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LINKING OF DHOM RESERVOIR TO NER RESERVOIR: UNDERSTANDING THE ALIGNMENT OF THE OPEN AND CLOSE CONDUIT, MAHARASHTRA.

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ABSTRACT:

Water forms the life line in human life. Increase in population leads to the increase in requirement of water. There are various places in Maharashtra where water scarcity is being observed and few places where surplus water is available. Inter linking of water bodies deals with the transfer of water from surplus region to the deficient region.

The present study specifically deals with transfer of water from Dhom dam near Mahabaleshwar, which comes under heavy rainfall region in Maharashtra state and another area is Ner reservoir in Satara district. Satara district is semi-arid region and has average amount of water storage. Shortage of rainfall is the main problem for the farmers from this area. Yerla River that runs from Ner reservoir is dry in most of the months of the year. Yerla River provides water to Ner reservoir in rainy season, but in later season it gets dry and water scarcity problem continues in remaining period.

The present study is an attempt made to supply surplus amount of water from Dhom dam (high rainfall region) to Ner reservoir (less rainfall region) with the use of canals and closed conduits according to the geological conditions of the area. Distance between these two regions is near about 60 km. As Dhom dam is at high altitude than Ner reservoir, so the flow of water is by gravity only. Canal alignment is decided based on the geological formations of the end to end regions. Electrical resistivity is best suitable and economic method to study the geological conditions. This method will help to delineate the open canal and close conduit canal by understanding the geological conditions for proposing the low cost and less distance alignment. After checking the feasibility of this project, it will definitely improve the planning of water balance and improve the living standard of people from the Ner region.

KEYWORDS: Interlinking, Canal, Electrical Resistivity, etc.

I. INTRODUCTION:

Food, clothing and shelter are basic need of human being. In addition, water is the most essential to stay alive for human being. Water availability varies from place to place. This dissimilarity depends on rainfall intensity at that place. Abundant water is available in Himalayan region of India, as per National Water Development Authority (NWDA).

There are various places in Maharashtra where water scarcity is being observed and few places where surplus water is available. Rainwater is free gift of nature to mankind, which is being wasted in the form of flood. Day by day the population and demand of water is increasing. India is an agriculture based country, so the irrigation faces more problems when the area belongs to water scarcity. Movement of lands from deficit region to water surplus region is not possible, the best solution is to transfer water to deficit from surplus region.

Water can be transferred from one place having surplus water to other place having water scarcity. This transfer will not harm the people or environment as only excess water is to be transferred. This transfer can be done by use of open cannels, tunnels, close conduits etc, depending on the geological conditions. It is necessary to know the geological conditions like, what type of strata is present, rock distribution, soil condition, structures (folds, faults, joints etc). Geophysical investigation techniques such as seismic, electrical, electromagnetic etc. are used for mapping the sub surfacial condition, which helps in further work of water transfer.

In Maharashtra, Dhom dam is having excess amount of water due to heavy rainfall in this region which is situated in Satara district. Surplus water is available at Dhom dam after fulfilling required demand under this command area. While the Ner reservoir from Satara district faces water

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scarcity. Thus the people under Ner command area face many problems due to poor availability of water. As per survey carried out for the present study the distance between Dhom dam and Ner reservoir is nearly 60 km.

The two alignments of canal which started this project work are:

1. Dhom – Eksar – Wai – Dhumalwadi – Bhuinj – Chodharwadi – Shirgaon – Wathar – Koregaon – Aasgaon – Ner – Lalagun.
2. Dhom – Eksar – Wai – Sultanpur – Pandav Nagar – Chandwadi – Mahalewadi – Salwan – Hanmantwadi – Tadawale S Koregaon – Bhandarmachi – Bodhewadi - Lalagun.

Present paper is an attempt to study the feasibility of linking two surfacial water bodies, Dhom dam to Ner reservoir using Geophysical Technique.

II. STUDY AREA:

Krishna River flows through three different states namely Maharashtra, Karnataka and Andhra Pradesh. Extend of Krishna Basin is 258,948 square kilometer (99,980 sq mi) over an area. This rises in the Western Ghats, at an elevation of about 1337 m just north of Mahabaleshwar. Location map of study area is shown in Figure1.

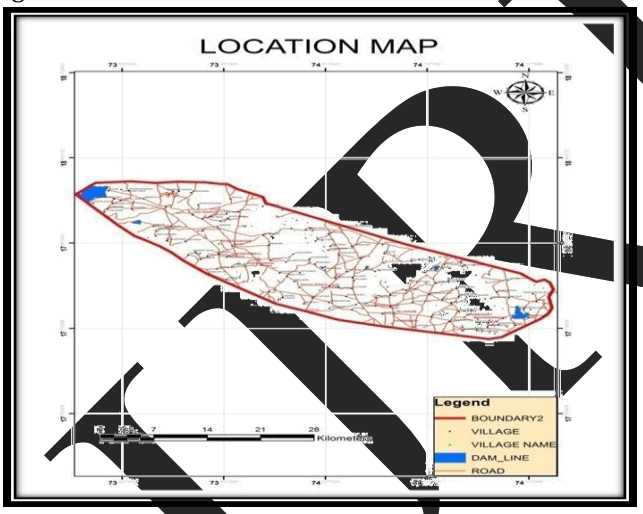

Fig. No. 1: Location Map of study area.

Mahabaleshwar is located in Satara district which is in Western part of Maharashtra. 17.92 °N Latitude and 73.66°E Longitude can be mapped to closest address of Mahabaleshwar, Maharashtra. The Average Rainfall at Mahabaleshwar region from 1985 to 2013 is 5636.103 mm. This Rainfall water is stored in Dhom dam at downstream side of Mahabaleshwar.

DHOM DAM:

This Dhom Dam is located in Wai at a distance of nearly 28 km from Mahabaleshwar. Dhom dam is constructed in 1977 under the Government of Maharashtra. Latitude and Longitude of Dhom dam are 17.98°N and 73.80°E respectively. Details of Dhom Dam and its spillway are shown below in Table No. 1

Table No. 1: Details of Dhom Dam and its spillway.

Type Of Dam	Earth Fill Gravity
Height	50 M (160 Ft)
Length	2,478m (8,130 Ft)
Volume	6,335 Km^3 (1,520 Cu Mi)
Impounds	Krishna River
Reservoir Capacity	331,100 Km^3 (79,400 Cu Mi)
Surface Area	2,498 Km^2 (964 Sq Mile)
Spillway type	Ogee
Type of Gate	Circular
No. of gate	5

Dhom dam provides water for various purposes like drinking, irrigation, industrial etc to the villages under its command area. Excess water is available in Dhom dam after fulfilling the requirements of the people coming under this area, due to high rainfall.

NER RESERVOIR:

Ner reservoir is located near Lalagun in Satara district, Maharashtra. Latitude and Longitude of Ner reservoir are 17.78°N and 74.29°E respectively. Average rainfall in this region is 840.7 mm. Yerala River supplies water to Ner reservoir and continues to downstream. Yerala River flows dry in most of the seasons and also it is tributary of Krishna river, which flows with abundant amount of water. As this region is having less rainfall, it is not capable to fill all the requirements of people under it.

III. AVAILABILITY OF DATA

To study the feasibility of linking two surfacial water bodies, Dhom dam to Ner reservoir, various data is collected.

Following data was collected and studied for the present study:

1 Topo-sheets were collected from Survey of India Department, Pune. The scale of topo-sheets collected is 1:50,000. Total five topo-sheets were collected for preseent study, following are numbers of topo-sheets: E4314, 47 K/1, 47 K/5, E43O2, 47 K/6

2 Rainfall data were collected from Indian Meteorological Department, Pune. Annual Rainfall is collected for this study of two places that is Dhom dam and Ner reservoir. Data collected from year 1985 to 2013.

IV. METHODOLOGY:

For present study, various data collection like annual rainfall data from Indian Meteorological Department, topo-sheets of the study area from Survey of India, etc, were collected. To study the soil and rock strata beneath the earth's surface, the geophysical methods i.e. electrical

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resistivity test has been performed in the present study area. Electrical Resistivity is the cheapest and more convenient instrument that can be handled on the field with less man power. The other geophysical techniques like electromagnetic surveys, seismic surveys are more costly and are not readily available for experimentation, so the electrical resistivity method is used for the present study. In the present study Wenner's resistivity method is adopted and this method is routinely used for:

1 Determining the sub-surface strata classification
2 Determination of hard rock foundation
3 Estimation of overburden thickness and hard rock quantities and
4 Determination of the suitability of the area for quarrying and excavation.

V. RESULTS OF EXPERIMENT

The results obtained through geophysical studies are tabulated (Table No. 2) and the respective 2 D sketches are attached to have a better interpretation of the sub-surfacial formations. This investigation has helped for deciding the proper alignment of the canal, through which the command area can be developed and wherever necessary the closed conduit are been provided to the canal, so that the water can reach upto Ner reservoir. The present study area is having a sloping ground, covering a wide spectrum of about 60 Km. The actual contours observed at Dhom reservoir are 1000 m, while that of Ner reservoir are 500 m, this difference of 500 m leads for the gravitational movement of the water toward Ner reservoir.

Almost area is hilly, wherever required the alignment is changed based on the strata available from surfacial and sub-surfacial data. Wenner method helped the area to understand the subsurface geological and aquifer conditions extending up to 80 meters depth, vertical electrical soundings were conducted at 13 different locations. Using of IPI2WIN software, a WINDOW based software, the data obtained from electrical resistivity was processed. This software helped in interactive semi – automated interpretation of the field data. All the sounding data are modelled for the existing sections. The VES data on apparent resistivity values was modelled by using IPI2WIN, to get different layers depicting their thickness, depth and true resistivity. In nutshell, the above interpretation gives an overlook of geological situation with depth-wise variations. As discussed above the sounding points with typical curves at selected sites give point information, which was further utilized to build up the comprehensive picture of subsurface geological situation depth-wise by preparing 2-D geo-electrical sections.

The data is created and the respective readings of the same are tabulated. The graphs with 2 D maps are tabulated. A sample reading of electrical resistivity of present study is shown below.

Table No. 2: Resistivity reading at Dhom Dam.

Location no		1			Village		DHOM	
Sr No	A	R1	R2	Avg R	X Ohm	Final R	2πaR	1/R
1	1.25	5.98	5.96	5.97	1	5.97	46.8	0.17
2	2.5	3.89	3.8	3.85	1	3.85	60.4	0.26
3	3.75	2.51	2.58	2.55	1	2.55	59.9	0.39
4	5	2.45	2.48	2.47	1	2.47	77.4	0.41
5	7.5	1.86	1.88	1.87	1	1.87	88.1	0.53
6	10	1.5	1.54	1.52	1	1.52	95.5	0.66
7	15	1.44	1.48	1.46	1	1.46	137.5	0.68
8	20	0.71	0.73	0.72	1	0.72	90.4	1.39
9	25	0.56	0.59	0.58	1	0.58	90.3	1.74
10	30	0.34	0.34	0.34	1	0.34	64.1	2.94
11	35	0.22	0.23	0.23	1	0.23	49.5	4.44
12	40	0.19	0.2	0.20	1	0.20	48.9	5.13
13	45	0.15	0.15	0.15	1	0.15	42.4	6.67
14	50	1.1	1.1	1.1	0.1	1.1	345.4	0.91
15	55	0.94	0.94	0.94	0.1	0.94	324.6	1.06
16	60	0.76	0.74	0.75	0.1	0.75	282.6	1.33
17	65	0.62	0.62	0.62	0.1	0.62	253.1	1.61
18	70	0.59	0.59	0.59	0.1	0.59	259.3	1.69
19	75	0.51	0.51	0.51	0.1	0.51	240.2	1.96
20	80	0.49	0.50	0.49	0.1	0.49	247.4	2.03
21	85	0.45	0.45	0.45	0.1	0.45	240.2	2.22
22	90	0.41	0.43	0.42	0.1	0.42	237.3	2.38

Figure 2 describes the variation in the lithological units of the region from Dhom and Eksar area.

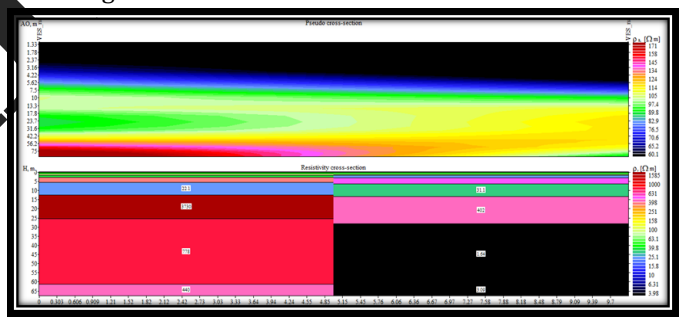

Fig No. 2: 2 D Section of Dhom & the relationship of Dhom area and Eksar area after compiling the data.

Table No. 3: Lithology Units of Figure 2

LITHOLOGY	THICKNESS
Soil &Weathered Basalt	0-6 m
Vesicular Amygdaloidal Basalt	6-10 m
Compact basalt	10-16 m
Vesicular Amygdaloidal Basalt	16-34
Compact Basalt	34-75

Varying litho logical sequence gives an idea about the difference in the elevation as well as the rock types exposed in the Dhom and Eksar. The above table describes the exact lithology where the soil and weathered basalt of 6 m, Vesicular amygdaloidal basalt of 22 m, and Compact basalt of 47 m thick layer present at present site.

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VI. DISCUSSION:

The two alignments have a wide difference in selection. The first alignment (Dhom – Eksar – Wai – Dhumalwadi – Bhuinj – Chodharwadi – Shirgaon – Wathar – Koregaon – Aasgaon – Ner – Lalagun) was decided based on the road route, which found to be more appropriate considering the optimistic distance. From Dhom onwards the area had gradual sloping ground i.e. falling contours, where the gravity flow of water could be sustained properly. But after Bhuinj towards Chodharwadi followed by Shirgaon and Wathar, the region has high hills and valley regions, which has increasing contours. From mid of Bhuinj and Chodharwadi onwards more than 25 km of region needs to have the closed conduit for the canal alignment. The region being heavily tectonically disturbed, the rocks occurring in this region is mostly compact basalt and has an individual flow width of more than 45 ft.

The reduced level of Bhuinj is 650 m while that of Chodharwadi is about 780 m. The elevation difference leaded to have the uplift method of canal or to have the close conduit. But when geophysical investigations were carried at this alignment it was found that most of the rock is fractured compact basalt and to have a close conduit it is not suitable. During the exploration of the close conduit it was likely to have roof collapse and further the maintenance issues related to the close conduit could be troublesome.

Further in the region of Shirgaon and Wathar the formations exposed are amygdaloidal basalt but the second flow occurring is the compact basalt. The reduce levels of Shirgaon and Wathar are 760 m and 865 m respectively. This will again lead for the second phase of uplift of water stations at both the sites inclusive of the close conduit. Considering the cost benefit ratio it was highly impossible to have a canal alignment from this route. This leaded to have a second alignment.

By understanding the present above stated conditions it was decided to have the second route from Dhom to Lalagun which is stated below:

Dhom – Eksar – Wai – Sultanpur – Pandav Nagar – Chandwadi – Mahalewadi – Salwan – Hanmantwadi – Tadawale S Koregaon – Bhandarmachi – Bodhewadi - Lalagun.

From Dhom to Wai there is gradual slope as the region being hilly and originally the discharged water already flows from this region. From Sultanpur – Pandavnagar – Chandwadi – Mahalewadi region the area forms to be plan plateau region where the canal water can move freely. Salwan to Hanmantwadi region has an issue of driving a close conduit. The geophysical investigations have revealed following sub surfacial formation.

About 4 m of soil and weathered basalt occurs to the top of this region followed by the occurrence of Vesicular Amygdaloidal Basalt. The compact basalt occurring in the area is about 10 to 50 m depth and then after its again Vesicular Amygdaloidal rock. From engineering point of view the reduce levels of Mahalewadi is 750 and that of Salwan and Hanmantwadi is 750 and 720 m respectively. Considering the elevation difference it's not appropriate to have the uplift method of canal system at this point, inspite of that if the closed conduit is provided it's more suitable. As the rock occurring at 740 m is compact basalt which in non-jointed. This basalt is impervious so if closed conduit is explored in this region it is much better to conserve the water body from the canal.

The total stretch of the closed conduit is about 6 km considering the region and its utility; it is possible to have a closed conduit in the said area. After Salwan the opening of the closed conduit starts and ends to the end point of Hanmantwadi where the reduced level is about 720 m.

Further from Tadawale S Koregaon – Bhandarmachi – Bodhewadi the region has similar elevation difference i.e. 700 – 750 – 740 m while Ner has 730 m of elevation difference. In between Bodhewadi and Ner reservoir there exists a hilly region which needs to either divert the can or if the closed conduit with an elevation of 730 m is provided from Tadawale S Koregaon to Ner reservoir the free flow moment of water can occur in the canal region. The area comprises of compact basalt having less joint frequency will lead for the proper percolation of water in turn developing the command area of irrigation. Due to which the present crop patter can be converted to economic crop pattern like sugarcane production or grapes production. This will definitely lead for the development of the farmers as well as the socio-economic status of the region.

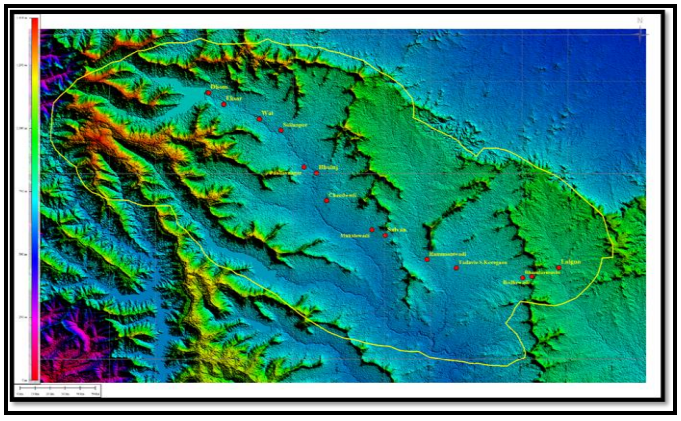

Fig. No. 3: Digital Elevated Model of the Study Area.

Fig. No. 3 shows the Digital Elevated Model of the present project study area, which shows gradual sloping ground from Dhom to Salwan. If we consider the evaporation losses of 20% from the open canal system, it can be presumed that about 80% of the total discharge can reach to Salwan region, without assuming the thept losses. After Salwan towards Hanmantwadi the region shows high elevations in between forming a hillock

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region, but the geophysical survey of this area has proven more suitability of having a close conduit at this region of about 3 km. At the depth of 10 m the occurrence of the compact basalt has non jointing pattern and above which is vesicular amygdaloidal basalt which justifies the present location studies. The exploration cost and the provision of close conduit can be economic if the method of Close Conduit Irrigation used by G R. Gadekar et al. (2015), which states the use of G R Pipe in the CCI.

After Hanumantwadi area till Bhandarmachi the canal can remain as Open Channel as the region has perfectly 740 – 730 m of reduce level. From Bhandarmachi to Bodhewadi this area shows some high tectonic upliftments, due to which the studies were again focused for geophysical investigations (Fig. No. 3). Bhandarmachi onwards the region shows the hilly terrain, if at all the canal alignment is diversified then too the construction cost will increase for more than 20 km. Hence, after geophysical investigation the sub-surfacial lithological units were studied and it has revealed that the region has amygdaloidal basalt at 730 m reduce level.

The engineering property of this amygdaloidal basalt states that the rock is more suitable for tunnel. As these strata's don't have any joints or structural issues. The exploration cost also gets reduced as this rock is soft for removal (T. D. Bhosale et al, 2014).

Near to the Ner Reservior the opening of the Closed Conduit Canal can be provided where the stretch is about 7 Km from Bhandarmachi to Ner. This will definitely carry forward the total water without any thept losses as well as evaporation losses. Fig. No. 3 describes the total alignment of the Canal from Dhom to Ner and the respective locations where the Closed Conduit provisions are to be made in the study area and were the open canal is to be set.

Considering the total economic growth of the Ner Reservoir, the existing system can be adopted with due consideration to the crop patterns changing ratio in the study region. This will not only satisfy the study area but also the downstream of Ner which has Yerla River, which founds to be draught. By achieving this we could enrich the downstream part of the Ner reservoir too.

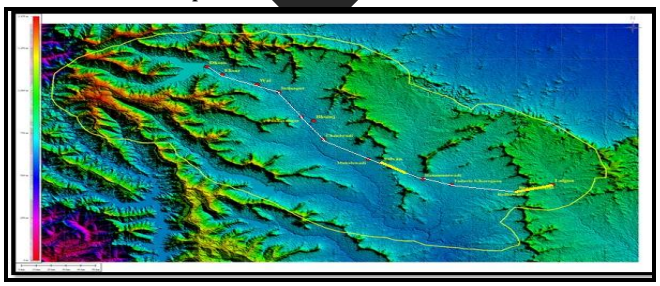

Fig. No. 4: Final Stretch of the Canal Alignment for Dhom - Ner Reservior.

VII. CONCLUSION:

Finally with all the above studies carried from the topographical survey to GIS mapping and further electrical resistivity studies, the conclusions are enlisted below:

i. The best optimistic alignment of the canal can be only and only Dhom – Eksar – Wai – Sultanpur – Pandav Nagar – Chandwadi – Mahalewadi – Salwan – Hanmantwadi – Tadawale S Koregaon – Bhandarmachi – Bodhewadi – Lalagun.
ii. The electrical studies have revealed different lithological conditions at different regions of the study area.
iii. Fig. 3 shows the total command area by which we can achieve the more irrigated region of the area.
iv. Fig. 4 shows the open and closed conduit canal systems on the stretch. The length of the closed conduit will be approximately 10 km of total stretch of 62 km of the canal alignment.

REFERENCES:

1) B. N. Gophane, (2013): *"Environmental Degradation of River Krishna in Maharashtra - A Geographical Study"*, A Report submitted to UGC, 51 p.
2) B. S. Prakasa Rao, P. H. V. Vasudeva Rao, G. Jaisankar E. Amminedu, M. Satyakumar and P. Koteswara Rao (2010): "*Interlinking of River Basins: A Mega Harvesting Plan-A Review*", J. Ind. Geophys.Union.Vol.14, No.1, PP.31-46.
3) Dharmendra Mehta, Naveen K. Mehta (2013): "*Interlinking of Rivers in India: Issues and Chalenges*.", J. of Geo Eco Marina, pp. 137 – 143.
4) Gayatri R. Gadekar, Dr. Sunil Kute, Dr. N. J. Sathe (2015): "*Optimal Utilisation of Irrigation Water: A Case Study On Nashik Left Bank Canal [nlbc], Nashik*", Vol-5, Issue-1, ISSN-2249-555X, pp. 15-17.
5) Gov. of India MOWR Retrieved 27 Mar 2015: *"Krishna Basin status report*, March 2014", 231 p.
6) Government of India, Ministry of Water Resources, Central Ground Water Board (2013): *"Ground Water Information, Satara District, Maharashtra"*, 211 p.
7) H. Mahabaleshwara, H. M. Nagabhushan (2014): "*Inter Basin water transfer in India: A Solution to hydrological extrimities"* paper published in IJRET: International Journal of Research in Engineering and Technology eISSN: 2319-1163, pp. 530 – 537.
8) Hossien Samadi-Boroujeni and Mehri Saeedinia (2013): "*Study on the impact of Inert-Basin Water transfer: Northern Karun*", African journal of agricultural research, Vol. 8(18), pp, 1996-2002.
9) J. G. Dahigaonkar, 2nd revised and updated edition 2006: "*Irrigation Engineering*."

IJRPET

10) Luna Bharti, B. K. Anand and Vladmir Smakhtin (2001): "*Analysis of Inter-basin water transfer scheme in India: A case study of Godavari-Krishna link.*" A report from International water management Institute, Sri Lanka. pp. 63 – 78.
11) R. K. Bansal, edition 2006: "*Fluid Mechanics and Hydraulic Machines*."
12) T. D. Bhosale, Dr. G. A. Hinge and Dr. N. J. Sathe (2014): "*Effect of Scouring in Basaltic Rock on Hydraulic Structures in the Vicinity of Pune Region*", Industrial Science- Vol-1, Issue-5, ISSN: 2347-5420, pp. 1-11.
13) United State Geological Survey Retrieved 2009-05-13: "*Earth's water distribution*.

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