

**VOLUME 3**

**TECHNICAL SPECIFICATIONS**

**EMERGENCY RECONSTRUCTION WORKS  
FLOOD PROTECTION SYSTEM „MAČVA: SAVA – DRINA“,  
WEST ZONE**

**Section 2:  
BANOV BROD – SALAŠ CRNOBARSKI  
Reconstruction of the right embankments  
of the Sava River and of the Drina River  
(km: 52+832 - km: 63+753)**

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## 1. LIST OF ABBREVIATIONS

1.	BoQ	Bills of Quantities
2.	CA	Contracting Authority
3.	ConstBook	Construction Book ( presented executed works)
4.	Day	Calendar Day
5.	DD	Detailed Design
6.	DIN	German Standards
7.	DNP	Defects Notification Period
8.	EmDefWL	Water level for proclamations of Emergency Flood Defence
9.	EmW Design	Emergency Works Design – temporary Technical documents, according to the act of Government of the Republic of Serbia (Conclusion No25, March 2016), based on Article 143 of the Serbian Law on Planning and Construction.
10.	EN	European Norms
11.	FP	Fire Protection
12.	H&S&E	Health, Safety and Environment
13.	IEC	International Electrotechnical Commission
14.	ISO	International Organisation for Standardisation
15.	LAN	Local Area Network
16.	LS	Lump sum
17.	m.a.s.l.	Meters above sea level
18.	m.b.g.l.	Meters below ground level
19.	m/d	Man-day
20.	MSDS	Material Safety Data Sheet
21.	OSHA	Occupational Safety and Health Administration
22.	PA	Provisional Acceptance
23.	PAC	Provisional Acceptance Certificate
24.	PBAB	Concrete and Reinforced Concrete Rulebook ( <i>Serbian executive act: Pravilnik o betonu i armiranom betonu</i> )
25.	PE-HD	High Density Poly-Ethylene
26.	pcs	Pieces
27.	PP	Polypropylene
28.	PM	Project Manager
29.	PPA	Partial Provisional Acceptance
30.	PS KAL REV	Existing Pump Station “Kalenica – Revenica”

*Serbia Floods Rehabilitation Support*  
**EMERGENCY RECONSTRUCTION WORKS PROJECT**  
*Flood Protection System „Mačva: Sava – Drina“, West zone*  
LOT 2-WEST ZONE

31.	PVC	Polyvinyl Chloride
32.	PWMC	Public Water Management Company (Beneficiary)
33.	QAP	Quality Assurance Plan
34.	QAS	Quality Assurance System
35.	RAL	Colouring system ( <i>Reichs-Ausschuß für Lieferbedingungen und Gütesicherung</i> )
36.	RegDefWL	Water level for proclamations of Regular Flood Defence
37.	RC	Reinforced Concrete
38.	SRPS	Serbian standards
39.	Survey "0" TDoc	Survey Technical Documentation of initial terrain state
40.	TA	Technical Assistant
41.	TR	Technical Requirements
42.	TS	Technical Specification
43.	WL	Water level

## 2. GENERAL REQUIREMENTS

### 2.1. BACKGROUND OF THE PROJECT

#### 2.1.1. Flood protection emergency works - Project description

After the flood event in May 2014 that caused major damages to Mačva and PWMC “Srbijavode”, the cities of Belgrade and Šabac, and the Municipality of Bogatić concluded Agreements on joint financing of reconstruction works on Mačva’s flood protection system, which would include reconstruction and rehabilitation of the levee / embankment, as well as other structures in the immediate vicinity that hindered the safety of the defensive line during the floods in 2014.

The Agreements include works in two zones: the East Zone in the length of ~ 5 km and the West Zone in the length of ~ 20 km.

Funds for financing the investment of “reconstruction of Mačva’s flood protection system” have been provided upon the proposal of PWMC “Srbijavode” within the IPA programme for 2014, *Action Plan for support in eliminating the consequences of floods that will be funded through a financial agreement between the Republic of Serbia and EU for 2014.*

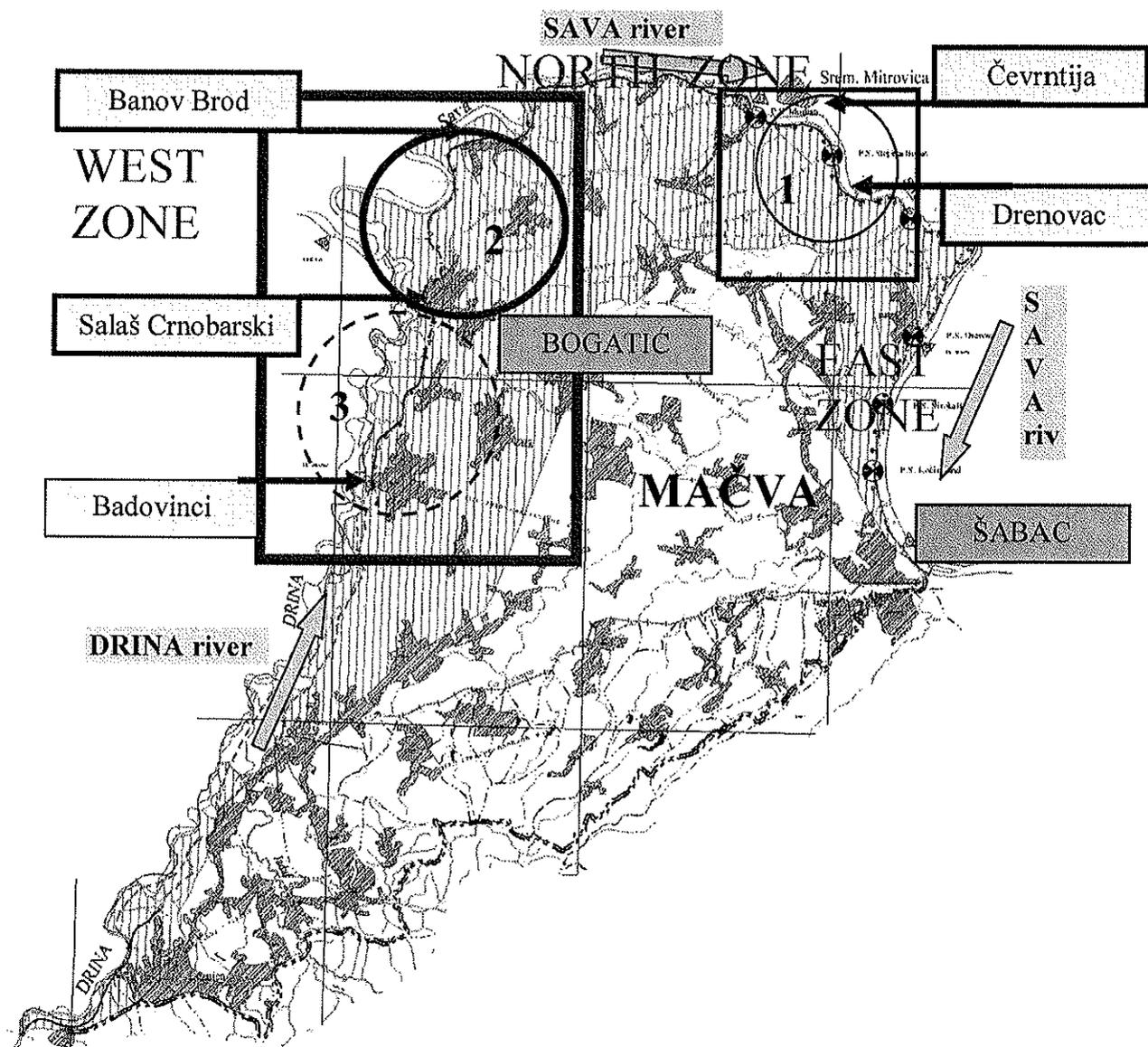
So far and in accordance with the provisions of the Agreement, PWMC “Srbijavode” has successfully completed several tasks providing necessary preconditions for reconstruction of Mačva’s flood protection system.

The following tasks have been completed:

1. *An Expertise on the flood events with the concept of improving the protection of the wider Macva area from high flows of the Sava and Drina Rivers (“Jaroslav Cerni” Institute),*
2. *The technical documentation for works - Emergency Reconstruction Works Designs (EmW Design) for the Protection System Mačva.*

The EmW Design includes 3 sections of the Flood Defence line in Mačva area:

- 1) **Section 1: Flood Protection System „Mačva: Sava – Drina“, East zone: Drenovac - Čevrntija - reconstruction of the right embankments of the river Sava (km: 18+030 – km: 23+100), (5,070 m).**
- 2) **Section 2: Flood Protection System „Mačva: Sava – Drina“, West zone: Banov Brod – Salaš Crnobarski - reconstruction of the right embankment of the Sava river and of the Drina river (km: 52+832 - km: 63+753), (10,921 m).**
- 3) **Section 3: Flood Protection System „Mačva: Sava – Drina“, West zone: Salaš Srnobarski – Badovinci - reconstruction of the right embankment of the Drina river, km: 63+753 - km: 71+280, 7,527 m). Note: reconstruction works on this section are finished and are not the subject of the procurement.**



Based on this design, and in accordance with Article 143 of the *Law on Planning and Construction* (“Official Gazette of the Republic of Serbia”, number 132/14), those works shall have the status of emergency works, and shall be carried out without previously obtaining a building permit, “because the structure is being built immediately before or during natural disasters, or for the purpose of eliminating harmful consequences of these disasters, immediately after their occurrence”:

- PWMC “Srbijavode” submitted to the competent Ministry of Construction, Transport and Infrastructure a request for consent to carry out the works in question by applying this provision, in accordance with the Decision on

- Emergency Works that was issued by a competent municipal authority at the proposal of the Emergency Situations Headquarters of the city of Šabac.
- Pursuant to Article 143, Paragraph 3 of the Law on Planning and Construction, the said Decision on Emergency Works determines an obligation to immediately initiate the procedure and, in parallel with the emergency works, obtain all planning and other documents in order to obtain a building permit for these capital structures of general interest in public ownership, based on which they become permanent structures, “within one year from the cessation of dangers that caused its construction, i.e. the execution of works“.
  - In its memo (number 001-00-00252/2015-07 of 6th April 2015), the competent Ministry of Construction, Transport and Infrastructure confirmed that, due to their urgency and significance, the works in question could be executed as emergency works, in accordance with the said provisions of the Law on Planning and Construction.

Furthermore, the following documents relevant for the emergency reconstruction works of the flood protection system Mačva were prepared (Emergency Works Design):

- Technical specification of the works
- Bill of Quantities
- Design drawings

### **2.1.2. Subject of the procurement, Contracting Authority and Beneficiary**

Subject of the procurement are

**Emergency reconstruction works  
on the Flood Protection System „Mačva: Sava – Drina“,  
West zone: Section 2: Banov Brod – Salaš Crnobarski –  
Reconstruction of the right embankments of the Sava river and of the Drina river  
( km: 52+832 - km: 63+753)**

The current document for procurement presents Technical Specifications (TS) that define the requirements for execution of those Emergency Reconstruction Works.

The Contracting Authority is the European Union, represented by the European Commission on behalf of and for the account of the partner country, Serbia.

The direct Beneficiary is the Public Water Management Company „Srbijavode“ (hereinafter PWMC „Srbijavode“), and the target groups are Municipality of Šabac and citizens of flooded area.

### **2.2. LOCATION**

The Municipality and the city of Bogatić are situated in the northern part of north-west Serbia.

Existing Mačva’s Flood protection system includes the area bordered by the Drina and Sava

Rivers. In this area, there are around 400,000 ha of the most fertile land and two larger settlements – Šabac and Bogatić, and 35 smaller settlements and villages with a total of about 130,000 residents, and numerous industrial and infrastructural facilities. Mačva's protection system is designed as a system that comprises three technical units – zones: East Zone (from km 0+000 to km 23+342), North Zone (from km 23+342 to km 52+832) and West Zone – (from km 52+832 to km 71+280).

### **2.3. SCOPE OF THE WORKS**

The total length of embankment for reconstruction is 10,921 m.

Since the works have the status of emergency works (Flood Protection System „Mačva: Sava – Drina Section 2: “, West zone: Banov Brod – Salaš Crnobarski - the right embankment of the Sava river and of the Drina river ( km: 52+832 - km: 63+753), (10,921 km); they will be carried out without previously obtaining a building permit, according to the act of Government of the Republic of Serbia (Conclusion, 25 of March 2016), based on Article 143 of the Law on Planning and Construction. This act also obliges PWMC "Srbijavode" (as Beneficiary) to complete the obtaining procedure of building permits within one year after completion of the above mentioned protection infrastructure.

For these reasons producing of “As Built Design” (as part of Bill of Quantities) is extremely important for the Beneficiary.

According to this, it is assumed that the present works will be executed in line with the technical documentation, which has the status of Emergency Works Design.

- Besides the need to carry out a complete reconstruction of the levee on the stretch from ~10,9 km, the importance of the structures along the levees, which during flood events have a significant function in terms of protection against high water and successful implementation of flood defense, was also recognized.
- Based on the flood events in 2014, the great importance and role of the access and service roads for successful flood defense was recognized. Stable communication, which allows for a smooth transport of resources and equipment during floods, proved to be one of the important factors for a rapid response and a successful defense. For these reasons, the design provides for the reconstruction of service roads on the crown, on both sides of the levee, as well as 13 access roads in the protected area that ensure stable communication and transport of resources.

During the 2014 flood, there was a significant risk of linear overflow of the existing embankment and also critical points with pronounced instability.

For these reasons, the importance of the reconstruction of certain parts of these facilities was recognized, having in mind that they pose a danger in floods.

### **2.4. CLIMATE**

In Mačva area, the climate is warm and temperate. There is significant rainfall throughout the year in Sabac. Even the driest month still has a lot of rainfall. This climate is considered to be Cfb according to the Köppen-Geiger climate classification. The average temperature in Sabac is 11.6 °C.

The average annual rainfall is 699 mm.

- On average, the warmest month is August,
- On average, the coolest month is January,
- June is the wettest month,
- March is the driest month.

## **2.5. DRAWINGS PROVIDED BY THE CONTRACTING AUTHORITY**

All basic drawings necessary for preparation of Contractor's Proposal are enclosed in Volume 5 of the tender documentation.

All construction works shall be performed in compliance with the requirements of the provided technical and working designs, the regulations in force and these TS.

## **3. CONSTRUCTION SITE**

### **3.1. FENCING AND SIGNBOARDS AT THE CONSTRUCTION SITE**

The Contractor must maintain the security of its activities, including fencing of the construction site according to the regulatory requirements;

- 1) The Contractor should not start any activity, before the Engineer and the Beneficiary have agreed that the fences or other protective measures planned by the Contractor are sufficient to prevent, in a reasonable way, any obstruction or interference in the existing court activities.
- 2) The Contractor shall fence the construction site. The fence shall be installed in line with the regulations on occupational health and safety and a sketch of the construction site approved by the Engineer. The cost for fencing will be as specified in BoQ.
- 3) A Signboard, prepared according to the "Visibility Guidelines of the European Union", shall be fixed on the temporary fence adjacent to the entrance gate to the site;
- 4) The Contractor shall obtain instructions from the Engineer regarding information to be displayed on the signboard. The dimensions and text on the board shall be as per the requirements in the latest version of the EU "Visibility Guidelines" which can be found at [http://ec.europa.eu/europeaid/work/visibility/index\\_en.htm](http://ec.europa.eu/europeaid/work/visibility/index_en.htm). The Contractor shall not undertake or allow billposting or advertising of any kind upon the Works without the written consent of the Engineer. At finalization of works (Provisional Acceptance), all temporary fences, gates and signs erected by the Contractor must be removed;
- 5) The Contractor shall install commemorative plaques at the main site in line with the above manual and in agreement with the Contracting Authority after Provisional Acceptance.

- 6) Construction site board prepared in accordance with the Law on Planning and Construction shall be placed on the temporary fence adjacent to the entrance gate to the site;
- 7) Temporary fences, gates and signs placed by the Contractor must be maintained in good shape until the completion of construction works;
- 8) The Contractor shall provide the whole information concerning the regulations and procedures governing the use of local facilities for access, transport, storage facilities and in compliance with them to take measures for providing the necessary documents;
- 9) The Contractor shall be aware of existing restrictions and shall be responsible for their observance during construction;
- 10) The Contractor shall be liable for all damages on the existing infrastructure caused by him - they shall be repaired at its expense;
- 11) The Contractor will be responsible for ensuring the control of any access or the right to leave the boundaries of the construction site, so that it does not lead to interference with the locals or damage to public or private property as a result of the entry or exit of its employees and subcontractors;
- 12) The Contractor shall indemnify and hold harmless the Contracting Authority against any accusations arising from its failure to comply with the above point, including legal fees and costs.

### **3.2. SITE SERVICES**

Where utility services are not already available on the site, the Contractor is to make its own arrangements for the supply of electricity, water, telephone and sewerage until such time as the permanent works are available for use.

The Contractor shall provide and maintain wherever required adequate supplies of electricity at a suitable voltage and compressed air for all operations to be undertaken to complete the Contract. The Contractor shall also make these services available to subcontractors and, when instructed by the Engineer, to other contractors and employees of the Engineer.

The Contractor shall be responsible for entering into any agreements with the appropriate suppliers, and shall issue all notices and pay all fees, dues, rents, charges and other costs incurred thereby. The Contractor shall, in connection with such supplies, adopt precautions to ensure the safety of all personnel.

#### **3.2.1. Site Lighting and Electrical Power**

The Contractor shall provide and maintain efficient temporary lighting and power supplies for all parts of the works as may be necessary and shall, in connection with such supplies, adopt precautions to ensure the safety of all personnel.

### **3.2.2. Drinking Water and Technical Water**

The Contractor shall provide wherever required adequate supplies potable and service water of proper quality and pressure for all operations to be undertaken to complete the Contract. The Contractor shall also make these services available to subcontractors and, when instructed by the Engineer, to other contractors and employees of the Engineer.

The Contractor shall be responsible for entering into any agreements with the appropriate suppliers, and shall issue all notices and pay all fees, dues, rents, charges and other costs incurred thereby.

### **3.2.3. Hygiene**

The Contractor shall clean as necessary and maintain the site in a hygienic condition and shall comply with the equipment of the Safety Officer appointed by the Engineer and any instructions of the Engineer.

The Contractor shall provide, maintain and remove at the end of the Contract or when directed by the Engineer, adequate toilet facilities including flushing toilets, hot water and showers for the use of its own staff and that of the Engineer adjacent to or as part of their site offices and additional suitable facilities in various parts of the site as necessary for the use of its workmen.

## **3.3. TEMPORARY SITE FACILITIES**

- 1) The Contractor, prior to the start of construction works, shall submit a draft *Design for the organisation and execution of construction*. The Design must be submitted no later than 15 days before the planned start of construction works. The design must indicate the work zones, as well as areas for temporary storage of necessary construction materials and goods, and areas for temporary settlements for the personnel of the Contractor and Engineer.
- 2) The Contractor shall provide and install all necessary facilities/installations for accommodation of its staff, including dressing and rest containers, toilets, drinking and washing water, electricity, etc. All costs for temporary facilities shall be included in the Bid.

### **3.3.1. Facilities for the contractor and Engineer**

- 1) The Contractor shall hand over the fully equipped office to the Engineers within 2 weeks of being ordered to do so.
- 2) The cost of office and accommodation shall be paid by the Contractor and shall be included in the unit prices in the Bill of Quantities.

- 3) All the offices, furniture and equipment, provided to the Engineers under item 3.4.2 and 3.4.3 for perusal during the implementation of the works remain property of the Beneficiary. The assets will be handed over to the Beneficiary in one month time after the date of issuance of the Provisional Acceptance for the works.
- 4) The Contractor shall procure, at its own risk and expense, all additional facilities outside the site that may be necessary for its work.

### 3.3.2. Offices

The Contractor shall design and place, at the location defined by the Beneficiary and the Engineer, the facilities (Office for Engineer) indicated in Table 1 below. Before placing the facilities the Contractor shall arrange terrain on this location (paths, parking places, external lights...)

*Table 1- Facilities for the Engineer*

Room	Size	Furniture
Container Type Office (Locality is defined by the Beneficiary and the Engineer) Together with necessary circulation space, covered entrance porch and parking places for minimum two vehicles.		
One Office	15 m <sup>2</sup>	2 Desk ≥ 2 m <sup>2</sup> , with file drawer and drawers, all lockable, incl. keys; 1 low table ≈ 1 m <sup>2</sup> ; 2 chairs with rolling casters, 1 file cabinet, steel, lockable incl. keys, 50/150/50 cm; 1 bookshelf, 1 m x 2 m, 30 cm deep; 1 coat stand; 1 wastepaper basket 1 AC unit (cooling and heating) inverter type 12 BTU
One Meeting room	15 m <sup>2</sup>	1 Desk ≥ 4 m <sup>2</sup> ; 8 visitors' chairs; 1 wastepaper basket 1 AC unit (cooling and heating) inverter type 12 BTU
One Kitchen - tea room	6 m <sup>2</sup>	1 cupboard; 1 table (1 m <sup>2</sup> ) 1 refrigerator, capacity ≥ 150 l; 1 boiler 10 l; 1 locker
One Toilet	6 m <sup>2</sup>	1 boiler 30 l 1 complete sanitary facilities
One Store	9 m <sup>2</sup>	1 bookshelf, 1 m x 2 m, 30 cm deep; 2 low tables ≈ 1 m <sup>2</sup> ; 2 fire extinguishers, wall mounted and 1 first aid kit

All external doors shall be fitted with a secure lock for which a minimum of three keys shall be provided.

All windows shall have double vacuum glass, anti-mosquito gauze and venetian blinds.

Lighting shall be of the led raster type (40-60 W/room).

All offices shall have at least two grounded electrical sockets, rooms exceeding 10 m<sup>2</sup> floor area, having at least one additional socket per 5 m<sup>2</sup> of floor area or part thereof.

The Contractor shall provide external lighting (at each side of the container) for the office and arrange for collection and disposal of waste.

The Contractor shall supply, install and maintain in the offices, equipment and furniture which shall be new, undamaged and complete with all necessary keys.

The Contractor shall supply, install and maintain furniture such as desks, cupboards, drawing tables and plan chests, chairs and shelves, etc. in the numbers, trademarks and quality as approved by the Beneficiary and the Engineer.

The Contractor shall arrange internet connection.

### **3.3.3. Equipment**

- 1) 4x4 Vehicle, 4-5 seats, 5-Door, diesel, >100 hp, with AC, Central Locking, ABS braking system, Radio/MP3/CD, including fuel and maintenance, for the exclusive use of the Engineer and its staff for the entire duration of the contract. The vehicle will be maintained by the Contractor in all respects (fuel, insurance, taxes, license, all maintenance) and in the event of the unavailability of the vehicle for whatever reason and at any time, the Contractor shall provide a replacement vehicle,
- 2) Compact digital camera, in carrying case, minimum 10 megapixels and 4 x optical zoom function, including 2 x 4Gb memory cards and additional battery,
- 3) AC units of sufficient capacity equal to the gross volume of all the rooms served, complete with all supports, electrical and plumbing work;
- 4) Two Lap-top computers 7<sup>th</sup> generation, 15.6", intel Core 7, Windows certified OS
- 5) Multifunctional Laser Printer/Scanner/Copier/Fax size A3 with scale up/down function, minimum 12 pages/min, double-sided printing function, automatic paper feeding and collating function, 3 paper trays,
- 6) Separate High speed internet connection with access in each office (hard wired or wireless),
- 7) Two mobile smartphones: waterproof, shockproof, touchscreen, 4,5 inch, Android, Colour: (24-bit) 16.777.216, 4G, Octacore processor, at least RAM 3Mb, Li-on battery 3800 mAh; external charger 2A.
- 8) The Contractor shall supply consumables, such as fax/photocopy paper (A4/A3 sizes), computer diskettes and CDs, towels, soap, toilet paper, disinfectant, and cleaning materials as required. The cost of telephone, internet and fax usage shall be borne by the Contractor.
- 9) Local transportation is at the cost of the Contractor.

### **3.3.4. Protective equipment for the Engineer**

The Contractor shall initially provide the Engineer with protective clothing and equipment, as follows, and, as the Engineer considers necessary, provide replacement items under the provisions for maintenance of the Engineer's facilities. Prior to making this provision, the Contractor shall obtain a list of appropriate sizes from the Engineer. As and where the Contractor's methodology, activities or planned testing programme may require additional protective equipment (such as gloves, earplugs, goggles, torches etc) the Contractor shall make these available to the Engineer and when the need arises.

The protective equipment remains the property of the Beneficiary.

### **3.3.5. Topographical Survey Equipment**

Principal items of the survey equipment shall be procured by the Contractor to be used by the Engineer, and are listed below. All equipment shall be as good as new, calibrated and with all necessary carrying containers, etc:

- 1) 1 Piece: Precise automatic level including tripods (Wild or similar)
- 2) 1 Piece: Total station including tripod, complete with reflectors, poles and brackets
- 3) 2 Pieces: Metric extending levelling staffs with vertical bubble
- 4) 2 Pieces: 30 m (enamelled or otherwise protected) steel bands
- 5) 1 Piece: Wet and Dry bulb thermometer
- 6) 4 Pieces: 3 meter-ranging rods
- 7) 2 Pieces: 5 meter steel lath
- 8) 1 Piece: Builder's spirit level 1000 mm long
- 9) 1 Piece: Disto laser distance meter, up 200 m, measuring accuracy  $\pm 1$  mm, including tripod

Supply of wooden pegs, crayons, spray paint, nails and all other items required for setting out and measuring the work shall also be provided.

A set of precise survey equipment as well as all of the ancillary and consumable items, attendance and assistance necessary to measuring the works, determining the necessary scope and quantities of any works and determining the precise levels and locations of any parts of the Works shall be maintained and kept by the Contractor for the Engineer's needs within the duration of the Contract and until all measurement relevant to the Final Payment Certificate has been completed and agreed,.

The survey equipment remains the property of the Beneficiary.

### **3.3.6. Facilities for the Contractor**

The Contractor shall provide and maintain on site suitable site offices for its own use. It shall also provide and maintain on approved sites, sufficient stores, tanks and workshops for the proper storage of materials, fuel plant and equipment.

The stores shall be of such size and construction to provide adequate storage and protection of stocks of material, fuel, spares, etc. in quantities ensuring uninterrupted progress of the work. Workshops shall be suitably equipped to ensure carrying out of major repairs, overhaul or modification by the Contractor of all plant and equipment in or on the Works. The Contractor shall allow in its rates for all costs related to provision of the offices and workshops for its own use.

Prior to construction of the site facilities, the Contractor shall prepare drawings for site facilities which will cover the following aspects of the works:

- Location and arrangement of the Constructor’s buildings and offices, including access facilities, utilities and fencing;
- Location and arrangement of work-yards, workshops, depots and stores for equipment, fuel and materials, including access facilities, electricity, water and telephone connections and fencing;
- Location of and proposals for the temporary works required for constructing the Works;
- Working drawings and calculations for all the temporary works proposed by the Contractor for constructing the Works.

### **3.4. SITE CLEANING**

The Contractor shall make every effort to keep the site tidy and in orderly manner and to take at any time every possible precaution against the contamination of subsoil and groundwater.

The Contractor shall be responsible for making all arrangements for the disposal of solid and liquid wastes from the site. Furthermore, it shall give strict instructions to all its employees to use the sanitary accommodation provided at the site.

#### **3.4.1. Access and Public Roads**

The Contractor shall, at its own expense, carry out all protective works and strengthening of public streets and roads used by it as necessary to avoid damage from heavy loads and plant moved to the site.

It shall also construct, maintain and remove temporary access roads as it may require for carrying out the works at its own expense.

Note: According to BoQ items of the Preparatory Works, (Volume 4) these costs are included in Contractor unit prices.

The Contractor shall observe all restrictions, which apply to public roads.

The Contractor shall comply with all reasonable restrictions, which may be imposed by the Engineer, the Police or other competent Authorities.

Public and private streets, roads and other surfaces used by the Contractor shall be kept free from dirt and rubbish and be cleaned as required by the Engineer. Immediately after ceasing the use of any temporary road, the Contractor shall restore the road to the agreement of the Engineer and the responsible Owner Authority.

Before any work in, or affecting the use of, any highway or road is commenced, the Contractor's proposed method of working, including any special traffic arrangements, shall be agreed with, and confirmed in writing by the Engineer and the Authorities.

The Contractor shall inform the Engineer, of any requirements of, or arrangements made with, the Highway / roads, and Police Authorities.

Barriers shall be fixed around trenches in streets and pedestrian areas and properly signs posted. All barriers on roads and pedestrian areas shall be lit with warning lights during night time or when there is poor visibility.

Where the diversion or closure of any existing road is needed, the Contractor shall provide and maintain an alternative one, which shall be operational before the existing one is closed.

Where ramps are required, they shall be provided and maintained according to a standard for the class of traffic

#### **3.4.2. Temporary Access**

The Contractor shall provide and maintain all footways and structures necessary for the purposes of the Contract. Upon completion of the works, unless instructed otherwise by the Engineer, the Contractor shall remove such footways and structures and restore the ground to the agreement of the Engineer.

The Contractor shall provide and maintain all temporary paths, ladders and staging on and about the Sites necessary for the purposes of the Contractor and shall remove such paths, ladders and staging when no longer required.

#### **3.4.3. Public Roads Cleanliness**

The Contractor shall minimize pollution of public roads.

The Contractor shall take all measures to keep all public roads clean of any spillage or droppings from its own and its sub-contractor's vehicles travelling to and from the site. All such spillage or droppings shall be immediately cleared to the agreement of the Engineer and appropriate Public Authority. The Contractor shall indemnify the Engineer against all claims

by the third parties, which may arise out of the Contractor's failure to comply with this Section.

Reinstatement of public roads shall be carried out as soon as is practical after completion of the Permanent Works and before the section of the road or pavement is re-opened for public use. Reinstatement shall be maintained by making good any subsidence, shrinkage, defect, imperfection or fault during the Defects Correction Period.

The types and thicknesses of the materials used in the road reinstatement shall be, as a minimum, as those of the existing construction.

Reinstatement where not specifically required by the Authorities shall comprise an additional depth of sub-base material as instructed by the Engineer. Original surface materials may be placed by hand with the wearing course upper most. The method of placing and compacting of materials shall be similar to that for road base construction, to the same surface tolerance, and to suit levels of the surrounding undisturbed road or pavement.

Only materials approved by the Engineer shall be used for reinstatement.

#### **3.4.4. Storage of Equipment and Materials in Public Space**

Construction materials and equipment shall not be stored outside the limits of the site.

Where Works are to be completed in public spaces, all plant and excess material shall be removed immediately from the site upon completion of the relevant task so as to limit public objections and complaints.

#### **3.4.5. Traffic Arrangements**

The Contractor shall as far as required, comply with all requirements and recommendations of the Police and Authorities regarding traffic arrangements and road safety measures on public roads outside the construction sites.

The Contractor shall, where necessary, provide all barriers and traffic signs agreed by the Engineer.

Traffic diversions, if necessary, shall be planned and arranged with the responsible Authorities by the Contractor and harmonized with the Engineer. No diversion shall be implemented without a written consent of the responsible Authority and after given information to the Engineer. Access to the site shall be available to vehicles of emergency services and residents in the areas.

All traffic signs and traffic control signals, as necessary and/or may be required by the Police Authority for the safe direction and control of the traffic shall be provided, placed and maintained by the Contractor on the appropriate sites and locations on the access to the sites. The location and size of all such signs and the lettering thereon shall be agreed by the Engineer before placement of the signs.

*Serbia Floods Rehabilitation Support*  
*EMERGENCY RECONSTRUCTION WORKS PROJECT*  
*Flood Protection System „Mačva: Sava – Drina“, West zone*  
*LOT 2-WEST ZONE*

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The Contractor shall reposition, cover or remove signs as required during the progress of the works.

## **4. CONTRACTOR'S GENERAL RESPONSIBILITIES**

### **4.1. MANAGEMENT OF THE PROJECT BY THE CONTRACTOR**

- 1) The Contractor shall provide the Quality Assurance Plan (QAP) for the management and execution of construction works;
- 2) The QAP should reflect the management structure and clearly describe the duties, responsibilities and powers of each member of the Contractors' staff;
- 3) The representative of the Contractor and its staff must possess experience and qualifications according to the contract, RS Law and type and scope of works;
- 4) This QAP will be updated and provided again whenever there is a change in personnel.

### **4.2. APPROVAL AND INSTRUCTION BY THE ENGINEER**

Where reference is made in this Specification, the Bills of Quantities or in the drawings for approval, instruction or direction, they shall be given by the Engineer.

Approvals, instructions or directions by the Engineer shall not relieve the Contractor from its liabilities and responsibilities under the Contract.

### **4.3. QUALITY ASSURANCE PLAN**

- 1) The Contractor shall be responsible for assuring such quality of materials, works and processes that shall comply with the requirements of the Specifications.
- 2) In order to meet the specified requirements, the Contractor shall implement Quality Assurance System presented in Quality Assurance Plan containing the following details:
  - Quality control procedures;
  - Personnel responsibilities;
  - Procurement procedures;
  - Testing procedures;
  - Equipment and measurement devices;
  - Frequency of testing, measurements etc.;
  - Holding points in production for inspection;
  - Rejection and corrective procedures;
  - Documentation and communication
  - H&S and Environmental Plan.
- 3) The Contractor shall be liable to keep a register of all materials delivered on site or implemented in the construction to be accessed for review upon request by the Engineer

or Contracting Authority. Also, the Contractor shall maintain archive of the whole correspondence and instructions.

The Contractor shall within 28 days of the date of the Letter of Acceptance provide the Engineer with the Organisation chart containing names, CVs and duties of all key personnel whether or not they are related to quality assurance directly.

#### **4.4. WORK PROGRAMME**

##### **4.4.1. Form of submissions**

The Work Programme presented by the Contractor shall consist of a detailed schedule of all construction works and phases. Once approved, the Work Programme shall be binding for the construction works on site.

##### **4.4.2. Requirements**

The Contractor shall present a Work Schedule for execution of the works with distribution of resources and manpower, including volume of works, number of workers for the stage, coordination of activities, interaction with different participants in the process, time limit for execution and sequence of the works.

##### **4.4.3. Work Program**

Pursuant to the requirements, the Work Programme to be submitted by the Contractor shall show the planned monthly rates of progress between the programme dates for commencement and completion of each major item or work for the various stages of construction, in accordance with the Conditions of Contract.

The Work Programme shall take into account climatic conditions, groundwater, geo-technical data, completion of critical components by the Contractor or other contractors, water supply service conditions and other conditions, to ensure the completion of the works in accordance with the Contract.

The Contractor shall not be permitted to commence any construction work on that part of the works until the Engineer has no objection to the method statements, drawings and calculations. Sufficient time for approval of drawings materials and method statements must be allowed for in the Work Programme for each component.

The Contractor shall allow in its Programme a reasonable period for work to be carried out by Public Utility Services, Authorities and the Beneficiary where necessary. The Beneficiary will provide all necessary assistance in liaising with such Authorities.

The Contractor shall also allow in its Programme sufficient time required for provisional acceptance and for the maintenance periods (Defects Notification Period) as stipulated in the Contract.

#### **4.5. MONTHLY PROGRESS REPORTS**

During of the execution of the Contract, the Contractor shall follow the progress of activities relative to the time schedule and shall submit to the Engineer Monthly reports for the results of its activities, conforming to the following requirements:

- 1) The Report to be provided to the Engineer in 1 hardcopy in Serbian and English languages as well as digitally (on CD enclosed to the Report);
- 2) Diagrams with detailed progress description, Contractor's documents, delivery, construction works, assembly and tests;
- 3) Digital photos (on CD enclosed to the Report);
- 4) Linear chart (schedules) for the current Stage, showing the actual and the planned progress;
- 5) Provision of resources - actual and planned;
- 6) Diagram for labour flow - actual and planned;
- 7) Report, reflecting all considerable differences from the construction programme, and if necessary, explanation for the proposed steps to be undertaken for the completion of the approved programme;
- 8) Statistics on safety and environment protection;
- 9) Financial Statement.

When actual work progress differs from that shown in the Construction Programme, the Contractor shall submit an updated schedule to the Engineer. The updated time schedule shall be current to the last day of a calendar month and shall show the detailed "work-as-executed" programme in respect of work carried out. They shall be submitted within ten working days of the following month at the latest.

#### **4.6. PROGRESS PHOTOGRAPHS**

Digital colour photographs showing the progress of the Works in detail shall be taken by the Contractor every week, from positions to be selected by the Engineer.

The Contractor shall hand over the corresponding electronic files to the Engineer on a CD, as well as an electronic list numbering and labelling each photograph (location, date when taken and a brief description or title).

#### **4.7. CONTRACTOR'S DOCUMENTATION**

##### **4.7.1. General**

- 1) For design, works and supply use of metric units is compulsory.
- 2) All documents will be issued in English. Official documents, which are to be presented to state or municipality authorities, will be also issued in Serbian.

- 3) Works documentation (see Chapter 4.7.3.) will be in English and in Serbian, except Construction Log, which will be in Serbian.
- 4) Reports and correspondence documentation will be in English and in Serbian.
- 5) When submitted as computer files the documents shall be under Windows, texts in MS Word, Tables in MS Excel, drawings in ACAD, time schedules in MS Project.

#### **4.7.2. Detailed Design Drawings**

The Contractor shall prepare, if needed, detailed design drawings developing the drawings included in this Tender Dossier and taking into account the Contracting Authority's Requirements, written in the present Technical Specifications. Contractor's drawings will be checked and can be applied after a written consent is issued by the Engineer and the Beneficiary.

#### **4.7.3. Works documentation**

The Contractor shall be liable to provide the Engineer with due documentation as per local Regulations. The Contractor shall keep/maintain the following Works documentation:

- 1) Inspection Book (forms laid down by the Law of the Republic of Serbia),
- 2) Construction Log (forms laid down by the Law of the Republic of Serbia),
- 3) Measurement Book (forms laid down by the Law of the Republic of Serbia),
- 4) All necessary certificates (for material, equipment and other) during the works execution.

The Works Site Manager shall keep the Construction Log and submit the Measurement Book sheets of the executed works along with each invoice. The Measurement Book has to be verified by the Engineer.

The Construction Manager has to enter the following data into the Construction Log:

- Number and qualification of workers executing the works,
- Number and type of construction machinery used for works execution,
- Weather conditions under which the works are executed,
- How the works are executed and if there is any deviation from the design, contract and regulations in doing so.

#### **4.7.4. As-built design**

- 1) Based on a survey of executed works, as-built technical documentation will be prepared by the Contractor and delivered to the Engineer (in accordance with Law on Construction and Planning).
- 2) As-built drawings for all executed works must be delivered in digital form and 3 (three) printed and bind hard copies, signed by the Responsible Designer and the Engineer.

- 3) Contractor is obliged to support the Beneficiary during technical acceptance and make necessary corrections in the submitted documentation and designs upon the request of Authorities in order to obtain a use permit.

#### **4.7.5. Operation and maintenance manuals**

- 1) The Contractor shall provide comprehensive operation and maintenance manuals for the delivered equipment including a full technical description and operational characteristics thereof. The Contractor shall provide 2 copies in both English and Serbian of each of the manuals bound loose leaf in ring binder folders.
- 2) Manuals shall be prepared in accordance with the approved standard. Manuals shall also be subject to the approval of the Engineer.

## **5. HEALTH & SAFETY AND ENVIRONMENT PROTECTION**

### **5.1. HEALTH & SAFETY**

#### **5.1.1. General requirements**

Without limiting the Contractor's obligations under the Conditions of Contract, the Contractor shall take all measures and precautions necessary to ensure the health, safety and welfare of staff, labour, and other persons authorised to be on the Site, as well as visitors and third parties. The Contractor shall prepare H&S&E Plan and develop detailed sequence and safety measures in the Organisational plan for the management and execution of the works.

The Contractor shall:

- 1) Fully comply with the *Law on Safety and Health at Work (Official Gazette of the Republic of Serbia no. 101/2005, 91/2015)*.
- 2) Appoint a member of staff responsible for all matters related to health and safety for the duration of the Contract according to RS regulations.
- 3) Provide and maintain equipment in a safe working condition and adopt safe methods of work.
- 4) Adopt methods for the use, handling, storage, transport, and disposal of materials, and substances which are not injurious to health and safety.
- 5) Provide and maintain adequate lighting, signing, and fencing of the Works.
- 6) Provide adequate protective clothing and safety equipment, including such information, instruction, training and supervision as are necessary to ensure the health and safety of all persons employed on or entering on the Site in connection with the Works.

Safety equipment shall include but not be limited to:

- safety helmets,
  - protective footwear with integral steel toe-caps,
  - safety glasses, welding goggles and other eye protectors,
  - ear defenders,
  - safety harnesses,
  - high visibility reflective vests,
  - fire extinguishers.
- 7) Provide and maintain access to all places on the Site in a condition that is safe and without risk of injury.
  - 8) Provide and maintain adequate water, waste water and waste collection, for all offices, workshops, and laboratories erected on the Site.
  - 9) Provide and maintain adequate sanitary units at locations where works are in progress.

- 10) Appoint a member of its staff to be responsible for the safety of the Works throughout any shutdown period and notify the Engineer of the name and contact telephone number of the responsible person.
- 11) Report all accidents to the Engineer and appropriate authorities at the time of occurrence or as soon as possible thereafter.

#### **5.1.2. Testing and certification of mechanization and equipment**

- 1) The Contractor shall provide and maintain equipment for lifting, embedding and transporting materials and must comply with all relevant requirements of the standards in Serbia;
- 2) All equipment must be regularly maintained in accordance with the recommendations and standards of the manufacturer, according to local laws and recommendations of the relevant authority;
- 3) The Contractor shall prepare and update a register of certificates of testing of the equipment used on construction sites according to RS Law;
- 4) The Contractor must appoint competent personnel responsible for the operation of all kinds of equipment. They must provide evidence that they have passed training and have respective license for operating the specific equipment;
- 5) All the technological equipment (with test certificates) used on or around the site must be equipped with the necessary protective devices that will be in continuous readiness;
- 6) Should the Engineer consider the Contractor's method of working unsafe or that there are insufficient or inadequate safety barriers or other devices or that there is insufficient safety or rescue equipment, the Contractor shall change its method of working or install or strengthen safety and rescue equipment if so instructed. Such instructions shall not relieve the Contractor of any of its responsibilities under the Contract.
- 7) The Contractor shall immediately notify the Engineer about any accident that occurs, whether on site or off site, in which the Contractor is directly involved, and which resulted in any injury to any person whether directly concerned with the site or a third party. Such initial notification may be verbal and shall be followed by a written comprehensive report within 24 hours of the accident.
- 8) Transportation of any material by the Contractor shall be in suitable vehicles, which do not cause spillage when loaded, and all loads shall be suitably secured. Any vehicle shall be removed from the site, which does not comply with this requirement or any of the local traffic regulations and laws.
- 9) The Contractor shall ensure access to sites at all times to any authorised external institutes or experts carrying out safety inspections.

#### **5.1.3. Fire protection**

During the performance of the Contract the Contractor shall make arrangements to the agreement of the Engineer for the protection of the permanent works and any temporary

works and any adjacent property from fire and, if required, it shall give the Fire Authority access to all facilities periodically to inspect the fire prevention arrangements.

Particular care must be exercised in connection with the operation of electric arc welding equipment, oxyacetylene cutting equipment and other processes involving the use of naked lights. Special arrangements will be necessary for the storage of highly flammable liquids on the site.

The Contractor shall remove all waste and material of a flammable nature and take other steps as the Engineer may require but this shall not relieve the Contractor of any of its obligations under the Contract.

## **5.2. ENVIRONMENT PROTECTION**

### **5.2.1. General**

- 1) The Contractor shall take all necessary measures and precautions and otherwise ensure that the execution of the Works and all associated operations on or off site are carried out in conformity with statutory and regulatory environmental requirements.
- 2) The Contractor shall take all measures and precautions to avoid any nuisance or disturbance arising from the execution of the Works. This shall be achieved wherever possible by suppression of the nuisance at source rather than abatement of the nuisance once generated.
- 3) The provisions of these Sub-Clauses shall only be disregarded in respect of emergency work required for the saving of life or property or the safety of the Works.
- 4) In the event of any spoil or debris or silt from the Sites being deposited on any adjacent land, the Contractor shall immediately remove all such spoil debris or silt and restore the affected area to its original state to the agreement of the Engineer.
- 5) The Contractor should comply with the guidelines of the Banks in this regards as well as those for resettlement and rehabilitation of the affected population.

The offer should include appropriate cost-effective mitigation measures, which should form part of the project cost.

*Environmental Management Plan (EMP)* shall be prepared by the Contractor incorporating proposals concerning the implementation, management and monitoring of the environmental components of the project.

Within one month from the commencement of the works, the Contractor shall submit an EMP with operational details of its proposals to the Engineer for approval.

### **5.2.2. Environmental officer**

The Contractor shall nominate an Environmental officer qualified to promote and maintain environmental management during construction and implement the approved Environmental Management Plan.

This officer shall have authority to issue instructions and take precautionary measures to prevent environmental accidents, including but not limited to the establishment of environmentally friendly practices and to train the staff and labour accordingly.

### **5.2.3. Environmental protection during construction period**

The Contractor shall use such construction methods and shall maintain all borrow/stockpile/spoil disposal area so as to assure the stability and safety of the Works and any adjacent feature, to assure free and efficient natural and artificial drainage and to prevent erosion.

The Engineer has the power to disallow the methods of construction and/or the use of any borrow/stockpile/spoil disposal area if in their opinion the stability and safety of the Works or any adjacent features are in danger, or if they disturb natural or artificial drainage, or if the method or use of the area will promote undue erosion.

Following excavation for the works, the Contractor shall take all steps necessary to complete drainage and slope protection works in advance of each rainy season. Erosion or instability or sediment deposition arising from operations not in accordance with the Specifications shall be repaired immediately by the Contractor at its expense. The Contractor shall also take all steps necessary to complete drainage in advance of each winter rainy season in the areas excavated for borrowing materials.

Notwithstanding approval of the intended method of working, the Contractor shall at all times be responsible for constructing the earth works in accordance with the Specifications, the Design and drawings.

Where directed by the Beneficiary, the Contractor shall recultivate the land on slopes, used borrow pits and other areas which may include verges, spoil disposal areas, stock pile areas, quarries, access tracks, plant sites, camps, land slide scars, gullies, and stream and river banks. Prior to placing top soil and/or establishing vegetation on embankments, all fill material not compacted to the required standards shall be removed from the side slopes.

The Contractor shall be responsible for supplying sufficient planting material to carry out all re-vegetation work, and shall establish and operate plant nurseries as necessary and shall make its own arrangements for procuring cuttings, slips and seed for growing.

### **5.2.4. Prevention pollution**

The Contractor shall ensure that its activities do not result in any contamination of land or water by polluting substances.

The Contractor shall implement physical and operational measures such as: earth dikes of adequate capacity around fuel, oil and solvent storage tanks and stores, oil and grease traps in drainage systems from workshops, vehicle and plant washing facilities and service and fuel ingress and kitchens, the establishment of sanitary solid and liquid waste disposal systems, the maintenance in effective condition of the same assures, the establishment of emergency response procedures for pollution events, and dust suppression, all in accordance with normal good practice and to the agreement of the Engineer.

#### **5.2.5. Protection of trees and vegetation**

Unless otherwise provided in these Specifications, the Contractor shall ensure that no trees or shrubs or water side vegetation are felled or harmed except for those required to be cleared for execution of the Works. The Contractor shall protect trees and vegetation from damage to the agreement of the Engineer and the Beneficiary.

The Contractor shall be responsible for obtaining any necessary felling permits and for ensuring the disposal of felled trees in accordance with prevailing regulations. No tree shall be removed without the prior approval of the Engineer and the Beneficiary.

In the event that trees or other vegetation not designated for clearance are damaged or destroyed, they shall be repaired or replaced by the Contractor at its own expense to the agreement of the Engineer and the Beneficiary.

#### **5.2.6. Use of woods as fuel**

The Contractor shall not use or permit the use of wood as a fuel for cooking, space and water heating in all its camps and living accommodations. Any wood so used must be harvested legally, and the Contractor shall provide the Engineer and the Beneficiary with copies of the relevant permits if required.

#### **5.2.7. Fire prevention**

In addition to the provision of adequate fire-fighting equipment at its offices, workshops, construction areas and other facilities to the agreement of the Engineer and the Beneficiary, the Contractor shall take all precautions necessary to ensure that no vegetation along and outside the area of the permanent works is affected by fires arising from the execution of the Works.

Should a fire occur in the natural vegetation or plantations adjacent to the project area for any reason the, Contractor shall immediately take all measures to suppress it. In the event of any other fire emergency in the vicinity of the Works the Contractor shall render assistance to the civil authorities to the best of its ability.

Areas of forest, shrub or plantation damaged by fire considered by the Engineer and the Employer to have been initiated by the Contractor's staff or labour shall be replanted and otherwise restored to the agreement of the Engineer and the Beneficiary at the Contractor's expense.

#### **5.2.8. Relation with local communities and authorities**

During execution of the Works the Contractor shall minimize the impact of its activities on existing communities.

Where communities are likely to be affected by major activities the Contractor shall liaise closely with the concerned communities and their representative and if so directed, it shall attend additional meetings arranged by the Engineer and the Beneficiary to resolve issues and claims and minimize impacts on local communities.

Any problems arising from its operations which cannot be resolved by the Contractor shall be referred to the Engineer and the Beneficiary.

The Contractor shall be responsible for any compensation due or reinstatement necessary with respect to any damage caused by it to areas outside the Site and no separate payment will be made in this regard.

#### **5.2.9. Water supply for construction**

The Contractor shall make its own arrangements at its own expense for water supply for construction and other purposes.

Only clean water free from deleterious materials and of appropriate quality for its intended use shall be used. In providing water the Contractor shall ensure that the rights of and supply to existing users are not affected either in quality, quantity or timing.

In the event of a dispute over the effect of the Contractor's arrangements on the water supply of others, the Engineer shall be informed immediately and shall instruct the Contractor as to appropriate remedial actions to be undertaken at its expense.

#### **5.2.10. Environmental considerations**

The following environmental protection measures shall be observed during the execution of the construction of the works:

- **Demolition material** - Reuse of demolition materials as backfill for trenches and excavations or/and hard fill for construction foundations and roadways is possible, unless contaminated or hazardous materials such as asbestos are identified. The Contractor will be responsible for environmentally safe disposal of any material resulting from the demolition and other site materials with approval from the relevant local Authorities at a designated licensed disposal facility.

- **Excavated soil** - Reuse of excavated natural soil, which is free of cohesive components, salt, sulphate and/or clay materials, may be used as backfill for trenches and excavations. The Contractor will be responsible for environmentally safe disposal of surplus materials with approval from the relevant local Authorities at a designated licensed disposal facility.
- **Ground water** - Temporary and/or permanent groundwater lowering may be required. The Contractor shall apply appropriate dewatering measures as required and shall also ensure that adequate measures are implemented to control surface water discharge.
- **Air pollution** - Construction may give rise to dust and construction equipment exhaust emissions. Due note shall be taken of the proximity of residential housing to the works. The normal health and safety controls will be required to safeguard the residential and passing population.
- **Noise pollution** - Construction works may cause annoyance caused by noise. The normal health and safety controls will be required to safeguard the residential and passing population.
- **Maximum noise levels** - During construction works the Contractor shall comply with the local and national requirements. The Contractor shall be legally responsible and financially liable to observe Serbian environmental legislation.  
The noise levels shall be in accordance with the relevant Serbian noise environmental legislative.  
Noise and disturbance shall be kept to the reasonable minimum as far as required for this project. The Contractor's attention is drawn to the close proximity of some residential areas. All plant and tools used at such sites above or near ground level shall be silenced or of a silent type.  
The Contractor shall take all necessary steps to ensure that its workmen carry out their duties in a quiet manner particularly when working at night.
- **Pollution prevention** - The Contractor shall not pollute or unnecessarily disturb lands, roads and other places on and around the Site. No trees or other vegetation shall be removed except to the extent necessary for the Works.

The Contractor shall take all reasonable precautions to prevent:

- **Silting, erosion of beds and banks and pollution of rivers and watercourses;**
- **Interference with the supply to or abstraction from underground water sources;**
- **Pollution of the surface waters at site.**

The Contractor shall provide, maintain and remove on completion of the works, settling lagoons and other facilities to avoid pollution caused by the Contractor's operations such as but not limited to quarrying, aggregate washing, concrete mixing and grouting.

#### **5.2.11. Water quality**

- 1) The Contractor shall prevent any interference with the supply to or abstraction from or the pollution of water resources (including underground percolating water) as a result of the execution of the Works.
- 2) Areas where water is regularly or repetitively used for dust suppression purposes (including without limitation stockpiles for concrete-batching and asphalt plants) shall be laid to fall to specially-constructed settlement tanks to permit sedimentation of particulate matter. After settlement, the water may be re-used for dust suppression and rinsing.
- 3) All water and other liquid waste products arising on the Sites shall be collected and disposed of at a location on or off the Sites and in a manner that shall not cause either nuisance or pollution.
- 4) The Contractor shall not discharge or deposit any matter arising from the execution of the Works into any waters except with the permission of the Engineer and the regulatory authorities concerned.
- 5) The Contractor shall at all times ensure that all existing stream courses and drains within and adjacent to the Site are kept safe and free from any debris and any materials arising from the Works.
- 6) The Contractor shall protect all watercourses, waterways, ditches, canals, drains, lakes and the like from pollution, silting, flooding or erosion as a result of the execution of the Works.
- 7) The Contractor shall submit details of its temporary drainage systems (including all surface channels, sediment traps, washing basins and discharge pits) to the Engineer for approval prior to commencing work.

#### **5.2.12. Air quality**

- 1) The Contractor shall devise and arrange methods of working to minimize dust, gaseous or other air-borne emissions and carry out the Works in such a manner as to minimize adverse impacts on air quality.
- 2) The Contractor shall utilize effective water sprays during the delivery and handling of materials when dust is likely to be created, and to dampen stored materials during dry and windy weather.
- 3) Stockpiles of materials shall be sited in sheltered areas, away from sensitive areas. Stockpiles of friable material shall be covered with clean tarpaulins, and sprayed with water during dry and windy weather. Stockpiles of material or debris shall be dampened prior to their movement, except where this is contrary to the Specification.
- 4) Any vehicle transporting no coherent material shall not be loaded to a level higher than the side and tail boards, and shall be covered with a clean tarpaulin in good condition. The tarpaulin shall be properly secured and extend at least 300 mm over the edges of the side and tail boards.

- 5) In periods of high wind, dust generating operations shall not be permitted within 200 m of residential areas having regard to the prevailing direction of the wind.
- 6) Construction vehicles and machinery shall be kept in good working order and engines turned off when not in use. Appropriate measures shall be taken to limit exhaust emissions from construction vehicles, machinery and plant.
- 7) An advance warning shall be given to potentially affected persons, so that some measures can be taken by them before commencement of works, especially before dismantling/demolition.

#### **5.2.13. Noise**

- 1) The Contractor shall consider noise as an environmental constraint in its planning and execution of the Works.
- 2) The Contractor shall take all necessary measures to ensure that the operation of all mechanical equipment and construction processes on and off the Site shall not cause any unnecessary or excessive noise, taking into account applicable environment requirements. The Contractor shall use all necessary measures and shall maintain all plant and silencing equipment in good condition so as to minimize the noise emission during construction works.

#### **5.2.14. Preservation of archaeological finds and burial sites**

The Contractor shall take all necessary measures to protect any archaeological features, antiquities, burial sites, or other finds, immediately report such finds to the Engineer and appropriate authorities, and allow adequate time for experts to visit and survey the finds, all according to RS regulations. Such finds shall be protected by means of suitable fencing and barriers to the agreement of the Engineer unless or until approval is given to remove or relocate the finds to allow the Works to proceed.

#### **5.2.15. Preservation of existing landscape**

The Contractor shall exercise care to preserve the natural landscape in the vicinity of the Works and shall conduct its operations so as to prevent any unnecessary destruction, scarring, or defacing of existing landscape features. The removal of trees, bushes, and other natural vegetation shall only be carried out with the prior approval of the Engineer. On completion of substantial parts of the Works the Contractor shall make proposals for reinstating the landscape and natural vegetation and, on approval by the Engineer, shall carry out such reinstatement to the agreement of the Engineer.

### **5.2.16. Measures for decreasing the negative environmental impact**

In order to mitigate negative environmental impact, the Contractor should propose necessary actions in its Environmental Management Plan (EMP), such as:

- 1) to create adequate organisation for execution of construction works which shall comply with local construction regulations;
- 2) to provide water sprinkling of the construction site and service roads;
- 3) to create organisation for control on the facilities storing fuel and lubricants and on the technical condition of the machines in order to avoid accidental oil spills;
- 4) along the construction site, waste water should be treated and sedimentation tanks and oil separators should be placed if needed;
- 5) to foresee the necessary maintaining and drainage measures for the construction site, access roads and service roads, in order limiting the erosion processes;
- 6) to specify the quantity and type of waste and how its disposal is intended to be transported and removed from the site area;
- 7) measures for fast conservation of unfinished works at unfavourable conditions.

## **6. MATERIALS**

### **6.1. GENERAL**

- 1) All materials used shall be of the best quality as specified and described in the Specification, EmW Design, Drawings and the Bills of Quantities. Where in the Design Drawings and/or BoQ the products are brand named, this should be understood as supplemented by 'or equivalent'. These materials shall be procured from approved manufacturers or suppliers.
- 2) The Contractor must secure the compliance with the Specification of materials or plant to be provided under this Contract before the supplier or manufacturer is proposed for approval to the Engineer.
- 3) The Contractor shall take into consideration the local climatic and other environmental conditions when selecting and proposing the materials. The quality of the material has to be confirmed by the attests and suppliers certificates, all according to TS and RS regulations.
- 4) Whenever possible, the Contractor shall provide equipment of a similar nature from the same manufacturer, e.g. electric motors;

The Contractor shall note that particular attention will be paid to these requirements. In cases where the proposed equipment is not standardized with regard to manufacturer and type, the Contractor shall be required to provide conclusive technical justification; considerations of price alone will not be accepted. Equipment and components that have not been standardized will not be accepted.

## **6.2. ORIGIN**

Certificates of origin have to accompany the products proving that supplies originate from an eligible country as stated in GC of the Contract.

## **6.3. CONFORMITY OF MATERIALS**

All materials implemented during construction shall be in compliance with the requirements of:

- Requirements of the local legislation;
- REGULATION (EU) No 305/2011 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 9 March 2011 laying down harmonized conditions for the marketing of construction products;
- The present Technical Specifications;
- Requirements of the design documentation.

All materials applied shall be accompanied with quality certificates to prove their concordance with the requirements set out in the design, the Specification and the Code for Civil Construction Works.

The Contractor shall make diligent efforts to procure the specified materials. Where, due to different reasons, the materials required by the Contract are not available, substitute materials may be used but with the prior approval by the Engineer and the Designer.

## **6.4. INSPECTION AND TESTING OF MATERIALS**

The Contractor has to present documentation for quality, origin and purpose for all materials delivered on site.

Upon request by the Engineer, the Engineer shall provide also samples for approval. The staff of the Engineer at any time, where applicable, shall have access for inspections to all site parts, where anything being prepared, fabricated or manufactured for delivery under the contract in order to establish whether the components, materials and workmanship are of the requisite quality and quantity. The control and testing of materials shall not relieve the Contractor's responsibility for the conformity of the materials and equipment with the present specifications.

Materials and equipment delivered by the Contractor shall be subject to inspection and testing by the Engineer.

The Contractor shall provide the entire equipment, support, documents and other information, electricity, facilities, fuel, consumables, instruments, manpower, materials and team with relevant qualification and experience as necessary for the effective conduct of the tests.

In case of verification, inspection or testing prove that technological equipment, materials or work are defective or in any other way non compliant to the Contract, the Engineer may reject the technological equipment, materials or work as specified in GC of the Contract.

## **6.5. APPROVAL OF MATERIAL FOR USE**

The Contractor shall, before the delivery and/or use of adequate building materials, semi-finished, and finished products, provide the certificate on the completed pre-testing of quality and suitability of the materials, semi- finished and finished products he intends to use, to the Engineer for check-over and approval.

The Contractor shall not use any building materials without the Engineer's approval, and if he uses them, he shall be at the risk and costs that may arise on such grounds.

## **6.6. INDEPENDENT LABORATORY**

The Contractor shall carry out control tests through an Independent accredited Laboratory, The testing should be done according to relevant standards and defined methodology, all according to RS standards and regulations. Independent testing shall be established as final assessment of quality of material and works, The results of control tests shall be considered as relevant.

# **7. TECHNICAL REQUIREMENTS FOR EXECUTION OF WORKS**

## **7.1. TECHNICAL REQUIREMENTS**

### **7.1.1. Purpose of the technical requirements**

The purpose of the technical requirements is to provide quality performance of works to comply with technical regulations and standards. Therefore, the Contractor is obliged to adhere strictly to them and to perform all the works that are the subject of this project, in accordance with technical requirements, design documentation, accompanying drawings and Bill of Quantities.

In addition, technical requirements define the method of measurement. Therefore, bidders are required to include all costs for not separately analysed and measured items in the unit prices of the existing ones.

## **7.2. GENERAL TERMS**

### **7.2.1. Notice of Commencement**

The Contractor shall give a written notice to the Engineer of its intention to commence works (Notice of Commencement).

Also, according RS law, Notice of Commencement must be submitted to competent Local and National Authority.

The works shall not be commenced until written approval has been received from the Engineer.

### **7.2.2. Technical specification for works**

Technical Specifications are an integral part of the Tender Documentation, and are Annexed to the Works Contract.

The Contractor is fully familiar with all details of the EmW Design, as well as with all local regulations, local standards (SRPS), common practice of trade and circumstances for their execution. Nevertheless, it is understood that, whenever local regulations, local standards (SRPS), or any common practice of trade, are subject to any interpretation, clarification, ambiguity, or dispute, a ruling by the Engineer will prevail, always provided that such ruling will be fully in compliance with and will be based on the subject local regulations, local standards (SRPS), as well as in accordance with common practice of trade, and any such ruling by the Engineers and subsequent instruction in that respect, will not constitute any ground for variation order and/or any additional payment.

Communication between the Contractor and the Beneficiary (also Designer), during the works will be carried out exclusively through the Engineer.

All works must be carried out precisely and professionally. Prior to application, the Engineer must examine all material and all his comments referring to material and quality of work will be obligatory for the Contractor. The agreed prices include all fully completed works and final products ready for use.

ICS Number	Standard Number	Year	TITLE
03.120.10	SRPS ISO 9001	2008	Quality management systems-Requirements
	SRPS ISO 10001	2008	Quality agreement-Customer agreement-Guidelines for codes of conduct for organisation

The Contractor will be responsible for any and all damages caused by the Contractor during any works, to any third party, structure, main building or adjacent buildings, and any and all repair works and compensations of any kind will be at the Contractor's expense.

According to BoQ: Preliminary works: Item A-I / 1.1.):

- The Beneficiary will provide to the Contractor the area necessary for organisation of the building site
- All other matters in this regard will fall within the competence of the Contractor
- Supply of water, electricity and all other raw materials to the site, all the time during the execution of the works, will be the sole liability of the Contractor, including all costs and necessary administrative procedures.

Before starting the works, the Contractor is required to be familiar with local terrain conditions, regulations, access roads, borrow pits, landfills and all possible other factors that could affect the smooth performance of the works (Beneficiary's responsibility is to provide necessary information about mentioned conditions).

Prior to the commencement of the works, and also in the course of the execution of every work item, the Contractor will ask the Engineer for any explanations and clarifications required, therefore, the Contractor will solely bear full material responsibility for all works not completed in accordance with the concept and details of this EmW Design.

The Contractor will be responsible to keep records on the progress of works in the measurement book and have it controlled and verified by the Engineer.

Any damage caused by exceeding the designated area of expropriation, falls on the Contractor.

Property relations (permanent and temporary expropriation at works area) are not the subject of this Contract, and property and expropriation issues are the Beneficiary's responsibility.

Upon the completion of the works the Contractor will remove from the building site and other used areas all its tools, machinery, surplus material, etc. so as to have the site neatly arranged as defined in the investment-technical documentation, and all other areas restored in same condition as before the construction.

All construction works must be carried out under the conditions and in the manner prescribed by RS Law on Construction and Planning.

For all works, applicable Serbian regulations and standards shall prevail.

The Contractor shall transport materials along the roads provided by the Beneficiary. Routes of access and service longitudinal roads are defined in the design documentation. Access roads must be kept passable during construction period. After completing works, access and longitudinal service roads must be constructed and repaired as defined in EmW Design and Bill of Quantities.

For all the works the Contractor is obliged to give the warranty period of 1 year from the date of Provisional Acceptance. Within this period, the Contractor is obliged to remedy all the defects that are resulting from poor quality of works.

Initial survey (according to BoQ): Before starting the works the Contractor shall survey and mark the route. All geodetic marking must be present in the *Survey documentation of initial terrain state* (Survey "0" Doc )

All geodetic marking must be checked before starting work and approved by the Engineer.

Except where otherwise specified all levels shall be in meters above Sea level (m.a.S.l) with accuracy of three decimals. The data for all levels shall be based on benchmarks approved by the Engineer.

During the period of construction of the Works, The Contractor shall establish and construct necessary additional benchmarks, which shall be protected and checked periodically.

The Contractor shall be responsible for constructing the Works in accordance with the data on levels. Benchmarks and other points of reference in the vicinity of the Site(s) will be supplied to the Contractor by the Engineer before execution of the Works.

The Contractor shall maintain a record of the levels of all the benchmarks and shall submit one copy of the records to the Engineer immediately after the completion of the survey work.

The survey instruments to be used by the Contractor shall be suitable for the work to be executed and shall be maintained in a first class condition. For all survey instruments used in the Works the Contractor shall submit recent calibration certificates issued by competent authorities. Further calibration of the instruments shall be carried out every six months.

The Contractor shall provide, for State Quality Control Inspection, a schedule of the main phases of the construction.

Labelling of cross sections is performed by the Contractor in a clear and understandable manner, so that there are no errors in the works. Any errors caused by incorrect marking of the route are borne by the Contractor.

Locations of borrow pits are provided by the Beneficiary (the cadastral plots are defined in the design documentation and BoQ).

Site preparation consists of cutting and removal of trees and shrubs, and is carried out only along the designed work area (embankment and surrounding area of the river and defended side).

Since the quality of works depends on the meteorological and hydrological conditions during the works, the Contractor is obliged to continually monitor the meteorological and hydrological conditions during the works.

- 1) In general, the Contractor is required to adjust its own dynamics and methodology of the work with field conditions, meteorological and hydrological conditions, without delays or interruptions in the period of performance of the work (works will take place throughout the year, during which there can be different meteorological and hydrological conditions).
- 2) Emergency delays and possible temporary interruptions are possible only in case of exceptional hydrological conditions - when entering high water and rising water levels that may threaten coastal areas.
- 3) The technical documentation (Synchron work plan for reducing the risk of large water PWMC „Srbijavode“- synchron plan of works) defines the critical locations and critical

- work operations and critical (emergency) hydrological conditions that could affect the dynamics and quality of works.
- 4) As a matter of prevention, critical locations on the site must be protected from adverse hydrological impacts, in a timely manner, in accordance with the synchronization plan of works. Synchronization plan of works imposes restrictions on the length of the opening / decrease elevation of the embankment and defines special requirements during critical hydrological conditions. The Contractor has to include in its offer all costs that may arise in such defined conditions of works.
  - 5) PPMC "Srbijavode", in accordance with the applicable regulations, defines procedures to be followed during unfavourable hydrologic extraordinary circumstances. They are defined for different stages (regular and extraordinary flood protection, emergency situation) of flood protection. The procedures and way of notification of the Engineer and Contractor are included in technical documentation and special conditions. Orders for performance of certain works and implementation of measures in the course of flood defence will be issued by the Engineer to the Contractor and will be in accordance with these procedures.
  - 6) Critical hydrologic conditions are defined in the EmW Design with respect to the authoritative water levels, laid down in this design by the PPMC "Srbijavode" (observation post, gauging rod, water level at which certain Flood Defence Phase is proclaimed / cancelled).
  - 7) PPMC "Srbijavode" has defined, in accordance with the applicable regulations, the role of third parties (in charge under Operation plan for the flood defence for relevant section of the embankment), as well as obligations of the Contractor in the course of flood protection
  - 8) In the BoQ there are defined items for works performed by the Contractor under the critical work operations, implementing preventive protective measures (forming temporary protective structures, hiring equipment, machinery and manpower).
  - 9) Damages caused by non-observance of prescribed procedures in performing critical operations are borne by the Contractor.

The Contractor is obliged to keep and preserve all completed works up to the final acceptance and has to safeguard the site for this purpose. The cost for it should be included in the unit price and will not be paid separately.

### **7.3. TECHNICAL STANDARDS AND REGULATIONS**

In accordance to these Technical Requirements the Contractor shall ensure that its performance incorporates the following key principles

- For all required works and services specified in this Tender Dossier, the relevant Serbian standards and codes of practice shall apply. In any case, if Serbian standards are more strict or dominant, they shall apply to replace other standards given or not in other parts of this document.

- For works and services where no relevant Serbian standards or codes of practice exists the latest European Standards and code of practice shall be applied.
- The proposed application of other standards and code of practice for certain works and/or services shall be such as to ensure equal or higher than specified quality and safety of works, and to facilitate operation, inspection, maintenance, repairs, lubrication and similar operations.
- In any case, National standards and code of practice have to be used for each service and work, accompanied with explanations, to demonstrate to the agreement of the Engineer that application of these standards and code of practice shall give required quality, safety, functionality and durability of the completed works.
- The applicable version of any standard shall be that valid 28 days prior to the latest date for submission of tenders.

### **7.3.1. Matters not covered by Standards**

Any materials and workmanship not fully specified herein or covered by the Standards, Codes or Manuals shall be of such type and quality so as to produce a required quality of work. In such circumstance the Engineer shall determine whether all or any of the materials offered or delivered to the site are suitable for use in the Works and the Engineer's decision in this respect shall be final and conclusive.

### **7.3.2. Civil Works**

The term "Civil Works" means the obligations of the Contractor to perform all manufacturing, excavation, building, structures and other construction Works.

The following shall be included, but not limited to, within the limits of the Works:

- Site investigation levelling, excavation, filling and other earth works;
- Demolition of existing structures and removal of debris;
- Civil works related to complete drainage systems and structures necessary for the disposal of process waste, overflow and drainage water and waste
- Landscaping and similar area works with plant roads, temporary roads, and site facilities;
- All other works from the Contractor's Offer whether specified or not in the BoQ or any other Contract Document (including the Contractor's proposal), as necessary for the completion of the Works and the operation thereof, and as required under the terms of the Contract;
- Excavation of trenches, laying of underground diaphragm, welding and protection;

- Soil stabilization using a binder ( with laboratory recipe) to improve the characteristics of the soil;
- Excavation of trenches, laying of pipes, welding and protection of the pipes, transport and disposal of excess and demolished materials;
- Reinstatement of any existing facilities demolished during construction;
- All temporary and provisional works necessary for proper execution of the Contract (temporary roads, keeping excavation free of water, excavation sheeting and bracing, etc.).

### **7.3.3. Mechanical Installations**

The term "Mechanical Installations" shall mean the obligations of the Contractor under the Contract to cover all manufacturing, delivery, assembling and installation, testing and commissioning of the required mechanical equipment and machinery for the proper completion of Works, which shall be performed by the Contractor.

The following shall be included, but not limited to, within the limits of the Works:

- Mechanical equipment and machinery, including motors and pumps and spare parts;
- Complete piping system, incl. armatures and fittings;
- Complete equipment for installing the underground diaphragm;
- Specialized mechanization with integrated equipment for stabilization and homogenization of the soil ” in situ cold recycling”;
- Workshop equipment;
- All other auxiliary materials of any description and all materials.
- Spare parts for fixed and mobile mechanical equipment.

### **7.3.4. Dealing with surface and underground water**

The Contractor shall be responsible for dealing with water, whether from existing watercourses, surface water and storm water, drainage systems ground water, underground springs or any other source or cause. In discharging and diverting water it shall avoid flooding or damaging other works or services, causing erosion and polluting watercourses.

The Contractor shall provide all temporary works and do all things which may be necessary to maintain those parts of the existing water supply, sewerage, and drainage systems and water courses which may be affected by its operations in a condition not less satisfactory than they were prior to the commencement of the works, and shall maintain the normal flows therein at all times until the connections to the new system shall have been made except when written permission to interrupt the flows has been obtained from the Engineer.

The Contractor shall submit its proposal to the Engineer accompanied with a schedule for maintaining the drainage systems and water courses affected by the Works. The Contractor's

method proposed for each location shall be subject to the review of the Engineer. Such review will not relieve the Contractor of its obligations under the Contract.

The Contractor shall perform all works for maintaining flow in existing drainage systems and water courses including but not limited to the construction of diversion systems and relocations and other works necessary during the construction period including the removal and dismantling of such works on completion as required by the Engineer.

The Contractor shall, as specified in the design, keep the working area free from water whether caused by floods, storms or otherwise so that the works can be constructed in dry conditions.

Unless otherwise specified, the Contractor shall furnish, install, maintain and operate all necessary equipment for de-watering and keep free from water the location where construction works are in progress.

The de-watering shall be done in a manner that will prevent loss of fines from the foundation, keep stability of excavated slopes and result in all works being performed free from standing water, and enable backfilling and proper compaction of the materials.

The Contractor shall be responsible for dealing with storm water, whether from normal or extraordinary rainfalls and weather conditions or any other source or cause. In discharging and diverting water it shall avoid flooding or damaging other works or services, causing erosion and polluting watercourses.

The Contractor shall perform all works for maintaining storm water flows and shall, as required by the Engineer, keep excavations free from water and sewage whether caused by tides, floods, storms or otherwise so that the works can be done in dry conditions.

Note: detailed critical work operations are presented in this Technical Specification, which are possible and expected during critical hydrological scenarios. TS also presents Synchronization Plan of mandatory preventive measures (part of Contractor Offer and of BoQ in Contract).

### **7.3.5. Existing Underground Utilities/Structures**

The Contractor shall (for its own safety) search for, locate and identify all buried utilities such as, for example, power cables, gas lines, water pipes, telephone cables.

The Contractor shall locate these utilities/structures sufficiently in advance of its construction operation and use modern detection equipment, satisfactory to the Engineer, in order to minimize the risks of damage or interruption of these utilities/structures. The Contractor shall take full responsibility for any damage caused by its operations to these utilities. Any damage shall be repaired without any delay at its own expense.

No excavating machines shall be used in the immediate vicinity of cables and/or pipelines unless approved by the Engineer. Special care shall be taken to ensure that the existing facilities are accessible in the case of an emergency.

Temporary works which may be necessary in the vicinity of the existing facilities during the execution of the works shall be maintained by the Contractor and shall be removed as soon as practicable. Before the commencement of works that might affect or damage neighbouring structures, the Contractor shall prepare a “Record of Evidence” by experts indicating and establishing the condition of the structure. This “Record of Evidence” should include photographs to prove any existing defects of utilities/structures prior to commencement of the works.

The Contractor shall indemnify the Employer and PWMC (as the Beneficiary) against all claims arising from any damage, injury etc. caused to the utilities as a result of its construction activities associated with this Contract.

### **7.3.6. Contractor's Equipment**

Details of all Contractors' Equipment to be used in the execution of the Works shall be submitted to the Engineer prior to its use.

The Engineer's consent to use such Equipment will not be unreasonably withheld, but if, in the Engineer's opinion, circumstances arise which make it desirable that the use of the said Equipment should be suspended either temporarily or permanently, the Contractor shall change the method of performing the work affected and it shall be deemed to have no cause for claims against the Engineer on account of having to carry out the work by another method, nor it shall be deemed to have cause for claim if any order issued by the Engineer results in the Contractor's Equipment having to stand idle for a period of any duration whatsoever or having to be removed.

In particular, where it is impossible due to the proximity of, and danger to, existing roads, structures, or services, to excavate except by hand methods, then in such cases it shall be deemed reasonable for the purpose of this Clause for the Engineer to withhold consent to use the Equipment.

### **7.3.7. Other Contractors on the Site**

The Contractor shall make appropriate allowance for liaison and co-operation with other Contractors who may be working on the Site which may interfere with the Works under this Contract.

In case it is necessary for other contractors employed by the Beneficiary, and employees of the Beneficiary to work on and around the Site, such other contractors and employees may reserve areas for use (example: food defence activities and works by the Chief of Flood Defence orders). The Contractor shall not enter or use these areas without the prior written permission of the Engineer, unless such entry is permitted elsewhere in the Contract, and shall not obstruct access to such areas without having provided an acceptable alternative access.

The Contractor shall not interfere in any way with any works, whether the property of the Engineer or of a third party and whether the position of such works is indicated to the Contractor by the Engineer or not. The Contractor shall respect the construction and finish of works and articles supplied or installed by others and will be held responsible for any loss or damage thereto if caused by it, its employees or its subcontractors.

#### **7.3.8. Subcontracted Works**

The Contractor shall appoint subcontractors for the work for which the Contractor is not experienced, recognized or approved.

The Contractor shall submit for consent, the names of all proposed subcontractors and suppliers of special manufactured items with full details of the company, reference list and all other documentation needed for approval of the subcontractors and shall indicate the precise sections of the work for which each will be responsible.

The Contractor shall be solely responsible for the overall co-ordination of the Contract. Direct formal communication between its sub-contractors and the Engineer will not be allowed.

#### **7.3.9. Materials in Stacking Yards**

Considerable quantities of material shall need to be stored during the execution of the Works. The Contractor shall take all reasonable precautions to protect these materials from any damage including fire and theft and shall furnish evidence of the insurance cover in this respect.

For these materials, after the Engineer's control and approval, payment may be accepted and performed up to 80% of its value, as per Article 14.5 of the General Conditions of the Contract.

#### **7.3.10. Method Statements**

The Contractor shall provide, in writing, a description of the arrangements and methods it intends to apply for the execution of the Works.

Method Statements (MS) shall show in detail the methods proposed by the Contractor for carrying out the principal activities of construction in full safety. In particular, the Contractor shall indicate the resources (plant, personnel, materials) to be allocated, timing and sequencing, emergency/contingency measures, and any other information required to clearly detail the proposed methods. All necessary health and safety and environmental measures required shall be clearly indicated.

This will be supported by calculations for temporary works for supporting excavated faces and shuttering of concrete. Flowcharts, sketches and drawings shall be included if necessary.

Proposed MS will be submitted to the Engineer (also to the Beneficiary) for approval. The Engineer (in cooperation with the Beneficiary's representative) will review and provide its comments within 10 days. The Contractor shall make final corrections (if any) and submit them to the Engineer for final approval, 15 days before the commencement of relevant work. Written agreement shall be obtained before any work is commenced.

#### **7.3.11. Provisional Time Schedule**

The Defects Notification Period (DNP) shall be twelve (12) months under the Contract and shall commence after completion of the Works.

The Completion Period for all works under the Contract shall be eighteen (18) months.

The duration and sequence of the various activities constituting the Works may be varied by the Contractor to suit its own proposals for carrying out the works, subject to the approval of the Engineer, but no consideration will be given to any request by the Contractor to extend the Contract completion dates.

#### **7.3.12. Standards on Site**

The Contractor shall purchase and keep on Site at least one copy of each of the relevant Standards, Codes and Manuals or approved National Standards which are referred to in the Specification. In addition, the Contractor shall keep on Site a copy of any other Standard, Code, Manual, or National Standard, which applies to materials supplied.

Copies of the standards shall be made available for reference at all times at the office of the Engineer.

Should the Engineer require an English or Serbian translation of any of the Standards or Manuals, the Contractor shall provide a translation within 7 days of receiving a written request from the Engineer.

#### **7.4. MARKING THE ROUTE AT THE BEGINNING OF WORKS AND RECORDING INITIAL (“0”) TERRAIN STATE**

The Contractor shall establish and provide, where necessary, benchmarks during the period of construction of the Works, which shall be checked periodically. The Contractor shall be solely responsible for carrying out these operations. It shall make the control points and benchmarks available to the Engineer together with the relevant records.

The Contractor shall provide the Engineer, for approval, with drawings showing the locations and levels or co-ordinates as appropriate of each and every temporary benchmark and survey station used for the setting out of the works.

The Contractor shall be responsible for constructing the works in accordance with the data on levels, benchmarks and other points of reference in the vicinity of the site(s) if they are not shown on the drawings.

The Contractor shall carry out marking of the object and boundaries of land intended for the construction site (expropriated area), and land for temporary occupancy (borrow pits, landfills, access ramps and other facilities related to construction works).

The control of this field work shall be carried out by the Engineer, but this control shall not relieve the Contractor of responsibility for the correct marking of works.

The Engineer can perform geodetic control, with due notice to the Contractor on the day and time of their geodetic control so that the Contractor could provide necessary small tools and supplies as well as auxiliary work force.

The duty of the Contractor shall be to:

- develop micro trigonometric network for all objects, which will be the basis for horizontal marking,
- develop hybrid networks for all objects, which will be the basis for all the height markings,
- in the field, bookmark all the main points and wasps of facilities beyond the reach of possible works,
- set up, secure and preserve and maintain all benchmarks, points and other surveying marks required in the performance of facilities, as well as for the execution and control of performed works.

#### **7.4.1. Geodetic route marking**

Items foresee marking (stakeout) route on-site prior to the commencement of works, the establishment of benchmark points along the route, recording of cross sections and built diagnostics by entering the data in the cadastre carried out by authorized institutions for this type of work.

Upon completion of the works, Contractor is obliged to submit a written certificate (in the Construction Log) to the Beneficiary on executed geodetic recording of built construction, issued by the authorized institutions (cadastral administration of property).

#### **7.4.2. Recording of initial state**

Before starting the works the Contractor shall:

- Based on the EmW Design and existing geodetic documentation, mark the design route, as well as cross sections for calculation. Cross-section profile for calculation should be done in line with the design. Cross-section profile

density has to be greater at locations where deviations from the design have been identified. Marks and benchmarks must be clearly identified, so that they could be easily seen on the route in order to give the required orientation. Geodetic securing of points also needs to be carried out.

- record the baseline condition of profiles on the basis of which calculation of quantities will be made, and prepare *Survey technical documentation of initial terrain state*, along the route of works. Locations where the embankment is crossed by the existing infrastructure, must be recorded in detail and presented in the Survey “0” Tdoc.
- Any discrepancies must be certified by the Engineer. In case of any mismatching of Survey “0” Tdoc with the EmW Design, the Contractor shall immediately inform the Engineer, and this is to be notified in the Construction Log. If it is determined that there are significant differences in the amounts of necessary works, the Contractor is obliged to carry out adjustment of designed objects to the conditions on the ground, according to the plans that will be obtained from the Engineer. The calculation of the payment shall be made according to the actual quantities of the works performed.
- Calculation of the works will be done according to recorded cross-sections of performed work segment, based on comparisons with the accepted and signed by all parties (Engineer, Beneficiary and Contractor), Survey “0” TDoc and measurements noted in the Construction Book (ConstBook) and confirmed by the Engineer, Beneficiary and the Contractor.

## **7.5. DEMOLISHING AND PROTECTION OF WORKS**

### **7.5.1. General**

No demolition of any existing structure shall be carried out until it has been approved by the Engineer in writing.

The complete demolition shall be carried out including the foundations, unless otherwise specified in the design or directed by the Engineer.

### **7.5.2. Disposal of Demolished Materials**

All materials arising from the demolition and clearance of the structures and other objects on the site shall be disposed of the Site, unless specified otherwise and instructed by the Engineer.

### **7.5.3. Backfilling and Finishing**

All excavated holes shall be backfilled with soil compacted to the same density as the surrounding soil and the surface shall be finished to the existing ground level and to the agreement of the Engineer.

### **7.5.4. Protection of Existing Objects**

The Contractor shall not demolish or remove any existing buildings, structures or other objects including trees, whether indicated on the Drawings or not, unless on a specific instruction from the Engineer.

The Contractor shall take every care and precaution to protect any of these objects from damage, including houses, buildings, fences or trees, which are situated on or near the Site(s).

Any property situated in close proximity to the Works shall be protected against any damage which could be caused by vehicles, subsidence, vibration, etc. Any damage caused shall be repaired by the Contractor to conform to the condition of the property prior to damage and to the agreement of the Engineer.

## **7.6. CLEANING THE FIELD, CUTTING OF TREES AND REMOVAL OF STUMPS**

Before the start of works, marking of the border of work zone should be done, which includes:

- route of designed embankment
- work area covering the area surrounding the embankment with future service road in foreland (width 10 m)
- Cutting and removal of trees out of the work area, removing stumps from the track of embankment and future service road in foreland, cutting the stumps from the area surrounding the embankment in width of 10m.

Wood, cut, classified and properly stacked on the previously approved site, shall belong to the Contractor.

The Contractor is obligated to pay the prescribed fee for harvested wood.

Cleaning shall be done in accordance with the regulations.

The Contractor is obliged to execute harvest activities by hiring the licensed staff.

Wood must be properly cut, classified (firewood and technical wood) and temporarily stored outside the site on the area which will be provided by the Engineer - protected fenced area.

Burning of wood is not allowed.

The Contractor shall take all necessary protective measures.

After removal of trees and stumps the Contractor and the Engineer will perform recording, which will serve as a basis for determining the amount of the executed works.

#### **7.6.1. Cutting of shrubs and trees up to 7cm in diameter, from the work area**

Combined (manual and mechanical) cutting of shrubs and trees up to 7 cm in diameter, with the disposal aside, grinded for biomass;  
Removal, out of work zone (loading, transport, unloading on the landfill - the distance up to 5.0 km);

#### **7.6.2. Removal of wood and stumps from the work area**

Cutting trees, into the logs no shorter than  $L=2.05$  m;

- Disposal of trees on the side, removing them outside of the work area (loading and transport to the secured landfill up to 15.0 km);
- Machine stump removal;
- Loading, transport and unloading of trees and stumps, branches, deposit (trees and stumps are disposed in a controlled manner, and branches are grinded with the use of protective measures);

#### **7.6.3. Protections**

Trees and/or other vegetation to be preserved shall be kept out from the clearing operation and be protected from injury during execution of the Works.

#### **7.6.4. Road Signalization**

The Contractor shall uninstal road signalization (street lighting, traffic signs or traffic lights) that has to be removed during the progress of the Works.

Installation of the road signalization shall take place at its original location, in a condition at least equal to the one prior to removal and as soon as practicable after completion of the works at particular location.

#### **7.6.5. Notice of Commencement**

The Contractor shall give a written notice to the Engineer of its intention to commence the clearing and grubbing operations (Notice of Commencement).

The works shall not be commenced until written approval has been received from the Engineer.

The Contractor shall ensure that all clearing and grubbing are carried out far enough in advance of other construction operations within the relevant areas in order to avoid delays.

## **7.7. TECHNICAL REQUIREMENTS FOR EARTHWORK - MAKING OF THE EMBANKMENT**

### **7.7.1. General**

The Contractor shall give a written notice to the Engineer of its intention to commence earthworks on any part of the Site at least seven days in advance, and shall provide the Engineer with all relevant documentation the Engineer may require for the purpose of carrying out measurements.

Earthworks shall not be commenced until written approval has been received from the Engineer.

Excavation will be controlled by geodetic surveying in the presence of the Engineer. All excavations must be brought up to the level envisaged in the design, which will be checked and accepted by the Engineer. All data must be shown in sketches, profiles and a sufficient number of measures in the construction book and must be certified by the Engineer.

Details of the excavation are defined in the design.

Within 5 days after receiving the plan of excavation, the Engineer shall approve or reject in writing the Contractor's plan, partly or entirely. In case of rejection of the plan, the Contractor shall submit a new plan for the excavation.

No excavation can start if the plan had not been approved and signed by the Engineer.

Control of the excavation and the amount of material is to be geodetically checked in the presence of the Engineer, and the Contractor is obliged to eliminate identified discrepancies.

In addition to work operations from the general description, the unit price for each item of earthworks shall also covers all working operations provided in the respective item.

### **7.7.2. Removing of humus**

Removing of humus top soil is done before other earthworks. Humus is removed from the crown and slope of embankment to future defended and undefended feet of the newly designed embankment. Removing of humus will be performed by machine within the design specified thickness or by of the instruction of the Engineer.

Removal of humus can be done only after the required labelling.

The excavated humus is used to form the walls of temporary cassettes for dredged sand used for incoherent part of the embankment. Humus is moved to a temporary landfill at an approximate distance of 30 m or immediately outside the embankment base with newly

designed defended side, in parallel with the designed route of the embankment, taking into account that a deposit is done within the expropriated zone.

Temporary humus landfills should be of appropriate geometric shape and compact enough to allow reception of dredged sand in the cassette. Protective film and other technical measures to prevent the endangerment of privately owned land must be applied.

The Contractor, on the basis of the technology of construction of drainage part, by installation of dredged sand from borrow pits of sand, defines the optimum number and arrangement of cassettes and ensures stability and waterproofing of cassette walls.

Where ordered by the Engineer, topsoil shall be stripped from the whole or a part of the Site to a depth of 30 cm or to such other depths as indicated in the Contract or such other depths and over such areas as the Engineer may direct, and set aside for re-use as a separate operation prior to any further excavation which may be required.

Topsoil shall include any surface material capable of supporting vegetation and suitable for use in soiling areas to be grassed or cultivated.

The Contractor shall not dispose of surplus topsoil without a written permission of the Engineer.

#### **7.7.3. Trial Investigative Holes**

The Contractor shall excavate trial investigative holes it may require to determine the position of underground services, sub-soil drains or for any other reason.

The Contractor shall arrange refilling and reinstatement of trial holes immediately when the required information is obtained.

The reinstatement of the surfaces of trial holes shall be carried out upon the written approval of the Engineer.

#### **7.7.4. Inspection by the Engineer**

When the specified levels or limits of any excavation are reached, the Engineer will inspect the ground exposed and if it considers that any part of the ground is by its nature unsuitable the Engineer may direct the Contractor to excavate further.

Such further excavation shall be refilled to the specified levels or limits with concrete, selected excavated material or selected imported material.

Should the material forming the bottom or sides of any excavation, while acceptable to the Engineer at the time of inspection, subsequently become unacceptable due to its exposure to weather conditions or due to groundwater, flooding or moisture contents, the Contractor shall remove such damaged, softened or loosened material using approved methods and excavate

further to a solid surface. Such further excavation shall be deemed to be additional Excavation works and material emanating therefrom shall be removed from the Site.

#### **7.7.5. Crossing Watercourses**

Where the excavation crosses streams, ditches, culverts and other watercourses, the Contractor shall be deemed to have allowed for all the additional measures necessary for the proper construction of the Works at these crossings including maintaining the full flow of water.

#### **7.7.6. Leveling of the Areas**

Areas around or on top of structures shall be levelled to the required levels as indicated on the drawings or instructed by the Engineer.

The Contractor shall take all due precautions to prevent any damage to the structures during the levelling.

The levelling of areas around structures shall be carried out by approved methods. Any damaged item shall be replaced or repaired at the Contractor's expense and to the agreement of the Engineer.

### **7.8. GROUND TREATMENT**

Any ground treatment proposed by the Contractor to improve the bearing capacity and/or settlement characteristics of the soil must be supported by a full method statement and design calculations with a statement of the minimum performance to be achieved.

Where directed by the Engineer, the Contractor shall carry out a field trial investigations of the proposed treatment to demonstrate that it meets the stated performance criteria.

### **7.9. THE CRITERIA FOR ASSESSING THE QUALITY OF MATERIALS**

Technology of reconstruction and construction works on the embankment is described in detail in Chapter 7.16 of this Technical Specifications (with schematic drawings).

The embankment involves spreading earlier hopped up materials, rough and fine planning, wetting and compaction of the material according to the dimensions given in the design.

All inorganic materials which satisfy the following criteria can be used for the embankment:

- Moisture content should be approximately close to optimal (according Proctor compaction test min 95%).

- Minimum dry bulk density (realized in the laboratory with the energy of 600 KN/m<sup>3</sup>) should be greater than 14.7 kN/m<sup>3</sup>, for the permitted load of the embankment vehicles during operation. Otherwise, it may be less.
- Air humidity should be less than 25%.
- Yield less than 65%, and plasticity index of less than 30%.
- Coefficient of permeability for coherent material built less than 10<sup>-7</sup> m/s.
- The coefficient of uniformity  $C_u = D_{60} / D_{10}$ , ( $C_u > 5$ , uniform composition for coherent material), and ( $5 < C < 15$  - moderately uniform composition, for incoherent material).

Proof of eligibility and testing materials conducted at each site changes in the quality and types of excavated material.

## **7.10. PREPARATION OF THE EMBANKMENT SUBSOIL**

Rebating of subsoil is performed with the use of bulldozer rippers in a layer 30 to 50 cm thick, with compacting, using single drum padded vibrating devices. The compaction of the subsoil is carried out according to the current regulations and standards (SRPS U.E8.010 and mere U.E1.010). The results of compaction must be controlled by the Engineer, and further work is subject to approval by the Engineer. The calculation for performed work is done per m<sup>2</sup>.

## **7.11. MAKING THE SCREEN OF THE EMBANKMENT**

### **7.11.1. Excavation of material from the body of the embankment**

This position includes the excavation of coherent materials from the existing embankment with transport to body of the embankment screen.

### **7.11.2. Construction of the body of the embankment from coherent material**

This position involves working with machines on spreading, coarse and fine planning, wetting and compaction of material from the excavation.

Filling is done mechanically, in layers of maximum 0.30 m.

In parallel with the filling, compacting of material from local excavation is done by appropriate means.

Filling is done according to profiles, altitudes and laid down inclines from the design.

The optimum thickness as a function of the number of crossings and the resulting compaction is determined on the test section. Details of test regime on the test section, such as the thickness of the layers and the number of crossings (depending on the type and characteristics

of the machinery that will be used for building) are given in the following technical requirements:

If the material is not of appropriate moisture for filling, evenly spread layer should be dried or dabbled, in order to achieve optimum moisture (SRPS U.B1.038) for installation. Optimal moisture is confirmed by tests on a test section.

Each applied layer is compacted to the required compaction capacity  $M_s=30$  MPa.

Control of incorporation into the body of the embankment consists of a visual inspection, field and laboratory tests.

Visual inspection shall be the control of: layer thickness, embedding methods, material homogeneity, impurities in materials, cleaning and wetting of the surface layers, roughening etc.

Field tests involve checking of realized compaction capacity of each of layers (30 cm high).

Previous laboratory tests involve checking a moisture content to define optimal (Proctor compaction test), and at last tests of realized Coefficient of permeability of embankment screen.

Delivery of materials is carried out on already completed and compacted part of the embankment. When there are heavy rains it is allowed to move around already built embankment.

Tamping of end edge of the embankment should be made with light rollers or handy machines. When working, the material must not be allowed to slip on already constructed parts of embankments and slopes must be protected from erosion due to rainfall. Damaged parts of the slope need to be repaired and material re-incorporated by the same procedure as the main works. Embedding must achieve the necessary impact resistance. Compaction is carried out evenly over the entire width and length of embankments. Compaction of material should provide the necessary level of permeability.

Embankment slopes are particularly compacted, after removal of any excess material that is outside the profile of the embankment.

### **7.11.3. Construction of the embankment ballast by incoherent material**

Dredging of sand into the prepared cassette in order to develop part of the embankment of the incoherent material and service roads in foreland consists of sand excavation in borrow pit, in the bed of the river Sava, with the use of dredge-sender/ re-fuller and transportation pipelines.

Through the pre-assembled steel pipes, with dredging pipes, sand with water (pulp) is pushed to the site into prepared cassettes, where the sand is precipitated from pulp, and the water still flows toward the outlets where it is evacuated into the channels or pumped into the river.

In addition to dredged material for the part of the embankment of incoherent material, material for making ramps on defended side of the embankment should also be dredged.

In addition to the above mentioned works, the unit price covers transportation, moving and installation of steel pipeline, construction of the pier on the coast and intervention in cases of evacuation of dredged water through the drain and maintaining of cassette with the use of bulldozers.

The Contractor, using technology of installation of dredged sand, from secured area of borrow pit, defines the optimum number and distribution of cassettes and therefore the optimal number and distribution of sites of temporary pier for vessels in the area of reconstruction of the embankment, as well as the length of piping, location and length of drainage canals.

#### **7.11.4. Separation of incoherent material from cassette walls**

Mechanical excavation of incoherent material for separation from the humus prisms and uniform depositing on the defended embankment slope in the amounts shown in the BoQ. In this way draining of dredged sand is provided.

This BoQ works item also covers making of slits in the body of the embankment and cassette on a distance determined by the Contractor according to its technology.

#### **7.11.5. Profiling the defended slope of the embankment**

Mechanical excavation is considered to encompass filling-profiling part of the embankment of the incoherent material using a bulldozer to the designed line of defended side of embankment. The crown and the slope of the embankment should be planned to the angle and slope defined in the EmW design and with possible deviations as defined in the design.

#### **7.11.6. Humus coverage**

Previously removed and deposited humus will be used for top soiling of the embankment body. Before the humus is returned, shallow grooving of the slope (10 - 20 cm) is done, at a distance of 1.0 m parallel to the axis of the embankment. Then, the humus layers 10-15 cm thick are applied. Top soiling is done from the bottom to the top of the slope.

After the topsoil is placed, light tamping shall be performed with the mechanical equipment. Until the grass is seeded, the surface humus must not be allowed to dry out. The final thickness of the humus cover is defined by the design (cross-sections). Finished surfaces must comply with the design.

During these works the Contractor is obliged to respect the marked boundaries of expropriation.

### **7.11.7. Grassing**

Grassing should be performed after the top soiling and planning are done, according to meteorological conditions. The choice of species should be carried out according to local conditions, and the following mixture of grass seed is recommended for the treatment of an area of 1.00 ha:

Grassing of the embankment:

- Meadow bolt	15 kg
- Orchard	10 kg
- Trefoil	8 kg
- French ryegrass	8 kg
- Red clover	4 kg
<hr/>	
Total:	45 kg per 1 ha

If it is necessary to perform repair on grass-covered slopes, seeding of the grasslands should be done with a mixture of grass seed with the following composition:

- Orchard	7 kg
- Meadow bolt	2 kg
- Grass meadow	1 kg
- Smooth browengrass	4 kg
- French ryegrass	2 kg
- Red clover	2 kg
- Trefoil	2 kg
<hr/>	
Total:	20 kg per 1 ha

This measure applies only in those places where the density of original grassing is lower, and repair turf after major floods and prolonged droughts.

Reception of completed works shall be carried out by the Engineer.

## **7.12. BORROW PITS FOR MATERIAL**

### **7.12.1. Borrow pit of coherent material for making the embankment screen**

Available amount of cohesive material from the body of the embankment is not sufficient for the formation of the screen. Additional amounts of high quality materials are provided:

1. From the existing body of the embankment, (geological exploration works have demonstrated the quantity and quality of materials for installation in embankments screen). Substandard material was used temporarily for the formation of temporary protection along the route or temporary protection embankment in the zone of temporary hole in the embankment.

2. From the borrow pit 15 km away, which has already been formed (on a plot provided by the investor).

The Contractor shall, with Elaborate on balance of recovered coherent materials, report the amount of extracted material.

After use, borrow pits are regulated in accordance with the given description of works (rough grading with the falling for draining).

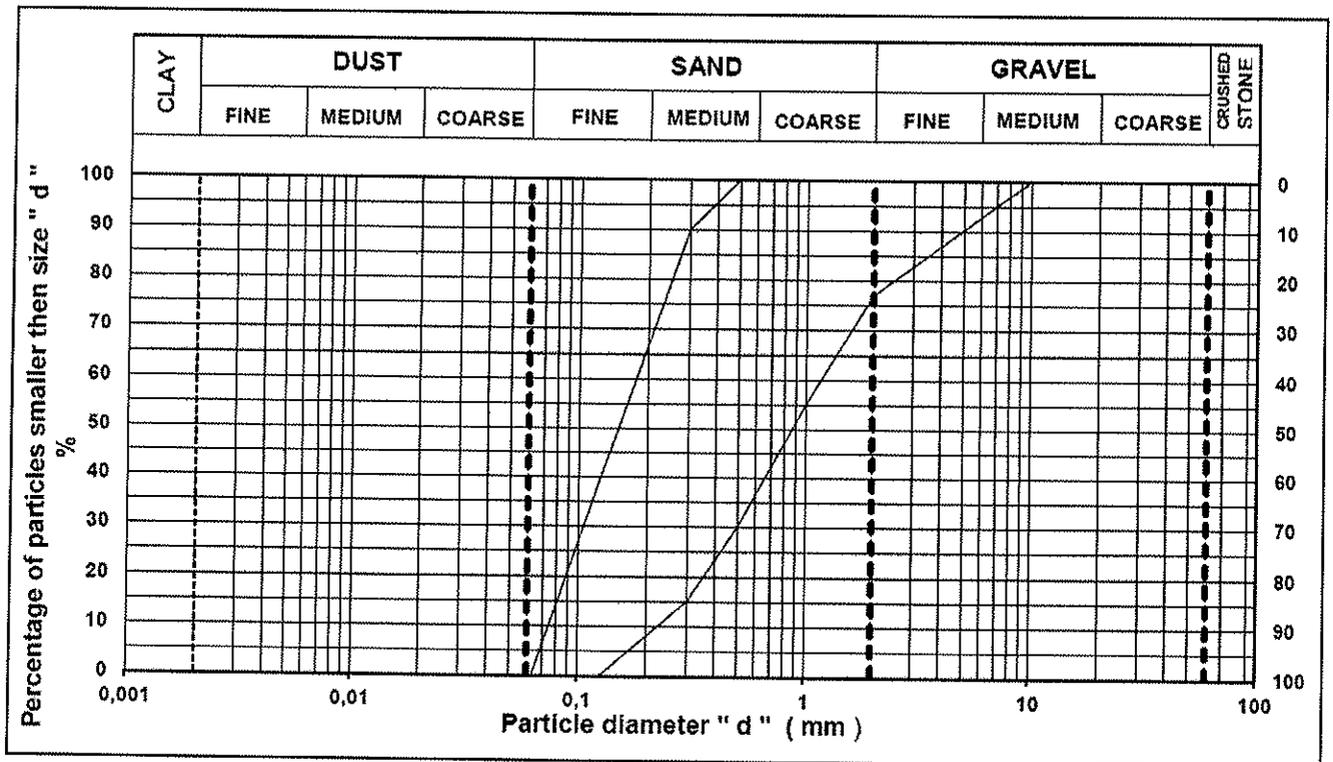
#### **7.12.2. Borrow pit of incoherent material for making ballast of the embankment**

Borrow pit of incoherent materials (riverbed of Sava river):

1. The borrow from the riverbed for which the Investor has secured approval (by the river chainage): 1. from km 169+300 to km 171+000, 2. from km 180+000 to km 183+000, 3. from km 185+000 to km 188+000, or
2. Other borrow pit at a distance from the construction site - the route of embankment up to 10 km, for which the Contractor will provide the necessary approvals. according the Serbian Water Law and subordinate legislation: previous geological field investigation, survey, Technical documentation for dredging (made by licensed designer), obtaining permission from PWMC (the approximate period for implementation of the procedure: ~3 months)

Borrow pits are previously geodetically recorded, the control testing of representative samples (3 pieces) from all layers is provided.

The installation of incoherent material of particle size distribution shall be approved in the range in accordance with the attached diagram (enclosed in Technical documentation).



After using the borrow pit from the riverbed, the borrow pit is geodetically recorded, built status is defined and the balance is constituted.

The Contractor is obliged to report the amount of extracted material, together with the Study on the balance of recovered materials.

The Contractor is exempted from the payment of compensation for the material extracted from the riverbed.

### 7.12.3. Geotextiles

The Contractor shall carry out the works described in accordance with the appropriate standards or equivalent local or international standards.

The materials shall comply with standards, but shall not be limited by the following:

- DIN 53352                      Mass per unit area
- DIN 53354                      Break resistance / elongation
- DIN 53363                      Tear strength
- DIN 53854                      Density
- DIN 53857                      Tensile strength
- DIN 53885                      Compressibility
- DIN 54307                      Puncture strength

- DIN 60500                    Hydraulic properties of geotextiles
- EN ISO 10319 Tensile strength (wide width)
- EN ISO 10320 Identification of geotextiles at the construction site
- EN ISO 10321 Tensile test on seams and joints by wide width method
- EN ISO 10722 Damage to geotextiles during installation in grained material
- EN ISO 11058 Water Flow (normal to plane)
- EN ISO 12236 Static puncture strength (CBR)
- ENV 12447                    Resistance against hydrolysis
- EN ISO 12956 Characteristic opening size
- EN ISO 12957 Friction values
- EN ISO 12958 Water flow capacity (in plane)
- ENV ISO 12960            Resistance against liquids
- EN SIO 13427 Abrasion test
- EN ISO 13431 Tensile creep test
- EN ISO 13437 Sampling and testing of geotextiles at the construction site
- ENV ISO 13438            Resistance against oxidation

The applications of geotextile fabrics are divided into the following three main classes:

Drainage: under all rubble rip-rap, including cyclopean stone and under gabions; wrapped around drains, pipe joints, and edge-drains; filter behind walls, etc.;

Erosion Control: silt fence and staked silt barrier;

Stabilization: separator between embankment and soft subsoil, reinforcement and pipe bedding.

The geotextile shall be of the type appropriate for the intended use. The geotextile fabric shall be a woven or non-woven fabric consisting of long-chain polymeric filaments or yarns such as polypropylene, polyethylene, polyester, polyamides or polyvinyl chloride formed into a stable network such that the filaments or yarns retain their relative position to each other. The base plastic shall contain stabilizers and/or inhibitors to make the filaments resistant to deterioration due to ultra-violet light (except for subsurface and stabilization classification), heat exposure and potential chemically damaging environment. The fabric shall be free of any treatment, which may significantly alter its physical properties. The edges of the fabric shall be salvaged or otherwise finished to prevent the outer yarn from pulling away from the fabric.

Synthetic filter fabric used for reinforcing grades (in water environments under block or rock covers) shall conform to the following specifications:

Fabric Properties	Requirements
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1. Tensile Strength	min. 50 kN/m
2. Tensile Strength at 5 % elongation	min. 60% of tensile strength acc. to No. 1
3. Elongation at max. load	max. 10%
4. Puncture resistance	min. 6 kN
5. Cone drop penetration	max. 8 mm
6. 10% fraction of pore size distribution	0.15 – 0.4 mm *
7. Permeability normal to plane	15 - 22 l/m <sup>2</sup> /s *
8. Weight	min. 200 g/m <sup>2</sup>

Synthetic filter fabric used as filter (protection of drainage pipes etc.) shall conform to the following specifications:

Fabric Properties	Requirements
1. Tensile Strength	min. 25 kN/m
2. Tensile Strength at 5 % elongation	min. 30% of tensile strength acc. to No. 1
3. Elongation at max. load	max. 25%
4. Puncture resistance	min. 2 kN
5. Cone drop penetration	max. 15 mm
6. 10% fraction of pore size distribution	0.4 – 0.5 mm *
7. Permeability normal to plane	100 l/m <sup>2</sup> /s *
8. Weight	min. 120 g/m <sup>2</sup>

\*) Fabric material shall have a permeability and characteristic pore size as required by the specific need or directed by the Engineer. Generally, low porosity fabric shall be used at the toes of slopes and around inlets. High porosity fabric shall be used in drainage ways.

Fabric material shall have a minimum of 10 years of expected usable construction life at a temperature range of 0° to 40°C.

The Contractor shall furnish two certified copies of a test report from the manufacturer certifying that the geotextile to be incorporated into the completed project meets the requirements of this Specification. The certified test reports to be issued by the manufacturing company shall be attested by a person having legal authority. The Contractor shall also furnish two 100 x 100 cm samples of the geotextile for product identification and any onsite testing. In addition, the manufacturer shall maintain test records as required by this Specification. These records shall be made available to the Engineer on request.

The fabric shall be wrapped in a protective covering which is sufficient to protect it from sunlight, dirt, and other debris during shipment and storage. After it is placed, the geotextile shall not be left uncovered for more than 2 weeks. Traffic or construction equipment will not be permitted directly on the geotextile.

Torn or damaged geotextile shall be replaced or patched. The patch shall extend 1 m beyond the perimeter of the tear or damage.

Overlaps shall be as specified by the manufacturer or as directed by the Engineer. In order to reduce overlaps, the geotextile fabric may be sewn together. Seams of the fabric shall be sewn with thread meeting the chemical requirements and minimum seam strength requirements given for the fabric and application. Sewn seams shall be lapped a minimum of 10 cm and double sewn.

Non-sewn seams shall have a minimum overlap of 50 cm except where placed under water where the overlap shall be a minimum of 100 cm. All seams shall be subject to the approval of the Engineer.

The geotextile shall be placed and anchored on a prepared surface approved by the Engineer. The geotextile shall be laid loosely so that placement of the overlying materials will not stretch or tear the geotextile. Where geotextile is placed above water, the backfill placement shall begin at the toe and proceed up the slope.

Where geotextile is placed under water, the long dimension shall be placed parallel to the direction of flow. Successive geotextile sheets shall be overlapped in such a manner that the upstream sheet is placed over the downstream sheet. As the geotextile is placed under water, the backfill material shall be placed on it to the required thickness. The geotextile placement shall not progress more than 15 m ahead of the backfill placement.

Rip-rap, stone filling (heavy) or stone filling (medium) shall not be dropped onto the geotextile from a height greater than 0.3 m. Slope protection and smaller sizes of stone filling shall not be dropped onto the geotextile from a height exceeding 1 m.

If the above conditions cannot be met, a protective layer shall be placed on top of the geotextile (i.e. wire mesh, steel wire fabric used for concrete reinforcement, etc.). The surface upon which the geotextile is to be placed shall be within reasonable conformity to the proposed grade. The geotextile shall be laid loosely so that placement of the overlying material will not stretch or tear the geotextile. The overlying course shall be placed in 1 lift and compacted as approved by the Engineer.

The geotextile shall be placed to conform loosely to the shape of the trench.

After the filter material is placed, the geotextile shall be folded over the top of the filter material to produce a minimum overlap of 30 cm. The geotextile shall then be covered with the subsequent course.

## **7.13. FILLING**

### **7.13.1. General**

Extensive filling is hereinafter referred to as provision of the final ground levels (including slopes), which are shown in the design, or raising of ground levels at the required locations (taking into account the thickness of cover necessary for landscaping).

Back-filling is hereinafter referred to as backfill of excavations for structures or pipes.

Filling includes generally loading and transport of materials from intermediate stockpiles, placing of fill material in layers, adjusting of moisture content, compaction to the specified density and trimming of compacted surfaces.

No backfill work shall be carried out until approved by the Engineer.

### **7.13.2. Fill Materials to be Provided by the Contractor**

Except where otherwise specified, the Contractor shall be responsible for the location of suitable sources of natural materials for the execution of the Works, whether such sources are on the Site or not, and for obtaining all necessary permissions, including certificates of occupancy, quarry licenses and water rights.

Materials available on the Site or materials made available or supplied by the Employer shall be used for the execution of the Works if the quality of such materials is sufficient.

It is the Contractor's responsibility to obtain, transport and place materials when needed for the executions of the Works. The Contractor shall obtain the approval of the Engineer for the areas as well as for the materials he proposes to use.

Where specified or ordered by the Engineer, fill material for incorporation in the Works shall be obtained from approved borrow areas after the completion of any tests to confirm the suitability of the material.

Upon completion of excavation, the Contractor shall trim, grade and leave the borrow area in a tidy condition to the agreement of the Engineer and, if ordered, shall carry out without charge any further earthworks necessary to prevent accumulation of water in the area.

### **7.13.3. Fill Materials Obtained from the Site Excavations**

If the excavated materials are found to be appropriate for fill, these materials can be used with the approval of Engineer up to level excluding topsoil. If it is not sufficient, additional fill material shall be provided. Excavation materials shall be sorted and graded.

### **7.13.4. Preliminary Tests for Compacted Fill**

If ordered by the Engineer, materials proposed for use as compacted fill (other than the materials previously excavated at the same location on the site) shall be tested on site in accordance with the procedures as prescribed in DIN 18196 to determine its characteristics and suitability.

### **7.13.5. Filling not to Endanger Structures**

The Contractor shall arrange the timing and rate of placing of back-filling or of filling to structures in such a way that no part of the Works is over stressed, weakened, damaged or endangered. The layers of material shall be so placed as to maintain adequate drainage and to prevent accumulation of water.

In particular, the placing of material around concrete structures shall commence only after they have been completed and have attained their full specified strength. The material shall be placed so as to exert a uniform pressure around the structures.

Regardless of the method of back-filling adopted, the Contractor shall ensure that back-filling to excavations is carried out to the agreement of the Engineer. The Contractor shall take all necessary precautions to ensure that no damage is caused to the Permanent Works or to adjacent structures.

Where backfill is to be placed on two or more sides of the structure, it shall be placed simultaneously on the opposite sides so that the difference in level never exceeds 0.30 m, or as otherwise instructed.

### **7.13.6. Back-filling of Excavations for Pipes or Cables**

The bedding zone below, lateral and above the pipe or cable shall be filled and carefully compacted by a method approved by the Engineer to avoid change in alignment and level of the pipes or cables.

Unless specified otherwise, the excavation for pipes or cables shall receive a minimum layer of approved bedding material below the pipe or cable of depth in the trench according to EN 1610 but at minimum within the following range: 0.15 m (internal diameter of pipe up to and including 1.0 m or for cables); 0.2 m (internal diameter of pipe above 1.0 m). Lateral bedding shall be formed by spreading and compacting bedding material over the full width of the trench. Sufficient bedding material shall be provided to allow the pipes or cables to be worked into the bedding material and firmly supported to true line and level.

Sufficient space shall be left to enable the pipe joints to be made, tested and inspected and the Contractor shall ensure that at least three quarters of each pipe length is fully supported. Before any further filling, the pipeline has been tested and approved by the Engineer. Pipe trenches shall be carefully filled with bedding material. Unless specified otherwise for the specific pipe types, all pipes shall be covered by bedding material to a level of 0.3 m above the top of the pipes. Unless specified otherwise for the specific cable types, all cables shall be covered by bedding material to a level of 0.2 m above the top of the cables.

The bedding material for plastic pipes (PE-HD, PVC) shall be according to the manufacturer's requirements.

The bedding material for concrete and steel pipes shall consist of sand-gravel, graded 0/25 mm.

The bedding material for cable conduits and cables shall consist of sand, graded 0/2 mm.

The remainder of the trench shall be back-filled with approved selected material in accordance with the Contracting Authority's Requirements.

The difference in level of backfill on either side of pipes shall not exceed a maximum of 0.2 m. Backfill to structures shall generally be carried out as soon as practicable.

Embedding of pipes and cables includes the supply of bedding material, preparation of the bed, placing of embedding layers (not more than 0.1 m compacted thickness) and compaction either by hand or with appropriate machines to the specified density below and around the pipes. The embedding works shall be carried out in compliance with DIN EN 1610.

#### **7.13.7. Stanks to Pipeline with Granular Bedding**

When pipes are laid with granular material or backfill, a stank (which is an impermeable barrier designed to prevent groundwater flow along the trench) shall be provided across the full width of the trench and for the complete depth of the bedding. Fill between stanks shall not exceed 50 m intervals and shall be generally midway between manholes or thrust blocks. Stanks shall be provided at any points where pipe trenches pass through or into impermeable strata whose permeability is lower than that of the adjacent ground so as to form a restriction to the flow of groundwater. In these cases, the stanks shall be formed so as to restore the continuity of the impermeable or low permeability, stratum where it has been intersected by the trench excavation.

The stank shall consist of:

- a) 300 mm long plug of clay, clayey soil or other approved impermeable soil, or of a mixture of sand and bitumen, consolidated in an approved manner.
- b) layer of plastic sheeting, minimum thickness 1 mm, cut to fit around the pipe across the full width of the trench and laid on the granular bedding or fill material at the natural repose angle.

All methods must form an impermeable barrier.

Bitumen shall not be used for trenches containing thermoplastic pipes.

The cost of providing stanks shall be included in the Contractor's rates for pipe laying.

#### **7.13.8. Back-filling of Excavations for Structures**

Compacted fill shall consist of approved material, spread and compacted in layers approximately horizontal and of uniform thickness with a slight outward slope and of a compacted depth not exceeding 0.2 m after compaction.

Soil lumps larger than 0.1 m in size shall be broken before compaction. The moisture content of the soil shall be carefully controlled either by the natural drying or wetting with a fine spray before filling.

Compaction shall be carried out by mechanical rollers, power rammers, vibro-tampers vibrating plate compactors or other approved plant so as to produce the specified density determined in accordance with DIN 18126 or such other minimum dry density as may be otherwise specified or ordered by the Engineer.

**Required Compaction for Various Fills:**

Dry density of compacted fill 100% of the maximum dry density:

Dry density of compacted fill 95% of the maximum dry density according to DIN 18126:

Formation levels and pipe/cable bedding fills, Final backfill of trenches in general

**Main Tests and Standards**

The Contractor shall carry out all tests in accordance with SRPS standards.

The Contractor shall be responsible for the design, installation, maintenance during construction, and where appropriate, removal of all support works needed for trenches and other excavations (timbered walls with concrete or wood infill, sheet pile walls, etc.). The Contractor shall submit details of its proposal for excavation support to the Engineer for approval, which details shall include such drawings, calculations or other explanatory matter as the Engineer may require, but such approval shall not relieve the Contractor of its responsibilities under the Contract. No excavation work may proceed until the Engineer's approval has been given to the Contractor's proposals.

The Contractor shall not remove temporary works supporting the excavations until the Permanent Work is sufficiently advanced in the Engineer's opinion to permit such removal which shall be executed under the personal supervision of a competent foreman. Where the removal of excavation support works is considered by the Engineer to endanger existing structures thus making them liable to subsidence damage, the Contractor shall leave such support works in place, removing only the minimum necessary to allow the reinstatement of the surfaces.

Works for pit sheeting and bracing close to private or public properties, structures and utilities shall be carried out with low vibration and low concussion.

**7.13.9. Temporary Sheeting and Bracing**

The Contractor shall be responsible for the design, installation, maintenance during construction, and where appropriate, removal of all support works needed for trenches and other excavations (timbered walls with concrete or wood infill, sheet pile walls, etc.). The Contractor shall submit details of its proposal for excavation support to the Engineer for approval, which details shall include such drawings, calculations or other explanatory matter as the Engineer may require, but such approval shall not relieve the Contractor of its responsibilities under the Contract. No excavation work may proceed until the Engineer's approval has been given to the Contractor's proposals.

The Contractor shall not remove temporary works supporting the excavations until the Permanent Work is sufficiently advanced in the Engineer's opinion to permit such removal which shall be executed under the personal supervision of a competent foreman. Where the removal of excavation support works is considered by the Engineer to endanger existing structures thus making them liable to subsidence damage, the Contractor shall leave such support works in place, removing only the minimum necessary to allow the reinstatement of the surfaces.

Works for pit sheeting and bracing close to private or public properties, structures and utilities shall be carried out with low vibration and low concussion.

#### **7.14. LANDFILLS FOR DISPOSAL OF LOW-QUALITY MATERIAL**

The material that is not suitable for embedding or is in excess from excavation shall be deposited. Depositing material from the excavation will be performed on surfaces which are defined in Bill of Quantities.

If the need arises, the Contractor may also undertake temporary depositing of excavated material at places determined by the Engineer, on the ground that is already expropriated.

Upon completion of works, or because the need for the temporary deposit of materials from the excavation ceased, the Contractor is required to drive all the remaining material to permanent landfills, and bring the place where temporary landfills were, into its original condition, or arrange it in the way determined by the Engineer.

Depositing of material must be conducted in such a way that landfills are always dried and planned. Slopes of the landfill and the landfill itself must be stable.

The arrangement of temporary landfill is not paid separately but is considered to be included in unit prices for excavation.

#### **7.15. TECHNICAL REQUIREMENTS FOR ACCESS AND SERVICE ROADS**

##### **7.15.1. Formation and profiling of the access road**

Removal of vegetation from the area of the future roads.

Creating a substructure of road of incoherent material, excavation, relocation of materials to the zone of the service road on the defended side, roughly spreading material in layers of 30cm in the area of service roads on the defended side, compaction evenly over the entire width with application of prescribed measures for achieving compaction:  $M_s=40.0$  MPa;

Making the final layer of the road of CSA (crash stone aggregate) the width of 3.5 m; thickness  $d=30$  cm.

Material must meet the terms of quality of all standards for this type of work.

#### **7.15.2. Formation of access road - surfacing asphalt concrete**

Pavement of asphalt concrete over already made base layer in thickness and in the area given in the design, which includes provision of all plant, equipment, materials and labour and performing all operations in connection with the production, transport and placing the asphalt concrete.

For making of the pavement, asphalt concrete mark AB-16 is used, under the terms of SRPS U.E4.014 (1983).

Bitumen is used as a binder polymer (BIT 90 + 0.5% DOP for improvement of adhesion + 5% polymer).

#### **7.15.3. Formation and profiling service road surrounding the embankment in the floodplain**

The Contractor shall construct substructure of road of incoherent material that has to be created by excavation and subsequent relocation of material to the zone of service road on the river side of dike - undefended side, by roughly spreading the material in 30cm layers in the area of the service road (B=3,5 m).

- Required compaction of layers is  $M_s=30$  MPa, and the final layer of CSA stone with thickness of 30 cm and  $M_s=40$  MPa.

Material must meet terms of quality of all standards for this type of works.

The slopes in the area surrounding the embankment have to be top-soiled and grassed in accordance with technical requirements for these works: top-soiling of service road slopes with exquisite humus from landfill.

#### **7.15.4. Service road in the defended part - drainage carpet in the ballast leg of the embankment**

The sub-soil has to be consolidated and further strengthened by using mechanization in order to construct the consolidated service road and multiple crossings on the defended side. Non-woven polypropylene geotextile has to be laid on a prepared subsoil service road (before making the final layer of sand and a layer of crushed stone), in accordance with the technical requirements for installation of these types of material.

- The drainage road substructure has to be constructed on the defended side (incoherent material is transported from the temporary landfill that is formed with the excavation material). This item (3.2) covers rough spreading of incoherent material transported

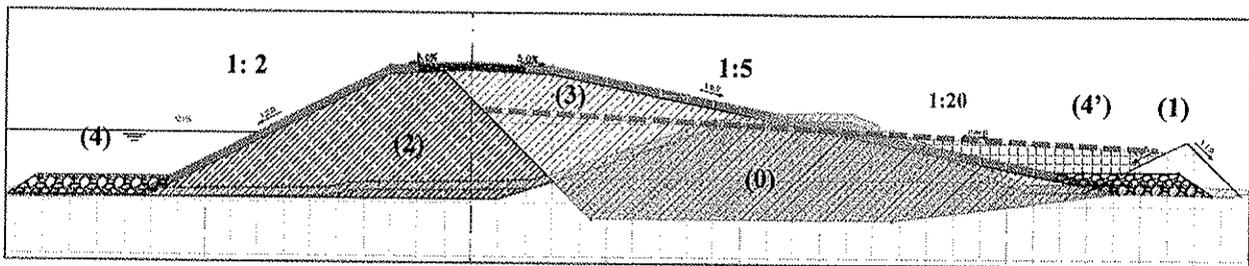
from the temporary landfill. Required compaction of layers is  $M_s=30$  MPa, and the final layer of CSA stone has to be 30 cm thick, with the compactness of  $M_s=40$  Mpa.

Material must meet all the requirements in terms of quality of all standards for this type of work.

The slopes of the area surrounding the embankment have to be top-soiled and grassed in accordance with technical requirements for these works: service road slopes have to be top-soiled with exquisite humus from landfill in the layer of  $d=20$  cm thickness; longitudinal displacement (up to 20 m) of the deposited material (humus), spreading and planning of humus along the slope is needed.

## 7.16. TECHNOLOGY OF RECONSTRUCTION AND CONSTRUCTION WORKS ON THE EMBANKMENT AND ACCESS ROADS

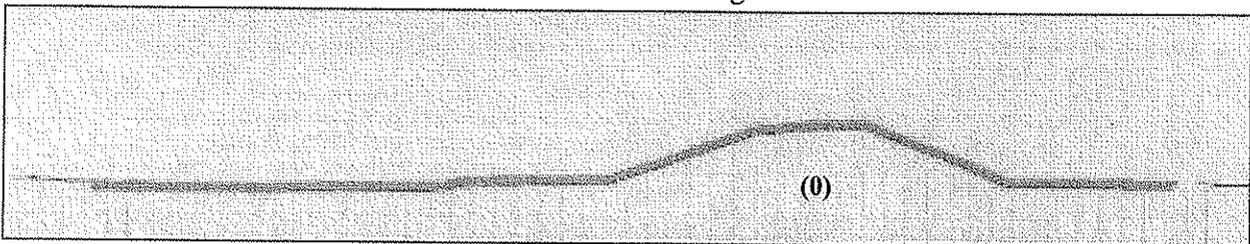
### 7.16.1. Technology of reconstruction and construction works on the embankment



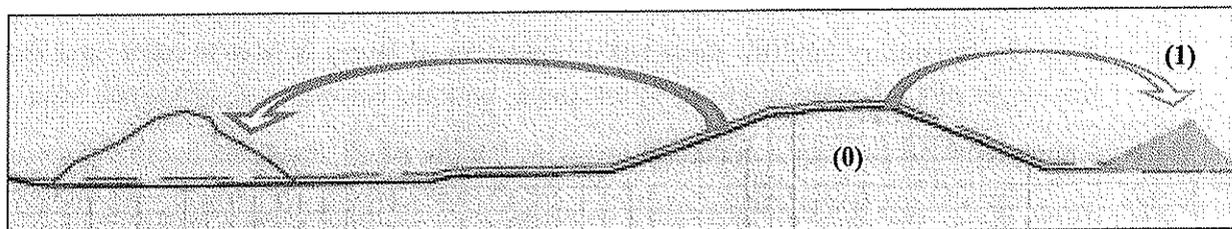
*Schematic drawing No 1: Embankment cross-section (existing state, phase of construction, final state)*

Schematic drawing 1 presents the embankment with a screen of coherent materials (2), using material from the existing embankment (0), ballast of incoherent material (3), made by dredging of sand/gravel from the river bed, with service roads ((4) and (4')) on both sides (the road on the defended side (3') with the function of drainage "carpet"). Also, position of temporary "wall" (1) of the cassette/reservoir for dredging sand/gravel and water mixture is shown (with temporary level slope of 1:20).

The process of reconstruction of the embankment on the right bank of the Sava River is given in the technological scheme, and consists of the following:

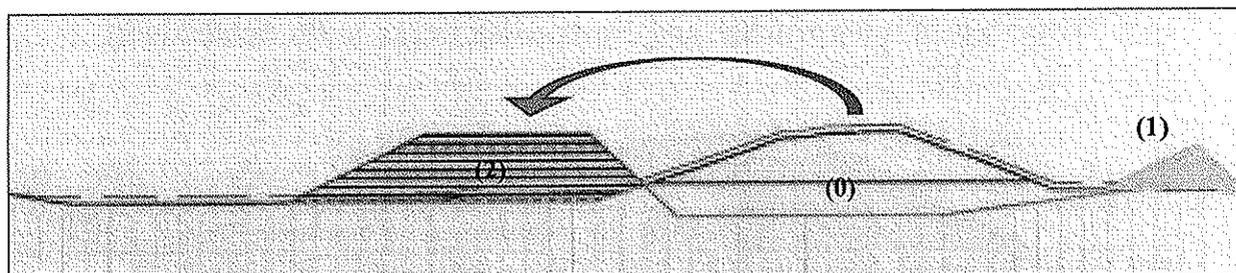


*Schematic drawing No 2: Existing state cross-section*



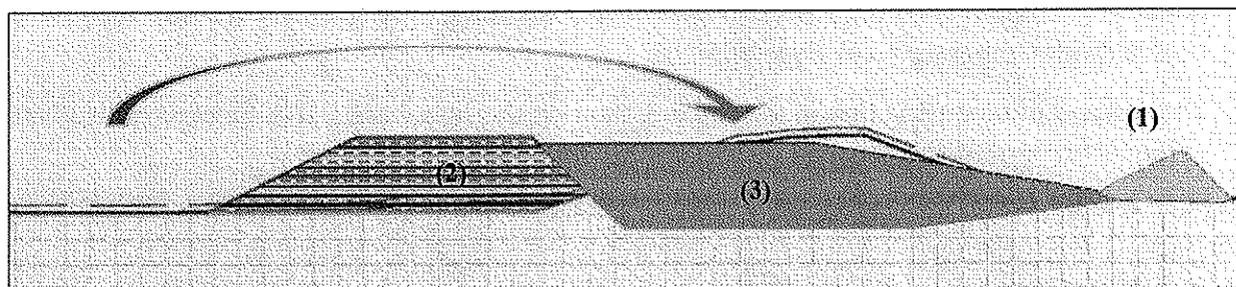
Schematic drawing No 3: Preparatory works

- Preparatory works intended for area surrounding the embankment, with clearing of vegetation.
- Construction of the temporary wall (1) of the reservoir/cassettes for the sand/gravel/water mixture: remove the topsoil from the existing embankment (0) by bulldozers in a layer of 30 cm and produce a wall of the removed topsoil with slope 1: 2 and 1: 1 and a minimum height of 0.80 m above the temporary level of dredged sand in the cassette.



Schematic drawing No 4: Excavation and installation of the embankment screen

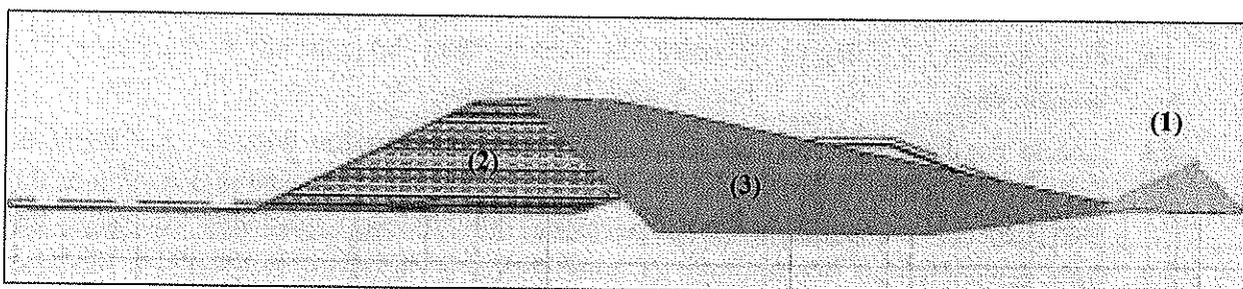
- Excavation of cohesive material of the hull of the existing embankment (0) from the defended side, and installation on the undefended side of the reconstructed embankment (2). Embankment screen is formed by spreading the material in 30 cm layers and compacting it by static or dynamic compacting mechanization/equipment, in order to achieve compaction of  $M_s=30\text{MPa}$ ;



Schematic drawing No 5: Refilling of the incoherent material into the prepared area

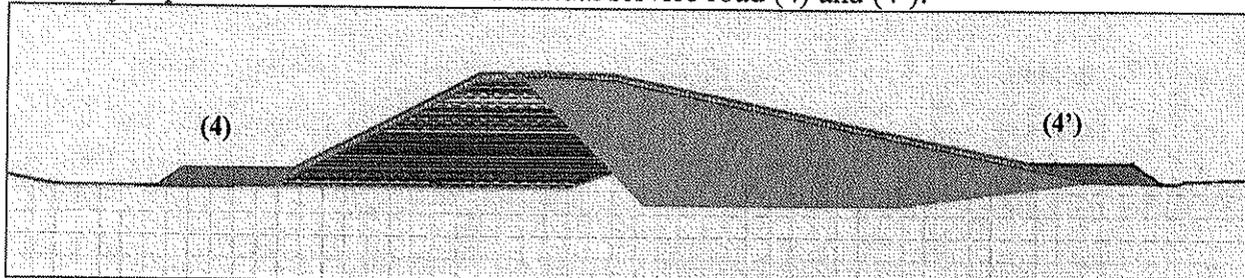
- Excavation of incoherent material from the riverbed of the Sava river - from borrow pits defined by the Beneficiary - providing particle size distribution

- within the required range (in accordance with the attached granulometric diagram), transport by water to the site in the zone of the route of works.
- Cross of incoherent material in the ballast embankment (two different ways are applied, depending on weather and hydrological conditions and the possibility of vessels to access the coast in the area of the construction site):
    - a. Refilling incoherent material into the prepared barges of dredger from borrow pits in the minor riverbed of the Sava River.
    - b. Deposit on the coast in the zone of section of the reconstructed embankment, no further than 5 km from the place of installation. Loading, transportation of incoherent material in the pre-prepared cassettes/reservoir (3).
  - After siltation (mixture of water sand/gravel) from the cassette, by gravity, the liquid product is returned to the river via specially constructed outlets in the hull of embankment and drainage canals to the river bed.
  - Final profiling of the embankment body. After the body of the embankment is profiled, it is covered with humus from the cassette wall in a 30 cm thick layer. Surfaces covered with humus are planned with accuracy of  $\pm 3$  cm, and then sown with the appropriate mix of herbs in a suitable period of time.
  - On the crown, surface pavement is formed of crushed stone-gravel and compacted up to  $M_s=40$  MPa.



*Schematic drawing No 6: Refilling incoherent material into the prepared area – full embankment body*

The Project provides access routes and mutual service road (4) and (4'):



*Schematic drawing No 7: Service roads on the both sides of the embankment body*

### 7.16.2. Technology of construction of the access, service roads and loading ramps

- **Service roads on undefended sides of the embankment:** To create a service road in foreland, filling of existing pits with incoherent material is envisaged, after removing the humus layer  $d=20$  cm in the width of 3,5 m. Inclination of the service road body is 1: 2. Required compaction of layers is  $M_s=30$  MPa, and the final layer of gravel - crushed stone thickness of 20 cm is  $M_s=40$  MPa. Slopes of service roads are planned, covered with humus and grassed.
- **Service roads on defended sides of the embankment:** Service road on the protected side is designed with a drainage function in the leg of the ballast: the removal of humus is envisaged in the width of 3.5 m, longitudinal and transversal levelling, installation of geo textile, forming the body of the drainage gravel surfacing and compaction to the prescribed value.
- **Access roads on the embankment section from km 18+030 to km 23+100:** To create the access roads (construction site roads during the construction and during the exploitation of the construction, as well as access roads for maintenance and flood control) filling is envisaged, after removing the humus layer of  $d = 20$  cm in the 3.5 m width, levelling and compacting.
- Required compaction of layers is  $M_s=30$  MPa, and the final layer of CSA stone is 30 cm thick and compacted to  $M_s=40$  MPa. (supporting layer,  $d=20$  cm will be made of CSA 0/63 mm and final layer,  $d=10$  cm, will be made of CSA 0/31,5 mm).
- For access to PS Kalenića Revenica, the existing road along the left bank of canal will be asphalted.
- **Access road on the downstream embankment section km 8+950 – km 18+030:** For access road from Drenovac settlement on the crown of downstream section of the reconstructed embankment it is necessary to lift the level and stabilize the embankment crown. Technology of stabilisation is described in details in the next chapter. Final layer,  $d=10$ cm, will be made of CSA 0/31,5 mm, compacted to  $M_s=40$  MPa.
- **Access embankment ramps:** Bodies of embankment ramps are formed by the coherent material (with the undefended side of the bank) or of the incoherent material (with the defended side of the bank). Final layer of slopes is made of humus with grassing.
- Roadway surface of the access road to the crown of the embankment and access output section of the embankment crown is formed using technology of stabilization and homogenization.
- Technology of stabilization is described in details in the next chapter. Final layer,  $d=10$ cm, will be made of CSA 0/31,5 mm, compacted to  $M_s=40$  MPa.

## **7.17. CONCRETE**

After the Contract commencement, the Contractor shall submit for the Engineer's approval a Method Statement with proposals for organisation of the on-Site concrete works according to these Specifications.

The Method Statement shall include the following items:

1. Plants proposed.
2. Location and layout of concrete plant.
3. Proposed method of organisation of the concrete production facility.
4. Quality control procedures for concrete and concrete materials.
5. Transport and placing of concrete.
6. Details of formwork including striking times and procedure for temporary support of beams and slabs.
7. Protection and curing.

The quality of Concrete and its components has to be in accordance with the technical specifications and Standards:

- Regulation on technical measures and requirements for concrete and reinforced concrete (hereinafter PBAB);
- The RS Standards (hereinafter referred to as SRPS).

The Contractor is required to obtain a copy of all standards set forth herein and hold it on-site.

### **7.17.1. Type of Cement**

The type of cement used shall be as specified in the design or as ordered by the Engineer. Sulphate resisting cement shall be used for all concrete in contact with sewage and drain water or subjected to moist air or atmosphere here from, unless otherwise agreed with the Engineer. Portland cement shall be used in all other concrete, unless otherwise agreed by the Engineer. The cement shall either be delivered in sealed bags marked with the manufacturer's name or in bulk consignments in a manner approved by the Engineer.

Before cement is ordered and delivered to the Site, the Contractor shall submit a detailed list of the sources, country of origin and manufacturer's brand names of the types of cement proposed for usage to the Engineer for its approval.

### **7.17.2. Quality of Water**

The water used for all Works shall be potable, clean, fresh and free from objectionable quantities of silt, organic matters, alkali, salt or other impurities.

The water used for mixing concrete and mortar, washing of aggregates and for curing the concrete, shall be from an approved source and shall contain no deleterious matter which significantly affects the reinforcement, setting time, strength or durability of the concrete or

which has any effect on the appearance of the hardened concrete by discolorations or efflorescence.

The Contractor shall provide the Engineer, free of charge, with samples of the water proposed for use on the Works in order to enable the Engineer to carry out such tests as deemed required. Water samples will be delivered sufficiently in advance of the tests. The tests shall be carried out before the water is required for use and at such other times during the course of the Contract as the Engineer may direct.

If required by the Engineer, the Contractor shall, without extra cost, treat the water taken from any other source to such a degree as may be necessary in order to render it suitable for mixing concrete and mortar.

### **7.17.3. Aggregates**

Aggregates for concrete shall be obtained from sources approved by the Engineer. Fine aggregates shall consist of natural sand unless otherwise approved.

Except as may be modified hereunder (fine and coarse) aggregates for all types of concrete shall comply in all respects with BS 882 “Concrete aggregates from natural sources”. They shall be hard, strong and durable and shall contain no harmful material of sufficient quantity to affect adversely the strength or durability of the concrete or, in the case of reinforced concrete, to attack the reinforcement.

Fine and coarse aggregate shall comply with the following physical requirements:

- 1) The proportion of void forming hollow shells in fine aggregate and retained on a 2.36 mm BS sieve shall not exceed 3%.
- 2) The clay, fine silt and dust content shall not exceed the following limits:
  - Coarse aggregates 1% by weight
  - Natural sands 3% by weight
- 3) Fillers (for water tight concrete)
  - Fly ashes max. 2% of cement contents
  - Silica max. 2% of cement contents
- 4) The flakiness index and elongation index of coarse aggregates as measured in accordance with BS 812 shall not exceed 20% and 35% respectively.
- 5) The absorption of fine and coarse aggregates as measured shall not exceed 3% by weight.
- 6) The aggregate impact value for coarse aggregates as measured shall not exceed 30%.
- 7) Fine aggregates shall be clean, sharp, coarse naturally occurring sand
- 8) Coarse aggregates shall be obtained by mechanical crushing and screening.
- 9) Fine and coarse aggregates when tested in accordance with ASTM-C88, using Na<sub>2</sub>S<sub>0</sub>4, solution, shall show a loss not greater than 10% or 12% respectively by weight.

Fine and coarse aggregates shall comply with the following chemical requirements:

- 1) Fine and coarse aggregates shall not contain more than 0.10% and 0.05% respectively by weight of chlorides (as NaCl). If either material exceeds the above limits the material shall still be acceptable in this respect provided the total sodium chloride concentration in the mix complies with Paragraph “Concrete Mix Design”.
- 2) Fine and coarse aggregates shall not contain more than 0.40% by weight of acid soluble sulphates (as SO<sub>3</sub>).
- 3) Coarse aggregates shall be a minimum of 85% by weight calcium carbonate.
- 4) fine and coarse aggregates shall not be potentially reactive with alkalis.

If this requirement cannot be met the Contractor shall adopt constituents for its concrete such that either:

- 1) the cement material shall have a reactive alkali content not exceeding a maximum value of 0.6% by mass when defined and tested in accordance with the method prescribed, or
- 2) the total mass of reactive alkali in the concrete mix shall not exceed 3 kg per m<sup>3</sup> of concrete when defined, tested and calculated in accordance with the method prescribed.

The Contractor shall notify the Engineer of its proposals for complying with this requirement at the time of commencement of the Works.

If, in the Engineer's opinion, the aggregates fail to comply with, or if there are doubts as to the uniformity of their compliance with the specified requirements, it will order all aggregates to be washed before use in the Works. When washing is ordered, it shall be done by using water of the quality specified in Paragraph “Water” and using methods and plant approved in advance by the Engineer and all costs shall be paid by the Contractor.

The Contractor's attention is drawn to the fact that it may be necessary to combine two or more fine aggregates, or remove some fractions by hydraulic classification, in order to achieve the grading as specified.

The maximum size of aggregates required will not normally exceed 40 mm. At least four separate size ranges of aggregate are required as follows:

- fine aggregate: 8 mm
- coarse aggregate, nominal size: 16 mm
- coarse aggregate, nominal size: 32 mm
- coarse aggregate, nominal size: 40 mm (Mass Concrete)

Each size of fine and coarse aggregate shall be stored in separate bins or on areas covered with steel plate, concrete or other hard and clean surfaces, which shall be self-draining and protected from contamination by earth or other deleterious matter.

Fine and coarse aggregates shall be stored in such a way so as to avoid the two materials from becoming intermixed.

The Contractor shall provide the Engineer with samples of the fine and coarse aggregates proposed for use in the Works. Samples shall be of a size sufficient to carry out all

preliminary tests specified which the Engineer may order in addition to the concrete tests specified for the Concrete testing, and to provide a 50 kg sample for comparison purposes described below. The samples shall then be tested in the presence of the Engineer by the Contractor in accordance with the Specification or the Engineer's request.

If the source of aggregates is changed at the Contractor's request and with the approval of the Engineer at any time during the course of the Works, all sampling and testing described in the relevant Paragraphs shall be repeated at the Contractor's expense.

After approval has been given for any particular aggregate, a sample weighing at least 50 kg of the approved aggregate shall be retained by the Engineer as a standard against which all future samples shall be compared.

During the course of the Contract, fine and coarse aggregates shall be tested at the Site as often as required by the Engineer and at the Contractor's expense.

All concrete work will be carried out fully in accordance with the Final Design, Structural Analysis and applicable regulations and standards.

The EmW Design will define concrete quality, separately for each Structural Analysis item, including crushing strength after 28 days (C) and class of concrete, frost resistance, as well as number of test samples for each Structural Analysis item, provided that the Contractor will be obliged to fully observe the above stated.

Natural aggregate mixture will be used for concrete C12/15 at the maximum; all other concrete quality will be made from separated aggregate, which will be comprised under the unit price.

The concrete will be mixed mechanically from aggregate, cement and water, subject to the Engineer's approval, following the prevailing regulations:

MATERIAL	ICS Number	Standard Number	Year	TITLE
Cement	91.100.10	SRPS B.C1.011	2001	Cement - Portland cement, Portland composite cement, plastrum cement, pozzolanic cement, composite cement - Definition, classification and technical conditions
		SRPS B.C1.012	1996	Cement - Delivery, packing and storage density
		SRPS ENV 196-4	1995	Methods of testing cement - Quantitative determination of constituents
		SRPS ENV 197-1	1997	Cement - Composition, specifications and conformity criteria - Part I: Common cements
Natural and crushed aggregate	91.100.15	SRPS B.B2.009	1986	Raw materials for production of aggregates for concrete – Technical requirements
		SRPS B.B2.010	1986	Aggregate for concrete – Technical requirements
		SRPS B.B3.100	1983	Crushed aggregates for concrete and asphalt
		SRPS B.B8.040	1982	Crushed aggregate for concrete and mortar - Examination of aggregate with organic impurities
		SRPS B.B8.042	1984	Natural and crushed aggregate - Chemical analysis of aggregates for concretes and mortars

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	91.100.30	SRPS U.M1.057	1984	Concrete - Grading of aggregate for concrete
Water	91.100.30	SRPS U.M1.058	1985	Concrete - Water for making concrete - Technical requirements and testing methods
Admixtures for concrete	91.100.30	SRPS U.M1.034	1996	Concrete - Admixtures for concrete - Definitions and classification
		SRPS U.M1.035	1996	Concrete - Admixtures for concrete - Quality requirements and testing
		SRPS U.M1.037	1981	Concrete - Admixtures for concrete - Previous testing

The aggregate has to be clean, without organic impurities, or earth (acceptable up to 2% by weigh), otherwise the aggregate has to be washed.

The Contractor will be under obligation to present evidence on quality of material used for concrete manufacturing (cement, aggregate, water).

The concrete quality and executed works have to be in accordance with prevailing regulations:

ICS Number	Standard Number	Year	TITLE
91.100.30	SRPS ISO 2736-1	1997	Concrete tests - Test specimens - Part 1: Sampling of fresh concrete
	SRPS ISO 2736-2	1997	Concrete tests - Test specimens - Part 2: Making and curing of test specimens for strength tests
	SRPS ISO 4012	2000	Concrete - Determination of compressive strength of test specimens
	SRPS ISO 4013	2000	Concrete - Determination of flexural strength of test specimens
	SRPS ISO 4109	1997	Fresh concrete - Determination of the consistency - Slump test
	SRPS ISO 4848	1999	Concrete – Determination of air content of freshly mixed concrete – Pressure method
	SRPS U.M1.051	1987	Concrete - Production control in the concrete plants
	SRPS U.M1.021	1997	Concrete - Classification by compressive strength
	SRPS U.M1.055	1984	Concrete - Method of test for resistance of concrete against freezing
	SRPS U.M1.015	1998	Concrete – Concrete, hardened – Determination of the depth of penetration of water under pressure
	SRPS U.M1.016	1992	Concrete - Method of test for resistance of concrete against freezing and thawing
	SRPS U.M1.045	1987	Transport and delivery of ready-mixed concrete
	SRPS U.E3.050	1981	Prefabricated concrete units - Technical requirements for manufacture and installation

The Contractor will be under the obligation to prepare design documentation for the concrete works fully in accordance with the article 232 of the Rules on concrete and reinforced concrete (BAB 87) and to deliver for the Engineer's approval.

The concrete works will be executed by qualified work force only, respecting technical specifications and prevailing regulations, national and international standards for such type of works.

Prescribed number of samples will be tested by an accredited testing laboratory at the Contractor's expense. The Engineer will be entitled to request additional sample testing, up to the maximal number of samples foreseen under the regulation, free of any additional expense on its side. Should the Engineer request additional sample testing, exceeding the maximal number of samples foreseen under the regulation, then in case of unsatisfactory test results expenses will be borne by the Contractor.

Concreting will not commence prior to the inspection and acceptance of the reinforcement by the Engineer.

Only plain concrete casting will be done manually in 5-15 cm layers, the reinforced concrete casting will be done mechanically with vibration, provided that vibration equipment will be in accordance with the type of structure, subject to the Engineer approval.

Prices cover fully completed work per unit measure, except the price for fabrication of the reinforced and prestressed concrete, where reinforcement and cables will not be included in the concrete price.

Contractor procures the form material, which shall remain in its possession upon use. During reuse, material must be cleaned from concrete, dirt, etc. Prior to concreting, plate must be wetted well. Form, supports and scaffolding are not paid separately, but are included in concreting unit price.

**CONCRETE CLASSIFICATION FOLLOWING NEW SRPS U.M1.021**

ICS Number	Standard Number	Year	TITLE
91.100.30	SRPS U.M1.021	1997	<b>Concrete - Classification by compressive strength (neq ISO 3893:1977)</b>

The common regulation for concrete in the Republic of Serbia is “the Regulation for Concrete and Reinforced Concrete” (always referred to as: “BAB87”), meanwhile, applying newly introduced 1997 standard SRPS U.M1.021 (Concrete - Classification by compressive strength - ISO 3893:1977) and “BAB87”, certain discrepancies appear. The newly introduced standard SRPS U.M1.021 refers to EUROCODE 2 and EN 206 and subsequently defines 28 days compressive strength [ N/mm<sup>2</sup> ] using, either a cylinder Ø15 cm / 30 cm test sample, or a 15 cm cube test sample, compared to the 20 cm cube test sample usual and prescribed for “BAB87”.

Please find below a table presenting and emphasizing such discrepancies:

“MB” following “BAB 87”	Concrete Classes following EUROCODE 2 & EN 206	28 days Compressive Strength [ N/mm <sup>2</sup> ]	
Cube 20 cm	C [Cylinder Ø15 cm / 30 cm] / [Cube 15 cm]	Cylinder Ø15 cm / 30 cm	Cube 15 cm
MB 10	C 8/10	8	10
MB 15	C 12/15	12	15

MB 20	C 16/20	16	20
MB 25	C 20/25	20	25
MB 30	C 25/30	25	30
MB 35	C 30/37	30	37
MB 40	C 30/37	30	37
MB 45	C 35/45	35	45
MB 50	C 40/50	40	50
MB 55	C 45/55	45	55
MB 60	C 50/60	50	60

#### **7.17.4. Formwork**

Formwork for concrete shall be rigidly constructed of approved materials and shall be true to the shape and dimensions. Formwork shall be constructed of material or lined with materials as may be necessary to achieve the finishes specified in this section. The formwork design shall be submitted to the Engineer for approval before construction commences.

All material brought onto the Site as forms, struts or braces shall be new materials.

Faces in contact with concrete shall be free from adhering grout, projecting nails, splits or other defects. Joints shall be sufficiently tight to prevent the leakage of cement grout and to avoid the formation of fins or other blemishes.

Formworks for exposed surfaces shall be laid out in a regular and uniform pattern with the long dimension of panels vertical and all joints aligned, in accordance to PBAB/87.

If openings of the formwork for the escape of water used for washing out are made, they shall be formed so that they can be conveniently closed before placing the concrete.

Connections shall be constructed to permit easy removal of the formwork and shall be strong enough to retain the correct shape during consolidation of the concrete.

Metal ties or anchors within the form shall be so constructed as to permit their removal to a depth of at least 50 mm from the face without injury to the concrete. All fittings for metal ties shall be of such design that, upon their removal, the cavities which are left shall be of the smallest possible size. Spreader cones or ties shall not exceed 25 mm in diameter.

Before any concrete is placed, forms shall be properly cleaned by washing out with water and/or air under pressure to remove sawdust, shavings, metal and other foreign matter. All water shall then be drained and mopped out from the formwork. In no case shall concrete be placed in the forms until such forms have been approved by the Engineer. Such approval shall not relieve the Contractor of its responsibility for the formwork.

Details of any fixtures to be cast into the concrete shall be approved by the Engineer. No fixtures shall be attached to the concrete by shot-firing without prior permission of the Engineer. Notwithstanding any such authorisation, the Contractor shall take full responsibility for any damage caused to the structure and make good to the agreement of the Engineer.

Shuttering shall include all temporary moulds for forming the concrete together with all temporary constructions required to support such moulds.

The Contractor shall bear the sole responsibility for the safety and stability of the forms, scaffolds etc., and in case of collapse, excessive deflections, buckling and/or any other changes in shape, the damage shall be repaired by the Contractor at its expenses.

#### **7.17.5. Placing and compaction of concrete**

Mixing, placing and curing of concrete shall be made in accordance with PBAB/87 and relevant RS standards.

##### a) Preparatory work

The Engineer's approval in writing shall always be obtained before any concrete is placed in the Works. All constructional plant and materials required, or which may be required during the concreting work and for curing shall be on site and the Contractor shall be fully prepared for the work. The Engineer's approval to place concrete shall only be given after such preparations and other relevant requirements of the Technical Specifications have been carried out and complied with.

##### b) Concreting

The methods of conveying and depositing concrete shall be such as to prevent segregation of the materials and shall be approved by the Engineer before concreting begins. The placing and compaction of concrete shall be carried out under the direct supervision of a competent member of the Contractor's staff.

Concrete shall be placed directly in the Works as soon as possible without the need for re-handling and not more than 45 minutes after mixing and, in any case, before the initial setting has taken place. If any delay has occurred after mixing and the concrete has begun to set, it shall not be used in the Works and shall be removed from the site. Unless otherwise agreed by the Engineer on the basis of satisfactory site trials, concrete shall not be dropped into place from a height exceeding 1.5 m.

Concrete shall be deposited in approved quantities and horizontal layers of such depth as to permit thorough incorporation with the layers below by vibration, spading, ramming and working. If, for unforeseen reasons, it is necessary to stop concreting before completion of a section, then construction joints as specified shall be formed and further concreting shall be suspended for at least 24 hours.

Concrete shall not be placed under water without the written approval of the Engineer. The Contractor shall submit its detailed proposals of the plant and method for underwater concreting.

The method of placing concrete under water shall be such as to keep as much as possible of the concrete being placed out of direct contact with the water so as to avoid any rapid

movement or agitation of exposed surfaces. The work shall, where possible, be carried out in one operation.

Where this is impracticable, laitance, washed out aggregate or foreign matter which may have accumulated on the previously placed concrete shall be completely removed prior to additional concrete being placed. This concrete shall then be placed directly on the cleaned surface.

During and after concreting underwater, pumping or dewatering operations in the immediate vicinity shall be suspended until the Engineer permits them to be continued.

c) Concreting in hot weather

The Contractor shall take great care during hot weather to prevent the cracking or crazing of concrete. The Contractor shall arrange for concrete to be placed in the early morning or late evening as directed by the Engineer.

The Contractor shall pay particular attention to the requirements specified herein for curing. Formwork shall be shaded from direct exposure to the sun both prior to placing of the concrete and during its setting. The Contractor shall take appropriate measures to ensure that reinforcement in the section to be concreted is maintained at the lowest temperature practicable.

Concrete at placing shall have a temperature of not more than 32 °C. If necessary, the Contractor shall cool the aggregates and mixing water by methods approved by the Engineer. Where necessary, the Contractor shall design, install and operate a cooling system by which cooling water is pumped through a piping system in order to decrease the heat of hydration during concreting. The proposal for such a cooling system shall be submitted to the Engineer for approval well in advance of the concreting operations.

The temperatures of ambient air, concrete at various levels and intervals not exceeding 5 m and cooling water where applicable shall be measured by means of thermocouples and recorded.

d) Concreting in cold weather

Cold weather is defined as the situation existing at the Works, where either or both of the following conditions existing:

The air temperature at the time considered is below 2°C

The mean daily air temperature over three or more successive days has dropped below 5°C.

Under no circumstances may concrete be placed in contact with frozen ground or formwork, or in contact with ice, snow or frost on the ground or on formwork or reinforcement. Concrete shall not be made with frozen materials.

Concreting may proceed in cold weather provided that special precautions are taken to ensure that the surface temperature of the concrete at the time of placing is not less than 5°C for a succeeding period of at least:

- 4 days when the cement used in the concrete is ordinary Portland cement
- 4 days when the cement used in the concrete is rapid hardening Portland cement.

Such precautions may include the following:

- Warming the aggregates and heating the water, provided that the temperature of either does not exceed 60°C. Water and aggregates shall be mixed for a period sufficiently long for them to acquire a uniform temperature before cement is added.
- Completely surrounding the freshly placed concrete with a cover and heating the enclosed air, which shall be kept moist. Draughts of hot or dry air shall not be directed at surfaces.
- Insulating the formwork and finished concrete surfaces.
- Providing screens to protect the concrete from air currents.

The Contractor shall provide the Engineer with details of the precautions it proposes to take to protect the concrete from the effects of low temperatures and with details of the methods it proposes to use to assess the correct timing at which such protection may be removed. No concreting shall be done in cold weather prior to the approval the Engineer for the proposed measures.

e) Compaction of concrete

The Contractor shall regard the compacting of the concrete to be of fundamental importance. A watertight concrete of maximum density and strength shall be obtained.

Concrete shall be thoroughly compacted during the operation of placing and shall be thoroughly worked around the reinforcement and embedded fixtures and into corners of the formwork and moulds.

Mechanical vibrators shall be of the immersion type with a frequency of not less than 6000 vibrations per minute and as approved by the Engineer. A sufficient number of vibrators shall be used to handle the maximum rate of concrete production with a 50% allowance for standby units during any period of concreting. All operators handling vibrators shall be trained in their operation.

Every care shall be taken to see that reinforcement and fittings attached to the shuttering are not disturbed and that no damage is caused to concrete that has already set or to the internal face of the shuttering by using immersion type vibrators. In areas of congested reinforcement, it may be necessary to use small diameter pokers and the Contractor shall supply suitable sizes of pokers for each part of the work. Vibration of concrete by hammering the shuttering with hand tools shall not be permitted.

The duration of vibration shall be limited to that required to produce satisfactory compaction without causing segregation. Vibration shall not be continued after water or excess grout has appeared on the surface.

f) Protection and curing of concrete

Concrete shall be protected from damage by climatic conditions (direct sunlight, rain, snow or frost), running water or mechanical damage during curing. All methods to be used for curing and protection of freshly placed concrete shall be subject to the prior approval of the Engineer.

The maximum and minimum ambient temperatures and humidity shall be measured and recorded each day by the Contractor. The records shall be made available for the Engineer's inspection.

As finishing proceeds, all exposed surfaces shall be covered with a wet hessian sheet followed by a reflective polythene sheet. These shall be securely fastened around the edges and supported in order not to damage the finished concrete surface. As soon as practicable, the hessian and polythene shall be lowered into close contact with the concrete and securely weighted or fastened down to prevent wind blowing underneath. The hessian sheet shall be maintained in a moist condition at all times and shall be inspected at intervals not exceeding 6 hours. Concrete shall be kept moist on exposed surfaces for a period of not less than 10 days or as approved by the Engineer.

During very hot weather conditions, the Contractor may be required to cool formwork containing concrete by spraying with water. This shall be carried out where directed notwithstanding and whatever other measures the Contractor may have employed for the curing of the concrete.

**7.17.6. Remedial treatment of concrete surfaces**

Any remedial treatment to concrete surfaces shall be agreed with the Engineer following inspection immediately after the stripping of formwork and shall be carried out without delay. Any concrete surface which is found to have been treated before inspection by the Engineer shall be rejected.

Any minor surface blemishes shall be repaired to the agreement of the Engineer immediately after completion of curing.

**7.17.7. Penetrating sealants**

In order to achieve high quality characteristics of visible surfaces of newly constructed hydraulic concrete components (head and wing walls) inlet RC structures, susceptible to the impact of frost and abrasion from drifts and coarse objects, penetrating sealants should be applied. Application of penetrating sealants helps the following characteristics to be achieved: increase of concrete surface hardness, concrete pressure resistance, concrete surface resistance to wearing and abrasion, in addition to enhanced adhesion potential of concrete surface for other finishing coatings.

Penetrating sealants should be applied entirely in accordance with manufacturer's instructions, including preparation of the new concrete surface (or surface of old cleansed concrete).

- All concrete surfaces which are to be treated with penetrating sealants should be meticulously cleansed. Paint, glue, oil and grease should be removed either by scraping, rinsing or other environmentally friendly chemical procedure.
- Fill damages – cracks and ruptures. Remove residue. (fine cement particles on the surface of the fresh concrete – due to moving of water towards the surface in the case when larger quantities of water are being used for preparation of the product).
- Remove salt residue. (powdery layer of degradable salt crystals on the new concrete after evaporation of the surface water)
- Remove visible dust and earth.

Once the formwork is removed (after 24hrs at the most), immediately soak the surface with penetrating sealant. In this case, it is essential to remove all remaining oil, originating from formwork or moulds.

The second coating of penetrating sealant should be applied after 24hrs.

Prior to application of penetrating sealants, the Contractor is obligated to provide the Engineer with relevant certification documents and get its approval.

#### **7.17.8. Admixtures**

Depending on weather conditions and in order to achieve high quality characteristics and impermeability of placed concrete, admixtures, accelerators retardations, ductility enhancers or combination of admixtures should be used, of the quality equivalent to admixtures of the quality L20, L10, BV, hyper, LPA.

Admixtures application should be entirely in accordance with manufacturer’s instructions.

Prior to application of admixtures, the Contractor is obligated to provide the Engineer with appropriate certificate.

#### **7.18. REINFORCEMENT WORKS**

The Contractor shall carry out the works described in accordance with the appropriate standards or equivalent local or international standards.

ICS Number	Standard Number	Year	TITLE
91.080.40	SRPS EN ISO 15630-1	2008	Steel for the reinforcement and prestressing of concrete - Test methods - Part 1: Reinforcing bars, wire rod and wire
	SRPS EN ISO 15630-2	2008	Steel for the reinforcement and prestressing of concrete - Test methods - Part 2: Welded fabric

The works included in this section of technical descriptions, consist of the acquisition of machinery, equipment, materials and labour and performing all operations in connection with

reinforcing steel in accordance with the terms and conditions of contracts in full compliance with this section Technical description, drawings and instructions of the Engineer.

Reinforcement steel shall be in accordance with the Regulations on technical standards for concrete and reinforced concrete / PBAB 87 /, application guidelines and related standards:

SRPS C.K6.020      Hot-rolled steels.      Concrete steels Specification (1987).

SRPS C.K6.120      Hot rolled steels.      Concrete steels shape and dimensions (1986).

SRPS U.M1.091                              Construction welded wire mesh (1986).

Standards provide for shape and dimensions, as well as the test methods for the quality requirements laid down in PBAB '87.

Wires and rods of soft steel, high-value natural hard ribbed steel bar and wire mesh of soft cold drawn wire are used for reinforcing structures and concrete elements .

All reinforcement shall be clean and free from pit corrosion, loose rust, mill scale, paint, oil, grease, adhering earth, or any other material that may impair the bond between the concrete and the reinforcement or that which may cause corrosion of the reinforcement or may be detrimental to the quality of the concrete.

Storage of reinforcement shall be on racks or supports clear of the ground. Different types and sizes of reinforcement shall be kept separate.

#### **7.18.1. Smooth fitting SF 240/360**

Smooth fitting / SF / is made from soft reinforcing steel quality 240/360 and is made in the form of wires and rods. For reinforced concrete structures soft steel reinforcement, of circular cross section, is made according to the approved procedure.

#### **7.18.2. Ribbed reinforcement RR 400/500**

Ribbed reinforcement / RA / from naturally hard steel quality 400/500 is made in the form of wires and rods. For reinforced concrete structures, corrugated steel reinforcement, of circular cross section, is made according to the approved procedure.

#### **7.18.3. Welded wire mesh MAG 500/560**

Welded wire mesh are made of cold drawn wire of smooth steel quality 500/560. Mesh, wire diameter and spacing, tolerance and others shall be determined by SRPS U.M1.091.

#### **7.18.4. Protection valves**

Steel for the reinforcement must be protected from damage at all times. When incorporated into the structure, it must be free of dust, loose flakes slag and rust, paint, oil or other foreign material.

### **7.18.5. Bending**

Bars for reinforcement should be carefully cut and bent by a qualified worker. They must be bent in cold templates and should not noticeably deviate from the shape and dimensions shown on the drawings. Sharply bent parts must be avoided and must not be of smaller radius than those indicated in Table 24 PBAB a '87.

### **7.18.6. Installing and connections**

All the reinforcing steel must be installed correctly - bars at each intersection must be connected by wire, so as to maintain the position shown in the drawings during the concrete setting. Limiting to prevent contact between the fitting and formwork and reinforcement between the lines shall be made of precast concrete blocks, or other suitable materials of approved forms and dimensions. Concrete cubes must be of such dimensions that they can be filled with concrete. Coarse gravel, crashed stone or brick, metal pipes and wooden coasters are not allowed. Viewing mounted reinforcement is done macroscopically.

Tolerances are moving in the following ranges:

Tolerances between individual rods

- With pillars and beams ..... - 10 mm.
- With plates and walls ..... - 15 mm.

Discrepancies between the rows of reinforcement height, as well as the deviation of the protective layer of the projected measures

- With elements having constructive height greater than 1 m..... - 10 mm.
- With beams and slabs of a thickness exceeding 10 cm..... - 5 mm.
- With a thickness of less than 10 cm..... - 3 mm.

Deviation of stirrups to the horizontal or vertical

- With elements having constructive height greater than 1 m ..... 10 mm.
- With elements of a constructive height of less than 1 m.....5 mm.
- With the axle in face welding rods ..... 0.10 Ø.

All reinforcement steel shall be accurately placed and fixed in position and retained in that position during the placing of the concrete.

Apart from any other requirement, the reinforcing steel shall be fixed in such a manner that it shall support its own weight and any loads which may be imposed upon it during construction without displacement, deflection or movement of any kind.

The distance between any two parallel bars except at laps shall not be less than 5 mm greater than the nominal aggregate size.

All reinforcement exposed to the weather for long periods before concreting is commenced shall be covered with polythene binding tape, cement grout or other materials to the surrounding concrete. Should rust staining occur on any permanently visible surfaces, it shall be removed at once to the agreement of the Engineer.



- Grit stone material depending on the type of work should be of the mean diameter of 30 cm, ranging from 15-60 cm;
- The stone should be resistant to abrasion and cold, whose compressive strength is not less than 100 N/mm<sup>2</sup>,
- Stone should have a certificate of being suitable for this type of work. According to the approval no need to have a 35% loss in weight after 5500 rpm, and its resistance to frost should be satisfactory (according JUSB.B8.001).

#### **7.19.2. The substrate of sand and gravel stone (or concrete) lining**

Natural sandy-gravel or crushed stone material will be used as a basis for stone or concrete lining. Material for surface stone cladding should not exceed grain size of 50 mm. Material for surface concrete lining should not exceed the grain size of 40 mm. Spreading is carried out in layers according to the design.

Measurement for payment is made according to the number m<sup>3</sup> of material embedded in the substrate. Price should include excavation, transport, waste, installation, compaction, surface preparation and others.

#### **7.19.3. Stone works for the protection of the slope and banks of canal**

The stone used for the regulation works in preparing the protection of the coast by installing crushed stone on the previously prepared surface - geotextiles and buffer.

Stone should meet the following requirements:

- Grit stone material depending on the type of work, should be of the mean diameter of 30 cm, ranging from 15-60 cm;
- The stone should be resistant to abrasion and cold, whose compressive strength is not less than - 100 N/mm<sup>2</sup>;
- Stone should have the certificate of being suitable for this type of work.
- According to attest shall lose 35% in weight after 5500 revolutions, and its resistance to frost should be satisfactory (JUS B.B8.001).

#### **7.19.4. Making protection of bank of canal by installation of rolled crushed stone**

Stone protection of landfills will be made of the stone to the measures and dimensions shown on the drawings. Stone resistant to the influence of weathering and frost will be used for creation of the landfill, as defined by the standard JUS B.B8.044, JUS and JUS B.B8.001 B.B8.013. The minimum strength of rock pressure should amount to 100 MN / m<sup>2</sup>. Quality of stone for hydro regulation work is proven by attest.

Quality of stone for hydro regulation work is proven by attest. The coarseness of crushed stone  $d=30$  cm was adopted, with grain composition characteristic as defined by JUS U.C5.020 -  $d_{max} / d_{50\%} = 2$ ;  $d_{50\%} / d_{20\%} = 2$  ( $d_{max}=60$  cm;  $d_{50\%}=30$  cm;  $d_{20\%}=15$  cm). The stone is built in revetments by direct unloading from the means of transport, and then rough alignment (combined mechanical and manual) is performed - rolling.

#### **7.19.5. Making of groundwork of geo textile**

After completing the preparation of the field, as a basis for the development of base layer riprap banks of the canal and repair of roads, a non-woven geo textile is placed. Non-woven geo textile products are needed from pure polypropylene fibbers of high strength.

The geo textile must meet the following specifications:

- Tensile strength (tensile strength)  $\geq 22$  kN/m (EN ISO 10319)
- Elongation (Elongation at break)  $\geq 55\%$  (EN ISO 10319)
- Resistance to breakage (CBR test)  $\geq 3500$  N (EN ISO 12236)
- Dynamic perforation test (Dynamic perforation)  $\leq 15$  mm (EN ISO 13433)

Before using nonwoven geo textile the Contractor shall obtain the Statement on the properties of geo textiles (Declaration of performance - DoP) and present it to the Supervision for approval.

Samples of incoming materials are tested in a laboratory for the testing of materials, provided that the results must comply with the Declaration on the properties of geo textiles, which manufacturer had delivered with the very material.

The Contractor selects samples for testing in the presence of the Engineer with a commitment that at least one sample must be taken for each 10,000 m<sup>2</sup> of material that arrives.

Non-woven geo textile is laid on a solid and levelled foundation soil. The subsoil must be free of major irregularities and without roots, or other materials that can cause damage (perforation) to geo textile.

Connecting of geo textile should be done in the way that geo textile is a continuing entity (mutually overlapping tape must be at least 20 cm).

A layer of sand 30 cm thick is placed over the geo textile, then gravel of granulation 0-63 mm of minimum thickness 15 cm.

Calculation of work is done by m<sup>2</sup> of surface on which geo textile is laid.

When installing the geo textile, care should be taken that overlaps are performed properly in order to prevent slipping of geo textile. Overlapping should go in the direction of the filling material while preventing the crease of geo textiles or making sure the geo textile is evenly tightened across the surface of the ground.

Unit price includes the cost of purchase, transportation and laying of geo textile.

## **7.20. FLOOD RISK DURING THE WORKS ON RECONSTRUCTION OF EMBANKMENT**

For the reconstruction of embankments along the whole length of the route, Contractor performs the following high-risk operations:

1. Dike route: Lowering of embankment elevation on the working sections, along the whole route of the dike (Reduction of the crown elevation of the existing dike under the EmDefWL, which is respective for proclamation of emergency flood defense measures and works).
2. Local points: Reduction of the crown dike elevation at certain working sections, for injection of refuler materials and local total collapsing of the dike for draining refuler water (Reduction of the crown elevation of the existing embankment below the RegDefWL, which is respective for proclamation of flood defense measures and works).

For the purposes of reconstruction, it is necessary to perform the following high-risk work operations which can cause damage in coastal areas in critical hydrological conditions.

The Beneficiary, PWMC “Srbijavode”, has a legal low obligations to designate the phase of a flood if reached critical level / lowest level of the protection of critical water level of the river basin / critical water levels in drainage channels cleats).

PWMC “Srbijavode” has a legal obligation to designate the specific Phases of Defence due to the critical condition during the reconstruction of the embankment forms a weak spot in the embankment in a length of 150 m – possible leak into the protected part.

### **7.20.1. Preventive measures : Dike route**

During the reconstruction of gravity sewers, the demolition of the embankment forms weak spot in the embankment in a length of 150 m - possible leak into the protected part.

Technical documentation prescribed positions (included in BoQ) of making temporary protection dumps along the route using dredged material, that is not removed from the route immediately, instead of that material is temporarily deposited along the entire route in the defended zone (excess materials, substandard material).

### **7.20.2. Preventive measures : local points of the dike**

Technical documentation prescribed position of making temporary protection facilities (items included in BoQ),

1. Adapting technology work performance current hydrological conditions
2. Monitoring hydrological conditions (representative gauging bar),
3. Coordination with competent experts from Srbijavode.
4. Forming a temporary landfill of materials for flood defense intervention (for temporary circumferential dikes, near critical points).

In addition to the required preventive measures, the Contractor will implement its own technology and dynamics to perform the work which excludes the risk of flooding, which will be included in the offered price:

Engineer is obliged, prior to granting the approval to the Contractor, to provide written approval from PWMC "Srbijavode" for start of the works on temporary demolition of embankment - term of starting and performance period are defined in the written request.

## **8. GOVERNMENT MEASURES**

### **8.1. RS STANDARDS AND LEGISLATION**

If not specifically stipulated in the sections above, the following framework laws shall be applicable to the works in the Republic of Serbia, namely:

- Law on Planning and Construction,
- Water Law
- Law on Emergency Situations
- Other RS Laws, directives and subordinate legislation which govern the area of water and protection from water.

If not otherwise specified in separate sections above, the technical standards shall apply in the following priority order of prevalence:

- I. If there is no given standard for separate parts of the works, or the standard given provides for lower/lighter technical requirements, the standard in this session shall prevail;
- II. If there is no existing national standard for an element/work/equipment/material, or the conditions it sets forth are lower/lighter than those of the standards in this session, the latter shall prevail.
- III. In any case, the Engineer shall have the right to authorize and adopt in writing the use of the proper standards.

### **8.2. NATIONAL FLOOD DEFENCE PLANS**

The Contractor has to be aware of and respect the Flood Defence Plan:

- **General Flood Defence Plan** (<http://www.rdvode.gov.rs/lat/uredjenje-vodotoka-opsti-plan-odbrane-od-poplava.php>)
- **Operational Flood Defence Plan** (<http://www.rdvode.gov.rs/lat/uredjenje-vodotoka-operativni-planovi-odbrana-od-poplava.php>)

These plans define obligations, responsibilities and conditions for announcing

- **regular flood defense,**
- **emergency flood defense, and**
- **emergency situation**

Jurisdiction for announcing is defined by RS Law, Water Law and Law on Emergency Situations and other RS Laws, directives and subordinate legislation which govern the area of water and protection from water.

Under the conditions of regular flood protection, the Contractor can continue with works without being disturbed (exceptionally in the unprotected zones);

In case of emergency flood protection, the works have to be stopped. Exceptionally, depending on the technology process and the phase the works are in, the works can be continued after obtaining a special permit from the responsible institutions – institutions responsible for implementation of flood protection measures on the locations where the works are in progress.

The institutions (Flood Defence Managers) responsible for definition of the waterways conditions are the Ministry of agriculture, Water Directorate (Flood Defence Coordinator), PWMC "Srbijavode" (General Manager of Flood Defence), Republic Hydrometeorological Institute and they act in accordance with the General and Operational Flood Defence Plan.

In case of Emergency situations all the works shall be stopped.

All subjects must execute commands issued by Command Body of the Government.

All procedures are defined by the *Law on Emergency Situation* and other subordinate legislation and they clearly define responsibilities and conduct in these situations. The

Contractor will be instructed accordingly by the Engineer, according Commands of General Manager of Flood Defence (PWMC Srbijavode)

### **8.3. FLOOD DEFENSE**

#### **8.3.1. Flood Defense Phases - obligations of the Participants**

The Contractor is obliged to comply with the stipulated preventative measures - before opening the embankment by establishing a temporary peripheral embankment, cofferdams, temporary piping, and providing additional mobile pump unit of high capacity, upon the order by the Engineer.

The Contractor has to set a Local temporary observation posts. (Bill of Quantities includes):

- Water level Gauging rod No. 1 (WLG rod 1) in the riverbank of the Sava (15m from existing embankment), in the area of the dike base – for measuring of the water level of the Sava river;
- Water level Gauging rod No. 2 near the settlement Banov Brod (referent CrossSection km: 52 + 890).

#### **Flood defense works and measures during high water level of the Sava river:**

1. PWMC determines Relevant Water Levels at WLG rod 1 (in the floodplain, in the embankment base), at which the prescribed Phase measures of flood defence against high waters of the Sava River will be conducted, in the following cases, in accordance with the next table (with defined obligations of Beneficiary, Engineer and Contractor during flood defense ):

<b>Local temporary observation post: Water level Gauging rod No. 1 on the river side of existing embankment (on distance of 15m)</b>				
Relevant Water Level on WLG rod 1.	Phase of Flood Defense/ Estimated Duration (days):	Beneficiary's obligations (by Water Low, Annual Flood Defense Operational Plan):	Engineer's obligations:	Contractor's obligations
<p><b>RegDefWL</b> <b>79.50</b> <b>m a.s.l.</b></p> <p>~ Level of the existing dike base</p>	<p style="text-align: center;"><b>Regular Flood Defence</b></p> <p style="text-align: center;">15 days</p>	<p><b>PWMC:</b> <b>Preventive activities:</b> To perform control of the preventive measures and works (executed by the Contractor, according BoQ). <b>According state of water level:</b> 1) to provide official forecasts of water levels of the Sava river (Republic Hydro-Meteorological Agency) 2) to proclaims Regular flood defense measures against high water level of the Sava river (Command in writing form by General Manager of Flood Defense), 3) to publish (on the official site of PWMC) the Command and orders in the Daily Bulletin of Flood Defense, 4) to control the execution of commands 5) to take action if they are not carried out - to proclaim additional Command of emergency orders to the competent Water Management Company (from Annual Defense Plan). <b>Note:</b> in that case: a) the Contractor can not charge the costs of flood defense activities (from BoQ items), b) the Contractor must admit Water Management Company (from Annual Defense Plan), as a Subcontractor for flood defense works and measures.</p>	<p><b>ENGINEER:</b> <b>Preventive activities:</b> To perform control of the preventive measures and works (executed by the Contractor, according BoQ). <b>After proclamation of Regular Flood defense, immediately, without delay, Engineer's obligations will be:</b> 1) to forward the Command from PWMC to the Contractor, 2) to write orders in Construction Log: a) for controlled works in the embankment area, without the right of Contractor to charge costs of stoppage due to a period of flood defense (15 days); b) to perform a control of the state along the whole temporary defense lines, in particular in the zone of PS Kal Rev c) to prepare for the eventual rise of the water level (to preparation works to close every opening area in the defense line) d) to continue to perform work on other items, without interruption, only on the defended side of the new embankment, under control of the Engineer and Beneficiary</p>	<p><b>CONTRACTOR:</b> <b>Preventive activities:</b> To perform preventive measures and works (according BoQ). <b>After proclamation of Regular Flood defense, immediately, without delay, Contractor's obligations will be:</b> 1) to execute the order of the Engineer 2) to inform (in writing form) Engineer and Beneficiary about executed works according Command and orders.</p>
<p><b>EmDefWL:</b> <b>80.30</b> <b>m a.s.l.</b></p>	<p style="text-align: center;"><b>Emergency Flood Defence</b></p>	<p><b>PWMC:</b> <b>Preventive activities:</b> To perform control of the preventive</p>	<p><b>ENGINEER:</b> <b>Preventive activities:</b> To perform control of the</p>	<p><b>CONTRACTOR:</b> <b>Preventive activities:</b> To perform preventive</p>

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<p>(~1.50m below existing dyke crown elevation - 80.50 m a.s.l.)</p>	<p>15 days</p>	<p>measures and works (executed by the Contractor, according BoQ).</p> <p><b>According state of water level:</b></p> <p>1) to provide official forecasts of water levels of the Sava river (Republic Hydro-Meteorological Agency)</p> <p>2) to proclaims Emergency flood defense measures against high water level of the Sava river (Command in writing form by General Manager of Flood Defense),</p> <p>3) to publish (on the officilal site of PWMC) the Command and orders in the Daily Bulletin of Flood Defense,</p> <p>4) to control the execution of commands</p> <p>5) to take action if they are not carried out - to proclaim additional Command of emergency orders to the competent Water Management Company (from Annual Defense Plan).</p> <p><b>Note:</b> in that case:</p> <p>a) the Contractor can not charge the costs of flood defense activities (from BoQ items),</p> <p>b) the Contractor must admit Water Management Company (from Annual Defense Plan), as a Subcontractor for flood defense works and measures.</p>	<p>preventive measures and works (executed by the Contractor, according BoQ).</p> <p><b>After proclamation of Flood defense, immediately, without delay, Engineer's obligations will be:</b></p> <p>1) to forward the Command from PWMC to the Contractor,</p> <p>2) to write orders in Construction Log:</p> <p>a) to perform a control of the state along the whole temporary defense lines, in particular in the zone of PS Kal Rev</p> <p>b) to close every opening area in the embankment,</p> <p>c) to suspend works on embankment without the right of Contractor to charge costs of stoppage due to a period of flood defense (15 days);</p> <p>d) to perform safety works and safety measures ( working staff, mechaniyations, equipment);</p> <p>e) to perform (optionaly) other controled works, without interruption, only on the defended side of the new embankment, under control of the Engineer and Beneficiary</p>	<p>measures and works (according BoQ).</p> <p><b>After proclamation of Emergency Flood defense, immediately, without delay, Contractor's obligations will be:</b></p> <p>1) to execute the order of the Engineer</p> <p>2) to inform (in writing form) Engineer and Beneficiary about executed works according Command and orders</p>
<p><b>EmSitWL:</b> 79.8 m a.s.l.:</p> <p>(~0.20 below existing dyke crown elevation - 80.50 m asl )</p>	<p><b>Emergency Situation</b></p> <p>Flood defense 15 days</p> <p>Recovery works 15 days</p>	<p><b>PWMC:</b></p> <p><b>Preventive activities:</b></p> <p>To perform control of the preventive measures and works (executed by the Contractor, according BoQ).</p> <p><b>According state of water level:</b></p> <p>1) to provide official forecasts of water levels of the Sava river (Republic Hydro-Meteorological Agency)</p> <p>2) to proposes to Government Emergency Body to proclaim declaration of an Emergency Situation, because it cannot organize</p>	<p><b>ENGINEER:</b></p> <p><b>Preventive activities:</b></p> <p>To perform control of the preventive measures and works (executed by the Contractor, according BoQ).</p> <p><b>After proclamation of Emergency Flood defense, immediately, without delay, Engineer's obligations will be:</b></p> <p>1) to forward the Command from PWMC to the Contractor,</p> <p>2) to write orders in Construction Log:</p>	<p><b>CONTRACTOR:</b></p> <p><b>Preventive activities:</b></p> <p>To perform preventive measures and works (according BoQ).</p> <p><b>After proclamation of Emergency Flood defense, immediately, without delay, Contractor's obligations will be:</b></p> <p>1) to execute the order of the Engineer</p>

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		<p>and implement flood defense against high water level of the Sava river (Emergency Proposal in writing form by General Manager of Flood Defense),</p> <p><b>3) to publish (on the official site of PWMC) the Command and orders in the Daily Bulletin of Flood Defense,</b></p> <p><b>4) to proclaim especially Command, to the Engineer and to the Contractor ( according Declaration of Emergency Situation), with orders:</b></p> <p>a) of mandatory participation in flood defense activities (to perform Emergency works - optional)</p> <p>b) to control the execution of commands,</p> <p>c) to take action if they are not carried out - to proclaim additional Command of emergency orders to the competent Water Management Company (from Annual Defense Plan).</p> <p><b>Note: in that case:</b></p> <p>a) the Contractor can not charge the costs of flood defense activities (from BoQ items),</p> <p>b) the Contractor must admit Water Management Company (from Annual Defense Plan), as a Subcontractor for flood defense works and measures.</p>	<p>a) to suspend all works, without the right of Contractor to charge costs of stoppage due to a period of flood defense (15 days);</p> <p>b) mandatory to participate in execution (to perform Emergency works – by PWMC and Engineer orders, according BoQ items)</p> <p>c) to perform a continuous control of the state along the whole temporary defense lines, in particular in the zone of PS Kai Rev</p> <p>d) to perform safety works and safety measures ( working staff, mechanisations, equipment);</p> <p>e) to perform recovery works on embankment</p>	<p>2) to inform (in writing form) Engineer and Beneficiary about executed works according Command and orders.</p>
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8.3.2. Reference cross section: no. 2: km 52 + 890

PWMC Srbijavode: WATER LEVELS FOR FLOOD DEFENSE MEASURES

