

Chapter 4

Surveys and Investigations

4.0 General

Surveys and Investigations provide field data required for planning and designing of various, components optimally and economically, of a water resources development project. The Bedti - Varada link project (Link-I) envisages construction of two weirs viz., Pattanadahalla and Shalamalahalla across Pattanadahalla stream and Shalamalahalla stream respectively in Bedti basin to divert combined quantity of 302 MCM and a barrage is also proposed across Bedti river at Suremane to divert additional 222 MCM to Tungabhadra reservoir.

The Link I comprise of the following components:

- (a) 145m long weir across Pattanadahalla stream located at Latitude $14^{\circ}40'15''$ N and Longitude $74^{\circ}41'18''$ E near Siralabail village in Sirsi Taluk.
- (b) 100m long approach channel from foreshore of Pattanadahalla weir to the proposed tunnel entry.
- (c) 6.5 km long tunnel proposed to connect Pattanadahalla and Shalamalahalla located at Latitude $14^{\circ}40'03''$ N and Longitude $74^{\circ}41'31''$ E.
- (d) 300m long canal from tunnel exit (at Latitude $14^{\circ}00'00''$ N and Longitude $74^{\circ}45'16''$ E) to join the stream leading to Shalamalahalla stream.

- (e) 202m long weir across Shalamalahalla stream located at Latitude 14°42'26" N and Longitude 74°48'31" E near Hulgol village in Sirsi Taluk.
- (f) 10.15 km long raising main taking off from the Jackwell/pump house from the foreshore of the Shalamalahalla weir located at Latitude 14°42'56" N and Longitude 74°48'43" E.
- (g) 6.7 km long tunnel taking off from the cistern, located at the end of the raising main, at Latitude 14°39'03" N and Longitude 74°51'40" E.
- (h) 1.73 km long canal from tunnel exit at Latitude 14°35'50" N and Longitude 74°54'02" E to join the stream leading to Varada river.

Link II comprises the following components:

- a) 165m long weir across Bedti river located at Latitude 14°52'53" N and Longitude 74°47'13" E near Suremane village in Yellapur taluk.
- b) 22.30 km long raising main taking off from the Jackwell/pump house from the foreshore of the Suremane pond located at Latitude 14°53'04" N and Longitude 74°47'14" E.
- c) 4.23 km long tunnel taking off from the 0.35 km long delivery chamber/approach channel, located at the end of the 2nd stage raising main at Latitude 14°46'01" N and Longitude 74°55'05" E to directly outfall into a stream leading to Dharma river at Latitude 14°44'10" N and Longitude 74°56'50" E.

Topographical field surveys, geological and geotechnical investigations including foundation investigations i.e., drilling bore holes at weir axis / barrage axis and tunnels for obtaining contour plans, rock cores,

construction materials investigations, geophysical investigations, geotechnical investigations including borrow area surveys etc., are essential for preparation of detailed project report. However, these surveys could not be taken up due to stiff resistance from several locals while planned for survey and investigations during FR stage due to dense green patches and need for preservation of ecological balance in west flowing river valleys.

However, keeping in view the up gradation in technology, the topographical features of the project area are generated with digitised contour DEM (from 1:50000 SoI toposheets) by using GIS software and the contour plan with 1m interval was generated for whole project area from generated DEM. This approach is felt sufficient at this stage and the field surveys will be taken up at the pre-construction stage in case the link project gets the nod of the state and other stake holders.

4.1 Topographical surveys

The topographical features including contours are digitised from the Survey of India toposheets of scale 1:50,000 covering the project area (48-J/9,10,13 and 14). With digitised contours, DEM (Digital Elevation Model) was generated by using GIS software. The contour plan with 1m interval was generated for whole project area from generated DEM.

4.1.1 Rivers

Required river surveys include (i) Longitudinal section of the river to cover up to a level equal to MWL+5m on the u/s side (ii) Longitudinal section upto 10 km on d/s side of the proposed structure (iii) u/s side cross sections at 200 m interval to cover 1.0 km on either side the firm bank or

MWL+5 m whichever is less up to 2 km and thereafter at 1 km interval corresponding to length of the L. section and (iv) d/s side cross sections at 200 m interval to cover upto a level equal to HFL+1 m on either side of firm bank for a distance of 2 to 5 km from the axis of the structure depending upon meandering nature of the river. However, no river surveys are taken up presently which will be carried out at a later stage.

4.1.2 Reservoirs

No new reservoirs are proposed as part of the Bedti - Varada link project. However, under Link-II of the project, the diverted water is proposed to be let off into a stream joining the Dharma river upstream of existing Dharma project, from which, the diverted water passes downstream to Dharma river and joins Varada river. The salient features of the existing Dharma reservoir are given at **Annexure 4.1**.

Further, the water diverted through both Link-I and Link-II of Bedti - Varada link project, reaches the existing Tungabhadra dam (via Varada river) and is used to augment the irrigation in the existing TBLBC command in Raichur district. The salient features of Tungabhadra project are furnished at **Annexure 4.2**. The Elevation - Area - Capacity values of Tungabhadra reservoir based on the capacity survey of 2008 is given at **Annexure 4.3** and the corresponding EAC curves of Tungabhadra reservoir are given as **Plate 4.1**.

4.1.3 Head works

The Pattanadahallaweir intercepts catchment area of 52.80 Sq.km. The river bed level at the weir site is 491.0 m. The pond level / crest level is

kept at 499.0 m. The water spread area of weir is found to be 17.88 ha. The length of the weir is kept at 145.00 m to pass the design discharge safely. The contour plan of the area showing the alignment of weir axis, water spread area at RL 499.0 m developed from the DEM is given as **Plate No. 4.2.1**. The cross section of the river along the proposed weir axis is given as **Plate 4.2.2**.

The Shalamalahalla weir intercepts catchment area of 169.42 Sq.km. The river bed level at weir site is 458.0 m. The pond level / crest level is kept at 468.0 m. The water spread area of weir is found to be 88.53 ha. The length of the weir is kept at 202.0 m to pass the design discharge safely. The contour plan of the area showing the alignment of weir axis, water spread area at RL 468.0 m developed from the DEM is given as **Plate No. 4.2.3**. The cross section of the river along the proposed weir axis is given as **Plate 4.2.4**.

The Suremane barrage intercepts catchment area of 2078 Sq.km. The river bed level at barrage site is 419.5 m. The pond level is kept at 426.0 m. The water spread area at the barrage is found to be 54.38 ha. The length of the barrage is kept as 165.0 m (including under sluices) to pass the design discharge safely. The contour plan of the area showing the alignment of barrage axis, water spread area at RL 426.0 m developed from the DEM is given as **Plate No. 4.2.5**. The cross section of the river along the proposed barrage axis is given as **Plate 4.2.6**.

4.1.4 Plant and colony layout

The area proposed for locating the plant and colonies at all the three headworks is covered in the contour plan for headworks given at **Plates No.**

4.2.1, 4.2.3 and 4.2.5 respectively for Pattanadahalla weir, Shalamalahalla weir and Suremane barrage site.

4.1.5 Canal and water conductor system and canal structures

i) Link canal/tunnel from Pattanadahalla weir to Shalamalahalla weir

The total length of the conveyance system from Pattanadahalla to Shalamalahalla is 6.9 km comprising 0.10 km long approach channel up to tunnel entry, 6.5 km long tunnel and 0.3 km long canal from tunnel exit to reach natural stream leading to Shalamalahalla. The alignment of the conveyance system from Pattanadahalla to Shalamalahalla is shown in **Plate No. 4.3**. The strip contour plan covering an area up to 150 m on either side of the canal alignment and 500 m on either side of tunnel alignment along with longitudinal section of link from Pattanadahalla to Shalamalahalla is given in **Plate No. 4.3.1(1/4) to 4.3.1(4/4)**. The Pattanadahalla tunnel takes off from the foreshore of the Pattanadahalla weir at an FSL of 492.00 m. and after traversing a distance of 6.5 km falls into a canal with an FSL of 489.783 m. The canal after traversing 0.3 km falls into a stream leading to Shalamalahalla with an FSL of 489.753 m.

ii) Raising main/tunnel/canal from Shalamalahalla weir to stream leading to Varada river.

The total length of the conveyance system from Shalamalahalla diversion weir to stream leading to Varada river is 18.58 km comprising 10.15 km long raising main from the Jack well in the foreshore of the Shalamalahalla weir to the tunnel entry, 6.7 km long tunnel and 1.73 km long open canal (from tunnel exit), which joins a stream leading to Varada river. The alignment of the conveyance system is shown in **Plate 4.3**. The strip contour plan covering an area up to 150 m on either side of

the raising main and the canal and 500 m on either side of the tunnel alignment along with longitudinal section of link from Shalamalahalla to the stream joining Varada river, is given in **Plate No.4.3.2(1/9) to 4.3.2(9/9)**. Water will be lifted from the MDDL 463.00 m through a static head of 107.50 m to a level of 570.5 m to a cistern located at RD 10.15 km. From the cistern water will be let into the tunnel with an FSL of 570.000 m and after traversing a distance of 6.7 km, it outfalls into a canal with an FSL of 568.267 m. The canal after traversing for 1.73 km, outfalls into a stream leading to Varada river with an FSL of 568.094 m.

iii) Raising main / tunnel from Suremanebarrage to Dharma river

The total length of the conveyance system from Suremanebarrage to Dharma reservoir is 26.88 km comprising 22.30 km long raising main from the jack well in the foreshore of the Suremane barrage to 0.35 km long delivery cistern cum approach channel and a tunnel of 4.23 km. At the end of the approach channel, at RD 22.65 km, 4.23 km long tunnel starts. At the exit of tunnel, the diverted water directly out falls into a stream leading to Dharma river. The alignment of the conveyance system is shown in **Plate 4.4**. The strip contour plan covering an area up to 150 m on either side of the raising main and 500 m on either side of the tunnel alignment along with longitudinal section of link from Suremane to stream leading to Dharma river is given in **Plate No.4.4.1(1/14) to 4.4.1(14/14)**. Water will be lifted from the MDDL of 420.00 m at Suremane barrage through a static head of 120.0 m to a level of 540.0 m to a cistern located at RD 10.90 km. From the cistern at RD 10.90 km, the water will be further lifted from a level of 534.000 m through a raising main of length 11.40 km with a static head of 65.5 m to a delivery cistern cum approach channel at RD 22.3 km. The tunnel starts with an FSL of 599.0 m at the end of the 0.35 km long delivery

cistern cum approach channel at RD 22.65 km. At the end of the 4.23 km long tunnel, the water will be let out directly into a stream leading to the Dharma river with an end FSL of 597.871 m at RD 26.88 km.

A statement showing distances and bearings of the conveyance system from Pattanadahalla to Shalamalahalla and Shalamalahalla to Varada river under Link-I is furnished at **Annexure 4.4.1** and that from Suremane barrage to Dharma river under Link-II, is furnished at **Annexure 4.4.2**.

iv) CD/CM structures

Most of the conveyance system in both the links viz., Link-I and Link-II comprises raising mains and tunnels with open canal limited to 2.48 km only. The raising main will be taken mostly below ground, parallel to NSL and hence no head loss is considered for CD/CM structures for the present. However, the locations of these crossings are shown in the respective L-section of the conveyance system.

(a) Link from Pattanadahalla weir to Shalamalahalla weir

The link from Pattanadahalla to Shalamalahalla is fully tunnel except for 0.10 km approach channel upto tunnel entry and 0.30 km long canal, from tunnel exit, to join a stream leading to Shalamalahalla. The alignment of conveyance system does not cross any streams / roads, in this reach.

(b) Raising main/tunnel/canal from Shalamalahalla weir to stream leading to Varada river

The 18.58 km link conveyance system from Shalamalahalla to stream leading to Varada river is a combination of raising main, tunnel and open

canal. In the first reach of 10.15km of raising main, the alignment crosses one state highway, one village road and ten streams/nallas. In the second reach of 6.70 km of tunnel, the alignment crosses one state highway, one village road and five streams/nallas. In the last reach of 1.73 km long open canal, the alignment crosses two streams/nallas. The locations of these crossings are shown in L. Section of the conveyance system given at **Plate Nos. 4.4.1(1/9) to 4.4.1(9/9)**.

(c) Link from Suremanebarrage to stream leading to Dharma reservoir/ river

Entire link from Suremane barrage to the stream leading to Dharma river comprises raising main (22.30 km), approach channel (0.35 km) and tunnel (4.23 km). In the initial reach of 1.0 km the rising main passes through thick forest in south-east direction up to the state highway connecting Yellapur to Sirsi. Thereafter, the raising main is aligned along/beneath the State highway up to 10.15 km. In the entire length of 22.30 km, the alignment of raising main crosses two village roads, state highways at four places and six streams/nallas. The locations of these crossings are shown in L. Section of the conveyance system given at **Plate Nos. 4.5.1(1/14) to 4.5.1(14/14)**.

4.1.6 Power house, switch yard, surge shaft, tail race etc.

The hydro power house is not proposed in the link project.

4.1.7 Command area

The Bedti-Varadalink is proposed to augment irrigation in the existing command area under Tungabhadra left bank canal command. Hence no command area survey is taken up.

4.2 Other surveys

4.2.1 Archaeological survey in the canal area

As discussed earlier, due to prevailing pandemic situation due to Covid-19, no field surveys, investigations etc., were taken up now. A detailed archaeological survey in the project area is proposed to be taken up separately.

4.2.2 Mineral survey in the canal area

A detailed mineral survey in the project area is proposed to be carried out at Pre-construction stage.

4.2.3 Right of way surveys for the reservoir

No new reservoirs are proposed in the project proposals. The submergence due to proposed weirs / barrage is mostly confined to river course only. Therefore, no right of the way surveys were taken up.

4.2.4 Communication surveys

National highways NH 48 connecting Bengaluru to Mumbai, NH 66 connecting Mangaluru to Mumbai and NH 52 connecting Ankola to Hubli pass through and nearby the project area. State highway connecting

Sirsi&Yellapur and Sirsi& Hubli also are passing through project area. The project area is approachable with other major district roads also. Konkan railway connecting Mangaluru to Goa and another broad-gauge line connecting Bengaluru and Mumbai also pass nearby. The seaport of Gangavali is situated at the mouth of Gangavali (Bedti) river. However, Karwar sea port located at about 50 km from Link-I and 100 km from Link-II project area is the nearest seaport. The nearest airport is located at Hubli which is located at about 120 km from Link-II area and 70 km from Link-II area. Hence the link project areas viz., headworks and water conveyance systems are easily approachable by these communication systems. The communication map of the project is furnished as **Plate No. 4.5**.

4.2.5 Drainage surveys

The link project envisages transfer of water for augmenting the irrigation in water short areas of the existing Tungabhadra left bank canal command. As such, no drainage surveys are needed to be taken up. However, appropriate provision is made in the cost estimates for improving the existing drainage network.

4.2.6 Soil surveys

The diverted water is proposed to augment irrigation in the existing command area of Tungabhadra left bank canal and hence no soil survey of the command area is needed to be taken up.

4.2.7 Cadastral surveys

Based on the cadastral data available on the website of Karnataka State Remote Sensing Application Centre (KSRSAC), Govt. of Karnataka the cadastral map showing the village boundaries near the headworks as well as along the link alignment for Link-I and Link-II is given in **Plates No 4.6(1/2) and 4.6(2/2)**.

4.3 Geology, Geo technical features and seismicity

4.3.1 Geological and geotechnical investigations

The objective of the geological investigations is to find out type of rock, major joints, shear zones, fault and fractured zones if any, in the project area. However, due to pandemic situation, no field investigations are taken up now and are proposed to be taken up separately.

Therefore, based on regional geology, it can be stated that geologically, the project area is underlain by the Peninsular gneissic complex of Archeans and meta volcano- sedimentary sequence of Dharwar super group and younger, intrusive at granites. All these lithounits have been intruded by basic and acid dykes. Laterites occur overlying the schist and granites and alluvium along the rivers and lagoons of the coast. Alluvium occurs along the river banks in few to 14.0m thickness holds the bank storage and occurs as narrow strip along sea coast and creeks occur upto a depth of 50m. During sub-recent to recent age these rocks have undergone laterisation resulting in a cover of laterite varying in thickness. Alluvial deposits of limited thickness occur along the major drainage course of Bedti river. The basic dykes (gabbro and dolerite) are common intrusive, especially in the eastern & southern sectors of area.

The target command area lies in Raichur district of Karnataka. The area lies at 500m above MSL. Granites, gneisses and Dharwar schists are the

main rock formations in the region of Raichur district. They are grouped as hard rock as they do not have any primary porosity.

4.3.2 Geophysical Investigations

Geophysical investigations are not proposed to be taken up.

4.3.3 Seismic investigations

The proposed project area falls in the Zone II (least active) as per the Bureau of Indian standards (IS: 1893 - 2002). Since no new dams/ reservoirs are proposed in the present project, site specific seismic studies are not carried out now.

4.4 Construction material survey

Several stone quarries are located in the close vicinity of the project area viz., at Arga (in Karwar Taluk) and Hanehalli (in Kumta taluk) villages in Uttar Kannada district. Further, quarry areas are identified in the forest area at Devkar village in Karwar taluk, Khurse village in Sirsi taluk. The Arga is located at about 50 km from the project area whereas Hanehalli, Devkar and Khurse stone quarries are located at about 45km, 30 km and 25 km from the project area. Similarly, several sand quarries are located in Karwar, Honavar and Kumta taluks in Uttara Kannada district which are located at about 50 km from the project area. The quarry map showing locations of these quarries is given as **Plate No. 4.7**.

4.4.1 Rock and aggregates

Significant quantity of rock material is expected to be available from the excavation works like approach channels, tunnel, pumphouses etc., The same is proposed to be used to fulfil the part requirement as construction material (both coarse and fine aggregate) after carrying out required field and laboratory tests to confirm their suitability. The remaining requirement will be met from the stone quarries located in the vicinity of the project.

4.4.2 Sand

Crushed sand from stone quarries or crushing the material available from excavation (for tunnels, approach channels etc.,) of the project is proposed to be utilised in the construction as manufactured sand, in case natural sand is not available in adequate quantities from the sand quarries located in the vicinity of the project area.

4.4.3 Bricks and tiles

Cement bricks/hollow concrete bricks/red bricks and tiles are available locally in the vicinity of the project area.

4.4.4 Pozzolana

The pozzolana materials are not considered to be used in the construction of the project.

4.4.5 Cement

Cement Industries are located in the vicinity of project area in Dharwad and Bellary districts from where the cement required for construction of the project could be obtained easily.

4.4.6 Steel

The steel required for the project construction can be procured from the plants located in Hospet taluk of Bellary district.

4.4.7 Scarce material

No scarce materials are anticipated to be used in the project which may cause hindrance to the construction of the project.

4.4.8 Any other material

Apart from the above, there will be many other items such as iron rods/ pillars, iron sheets, CGI sheets, coal tar, wood, paints, ropes etc., which are required for construction of temporary sheds/ rooms etc., All such items are available in Karwar, Sirsi, Yellapur, etc., in Uttara Kannada district which are in close vicinity of the project area.

4.5 Hydrological and meteorological investigation.

The hydrological and meteorological investigations are dealt in detail in "**Chapter5: Hydrology and water assessment**".