

Chapter 2

Physical features

2.1 Geographical Disposition

The Pennar (Somasila) – Palar - Cauvery (Grand Anicut) link canal off takes from the existing Somasila reservoir located across the Pennar River near Somasila village in Nellore district of Andhra Pradesh state. The link canal is proposed to pass through the Kaluvaya, Rapur, Dakkili, Venkatagiri mandals of Nellore district; Srikalahasti, Thottambedu, Pitchattur and Nagari mandals of Chittoor district of Andhra Pradesh state, Tiruttani taluk of Tiruvallur district; Arakonam taluk of Vellore district; Cheyyar and Vandavasi taluks of Tiruvannamalai district; Kancheepuram, Uthiramerur taluks of Kancheepuram district; Tindivanam, Gingee, Villupuram, Tirukoilur taluks of Villupuram district; Ulundurpettai, Vridhachalam, Tittagudi taluks of Cuddalore district; Udaiyarpalayam, Ariyalur taluk of Perambalur district; and Lalgudi taluk of Tiruchchirappalli district of Tamil Nadu state. The link canal alignment passes through Pennar basin, Streams between Pennar and Palar basins, Palar basin and streams between Palar and Cauvery basins.

The link canal takes off from the right flank of Somasila dam with a full supply level of 95.420 m. and runs parallel on right side of the Kandaleru flood flow canal, upto RD 10 km. The canal generally runs in south direction till it out-falls into Grand Anicut across Cauvery River at RD 529.190 km. The major rivers that would be crossed by the canal are Swarnamukhi, Arani Ar, Nagari, Palar, Cheyyar, Ponnaiyar, and Vellar. The districts that would be benefited by the link canal through enroute irrigation are Nellore, Chittoor of Andhra Pradesh state and Tiruvallur, Kancheepuram, Vellore, Tiruvannamalai, Villupuram, Cuddalore districts of Tamil Nadu state and Pondicherry (U.T).

2.2 Topography of the basins and command area

The link project including its command area lies in the basins of the Pennar, Streams between Pennar and Palar, Palar, Streams between Palar and Cauvery and Cauvery. The topography of these basins is described briefly in the following sections:

2.2.1 Pennar basin

The Pennar basin is a fan shaped basin and is bounded on the north by the Erramala hills, on the east by the Nallamala and Velikonda range of Eastern Ghats, on the south by the Nandidurg hills and on the west by the narrow ridge separating it from Vedavathi valley of the Krishna basin. The other hill ranges in the basin to the south of the river are the Seshachalam and Paliconda ranges. Its maximum length east to west is 433 km. The maximum width of 226 km from north to south is attained in the middle of the basin.

There are a number of hills and peaks of varying heights in the Pennar basin. A few notable hill ranges are the Nallamala to the east of the basin, the Erramala on the north, and the Palikonda ranges to the south of the river. The highest hill is the Horsely hill with an altitude of 1314 m. The interior of the Pennar basin has long ridges with isolated hills and small streams.

2.2.2 Area Covered by the Streams between Pennar and Palar basins

The basin is bounded on the north and west by the various ranges of eastern ghats like the Velikonda range, suddenly upheaved by volcanic action overlooking the valley with high precipitous cliffs. The prominent cliffs popularly known as Nagari nose is conspicuous for miles around. The imposing Seshachalam hills (Tirupati hills) over which the pilgrim centre Tirupati is located is perhaps one of the most picturesque spot in this basin.

There are three major topographical divisions in the basin. At the upper reaches the general topography of the basin is hilly and rocky and rather rugged with abrupt diverse slopes conducive to appreciable erosion. The coastal uplands have undulating to rolling topography while the delta is flattish and even trough shaped at places.

The catchment area of the basin is roughly rectangular in shape, having average length and breadth of about 173 km and 94 km respectively. The basin is bounded on the north by Pennar delta sub-basin and west by the Lower Pennar sub-basin and Palar basin and south by Palar basin and east by Bay of Bengal.

2.2.3 Palar basin

There are three major topographical divisions in the basin i) the hilly ranges at the upper reaches separating the Pennar and Ponnaiyar basins ii) the table land or the plateau region and iii) the coastal plains. At the upper reaches and the area separating the Cheyyar with Palar, the general topography is hilly, rocky and rather rugged with abrupt diverse slopes conducive to appreciable erosion. The plateau has undulating to rolling topography with occasional hillocks while the coastal plains are flattish and even trough shaped at places. Among the hills present in the basin, the famous are Javadi, Elagiri, Kalrayan etc.

The catchment area of the basin is roughly rhombus in shape with broader width in the middle reach and narrow width at the upper and lower reaches. The basin is bounded by Pennar basin in north "Streams between Pennar and Palar" basin in the northeast and Bay of Bengal in the east and by the "Streams between Palar and Cauvery" basin on the west and south.

2.2.4 Area covered by the streams between Palar and Cauvery basins

The shape of this basin area resembles the letter 'L' with a maximum width of 250 km in the western portion and 100 km in the eastern side. Most of the rivers in this basin are flowing in the southeast direction and join the Bay of Bengal. This basin has a coastal line extending over 125 km.

The catchment area covered by the streams between Palar and Cauvery has been divided into three hydrological zones. The zone – I with a catchment area of 4513 km² is drained by two streams i.e. Ongur and Varahanadi. This zone is situated in the coastal region with elevation ranging for 0 to 200 m. The two streams draining in this area are non-perennial in nature and flow only during the rainy days. The length of Ongur and Varahanadi rivers from the origin to the outfall are about 42 km and 95 km respectively.

The Zone – II i.e. Ponnaiyar river basin with a catchment area of 14,449 km² is drained by the Ponnaiyar and its tributaries such as Markandanadi, Pambar, Vaniar, Kallar and Gadilam river. The Ponnaiyar has its origin

near Nandidurg in Karnataka State. The length of this river is about 351 km and its average bed slope is 1 in 390.

The Zone – III (Vellar river basin) with a catchment area of 8086 km² is drained by the Vellar river and its tributaries such as Sweta nadi, Chinnar river, Anaivari Odai, Manimuktha nadi etc. The Vellar River originates on the southern boundary of Attur Taluk of Salem district. The length of this river is about 181 km and its average bed slope is 1 in 165.

2.2.5 Cauvery Basin

The Cauvery basin is bounded on the north by the ridges separating it from Krishna and Pennar basins, and the basin area covered by the streams between Palar and Cauvery on the south and by the Eastern Ghats on the east and by Western Ghats on the west. The upper reach of the basin is covered with hill ranges of the Western Ghats and the basin area is broad and open with gently undulating country. In the north – west and south, there are a number of hill ranges which have steep slopes. The maximum length of Cauvery basin from west to east is 540 km. The maximum width from north to south is 255 km.

2.3 Geology of the Basins

2.3.1 Pennar basin

The basin consists mainly of red, black, sandy and mixed soil. The important rock formations are hard or crystalline rocks of Archaean age Dharwar super group, Cuddapah series of rocks belonging to Proterozoic age, soil comprising of Guvalacheruvu quartzite, Vempally dolomites, lime stones and shales of Papagni series and Cheyyeru series. The Nallamala series comprise of Cumbum shales, which are metamorphosed to slates and phyllites.

2.3.2 Area covered by the streams between Pennar and Palar basins

The northern and Central portion of the basin is predominantly covered by granite gneisses, Cuddapah formations of Archaeans belonging to Dharwarian system with basic intrusive and the southern region with Gondwanas. Alluvial deposits are found all along the coastal belt comprising of marine and riverine deposits.

2.3.3 Palar basin

In the upper reaches of the basin it is predominantly covered by granite gneisses, Gondwanas, Cuddapah formations of Archaeans belonging to Dharwarian system with basic intrusives. The central portion of the catchment is covered by archaean crystalline hard rock and sedimentary rocks. Alluvial deposits are found all along the coastal belt and Palar River course comprising of marine and riverine deposits. Due to uplift of landmasses and tectonic activities, the archaean dharwarian hard rocks were subjected to deformation into folds and faults and also resulted in shifting of river courses in basin area.

2.3.4 Area covered by the streams between Palar and Cauvery basins

The geology of the basin is rather varied. The main rock types encountered in this basin area are charnockites, Granite gneiss (Peninsular gneiss) of Archaean age, Cuddalore sand stone of miocene and Pliocene and cretaceous age and alluvium of recent age. The widely exposed charnockites is more prominent which is exposed in the hill ranges. It is massive and also well foliated. The gneiss is medium to coarse grained and generally, less massive and is highly prone to weathering. The Cuddalore sand stone occurring in South Arcot district of this basin includes lignite deposits, which are being mined presently by open cast method at Neyveli. They are overlain in the coastal tract and in the river valleys by alluvium and coastal sands.

2.3.5 Cauvery Basin

The Cauvery basin consists largely of charnockites, high grade schists, migmatites, green stone belts and consolidated gneiss of Archaean age. In the upper part of the basin upto Grand Anicut, sand stone is generally lateritised and ferrugeneous and occurs in wide stretch in southern parts of the basin. Ground water occurs in the hard rocks normally in under water table conditions in the weathered mantle and under semi – confined to confined conditions in fractures, fissures, joints and shear planes.

2.4 River system and Catchment area

2.4.1 Pennar Basin

The Pennar River is one of the major rivers of the Indian peninsula flowing eastwards and draining into the Bay of Bengal. The river rises in Chennakesava hills of the Nandidurg range in Kolar district of Karnataka state. The total length of the river from the source to its out fall into the sea is 597 km, of which about 61 km is in Karnataka and the remaining 536 km is in Andhra Pradesh. Important tributaries of the Pennar River are Jayamangali, Chitravati, Kunderu, Papagni, Sagileru, Cheyyeru and Buggeru. The basin area lies in the States of Karnataka and Andhra Pradesh. State wise break up of the drainage area of Pennar basin is given in Table 2.1.

Table 2.1
State-wise drainage area of the Pennar basin

Sl. No.	Name of the state	Drainage area (km ²)	Percentage of total basin area (%)
1.	Karnataka	6937	12.56
2.	Andhra Pradesh	48276	87.44
	Total	55213	100.00

2.4.2 Area covered by the streams between Pennar and Palar basins

There are seven rivers systems in the basin and these are grouped together to form the streams between Pennar and Palar basins. They are (i) Kandaleru, (ii) Swarnamukhi (iii) small streams draining into the pulicat lake, (iv) Arani Ar (v) Kortalaiyar, (vi) Cooum and (vii) Adyar.

- (i) The river Kandaleru rises in the Velikonda range of the eastern ghats in Andhra Pradesh at an elevation of about 150 m and flows in a generally easterly direction through the Nellore district for a total length of 93 km to fall into the Bay of Bengal near Mathukuru.
- (ii) The Swarnamukhi river rises in the eastern ghats ranges near Pakala in Andhra Pradesh at an elevation of 300 m and flows upto Chandragiri in a north-easterly direction, thereafter, it flows

- eastward for a distance of 50 km and just before Srikalahasti, changes its direction northwards to flow for a length of 13 km. Beyond this, it flows in a generally easterly direction and falls into the Bay of Bengal near Durgarajupatnam. The river has a total length of 130 km from its source to its outfall, through the districts of Chittoor and Nellore in Andhra Pradesh.
- (iii) There are many streams, which drain into the Pulicat lake of which, the Kalangi and Kaler rivers are the important ones. The Kalangi river rises in the eastern slopes of the Nagari and Nagalapuram hills at an elevation of 300 m near Olluru in the Chittoor district of Andhra Pradesh, flows in a northerly direction for a considerable distance to turn east and south-east to outfall into Pulicat lake near Tada. The Kaler rises near Satyavedu at an elevation of 150m and joins the Pulicat lake near Elavur.
 - (iv) The Araniar rises from the eastern slopes of the eastern ghats at an elevation of 300 m and flows in a generally easterly direction for a total length of about 108 km to join the Bay of Bengal near Pulicat.
 - (v) The river Kortalaiyar rises near Kaveripak in the Vellore district of Tamil Nadu at an elevation of about 150 m and flows in a generally easterly direction for a total length of 131 km through Chittoor district of Andhra Pradesh and the Tiruvallur district of Tamil Nadu to join the Bay of Bengal near Ennur. The river is tapped to feed the Chembarambakkam tank and numerous other tanks, the most important being the Poondi reservoir formed across it, the Red hills and the Cholavaram tanks which are the main sources of water supply to Chennai city. The Nagari is the important tributary of the Kortalaiyar and joins it on the left. The river Kortalaiyar and stream Cooum are bifurcated with a saddle at Pudukesavaram to form an independent river Cooum.
 - (vi) The Cooum flows through Kancheepuram, Tiruvallur districts of Tamil Nadu for a total length of 68 km in a generally easterly direction and joins the Bay of Bengal through the Chennai city.
 - (vii) The Adyar, a small stream flows for a total length of 39 km through the Kancheepuram district of Tamil Nadu, first in a north-easterly direction and joins the Bay of Bengal, just north of Tiruvanmiyur of Chennai city.

The stream wise/state wise drainage area is given in Table 2.2.

Table 2.2
The stream wise / state wise drainage area of the basin

Sl. No.	Name of stream	State	Drainage area in km²	Percentage to the total area of basin
1.	Kandaleru	Andhra Pradesh	3534	20.66
2.	Swarnamukhi	Andhra Pradesh	3225	18.85
3.	Small streams draining into Pulicat lake	Andhra Pradesh & Tamil Nadu	3063	17.91
4.	Arani ar	Andhra Pradesh & Tamil Nadu	1290	7.54
5.	Kortalaiyar	Andhra Pradesh & Tamil Nadu	3521	20.59
6.	Cooum	Tamil Nadu	942	5.51
7.	Adyar	Tamil Nadu	1529	8.94
		Total	17104	100.00

The basin of streams between Pennar and Palar has a total catchment of 17,104 km². A major portion of 11335 km² (66.3%) of the catchment area of the basin lies in Andhra Pradesh and balance 5769 km² (33.7%) in Tamil Nadu.

2.4.3 Palar basin

The Palar River originates from Karnataka state in Kolar district from the neighbourhood of Kaivara village at an altitude of 900 m to the west of Ambojidurga and Rahamankhar peaks. It flows south-eastwards through Kolar and Bangarpet taluks of Kolar district for about 100 km and enters in Kuppam taluk of Andhra Pradesh. It flows about 30 km distance in Kuppam taluk of Chittoor district and then enters Vellore district of Tamil Nadu near the village Gundalapalli. Running southwards, the Palar turns to North-east near Vaniyambadi town and runs upto Gudiyattam. Then it turns in easterly direction upto Kancheepuram town and runs in a southeasterly direction till draining into Bay of Bengal. The tributaries of Palar are Poini, Malattar, Kavandinya nadi and Cheyyar, of which Poini

and Cheyyar are the two main tributaries, Poini joining from the left side of the river near Ranipet and Cheyyar joining the right side near Gurumancheri.

The total length of the Palar River is 348 km and it drains an area of 17871 km² lying in three states viz. Karnataka, Andhra Pradesh and Tamil Nadu. The statewise break- up of catchment area of the basin is given in Table 2.3 below:

Table 2.3
State wise drainage area of the Palar basin

Sl. No.	State	Area falling in the basin in km ²	Percentage to the total area of the basin
1	Karnataka	2813	15.74
2	Andhra Pradesh	5018	28.08
3	Tamil Nadu	10040	56.18
	Total	17871	100.00

2.4.4 Area covered by the streams between Palar and Cauvery basins

This basin area comprises of the combined catchments of four rivers viz. Ongur, Varahanadi, Ponnaiyar and Vellar draining the entire area lying between Palar and Cauvery river basins with each of the four rivers draining independently with their outfall in the Bay of Bengal. Ponnaiyar and Vellar rivers with their tributaries are the two major rivers in this basin area. It is bounded on the north by the Palar river basin, on the west and south by the Cauvery river basin and on the east by the Bay of Bengal.

This basin area with a total catchment of 27048 km² is spread over parts of Tamil Nadu, Karnataka, Andhra Pradesh states and Union Territory of Pondicherry. The state -wise break-up of the catchment area is given in Table – 2.4.

Table 2.4
State-wise drainage area of the area covered by the Streams
between Palar and Cauvery

Sl. No.	State/District	Area of the state within the basin in km ²	Percentage over total basin area
1	Andhra Pradesh	133	0.50
2	Karnataka	3545	13.10
3	Tamil Nadu	23076	1.10
4	Pondicherry (U.T)	294	1.10
	Total	27048	100.00

2.4.5 Cauvery basin

The Cauvery is the fourth largest river in the Peninsular India flowing east and draining into the Bay of Bengal. The river rises in the Western Ghats in Kodagu district of Karnataka at an altitude of about 1341 m above mean sea level and flows through the states of Kerala, Karnataka, Tamil Nadu and the Union Territory of Pondicherry. The total length of the river from the source to its outfall in Bay of Bengal is about 800 km of which 320 km is in Karnataka, 416 km in Tamil Nadu and 64 km in the common boundaries between Karnataka and Tamil Nadu.

The principal tributaries of the Cauvery are Lakshmanthirtha, Hemavathi, Harangi, Shimsha, Kabini, Arkavati, Suvarnavathi, Bhavani, Amaravathi, Noyil and Ponnanaï ar. State wise break up of the drainage area of Cauvery basin is given in Table 2.5.

Table 2.5
State-wise drainage area of the Cauvery basin

Sl.No.	Name of the state	Drainage area (km ²)	Percentage of total basin area (%)
1.	Karnataka	34273	42.20
2.	Kerala	2866	3.50
3.	Tamil Nadu	43867	54.10
4.	Pondicherry (U.T)	149	0.20
	Total	81155	100.00

2.5 Characteristics of the Command Area

The command area of the link canal is spread over Nellore, Chittoor districts of Andhra Pradesh state and Tiruvallur, Vellore, Kancheepuram, Tiruvannamalai, Villupuram, Cuddalore districts of Tamil Nadu state and Pondicherry (U.T). The climate of command area is characterized by oppressive hot weather during summer in the area lying in Nellore, Chittoor, Tiruvallur, Vellore, Kancheepuram and Tiruvannamalai districts. The major part of the command area receives its rainfall from the South-west and North-east monsoons.

The predominant rock groups found in command area are the granite gneisses, Gondwanas, Cuddapah formations of Archaeans belonging to Dharwarian system with basic intrusives, Charnockites, Cuddalore sand stone, etc.

The quality of groundwater in the command area is generally good for irrigation use except in Palar river region, where the quality of groundwater is poor due to the discharges of waste and effluents of tanneries, rubber and plastic industries from the towns located along the river course to the Palar River.

The main soils in the command are red loamy soils, brown sandy soils, red sandy clay loam soils, coastal sands, black clayey soils, forest soils and alluvial soils. Red loamy soils have developed from granite – gneissic complex and at times from quartzites and coarse – grained stones. At present, irrigation to the crops is provided from the wells and tanks in the proposed command area of the link project.

The food crops usually grown in command area are paddy, jowar, Bajra, Ragi, Greengram, Blackgram, Chillies, Sugarcane, onion, cotton, groundnut, coconut, gingelly, etc.