Let's Make Airport Water Positive

By Hrushikesh Sandhe PE LEED AP, Head- Civil/ Water, Walter P Moore

INTRODUCTION

Water conservation is important worldwide due to acute shortage of potable water in many of our most populated areas. The increasing impervious cover due to urbanization has impacted infiltration of rainwater into sub-soil and recharging of groundwater. Hence artificial storage or recharging of groundwater is required to restore our natural groundwater supply. Rainwater harvesting is one of the artificial recharge applications that can help to either store for beneficial use or recharge groundwater back into the aquifer.

Airports have one of the highest water demands (potable and non-potable) in the country. The typical categories that require water are irrigation, flushing, domestic drinking etc. In addition, airports typically have large areas for safety zones that can provide water collection and storage. Hence airports are a good place where rainwater harvesting application can be very useful. It is estimated that if rainwater harvesting is planned and implemented as per design, 100% airport potable water demand can be provided for an average rainfall year. This will help reduce airport capital expenditures in the long term and make airports water self-sustainable. In addition, the rainwater harvesting techniques can help reduce flash floods both at the airports and in the surrounding areas.

Walter P Moore has been associated with airport related civil/water infrastructure design globally. Recently we have started supporting Indian airports using global standards and expertise to provide a sustainable solution to water conservation. The interconnected rainwater harvesting network on airport property can help maximize storage on-site helping to reduce flood risk and help to provide water for beneficial use during dry months.

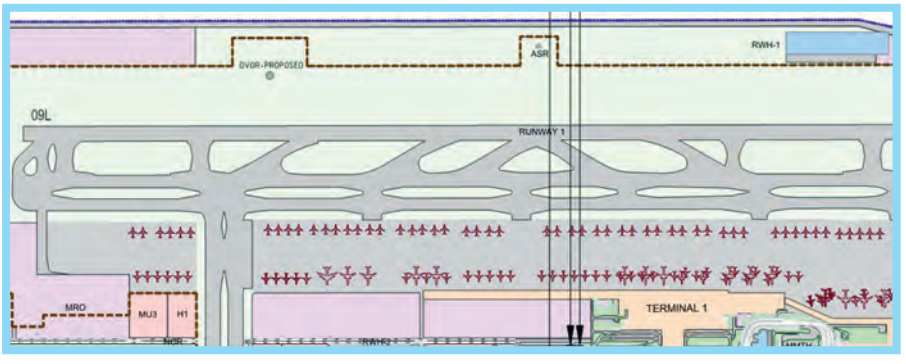

Figure 1: Typical Airport Runway

APPROACH

The approach to developing a sustainable water supply begins with a review of the on-site drainage areas to make sure maximum storage is captured by storage tanks or ponds. Also, existing infrastructure for non-greenfield airports should be reviewed to understand site outfalls to determine how best to capture rainfall runoff. The rainfall data from Indian Meteorological Department (IMD) gaging station near airport can be analyzed to understand trends for the site of interest. The recent trend in most parts of the country has shown increase in average annual rainfall and reduction of recurrence of dry year due to change in monsoon patterns. See Figure 2 below showing rainfall pattern for one of the airports in India.

The surface excess runoff that occurs post rainfall event is

collected via the airport drainage network. The drainage network discharges this runoff to storage areas, either an open pond or underground tank. The water from the storage areas is then distributed to an on-site water treatment plant. The treated water is then distributed to provide for the airport water demands. The waste water generated from airport is also treated through on-site sewage treatment plant (STP) and recycled water is used for irrigation and flushing purposes.

The Indian sub-continent does not receive consistent rainfall throughout year. Hence a water management plan should be developed in such a way that excess runoff during the monsoon season can be captured to supply water during deficits in dry months.

To support the water harvesting process, the water balance calculations need to account for the rainfall refill volume that gets added to the pond during the rainy months.

The simultaneous removal of water to meet the airport's water demand and the addition of water from runoff during monsoon is analyzed using water balance equation. The inflow to the pond is added and the outflows are subtracted to estimate the monthly available volume stored at the site. Figure 3 below showcases rainfall volume pattern for a year. The pond or underground tank operation rule should be setup in such a way that the storage is empty before monsoon season starts. The empty storage tank ensures maximum storage of runoff during the monsoon season. It is important that the operation of the system be aligned with the Meteorology Department forecast for the year.

It is recommended that the latest available tools and technology be used to model this setup and analyze various scenarios. The system can be modelled using various water resources software such as US Corps of Engineer's developed HEC-HMS, US EPA SWMM, and others. The hydrologic modeling helps replicate the storm event volume as it passes the site and routes the runoff through rainwater harvesting ponds. Also, the models can represent interconnectivity between pond and get more realistic information on how the transfer of volume will work. Using historical rainfall data, models can be set up using several years of data to help predict how best to design and operate the system. The modeling helps in designing the network and determining the maintenance protocols. The design goal is to provide solutions to store rainfall runoff to the most practical capacity possible in all the catchments and optimize the supply capacity of the storage system. In order to improve the system, the enhancements in the storage capacity, pond size and outflow structure parameters are always required. The interconnectivity can be achieved by using gravity pipe or a pumped distribution system. To conserve energy, the pump system is activated only during the dry periods to transfer water to the treatment facility. The pump

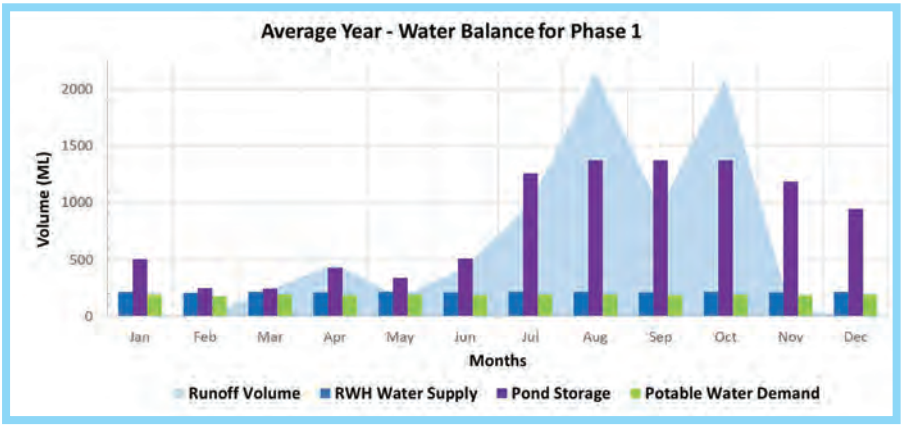

Figure 2: Rainfall Volume Month wise

Figure 3: Tank/Pond Interconnectivity

system can either be manual or automated.

The interconnectivity between ponds can be monitored using sensor or metering applications. The data collected through this application is used to optimize storage and usage for future years. It is recommended that active rain gages be installed at the airport and be integrated into the system operations. The gages will collect airport rainfall information data which can help forecast the impact of any rain event.

As per design standards, the airport drainage network should be designed for 100-yr or 1% chance of exceedance return interval storm event. Hence the rainwater harvesting storage provides benefit of detention and controlling floods and erosion offsite downstream of the airport. This approach is cost effective, environmentally friendly over the life cycle of the facility while integrating well with the existing infrastructure.

CONCLUSION

The water supply at the airport depends on various on-site and public sources. The water is mostly used for domestic activities. Hence conservation approaches such as rainwater harvesting have multiple benefits such as water supply, groundwater recharge, flood control and energy conservation. Assessing and managing rainfall on-site can help provide a long-term sustainable solution and help airports become water positive.

About Walter P Moore

Walter P Moore is an international company of engineers, designers, innovators and creative people who solve some of the world's complex structural and infrastructure challenges. Providing structural, diagnostics, civil, water resources, traffic, parking, transportation, enclosure and construction engineering services. We design solutions that are cos- and resource-efficient, forward-thinking, and help support and shape communities worldwide. Founded in 1931 and headquartered in Houston, Texas. Our 700+ professional work across US offices and five international locations. Walter P Moore established office in India in 2011. The office enhances the firm's ability to serve clients and projects throughout India for a wide variety of project types, including aviation, commercial, residential, healthcare, hospitality, sports, entertainment and government facilities. We are currently working with Bangalore International Airport providing Sustainable Water management solutions to make the airport water positive.

For more information please contact

Abhijit Shah LEED AP
Principal, Managing Director of India Operations
ashah@walterpmoore.com

Hrushikesh Sandhe PE LEED AP
Head- Civil / Water
hsandhe@walterpmoore.com

Walter P Moore
Office No. 5B, Down-Town City Centre (DTC), 5th Floor, Near Mhatre Bridge, Erandwane, Maharashtra, India Pune, Maharashtra 411 004