inside the entrance to the right, there are some rock carvings: an apparent palm branch and a naked human male figure [*Fig. 3*]. A palm branch carving can be seen in another of the tombs, where it is hewn on the wall near the burial niche. This is unusual iconography as far as the decoration of rock-cut tombs in the area is concerned. It is unfortunate that a few days after our discoveries the tombs were vandalized.

Site 72 (N 33°33'57.5"; E 35°29'47.9"; 476 m a.s.l.). Chamber tomb found below a modern road several hundred meters north of site 70. Almost square entrance and three

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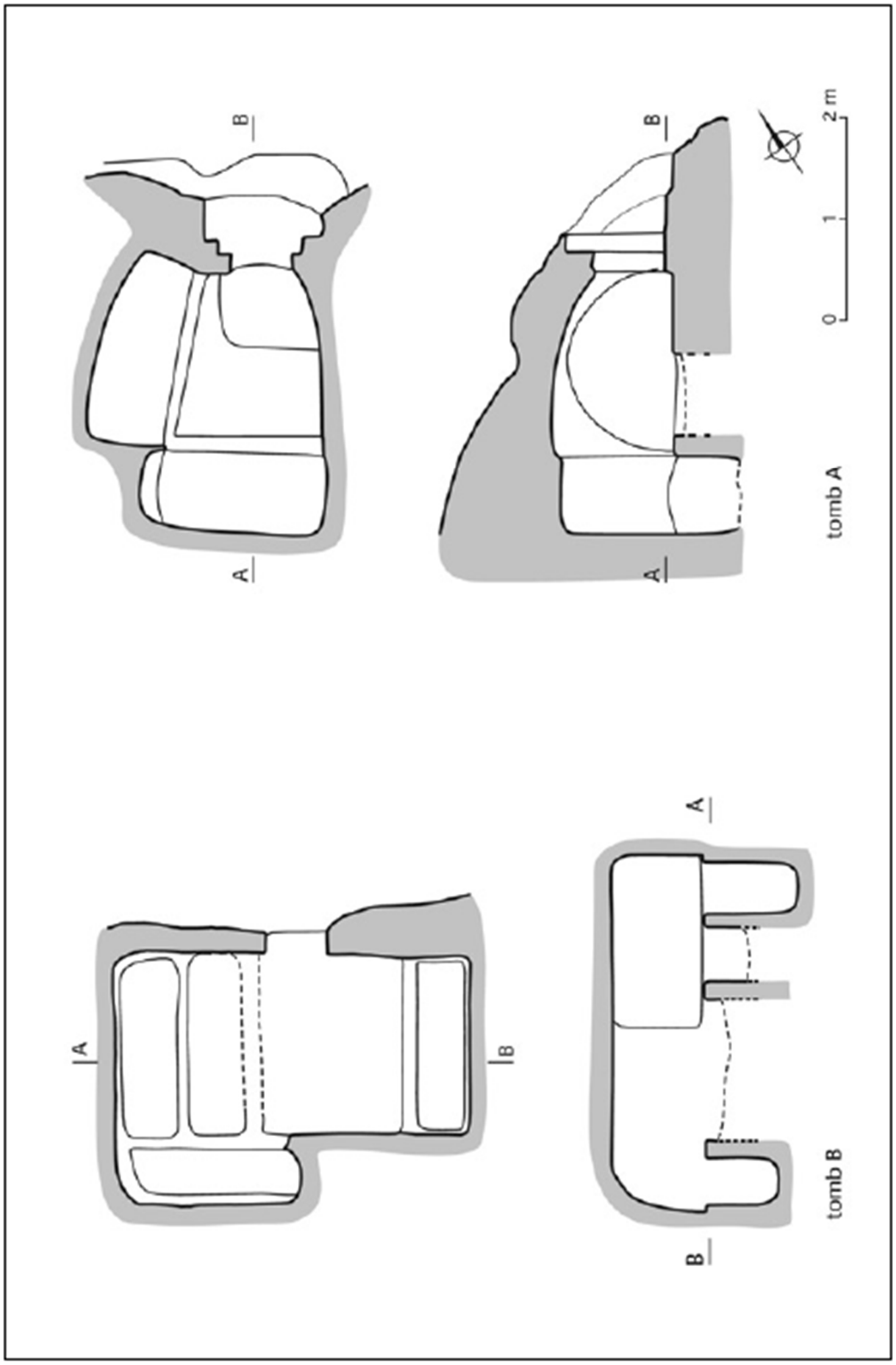

Fig. 2. Rock cut chamber tombs A and B from Site 46 (Drawing O. Wasilewska)

burial niches inside the chamber, identified only tentatively because of severe damages. The crudeness of the stone-dressing suggests that the tomb was never finished.

Pit graves cut into the rock and possibly containing lead coffins were found on sites 51 and 70. On the former of the two, the trench had been cut in a piece of grey rock sticking out in the middle of a cultivated field. As for the other site (N 33°33'47.7"; E 35°29'48.9"; 506 m a.s.l.), believed to be a settlement or village, pit graves were found cut in the rock inside a recent stone construction used as a keep for goats or sheep. Two of these graves were oriented N-S and were equipped with recesses around the edges for fitting covering slabs. A third pit was oriented E-W, but it was so severely damaged that its identification as a grave is purely tentative.

Remains of Roman-age settlements or farmsteads were discovered on eight sites, identified from the surface pottery and glass collection (nos 47, 53, 62, 65, 70, 71, 74, 75), augmented with Roman coins on sites 62 and 75. Typical water cisterns were localized on sites 65, 70 and 71. As it is only natural that cemeteries did not exist in a void away from settlements, it can be assumed, for example, that the necropolis on site 46 was connected with the village on site 47. (We were told by the local inhabitants that the locality on site 47 had once been called Maloulith or Maloula, which was apparently the name of the village in Aramaic). Other connected settlements and burial grounds include 53 and 51, 37 and 55. In the case of site 70, some graves were found near the settlement. Four sites are presumed to date to the Late Roman Period, two on the northern slopes and two on the southern ones. Site 66 was located on the edge of the slope west of El Kharbe. The site and the location were discussed above. Several Late Roman potsherds found among modern ceramics within the limits of El Kharbe village located site 69 there. On the opposite side of the valley, potsherds from the same period were found north of the modern village of Mazraat el-Mathane. Meriting special attention is site 63 located on the flat

Fig. 3. Carved decoration inside the chamber of a tomb from Site 55 (Photo K. Jakubiak)

ground of the second geological terrace. About four dozen distinctive potsherds of the Late Roman and Early Byzantine period were discovered scattered over an area of approximately 3500 m^2. Since the area is cultivated, there exists the risk that the sherds were brought there with fertile soil trucked in from elsewhere.

Other sites identified by the survey team (nos 50, 52, 54, 57, 58, 60, 61, 67 and 73) could not be attributed safely for lack of distinctive material in the surface collections. The ruins of a stone mill at site 73 dated to the 19th-20th century. Most other sites appeared to be recent (like site 60 localized in Bisri village), but it cannot be excluded that at least a few of them contained also ancient vestiges.

Site 25 found in 2004 was examined as part of the rechecking program. It lies in steep terrain north of Bhannine Village on the eastern side of Wadi Bhannine. It is overgrown with grass except for the cultivated terraces. At about 8 hectares of area it is the biggest site detected by the expedition so far. The pottery surface collection represents virtually all periods from the Hellenistic through Ottoman times with the nearby Bhannine Village still being inhabited today.

Continued geological reconnaissance resulted in geological and geomorphological maps being prepared for the middle part of valley, called the Bisri Plain, between Bisri village and Nahr El Barouk stream. Three superposed accumulation-erosional terraces were found. The upper two constitute two different erosional surfaces of the first, lowest accumulation terrace, which is built of lacustrine silts and represents a lake stage of valley development. The upper part of the second terrace is made of sands and gravels which covered the silts. The boundary between the two demonstrates erosional character with sands and gravel being deposited in high-energy conditions representing a flood facies (distinct near the water course and particularly in the geological sections cut by water in the erosional deposits). The uppermost terrace is also built of sands and gravels, and is of alluvial origin.

The geological development of the valley can now be reconstructed. The first important episode in historical times was the appearance of a lake, which built up behind a natural dam in the form of a huge landslide tongue. The lake filled all of the Bisri Plain, giving rise to the lacustrine silt deposits which accumulated on its bottom. It went through different stages before drying up finally sometime in the Late Hellenistic or early Roman period. The lacustrine silts proved to be highly fertile agricultural soil used throughout Roman times. A second important change in river regime occurred in the Late Roman period. From a stabilized river with low flows, it changed to an annual cycle with floods. Deluges presumably damaged or destroyed Roman buildings, like the Bisri Temple, for example. It was then that the river finally cut through the natural dam, forming a deep eroded channel. In the end effect, the river regime and water level were stabilized once again.

The dating of erosional episodes and accumulation cycles depends generally on archaeological finds. The creation of the lake, however, and the rate of late lacustrine sedimentation will be determined once a thermoluminescence analysis is carried out of samples that the team has taken from the sediments.

APPENDIX I

BENEFIT SHARING PROGRAM

BACKGROUND

Many dams are located far from their supply areas, sometimes in different countries. Notwithstanding that Bisri Dam is just 25-30 km from its water consumers, the benefits from the project, both increased water supply and additional power supply, will primarily benefit the residents of Greater Beirut rather than landowners in the valley whose land will be inundated or the villages in the surrounding hills that will potentially suffer noise, dust and traffic congestion during construction and perhaps the adverse impacts of induced development afterwards.

To overcome this, a fund to be established that will fund projects and in some small way spread the sharing of derived benefits to local communities in the vicinity of main project activity.

Thus GOL will thus establish the Benefit Sharing Program. Within the context of the present environmental assessment, the objectives of the Program, the type of structure envisaged, and the variety of projects it might execute have been considered. The establishment of such a program under Lebanese Law is a complex process that should be vigorously pursued throughout the period of dam construction and enable benefit-sharing to commence at about the time the water and power benefits also start to become available to Greater Beirut.

Pending this, the primary concepts of the Benefit Sharing Program are discussed below.

MISSION STATEMENT

To extend and share the benefits of Bisri Reservoir beyond water supply consumers in Greater Beirut.

AIMS AND OBJECTIVES

The aims and objectives of the Benefit Sharing Program are:

- To improve community services and social welfare throughout the areas impacted by construction and inundation;
- To ensure the surrounding communities share the benefits from subsequent development of the reservoir shoreline and adjacent areas;
- To enhance power and water supply to reflect the benefits provided elsewhere by the Reservoir;
- To promote employment opportunities.

AREAS OF OPERATION

The areas of operation within which projects meeting the aims and objectives of the Benefit Sharing Program may be eligible for funding are those areas falling within the administrative jurisdiction of the municipal authorities within reservoir surface water catchment area, and areas downstream impacted directly or indirectly by dam construction and operation. The municipalities currently expected to benefit from the Fund are as follows:

Caza	Unions of Municipalities	BSP Municipalities within the Unions
Chouf	South Iqlim El kharroub	Bsaba; Mazraat El Dahr
	Chouf El Souayjani	Mazraat El Chouf
	Chouf El Aala	Aamatour; Bater
Jezzine	Jezzine	Aariye; Benouati; Bkassine; Midane

Excluded from this list are the villages of Bisri, Khirbet Bisri, Harf, Ghabatiye, and Bhannine that are not municipalities and are not included in any union, but are administered by the *Ka'em Maqam* for Jezzine. In respect of the ministration of the BSP, the *Ka'em Maqam* should therefore be treated as a Union. With time, shared interests based on the proximity of villages to Bisri reservoir will become paramount and those villages not a member of a Union are likely to choose to do so as they become municipalities.

ESTABLISHMENT

The BSP will be established under the auspices of a Federation of Municipalities within the area of operation.

FUNDING

The BSP will initially be funded through an injection of 1.5 million US Dollars from the GoL project budget for GBWSAP. Other sources of local funding will need to be identified in the long term. These may include contributions from the following:

- A small levy on GBWASP consumers relative to the volumetric consumption;
- A contribution from the annual municipal charge levied on new construction within the Bisri catchment;
- Voluntary donations, which may be project-related, from individuals and organisations.

BOARD OF TRUSTEES

Members of the Board of Trustees shall be elected by agreement between the BSP municipalities. The Chairman shall be elected by a simple majority of the trustees.
The BSP boards will comprise the following:

- The Emeritus Head of one of the BSP's union of municipalities, who will act as the Chairman;
- Representatives of the other BVCP union of municipalities and the *Ka'em Maqam*, one of whom will act as Secretary;
- A representative of a third union of municipalities;
- A Judge or Magistrate of at least the 8th degree;

- A qualified Accountant, who will also act as Treasurer;
- Representatives of NGOs and CBOs active in the BSP area of operations.

The Board shall appoint a Clerk to undertake day-to-day administrative duties and other staff as agreed.
The Board shall retain the services of a qualified and experienced Auditor unconnected to any Board member or the organisation they represent, to annually prepare audited accounts.

OPERATIONS COMMITTEE

The Operations Committee will distinguish the policy, revenue and financial oversight responsibilities of the Board of Trustees from those of fund allocation and project monitoring undertaken by the Committee.

- A Trustee representing one of the BVCP's union of municipalities, who will act as Chairman;
- A representative of the Ministry of Environment, who will act as Secretary;
- Representatives from each of the BVCP municipalities and the *Ka'em Maqam*;
- Rotating representation of the NGOs and CBOs represented on the Board; and,
- Other members elected by a simple majority of sitting members.

The Committee shall be responsible for developing and implementing the criteria used to assess funding applications and to ratify completion.

DISBURSEMENT OF FUNDS

Any municipality, commercial enterprise, NGO, CBO or individual resident within the BSP's area of operations may apply to the Operations Committee for funding of projects that further the aims and objectives of the BSP.

The maximum disbursement to any single project shall be US$ 300,000 unless a higher disbursement is approved by the Committee and confirmed by a majority of the Board of Trustees.

All applications for funds shall be made in the prescribed manner and give full and unambiguous details of at least the following:

- The name of the project and its location;
- Contact details of each and every project proponent;
- Details of the project objectives;
- Confirmation that these objectives meet those of the BSP;
- A list of beneficiaries and the extent of their benefit;
- An environmental statement identifying significant environmental and social impacts during project construction and operation, and the measures to be taken to mitigate them;
- A schedule of construction and operation;
- A schedule showing the drawdown of BSP funding and any other funding.

PROJECT ELIGIBLE FOR BSP FUNDING

The type of projects deemed to further the aims and objectives of the BSP will be determined on a case-by-case basis by a simple majority of the Operations Committee. Applications for funding will be submitted according to a specific format as agreed by the Board.

Projects likely to be suitable for BSP funding may include, but not be limited to, the following:

- Reforestation not exceeding 2 ha where there is limited public access;
- Reforestation projects up to 500 ha where there is open public access;
- Run-of-river hydroelectric schemes using hydrokinetic turbines and axial tube turbines;
- Community halls and meeting rooms with seating capacity up to 100 persons;
- Performance and display of traditional arts and crafts, music and local produce;
- Promotion of eco-tourism/educational facilities, such as those in the Damour Valley;
- Heritage conservation activities, including traditional cultural industries and production
- Visitor facilities overlooking Bisri Reservoir;
- Promotion of non-commercial fishing on the reservoir;
- Grant aid to other NGOs and CBO also pursuing BSP aims and objectives;
- Promotion of community wind and solar energy power; and,
- Conversion of public planting irrigation schemes to drip irrigation

Appendix J

DAM BREACH REPORT

CONSTRUCTION SUPERVISION & QUALITY ASSURANCE PLAN

REPUBLIC OF LEBANON

COUNCIL FOR DEVELOPMENT AND RECONSTRUCTION

DETAILED DESIGN OF BISRI DAM PROJECT

CONTRACT NO.17909

DAM BREACH MODEL

August 2013

Founded 1956

DAR AL HANDASAH NAZIH TALEB & PARTNERS

دار الهندسة نزيه طالب وشركاه

Table of Contents

List of Tables

List of Figures

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	Revision:	Date: August 16th, 2013
	☑ Draft	☐ Final
	Signature:	

EXECUTIVE SUMMARY

This report considers the modeling of a potential dam break from the Bisri Dam in the Bisri River Basin using an unsteady HEC-RAS model. Topographic data for the Bisri River Basin was obtained from actual land survey and converted to a 5m x 5m cell-size Digital Elevation Model (DEM) representing the Bisri River Basin. The Bisri Dam is located at an elevation of 400m above sea level. The clay core rockfill dam has a maximum capacity of 125 million m^3.

The Bisri River Basin downstream of the Bisri Dam is very steep, dropping 400m in approximately 22 km distance to the mouth of the river at the Mediterranean Sea. The river flows through several deep and winding canyon sections interspersed with wide, flat reaches over this interval making the dam break modeling problem challenging as many cross-sections must be used in the model (10 m spacing between sections), along with a short time step (5 seconds).

A Potential Failure Mode Analysis (PFMA) of the Bisri Dam identified the main potential failure modes as due to seismic loading and flood overtopping. Overtopping and breaching after seismic activity is the most probable and worst mode of potential failure of the Bisri Dam (consideration of a river flood, even exceptional, would not add much to the peak flood generated by the dam breaching and reservoir emptying). It is the failure mode described and modeled in this report. The unsteady hydraulics of the dam breach due to this failure mode was modeled using U.S. Army Corps of Engineers HEC-RAS software. The breach formation time used in the model is 1.5 hours, as calculated using the U.S. Bureau of Reclamation recommended procedure.

The model results show a peak flow of 43,000 m^3/s at the dam and 41,000 m^3/s at the sea outlet. The flood wave generated by the breach is initially 28 m high and does not abate significantly until the reaching the coastal valley where it decreases to 10 m. The lag time between the peak flow at the dam and at the mouth of the river is 30 minutes; the flood wave travels 21.6 km in 30 minutes or 43.2 km/hr. Sensitivity analysis was performed on the time of the dam breach and the width of the formed breach, showing that the model results are sensitive to the breach formation time and not to the width of the breach formation.

Cross-section (distance in km from sea outlet)	Initial Rise Time *	Peak Time *	End Time *	Peak Flow	Flood Height
	hr:min	hr:min	hr:min	m3/sec	m
21.6 km(dam)	0:00	1:10	2:40	43000	28
19 km	0:20	1:10	3:00	42800	27
10.9 km	0:40	1:20	3:40	41700	25
5.4 km	0:50	1:30	4:10	41200	20
Sea outlet	1:00	1:40	4:50	41000	10

* Time from time of breach initiation

GIS mapping of the areas inundated by the dam break flood were undertaken using the HEC-GeoRAS software.

Validation of the HEC-RAS model was performed by using a three dimensional CFD mathematical model of commercial use "Flow-3D". Based on the comparison between one dimensional modeling (HEC-RAS) and three dimensional CFD modeling (Flow-3D) no significant differences were found.

The inundation mapping downstream the dam considers the envelope of both models. The resulting inundated areas were also mapped in Google Earth for easy interpretation by local communities and responsible officials.

A rough damage assessment based on the results of the flood model was also performed. The results provide an average estimate and should not be considered as a detailed cost assessment of the damage, since they are strongly depending on the quality of the damage functions and the availability of detailed datasets. The quality of the damage assessment also depends on the quality of the classification which was made considering satellite views, previous studies data and the field survey collected information. The total damage cost estimation is approximated to 110 to 130 Millions US$.

The dam break model results were also used in the preparation of an Emergency Action Plan developed for protecting downstream communities in the event of a dam break and subsequent flood.

1 INTRODUCTION

1.1 Overview

The principal purpose of the Bisri Project is to provide a reliable water supply for the City of Beirut, using the water resources of the Bisri River at a site approximately 30 kilometers south of Beirut. A secondary purpose includes water supply for generating hydroelectric energy.

The Bisri Dam Project is located on the Bisri River, approximately 17 kilometers inland from the City of Sidon, which is on the coast of the Mediterranean Sea. The City of Beirut lies approximately 30 kilometers to the north and west of the dam site.

1.2 Main Purpose of this Report

The purpose of this report is to look at the issue of modeling a potential dam break from the Bisri Dam in the Awali River Basin using an unsteady US Army Corps of Engineers HEC-RAS model. The Bisri River drains the western slope of the mountains named Jabal el Barouk and Jabal Niha. These mountains, rising to elevations higher than 1,900 m above mean sea level, are characterized by a continuous snow cover throughout most winter months. Downstream the dam location, the river flows through a narrow valley, a canyon in some places dropping 400 m to sea over some 22 km.

The main task of this report are:

- Modeling a potential dam break from the Bisri Dam using an unsteady U.S. Army Corps of Engineers HEC-RAS (USACE, 2010) model for the dam and the downstream river to the sea.
- Validating the HEC-RAS Model by comparison the FLOW 3D Model.
- Performing a damage assessment based on the Dam Break Model results.
- Drafting an Emergency Action Plan developed for protecting downstream communities in the event of a dam break and subsequent flood.

2 BISRI RIVER BASIN

2.1 Introduction

The Bisri Dam Project is located in Southern Lebanon, east of the coastal city of Sidon. The proposed dam site is located on the Bisri River, at an elevation of 395 m, just east of the village of Bisri. The area of the project watershed is 215 km2, mostly draining the western slope of the mountains named Jabal el Barouk and Jabal Niha. These mountains, rising to elevations higher than 1,900 m above mean sea level, are characterized by a continuous snow cover throughout most winter months.

The project watershed is located between latitude 33^{o} 30' and 33o 45' North and longitude 35^{o} 32' and 35^{o} 46' East. Towns, villages and farms are scattered throughout the watershed primarily below 1,300 m in elevation. The town of Jezzine is the largest population center in the watershed.

The watershed hydrology is characterized by a rainy season of approximately seven months which begins in October or November of each year and lasts into April or May. Rainfall during the months of June through August is extremely rare. Streamflow is normally highest in February. During September, the average is lowest.

The annual precipitation in the Bisri River Basin averages 1255 mm/year and ranges between 900 mm/year inland and 1300-1400 mm/year over the mountains. The average flow for the basin is approximately 130 million m3 per year for the period 1952-2010, 15% occurring in the summer (May-October) and 85% during the winter (November-April).

Floods created by heavy winter precipitation are common occurrences in the valley and their impacts have been increasing recently. In February 2003 one of the largest floods was experienced in the basin with an estimated return period of about 70 years or 1.4 % probability of exceedance in any year. This flood occurred after approximately 10 consecutive days of heavy rainfall in combination with snowmelt. Limited flow data exists in the Bisri River Basin (only daily discharge values with unknown accuracy and limited duration) and some historical flooding information has been collected from accounts of witnesses.

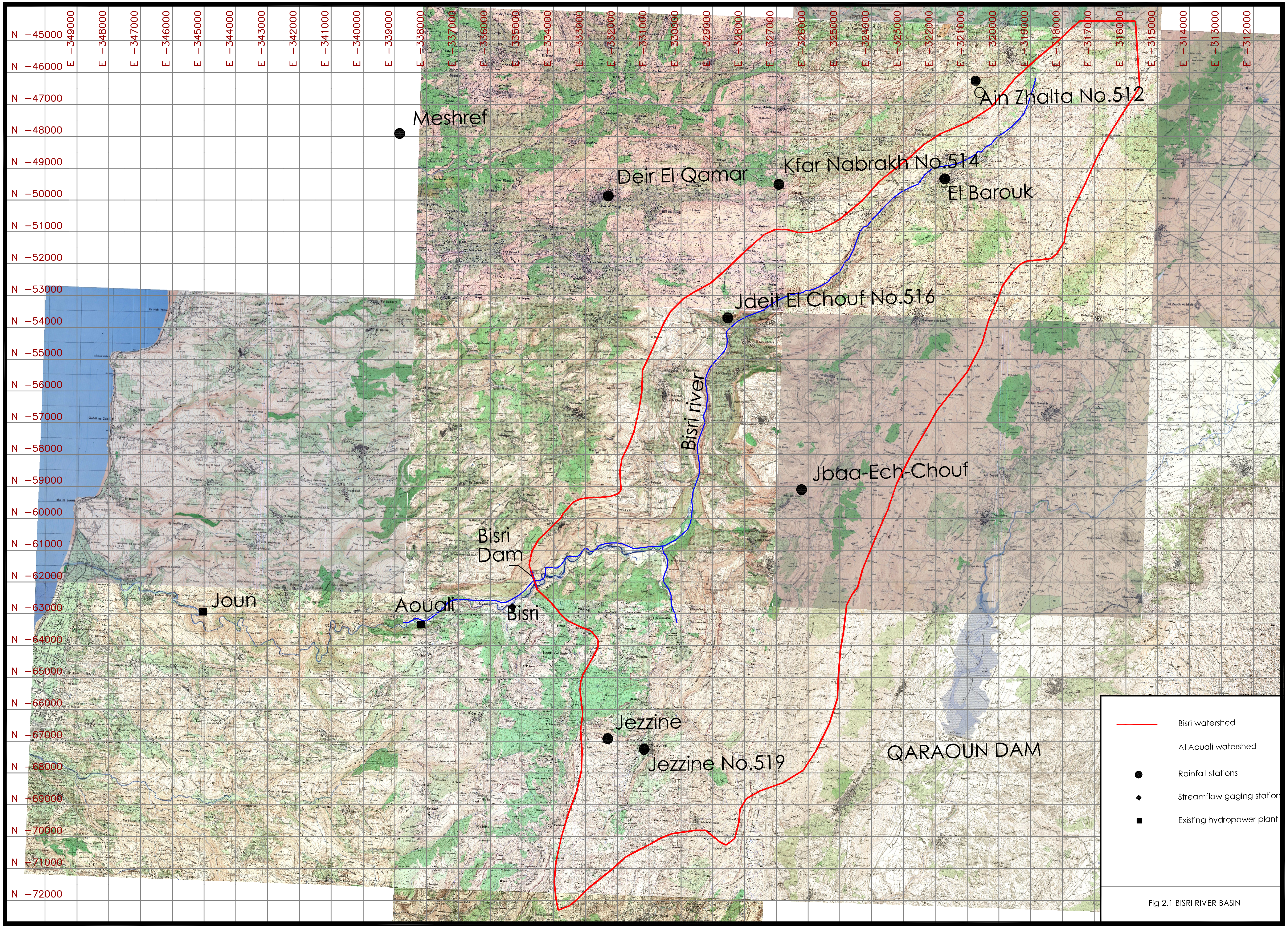
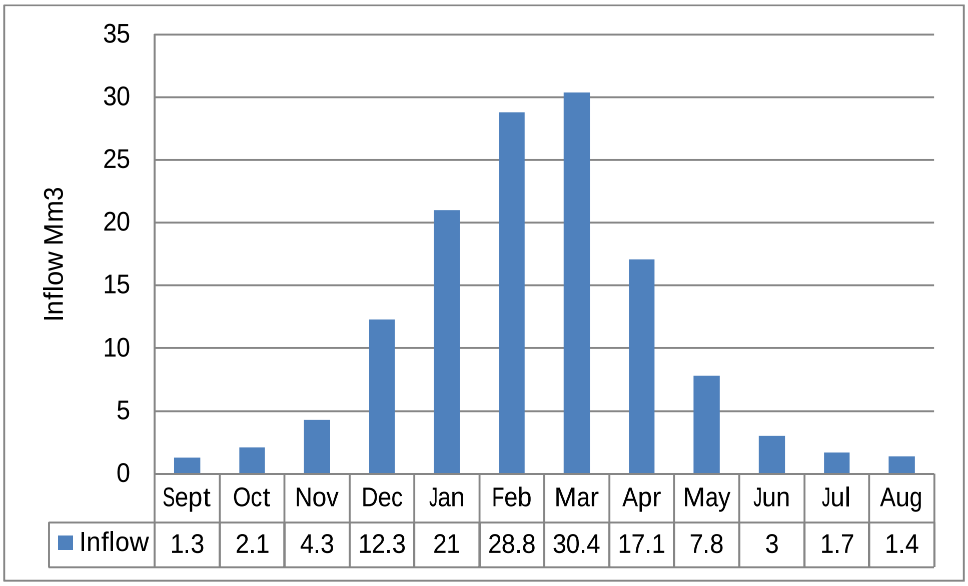


Fig 2.1 BISRI RIVER BASIN

Table 2-1 Average Monthly Bisri River Flows at Bisri Dam inflow (1952-2010)

Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Mm^3	m^3/s
1.3	2.1	4.3	12.3	21.0	28.8	30.4	17.1	7.8	3.0	1.7	1.4	131.2	4.2

Figure 2-2 Average Monthly Bisri River flows at Bisri Dam



2.2 Topographic Data

Topographic data for the Bisri River Basin was obtained by actual land survey.

The area between the dam and the sea was surveyed as shown on the drawings submitted separately (Scale 1/5,000).

Coordinates and elevations of National Bench Marks and Delta points existing in the study area were obtained from "Ministère de la Défense Nationale- Armée Libanaise- Direction des Affaires Géographiques".

A visit to the site and adjacent areas was conducted to locate the bench Marks in order to determine the traverse and reach with it the project site with no tolerance and with an acceptable accuracy. After shifting the coordinates to the site, several benchmarks were located.

Benchmarks points located inside and outside the project limits were marked on concrete elements such as rooms and houses and huge rocks. All these points (inside & outside project) are given as X, Y, Z with relation of National Lebanese Grid and Levels.

These maps were scanned and georeferenced according to the local coordinate system in Lebanon (Double Stereographic Projection). The contours lines from the maps were digitized on 5-meter intervals and the contours were converted to a 5m x 5m cell-size raster file (Digital Elevation Model or DEM) representing the Bisri River Basin. The final DEM is shown in Figure 2.3 along with an outline of the lake behind the Bisri Dam and the Bisri River from the lake to the sea. The elevation change from the dam to the sea is shown in Figure 2.4.

Figure 2-3 Digital Elevation Model (DEM) of the Bisri River Basin below Bisri Dam

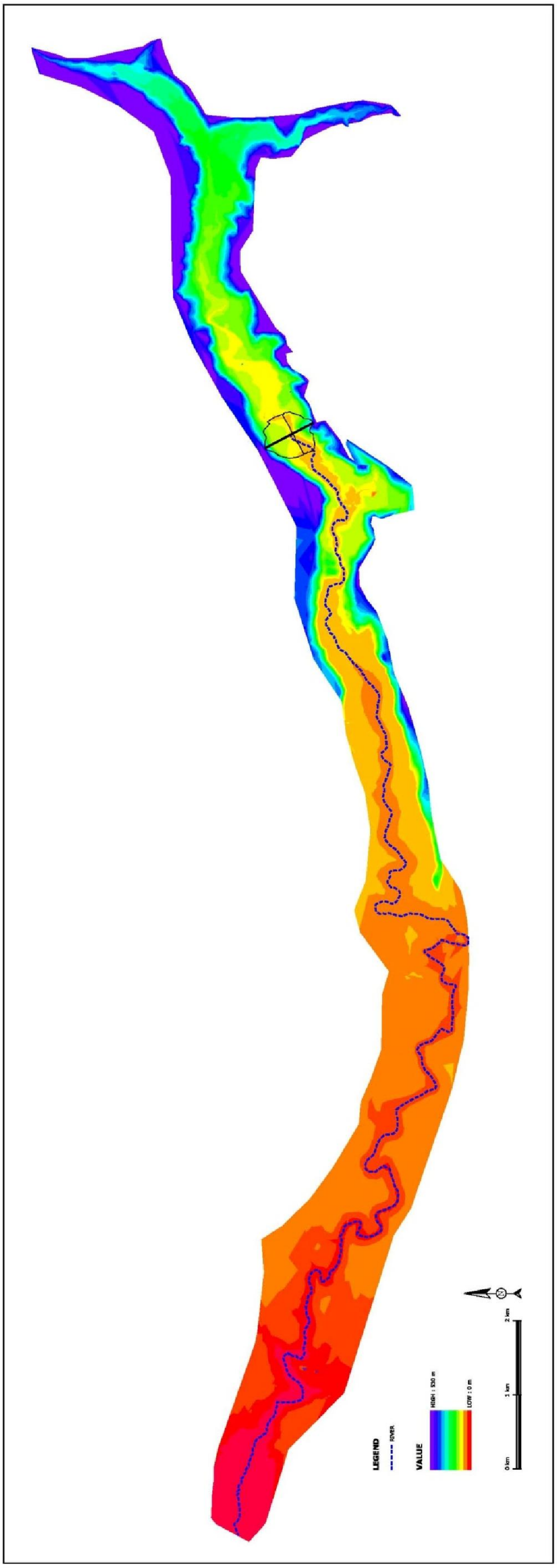
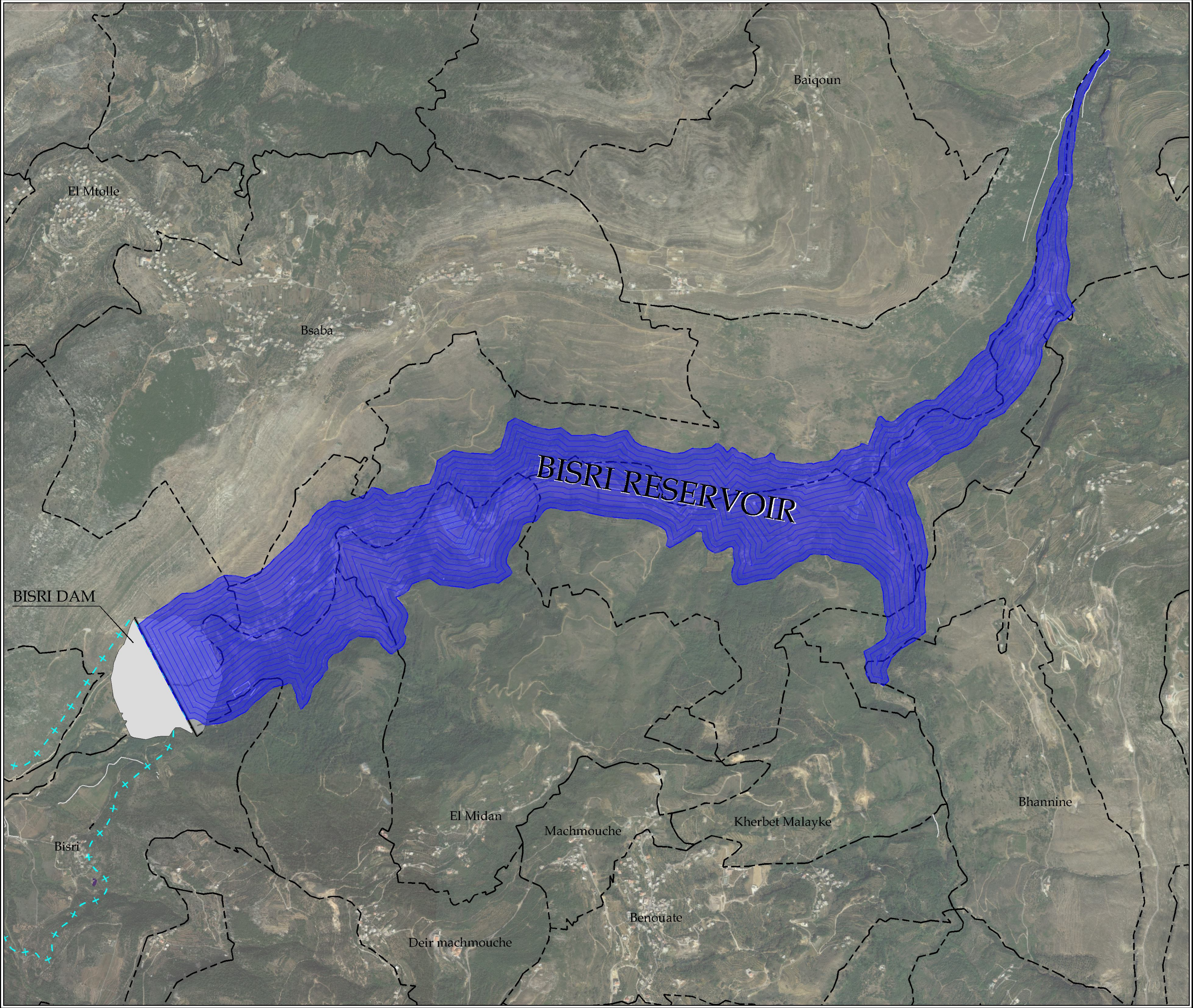


Figure 2-4 Bisri River Basin elevation profile from Bisri Dam to the Mediterranean Sea

2.3 Bisri Dam

2.3.1 Basic Characteristics of the Dam

The Bisri dam site is situated in a wide valley with moderately sloping abutment walls. The general site plan for the dam and reservoir is shown in Figure 2.5. The reservoir for the proposed Bisri Dam extends about 4 km upstream of the dam axis on the Bisri River and then branches out along both the Nahr Barouk awards the north and the Ouadi Bhannine towards the south. The catchment area above the dam is 215 km2. The dam has a maximum capacity of 125 million m^3 (at water level elevation of 461m above mean sea level. The dam has a length of 790m and is a clay core rockfill dam with the principal characteristics as summarized in Table 2.2. The maximum height of the dam is 73 m, and it is 10m at the crest level. The full lake covers an area of about 4 km^2. The dam is multipurpose, including: hydropower generation and domestic water supply. The maximum flood elevation for the spillway is 467.4m where the area of the lake is 4.3 km^2. The minimum operational level is 422m. Plan and center cross-section views of the dam are shown in Figure 2.6 and 2.7.



Legend

Flood Limit

River

Fig. 2.5

0m 200m 500m

Scale $\frac{1}{20000}$ @ A3 Size

N

BISRI DAM & RESERVOIR

DAR AL HANDASAH NAZIH TALEB & PARTNERS
دار الهندسة نزيه طالب وشركاه

Figure 2-6 Bisri Dam plan view

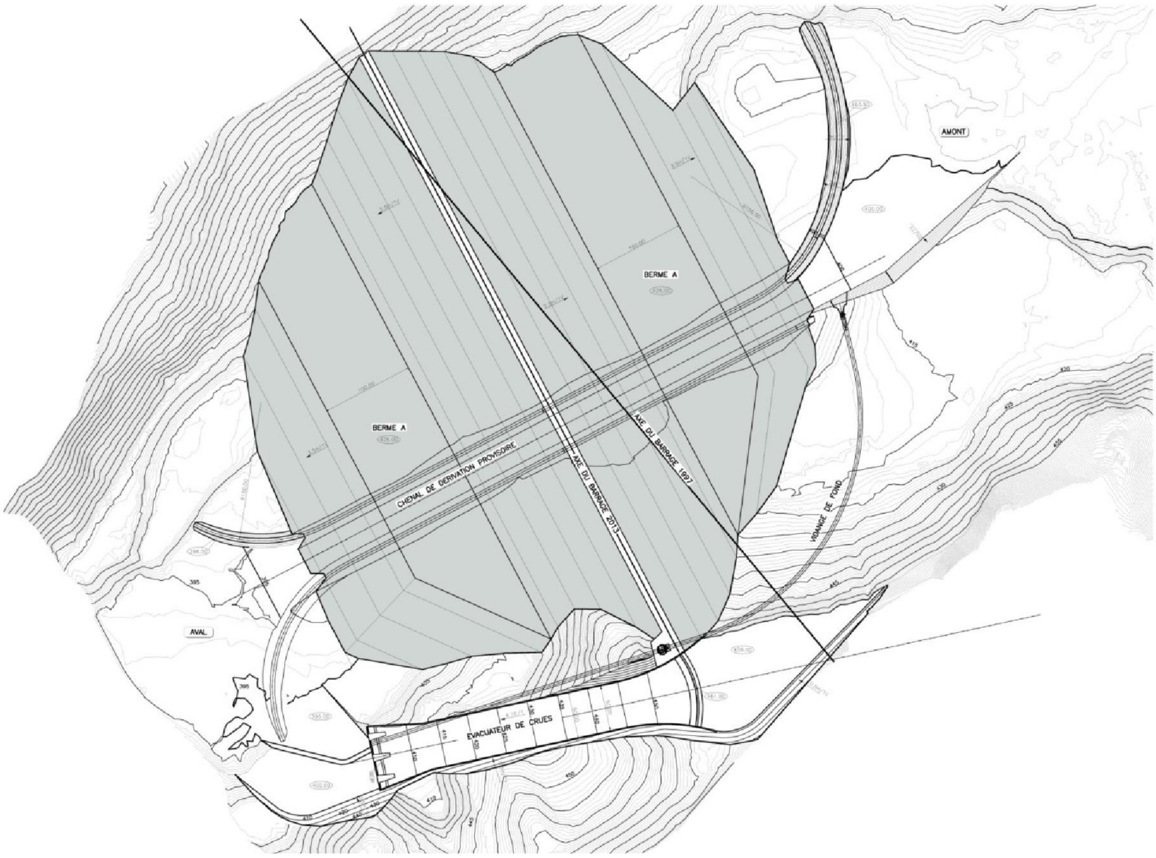


Figure 2-7 Bisri Dam main section view

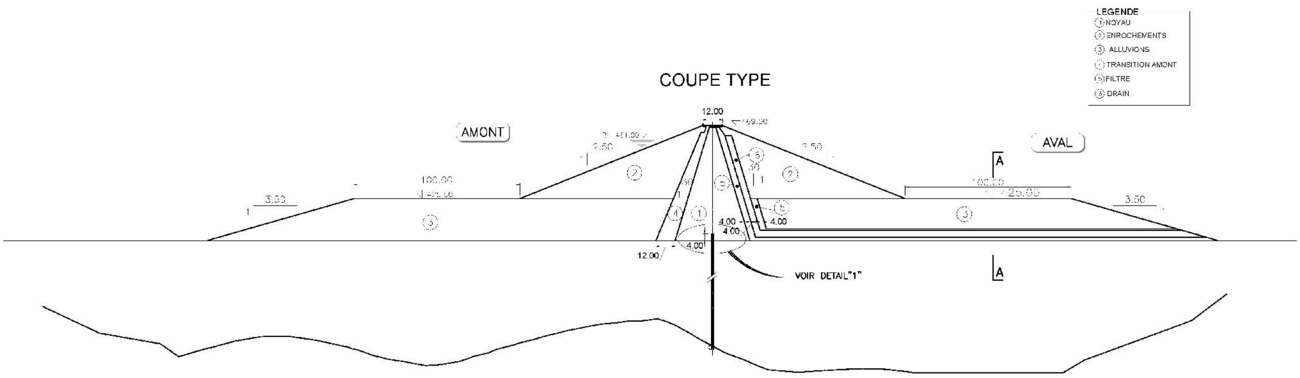


Table 2-2 Bisri Dam Charactistics

HYDROLOGY	
Average Inflow Mm^3	131
Probable Maximum Flood, m^3/s	3000
100 years Return Period Flood, m^3/s	550
RESERVOIR	
Maximum Water Level MWL, m	467.4
Normal Water Level NWL, m	461
Reservoir Volume Under NWL, Mm^3	125
Minimum Operation Level, m	422
DAM	
Type	Clay Core Rockfill Dam
Crest Level, m	469
Maximum Dam Elevation, m	73
Crest Length, m	790
Crest Width, m	10
Upstream Face Slope	2.5H:1V then 3.5H:1V
Downstream Face Slope	2.5H:1V then 3.5H:1V

2.3.2 Potential Failure Mode Analysis

A Potential Failure Mode Analysis (PFMA) was performed for the Bisri Dam to identify potential failure modes under static loading, normal operating water level, flood water level, and earthquake conditions. The PFMA results indicate that, while the risk of failure is very low, the most probable failure modes are seismic loading and flood overtopping.

Seismic loading failure:

The dam is located in an earthquake-prone zone where high intensity earthquakes are considered probable. The Bisri Dam is considered to be susceptible to damage and potential catastrophic failure under high earthquake loading. Deformations result in freeboard loss to such a degree that the crest is lower than the reservoir, causing a breach by overtopping erosion of the rockfill structure. Such a breach would enlarge through progressive erosion and collapse of the crest of the dam resulting in a catastrophic loss of the reservoir. This breach could form whether or not there is flow through the rockfill (piping) as the result of damage to the upstream face of the dam.

Flood overtopping failure:

An extreme flood occurrence causing the dam to be overtopped has significant potential to cause a rapid breach of the dam if overtopping is significant. Flow over an embankment dam (earth or rockfill) usually leads to erosion of material on the downstream slope and failure of the dam. Overtopping of Bisri Dam could result in movement of the material on the downstream slope of the dam with progressively more material dislodged causing collapse of the concrete face panels resulting in higher flows over the dam until total collapse occurs.

2.3.3 Dam Failure Scenarios

Three types of failure scenarios for the Bisri Dam could be considered, as follows.

Seismic loading failure:

An earthquake weakens the dam, which fails when the reservoir is full with a breach opening from the top and reaching a width equal to 1-2 H (H = dam height of 73m) with slopes 1/1 and a failure time of about 1 hour. Breaching parameters are calculated according to the US Bureau of Reclamation standard of practice as described in Froelich (1995a, b) and Wahl (2004). Initial conditions are minimal river flow, 200 m^3/s. Upstream flow conditions are the flow generated automatically by HEC-RAS based on the breach starting at a given time, 1 hour after the start of simulation and developing as mentioned above. Downstream boundary condition is the river outlet into the sea.

Flood overtopping failure:

The reservoir is full and a large flood comes. The spillway for Bisri Dam is uncontrolled (i.e. it operates automatically when water level reaches the overflow) and is sized for very large flood discharges (i.e. PMF), so the overtopping risk is almost nil. This risk could become of consideration only if the spillway and bottom gate are blocked/non-operational during a very large flood that overtops the dam causing failure. This scenario would have actually have the same consequences as the seismic failure: breaching would be similar while the addition of a large flood (hundreds of m^3/s) is negligible considering the flood generated by the reservoir emptying (tens of thousands of m^3/s).

For this report, the primary mode of potential failure of the Bisri Dam is considered to be breaching and overtopping due either to seismic activity or flooding.

3 DAM BREAK MODELING

3.1 Introduction

Dam break modeling requires the solution of an unsteady (rapidly time varying) river flow hydraulics problem. Many early dam-break investigations assumed that the breach or opening formed in a failing dam encompassed the entire dam and occurred instantaneously. While this assumption may be nearly appropriate for concrete arch dams, it is not valid for earthen dams or concrete gravity dams. Because earthen dams generally do not fail completely nor instantaneously, dam break models allow for the investigation of partial failures occurring over a finite interval of time (Fread et al., 1991). The U.S. Army Corps of Engineers HEC-RAS software (USACE, 2010) includes the capability to model the unsteady hydraulics of an embankment dam breach due to several failure mode options. Using HEC-RAS for the routing modeling of dam failures is the current standard procedure in the US, and notably for US Army Corps of Engineers and US Bureau of Reclamation.

The primary input variables of importance in the dam break analysis are (Wahl, 1998):

1. Reservoir volume when breaching commences (m^3). This is often taken as the full reservoir volume for overtopping failure cases;

2. Reservoir water surface elevation when breaching commences (m). This is often taken as the top of the dam for overtopping failure cases;

3. Breach depth (h) – the vertical extent of the breach, measured from the dam crest to the invert of the breach (m). This is often taken as the elevation of the river channel at the upstream base of the dam. The bottom of a fully formed breach usually is the dam foundation, which is more resistant to erosion than the embankment material. However, the height might be limited by the volume of water in the reservoir at the time of failure, or by the presence of a layer of erosion-resistant material located in the embankment (Froehlich 2008).

4. Breach width (B) – the final width of the breach (m). The breach width and rate of formation have an impact on the peak flowrate and the inundation level downstream from the dam.

5. Breach initiation time – the time from the first flow over or through the dam that will initiate warning, evacuation, or heightened awareness of the potential for dam failure. The breach initiation time ends when breach formation starts.

6. Breach formation time (t) - the time required for the breach formation (hours). The breach formation time is the duration of time between the first breaching of the upstream face of a dam until the breach is fully formed. For overtopping failures the beginning of breach formation is after the downstream face of the dam has eroded away and the resulting crevasse has progressed back across the width of the dam crest to reach the upstream face;

3.2 Estimating Dam Breach Parameters

3.2.1 Maximum Breach Discharge

Several researchers have compiled data on the failure of rock-filled embankment dams (Froehlich 1995; Wahl 2004; Froehlich 2008). Wahl (2004) compared the uncertainty of several breach parameter prediction formulas, including the aforementioned equations. The Froehlich equations were found to have the smallest uncertainty and are currently considered as standard procedures.

Using data from numerous embankment dam failures, Froehlich (1995) related the peak outflow in a dam breach to a power function of both the breaching head and outflow volume

$Q_{max} = 0.607KV^{0.295}\,h^{1.24}$ (1)

where

- Qmax is the peak flow (m3/sec),
- h is the height of the dam breach (m),
- V is the reservoir volume (m3),
- K is an overtopping multiplier (1.4 for overtopping failure, 1.0 for piping failure).

The maximum volume of Bisri Dam is about 125 million m^3. Eq. 1 can be used to compute the hypothetical maximum outflow from Bisri Dam as

$Q_{max} = 0.607(1.4)(132x10^{6})^{0.295}\,(73)^{1.24} = 42{,}503\ m^3/sec$ (2)

3.2.2 Breach Development Time

The expression developed for the breaching time (t, hr) is (Froehlich 1995)

$t = 0.00254V^{0.53}\,h^{-0.9}$ (3)

In the case of Bisri Dam, the breaching time is approximated as

$t = 0.00254(125x10^{6})^{0.53}(73)^{-0.9} = 1.05$ hr (4)

3.2.3 Breach Width

An expression for the breach width (*B*, m) was also developed (Froehlich 1995)

$B = 0.1803V^{0.32}\,h^{0.19}$ (5)

In the case of Bisri Dam, the final breaching width can be approximated as

$B = 0.1803(125x10^{6})^{0.32}(73)^{0.19} = 158.9$ m (6)

3.3 Representation of Bisri River and Bisri Dam in Hec-Ras

3.3.1 Bisri River

The Bisri River Basin downstream of the Bisri Dam is very steep, dropping 400m in the approximately 22 km distance to the mouth of the river at the Mediterranean Sea. The river flows through several deep and winding canyon sections interspersed with wide, flat reaches over this interval. These aspects of the river make the dam break modeling problem challenging as it is difficult to determine the appropriate number and placement of cross-sections for the model as well as the best model time step for the simulations.

The final DEM is shown in Figure 2.3 along with an outline of the lake behind the Bisri Dam and the Bisri River from the lake to the sea. Initial river cross-sections for the HEC-RAS model were generated using this DEM. The initial set of river cross-sections are shown in Figure 3.1.

The stability of the HEC-RAS model is function of the distance between the cross sections and the time step used in the simulation. The minimum value allowed by HEC-RAS is one second. A one second time step was used for the Bisri model to achieve stability of the calculations. Other, larger time steps were tested, but not found to result in stable calculations.

New cross-sections with a shorter distance between them were interpolated between the initial sections at locations where the HEC-RAS solution became unstable. First, all of the initial river cross-sections were interpolated to 30 m and then further interpolation to 20 m was carried out. Finally, some reaches of the river had to be interpolated to 10 m distance between cross-sections in order to achieve a stable solution.

The roughness of the terrain due to ground materials and vegetation is represented in the HEC-RAS calculations by the Manning roughness coefficient. The roughness coefficient was considered homogeneous for the entire Bisri River model with a value of 0.05. According to Chow (1959) this value is recommended for mountain streams.

Figure 3-1 Initial cross-sections for Bisri River HEC-RAS model

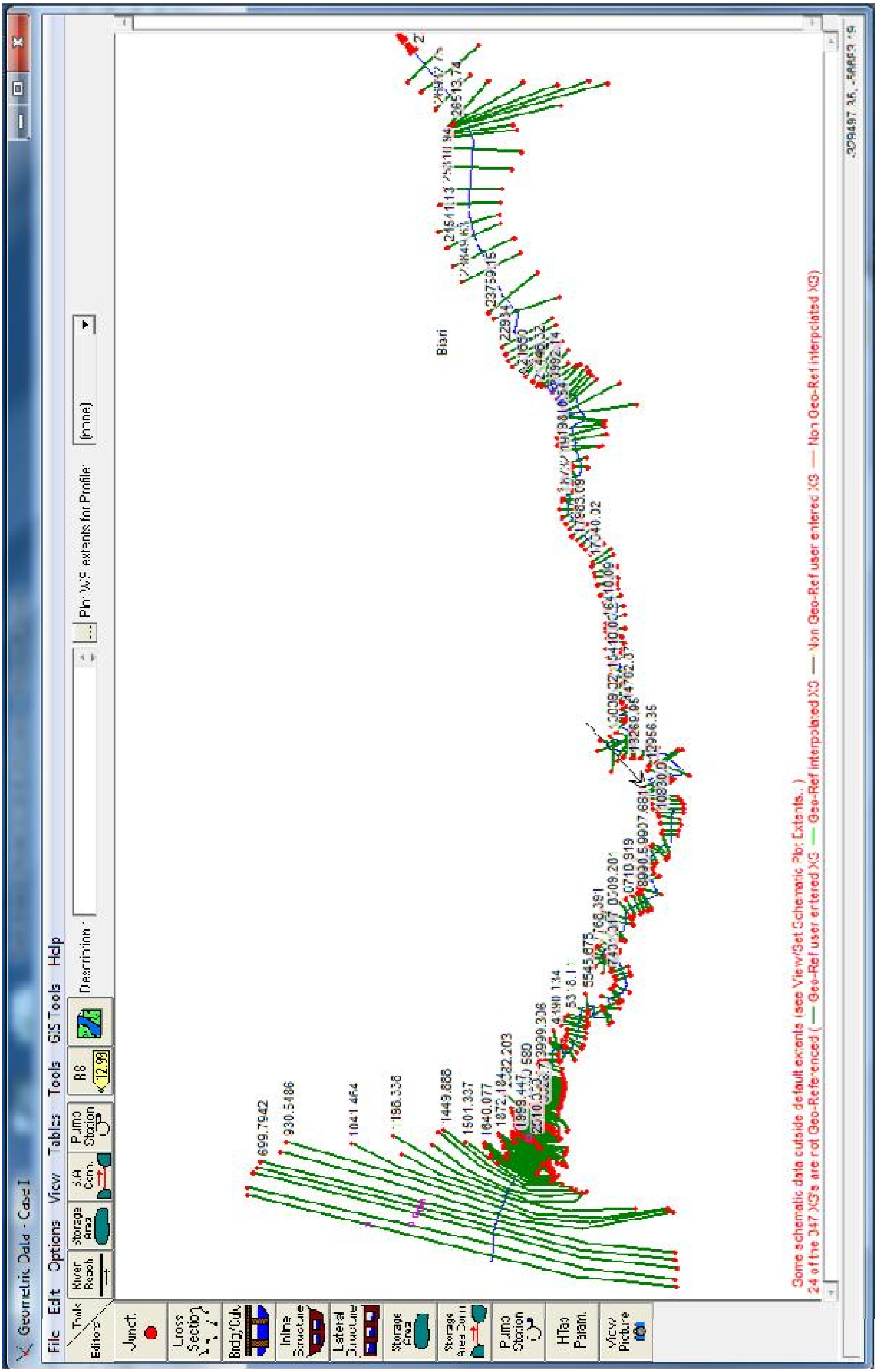
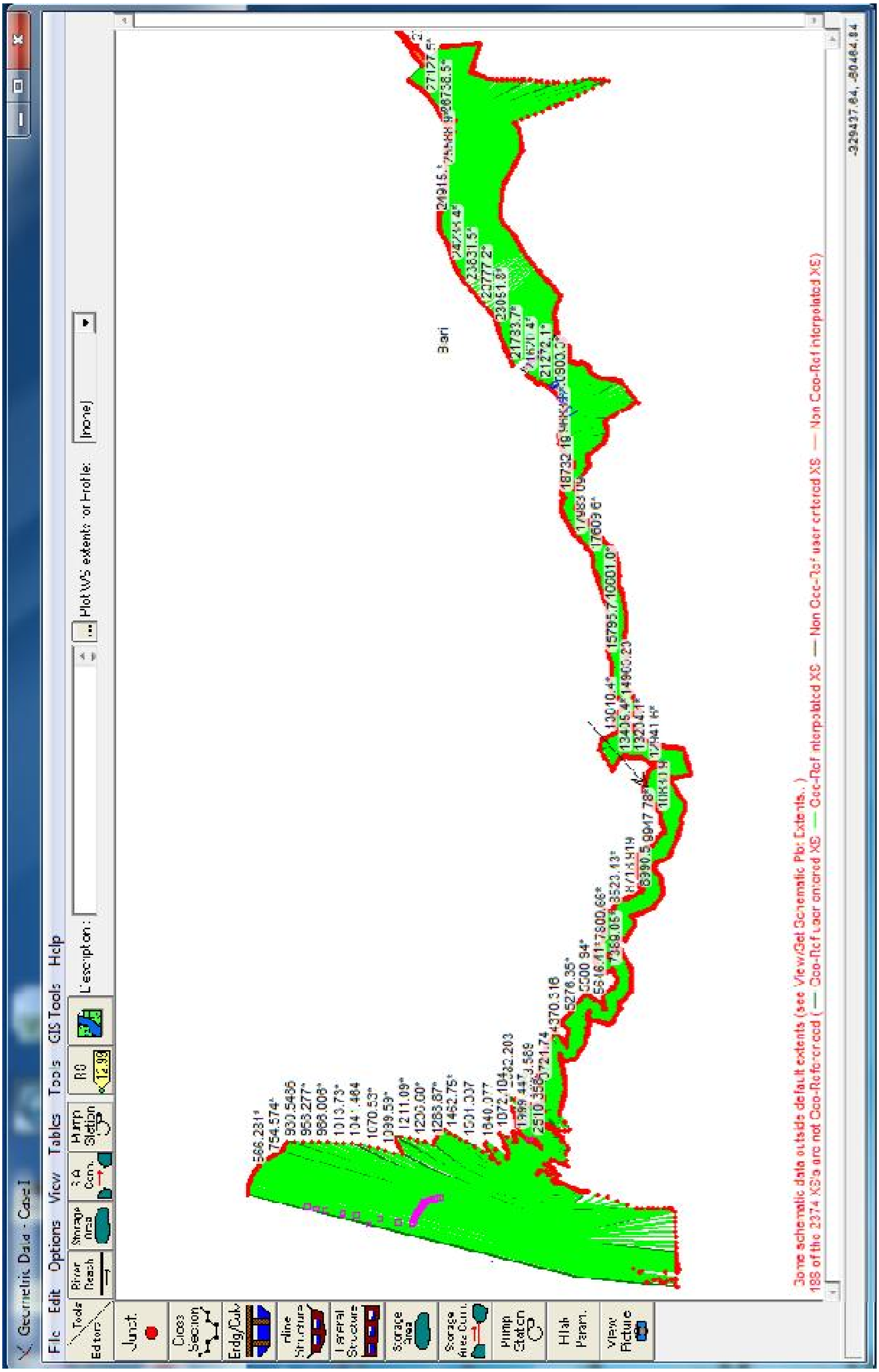


Figure 3-2 Interpolated cross sections for Bisri River dam breach model



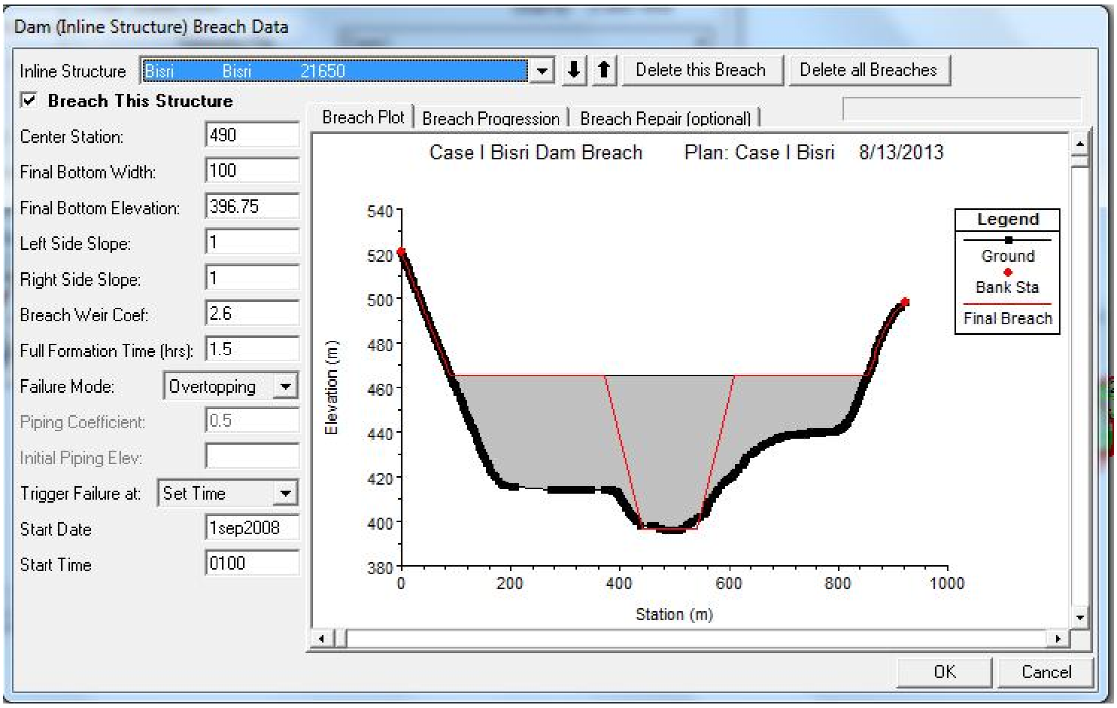
3.3.2 Bisri Dam Breach Data

HEC-RAS allows the modeling of the breach process by entering key data and assumptions regarding the dam, the reservoir and the breach most probable characteristics, as shown in Table 3.1 and Figure 3.3. The breach formation time for an embankment dam with the same characteristics as Bisri Dam was estimated to be 1.05 hours (Froehlich equations). The breach formation time used in the model was set to 1.5 hours to test stability of the model. The breach is produced by overtopping, since this is the most probable case. The bottom width of the breach is 100 m, representing the river channel width at the bottom of the dam (see Figure 3.4). In order to have a stable model, the river was considered wet at the beginning of the simulation with an initial flow of 200 m^3/sec.

Table 3-1 HEC-RAS Dam Breach Plan for Bisri Dam on Bisri River

Item	Value
River station of Dam	21650 m (upstream from the sea)
Pilot Flow	200 m^3/sec
Upstream Embankment slope	2.5:1 then 3.5:1
Downstream Embankment slope	2.5:1 then 3.5:1
Center station	490 m
Final Bottom Width	100 m
Final Bottom Elevation	397 m
Left side slope	1:1
Right side slope	1:1
Full formation time	1.5 hr
Failure mode	Overtopping
Trigger Failure	Set Time
Start time	0100

Figure 3-3 Bisri Dam breach model data



3.4 Hec-Ras Unsteady Flow Analysis Parameters

To model the dam breach process in HEC-RAS, an unsteady flow calculation is performed. A simulation period of 23 hours was used with the dam breach initiated one hour after the start of the simulation. The Bisri Dam is modeled as an “inline structure” in the HEC-RAS model. The dimensions of the dam are known from the plan (Fig. 2.6) and section (Fig. 2.7) illustrations and the data in Table 2.2. The data needed to represent the dam breach in HEC-RAS are shown in Table 3.1 and Figure 3.3.

Boundary condition and initial condition data must be entered for the unsteady analysis. Boundary conditions at the upstream river reach above the dam was entered as a constant flow rate of 200 m^3/sec. The downstream boundary condition at the sea was as a normal depth boundary condition with a water surface slope of 0.002 m/m. Also, the initial flow in the basin at the start of the simulation period was set to 200 m^3/sec in each section. A number of computational parameters have to be set in order to achieve a stable simulation when modeling a dam break flood. These parameters are shown in Figures 3.5 and 3.6.

Figure 3-4 Boundary and initial condition data for Bisri Dam breach model

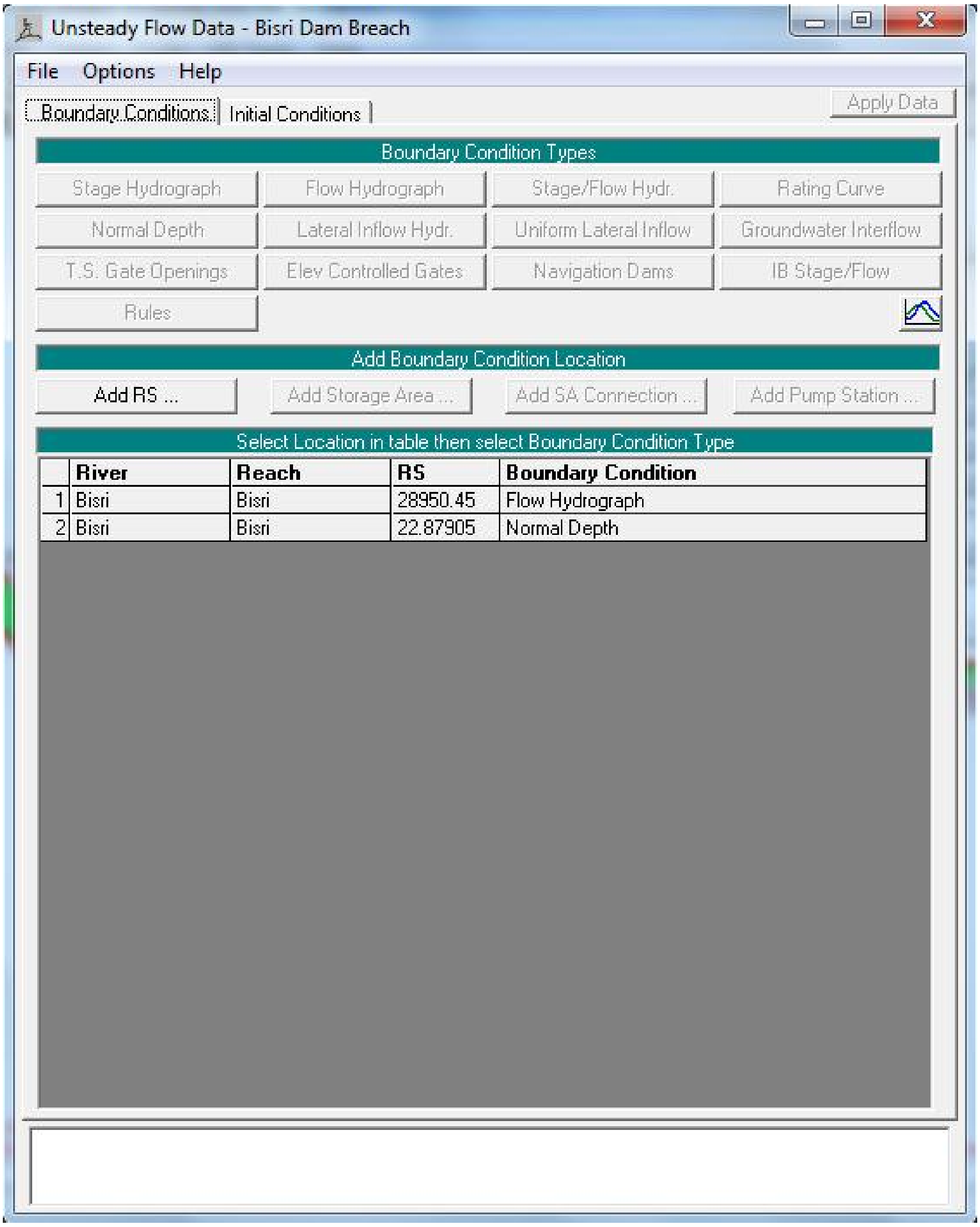


Figure 3-5 Unsteady flow simulation parameters for Bisri Dam breach model

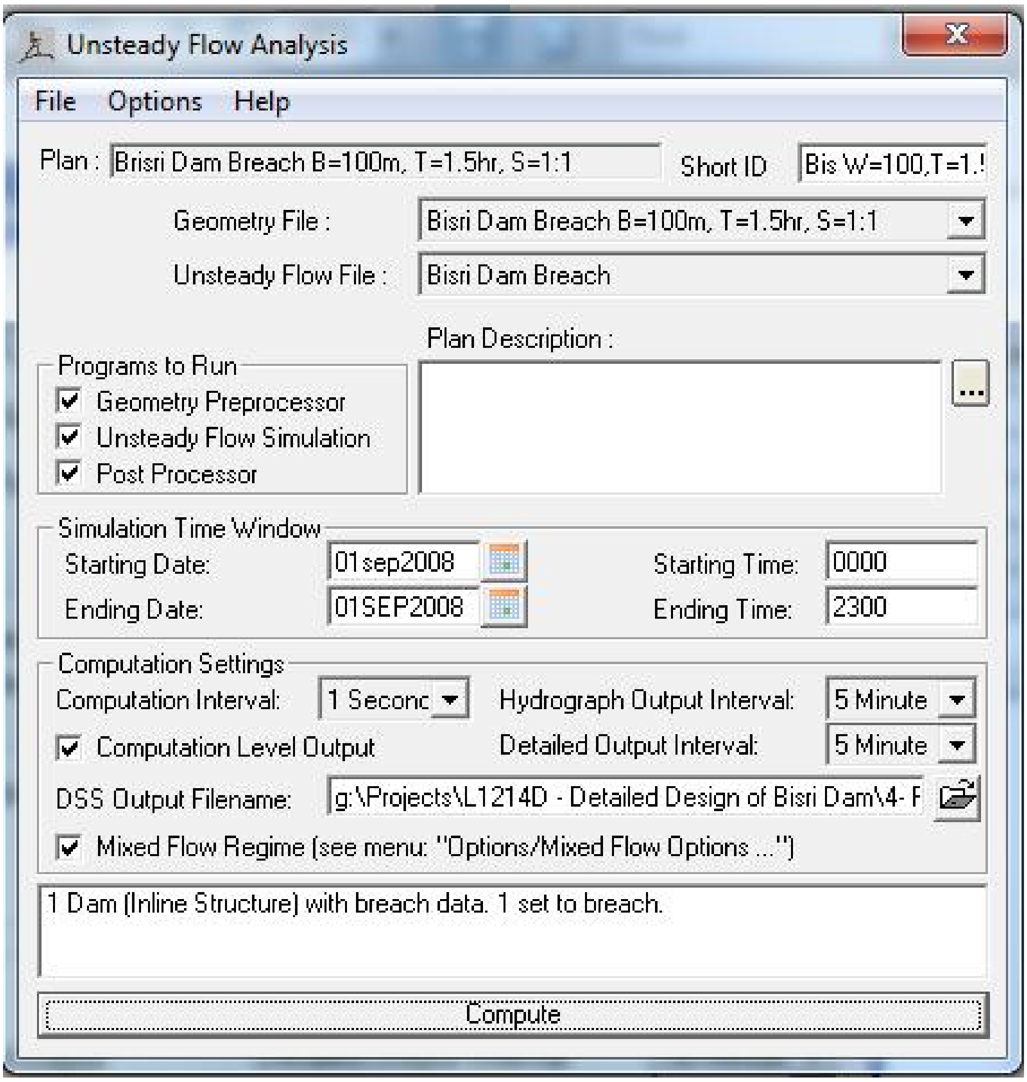
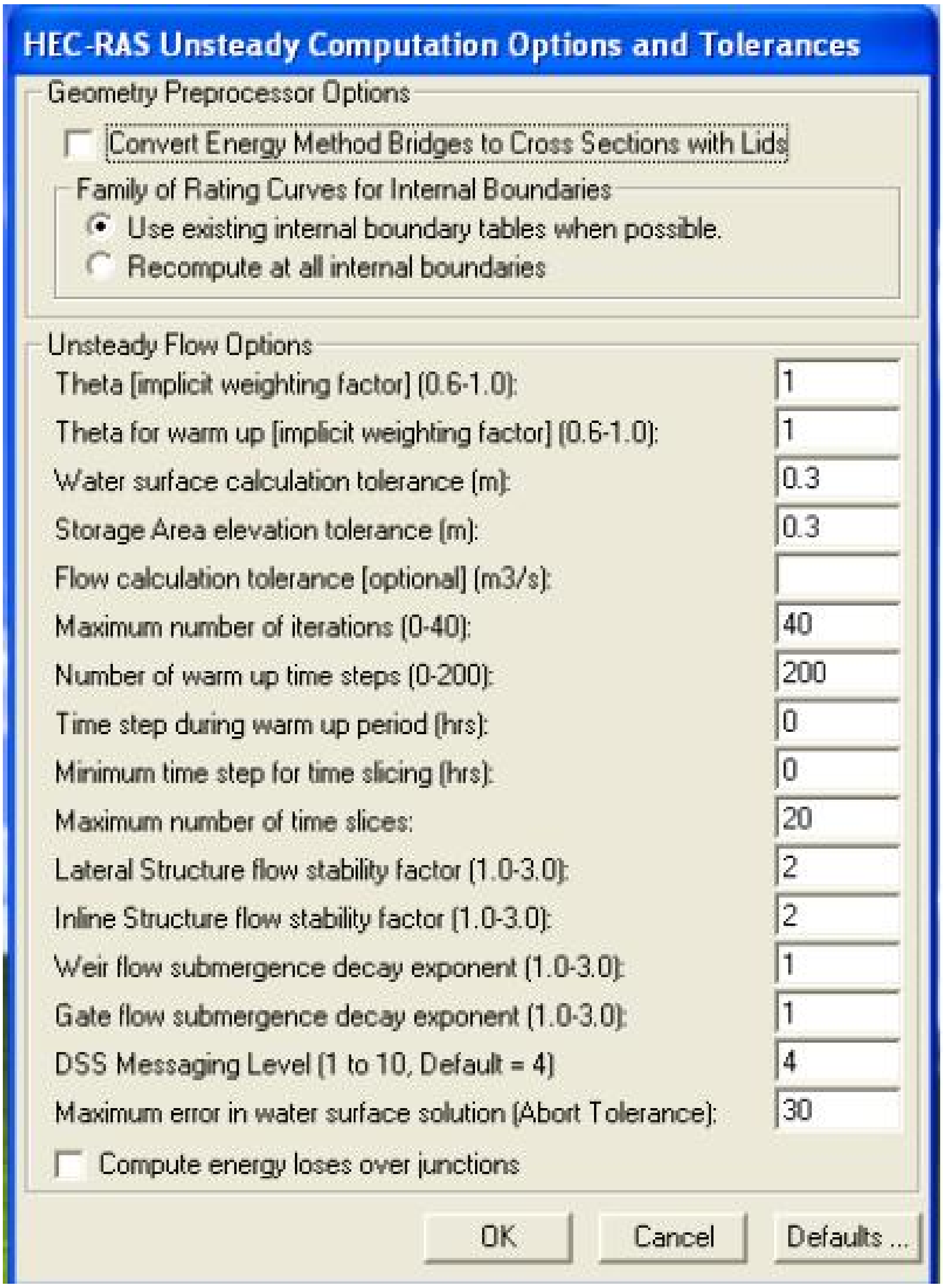


Figure 3-6 Computational parameters set for the Bisri Dam breach model



4 RESULTS

4.1 Dam Breach Time of 1.5 Hours

The time for the dam to breach is 1.5 hours, the peak of the outflow from the dam occurs 1 hour and 25 minutes after the beginning of the breaching process. The maximum flow rate from the dam is 43,000 m^3/sec. This value is comparable to the previous estimate (from Froehlich equations) of 42,500 m^3/s.

Table 4.1 lists some selected sections along with the main results: initial stage (water elevation) in the river before the dam breach; the maximum stage of the river during the flood; the height of the flood wave passing the section; and the time of the peak of the flood. The flood wave is about 30 m high and does not attenuate much till reaching the coastal valley. The peak flow abates progressively from initially 43,000 m^3/s to 41,000 m^3/s at the sea outlet.

Figures 4.1 and 4.2 show the water elevation, flow rate and cross-section for the cross section at the dam and at the sea outlet. From this it is possible to determine that the lag time between the peak flow below the dam at river station 21650 and the peak flow at the downstream cross section at the mouth of the river is 30 minutes. Hence, the dam breach wave would travel the 21.6 km in 30 minutes that is at a pace of 43.2 km/hr.

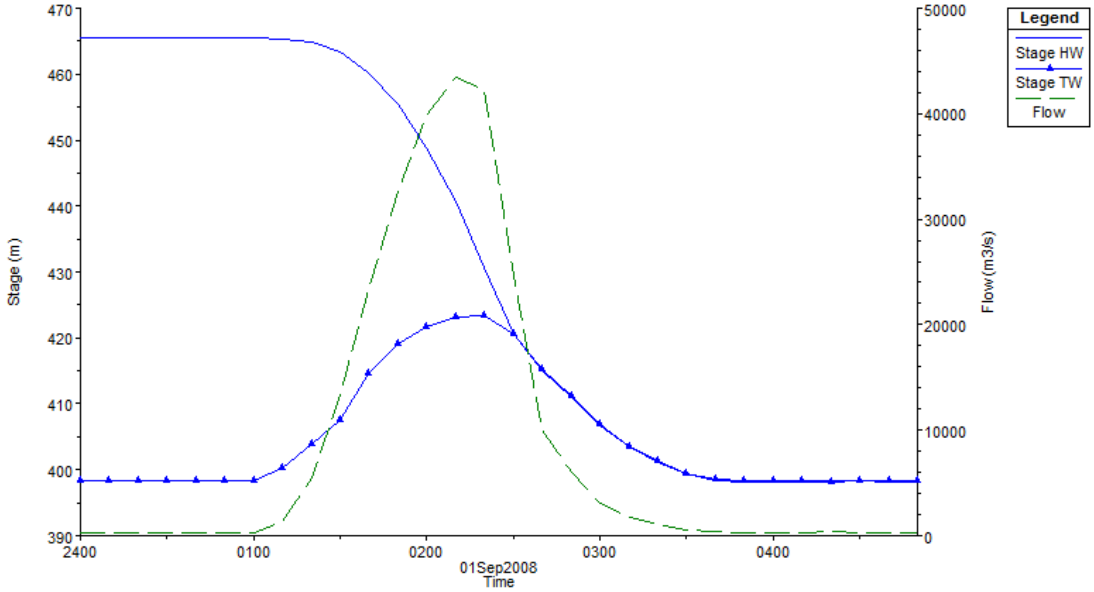
Figures 4.3 to 4.18 show the water levels at several times counting from the initiation of the breach and Figure 4.19 shows the maximum flood Plain. Figure 4.20 shows the Flood Hydrographs corresponding to different locations (0km corresponds to the sea mouth).

Table 4-1 Maximum stage, flow and time of peak flow for selected Bisri River stations below Bisri Dam

Cross-section (distance in km from sea outlet)	Initial Rise Time *	Peak Time *	End Time *	Peak Flow	Flood Height
	hr:min	hr:min	hr:min	m^3/sec	m
21.6 (dam)	0:00	1:10	2:40	43200	28
19 km	0:20	1:20	3:00	43100	27
10.9 km	0:40	1:30	3:40	42100	25
5.4 km	0:50	1:40	4:10	41100	20
Sea outlet	1:00	1:40	4:50	41000	10

* Time from time of breach initiation

Figure 4-1 (a) Hydrograph at Dam, (b) Cross Section just Downstream Dam



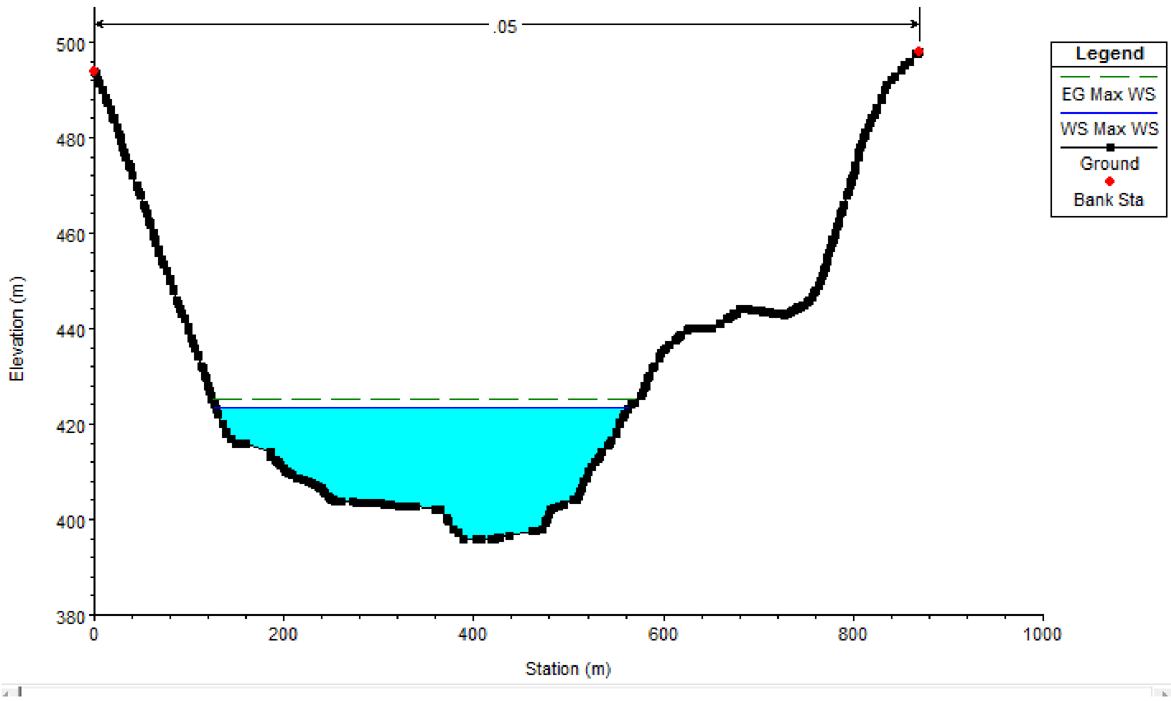
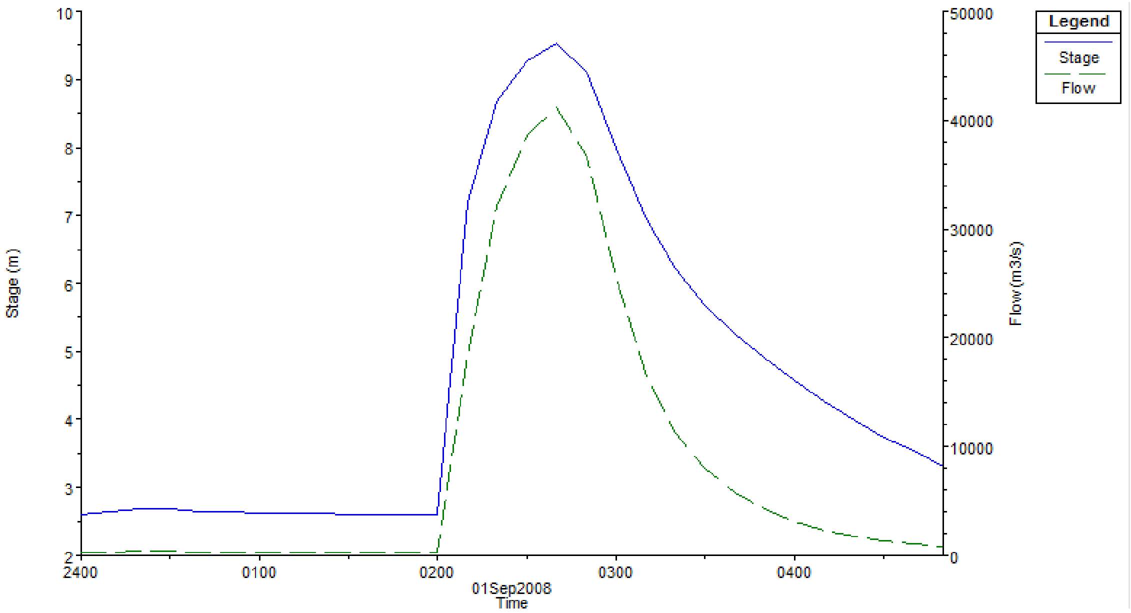
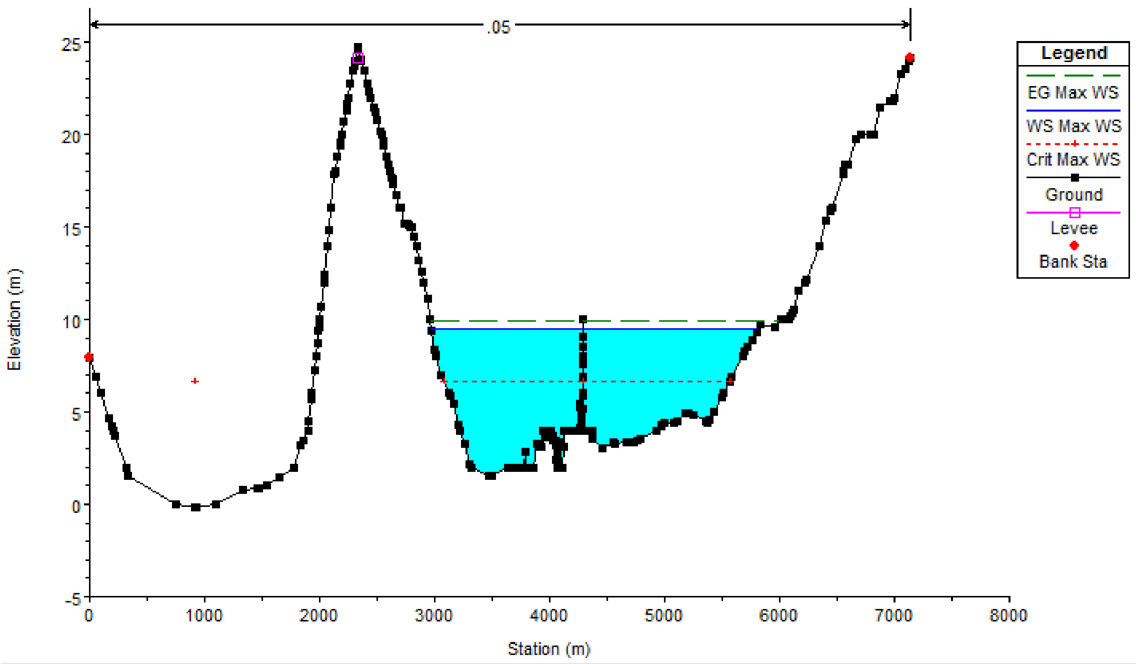


Figure 4-2 (a) Hydrograph at station Sea Outlet, (b) Cross Section at station Sea Outlet





Floodplain Prior To Dam Breach

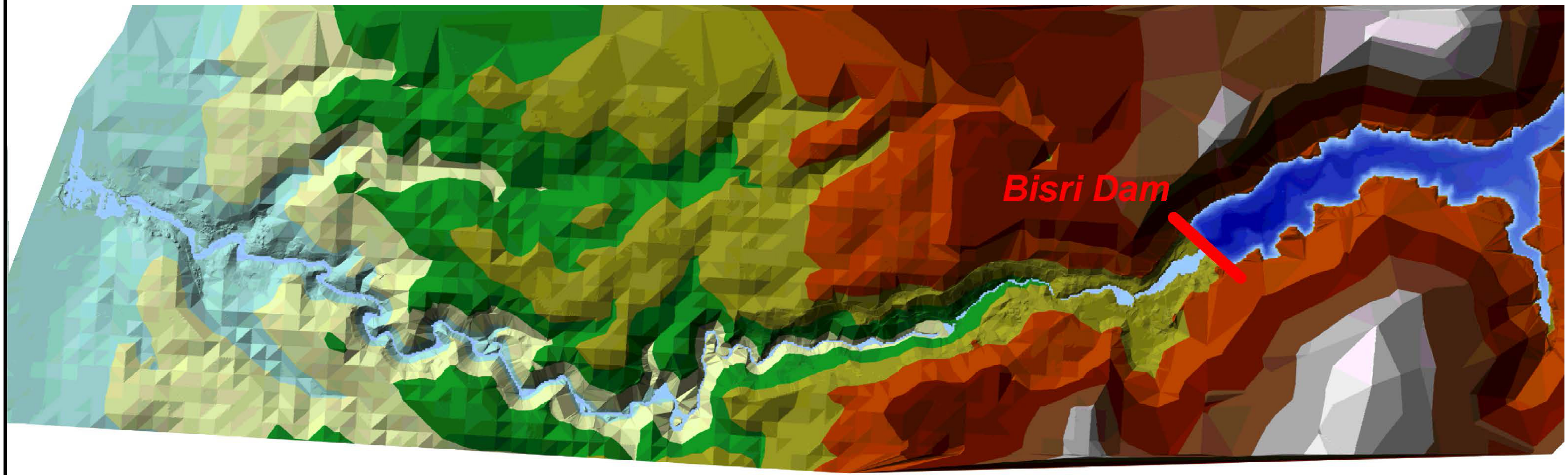


Fig. 4.3

Water Depth (m)

Value

High : 69.4281

Low : 0.00109863

0 0.5 1 2 3 4 Kilometers

Floodplain 10 Minutes After Start of Dam Breach

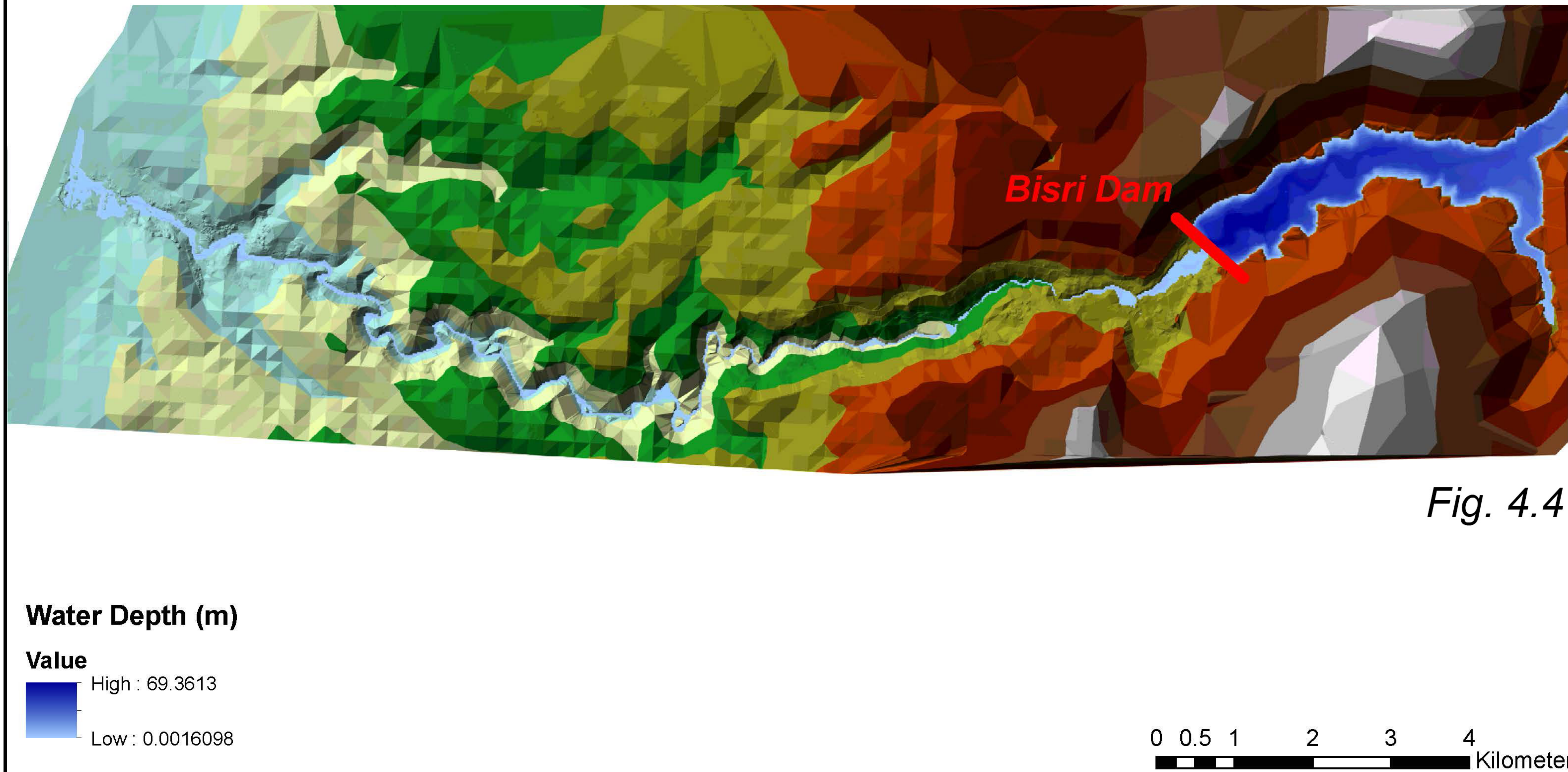


Fig. 4.4

Floodplain 20 Minutes After Start of Dam Breach

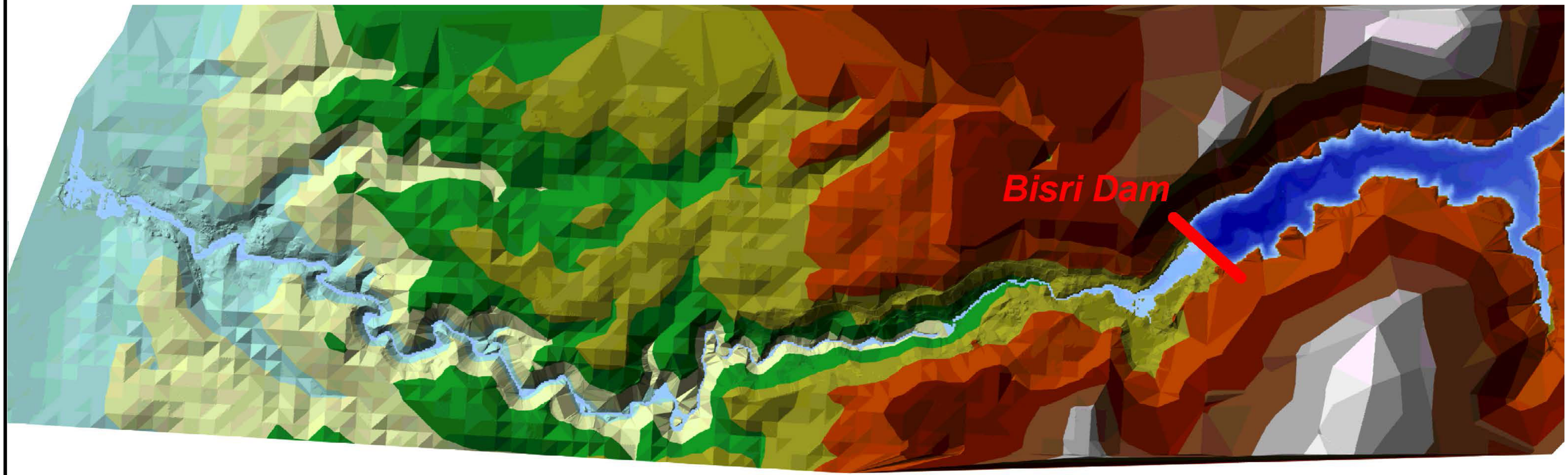


Fig. 4.5

Floodplain 40 Minutes After Start of Dam Breach

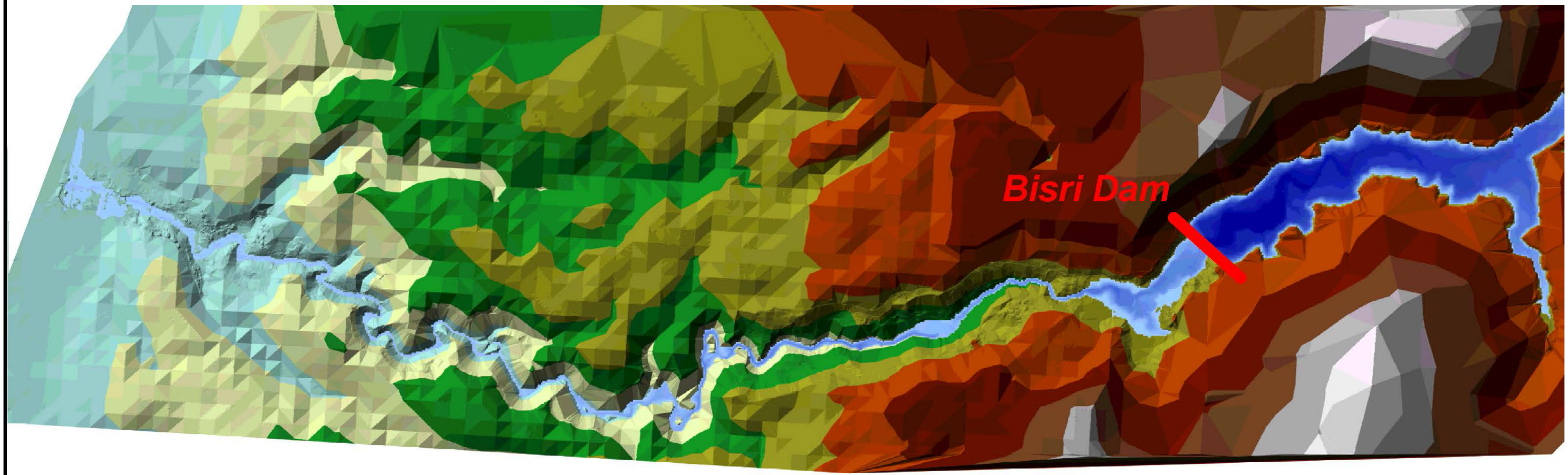


Fig. 4.7

Water Depth (m)

Value

High : 64.7365

Low : 0.000213623

0 0.5 1 2 3 4 Kilometers

Floodplain 40 Minutes After Start of Dam Breach

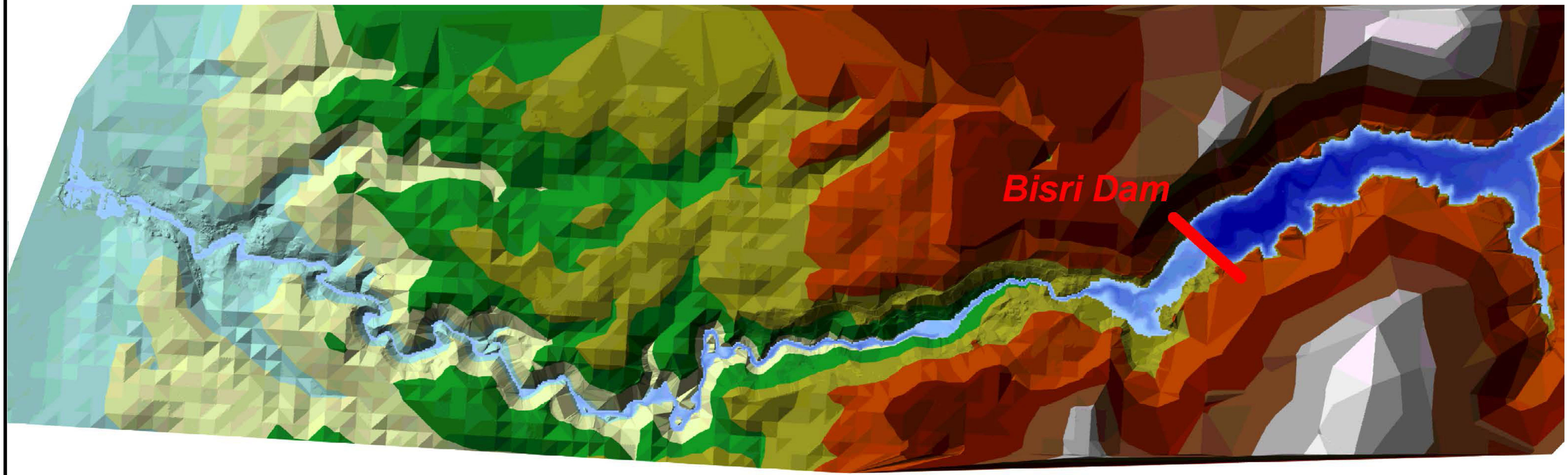


Fig. 4.7

Floodplain 50 Minutes After Start of Dam Breach

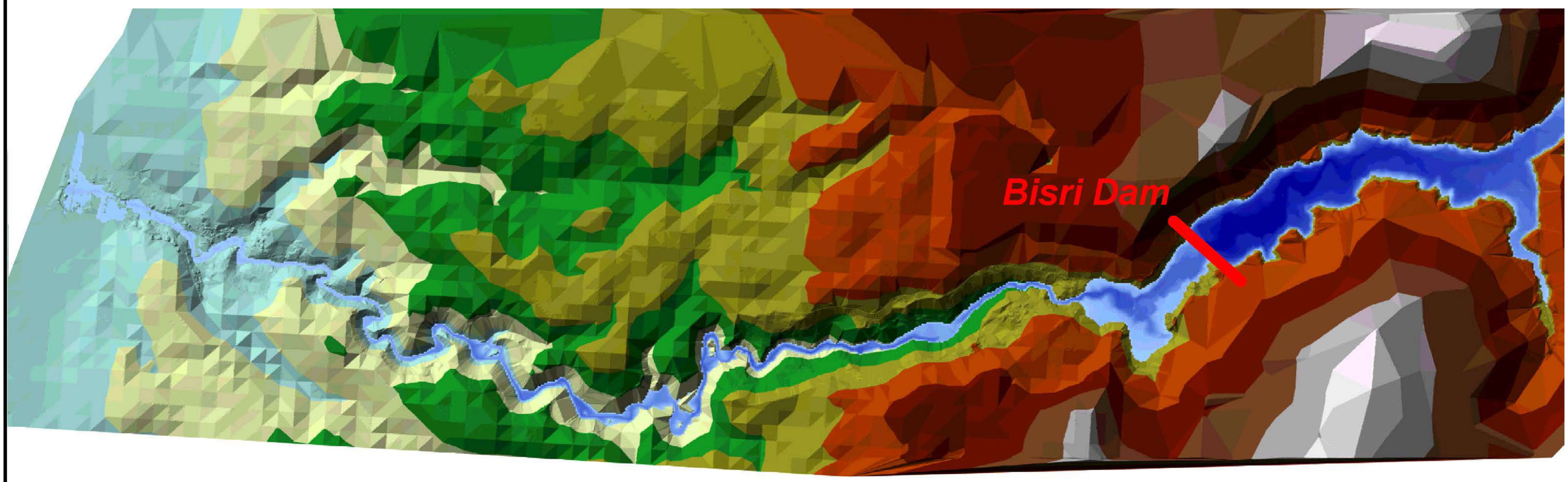


Fig. 4.8

Water Depth (m)

Value

High : 60.2755

Low : 6.10352e-005

0 0.5 1 2 3 4 Kilometers

Floodplain 60 Minutes After Start of Dam Breach

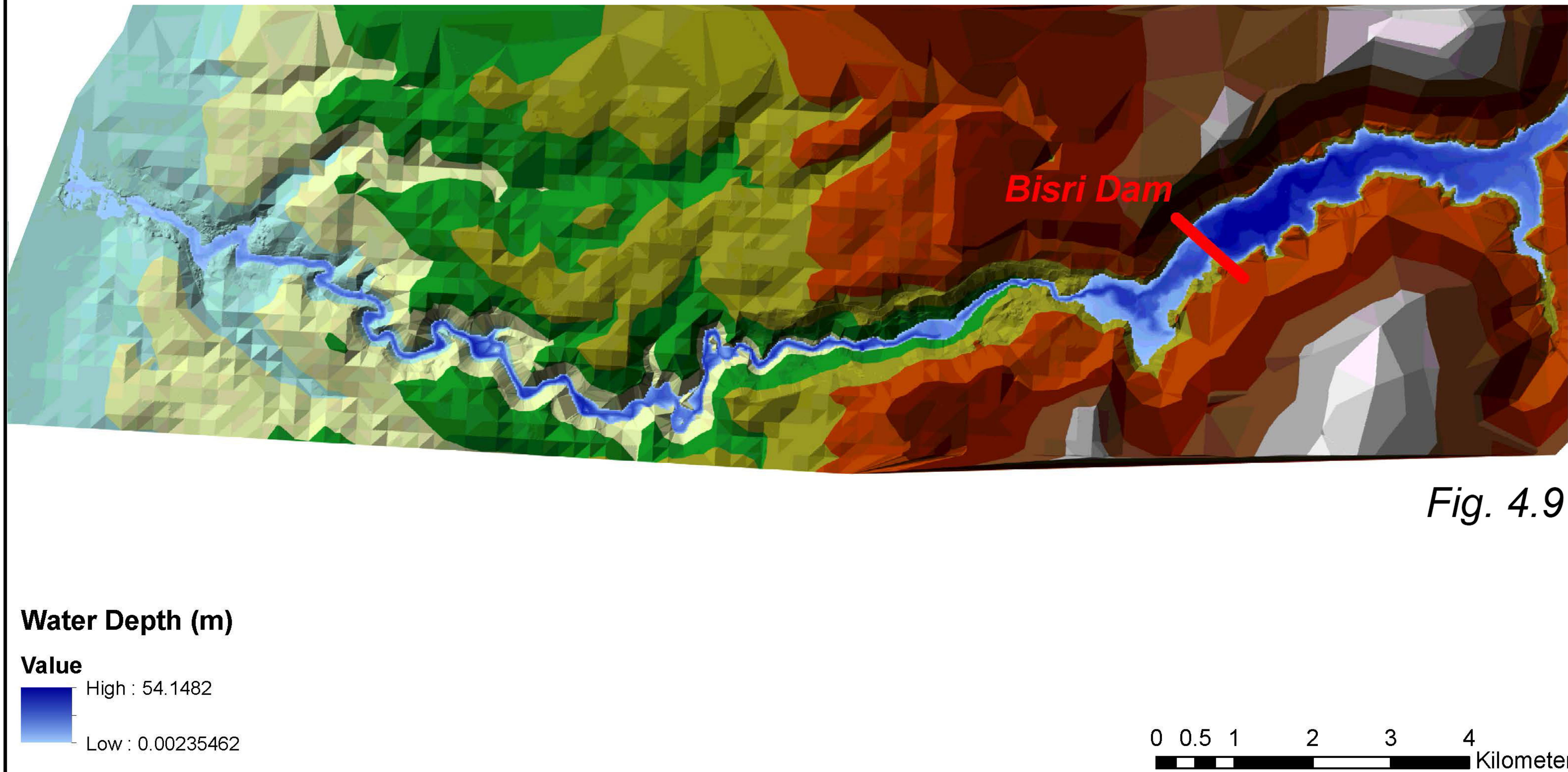


Fig. 4.9

Floodplain 70 Minutes After Start of Dam Breach

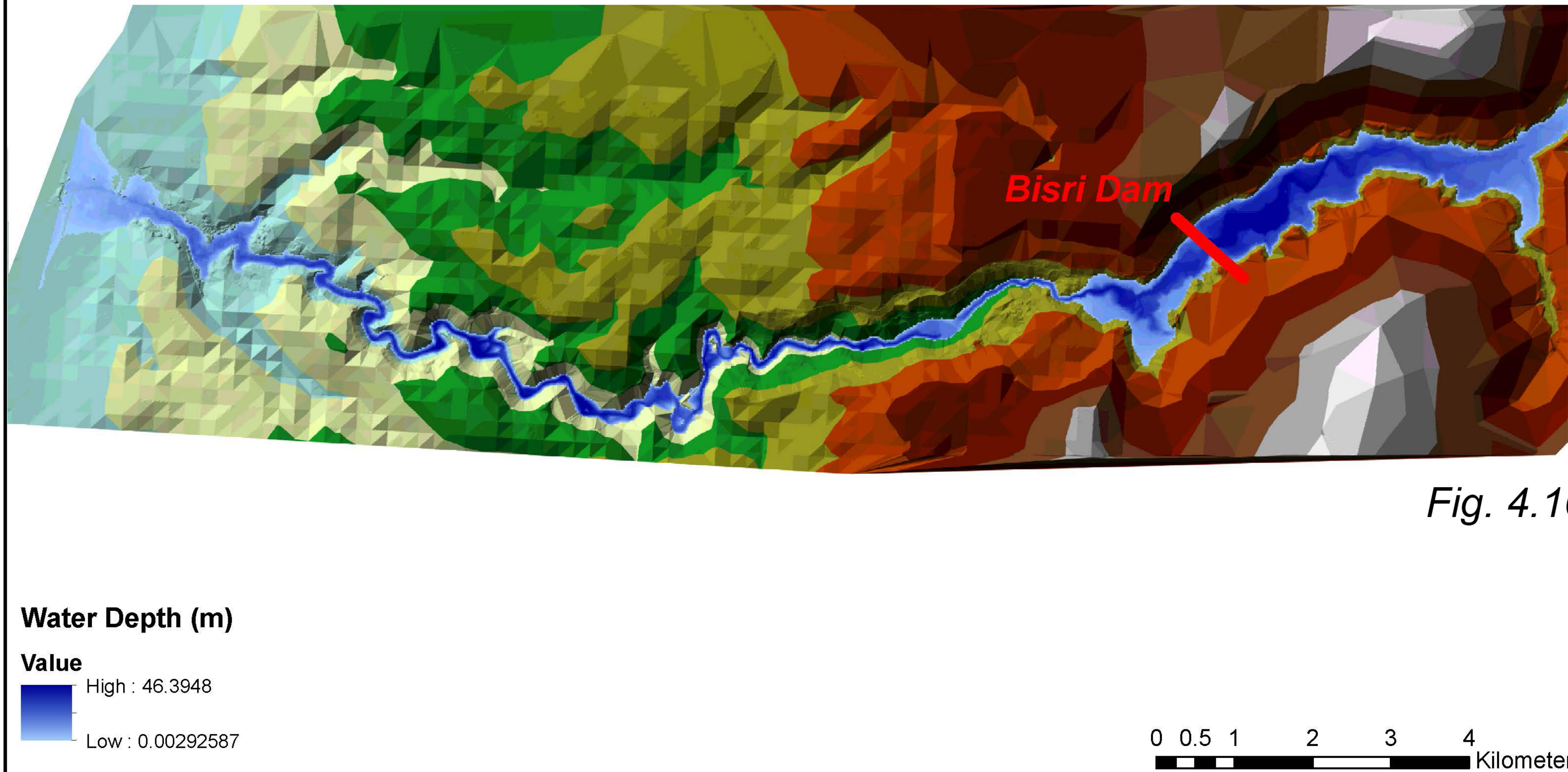


Fig. 4.10

Floodplain 80 Minutes After Start of Dam Breach

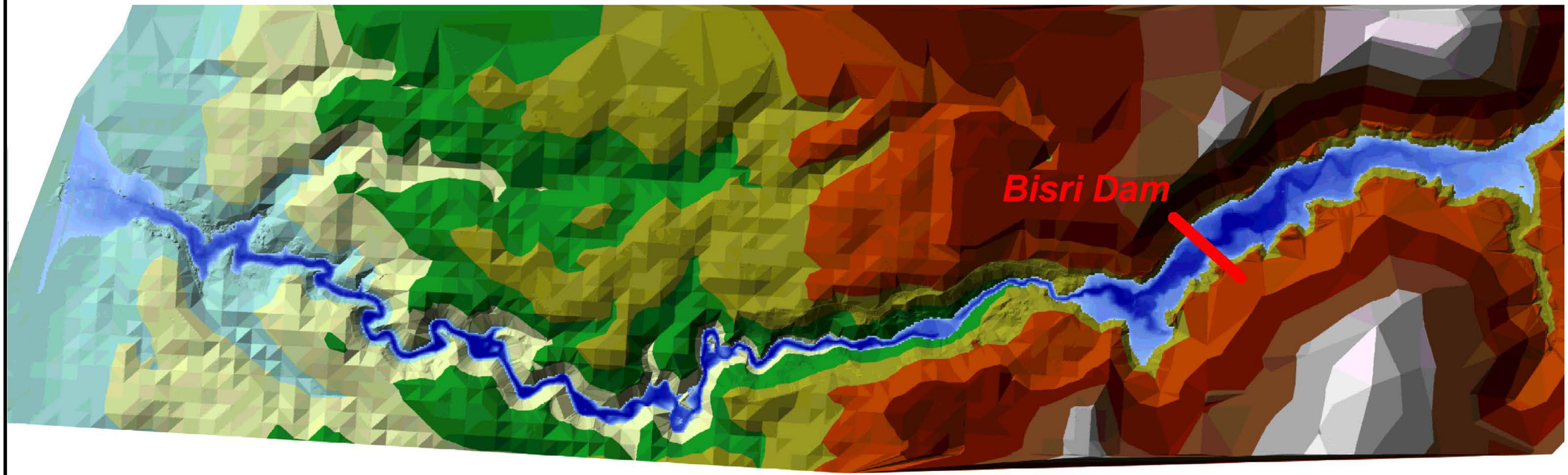


Fig. 4.11

Water Depth (m)

Value

High : 50.154

Low : 0.000348091

0 0.5 1 2 3 4 Kilometers

Floodplain 90 Minutes After Start of Dam Breach

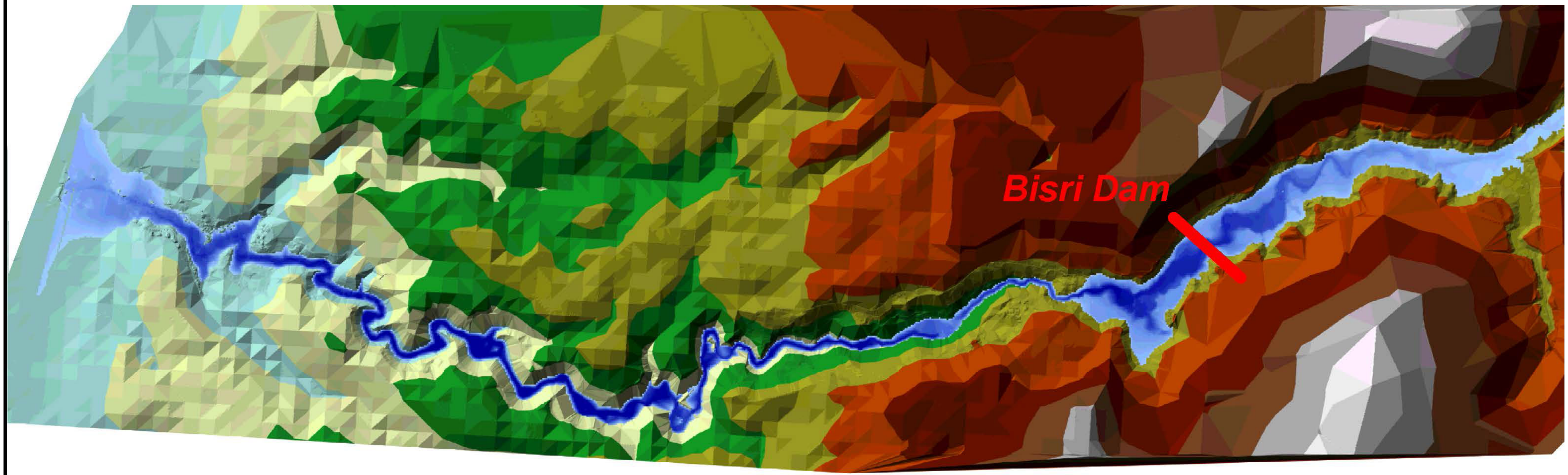


Fig. 4.12

Water Depth (m)

Value

High : 52.6679

Low : 0.000152588

0 0.5 1 2 3 4 Kilometers

Floodplain 100 Minutes After Start of Dam Breach

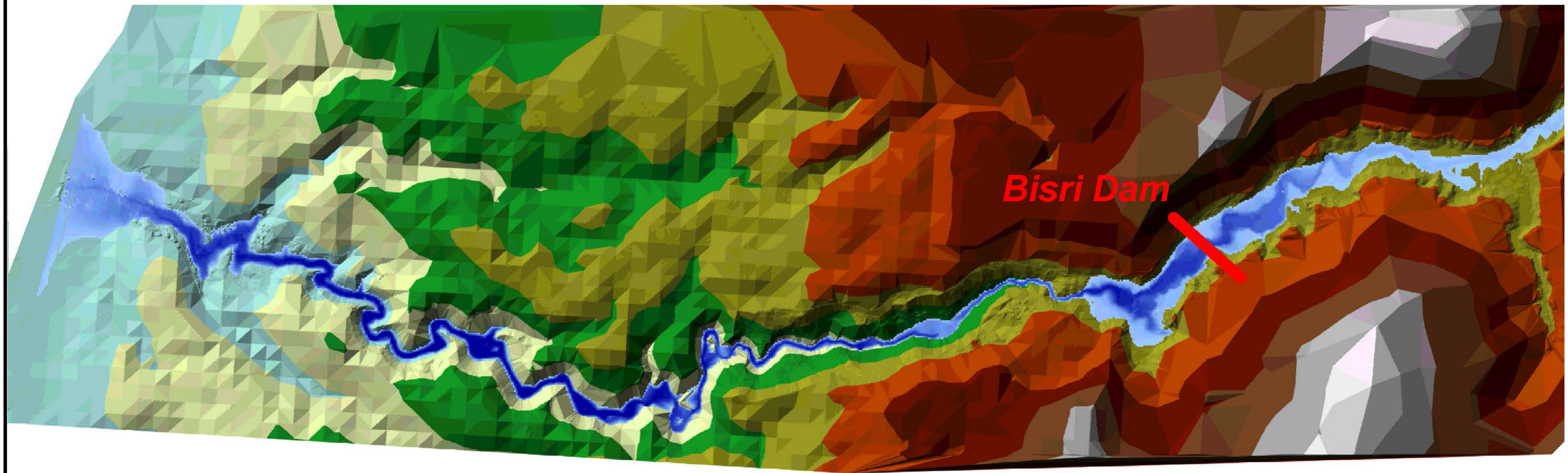


Fig. 4.13

Floodplain 110 Minutes After Start of Dam Breach

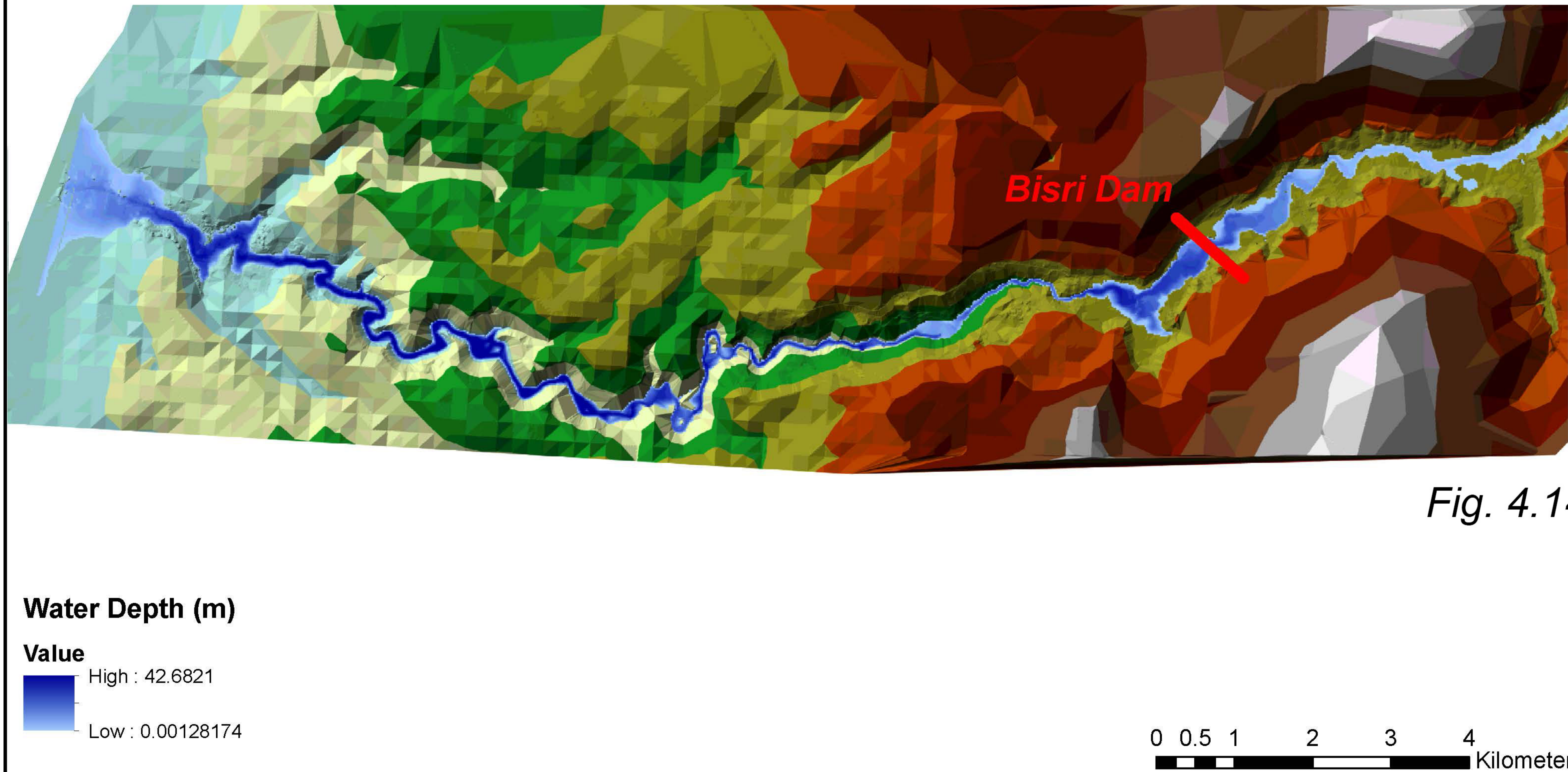


Fig. 4.14

Floodplain 120 Minutes After Start of Dam Breach

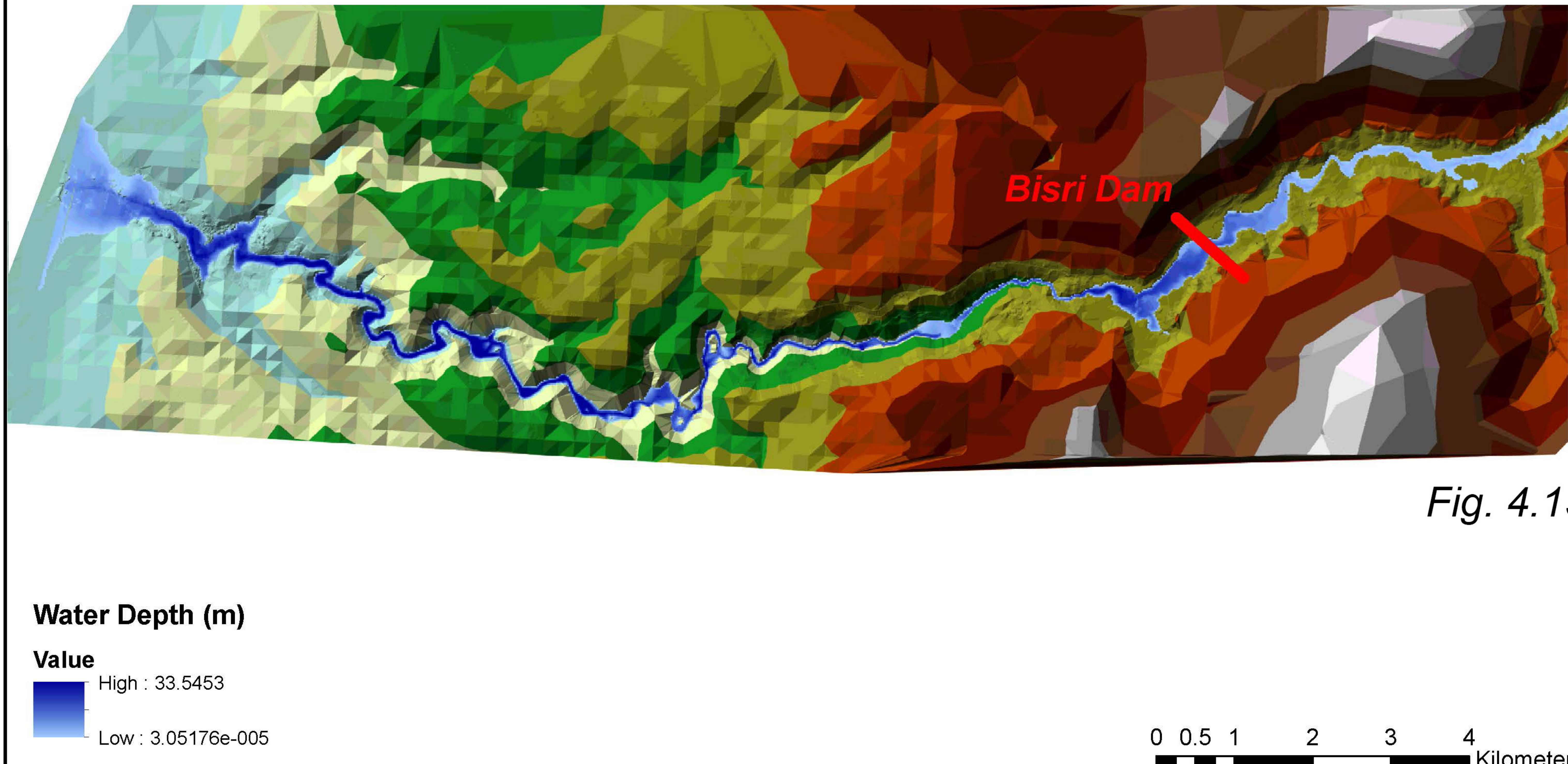


Fig. 4.15

Floodplain 130 Minutes After Start of Dam Breach

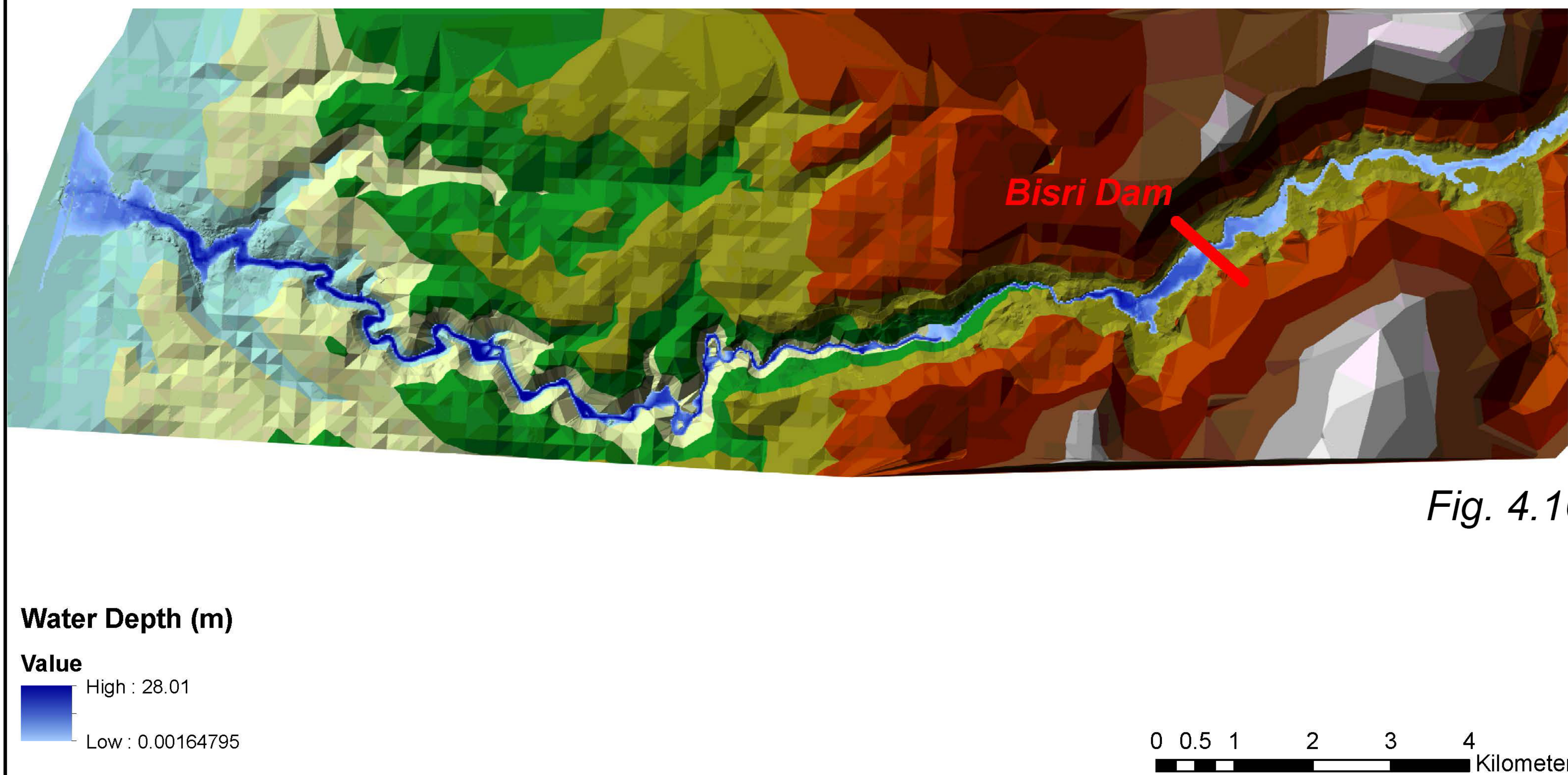


Fig. 4.16

Floodplain 140 Minutes After Start of Dam Breach

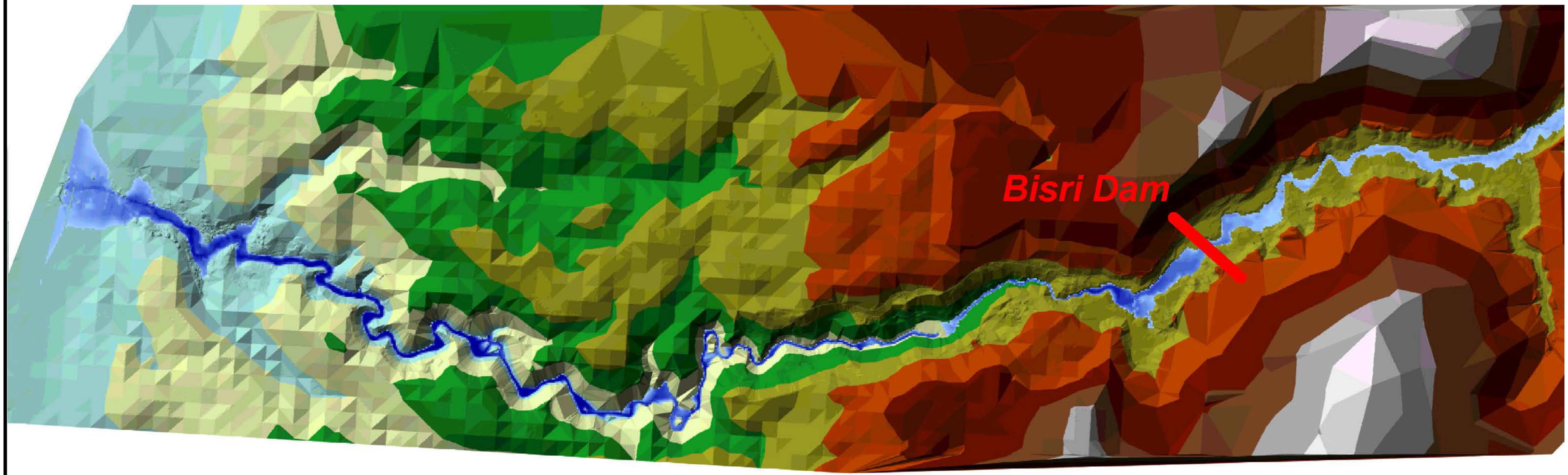


Fig. 4.17

Floodplain 150 Minutes After Start of Dam Breach

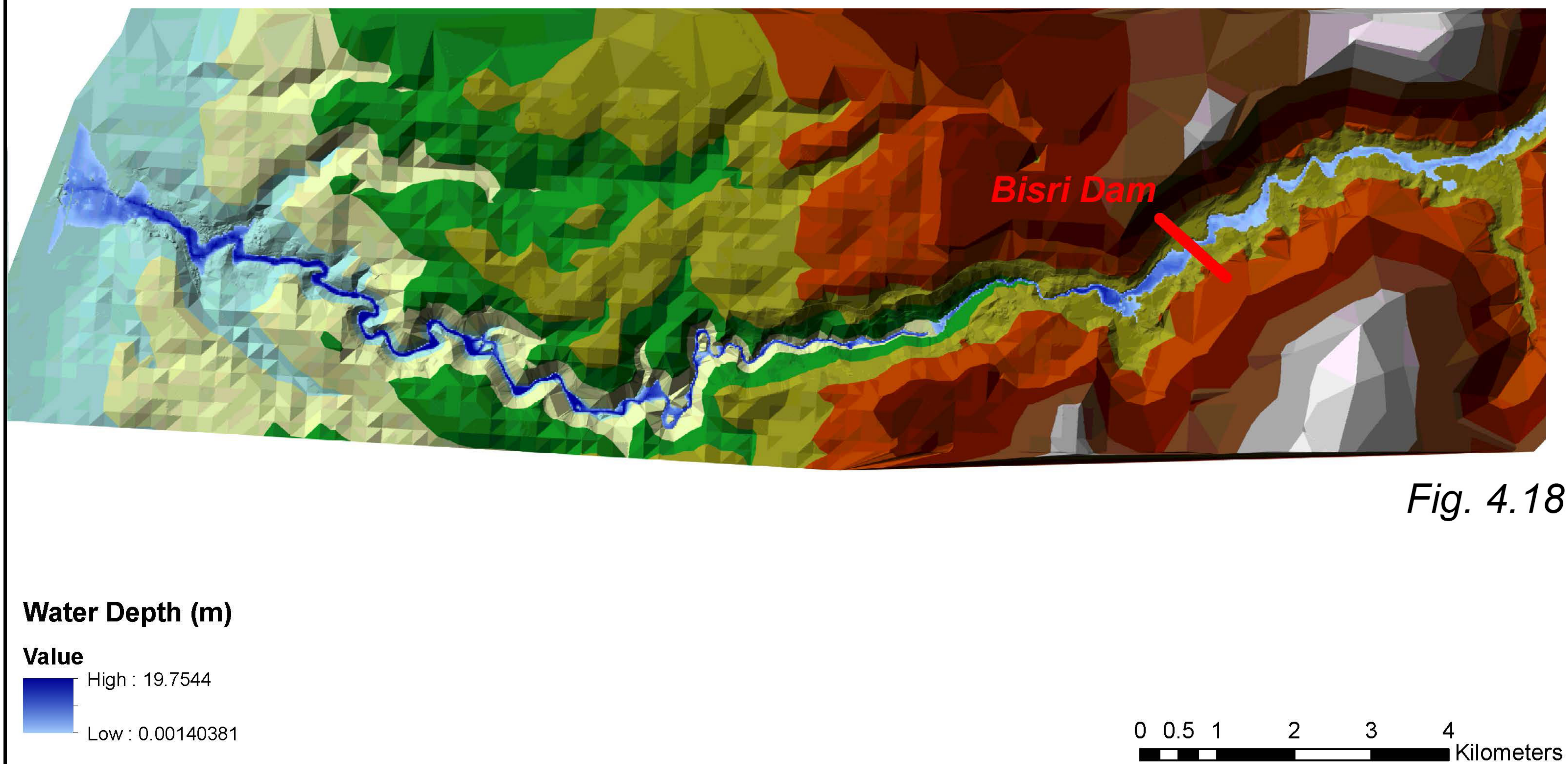


Fig. 4.18

Maximum Floodplain

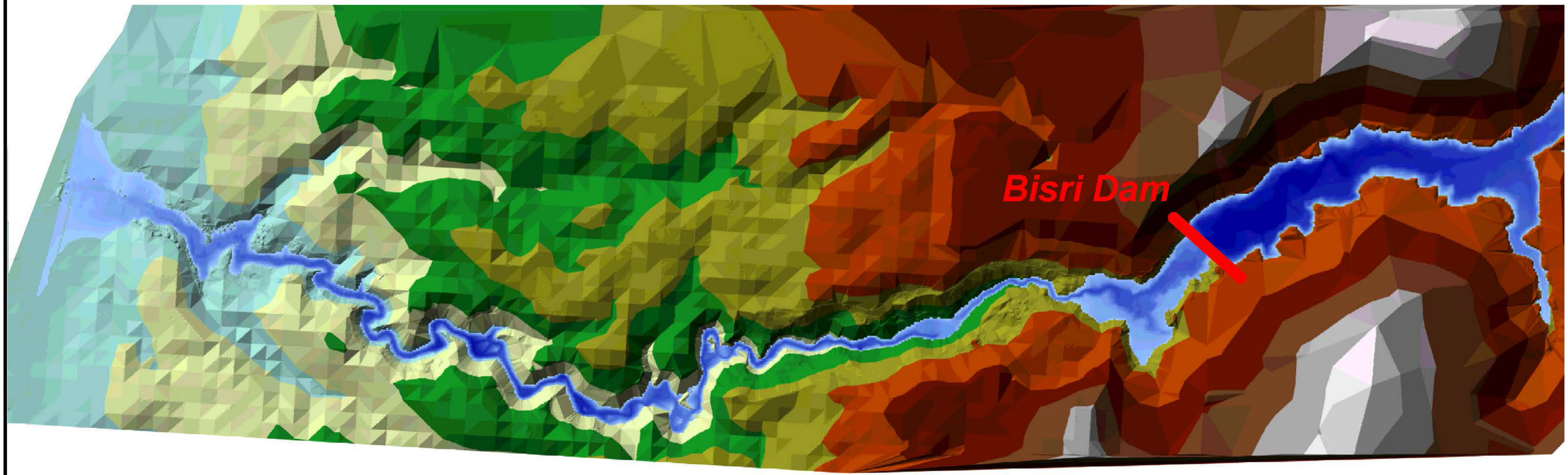
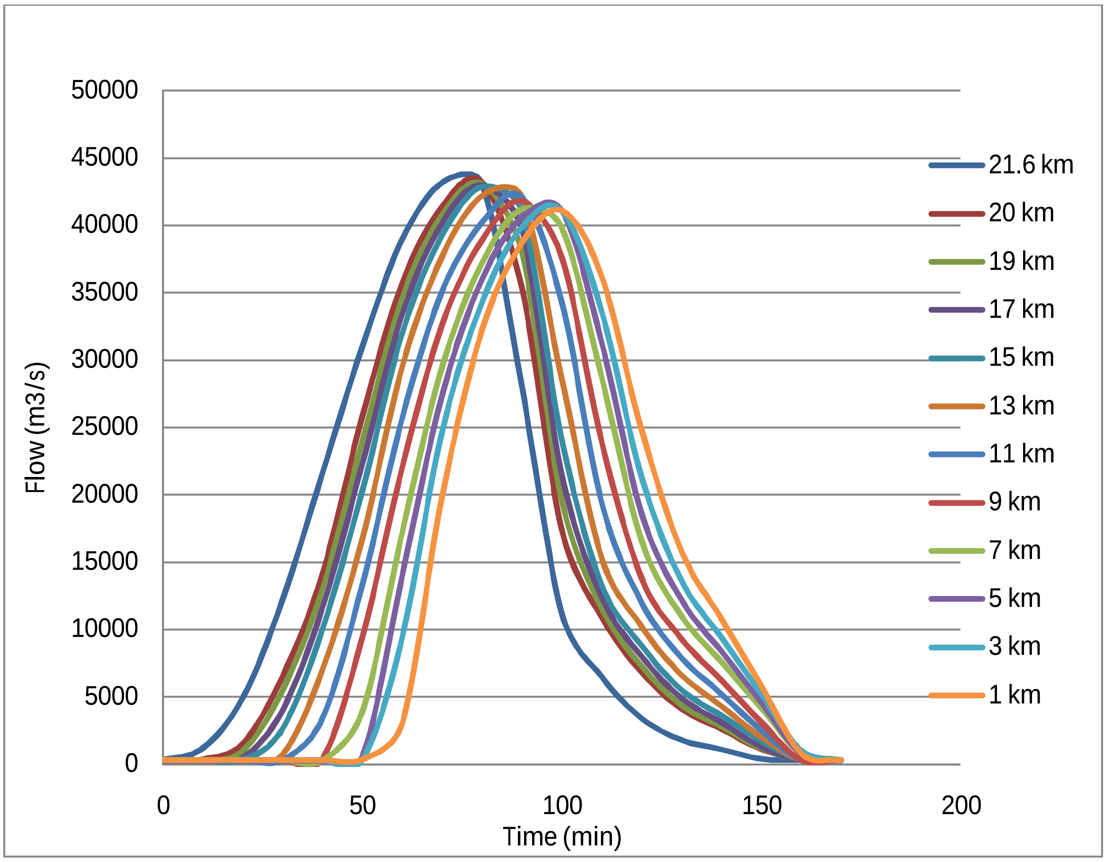


Fig. 4.19

Figure 4-20 Flood Hydrographs at different locations throughout the Bisri River



4.2 Sensitivity Analysis of Dam Breach Time

Table 4.2 lists the results for a breaching time of 2 hours. For the dam and the outlet stations the table lists the height of the flood wave passing the section; the time of the peak of the flood, and the peak follow of the flood. The flood wave is between 9m and 28m in height. These results show a flood of lower magnitude than for a 1.5-hour breaching time.

Table 4-2 Maximum stage, flow and time of peak flow for selected Bisri River stations below Bisri Dam with a 2.0 hour breach formation time

Cross-section (distance in km from sea outlet)	Initial Rise Time *	Peak Time *	Peak Flow	Flood Height
	hr:min	hr:min	m^3/sec	m
21.6 (dam)	0:00	1:30	34000	25
Sea outlet	1:10	2:00	33000	9

Table 4.3 shows the results for a breaching time of 3 hours. For the dam and the outlet stations the table lists the height of the flood wave passing the section; the time of the peak of the flood, and the peak follow of the flood. The flood wave is between 8m and 23m in height. These results also show a flood of lower magnitude than for a 1.5-hour breaching time.

Table 4-3 Maximum stage, flow and time of peak flow for selected Bisri River stations below Bisri Dam with a 3 hour breach formation time

Cross-section (distance in km from sea outlet)	Initial Rise Time *	Peak Time *	Peak Flow	Flood Height
	hr:min	hr:min	m^3/sec	m
21.6 (dam)	0:00	2:00	24000	23
Sea outlet	1:20	2:30	23000	8

4.3 Sensitivity Analysis of Breach Side Slopes

In the results reported above the side slope of the breach formed in the dam is specified as 1:1. The time for the dam to breach is 1 hours and 30 minutes, the peak of the outflow from the dam occurs 30 minutes after the beginning of the breaching process. The maximum flow rate from the dam is 43,000 m^3/sec. In order to understand the impact of the breach slope on the resulting flood characteristics, a breach slope of 2:1 was simulated.

Table 4.4 lists the results for a breach slope of 2:1. These results are almost the same as the results for a breach slope of 1:1, indicating slopes beyond the 1:1 do not have much impact on the flood formation, since the flow from the breach occurs before the water has a chance to further widen the breach beyond the 1:1 slope.

Table 4-4 Maximum stage, flow and time of peak flow for selected Bisri River stations below Bisri Dam with a 1.5 hour breach formation time and side slopes of 2:1 instead of 1:1

Cross-section (distance in km from sea outlet)	Initial Rise Time *	Peak Time *	Peak Flow	Flood Height
	hr:min	hr:min	m^3/sec	m
21.6 (dam)	0:00	1:10	43000	28
Sea outlet	1:00	1:40	41000	10

5 VALIDATION USING A 3D MODEL

5.1 Introduction

The dynamics of the dam-break wave propagation is quite complex and its behavior does not comply with the common assumptions of conventional steady and gradually-varied open channel flows. Dam break flows are highly unsteady and rapidly varied, typically with mixed subcritical and supercritical flow regimes.

In most practical dam-break applications, one dimensional numerical modeling is commonly used to simulate the flood wave propagation downstream from the dam. However, in certain cases the simplifications assumed in one dimensional models may be too restrictive to accurately reproduce the flood wave dynamics such as when the flow is not confined to a single channel or the channel has sharp bends. Such special cases require the application of a full three dimensional flow model. Accordingly, a three dimensional Computational Fluid Dynamics (CFD) model was performed.

5.2 Objective

The work aims to validate the HEC-RAS model by using a three dimensional CFD mathematical model of commercial use "Flow-3D" for the representation and verification of the inundation modeling and wave propagation from the flow originated by the breaching of Bisri dam.

5.3 Methodology

5.3.1 Software

Flow-3D was developed by Flow Science Inc. in the United States and it is a code that simulates fluid dynamics based on the numerical solution of the Navier-Stokes equations and continuity. It computes the three velocity components and pressure at the nodes of orthogonal Finite Difference Grid, using different turbulence models (K-ε, RNG, LES). Among the general-purpose CFD programs commercially available in the market, Flow 3D stands out for its capabilities intended for hydraulic engineering applications. The free surface in Flow-3D is tracked by means of the VOF method (Volume of Fluid) and the model uses FAVOR method to determine the solid boundaries.

5.3.2 CFD Model

5.3.2.1 Geometry and Boundary Conditions

For the simulation of Bisri dam breach three linked meshes were used and all of them had cubic cells of 10 meters size. Figure 5.1 and Table 5.1 show the location and boundary conditions of each mesh.

Table 5-1 Characteristics of Meshes

Mesh Number	Coordinates						Boundary Condition
	$X_{minimum}$	$X_{maximum}$	$Y_{minimum}$	$Y_{maximum}$	$Z_{minimum}$	$Z_{maximum}$	
Mesh 1	-338000	-334785	-64400	-61500	50	600	Flow rate equals 43,412 m^3/s obtained from HEC-RAS
Mesh 2	-342000	-338000	-65000	-62400	50	500	Continuity of flow
Mesh 3	-347900	-342000	-65000	-60700	-5	300	Outflow conditions

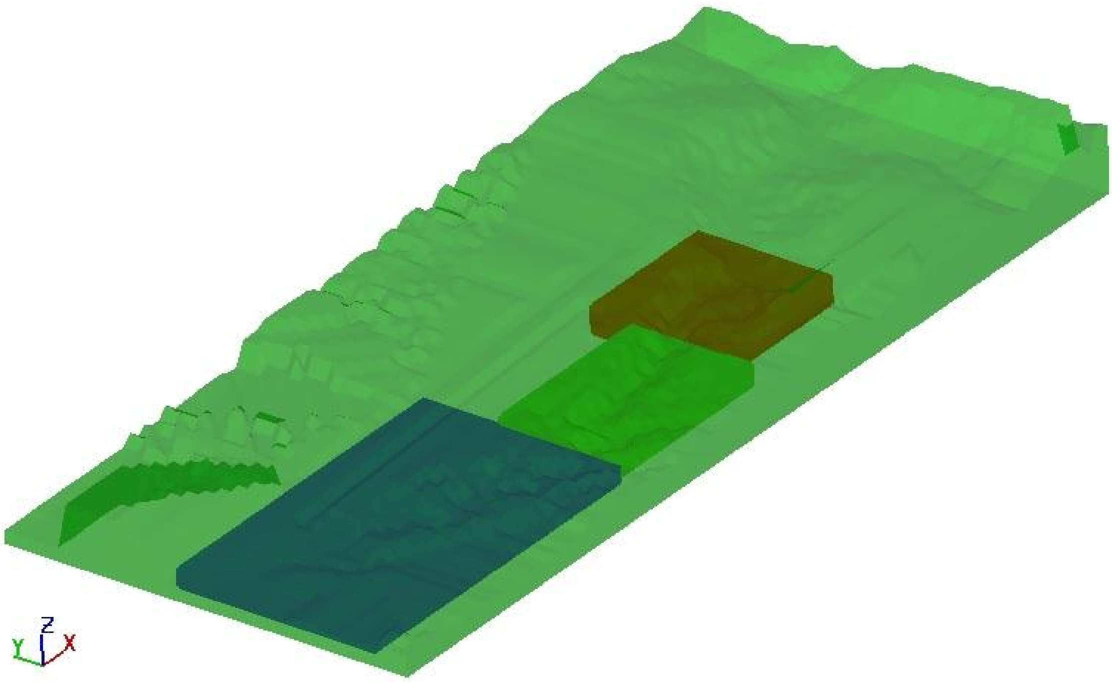


Figure 5-1 Meshes used in the modeling

5.3.2.2 Physical Models

The fluid was considered monophasic and incompressible, at a temperature of 20°C. The physical models activated were gravity and turbulence. The gravity acceleration was set to 9.81m/s2 and the turbulence model used is the standard Κ-ε model.

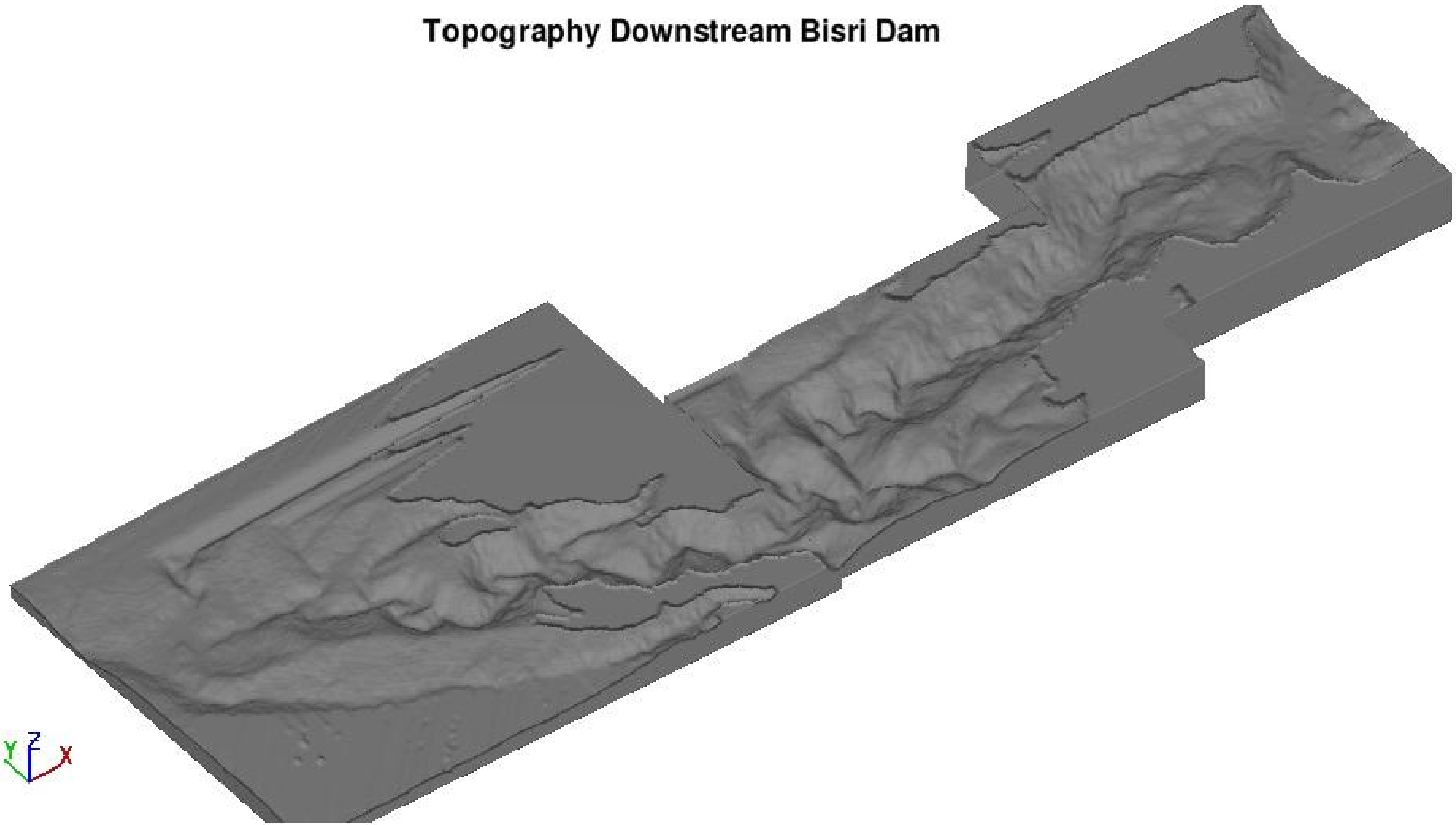


Figure 5-2 3D View of topography after meshing for area downstream Bisri dam

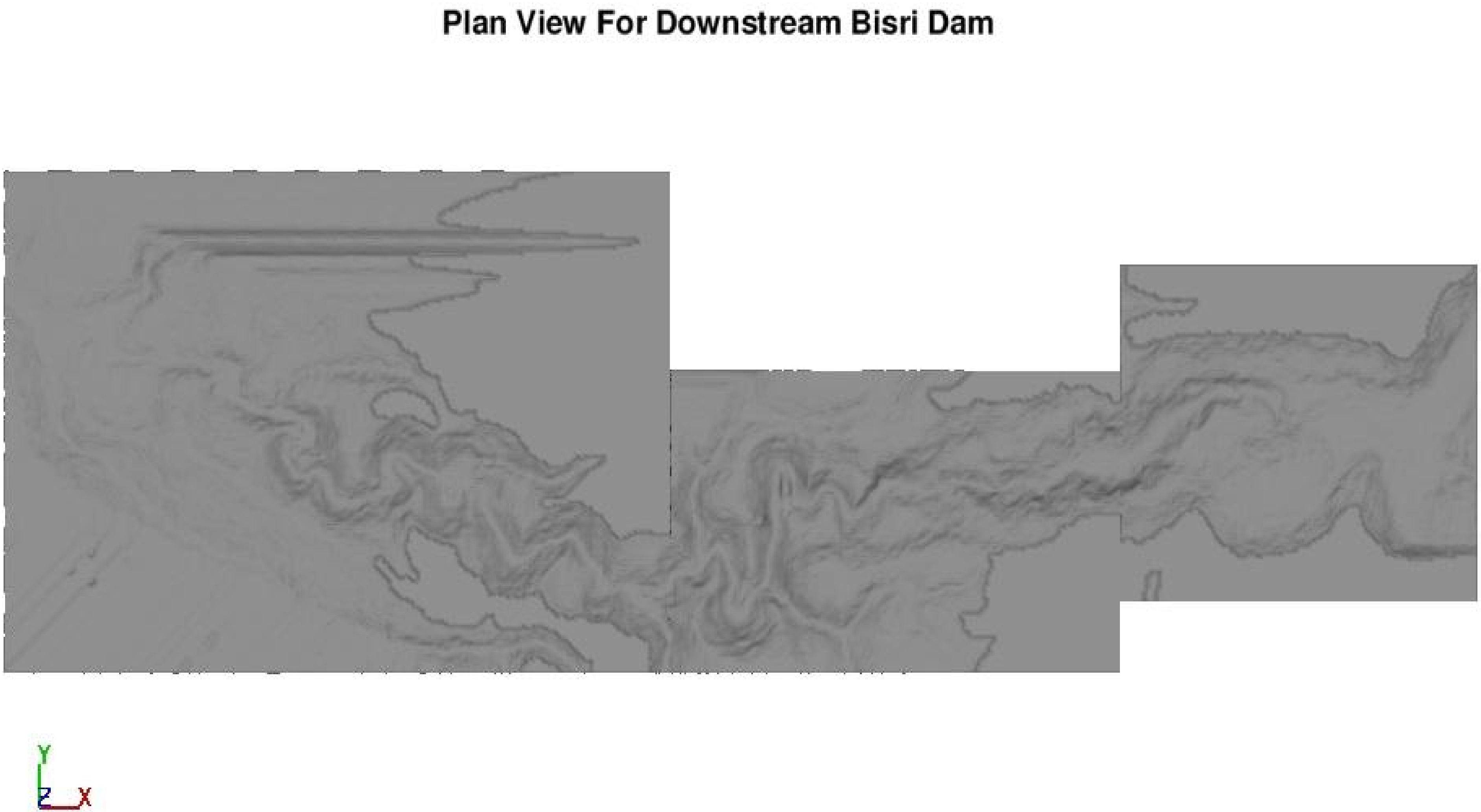


Figure 5-3 Plan View of topography after meshing for area downstream Bisri dam

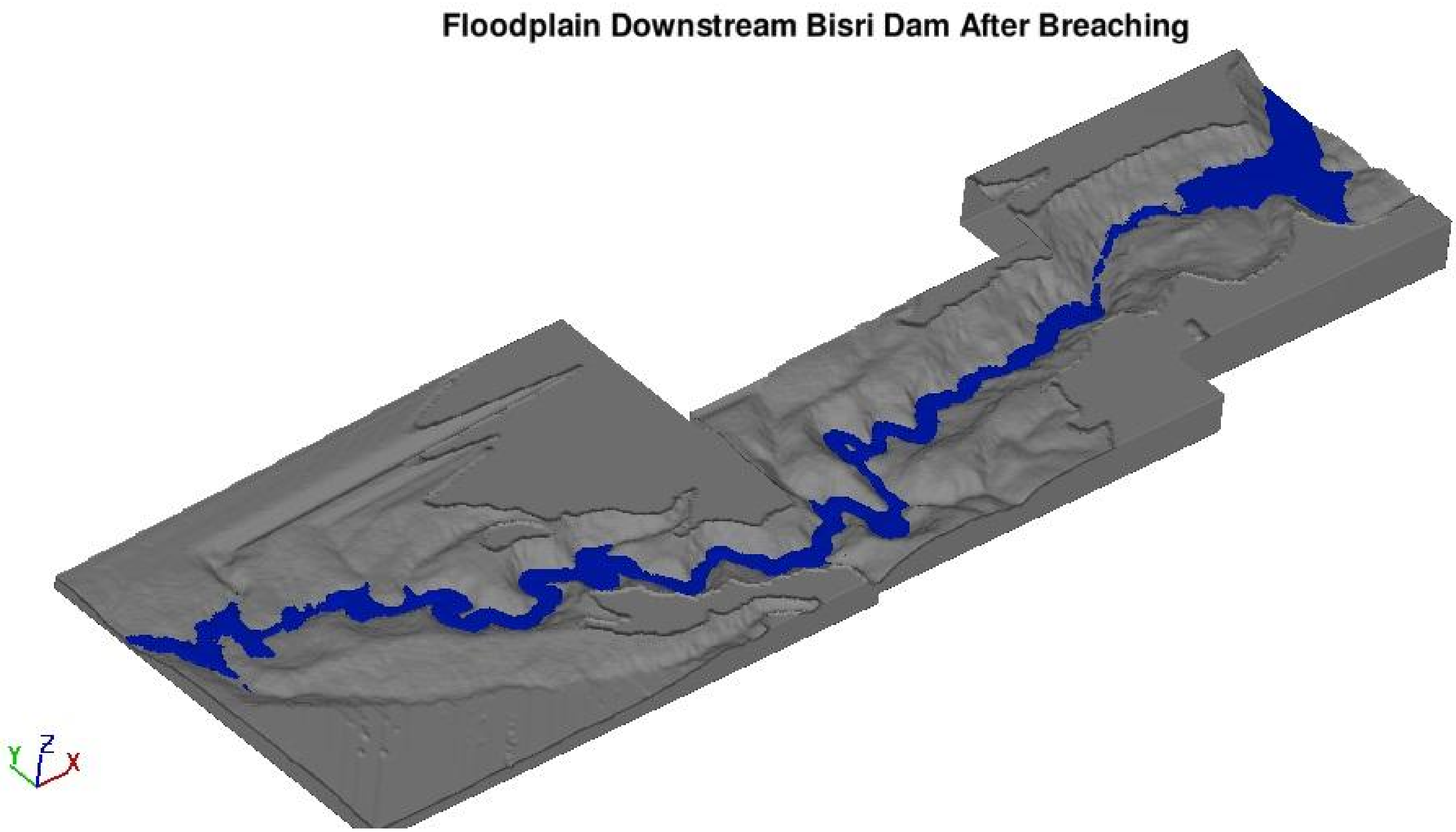


Figure 5-4 3D view for maximum floodplain downstream Bisri dam

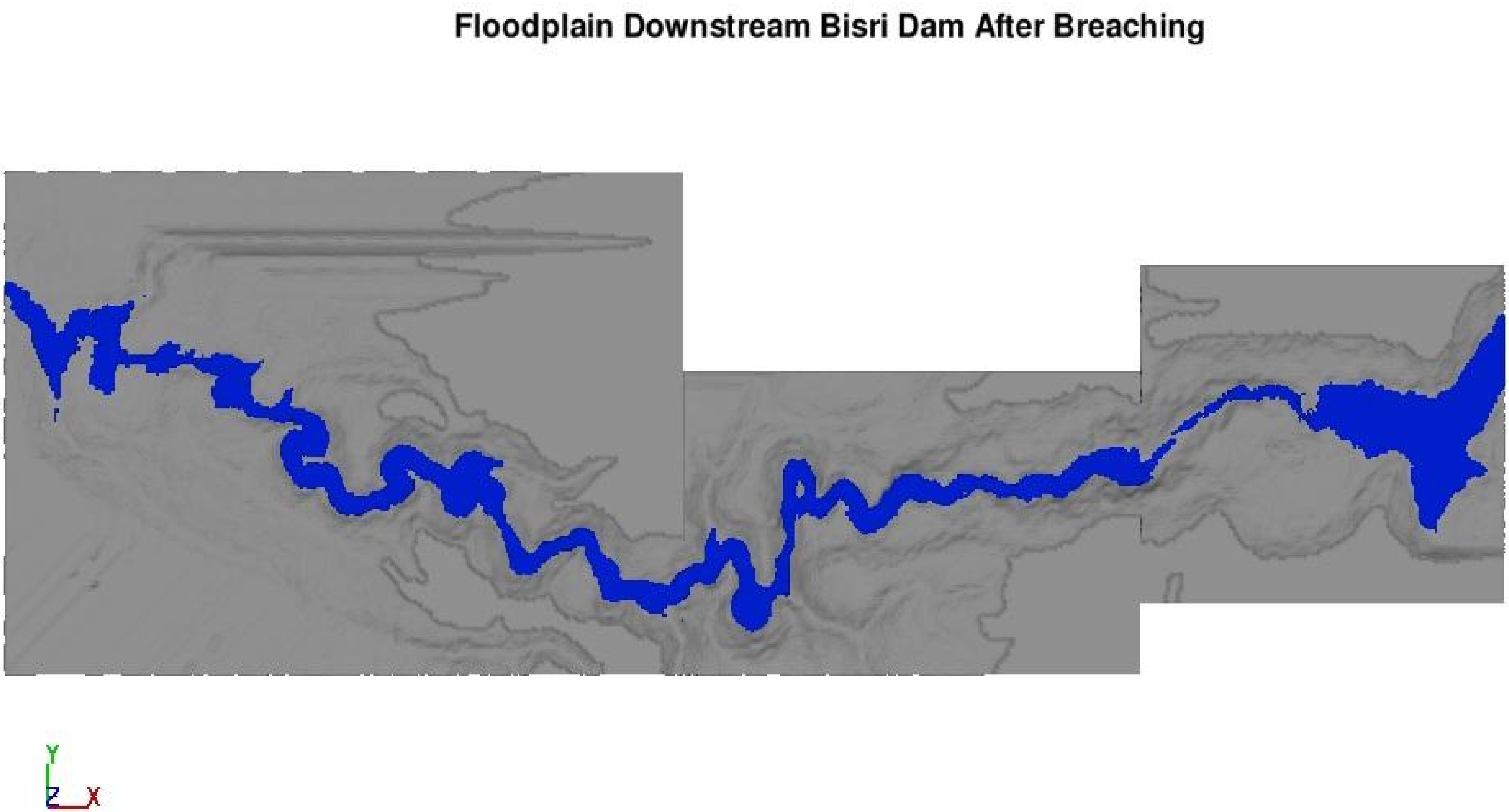


Figure 5-5 2D view for maximum floodplain downstream Bisri dam

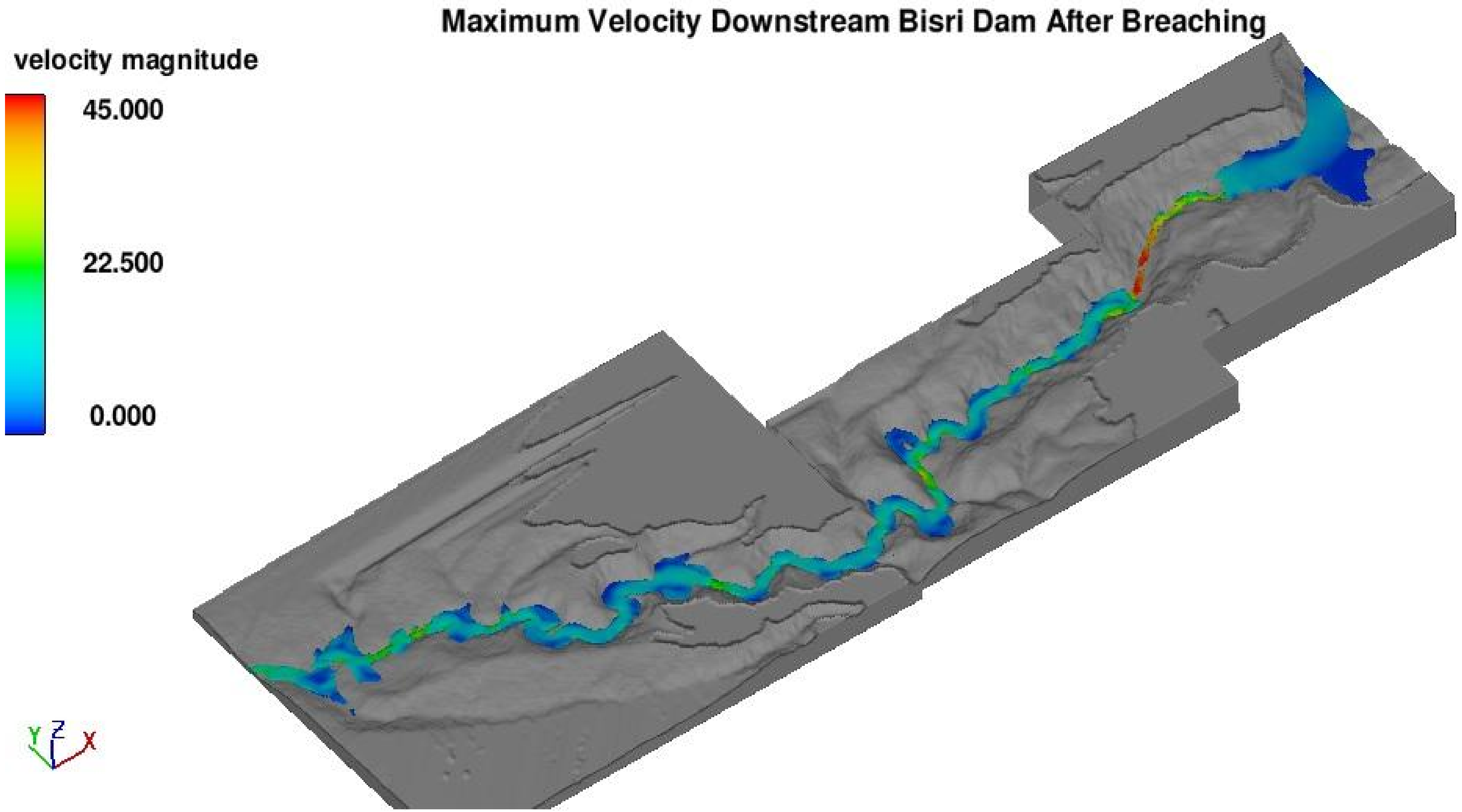


Figure 5-6 3D view for maximum flow velocities downstream Bisri dam after breaching

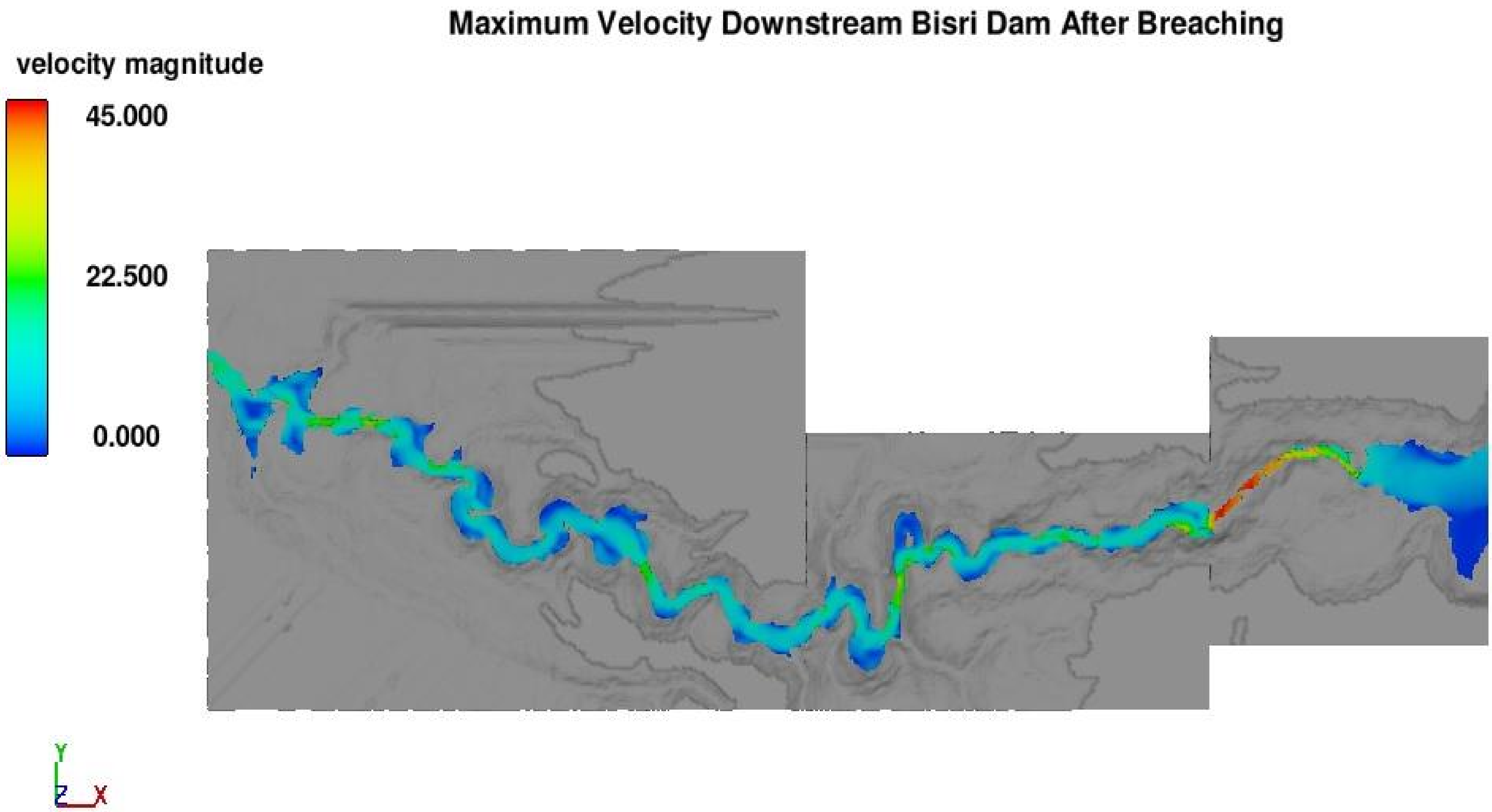


Figure 5-7 2D view for maximum flow velocities downstream Bisri dam after breaching

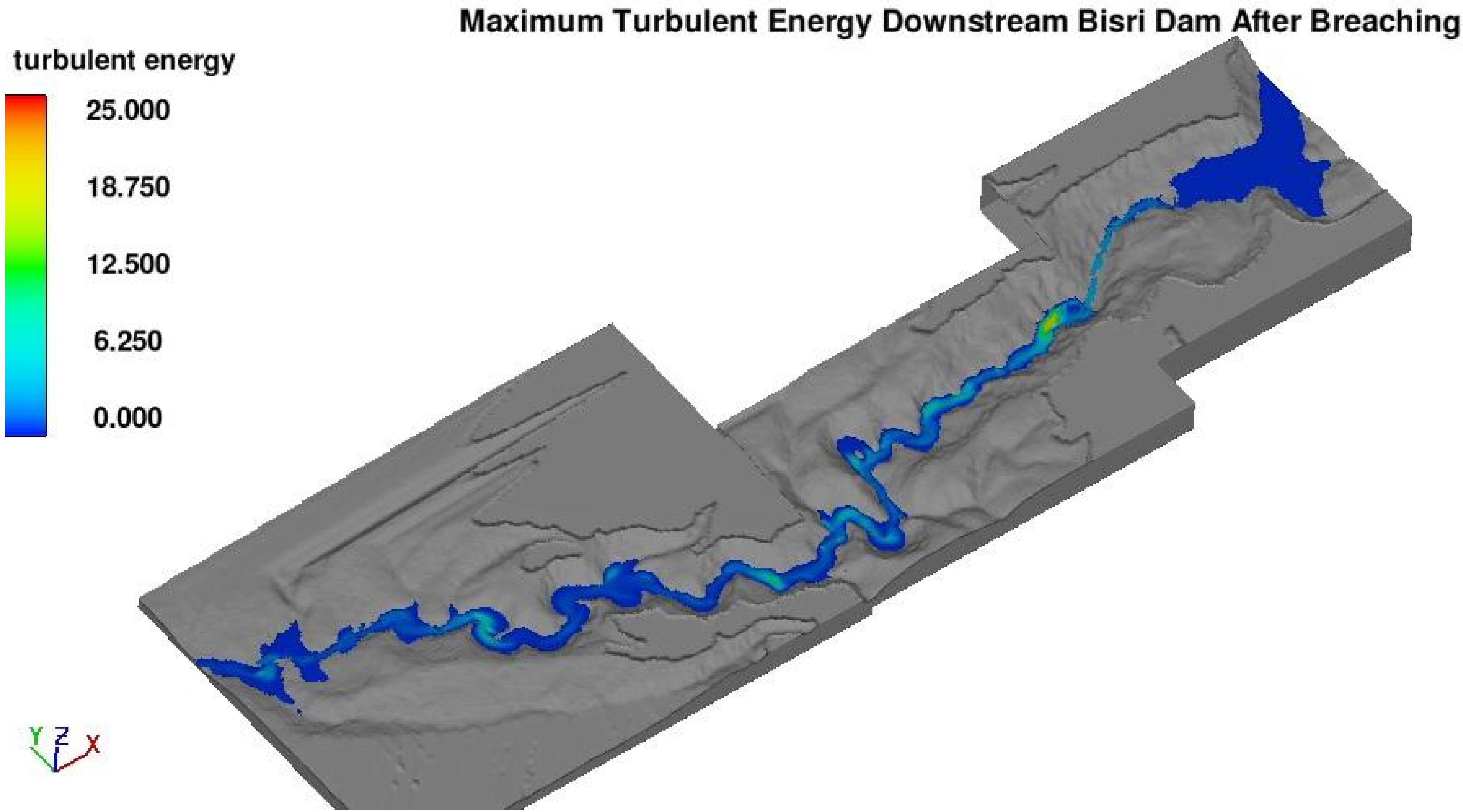


Figure 5-8 3D view for maximum flow turbulent energy downstream Bisri dam after breaching

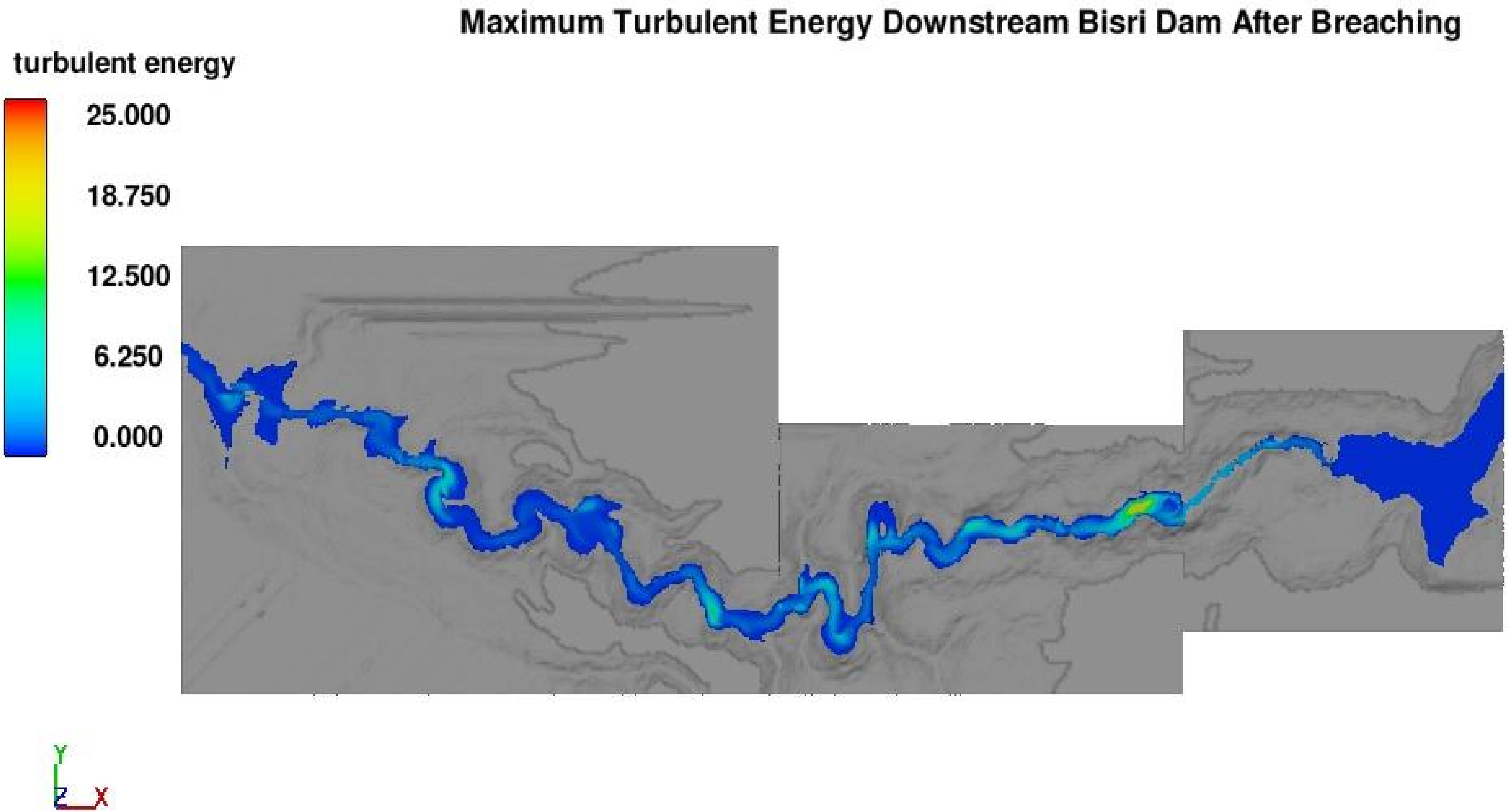
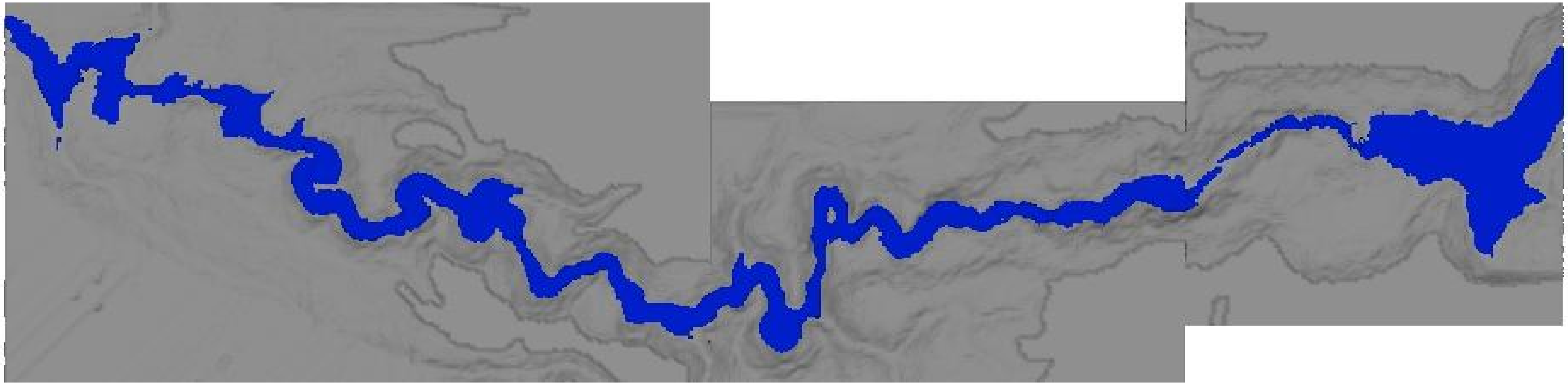
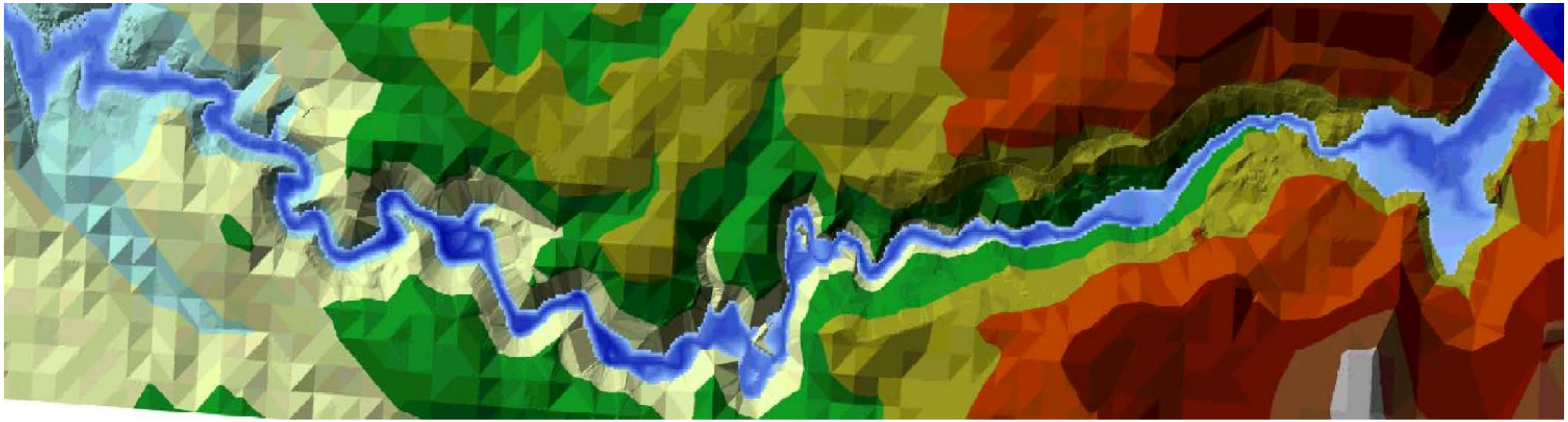


Figure 5-9 3D view for maximum flow turbulent energy downstream Bisri dam after breaching



(a)



(b)

Figure 5-10 Floodplain results of Flow-3D (a) and HEC-RAS (b)

5.4 Conclusion

Based on the comparison between one dimensional modeling (HEC-RAS) and three dimensional CFD modeling (Flow-3D) no significant differences were found. However, the inundation mapping downstream the dam considers the envelope of both models.

6 DAM BREAK DAMAGE ASSESSMENT

6.1 Introduction

Damages due to Dam Break impact different types of structures or activities (stakes) and can be direct (physical damage due to submersion and water flows) or indirect (disruption of human and notably economic activities).

The table below is commonly used to categorize flood damages per stake and type of impacts.

Types of damage	Direct		Indirect	
Stakes	Examples	Cost evaluation	Examples	Cost evaluation
Residential houses	Destruction or degradation	Reconstruction, repair or cleaning costs	Alternative housing during reconstruction/repair Decrease in house value	Cost of alternative housing
Factories and private sector facilities	Destruction or degradation	Reconstruction, repair or cleaning costs	Interruption of production, loss of clients, loss of jobs, bankrupcy	Production decrease and economic losses, impacts from long-term job losses?
Farms	Destruction or degradation of crops	Areas impacted and estimated yield decreases	Decrease in land value Bankrupcy, loss of jobs	Production decrease and economic losses, impacts from long-term job losses?
Public infrastructure (hospitals, schools, administrative buildings, etc.)	Destruction or degradation	Reconstruction, repair or cleaning costs	Service interruption	Cost of delays or of alternative service sources
Road infrastructure	Destruction or degradation of roads and structures (e.g. bridges)	Reconstruction, repair costs	Road or bridge restriction or closure, increased travel times for users	Increased costs for transport companies Economic losses for factories, farms, etc.
Other transport infrastructure (ports, airports, railways, canals, etc.)	Destruction or degradation	Reconstruction, repair costs	Transport restriction or closure, increased travel times for users	Increased costs for transport companies Economic losses for factories, farms, etc.
Public services (water, electricity)	Destruction or degradation of infrastructure (networks, plants, etc.)	Reconstruction, repair costs	Service interruption	Production losses and economic losses for factories, farms, etc.

Types of damage	Direct		Indirect	
Stakes	Examples	Cost evaluation	Examples	Cost evaluation
Tourist infrastructure (hotels, restaurants, campings, etc.) & historic locations/buildings	Destruction or degradation	Reconstruction, repair costs	Decrease in tourism	Economic losses
Natural environment (rivers, wetlands, forests)	Destruction or degradation	Reconstruction, repair costs	Pollution	Pollution impacts Depollution costs

Dam Breaks can also claim lives of human beings. These are direct impacts that are not considered here because financially estimating the cost of life is always a difficult and controversial topic.

Assigning costs to direct impacts is not always easy as it may be more than just physical repairs (for example crop losses are difficult to "repair"). It is however becoming feasible as formulas and mechanisms are being developed in Europe and in the US. These formulas or standard values are mostly established by insurance companies.

Numerous surveys have also been carried out to assess the costs of flood damages and references exist. These references have been adapted here to Lebanon where such formulas or standard values do not exist yet.

Assigning costs to indirect impacts (which can go as far as including psychological impacts on populations) is much more difficult. Most of the associated economic losses are caused by the temporary or permanent unavailability of structures or equipment. Such losses can even lead to job losses and bankruptcies.

As the objective of this damage estimation study is simply to give an idea of the magnitude of the economic cost of a Dam Break in the Bisri River, only direct impacts will be calculated. Indirect impacts will be for now considered to be, at most, of an equivalent magnitude."

6.2 Damage Assessment: Methodology and Results

The study area includes the region situated between Bisri Dam and the Sea Mouth.

Combined with information collected on land use and simulated flood depth, maps of the flooded areas provide information that can be used for flood damage assessment, urban and rural planning and validating flood simulation models. The concept of damage function is used when calculating flood damage.

In order to assess flood damage correctly, the impact parameters need to be incorporated in a method (Water depth, Duration of flooding, Flow velocity, Sediment concentration, Sediment size, Wave or wind action, Pollution load of flood water, Rate of water rise during flood onset). However, due to the difficulty in integrating such variables, damage is generally related to only water depth.

In the case of built-up areas, the land use class is expressed per unit area. The economic value of the land use class is estimated in order to calculate the damage. This value is based on the principle of replacement value: how much money it would cost to obtain the ‘identical’ object. The damage function has values included between 0 and 1, with the value 0 if there is no damage and the value 1 if there is maximum damage.

This analysis has the purpose to give an assessment of the damage of flood by using the damage functions which are available in the literature. The assumptions listed below had to be made to do the flood damage assessment:

- The damage function is a function only of inundation depth, although flood damage is determined by more factors, as explained before.
- The damage functions must be increasing functions, which means that as the inundation depth grows, also damage rises.
- During a flood event, some damage can be avoided by appropriate action from the people who live in the floodplain. Therefore cars are not taken into account of the damage assessment.
- An important question in damage calculation is which assumption has to be made with respect to the behavior of the people. This is caused by the fact that damage is a function of many physical and behavioral factors, like for example the content of the house and the preparation time. Hence, uncertainties in the damage functions are not dealt with in this analysis.
- The maximum damage values are here only indicative and are based on the average price per m^2 for a house or an apartment. This information is deducted from the local market prices.

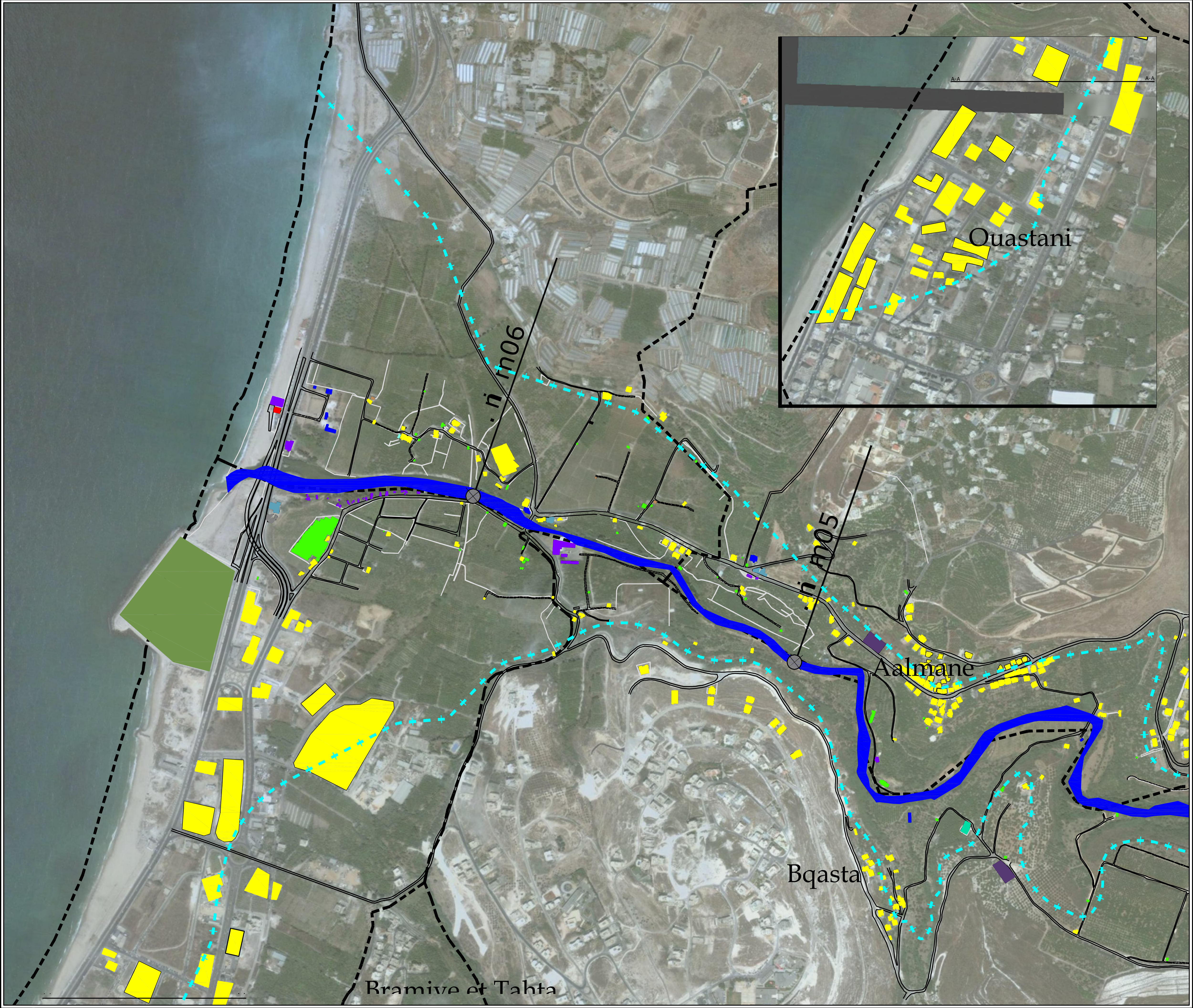
The damage function used in this study depends on several components: different land used classes, flood depth factors, economical value per square meter.

The flooded area was individuated and considered according to the map of the flooded area provided based on the Dam Break Model.

The flood damage depends on the land use type: in urban areas floods produce as a consequence much more damage than floods in a rural area. The land use classes, which are used to calculate the flood damage, correspond to:

- Vegetated and Agricultural areas
- Built-up area (Residential, Industrial and Commercial areas)
- Infrastructure

A satellite view showing the estimated delimitation of the flood and an estimation of land use based on the information collected during the field survey is illustrated in Figures 6.1 to 6.5.



Legend

- Flood Limit
- River
- Residential
- Hospitality & Restaurants
- Retail & Commercial
- Religion & Heritage
- Cemetery
- Government (Police , Hospital , Red Cross , Fire Station)
- Service Station
- Workshop & Quarry
- Sport
- Agricultural (Houses , Plastic Rooms , Stable & Warehouse)
- Electrical (Stations , Generator Room ,Column tension
- Reservoirs & Water
- Parking & Transport Station
- 60 Min

Initial rise time of the flood counting from initiation of the dam breach is 60 minute at this location

0m 100m 250m

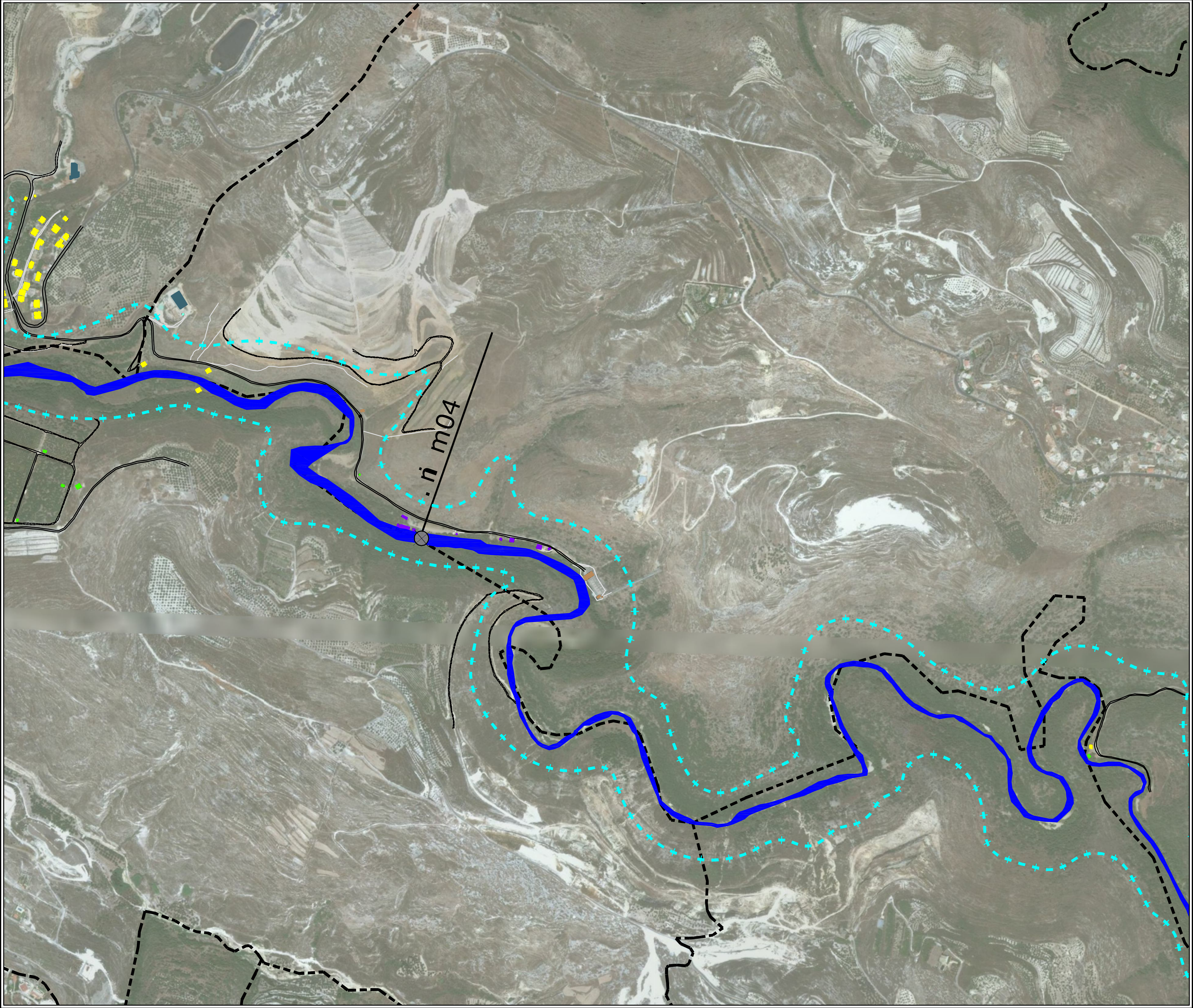
Scale @ A3 Size

N

Fig. 6.1

LAND USE OF THE FLOODED AREA (5 / 5)

DAR AL HANDASAH NAZIH TALEB & PARTNERS



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- Reservoirs & Water
- Parking & Transport Station
- 60 Min

Initial rise time of the flood counting from initiation of the dam breach is 60 minute at this location

0m 100m 250m

Scale $\frac{1}{10000}$ @ A3 Size

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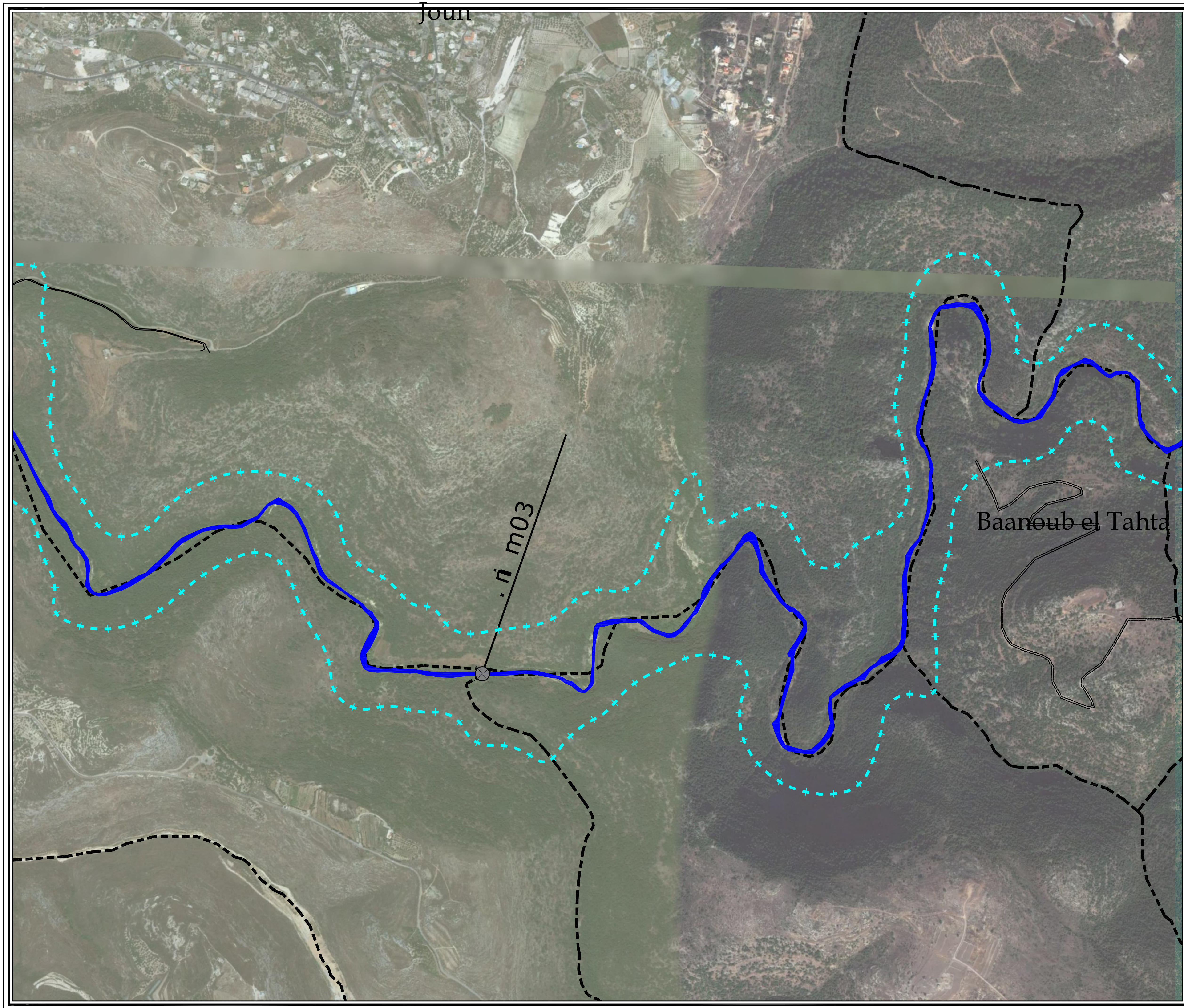
Fig. 6.2

LAND USE OF THE FLOODED AREA (5 / 5)

DAR AL HANDASAH NAZIH TALEB & PARTNERS



Legend

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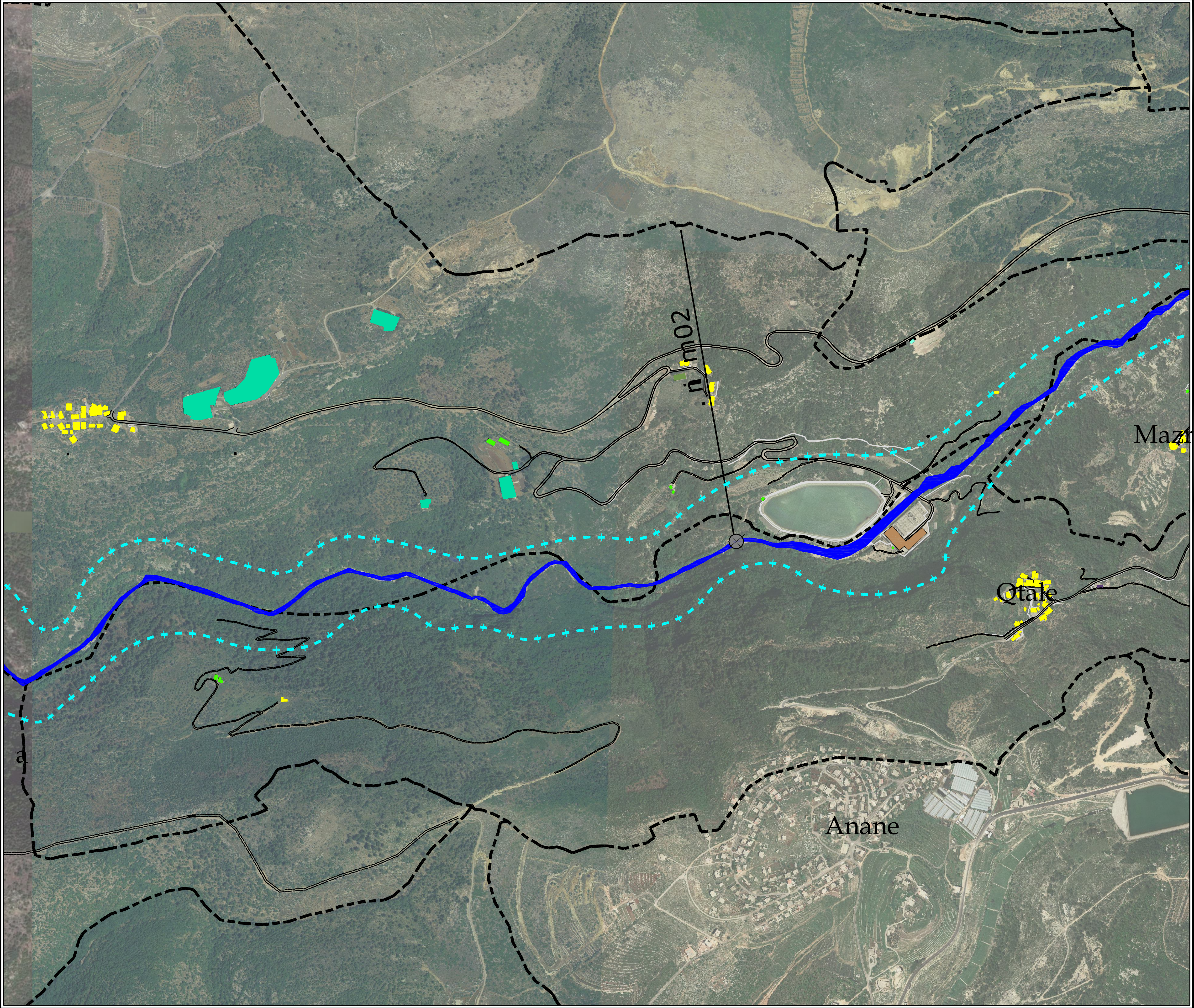
- 60 Min

Initial rise time of the flood counting from initiation of the dam breach is 60 minute at this location

0m 100m 250m

Fig. 6.3

LAND USE OF THE FLOODED AREA (5 / 5)



Legend

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- Reservoirs & Water
- Parking & Transport Station
- 60 Min

Initial rise time of the flood counting from initiation of the dam breach is 60 minute at this location

0m 100m 250m

Scale $\frac{1}{10000}$ @ A3 Size

N

Fig. 6.4

LAND USE OF THE FLOODED AREA (5 / 5)

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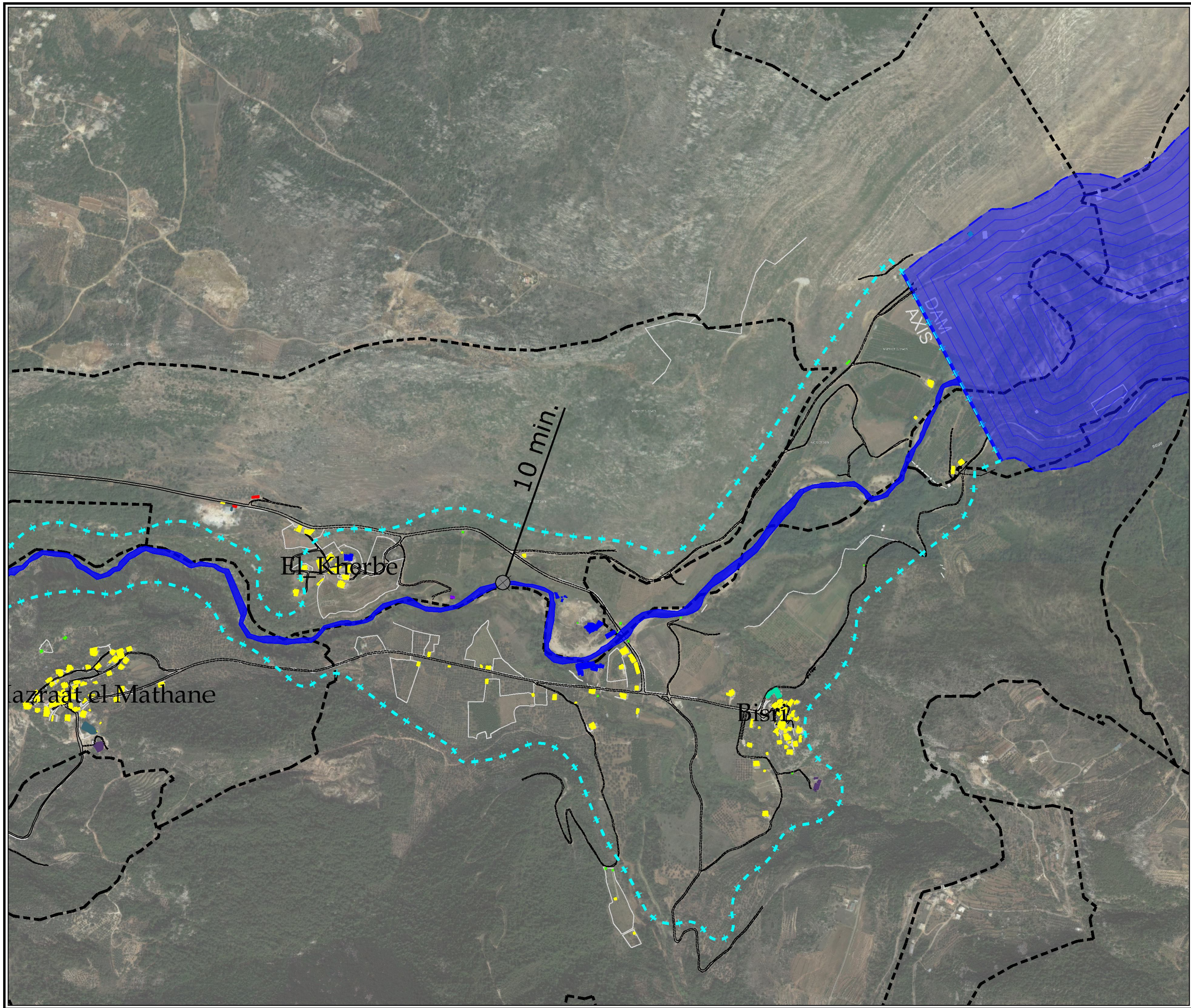
DAR AL HANDASAH NAZIH TALEB & PARTNERS

دار الهندسة نزيه طالب وشركاه



Legend

- Flood Limit
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- Electrical (Stations , Generator Room ,Column tension
- Reservoirs & Water
- Parking & Transport Station
- 60 Min

Initial rise time of the flood counting from initiation of the dam breach is 60 minute at this location

0m 100m 250m

Scale 1/10000 @ A3 Size

N

Fig. 6.5

LAND USE OF THE FLOODED AREA (5 / 5)

6.2.1 Vegetated Areas

The damage in vegetated and agricultural areas composed of agricultural lands and trees does not depend on the inundation depth.

The overall vegetated and agricultural area that will be damaged directly from the Dam Break Flood is estimated to 550 ha.

An estimation of the agricultural revenues and cost of trees gives a value of 0.5 to 1.0 US$/m^2 of cultivated or vegetated land.

The evaluation of the damage caused by the flood in agricultural areas is estimated to 3 to 5 Millions of US$.

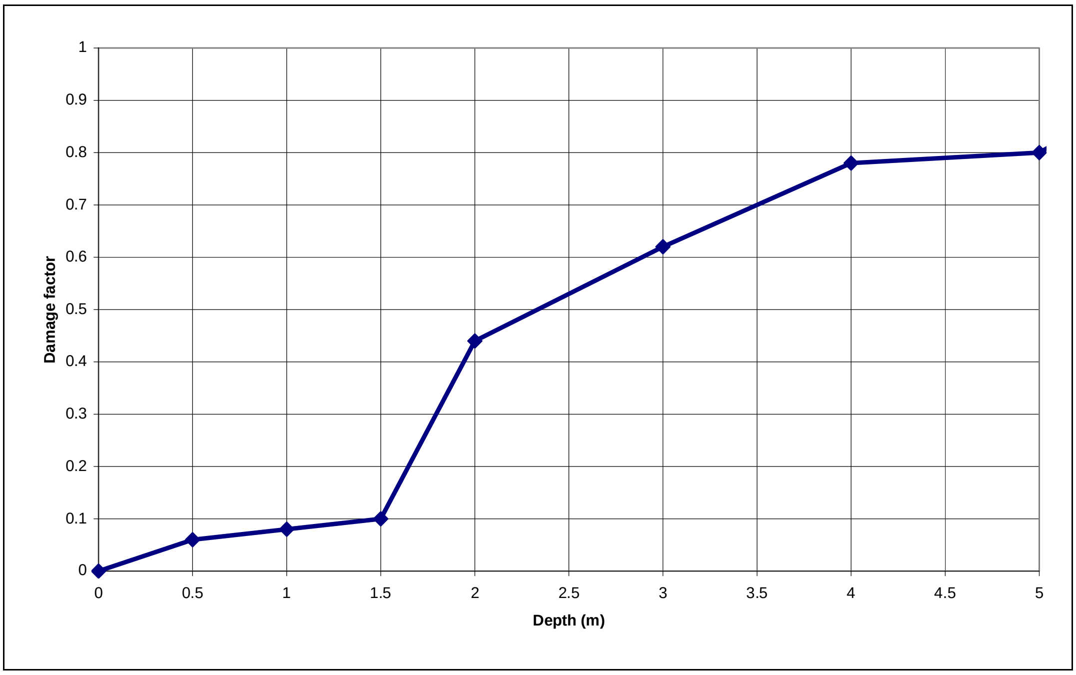
6.2.2 Residential Areas

Flood damage in residential areas is calculated per hectare. The applied flood damage function is based on damage data of the Commissie Watersnood Maas provided for assessing damage in the floodplain of the Meuse River. Damage to cars is not taken into account because there is usually enough time to move these cars onto the higher parts of the area.

A hazard map where the hazard levels correspond to different water depth was considered to obtain the hazard flood depth.

Linear interpolation is used to obtain the complete function of damage factor for the house and its content that is presented in Figure 6.6.

Figure 6-6 Proposed damage function for houses (property and content)



According to known market prices, the average price per m2 for built up area in the region in 2013 is estimated to 500 US$. For the purpose of the damage evaluation method herein proposed, these figures should be considered like a reconstruction cost, namely the costs for rebuilding to a standard responding to local conditions.

All the necessary data are available to propose an assessment for the different residential categories of land use which is considered representing 90% of built-up area (total built-up area is 20 ha).

In order to estimate damage cost for the residential built-up area, the generic formula below was applied:

Damage Cost = A * H * V

- A= area (m2)
- H= water depth damage factor
- V= average price for m^2 for an apartment.

The results are illustrated in Table 6.1.

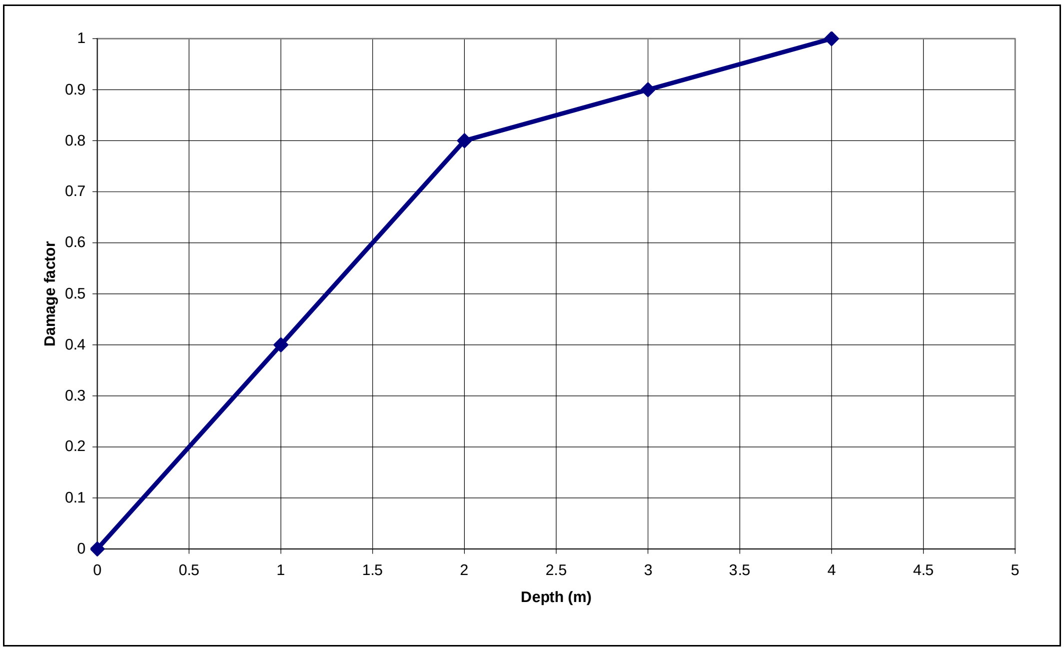
Table 6-1 Residential areas damage cost

Area (m^2)	Water Depth	Water Depth Damage Factor	Damage Cost (US$)
40,000	Below 5m	70%	≈ 15,000,000
140,000	Above 5m	100%	≈ 70,000,000

6.2.3 Industrial, Commercial and Service Areas

The most suitable method is to evaluate flood damage in industrial, commercial and service areas according to water depth. The maximum damage cost of industry is assessed per m2. The damage function adopted in our study is illustrated in Figure 6.7.

Figure 6-7 Proposed Damage Function for Commercial and Industrial Areas



All the necessary data are available to propose an assessment for the different commercial and industrial categories of land use which is considered representing 10% of built-up area. The results are illustrated in Table 6.2.

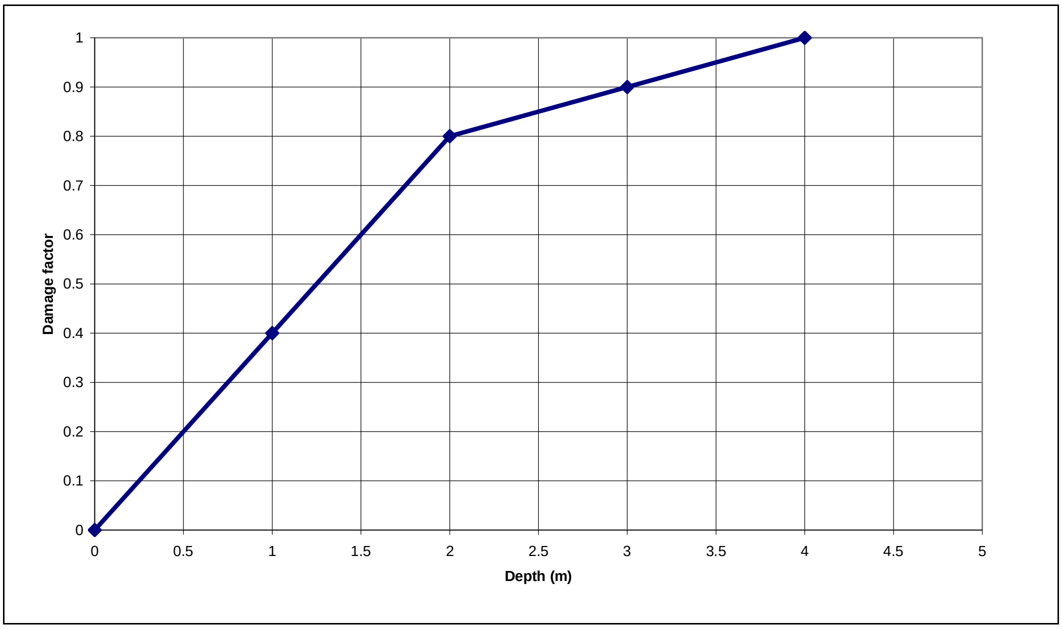
Table 6-2 Residential Areas Damage Cost

Area (m^2)	Water Depth	Water Depth Damage Factor	Damage Cost (US$)
4,000	Below 4m	65%	≈ 4,000,000
14,000	Above 4m	100%	≈ 21,000,000

6.2.4 Infrastructure

The damage is calculated per unit length rather than per unit area. The maximum damage values vary depending on the type of road. In the flooded area there are 90 km of mainly roads and rails. The used damage function is illustrated in Figure 6.8.

Figure 6-8 Proposed Damage Function for Infrastructure



Considering an average water depth varying between 0m and 30m for all roads and an average price of 200 US$ for the construction of one linear meter of road, the damage cost of infrastructure is estimated between 10 to 15 Million US$.

6.3 Conclusion

The results listed above, provide an average estimate and should not be considered as a detailed cost assessment of the damage, since they are strongly depending on the quality of the damage functions and the availability of detailed datasets.

The quality of the damage assessment also depends on the quality of the classification which was made considering satellite views, previous studies data and the field survey collected information.

The total damage cost estimation based on the above functions and assumption is approximated to 110 to 130 Millions US$.

7 EMERGENCY ACTION PLAN

7.1 Introduction

The Bisri Dam and Reservoir will be owned and operated by the Litani River Authority (LRA).

According to the Bisri Dam Breach Analysis, if a breach of the dam were to occur, a 100m opening could form in as little as 90 minutes. The subsequent flood wave would flow downstream through the floodplain with significant effects on the Bisri and Awali river. A breach of the dam has the potential to result in the loss of human life and loss of property.

7.1.1 Authority

The development and implementation of an Emergency Action Plan (EAP) is a positive step dam owners can take to accomplish dam-safety objectives, to protect their investment, and to reduce the potential liability associated with a dam failure.

As stipulated in ministerial decision No 93/30, issued on August 2nd, 1993, the High Relief Commission is presided by the Prime Minister and made up of members in the persons of the Ministers of Defense, Health, Social Affairs, Interior, Finance, Public Works, Energy and Housing. The High Relief Commission's members also include the Director Generals of Social Affairs, Council of the South, and the Fund for the Displaced, and representatives from the ISF and the Lebanese Army. The High Relief Commission is managed by its Secretary General, General Ibrahim Yehya.

The High Relief Commission has the authority to direct the LRA to take immediate and appropriate action to remedy situations posing serious threat to human life or health, or risk of property damage.

7.1.2 Purpose

The purpose of this Emergency Action Plan is to identify emergency situations that could threaten the Bisri Dam, and to plan for an expedited, effective response to prevent failure of the dam. This plan defines the notification procedures to be followed in the event of a potentially hazardous situation or the potential failure of the dam. The procedures are intended to protect lives and prevent property damage from an uncontrolled release of water from the reservoir.

7.2 Responsibilities

7.2.1 Emergency-Response Procedures

When conditions at the dam have caused the declaration of an emergency, actions are to begin immediately with the notification of the Emergency planning Manager (TBD). An Emergency Operations Center will be set up in the Dam Administration Building to monitor the progression of the situation and to coordinate remediation activities. Alternate phone numbers should be available. Provisions for light may be necessary due to darkness, and alternate access to the dam from both sides should be available.

Immediately upon determination of a "watch" or more serious condition, this Emergency Action Plan will be implemented. Surveillance of the problem will be maintained on a 24-hour basis. The prime minister (High Relief Commission), the South-Lebanon Governate, Saida municipality, Er Rmaile municipality, Karkha municipality, Joun municipality and the LRA will be notified according to the Notification Flowchart (Figure 7.6) by the Emergency planning Manager. The following are possible actions at the dam to prevent or delay failure after an emergency is first discovered:

Seepage Failure

1. Plug the flow with whatever material is available (clay, bentonite, or plastic) if the entrance is in the reservoir.
2. Lower the water level in the reservoir by using the low-flow outlet and pumping if necessary, until the flow decreases to a non-erosive velocity or until it stops. Place an inverted filter (a protective layer of sand and gravel) on the exit area to hold the material in place.
3. Continue operating at a lower level until a repair is made.

Embankment or Foundation Sliding

1. Lower the water level in the reservoir by pumping if necessary at a rate and to an elevation considered safe, given the slide condition.
2. Stabilize the slide, if on the downstream slope, by weighting the toe area below the slide with soil, rock, or gravel.
3. Continue operating at a lower level until a repair is made.

Structural Failure

1. Implement temporary measures to protect the damaged structure, such as placing rock riprap in the damaged area.
2. Lower the water level to a safe elevation through the low-flow release valve and by pumping if necessary.

Preventive measures can be taken in an emergency to prevent the catastrophic failure of the dam, but such repairs should be undertaken with extreme caution. The repairs are only temporary, and a permanent repair should be designed by an engineer as soon as possible.

7.2.2 Responsibilities for Notification

The Emergency planning Manager shall make all initial notifications. Technical advice shall be sought when time allows. However, for rapidly developing situations, immediate notification of the prime minister (High Relief Commission), the South-Lebanon Governate, Saida municipality, Er Rmaile municipality, Karkha municipality, Joun municipality and the LRA may be necessary for quick action. The South-Lebanon Governate officials will in turn notify the internal security forces, army personnel and the Fire Department for appropriate action. The LRA's public-affairs representative will issue news releases.

7.2.3 Responsibilities for Evacuation

The internal security forces, army personnel and the Fire Department shall be responsible for evacuating residents in the event of a dam emergency. After notification by the Emergency planning Manager through the prime minister (High Relief Commission), the South-Lebanon Governate, Saida municipality, Er Rmaile municipality, Karkha municipality, Joun municipality and the LRA officials, the internal security forces, army personnel and the Fire Department will be responsible for the warning and evacuation of people in the threatened areas.

7.2.4 Responsibilities for Duration, Security, Termination, and Follow-up

The Emergency planning Manager or his or her designated representative will be responsible for on-site monitoring of the situation and for keeping local authorities informed of developing conditions at the dam from the time that an emergency starts until it ends. The internal security and army shall maintain security at the dam. The Emergency planning Manager shall be responsible for declaring the situation terminated and for a follow-up evaluation of the emergency.

7.2.5 Plan Coordinator

The Emergency planning Manager who takes care of the day-to-day operations of the dam is responsible and has the authority to implement and carry out all procedures and surveillance found in this Plan. He shall be responsible for initiating the notification procedures when signs of distress or failure are noted. All participating parties should be familiar with this plan and their responsibilities during an emergency. Precautionary measures shall be taken to prevent the uncontrolled release of water from the reservoir. In the event that a failure is imminent, proper notification of persons in the downstream area shall be made. Any resources available to the Emergency planning Manager shall be used to minimize uncontrolled releases. The Emergency planning Manager alternates listed on the Notification Flowchart shall implement and carry out these procedures in his absence.

7.2.6 Emergency Operations Center

In the event of a “watch” or more serious condition, the Emergency planning Manager shall activate the Emergency Operations Center for the overall direction and response activities. The Emergency Operations Center shall be established at the Dam Administration Building. The Emergency planning Manager will be responsible for initiating actions from this location.

7.2.7 Communications

Local officials and downstream residents will be notified by landline telephone or internet if available; otherwise via cell phones or emergency personnel (in person or using their radios). The various radio networks for emergency use include the informal ham-radio network, and networks belonging to:

- The South-Lebanon Governate office
- Saida Municipality office
- Er Rmaile municipality office
- Karkha municipality office
- Joun municipality office
- The Lebanese Army
- The Internal Security
- The Fire Department

Verification or authentication of the situation can be made by contacting the prime minister (High Relief Commission), the South-Lebanon Governate, Saida municipality, Er Rmaile municipality, Karkha municipality, Joun municipality and the LRA officials. Television and radio can be used as much as possible to notify area residents of the possible dangers. News releases are to be issued by the LRA's public-affairs officer. The following summarizes the notification procedures for different levels of alert:

“Abnormal” Condition

1. The Emergency planning Manager will be notified.
2. The Emergency planning Manager will notify officials at LRA's headquarters.
3. LRA will contact its Technical Team to inspect the situation.

"Watch" Condition

1. The Emergency planning Manager will notify officials at LRA's headquarters.
2. LRA will contact its Technical Team to inspect the situation.
3. A "watch" message will be issued by local emergency management officials to downstream contacts, if so directed by LRA's officials.

Possible Dam Failure

1. The Emergency planning Manager will notify the prime minister (High Relief Commission), the South-Lebanon Governate, Saida municipality, Er Rmaile municipality, Karkha municipality, Joun municipality and the LRA officials.
2. LRA will contact its Technical Engineering Team.
3. Local emergency-management officials will send a "possible dam failure" warning message to downstream residents, if so directed by LRA's officials.

Imminent Dam Failure

1. The Emergency planning Manager will notify the prime minister (High Relief Commission), the South-Lebanon Governate, Saida municipality, Er Rmaile municipality, Karkha municipality, Joun municipality and the LRA officials.
2. LRA will contact its Technical Engineering Team.
3. Local emergency-management officials will issue a "failure" message to downstream residents and evacuation programs shall begin.

The Emergency planning Manager shall ensure notification of personnel in the event of an emergency at the dam, and may delegate contacting some personnel to other LRA's personnel. The delegation of contacts should be very specific as to which ones are to be made. The Notification Flowchart should contain contact information for LRA staff, as well as the other officials which may be involved in the event of a situation at the dam.

7.3 Possible Emergency Conditions

7.3.1 Situations

Many dam conditions can lead to emergency situations, not all of which will necessitate the implementation of the Emergency Action Plan; however, if any of them occur, the appropriate action must be taken.

- Severe storms: Although generally not in themselves a threat to the dam, severe storms can contribute to an existing problem and hinder any remediation efforts. Severe storms also cause the uncontrolled release of floodwater, and increase flow in already rain-swollen areas.
- Earthquakes: The Bisri Dam is located in a seismic zone with high activity. An earthquake is a possibility, and appropriate post-earthquake inspections should be performed.
- Sabotage: Threats to damage the dam are very probable in the dam region. Appropriate actions must be taken to protect the dam.

7.3.2 Signs of Failure

The following sections describe some of the different types of failure which could lead to a dam breach. The impacts of a dam breach have been evaluated and the results are included in this report.

- Seepage Failure: Although all earthen embankments allow some minor seepage through the dam or the foundation, excessive, uncontrolled seepage can result in piping (or the movement of embankment material in the seepage flow) and lead to failure. Piping can occur for years at a slow rate. If the piping has progressed to a dangerous level, it will be evident by increased flow or the discharge of muddy water (or both). At that stage, immediate action to stop the piping is needed. Fully developed piping is difficult to control and is very likely to result in failure. A whirlpool in the reservoir is a sign of uncontrollable piping and necessitates immediate emergency action.
- Embankment or Foundation Sliding: Sliding is usually first apparent when cracks or bulges in the embankment appear. Slides with progressive movement can cause failure of the embankment.
- Structural Failure: The structural failure or collapse of any portion of the service spillway or spillway gates could result in loss of the reservoir. A structural failure of a portion of the spillway could cause piping and possibly embankment failure.
- Overtopping Failure: Overtopping of the embankment results in erosion of the dam crest. Once erosion begins, it is very difficult to stop.

7.3.3 Emergency Identification

A. Signs of Failure

In an emergency, the *Emergency planning Manager* is responsible for the dam's operation, maintenance and inspection. The early identification of potentially dangerous conditions can allow time for the implementation of emergency action plans. It is important to understand how distress can develop into failure. With appropriate action, distress need not lead to a catastrophic failure of the dam. Early identification, close monitoring, planned action and remedial measures will help alleviate a potentially dangerous situation. The following sections describe some of the different levels of distress which could lead to a dam breach.

B. "Abnormal" Conditions

The conditions listed below are not normal occurrences. When these conditions are present, they should be noted, and action should be taken to prevent the possible failure of the dam.

- piping or boils in the area of any structure such as the embankment, spillway, or in the vicinity of the toe of the embankment, as evidenced by muddy water
- slides or sloughs in the embankment, discharge channel or abutments
- a significant increase in seepage quantities through or under the embankment, abutments or emergency spillway
- unusual vertical or horizontal movement or cracking of the embankment or abutments

- small sinkholes or subsidence within 150m of the embankment or spillway
- excessive displacement of the rip-rap on the embankment slope
- an earthquake
- a severe storm
- threat of sabotage

In the event that any of these items are observed, the LRA Technical Team should be contacted to inspect the dam to document the distress and determine whether remedial action is necessary. Notification of local authorities is not necessary for “abnormal” conditions.

C. “Watch” Conditions

A “watch” indicates that a significant problem that may potentially progress to a dangerous situation has been detected, but that a breach is considered unlikely and no flooding is imminent. This situation will require monitoring and repair or correction as soon as possible. Upon detection, the notification procedures must be implemented. The *Emergency planning Manager* shall institute all practicable measures to mobilize personnel to control the situation. The following is a list of conditions which constitute “watch” conditions:

- small boils if conditions are muddy, on the downstream slope of the embankment or downstream from the toe, or if there is flowing muddy water downstream from the embankment
- large sinkholes with corresponding seepage anywhere on the embankment or downstream from the toe
- any slide that degrades the crest of the embankment or that is progressively increasing in size
- significantly increasing seepage or flow
- cracking or movement of any concrete structure

D. Possible Dam Failure

A “possible dam failure” warning is issued when a “watch” condition is becoming progressively worse, and a dam failure is considered possible. The *Emergency planning Manager* will immediately notify the prime minister (High Relief Commission), the South-Lebanon Governate, Saida municipality, Er Rmaile municipality, Karkha municipality, Joun municipality and the LRA officials and others in accordance with the Notification Flowchart. He or she will continue all practicable measures to correct the problem, including lowering the reservoir level if appropriate. The existence of any of the following conditions constitutes possible dam failure:

- large boils, increasing in size and flow rate, especially if there is flowing muddy water
- significantly increasing seepage, especially flowing muddy water
- slides involving a large mass of material that impairs the crest of the dam and is continuing to move
- sinkholes with seepage flowing muddy water
- large cracks, movement or failure of a portion of any major concrete structure that forms an integral part of the dam

- an increase in the reservoir level to near the top of the dam

E. Imminent Dam Failure

"Imminent failure" is the determination that a "warning" condition will most likely progress to a failure of the dam and the reservoir will be uncontrollably released, regardless of the actions taken. When this determination is made, immediate notification and warning of downstream areas becomes the primary concern. The existence of any of the following conditions constitutes imminent failure:

- rapidly increasing boils or the presence of new, significantly flowing boils, particularly muddy ones near previously identified ones
- rapidly increasing seepage, especially flowing muddy water
- slides involving a large mass of material or which have degraded the crest of the embankment to a level that approaches the water surface level, or if significant seepage is observed through the slide area
- settlement that is predicted to degrade to the reservoir level
- cracks that extend to the reservoir level
- significant movement or failure of any major concrete structure that forms an integral part of the dam
- overtopping of the dam

7.4 Preventive Actions

This section lists the conditions and actions which may be used to classify the level of emergency response, as a guide for LRA's personnel.

7.4.1 Abnormal Condition

Periodic inspections of the dam will evaluate its structural safety, stability, and operational adequacy. If *LRA's* personnel who visit the dam site notice visual evidence of distress, the structure should be inspected by a consultant engineer specializing in dam design and construction. In the event of an abnormal occurrence, such as earthquake, or unusually heavy rainfall, special inspections by an engineer of the embankment and spillway are warranted. An abnormal condition can generally be repaired or corrected in the next few months with no immediate action necessary.

7.4.2 "Watch" Condition

If a problem has been detected at the dam which requires constant monitoring or immediate action to repair and the condition is manageable by LRA's staff, a "Watch" condition exists. A "watch" will continue until the problem is corrected or a "possible dam failure" warning is issued. The Emergency planning Manager should notify the officials at LRA's headquarters.

7.4.3 Possible Dam Failure

A "watch" condition that is progressively getting worse is considered a possible dam failure. Efforts to correct the situation will continue, and—although there is no imminent danger—if conditions continue to deteriorate, a dam failure could occur. A "possible dam failure" condition generally has already involved extensive efforts by *LRA's* personnel and potentially other contractors. A "possible dam failure" condition will continue until the problem is corrected, or until an "imminent dam failure" warning is issued. Notifications have been issued and the internal security and army personnel are ready to begin evacuation of threatened areas.

7.4.4 Imminent Dam Failure

If the Emergency planning Manager has determined that the condition at the dam will continue to progress to failure and result in the uncontrolled release of water, an "imminent dam failure" condition exists. Dam failure will most likely occur regardless of what actions are taken. Numerous forces are involved in trying to correct the situation. Evacuation has begun and will continue until the situation is stabilized.

7.4.5 Dam Failure

A dam failure has occurred and a flood wave is moving downstream. Flooding will occur immediately and will continue to move downstream until water levels in the reservoir are stabilized. Considerable destruction can be expected, and evacuation of low-lying areas should continue.

7.4.6 Other Considerations

Alternate Access

Alternate access routes should be planned in the event of an emergency at the dam. The access road which runs along the crest of the dam should be reachable from Mazraat Ed Dahr on the north and from Deir Machmoucheh on the south.

Darkness

In a nighttime emergency, the Emergency planning Manager should arrange for access to generators and lights to adequately monitor the situation.

7.5 Supplies and Resources

7.5.1 Contracts

Should LRA's personnel and resources prove to be inadequate during an emergency, requests will be made for assistance from other local jurisdictions, other agencies, and industry, as needed. Such assistance may include equipment, supplies, or personnel. All agreements will be entered into by authorized officials and should be in writing whenever possible. The Emergency planning Manager shall have the authority to enter into agreements as deemed necessary to prevent the failure of the dam.

7.5.2 Equipment and Supplies

The following equipment and supplies may be necessary for use during emergencies: backhoes, dump trucks, portable welding equipment, generators, dozers, excavators, loaders, motor graders, crane, sandbags, rock riprap...

Contractors in the area may be needed. A list of possible Contractors should be available.

7.5.3 Reports

Technical Data

Periodic inspections of the dam will be made to evaluate its structural safety, stability, and operational adequacy. In the event of an abnormal occurrence, reference to these reports, particularly the photographs, can be beneficial in the evaluation of a potential problem.

Technical records such as drawings and inspection reports should be stored and carefully maintained at the LRA's Site offices (Dam Administration Building). Alternate personnel shall be familiar with the location of the documents in the event of an emergency situation.

Emergency Operations Center Activity Log

Any unusual or emergency condition should be documented, including the following:

- activation or deactivation of emergency facilities
- emergency notifications
- significant changes in the emergency
- major commitments of resources or requests for additional resources from external sources
- telephone calls should be recorded in chronological order
- issuance of protective action recommendations to the public
- evacuations
- casualties
- termination of the incident

Costs of the Emergency Operations Center

For major emergencies, the emergency operations center shall maintain detailed records of costs expended. These records may be used to recover costs from the responsible party or insurers, or as a basis for requesting financial assistance for certain allowable response and recovery costs from the government. Documented costs should include:

- personnel costs, especially overtime
- equipment operation
- equipment leasing and rental
- contract services to support emergency operations
- specialized supplies expended in emergency operations

7.6 Inundation Area

The impacts of a dam breach have been evaluated and the results are included in the Dam Breach Analysis. The inundation mapping resulting from the breach analysis is included in the figures 7.1 to 7.5. It illustrates the areas subject to flooding under a failure of the dam. Also included on these maps are the initial times to flood.

After examining the results of the breach analysis of the Bisri Dam, it has been determined that there were a significant number of structures that could be affected due to a sunny-day dam breach. The most important structures affected are the Anane lake and hydroelectric power plant and the Saida Municipality Stadium. Parts of the cities of Saida and Rmeileh can suffer a dramatic impact from a breach of the dam.

The Dam-Breach Analysis contains profiles of the peak flood levels expected, as well as an estimation of the time from the beginning of the breach to the peak flood elevations. A comparison of the areas that are likely to be flooded with the plots showing the times from the start of the breach to the flooding shows the areas of evacuation and the time constraints involved. Figures 7.1 to 7.5 of the Bisri Dam Breach Analysis include information on the estimated impact of flooding on the bridges along the Bisri River. These structures may suffer such impacts before the peak elevation of the flood wave.

7.6.1 Local Evacuation Plan

If imminent failure of the dam with uncontrolled downstream flooding is anticipated, local emergency-management , internal security forces, army personnel and the Fire Department should notify those downstream of evacuation in the most expedient manner possible. The organizations and personnel on the Notification Flowchart should be contacted immediately. The internal security and army officials, along with radio and television stations, can best spread the notice for evacuation. The immediate impact will be to rural areas along the Bisri River downstream of the dam. For sunny-day breaches, the following actions should be taken:

- Barricading all bridges that could possibly be flooded to prevent access to the affected area. These bridges include the bridge crossing of the littoral main highway. See the figures 7.1 to 7.5 to determine appropriate barricade locations and evacuation roads and directions of evacuation.
- Barricading all roads leading to the affected area and forbid any vehicle to enter this area.
- Municipalities officials are generally familiar with developed areas in their jurisdiction. Such knowledge make them the logical officials to be notified and to spread the warning message to all areas subject to flooding.

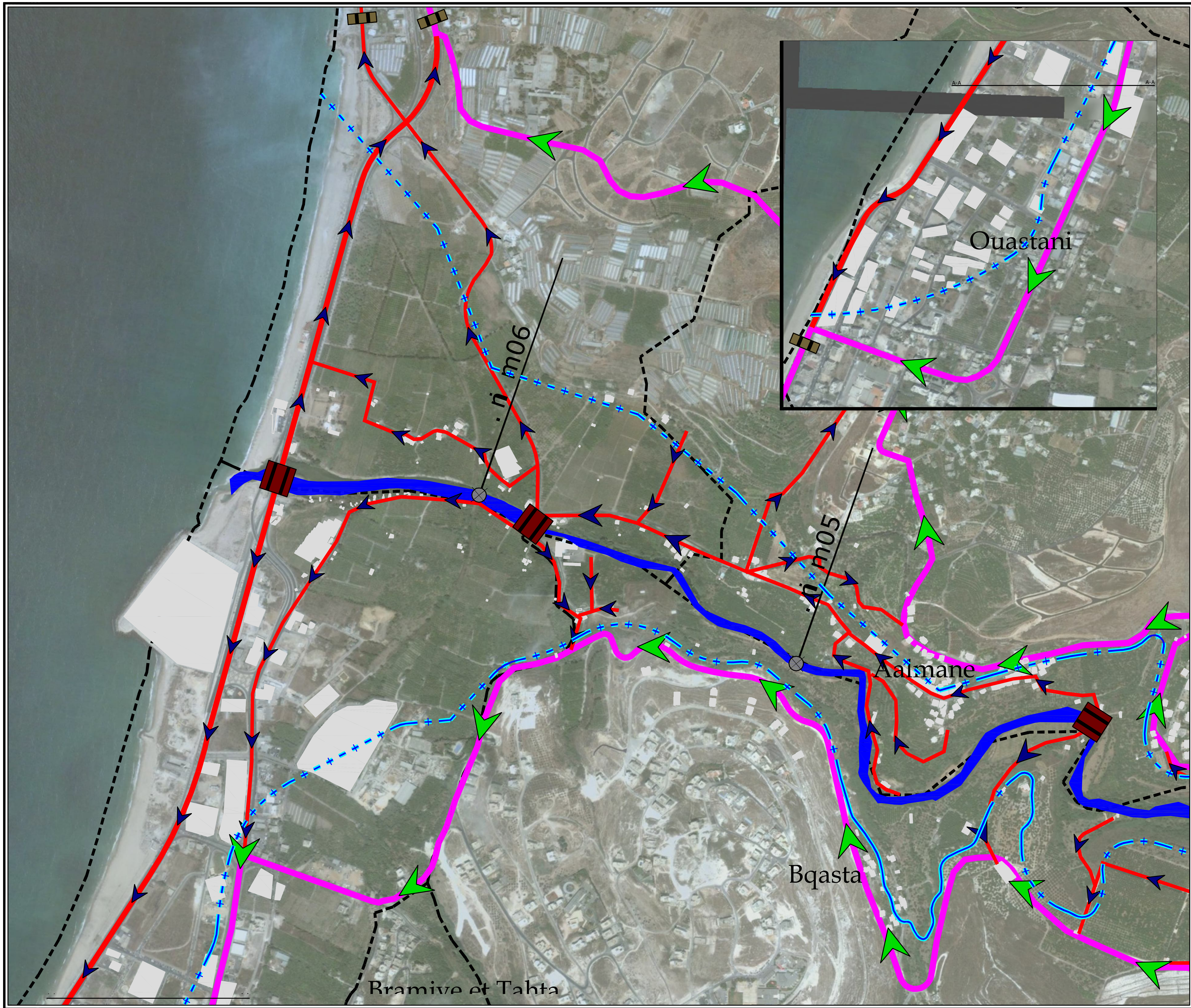
7.7 Implementation

7.7.1 Development

The present chapter constitute the draft Emergency Action Plan.

7.7.2 Testing

The draft Emergency Action Plan will be reviewed at the end of the construction of the dam in order to constitute the final emergency action plan and then annually for contacts and numbers and will be tested every five years using a tabletop exercise conducted under the direction of the Emergency planning Manager. The purpose of this exercise is to review the plan with key personnel. Any revisions to the plan will be implemented after the exercise. The timing and frequency of testing can be adjusted as needed by the Emergency planning Manager. The table top exercise should include emergency scenarios; notification of participants, including verification of all phone numbers and personnel; and notification of local officials. Area residents should not be included.



Legend

- Maximum Flood Limit
- Flooded Evacuation Road
- Safe Evacuation Road
- Bisri River
- Bisri River
- Barricade 1 Way
- Barricade 2 Way
- 60 Min

Initial rise time of the flood counting from initiation of the dam breach is 60 minute at this location

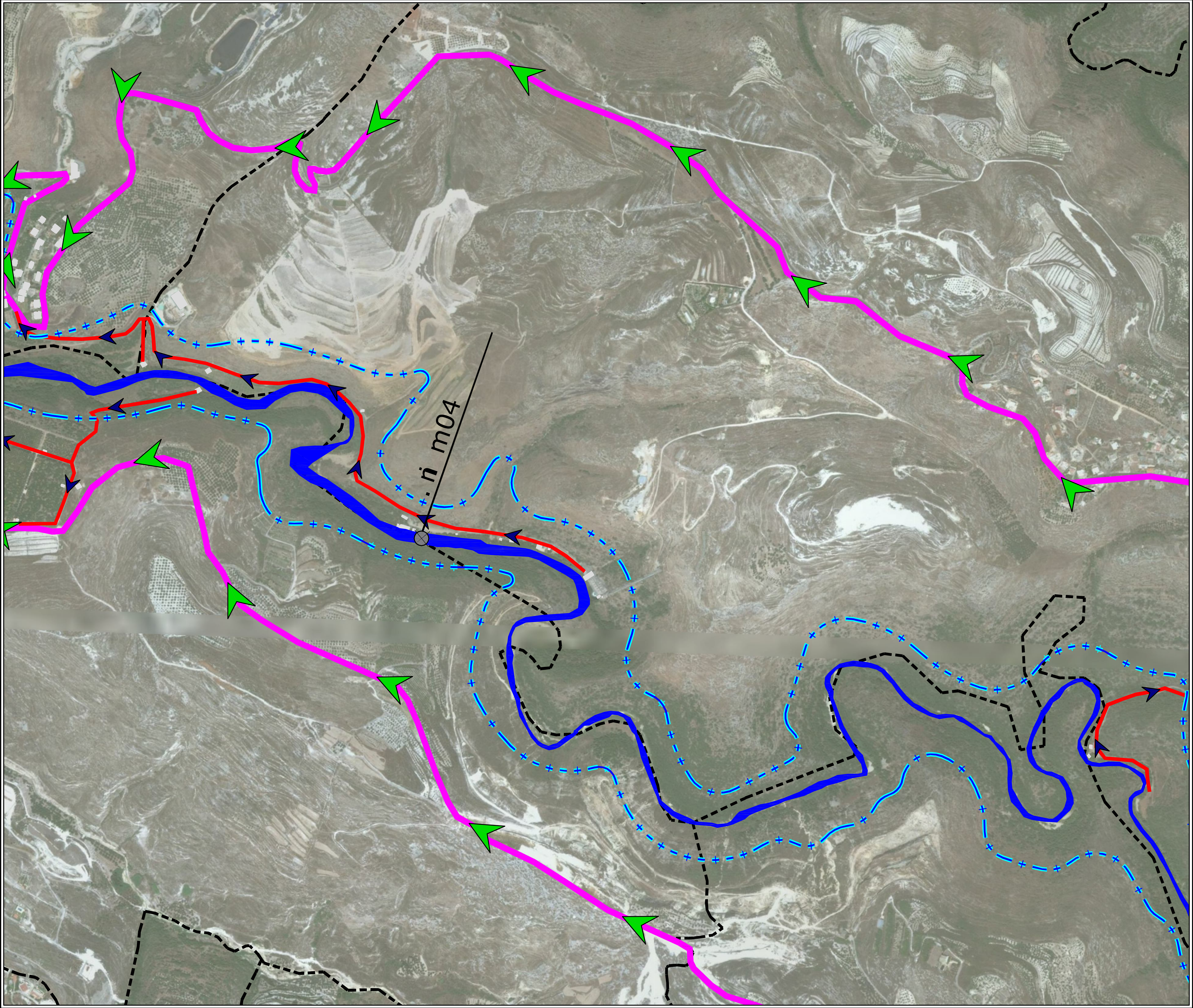
Fig. 7.1

0m 100m 250m

Scale @ A3 Size

INUNDATION AREA AND LOCAL EVACUATION PLAN

DAR AL HANDASAH NAZIH TALEB & PARTNERS



Legend

- Maximum Flood Limit
- Flooded Evacuation Road
- Safe Evacuation Road
- Bisri River
- Bisri River
- Barricade 1 Way
- Barricade 2 Way
- 60 Min

Initial rise time of the flood counting from initiation of the dam breach is 60 minute at this location

0m 100m 250m

Scale $\frac{1}{10000}$ @ A3 Size

N

Fig. 7.2

INUNDATION AREA AND
LOCAL EVACUATION PLAN

DAR AL HANDASAH NAZIH TALEB & PARTNERS

دار الهندسة نزيه طالب وشركاه

Founded 1956

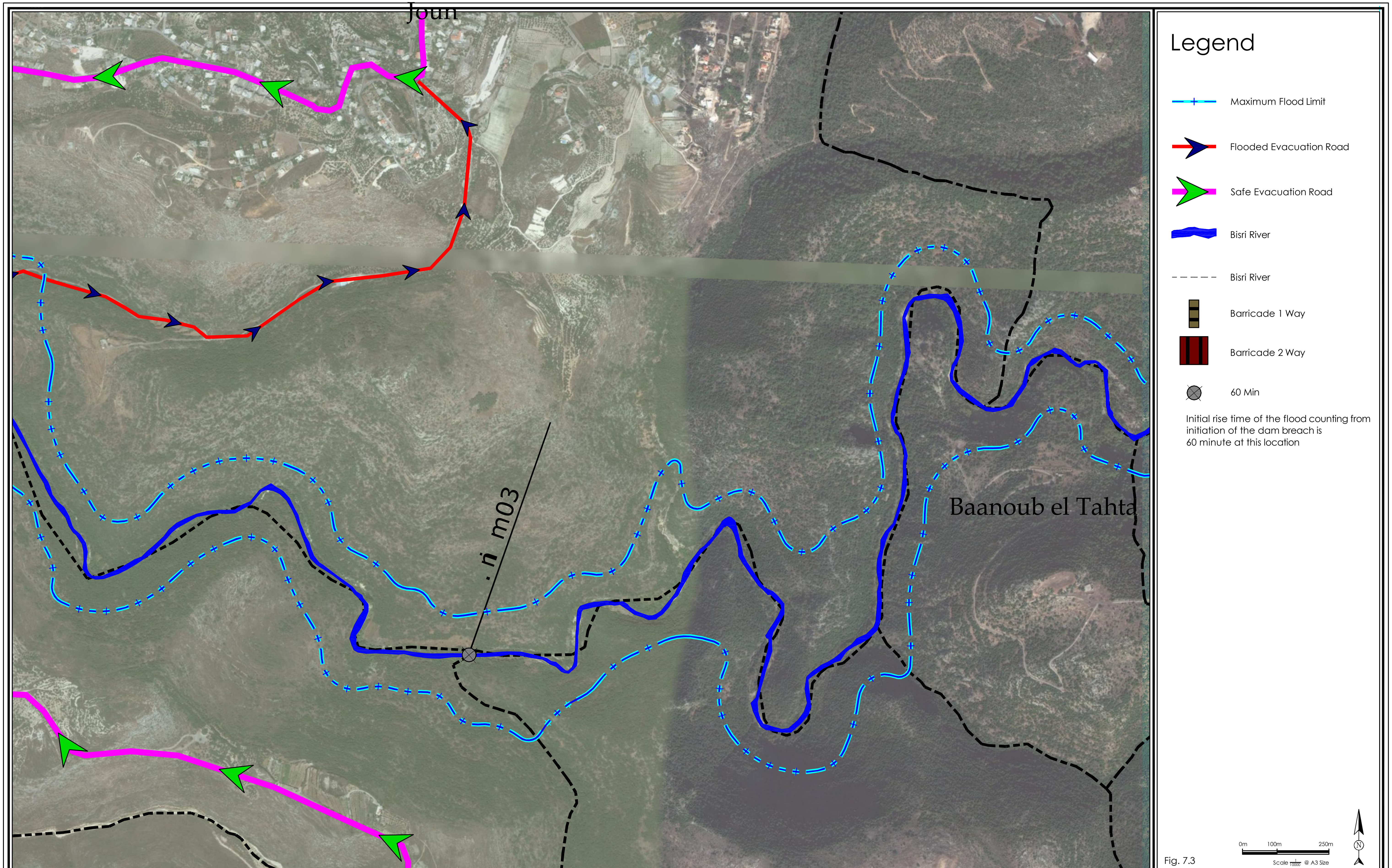


Fig. 7.3

INUNDATION AREA AND LOCAL EVACUATION PLAN

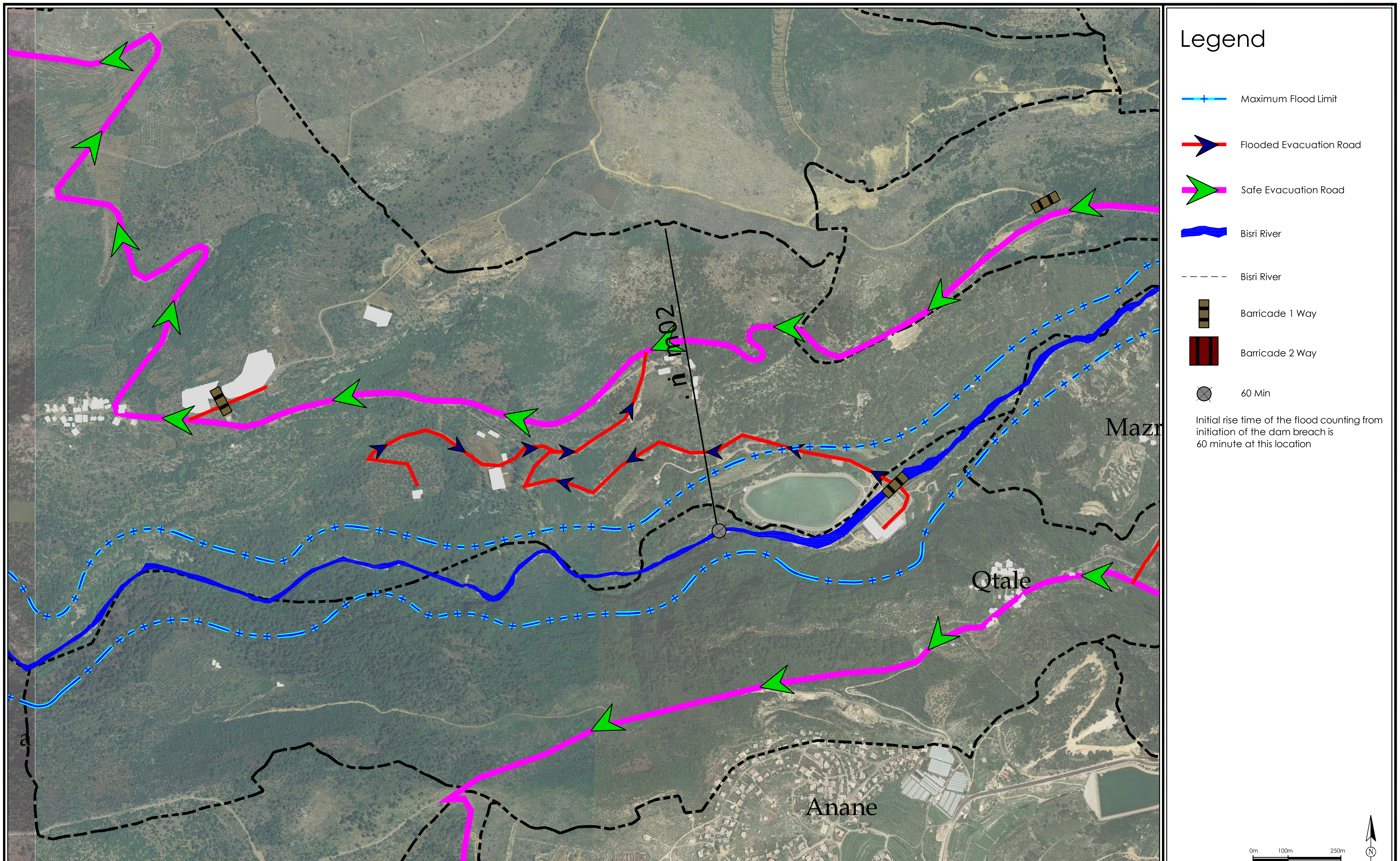


Fig. 7.4

INUNDATION AREA AND LOCAL EVACUATION PLAN

DAR AL HANDASAH NAZIH TALEB & PARTNERS
دار الهندسة نزيه طالب وشركاه
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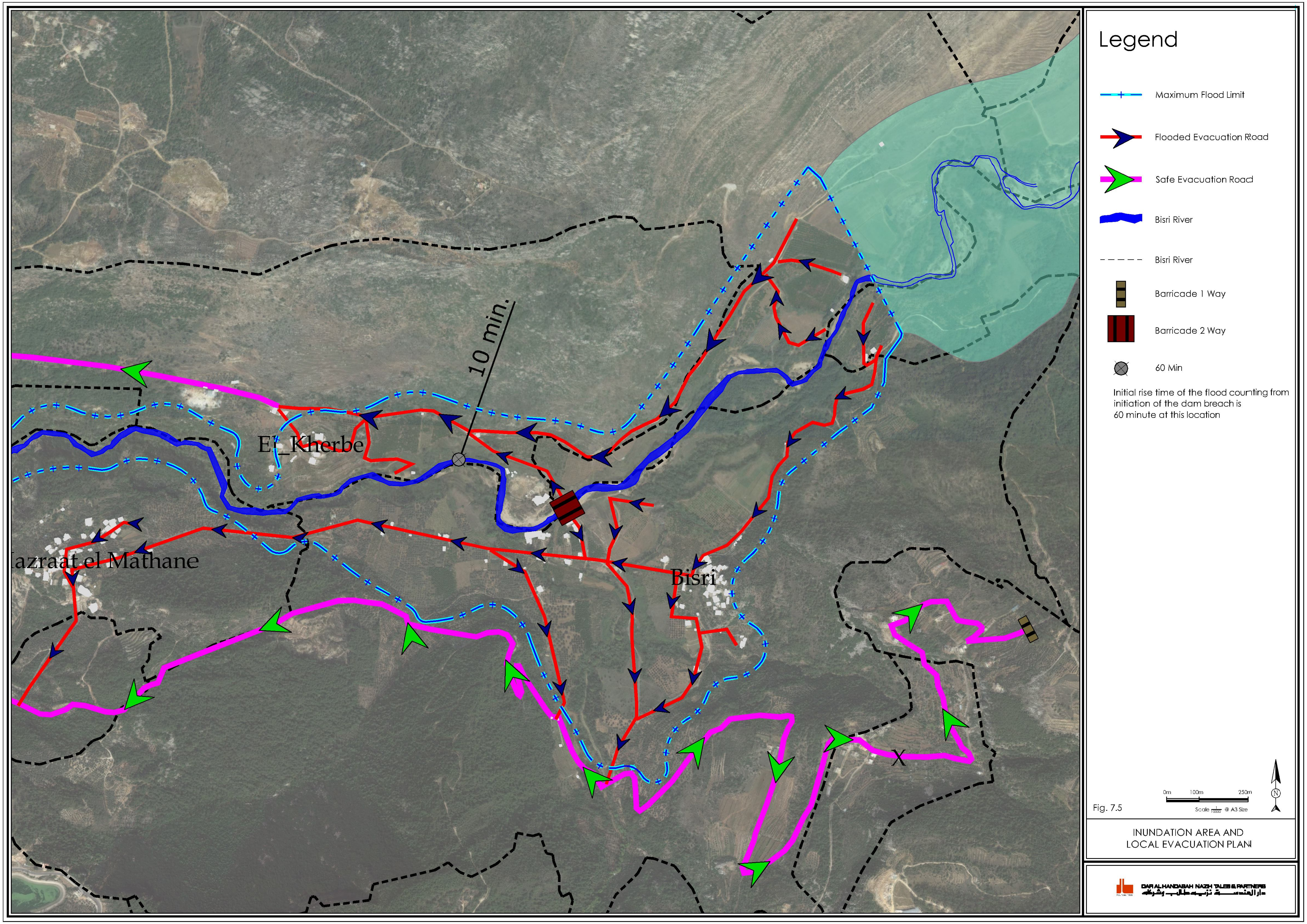
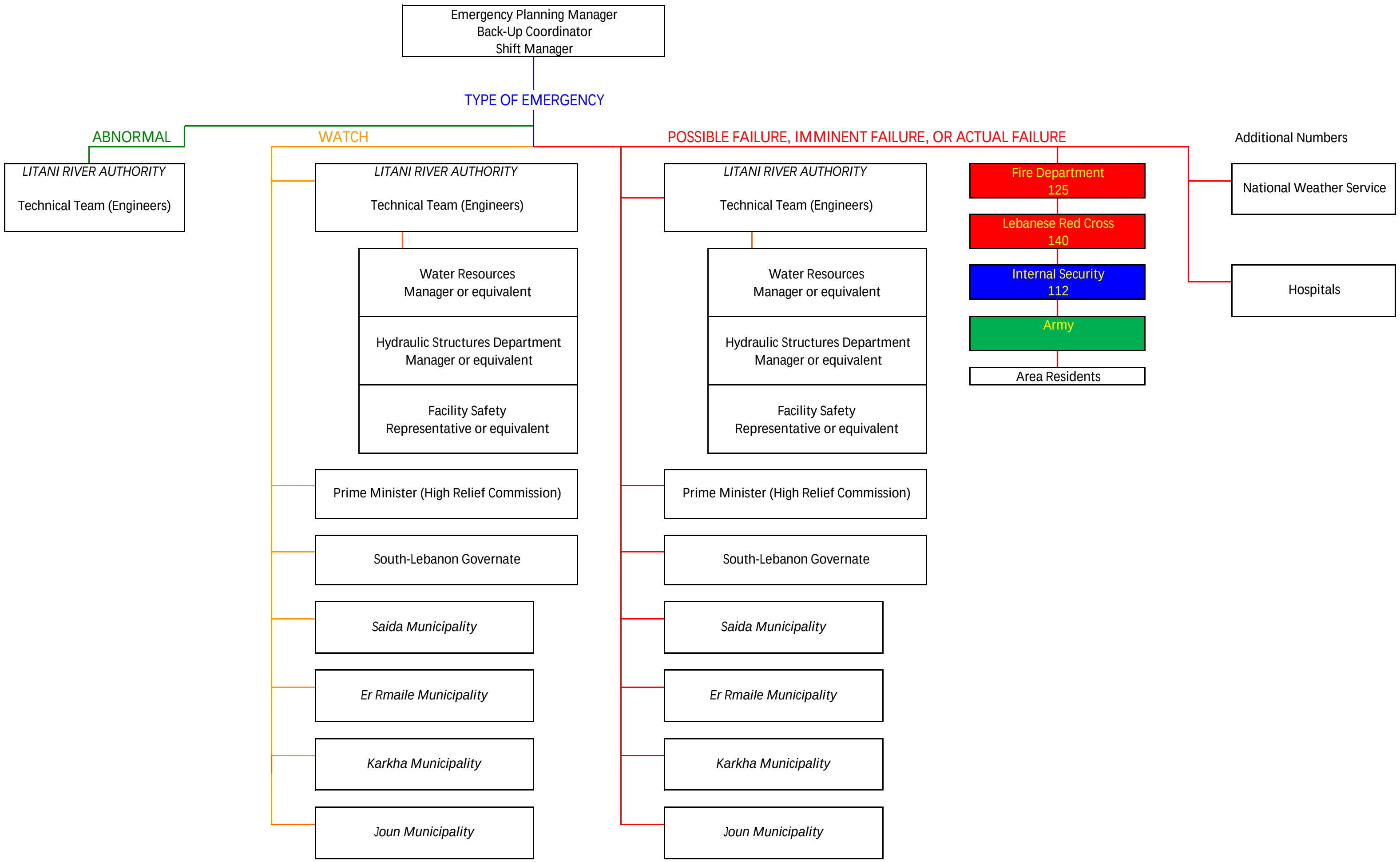


Fig. 7.5

INUNDATION AREA AND LOCAL EVACUATION PLAN

Figure 7-6 Notification Flowchart



Project Name:	**Dam Safety Plans (DSP)**
Project Number:	
Report Title:	**Construction Supervision and Quality Assurance Plan**
Report for:	**Ministry of Water and Energy**

REPUBLIC OF LEBANON

COUNCIL FOR DEVELOPMENT AND RECONSTRUCTION

BISRI DAM

Dam Safety Plans (DSP)

1 - Construction Supervision and Quality Assurance Plan

November 2013

Founded 1956

DAR AL HANDASAH NAZIH TALEB & PARTNERS

دار الهندسة نزيه طالب وشركاه

Table of Contents

List of Tables

List of Figures

List of Appendices

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	Revision:	Date: November, 2013
	☑ Draft	☐ Final
	Signature:	

1 INTRODUCTION

1.1 GENERAL

Dar Taleb, have been appointed in this Consultancy Services contract to prepare the detailed design and the tender documents of BISRI Dam and to prepare Dam Safety Plans for the project which is currently under design and will provide a water storage facility to supply Beirut city by potable water. The Project is financed by the World Bank and other finances agencies.

The scope of services required is defined by the CDR, reference is made to the World Bank's operational policy OP4.37 “Safety of Dams' for guidance on Dam Safety Plan requirements”.

The Construction Supervision and Quality Assurance Plan is one of four Dam Safety Plans (DSP's) included in preparation of Dam Safety Plans for BISRI Dam.

The following Dam Safety Plans are required:

1. Plan for Construction Supervision and Quality Assurance,
2. Instrumentation Plan,
3. Operation and Maintenance (O&M) Plan, and
4. Emergency Preparedness Plan (EPP).

1.2 SCOPE OF THIS GUIDE

This Construction Supervision and Quality Assurance Plan for BISRI Dam consider the requirements for the embankment dam and its appurtenant structures which are essential for safe operation of the dam. This DSP is not exhaustive, and there may be need for additional considerations in the event of design changes and / or unforeseen ground conditions, beyond the descriptions included herein. This document should be considered to be a live document and should be added to and amended if necessary as the construction proceeds.

Topics covered in this Dam Safety Plan (DSP) are summarized below:

Chapter 1	Introduction
Chapter 2	Development of Construction Supervision and Quality Assurance Plan
Chapter 3	Project Organization for Quality Outcomes
Chapter 4	Project Information
Chapter 5	Contractor's Approach to Construction
Chapter 6	Dam Safety Risk Assessment
Chapter 7	Construction Contingency Measures
Chapter 8	Dam Safety during Construction
Chapter 9	Quality Assurance Testing and Inspection Plan
Chapter 10	Reservoir Filling and Commissioning

The electrical and mechanical aspects associated with the power station are not covered by this plan and are not part of the appurtenant structures. A separate plan should be produced to cover the quality assurance during installation and commissioning of these elements

1.3 DEFINITION OF PROJECT ELEMENTS

The following definitions of project elements apply in this DSP:

Project Element	Definition
Abutment	The part of a valley side wall against which a dam is constructed
Cofferdam	A temporary watertight enclosure (e.g. small dam) that is pumped dry to expose the bottom of a body of water so that construction may be undertaken
Dam	A barrier that impounds and retains water
Diversion Channel	Channel crossing under the embankment diverting the water to keep the construction site dry, this is later to be backfilled
Embankment Dam	An earth-fill or rock-fill dam with an impermeable core or upstream blanket to control seepage. Side slopes on both faces vary from 1:2 to 1:4
Intake Tower	Placed at the beginning of the outlet-works waterway (water supply outlet), this concrete structure establishes the ultimate drawdown level of the reservoir by the position and size of the openings of the gates
Water Supply	Pipe through the embankment dam, used as a culvert passing water from the intake tower to the outlet valve chamber and mini hydropower on the downstream face of the dam
Mechanical and Electrical Plant	Refers to control gates, valves, mechanical, and auxiliary equipment and associated electrical works and control systems
Saddle Dam	A subsidiary dam of any type constructed across a saddle or low point on the perimeter of a reservoir
Shoulder	The upstream or downstream portion of an embankment dam
Spillway	A structure over or through which flood flows are discharged
Side Channel Spillway	Spillway built independent of the main dam, on the side of the valley and dissipating the flow through a channel to the downstream
Stilling Pit	Pit dissipate excess energy from flows from the spillway or bottom outlet
Tailrace	Channel conveying discharge to the natural watercourse from the spillway or bottom outlet
Valve Chamber	Chamber on the downstream side of the dam containing the water supply water control valves

1.4 DEFINITION AND ABBREVIATIONS

The following definitions and abbreviations have been used throughout this plan.

Abbreviation	Definition
AAR	Alkali Aggregate Reaction
AEP	Annual Exceedence Probability
ANCOLD	Australian National Committee on Large Dams
CDA	Canadian Dam Association
Constructor	Construction company building the project.
D/S	Downstream
DHDDA	Directorate Director of the Hydropower Development and Dam Administration
DHDD	Director Irrigation and Drainage
DSCP	Dam Safety Critical Plant
DSCS	Dam Safety Critical Structure
DSE	Dam Safety Engineer
DSF	Dam Safety Framework
DSP	Dam Safety Plan
DSRE	Dam Safety Review Engineer
DSRP	Dam Safety Review Panel
EPP	Emergency Preparedness Plan
ERP	Emergency Readiness Plan
FM	Failure Mode
HDDA	Hydropower Development and Dam Administration Directorate
HWQ	Hydrology and Water Quality Directorate
HYD	Hydrologist
I&D	Irrigation and Drainage
MCM	Millions of Cubic Meters
MM	Modified Mercalli
MOWE	Ministry of Water and Energy
MOWR	Ministry of Water and Resources
O&M	Operation and Maintenance
OGL	Original Ground Level
OPERATOR	Irrigation Scheme Operator
PMF	Probable Maximum Flood
PSP	Private Sector Participation
RE	Resident Engineer
RL	Reservoir Level

Abbreviation	Definition
SDSE	Senior Dam Safety Engineer
SMT 1	Site Management Team
ToR	Terms of Reference
U/S	Upstream
UPS	Uninterruptible Power Supply
USD	United States Dollar
WB	World Bank
WWCE	Water Works Construction Enterprise
WWDSE	Water Works Design & Supervision Enterprise

2 DEVELOPMENT OF CONSTRUCTION SUPERVISION AND QUALITY ASSURANCE PLAN

This section of the DSP provides the approach taken to develop the Construction Supervision and Quality Assurance Plans for BISRI Dam

2.1 DAM SAFETY DURING CONSTRUCTION

The quality of construction is very important for dam safety. The dam components will not have the level of safety targeted or adopted by the designer if construction materials or workmanship do not equal or exceed the design specifications. Even a small change in detail can severely prejudice the functional safety in the area of the detail and have wide reaching implications.

The following requirements are necessary from a dam safety viewpoint:

- The constructor must be suitably experienced and committed to achieving the standards of work specified;
- The level of supervision of the works, quality assurance and designer / technical specialist continuity, must be appropriate to the scale and complexity of the dam;
- The owner must recognize that inherent uncertainties may remain after design investigations and only be revealed during construction;
- A suitably detailed design report and drawings showing the as-built structures of all components of the dam and foundation shall be developed as an on-going integral part of the construction process so that there is a reliable record to refer to at all times in the future;
- Foundation and construction material testing shall be undertaken with quality assurance methods; and
- An Emergency Action Plan shall be put in place during the construction and commissioning of the works.

2.2 PURPOSE

The purpose of the Construction Supervision and Quality Assurance Plan is to confirm:

- The quality assurance requirements for the project during construction;
- The construction activities and their potential influence on dam safety;
- The construction controls necessary to manage the identified dam safety risks;
- The quality control tests required to demonstrate that construction has been performed to an acceptable standard; and
- The extent of reporting during construction and on completion of the project

The document is one of a set of Dam Safety Plans and is directed at the construction of the dam in order to achieve a safe structure. It does not include guidance on construction safety and environmental protection these are both important criteria that must be taken into account during the construction of the dam and its appurtenant structures National and International guidelines are readily available for these aspects of construction.

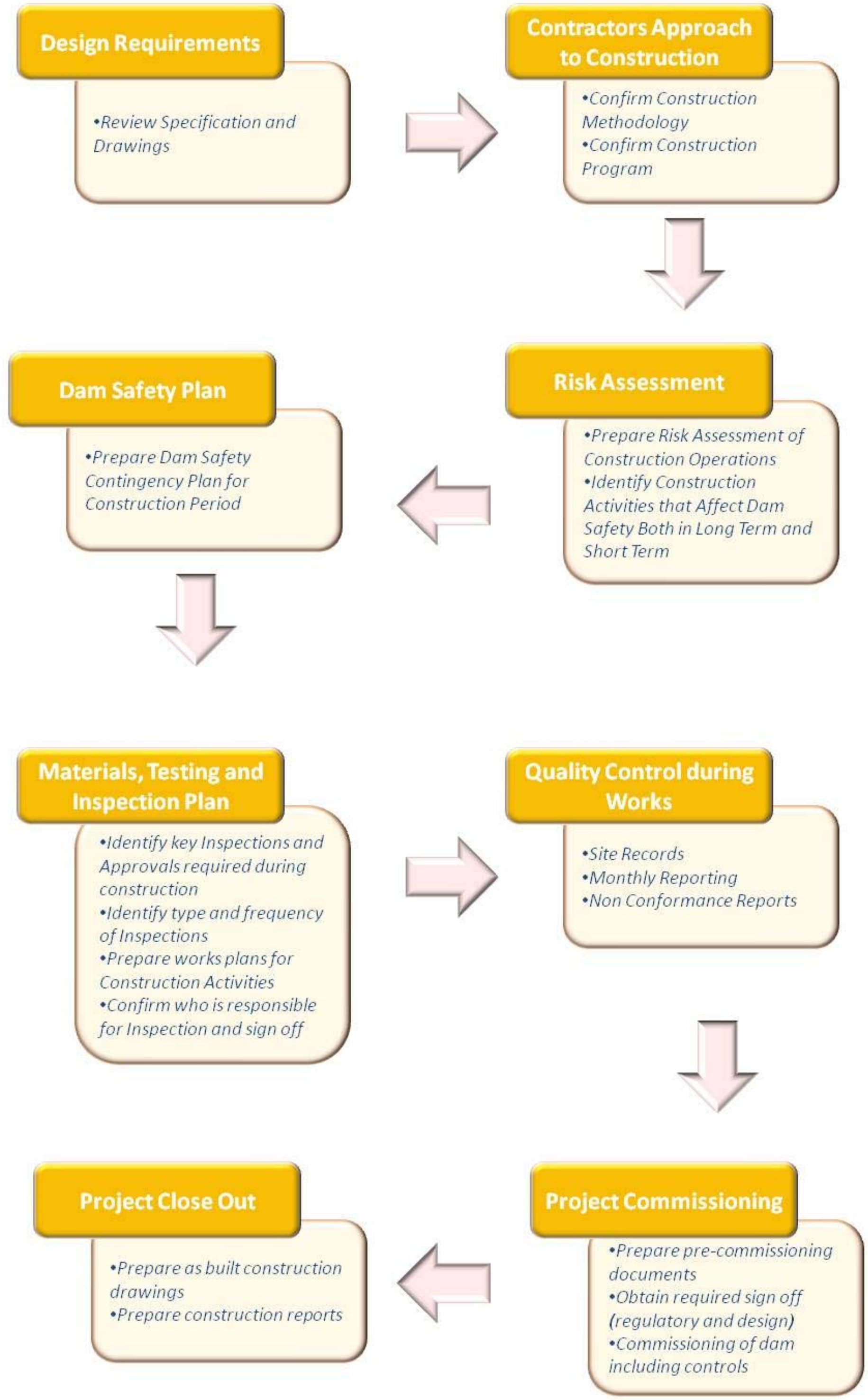
It is expected that this document is used by the Site Management Team for BISRI Dam to prepare or amend their detailed Quality Assurance Plan for the works.

2.3 DEVELOPMENT OF CONSTRUCTION SUPERVISION AND QUALITY ASSURANCE PLAN

The development of a Construction Supervision and Quality Assurance Plan to achieve an appropriate level of dam safety is illustrated in Figure 2.1. The Plan will incorporate the following key steps:

1. Determine the roles and responsibilities of each party involved in the project;
2. Confirm the design requirements and design standards;
3. Documentation of the construction activities and resources associated with the project;
4. Identify events and construction issues that may lead to dam failure;
5. Determine the construction controls placed to mitigate the risk of an event or construction issue occurring,
6. Determine the contingency measures required to respond to critical problems during construction;
7. Document the specific dam safety emergency procedures to follow during construction if there is an indicator of dam failure;
8. Determine the quality assurance procedures that are needed for dam safety,
9. Document the quality control testing and inspection plan;
10. Determine the quality assurance documentation required for sign-off of elements of the construction;
11. Document the commissioning and testing procedures required to fill the reservoir and operate the dam, and
12. Document the as-built project through construction report and as-built drawings.

Figure 2-1 Developing Quality Control Procedures for Dam Construction Projects



3 PROJECT ORGANIZATION FOR QUALITY OUTCOMES

This section of the DSP states the requirements of the quality assurance plan to document the roles and responsibilities of each party involved in the project and the overall approach to quality assurance.

3.1 PROJECT PARTICIPANTS AND ROLES

The quality assurance plan should document the participants and their roles in the project. Table 3.1 below lists the key participants and their roles in the project.

Table 3-1 Project Participants

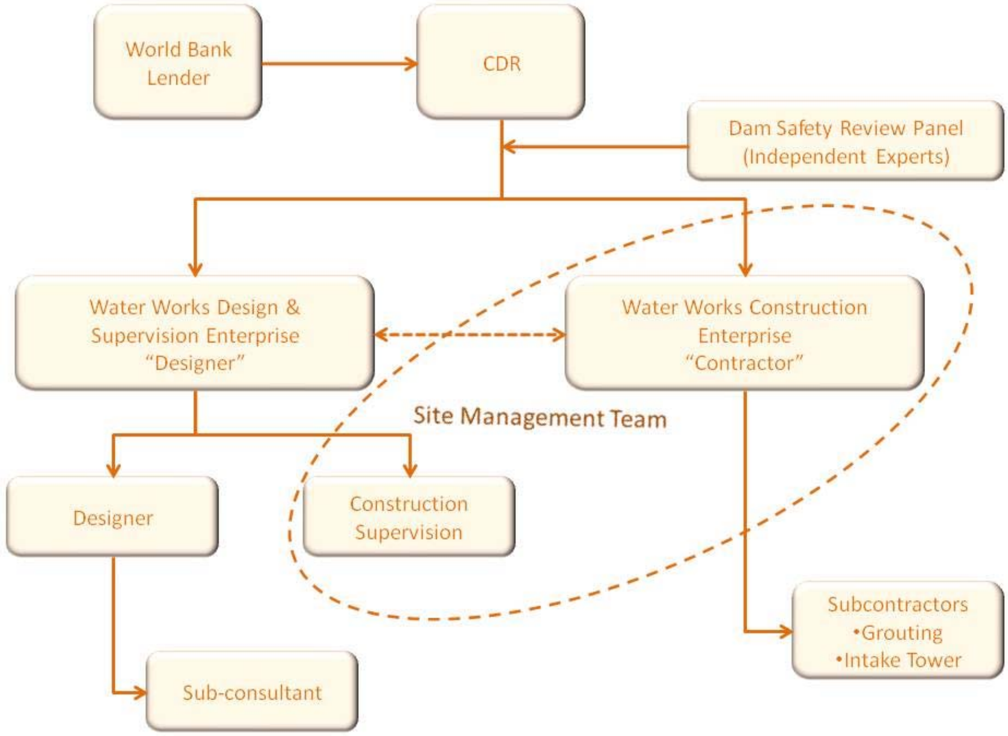
Participant	Role
Ministry of Energy and Water (MEW)	Owner and future operator of the Dam scheme
Council for Development and Reconstruction (CDR)	Implementing agency responsible for regulating and implementing these guidelines
World Bank, Islamic Development Bank, Saudi Fund for Developments (Banks)	Financiers of the Dam construction
Water Works Design & Supervision Enterprise	Company undertaking detailed design and design representation during construction
Water Works Construction Enterprise (WWCE)	Company undertaking construction of the Dam scheme
Dam Safety Review Panel (DSRP)	Independent expert review panel for design and construction

From an overall dam safety and quality assurance perspective it is important to maintain a professional level of independence between all parties, this is achieved by having an independent body from the developer, constructor and designer to provide peer review of the design, construction, quality assurance records and the commissioning of the project. The DSRP provide this role of independent reviewer for the project. The World Bank mission also provides a high level independent review of dam safety for the project.

3.2 PROJECT STRUCTURE AND APPROACH TO QUALITY CONTROL

The quality assurance plan should document the organizational structure of the project and how each participant of the project interacts and signs off on quality assurance during the construction period. Figure 3.1 shows the project structure and relationship between the key participants.

Figure 3-1 Project Structure



The project reporting structure is based on the traditional concept of constructor being responsible for quality control and reporting directly to the Resident Engineer and his construction supervision team. For the purpose of this DSP, the organizational structure of the project shall be referred to as the Site Management Team (SMT). The Site Management Team consists of the following participants;

- Constructor
- Designer's Construction Supervision Team

The CDR and DSRP are considered to be independent of the SMT and their roles are defined in Sections 3.3 and 3.4.

The SMT is responsible for implementing the quality control for Project. The SMT will collectively develop the processes that will be followed for the implementation, review and sign-off of all quality assurance measures and documents. The main requirement of these processes is that there are sufficient staffing levels of appropriately qualified people to both implement and record quality control actions and that a representative from each participant sign's off on the quality assurance documentation

Representatives signing off on quality control project minutes shall have appropriate qualifications with respect to the details they are signing off. Qualifications shall be submitted to the CDR for verification.

Quality assurance documentation, once signed off by all participants in the SMT shall be submitted to the DSRP for review and verification.

3.3 DAM SAFETY REVIEW PANEL (DSRP) ROLE IN QUALITY ASSURANCE

A Dam Safety Review Panel (DSRP) independent of the developer (CDR) and its subsidiary companies design (WWDSE) and construction (WWCE) has been engaged by CDR. The World Bank Procedures[1] require the panel of experts to be independent of the developer.

The DSRP should be fully integrated into the design and construction process. It is critical to success that the DSRP is engaged by the site team at frequent intervals and more frequently when key activities take place. The DSRP will remain in a review capacity through construction and commissioning. This is an important requirement to provide assurance to the funders that important elements of the dam are being designed and then constructed correctly.

The DSRP members should have extensive experience in all aspects associated with the construction of a dam and its appurtenant structures. A member may have experience in one or more areas of expertise. Where an area of expertise is not represented by the DSRP, they should engage other independent specialist consultants to review aspects of the project relevant to this expertise. It is good practice to have at least one international specialist on the DSRP. The areas of expertise should include the following:

- Dam design and construction
- Geology
- Hydrology
- Hydraulics
- Structural design and construction
- Mechanical design and construction
- Electrical design and construction

The DSRP acts as the independent review of quality and their role includes:

- Review and sign off on quality assurance including monthly inspection and testing / progress reports during the construction period:
- Inspect the site for key activities during construction and sign off on work completed;
- Prior to filling of the dam and commissioning, sign off that all work has been satisfactorily completed and the dam is safe for commissioning,
- On completion of commissioning, sign off that all work is complete and Dam is safe for long term operation.

The DSRP should make at least 2 site visits per year, unless additional visits are required due to key activities. A typical site visit schedule would be:

- Day 1; meet with Designer
- Day 2: travel to site, with Designer, and site visit;
- Day 3: site visit/ bullet points preparation/ return to
- Day 4: debriefing CDR about main findings (bullet points); and
- Day 5: report preparation

[1] BPa.37: Safety of Dams, The World Bank Operational Manual – Bank Procedures BP4.37 October 2001

The DSRP report format should include:

- Confirmation of activity on site during site visit,
- Document dam safety recommendations resulting from the site visit,
- Identify any documents reviewed during the site visit for example site quality control inspections, site testing results and monthly progress reports.
- Status of any proposed and approved design changes.
- Maintain a summary of DSRP recommendations and status at time of visit; and
- Any interim activity by the DSRP between site visits for example design review or progress reports received.
- Reports prepared by the DSRP should be signed off by the DSRP team members who visited site.

3.4 COUNCIL FOR DEVELOPMENT AND RECONSTRUCTION (CDR) ROLE IN QUALITY CONTROL

The CDR is the developer of the project and has contractual relationships with both the contractor and designer. The CDR is responsible for ensuring that the SMT discharges their duties in regards to quality control, as outlined in this plan.

The DSRP provides the CDR with technical review and advice on elements of the project related to dam safety. Concerns in regard to quality control on the project should be reported to the CDR by both the SMT and DSRP.

The CDR is responsible for ensuring the SMT rectifies any quality issues on the project which may cause a risk to the safety of the dam.

4 PROJECT INFORMATION

This section of the guidelines states the required information about the project that is relevant to the dam design requirements and should be documented in the quality assurance plan. The required information includes the following:

- Brief description of the overall project
- Specific details of the project relevant to construction
- Details on the specifications, drawings and dam safety documentation relevant to construction: and
- Typical details required for the information are given in the sections below.

4.1 PROJECT DESCRIPTION

The project description should give a brief overview of the following aspects of the project:

- Dam type and details
- Spillway arrangement
- Foundation geology
- Intake arrangement
- Water conveyance structures & flow control equipment
- Environmental flow requirements

4.2 DAM PROJECT DATA

Table 4.1 provides key details to be confirmed in the quality assurance plan.

Table 4-1 Major Components of the Project

Element	Details
Main Dam	
Type	Rockfill Dam with claycore
Length (m)	790
Crest width (m)	10
Dam height above the river bed level (m)	**73**
U/S and D/S slope	2.5 H/1V & 3.5H/1V
Volume of Rip Rap material (m^3)	
Volume of fill material (Rock) (m^3)	
Volume of fill material (shell) (m^3)	
Volume of filter material (F1&F2) (m^3)	
Total Volume of fill (m^3)	7,300,000
Reservoir capacity (Mm^3)	125
Water surface area at normal reservoir level (m^2)	4,000,000
Dam crest elevation (m)	469
Normal Water Level (NWL) (m)	461
Maximum Water Level (MWL) (m)	466.70
Minimum Draw Down Level (MDDL) (m)	405
PMF (m^3/sec)	3,270

Main Dam body - construction details	
Material processing, borrow pits and stockpiles	Construction material available in the reservoir area.
Construction period	4 years with 8 months (224 days) of dry season available for construction each year
Internal Drainage	
Type	1-Chimney drain composed of fine & coarse 2-Horizontal
Location	1-Between the core and filter 2-Below the downstream embankment
Dam foundation	
Maximum excavation slopes	Over 20% excavation in steps
Seepage cut off	Slurry wall and grout curtain along the dam axis + chimney drain + horizontal drain
Slurry wall and curtain grouting arrangement and depth	Slurry wall and grout curtain of depth reaching 130 m
Consolidation grouting arrangement and depth	U/S and D/S, spaced 6m apart, 10m deep
Temporary River Diversion / Only for the dry season	
Inlet	Left of the U/S coffer dam, diversion channel entrance at 400 m
Outlet	Diversion channel ends at level 395
Dry season discharge (50 years period)	490 m^3/sec
Diversion channel crest level (m)	404.50 – 389.50
Width (m)	30
Length (m)	714
Slope (%)	0.7
Side Channel Spillway	
Effective Crest length (m)	80
Type	Freeweir on left abutment
Crest level (m)	461
Design discharge (m^3/sec)	2,240
Channel slope (%)	15
Length (m)	360
Width (m)	80-50
Dissipation type	Deflector ski jump
Height of Spill weir (m)	2
Volume of Concrete work	
Intake tower	
Discharging capacity at NWL	
Height (1955m-1884.50m)	
Gate level and size	Base intake isolation gate Draw-off gates Draw-off gates Water supply isolation gate
Gate type	Sluice gates
Gate maintenance	Maintenance access from the top of the intake tower via the pedestrian bridge. Internal ladders from the top to the lowest gate.

Bridge to Intake Tower	
Access	
Type	Concrete box section supported
Length	i
Width	1
Bridge deck elevation	
Truck bridge across Spillway Chute	
Width	
Length	
Bridge Deck Elevation	
Interfaces	
Upstream Coffer dam	
Type	Fill with daycore
Height (m)	4.5
Crest elevation (m)	404.50
Crest width	
U/S and D/S slope	
Embankment upstream protection details	
Downstream Coffer dam	
Type	
Height (m)	3.5
Crest elevation (m)	398.50
Crest width	
U/S and D/S slope	
Embankment protection details	
Water Supply Outlet	
Design Discharge	
Conduit {Irrigation outlet) diameter	
Conduit length (updated)	
Control Valves at downstream end	
Stilling Basin length	
Irrigation command area	

This table should be updated if necessary in accordance with the works being constructed on site

4.3 DAM PROJECT DRAWINGS AND SPECIFICATIONS

All the relevant drawings, specifications and dam safety documentation issued for construction of the dam and appurtenant structures should be compiled into a single location/document. Table 4.2 provides a typical register for compiling the relevant dam design documents for construction.

Table 4-2 Typical Register for Dam Design Documents

Design Documentation	Document Title
Design Report	Design Report (May, 2014)
Specifications	Technical Specifications (May 2014)
Drawings	General Arrangements
	Main Dam
	Diversion Channel
	Spillway
	Intake and Irrigation Outlet
	Instrumentation
	Gates and Trash Racks
	Electrical
Dam Safety	Construction Supervision and Quality Assurance;
	Instrumentation Plan
	Operation and Maintenance (O&M) Plan
	Emergency Preparedness Plan (EPP)

5 CONTRACTOR'S APPROACH TO CONSTRUCTION

This section provides the required information about the project that is relevant to the dam construction and contractor's methodology and should be documented in the quality assurance plan. The required information includes the following:

- Summary of the construction activities associated with the project
- Summary of the resources required for construction
- Details of the construction program

5.1 CONSTRUCTION ACTIVITIES

Table 5.1 provides a summary of construction activities identified for the Dam construction project. These activities should be documented in the quality assurance plan.

Table 5-1 Example of Construction Activities and Operations for the Dam

Project Element	Activity	Construction Operations
Temporary River Diversion	Upstream cofferdam cutoff	▪ Excavate cutoff trench ▪ Place plastic concrete
	Construction of cofferdams	▪ Excavate overlying alluvium to lines and levels shown on drawing for coffer dam and diversion channel; ▪ Stockpile rock and earth material to be used as fill and dispose of excess or unsuitable rock and earth material; ▪ Condition material (if required) and transport soil material to site; ▪ Place earth and rock fill material; ▪ Compact rock material to required Specification
	Construct River Diversion channel	▪ Excavate overburden to tines and levels shown on drawing for diversion channel; ▪ Stockpile rip rap and clay lining material to be used for channel lining; ▪ Condition material (if required) and transport soil material to site; ▪ Place rip rap and clay lining material to required Specification.
	Demolish cofferdams	▪ Excavate rock and soil material from coffer dam, in a controlled manner to release any stored water; ▪ Transport and dispose of rock and earth material

Project Element	Activity	Construction Operations
Main Dam	Foundation and abutment excavation in the Core Zone	▪ Excavate overburden and weathered rock to expose the suitable dam foundation, clean the foundation to the standard required by the Specification; ▪ Excavate overlying alluvium and any unsuitable material on abutments (above dam level) to lines and levels shown on drawing; ▪ Stockpile rock and earth material to be used as fill and dispose of unsuitable or excess rock and earth material.
	Foundation and abutment excavation under shoulders and filters (Zones 2 to 6)	▪ Excavate overlying alluvium to lines and levels shown on drawing, ▪ Excavate unsuitable overburden as directed by the Engineer, e.g Palaeo-channels,
	Foundation and abutment treatment in the Core Zone	▪ Curtain grouting of foundation rock to prevent seepage; ▪ Consolidation grouting of foundation surface to improve strength of foundation rock; ▪ Dental concrete to fill in voids and seams in rock surface.
	Foundation and abutment treatment under shoulders and filters (Zones 2 to 6)	▪ Unsuitable material replaced by Zone 3 or other suitable fill material
	Construct dam	▪ Excavate / quarry and stockpile rock and earth materials to be used as Zoned fill (zones 2 to 6) for dam construction, ▪ Condition materials (if required) and transport to site; ▪ Place earth and rock fill material; ▪ Compact rock material to required Specification
Side Channel Spillway	Excavation for spillway and chute	▪ Excavate overburden and rock to lines and levels shown on drawing and clean to standard required by Specification; ▪ Excavate any unsuitable material to level approved by the Engineer, ▪ Stockpile rock and earth material to be used as fill and dispose of unsuitable or excess rock and earth material.
	Foundation and abutment treatment for spillway, discharge channel, chute and stilling pit	▪ Consolidation grouting of foundation surface to improve strength of foundation rock; ▪ Dental concrete to fill in voids and seams in rock surface; ▪ Install rock anchors or rock bolts.

Project Element	Activity	Construction Operations
	Construct concrete side spillway, discharge channel, chute and stilling pit	▪ Supply, stockpile and prepare concrete materials (aggregate, cement, sand, additives) ▪ Prepare site for placement of concrete (place formwork, reinforcement, embedded items, water stops, etc) ▪ Mix and test concrete prior to placement ▪ Place concrete layer (including vibration) ▪ Cure, treat and prepare lift joints for subsequent concrete pours ▪ Finish exposed concrete surfaces. ▪ Install retaining wall drainage and backfill as required by the Specification
	Construct exit channel	▪ Excavate river channel to line and level; ▪ Install rip rap on geotextile.
	Construct concrete side spillway truck bridge (abutments and deck)	▪ Concrete works as spillway channel; ▪ Backfill abutments to line and level using dam core material; ▪ Access road construction.
Intake structure	Install tower foundation	▪ Excavate overburden and weathered rock to foundation platform level; ▪ Construct concrete foundations (see below).
	Construct intake tower concrete superstructure	▪ Supply, stockpile and prepare concrete materials (aggregate, cement, sand, additives); ▪ Prepare site for placement of concrete (place formwork, reinforcement, embedded items, water stops, box outs for embedded parts etc); ▪ Mix and test concrete prior to placement; ▪ Place concrete layer (including vibration); ▪ Cure, treat and prepare lift joints for subsequent concrete pours; ▪ Finish exposed concrete surfaces.
	Install bulkheads, gates and trash rack	▪ Fabricate inlet closure bulkhead, trash racks, valves and gates in factory; ▪ Transport trash racks, valves and gates to site; ▪ Install embedded parts and carry out second stage concreting; ▪ Install and fit trash racks, valves and gates; ▪ Commission and test operation.
	Construct reinforced concrete intake culvert and tunnel	▪ Excavate trench for culvert in areas of cut; ▪ Drill the tunnel in the rocky areas with support system ▪ Underground concreting ▪ As intake tower concrete superstructure; ▪ Includes installing the washout pipeline

Project Element	Activity	Construction Operations
	Construct valve house and install valves	▪ Construct valve house {concrete works as spillway works); ▪ Fabricate valves; ▪ Transport valves to site; ▪ Install and fit manifold and valves, ▪ Carry out second stage concreting around valves as necessary. ▪ Commission and test operation.
Intake Bridge	Install bridge foundations	▪ Excavate overburden and weathered rock to foundation platform level; ▪ Install concrete foundations (see above)
	Construct bridge superstructure (piers and deck)	▪ As intake tower concrete superstructure;
Bottom outlet and diversion culvert and tunnel gate valves and energy dissipation	Construct reinforced concrete bottom outlet culvert and tunnel	▪ Excavate trench for culvert in areas of cut; ▪ Drill the tunnel in the rocky areas with support system ▪ Underground concreting ▪ As intake tower concrete superstructure; ▪ Includes installing the washout pipeline
	Construct valve house and install valves	▪ Construct valve house {concrete works as spillway works); ▪ Fabricate valves; ▪ Transport valves to site; ▪ Install and fit manifold and valves, ▪ Carry out second stage concreting around valves as necessary. ▪ Commission and test operation.
	Excavate exit channel	▪ Excavate overburden and weathered rock and any unsuitable material to lines and levels shown on drawing; ▪ Stockpile rock and earth material to be used as fill and dispose of unsuitable or excess rock and earth material. ▪ Unsuitable ground may require local foundation treatment as directed by engineer (grouting, anchoring etc.).
	Construct exit channel	▪ As side channel spillway
	Construct downstream spillway channel	▪ Excavate river channel to line and level ▪ Install rip rap on geotextile;
Instrumentation	Install benchmarks, piezometers, settlement sensors, weirs, earth pressure cells,….	▪ Refer to instrumentation plan
Materials testing before use in the works	Concrete works	▪ Carry out testing of aggregates, cement, additives, water; ▪ Carry out mix design trials to ensure that mixes detailed in the Specification are suitable with the available materials

Project Element	Activity	Construction Operations
	Other materials	▪ Test embankment construction materials to ensure compliance with Specification requirements ▪ Test all other materials to ensure compliance with Specification requirements
Ancillary Works	Temporary and Permanent Roads Construction	▪ Excavate overlying alluvium to lines and levels shown on drawing ▪ Stockpile rock and earth material to be used as fill and dispose of excess rock and earth material ▪ Condition road base (if required) and surface material and transport to site ▪ Place road base and surface material ▪ Compact road base and surface to required Specification
	Construction Site Establishment	▪ Clear construction site building foundations, stockpile areas ▪ Establish machinery hardstand areas and stockpile base ▪ Construct construction site buildings and workers accommodation (if required) ▪ Construct bores and lay pipework to establish domestic water supply to construction site and workers accommodation ▪ Install construction site and workers accommodation power supply and communications ▪ Construct environmental protection structures such as oil traps, silt ponds etc

5.2 CONTRACTORS RESOURCES

Table 5.2 outlines an example of the resources applied for the Dam project. These resources should be documented in the quality assurance plan.

Table 5-2 Example of Construction Resources for Dam

Construction Operation	Relevant Construction Activities	Resources
Excavation of rock and soil material	▪ Main dam ▪ Spillway ▪ River diversion channel ▪ Intake structure ▪ Bottom outlet and diversion culvert ▪ Outlet discharge channel ▪ Earth coffer dam ▪ Temporary and permanent roads construction ▪ Construction site establishment	▪ Hand tools (Jack hammers, etc) ▪ Hydraulic machinery {excavators, earth movers etc) ▪ Dewatering machinery (Centrifugal pumps, hoses, generators etc) ▪ Transport machinery (Trucks etc) ▪ Lifting equipment {cranes, hoists etc.) ▪ Explosives (Type and size) ▪ Drilling machinery Temporary works equipment (scaffolding, ladders etc) ▪ Survey equipment
Grouting	▪ Main dam foundation and abutment treatment ▪ Saddle dam foundation and abutment treatment ▪ Cofferdam foundation treatment ▪ Side spillway and chute foundation ▪ Intake tower foundation ▪ Outlet discharge channel	▪ Drilling machinery ▪ Grout production equipment ▪ Grout injection and monitoring equipment ▪ Testing equipment
Tunnels	▪	▪
Sturrywall	▪	▪
Piling	▪ Intake tower and bridge construction	▪ Drilling machinery ▪ Mobile crane ▪ Temporary works equipment (scaffolding, ladders etc) ▪ Testing equipment ▪ Survey equipment
Placement of zoned materials for dam construction	▪ Earth cofferdam construction ▪ Main dam construction ▪ Construction of saddle dams	▪ Hydraulic machinery (excavators, earth movers, etc) ▪ Compaction machinery (rollers, etc) ▪ Transport machinery (trucks, etc) ▪ Survey equipment
River channel construction	▪ River diversion channel ▪ Irrigation outlet channel ▪ Spillway outlet channel	▪ Hydraulic machinery (excavators, earth movers, etc) ▪ Transport machinery (Trucks, etc) ▪ Compaction machinery (rollers, etc) ▪ Explosives (Type and size) ▪ Drilling machinery {Drill rig 42mm to 102mm size hole) ▪ Survey equipment

Construction Operation	Relevant Construction Activities	Resources
Concrete aggregate supply	▪ Spillway and truck bridge construction ▪ Diversion culvert and valve house construction ▪ Intake tower and pedestrian bridge construction	▪ Transport machinery (trucks, etc) ▪ Hydraulic machinery {excavators, etc) ▪ Hand tools (jackhammers, etc) ▪ Explosives (type and size) ▪ Material screening / crushing plant ▪ Water supply and pumps ▪ Testing laboratory
Concrete supply	▪ Irrigation outlet energy dissipater	▪ Transport machinery (trucks, cranes , etc) ▪ Concrete batch mixing plant ▪ Water supply and pumps ▪ Hydraulic machinery (loaders, earth movers, etc) for stockpile management ▪ Testing laboratory
Concrete placement		▪ Testing equipment ▪ Concrete mixer trucks ▪ Pillar, wheel mounted and chain cranes ▪ Concrete pump machines ▪ Concrete chutes ▪ Formwork ▪ Reinforcement steel ▪ Steel embedded items ▪ Water stops ▪ Concrete vibrators ▪ Miscellaneous hand tools ▪ Generators and compressors ▪ Testing laboratory
Steel pipe placement and joining	▪ Supply and Install Steel Pipes for irrigation outlet and water supply pipe	▪ Transport machinery (trucks, etc) ▪ Crane for placement and maneuvering ▪ Welding equipment for joining pipes ▪ Testing equipment ▪ Survey equipment
Install bulkheads, trash racks, valves and gates	▪ Intake tower install bulkhead, gates and trash racks ▪ Irrigation outlet install gate valve	▪ Transport machinery (trucks, etc) ▪ Crane for placement and maneuvering ▪ Tower crane ▪ Hand tools for fixing gates, valves and trash racks ▪ Temporary works equipment (generators, scaffolding, ladders, lighting, pumps etc) ▪ Survey equipment
Construction site buildings and workers accommodation construction	▪ Construction site establishment	▪ Domestic building supplies ▪ Hydraulic machinery (excavators, earth movers, etc) ▪ Transport machinery (Trucks, etc) ▪ Concrete supply and placement equipment »
Water bore establishment		▪ Drilling machinery ▪ Transport machinery (Trucks, etc) ▪ Bore water pump machinery ▪ Water testing equipment

Construction Operation	Relevant Construction Activities	Resources
Domestic water pipeline installation		▪ Hydraulic machinery (excavators, earth movers, etc) ▪ Transport machinery (Trucks, etc) ▪ Pipework and fittings
Power supply and communications installation		▪ Hydraulic machinery (excavators, earth movers, etc) ▪ Electricians and linesmen
Road construction	▪ Temporary and permanent roads construction ▪ Construction site establishment	▪ Hydraulic machinery (excavators, earth movers, etc) ▪ Transport machinery (Trucks, etc) ▪ Compaction machinery (rollers, etc)

It is anticipated that construction plant and equipment requirements will change during the course of the project. At this early time the following plant and equipment are supposed to be on site.

Resources	Number
Cat Dozer - D8, Komatsu	
Excavator	
Loader	
Dump Trucks	
Roller / Compactor	
Fuel tanker	
Generator	
Dewatering pump	
Aggregate crushing plant	
Concrete Batching Plant	
Concrete truck	
Tower Crane	
Concrete pump	
Drilling rig	
Grout pumps and mixers	

5.3 CONSTRUCTION PROGRAMME

The construction programme should be documented within the quality assurance programme. For quality assurance purposes, the construction programme should be sufficient to give the following details:

- Commencement dates and estimated durations for construction activities;
- Commencement dates of seasons and required works to protect against the rainfall intensities and flood events expected in each season (River Diversion Management);
- Regular SMT quality meetings;
- SMT sign-off events requiring inspection and approval;
- Key inspection and sign-off points for the DSRP; and
- Key inspection and sign-off points for the CDR.

6 DAM SAFETY RISK ASSESSMENT

This section describes the procedures to be undertaken and details to be documented in the "quality assurance plan in regards to the dam safety risks during construction, the construction controls and quality assurance records implemented to help minimize the risks.

6.1 PROCEDURE FOR IDENTIFYING HAZARDS AND DAM SAFETY RISKS

The recommended procedure for identifying hazards and dam safety risks is to involve all parties within the SMT and the DSRP in identifying the risks. The expertise combined with the knowledge of the specific aspects of the Dam project by the members of the SMT and DSRP will be essential in identifying and ranking all issues.

A suggested way to undertake this process is to hold a workshop, with all members of the SMT and the DSRP participating in the workshop. Hazards and potential construction defects can be identified and recorded. Once this is complete each hazard and construction defect can be assessed in terms of the potential resulting failure mode, the likelihood and the consequences of -the hazard or construction defect occurring. This risk rating of each hazard and construction defect will assist in identifying the key issues that need to be addressed with construction controls and contingency measures.

6.2 RISK RATINGS

What is Risk? A risk is chance of something happening that will impact on our objectives. Actions taken to respond to a risk can be classified as mitigate, transfer, accept or avoid the risk. These actions are broadly termed controls.

The likelihood is the frequency or probability of occurrence. A suggested criterion for assessing the likelihood is given in Table 6.1.

The consequences are the results of an event occurring. A suggested criterion for assessing the consequences is given in Table 6.2.

The overall risk rating can be defined by the following equation:

Risk Rating = Likelihood Rating x Consequence Rating

Table 6-1 Criterion for Assessing Likelihood

Likelihood Assessment	Rare	Unlikely	Possible	Likely	Almost Certain
Frequency during lifespan of structure	Once in 50 to 100 years or less frequently	Once in50 years	Once in 5 to10 years	Once in 1 to 4 years	Once or more per year
Probability of occurrence within the next12 months	0.01% to 2%	2% to10%	0% to 25%	25% to90%	90% to100%
Rating Scale	1	2	3	4	5

Table 6-2 Criterion for Assessing Consequences

Consequence Assessment	Insignificant	Minor	Moderate	Major	Severe
Rating Scale	1	2	3	4	5

Once the Likelihood and Consequence of the identified dam safety hazards are understood the next step is assess the risks and identify the risk profile for the Dam project. Table 6.3 provides a relatively simplistic approach to aid understanding of the risk profile for a project. Once identified, controls can be put in place to manage the identified risks and thus reduce the residual risk rating (likelihood x consequence),

Risk rating helps identify the level of risk associated with activities:

- Low Risk where risk rating is less than 4;
- Medium Risk where risk rating is less than 10;
- High Risk where risk rating is less than 15;
- Extreme Risk where risk rating is less than 25;

Table 6-3 Example of Assessment of Potential Dam Safety Risks

Risk Number	Project Element	Construction Activity	Activity resulting in risk	Risk Event / Failure Mode	(L)	(C)	Risk Rating (LxC)	Risk Ranking	Potential Occurrence	Constructor Control
1	Dam	Foundation Excavations	No inspection of foundation resulting in non-removal of unacceptable foundation material	Seepage under dam Uplift	4	4	16	Extreme	Commissioning Long term operation	Foundation inspection sign-off an geological mapping
2		Foundation Treatment	Poor quality grout or cutoff wall not filling joints under dam	Short seepage path under dam Increased seepage	3	5	15	High	Commissioning Long term operation	Grout mix injection control
3		Foundation Treatment	Uncontrolled grout pressures or cutoff wall leading to hydro fracture of rock	Increased seepage	3	4	12	High	Commissioning Long term operation	Control gross pressures within accept practice for rock on site

Note: *These are only examples to assist in the risk workshop. Every part of the construction process should be examined in order to identify impacts on dam safety*

6.3 HAZARDS AND CONSTRUCTION DEFECTS AFFECTING DAMS AND APPURTENANT STRUCTURES

A dam hazard is an issue or event that has the potential to impact on the safety of the dam and the consequences downstream that dam failure might influence. A hazard may be a natural event such as an earthquake, a construction issue such as poor materials, or an operational issue such as sudden changes in river flow

Typical dam hazards are:

- Earthquake event;
- Extreme Rainfall event;
- Extreme Flood event;
- Landslide upstream of the dam,
- Leakage of pipes or conduits through embankments;
- Ongoing deterioration with age

In addition to hazards, there are potential construction defects that may lead to failure of dam which may induce a hazard or failure mode.

Typical dam construction defects include;

- Insufficient excavation of foundation material;
- Poor quality foundation treatment;
- Poor construction practices in placement of embankment fill materials (Zones 1 to 6);
- Poor concrete quality and placement;
- Poorly constructed concrete lift joints, construction joints or contraction joints;
- Poor bond between dam and foundation material,
- Unprotected poor quality material in plunge pool or at dam toe

The quality assurance plan needs to identify the hazards and construction defects relevant to the specific dam, the damage that the hazards may cause and the construction controls and contingency measures required to mitigate the risks posed.

6.4 POTENTIAL FAILURE MODES

Dam failure is an event resulting in the uncontrolled release of reservoir water threatening loss of life, significant economic losses downstream and environmental consequences. Dam failures result from a dam hazard manifesting itself and vary according to the type of dam, its location, design, construction, operation and natural environment.

Dams are unique structures hence Failure Modes relevant to each dam construction project need to be considered and identified on an individual basis. Understanding Failure Modes forms a critical component for establishing an effective quality assurance plan.

Potential Failure modes identified for Dam are summarized in Table 6 4, refer to Section 5.6 of the Operation and Maintenance Plan for more detail.

Table 6-4 Potential Failure Modes for Dam

ID	Potential Failure Modes	Description
1	Piping through dams	Excessive seepage through the dams and their cores leading to movement of dam material, eventually creating pipes through the dams and ultimately failure of the dams.
2	Piping into foundation	▪ Same as 1 except seepage is through the foundations or abutments. ▪ Paleo soils particularly prone to piping. ▪ Areas below Saddle Dam A and between the Main dam and Saddle Dam B have steep downstream slopes and may be prone to seepage and piping.
3	Piping along culvert	Same as 1 except seepage likely to occur along the line of the irrigation outlet pipe (diversion culvert).
4	Piping due to cracking induced by near vertical sides of excavations/caps/ culvert	Settlement in the areas of poor compaction or different materials such as above the old river channel or above the culvert.
5	Loss of freeboard due to earthquake shaking	Following significant earthquakes rock fill dams tend to settle. If the settlement is significant then there may be insufficient freeboard above reservoir level,
6	Fault movement in main dam foundation	If significant movement occurs along one of the faults under the main dam this may lead to an offset displacement of the filters protecting the core. Cracking of the dam material may also occur and lead to piping failure (See failure mode 1).
7	Stability failure of downstream shoulder	Failure of the downstream slope could occur due to excessive uplift pressures
8	Overtopping due to excessive or differential settlement {post construction)	Long term settlement of the dam crest could reduce the freeboard to the extent that the dam crest could be overtopped.
9	Slope failure due to poor compaction	Inadequate compaction of the dams during construction could lead to instability in the slopes.
10	Overtopping during construction	Overtopping of earth dam during construction due to inability to pass a large flood. Overtopping leads to breach failure of dam.

6.5 OVERTOPPING DURING CONSTRUCTION

This potential failure mode is not discussed in the Emergency Preparedness Plan for long term operation and maintenance. The failure mode only exists during the construction phase of the dam. The upstream cofferdam controls the river level upstream of the construction site in order to reduce the risk of large floods from overtopping the main embankment dam. Overtopping can lead to a breach failure of the embankment dam.

Once the diversion channel, intake tower and diversion culvert (irrigation outlet) are constructed the River can be diverted through the diversion culvert.

Note from: *We have carried out a preliminary review of the proposed upstream cofferdam height based on a 10 year flood event considering the following scenarios a) reservoir empty and b) reservoir full. The crest of the coffer dam and diversion channel appears to be approximately 3m low for scenario b),*

It is our understanding that the cofferdam and diversion channel are currently planned for use during the 4"1 year of construction. The design appears to be based on dry season flows. If the construction period extends over a number of years then there is an increased risk of flood overtopping the cofferdam and main embankment during the rainy season.

We recommend that the cofferdam crest level be reviewed considering both a full reservoir and extended construction seasons.

6.6 CONSTRUCTION CONTROLS TO REDUCE DAM SAFETY RISKS

The construction controls are the primary way for the project to minimize the risk of hazards or construction defects occurring or posing a significant consequence to the construction and downstream stakeholders

Construction controls need to be developed with close consultation with the Designer and Constructor, as construction controls need to be practical to implement and also address the key hazards and construction defects, defined above Details that should be presented in the quality assurance plan include:

- Construction activities identified in Section 5,1;
- Potential hazards or construction defects associated with each construction activity (discussed in Section 6.1);
- Failure modes linked to the construction defects or hazards (identified in Section 6 4).
- Construction controls to be implemented to minimize the risks associated with a „ construction defect or hazard;
- Quality assurance records which document the standard of construction work undertaken and the testing or standard of construction controls implemented.

Construction control details developed for Ribb Dam and the associated quality assurance program is outlined in Table 6.5.

Table 6-5 Construction Controls for Dam

Project Element	Construction Activity	Potential Problems With Activity That Affects Dam Safety	Link To Failure Mode or Dam Safety Critical Feature	Construction Controls	Quality Assurance Record
Main Dam, Cofferdams and Spillway	Foundation and abutment excavation	Failure to remove unsuitable materials. Paleo soils not identified or removed	▪ Piping into foundation ▪ Settlement	▪ Foundation clean down ▪ Foundation mapping be inspected ▪ Foundation sign off	▪ Photographic and descriptive record and foundation mapping records ▪ DSRP inspection report
		Fractured / weak rock encountered	▪ Piping into the foundation / under dam	▪ Blasting control to prevent over blasting ▪ Consolidation grouting on dam footprint area to reduce seepage under dam ▪ Foundation sign off	▪ Blasting records ▪ Photographic and descriptive record sign off sheet ▪ DSRP inspection report ▪ Consolidation grouting mix results and grouting records
		Geometry of excavation induces cracking of embankment fill due to near vertical sides of excavations	▪ Piping through dam due to cracking	▪ As built survey of foundation ▪ Inspection and agree ▪ remediation methods ▪ Design / DSRP review ▪ at key points of ▪ construction	▪ Photographic and descriptive record ▪ Engineer's inspection and approval to proceed ▪ DSRP approval at key points ▪ As built construction drawings
	Foundation and abutment treatment	Dental concrete failure due to poor concrete quality or lack of curing	▪ Abutment slope failure sliding on feature	▪ Mixing and testing dental concrete to meet Specification requirements ▪ Remove or replace concrete that does not meet the Specification	▪ Photographic and descriptive record sign off sheet ▪ DSRP inspection report ▪ Concrete placement and testing records

Project Element	Construction Activity	Potential Problems With Activity That Affects Dam Safety	Link To Failure Mode or Dam Safety Critical Feature	Construction Controls	Quality Assurance Record
		Grouting and sturry wall does not treat all potential seepage paths under the dam	▪ Piping into foundation	▪ Water testing of grout holes to ensure bottom stage is 'tight' ▪ Grout mix to meet Specification ▪ Secondary grout holes and reducing spacing of primary holes if large grout takes occur ▪ Assess the need for additional grouting (tertiary / quaternary etc]	▪ Water testing records of each hole pre- grouting ▪ Water testing of adjacent hole post-grouting ▪ Grouting records including grout take records of each hole ▪ DSRP inspection report
	Construct earth dam	Failure lo achieve required compaction and grading criteria	▪ Piping through dam ▪ Slope failure due to ▪ poor compaction ▪ Stability failure of downstream shoulder ▪ Overtopping due to excessive or differential settlement	▪ Material testing of stockpiles including grading and moisture content ▪ Placement trials prior to start of embankment construction ▪ Placement inspection for layers - witness material condition, type of plant, number of passes ▪ Compaction and grading test results	▪ Material test results for stockpiles ▪ Material placement request ▪ Inspection and sign off including testing of placed material ▪ DSRP inspection report

Project Element	Construction Activity	Potential Problems With Activity That Affects Dam Safety	Link To Failure Mode or Dam Safety Critical Feature	Construction Controls	Quality Assurance Record
Intake structure	Install tower foundation	Anchor Piles not installed as design resulting in loss of foundation support / uplift of structure	▪ Intake tower collapse ▪ Loss of dam safety critical plant function	▪ Check adequacy of drilling and anchor installation methodology ▪ Inspect drilling and actual ground conditions ▪ Reassess design against actual ground conditions • ▪ Inspect anchors and document condition prior to installation ▪ Trial test of grout mix design prior to anchor installation ▪ Witness stressing and testing of anchors	▪ Approve contractor's methodology ▪ Photographic and descriptive record and foundation mapping records ▪ Inspection and sign off ▪ Grout testing records ▪ Anchor stressing and load testing records ▪ DSRP inspection report
	Construct intake tower concrete superstructure	Poor quality concrete construction leads to deterioration of the structure: ▪ loss of strength ▪ voids in structure	▪ Intake lower collapse ▪ Loss of dam safety critical plant function	▪ Store concrete materials in accordance with specifications ▪ Concrete mix trials to confirm design mixes ▪ Undertake concrete testing to verify concrete mix meets strength and Specification	▪ Concrete mix testing records ▪ Pre concrete inspection of formwork, reinforcement and inserts and sign off ▪ Concrete placement testing records ▪ DSRP inspection report
		Concrete damaged or does not meet strength due to extreme weather conditions	▪ Loss of dam safety critical plant function	▪ Concrete only to be poured within specified temperatures ▪ Concrete curing method to be appropriate for weather conditions ▪ Concrete surfaces to be protected against weather during curing	▪ Ambient temperatures during pouring and curing recorded ▪ Concrete placement testing records ▪ Concrete temperature monitoring records to monitor curing progress ▪ Inspection and sign off ▪ DSRP inspection report

Project Element	Construction Activity	Potential Problems With Activity That Affects Dam Safety	Link To Failure Mode or Dam Safety Critical Feature	Construction Controls	Quality Assurance Record
	Install bulkheads, gates and trash rack	Install damaged bulkheads, gates and trash rack - unable to operate due to poor alignment or insufficient fastening.	▪ Loss of dam safety critical plant function	▪ Install to required alignment, strengths and tolerances ▪ Commissioning testing of items	▪ As Built Drawings ▪ Commissioning Report ▪ Inspection and sign off ▪ DSRP inspection report
		Supplied item does not meet required standards	▪ Loss of dam safety critical plant function - failure to operate	▪ Implement verification process where supplied items are checked against design requirements	▪ Certificates of supplied specifications signed as received by construction supervisor
	Construct reinforced concrete intake culvert and tunnel				
	Construct valve house and install valves				
Intake Bridge	Install bridge foundations	Anchor Piles not installed as design resulting in loss of foundation support	▪ Loss of dam safety critical function -bridge failure with loss of access to uplift of structure	Refer to Intake Tower intake tower	Refer to Intake Tower
	Construct bridge superstructure (piers and deck)	Poor quality concrete construction leads to deterioration of the structure: ▪ loss of strength ▪ voids in structure	▪ Loss of dam safety critical function -bridge failure with loss of access to intake tower	Refer to Intake Tower	Refer to Intake Tower
		Concrete damaged or does not meet strength due to extreme weather conditions	▪ Bridge collapse	Refer to Intake Tower	Refer to Intake Tower

Project Element	Construction Activity	Potential Problems With Activity That Affects Dam Safety	Link To Failure Mode or Dam Safety Critical Feature	Construction Controls	Quality Assurance Record
Side Channel Spillway	Foundation and abutment treatment for spillway, discharge channel, chute and stilling pit	Failure to remove unsuitable materials	▪ Settlement of structure ▪ Loss of dam safety critical function -spillway operation	Refer to Main Dam	Refer to Main Dam
	Construct concrete side spillway, discharge channel, chute and stilling pit	Concrete lift joint not fully bonded allowing uplift and erosion of concrete spillway	▪ Loss of dam safety critical function -spillway operation ▪ Piping into foundation ▪ Uplift of structure leading to collapse	▪ Remove any honeycomb, damaged or unvibrated concrete from lift joint ▪ Clear loose material and surface laitance from lift joint, roughen (scabble) and water lift joint prior to placement	▪ Photographic and descriptive record of prepared surface prior to concrete placement ▪ Inspection and sign off sheet
		Poor quality drainage installed	▪ Uplift of structure leading to collapse	▪ Confirm construction meets design requirements	▪ Photographic and descriptive record ▪ Inspection and sign off sheet
		Poor quality concrete construction leads to erosion / deterioration of the structure: ▪ loss of strength ▪ voids in structure	▪ Loss of dam safety critical function - spillway operation ▪ Uplift of structure leading to collapse ▪ Erosion or cavitations damage	Refer to intake tower Ensure good surface finish and alignment of slabs at joinls in chute	Refer to intake tower Records of concrete strengths, photographic record, Inspection and sign off

Project Element	Construction Activity	Potential Problems With Activity That Affects Dam Safety	Link To Failure Mode or Dam Safety Critical Feature	Construction Controls	Quality Assurance Record
		Concrete cracking due to uncontrolled block size	▪ Loss of dam safely critical function -spillway operation ▪ Uplift of structure leading to collapse	▪ Place limits to block sizes (widths) and lift heights ▪ Carry out trial curing of concrete block ▪ Redo trial curing of concrete block witfi change in concrete mix design ▪ Monitor concrete temperature during curing	▪ As-built drawings show location of block joints and lift joints ▪ Records of trial concrete block curing for thermal properties of concrete ▪ Concrete temperature monitoring records to monitor curing progress
Temporary River Diversion	Construction of cofferdams	U/S Cofferdam constructed too low	▪ Overtopping failure of dam (during construction)	▪ Temporary design to consider actual construction programme ▪ Review design with changes to construction programme ▪ Review adequacy of construction flood selected	▪ Regular update of construction programme ▪ Regular design review ▪ As Built Drawings ▪ Inspection and sign off ▪ DSRP inspection report
	Construct River Diversion channel	River channel not slable during flood event resulting in erosion of lining and damage to d/s valves and gates	▪ Loss of dam safety critical function (during construction)	▪ Check temporary works design ▪ Routine monitoring of condition of channel ▪ Inspect after flood events ▪ Maintain stockpile of emergency repair materials	▪ Regular inspection and sign off ▪ Maintain Emergency Preparedness Plan for construction ▪ DSRP inspection report

Project Element	Construction Activity	Potential Problems With Activity That Affects Dam Safety	Link To Failure Mode or Dam Safety Critical Feature	Construction Controls	Quality Assurance Record
Bottom outlet and diversion culvert, gate, valves and energy dissipation	Construct reinforced concrete diversion bottom outlet culvert and tunnel	Poor quality compaction of fill against diversion culvert leads to seepage path developing along the length of the culvert	▪ Piping along culvert	▪ Material testing of stockpiles including grading and moisture content ▪ Placement inspection for layers - witness material condition, type of plant, number of passes ▪ Compaction and grading test results	▪ Material test results for stockpiles ▪ Material placement request ▪ Inspection and sign off including testing of placed material ▪ DSRP inspection report
		Geometry of diversion culvert induces cracking in embankment fill	▪ Piping due to cracking induced by near vertical sides of culvert	▪ As built survey of diversion culvert ▪ Design DSRP review at key points of construction	▪ Photographic and descriptive record ▪ Inspection and sign off ▪ DSRP approval at key points ▪ As built construction drawings
	Install valves and valve house	Refer to Intake Tower			
	Excavate energy dissipation channel and pit	Refer Side Channel Spillway			
	Construct energy dissipation channel and pit	Refer Side Channel Spillway			
Instrumentation	install benchmarks, piezometers, settlement sensors, weirs and earth pressure cells	Instrumentation damaged during installation	▪ Loss of critical dam safety monitoring equipment data	▪ Check suppliers installation requirements ▪ Review and approve contractor's methodology ▪ Monitor construction -staged construction with embankment lifts ▪ protection from other construction activities	▪ Contractor's method statements ▪ Photographic and descriptive record ▪ Inspection and sign off at key levels ▪ DSRP approval at key points ▪ As built construction drawings

Project Element	Construction Activity	Potential Problems With Activity That Affects Dam Safety	Link To Failure Mode or Dam Safety Critical Feature	Construction Controls	Quality Assurance Record
		Instrumentation induces cracking in the dam	▪ Piping through dam	▪ Inspect compaction and fill around instrumentation ▪ Minimize or eliminate drilling with water in dam core or other sensitive areas of the dam	▪ Contractor's method statement ▪ Photographic and descriptive record ▪ Inspection and sign off at key levels

7 CONSTRUCTION CONTINGENCY MEASURES

This section identifies critical construction activities and their associated potential dam safety problems. The quality assurance plan needs to develop and document the construction controls and contingency measures that will be put in place during construction. Contingency measures allow for potential critical problems in the construction process which could result in a construction defect or development of a failure mode to be assessed. The result of the assessment is identifying any planning measures or quality assurance controls that can be implemented to minimize the likelihood of the problem occurring and identifying the response procedure to be followed if the problem does occur.

Critical problems and contingency measures need to be developed in close consultation with the Designer and Constructor as previous experience in dam construction and knowledge specific to the project will be essential in the process, A risk based approach can be adopted to priorities the highest risk issues.

In planning to avoid dam safety problems, in the long and short term, contingency measures are needed. Table 7.1 provides an example of the development of contingency measures for critical activities in the quality assurance plan.

Table 7-1 Contingency Measures for Dam

Critical Problem	Description	Planning to Avoid Problem	Response to Problem
Foundation Excavation and Treatment			
Insufficient excavation of rock surface	Poor quality material not removed prior to placement of embankment materials or concrete.	▪ Geological mapping of foundation surface prior to concrete placement	▪ Undertake consolidation grouting directly below embankment dam ▪ Re-assess design based on poor quality material to verify stability, foundation permeability and any remedial works required ▪ Assess the need for long term monitoring
Grout curtain insufficient to prevent excessive seepage	Poor quality grout mix or insufficient grout penetration preventing an effective cut-off	▪ Grout mix trials to determine appropriate grout mix ▪ Water testing holes prior to grout placement ▪ Water testing adjacent holes after grout placement ▪ Monitoring and recording grouting details (pressure, flow, mix, etc)	▪ Undertake secondary or tertiary holes if grouting is found to be insufficient ▪ Modify grout hole spacing and grout mix as required
Concrete damage from foundation excavation	Blasting of foundations near poured concrete structure causes damage to concrete	▪ Minimize blasting undertaken ▪ Undertake as much blasting prior to any concrete placement as possible ▪ Maintain appropriate distance between poured concrete structure and blasting	▪ Assess damage to concrete structure ▪ Repair concrete using approved methods or remove concrete and replace
Earth Embankment Construction			
Stability failure of downstream shoulder	Failure to achieve required quality control for embankment construction, e.g. compaction and grading criteria.	▪ Material testing of stockpiles ▪ Placement trials prior lo start of embankment construction ▪ Placement inspection for layers - witness material condition, type of plant, number of passes ▪ Compaction and grading test results ▪ Before reservoir filling sign off is required by DSRP	▪ Non compliances during construction to be identified and remediation method ' agreed.
Piping through dam on commissioning			▪ Develop lake drawdown plan ▪ Drawdown reservoir and maintain safe level ▪ Develop remediation of embankment with all parties.
Concrete Supply and Placement			
Concreting supply breakdown	Supplier unable to provide a continuous supply Breakdown **of** delivery system	▪ Ensure concrete plant is ready prior to commencement of batching ▪ Ensure material supply available	▪ Stop concrete pour and form cold joint ▪ Remove unfinished concrete ▪ Prepare construction joint for next layer

Critical Problem	Description	Planning to Avoid Problem	Response to Problem
Concrete fails to meet tests	Concrete testing determines that concrete quality is not to standard	▪ Monitor concrete quality trends. ▪ Test batching plant	▪ Reject all loads non compliant loads ▪ Remove any loads from pour
Valve, Gate and Pipeline Supply and Installation			
Damage to valves or gates during transport and installation	Valves or gates are damaged during transport or during installation such that they no longer meet functional requirements	▪ Inspection of valves and gates prior lo installation and upon completion of installation ▪ Dry testing of valves and gates prior to commissioning to ensure functional requirements are meet	▪ Remove and replace damaged equipment
Damage concrete or steel pipeline during transport and installation	Concrete pipeline is cracked during transport or during installation	▪ Inspection of pipeline prior to installation cracked during transport or during installation	▪ Remove and replace damaged pipeline section
River Diversion			
Flood event overtops cofferdam	▪ Construction not completed on time. ▪ Additional seasons required to complete construction. ▪ Upstream cofferdam design flood is exceeded (rainy season).	▪ Review construction program. ▪ If construction period will be over a number of seasons review the cofferdam design flood.	▪ Increase crest height of temporary cofferdam to minimize potential for overtopping ▪ Remove and replace damage to main dam ▪ Drawdown flooding in works area ▪ Repair cofferdam ▪ Ensure off season emergency response available
Damage to temporary river diversion channel	River channel not stable during flood event resulting in erosion of lining and damage to other works	▪ Check temporary works design assumptions ▪ Routine monitoring of condition of channel ▪ Inspect after flood events ▪ Maintain stockpile of emergency repair materials	▪ Stockpile additional repair materials ▪ Regular routine maintenance ▪ Repair diversion channel after flood event
Overall Construction Practices			
Incorrect geometrical sizes and levels	Tolerances not adhered to or construction levels and sizes incorrect, causing dam safety or operational issues in the dam	▪ Establish survey network and undertake surveys to control sizes and levels ▪ Measure key dimensions prior to constructing segments	▪ Undertake survey to confi rm as-constructed levels ▪ Re-assess design to determine if as constructed levels are acceptable ▪ Modify design and implement ▪ modifications to rectify any issues

8 QUALITY ASSURANCE TESTING AND INSPECTION PLAN

This section describes the preparation of the quality assurance testing and inspection plan for construction to ensure that the construction controls described in Section 6.5,

8.1 QUALITY ASSURANCE TESTING

The method, frequency and acceptance criteria for quality assurance testing will be defined in the particular Construction Specification or within the applicable National Standard.

A table of relevant construction standards for Dam is provided in Appendix B. The construction standards that apply to Dam should be confirmed in the design report and technical specification.

The testing requirements of materials and construction for quality assurance purposes, records and required for quality assurance sign off are provided in Table 8 1. These do not include commissioning testing requirements provided in Section 9

Table 8-1 Dam -Testing and Records Requirements

Project Element	Construction Activity	Element	Properties Tested	Quality Assurance Records	Frequency	Acceptance Criteria
Dam, Spillway. Intake Structure, Bottom outlet and Diversion Culvert, tunnel and Appurtenant Structures	Foundation Excavation	Foundation Rock Surface	Visual inspection	Photographic record sign off sheet	Weekly	Acceptance Criteria to be inserted from design and specification
				Geological mapping of foundation surface and exploratory drilling signed off by Engineer	Every 10m at completion of excavation stage	
				DSRP inspection report	At completion of excavation	
				Blasting activity records	Daily	
	Foundation Treatment	Consolidation Grouting	To be inserted from Specification	Mix Design (water/cement ratio)	At commencement and for new mixes	Acceptance Criteria to be inserted from design and specification
			▪ Grout take ▪ Grout viscosity ▪ Grout Bleed	▪ Marsh funnel viscometer tests ▪ Grout Bleed tests ▪ Volume of grout ▪ Grouting pressure/flow	Daily during grouting	
		Curtain Grouting	Foundation Permeability (via water testing)	Drill hole and Water testing results (see Appendix C)	On completion of each hole	Acceptance Criteria to be inserted from design and specification
			To be inserted from Specification	Mix Design (water/cement ratio)	At commencement and for new mixes	Acceptance Criteria to be inserted from design and specification
			▪ Grout take ▪ Grout viscosity ▪ Grout Bleed	▪ Marsh funnel viscometer tests ▪ Grout Bleed tests ▪ Volume of grout ▪ Grouting pressure	Daily during grouting	
		Dental concrete	▪ Aggregate Hardness and Silica Contend	▪ Mix Design ▪ Aggregate testing results	At commencement and after change in mix or aggregate source	Acceptance Criteria to be inserted from design and specification

Project Element	Construction Activity	Element	Properties Tested	Quality Assurance Records	Frequency	Acceptance Criteria
			▪ Compressive Strength Slump ▪ Air Content ▪ Unit Weight Drying Shrinkage	▪ Concrete material testing results ▪ Slump tests	Once per 50 m^3 (minimum once per day)	
Spillway. Intake Structure and Gates, Diversion Outlet and ancillary structures	Construct Concrete Structure	Concrete Supply	▪ Aggregate Hardness and Silica Content	▪ Mix Design ▪ Aggregate testing results	At commencement and after change in mix or aggregate source	Acceptance Criteria to be inserted from design and specification
			▪ Compressive Strength Slump ▪ Air Content ▪ Unit Weight ▪ Drying Shrinkage	▪ Concrete material testing results ▪ Slump tests	Once per 50 m^3 (minimum once per day)	
		Concrete Placement	▪ Hardened Concrete Compressive Strength	▪ Hardened Concrete Compressive test results	As Required - For verification of poor quality concrete prior to rejection only	Acceptance Criteria to be inserted from design and specification
		Concrete Curing	Concrete and ambient temperature	Concrete temperature monitoring records to monitor curing progress	Continuous monitoring during curing assessed twice daily	Acceptance Criteria to be inserted from design and specification
Main Dam and cofferdams	Construct earth embankment dams	Material Supply	▪ Particle Size ▪ Distribution ▪ Atterberg ▪ Limits ▪ Moisture ▪ Content	Testing records for stockpiled materials	Establish during site trials and material stockpiling	Acceptance Criteria to be inserted from design and specification
		Material Placement	▪ In situ ▪ Density Test compaction tests ▪ Particle size distribution	▪ Photographic Record of dam foundation and layer placement ▪ Testing records for dam, signed off by Engineer ▪ DSRP inspection report	Establish during site trials	Acceptance Criteria to be inserted from design and specification

Project Element	Construction Activity	Element	Properties Tested	Quality Assurance Records	Frequency	Acceptance Criteria
Water supply outlet and pipelines	Pipeline Supply	Pipeline Material Quality	To be inserted from Specification	▪ Certificates of quality assurance that pipelines received meet specified standards ▪ Material delivery inspection	Each load transported	Acceptance Criteria to be inserted from design and specification
	Pipeline Installation	Pipeline joints	Leakage and strength under pressure	▪ Site inspection ▪ Non destructive testing results ▪ Records pressure testing	Prior to placing concrete around pipe section	Acceptance Criteria to be inserted from design and specification
Gates, Trash Racks and Gate Valves	Materials supply	Material Quality	To be inserted from Specification	▪ Certificates of quality assurance that materials items received meet specified standards ▪ Site inspection on delivery to confirm acceptability	Each load transported	Acceptance Criteria to be inserted from design and specification
	Supply and install Gates. Trash Racks and Gate Valves	Installation	Geometric size	▪ Photographic recorded of installation Inspection and sign off ▪ As built structural survey prior to installation	Each element	Acceptance Criteria to be inserted from design and specification

8.2 QUALITY ASSURANCE MEETINGS AND SIGN-OFF

The Quality Assurance Meetings and minutes from meetings form the basis of quality assurance auditing and reporting for the project. These meetings will discuss all quality testing undertaken on the project since the previous meeting and any construction issues or events that may have an effect on quality assurance or design

The quality assurance meetings shall be held on a monthly basis and special meetings shall be held at key sign-off events to ensure approval is given from all parties to proceed with the next stage of works.

The minutes of the quality assurance meetings shall be produced and submitted to the DSRP for review. The minutes shall be in a format similar to that shown in Appendix D and shall include all quality assurance data, including materials testing up to the date of the report.

A diagram of the sign-off procedure for each sign-off event is given in Figure 8.1.

Key sign-off events for SMT quality assurance meetings include the following (not in order):

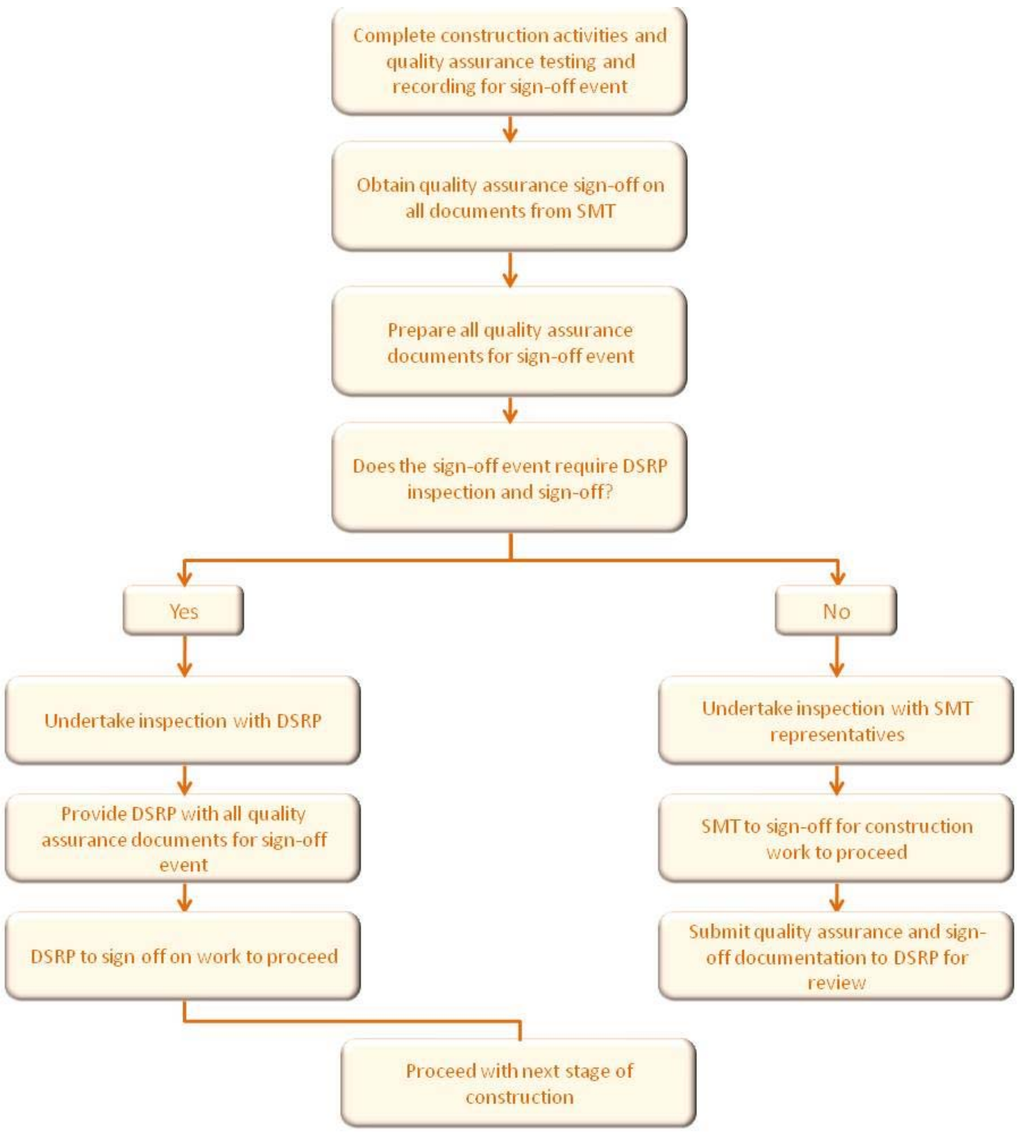
- Completion of embankment construction trials;
- Coffer dam that layer placement;
- Foundation excavation completion, including geological mapping (separate sign-off for each foundation - dams and appurtenant structures);
- Foundation excavation completion for saddle dams (including geological mapping);
- Grouting mix design preparation;
- Foundation treatment (grouting) completion, including water tests,
- Excavation of foundation for irrigation outlet and energy dissipater,
- Completion of coffer dam and diversion works, prior to diversion;
- Completion of preparation works following each shut down period Iri the wet season, prior to restarting works;
- Completion of main dam construction;
- Completion of saddle dams construction;
- Concrete mix design preparation;
- Completion of intake tower structure;
- Completion of gate/valve installation;
- Completion of side channel spillway,
- Completion of commissioning testing of valves/gates, pipeline
- Completion of reservoir filling to normal water level RL 1940m (dam commissioning),
- Completion of works prior to closure of diversion works and start of reservoir filling; and

The DSRP shall undertake an inspection and provide sign-off at the following key events:

- Foundation excavation completion (including geological mapping);
- Foundation treatment (grouting) completion;

- Trial embankment placement trials for zoned materials;
- Staged completion of embankment dam construction;
- Completion of dam construction and approve closure of the diversion works to start filling reservoir;
- Completion of reservoir filling to spillway .level;
- Completion of commissioning testing of appurtenant structures; and
- Inspection 18 months after completion of reservoir filling to spillway level.

Figure 8-1 Sign-off procedures during Construction



9 RESERVOIR FILLING AND COMMISSIONING

This Section of the Guideline provides guidance on reservoir filling and commissioning which comprises two separate tasks, these are:

- Dam Safety Surveillance during reservoir filling and immediately following reservoir filling
- Functional testing of gates, valves and pressure testing of the pipeline and penstock

Reservoir filling and commissioning can only occur once sign-off of completion of the works from the DSRP has been received. A diagram showing the procedure for reservoir filling and commissioning is given in Figure 9,1.

A detailed reservoir filling plan and plan for functional testing of gates, valves and pressure testing of the pipeline and penstock shall be developed as part of the design and commissioning documentation. A checklist outlining the requirements to commence reservoir filling and commissioning and the required tests and inspections for commissioning is given in Appendix E. It is important that the detailed reservoir filling plan references the Emergency Preparedness Plan in case of any dam safety events occurring during this critical period.

9.1 DAM SURVEILLANCE DURING RESERVOIR FILLING

Reservoir filling may occur before commissioning provided that:

- Sign-off on completion of the dam is received from the DSRP;
- The irrigation outlet is functional; and
- Commissioning in the dry is complete.

The dam surveillance during reservoir filling shall be undertaken by personnel trained in accordance with Section 5.2 of the Guidelines for preparation of Operation and Maintenance Plan.

If average river flows occur during the filling period it is anticipated that the reservoir will take approximately one rainy season to fill to the level of the spillway weir, This is a relatively slow filling period and should not cause any significant safety problems due to fast filling. However, the dam still requires regular monitoring during this period to ensure that it behaves in accordance with the design. Based on this, Table 9.1 provides the schedule of inspections and monitoring during reservoir filling

Surveillance during reservoir filling shall be in accordance with the regular surveillance designated in Section 5.7 and Appendix E of the Operation and Maintenance Plan.

Baseline deformation surveys shall be undertaken prior to reservoir filling. Deformation surveys shall be undertaken in accordance with Section 5.7.6 of the Guidelines for preparation of Operation and Maintenance Plan.

The monitoring of most of the instrumentation will have started during the construction of the works and these readings should continue. It is important that the instrumentation results are promptly reviewed by the dam safety review engineer so that any anomalies can be discussed with the designers and action taken if necessary. Emergency action plans should also be developed so that the filling of the reservoir can be stopped or reversed if necessary.

Table 9-1 Example Project - Reservoir Filling Surveillance and Monitoring

Monitoring	Frequency
Visual	Daily
Water Level	Daily
Deformation - Levels	Monthly
Deformation - 3 dimensions	3 Monthly
Instrumentation	Monthly
Seepage Flows	Weekly

9.2 DAM SURVEILLANCE POST-RESERVOIR FILLING

Once reservoir filling is complete, surveillance shall be undertaken as outlined in Table 9.2.

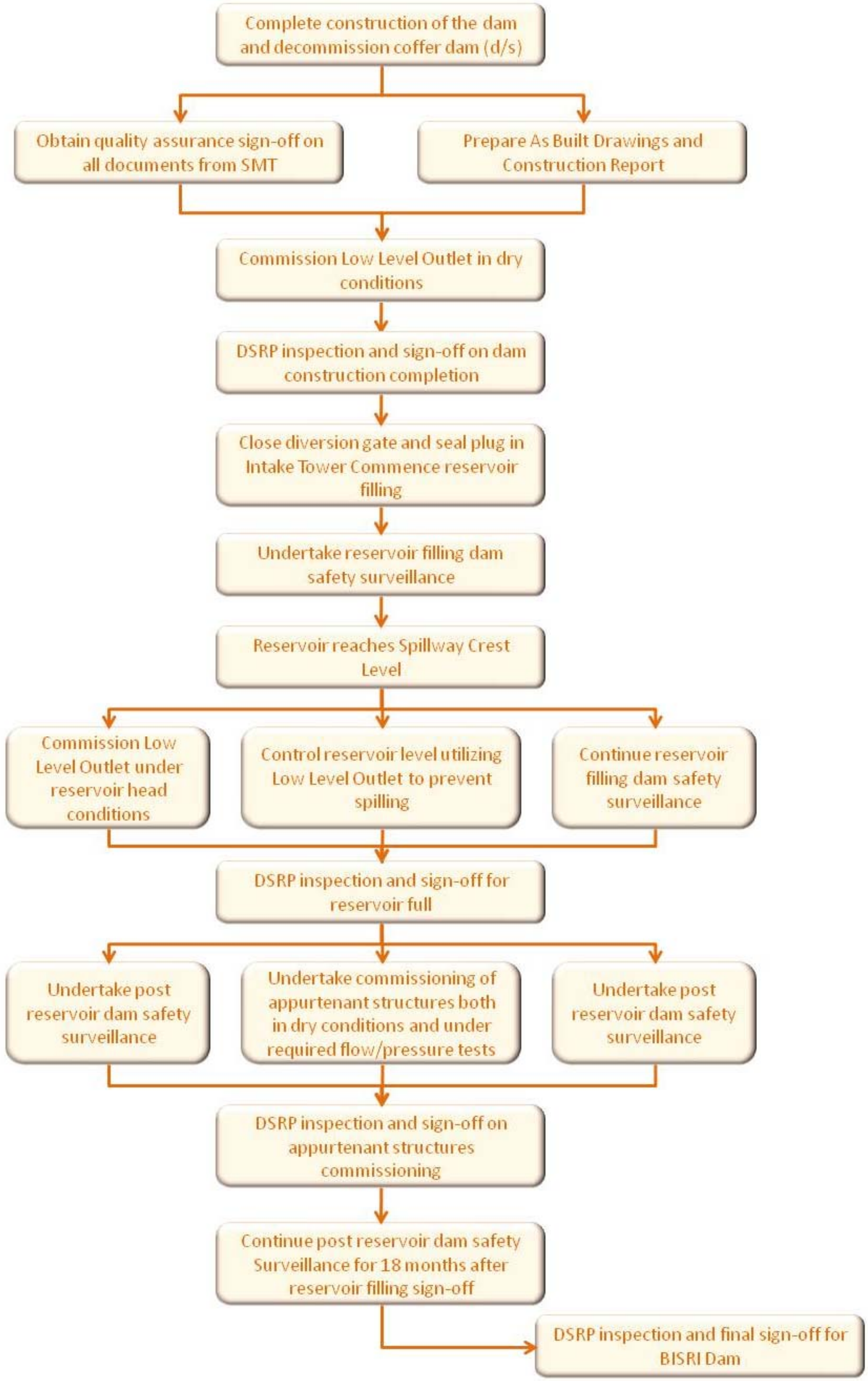
Visual inspections and reservoir level recording undertaken in accordance with Section 5,7 of the Operation and Maintenance Plan. Deformation surveys should be undertaken in accordance with Section 5.7.6 of the Operation and Maintenance Plan.

After 18 months, the data from reservoir filling, commissioning and post commissioning surveillance shall be analyzed by the Irrigation and Drainage Department's dam safety review engineer. The DSRP will then advise if the performance of the dam is satisfactory and the dam can revert to normal surveillance in accordance with the frequencies given in Section 5 8 and of the Operation and Maintenance Plan.

Table 9-2 Post-Reservoir Filling Surveillance and Monitoring

Time after Reservoir Filling	Visual Inspection and Reservoir Level Recording Frequency	Seepage Flows Frequency	Other Instrumentation and Levels
0 - 3 Months	Daily	Weekly	Monthly
3 - 1 8 Months	Twice a Week	Monthly	Monthly
18+ Months	To be determined by DSRP		

Figure 9-1 Reservoir Filling and Commissioning Procedures



9.3 COMMISSIONING OF APPURTENANT STRUCTURES

Appurtenant Structures are structures and equipment on a dam site, other than the dam itself, which are critical to the ability of the dam to safely control and release reservoir contents.

The appurtenant structures that will be commissioned include the following;

- Spillways;
- Intake structure;
- Bottom outlet (termed diversion culvert during construction);
- Bridges;
- Energy Dissipation Valves;
- Control Gates; and
- Power supplies and control systems.

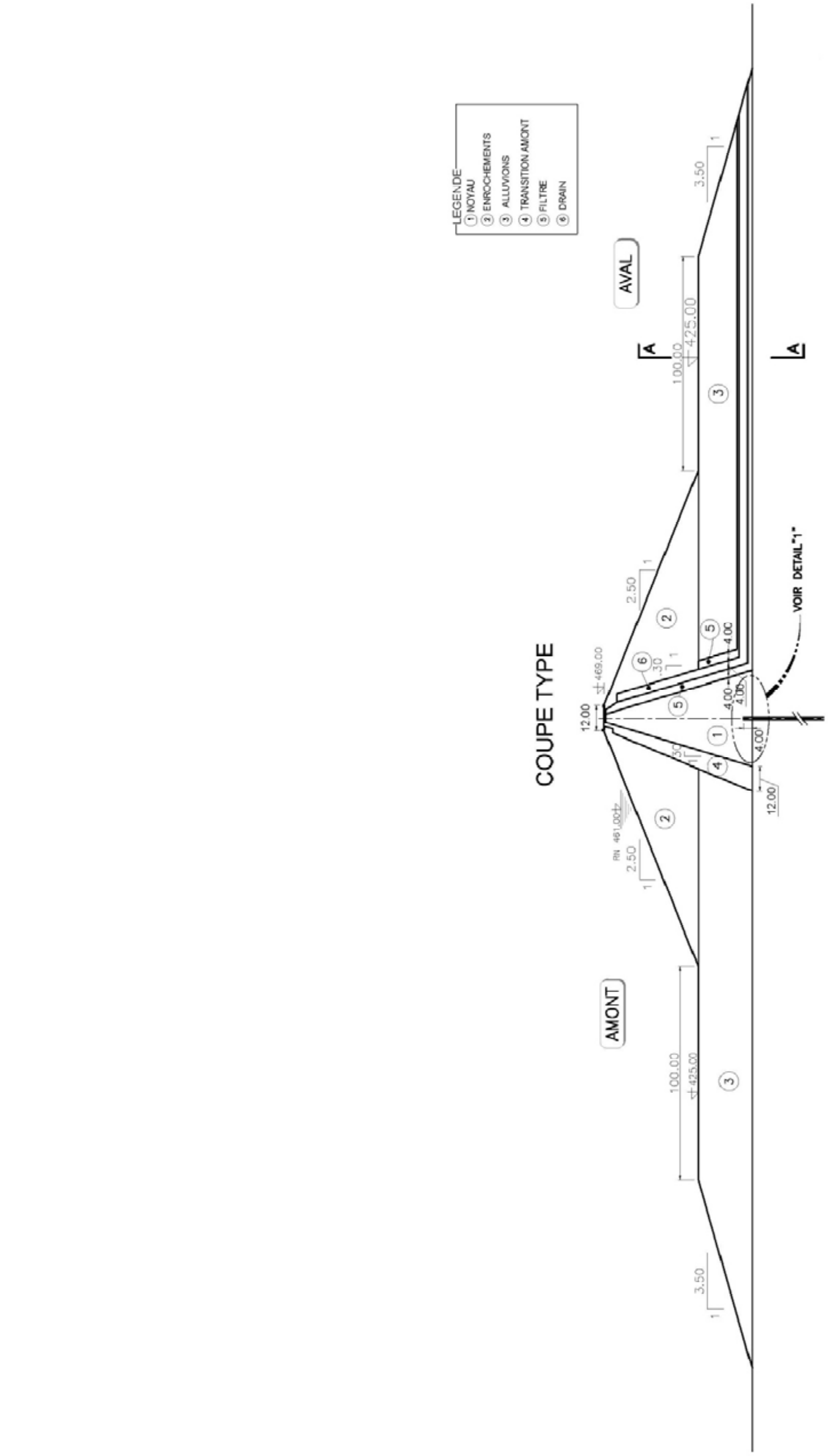
Generic operational procedures for each item of flow control equipment are given in Section 6 of the Operation and Maintenance Plan.

A detailed commissioning plan will need to be developed for each item above in order to demonstrate that the equipment meets functional requirements and is capable of normal and emergency operation. For example specific commissioning required for the following appurtenant structures include:

- Intake gates - Operation of primary systems and backup systems over the full range during dry conditions (prior to reservoir filling) and under reservoir loading and flow;
- Diversion conduit - Operation of primary systems and backup systems over the full range during dry conditions (prior to reservoir filling) and under reservoir loading and flow;
- Gate valves - Operation of the gate valves during dry conditions and under flow conditions, with testing of valve closing time in the event of pipe burst.

These documents must be prepared based on the manufacturer's catalogues, installation and operation manuals. Commissioning of some of these items may require the presence of the supplier on site during commissioning.

APPENDIX A Key Project Drawings


COUPE TYPE
LEGENDE
1 NOYAU
2 ENROCHEMENTS
3 ALLUVIONS
4 TRANSITION AMONT
5 FILTRE
6 DRAIN
AMONT
AVAL
VOIR DETAIL "1"
A
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12.00
469.00
RN 461.00
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100.00
425.00
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.30

APPENDIX B Relevant Construction Standards

Construction Standard	Reference
Concrete	
Air-entraining agent for concrete mix	BS 5075
Batching and mixing	BS 3963
Cement	BS 12
Formworks	BS 5975
Pipes: Concrete pipes and fittings shall Porous concrete pipes Reinforced concrete pipes Rubber rings and socket pipes	 BS 556 BS 1194 BS 881 BS 2494
Protection of concrete	BS 8110
Reinforced concrete structures	BS 5606
Salt content: Chlorides in aggregates Sulphates in aggregates Chloride ion in mixing water Sulphates in mixing water	 ASTM D 1411 BS 1377 test 9 ASTM D 512 ASTM D 516
Testing, aggregate: Aggregates Sampling Particle shape Material finer than ,075mm Light particles Friable particles Organic impurities Soundness Grading Los Angeles Abrasion Unit mass Specific gravity and absorption Alkali reactivity	 BS 882 BS 812 Part 102 BS 812 Part 1 BS 812 Part 1 ASTM C123 ASTM C142 ASTM C40 ASTM C88 BS 812 Part 103 BS 812 Part 3 BS812 Part 2 BS 812 Part 2 ASTM C227, C285
Testing concrete: Aperture dimensions in mm of sieves Sampling Compressive strength Slump Air Content Unit Weight Chloride Ion Content Drying Shrinkage Static modulus of elasticity and Poisson's ratio	 BS410 BS 1881 Part 101 BS 1881 Part 116 BS 1881 Part 102 BS 1881 Part 107 BS 1881 Part 107 BS8110Part1,BS6337 Part 4 BS 1881 Part 109 ASTM Test Method C 469
Testing Fly Ash: Moisture content Loss of ignition Fineness Autoclave expansion Specific gravity Pozzolanic activity Remaining physical and chemical tests	 BS 3892 Part 1 BS 3892 Part 1 BS 3892 Part 1 ASTM C311, C151 ASTMC311,C118 BS 3892 Part 1 BS 3892 Part 1
Waterstops	BS 2571
Steel	
Castings: Carbon steel	 BS 3100

Copper and copper alloy Grey-iron Stainless steel	BS 1400 BS 1452 BS3100
<u>Metalwork testing cleaned surface</u> Soluble Iron Salts Grease, oil and epoxy residues Millscale, rust and dust Solvent Free Epoxy Linings Steel surfaces Row metal surface painting	 DIN 55928 Part 4 DIN 55928 Part 4 BS 5493 Appendix F BS 6920 BS 7079 SIS 05 5900
<u>Steel and metalwork:</u> Structural Steel Section Part 1, Hot rolled sections Steel Girder Bridges Steel Wire Ropes The Use of Structural Steel in Building Covered Electrodes for the Manual Metal-Arc Welding of Mild Steel Methods of Testing Welds Hot Dip Galvanised Coatings on Iron & Steel Articles Black Bolts, Screws and Nuts Steel Tubes and Tubular suitable for Screwing to BS 21 Pipe Threads Grey Iron Castings Zinc plating or Anchor bolts Steel Tubes for Structures Sprayed Metal Coatings Electroplated Coating on Threaded Comp. ISO Metric Precision Hex Bolts, Screws and Nuts ISO Metric Precision Hexagon Bolts, Screws and Nuts ISO Metric Black Hexagon Bolts, Screws and Nuts Wrought Aluminium and Aluminium Alloys for General Engineering Purpose Weldable Structural Steels High Strength Friction Grip Bolts and Ass. Nuts & Washers High Strength Friction Grip Bolts in Structural Steelwork, Metric Series Structural Hollow Sections Sheradized Coatings on Iron and Steel Articles	 BS 4 BS 153 BS 302 BS 449 BS 639 BS 709 BS 729 BS916 BS 1387 BS 1452 BS 1706 BS 1775 BS 2569 BS 3382 BS 3692 BS 4190 BS 4300/6 BS 4360 BS 4395 BS 4604 BS 4848 BS 4921
Metal-Arc Welding of Carbon and Carbon Manganese Steels Steel pipe and fittings	BS5135 BS 534 or AWWA C208 if not BS 534 API 5L
<u>Structural steel:</u> Fabrication, welding and erection Shielded consumables for (semi)-automatic welding Welding Operators of manually-guided machine welding equipment Ductile iron pipes	 ASTM A36 ASTM A242 AWS D1.1 AWS-ASTM A559-65T Grades E70S or E70T BS 5135 AWS D1.1 BS 4772 BS 4504 BS 3416 or BS 4164
Welders qualification	BS 2645
Equipment	
Alternators	BS 5000
Bolts, studs, screws, and nuts	A320, Grade B8 (bolts) A134, Grade 8 (nuts)
<u>Doors:</u> Quality timber Windows Leakage	ANSI/AWWA Standard C501 BS459 and BS CP 151 BS 5368 AWWA standard C501
Elastomeric bearings	BS 5400

<u>Fencing and gates:</u> Type of fence	AWWA Standard C501 BS 4 Part 1/2 BS 729 BS1722 Part 1 BS 3470 BS 1775 BS 4102 BS 4360 GLS 180 to BS 1722
Flush bottom retainer bar	ASTM A126, Class B
Glass	BS 952 BS CP 152
Stem guide liners	B139, CA521 orCA524
Stems	ASTM A582, type 303 or ASTM A276, type 302 or type 304
uPVC pipes and fittings shall	BS 3505
Wedges, thrust nut, stem couplings and gate actuator lift nut	B584, CA872
Materials	
<u>Filter and drainage materials:</u> Los Angeles abrasion test Sodium soundness Water absorption	 ASM C131 ASTM 88 ASTM C128
Impervious fill	BS 1377 ASTM - D2292 - 91
<u>Material testing:</u> Packer permeability test SPT-and VT	 BS 5930 ASTM D-1586 or BS 1377 ASTM D-2573
<u>Field Density and Compaction Testing:</u> Granular material	 ASTM D5030-89 BS 1377 ASTM D4253-9
Rockfilt, clay core, beddings, shoulder and shell zones	BS 1377
Miscellaneous	
Filtration requirement	ASTM D422
Gabions	BS 1052 and BS 443
Illuminance instrument	BS 667
Mastic filter	BS 4254
Membrane curing	ASTM C309
Painting buildings	CP231 BS 5493
Painting of softwood	BS 4072
Polystyrene Filter	BS 3837
Road paintings and signs	BS 873 BS 6044
Shop cleaning and painting second quality surface finish	BS 4232
Shop test	AWWA Standard C501
Testing pressure pipework	CP2010

APPENDIX C Quality Assurance Record Sheets List of sheets:

C1. Drilling for Grouting Record Sheet

C2. Concrete Placement Record

C3. Grout Record

C4. Concrete test results

C5. Foundation Excavation Photographic Record

C6. Geological Foundation Mapping Photographic Record

C1. Drilling for Grouting Record Sheet

Dam Project

Drill Hole Number	Location on Dam Footprint	Top Level (RL m)	Drill Hole Angle	Drill Hole Depth (m)	Stage		Start date & time	Finish date & time	Stage Depth (m)	Water Test (Lugeon)	Remarks
					From	To					

______________________ Design Representative

______________________ Construction Representative

______________________ QA/Monitoring

C2. Concrete Placement Record

Dam Project

Batch #	Batch Date & Time	Structural Element	Pour Location	Pour Start Date & Time	Pour Finish Date & Time	Volume Placed (m^3)	Temperature During Placement (^oC)	Measured Slump	Test Cylinder #	Remarks

Design Representative

Construction Representative

QA/Monitoring

C3. Grout Record

Dam Project

Drill Hole Number	Location on Dam Footprint	Stage		Start date & time	Finish date & time	Stage Depth (m)	Weight of Grout Solids Injected	Volume of Grout Fluids Injected	Maximum stage Pressure	Minimum stage Pressure	Final Stage Pressure	Time for Injection	Adjacent Water Test (Lugeon)	Remarks
		From	To											

Design Representative

Construction Representative

QA/Monitoring

C4. Concrete Test Results

Dam Project

<table>
<tr><td colspan="2">Test Cylinder #:</td><td colspan="2">Batch Date & Time:</td></tr>
<tr><td colspan="2">Location of Pour</td><td colspan="2">Pour Date & Time:</td></tr>
<tr><td colspan="4"><u>Mix Information</u></td></tr>
<tr><td colspan="2" rowspan="2">Aggregate Source:</td><td colspan="2">Aggregate Hardness:</td></tr>
<tr><td colspan="2">Aggregate Silica Content:</td></tr>
<tr><td colspan="2">Mix Design #:</td><td colspan="2">Type Cement Used:</td></tr>
<tr><td colspan="2">Specified Strength:</td><td colspan="2">Specified Slump:</td></tr>
<tr><td colspan="4"><u>Curing</u></td></tr>
<tr><td>Specimen #:</td><td>Stored in:</td><td>Days after moulding:</td><td>Average Temp during curing:</td></tr>
<tr><td>Specimen #:</td><td>Stored in:</td><td>Days after moulding:</td><td>Average Temp during curing:</td></tr>
<tr><td colspan="4"><u>Testing Results</u></td></tr>
<tr><td>Specimen #:</td><td>Age at test: 7 days</td><td>Compressive Strength:</td><td>Slump:</td></tr>
<tr><td>Air Content:</td><td>Unit Weight:</td><td colspan="2">Drying Shrinkage:</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td>Specimen #:</td><td>Age at test: 28 days</td><td>Compressive Strength:</td><td>Slump:</td></tr>
<tr><td>Air Content:</td><td>Unit Weight:</td><td colspan="2">Drying Shrinkage:</td></tr>
</table>

Tested By: ______________________________

Verified By: ______________________________

QA / Monitoring

C5. Foundation Excavation Photographic Record

Dam Project

Insert Photo Here

Location:		Date & Time:	
Chainage:		Inspected By:	
Excavated Surface Level:		Rock Surface Exposed:	
Excavated Depth:			
Volume Dental Concrete Placed:		Dental Concrete Strength:	
Batch #:		Date & Time Dental Concrete Placed:	

Remarks:

Design Representative: ______________________________

Construction Representative: ______________________________

QA / Monitoring: ______________________________

C6. Geological Excavation Photographic Record

Dam Project

Geological Mapping Sketch			
Location:		Date & Time:	
Chainage:		Inspected By:	
Remarks			

Design Representative: ______________________________

Construction Representative: ______________________________

QA / Monitoring: ______________________________

C6. Geological Excavation Photographic Record

Dam Project

Insert Photo Here

Location:		Date & Time:	
Chainage:		Inspected By:	

Remarks

Design Representative: ______________________

Construction Representative: ______________________

QA / Monitoring: ______________________

APPENDIX D Quality Assurance Meeting Minutes Template

Minute of Quality Assurance Activity

Dam Project

Date	
Activity	
Specification of Activity	
Quality Requirement	
Record Quality Check	
Result Acceptance / Remedial Action Taken	
Remarks	

Design Representative: ______________________________

Construction Representative: ______________________________

QA / Monitoring: ______________________________

APPENDIX E Reservoir Filling and Commissioning Checksheet

Reservoir Filling and Commissioning Checksheet

Pre-reservoir filling activities

- ☐ Obtain sign-off on all dam related construction activities
- ☐ Gather all dam quality assurance documents for DSRP review
- ☐ Prepare and sign-off as-constructed drawings and construction report
- ☐ Establish deformation survey points and undertake baseline survey
- ☐ Decommission coffer dam
- ☐ Test and commission low level outlet in the dry
- ☐ Undertake DSRP dam construction inspection
- ☐ Receive sign-off from DSRP to commence reservoir filling

Reservoir filling activities

- ☐ Close diversion gate/valve
- ☐ Undertake dam safety surveillance during reservoir filling
- ☐ Test and Commission low level outlet under reservoir head (flow)
- ☐ Undertake DSRP reservoir filling inspection
- ☐ Receive sign-off from DSRP for completion of reservoir filling

Post filling activities

- ☐ Undertake enhanced dam safety surveillance post reservoir filling for 18 months
- ☐ Undertake DSRP post 18 month dam inspection
- ☐ Receive sign-off from DSRP for dam commissioning completion

Appurtenant structure commissioning -

- ☐ Gather all appurtenant structure quality assurance documents for DSRP review
- ☐ Test concrete pipeline under pressure prior to backfilling of pipeline
- ☐ Test irrigation outlet under design operation pressure/flow
- ☐ Test intake gate function in dry conditions
- ☐ Test intake gate function under full reservoir head/flow
- ☐ Test gate valves in dry conditions
- ☐ Test gate valve under full reservoir head/flow
- ☐ Test gate valve closing time and gate valve protection systems
- ☐ Undertake DSRP appurtenant structure inspection
- ☐ Receive sign-off from DSRP for completion of appurtenant structure commissioning

***Note**: This check sheet needs to be developed by site staff as part of the final commissioning documentation.*

APPENDIX K

TOR for Consultancy Services to Monitor Water Quality Entering Bisri Reservoir

Background

Bisri Dam in the Nahr Awali catchment is currently in the final stages of detailed design. Construction is expected to commence in 2015, with final commissioning in 2020.

Water quality analyses undertaken as part of the Environmental Impact Assessment in 2012 and 2013 identified that some inflow to the area to be inundated contained constituents detrimental to human health; specifically Dieldrin and Lindane, organo-chlorine insecticide residues that are highly resistant to natural environmental degradation. While the recorded concentrations of these compounds was at or near the threshold of analytical determination and mostly below the Maximum Contaminant Level (MCL) set by the US EPA and WHO or the Lebanese Ministry of Health[91], both are substances whose production and use is restricted or banned under the 2001 *Stockholm Convention on Persistent Organic Pollutants* (POPs), which the Government of Lebanon (GOL) signed on 23 May 2001 and Parliament ratified on 3 January 2003. The ban on POPs for agricultural use in Lebanon came into force in 2009.

There is therefore concern that (i) stocks of POPs are still in use in contravention of both GOL's international commitment and Lebanese law, and (ii) that residues remaining within the catchment environment will continue to pollute Bisri Reservoir.

While the concern is raised in respect of Dieldrin and Lindane, it is prudent to consider other POPs, such as Dioxins and Furans that are also common by-products of waste incineration and vehicle exhaust, as well as other forms of pollution that may adversely impact reservoir water quality and afford a risk to public health.

Overall Objective

The objective of the present contract is to monitor the presence of polluting substances present in surface water courses draining to the reservoir area and to investigate their sources of origin.

Consultant's Qualification

To pursue this objective, the Ministry of Environment seeks to engage a specialist water and environmental consultancy practice registered to operate in Lebanon and having appropriately qualified and experienced staff to provide *Consultancy Services to Monitor Water Quality Entering Bisri Reservoir*.

The Consultant's project team shall include but not be limited to:

- Environmentalist, who will also be Project Manager;
- Water quality specialist;
- Field hydrologist;
- Water treatment process engineer; and
- Field technicians and sample-takers.

[91] Ministry of Health Decision No 8/1 March 1 2001.

The Consultant shall identify sources of pollution only insofar as is possible from field observations and analytical results. There will be no requirement to become involved with, nor to challenge, individual polluters or polluting enterprises.

Period of Assignment

The period of the assignment is expected to be 3-years from the date of commencement, currently expected to be November 2014.

Major Stakeholders

While the water quality monitoring contract shall be implemented through the Ministry of Environment, the Consultant's Interim Reports will be circulated by the Ministry to other major stakeholders, which are expected to include but not necessarily limited to, the following:

- Council for Development and Reconstruction;
- Ministry of Electricity and Water;
- Ministry of Health;
- Beirut and Mount Lebanon Water Establishment;
- Litani River Authority;
- Union of Municipalities;
- Concerned Heads of Municipalities;
- Internal Security Force.

Scope of Work

The Consultant is required to establish a network of monitoring sites on each of the most significant inflows to the Bisri Reservoir area and to sample each site four times throughout the hydrological year, on or about the middle of the months of January, April, July and October. As each sample is taken, the rate of flow at the site will be estimated. Each sample is be analyzed for a broad range of water quality parameters at a laboratory accredited for the purpose by the Ministry of Environment, and strict 'chain-of-custody' procedures shall be observed.

For those parameters deemed to impart potentially significant public health risk after accounting for any degradation during reservoir storage or treatment and disinfection, the present study has defined 'Actionable Results'. These vary from any presence of the worst pollutants, such as POPs, to exceedance of Maximum Permissible Limit (MPL) where these are defined. An 'actionable result' triggers additional sampling upstream to more clearly identify the pollutant source.

The exact nature of the work; the sites to be sampled, the frequency of samples, and the parameters to be analyzed may need to vary over the period of the contract in response to accumulating data and interpretation. At the present time the scope of activities on which shall be based offers of consultancy services are envisaged to be as follows:

1. Establish a water sampling and flow monitoring network with sampling protocol that covers all significant inflows to the reservoir area;

2. Undertake water quality sampling at each network site on or about the middle of January, April, July and October each year for three years. An estimate of flow at each site shall be made at the time of sampling;
3. For each sample for which one or more 'Actionable Results' are obtained, a repeat sample shall be taken within 3 days of receipt of the first sample results from the laboratory[92];
4. At the same time, the Consultant shall take up to 4 additional samples upstream of the original sample site and in tributary streams to more closely identify the source of pollution;
5. In early December each year, hold a Stakeholder's Conference with major stakeholders and other concerned parties to present the results to date, and discuss any recommendations for changes to network locations, the timing of samples or the analyses undertaken. Any reduction in the parameters monitored is likely to be restricted to POPs and heavy metals. Additional determinations may also be added.

The numbers of samples to be collected and analysed, on which the Consultant's offer shall be based, is estimated as follows:

Sample	**January**	**April**	**July**	**October**	**Annual Total**
One at each of up to 12 network sites	12	12	12	12	48
Repeat samples of those of the 12 with 'Actionable Results' (estimate)	3	3	5	5	16
Additional samples to more fully identify sources of pollution (estimate)	12	12	20	20	64
Contingency	3	3	3	3	12
TOTAL	30	30	40	40	140

Reporting Schedule

During the study the following reports shall be generated.

- *Inception Report*, to include details of the proposed monitoring network (to be submitted one month after commencement);
- *Interim Reports* giving details of the samples collected, the flows estimated, and the results of analyses (to be submitted within one month of receiving the laboratory report sheet for last samples in the set – i.e. February, May, August and November);
- Recommended Remediation Reports, summarising the remedial measures recommended to address identified pollution (to be submitted separately from but concurrently with Interim Reports);
- Annual Summary Report and PowerPoint presentation of results to date (Summary Report to be submitted one week before the annual Stakeholders Conference, the presentation to form the basis of conference hand-outs);
- Monitoring Scheme Revision Report detailing the proposals (if any) for revising the monitoring network, the sampling program or the parameters analysed, as agreed at

[92] The repeat and additional samples to be analysed for the full suite of parameters.

the Stakeholder's Conference (to be submitted within one month of the Year 1 and Year 2 Stakeholders' Conferences;

- Final Project Report detailing the work undertaken throughout the project, the results, conclusions and recommendations, together with all analytical results appended, if necessary as a separate volume.

Water Quality Analyses

The water quality analyses to be undertaken shall include at least those parameters listed below. Where standard sampling procedures require parameters to be measured in the field, or samples to be treated prior to submission to the laboratory, the cost shall be included in the cost of sampling. All field measurements of water quality shall be repeated by the laboratory.

Physical Parameters	Chemical Constituents	POPs	Others	Heavy Metals
pH Conductivity Color Turbidity Total Alkalinity Total Hardness TDS TSS	Calcium Magnesium Sodium Potassium Chloride Sulphate Fluoride Nitrate Nitrite Ammonia Ammonia-N Orthophosphate Total Phosphorous	Aldrin Chlordane DDT Dieldrin Endrin Lindane Endosulphan Heptaclor Hexachlorobenzene Mirex Hexachlorocyclohexane Toxaphene PCB PCDD (Dioxins) PCDF (Furans) Pentachlorobenzene	PAH Suite VOC Suite Dissolved Oxygen BOD COD TOC Faecal coliforms Total coliforms	Aluminium Arsenic Barium Cadmium Chromium Cobalt Copper Cyanide Iron Lead Manganese Mercury Nickel Selenium Zinc

All samples submitted for analysis shall include a waterproof label on which will be entered, in water repellent media, the following:

- Site Name;
- Date and Time of collection;
- Weather conditions;
- Estimated flow rate;
- Preservatives used (if any)
- Suspected hazards (if any)
- Name of Sampler
- Name of Consultant

Samples sets submitted by the Consultant for analysis shall include equipment, field and trip blanks (the latter for VOCs only) in accordance with *best practice* procedures. The Consultant shall ensure the laboratories QA/QC procedures include for the provision of method and instrument blanks and that these are used.

Contractual Arrangement

The monitoring study will be the subject of a standard consultant contract between the appointed Consultant and the Ministry. As shown in the table above, the majority of field sampling and hence also the majority of laboratory analyses, is dependent upon previous results. In order to attain expeditious response to contamination when identified, it is important that the responsibility for the appointed Consultant to authority to undertake Due Diligence on the results and implement follow up sampling according to the contract schedule is not delayed due to the prior need for formal Ministry approval.

Budget Estimate (US$)
Staff costs: 70,000 (including field equipment and transport)
Lab costs: 260,000 (including sample bottles)
Total: US$ 330,000.

APPENDIX L

RECORDS OF PUBLIC CONSULTATIONS

APPENDIX L1

PUBLIC CONSULTATION SESSIONS (April 2014)

Introduction

Following revisions to the ESIA and RAP consequential upon changes to Dam design, land expropriations requirements, completion of the household survey and the establishment of indicative costs, further sessions of public consultation were held as follows:

Date	Location	Time	Venue	Attendees
Friday 25 April	Aamatour	10.00am	Municipality Hall	
	Mazraat El Chouf	3.00 pm	Municipality Hall	
Saturday 26 April	Bisri	10.00am	Church Hall	
	Mazraat El Dahr	3.00 pm	Municipality Hall	

In addition to the attendees noted above and given on the list of attendees, listed above, the following were also present to undertake the presentations and respond to comments from the floor:

Organisation	Persons
ESIA/RAP Consultant	4
CDR	2
World Bank	1
Dam Design Consultant	2

Attendees were predominantly male. Those females that did attend were as follows:

Location	Number	Details
Aamatour	None	-
Mazraat El Chouf	2	1 municipality office employee 1 young daughter with her father
Bisri	4	1 wife accompanying her husband 2 sisters
Mazraat El Dahr	None	-

One month prior to these sessions, on Wednesday 26 February, copies of plans showing the extent of proposed expropriation together with a list of plot numbers was posted in each of the four meeting venues for public reference. The scale of these diagrams was such that plot numbers could easily be distinguished. During each of the sessions, the ESIA/RAP consultant erected special display panels showing the previously. At two locations, Mazraat Al Chouf and Bisri, the original diagrams were still in place but considerably faded. At the other two sites the municipality had removed the diagrams from the walls but kept them available for public reference. At all four sites on the day of the sessions new copies of the plans were given to each municipality for future public reference.

Each of the four sessions followed the same general format:

- Distribution of hand-outs and attendance sheet;
- Short introduction by CDR;
- Introduction by ESIA/RAP Consultant, explaining the purpose of the session, introducing those present from CDR and the consultants, and explaining the current status of the project;
- PowerPoint slide presentation of ESIA study and its outcome;
- PowerPoint slide presentation of the RAP, with specific details of land expropriation procedures, grievance redress and indicative rates of compensation;
- The majority of each session was then open to receive comments and concerns from the floor.

The comments received are given below. In addition, two of the municipalities (Mazraat El Chouf and Bisri) submitted pre-prepared comments, while one of the attendees at Bisri, a lawyer representing several landowners, drew up a petition at the end of the session to which several landowners appended their signature. A small number of people, refused to sign the attendance sheet, while some other refused to acknowledge their comments in writing.

The overall attitude of all four audiences was strongly opposed to the construction of Bisri Dam. At Aamatour, barely has the introduction to the session been completed when for several minutes the meeting descended into uproar as attendees stood and shouted their opposition. At the other three sessions the presentations were received more politely, but at each, mild uproar again resulted when the indicative rates of compensation, everywhere considered far too low by attendees, were displayed. As was always anticipated, the majority of comments raised from the floor concerned land expropriation and asset compensation.

While Figure here below shows how these meetings were notified to the public via the national press, the Tables, that follow, report the details of these venues.

مجلس الإنماء والإعمار
إدارة التخطيط والبرمجة
التاريخ: ٢٠ آذار ٢٠١٤

COUNCIL FOR DEVELOPMENT AND RECONSTRUCTION
CDR/PR4.1A2
Rev.00

PROJECT : مشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب / وضع محيط الموقع المقترح لسد بسري تحت الدرس

I- NETCOM

	MEDIA	NO. OF INSERTIONS	DAY (1) & DATE	DAY (2) & DATE	DAY (3) & DATE	SIZE
1.	NAHAR	2	THU 20/03/14		SAT 22/03/14	4 COL. X 5.5
2.	LIWA'A	1		FRI 21/03/14		4 COL. X 5.5
3.	HERALD TRIBUNE					
4.	LE MONDE					

II- MEDIA MARKET LEADERS (MML)

	MEDIA	NO. OF INSERTIONS	DAY (1) & DATE	DAY (2) & DATE	DAY (3) & DATE	SIZE
1.	MUSTAQBAL	1	THU 20/03/14			4 COL. X 5.5
2.	DIYAR	1		FRI 21/03/14		4 COL. X 5.5
3.	AL-BALAD	1			SAT 22/03/14	4 COL. X 5.5
4.	L'ORIENT LE JOUR					
5.	HAYAT					
6.	ASHARQ AL AWSAT					
7.	AL-RIYADH (RIYADH)					
8.	AL-ANBA'A (KUWAIT)					
9.	AL-KHALIG (U.A.E.)					
10.	OKAZ (JEDDAH)					
11.	AL SEYASSAH					
12.	AL-RAY- AL –AM (KUWAIT)					
13.	AL QABAS					

III- ALLIED

	MEDIA	NO. OF INSERTIONS	DAY (1) & DATE	DAY (2) & DATE	DAY (3) & DATE	SIZE
1.	SAFIR	1	THU 20/03/14			4 COL. X 5.5
2.	ANWAR	1		FRI 21/03/14		4 COL. X 5.5
3.	ASHARQ	1			SAT 22/03/14	4 COL. X 5.5
4.	DAILY STAR					

III- AL-ADIB

اعلانات استملاك عائدة لمنطقة الشمال	NO. OF INSERTIONS	DAY (1)	DAY (2)	DAY (3)	SIZE

رئيس إدارة التخطيط والبرمجة
إبراهيم شحرور

نسخة إلى : دائرة المناقصات لنشر الإعلان على صفحة الإنترنت العائدة للمجلس
نسخة إلى : إدارة التخطيط والبرمجة - إدارة المشاريع – إدارة التمويل - المكتب الإعلامي – القلم

- نسخة للسيد علي
- نسخة للسيد ميداوي
- الحفظ

٢٠/ ٣/ ٢٠١٤

REPUBLIC OF LEBANON • COUNCIL FOR DEVELOPMENT & RECONSTRUCTION •
19 MAR 2014

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Session 1: Aamatour

25 April 2014

مشروع "زيادة تغذية منطقة بيروت الكبرى بمياه الشرب"

إستشارات العامة – المكان: دار بلدة عماطور الزمان: ٢٥/٤/٢٠١٤

جدول الحضور

البريد الإلتروني	الهاتف	المؤسسة	الإسم	
—	٠١/٧٩٠٠٠٢	دار الهندسة - شاعر وشركاه	ايلي ابو جيلي	21
	70 747480	مالك	علي حسن مراد	22
	03/708524	ملاك	ذوقان عبد الصمد رئيس البلدية	23
	03/200654	وزارة الاشغال	سعيد فايز مرسل	24
salim.salem@usj.edu.lb	78/82911[illegible]	ملاك	سليم سالم	25
	05/310670	ملاك مجاور	انور فؤاد ابو شقرا	26
	03/389525	ملاك	اكرم رافع ابو شقرا	27
	03/355297			28
	03/813303	مشارك مستمع	وليد حسن ابو شقرا	29
	70778957	ملاك مجاور	مكرم عبد الصمد	30
	03/915386	مشارك مستمع	وفيق ابو شقرا	31
[illegible]	03/232311	وكيل املاك	حكمت فارس	32
	٧٠/٨٦١٩٩٢		عباس ابو شقرا	33
MaamounAbouChakra@live.com	٠٢-٧٠٠٢٦٠	وكيل املاك	مأمون بديع ابو شقرا	34
robert.bounaked@daralhandasah.com	03/312663	دار الهندسة نزيه طالب	روبير بو ناهض	35
	03/892746	دار الهندسة نزيه طالب	[illegible]	36
majid.hachem@hotmail.com	03/214621	وزارة الداخلية والبلديات	مجيد هاشم	37
mfadel@aub.edu.lb	٠٢/٥٠٢١٠٦	عضو بلدية	جهاد ابو شقرا	38
	٠٤/٤٤٨٤٤٨	الجامعة الاميركية بيروت	[illegible]	39
	03/970312	ملاك	نصار ابو شقرا	40

Name	Company / Position	المؤسسة	الاسم
Ali Hasan Mourad	Owner	مالك	علي حسن مراد
Zoukan Abdel Samad	Head of Municipality / Owner	رئيس البلدية / ملاك	ذوقان عبد الصمد
Saed Fayez Moursel	Ministry of Public Works	وزارة الاشغال	سعيد فايز مرسل
Salim Salem	Owner	ملاك	سليم سالم
Anwar Fouad Abou Chakra	Landowner	ملاك مجاور	انور فؤاد أبو شقرا
Akram Rafea Abou Chakra	Owner	ملاك	اكرم رافع أبو شقرا
Walid Hasan Abou Chakra	Participant	مشارك مستمع	وليد حسن أبو شقرا
Makram Abed Al-Samad	Landowner	ملاك مجاور	مكرم عبد الصمد
Wafic Abou Chakra	Participant	مشارك مستمع	وفيق ابو شقرا
Hikmat Abou Chakra	Landowner representative	وكيل املاك	حكمت فارس
Abbas Abou Chakra			عباس أبو شقرا
Maamoun BAdia Abou Chakra	Landowner representative	وكيل املاك	مأمون بديع أبو شقرا
Majid Hachem		وزارة الداخلية والبلديات	مجيد هاشم
Jihad Abou Chakra	Municipality Member	عضو بلدية	جهاد أبو شقرا
Nassar Abou Chakra	Owner	ملاك	نصار أبو شقرا

Summary of issues raised at Aamatour Session

and Client Responses

Zoukan Abdel Samad **Head of Municipality/Landowner**	**Response**
The main affected people from Bisri dam are the farmers.	Farmers will be compensated for the loss of their lands, assets and livelihoods according to Lebanese Law and RAP. While loss of agricultural employment and income will be unavoidable, new economic opportunities will result.
People are worried about the side effects of the dam. (i.e: In France, the collapse of a dam killed lots of people)	Dam Safety Plans have been formulated based on Dam Breach modelling and inundation analysis undertaken by the dam designer. The dam breach report includes an Emergency Action Plan with details of implementation.
The project is refused by several Aamatour citizens; therefore it is important to find alternatives.	An Analysis of Alternatives has been undertaken and based on a multi-criteria comparative assessment Bisri dam was recommended to be the priority scheme for Greater Beirut Water Supply Augmentation.
People of Aamatour and the region should not face the consequences of supplying Greater Beirut citizens with water. Ammatour citizens are themselves facing water shortage and need water as much as Beirut.	It is common practice to move water from rural areas with plentiful resources to urban areas that suffer shortages. Surrounding villages in Chouf and Jezzine will benefit from improved infrastructure such as sanitation and from the economic opportunities provided by future development. A Benefit Sharing Fund may be established to fund projects in the surrounding villages.
Maamoun Badia Abou Chakra **Landowner representative**	**Response**
From the very beginning, the project is being refused by most of the citizens in the area. The land to be expropriated constitutes a property of material and sentimental value.	Compensation to landowners will be undertaken according to Lebanese Law and the provisions of World Bank Operating policy OP 4.12, both of which are described in the RAP, which when approved will be disclosed publically.
The Project will be done without any compensation that gives material entitlement to the landowners and their heirs and without compensation to the community benefiting from the land, especially the Municipality of Aamatour which is entitled to collect taxes.	There are established project-specific eligibility criteria incorporating all persons deemed affected by the project and establishing eligibility for compensation or other assistance as a result of all project-related impacts. All these were included into the Compensation Matrix in the RAP. If the PAP remains unsatisfied with the compensation offered, there is a Grievance Redress Mechanism that provides for independent review. It is proposed to establish the Benefit Sharing Program to share Project benefits with local communities. It is also expected that contractors will favor local residents with employment opportunities that will be generated by the Project.

It deprives the area of a valley and a plain that are favorable for the environment, for agriculture and more.	This is understood, and the project has investigated environmental degradation, the results of which are accepted by the Ministry of Environment.
Will this project be able to compensate the profit of 90 million L.L/ year that my pine trees provide?	All lost assets will be compensated on the basis of Lebanese Law and World Bank OP 4.12 as described in the RAP. All land and assets will be compensated at current market prices.
Hikmat Abou Chakra Landowner representative	**Response**
I refuse the project since it is the main source of income for farmers.	Farmers will be compensated for the loss of their livelihoods, lands and assets according to Lebanese Law and RAP. While loss of agricultural employment will be unavoidable, new economic opportunities will result. Where land acquisition is extensive, affects a person's means of livelihood, or requires the physical relocation of households, additional compensation will be made available.
I wonder if the dam has really been studied environmentally and whether it has been approved internationally especially that the Project is a massacre to the trees and crops animals, reptiles, birds, and fish, as well as the community and their livelihoods. Emphasize more on the environmental aspect especially that the dam side effects is considered to be a massacre.	The ESIA identifies a wide range of potential environmental and social impacts, and proposes measures to avoid mitigate or manage each during both construction and subsequent operational life. Extensive environmental quality monitoring and reporting is proposed to ensure the adequacy of these measures. A 1:1 tree planting program has been proposed to compensate for the trees lost. A Biodiversity Management Plan has also been proposed for the rescue of any species that might need this. Livelihoods will be compensated for according to the provisions of the RAP.
Study desalination as an alternative.	Desalination was one of the considered alternatives. While it may be feasible, it has many disadvantages, such as requiring a heavy industrial plant located on the coast, the generation of large quantities of highly saline brine that will impair seawater quality, and a significant increase the cost of water to consumers.
Ali Hasan Mrad Landowner	**Response**
Are there going to be access roads from the villages to the dam area? Severance needs to be considered.	There will be a service road to the dam. The need for additional roads will be considered by the Master Plan for catchment development.
Why is the price of agricultural lands less than 100 m and more than 100 m from the river the same price?	The rates given are only indicative for the purpose of estimating RAP budgets. It will be the responsibility of the Expropriation Commission to set the fair and appropriate values of land based on site inspection.
The last two slides showing prices lack kidney beans.	For indicative purposes only, kidney beans are grouped under the Grains

Session 2: Mazraat El Chouf

25 April 2014

مشروع "زيادة تغذية منطقة بيروت الكبرى بمياه الشرب"

إستشارات العامة – المكان: بلدية مزرعة الشوف الزمان: ٢٥/٤/٢٠١٤

جدول الحضور

	الإسم	المؤسسة	الهاتف	البريد الإلتروني
1	روى درباس	دار الهندسة شاعر	01-790003	Riwa.Elderbas@dargroup.com
2	يوسف ذبيان			
3	ميا نصر	دار الهندسة	01_790 003	Mia.Nasr @ dargroup.com
4	عفيف ذبيان			
5	عايدة ذبيان	بلدية مزرعة الشوف	70-098976	—
6	بشارة عزام	عضو بلدية	03-842755	—
7	أيوب بوكروم	موظف	70 320230	—
8	غسان بوكروم	متقاعد	05 320296	—
9	نديم محمد	دار الهندسة طالب	03 892746	
10	روبير أبو ناضر	دار الهندسة طالب	03 312663	robert.bounahed@daralhandasah.com
11	محمد يوسف البعيني	تجارة	70 320426	
12	نادين يوسف البعيني	تجارة	03 601703	
13	فاروق أحمد ذبيان	متقاعد	٠٧/٤٧٧٧٥٠	
14	جهاد غيث	كاتب البلدية	٠٧/٢٩٤٠٤٠	
15	شفيق البعيني	عضو بلدي	٧٠٠٢٨٦٤٤	
16	يوسف بوكروم			
17	حسن أبو كروم	عضو بلدي ملاك	٧٠/٨٥٠٤٧٤	haisambk8 gmail.com
18	علي رضا ذبيان	مزارع ملاك	٠٥/٣٥٠٧٧٦	
19	ملحم بوكروم	مختار البلدة مزرعة	٠٣/٧١١٠٨٧	
20	نبيل العمي	متقاعد	٧١/١٩٠٤٤٤	

مشروع "زيادة تغذية منطقة بيروت الكبرى بمياه الشرب"

إستشارات العامة – المكان: الزمان:

جدول الحضور

	الإسم	المؤسسة	الهاتف	البريد الإلتروني
21	عدنان العمي	موظف	٠٣/٧٠١٩٢٧	
22	مروان العمي	موظف	٠٣/٨٢٥٤١٦	
23	رها العمي	موظف	٠٣/٧١٧٤٥٦	
24	شوقي البعيني	ملاك	03 623491	
25	سعيد بوكروم	ملاك	03-747981	
26	عماد بوكروم	ملاك	05350333	
27	محمد ذبيان	ملاك	٠٥/٠١٧٥٥	
28	عفيف ذبيان			
29	يوسف ذبيان	مزارع	٠٣/٩٤٠٠٤٠ / ٧٠/٥٤٠٦٦٧	
30	مروان ذبيان	ملاك	03-959590	marwan@westlakeVP.com
31	طارق بوكروم	ملاك	71-883113	
32	ايلي البو رجيلي	دار الهندسة	—	—
33				
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Name	Company/Position	المؤسسة	الاسم
Youssef Zibyan			يوسف ذبيان
Afif Zibyan			عفيف ذبيان
Ayda Zibyan	Mazraat Al-Chouf Municipality	بلدية مزرعة الشوف	عايدا ذبيان
Bechara Azam	Municipality member	عضو بلدية	بشارة عزام
Ayoub Bou Karoum	Employee	موظف	ايوب بو كروم
Ghassan Bou Karoum	Retired	متقاعد	غسان بو كروم
Mohamad Youssef Al-Beaini	Trading	تجارة	محمد يوسف البعيني
Ghandi Youssef Al-Beaini	Trading	تجارة	غاندي يوسف البعيني
Farouk Ahmad Zebyan	Retired	متقاعد	فاروق احمد ذبيان
Jihad Ajab	Municipality Clerk	كاتب البلدية	جهاد عجب
Chafik Al-Beaini	Municipality member	عضو بلدية	شفيق البعيني
Youssef Bou Karoum			يوسف بو كروم
Haitham Abou Karoum	Municipality member/ Owner	عضو بلدية / ملاّك	هيثم أبو كروم
Ali Zebyan	Farmer/ Owner	مزارع / ملاّك	علي ذبيان
Walid Bou Karoum	Mukhtar/ Owner	مختار البلدة / ملاّك	وليد بو كروم
Nabil Al-Beaini	Retired	متقاعد	نبيل البعيني
Adnan Al-Beaini	Employee	موظف	عدنان البعيني
Marwan Al Beaini	Employee	موظف	مروان البعيني
Rajaa Al-Beaini	Employee	موظف	رجا البعيني
Shawki Al-Beaini	Owner	ملاّك	شوقي البعيني
Saed Bou Karoum	Owner	ملاّك	سعيد بو كروم
Afaf Bou Karoum	Owner	ملاّك	عفاف بو كروم
Rajab Zibyan	Owner	ملاّك	رجب ذبيان
Afif Zibyan	Inheritance	ميراث	عفيف ذبيان
Youssef Zibyan	Inheritance	ميراث	يوسف ذبيان
Marwan Zibyan	Owner	ملاّك	مروان ذبيان
Tarek Bou Karoum	Owner	ملاّك	طارق بو كروم
Elie Abou Rejaili	Dar Al-Handasah	دار الهندسة	ايلي ابو رجيلي

Consultation session underway in Mazraat El Chouf Municipality

25 April 2014.

Summary of issues raised at Mazraat El Shouf Session and Responses

Ali Zebyan	**Response**
The dam will not benefit the village since the project aims to improve Greater Beirut area only.	It is common practice to move water from rural areas with plentiful resources to urban areas that suffer shortages. Surrounding villages in Chouf and Jezzine will benefit from improved infrastructure such as sanitation and from the economic opportunities provided by future development. Also, a Benefit Sharing Fund may be established to fund those projects in the surrounding villages.
The fertile land, which is the main source of income for farmers, will be destroyed by the construction of the dam.	Agricultural land will be compensated according to its value established under Lebanese Law and World Bank OP 4.12. For persons directly and significantly affected by the project, there will also be provision for the restoration of incomes or livelihoods. Where land acquisition is extensive, affects a person's means of livelihood, or requires the physical relocation of households, additional compensation will be made available.
Shawki Al Beani Landowner	**Response**
Lebanon is in need of dams and the people are willing to accept the project only if it benefits the area and its people (such as provide electricity to Jezzine)	Bisri Dam will include additional provision to generate hydropower to the national grid and a Benefit Sharing fund will be established to spread the benefits to the areas most affected.
Is still possible to change the project?	Yes. The objective of public consultation is to note the comments and concerns of the affected population and to take these views into account during project design, construction and execution.
Haitham Abou Karoun Municipality member/ Landowner	**Response**
The project opposes the government law which states that people should remain attached to their lands and properties.	The RAP stipulates that every reasonable effort is to be made to avoid or minimize the need for land acquisition and resettlement. Where they are unavoidable, the RAP lays out the policy and procedures to ensure persons subjected to adverse impacts are fairly compensated for all lost land and assets, and otherwise provided with other assistance to provide sufficient opportunity to at least restore their incomes and living standards.
The proposed dam project should stipulate benefits for the village of Mazraat Al-Chouf since the properties that are up for expropriation are mostly owned by the local community.	All surrounding villages in Chouf and Jezzine will benefit from improved infrastructure such as sanitation and from opportunities provided by future development. A Benefit Sharing Fund will be established to fund those projects in the surrounding villages.

Walid Adib Bou Karoum Mukhtar/ Landowner	**Response**
There was no mention of a seawater desalination project given that we own a long stretch of coast on the Lebanese border.	Desalination was one of the considered alternatives. While it may be feasible, it has many disadvantages, such as requiring a heavy industrial plant located on the coast, the generation of large quantities of highly saline brine that will impair seawater quality, and a significant increase the cost of water to consumers.
The town of Mazraat Al-Chouf is supposed to benefit from water and electricity; and we insist on this.	Bisri Dam will include provision to generate hydropower and deliver it to the national grid.
The creation of the dam constitutes a great loss for agriculture since this is the best land we have in terms of agriculture + natural beauty + compensations are much lower than the value of the land.	Farmers will be compensated for the loss of their livelihoods, lands and assets according to Lebanese Law and RAP. While loss of agricultural employment will be unavoidable, new economic opportunities will result. Where land acquisition is extensive, affects a person's means of livelihood, or requires the physical relocation of households, additional compensation will be made available.
Shawki Al-Beaini Landowner	**Response**
The landowners' consent or lack thereof depends on the services supplied by the dam. If it will not supply electricity to the surrounding villages, what is the use of the dam? If it will not supply water to the people who need it, why should we build it?	Bisri Dam will provide both water and electricity. While this will not go directly to local consumers, it will free up resources currently dedicated to Greater Beirut for distribution to more rural communities.
Representatives of landowners from Mazraat Al-Chouf and Aamatour should be added to the Expropriation Commission to discuss fair remuneration for the land.	The Purpose of the Public Consultations is to convey PAPs concerns to the Project Proponent and to voice their ideas. Moreover, and as explained to public consultations audience the Expropriation Commission will include one independent observer to ensure that no-biased compensations will be decided.
Nabil Chahine Al-Beaini Landowner	**Response**
I object to constructing the dam at this particular site because the land that will be expropriated, especially the plain, has been our ancestral land for 400 years. Therefore, we ask that the dam be moved somewhere else.	All views will be considered by the project proponent and funding agencies.
Nabil Ali Qassem Zibyan	**Response**
Instead of serving Beirut, kindly supply services to Mazraat Al-Chouf and the neighboring villages to encourage people to stay and cultivate the land instead of migrating.	All surrounding villages in Chouf and Jezzine will benefit from improved infrastructure such as sanitation and from opportunities provided by future development. A Benefit Sharing Fund will be established to fund those projects in the surrounding villages.

Saed Bou Karoum **Landowner**	**Response**
The dam should be moved from its current location to a site below Moukhtara – Ain Qeni which will provide the needed water supply to the neighboring villages and prevent expropriation of agricultural land.	The proposed dam location has been studies from all standpoints including geology, seismology, water tightness, etc. The site below Moukhtara-Ain Qeni is very karstic, therefore water leakage at this site is expected to be very high.
I own and operate a park during the summer and that it constitutes my livelihood.	For persons who are directly and significantly affected by the project, there is provision to at least restore, their incomes or livelihoods. Where land acquisition is extensive, affects a person's means of livelihood, or requires the physical relocation of households, additional compensation will be made available.
Mohamad Al-Beaini **Landowner**	**Response**
While the city of Beirut is supplied with water for 3-4 hours per day, while our town, Mazraat Al-Chouf, is supplied with water for an approximate 3-4 hours, twice a week.	Water from Bisri Dam will help release currently oversubscribed resources for less fortunate areas. The benefit Sharing fund will also focus on community projects such as water and electricity supplies.
Create a special committee of landowners for Mazraat Al-Chouf and Aamatour given the proportion of landowners, in order to follow up on all details.	The Purpose of the Public Consultations is to convey PAPs concerns to the Project Proponent and to voice their ideas. Moreover, and as explained to public consultations audience the Expropriation Commission will include one independent observer to ensure that no-biased compensations will be decided.

Farouk Ahmad Zebyan Landowner	**Response**
I agree with everything that was mentioned in the explanation. I support the construction of the dam.	Your comments are noted with many thanks.
Marwan Zebyan Landowner	**Response**
What are the direct benefits for the town community?	All surrounding villages in Chouf and Jezzine will benefit from improved infrastructure such as sanitation and from opportunities provided by future development. A Benefit Sharing Fund will be established to fund those projects in the surrounding villages.
Participation of the municipality in the valuing committee.	The composition of the various commissions and committees is laid down under Lebanese law. Local municipalities have a role in the special grievance Redress procedure formulated for this project at the behest of the World Bank. They will therefore play a major role in achieving the levels of compensation PAPs to which PAPs feel entitled.
Roads should be created to connect towns and reap economic benefit. We need water and electricity from the dam.	The need for new roads will be considered by the Master Plan for catchment development. Water from Bisri Dam will help release resources for less fortunate areas. The Benefit Sharing fund will focus on community projects such as water and electricity.
A percentage or amount should be supplied and added to the revenue of the municipality instead of using part of the town properties (e.g. telephone and electricity).	A Benefit Sharing Program will be created to spread the benefits of the project to local communities. Initially this will utilize the capital funds for the project, but later will continue through continued revenue from primary beneficiaries and other sources.
Where will the archeological monuments be transferred? Identify the location before proceeding with expropriation.	The directorate of Antiquities will be responsible for rescue archaeology and the project will fund all necessary activities to preserve heritage remains.
Establish the location to which fertile soil will be transferred and the beneficiaries.	The transfer of fertile soil to less-fertile areas is a proposal already included in the ESIA.
Propose a different location between the towns of Mazraat Al-Chouf, Aamatour and Moukhtara.	The proposed dam location has been studies from all standpoints including geology, seismology, water tightness, etc. The site below Moukhtara-Ain Qeni is very karstic; therefore water leakage at this site is expected to be very high.

Mazraat Al-Chouf Municipality	Response
The expropriated properties constitute the most productive land and the principal source of livelihood of many of the landowners. The compensation that we will receive for our land will not cover the deficiency that will occur after expropriation.	Farmers will be compensated for the loss of their livelihoods, lands and assets according to Lebanese Law and RAP. While loss of agricultural employment will be unavoidable, new economic opportunities will result. Where land acquisition is extensive, affects a person's means of livelihood, or requires the physical relocation of households, additional compensation will be made available.
The Bisri site is environmentally vital and is unique in the Chouf region.	The ESIA identifies a wide range of potential environmental and social impacts, and proposes measures to avoid mitigate or manage each during design, construction and subsequent operation. Extensive environmental quality monitoring and reporting is proposed to ensure the adequacy of these measures.
The Bisri site is located on a seismic risk zone and the presence of a lake increases the threat in this concern.	Protection against seismic effects have been incorporated into dam design to the maximum it is possible. Dam Breach modelling and inundation analysis have been undertaken by the dam designer. This work includes an Emergency Action Plan.
The area is home to an archeological Roman city buried underground, some monuments of which are still visible above ground.	The DGA will execute and archaeological rescue plan in accordance with their responsibilities under Lebanese law.
The Mazraat Al-Chouf town will not benefit neither from the dam's water nor from the generation of electricity.	All surrounding villages in Chouf and Jezzine will benefit from improved infrastructure such as sanitation and from opportunities provided by future development. A Benefit Sharing Fund will be established to fund those projects in the surrounding villages.
The water level elevation and expropriation of a 50 meter zone on the borders of the lake include hills that are significant for investment.	The ESIA Consultant has recommended the development of a Master Plan for the Development of the Bisri Lake Shoreline and Surrounding Areas.
Many townspeople were born in this area; thus the area is of sentimental value to them.	The comment is noted.
It is worth mentioning that there are other sites that are not fit for agriculture where the project can be built, including, for example, the valley located between the towns of Aamatour and Al-Mazraat and the valley of Damour.	The proposed dam location has been studies from all standpoints including geology, seismology, water tightness, etc. many other possible sites are very karstic; therefore water leakage at this site is expected to be very high.

Session 3: Bisri

26 April 2014

مشروع "زيادة تغذية منطقة بيروت الكبرى بمياه الشرب"

إستشارات العامة – المكان: كنيسة سيدة بسري الزمان: ٢٦/٤/٢٠١٤

جدول الحضور

	الإسم	المؤسسة	الهاتف	البريد الإلتروني
1	رشيد ابو عيشه	مختار بلدة مشموشه	٠٢/٢٦٠٦١٢	
2	المهندس سيزار ابو عيشه	مكتب استشارات هندسية	03363744	
3	جميل جبران	ملاك	0/376672	
4	[illegible]	بلدية [illegible]	3/770250	
5	طوني يوسف حبيب	مهندس	03/759787	
6	ريمون جرجي توسليان	امن الدولة	03/438694	
7	فادي جرجي توسليان	هاوي	71 914830	
8	جوزيفا جرجي توسليان	مشاريع الدوفا [illegible]	70/824379	
9	غادة جرجي توسليان	[illegible]	70/543732	
10	طوني جرجي توسليان	مشاريع [illegible]	76/358786	
11	مارون حيمصد	مختار الميدان	٠٢/٩٤٤٣٧٧ ٠٧/٨٠٠٢١٤	
12	مارون ابو الخوري	نائب رئيس البلدية الميدان	٠٢/٨٥٦٨٩٩ ٧/٨٠٠٠٥	
13	شربل بولس	مختار [illegible]	٠٧/٨١٠٨١٢	
14	الخوري بشير المعلم	[illegible]	03/418774	
15	سليم عيد	مختار مزرعة بسري	07/452747	
16	المهندس مروان أمين	وزارة الأشغال العامة	03/358734	
17	التلميذ عبد قطار	مدرسة [illegible]	76/614757	
18	جهاد قطار	موظف ملاك في بسري	03 721129	
19	ذاكر سنان	مندوب بلدية الميدان	70 373490	
20	ماري دومينيك عواد فرحات	ملاكة في مرج بسري الميدان	70/810400	mariedofarhat@gmail.com

مشروع "زيادة تغذية منطقة بيروت الكبرى بمياه الشرب"

إستشارات العامة – المكان: كنيسة السيدة بسري الزمان: ٢٦/٤/٢٠١٤

جدول الحضور

	الإسم	المؤسسة	الهاتف	البريد الإلتروني
21	كرازييلا عواد شباط	مالكة في مرج بسري	01/280630	Graziella.aouad.chbat@Gmail.com
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27	يوسف بطرس العميل	مالك في عماطور وبحنين	03/800811	
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35	الياس جورج [illegible]	مالك بسري	٠٢ ٤١٥ ٤٢٧	[illegible]
36				
37	[illegible]			
38	جورج [illegible] الدبس	مالك مزرعة الضهر	٠٣/٧٠٤٤٧١	
39	[illegible]	مالك	٠٣/٤٤٠٦٤٧	
40	المحامي شربل جرجس [illegible]	مالك	٠٣/٧٥٤٥١٥	

Name	Company / Position	المؤسسة	الاسم
Rafic Abou Atmeh	Mukhtar - Machmouchy	مختار بلدة مشموشي	رفيق أبو عتمة
Engineer Micheal Abou Atmeh	Engineering Consultant	مكتب لستشارات هندسية	المهندس ميشال أبو عتمة
Jamil Jebran	Owner	ملاك	جميل جبران
Emil Mourad	Binwati Municipality	بلدية بنواتي	أميل مراد
Toni Youssef Habib	Engineer	مهندس	طوني يوسف حبيب
Remond Gergy Bou Sleiman	Government Security Agent	امن الدولة	ريمون جرجي بو سليمان
Fady Gergy Bou Sleiman			فادي جرجي بو سليمان
Joseph Gergy Bou Sleiman	Ministry of Telecommunication	وزارة الاتصالات	جوزيف جرجي بو سليمان
Ghassan Gergy Bou Sleiman	Ogero	هيئة أوجيرو	غسان جرجي بو سليمان
Toni Gergy Bou Sleiman	Ministry of Telecommunication	وزارة الاتصالات	طوني جرجي بو سليمان
Maroun Houbaika	Mukhtar – Al-Midan	مختار الميدان	مارون حبيقة
Maroun Abou Samra Al-Khoury	Vice head of Municipality – Al-Midan	نائب رئيس البلدية – الميدان	مارون ابو سمرا الخوري
Shafic Boulos	Mukhtar Bisri	مختار بسري	شفيق بولس
Priest Peter Al-Khawand	Bisri Priest	خادم رعايا	الخوري بيتر الخوند
Chafic Eid	Mukhtar - Bisri	مختار خربة بسري	شفيق عيد
Engineer Marwan Amine	Ministry of Public Works	وزارة الاشغال العامة	المهندس مروان امين
Student Eid Khatar	Sagesse School	مدرسة الحكمة	التلميذ عيد خطار
Jihad Khatar	Employee / Owner Kherbet Bisri	موظف – ملاك خربة بسري	جهاد خطار
Chaker Sinan	Owner – Al-Midan	ملاك بلدة الميدان	شاكر سنان
Marie Dominic Awad Farhat	Owner – Marj Bisri – Al-Midan	ملاكة في مرج بسري - الميدان	ماري دومينيك عواد فرحات
Krazella Awad Chebat	Owner – Marj Bisri	ملاكة في مرج بسري	كرازييلا عواد شباط
Nazira Awad Sabagha	Owner – Marj Bisri – Al-Midan	ملاكة في مرج بسري - الميدان	نظيرة عواد صباغة
Jean Houbaika	Owner – Aamatour – Al-Midan	مالك – عماطور - الميدان	جان حبيقة
Youssef Chaker Sinan	Owner – Al Midan	مالك – الميدان	يوسف شاكر سنان
Louis Afif	Owned by Deir Al-Mukhales	ملك دير المخلص – بحنين	الاب لويس عفيف
Henry Al Sayegh	Investor - Deir Dhanin	مستثمر عقارات دير بحنين	هنري الصايغ
Youssef Boutros Al Ajeil	Owner – Aamatour and Bhanin	مالك في عماطور وبحنين	يوسف بطرس العجيل
Tanous Boutros Al Ajeil	Owner Aray	مالك في عاراي	طانوس بطرس العجيل
Wafaa Maarouf Saad	Owner – Marj Bisri	مالكة في مرج بسري	وفاء معروف سعد
Adel Salim Al Kadi	Owner – Marj Bisri	مالك في مرج بسري	عادل سليم القاضي
Antoine Wehbeh	Owner / Mukhtar	مالك ومختار	انطوان وهبة
Ghada Gerges Harb	Owner – Aamatour	مالكة – عماطور	غادة جرجس حرب
Elie Charbel Awad	Owner – Al-Midan	مالك – الميدان	ايلي شربل عواد
Maroun Sleiman Karam	Owner – Aamatour, Bkassine, AL-Ghabatiye	مالك عاماطور – بكاسين – الغباطية	مارون سليمان كرم

Name	Company / Position	المؤسسة	الاسم
Elias George Assaf	Owner – Bchary	مالك بشري	الياس جورج عساف
Asaad Btaich			اسعد بطيش
George Nadim Abou Samra	Owner – Mazraat Al-Daher	مالك في مزرعة الضهر	جورج نديم ابو سمرا
Chadi Akel	Owner	مالك	شادي عقل
Lawyer Charbel Gerges Harfouch	Owner	مالك	المحامي شربل جرجس حرفوش
Remon Habib Abou Samra	Owner – Al-Harf	ملاك – الحرف	ريمون حبيب ابو سمرا
Wissam Akel	Owner – Al Harf, Al-Midan	مالك (الحرف – الميدان)	وسام عقل
Najib Akel	Owner – Al Harf, Al-Midan	مالك (الحرف – الميدان)	نجيب عقل
Maroun Akel	Owner – Al Harf, Al-Midan	مالك (الحرف – الميدان)	مارون عقل

Consultation seesion underway in Bisri Church Hall

26 April 2014.

Summary of issues raised at Bisri Session and Responses

Sleiman Bou Seiman	**Response**
I am against the project especially that people live from this land and educated their children from it. I am vehemently opposed to the project.	The Purpose of the Public Consultations is to convey PAPs concerns to the Project Proponent and to voice their ideas. You comment is noted.
George Nadim Abou Samra Landowner	**Response**
What were the feedbacks of other public consultations and is still the possibility to stop the project?	Opinion is variable. The Purpose of the Public Consultations is to convey PAPs concerns to the Project Proponent and to voice their ideas.
Charbel Harfouche Lawyer	**Response**
Building the dam is not considered to be fair for people living from this land (especially that many of the people living in the area are poor and overcame many wars thus need this land for survival).	For persons who are directly and significantly affected by the project, there is provision to at least restore, their incomes or livelihoods. Where land acquisition is extensive, affects a person's means of livelihood, or requires the physical relocation of households, additional compensation will be made available.
Create a company of shares as the best solution for fairness in compensation- creation of a joint-stock company, like Solidere, whereby landowners are given shares in the company capital and funding parties given shares based on their financial contributions. Fairness predicates the participation of landowners by holding company stock, collecting dividends and trading on the stock exchange.	This idea for a joint-stock company may have merit but encompasses a range of legal issues beyond the scope of the present ESIA and RAP. Your comment is noted and has been passed to the project proponent for further consideration.
Adel Salim Al Kadi	**Response**
Provide yearly compensation for all farmers in the affected area. Create an agenda for improving and enhancing the Jezzine/Chouf area instead of supplying Greater Beirut.	All surrounding villages in Chouf and Jezzine will benefit from improved infrastructure such as sanitation and from opportunities provided by future development. A Benefit Sharing Fund will be established to fund those projects in the surrounding villages.
Create an organization to protect the dam and water quality.	The dam will be designed with a degree of earthquake projection and an Emergency Action Plan will be put in place. Water quality monitoring will be routine throughout dam operation and improved sanitation in the surrounding villages will improve the quality of inflowing streams.

The study did not stipulate payment of annual compensation for developing the area around the dam The study did not stipulate the creation of a body to monitor the protection of the dam from pollution and preservation of fishery resources.	An Environmental and Social advisory panel will be appointed to provide independent review of, and guidance on, the treatment of environmental and social issues associated with planning, design, construction and operation of Bisri dam and reservoir from the date of their appointment to a period expected to be not less than 3 years into dam operation.
Jamil Jebran **Landowner**	**Response**
I: Seismic Risk The planned dam is to be constructed over the Room fault line and an "earthquake of high magnitude" is expected. Certain historical literature and ancestral accounts passed down through generations tell of a strong earthquake that occurred in the mid-6th century (probably the year 556) which resulted in a massive collapse that blocked the riverbed and prevented the flow of water for fourteen months, thus creating the fertile, sedimentary Bisri plain irrigated by the river and the springs issuing from its banks. The villages of Mazraat Al-Mathaneh and Kherbet Bisri were built on the debris left by the aforementioned earthquake. Any flash flood that leads to the dam collapsing will have as a consequence the destruction of the greatest part of the two villages and may carry them away entirely. A flood occurred in the early seventies due to abundant, late rainfall. It caused considerable destruction on the outskirts of Mazraat Al-Mathaneh and mudslides that buried Al-Awali power plant (Boulos Arqash plant). The dangers created by the collapse of the dam due to an earthquake are not limited to the volume of water rushing down suddenly. One must consider the soil, rocks and trees that will be carried by the sudden onslaught, which will raise the water level even further. The riverbed would be too narrow to hold it all in and the banks would collapse. This increases the risk that the villages of Kherbet Bisri and Mazraat Al-Mathaneh will be carried away, given that, as we mentioned earlier, they stand on the debris left by the earthquake in ancient times, and will surely destroy the two power plants located along the riverbed, downstream from the dam. The explanations offered by the engineer responsible for designing the dam and its earthquake resistance were somewhat reassuring.	Protection against seismic effects have been incorporated into dam design to the maximum it is possible. Dam Breach modelling and inundation analysis have been undertaken by the dam designer. This work includes an Emergency Action Plan.

Early warning and population evacuation plans in the event of a collapse, however, were vague. Indeed, the Lebanese State lacks an adequately equipped service or facility to handle natural disaster management. Moreover, the measures established in the study for the maintenance of the dam were merely theoretical.	
II: Archeological Monuments There are visible archeological monuments along the banks of the river, from its source to Moltaka Al-Nahrayn, including: the Eshmun Temple; Abu Al-Hisn Fort (probably a remnant from the Crusades) located on a hill in the riverbed, and a stone bridge standing nearby, opposite Deir Al-Mukhales; a historical mill in the village of Kherbet Bisri, which was recently classified by virtue of a decree; the Church of Our Lady of Bisri; the Mar Moussa Church; the convent of St. Sofia; an old Roman temple and historical bridge at Moltaka Al-Nahrayn. The area, from the village of Kherbet Bisri to Moltaka Al-Nahrayn, is certainly the site of buried archeological monuments because the Bisri plain was densely populated before and after the earthquake of old. This is evidenced by the visible vestiges of religious monuments (the temple at Moltaka Al-Nahrayn) and is further corroborated by the tales of senior members of the community who say that people from the coast would come to the temple in horse-drawn carriages by way of a path adjacent to the riverbed.	The DGA will execute and archaeological rescue plan in accordance with their responsibilities under Lebanese law. Heritage preservation, as distinct from archaeological rescue, will be implemented to relocate Mar Moussa Church, St. Sophia's Monastery and similar structures throughout the valley.

III: Expropriation Expropriation is, of course, subject to the law. Nevertheless, some comments are necessary on the conducted study that will constitute the actual basis for the expropriation decree. • Valuation of the land based on its distance from or proximity to the river is not sufficient to establish its value. The type of land (flat or steep), type of soil (fertile sedimentary, sandy or rocky), whether the land is irrigated or not, and the type of crops actually cultivated on it are all factors that should be taken into account to determine its value. Therefore, the stipulated prices are far below the real value of a flat, sedimentary, fertile, irrigated, cultivated citrus orchard. Furthermore, the prices stipulated for equipment are lower than their actual cost. • Compensation is due to resident and non-resident landowners and covers the land, tenancy, built structures, trees, crops, etc. However, if there is proof of sharecropping, investment or similar contracts, the content of such contracts should be examined to apportion compensation accordingly. • Compensation should be made in cash exclusive of any other previous payment mode (payment in treasury bonds). The study does not state whether the money for compensating expropriation is available or not. This is a cause for concern among rightful beneficiaries, especially given that it has been years since a budget was ratified in Lebanon. • No matter how fair the compensation, forcibly taking a property by expropriation, in particular lands which are mostly inherited, involves not only considerations of material gain but sentimental value that should be taken into account. Allowing landowners to uproot or cut down trees, uninstall equipment and perhaps transferring soil, all within a certain period (e.g. 6 months) from the date on which the Expropriation Commission's decision is issued, may alleviate the sentimental damage.	The compensation rates provided are indicative only and the actual levels of compensation will be determined by the Expropriation Commission on the basis of land and asset inspections and evaluations. One of the key tasks of the Commission is to examine all claims relating to contracts, agreements, bills and other documents. Share cropping agreements will certainly be accepted for consideration. The ESIA has identified the presence of archaeological remains and cultural heritage and there will be a program of rescue archaeology and heritage relocation prior to filling the reservoir in order to preserve their cultural heritage and any other meaningful asset to the local people memory. Landowners will be allowed to remove whatever assets they wish to retain, including plants and soil without affecting compensation payments.
IV: Post-Construction	The ESIA identifies a wide range of potential

In addition to seismic risk, climate and overall environmental changes will have a considerable impact, least of all the rise in humidity, insects and diseases resulting from stagnant water and the discharge of wastewater, especially given that the towns and villages along the riverbanks lack sewage networks and treatment plants. Growing tourism due to the dam and lake will create tremendous human, health, pollution, noise and other pressures on an environment that used to be rural, quiet and wholesome. The environment will lose its characteristics and will change forever. We are not entirely confident that the various State services (Directorate-General of Urban Planning and other such) will take measures to ensure proper management of the land surrounding the dam and lake. We would prefer for the Council for Development and Reconstruction to contact the competent administrations to develop as of the present a comprehensive management plan that would enter into effect upon the issuance of the expropriation decree or, at least, before the land take decision. The same applies for studies on the flow of water downstream from the dam, allocation of water for land irrigation, forestation and other plans on distributing the benefits of the project. These should be ready and disseminated to the community by land take. A sole management should be created for the dam, lake and basin as a whole. Local committees should take part in this management. Dividing responsibilities among State administrations, especially under the current situation, will result in no accountability, failure to implement the set plans, neglect of maintenance and undermining the natural, environmental and community resources, and perhaps the collapse of the dam, even without the contribution of an earthquake.	environmental and social impacts, and proposes measures to avoid mitigate or manage each during both the period of construction and subsequent operations. Extensive environmental quality monitoring and reporting is proposed to ensure the adequacy of these measures. The ESIA Consultant has recommended the development of a Master Plan for the Development of the Bisri Lake Shoreline and Surrounding Areas.
Maroun Hobeika **Mukhtar**	**Response**
Will there be compensation for the sand quarries?	Yes. Compensation for those plots to be expropriated will include consideration of any and all commercial activities undertaken.
The town of Al-Midan (Jezzine Caza) lacks a sewer network. A study was previously conducted by the Ministry of Energy and Water, but has not been implemented yet. There are sewer projects in several towns and	In order to protect water quality in Bisri reservoir it is intended to fast-track the installation of sewerage and sewage treatment across all villages within the catchment.

area, but no treatment plants; mostly, sewage is discharged into the Bisri River.	
A public road project connecting Al-Midan to the town of Bisri has been studied and planned, and a Presidential decree issued in its regard. The road is 6 kilometers long and its established width is 12 meters. The road is highly vital; it connects Jezzine and the upper South to Marj Bisri. The project should be carried out to connect and facilitate access from and to Marj Bisri through Deir Al-Mukhales, Joun and the coastal highway to the capital city of Beirut. The road will not be blocked by snow during the winter. It facilitates summer and winter travel to the coastal highway and is shorter than the Room – Saida road and the Beirut main road by 30 kilometers.	The needs for new roads will be a major element of the proposed Master Plan for the development of the upper catchment area.
George Nadim Abou Samra **Landowner – Mazraat Al-Daher**	**Response**
The project is inequitable; a different location should be sought for the project.	The objective of public consultation is to note the comments and concerns of the affected population and to take these views into account.
Marie Dominique Awad Farhat **Landowner – Marj Bisri – Al-Midan**	**Response**
We request that compensation per square meter be reconsidered because it is very low.	The compensation rates provided are indicative only and the actual levels of compensation will be determined by the Expropriation Commission on the basis of land and asset inspections and evaluations.
We request that the dam be kept clean, i.e. that dedicated infrastructure be created in neighboring towns. We also request that the surrounding area be well maintained in terms of planting fruit and natural tree cover.	BMLWE shall maintain the dam the reservoir shoreline and operational monitoring.
Is it possible to build ponds instead of a dam since it will be constructed on an earthquake prone site?	A series of ponds would not offer the storage potential of a dam and hence fail to satisfy the demand for water that has to be served.
Shafic Boulos **Mushtar, Bisri**	**Response**
Deteriorating water quality and sewerage	Sewerage schemes will be executed in all villages discharging into the Bisri valley. Monitoring of water quality will be undertaken throughout dam operation.
Lack of oxygen	Dam design provides for multi-level releases to allow for deeper water to be circulated and oxygen levels maintained.
Discharge of mineral water; manganese, iron, sulphur, arsenic, phosphorus, ammonia, etc.	It is assumed the questioner refers to the potential for water pollution. Water pollution studies have previously been undertaken and water quality monitoring will extend throughout the period of dam operation.

	Current water quality is such that it can be rendered suitable for public consumption with conventional treatment, i.e. without special treatment.
Testing showed traces of organophosphate pesticides – Lindane and Dieldrin – the use of which is internationally prohibited	The project will fund a program administered by MOE to monitor water quality and find and curtail any remaining sources of any potentially polluting substances.
Rise in diseases and multiplication of mosquitoes	The proliferation of mosquitoes is a potential threat to any standing water body. Mitigation is primarily achieved through efficient design that does not allow high water levels to overtop reservoir sides, and yet permits efficient shoreline drainage, both aimed at reducing mosquitos breeding sites. Bankside vegetation will be managed.
Odors and impact on the environment	Odor currently arises in the vicinity of sewage discharge into the river from surrounding villages. CDR's proposals for fast-tracking the execution of sewerage schemes in all catchment villages will prevent this type of odor in the future.
Salinity downstream from the dam will rise and negatively impact agriculture and the population – insects will increase	Compensatory discharges from the dam will be sufficient to maintain existing irrigation efficiency and prevailing ecological conditions.
Rise in seismic risk; what will happen to the community living downstream from 125 million cubic meters of water? What measures will be taken to reduce these risks?	Dam Safety Plans have been formulated based on Dam Breach modelling and inundation analysis undertaken by the dam designer. The dam breach report includes an Emergency Action Plan with details of implementation.
Document prepared by Lawyer at the end of the Session and signed on behalf of 25 landowners	**Response**
We propose that a law on the construction of the Bisri dam be issued via a joint-stock company whereby landowners obtain their compensations and entitlements based on shares in the proposed company, allowing them to collect dividends and trade the stock exchange to protect their rights and as fair distribution of entitlements resulting from the project.	This idea for a joint-stock company may have merit but encompasses a range of legal issues beyond the scope of the present ESIA and RAP. Your comment is noted and has been passed to the project proponent for further consideration.
Prevent traditional expropriation methods based on the applicable law for a vast area of 520 hectares in which the State does not own any public or state-owned land.	Land expropriation will be undertaken in accordance with Lebanese law modified as appropriate by the provisions of World Bank OP 4.12, as defined and discussed in the RAP. Some 50 ha of the land to be taken by the project is already *Domaine Publique*.
The community welcomes the project on this fair basis and based on sharing project profits with landowners, the community and future generations, given that the area has been underserved since before independence. One should take into account the chronic state of deprivation and the need to revive the area but	Compensation to landowners will be undertaken according to Lebanese Law and the provisions of World Bank Operating policy OP 4.12, both of which are described in the RAP, which when approved will be disclosed publically.

not at the expense of the local community by giving them the lowest compensations possible through the traditional approach; rather, the community should be allowed to share in the considerable profits that the State and the administration stand to make off of their land which is proposed for expropriation in exchange for minimal return.	The compensation rates provided are indicative only and the actual levels of compensation will be determined by the Expropriation Commission on the basis of land and asset inspections and evaluations. All surrounding villages in Chouf and Jezzine will benefit from improved infrastructure such as sanitation and from opportunities provided by future development. A Benefit Sharing Fund will be established to fund those projects in the surrounding villages.
The Jezzine community, particularly the landowners here present, wishes success to the endeavor to create the Bisri dam construction company by virtue of a law that stipulates the establishment of such a company, without full objection to the currently proposed mechanism.	This idea for a company may have merit but encompasses a range of legal issues beyond the scope of the present ESIA and RAP. Your comment is noted and has been passed to the project proponent for further consideration.
Shafiq Eid **Mukhtar, Kherbet Bisri**	**Response**
The appended map does not allow us to identify in detail the expropriations and projects downstream from the dam where our village is located. We ask to be provided with a detailed map showing the number of each property affected by expropriation.	Larger scale maps on which it is possible to identify individual plots and their numbers were displayed at the public consultation sessions. Copies of these maps for public reference have been given to the municipalities where consultation sessions were held. The expropriation map is also available at CDR website: www.cdr.gov.lb
On the outskirts of our village, or perhaps within the scope or in the vicinity of expropriations, is located a historical mill that was recently classified as an archeological site (please find attached a copy of the classification decree). No reference was made in this regard in the executive summary. Please clarify.	The ESIA/RAP Consultant has reported the presence of the mill to the consultant preparing the Expropriation File. So far as we are aware the transmission pipeline corridor is some 50 m from the mill. In any case, all lands and assets will be inspected prior to the deliberations of the Expropriation Commission.
Valuation of land based on its proximity to the river is not a reasonable or scientific method for establishing land price. The type of soil, the type of land, whether irrigated or not, etc. should constitute the criteria adopted in determining the sum paid for expropriation. In any case, the price of irrigated land cannot be equivalent to the price of non-irrigated land.	The rates given are only indicative for the purpose of estimating RAP budgets. It will be the responsibility of the Expropriation Commission to set the fair and appropriate values of land based on site inspection.

It is well known that the site where the Bisri dam will be built is a high-seismic-risk zone. The construction of the dam will increase the risk multifold. The executive summary merely confirmed the rise in seismic risk – which is expected – and its great potential magnitude, and simply mentioned general guidelines on protection against the consequences of earthquakes which will inevitably worsen if the dam were to collapse as a result. This threatens the very existence of our village and may lead to the village being destroyed and carried away, for the precise reason that it is built on the debris left by past earthquakes which are said to have occurred in the mid-6th century. Therefore, we should be informed of the practical measures that you will take to prevent the collapse of the dam in the event of an earthquake and the population safety, prevention and rescue procedures in case the dam collapses. At present and for the foreseeable future, the State does not have any qualified service or staff for rapid intervention in the event of natural disasters. Whatever the adopted methods and established plans, we will have, after the dam is constructed, to live in our village in constant fear and concern about the occurrence of a disaster that is prone to wipe out our village and, perhaps, its residents, too.	Dam Safety Plans have been formulated based on Dam Breach modelling and inundation analysis undertaken by the dam designer. The dam breach report includes an Emergency Action Plan with details of implementation.

Session 4: Mazraat El Dahr

26 April 2014

مشروع "زيادة تغذية منطقة بيروت الكبرى بمياه الشرب"

إستشارات العامة – المكان: بلدية مزرعة الضهر الزمان: ٢٦/ ٤/ ٢٠١٤

جدول الحضور

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	03/297858		شاهين نعيم عيد	5
	03/140699		فادية عيد	6
	03/998836		خولة عيد	7
	03/500949		شادي عيد	8
	70/845289		شادي عصام عيد	9
~~[illegible]~~	03/305057	رئيس البلدية مزرعة الضهر	حسين عيد	10
				11
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Name	Company / Position	المؤسسة	الاسم
Elias Al-Haddad	Dar Al-Handasah Taleb	دار الهندسة طالب	الياس الحداد
Chahine Naim Eid	Vice Head of Municipality	نائب رئيس البلدية	شاهين نعيم عيد
Safi Eid			صافي عيد
Asaad Wadia Eid			اسعد وديع عيد
Fadi Eid			فادي عيد
Charbel Eid			شربل عيد
Chadi Eid			شادي عيد
Chadi Isam Eid			شادي عصام عيد
Hasib Eid	Head of Municipality – Mazraat Al-Daher	رئيس البلدية – مزرعة الضهر	حسيب عيد

Consultation seesion underway in Mazraat El Dahr Municipality

26 April 2014.

Summary of issues raised at Mazra'at El Dahr Session and Responses

Chahine Naim Eid **Vice Head of Municipality**	**Response**
Wonders whether there is enough time to invest in snail farming before the Expropriation Decree.	The Project Proponent formally adopts a project cut-off date after which persons settling in the project area or initiating improvements to property may not be considered eligible for compensation or other assistance. For Bisri, the cut-off date is 20 March 2014.
The Bisri dam project should not only supply Greater Beirut with water but also Bisri.	All surrounding villages in Chouf and Jezzine will benefit from improved infrastructure such as sanitation and from the economic opportunities provided by future development. Also, a Benefit Sharing Fund may be established to fund those projects in the surrounding villages.
A modern economic feasibility study undertaken for the construction of a farm on the land located within the scope of the project reveals an annual income of USD 4,500-5,000 for 1000 sqm of land, i.e. a minimum USD 45,000-50,000 in income per year for 10,000 sqm. We will begin construction within a month of the present date. Therefore, we find that the compensation schedule is unfair and should be reconsidered to set the prices based on the productive value of the land, which has always constituted the livelihood of the community of Mazraat Al-Dahr. I hereby propose that the project be reexamined to take into account the value of the agricultural land which, no matter how high the compensation and no matter its value, will remain, as the heritage of our ancestors, priceless, because it was the reason why they resisted in the face of adversity and was the source of their livelihood throughout their lives. We will today be economically and morally affected and no amount of money can compensate for the land that we love and which we have farmed and cultivated.	The rates given are only indicative for the purpose of estimating RAP budgets. It will be the responsibility of the Expropriation Commission to set the fair and appropriate values of land based on site inspection.
We support the irrigation project, but hope that it does not end up depriving our children of an indispensable and irreplaceable natural resource.	Compensation will be undertaken according to Lebanese Law and the provisions of World Bank Operating policy OP 4.12, both of which are described in the RAP, which when approved will be disclosed publically.

Asaad Nadia Eid	**Response**
Some people are wondering whether compensation will apply for Bisri citizens.	Those loosing land or other assets, or whose livelihood is affected by the project will be eligible for compensation as identified in the RAP. Compensation will be undertaken according to Lebanese Law and the provisions of World Bank Operating policy OP 4.12, both of which are described in the RAP, which when approved will be disclosed publically.
Suggest employing locals in operating the future dam.	Construction contractors are encouraged to prioritize the employment of those residing within the project area.
Hasib Eid **Head, Municipality–Mazraat Al-Daher**	**Response**
It is important to make sure the relocation of the church will involve Mazraat el Dahr citizens. People along with the municipality should have their say in moving the church.	The relocation of Mar Moussa Church has been discussed with the Diocese of Saida which in turn has discussed the issue with the municipality. The relocation was also discussed during public consultation in the Municipality, whereby the 4 proposed locations have been discussed and the best option recommended based on a multi-criteria analysis.
Asaad Wadia Eid	**Response**
I am currently conducting a study for an agricultural and farming project on the property that I own in Sabil Bisri, which will be implemented in June 2014. Is the date set in the study, 20 March 2014, a dividing point between the currently expected compensation and the amount I will incur in the future – which will amount to a considerable difference?	20 March 2014 is the cut-off date currently established by CDR after which persons settling in the project area or initiating improvements to property may not be considered eligible for compensation or other assistance. It is possible this date will change, but at the present time this cannot be confirmed.
What is the benefit to the town of Mazraat Al-Dahr in terms of irrigation, electricity or other such…?	While surrounding towns and villages will not receive water or electricity directly from the dam, they will benefit from improved infrastructure such as sanitation and from the economic opportunities provided by future development. Also, a Benefit Sharing Fund may be established to fund projects such as renewable energy and community facilities throughout surrounding villages.

PowerPoint Presentation


dar al-handasah
shair and partners
مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي
وخطّة إعادة الإسكان
Greater Beirut Water Supply Augmentation Project
Environmental and Social Impact Assessment (ESIA)
and Resettlement Action Plan (RAP)


مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي
Presenters
المقدّمون
سيقوم كلّ من السّيّدة روى درباس والسّيّد إيلي أبورجيلي بدور المقدّمين الرئيسيّين لهذه النّدوة.
كما حضر للاجابة عن أسئلتكم:
الدّكتور سهيل سرور - الذي سيقوم بدور رئيس الجلسة
الدّكتور جون دايفي - قائد فريق تقييم الأثر البيئي والاجتماعي
السّيّد عاصم فيداوي- مدير مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه لدى مجلس الإنماء والإعمار.


مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي
Objectives of this session
أهداف النّدوة
أهداف النّدوة اليوم هي:
عرض ملخّص عن المستجدّات الأخيرة للمشروع.
عرض ملخّص عن نتائج تقييم الأثر البيئي والإجتماعي للمشروع وفقاً للمرسوم رقم ٨٦٣٣ الصّادر من وزارة البيئة (آب ٢٠١٢)، وقانون البيئة رقم ٤٤٤.
عرض ملخّص عن العقارات الخاضعة للإستملاك وشرح عمليّة دفع التّعويضات للأشخاص المعنيّين.
الحصول على تعليقاتكم وآرائكم بشأن المشروع، وتسجيل إقتراحاتكم لأخذها بعين الإعتبار في المراحل النّهائيّة للدّراسة.


مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي
Outline
العناوين
نتائج تقييم الأثر البيئي والإجتماعي
الوضع الحالي لامدادات المياه
معالجة مشكلة شحّ المياه على المدى القصير والمتوسّط
معالجة مشكلة شحّ المياه على المدى البعيد
مراحل المشروع
موقع المشروع
سدّ بسري
الإستخدام الحالي للأراضي
إعتبارات خاصّة
المشاورات والدّراسات المتخصّصة
الآثار المتوقّعة والإجراءات للتّخفيف منها
تعميم فوائد المشروع
متطلّبات مراقبة الجودة البيئيّة
استشارات العامّة
خطّة إعادة الإسكان
المسح الإجتماعي الإقتصادي
مسح العقارات و المساحات المتأثرة
آلية التعويضات ومستحقيها
آلية الإستملاك وإعادة الإسكان
المراحل الزمنية
مؤشر التعويضات المادية
إنقاذ المواقع الأثرية


مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي
Present Water Supply Situation
الوضع الحالي لامدادات المياه
يعاني لبنان من نقص في كمية المياه المتوفرة سنوياً لتلبية احتياجات المواطنين.
قُدّر عدد سكان بيروت الكبرى وجبل لبنان في العام ٢٠١٠ بـ ١,٩مليون ومن المتوقع ان يصل العدد الى ٢,٣ مليون بحلول العام ٢٠٣٥.
حالياً يتلقى سكان بيروت الكبرى المياه من جعيتا عبر محطات المعالجة في ضبية، وآبار الدامور، وعدّة مصادر ثانوية.
ولكن الإمدادات غير كافية بحيث تتلقّى بعض الاسر المياه لأقلّ من ٣ ساعات يومياً خلال فصل الصّيف في منطقة بيروت الكبرى.
لذلك يلجأ العديد من الأسر الى مصادر بديلة:
(أ) الآبار الإرتوازية والتي أصبحت تستخدم بشكل مفرط وغالباً ما تكون غير قانونية وذات جودة متردّية
(ب) شراء المياه المنقولة بالصهاريج العائدة للقطاع الخاص، منها ما هو غير صالح للشرب
(ج) مياه الشرب المعبئة ذات الكلفة العالية ومنها ما لا تحظى بتراخيص من وزارة الصحة
٢٠٣٥ ٢٠٢٥ ٢٠١١
العجز المائي الواجب تغطيته (مليون م٣) 195 155 205
المصدر: موازنة مياه الشفة التي أعدتها وزارة الطاقة والمياه لمنطقة بيروت الكبرى للفترة الممتدة بين ٢٠١١ و٢٠٣٥.


مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي
Addressing Water Stress (long-term)
معالجة مشكلة شح المياه على المدى البعيد
لمعالجة مشكلة شح المياه على المدى البعيد، أوكل الى مجلس الانماء والاعمار وبالتعاون مع وزارة الطاقة والمياه ومؤسسة مياه بيروت وجبل لبنان، مشروع: "زيادة تغذية منطقة بيروت الكبرى بالمياه" GBWSAP.
أهداف المشروع هي:
توفير المياه على المدى البعيد لمنطقة بيروت الكبرى.
أن يكون الحلّ مقبولاً بيئياً وإجتماعياً، وممكناً تقنياً وذات جدوى إقتصادياً.


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مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي
Phases of the project
مراحل المشروع
تنقسم مهام المشروع الى المراحل التّالية:
جلسات استشاريّة لتحديد نطاق المشروع (٢٠١٢)
مراجعة تقنيّة، بيئيّة، اجتماعيّة، واقتصاديّة للبدائل
دراسة تحليليّة للبدائل
تحديد الخيار الأوّلوي للمشروع
القيام بمسح إجتماعي
مسودّة تقييم الأثر البيئي والإجتماعي للموقع من ضمنها خطّة إدارة بيئيّة ومسودّة خطّة إعادة الإسكان
جلسات استشاريّة لمناقشة نتائج تقييم الأثر البيئي والإجتماعي مع العامّة (٢٠١٣)
تقييم الأثر البيئي والإجتماعي النّهائي
وخطّة إعادة الإسكان
7


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مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي
Project Area (1)
موقع المشروع (١)
8


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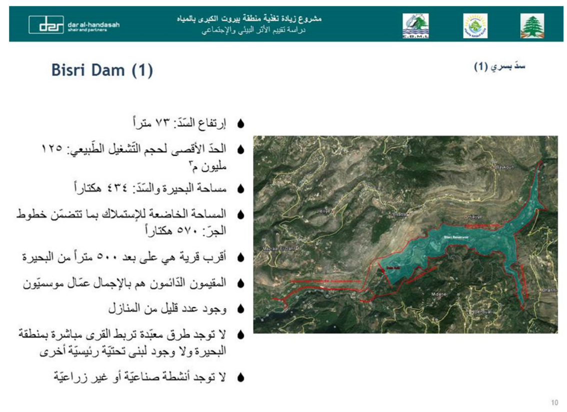
مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي
Project Area (2)
موقع المشروع (٢)
موقع السّدّ المقترح
مجرى النّهر
بإتّجاه المصبّ
9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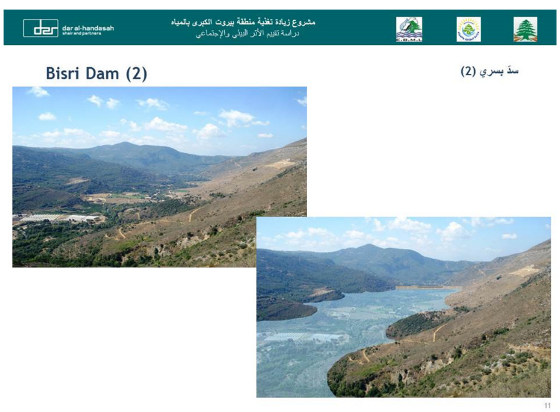
مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي
Bisri Dam (1)
سدّ بسري (1)
إرتفاع السّدّ: ٧٣ متراً
الحدّ الأقصى لحجم التّشغيل الطّبيعي: ١٢٥ مليون م٣
مساحة البحيرة والسّدّ: ٤٣٤ هكتاراً
المساحة الخاضعة للإستملاك بما تتضمّن خطوط الجرّ: ٥٧٠ هكتاراً
أقرب قرية هي على بعد ٥٠٠ متراً من البحيرة
المقيمون الدّائمون هم بالإجمال عمّال موسميّون
وجود عدد قليل من المنازل
لا توجد طرق معبّدة تربط القرى مباشرة بمنطقة البحيرة ولا وجود لبنى تحتيّة رئيسيّة أخرى
لا توجد أنشطة صناعيّة أو غير زراعيّة
10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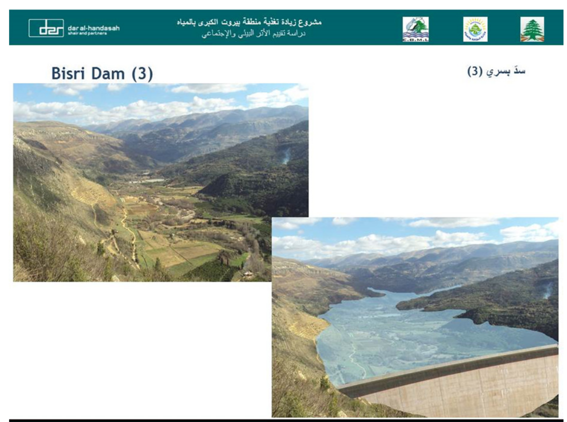
مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي
Bisri Dam (2)
سدّ بسري (2)
11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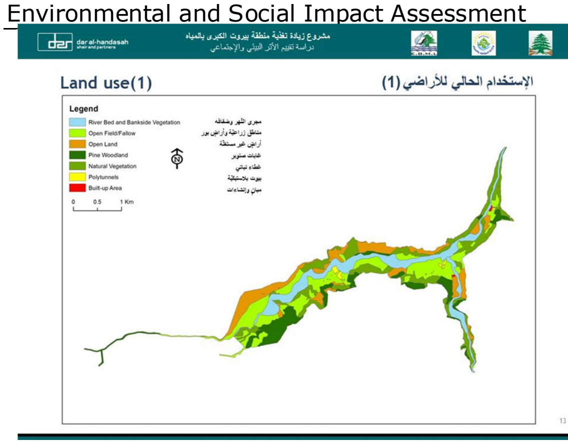
مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي
Bisri Dam (3)
سدّ بسري (3)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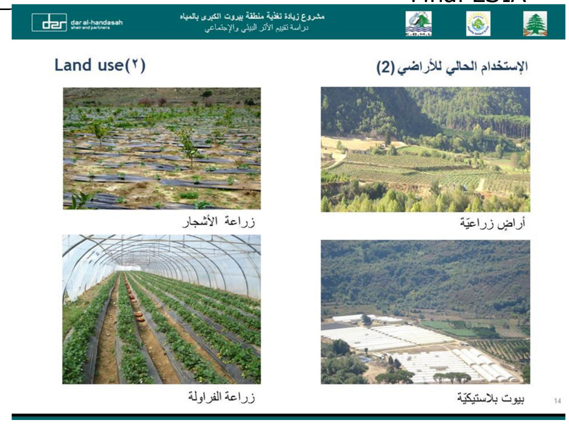
مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي
Land use(1)
الإستخدام الحالي للأراضي (1)
Legend
River Bed and Bankside Vegetation
Open Field/Fallow
Open Land
Pine Woodland
Natural Vegetation
Polytunnels
Built-up Area
مجرى النّهر وضفافه
مناطق زراعية وأراضٍ بور
أراضٍ غير مستغلّة
غابات صنوبر
غطاء نباتي
بيوت بلاستيكيّة
مبانٍ وإنشاءات
0 0.5 1 Km
N
13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مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي
Land use(٢)
الإستخدام الحالي للأراضي (2)
زراعة الأشجار
أراضٍ زراعيّة
زراعة الفراولة
بيوت بلاستيكيّة
14


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مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي
Land use(٣)
الإستخدام الحالي للأراضي (٣)
15


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مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي
Special Considerations
اعتبارات خاصّة
ان أيّ دراسة هندسيّة للسدود، عليها الأخذ بعين الإعتبار المعطيات الأساسيّة لأرض الموقع والتي تتلخّص بالتالي:
❑ الهزّات والزّلازل: وقد أخذت بعين الإعتبار في التّصاميم الهندسيّة
❑ جودة المياه السّطحيّة
❑ تدفّقات المياه في مجرى النّهر أسفل السدّ
❑ الإرث التّاريخي والثّقافي
❑ التّنوّع النّباتي والحيواني
❑ تحضير الأراضي
❑ النّموّ المستحثّ جرّاء بناء السّدّ
16


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مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي
Special Considerations
Water Quality
إعتبارات خاصّة
جودة المياه السّطحيّة
تمّ أخذ عينات على طول نهر بسري وبحيرة جون وأماكن مختلفة على مدار أكثر من ١٨ شهراً.
وقد تمّت دراسة نتائج هذه العيّنات المكثّفة من قبل جهة مستقلّة من قبل خبراء دوليّين.
أكّد الخبراء من إمكانيّة معالجة المياه وفقاً للمعايير اللّبنانية والدّوليّة لمياه الشّرب في محطّة الوردانيّة لمعالجة المياه .
وتشمل هذه المحطّة التّقنيّات التّقليديّة اللّازمة لمعالجة المياه.
وتشمل خطّة الإدارة البيئيّة والاجتماعيّة رصد دوري لنوعيّة المياه في البحيرة.
على أن يقوم مجلس الإنماء والإعمار بإعداد مخطّط توجيهي يعنى بإدارة المياه المبتذلة للقرى الواقعة في الحوض الأعلى.
17


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مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي
Special Considerations
Downstream Abstractions
إعتبارات خاصّة
تدفّقات المياه اسفل السدّ
سوف تؤمّن تدفّقات المياه من البحيرة الى منطقة أسفل السدّ التّالي:
توفير المياه اللّازمة للاستخدامات المطلوبة أسفل السدّ (كالرّيّ بالدّرجة الأولى، بالإضافة الى إستعمالات اخرى).
الحفاظ على التّنوع البيولوجي والموائل الطّبيعيّة. وقد تمّ تصميم السّدّ للسّماح لمتطلّبات التّدفّق البيئي وفقاً للممارسات الفضلى للمعايير الدوليّة.
وقد تمّ إدراج هذه التّدفقات البيئيّة في إجراءات تشغيل السدّ.
18

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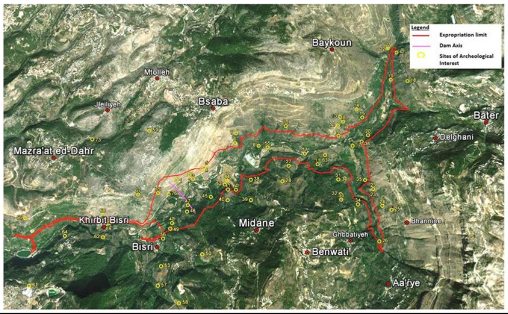
مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي

Special Considerations
Historical & Cultural Heritage(1)

إعتبارات خاصّة
الإرث التّاريخي والثّقافي (1)



19

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مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي

Special Considerations
Historical & Cultural Heritage(2)

إعتبارات خاصّة
الإرث التّاريخي والثّقافي (2)


جسر حجري أثري


أعمدة رومانيّة


دير القديسة صوفيا


كنيسة مار موسى

20

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مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي

Special Considerations
Ecological Diversity

إعتبارات خاصّة
التّنوّع النّباتي والحيواني


أشجار حمضيّات


زهرة السّحلبيّة


ثعبان المياه


شبّوط الشرق الأوسط الأخضر (Carp)


أشجار حرجيّة


سالاريا المياه العذبة (Blenny)


النّسر القصير المخالب

21

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مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي

ESIA and RAP Specialist Surveys

دراسات الأخصّائيين

تمّ القيام بعدد من المشاورات والدّراسات مع الأخصّائيّين خلال تحضير تقييم الأثر البيئي والاجتماعي وخطّة إعادة الإسكان:

- **مسح ميداني عام**
- **مسح ميداني يعنى بالموارد المادّيّة والثّقافيّة** ← لقد تمّت عمليات تفتيش في الموقع وعُقدت إستشارات مع المديريّة العامّة للآثار.
- **مسح إيكولوجي تمهيدي ومفصّل**
- **مسح إجتماعي أوّل ونهائي**
- **إستشارات مع أبرشيّة صيدا فيما يختصّ بكنيسة مار موسى**

22

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مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي

Potential Impacts & Mitigation Measures (1)

الآثار المحتملة وإجراءات التّخفيف منها (١)

أهمّ الآثار المحتملة النّاتجة عن المشروع والإجراءات المقترحة للتّخفيف منها هي التّالية:

المسألة	الأثر المحتمل	الإجراءات المقترحة للتّخفيف من الآثار
إستملاك العقارات	الأرض لبناء السدّ والبحيرة وطرق الوصول	التّعويض عن استملاك الأراضي تبعاً للقوانين اللّبنانية وخطّة إعادة الإسكان
	الأراضي المنتجة	
	الإرث التّاريخي والثّقافي	نقل الآثار وحفظها في مواقع أخرى
التّرسّبات	خسارة في السّعة التّخزينية	مراقبة ارتفاع الترسّبات والحفاظ على صيانة سليمة للبحيرة
تجميع المياه	خطر الزّلازل	تمّ تصميم السدّ وفقاً للمعايير المطلوبة لمواجهة خطر الزّلازل. كما وقد تمّ التّدقيق بالتّصاميم الهندسيّة من قبل خبراء عالميّين واللّجنة الّتي تعنى بسلامة السد.
	تردّي جودة المياه	تأمين محطّة لمعالجة المياه الوافدة إلى منطقة بيروت الكبرى

23

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مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي

Potential Impacts & Mitigation Measures (٢)

الآثار وإجراءات التّخفيف منها (٢)

المسألة	الأثر المحتمل	إجراءات تخفيف الأثار
الزّراعة	خسارة التّربة الخصبة	نقل التّربة الخصبة من موقع المشروع إلى أراضٍ مجاورة أقلّ خصوبة
	أعمال الريّ في أسفل السدّ	لقد تمّ تصميم السّدّ لتأمين إحتياجات المزارعين من مياه الرّيّ بالإضافة إلى كافّة الاستخدامات أسفل السدّ
التّنوّع الحيويّ والموائل الطّبيعيّة	تضاؤل الموائل المائيّة	تأمين المدرّجات للأسماك وغيرها من الممرّات وحماية أماكن وضع البيض.

24

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مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي

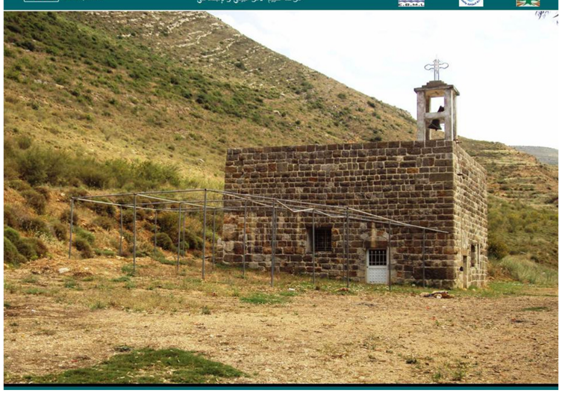
Potential Impacts & Mitigation Measures (٣)

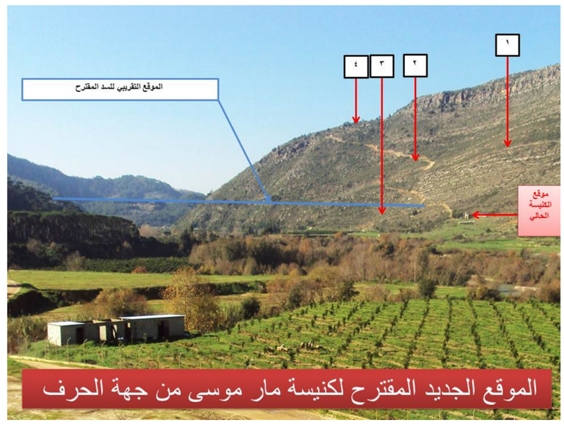
الآثار وإجراءات التّخفيف منها (٣)

المسألة	الأثر المحتمل	إجراءات تخفيف الآثار
إدارة الحوض المائي العلوي	تلوّث البحيرة والبناء العشوائيّ جرّاء النمو المستحثّ	التنسيق مع وزارة البيئة والأطراف المعنية لوضع مخطّط توجيهي لضفاف البحيرة والمناطق المحاذية لها لتشمل
	نشاطات ترفيهيّة وسياحيّة	إرشادات تتعلق بعمليّات البناء والنّشاطات المسموحة حول البحيرة
	تردّي جودة المياه بسبب تدفّقات الصّرف الصّحّي المنزلي، الصّناعي، والزّراعي في البحيرة	وضع شبكات ومحطّات لمعالجة الصّرف الصّحّي في القرى المجاورة خطّة مراقبة نوعيّة المياه إرشاد للمزارعين

25

منظر على مرج بسري وكنيسة مار موسى من مزرعة الضهر





الموقع الجديد المقترح لكنيسة مار موسى

عناصر المقاربة	المواقع المقترحة موقع رقم ١	موقع رقم ٢	موقع رقم ٣	موقع رقم ٤
قوّة الإنحدار	١	٢	٣	٤
إطلالة خلّابة	٣	٢	١	٤
سهولة الوصول	١	٢	٣	٤
سهولة إعداد موقع البناء	١	٢	٤	٢
حاجة موقع البناء لحيطان دعم	١	٣	٢	٤
قرب الموقع من بلدة مزرعة الضّهر	٢	٣	١	٤
الحاجة إلى إستملاكات إضافيّة	٤	٤	٤	١
توافر المساحة الكافية لإنشاء منطقة خدمات محيطة	١	٣	٢	٤
سلامة الموقع ضد أي إنهيار بنيوي للسد	٤	٣	١	٣
سهولة و تكاليف عملية إعادة البناء	١	٢	٤	٣
المجموع	١٩	٢٦	25	٣٣

مقياس من ١ (الأضعف) إلى ٤ (الأقوى)

Benefit Sharing

تقاسم فوائد المشروع

- من أجل تحقيق تنمية منصفة لجميع الأشخاص المعنيّين بالمشروع، يدرس المشروع إمكانية إنشاء صندوق للمجتمع المحلّي في محيط السّدّ والبحيرة لنشر فوائد المشروع خارج حدود مجموعة مستهلكي إمدادات المياه في بيروت الكبرى.
- وقد تشمل المشاريع المتوقع تمويلها ما يلي:
- وضع خطط لإعادة التّشجير
- وضع مخطّطات كهرمائيّة محلّيّة
- قاعات إجتماعات
- تشجيع الفنون والحرف التّقليديّة
- تفعيل السّياحة البيئيّة والمرافق التّعليميّة
- تخصيص أماكن لمحبّي هواية صيد الأسماك في محيط البحيرة
- وضع مخطّطات لطاقتيّ الرّياح والشّمس
- تشجيع مخططات الرّيّ في الأماكن العامّة
- إنّ الآليّة التي سيتمّ إقتراحها تعتمد إلى حدٍّ كبير على ما **أنتم** - كمستفيدين - تريدون أن تحقّقوا من هذا الصّندوق.
- إذا كان لديكم أيّة أفكار تعنى بالإطار المؤسّساتي أو نوع المشاريع المقترح تمويلها، يرجى رفعها في وقت لاحق أو الاتّصال بنا لمناقشتها بشكل مفصّل

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دراسة تقييم الأثر البيئي والإجتماعي

Environmental Quality Monitoring Requirements — متطلّبات مراقبة الجودة البيئيّة

قبل البناء

تطبيق إستراتيجيّة التّنفيذ والتّأكّد من:

- **جودة المياه السطحيّة**
- **نسبة الترسّب**
- **إنقاذ الأجناس البيولوجيّة والحيويّة ونقلها**
- **الحفاظ على الآثار ونقلها من مكانها**
- **إستملاك العقارات وفقاً للقوانين اللبنانيّة وخطّة إعادة الإسكان**

أثناء البناء

مراقبة بيئيّة أثناء مرحلة البناء للحرص على تخفيف التّلوّث والضّجيج، والتقيّد بتوجيهات البناء السّليمة، وخطّة الإدارة البيئيّة.

بعد البناء

مراقبة بيئيّة بعد مرحلة البناء للتّأكد من الإلتزام بخطّة الإدارة البيئيّة والتّشغيليّة، والتّركيز على سلامة السدّ، جودة المياه، والتدفّق البيئي أسفل السدّ.

31

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دراسة تقييم الأثر البيئي والإجتماعي

Public Consultation — استشارات العامّة

١ - **تمّ عقد إستشارات للعامّة** من قِبل استشاري دراسة تقييم الأثر البيئي والإجتماعي وخطّة إعادة الإسكان على النّحو التّالي:

- ستّ ندوات لعرض نطاق الدّراسة في آذار ٢٠١٢
- ستّ ندوات لعرض نتائج الدّراسة في شباط ٢٠١٣

٢ -يأتي **برنامج الإستشارات العامّة الحالي** من قِبل استشاري دراسة تقييم الأثر البيئي والإجتماعي وخطّة إعادة الإسكان على النّحو التّالي:

الزمان	المكان	الحضور المقترح
الجمعة ٢٥ نيسان العاشرة صباحاً	دار عمّاطور	الأشخاص المتأثّرين بالمشروع
الجمعة ٢٥ نيسان الثانية من بعد الظهر	بلديّة مزرعة الشّوف	الأشخاص المتأثّرين بالمشروع
السبت ٢٦ نيسان العاشرة صباحاً	قاعة الكنيسة في بسري	الأشخاص المتأثّرين بالمشروع
السبت ٢٦ نيسان الثالثة من بعد الظهر	بلديّة مزرعة الضّهر	الأشخاص المتأثّرين بالمشروع

٣ - **بعد تسليم التّقرير النّهائي وخطّة إعادة الإسكان**، سيتّم إنشاء **مركز معلومات للمشروع** حيث سيتمكّن الأشخاص المتأثّرين بالمشروع من:

- الإستفسار عن إجراءات الإستملاك
- الإطّلاع على المستندات والخرائط

32

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دراسة تقييم الأثر البيئي والإجتماعي

خطة إعادة الإسكان

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دراسة تقييم الأثر البيئي والإجتماعي

المسح الإجتماعي الإقتصادي ٢٠١٣ - ٢٠١٤

مع مشارفة التصميم الهندسي لسد بسري مع منشآته الملحقة على الإنتهاء فإن الإستشاري الهندسي للمشروع قد أتمّ إعداد ملف الإستملاكات الذي سوف يشكل القاعدة الأساس لمرسوم الإستملاك العتيد.

بناءً عليه فإن إستشاري دراسة التقييم البيئي وخطة إعادة الإسكان قد أتم القسم الأول من المسح الإجتماعي-الإقتصادي لمنطقة المشروع وهو في طور إكمال القسم الثاني منه وذلك بغية:

☑ **تحديث البيانات والمعطيات الإجتماعية للدراسة التي تشتمل على خطة إعادة الإسكان وآلية للتعويضات**

☑ **التأكد من أن المسح الجديد سوف يغطي كل العقارات التي سوف يشتمل عليها مرسوم الإستملاك**

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دراسة تقييم الأثر البيئي والإجتماعي

dar al-handasah — مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي

عدد العقارات والمساحات المتأثرة بحسب القضاء

القضاء	المنطقة العقارية	مجموع العقارات الخاضعة للإستملاك	عدد العقارات المطلوب إستملاكها بالكامل	عدد العقارات الخاضعة للإستملاك الجزئي	المساحة المطلوب إستملاكها بالهكتار	نسبة الأراضي الخاضعة للإستملاك
الشوف	عماطور / حارة جندل	310	279	31	160	31%
	مزرعة الشوف	277	225	52	120	23%
	مزرعة الضهر	55	36	19	42	8%
	خربة بسري	13	4	9	18	3%
	باتر	14	6	8	8.8	2%
	بسابا	9	5	4	6.8	1.3%
	دير المخلص	3	0	3	2	0.4%
المجموع الفرعي لقضاء الشوف		681	555	126	358	69%
جزين	الميدان	80	70	10	48	9%
	الحرف	69	64	5	46	9%
	بسري	74	62	12	44	9%
	بحنين	28	15	13	10	2%
	الغباطية	4	1	3	6	1.2%
	بنواتي	27	19	8	4	0.8%
	عاراي	1	0	1	0.95	0.2%
	بكاسين	2	0	2	0.3	0.1%
المجموع الفرعي لقضاء جزين		285	231	54	159	31%
مجموع الإستملاكات ضمن منطقة المشروع		966	786	180	517	100%
الأملاك العامة من طرقات وحرم النهر					53	
المجموع العام					570	


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مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي
الإستملاكات وإعادة الإسكان
إن إستملاك الأراضي والحيازات سوف يتمّ بحسب:
✓ قانون الإستملاك اللبناني الصادر عام ١٩٩١؛
✓ سياسة العمليات وإجراءات البنك الدولي (رقم OP4.12) بخصوص إعادة الإسكان القسري.
بالرغم من أوجه التشابه العديدة ما بين المرجعيتين، إلا أن السياستين تلحظان تبايناً في خمسة جوانب والتي سوف يقوم مشروع سد بسري بسد الفجوات فيما بينها كالتالي:
37


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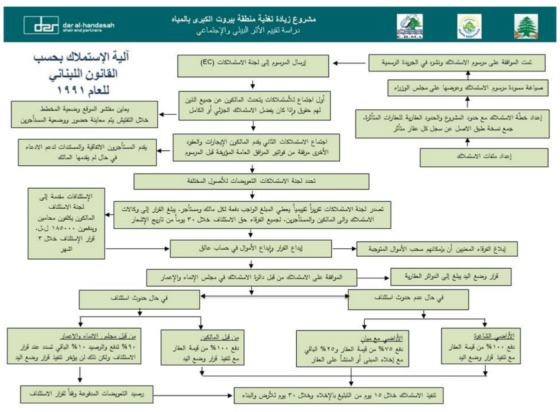
مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي
الإستملاكات وإعادة الإسكان
نقاط التباين
إجراءات التخفيف المقترحة لسد فجوات التباين
إستشارات الهيئات الفاعلة للمشروع
• إستشارات عامة قد عُقدت في البلدات المتأثرة حول منطقة المشروع وفي العاصمة بيروت؛
• سوف ينشأ القيِمين على المشروع مركز معلومات خاص بالمشروع.
التواصل مع الأشخاص المتأثرين بالمشروع
• إستشارات عامة قد عقدت لإستطلاع رأي الأشخاص المتأثرين بالمشروع.
• أعلن المشروع عن خط هاتفي للتواصل مع العامة فيما خص جلسات الإستشارات عامة التي تُعقد (03-867799) بالإضافة الى رقم فاكس (01 - 869026) وبريد إلكتروني: BSWA.12002@dargroup.com - www.cdr.gov.lb .
نطاق التعويضات
• كل العقارات سوف تعوض بحسب كلفة الإستبدال كاملة؛
• إن التعويضات سوف تدفع كاملة لمستحقيها وذلك قبل تنفيذ قرار وضع اليد على أي عقار أو أصول.
إستئناف قضايا الإجحاف
• بغية تمكين الأشخاص المتأثرين بالمشروع، ذو أصحاب الدخل المحدود، من إستئناف اي قرار إستملاك يرونه مجحفاً، سوف يقوم المشروع بتغطية التكاليف القانونية لطلبات إستئنافهم.
تعويضات للمتضررين غير المتمتعين بالحقوق القانونية
• سوف يتم تعويض هذه الفئة من الأشخاص بحسب التكاليف التي تكبدوها لتحسين ظروف المسكن/الحيازة/ إنتاجية الأرض الزراعية وألخ.
38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مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي
آلية الإستملاك بحسب القانون اللبناني للعام ١٩٩١
إعداد ملفات الاستملاك
إعداد خطّة الاستملاك مع حدود المشروع والحدود العقارية للعقارات المتأثرة. جمع نسخة طبق الاصل عن سجل كل عقار متأثر
صياغة مسودة مرسوم الاستملاك وعرضها على مجلس الوزراء
تمت الموافقة على مرسوم الاستملاك ونشره في الجريدة الرسمية
إرسال المرسوم إلى لجنة الاستملاكات (EC)
أول اجتماع للأستملاكات يتحدث المالكون عن جميع الذين لهم حقوق وإذا كان يفضل الاستملاك الجزئي أو الكامل
يعاين مفتشو الموقع وضعية المخطط خلال التفتيش يتم معاينة حضور ووضعية المستأجرين
اجتماع الاستملاكات الثاني يقدم المالكون الإيجارات والعقود الأخرى مرفقة من فواتير المرافق العامة المؤرخة قبل المرسوم
يقدم المستأجرون الاتفاقية والمستندات لدعم الادعاء في حال لم يقدمها المالك
تحدد لجنة الاستملاكات التعويضات للأصول المختلفة
تصدر لجنة الاستملاكات تقريراً تقييمياً يعطي المبلغ الواجب دفعة لكل مالك ومستأجر. يبلغ القرار إلى وكالات الاستملاك والى المالكين والمستأجرين. لجميع الفرقاء حق الاستئناف خلال ٣٠ يوماً من تاريخ الإشعار
الإستئنافات مقدمة إلى لجنة الاستئناف المالكون يكلفون محامين ويدفعون ١٨٥٠٠٠ ل.ل. قرار الإستئناف خلال ٣ اشهر
إيداع القرار وإيداع الأموال في حساب عالق
إبلاغ الفرقاء المعنيين أن بإمكانهم سحب الأموال المتوجبة
الموافقة على الاستملاك من قبل دائرة الاستملاك في مجلس الإنماء والإعمار
قرار وضع اليد يبلغ إلى الدوائر العقارية
في حال حدوث استئناف
في حال عدم حدوث استئناف
من قبل مجلس الانماء والاعمار
٩٠% تدفع والرصيد ١٠% الباقي تسدد عند قرار الاستئناف ولكن ذلك لن يؤخر تنفيذ قرار وضع اليد
من قبل المالكين
دفع ١٠٠% من قيمة العقار مع تنفيذ قرار وضع اليد
الأراضي مع مبان
دفع ٧٥% من قيمة العقار و٢٥% الباقي مع إخلاء المبنى أو المنشأ على العقار
الأراضي الشاغرة
دفع ١٠٠% من قيمة العقار مع تنفيذ قرار وضع اليد
رصيد التعويضات المدفوعة وفقاً لقرار الاستئناف
تنفيذ الاستملاك خلال ١٥ يوم من التبليغ بالإخلاء وخلال ٣٠ يوم للأرض والبناء


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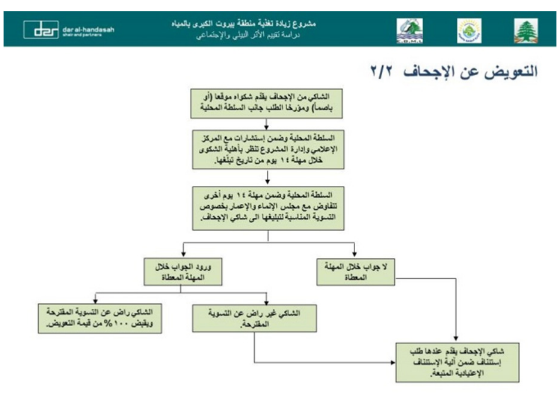
مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي
التعويض عن الإجحاف ١/٢
✓ إن آلية التعويض عن الإجحاف هي من متطلبات سياسة العمليات وإجراءات البنك الدولي بخصوص إعادة الإسكان القسري وتعتبر إجراء إضافي لما يتضمنه القانون اللبناني.
✓ شكاوى الإجحاف ترفع الى السلطات المحلية التي تقيِم أهليتها.
✓ يمكن للشاكي أن يُساءل قيمة التعويض ولكن ليس عملية الإستملاك ووضع اليد.
✓ إن هذه الآلية تجنب المتضرر اعباء وتكاليف التنقل لمسافات بعيدة وتعقيدات تقديم طلبات الاستئناف لدى المراجع المختصة.
آلية الشكوى: شكاوى التعويض عن الإجحاف تسلم باليد الى السلطات المحلية كالتالي:
1) أشخاص ذوو حق شرعي: يمكن تقديم شكواهم بعد إبلاغهم بقرار لجنة الإستملاكات بقيمة التعويض وقبل تقديم طلب إستئنافهم أمام المراجع المختصّة إذا ما شاؤا ذلك؛
2) أشخاص من غير حق شرعي: يمكنهم رفع شكواهم في أي وقت بعد صدور مرسوم الإستملاكات.
وفي كلتا الحالتين يستطيع الأشخاص الغير قادرين على رفع شكواهم خطيا الإستعانة بالبلدية أو بفريق العمل ضمن مركز معلومات المشروع.
40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مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي
التعويض عن الإجحاف ٢/٢
الشاكي من الإجحاف يقدم شكواه موقعاً (أو باصماً) ويؤرخها الطلب جانب السلطة المحلية
السلطة المحلية وضمن إستشارات مع المركز الإعلامي وإدارة المشروع تنظر بأهلية الشكوى خلال مهلة ١٤ يوم من تاريخ تبلغها.
السلطة المحلية وضمن مهلة ١٤ يوم أخرى تتفاوض مع مجلس الإنماء والإعمار بخصوص التسوية المناسبة لتبلغها الى شاكي الإجحاف.
ورود الجواب خلال المهلة المعطاة
لا جواب خلال المهلة المعطاة
الشاكي راض عن التسوية المقترحة ويقبض ١٠٠% من قيمة التعويض.
الشاكي غير راض عن التسوية المقترحة
شاكي الإجحاف يقدم عندها طلب إستئناف ضمن آلية الإستئناف الإعتيادية المتبعة.


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مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي
المراحل الزمنية
المرحلة
الفترة المخصصة لها
الإبلاغ والإعلان
جاري التنفيذ
التخمينات
بحسب اتساع نطاق الاستملاك
تسجيل طلبات الاستئناف
٣٠ يوماً اعتباراً من تاريخ تبليغ تخمين لجنة الاستملاك
دفع التعويضات
قبل تنفيذ قرار وضع اليد والإخلاءات.
وضع اليد والإخلاءات
بعد ١٥ يوماً من تاريخ تبليغ قرار الإخلاء إذا كان العقار خالياً،
بعد ٣٠ يوماً من تاريخ تبليغ قرار الإخلاء إذا كان العقار يحوي على منشآت،
وفي الحالتين، يعتمد الأمر على تسديد كامل مبلغ التعويض
الرصد والتقييم
من نشر مرسوم قرار الإستملاك لغاية تنفيذ قرار وضع اليد.
إن كافة التقارير المرتبطة بدراسة تقييم الأثر البيئي والإجتماعي وخطة إعادة الإسكان سوف تتوافر عبر التالي:
❑ الموقع الإلكتروني لمجلس الإنماء و الإعمار ومركز المعلومات التابع للمشروع سيعلن عنه لاحقاً؛
❑ في الوزارات المختصة وكذلك في بلديات القرى المحيطة بموقع المشروع.
سوف يتم الإعلان عن أماكن نشر التقارير أعلاه في وسائل الإعلام في الأوقات المحددة لها.
42

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مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي

آلية التعويضات ١/٣

معايير الأهلية

تم وضع معايير الأهلية للتعويضات المفترضة تحمي كل من الحكومة اللبنانية والأشخاص المتضررين من المشروع.
عماد هذه المعايير هو تحديد تاريخ لتوقف الأهلية للتعويضات لمنع الإنتقال الانتهازي الى منطقة المشروع

بناءً عليه حدد مجلس الانماء والاعمار رسمياً تاريخ ال

٢٠ من آذار ٢٠١٤

كحد زمني لتوقف الاهلية للتعويضات والمساعدات الأخرى للأشخاص القادمين حديثاً الى منطقة المشروع أو الذين يقومون بإدخال تحسينات ضمن حيازاتهم الموجودة أصلاً، بعد هذا التاريخ.

dar al-handasah shair and partners
مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي

آلية التعويضات ٢/٣

	الأشخاص المؤهلين	عدد الافراد	التعويض عن:	التعويضات المستحقة
اللبنانيين	المالكين المقيمين	17	الأرض الحيازة المنشأة الأشجار والمحاصيل أصول أخرى سبل كسب العيش	سوف يتم تعويض الأشخاص المتضررين، بتكلفة الإستبدال وبحسب تخمينات لجنة الإستملاكات، عن: • فقدانهم للأرض ؛ • خسارة المدخول والارباح؛ • تكاليفهم لتحسين أوضاع الحيازة وانتاجية الارض؛ • تكاليف اعادة التأهيل والاسكان في ظروف مشابهة لما قبل انتقالهم؛ • بدلات لتأهيل اي أرض زراعية في نفس الظروف الإنتاجية التي كانوا يشغلون قبل المشروع؛ • بدلات إنتقال كافية لنقل كافة المعدات، التجهيزات، التركيبات وألخ الى المكان الجديد.
اللبنانيين	المالكين غير المقيمين	855 ملكية	الارض الحيازة المنشأة	سوف يتم تعويض الأشخاص المتضررين، بتكلفة الإستبدال وبحسب تخمينات لجنة الإستملاكات، عن: • خسارة الارض • أو أي خسارة لأية حيازة بنتيجة خسارة الارض.
اللبنانيين	المقيمين من غير المالكين	47	المنزل المنشأة الأشجار المحاصيل أصول أخرى سبل كسب العيش	سوف يتم تعويض الأشخاص المتضررين، بتكلفة الإستبدال وبحسب تخمينات لجنة الإستملاكات، عن: • هؤلاء المقيمين بموجب عقد ايجار، لما بعد العام 1991، ما قيمته 3 أشهر ايجار مع إشعار المالك بإرجاع أية مبالغ مدفوعة مسبقاً من قبل المستأجر؛ • هؤلاء المقيمين من دون أي حق قانوني سوف يتم التعويض عنهم بقيمة التحسينات التي أدخلوها الى الحيازة أو الارض وذلك بحسب تخمينات لجنة الاستملاكات على اساس كل حالة على حدا؛ • تكاليف اعادة التأهيل والاسكان في ظروف مشابهة لما قبل انتقالهم؛ • بدلات لتأهيل اي أرض زراعية في نفس الظروف الإنتاجية التي كانوا يشغلون قبل المشروع؛ • بدلات إنتقال كافية لنقل كافة المعدات، التجهيزات، التركيبات وألخ الى المكان الجديد.

dar al-handasah shair and partners
مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي

آلية التعويضات ٣/٣

		الأشخاص المؤهلين	عدد الافراد	التعويض عن:	التعويضات المستحقة
من غير اللبنانيين	العمال المقيمين	من غير اللاجئين	36	العمل بدوام كامل أو بدوام جزئي المأوى	سوف يتم تعويض الأشخاص المتضررين من جراء خسارة عملهم كالتالي: • قيمة 10$ باليوم لمجموع 156 يوم للعمال بدوام كامل؛ • قيمة ثلاث اشهر لآخر أجر يستوفيه العامل بدوام جزئي؛ سوف يتم تعويض الأشخاص عن فقدان مأواهم كالتالي: • هؤلاء المقيمين بموجب عقد ايجار، لما بعد العام 1991، ما قيمته 3 أشهر ايجار مع إشعار المالك بإرجاع أية مبالغ مدفوعة مسبقاً من قبل المستأجر؛ • هؤلاء المقيمين من دون أي حق قانوني سوف يتم التعويض عنهم بقيمة التحسينات التي أدخلوها الى الحيازة أو الارض وذلك بحسب تخمينات لجنة الاستملاكات على اساس كل حالة على حدا.
من غير اللبنانيين	العمال المقيمين	اللاجئين	28	المأوى	سوف يقوم المشروع بتسهيل اتصال أولئك اللاجئين باللجنة العليا للاجئين التابعة للأمم المتحدة (UNHCR)
من غير اللبنانيين	المقيمين من غير العمال	من غير اللاجئين	36	المأوى	سوف يتم تعويض الأشخاص المتضررين من جراء خسارة المأوى كالتالي: • هؤلاء المقيمين بموجب عقد ايجار، ما بعد العام 1991، ما قيمة 3 أشهر ايجار مع اشعار المالك بإرجاع اية مبالغ مدفوعة مسبقاً من قبل المستأجر؛ • هؤلاء المقيمين من دون أي حق قانوني سوف يتم التعويض عنهم بقيمة التحسينات التي ادخلوها على المسكن الذي يشغلون وذلك بحسب تخمينات لجنة الاستملاكات على اساس كل حالة على حدا.
من غير اللبنانيين	المقيمين من غير العمال	اللاجئين	74		سوف يقوم المشروع بتسهيل اتصال أولئك اللاجئين باللجنة العليا للاجئين التابعة للأمم المتحدة (UNHCR)
		المجموع العام *	238		

dar al-handasah shair and partners
مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي

مؤشر التعويضات للأراضي والحيازات العُرضة للإستملاك

- إن مؤشرات التعويضات الواردة لاحقاً تساوي **كلفة الإستبدال** للأراضي و للأصول المصابة ولا تتعدى في الوقت الحاضر كونها قيمة توجيهية فقط
- إن هذه المؤشرات غير ملزمة لأي من الافرقاء لاحقاً نظراً الى أن قيمة التعويضات النهائية سوف تصدر عن **لجنة الاستملاكات** في مراحل لاحقة من المشروع.
- يحق لأي من الأفرقاء الإعتراض على التخمين المعطى للعقار أو الأصول وذلك بتقديم طلب إستئناف جانب **لجنة الإستئناف**.
- إن **لجنتي الإستملاك والإستئناف** هما هيئتان تتمتعان بإستقلالية تامة وغير مرتبطتان بمجلس الإنماء والإعمار

dar al-handasah shair and partners
مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي

مؤشر التعويضات للأراضي والحيازات العُرضة للإستملاك ١/٣

الأراضي	ل.ل/م2
أرض زراعية ، محاذية للنهر	50,000
غابة صنوبر طبيعية	50,000
أرض زراعية على بعد يقل عن 100 م من النهر	40,000
أرض زراعية على بعد أكثر من 100م من النهر	40,000
أرض مهجورة	40,000
أرض مكشوفة منبسطة مع غطاء نباتي جيد	40,000
غابات طبيعية أخرى	40,000
أرض مسطحة مع غطاء نباتي طبيعي	40,000
أرض مكشوفة مع منحدرات مع غطاء نباتي ضعيف	30,000
أرض منحدرة مع غطاء نباتي طبيعي	30,000
أرض مكشوفة مع صخور على السطح	20,000
المنشآت	**ل.ل/م2**
بناء مشيد حديثاً	500,000
منزل من أحجار الخفان	100,000
منزل قديم مرمم	100,000
غرفة تخزين من الباطون	50,000
بناء قديم مهمل	50,000
بناء قديم	50,000
غرف عمال	50,000
مأوى من الخشب والبلاستيك	25,000
حظيرة للحيوانات، جدران من الباطون وأرضية	15,000
خيمة من القماش	10,000

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مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي

مؤشر التعويضات للأراضي والحيازات العُرضة للإستملاك ٢/٣

الزراعات الحقلية		ل.ل/م2
ورد		50,000
أنواع ورد أخرى		50,000
فريز		20,000
بندورة		20,000
خس		20,000
ملفوف		20,000
عرايش عنب		10,000
فليفلة حلوة		10,000
حبق		10,000
حبوب		5,000
أصول مختلفة مرتبطة بالأرض	**الوحدة**	**ل.ل**
خزان مياه بلاستيك محفوظ ضمن إطار معدني	متر مكعب	600,000
خزان أرضي للمياه من الباطون	متر مكعب	100,000
معدات زراعية و شبكات الري	متر مربع	20,000
بيوت بلاستيكية زراعية	متر مربع	10,000
خيمة حديد	متر مربع	1,500
خيمة عريشة	متر مربع	1,000
قساطل حديد	المتر الطولي	1,000
قناة مياه مفتوحة من الباطون	المتر الطولي	15,000
شباك حديد	المتر الطولي	7,000
ضميمة للحيوانات ، من الأسلاك المعاوضة وأرضية	المتر الطولي	5,000
شريط شائك	المتر الطولي	500

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مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي

مؤشر التعويضات للأراضي والحيازات العُرضة للإستملاك ٣/٣

ل.ل / الشجرة		أشجار
كبير	صغير	
400,000	150,000	صنوبر
400,000	15,000	سنديان
75,000	40,000	حور
75,000	40,000	سرو
75,000	40,000	صبار
75,000	40,000	صفصاف
ل.ل / الشجرة		أشجار
كبير	صغير	مثمرة
750,000	300,000	زيتون
750,000	200,000	منغا
750,000	200,000	كستنة
750,000	200,000	نخيل
400,000	150,000	لوز
400,000	150,000	كيوي
400,000	150,000	اكي دنيا
400,000	150,000	دراق
400,000	150,000	رمان
400,000	150,000	افوكا
400,000	150,000	إجاص
400,000	150,000	ليمون
400,000	150,000	تفاح
400,000	150,000	تين
400,000	150,000	حامض
400,000	150,000	مشمش
400,000	150,000	سماق
400,000	150,000	بوملي
300,000	150,000	فستق

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مشروع زيادة تغذية منطقة بيروت الكبرى بالمياه
دراسة تقييم الأثر البيئي والإجتماعي

منظر على مرج من مزرعة الضهر

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E.B.M.L

شكراً

مشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب
دراسة تقييم الأثر البيئي والإجتماعي
(المرحلة الثانية)

Greater Beirut Water Supply Augmentation Project
Environmental and Social Impact Assessment
(Phase ٢)

51

dar al-handasah shair and partners

E.B.M.L

شكراً لمشاركتكم

نرحّب بتعليقاتكم
تبقى فرصتكم للتعليق مفتوحة لمدة ستة أيام عمل

1. الرجاء ترك إستمارة التعليقات بحوزتنا بعد تدوين أسئلتكم وتعليقاتكم عليها
2. بإمكانكم إرسال تعليقاتكم لـ BWSA 12002، وارسالها بالفاكس على الرقم ٠١/٨٦٩٠٢٦
3. بإمكانكم ارسال تعليقاتكم على البريد الالكتروني التالي: BWSA.12002@dargroup.com
4. هاتف او رسالة قصيرة على 03-867799

نتطلّع لسماع آرائكم

52

Log of Calls and Emails from the Public to GBWSAP-Dedicated Phone and Email

Date	Time	Caller	Contact Details	Village	Essence of Comments	Essence of Answer	Further Action
22/04/20	8:27	Mr. Hasib Abboud	03-127762	Ghbatiyeh	Caller claims to be the owner of lands in Ghbatiyeh and objects to their not being any public session in his village or the posting of maps and other information.	Dar explained that consultation sessions had been held in those villages with most affected plots. However, all municipalities, including Ghbatiyeh had been send a copy of the Executive Summary of both the ESIA and the RAP prior to consultation, and these should be made available to interested parties, including land owners. Notwithstanding this, the expropriation map is available on the CDR website at www.cdr.gov.lb.	Dar subsequently forwarded the caller the CDR website address.
26/04/20	06:48	Mr Amine Beainy	03-509666	Not stated	Caller claimed to be one of the landowners in the valley but had not been invited to any meeting. '*with God's will we shall not allow the inundation of that Paradise inherited from our ancestors to supply strangers with water*.'	Answer essentially as above. The caller was thanked for his comment and ensured it would be noted.	No further action.
29/04/14	9:20	Maroun Sleiman Karam	07-800788	Benwati	Caller claimed to be a landowner and asked how he could check the numbers of plots to be expropriated.	Caller advised to check the maps displayed in Bisri village hall or he could go to the CDR website.	No further action.
29/04/14	9:40	Ghassan Abou Sleiman	01-871258	Harf	Caller claimed to be a land owner wanting to check the number of his plots and if they will be expropriated or severed.	Caller advised to check CDR website.	No further action.
28/04/14	13:09	Yusef Sanan	yusef.sanan@gmail.com	Midane	Claimant suggested that the borders of some plots as shown on the expropriation plans are incorrect.	The caller was referred to the CDR website and that notwithstanding the boundaries shown, all land boundaries and	Dar subsequently forwarded the caller

Date	Time	Caller	Contact Details	Village	Essence of Comments	Essence of Answer	Further Action
						asset take would be formally re-confirmed during expropriation.	the CDR website address.

APPENDIX L2

PUBLIC CONSULTATION SESSIONS (JANUARY/FEBRUARY 2013)

Introduction

As part of the GBWSAP Consutlation and Communications programme, another set of Public consultations sessions were undertaken to dissiminate the results of the ESIA study. They presented the results and recommendations of the ESIA study in different venues for instutional stakeholders, for local PAPs in the villages in the vicinity of the proposed Bisri dam, and for Greater Beirut residents. While the Figure here below shows how these meetings were notified to the public via the national press, the Table that follows presents details of these meetings.

COUNCIL FOR DEVELOPMENT AND RECONSTRUCTION
CDR/PR4.1A2
Rev.00

مجلس الإنماء والإعمار
إدارة التخطيط والبرمجة
التاريخ: ٢٥ كانون الثاني ٢٠١٣

PROJECT: مشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب / اجتماعات

I- NETCOM

	MEDIA	NO. OF INSERTIONS	DAY (1) & DATE	DAY (2) & DATE	DAY (3) & DATE	SIZE
1.	NAHAR	2	SAT 26/01/13		TUE 29/01/13	4 COL. X 8.5
2.	LIWA'A	1		MON 28/01/13		4 COL. X 8.5
3.	HERALD TRIBUNE					
4.	LE MONDE					

II- APS

	MEDIA	NO. OF INSERTIONS	DAY (1) & DATE	DAY (2) & DATE	DAY (3) & DATE	SIZE
1.	MUSTAQBAL	1	SAT 26/01/13			4 COL. X 8.5
2.	DIYAR	1		MON 28/01/13		4 COL. X 8.5
3.	AL-BALAD	1			TUE 29/01/13	4 COL. X 8.5
4.	L'ORIENT LE JOUR					
5.	HAYAT					
6.	ASHARQ AL AWSAT					
7.	AL-RIYADH (RIYADH)					
8.	AL-ANBA'A (KUWAIT)					
9.	AL-KHALIG (U.A.E.)					
10.	OKAZ (JEDDAH)					
11.	AL SEYASSAH					
12.	AL-RAY- AL –AM (KUWAIT)					
13.	AL QABAS					

III- ALLIED

	MEDIA	NO. OF INSERTIONS	DAY (1) & DATE	DAY (2) & DATE	DAY (3) & DATE	SIZE
1.	SAFIR	1	SAT 26/01/13			4 COL. X 8.5
2.	ANWAR	1		MON 28/01/13		4 COL. X 8.5
3.	ASHARQ	1			TUE 29/01/13	4 COL. X 8.5
4.	DAILY STAR					

III- AL-ADIB

اعلانات استملاك عائدة لمنطقة الشمال	NO. OF INSERTIONS	DAY (1)	DAY (2)	DAY (3)	SIZE

نسخة إلى : دائرة المناقصات لنشر الإعلان على صفحة الإنترنت العائدة للمجلس
نسخة إلى : إدارة التخطيط والبرمجة — المكتب الإعلامي — القلم

- نسخة للسيد فيداوي
- الحفظ

رئيس إدارة التخطيط والبرمجة
إبراهيم شحرور

25 JAN 2013

REPUBLIC OF LEBANON • COUNCIL FOR DEVELOPMENT & RECONSTRUCTION

C:\Users\GISELES\Documents\... مشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب -- اجتماعات
10:04:56 AM

٢٥/١٢/٢٠١٢

Public Consultation Session	Venue, Date and Time	Attendees
Institutional Stakeholders	CDR, Central Beirut Wednesday 30 January 2013, 10am.	13
Local authorities and residents in the vicinity of the dam site	Midane Municipality Saturday 2 February 2013, 10am	36
Local authorities and residents in the vicinity of the dam site	Mazra'at ed-Dahr Municipality Saturday 2 February 2013, 3.30pm	15
Water consumers of Greater Beirut Area	Hadat Municipality Wednesday 6 February 2013, 5pm	10
Local authorities and residents in the vicinity of the dam site	Aamatour Municipality Saturday 9 February 2013, 10am	28
Local authorities and residents in the vicinity of the dam site	Mazra'at Echouf Municipality Saturday 9 February 2013, 2:30pm	35

The date and timing of all meetings were agreed with individual municipalities. The village sessions were scheduled at weekends and early evenings week-day for Beirut Water Consumers to allow the maximumm number of concerned people to attend.

Each session commenced with the introduction by the Project Proponent in which the scope, objectives and an update about of GBWSAP advancement were shared with the audience. The Consultant (Dar Al-Handasah), then gave a power point presentation covering the project base line conditions, the potentially expected impacts and mitigation measures and the study recommendations. The floor was then opened to attendees to air their comments and concerns. In order to focus on the expected concerns of the different audiences, the presentations varied slightly between sessions. The proceedings of all sessions were in Arabic.

As attendees arrived they were given a handout that related the content and the intent of the meeting. Shortly after the meeting commenced, to allow for late-comers. Attendance Sheets were circulated on which names, contact details and signatures were collected. As at previous sessions, attendees were given the option to make comments or ask questions verbally or in writing. Those doing so verbally were also asked to record what they said in writing so that in addition to the immediate verbal response, a formal written response, could be provided. In the event, few attendees chose to record their comment in writing and as a back-up, one of the Consultant's team transcribed much of what was said.

Attendees generally conducted themselves in an orderly fashion. Many of those in the vicinity of the dam recognised the potential for water supply, hydropower, and waterside developments, and were generally in favour. The most opposing concerns were heard and recorded during the two public sessions held in Amatour and Mazra'at el-Chouf municipalities. This was not a surprise to the ESIA study team considering that two thirds of the reservoir area will be taken from these two villages.

In the following pages the comments and concerns raised at each of the public consultation sessions are documented and a considered written response given. While audience response was good, they were less enthusiastic about committing their comments to paper. There are therefore unattributed comments recorded by the consultant in addition to those for whom a speaker was identified.

The primary issues of public concern were:

- The commencement date of construction works;
- The extent to which local populations will be served with water and/or hydropower;
- The returns for such project on local residents in economic and employment terms;
- The need to preserve archaeological, historic and cultural heritage;
- The impact on downstream and upstream irrigation water allowances;
- The future master planning of the lake surrounding area and plots classification;
- The impact of increased humidity on local microclimate due to a large water body;
- The fairness of compensations for expropriated lands;
- The connection roads from one to the other shoreline of the lake;
- The opportunities for tourism and other job creating initiatives the lake will afford;
- The impact on water quality due to lack of wastewater treatment across the villages surrounding reservoir.

Session 1: Institutional Stakeholders Attendees

Location/Date: CDR/January 30, 2013


مشروع "زيادة تغذية منطقة بيروت الكبرى بمياه الشرب"
إستشارات العامة- المكان:...مجلس الانماء والاعمار الزمان:...٣٠/١/٢٠١٣ الساعة العاشرة صباحا
جدول الحضور

	الإسم	المؤسسة	الهاتف	البريد الإلكتروني	الإمضاء
1	فاي مشنتف	دار الهندسة	01-790002 ext. 2651	fay.mushantaf@dargroup.com	
2	إيلي ابو رجيلي	دار الهندسة	01-790002 2648	elie.abourejaili@dargroup.com	
3	John Davey	Dar-Al-Handasah	01-790002	John.Davey@dargroup.com	
4	منى سري الدين	مديرية الشؤون العقارية	01/648753		
5	عاصم فداوي	مجلس الانماء والاعمار	01/981430	assemf@cdr.gov.lb	
6	مجيد هاشم	المديرية العامة للإدارات والمجالس المحلية - وزارة الداخلية والبلديات	01/610125	majid.Hachem@hotmail.com	
7	الدكتور بهيج عربيد	وزارة الصحة العامة	03/330747	bahig.arbid@hotmail.com	
8	فيفيان سسين	وزارة البيئة	01/976555ext499	v.sassine@moe.gov.lb	
9	حسن حطيط	وزارة البيئة	01/976555 ext 448	hhoteit@moe.gov.lb	
10	م. مايا مهنا	وزارة الزراعة	01/849623	[illegible]@agriculture.gov.lb	
11	م. رافي جرجيان	المديرية العامة للآثار	03/747105	raffi.gergian@dga.culture.gov.lb	
12	نبيل عماشة	المصلحة الوطنية لنهر الليطاني	03/280226	namacha@hotmail.com	
13	سهيل سرور	دار الهندسة	–	suhail.srour@dargroup.com	
14					
15					

Institutional Stakeholders, CDR – 30 January 2013		
No	**Name**	**Affiliation**
1	Fay Mushantaf	Dar Al Handasah
2	Elie Abou Rejaili	Dar Al Handasah
3	John Davey	Dar Al Handasah
4	Mona Sarieddine	Directorate of Cadastral Affairs
5	Assem Fidawi	Council for Development & Reconstruction
6	Majid Hashem	General Directorate for Administration and Councils / Ministry of Interior and Municipalities
7	Bahij Aarbid	Ministry of Health
8	Vivianne Sassine	Ministry of Environment
9	Hasan Hoteit	Ministry of Environment
10	Maya Mhanna	Ministry of Agriculture
11	Rafy Gergian	General Directorate of Antiquities
12	Nabil Aamasheh	Litani River Authority
13	Suhail Srour	Dar Al Handasah

Summary of issues raised at the Institutional Stakeholders session

Bahij Aarbid **Ministry of Health**	**Response**
It will be important to construct simultaneously the dam and the complete sewage networks of the surrounding villages currently discharging to the river.	The government recognises the problem. Most villages already have sewage collection, and the construction of sewage treatment for all those villages within the dam catchment will now be prioritized.
I would like to stress the importance of studying the future of the region around the reservoir, the possibility of development of tourism and thus develop a master plan for the next stages with the construction of roads, various infrastructures, sewerage system and other.	The ESIA included recommendations for a *Master Plan for Bisri Lake Shoreline and Surrounding Area Development*, and for sewerage schemes for all villages within the dam catchment area.
Treatment of the potential pollution emission sources: monitoring and treatment • Water source • Reservoir • Tanks • Distribution Pipes	The draft ESIA report has tackled this issue in identifying the potential sources and recommending the needed mitigation measures to counter the adversities.
Vivianne Sassine **Ministry of Environment**	**Response**
Has raised the concern about the way of cleaning such a reservoir capacity of 128 Mm3 of sediments and other unwanted materials.	This is essentially a design issue. Sluice gates will be provided at the bottom of the dam so that during periods of high inflow, water released flushes the accumulated sediment.
Will the dam construction materials such as concrete, stones, gabions, etc be excavated in-situ ?	All natural materials; rock, sand, gravel, aggregate, clay, are expected to be resourced in the vicinity of the construction site, within the reservoir area.
Majid Hashem **Ministry of Interior and Municipalities**	**Response**
The presentation was sufficiently clear enough, and questions has been discussed and answered.	The Consultant is pleased to record your satisfaction.

Session 2: Local authorities and residents in the vicinity of Bisri Dam and Nahr Awali

Location/Date: Midane Municipality/ February 02, 2013

مشروع "زيادة تغذية منطقة بيروت الكبرى بمياه الشرب"

إستشارات العامة- المكان: بلدية الميدان الزمان: ٢/٢/٢٠١٣

جدول الحضور

الإمضاء	البريد الإلكتروني	الهاتف	المؤسسة	الإسم	
[illegible]		٠٢/٨٢٨٨٧٦	بلدية الميدان	المحامي شربل بو خعوص	1
[illegible]		٧٠/٣٧٣٤٩٠	بلدية الميدان	نائب رئيس سنان	2
[illegible]		03/608027		شربل - اوكرا عواد	3
[illegible]		03/748810		د. انطوان عواد	4
[illegible]		٠٣/٨٥٦٨٥٩		مارون ايليا الخوري	5
[illegible]		٠٣/٨٠٧٤٤٤	مختار بحليس	يوسف الفحيلي	6
[illegible]		٠٣/٨٤٤٤٥٣	عضو مجلس بلدي	جان حبيقة	7
[illegible]		03.210730	خبير مالي واقتصادي	البير يوسف عواد	8
[illegible]		03. 944377	مختار الميدان	مارون شربل حبيقة	9
[illegible]		03/162086		ريمون حبيقة	10
[illegible]		03/927920		جورج فرحات	11
John C. Davey	Joh.Davey@dargroup.com	01-790002	Dar Al-Handasah	John Davey	12
[illegible]	E.C.Harmouche@Hotmail.com	٠٣/٧٥٤٥١٥	〃	الياس شربل حرموش	13
			〃	[illegible]	14
[illegible]	assem@cdr.gov.lb	01-981431	مجلس الانماء والاعمار	عاصم عذاري	15
[illegible]		—	دار الهندسة	ايلي ابو جيلي	16
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مشروع "زيادة تغذية منطقة بيروت الكبرى بمياه الشرب"

إستشارات العامة- المكان: ميدان الزمان: at 10:00am 02/02/2013

جدول الحضور

الإمضاء	البريد الإلكتروني	الهاتف	المؤسسة	الإسم	
[illegible]	fay.mushantaf@dargroup.com	01-790002 ext: 2651	دار الهندسة	فاي مشنتف	21
[illegible]	Hiba.Nasr@dargroup.com	01-790002 ext: 2665	دار الهندسة	هبا نصر	22
[illegible]	〃	03/731071	ممثل وزير الداخلية	محمد تاج	23
[illegible]		03/315902	ممثل وزير الصحة العامة	د. حسن علوية	24
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[illegible]	graziella.aouad.chbat@Gmail	70/103244 – 01/280630		غرازيلا يولف عواد شباط	29
[illegible]	charlesabousleiman@gmail.com 70/41020	04/444020	Petit Confort s.a.l	شارل ابو سليمان	30
[illegible]	〃	03/877212	اعمال حرة	فادي حبيقة	31
[illegible]	wg?@hotmail.com	70/300442	Business	جورج ابو خليل	32
[illegible]				فادي حبيقة	33
[illegible]		07/527190		ايلي حرموش	34
[illegible]		03 583037		انطوان [illegible]	35
[illegible]		07/800201		وديع حرموش	36
[illegible]		03/042922		انطوان طانيوس مراد	37
[illegible]		03/823711		ناجي طانيوس مراد	38
[illegible]		70/701602		جان كلود شربل عواد	39
[illegible]		03/287022		ايلي شربل عواد	40

Midane Municipality – 02 February 2013		
No	**Name**	**Affiliation**
1	Charbel Youssef Aoun	Lawyer – Midane Municipality
2	Chaker Youssef Seyyen	Midane Municipality
3	Charbel Abou Samra Ou'wad	Resident
4	Antoine Ou'wad	Doctor
5	Maroun el-Khoury	Resident
6	Youssef el-Ojeil	Mukhtar of Bhannine
7	Jean Hobeika	Council of Municipality
8	Albert Youssef Ou'wad	Financial and Economy counseling
9	Maroun Nassib Hobeika	Mukhtar of Midane
10	Raymond Habib Youssef	Resident
11	Georges Farhat	unaffiliated
12	John Davey	Dar Al Handasah
13	Charbel Harfoush	Lawyer
14	Charbel Badr	unaffiliated
15	Assem Fidawi	Council for Development & Reconstruction
16	Elie Abou Rejaili	Dar Al Handasah
17	Fay Mushantaf	Dar Al Handasah
18	Mia Nasr	Dar Al Handasah
19	Mohamad Kassem	Ministry of Interior
20	Hasan Aalawiyieh	Ministry of Health
21	Norma Tannous Feghali	Chief of Midane Municipality
22	Antoine Ou'wad	Grass Valley Company & lands owner
23	Marie-Dominique Ou'wad Farhat	Resident
24	Nazira Ou'wad Sabbagha	Resident
25	Graziella Youssef Ou'wad Shbat	Resident
26	Charles Abou Sleiman	Petit Confort S.A.R.L.
27	Fadi Hobeika	Free lancer
28	Georges Abi Akl	Free lancer
29	Fadi Hobeika	Resident
30	Elie Harfoush	Resident
31	Antoine Wehbeh	Resident
32	Wadih Harfoush	Resident
33	Abou Samra Tanios Ou'wad	Resident
34	Naji Tanios Ou'wad	Resident
35	Jean-Claude Charbel Ou'wad	Resident
36	Elie Charbel Ou'wad	Resident

Summary of issues raised at Midane Session

Youssef Botros el-Ojeil Mokhtar Bhannine	**Response**
On the list of lands to be expropriated, there are some missing plots.	The list posted today is 'work-in-progress', intended to give landowners, tenants and other users early warning of expropriation requirements. The Consultant will be pleased to take note of errors if contacted through as indicated at the presentation.
There are buried archeological ruins to be dug up before the commencement of works.	CDR and the Consultant are working with DGA to prepare a program for the investigation, excavation, documentation and if feasible, removal, of archaeological and other cultural heritage remains.
To allocate water from the lake to the surrounding villages.	While the majority of water will be used to supply GBA, downstream abstractors will benefit from environmental releases to maintain existing abstractions and downstream ecology. Villages upstream will receive water by gravity from the future Barouk-Beiteddine scheme. Both are included in the National Water Supply Strategy.
Masarra Jerjes Harfouche Lawyer	**Response**
Duration of project implementation and date of commencement of works.	The design consultant has suggested that the 3-year-period will be needed, while the ESIA consultant has suggested that these to be extended to a more realistic time frame of 5 years. The commencement of works will start once the designer will submit his tendered design and CDR will start then the call-for-offers procedure
What are the planned projects and works, not only in the dam-site, but in the reservoir area and its shorelines ?	The ESIA study has recommended the development of a Master Plan for Bisri Lake Shoreline and Surrounding Area, but this is currently outside the scope of the present contract.
Will there be any new land use classification for the surrounding lands?	The proposed Master Plan will include land reclassification and Parcellation for development.
What will be the mitigation measures to counter the environment pollution of surroundings areas?	As cited above, the ESIA study has proposed a Master Plan to be prepared to ensure the orderly and environmentally-responsible development of the surrounding areas. This would, need to include for effective measures to deal with sewerage, storm drainage and solid waste disposal such that it did not pose a threat to water quality. Various operational management procedures are also recommended. Further details are available from the Consultant via the contacts given in the presentation or from the ESIA report that will eventually be made public via the CDR website and World Bank *InfoShop*.

Charbel Youssef Aoun Lawyer	**Response**
Address the issue of discharging sewage into the valley.	The ESIA calls for prioritizing the establishment of complete sewerage and drainage networks for all villages within the dam catchment. Most villages already have collection networks, so what is most often missing is the treatment flows prior to discharge or reuse.
To give special care for the touristic projects that will have a major contribution into the region local economy.	The ESIA discusses the various opportunities and treats from induced development. A Master Plan as cited above is recommended to ensure the orderly and environmentally-friendly implementation of a wide variety of commercial and recreational options.
WE should be in favor of supplying GBA with water from the dam area since half of Lebanese population will be living in the targeted area.	Thank you.
Provide new roads in the surrounding villages and preserve the existing from damage due to heavy lorries.	The reservoir area itself contains no metalled roads. The Contractor will improve access to the dam site from the existing road. Other roads in the area will need to be upgraded and the Contractor will have to produce a Traffic Management Plan that avoids unnecessary congestion and delay to local traffic. With most construction materials coming from within the reservoir, construction traffic on public roads will be reduced.
Norma Tanios Feghali Head, Midane Municipality	**Response**
The sewerage network is a priority before constructing the dam.	The ESIA calls for prioritizing the establishment of complete sewerage and drainage networks for all villages within the dam catchment. Most villages already have collection networks, so what is most often missing is the treatment flows prior to discharge or reuse.
Who will operate and maintain the project after its completion to prevent the pollution of lake?	The dam and reservoir will be operated by BMLWE, perhaps via a service agreement with a private facilities management company. Bisri water is already of a much higher quality than Qaraoun water, and the same severity of pollution will not occur. As mentioned above, sewerage of the catchment villages and shoreline development only in compliance with a master Plan and strict development guidelines will also arrest any potential for pollution.
Who will follow up the issue of village infrastructure so as to prevent abusive construction around the lake?	MEW via BMLWE and EDL will operate and maintaining the future project facilities. The ESIA study has outlined the likely operational requirements for Bisri dam. CDR will oversee the installation of sewerage schemes. Adherence to the master Plan will prevent abusive development.

Antoine Ou'wad **Grass Valley Company and landowner.**	**Response**
How will land values be estimated, considering the past discouraging experiences in Lebanon?	A Resettlement Action Plan is being prepared for the project. Expropriation will essentially follow Lebanese Law, with additional safeguards where necessary to meet funding agency requirements.
What about the protection of the nature and environment from pollution?	The ESIA identifies a wide range of potential environmental and social impacts, and proposes measures to avoid mitigate or manage each during both the period of construction and subsequent operational life. Extensive environmental quality monitoring and reporting is proposed to ensure the adequacy of these measures.
Implementation of sustainable touristic projects in the whole region in general and in Midane in particular.	The ESIA study has identified a number of development opportunities. It will be the role of the proposed Master Plan to take these further.
Maroun Nassib Hobeika **Mokhtar al-Midane.**	**Response**
The access roads to the dam and surrounding villages must be taken into account. More particularly the planned road connecting Midane, Harf, Ta'aid and Bisri villages	The Contractor will have to prepare a Traffic Management Plan to ensure his activities do not cause undue delay and congestion. The proposed road will be further considered by the Master Plan, which will revisit the scheme in the light of the added attraction afforded by the dam.
Priority must be given to sewerage networks to prevent waste water discharging into the river.	As explained above, a condition of the Bisri scheme being a success is the installation of effective sewerage collection and treatment systems for all the villages within the dam catchment
All archeological remains from Marj Bisri and Ammatour should be collected and exposed in a facility near the lake as a touristic attraction.	Among other initiatives to be undertaken, the ESIA study has proposed the establishment of Visitor Center for the dam and the lake that would have both a recreational and educational function. It would be convenient to attach to it an Archaeological or Cultural Park in which the recurred remains could be displayed. Mar Moussa Church might also be resurrected here, but that would be the decision of the community and church.

Marie-Dominique Ou'wad Farhat - Midane Resident.	**Response**
Will the financial compensations to the lands owners be fair, considering that working the lands is the main income source of too many in the area?	Land expropriation will be undertaken in accordance with Lebanese Law, amended where necessary to also meet the requirements of the project funding agency. A Resettlement Action Plan, including land expropriation, detailing the extent of land take and the procedures for expropriation, is being prepared as part of the ESIA study.
Will the soil and geological formations beneath the dam sustain such a huge load? What will be its impact in inducing earthquakes?	Clearly the loading of the dam and the reservoir on the underlying geology is a significant issue and is being addressed by the dam design consultant. It is understood a seismo-tectonic study will be undertaken during the design process. Dam Safety Inspections will be a routine feature of operational procedure.
There are concerns about the negative impacts of the lac on the local environment with respect to increasing humidity, climate change, pollution, etc, especially that we are used to the poor maintenance of projects.	The ESIA has researched the likely impact on micro-climate, including rainfall, and humidity. It is currently expected the impact in the villages will be indiscernible, but perhaps more noticeable along the reservoir shoreline, particularly during the summer months when evaporation will locally increase humidity.
Jean Hobeika **Midane Municipality**	**Response**
Will the agricultural lands, adjacent to the project site, still get their irrigation water from the dam?	The agricultural lands downstream the dam will receive their irrigation waters by gravity from the dam from the regulated discharge. Productive lands upstream of the dam will receive water from the Barouk-Beiteddine irrigation scheme that will be diverted off Nahr Barouk. No water is expected to be directly pumped from the lake.
If productive land, with a water spring included, is in the expropriated area and the other part is out of it, will that other part receive its irrigation water directly from the lac?	Such cases will be reviewed individually. If part of a plot is expropriated and the remaining part is rendered unviable, perhaps because of the loss of buildings, loss of access, or loss of water source, Lebanese law requires GoL to purchase the whole plot if the owner so insists.

Session 3: Local authorities and residents in the vicinity of Bisri Dam and Nahr Awali

Location/Date: Mazra'at el-Dahr Municipality/February 02, 2013

مشروع "زيادة تغذية منطقة بيروت الكبرى بمياه الشرب"

إستشارات العامة- المكان:...مزرعة الضهر... الزمان:...02/02/2013... at 3:30 pm

جدول الحضور

	الإسم	المؤسسة	الهاتف	البريد الإلكتروني	الإمضاء
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5	رين عيد	جمعية الشعلة الثقافية	07/980320		Reine
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9	جعفر غصن	[illegible]	[illegible]		[illegible]
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Mazra'at el-Dahr Municipality – 02 February 2013		
No	**Name**	**Affiliation**
1	Fay Mushantaf	Dar Al Handasah
2	Michel Kfoury	Ministry of Health
3	Hayat Eid	Local resident
4	Yolande Kozhaya Eid	Al-Sho'la Cultural Association
5	Reine Eid	Al-Sho'la Cultural Association
6	Chadi Eid	Local resident
7	Jacques Eid	Local resident
8	Hassib Eid	Chief of Mazra'at el-Dahr Municipality
9	Jaafar Ghosn	BMLWE – Joun office
10	Dori Habib Eid	Local resident
11	Hani Elias Eid	Local resident
12	John Davey	Dar Al Handasah
13	Elie Abou Rejaili	Dar Al Handasah
14	Suhail Srour	Dar Al Handasah
15	Assem Fidawi	Council for Development and Reconstruction

Summary of issues raised at Mazra'at el-Daher Session

Hassib Eid **Chief of Mazra'at el-Dahr Municipality**	**Response**
The costs for dismounting, displacement, rebuilding and lands cost to relocate Mar Moussa Church and Ste-Sophia Monastery must be covered by the project.	The cost of deconstructing the Church and any of the associated remains if will be decided to relocate will be covered by the project. A budget sum for this work will be included in the Resettlement Action Plan.
The possibility of using the dam axis as a connection road between Chouf and Jezzine Cazas.	Due to security concerns, access across the top of the dam will be solely for operation and maintenance. The existing khirbit-Bisri Bisri road will remain open to the public to connect between the two Cazas. In addition, the Master Plan for surrounding development will consider if new road connections are required.
Michel Kfoury **Ministry of Health**	**Response**
Why has the possibility of using ground water resources not been considered?	The analysis of Non-Dam alternatives for GBWSAP included consideration of ground water. While the difficulties of ground water in the coastal plain are well documented, the potential for substantial abstraction in upland areas is clear from the performance of individual boreholes. Whether such potential is sufficient for supplying the quantities needed for GBA is uncertain. The comparison of alternatives concluded that ground water probably has the potential to contribute to some form of conjunctive use with surface water, but will not significantly reduce the need for dam storage to be the major source of supply. Notwithstanding this, the operational costs of pumping water from deep wells may prove prohibitive, even where saving, such as in the level of treatment prior to distribution, can be made.
Unattributed	**Response**
Concerns about the increasing air humidity that will favor the proliferation of Mosquitos during the hot summer months?	The proliferation of mosquitoes is a potential threat to any standing water body. Mitigation is primarily achieved through (i) efficient design that does not allow high water levels to overtop reservoir sides, and yet permits efficient shoreline drainage, both aimed at reducing ponding where mosquitos can breed, (ii) limiting seasonal growth of bankside and shallow water vegetation, and (iii) limiting public access to the extremities of the reservoir where wetland areas will develop, where access limitations will also promote biodiversity.
The possibility of using the dam axis as a connection road between Chouf and Jezzine Cazas?	Due to security concerns, access across the top of the dam will be solely for operation and maintenance. The existing khirbit-Bisri Bisri road will remain open to the public to connect between the two Cazas. In addition, the Master Plan for surrounding development will consider if new road connections are required.

Session 4: Water consumers of Greater Beirut

Location/Date: Hadat Municipality/February 06, 2013

مشروع "زيادة تغذية منطقة بيروت الكبرى بمياه الشرب"

إستشارات العامة- المكان: بلدية الحدث الزمان: ٦/٢/٢٠١٣ الساعة الخامسة

جدول الحضور

	الإسم	المؤسسة	الهاتف	البريد الإلكتروني	الإمضاء
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Hadat Municipality – 06 February 2013		
No	**Name**	**Affiliation**
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2	Fay Mushantaf	Dar Al Handasah
3	John Davey	Dar Al Handasah
4	Ali Al-Harakeh	Hareil Hreik Municipality
5	Abboud Zahr	Design Engineering Partner
6	Michel Kfoury	Ministry of Health
7	Georges Edward Aoun	Chief of Hadat Municipality
8	Georges Haddad	Hadat Municipal Council
9	Abdo Gerges Cherfane	Hadat Municipal Council
10	Nayla Raad	Dar Al Handasah

Summary of Issues Raised at Hadat Session

Unattributed	**Response**
What measures will be taken to deal with the sewage water discharging from surrounding villages into the river.	The government recognises the problem. Most villages already have sewage collection, and the construction of sewage treatment for all those villages within the dam catchment will now be prioritized.
It is nonsense to augment the water supplies to GBA without addressing the critical issue of water leakages throughout the existing networks.	Indeed it is. The GBWSP currently enhancing short-term supplies make provision of extensive leak detection and network upgrading.
Can you please better explain the interface between the GBWSP and the GBWSAP!	GBWSP is an on-going project to improve the short-term availability of water throughout GBA. Some additional water will be provided, but most improvements will come from the reduction of leakage and other losses and improved metering. GBWSAP focuses on the augmentation of the post-GBWSP situation to identify sources for additional water to meet medium and longer term demand. One of the key advantages of the GBWSAP is that will use some of the GBWSP facilities and infrastructures, in delivering the additional amount of water to GBA, resulting hence in a-cost-effective project.

Session 5: Local authorities and residents in the vicinity of Bisri Dam and Nahr Awali

Location/Date: Aamatour Municipality/February 09, 2013

مشروع "زيادة تغذية منطقة بيروت الكبرى بمياه الشرب"

إستشارات العامة- المكان: عماطور - دار البلدة الزمان: السبت في ٢/٩/٢٠١٣ الساعة ١٠:٠٠ صباحاً

جدول الحضور

	الإسم	المؤسسة	الهاتف	البريد الإلكتروني	الإمضاء
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3	حكمت سلوان	رئيس بلدية حارة جندل	٢،٨٤٧٧٦٦		
4	أمين ابو شقرا		٠٥٢٧٧٩٦٢		
5	الحسن وديع ابو شقرا	-	٧٠٥٨٩٢٨٨		
6	رشيد ابو شقرا ١٩٨٦	فني	٠٢٤٨٤١٦٢		
7	حكمت فارس		٠٢٢٢٢١١		
8	مأمون بديع ابو شقرا		٠٣-٧٠٠٣٦٠		
9	رفعت فارس	وكيل ربيع فارس	٠٢،١٨٦٤٩٥		
10	عصام بو مهدي		٠٢،٨٧٢٥١٥		
11	سمير عبد الصمد	بلدية عماطور	٧٠-٩٢٤٨٢٧		
12	رياض ابو شقرا	مراقب صحي وزارة الصحة	03/930420		
13	جميل ابو نرا		٠٢/٠٩٢٦٤٠		
14	انس عبد الصمد	الشرطي بلدية عماطور	٧١/١٥٥٢١٨		
15	ناجي عادل عبد الصمد		03 698101		
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18	أمين ابو شقرا	نائب رئيس بلدية عماطور	03/704946		
19	سعيد ابو شقرا	عضو بلدية عماطور	03/921701		
20	حسيب عبد الصمد	مختار سابق عماطور	70/817678		

نصوا رسال
PRESENTATION BY EMAIL

مشروع "زيادة تغذية منطقة بيروت الكبرى بمياه الشرب"

إستشارات العامة- المكان: بلدية عماطور الزمان: ٩ شباط ٢٠١٣

جدول الحضور

	الإسم	المؤسسة	الهاتف	البريد الإلكتروني	الإمضاء
21	انور بديع عبد الصمد		05 311418		
22	عدنان فرحان عبد الصمد	مختار عماطور	٠5 311994		
23	زياد هاني عبد الصمد		05/311049		
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25	John Davey	Dar Al-Handasah	01-790002	John.Davey@dargroup.com	John C Davey
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31					

Aamatour Municipality – 09 February 2013		
No	**Name**	**Affiliation**
1	Khaled Ghannam	Dar Al Handasah
2	Roger el-A'chi	Preseident of Chouf Municipalities Assembly
3	Hikmat Bilal	Chief of Haret Jandal Municipality
4	Ramez Amine Abou Chakra	Unaffiliated
5	Najib Wadi' Abou Chakra	Unaffiliated
6	Rodwan Abou Chakra	Technician
7	Hikmat Fares	Unaffiliated
8	Ma'moun Badi' Abou Chakra	Unaffiliated
9	Rif'at Fares	Rabi' Fares Representative
10	Issam Bou Mehdi	Unaffiliated
11	Samir Abdel-Samad	Aamatour Municipality
12	Riyadh Abou Chakra	Health Inspector – Ministry of Health
13	Jamil Abou Chakra	Unaffiliated
14	Anwar Abdel-Samad	Aamatour Municipality
15	Fadi Adel Abdel-Samad	Unaffiliated
16	Fouad Adel Abdel-Samad	Civil engineer and University professor
17	Bassem Camille Abou Chakra	Lecturer
18	Amine Abou Chakra	Vice-chief of Aamatour Municipality
19	Said Abou Chakra	Municipality Council Aamatour
20	Hassib Abdel-Samad	Aamatour Ex-Moukhtar
21	Anwar Badi' Abdel-Samad	Unaffiliated
22	Adnan Farhan Abdel-Samad	Aamatour Moukhtar
23	Ziad Hani Abdel Samad	Unaffiliated
24	Fay Mushantaf	Dar Al Handasah
25	John Davey	Dar Al Handasah
26	Suhail Srour	Dar Al Handasah
27	Elie Abou Rejaili	Dar Al Handasah
28	Nayla Raad	Dar Al Handasah

Summary of issues raised at Aamatour Session

Unattributed	**Response**
It has been now very long time the promised project has not come yet to the light will all consequences of hindering the residents locals activities in the area. Hope that will not take longer anymore to see it.	Comment noted. CDR and the ESIA consultant also hope the project will now proceed to conclusion.
The issue of balanced development is crucial. It is a big mistake to only be concerned with supplying GBA at the expenses of the area where that water will come from. If things proceed as they are, GoL will favor over populating already highly populated Beirut leaving behind the remote areas. What will the project bring to the local Chouf and Jezzine villages ?	It is common practice to move water from rural areas with plentiful resources to urban areas that suffer shortages. Surrounding villages in Chouf and jezzine will benefit from improved infrastructure such as sanitation and from the economic opportunities provided by future development.
Will the project be a copy of Qaraoun Lake with all its negative impacts especially in polluting and degrading the environment?	Both CDR and the design consultant are aware of the problems of Qaraoun and are determined to avoid them at Bisri. The water quality at Bisri is in any case much improved over that from Qaraoun.
The owners of the inundated lands will lose while those on the shorelines will see their lands values skyrocket. Compensation for the former should be taken from the latter.	In accordance with both Lebanese law and international funding agency procedures, all land expropriation will be undertaken at full prevailing market value.
There is No coordination between governmental institutions as lately DGUP declared 15 plots to be ''archeological reserves'' without noticing CDR	The ESIA consultant is aware of the various land use designations across the project area, the presence of sites of cultural heritage, and has developed proposals for their rescue.
Did the project consider desalination alternative to avoid disrupting the lives of local residents?	The desalination option was one of the considered alternatives. While it might be feasible and reliable, it has many disadvantages, such as requiring a heavy industrial plant on the coast, generating large quantities of highly saline brine that will impair seawater quality, and will unacceptably increase the cost of water to consumers.
Relocating the archeological remains and buildings that are highly valued by locals is not a simple stones transfer from one to another place, as the consultant suggests.	The Consultant apologizes if he gave that impression. Although the process is complex, it is one that is well practiced in many countries providing adequate budgetary allowances are set aside.
Is there any Master Plan for the whole project area?	The ESIA Consultant has recommended the development of a Master Plan for the Development of the Bisri Lake Shoreline and Surrounding Areas, but this is outside the scope of the present study.
How deep will the roman columns will submerged by water?	At the present time the roman columns are expected to be under 50-60 meters of water.
When is the commencement of construction works expected?	The date of commencement of construction remains to be determined.
Because agriculture is the main source of income in the area, this is a project to displace Chouf residents.	Relatively few permanent residents of the project area and its surroundings will be involuntarily resettled. While loss of agricultural employment and income will be

Unattributed	**Response**
	unavoidable, new economic opportunities will result.
What about the hydro-power generation?	Bisri Dam will include provision to generate hydropower and the maximum possible capacity for the available resources will be installed.
Why were local NGOs not invited to the consultations?	Local NGOs have been identified in the Draft ESIA. It is assumed that those responsible for inviting them to the public consultation sessions did so. NGOs that could not attend are welcome to contact the ESIA Consultant as advertised at the sessions.

Session 6: Local authorities and residents in the vicinity of Bisri Dam and Nahr Awali

Location/Date: Mazra'at el-Chouf Municipality/ February 09, 2013

مشروع "زيادة تغذية منطقة بيروت الكبرى بمياه الشرب"

إستشارات العامة- المكان: مزرعة الشوف الزمان: ٩/٢/٢٠١٣

جدول الحضور

الإمضاء	البريد الإلكتروني	الهاتف	المؤسسة	الإسم	
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		71/190324	مجلس الوزراء	نبيل البعيني	7
		03/334732	ممثل عن	سليم الخوري	8
		03/675826	رئيس بلدية وادي الست	يوسف محمود	9
		٠٥/٣٢٠١٧٦		محمد حسن البعيني	10
		٠٣/٤٢٩٨١٢		حسين البعيني	11
		٠٣/٧٤٤٦٨٤	جمعية التعاضد	حاتم محمد عجيب	12
		٠٣/٤٠٦٦٣٨		شكيب حسين عجيب	13
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			مزرعة الشوف	فادي نوفل البعيني	17
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مشروع "زيادة تغذية منطقة بيروت الكبرى بمياه الشرب"

إستشارات العامة- المكان: مزرعة الشوف الزمان: ٩ شباط ٢٠١٣ - البلدية

جدول الحضور

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		70/475593	شرطي بلدية	فادي البعيني	31
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Mazra’at el-Chouf Municipality – 09 February 2013		
No	**Name**	**Affiliation**
1	Elie Abou Rejaili	Dar Al Handasah
2	Shawki Zebian	Retired General Army
3	Ziad Saab	Kahlouniyeh Municipality
4	Adnan Shahine al-Be’ainy	Financial Inspector at Social Security Bureau
5	Salah Bou Hadir	Central Inspection
6	Nabil el-Be’ainy	Employee at Lebanese Parliament
7	Selim Khoury	Representative of Social affairs Minister
8	Youssef Maksoud	Chief of Wadi-el-Set Municipality
9	Mohamad Hassan el-Be’ainy	Unaffiliated
10	Hussein el-Be’ainy	Unaffiliated
11	Hatem Mohamad A’jab	Al-Ta’adod Association
12	Shakib Hussein A’jab	Unaffiliated
13	Chafik Amine Zebian	Unaffiliated
14	Assem Fidawi	Council of Development & Reconstruction
15	Ghassan Bou Karoum	Citizen
16	Ghandi Youssek el-Be’ainy	Mazra’at el-chouf
17	Mohamad Youssef el-Be’ainy	Mazra’at el-chouf
18	Ghassan Mahmoud A’jab	Private business
19	Wajih Mohamad el-Be’ainy	Mazra’at el-chouf
20	Rafik Zebian	Mazra’at el-chouf
21	Yehya Bou Karoum	Social Progressist Party
22	Afif Soulaiman el-Be’ainy	Mokhtar of Mazra’at el-chouf
23	Osmat Salim el-Be’ainy	Free lancer
24	Walid Adib Bou Karoum	Mokhtar of Mazra’at el-chouf
25	Marwan Afif Zebian	Unaffiliated
26	Al-sheikh Mas’oud Bou Karoum	Unaffiliated
27	Hamdi Zebian	Land owner
28	Amine Zebian	Mazra’at el-chouf
29	Jihad A’jab	Mazra’at el-chouf Municipality
30	Fadi el-Be’ainy	Mazra’at el-chouf Municipality
31	Youssef el-Be’ainy	Mazra’at el-chouf Municipality
32	Fay Mushantaf	Dar Al Handasah
33	John Davey	Dar Al Handasah
34	Suhail Srour	Dar Al Handasah
35	Nayla Raad	Dar Al Handasah

Summary of issues raised during Mazra'at el-Chouf

Unattributed	**Response**
The project must generate direct benefits to the local residents, either in employment or new business development. Dam operational staffing should favor local residents and local equipment.	The project is expected to afford new economic opportunities. Dam operational staffing and equipment will be a matter for the BMLWE.
Will Mazra'at el-Chouf Municipality have a role in operating the dam and what would be the direct financial return of the latter?	The affected municipalities may expect to be involved in the management of the reservoir shoreline and surrounding areas. The taxes paid by new developments will enhance municipality income.
Will the compensations be fair to all involved farmers considering that farming is the main income generating activity of many of them ? and if compensation is ''not fair'' will the owner have the right to appeal?	The expropriation of all lands, property and assets will be executed in accordance with Lebanese law amended where necessary to meet international funding agency requirements. the Right to Appeal is already incorporated into Lebanese Law.
Will the negative previous experiences on Qaraoun dam be avoided on this project?	Both CDR and the design consultant are aware of the problems of Qaraoun and are determined to avoid them at Bisri. The water quality at Bisri is in any case much improved over that from Karoun.
What will happen to Mar Moussa church?	The community has expressed a strong desire to see the church moved to a new location and the ESIA Consultant is recommending that this is provided for within the project.
Nabil el-Beainy **Employee in the Lebanese Parliament**	**Response**
The company that will owe the project in the future must include the owners of lands under expropriation as shareholders.	The development of Bisri Dam and reservoir is a public sector project and as such will be 'owned' by MEW on behalf of GoL, and operated by BMLWE.
Marwan Afif Zebian **Lands owner**	**Response**
Will there be any power generation plant to meet at least the needs of local villages?	A hydroelectric power plant will be provided at the dam. Its capacity and service area has yet to be determined.
Shawki Zebian **Retired General of Lebanese Army**	**Response**
Re-run a new Public Consultation session showing better the economic feasibility of the project supported by all types of tables, maps, graphs, etc?	The present PC session included a summary of the economic feasibility. For additional information, attendees are welcome to contact the Consultant as advertised in the session or await the public availability of the ESIA reports on the CDR website and World Bank *Infoshop*.
Directly involve municipalities in the construction works, equipment, etc.	This is primarily an issue for the dam construction contractor.
In addition to the fair compensations for the expropriated lands, support directly the induced development initiatives in the local villages especially in terms of touristic projects.	Expropriation will be undertaken in accordance with Lebanese Law and funding agency provisions. While the Consultant has recommended the development of a master Plan for shoreline and surrounding area development, these are most likely to be implemented by the private sector.
Favor the lake surrounding villages in terms of Hydro-power supplies from the dam.	The final capacity of the hydropower plant remains to be confirmed, but is likely to be limited by the restricted dry season river flows.

APPENDIX L3

PUBLIC CONSULTATION SESSIONS (APRIL 2012)

Introduction

At the outset of the EIA process, the preparation of the PD ESIA, a series of Scoping sessions was held during April and May 2012, commencing with an Institutional Stakeholders session at CDR offices in Central Beirut to which ministries, other governmental agencies and NGOs were invited. This was followed by separate meetings

in the vicinity of the three potential dam sites, that for Bisri being held at Mazraat El Dahr Municipality on Tuesday 10 April. Finally, two separate sessions were held for Beirut residents, the prime GBWSAP beneficiaries, at Hadath Municipality on Tuesday 24 April for southern suburb residents and in Downtown Beirut at Beirut Municipality on Saturday 5 May for Beirut municipality residents. All presentations and the subsequent proceedings were conducted in Arabic, but the Consultant's team was also prepared to present and respond in English and French had the need arose. The schedule for the Scoping Consultations is presented here after.

Public Consultation Session	Venue, Date and Time	Attendees
Institutional Stakeholders	CDR, Central Beirut Tuesday 3 April 2012, 10am.	16
Local authorities and residents in the vicinity of Bisri Dam and Nahr Awali	Mazraat El Dahr Municipality Tuesday 10 April 2012, 10am	23
Local authorities and residents in the vicinity of Damour Dam and Nahr Damour	Dmit Municipality Thursday 12 April 2012, 10am	46
Local authorities and residents in the vicinity of Jannah Dam and Nahr Ibrahim	Qartaba Municipality Saturday 21 April 2012, 11am	28
Water consumers of Beirut southern suburbs	Hadath Municipality Tuesday 24 April 2012, 10am	25
Water Consumers of Central Beirut	Beirut Municipality Saturday 5 May 2012, 10am	43

The date and timing of all meetings was agreed with individual municipalities. For instance, the session at Qartaba was delayed because the village is largely unpopulated during winter months and was scheduled for a Saturday when those working in Beirut during the week could attend. Similarly, the Beirut session was scheduled for a Saturday to enable those at work during the week to attend.

Each session commenced with the introduction by the Project Proponent in which the scope and objectives of GBWSAP were outlined and the Consultant (Dar Al-Handasah) introduced. The Consultant then gave a presentation about the project before the floor was opened to attendees to air their comments and concerns. In order to focus on the expected concerns of the different audiences, the presentations varied slightly between sessions. The proceedings of all sessions were in Arabic.

As attendees arrived they were given a handout that related the nature of the project and the intent of the meeting. Shortly after the meeting commenced, to allow for late-comers, Attendance Sheets were circulated on which names, contact details and signatures were collected. Attendees were given the option to make comments or ask questions verbally or in writing. Those doing so verbally were also asked to record what they said in writing so that in addition to the immediate verbal response, a formal written response, could be provided. In the event, few attendees chose to record their comment in writing and as a back-up, one of the Consultant's team transcribed much of what was said.

The consultant's presentation in Central Beirut, which encompassed all the changes for the individual site meetings, copies of the Beirut handout, and copies of the original attendance sheets, are given in Appendix F to the present report. A photograph taken at each session is presented in this appendix as hereafter.

Attendees generally conducted themselves in an orderly fashion. Many of those in the vicinity of the dams recognised the potential for water supply, hydropower, and waterside developments, and were generally in favour. The session in Beirut was briefly disrupted after Mr. Fathi Chatila had expounded his well- documented views and a number of his supporters tried to shout down opposing views.

In the following pages the comments and concerns raised at each of the public Scoping sessions are documented and a considered written response given. While audience response was good, they were less enthusiastic about committing their comments to paper on the forms provided. There are therefore unattributed comments recorded by the consultant in addition to those for whom a speaker was identified.

The primary issues on which comments were made were:

- The extent to which local populations will be served with water and/or hydropower;
- The need to preserve archaeological, historic and cultural heritage;
- The impact on downstream agricultural activities;
- The opportunities for tourism and other job creating developments the reservoirs will afford;
- The impact on water quality of the general lack of effective wastewater treatment across the villages surrounding each of the reservoirs;

Session 1: Institutional Stakeholders

Location/Date: CDR/April 3, 2012

مشروع "زيادة تغذية منطقة بيروت الكبرى بمياه الشرب"

إستشارات العامة- المكان: مجلس الانماء والاعمار الزمان: الثلاثاء ٣/٤/٢٠١٢ الساعة ١٠ صباحا

جدول الحضور

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	assemf@cdr.gov.lb	03/600337	مجلس الانماء والاعمار	عاصم فداوي	13
	b.sabbagh@moe.gov.lb	03/646171	وزارة البيئة	بسام الصباغ	14
	John.Davey@dargroup.com	01-790002	Dar Al-Handasah	John Davey	15
	Riwa.ElDerbas@dargroup.com	01-790002	دار الهندسة	روى دربس	16
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					18
					19
					20

Institutional Stakeholders, CDR – 3 April 2012	
Names	**Affiliation**
Mona Seridinne	Ministry of Finance, Dir. of Real Estate
Ziad Zakhour	Ministry of Energy and Water
Randa Nemr	Ministry of Energy and Water
Jean Jebran	Ministry of Energy and Water
Raffi Gergian	General Directorate of Antiquities
Antoinette Sleiman	Litani River Authority
Elie Mousalli	Council for Dev. & Reconstruction
Ismail Makke	Council for Dev. & Reconstruction
Roland Ghawi	Council for Dev. & Reconstruction
Assem Fidawi	Council for Dev. & Reconstruction
Bassam el Sabbagh	Ministry of Environment
John Davey	Dar Al Handasah
Riwa El Derbas	Dar Al Handasah
Suhail Srour	Dar Al Handasah
Fay Mushantaf	Dar Al Handasah
Mohammed Chamseddine	Information International

Insitutional Stakeholders Scoping Session at CDR

Summary of issues raised during Session 1

Ziad Zakhour **Advisor to the MEW on Water and Dams**	**Response**
Based on the strategy of MEW, there is no preferred alternative.	Noted
A technical comparison cannot be done for the three sites due to the discrepancies in data and the different stages of study of each site. There is a final executive study for Jannah whereas the study is just preliminary for Damour. The study can only be compared environmentally and socially.	No Response required
We suggest amending the expression “alternatives” to one that better fits the National Water Strategy for the eventual implementation of all three dams.	The ESIA will attempt to ‘prioritize’ the three dam projects
Is it possible not to abide by the Lebanese legislation in terms of land expropriation and adopt other policies?	Generally no. Lebanese law generally applies but may be amended by any special funding agency requirements, although these are almost always more onerous. If MEW wish to adopt other measures they would need to take it up with the Government lawyers.
Antoinette Sleiman - Litani River Authority	**Response**
I have included a copy of the annual report of the Litani River Authority (2010), which contains 2 reports that summarize the opinion of the LRA concerning the GBWSP. Report 1 (p68 to 79) and report 2 (p.79 to 81). We hereby insist that the GBWSP affects the LRA socially since the quantities of water taken will not be used to produce HEP in Joun.	We thank the LRA for the information provided and will take it into consideration in our report.
Dragging water from Bisri and Jannah to Beirut will be very expensive. The LRA suggests from expertise the 3rd option (1st option: No Option, 2nd option: Dam), to dig horizontal tunnels from the west mountains like the tunnel of Awali with length 17 km and provides 55 M m3/year. Ras Baalbeck tunnel 4 km and provides drinking water for villages of Ras Baalbeck. The quality of water from the tunnel is naturally filtered and won’t need treatment against pollutants (heavy metals, pesticides, coliforms, and organic pollutants…); unlike the water from the Qaraoun Lake.	Again thank you for the information, which we will follow up in preparing the ESIA.
Unattributed Comment	**Response**
GBWSP doesn’t only come from Qaraoun lake	Noted
Is an ESIA being done for the 3 dams?	The GBWSAP is divided into two phases. Phase 1 is a comparative technical economic, environmental and social assessment of the three dams and the identification of the priority in which they should be constructed. Thereafter, a full ESIA together with a RAP will be undertaken for the priority site
It is advisable to contact the Antiquities Authority if need be	This is standard practice in any ESIA study
People living in the vicinity of the dam need to benefit as well from the water	Noted

Session 2: Local authorities and residents in the vicinity of Bisri Dam and Nahr Awali

Location/Date: Mazraat El Dahr Municipality/ April 10, 2012

مشروع "زيادة تغذية منطقة بيروت الكبرى بمياه الشرب"

إستشارات العامة- المكان: مزرعة الضهر الزمان: ١٠/٤/٢٠١٢

جدول الحضور

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23	ألسيا مغّال	الدولية للمعلومات	01-983008/9	analysis@information-international.com	
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27	مارون يوسف	مختار المطلة [illegible]	03/944377		
28	مارون ابو الحزرة	نائب رئيس بلدية المطلة	03/836859		
29	حبيب جميل عيد	رئيس بلدية مزرعة الضهر	03/303057	hjeidlawfirm@[illegible]	
30	فؤاد عبد الصمد	رئيس بلدية عماطور	03/311158	fouad_absa[illegible]	
31	د. وضاح عبد الصمد	رئيس بلدية عماطور	03/708524		
32	مرشد الحاكم	رئيس بلدية [illegible]	71/222268		
33	انطوان حبيب عيد		03/299669	antonyeid@gmail.com	
34	جوني يوسف عيد	عضو مجلس بلدية مزرعة الضهر	70/988081	joeid@ic.edu.lb	
35	جان الياس عيد	عضو بلدية مزرعة الضهر	03/463177		
36	نوال الياس عيد	موظفة في بلدية مزرعة الضهر	07-980627		
37	حكمت قيصر عيد	[illegible]	07980198		
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40	وليم طنوس عيد		03/310566		

مشروع "زيادة تغذية منطقة بيروت الكبرى بمياه الشرب"

إستشارات العامة- المكان: مزرعة الضهر الزمان: ١٠/٤/٢٠١٥

جدول الحضور

	الإسم	المؤسسة	الهاتف	البريد الإلكتروني	الإمضاء
21	شادي عيد	بلدية مزرعة الضهر	70/845289		[illegible]
22	ايلي موصللي	مجلس الإنماء والإعمار	03/774461	emoussalli@cdr.gov.lb	[illegible]
23	فاي مشنتف	دار الهندسة	03/130146	fay.mushawah@dargroup.com	[illegible]
24	John Davey	Dar Al-Handasah	03/832251	John.Davey@dargroup.com	John C Davey
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Mazraat El Dahr Municipality - 10 April 2012	
Names	Affiliation
Riwa Al Derbas	Dar Al-Handasah
Elie Abou Rjeili	Dar Al-Handasah
Alicia Jammal	Information International
Issam Fidawi	Council for Dev. & Reconstruction
Roland Ghawi	Council for Dev. & Reconstruction
Maroun Houbaika	Midan Village
Maroun El Khoury	Midan Village
Hasib Jamil Eid	Mazraat El-Daher Municipality
Fouad Abdel Samad	Aamatour Municipality
Thoukan Abdel Samad	Aamatour Municipality
Monsif Al-Akkoum	Baba Municipality
Antoine Hasib Eid	Mazraat El-Daher Municipality
Johnny Yousef Eid	Mazraat El-Daher Municipality
Jack Elias Eid	Mazraat El-Daher Municipality
Nawal Elias Eid	Mazraat El-Daher Municipality
Hikmat Kaysar Eid	Mazraat El-Daher Municipality

Scoping Session at Mazraat El Dahr Municipalit

Summary of issues raised during Session 2

Hassib Jamil Eid **Head of Mazraat El Dahr Municipality**	**Response**
The priority and main concern of Municipality of Mazraat El Dahr is not to inundate the church of Mar Moussa and other historical ruins. In case it is impossible to preserve this church, we ask the Lebanese government to fund the protection or relocation of the church in coordination with the Municipality	Noted. The ESIA will address this issue
Johnny Youssef Eid **Mazraat El Dahr Municipality**	**Response**
What will happen to the present Awali-Joun HEP?	This will depend on the proposed compensatory flows discharged from the dam
Will there be a new HEP on the new dam?	A new HEP will be proposed
What are the GHG resulting from the reservoir?	GHG from reservoirs has been the subject of studies in several parts of the world. Much depends on efficient project management, and this will be fully discussed in the ESIA
Fouad Abd El Samad **Ammatour Municipality**	**Response**
Has there been an ESIA done in the previous studies and has an inspection been made to check the roman columns? The historical value is of great importance to the local people	An ESIA was undertaken previously. The Consultant is aware of the Roman columns and other historic and cultural remains, and will discuss them in the ESIA.
Maroun Hobeika **Midane Village**	**Response**
The Bisri Project is vital project for the region and we ask to speed up implementation because it will provide new job opportunities and improve tourism. This also requires the construction of the Midane/Bisri road which is ready for implementation and is of length 60 km and width 10 m.	Noted. New road construction is outside the scope of the present ESIA.
Please note the disposal of wastewater from Jezzine-Meshrif into the location of the dam will affect the quality of the reservoir	Noted. Sewerage for the villages discharging above the dam site will be a clear recommendation of the ESIA.
Unattributed Comment	**Response**
The overall attitude was positive towards the Project and they were expecting since long time	No Response required.
What will be 2 planned roads upstream of the projected dam and that connect the villages of Jezzine caza (southern bank of river) to Iklim villages (northern bank)?	Road construction other than to access the dam is outside the present scope of the ESIA.
This project is solely for Beirut Water supply, how can we be beneficiaries	In most dam projects, some allowance is made for local water use.
Should Permits for construction inside the reservoir continue to be given to people?	Since MEW has stated clearly that it intends to construct all three dams, planning policy should perhaps be reconsidered.

Session 3: Local authorities and residents in the vicinity of Damour Dam and Nahr Damour

Location/Date: Dmit Municipality/April 12, 2012

مشروع "زيادة تغذية منطقة بيروت الكبرى بمياه الشرب"

إستشارات العامة- المكان:..............................الزمان:..............................

جدول الحضور

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7	كمال قائدبيه	بلدية دميت	٩/٤٠٦١٤٨		
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مشروع "زيادة تغذية منطقة بيروت الكبرى بمياه الشرب"

إستشارات العامة- المكان:..............................الزمان:..............................

جدول الحضور

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مشروع "زيادة تغذية منطقة بيروت الكبرى بمياه الشرب"

إستشارات العامة- المكان:..............................الزمان:...............................

جدول الحضور

الإمضاء	البريد الإلكتروني	الهاتف	المؤسسة	الإسم	
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	ronaldg@cdr.gov.lb	01/980371	مجلس الإنماء والإعمار	رونالد غالي	29
اكرم لمريض		٠٥/٧٢٠١٦٢	دير بابا	اكرم طربيه مختار	30
		٧٠١٠٢٢٩٢	كفرحيم	انيس ابو كرم مختار كفرحيم	31
		٧٠/٩٦٧٦٢٤	كفرحيم	سعيد غنام مختار كفرحيم	32
		٠٦/٢٥١٠٨٨	بلدية دميت	ناجي وديع بو زيدان	33
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مشروع "زيادة تغذية منطقة بيروت الكبرى بمياه الشرب"

إستشارات العامة- المكان:..............................الزمان:...............................

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Dmit Municipality - 12 April 2012	
Alicia Jammal	Information International
Afif Abou Kheir	Dmit Municipality
Said Shahine Abou Dargham	Dmit Municipality
Riwa Al-Derbas	Dar Al-Handasah
John Davey	Dar Al-Handasah
Fay Mushantaf	Dar Al-Handasah
Suheil Srour	Dar Al-Handasah
Afif Zein El-Dine	Kfar Fakoud Municipality
Faouzy Naser	Kfar Fakoud Municipality
Marwan Mrad	Kfar Fakoud Municipality
Samih Azzam	*(not given)*
Adel Khadah	Kfar Matta Municipality
Ismail Makki	Council for Dev. & Reconstruction
Randa Nimr	Ministry of Energy and Water
Randa Daher	PMU Awali Project
Roland Ghawi	Council for Dev. & Reconstruction
Akram Torbey	Deir Baba Municipality
Anis Bou Dargham	Kfarhim Village
Said Ghannam	Kfarhim Village
Naji Wadia Zeidan	Dmit Municipality
Zouheir Al-Kadi	Dmit Municipality
Samer Al-Khawand	MoA
Ghazi Abou Khouzam	Progressive Socialist Party
Salim Ghanem Abou Dargham	Progressive Socialist Party
Basir Al Saadi	Dmit Municipality
Nabil Abou Chakra	Dmit Municipality
Karim Al-Khatib	Eco Village
Assem Fiddawi	Council for Dev. & Reconstruction
Nader Azzam	*(not given)*
Afif Abou Kheir	Dmit Municipality
Amin Torbey	*(not given)*
Said Shahine About Dargham	Dmit Municipality
Asaad Ghannam	Lawyer
Majed Said Zahreddine	Kfar Fakoud Municipality
Hamid Hilmy Torbey	Deir Baba Municipality
Bassam Nasrallah	PMU Awali Project
Antoinette Sleiman	Litani River Authority
Fandy Torbey	Bank of Beirut and the Arab Countries
Amin Ghneim	Kfarhim Municipality
Samir Khouzam	Kfarhim Municipality
Kamal Kaed Bey	Dmit Municipality
Hani Khaddaj	Dmit Municipality
Khaled Aoun	Mushref Municipality
Michel Mhanna	Mushref Municipality
Hassan Fouad Torbey	Deir Baba Municipality

Summary of issues raised during Session 3

with corresponding responses by the consultant

Hassan Fouad Torbey - Deir Baba Municipality	Response
There is an antique water mill and a natural cave in the reservoir area which were not mentioned in the presentation.	Thank you for informing us. The ESIA Consultant will investigate.
There is a productive land we depend on.	Loss of productive land will be minimized as much as is possible.
Ghazi Abou Khouzam - Progressive Socialist Party	Response
We understand the project is going to serve the water need of Greater Beirut, whereas the villages around the project will benefit from the drinking water and water for irrigation to develop the agricultural sector	Allowances for local water supplies will be provided.
Assaad Ghneim - Lawyer	Response
Will they implement the Expropriation law and pay the mandatory compensation or leave it to the World Bank based on the Municipalities' solutions?	Compensation for land and asset take will be in accordance with the laws of Lebanon, primarily the Expropriation Law of 1991 and its later amendments, and, if financed externally, with any particular requirements of the Funding Agency
Nabil Abou Chakra - Dmit Municipality	Response
Are we benefiting from the water and energy supply from this project or is this dam solely going to serve Beirut?	Allowances for local services will be provided.
Unattributed Comment	Response
How would productive land above the reservoir benefit from the water? Will the project account for any pumps?	Local water supplies are likely to be provided. The issue of pumps is one for detailed design.
Will there be HEP for the 3 sites?	It is expected that each of the dam sites will also supply hydropower.

Public Scoping Session for Residents of Damour Site Held in Dmit Municipality.

Session 4: Local authorities and residents in the vicinity of Jannah Dam and Nahr Ibrahim

Location/Date: Qartaba Municipality/April 21, 2012

مشروع "زيادة تغذية منطقة بيروت الكبرى بمياه الشرب"

إستشارات العامة- المكان: قرطبا الزمان: ٢١/٤/٢٠١٢ الساعة ١١

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مشروع "زيادة تغذية منطقة بيروت الكبرى بمياه الشرب"

إستشارات العامة- المكان: قرطبا الزمان: [illegible] الساعة ١١

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Qartaba Municipality - 21 April 2012	
Mohammad Chamseddine	Information International
Abdo Francis	Electricite du Liban
Kamal Youssef el Khoury	Kartaba Municipality
Riwa Al-Derbas	Dar Al-Handasah
John Davey	Dar Al-Handasah
Fay Mushantaf	Dar Al-Handasah
Suheil Srour	Dar Al-Handasah
Abdo Elias Saker	Kartaba Municipality
Joseph Tanious El Sokhn	Kartaba Municipality
Abdo Daniel Challita	Kartaba - Mkattaf Company
Walid Salem	Butcher
Melkan El Beainy	Yanouh & Hdaine Municipality
Chehade Karam	Electricite du Liban
Monsenieur Youssef el Sokhn	Maronite Parish of Jbeil
Akram Karam	Engineer
Ismail Makka	Council for Dev. & Reconstruction
Assem Fidawi	Council for Dev. & Reconstruction
Antoinette Sleiman	Litani River Authority
Joseph Dakkash	Lebanese Maronite Monastery
Roland Ghawi	Council for Dev. & Reconstruction
Elie Abou Rjeili	Dar Al Handasah
Nemr Beiruti	*(not given)*
Youssef Tanious Chahine	Kartaba- Truck Owner
George Antoine Najem	Kartaba- Engineer
Hanna Youssef Frem	Saraaita- Contractor
Randa Nemr	Ministry of Energy and Water
Karam Karam	Kartaba
Kalim Karam Karam	Karam Trade

Summary of issues raised during Session 4
with corresponding responses by the consultant

George Najem - Engineer	Response
The environmental impact on Qartaba is the humidity that will arise from the dam, knowing that its climate now is dry	*The reservoir will have a relatively small surface area for the volume of water stored. Direct evaporation will therefore be limited and while there will be an increase in humidity in the immediate vicinity of the shoreline; this is not expected to significantly extend to the surrounding villages on the higher slopes where regional air movements will generally reduce any local impact.*
Qartaba stands on top of underground reservoir of water. Is there any problem with its slope being linked permanently to water?	Slope stability will be considered within the ESIA.
Joseph Dakkash - Head of Mar Sarkis and Bacchus Monastery	**Response**
The project needs the scientific study of the geology	*MEW has already undertaken extensive geological investigations for Janneh and no doubt more will be undertaken as construction proceeds.*
The negative impacts affecting the villages surrounding the dam site and the damage to agriculture, plants, fisheries and the ecosystem	These will also be addressed by the ESIA.
Rights of land owners to irrigate the lands in the upstream and downstream of dam	The rights of Riparian owners under Lebanese law will be protected.
Conserving the categorization of Nahr Ibrahim as a World Heritage site, preserving the heritage and archaeological remains, and preserving the churched and monasteries.	Nahr Ibrahim is not formally classified as a World Heritage site. It is also not a Protected Area under Lebanese law, although it has long been recommended it should be. Its heritage is nonetheless significant and the ESIA will take account of this. Within the area of the proposed reservoir there are no churches or monasteries.
Means of compensation for land take	*Compensation for land and asset take will be in accordance with the laws of Lebanon, primarily the Expropriation Law of 1991 and its later amendments, and, if financed externally, with any particular requirements of the Funding Agency.*
Invest the tourism, agriculture and residential development. Guarantee establishing tourist projects	While it is likely investment will be attracted to the reservoir this is likely to be largely in the hands of the private sector. The steep slopes and cliffs within which the reservoir will be located may constrain shoreline development.
Abdo Daniel Challita	**Response**
The dam is for the benefit of our region in its tourism, agriculture, and development. Good luck in building the dam as soon as possible.	No Response required.
Abdo Samir Francis - Electricite Du Liban	**Response**
I support building the dam because it benefits Qartaba and its surroundings but keeping in mind the negative impacts on the environment.	Noted

Melkan El Beainy - Head of Municipality of Yanouh and Hdaine	Response
Treat the wastewater from the villages surrounding the reservoir by suggesting upgrading the system.	A major recommendation of the ESIA is likely to be that sewerage schemes for the villages currently discharging into the valley upstream of the dam be prioritized.
Improve the roads from Nahr Ibrahim to dam site to help tourism in the villages around the dam	Some improvements can be expected in order to improve the flow of construction traffic. The ESIA will address this and any need for subsequent improvements

Joseph El Sokhn - Instructor	Response
The course of Nahr Ibrahim is a path of historical value starting from the fortress of Jbeil to the Afqa cave, where religious rituals used to take place. It is certain that there are cultural monuments there, thus we ask to disclose of any archeological remains in order to take the proper decisions before losing them for good	A full archaeological, historical and cultural heritage survey will be undertaken on the priority site in accordance with the requirements of the General Directorate of Antiquities
Please categorize the Concerns in 2 phases: (before construction and after construction) and answer all the questions to have a positive outcome of this project	The ESIA will, as is usual, address the pre-construction, construction and post-construction impacts and their management separately
Unattributed Comment	Response
People are concerned with land slide in Saraaita	The potential for slope instability will be addressed by the ESIA.
What is the water level in the reservoir?	The currently proposed operating water level in the Jannah Reservoir is 834 m above national datum level
Is the dam site location final?	MEW have already completed substantial site investigations and subject to detailed design, is considered final.
Geology is not favorable for storing water in the reservoir	The water-tightness of the reservoir is an important consideration that will be addressed in the ESIA and subsequently
Will we get drinking water from the dam? Will the villagers benefit from the dam?	The design reports make an allowance for water supply to adjacent villages.
We want pumps to get water to Qartaba and Lassa	Noted.
Apple orchards will be inundated, compensation will not be enough.	Compensation for land and asset take will be in accordance with the laws of Lebanon, primarily the Expropriation Law of 1991 and its later amendments, and, if financed externally, with any particular requirements of the Funding Agency
There are archeological remains in: Wadi Betrayish, Wadi Adonis, Roman inscriptions on the rocks	A full archaeological, historical and cultural heritage survey will be undertaken on the priority site in accordance with the requirements of the General Directorate of Antiquities

Public Scoping Session for residents of the Jannah Area held at Qartaba Municipality

Session 5: Water consumers of Beirut southern suburbs

Location/Date: Hadath Municipality/April 24, 2012

مشروع "زيادة تغذية منطقة بيروت الكبرى بمياه الشرب"

إستشارات العامة- المكان:...بلدية الحدث...الزمان:...٢٤/٤/٢٠١٢...

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مشروع "زيادة تغذية منطقة بيروت الكبرى بمياه الشرب"

إستشارات العامة- المكان:..............................الزمان:..............................

جدول الحضور

الإمضاء	البريد الإلكتروني	الهاتف	المؤسسة	الإسم	
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Hadath Municipality - 24 April 2012	
Mohammad Chamseddine	Information International
Nassim Abi Fadel	Dar Al Handasah
Phillipe Nassar	Dar Al Handasah
Riwa Al-Derbas	Dar Al-Handasah
John Davey	Dar Al-Handasah
Elie Abou Rjeili	Dar Al Handasah
Suheil Srour	Dar Al-Handasah
Randa Daher	Awali Project
Elie Moussali	Council for Dev. & Reconstruction
Roland Ghawi	Council for Dev. & Reconstruction
Assem Fidawi	Council for Dev. & Reconstruction
Edward Aoun	Municipality of Hadath
Mohsen Sabra	Slomia Co.
Fathi Chatila	Arab World Water Magazine
Khalil Sasi	Furn El Chebbak Municipality
Marie-Noelle Cherfan Maalouk	Chiah Municipality
Elie Farhat	Kfarshima Municipality
Antoinette Sleiman	Litani River Authority
Elie Harb	Hadath Municipality
Mounir el Rishani	Choueifat Municipality
Farouk Arbid	Choueifat Municipality
Salim Sakr	Hazmieh Municipality
Elias Habib Hatem	Hazmieh Municipality

Summary of issues raised during Session 5
with corresponding responses by the consultant

Fathi Chatila - Arab World Water	Response
There will not be enough water in Qaraoun Lake to supply Greater Beirut	This is not disputed
There is a need to consult people from the South and Saida before taking water	The Ministry and CDR are committed to public consultation of internationally-funded projects
I am concerned about the poor water quality coming from Qaraoun	While Qaraoun water will not be used to supply Greater Beirut, recent and ongoing studies have shown it can be satisfactorily treated by conventional techniques
I believe Nahr Damour can store 90 Mm^3 in and not just 32 Mm^3 as suggested by Libanconsult	The Consultant will be checking the capacity for reservoir storage and supply during the study
90% of the water in Joun comes from Qaraoun	The proportion of Qaraoun water in Joun is subject to seasonal variation, which is unlikely to exceed 30% and may at times be significantly less
A dam in Damour will be more cost-effective than conveying water from Qaraoun	If taking Beirut water from Qaraoun Lake were possible, the two schemes would not be comparable
We are depriving the people of the south from getting their water, whereas if we get the water from Damour dam this will not be a problem.	The people of South Lebanon will not be asked to forfeit their rights to water for Beirut residents
Mohsen Sabra - Litani Water Authority	**Response**
Qaraoun is highly polluted and although treatment is very costly, though it's not impossible	Recent studies have shown Qaraoun water may be treated by conventional means.
What's the time frame for the preparation of the ESIA and when are you going to start implementation?	The current ESIA project will be completed by the end of September 2012. Implementation will commence with detailed design as soon as funding is made available
Damour dam is closer to Beirut and water quality is much better and more cost effective than the other options.	If so, the present study will confirm it
Municipality of Hazmieh	**Response**
Why don't we study constructing a dam at Beirut River?	The Beirut River is outside the present scope of study. The Consultant assumes Nahr Beirut has previously been studied and disregarded on technical and economic considerations

Session 6: Water Consumers of Central Beirut

Location/Date: Beirut Municipality/May 5, 2012

مشروع "زيادة تغذية منطقة بيروت الكبرى بمياه الشرب"

إستشارات العامة- المكان:..............................الزمان:..............................

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20	محمد شمس الدين	الدولية للمعلومات	01/983008-9		محمد

مشروع "زيادة تغذية منطقة بيروت الكبرى بمياه الشرب"

إستشارات العامة- المكان:...............................الزمان:...............................

جدول الحضور

	الإسم	المؤسسة	الهاتف	البريد الإلكتروني	الإمضاء
21	أرظان حبيب	FUTURE PIPE	01-800400	a.habib@futurepipe.com	
22	زياد الصليبي	FUTURE PIPE	01-800400	z.salibie@futurepipe.com	
23	عبود زهر	DEP	03-656203	baudi@yahoo.com	عبود زهر
24	نوال شبارو	Mahmoud Chehab	01-352398		نوال شبارو
25	زينب شهاب	Riad Chehabtr.co Riad Chehabtr.com	70-745306	Zeinab_chehab@hotmail.com	زينب شهاب
26	انطوانيت سليمان	مصلحة الليطاني	—		
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مشروع "زيادة تغذية منطقة بيروت الكبرى بمياه الشرب"

إستشارات العامة- المكان:...............................الزمان:...............................

جدول الحضور

	الإسم	المؤسسة	الهاتف	البريد الإلكتروني	الإمضاء
21	ايلي ابو جمال	دار الهندسة (شاعر)	٠١-٧٩٠٠٠٢		
22	محمد شبلك	يونيكويبال الكويت	٠٣/٥١٦٥٨٣	UNiEQuip@Hotmail.com	
23	[illegible]	جمعية الانماء/[illegible]	٠٣/٧٧٠٧٠		
24	سمية طرابلسي	الاتحاد النسائي الوطني	٠٢ ٥٧٦٤٢٠	www.CApL.com	
25	عاصم فواز	مجلس الانماء والاعمار	٠١/٩٨١٤٢١	asamf@cdr.gov.lb	
26	تانيا زاخم	المديرية العامة للآثار	01-426703		
27	احمد معربل	جمعية مركز الاحياء	70/850494	Fax 01/662646	
28	Prof Dr عارف مصفا	الجمعية اللبنانية [illegible]	03 734215	01366910	
29	محمد علي سكنو	الاتحاد [illegible]	03/284200		
30	محمد المغربي	الاتحاد البيروتي	03/937217		
31	إدريس الصلح	رئيس اتحاد الجمعيات اللبنانية العربية		03/371275	
32	فتحي شاتيلا	مجلة عالم الماء العربي	03 558949	f.chatila@cphworldmedia.com	
33	خالد الداعوق	تجمع [illegible]	03652547	KDAOUK1@IDM.NET	
34	عماد عكاوي	الحملة الأهلية	٠١/٩٨٦٧٦٦	akkawiimad@[illegible]	
35	John Davey	Dar Al-Handasah	01-790002	John.Davey@dargroup.com	
36	[illegible]	Dar Al Handasah	01-790002	[illegible]@dargroup.com	
37	فيليب إ. نصار	Dar Al Handasah	01-790002	penassar@dargroup.com	P.N.
38					
39					
40					

Beirut Municipality - 5 May 2012	
Mohammad Chamseddine	Information International
Fay Mushantaf	Dar Al Handasah
Mohammad Chatila	Universal Equipmentt
Riwa Al-Derbas	Dar Al-Handasah
John Davey	Dar Al-Handasah
Elie Abou Rjeili	Dar Al Handasah
Suheil Srour	Dar Al-Handasah
Basma Traboulsi	National Women's Union
Ismail makke	Council for Dev. & Reconstruction
Tania Zakhan	Directorate General of Antiquities
Assem Fidawi	Council for Dev. & Reconstruction
Ahmad Mgharbel	Association of the Charity Center
Aref Dia	Lebanese University
Mohammad Ali Sinno	Beirut Union
Mohammas el	Beirut Union
Idriss Saleh	Union of Lebanese & Arab Associations
Fathi Chatila	Arab World Water magazine
Khaled el Daouk	Group of Reform and Progress
Imad Akkawi	Organization of Isa'af Sha'abi
Phillipe Nassar	Dar Al Handasah
Antoine Habib	Future Pipe
Ziad el Salini	Future Pipe
Abboud Zahr	DEP
Nawal Chatila	*(not given)*
Zeinab Chehab	*(not given)*
Antoinette Sleiman	Litani River Authority
Mohammad el Z'anni	*(not given)*
Walid Deghman	Social Committee
Samir Knio	*(not given)*
Walid Itani	*(not given)*
Mahmoud Oz'or	Organization of Isa'af Sha'abi
Randa Nemr	Ministry of Energy and Water
Khaled Zahran	Beirut Inhabitants Association
Salim Kreidie	Dar El Nahda Engineering
Dahej el Mokdad	Ministry of Agriculture
Mona Itani	Beirut Inhabitants Association
Elham Bekdash	National Labor Campaign
Souhaila Edriss	Operation Big Blue
Samir Zaatiti	Lebanese University
Hassan Jaafar	Hydrogeologist
Bassam Jaber	Ministry of Energy and Water
Motassem Fadel	American University of Beirut
Mohammad Khaled Soubra	Office of MP Bahaa El Dine Itani

Fathi Chatila - Arab World Water	Response
The fact that the Damour reservoir can supply 32 Mm^3 is wrong. There is the capacity for 90 Mm^3	The Consultant will be checking the capacity for reservoir storage and supply during the study.
The Awali Project is 90% from Litani, it should not be called Awali	The current proposal is for no further water for Beirut to be taken from Nahr Litani
In the 1970's the people of South Lebanon were against water being conveyed from Nahr Litani to Beirut.	Noted
Nahr Litani is the most polluted river in Lebanon but MEW claims it can be treated conventionally. They disregard the fact that sixty villages around Qaraoun are susceptible to diseases such as cancer due to the bad water quality.	Whilst the Litani continues to suffer pollution, ongoing projects such as Litani Wastewater will substantially improve water quality. The enforcement of existing environmental laws could be used to address specific problematic discharges.
Salim Kriedieh - Dar El Nahda Engineering	Response
Provide drinking water from Bisri dam	As shown in the presentation, this is one of the options being studied.
Idriss Saleh - President of Union of the Lebanese and Arab Associations	Response
I recommend to group all the specialists to come up with a solution	To the same end, the Consultant has been appointed to consider everyone's point-of-view and make a considered judgment
Randa Nemer - Advisor to MEW	Response
With the construction of Canal 800 and Canal 900 there is insufficient water to supply Greater Beirut from Qaraoun to supply Greater Beirut area. If the money is provided, all three dams will be implemented, because over the years the costs will only rise.	No Response required
Basma Traboulsi - National Women's Union	Response
We don't want water if it will be polluted	It will be the intention of both the Ministry and the Water Establishment to ensure water delivered to consumers' taps meets current environmental health standards and is fit-for-purpose
Hassan Jaafar - Hydrogeologist	Response
Qaraoun water does not go to Beirut consumers	The Consultant confirms that at the present time no Qaraoun water is supplied to Greater Beirut, and as MEW has commented above, it is not proposed to do so in the future

Abboud Zahr - DEP	Response
I am a citizen who buys water due to water shortage in Beirut. We need a solution, I don't care what decision you take, and I just need to have water in my tap	I am sure your concerns are shared by the vast majority of Beirut's population and this is what the National Water Strategy aims to provide
My greatest concern is that after the water is conveyed, the water quantities will actually decrease rather than increase because of the excess of leakage that will occur when the water pressure suddenly increases in the pipes. Poor conditions of the household connections lead to leakage. Thus they need to be rehabilitated at the same time of the project.	You are correct to highlight the present significance of leakage. For this reason the GBWSP includes major elements of leakage identification and repair, and the installation of both bulk meters on the distribution network and household meters to monitor water use and assist with the identification of future leaks
Aref Dia - Lebanese University	**Response**
Qaraoun Lake contains cyanobacteria, which is a dangerous toxin. Does the Ministry know by what means and where it will be treated?	For those not familiar with the term, cyanobacteria are more commonly known as blue-green algae, a variety of planktonic cells found in most terrestrial and aquatic habitats; in the sea and fresh water, in the soil and on bare rock. Some cyanobacteria produce cytotoxins that may be harmful to animal and marine life, including humans but 30-50% of cyanobacteria are harmless. A number of standard elements of conventional water treatment process streams, such as flocculation, chlorination, microfiltration and ozonation have been shown to be effective in destroying cyanobacteria and in removing microcystins, a major cytotoxin common in fresh water for which the WHO has established a guideline value. Any future MEW/BMLWE treatment plant will be expected to meet or exceed WHO standards for water quality delivered to consumers. The reduction in discharges into the environment of nutrient-high wastewaters will also reduce the potential for cyanobacteria and algal bloom formation
Imad Akkawi - Organization of Isa'af Sha'abi	**Response**
For 42 years, studies have discussed Litani's pollution. People from the south need this water for their development	Litani water is indeed vital for South Lebanon. For this reason the GBWSP will not take water from Qaraoun Lake

Ahmad Mgharbel - Association of the Charity Center	Response
Leakage is external (visual) and hidden. I will focus on the visual leakage and leave the other leakage to be discussed by specialists. Leakage occurs as a result of float valve malfunction, water tank and pipe deterioration. I therefore suggest giving notice to fix all leakages within a specific time frame and thereafter penalize offenders, and increase public awareness of the negative impact of leakages.	Leakage is indeed an important issue and current estimates are that 50% or more of water put into distribution may be lost. The GBWSP includes elements for leakage identification and repair, for bulk metering to help identify future leaks, and for household metering to assist families better manage their own losses. Whether regulation of public activities within the water sector will work in Lebanon any better than it does in other sectors will doubtless be subject to debate. Almost certainly, one recommendation of the GBWSAP ESIA will be the establishment of a 'hot line' via which citizens can report leakages and water use abuse.
Unattributed Comment	**Response**
The stakeholders are not concerned with people's opinion; they do projects without asking people	While accepting this may be the view of many, the Consultant views everyone, those that supply and consume water, as stakeholders. Hence the Consultant has embarked on the present series of public consultation meetings and will hold another round of meetings to report the results of his study
The people of Beirut want Damour Dam because of its easy access and better water quality than other rivers	If this is the case the present study will confirm it.
The numbers in the presentation are not correct.	The numbers in the presentation are drawn from recognised sources such as MEW's National Water Strategy, the World Bank's GBWSP Project Appraisal Document, and the various Feasibility Reports for the dam options. For Scoping purposes they will suffice and the Consultant will endeavor to elicit the correct figures for presentation in the ESIA
Despite considering mainly surface water, 75% of Lebanon's geology comprises karst formations. Thus we need to take into consideration ground water	Ground water is already an important source of water supply and will continue to be so. Over-abstraction of the coastal aquifers has increasingly led to saline intrusion. While valuable ground water resources remain these have to be fully investigated and shown to be sustainable before they can be relied upon for vital supplies such as for the capital. There is currently a moratorium on the drilling of new water wells

PowerPoint Presentation and Handout


dar al-handasah
مشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب
دراسة تقييم الأثر البيئي والإجتماعي
المرحلة الأولى
Greater Beirut Water Supply Augmentation Project
Environmental and Social Impact Assessment
Phase I


Presenters
المقدمون
ستقوم السيدة روى الدرباس بدور المقدم الرئيسي لهذه الندوة
كما حضر للاجابة عن اسئلتكم:
د. سهيل سرور- الذي سيقوم بدور رئيس الجلسة
د. جون دايفي- قائد فريق تقييم الاثر البيئي والاجتماعي لمشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب
الآنسة فاي مشنتف- مختصة في مجال البيئة
كما يضم فريق تحضير تقييم الأثر البيئي والإجتماعي اخصائيين في مجال الجيوتقنية والهيدرولوجيا وبناء السدود واخصائيين اجتماعيين
كما حضر للاجابة على الاسئلة التي تتجاوز النطاق المباشر للمشروع السيد عاصم فيداوي - مدير مشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب لدى مجلس الانماء والاعمار


Objectives of this session
أهداف الندوة
إن أهداف الندوة اليوم هي:
1. شرح أولي عن نطاق مشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب.
2 . عرض ملخص للتقييم الأولي للاستشاري فيما يخص الآثار البيئية والاجتماعية المحتملة، منها الإيجابي والسلبي.
3. الحصول على تعليقاتكم بشأن المشروع، الإيجابية منها والسلبية، وتسجيل ملاحظاتكم وإقتراحاتكم لأخذها بعين الإعتبار خلال عملية تقييم الأثر البيئي والإجتماعي.

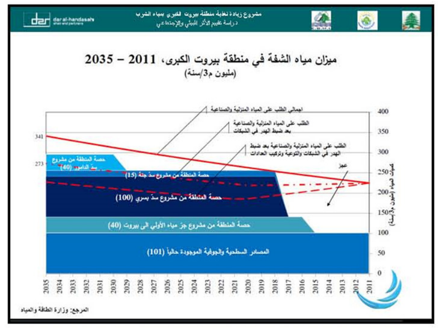

Outline
العناوين
• الوضع الحالي لامدادات المياه
• شح المياه في لبنان
• الوضع المستقبلي المتوقع
• معلجة مشكلة شح المياه
• مشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب GBWSAP
• الخيارات التي سيتم البحث فيها
• بناء السدود كحل محتمل
• مقارنة بين المواقع المقترحة
• الآثار المحتملة للسدود
• خطة للإدارة البيئية والإجتماعية
• الحد من إستملاك الاراضي
• استشارات العامة


Present Water Supply Situation
الوضع الحالي لامدادات المياه
• يقدر عدد سكان لبنان بـ4.4 مليون (2010)، 46% منهم يعيشون في بيروت الكبرى وجبل لبنان
• يتلقى 1.9 مليون شخصاً المياه من جعيتا عبر محطات المعالجة في الضبية وآبار الدامور وعدة مصادر ثانوية، إلا ان امدادت المياه غير كافية وغير متوازنة موسمياً
• تتلقى بعض الاسر المياه من الشبكة العامة لأقل من 3 ساعات يومياً في منطقة بيروت الكبرى
• تعتمد الكثير من الاسر على:
(أ) المياه الجوفية من الآبار ذات البنية الضعيفة وغالباً غير قانونية
(ب) شراء المياه من الخزانات العائدة للقطاع الخاص، منها ما هو غير صالح للشرب
(ج) مياه الشرب المعبئة ذات الكلفة العالية ومنها ما هو غير صالح للشرب


Lebanon's Water Stress
شح المياه في لبنان
• يقدر مجموع تدفق المياه السطحية بـ 735 مليون متر مكعب/سنوياً، تذهب كمية كبيرة مفقودة الى البحر
• تعود أسباب مشاكل قطاع المياه في لبنان إلى العوامل التالية:
✓شبكات نقل وتوزيع غير فعّالة ومحدودة وقديمة
✓غياب العدادات وهيكيلية التعرفة المتعلقة بالاستهلاك
✓الافراط في استخراج المياه الجوفية، مما يؤدي الى تسرّب المياه المالحة
✓نسبة عالية من المياه غير المحتسبة والضعف في استرداد التكاليف
✓نقص في الاستثمار في البنية التحتية الحديثة للمياه
✓ضعف في القدرة المؤسساتية
✓غياب الوعي والمشورة والمشاركة العامة

1


dar al-handasah
مشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب
دراسة تقييم الأثر البيئي والإجتماعي
Predicted Future Situation
الوضع المستقبلي المتوقع
• يقدر عدد سكان بيروت الكبرى بـ1.9 مليون (2010)
• من المتوقع ان يصل عدد سكان بيروت الكبرى الى 2.3 مليون بحلول العلم 2035
• من المتوقع أن يصل الطلب على المياه المنزلية والصناعية إلى 341 مليون م3\السنة بحلول العام 2035
• تقدر مصادر المياه الحالية بـ 101مليون م3\السنة
• تقدر حصة منطقة بيروت الكبرى من جر مياه الأولي إلى بيروت بـ 40 مليون م3\السنة
• يقدر حجم المياه التي ستتوفر من سد بسري، جنّة، والدامور بـ155 مليون م3\السنة
• الحد من الطلب من خلال ضبط الهدر في الشبكات، وتركيب العدادات وتوعية العامة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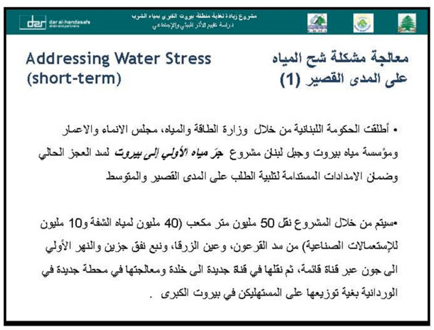
مشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب
دراسة تقييم الأثر البيئي والإجتماعي
ميزان مياه الشفة في منطقة بيروت الكبرى، 2011 – 2035
(مليون م3/سنة)
اجمالي الطلب على المياه المنزلية والصناعية
الطلب على المياه المنزلية والصناعية بعد ضبط الهدر في الشبكات
الطلب على المياه المنزلية والصناعية بعد ضبط الهدر في الشبكات والتوعية وتركيب العدادات
عجز
341
273
حصة المنطقة من مشروع سد الدامور (40)
حصة المنطقة من مشروع سد جنة (15)
حصة المنطقة من مشروع سد بسري (100)
حصة المنطقة من مشروع جر مياه الأولي الى بيروت (40)
المصادر السطحية والجوفية الموجودة حالياً (101)
كميات المياه (مليون م3/سنة)
400
350
300
250
200
150
100
50
0
2035 2034 2033 2032 2031 2030 2029 2028 2027 2026 2025 2024 2023 2022 2021 2020 2019 2018 2017 2016 2015 2014 2013 2012 2011
المرجع: وزارة الطاقة والمياه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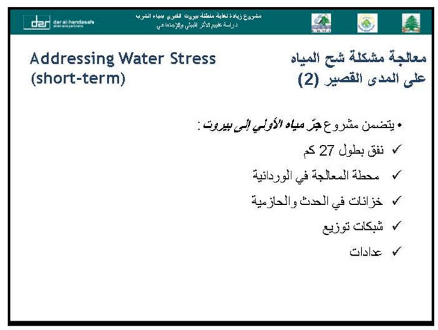
مشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب
دراسة تقييم الأثر البيئي والإجتماعي
Addressing Water Stress (short-term)
معالجة مشكلة شح المياه على المدى القصير (1)
• أطلقت الحكومة اللبنانية من خلال وزارة الطاقة والمياه، مجلس الانماء والاعمار ومؤسسة مياه بيروت وجبل لبنان مشروع جرّ مياه الأولي إلى بيروت لسد العجز الحالي وضمان الامدادات المستدامة لتلبية الطلب على المدى القصير والمتوسط
•سيتم من خلال المشروع نقل 50 مليون متر مكعب (40 مليون لمياه الشفة و10 مليون للإستعمالات الصناعية) من سد القرعون، وعين الزرقا، ونبع نفق جزين والنهر الأولي الى جون عبر قناة قائمة، ثم نقلها في قناة جديدة الى خلدة ومعالجتها في محطة جديدة في الوردانية بغية توزيعها على المستهلكين في بيروت الكبرى .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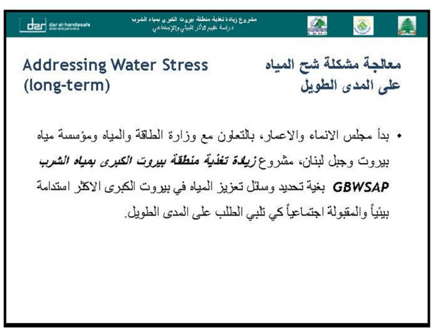
مشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب
دراسة تقييم الأثر البيئي والإجتماعي
Addressing Water Stress (short-term)
معالجة مشكلة شح المياه على المدى القصير (2)
• يتضمن مشروع جرّ مياه الأولي إلى بيروت :
✓ نفق بطول 27 كم
✓ محطة المعالجة في الوردانية
✓ خزانات في الحدث والحازمية
✓ شبكات توزيع
✓ عدادات


dar al-handasah
مشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب
دراسة تقييم الأثر البيئي والإجتماعي
Addressing Water Stress (long-term)
معالجة مشكلة شح المياه على المدى الطويل
• بدأ مجلس الانماء والاعمار، بالتعاون مع وزارة الطاقة والمياه ومؤسسة مياه بيروت وجبل لبنان، مشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب GBWSAP بغية تحديد وسائل تعزيز المياه في بيروت الكبرى الاكثر استدامة بيئياً والمقبولة اجتماعياً كي تلبي الطلب على المدى الطويل.


dar al-handasah
مشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب
دراسة تقييم الأثر البيئي والإجتماعي
مشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب GBWSAP (1)
ينقسم مهام المشروع الى مرحلتين :
المرحلة الاولى
•اجراء مراجعة تقنية، إقتصادية، بيئية، واجتماعية واسعة، من ضمنها تقييم اولي للاثر البيئي والاجتماعي لكافة المصادر البديلة واقتراح الخيار مفضّل
المرحلة الثانية
•اجراء تقييم للاثر البيئي والاجتماعي من الفئة أ، من ضمنها خطة ادارة بيئية، واذا لزم الامر، مستندات اعادة الإسكان، للخيار المفضل الموافق عليه

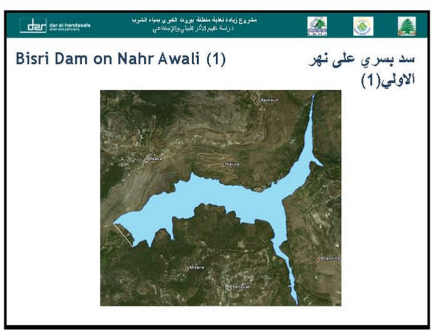
2


dar al-handasah
مشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب
دراسة تقييم الأثر البيئي والإجتماعي
مشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب GBWSAP (2)
• سوف يتبع تقييم الأثر البيئي والإجتماعي للمشروع المعايير الدولية مثل ضمانات البنك الدولي، وذلك وفقاً لسياسة الحكومة اللبنانية.
• تم تكليف دار الهندسة (شاعر ومشاركوه) لتحضير الدراسة، نظراً لخبرتها الطويلة في مشاريع البنى التحتية، ولكونها لم تقم بإعداد أي من الدراسات التي ستتم مراجعتها.


dar al-handasah
مشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب
دراسة تقييم الأثر البيئي والإجتماعي
مشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب GBWSAP (3)
إستشارات العامة الأولية
تحديد نطاق الدراسة
تقييم الأثر البيئي والإجتماعي الأولي (دراسة مقارنة)
مسودة تقييم الأثر البيئي والإجتماعي+المسح الإقتصادي والإجتماعي (الخيار المفضل)
مناقشة نتائج تقييم الأثر البيئي والإجتماعي مع العامة
تقييم الأثر البيئي والإجتماعي النهائي+ خطة إعادة الإسكان
يتضمن تقييم الأثر البيئي والإجتماعي خطة للإدارة البيئية والإجتماعية


dar al-handasah
مشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب
دراسة تقييم الأثر البيئي والإجتماعي
Alternative Source of Water
الخيارات التي سيتم البحث فيها
1. خيار الـ <<لا مشروع>>
2. التحسين بالتوزيع
3. الحد من التسرب
4. تخفيض المياه غير المحتسبة
5. بناء السدود
6. المياه الجوفية
7. تحلية مياه البحر
8. حصاد مياه الأمطار
9. معالجة مياه الصرف الصحي

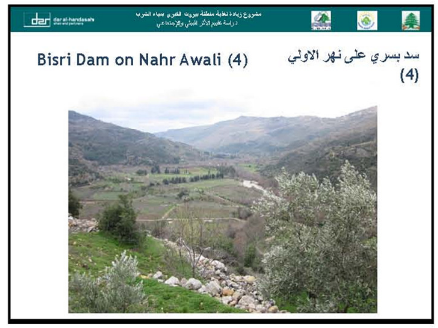

dar al-handasah
مشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب
دراسة تقييم الأثر البيئي والإجتماعي
Potential Dam Solutions
بناء السدود كحل محتمل
• سد بسري على نهر الاولي
• سد الدامور على نهر الدامور (موقعين)
• سد جنة على نهر ابراهيم
سد الدامور
سد بسري
سد جنة

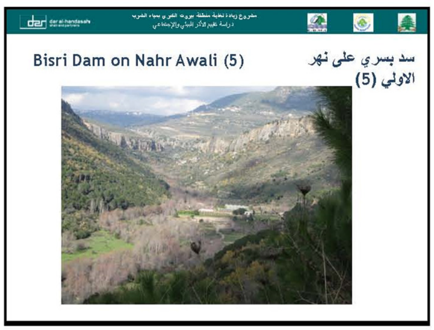

dar al-handasah
مشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب
دراسة تقييم الأثر البيئي والإجتماعي
Bisri Dam on Nahr Awali (1)
سد بسري على نهر الاولي(1)

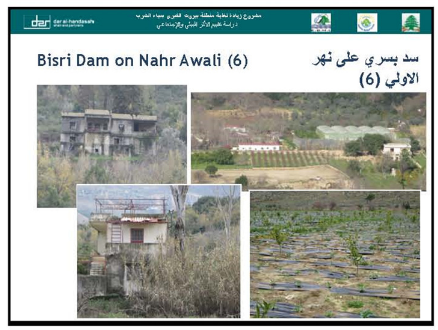

dar al-handasah
مشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب
دراسة تقييم الأثر البيئي والإجتماعي
Bisri Dam on Nahr Awali (2)
سد بسري على نهر الاولي (2)

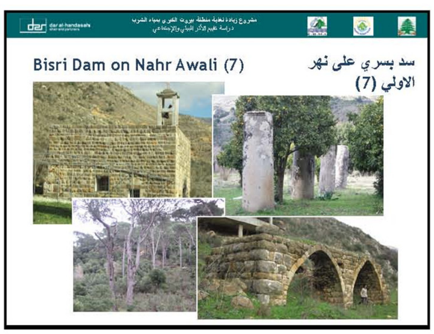
3


Bisri Dam on Nahr Awali (3)
سد بسري على نهر الاولي (3)


Bisri Dam on Nahr Awali (4)
سد بسري على نهر الاولي (4)


Bisri Dam on Nahr Awali (5)
سد بسري على نهر الاولي (5)


Bisri Dam on Nahr Awali (6)
سد بسري على نهر الاولي (6)


Bisri Dam on Nahr Awali (7)
سد بسري على نهر الاولي (7)


Damour Dam on Nahr Damour (2 sites)
سد الدامور على نهر الدامور (موقعين)

4


Jannah Dam on
Nahr Ibrahim (1)
سد جنة على نهر ابراهيم (1)


Jannah Dam on
Nahr Ibrahim (2)
سد جنة على نهر ابراهيم (2)


Jannah Dam on
Nahr Ibrahim (3)
سد جنة على نهر ابراهيم (3)

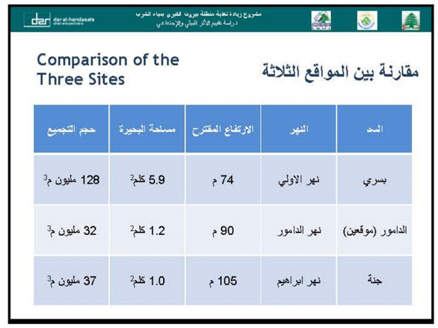

Jannah Dam on
Nahr Ibrahim (4)
سد جنة على نهر ابراهيم (4)

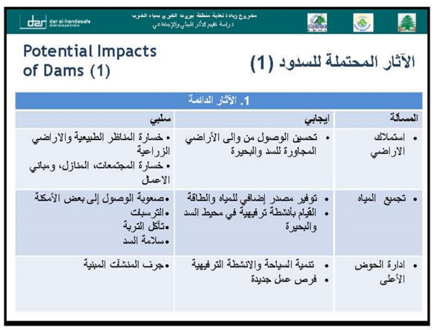

Jannah Dam on
Nahr Ibrahim (5)
سد جنة على نهر ابراهيم (5)

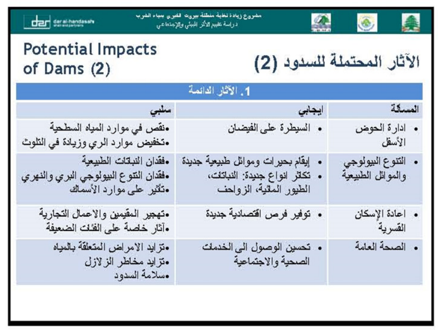

Jannah Dam on
Nahr Ibrahim (6)
سد جنة على نهر ابراهيم (6)

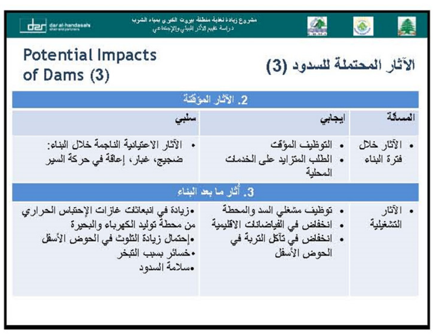
6


dar al-handasah
مشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب
دراسة تقييم الأثر البيئي والإجتماعي
Jannah Dam on Nahr Ibrahim (7)
سد جنة على نهر ابراهيم (7)


dar al-handasah
مشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب
دراسة تقييم الأثر البيئي والإجتماعي
Comparison of the Three Sites
مقارنة بين المواقع الثلاثة
السد
النهر
الارتفاع المقترح
مسلحة البحيرة
حجم التجميع
بسري
نهر الاولي
74 م
5.9 كلم2
128 مليون م3
الدامور (موقعين)
نهر الدامور
90 م
1.2 كلم2
32 مليون م3
جنة
نهر ابراهيم
105 م
1.0 كلم2
37 مليون م3


dar al-handasah
مشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب
دراسة تقييم الأثر البيئي والإجتماعي
Potential Impacts of Dams (1)
الآثار المحتملة للسدود (1)
1. الآثار الدائمة
المسألة
ايجابي
سلبي
استملاك الاراضي
تحسين الوصول من والى الأراضي المجاورة للسد والبحيرة
خسارة المناظر الطبيعية والاراضي الزراعية
خسارة المجتمعات، المنازل، ومباني الاعمال
تجميع المياه
توفير مصدر إضافي للمياه والطاقة
القيام بأنشطة ترفيهية في محيط السد والبحيرة
صعوبة الوصول إلى بعض الأمكنة
الترسبات
تآكل التربة
سلامة السد
ادارة الحوض الأعلى
تنمية السياحة والانشطة الترفيهية
فرص عمل جديدة
جرف المنشآت المبنية


dar al-handasah
مشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب
دراسة تقييم الأثر البيئي والإجتماعي
Potential Impacts of Dams (2)
الآثار المحتملة للسدود (2)
1. الآثار الدائمة
المسألة
ايجابي
سلبي
ادارة الحوض الأسفل
السيطرة على الفيضان
نقص في موارد المياه السطحية
تخفيض موارد الري وزيادة في التلوث
التنوع البيولوجي والموائل الطبيعية
إيقام بحيرات وموائل طبيعية جديدة
تكاثر انواع جديدة: النباتات، الطيور المائية، الزواحف
فقدان النباتات الطبيعية
فقدان التنوع البيولوجي البري والنهري
تأثير على موارد الأسماك
اعادة الإسكان القسرية
توفير فرص اقتصادية جديدة
تهجير المقيمين والاعمال التجارية
آثار خاصة على الفئات الضعيفة
الصحة العامة
تحسين الوصول الى الخدمات الصحية والاجتماعية
تزايد الامراض المتعلقة بالمياه
تزايد مخاطر الزلازل
سلامة السدود


dar al-handasah
مشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب
دراسة تقييم الأثر البيئي والإجتماعي
Potential Impacts of Dams (3)
الآثار المحتملة للسدود (3)
2. الآثار المؤقتة
المسألة
ايجابي
سلبي
الآثار خلال فترة البناء
التوظيف المؤقت
الطلب المتزايد على الخدمات المحلية
الآثار الاعتيادية الناجمة خلال البناء: ضجيج، غبار، إعاقة في حركة السير
3. آثار ما بعد البناء
الآثار التشغيلية
توظيف مشغلي السد والمحطة
انخفاض في الفياضانات الاقليمية
انخفاض في تآكل التربة في الحوض الأسفل
زيادة في انبعاثات غازات الإحتباس الحراري من محطة توليد الكهرباء والبحيرة
إحتمال زيادة التلوث في الحوض الأسفل
خسائر بسبب التبخر
سلامة السدود


dar al-handasah
مشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب
دراسة تقييم الأثر البيئي والإجتماعي
Environmental Management
الإدارة البيئية
سيتم إقتراح سبل لتفادي، الحدّ ، وإدارة كل من الآثار السلبية الناتجة عن المشروع، خلال فترة التصميم، والبناء، والتشغيل.
سيتم إعداد خطة للإدارة البيئية والإجتماعية.
سيقوم المقاول بتحضير خطة للإدارة البيئية خلال فترة البناء.

7

dar al-handasah

مشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب
دراسة تقييم الأثر البيئي والإجتماعي

Land Take Mitigation الحد من إستملاك الاراضي

- تطبيق عادل لاستملاك الأراضي وإعادة الإسكان.
- القيام بمسح اجتماعي واقتصادي من شأنه توفير المعلومات اللازمة عن الأسر والشركات. بغية ضمان تحقيق عملية الإستملاكات بأقل حدّ ممكن من الاضطراب والمشقة .
- تحضير الوثائق المتعلقة بإعادة الإسكان.

dar al-handasah

مشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب
دراسة تقييم الأثر البيئي والإجتماعي

Your Opinion Matters رأيكم يهمنا

نود الآن معرفة وجهات نظركم بعد أن اطلعتم على المشروع.

لا تترددوا بطرح أي سؤال والاشارة الى أية هواجس، أو إبداء أي ملاحظات.

ما هي بنظركم الآثار الأولية البيئية أو الاجتماعية؟

كيف يُحتمل ان يتأثر الاشخاص الذين تمثلونهم؟

كيف سيتأثر مجتمعكم؟

كيف ستتأثرون انتم وعائلتكم؟

dar al-handasah

مشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب
دراسة تقييم الأثر البيئي والإجتماعي

Addressing Public Consultation استشارات العامة

جلسة تحديد النطاق	المكان	التاريخ
ندوة مع المعنيين في القطاع	مجلس الانماء والاعمار	3 نيسان
سد بسري	بلدية مزرعة الضهر	10 نيسان
سد الدامور	بلدية دميت	12 نيسان
سد جنة	بلدية قرطبا	21 نيسان
مستهلكو المياه في ضواحي بيروت الجنوبية	بلدية الحدث	24 نيسان
مستهلكو المياه في مدينة بيروت	بلدية بيروت	5 أيار

- *سيتم عقد جلسات اخرى عند الطلب*
- *سيتم عقد مجموعة اضافية من المشاورات لنشر نتائج تقييم الآثار البيئية والاجتماعية*

dar al-handasah

شكراً لمشاركتكم

نرحّب بتعليقاتكم
تبقى فرصتكم للتعليق مفتوحة لمدة ستة أيام عمل

1. استخدموا ورقة التعليقات المقدمة واتركوها معنا اليوم
2. يمكنكم توجيه تعليقاتكم لـ **BWSA 12002**، وارسالها بالفاكس على الرقم 01/869026
3. يمكنكم ارسال تعليقاتكم على البريد الالكتروني التالي: BWSA.12002@dargroup.com
4. هاتف او رسالة قصيرة على 71-137532

نتطلع للسماع منكم

dar al-handasah

شكراً

مشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب
دراسة تقييم الأثر البيئي والإجتماعي
(المرحلة الأولى)

Greater Beirut Water Supply Augmentation Project
Environmental and Social Impact Assessment
(Phase 1)

8

مشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب

دراسة تقييم الأثر البيئي والإجتماعي

1. مقدمة

قدر عدد سكان لبنان بـ4.4 مليون في العام 2010، 46% منهم يعيشون في بيروت الكبرى وجبل لبنان. يتلقى حوالي 1.8 مليون شخصاً المياه من جعيتا عبر محطات المعالجة في ضبية، إلا ان إمدادت المياه غير كافية وغير متوازنة موسمياً. والجدير بالذكر أن بعض الأسر المعيشية تتلقى المياه من الإمدادات العامة لأقل من 3 ساعات يومياً.

من المتوقع ان يصل عدد سكان لبنان الى 6.8 مليون بحلول العام 2035. تبلغ الموارد المائية المتجددة في لبنان حوالي 600 متر مكعب/للشخص/سنوياً، بينما يبلغ خط الفقر المائي الذي وضعته الامم المتحدة 1000 متر مكعب/للشخص/سنوياً. بالتالي، هناك مخاطر عالية للنقص المزمن في المياه بحلول العام 2020.

أطلق مجلس الانماء والاعمار بالتعاون مع وزارة الطاقة والمياه ومؤسسة مياه بيروت وجبل لبنان مشروع تغذية منطقة بيروت الكبرى بمياه الشرب للتغلب على العجز الحالي وضمان الإمدادات المستدامة لتلبية الطلب على المدى القصير والمتوسط. سيتّم من خلال المشروع تحسين توزيع الإمدادات، بما في ذلك الحدّ من التسّرب ونقل 50 مليون متر مكعب من المياه سنوياً من بحيرة القرعون بغية توزيعها على مستهلكي بيروت الكبرى.

تبحث وزارة الطاقة والمياه منذ عدّة سنوات عن إمكانية تخزين المياه الناتجة عن جريان المياه السطحية المفقودة سنوياً الى البحر عبر إنشاء بحيرات وبناء السدود والخزانات الكبيرة لتعزيز الإمدادات الزراعية وتلبية متطلبات بيروت الكبرى والمراكز السكانية الاخرى على المدى الطويل.

مشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب GBWSAP

أطلق مجلس الانماء والاعمار، بالتعاون مع وزارة الطاقة والمياه ومؤسسة مياه بيروت وجبل لبنان، هذا المشروع الجديد لزيادة تغذية منطقة بيروت الكبرى بمياه الشرب GBWSAP بغية تحديد الوسائل الاكثر مستدامة بيئياً والمقبولة اجتماعياً كي تلبي الطلب على المدى الطويل. تنقسم مهام المشروع الى مرحلتين:

المرحلة الاولى

إجراء مراجعة بيئية وإجتماعية واسعة، من ضمنها تقييم أولي للاثر البيئي والاجتماعي لكافة المصادر البديلة واقتراح البديل المفضّل.

المرحلة الثانية

اجراء تقييم للاثر البيئي والاجتماعي من الفئة أ، من ضمنها خطة ادارة بيئية، واذا لزم الامر، مستندات اعادة الإسكان، للبديل المفضل الموافق عليه.

سوف يتبع مشروع زيادة تغذية منطقة بيروت الكبرى بمياه الشرب GBWSAP سياسات ضمانات البنك الدولي ومتطلبات الإستشارات العامة، وذلك وفقاً لسياسة مجلس الانماء والاعمار والاجراءات الدولية الثابتة للمستشارين.

تتضمن المصادر البديلة للمياه التالي:

1. تحسين توزيع المياه
2. الحد من التسرّب
3. تخفيض غيرها من المياه غير المحتسبة
4. بناء السدود

يمكن تحسين الامدادات الحالية للمياه بشكل كبير والتقليل من الخسائر نتيجة التسرّب والوصلات غير القانونية. سوف يساهم تحصيل الفواتير في تحسين استرداد التكاليف والمساعدة في تمويل عمليات خدمات المياه. في حين ان هذه التدابير ستمكّن الامدادات الحالية الإستجابة لمطالب المدى القصير والمتوسط، لا بدّ من توفير موارد اضافية للمياه لتلبية الطلبات على المدى الطويل.

ان الوسائل الأقل تكلفة لضمان امدادات جديدة ومستدامة للمياه هي الحفاظ على ما يزيد عن 160 مليون متر مكعب سنوياً من المياه السطحية العذبة التي تفيض الى البحر، من خلال بناء سدود مثل:

1. سد بسري على نهر الاولي
2. سد الدامور على نهر الدامور (موقعين)
3. سد جنة على نهر ابراهيم

يبيّن الجدول التالي مقارنة بين المواقع الثلاثة.

السد	النهر	الارتفاع المقترح	مساحة الخزان	حجم التجميع	امدادات المياه المتوقعة
بسري	نهر الاولي	74 م	5.9 كلم^2	128 مليون م^3	0.56 مليون م^3/يوم
الدامور	نهر الدامور	90 م	1.2 كلم^2	32 مليون م^3	0.2 مليون م^3/يوم
جنة	نهر ابراهيم	105 م	1.0 كلم^2	37 مليون م^3	0.2 مليون م^3/يوم

الآثار البيئية والاجتماعية

أيا كان البديل المفضّل ، سوف تنتج آثار بيئية واجتماعية عن المشروع. وقد تكون الآثار سلبية او ايجابية، مؤقتة او دائمة، مباشرة او غير مباشرة.

تتمركز الآثار الايجابية حول تزويد امدادات المياه المستدامة للعامة والتحسينات التي ستنعكس على الحياة الاجتماعية، هذا بالإضافة إلى فرص النمو والتطور الاقتصادي.

وتركز الآثار السلبية الدائمة على استملاك الاراضي، والحاجة الى اعادة إسكان الاسر ونقل الاعمال التجارية. هذا الى جانب المسائل الصحية العامة التي ترافق بناء السدود إجمالاً مثل تكاثر الحشرات والمخاطر المتزايدة للغرق. وتتم مناقشة الآثار الدائمة خلال تصميم المشروع.

تنتج الآثار السلبية المؤقتة بشكل اكثر شيوعا خلال فترة البناء نتيجة نشاطات المقاول ومستخدميه. وعلى الاغلب سوف تزيد من الضجة والغبار ومشاكل ادارة السير والاضطراب الاجتماعي بين المقيمين ونزوح العمال. تتم مناقشة هذه المسائل في خطة سلامة الصحة البيئية العائدة للمقاول، اضافة الى خطة الادارة البيئية والاجتماعية للمشروع.

اخيراً ان الآثار التشغيلية هي تلك التي سوف تنتج عن تشغيل المرافق. وقد تتضمن الضجة واهتزاز المضخات والتخلص من النفايات. وتتم مناقشة الآثار التشغيلية خلال تصميم المشروع.

سيتم إقتراح تدابير لتخفيف، تجنّب، وادارة جميع الآثارالمنتجة وسيتم التحقق من آلية الإمتثال لخطط الادارة البيئية.

الحد من إستملاك الاراضي

إن الأثر الأكبر للمشروع هو إستملاك الأراضي. سيتم تطبيق عملية استملاك الأراضي وإعادة الإسكان وفقاً للقانون اللبناني حول نزع الملكية والاجراءات العملية للبنك الدولي OP 4.12 ، وسيعتمد التطبيق الاكثر صرامة في حال وجود ثغرات بين الإجراءين.

سوف يقوم الاستشاري ، قبل تحديد البديل المفضل بشكل نهائي، بإعداد وثيقة *الإطار السياسي لاعادة الإسكا RPF* التي سوف تتضمن مقارنة مفصلة بين التشريع اللبناني ومتطلبات سياسة البنك الدولي، وتحديد إجراءات إعادة الإسكان التي سوف تتبعها عملية إستملاك الاراضي المتعلقة بالمشروع.

ما ان يتم الاتفاق على البديل المفضل وتحديد مدى إستملاك الاراضي وإعادة الإسكان، سيقوم الاستشاري بمسح اجتماعي واقتصادي من شأنه توفير المعلومات اللازمة عن الأسر والشركات بغية ضمان تحقيق عملية الإستملاكات باقل حد ممكن من الاضطراب والمشقة.

APPENDIX M

Assessment of Quarries and Associated Environmental Impact

Bisri Dam and Potential Use of Quarries

As per preliminary detailed design estimates, Bisri Dam will consume approximately 6 million tonnes of building materials, of which approximately 80% is expected to be from existing workings and borrow areas within the reservoir area.

The contractor will procure the remaining 20% of materials (mostly anticipated to be riprap materials) from existing commercial quarries. Lebanon has a large number of commercial quarries; all of which have been subject to a permit from the Ministry of Environment. Bisri is well located to take advantage of quarries in the foothills south of Damour and within the Nahr Awali Valley downstream of the dam site. Quarries in the vicinity of Bisri are shown in Figure 1.

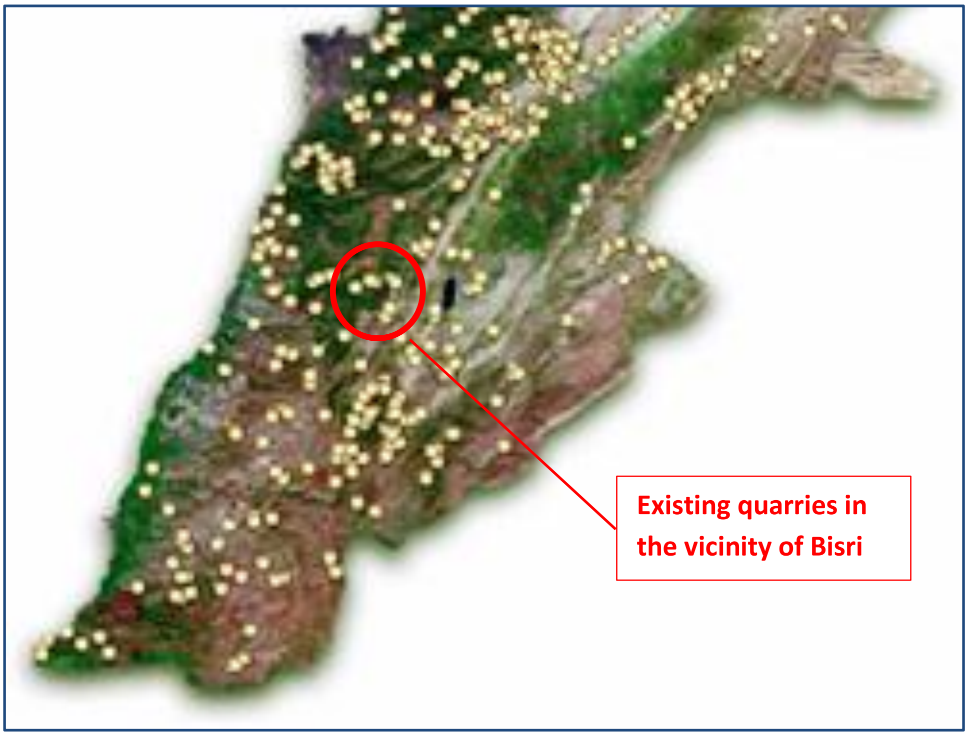


Figure 1: Location of Quarries in the Vicinity of Bisri

Quarry Permitting in Lebanon

Existing commercial quarries and/or re-opening new quarries are subject to strict environmental controls and permitting procedures through the Ministry of Environment (MoE). These include the following national applicable legislation:

- Law # 216 dated 2/4/1993 (Establishment of MoE) and its amendments (law # 667 dated 29/12/1997)
- Law # 64 dated 18/8/1988 (Conservation of the Environment Against Pollution from Harmful Wastes and Dangerous Substances)
- Order # 253/ LR dated 8/11/1935 (Organization of Existing and Future Quarries)
- Decree # 5591 dated 30/8/1994 (Organizational Structure of the Ministry of Environment and its Jurisdictions)
- Decree # 5616 dated 6/9/1994 (Organization of Quarries)
- Council of Ministers Decision # 15 dated 21/9/1994 (Halt All Work in Unlicensed Sand and Stone Quarries)

- MoE Minister Decision # 52/1 dated 29/7/1996 (Identification of Criteria for Limiting Air, Water and Soil Pollution)
- MoE Minister Decision # 182/1 dated 7/11/1997 (Documentation Requirements and Criteria for Stone Quarries)
- MoE Minister Decision # 183/1 dated 7/11/1997 (Documentation Requirements and Criteria for sand Quarries and Natural Pebbles)
- MoE Minister Decision # 184/1 dated 7/11/1997 (Documentation Requirements and Criteria of Stone Quarries for Mosaic Production)
- MoE Minister Decision # 185/1 dated 7/11/1997 (Documentation Requirements and Criteria of Quarries Producing Decorative Stones and Building Stones)
- MoE Minister Decision # 186/1 dated 7/11/1997 (Documentation Requirements and Criteria of Stone Quarries for Cement Production)
- Council of Ministers Decision # 31 dated 28/7/1999 (Quarry Permitting Requirements and Site Locations)
- MoE Minister Decision # 8/1 dated 30/1/2001 (National Standards for Environmental Quality)

MoE 2002 Decree no 8803 and its subsequent amendments governs the establishment of all new quarries. The Ministry of Environment procedure is well established and is illustrated in Figure 2.

As described in Figure 2, the licensing process commences with the owner applying to open a quarry through the Governor, who passes the request to the Ministry of Environment and its Higher Council for Quarries. Via the Ministry of Interior and Municipalities, the license application is passed to the local municipality or the “Kaim makam”. The decision on the application then returns to the Governor (via the stakeholders described above) with final authority to the Governor to deny approval or issue the permit.

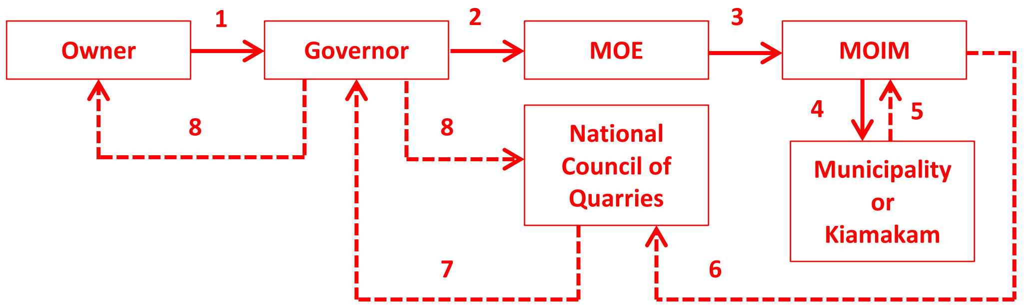


Figure 2: Permitting Procedure for Quarries in Lebanon

The Environmental and Social Impact of Quarries

In addition to the permitting requirements set by MoE, detailed environmental mitigation measures are also enforced by the Ministry on all quarries and this to mitigate positive and negative, short and long term, direct and indirect, reversible and irreversible impacts on the physical, biological and socio-economic environment.

In respect of the physical environment, the most significant impacts are likely to be the following:

- Degradation and/or pollution of water resources;
- Impairment of air quality and dust;
- Noise and vibration; and,

- Degradation of natural landscape and soils.
- Possibility of encountering archaeological materials

A list of potential impacts that commonly accrue form the development and operation of quarries are given below under Environmental Management Plan. To ensure these are addressed for any opening or re-opening of quarries for the construction of Bisri Dam, the contractor will take this framework document and produce an Environmental Impact Assessment (EIA) incorporating and Environmental Management Plan (EMP) tailored to his specific site, quarry plan, method of working, and after-use plan.

Considering Alternatives

The EIA for a new quarry will include an analysis of the consequences of adopting various alternatives including but perhaps not limited to:

- The quarry location, which depends on several factors such as distance to material destination, transportation access, adequate water supply and avoidance of areas with sensitive resources;
- The quarrying method which is determined for the most part by economics, depth, configuration, grade, characteristics of the body and the geology of the host rock;
- The site layout including the placement of the quarried material and the siting of structures/utilities in order to avoid resources conflict;
- The management or administrative practices including timing of operations and controlling rate of development in order to limit socio-economic impacts; and
- The mitigation and rehabilitation options.

The ‘Do Nothing’ or ‘Without project’ alternative will always be considered.

The selection of the preferred option will be justified in terms of:

- Meeting the project objectives (material quantity and quality);
- Considering environmental factors including biophysical and socio-economic factors;
- Complying with the national standards for environmental quality;
- Reducing the costs, including the environmental costs;
- Preserving natural and cultural heritage;
- Safeguarding public health and social issues; and
- Reducing public controversy.

Environmental Management Plan

An Environmental Management Plan (EMP), an integral element of any EIA, sets out the measures to be taken to avoid, mitigate potential environmental and social impacts, and to manage any residual impact. The EMP comprises three sections; Mitigation Plan to resolve the impacts, Monitoring Plan to show how the mitigation measures are succeeding, and Institutional Strengthening/Capacity Building Plan to provide the expertise necessary for project and EMP implementation throughout design, construction and operation.

Mitigation: Common impacts accruing from the development and operation of quarries, and their prime means of mitigation, are listed in Table 1.

Table 1: Potential Environmental Impacts of Quarries and Selected Mitigation Measures

Environmental Concern	Potential Impacts	Selected Mitigation Measures
Water resources and water quality	• Decrease in aquifer recharge and increase in surface runoff; • Disturbance to land drainage, overload and erosion of watercourses; • Changes to the surface over which water flows; • Changes to surface and groundwater resources quantity and quality due to stream blockage and contamination by particulate matter or waste; • Contamination of aquifers due to removal of the natural filter medium. • Groundwater contamination by quarry wastes.	• Utilise retention ponds to equalise storm discharge to watercourses and reduce sediment load; • No quarry-related activities to be located with the watercourse corridor; • Divert drainage from upper catchments around project area; • Implement affective waste management.
Air quality and dust	• Reduction in visibility due to dust plumes. • Coating of surfaces leading to annoyance and loss of amenity. • Physical and/or chemical contamination and corrosion. • Increase in the concentration of suspended particles in runoff water. • Coating of vegetation leading to reduced photosynthesis, • Inhibited growth, destroying of foliage, degradation of crops; • Increase in health hazards due to inhalation of dust.	• Plant wind breaks; • Cover crushers, screens and heaps of stared material; • Mist access roads and other place where dust may accumulate; • Cover trucks; • Fit dust suppression systems.
Noise and vibration	• Annoyance and deterioration of the quality of life; • Disturbance to animals and birds, reduced reproduction; • Shaking due to blasting of buildings and people; • Propelling of rocks fragments by blasting; • Disturbance to subsurface geology and ground water flow paths.	• Provide noise control measures; • Limit hours of operation; • Adopt suitable blasting techniques for each site; • Measure vibration and air overpressure as a function of distance, charge and delay; • Adopt adequate blasting design protocols; • Use more frequent blasting and reduce the surface area; • Use delayed detonation for better fragmentation and less vibration; • Avoid gas venting by filling shot holes; • Blast a heave depth not more than 6 m and adopt terracing to reduce rock flight, vibration, overpressure and instability; • Avoid blasting in adverse weather conditions.
Landscape and soils	• Destruction of natural landscapes; • Visual impairment; • Changes in soil characteristics; • Soil erosion and slope instability.	• Avoid unnecessary tree felling; • Create landscaped amenity bunds to improve distant vistas
Visual intrusion	• Excavated scars on open hillside visible from long distances; • Crushing, grading and coating plants visible from road; • Reject material and redundant plant dumped along roadside;	• Plant trees to provide local treatment and windbreaks; • Place crusher and other plant within quarry, not on the road; • Avoid a straight uninterrupted vision of the working site;

	• Surrounding areas coated in dust.	• Construct amenity embankments to obscure view, define rights of way of rivers, and prevent erosion; • Fill depressions with soil to promote vegetative growth; • Promoting vegetation on quarry faces.
Biological impacts	• Direct impacts include land clearance and excavation causing destruction of flora and fauna and loss of habitats; • Indirect impacts include habitat degradation due to noise, dust, and human activity.	• Early in project development, undertake an ecological survey; • Utilize mitigation measures as for the physical issues for the biological environment.
Socio-economic impacts	• Resettlement and loss of livelihood; • Health and safety of workers and the general public; • Reduction in property values; • Loss of agriculture; • Increase in traffic volumes and sizes of road vehicles; • Economic issues, including the increase in employment opportunities; • General deterioration of the quality of life. • Possibility of encountering archaeological materials.	• Avoid the need for resettlement; where inevitable, relocation will be fully compensated; • Train all staff in effective management and H&S; • Minimise transport-related impacts by effective fleet management including adherence to load capacities; vehicle maintenance; adequate space for site ingress and egress; clear signage, wheel washes at site exits, and driver instruction • Develop an After-Use Plan for the site. If no immediate use is expected, document proposals to maintain slope stability and Public Health and Safety. • Chance finds of archaeological materials can be mitigated by contacting the Directorate General of Antiquities (DGA) at the Ministry of Culture, and following the guidelines as provided in the relevant ESIA appendix.

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Monitoring*:* Appropriate environmental quality monitoring will be carefully designed and related to the predictions made in the EIA and the key environmental indicators that will demonstrate the sustainability of the project. The EIA will outline the need for and use of any monitoring, monitoring intervals and reporting procedures. Responsibility for monitoring primarily rests with the contractor, but check measurements will also be undertaken by the supervision consultant. The Ministry of Environment may also wish to undertake selected verification monitoring independently of other parties. Parameters that are commonly measured throughout quarry development and operation include:

- Air quality (particulate and equipment emissions);
- Groundwater (drawdown);
- Seismic (blast) vibrations;
- Noise level;
- Pit wall slope and stability;
- Surface water flow and quality (especially sediment);
- Amount and timing of stream diversion;
- Quarry drainage; and,
- Sanitary wastes.

The Monitoring Plan will separately identify and disposal of non-economic quarried material and that of other wastes, including any hazardous waste.
At crushing operations, the following parameters will be monitored:

- Air quality at stacks, on-site and facility boundaries;
- Quantity and quality of water discharge;
- Identification and proper handling of hazardous wastes; and,
- Noise levels both on-site and facility boundaries.

At rehabilitation operations, the following parameters will be monitored:

- Restoration of land surface (drainage, slope, and stability);
- Re-vegetation (cover, type, vigor);
- surface water quality; and,
- Other parameters depending on the future use of the quarry.

The Monitoring Plan must provide the following details:

- Key parameters that will be monitored, and for each, the monitoring locations, intervals and duration as well as the party responsible; and.
- Procedures to be undertaken if monitoring indicates non-compliance or abnormality, the internal reporting procedures and links to management practices and action plans, and reporting to relevant authorities.

Institutional Strengthening Plan: The institutional strengthening plan will demonstrate that sound environmental practice will be followed during the operation and rehabilitation of the quarry through:

- Training programs for the staff and labour such as equipment operation, materials disposal, occupational health and safety, and emergency response to accidents and incidents;
- Training programs for government officials charged with supervision of an environmental management and monitoring plans;
- Strategies to feed information from the monitoring plan back into the management practices and action plans to improve the environmental performance and sustainability of all components of the scheme;
- Organizational charts to show the division of responsibilities for environmental management and the reporting mechanism during quarry operation and rehabilitation;

Project Implementation Arrangements in case of quarry requirements

As described above, the exact volume of construction materials remains an estimate, as per standard dam design and construction practices. As agreed with CDR and described during public consultations, the project implementation agency, prior to, and during construction of Bisri dam as relevant, an EMP for required quarries that includes detailed mitigation measures, monitoring plan, roles responsibility and cost will be submitted to the World Bank for review and no objection. The EMP will include the estimated costs for applying the respective mitigation, monitoring and institutional strengthening measures during quarry operation and rehabilitation. The cost of EMP implementation will rest with the quarry developer and/or operator. Monitoring and supervision will be undertaken by the design consultant, as detailed in the terms of reference for the design engineer, also subject to Bank review.