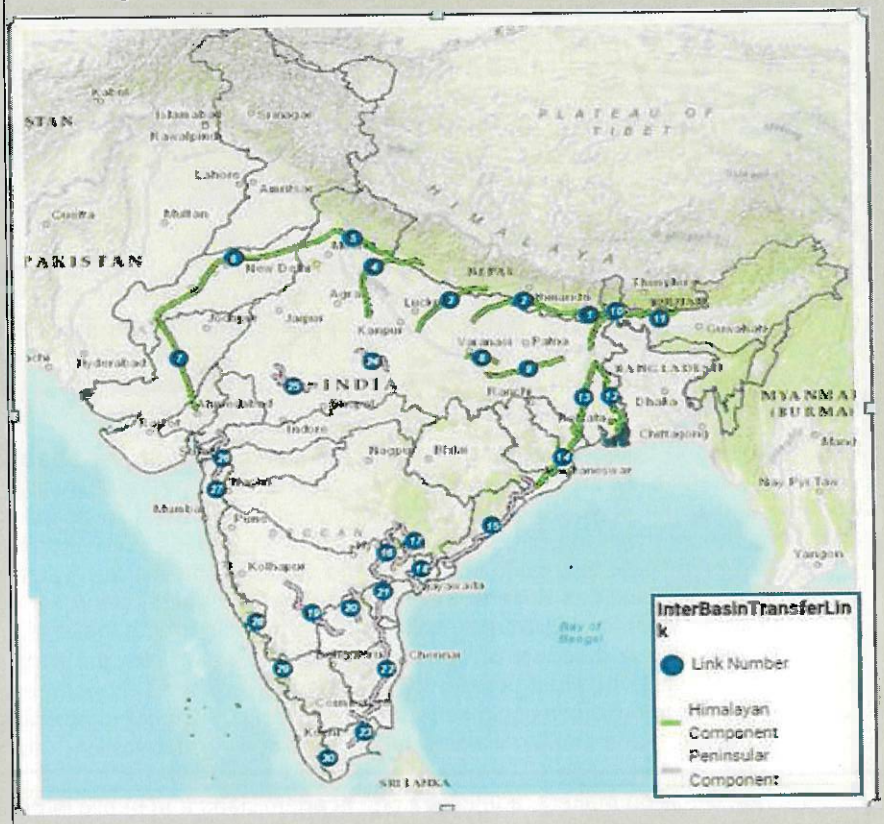
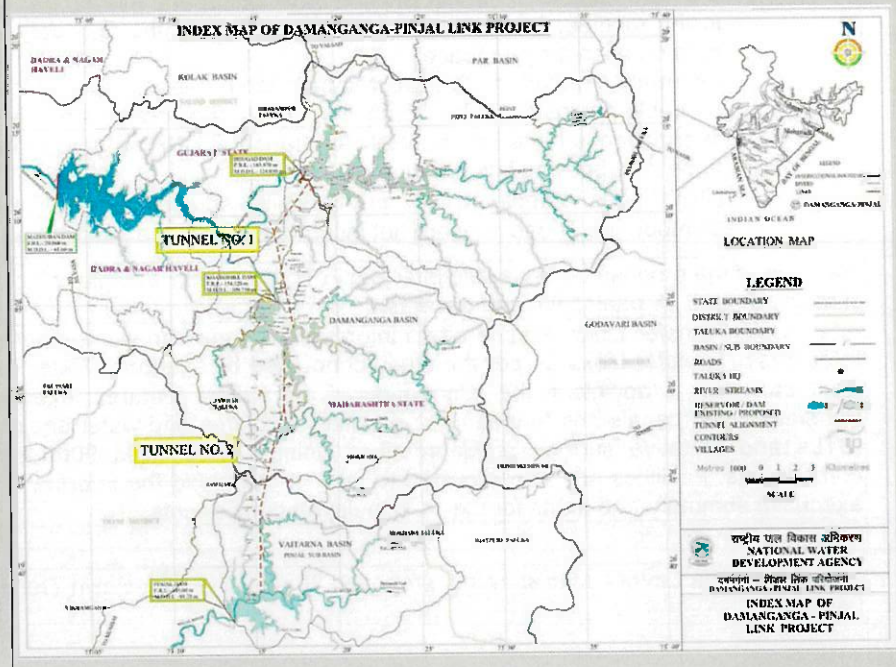
Business Specific Requirements	
Theme	Existing IT system for internal agencies of MoJS
Application	**WIMS expansion-WRIS**
Use Case	Inter basin transfer links
Use Case ID	WRIS-SSA-06
Other linked Use Case	Identification of nearest reliable source (WT-UC-02), Optimal route identification for existing network (WT-UC-03), Optimal route identification for new network (WT-UC-04), Interbasin transfer (WT-UC-05), Mapping of minor irrigation tanks/ schemes (WT-UC-06), Inflow to the schemes (WT-UC-07), Govt. Schemes and Policy Interventions (WT-UC-08), Water availability (WB-UC-01), Water demand (WB-UC-02), Water balance (WB-UC-03), Additional water harvesting structures (WB-UC-04), Additional schemes (WB-UC-05), Importing from surplus units (WB-UC-06), Rationalizing demand (WB-UC-07), Future need (WB-UC-08), Water Security Plans (WSP) (WB-UC-09), Water Audit (WB-UC-10), Plans for interlinking (WFP-UC-01), Inter basin transfer of wate (WFP-UC-02), Virtual water (WFP-UC-03), Virtual water transfer (WFP-UC-04), Virtual water saving (WFP-UC-05), Type of water foot print (WFP-UC-06), Features of water foot print (WFP-UC-07), River Basin Management (RBM) -Investigation of Water resources development scheme (IWRDS) NWDA component (Interlinking of Rivers) (IWRDS-PIT-01)
Description	NWDA studied in depth water balance studies of various major river basins including Mahanadi, Godavari, Krishna, Pennar, Cauvery, Vaigai, West flowing rivers of Kerala, Karnataka, north of Bombay and south of Tapi and southern tributaries of Yamuna to establish water surplus and deficit regions. These studies indicate that while Mahanadi and Godavari basins are water surplus, other basins in Peninsular India such as Krishna, Pennar, Cauvery and Vaigai are water deficit. As a next step, pre-feasibility studies for 16 probable links were carried out. Also, these studies suggest that it is technically possible and economically viable to transfer water from the surplus river basins to the deficit ones. Building the storage reservoirs on these rivers and connect them to other parts of the country, regional imbalances could be reduced significantly and lot of benefits by way of additional irrigation, domestic and industrial water supply, hydropower generation, navigational facilities etc. would accrue.
Used by	Researcher, Decision makers, administrators, academicians and public in general.
Priority	High Priority
Phase	Phase 1 WIMS expansion-WRIS
Business Problem	**Issue:** i) Survey sheets done by National Waterways Development authority was provided in the hard copy formats that requires digitization and further GIS operations for hosting in the module. Manual error while generation of the GIS data in different stages of data creation may increase. ii) Information provided are extracted from the pre-feasibility and feasibility studies for 16 probable peninsular links. Each link, in this component is briefly described here. This information is tentative and likely to change at DPR stage.Updated informations need to be incorporated into the module. iii) NWDA has completed the pre-feasibility studies of 14 links in the Himalayan Component. Those data are not incorporated into the module yet.
Output	Mapping of the proposed 30 possible Inter Basin Transfer links in India, which include 14 Himalayan and 16 peninsular components.
Outcome	Inter-Basin Transfer Links module offers information of the various components of the proposed Inter Basin Transfer Links as per the study conducted by National Water Development Agency. User can view & download the information of the salient features, executive summary, water transfer routes (canals and tunnels), the detailed structures and water bodies associated with the IBTLs and tentative surface profile (derived using SRTM DEM 90m) for the 16 peninsular components. Facilities are also provided to view & download the information of salient features, executive summary and maps for the 14 Himalayan components.
Visualization	1. **Map at India Level -** Map showing proposed 30 possible Inter Basin Transfer links at India Level.

Fig 1: Inter Basin Transfer links at India Level



2. Map of Individual Interbasin Transfer Link – Map regarding particular Inter Basin Transfer links

Fig 2: Map of Damanganga Pinjal Link



3. Report for Individual Interbasin Transfer Link : Report showing salient features of individual Inter Basin Transfer links in tabular format.

Table- 1 : Salient Features of Damanganga Pinjal Link

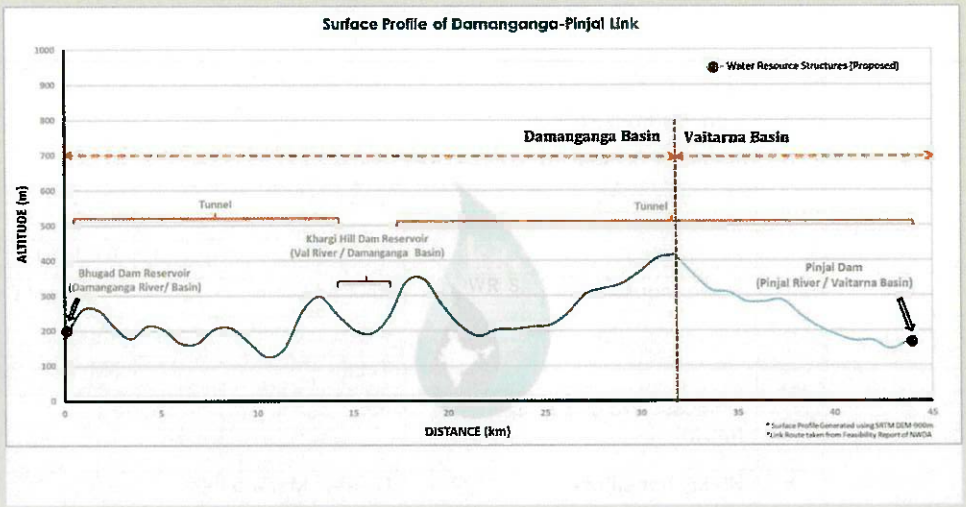
1	Location	Maharashtra and Gujarat		
2	Components of Project			
i)	Dam / Reservoir / Barrage	Dams (03 Nos)		
	a) River	Damanganga/Vagh; Vaitarna/Pinjal		
	b) Location	Maharashtra	Gujarat	
	c) Submergence area (ha)	Bhugad Dam	Khargihill Dam	
		1,903	1,558	
	d) Forest land (ha)	Bhugad Reservoir	Khargihill Reservoir	
		290	676	
	e) Culturable land (ha) & (Private land)	810	612	
	f) Private land (ha)			
	g) Others land (ha)	803	270	
	h) Population affected (Nos.)	20,501	19,273	
	i) Villages affected partially (No.) Fully	Nil	Nil	
	Partially	14	16	
ii)	Link Canal (RBC/LBC) / Tunnel			
	a) Length (km)	Tunnel Bhugad-Khargihill reservoir Length=17.488 km	Tunnel connecting Kharghill-Pinjal reservoir Length=25.244 km	
	b) Location (Passing through districts)	Bhugad dam	Khargihill dam	
		Thane district	Nasik district	
3	Diversion Quantity (MCM)	Bhugad dam	Khargihill dam	Pinjal dam
		210	369	316
		Total 895 (MCM)		
4	Benefits from Project			
i)	Irrigation Benefits (ha)	Nil		
ii)	Hydropower Generation (MU)	Maharashtra	Gujarat	
		16.20 MU	9.09 MU	
iii)	Power house (MW)	Bhugad Dam	Khargihill Dam	
		2MW	3MW	
		Total	5MW (25.29 MU)	
iv)	Domestic Water Supply (MCM)	895		
5	States benefitted	Gujarat, Maharashtra		

6	Employment Generation (No.)	The project affected households and also to each of the major son of such households, besides provision of Subsistence allowance, annuity, mandatory employment for one member from each family.
7	Total Cost of Project	(Rupees in Crores)
i)	As per DPR (Price level)	3008.49
ii)	Projected to year (2017-18) 5 % escalation per annum	3656.84
8	Annual Cost of the Project	(Rupees in Crores)
i)	As DPR (Price level)	407.58
ii)	Projected to year (2017-2018) 5 % escalation per annum	525.79
9	Annual Benefits (in Crores)	
i)	As per DPR (Price level)	732.21
ii)	Projected to year (2017-18) 5% escalation per annum	890.01
10	Economic Aspect	
i)	Benefit Cost Ratio (BCR)	1.8
ii)	Internal Rate of Return (IRR) (%)	14.95
11	Construction Period	7 Years

Source: National Water Development Agency

4. Surface profile for Peninsular components of the proposed Interbasin Transfer Link:

Fig 3: Elevation/ surface profile of the Damanganga Pinjal Link (Peninsular component)



5. Executive summery of Individual Interbasin Transfer Link : Executive summery of all the 30 components with compiled information i.e, structures, cost and other information are provided.

Damanganga Pinjal Link Project

(As per detailed project report, 2013-14)

The objective of the link Project is to transfer 895 MCM surplus waters available in Damanganga and Pinjal River basins to Mumbai city for augmentation of its domestic water supply and no irrigation is proposed under the link project. Maharashtra Government will get the benefits through the Damanganga-Pinjal Link Project by way of augmentation of water supply to meet the domestic water requirement of Mumbai city, while Government of Gujarat will be free to utilize remaining water spilled from Bhugad & Khargihill dams. The DPR of Damanganga-Pinjal link project has been completed by NWDA on 31st March 2014 and circulated in April 2014.

Three dams: (i) dam at Bhugad across river Damanganga; (ii) dam at Khargihill across river Vagh along with a saddle dam and (iii) dam across river Pinjal have been proposed. Two tunnels: (i) Connecting Bhugad reservoir with Khargihill reservoir; and (ii) Connecting Khargihill reservoir with Pinjal reservoir are also proposed.

The Damanganga-Pinjal link project envisages to diversion total 895 MCM water, out of which 210 MCM water from Bhugad dam, 369 MCM from Khargihill dam and 316 MCM water from Pinjal dam will provide annually to Mumbai. The powerhouses at the toe of both Bhugad and Khargihill dams are also planned to generate 5 MW of the hydro-power by utilizing water proposed to be released to meet the water requirements downstream of the respective dam sites.

Bhugad dam is proposed across river Damanganga near village Bhugad in Trimbak taluka of Nasik district of Maharashtra state. The total length of Bhugad dam is 851.50 m. The spillway has been proposed in the river portion. The FRL of Bhugad dam has been kept at 163.87 m and the corresponding gross storage capacity of the reservoir is 427.07 Mm^3. The surplus water of available at Bhugad reservoir is to be transferred to proposed Khargihill reservoir through a tunnel of 17.488Km long with diameter of 3.2 m.

Khargihill dam is proposed across river Vagh, a tributary of river Damanganga near village Behadpada in Jawhar taluka of Thane district of Maharashtra state. The total length of Khargihill dam is 618.20 m. The spillway has been proposed in the river portion. The FRL of Khargihill dam has been kept at 154.52 m and the corresponding gross storage capacity of the reservoir is 460.896 Mm^3. The combined surplus water available at Khargihill reservoir is to be transferred to proposed Pinjal reservoir through a tunnel of 25.224 Km long with diameter of 4.0 m.

Pinjal dam is proposed across river Pinjal, a tributary of Vaitarna River near village Khidse in Jawhar taluka of Thane district of Maharashtra. The total length of dam will be 545.0 m. The length of saddle dam will be 190 m. The spillway has been proposed on the right flank. The surplus water

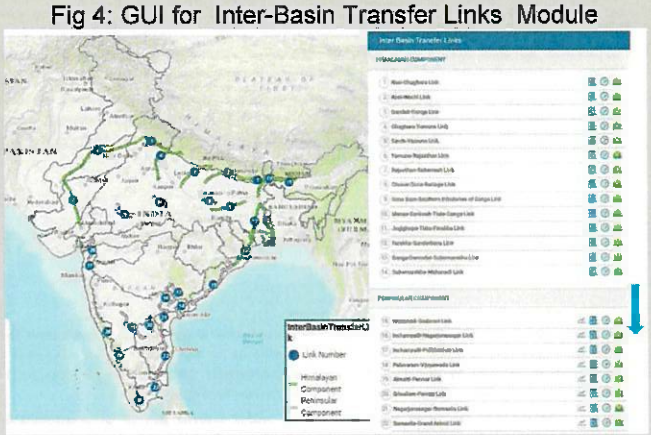
available at proposed Pinjal reservoir along with the water to be transferred from proposed Bhugad and Khargihill reservoirs of Damanganga basin is to be taken upto Mumbai city through suitable conveyance system as per the planning of Municipal Corporation of Greater Mumbai (MCBM) and Mumbai Metropolitan Region Development Authority (MMRDA).

About 3461 ha land area will come under submergence of proposed Bhugad and Khargihill reservoirs (Bhugad reservoir 1,903 ha; and Khargihill reservoir 1,558 ha). Total number of affected

Frequency	As per data made available by National Water Development Agency.
Measures of Success (KPIs)	Inter-Basin Transfer Links offers information of the various components of the water transfer links (source: NWDA). In India, rainfall distribution is highly variable both temporally and spatially. Inter basin transfer link proposes river water transfer from the region of surplus to deficit areas. This may provide an effective ways to enhance irrigation potential, to mitigate floods and droughts and reduce regional imbalance by way of additional irrigation, domestic and industrial water supply, hydropower generation, navigational facilities etc.
Input Data Required	Data Points:

Data Point	Data Type	Agency
Administrative Boundary	Polygon	NWIC
River Layer	Line	NWIC
Major Rivers	Polygon	NWIC
Interbasin Transfer links (all 30 links)	Line	NWDA
Link ALL (16 Peninsular link in detail)	Line	NWDA
Reservoir/ waterbody (associated with IBTL)	Polygon	IWAI/ NWDA
Structures (Dam/BWA/Lifts)	Point	IWAI/ NWDA

Process

Algorithm/Tool	National Water Development Agency has provided the detailed data for 16 peninsular components of the Inter Basin Transfer links. The integration of the data from NWDA to ht Inter-Basin Transfer Links module will require following steps. Step 1: Data received from NWDA in hard copy format is first scanned so that further digitization of various datasets can be performed. Step 2: Digitization of components of Inter Basin Transfer links such as – • Structures: name of the structure, type i.e dam/BWA etc, status i.e proposed/ existing), associated Link name. • Reservoir/ waterbody (associated with IBTL): Name of the Reservoir/waterbody linked with the proposed IBTL along with their status (proposed/ existing) & associated Link name. • Link_All: Link Name as well as the detail of each peninsular link i.e tunnel/ canal part etc. • Interbasin Transfer links: containing all the 30 links. Step 3: Topology Correction and data harmonization of digitized data. Step 4: Preparation of map document of Inter Basin Transfer Links data layers alongwith relevant hydrological layers i.e Basin, sub basin, major rivers, with label, legends, scale and suitable visibility of layers at varying scales. Step 5: Hosting GIS layers and reports in the Inter-Basin Transfer Links Module. A draft GUI of the IBTL module (from the Inter-Basin Transfer Links module of India-WRIS) can be shown below: Fig 4: GUI for Inter-Basin Transfer Links Module  The user may select and view any of the links available in Himalayan and peninsular components from the right side data panel. Reports/ maps i.e; surface profile (for peninsular component), salient features, executive summery and index map of individual links are provided in the data panel.
Data Validations	Digitization of components of inter basin transfer links from hard copy maps/ survey sheets/toposheets format requires geospatial as well as attribute validation time to time.
Software Requirement (specific if any)	ArcGIS Desktop/ ArcGIS Enterprise
Dependencies & Risks	Error during data preparation (hardcopy to GIS data creation) i.e. RMSE error, Inerpretational erros etc. impacts quality of the processed data. Requirement of data updation based upon the current status (DPR study/ under construction) and data validation by the concerning government agency.
User Acceptance Testing (UAT) By	NWIC
Development Responsibility	NWIC
Reference material	1. https://indiawris.gov.in/wris/#/interbasintransferLink 2. www.nwda.gov.in

For any communication/clarification on the BSR, the following Officer may be contacted.		
Nodal Officer Name & Designation:	Dr. Rakesh Singh, Deputy Director	Dr. Rakesh Singh, Deputy Director 22/5/23
Organization:	National Water Informatics Centre	
Contact No.: **Email id:**	9006150281 dd-services-nwic@gov.in	
BSR prepared by Subject Matter Expert (SME), Name & Designation:	Dr. Dharmesh Singh Hydrologist	22/05/23
Organization:	NWIC	
Contact No.: **Email id:**	8447025987 Hydrologist.nwic@gmail.com	

This is to certify that the above BSR has been vetted and found satisfactory.

Details of Domain Organization SPOC and SME for Verification and Approval of above BSR

22/5/23 **(Signature of SPOC)** **SPOC Name:** Rakesh Singh **SPOC Designation:** Dy. Director **Organization:** NWIC, Delhi	**(Signature of SME)** **SME Name:** **SME Designation:** **Organization:**