

Shri Joseba,
Auroville Development Council,
Bharat Nivas,
AUROVILLE, 605 101, Tamilnadu

Pramod-van, Chitrakoot
July 2002.

Dear Shri Joseba,

Hope this finds you all in the best of health and spirits with the kind Grace of the universal Mother.

Having gone thoroughly over the draft "Concept for Water Supply" prepared by Ingenieur burg Kraft, I got incited to myself prepare a note on the subject, which I enclose here-with for consideration.

I Shall request your kind attention to the following :

- (i) My note should be considered as a supplement and / or partial modification than any clear alternate option in an either / or manner ;
- (ii) While Kraft analyse the demands \ resources on basis of large areas (even entire Aurovillla) and are not afraid of pumping or long distance transport, I prefer to base on small habitations and trying to balance with minimum purring ~~pumping~~ and transport. Thus I am not in favour of a "Central recharge facility" or a large Water -Treatment or Sewage - Treatment plant. In my view, de-centri lisation and diversity are at the core of Auroville philosopy.
- (iii) For the above reasons, I do not support as large a lake/as proposed ^{gentling ground} by Kraft and would wish it to be no larger than 80,000 m² surface area, 100 m width and 5m average depth. To me, it cannot be a cost - effective infiltration basin

Probably the issues need wide and long discussions at the ADC. I wish I could join.
With best wishes and warm regards.

Encl. ; Note on "Water Management"

Your's Sincerely

G.D Agrawal

Copy to Shri Gilles B.
with a copy of the
note for information
and appropriate action

G. D. Agrawal
20/7/02

WATER MANAGEMENT FOR AUROVILLE TOWNSHIP

By : Dr. Guru Dass Agrawal¹

1- Background and Features of Auroville

1.1 - Location : Founded on Feb.28,1968 and conceived as an international township, housing 50,000 inhabitants, from various nationalities and backgrounds ; however belonging to no person or group in particular but to humanity as a whole, Auroville is located in the eastern coastal part of South Arcot District of Tamilnadu. The closest city is Pandycherry at 8Kms south while Chennai is about 160 Kms to the north.

1.2 Land Area and Township Layout : Auroville is planned to cover a nearly circular piece of land 5 kms in diameter and 19.6 km² in area. It shall have a unique lay-out with the township covering the central 2.5 km diameter and 4.9 sq. km area, with a 1.5 km wide greenbelt girdling the township all around to cover the remaining 14.7 sq. km area. The green belt shall be a mix of wooded area and agricultural fields on almost a 50:50 basis and shall serve both as lungs as also the support base providing all agricultural and other bio-mass needs of the township. The main 2.5 km diameter township also has a unique lay-out with a central core-zone housing the spiritual - cultural complex surrounded by 4 functional zones, viz. residential industrial, cultural and inter national, all laid - out in a galaxy - like spiral shape.

(1) D-19 Vriddha - Seva - Sadan, Pramod - Van, CHITRAKOOT. Dt Satna, MP, 485331 (India) honorary Advisor to Aurovilla Development Council. Formerly Professor of Env. Engg. IIT, KANPUR.

Parks, gardens, fruit - orchards and water - bodies shall be spewn at spots and pockets all over the township.

1.3 Topography and geology : The 5 km diameter land - piece chosen for Auroville resembles the surface of a gently sloping frustum of a cone, with a small plateau with maximum elevation of 52 m above MSL at the apex and with elevations of 20-25 m above MSL at the base periphery. Thus drainage routes are from centre to wards periphery to be collected by a natural system of drains ultimately carried to sea about 5 kms to the east.

The geology of auroville-land is dominated by sedimentary formations including laterites, sand stones, clays and limestones. Most of the soils are lateretic and thin, soil - erosion was quite rampant but has now nearly been halted by intensive conservation measures.

1.4 - Hydro - meteorology and Water - availability : The annual average rainfall in the area can be taken at 1200 mm with fluctuations between 700 and 1900 mm. The distribution of rainfall over different parts of the year can be taken as below:

a	Months	Jan.-Feb.	March-May	June-Sept.	Oct-Dec
b	Designated Season	Winter	Summer	SW Monsoon	NE Monsoon
c	Mean Rainfall, mm	10	45	400	750
d	Range of Rainfall, mm	0-20	0-130	250-650	300-1250
e	Evaporation std. pan, mm	240	500	700	300

Leaving out the nominal showers during winter and summer seasons a mean 1150 mm , with a range from 650 to 1850 mm could be taken as the water resource of the region. This would work out to 1.15 million m³ per sq km land area with a range between 0.65 and 1.85 million m³ per sq km. There is currently no stream or other surface - water source which could be tapped. However there is a reasonable shallow confined aquifer of 15-70 m thickness in the top 100m layer and also a deeper and thicker aquifer below the dominant clay layer in the 200m -350m below surface region. The aquifers, particularly the upper one, are being currently extensively exploited, even over exploited leading to apprehensions of sea water intrusion and rising salinities. There seems to be enough scope and potential for resolving such problems by appropriate rain - water - harvesting, ground - water recharge and sound water management.

1.5 Auroville Philosophy and Water Management : Auroville is to be no routine urban settlement ; it is conceived to set an example of eco-friendly living in peace and harmony with mother nature. As the revered mother charted on the Auroville. Foundation Day, "to live in auroville one must be willing to be the survivor of Divine Consciousness". Also, "Auroville will be a site of material and spiritual researches". Translated into the field of water management, these mandates could include;

- i) Utmost use of rain water harvesting water conservation, water recycling and such other practices that shall ensure minimum impact on the natural water quality and quantity regimes in the area and shall particularly not affect in any adverse manner the use, quality and availability of water to neighboring

and adjacent communities. In fact it should enrich the regional water resources.

- ii) Minimum use of fossil fuel based or conventional energy sources, for lifting and / or conveyance of water.
- iii) Shall significantly help up - grade the over all environmental and aesthetic quality of the region in general and Auroville in particular.
- iv) Shall provide enough scope for variations and diversity, enabling research and development on management practices and allowing freedom for individual and group action in a free democratic environment rather than a monolithic management pyramid.

2- Management of Domestic and Urban Water Use

2.1- De-Centralised Approach for Water Supply : With significant stress on freedom and commitment with concern, creativity and initiative of the human individuals in philosophy, Auroville developed as a set of micro to tiny settlements. Currently there are some 80 settlements of varying sizes accommodating a total of about 1500 Aurovillians from 31 nations. Each of the settlement has its own water supply based essentially on a "bore-well" operated mostly by wind / solar energy or by grid-electricity as per need. The advantage of such de-centralised system of water - supply has been

- (a) self reliance of the habitation for its water supply
- (b) simple management with primary responsibility assumed by the community itself
- (c) avoid long distance conveyance and pumping of water
- (d) with smaller units, alternate renewable energy becomes practical which may not be the case with centralised water supply systems. The only problem encountered is in terms of assuring the potability or quality of the

water on tap. Even this has been no more serious than similar problems in a centralised system. With the recently started "Water Group" taking responsibility for regular water quality monitoring and rendering needed advice, this problem has further declined. This author strongly favors continuation of such decentralised approach for domestic and urban water supply, where each zone, sector or habitation shall have its own independent water supply for which the user group shall own total responsibility for operation and maintenance with only water quality monitoring facilities and technical guidance being available from the Central "Water Group" of the Auroville Development Council.

2.2 - Decentralised Approach for Wastewater Collection, Treatment and Disposal

As for the case of water supply, arrangements for waste water collection, treatment and disposal have also been on a decentralised basis. Each of the habitations (or in some cases 2 or 3 adjacent habitations together) have a local sewerage system leading to a small treatment facility comprising one or more unit processes like septic tank, Imhoff tank, Baffled anaerobic reactor, Planted filter / Root zone treatment, Hyacinth pond, Stabilisation pond etc. The treated effluent is recycled for irrigation or for ground water recharge or disposed to natural drainages. While there have been problems in respect to adequacy or field performance of the treatment provided leading to nuisance and apprehension of water contamination and health risks, these have been found to be local and often infrequent and minor. Such problems are even more frequent and serious with large centralised systems. The basic advantages of variability as per needs, avoidance of long distance transport and decentralisation of responsibility for maintenance and operation stay as in case for water supply. This decentralised approach

domestic water use or 50-70% of the water used for all other purposes. Thus if one could use the waste-water from other domestic uses (essentially bathing and washing), after necessary clarification, for flushing toilets, the consumption of fresh water in a house-hold could be brought down by 30 - 40%. This is recommended to be adopted as a practice in Auroville to the largest extent possible. The first such system has been planned for Sangaman.

2.5 - Domestic Water Demands and Source Apportioning : Theoretically there should be very little difference between average water consumptions of different households in a universal township, Auroville. Practically however, the water demand shall vary somewhat with size of dwelling, size of family and life-style etc. A few typical variations are considered in table - 1. The A-grade water uses are to include drinking, culinary, bathing and all washing (utensils, crockery, clothes, even floors) but no flushing, watering or irrigation.

Due to a variation in the size of house and number of stories in the building the quantity of the harvested rain water per household would vary between 27 and 110 m³ per year per house-hold. Almost all of this would be in the June - Dec. monsoon period. The water demand shall depend on the number of persons living in the house and the per capita water consumption. It is estimated to be 55 to 125 m³ per house as detailed in (ix) (b) of table-1 for the June - Dec monsoon months. Thus except for the rather large sized, 1-2 storeyed individual houses the roof top harvested rain water shall not suffice even to meet the monsoon period demand and shall need to be supplemented by bore well water. The fraction of annual water

demand met from harvested roof top water shall vary from 60% for large individual houses to 40% for 3 storeyed flats, to 30% for multistoried flats, to a mere 25% for Janta housing (due to larger families per house- hold).

It needs to be noted here that the roof tops are to be no more than 25-30% of the total land area in a habitation or unit. Another 25% land area shall be occupied by other paved utilities like roads community buildings, game-courts etc. and remain 45 - 50% by unpaved facilities. Thus there shall be 4 options for harvesting and re-using harvested rain water.

- (A) Harvesting roof-top water separately storing it in clean pucca covered tanks and using it for A grade uses with minimal treatment supplemented by bore well water. Rain water harvesting from paved and unpaved areas (other than roof top) to be stored in unlined open ponds and reused for irrigation and / or ground water recharge.
- (B) Harvested roof-top water to be stored and used as above but supplemented by appropriately treated harvested rain water from the open ponds which may be lined.
- (C) All harvested rain water collected only in lined open ponds, part of which be used for domestic supplies after appropriate treatment.
- (D) All harvested rain water collected in open unlined ponds and used only for ground water recharge and / or irrigation. Domestic water supply to totally depend on bore-wells.

Options C and D do not need any covered storage while options B and C do not need any bore well support but do need water treatment facilities. Option D may look cheapest and simplest but may require much more pumping energy. It may be best to have a mix of the four options as demanded by site conditions and economics.

2.6 - Over-all Indicative Guidelines : The following general plan of action is suggested for the different categories of residential as well as other building and the un-built areas of the main urban complex.

Category I : Individual houses-habitations of upto 20 dwelling units, community buildings of over 100 sq m² roof area (including all educational, cultural, administration buildings, hospitals, hotels, dormitories, commercial and industrial buildings)

(a) Roof top rain water : harvested, stored in lined covered tanks of capacity 0.2 0.3 m³/m² roof area and reused for A grade use with minimal treatment.

(b) Flushing, irrigation and inferior industrial / commercial uses : only treated sewage to be used.

(c) Bore well support : When needed, operated on wind / solar energy.

(d) Plumbing : Dual lines, one for treated sewage for flushing, and the other for harvested roof-top / bore well water for other uses.

Category II : 2/3 Storeyed habitations of upto 20 - 50 dwelling units.

- (a) Roof top rain water : As for category I
- (b) Run off from all other areas within the habitation : harvested and stored in lined but open tanks used after appropriate treatment for A grade uses and untreated for others,
- (c) Flushing and inferior uses : As for category I,
- (d) No borewell support provided,
- (e) Plumbing as for category I,

Category III - Habitations of over 50 (upto 500) d / wellings

- (a) All run off (roof top as well as other area) harvested, stored in unlined open ponds and used after necessary treatment.
- (b) As for Category I,
- (c), (d) and (e) as for Category II.

3- Management of Green Belt Water Use

3.1 - As indicated under Section 2, all irrigation of lawns, parks, fruit-or-chards kitchen- gardens, road-side plantations etc falling in the urban zones shall be essentially done with treated sewage and waste waters and in case of shortage with harvested rain water stored in open tank / ponds. It is

suggested that no borewell supply be provided for such use. Once provided it is always likely to be mis / used.

3.2 - The 50% of the Green Belt land covered with "woods" is expected neither to need irrigation nor to need special facilities to collect surpluses run off and its subsequent recharge to ground water.

3.3 - The 50 % Green Belt land under farming shall need irrigation during fair weather (Jan- May) and shall generate surplus run off during the monsoons (June - Dec). With estimated evapo transpiration being 1600 mm and annual precipitation ranging from 700 to 1600 mm there may be little over-all shortfall but in years of low rain fall considerable supplementation from ground water shall be needed. However it is expected that such extraction from ground - water shall be more than balanced by the ground water recharge from the wooded area particularly during the high rain fall years.

3.4 - Over all the green belt is expected to be self sufficient and even a bit surplus in water.

4 - Management of Water in Core Zone & the Girdling Lake :

4.1 - With the Matri Mandir its appurtenant buildings, parks, lawns, gardens and the girdling lake the core zone shall be the heart area of Auroville. We shall take the total core zone to be a circle of 600 m diameter or 282,600 sq m area comprising of 196,000sq m core along with a 100m wide 86,600sq m surface area lake girdling around it.

4.2 - The lake may be of 8m maximum and 5 m average depth giving effective water volume of 433,000 m³ (it may noted that we are taking a smaller, narrower and shallower lake than taken by Ingenieurbuero Kraft in section 3.8 of their draft. We plan to provide the lake only as aesthetic / environmental feature and not as a ground water recharge facility since pumping power costs make such use highly uneconomical).

4.3 - Considering 50,000 m² of the core area to be built up or paved 50,000 m² to be lawns or flower beds needing irrigation in dry periods and the remaining 96,000 to be tree - groves and woods, the run off available from core area will be

Built up / paved area	50,000x1.0x0.8	= 40,000 m ³
Parks / lawns etc	50,000x1.0x0.1	= 5,000 m ³
Tree graves / woods	96,000x1.0x0.1	= 9,600 m ³
		<u>Total = 54,600 m³</u>

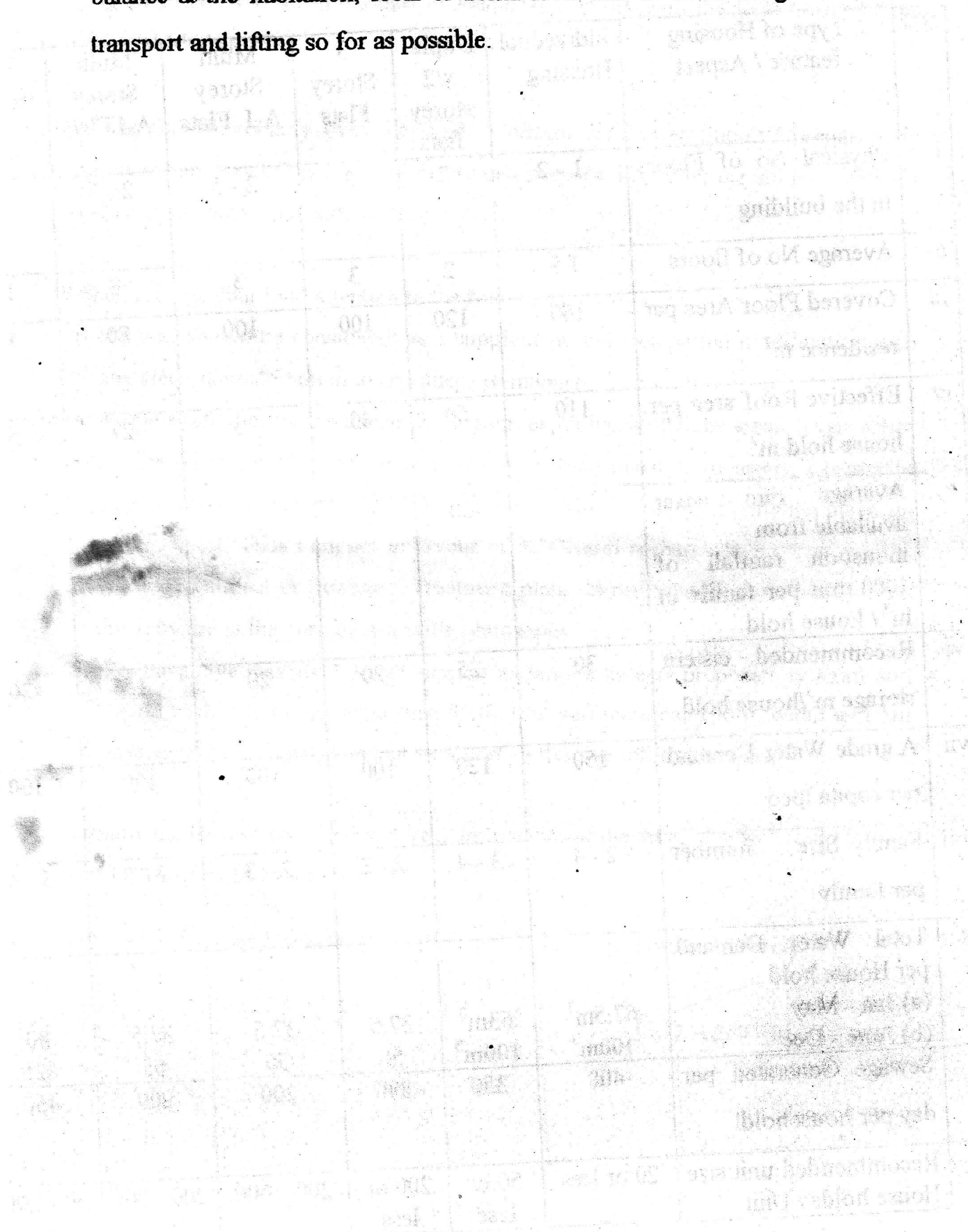
Losses from the lake in an average year will be

Percolation from Sealed bed / Sides	= 7,000 m ³
Excess evaporation above rainfall	= 34,600 m ³
<u>Total</u>	<u>= 43,600 m³</u>

Thus in an average or better than average rainfall year the run off from the core area shall be adequate to maintain the level in the lake. In years with rainfall below normal the water shall need to be made up from bore-wells, (or from rain harvesting ponds in other zones) through pumping.

4.4 - Though not large, there shall also be some water demands in the core area including that for irrigation of parks lawns etc. It is proposed to obtain all these from the rain water harvesting ponds of the cultural zone where considerable surpluses are expected to be available.

5 - The crux and basic thrust of the proposed approach is to strike an ecological balance at the habitation, local or zonal level and to avoid long distance transport and lifting so for as possible.



The table is a large grid with approximately 10 columns and 20 rows. The text within the cells is extremely faint and illegible, appearing to be a mix of numbers and words. The grid lines are visible, but the content is mostly lost to noise and low contrast. There are some darker smudges on the left side of the page, possibly from a stamp or ink bleed-through.