Rainwater Harvesting Principally by Collect-Filter-Store-Use for Sustainability in RBD

1. Introduction

'Rainwater harvesting (RWH) principally by collect-filter-store-use' (RWH CFSU) is presented here based on a reading of the BWSSB guidelines, RBD 416 resident's experience with RWH, followed by a brief study and analysis of the data.

RWH CFSU is juxtaposed with the current RBDPOA's mandatory requirement for RWH, ground water recharge well (GWR). A brief comparison of RWH requirements in RBDPOA and BWSSB provides the context for this note. This is substantiated by how historically, storage and use of rain water has been more predominant while ground water recharge has recently been put into practice only as a result of unplanned urbanization. RWH at #416 is used as an illustration to demonstrate the potential savings in RBD's ground water per dwelling unit, through significant reliance on rainwater for domestic potable use while adequately supplemented by STP treated water for garden use. Pros and cons of CFSU and GWR are subsequently summarized before recommendations emerging from this analysis are finally listed.

2. Requirements of RBDPOA RWH and BWSSB RWH

As per RBDPOA requirement (2013, Attachment 1), RWH was mandated because of BWSSB requirement. However BWSSB gazette notification of 2011 (Attachment 2) permits a choice between building a storage for use of rain water and digging a recharge well.

Further, RBDPOA mandates RWH because RBD depends exclusively on the ground water. Therefore in keeping with its current motto of 'reduce, reuse and recharge' and in order to first 'reduce' the dependence on the finite and limited ground water resources, this note suggests the storage and use of the immediate rainwater that is abundant in RBD as the primary means towards sustainability, only followed by recharge.

3. Background, History of Rain-Water Harvesting

For over a millennia, humans have collected and stored water for their principal needs:

1. Around the world where rivers were not in proximity, natural ponds and lakes that collect rain water have been the source of water for drinking and agriculture.
2. More recently man-made reservoirs with simple excavations or more complex dams have been built to imitate the natural reservoirs.
3. In the Jaigarh fort (1726 AD) Rajasthan where the resident toured recently, rain water from nearby hills are brought in through system of concrete canals into a system of 3 tanks, the biggest having a capacity of ~23,000 KL. This provided water for thousands of soldiers during many months for regular use and potential siege. The tank and concrete drains are in pristine condition and continue to provide for water in the arid region.
4. Even current government efforts are towards reviving village tanks for uninterrupted farming during drought years. (In 2008 the resident was fortunate to team up with NGO's and pooled-in with 20 other alumni from IIT-M and collected over 30 lakhs to protect several village tanks in Andhra and Tamil Nadu that are in the rain-shadow region and hence frequently suffer from short fall of water. E.g., Vilathikulam 'oorani'., Tamil Nadu. Today they are much secure.)

5. Bangalore's own 'lakes' which date back to 1,000 years were man-made and were developed for harvesting rain water by collecting storing and using primarily.
6. However current urban settlements do not have large tracts of land nor do they have clean water lakes. Therefore, Ground water recharging became prominent only in the recent era of extensive urbanization (e.g., Chennai in 1990's) that excessively drew on the ground water resources without replenishing them commensurately. Rain water was allowed to run off into public storm water drains and into the ocean eventually, thus wasting an invaluable resource without giving back to the ground that urban man was drawing from. Moreover, houses were constructed in plots without allowing enough space for sizeable collection of terrace rain water for storage & use, or a proper filtration system to replenish their open-wells / bore-wells. Thus the un-recharged and dwindling ground water table led to the various regulatory guidelines on water harvesting.
7. As recently as this week Dr. Ramachandra, IISC professor for ecological sciences has published a technical note for the benefit of citizens how Bangalore can be self-sufficient with its annual rainfall through suitable collection storage and use of the rain-water, and treated STP water.
8. Alternatives such as bringing Cauvery water to Sarjapur road can be estimated to cost a minimum of Rs. 120 Cr. (assume 4,000 m to the nearest artery X Rs. 300,000 / metre of pipeline as per BWSSB guidelines, Times of India). If this cost is shared by ~20,000 residential units on Sarjapur road, each unit on Sarjapur Road will need to contribute Rs. 60,000 as a minimum. It may take 4-5 years to agree amongst all the residents, by which time the cost is likely to escalate 2x to 3x. It may be 5-10 years before RBD can get Cauvery water if all residents converge and commence on the idea today.

4. Sizing Rainwater Tank

1) Assumed demand per dwelling unit for potable water = 15 KL per month; & for garden use = 6 – 9 KL / month from STP treated water
2) Input data of historical rainfall in Bangalore:
   a. Average annual rainfall = 860 mm
   b. Months/Year of rainfall = 6
   c. Therefore, average monthly rainfall = 143 mm
   d. Maximum 24 hour rainfall = 150 mm
3) Simplified (first-order) Sizing Calculation:
   e. Rainwater tank should be capable of holding the average monthly rainfall of 143 mm
   f. Assuming ~1100 sq.ft. or ~100 sq.m. of terrace rainwater catchment area, required volume of tank = 0.143 * 100 = 14.3 KL
   g. However, tank should also have capacity to hold a maximum 24 hour rainfall of 150 mm = 15.0 KL
   h. Taking Max(f,g), required volume for a 100 sq.m. terrace = 15 KL
   i. Probability of a 24 hour maximum rainfall in the same month is not more than ~50%
   j. Therefore expected heavy rainfall within the same month = 0.50 * 150 = 75 mm (i.e., Volume of 7.5 KL)
   k. Room for this additional 7.5 KL (the same month) needs to be made in the rain water tank for the expected 2nd heavy rain. This is accomplished by transferring water from the

rainwater tank soon after the rains into the following sump / tanks with the help of standard automatic level controlled pumps.

l. In order to address k. above, typically a dwelling unit has already one main sump for holding RBD ground water (bore-well water) and 2 nos. of overhead tanks. The cumulative capacity of all these tanks should be capable of holding a minimum of 7.5 KL from k. above.

m. Breakdown of these tank capacities is up to individual preference based on domestic practices, for example capacity of the main sump could be = 5 KL; Capacity of the main overhead tank = 2 KL; and capacity of the 2nd overhead tank = 1 KL (Sum of all three = 8 KL > 7.5 KL, therefore ok.)

n. The above (15 KL rainwater tank + 7.5 KL of remaining tanks) sizing can handle and provide 86 KL of water per annum per dwelling unit collecting rainwater from 100 sq.m. of terrace area.

o. In this sizing illustration, suppose the available terrace area for harvesting rain water is doubled, 200 sq.m. and provided there is sufficient ground space, then the capacity of the rainwater sump can also be doubled (to 30 KL capacity, with remaining tanks of 15 KL cumulative capacity) to further reduce dependence on RBD ground water.

p. Therefore with terrace area doubled (200 sq.m.), the above capacity (30 KL + 15 KL) can handle and provide 172 KL of rainwater per annum per dwelling unit.

5. Operational and Maintenance Requirements

During rainy months, filtered rainwater that is collected in the storage tank needs to be immediately transferred to the main sump and overhead tanks for immediate use and proper capacity utilization. However in the non-rainy months they need to be used prudently as and when the RBD ground water is unavailable. The 6 summer months should be used in cleaning the tanks. Terrace and filters should be kept clean periodically. Animal poops in terraces must be precluded. Bursting fire-crackers in the terrace must be avoided unless safe cleaning can be accomplished. Periodic testing of water is recommended.

6. Data on Rainwater Harvesting system (CFSU) at RBD #416 for Year 2015-2016

- Roof area collecting rainwater = ~1100 sft. (~100 sq.m.)
- Rainwater filters ('Raintap') = 2 nos.
- Rainwater storage sump capacity = ~28 KL (Dimensions 20' x 10' x 5') (BWSSB requirement for storage capacity of storage tank (for #416) = 6 KL)
- Range of capacity utilization 2015-2016 = 10% to 100% (Mean / Median = ~50%; Variance = 20%)
- Overflow pipe from rainwater tank leading out to RBD community borewell is blinded (terminated currently)
- Main water sump storage capacity (for RBD bore-well water) = 9 KL; Overhead tank #1 = 3 KL; Overhead tank #2 = 2 KL; Total = 9+3+2 = 14 KL
- Drinking water filter = Aqua guard R.O. filter

- <u>Numbers below are best estimates based on regular flow, level readings, observations and calculations:</u>
- Rainfall from October 2015 to September 2016 = ~1,000 mm
- Harvested rain water in above period = ~100 KL
- RBD water used = ~40 KL
- Tanker water used in 2015-2016 = NIL
- STP treated water for garden = ~120 KL
- 50% - 70% lesser draw by #416 on RBD ground water as a result of CFSU of RWH system (This is a conservative estimate partly for margin of error and the fact 416 used the rainwater only for toilets in the first few months resulting lower consumption. This is also the reason a large positive variance of tank capacity utilization over the mean was observed)

- <u>Planned expansion for 2016-2017</u>: To add 1000 sft. collection from pitch-roof to achieve capacity collection of ~172 KL per annum (based on expected average rainfall of 860mm), and towards 100% self-sufficiency and 0% draw from RBD bore-well ground water.

7. Advantages and Disadvantages of RW CFSU versus sole Ground Water Recharging

Criteria	RW Collect, Filter, Store, Use (CFSU)	Ground Water Recharge (GWR)
Rules	• BWSSB (2011 Gazette notification) permits both CFSU and GWR as equally permissible methods of RWH. • BWSSB specifies min. size of storage tanks. (20 lts/sq.m. terraced roof area & 10 lts/sq.m. of paved area)	RBD mandates recharge compulsorily (assuming BWSSB also does), and CFSU optionally.
Water Availability	CFSU provides for water almost immediately after the rains.	GWR provides for water (by recharging the aquifers) only after a year or so.
Water Loss	The losses are negligible, and all of the water received on the roof top can be used.	The losses are significantly higher. Also the GWR water may or may not recharge the aquifers that RBD is drawing water from, for its daily needs.
Energy Needs	Minimum energy (gravity) and time is required for collecting water in sump.	Water needs to be pumped up with more electric power (3 HP running 24 hours) from ~200' – 1000' underground.
Technical - Sizing & Costs Requirements	• Rain water tank needs to be substantially sized (12' X 8' X 6') to realise sustainable benefits. • Higher capital cost - a 15 KL tank will cost Rs. 150,000. • The excess / overflow will need to be let out through pipes into the closest GWH pit (only 2-3 times a year). • For a Rs. 50 Lakh to Rs. 100 Lakh house in RBD, this works out to 3% to 1.5% of total cost.	• Can be easily incorporated – lower capital cost – Rs. 30,000. • GWR can complement CFSU by taking in the excess water that overflows from the rain water tanks. But this will now be needed infrequently (2 times a year) if the rain water tanks are sized substantially (15 KL to 30 KL). • The common GWR on RBD roads should be able to accommodate this infrequent overflow. • For a Rs. 50 Lakh to Rs. 100 Lakh house in RBD, this works out to 0.3 % to 0.6 % of total cost.
Meeting RBD's Growing Water Needs	• A 15 KL rain water CFSU tank can provide drinking water for up to 30 days continuously to a dwelling unit of 4 pax. • This can potentially conserve 50% water from RBD ground water per dwelling unit assuming Bangalore receives the 860mm rainfall evenly over 6 months.	Rs. 30,000 is equivalent to a 3 KL rain-water tank that can sufficiently provide water to a household (4 pax) for only 6 days a month for 6 months (translates to 10% conservation)
Meeting RBD's Growing Water Needs	E.g., #416 has been able to manage for at least 9 months in a year with only CFSU rain water of ~100 KL per year.	Had #416 incorporated only GWR, this would have resulted in an extra draw of ~100 KL of ground water per year.

Meeting RBD's Growing Water Needs	If CFSU is encouraged in RBD it is possible to influence a positive outcome from the remaining ~100 potential constructions, and thereby reduce drawdown of ground water of ~1500 KL per month (assuming RBD will be all built-out in ~10 years) and a ~30% saving of ground water per annum.	• Allowing only GWR through the current bye-law translates to ~30% more demand on the RBD ground water in over the next 10 years to come. • Also ground water table and yield in RBD have been reducing over the last 2 years exacerbating the situation.
Meeting RBD's Growing Water Needs	Move towards CFSU will encourage already constructed dwelling units (many with 1KL to 5 KL) to creatively incorporate CFSU to the max possible extent. (e.g., collect rain water from terrace run-offs and pump it back up to the terrace to store in dedicated Sintex tanks, say 5 X 3KL tank capacities)	This could reduce the potential future drawdowns by as much as 50% if not more depending on the number of dwelling units that will increase the rainwater storage capacities.
Economics	• NPV of a substantially sized tank (providing water for 9 months for unit of 4 pax) is negative at a hurdle rate of 8% assuming we have inexhaustible ground water. • NPV will become positive after ~3n years assuming we are forced to switch exclusively to tanker water (of 5KL costing Rs. 600) n years after exhausting RBD ground water sources.	
Maintenance Requirements	Terrace and filters need to be kept clean of leaves before and after rains. Periodic water testing (e-coli) is prudent in both methods.	The pit may need periodic cleaning of Silt deposition once in few years.
Miscellaneous	No need for water softener. Minimised maintenance costs on RO filters	Higher salts in ground water are useful in supplementing the more pure rain water for drinking purposes.

8. Summary

The dictionary meaning for 'Harvest' is 'catch' or 'gather', therefore in rain water harvesting first and foremost effort should be using the time-tested hoary method of gathering and maximising the collection and storage of the rain water. Average rainfall per annum in Bangalore is 860mm with an annual growth of 16 mm for the last 16 years.

Substantial collection, filtering, storage and use (CFSU) of rain water as the primary method for RWH at RBD can reduce the dependence by a dwelling unit on RBD ground water by 50% - 90% (or 86 KL to 172 KL per annum). Considering there are potentially ~100 constructions remaining in RBD, drawdown of ground water up to ~1500 KL per month (assuming RBD will be all built-out in ~10 years) and a ~30% saving of ground water per annum can be achieved through new constructions alone. If existing residences also adopt this partially (5KL to 10 KL storage) then over 50% ground water can be conserved.

While the STP treated water may have succeeded in considerable reuse of waste water, the proposed RWH through CFSU is believed to significantly augment the RW harvesting program through utilizing the rain water first and then recharging the ground with excess, for addressing sustainability at RBD for the next 10 years when demand on ground water will otherwise increase by 30%. Although from a purely economic perspective RWH CFSU offers little return on the investment it is imperative to balance modern economics with practical and sustainable living.

9. Recommendations

1. To realise immediate and substantial benefits through RWH for individual dwelling units as well as for RBD's sustainable drawing of ground water, CFSU should be adopted by priority.
2. In view of BWSSB's own mandatory guidelines that RBDPOA defers to and further substantiated by data, CFSU and GWR must be equally mandated and permissible to a resident constructing a new house. Moreover, where the resident has a minimum stipulated capacity (say 15 KL as per this brief study), GWR within the dwelling unit must be waived as the overflow can be supported by community GWR.
3. A minimum storage tank capacity must be recommended so that frequency of overflow is balanced against size (cost) of tank while maximising the use of abundant rainwater in Bangalore. For instance using above environmental data, and a house terrace catchment area of 100 sq.m., design capacity of the rainwater tank (CFSU) should be 15 KL in order to fetch annual volume of 86 KL. The volume of overflow will be <~10% - The community GWR wells are believed to be sized to handle this marginal overflow.
4. For existing residential units CFSU should be encouraged as 'the right thing to do' for sustainable living at RBD.
5. Finally the motto of 'reduce, reuse and recharge' in RBDPOA's requirements which is synonymous with 'reduce, reuse and recycle' is applicable when referring to waste such as plastic. For instance in RBD it may be applicable with SWM (garbage) and with STP water. However In the context of rain water harvesting which is a precious life-giving resource, a more appropriate motto may be 'Save the rain, don't let it go down the drain'.

6. Attachment 1 – RBDPOA RWH Requirement Notice

Memo from the Managing Committee

Water Security and Rain Water Harvesting (RWH)

Dear Residents,

As you are aware, RBD like all other communities is facing water scarcity. We have taken several steps to mitigate the scarcity and ensure our water security. Towards this, we have constituted a separate water sub-committee which is working on implementing our motto of 'Reduce, Reuse and Recharge"

As part of recharge strategies, we have been requesting our residents to implement RWH at each of our residences. Please note that this is also mandatory bye-law now. Based on the recent survey in Apartment Adda, we do have significant number of households which are yet to implement RWH.

We request the residents who have not yet installed RWH, to ensure they complete it on or before 15th June 2013, i.e. before the onset of monsoon. This will ensure deriving maximum benefit of the investments you will have to make.

Also, please note that recharge is one of the main pillars of water security and your non-compliance affects other residents as well. **The committee also proposes fees / penalties for the residents who do not implement the scheme (by June 15th, 2013) by applying the water rate of Rs 120 per KL for ALL bore well water consumed by such residents. The slab rate will be Rs 120 / KL from the first 1 KL consumed. (Note: Rs 120 is roughly the tanker rate per KL)**

As the RWH is mandatory by law, the incentive provided by the MC for the existing residents who have installed the RWH systems, stands withdrawn from 15th June 2013.

RBDPOA will inspect all the declared RWH systems and certify that they comply with the requirements. All new installations have to be certified by the association before the work is completed by the contractor. Please note that the certification is for RBD POA purpose only.

We have also enclosed a FAQ on RWH for your ready reference.

- Why should I implement the RWH / What are the benefits of RWH
    - The primary reason for us to implement RWH at every house is to, not let even a single drop of water flow out of RBD. This was reiterated by the water experts that the Water SC talked to.
    - It is mandatory by law (all existing houses beyond 2400 sq. ft. of plot area and new houses on 1200+ sq. ft. plot area)

  - It ensures that the ground water is recharged (and in turn enhances the yield of our bore wells, our sole source of water)
  - Reduces the flooding on the roads
  - Reduced cost of water for day to day usage
  - Least capital investment with maximum benefits to households
  - Reduce soil erosion resulting from the unchecked runoff

- Is it mandatory for me to implement RWH
  - Yes, mandatory by law (please refer to the ACT here-http://bwssb.org/pdf/RWHACT.PDF and the notification here-http://bwssb.org/pdf/Compulsory.PDF)
  - It is also mandatory in RBD as we depend on ground water for our water needs
  - Even though some of the plots do not come under BBMP, we need all resident's cooperation in getting RWH implemented.

- What are the implications of non-adherence / non-compliance
  - Community is unable to take benefit of the available water
  - Continued water scarcity in RBD.
  - Increased dependence on water from outside, which will become costlier by the day (and may not be available when required)
  - Continued water clogging at the gate during rainy season

- What are the different methods of RWH
  - Rainwater Harvesting
    - Rainwater stored for direct use in tanks above ground or underground sumps or overhead tanks and used directly for flushing, gardening, washing etc. This is optional requirement for residents. But we highly encourage residents to reuse the rain water.
  - Ground water recharge
    - Recharged to ground through recharge pits, dug wells, bore wells, soak pits, recharge trenches, etc. This is a mandatory requirement for residents.

    For guidelines for implementing RWH, please refer here-http://bwssb.org/pdf/Guidlines.pdf

- What should be the size of the recharge well (in case of recharge Pits method)
  - The width and depth of the recharge pit/well depends on the catchment area / roof top area
  - **The recommendation from experts is 3 feet (ring) diameter and 25 feet depth. RBD POA recommends this size (3 feet by 25 feet) for all residents.**
  - The guidelines for the requirements are given in this guidelines document - http://bwssb.org/pdf/Guidlines.pdf from BWSSB.

- Why 25 feet depth?

  - The wells of these depths are found to recharge water fast. If the recharge is effective and if aquifer characteristics permit, 25 feet deep recharge wells can become WITHDRAWL wells also. This is not possible if well depth is less.
  - The well need to go down that deep to really replenish the shallow aquifer. 90% of the water that percolates in the first 6 to 15 feet of topsoil is evaporated, so not much recharge happens when using pits.

- What if I had already implemented RWH with the depth of less than 25 feet (say 8/10/15 or 20 feet)
  - The rain water recharge well has to comply with the RBD POA recommendation of 25 feet depth. The depth has to be 25 feet to have effective recharging. Residents with existing recharge well need to comply with the 25 feet depth requirement, to avoid the penalty.
  - Since digging additional feet with 3 feet diameter is not possible (possibility of mud slide, ring collapse), Peddanna/Muniappa will put 2 feet ring for the additional feet.
  - We are currently making our common recharge well go deeper by additional 10 feet. So, extending the depth is feasible without taking out the well rings and redoing the well.

- Is Water SC planning to do recharge wells at common areas of RBD?
  - Yes. We have plans to add additional recharge wells in the common areas of RBD. These common recharge wells will help us to recharge waters flowing in the rain water drainage.
  - As mentioned earlier, the work is going on to clean up the current common recharge wells, make them deeper by additional 10 feet. This will help us to recharge more water effectively.

- Where can I get more details on RWH
  - Karnataka State Council for Science and Technology is the nodal agency for devising various methods of RWH. You can get all the relevant information from their portal here - http://www.kscst.org.in/rwh_files/rwh_basics.html

- Will the subcommittee help me in implementing this
  - Mr. Peddanna (9742423145) or Mr. Muniappa (9448570684) and can help residents with the recharge well. Muniappa and Peddanna will not do plumbing related work.
  - Biome Environmental Solutions Private Limited (www.biome-solutions.com): Call 98451-84281 or email shubha@biome-solutions.com. They can come and suggest ways to implement RWH. Please call them to verify the charges. They can also work with Mr. Muniappa/Peddanna to get the RWH implemented. Biome has done RWH for varied sizes of houses/plots. If you have questions about doing RWH for smaller plots, they can guide you.
  - You can also find the BWSSB approved list of contractors here
  - You can email the water subcommittee members for any help: Srinivasan (peraisrini@yahoo.com), Bharathi (bharati3m@gmail.com) or Sashi (an_shashi@hotmail.com).

- What is the cost of RWH implementation
    - The cost of digging recharge well of 3 feet ring diameter by 25 feet depth is Rs 25,000. We have negotiated this price with Mr. Muniappa and Mr. Peddanna. This price include digging, putting 3 feet diameter ring, gravel around the ring, concrete cover for the well, disposing the mud/sand, transportation and labor.
    - If you are extending your current recharge well to 25 feet depth (say from 15 feet depth to 25 feet depth), then you have to pay Rs 1200 per feet. This is the per-feet negotiated price with Peddanna or Muniappa. Ex: if you need to go 10 feet deeper, you will have to pay Rs 12,000. The ring size used for this additional depth will be 2 feet.
    - Plumbing related expense depends on your plot. The rough estimate for plumbing materials is around Rs 140 to Rs 150 per running feet and the labor cost will be around Rs 6000. The actual price will vary depending on your plot. This is ONLY a rough estimate.

- What if my plot size is 30x40 (or 40x30) and doesn't have space for RWH?
    - MC will inspect your site to verify whether you *really* have no space for RWH. If MC agrees that there is no space, then you must pay RBD-POA Rs 30,000 which will be used to provide recharge well in common areas. If MC concludes (if needed, will consult experts) that you have space for RWH, then you will be requested to comply with this notification.

- What if I am financially strained because of school fees or other emergencies?
    - RBD POA will pay Mr. Peddanna or Mr. Muniappa Rs 25,000 (on your behalf) to do the recharge well for your house and you must give four post dated checks (each check with amount Rs. 6812) to RBD POA. The post dated checks (PDC), to RBD POA, will be for the months June, July, Aug and Sep 2013. It is resident's responsibility to work with Peddanna/Muniappa to identify the location in your site for recharge well and make sure the recharge well is done to comply with this notification.
    - It is resident's responsibility to make sure the plumbing is also done to connect your roof top rain water to the well. This work should also be done by June 15, 2013 to avoid additional water charge. Residents are requested to own the financial responsibility for plumbing, since it's a minor component of overall RWH.

- I am a tenant and my owner is not interested in implementing this
    - The Management committee will write to the owners of the residence separately urging them to implement the RWH
    - However, it is in the interest of the tenant - based on agreement / arrangement with the owner, the tenants – to install the RWH systems and recover the cost from the owner.
    - Non installation will attract substantial additional water charges as stated in the main letter

- I am planning to build a new House in RBD. How do I go about installing RWH

- All new houses should have adequate provisions for RWH from the construction stage.
- The plans to be approved by POA should clearly indicate the RWH implementation
- **The final water connection to any new dwelling will be done only after the RWH implementation certificate has been issued by the POA**

- More Info on RWH
  - Storage: http://www.youtube.com/watch?v=Ir1PW1zywPs
  - Filter: http://www.youtube.com/watch?v=yCAbpEz7GQI
  - Recharge: http://www.youtube.com/watch?v=zFcSA6qX4T0
  - Growing Rice on the roof: http://www.youtube.com/watch?v=xeE-BzCr8Gs
  - http://www.rainwaterharvesting.org/index_files/FAQ.htm
  - http://www.hindu.com/pp/2007/06/02/stories/2007060252080500.htm
  - http://www.hindu.com/pp/2007/06/09/stories/2007060952330200.htm

7. Attachment 2 – BWSSB Gazatte Notification

RWH MANDATORY - Amendment to BWSSB ACT with latest amendments

KA/DG-GPO/2515/2009-10/2009-2011

ಕರ್ನಾಟಕ ರಾಜ್ಯಪತ್ರ

ಅಧಿಕೃತವಾಗಿ ಪ್ರಕಟಿಸಲಾದುದು

ವಿಶೇಷ ಪತ್ರಿಕೆ

ಭಾಗ – IV-A	ಬೆಂಗಳೂರು, ಗುರುವಾರ, ಆಗಸ್ಟ್ 27, 2009 (ಶ್ರಾವಣ 5, ಶಕ ವರ್ಷ 1931)	ಸಂ. 2&3

ಸಂಸದೀಯ ವ್ಯವಹಾರಗಳು ಮತ್ತು ಶಾಸನ ರಚನೆ ಇಲಾಖೆ

ಅಧಿಸೂಚನೆ

ಸಂಖ್ಯೆ: ಸಂವ್ಯಶಾಇ 6 ಶಾಸನ 2009, ಬೆಂಗಳೂರು, ದಿನಾಂಕ: 27ನೇ ಆಗಸ್ಟ್, 2009

The Bangalore Water Supply and Sewerage (Amendment) Bill, 2009ಕ್ಕೆ, 2009ರ ಆಗಸ್ಟ್ ತಿಂಗಳ 25ನೇ ದಿನಾಂಕದಂದು ರಾಜ್ಯಪಾಲರ ಒಪ್ಪಿಗೆ ದೊರೆತಿದ್ದು, ಸಾರ್ವಜನಿಕ ತಿಳುವಳಿಕೆಗಾಗಿ ಇದನ್ನು 2009ರ ಕರ್ನಾಟಕ ಅಧಿನಿಯಮ ಸಂಖ್ಯೆ: 19 ಎಂದುದಾಗಿ ಕರ್ನಾಟಕ ರಾಜ್ಯ ಪತ್ರದಲ್ಲಿ ಪ್ರಕಟಿಸಬೇಕೆಂದು ಆದೇಶಿಸಲಾಗಿದೆ.

KARNATAKA ACT NO. 19 OF 2009

(First published in the Karnataka Gazette Extra-ordinary on the Twenty Seventh day of August, 2009)

THE BANGALORE WATER SUPPLY AND SEWERAGE (AMENDMENT) ACT, 2009

(Received the assent of the Governor on the Twenty Fifth day of August, 2009)

An Act further to amend the Bangalore Water Supply and Sewerage Act, 1964.

Whereas, it is expedient further to amend the Bangalore Water Supply and Sewerage Act, 1964 (Karnataka Act 35 of 1964) for the purposes hereinafter appearing;

Be it enacted by the Karnataka State Legislature in the sixtieth year of the Republic of India as follows:-

1. Short title and commencement.- (1) This Act may be called the Bangalore Water Supply and Sewerage (Amendment) Act, 2009.

(2) It shall come into force at once.

ಪ.ಪ.ನೋ.