Chapter 2

Delhi's Hydrology; Social and Institutional History of Water Management

1.1 Hydrology and Human Society — An Interface

The objective of this chapter is to situate, study and analyse the interface between hydrology and human society, as it evolved in the history of Delhi. The central argument of the chapter rests on two aims which in turn are related to the twin hypothesis of this research; questioning the dominant notions of scarcity of water in Delhi and to bring into focus the role of power relations as they shape Delhi's institutionalised water management. First, through a study of hydrology starting from the past and reaching to the present of Delhi and its water management efforts, relying on both geographical and historical assessments, this chapter will argue that geography, history, ecology and institutions and their interplay disproves that a biophysical scarcity of water existed in the past, or that it provides the main rationale for water management today. Also, the present discourse pointing to natural scarcity serves certain ideological and political ends, putting the economic aspect of water above the social and political facets. Second, by going through the history of water management of the pre-colonial and colonial periods, it is evident that current or post-colonial and contemporary water management policy and practice needs to be treated to a social and political assessment, and seen as a continuity of the past in order to reach an understanding about the structural causes of water 'crises' and problems in present day Delhi.

The study of the hydrology of Delhi, comprising of the geographical details and the water resources present, along with the human society and its civilizational and
in institutional history of the water management is important to understand the issues around present day Delhi's water management scenario and, as to how it has reached and formed its present order. The secondary literature available about the way human settlements, during ancient history period (15th century B.C. to 8th century A.D.), started to manage water around the river Yamuna in the present day region of Delhi, do not shed much light on the social dynamics of this exercise as it existed then. But the importance of studying this period lies in the fact that the physical structures created during those days and developed more later, remnants of which are still found in the city played crucial roles during the following periods categorised as the medieval and modern history periods. Even more significant is the fact that some of these structures are finding their way back into the management of water during today's efforts, to address the 'perpetual water crises' of this capital city. Crucial information about the social aspects of water management, in the secondary literature start appearing when we shall discuss the medieval and modern history periods. It will be the making, unmaking and remaking of the water management systems, institutionally and architecturally, as they got constructed, destructed, devised, improvised and revised during the medieval and modern periods by the powers that be, which will inform and guide our journey towards the present day understanding of water and the way it is managed in the 21st century Delhi.

Physiography's Role in Shaping of Delhi as a City

'A city like Delhi! Hills around it and a river in its midst!!'

Amir Khusrao14 in Wasat Ul Hayat15

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14 Amir Khusrao (1253-1325) was a prolific classical poet associated with the royal courts of more than seven rulers of the Delhi Sultanate
The unique location of Delhi, its topography and the related presence of sources of water, with a perennial river like Yamuna, played a very significant role with regard to the evolution of earliest human settlements. The two most distinguished geographical features of Delhi are (see map 1);

1) the terminal extensions of Aravali Mountains, stretching beyond the south of Delhi and running at a much lower height than their average when entering Delhi, these encircle the west, northeast and northwest parts of the city in the form of a forest covered ridge, and

2) the alluvial plains formed by the deposits of the river Yamuna.

It will be apt to say that the combination of the forest covered ridge and the alluvial plains situated over the waterbed of river Yamuna makes Delhi a very habitable location.  

15 Dihlavi, Amir Khusraw (1975) Amir Khusrao: Memorial Volume, Publications Division, Ministry of Information and Broadcasting, Govt. of India

16 One-Tenth of the semi-arid tropics of the world are located in India occupying almost 37% of the total geographical area of India, which includes Delhi and parts of the surrounding States of Punjab, Haryana, Uttar Pradesh & Rajasthan (Datta 2005). Climatologically, such semi-arid tropical areas are quite habitable and support dense populations. The latitudinal (28°-24'-17" and 28°-53'-00" North) and longitudinal (76°-50'-24" and 77°-20'-37" East) location of Delhi puts it in the zone which experiences extremes of cold and hot weather season along with a marked period of rainy as well as spring seasons each. April to June happen to be predominantly the months of summer season with the maximum temperature reaching 40 to 45 degrees Celsius. The winters are discerned by the months running from November to January with the minimum temperature falling to around 4 to 5 degrees Celsius. Similarly the spring occurs in the months of February and March and bulk of rainfall takes place in the three months of July, August and September with an average rainfall of 714 mm (Economic Survey of Delhi 2003-2004). Datta (2005) informs us that Delhi experiences erratic spatial and temporal distribution of annual rainfall (average: 500–1000 mm) and even periodic droughts.
Apart from being a climatically hospitable region, Delhi’s location is explained as politically very strategic. Gommans (1998) and Singh (1999) have described Delhi’s regional location as a very important strategic frontier, climatically and politically in the making of this city. From the perspective of various settlers who moved into India from the Middle-East and Central Asia at different times in history, Delhi was located at a point from where to its west starts the arid zone going through Gujarat and
Rajasthan extending to present day Sind in Pakistan. Moving towards the eastern extension of Delhi we come across the huge fertile belt of Gangetic plains with a more humid climate. The exact extant of present day Delhi has rightly so never been acknowledged as an agricultural region but only as the eastern tip of the vast fertile belt. To the north lie the Himalayan foothills. Delhi is also located in one of the important watershed zones of north India – that which divides the two great river systems of the Indus and the Ganga. Gommans notes that “…the well-watered river valleys full of settled life, the rich grazing lands of the Arid Zone stimulated the north-south mobility of both humans and animals, if not from grazing necessity, then for military campaigns and trade” (Gommans 1998:7). From this section we have broadly understood that location wise, Delhi is strategically located on the banks of river Yamuna, in a wide corridor between the mountains and the desert, through which traffic passed between Central Asia and Peninsular India.

2.1 Water Management History of Delhi – Constructions and Destructions

This section intends to discuss the way water management in the city of Delhi evolved through various stages of history. We will follow the trajectory of how the society from the time of recorded history created its water management techniques, structures and institutions around the existing sources of water. The importance of such a description lies in the fact that the two major sources, river Yamuna and the groundwater are still the ones providing most of the water this city makes use of and they are the ones on which the past societies too depended. However, the techniques of water procurement, distribution, utilisation and the institutions for the management of water have all undergone immense changes; from a distinct decentralized community driven and state patronised system in pre-British rule era to a completely
state managed public distribution of water starting from the colonial period and extending to the post-colonial times to the present.\textsuperscript{17}

An objective assessment of water availability for the population of Delhi shows that the total quantity of water still remains abundant to support its massive population in the 21\textsuperscript{st} century.\textsuperscript{18} The analysis to follow now will discuss and elaborate on what changes occurred, when and how, which have led to a situation where water has become such a contested territory, which divides the population so sharply. On the one hand, we have groups for which it has become difficult to manage even basic needs, on the other lie a few for whom there is abundance of water. In between are certain groups, who face temporal problems of water.\textsuperscript{19}

There are two ways of approaching this section. One is through following a historical detailing of various times and how water was managed in each period. Two, to see how and what have been the changes around managing them through techniques, structures and institutions over different periods in time. I will follow a mix of both the approaches to try and bring forth a picture which shows how different water sources functioned and society's interactions with them in different periods. The combination of these two approaches helps because the focus of this research is political in nature rather than historical.

\textsuperscript{17} This statement is not intended to invoke any romanticism of the past, as if there may not have existed social problems regarding water but the scope of this thesis primarily discusses the present day problems around water, the like of which do not figure in any of the acknowledged historical sources till the period of medieval history. Moreover the rationale of this historical detailing here in this chapter is to trace if there exists a structural and linear explanation, grounded in history, regarding the present day water crises. The works of Ashraf (2004), Mann (2007) and Hardiman (2002) from the domain of history and Cherian (2004) from urban planning will be seen as a guide in constructing my argument.

\textsuperscript{18} According to Delhi Human Development Report 2006 and Delhi Jal Board’s calculations the total availability of water in Delhi stands around 240-250 lpcd.

\textsuperscript{19} For a detailed understanding of this differential situation regarding water availability see the next chapter.
2.1a Delhi's Evolution – Cities within City

Landscape and hydrology in Delhi have evolved over the ages simultaneously, with both affecting each other. During the ancient and medieval periods and extending up to the 19th century, the impact of hydrology upon landscape was dominant with water bodies like the river Yamuna and groundwater dominating the way landscape was shaped and altered. But since the time of colonial period humans have dominated hydrology. Significant to note is that whereas the former was a natural process the latter development of Delhi is more anthropogenic or man-induced in nature. Studies by Ashraf (2004), Hardiman (2002) and Mann (2007) point towards the way human impact under the colonial regime and its practices has altered the landscape which in turn has sharply altered the hydrology of the city.

A related phenomenon has been the way Delhi has acquired its present day shape and size. The Delhi of today is the tenth city in a temporal sequence which consisted of nine others, formed and situated at different periods of time, at distinct places, although within the same broad geographical region and, with even separate names (sees Spear, Gupta and Skyes 1994 and Peck 2005). This process or pattern of spatial and temporal evolution has finally culminated in what we see as the contemporary megacity of Delhi, comprising all the other nine under the present one.

For the period from pre and post epic legend Mahabharat till the coming of the Rajputs in 700 A.D., very little is found in history. Ancient literature, much of which is religious in nature, gives us occasional glimpses into Delhi’s early history, but the dates of many of the texts are uncertain and the information they give is often a complex synthesis of mythology and historical fact. It is only with the help of
archaeology that significant evidence about the history of medieval Delhi in the form of impressive monuments of various kinds is found.

2.1b River Yamuna – The Principal Source of Water for Delhi

The importance of rivers in the making of civilisations is a fact, of axiomatic significance. Baviskar (2003:50), Bharati (2004:vii) and others have underscored the importance of the cliché that rivers have served as cradles of civilisation. Singh (1999:1) while noting that very little is known about the history of Delhi’s ancient past writes that since the time of the first city of Delhi named Indraprastha, founded by Pandavas in the legendary epic Mahabharata, the river Yamuna and its changing course along with the availability and level of groundwater effectuated the founding of earliest of the cities of Delhi. Apart from the reason of strategic location (Gommans 1998) and thus the predominant reason from a natural perspective for the presence of settlements, related settlements of different human populations in the various places, times and spaces of what we identify as present Delhi has been the river Yamuna.

Ashraf (2004) and Singh (1999) note that Yamuna is a river known for its temperament and has forever been a shifting river. This shift is ascribed to both natural tectonic movements and as a result of human impacts. In the ancient past and till the medieval periods the river Yamuna flowing in a north-south direction through Delhi has changed its course dramatically. Singh (1999:8-11) explains that with summers and its dry spell and a fierce torrential spree during monsoon months,

\[20\] Singh (1999 p-xxviii) clearly states that though epic legends and local traditions cannot be treated on par with history, these do serve as 'historically significant sub-texts'. To bring more clarity from an archeological perspective Singh further writes '... Archeology can tell us whether Hastinapur, Indraprastha, and Ayodhya were the sites of ancient settlements, but it cannot tell us for sure whether the Mahabharata war happened or where Ram was born.'
Yamuna has covered its course through Delhi by shifting eastwards rapidly all through its history. *Rig Veda* marks it as one of the foremost rivers in north India and mentions it as flowing into the Saraswati (identified with the modern Ghaggar-Hakra). Over time, in its further eastward deflection, abandoning Saraswati, it joined the Ganga system. There is archaeological evidence of at least six palaeo-channels (old channels or courses) of Yamuna which have been identified in the Delhi area. The present day lakes in and around modern Delhi, like Surajkund, Najafgarh and Barkhal lake are the ones showing evidence of the old courses of Yamuna. Studies of the old channels of Yamuna have shown that the migration of the river ranged over about 100 km in the north and west Delhi region to 40 km in the south. The evidence suggests that the Yamuna once flowed through the hills south of Delhi. Citing Grover and Bakliwal (1985), Singh (1999) writes that Yamuna seems to have abandoned its hilly route around 4000 years ago, gradually moving eastwards through the plains area till it settled into its present course. The migration of the river Yamuna is a very important part of the history of the ancient settlements in this region. While many Stone Age sites have been found in the hilly stretches that were once traversed by it, several ancient mounds mark settlements that grew up along the older courses of the river.

Considering the archaeological evidence, Singh (1999) tells about the importance of Yamuna as a water source in the ancient times. For this period Singh (1999) also informs about many a smaller water stream which formed the drainage of the Delhi area. Such streams used to emerge in the Aravali stretches in the present day Ballabhgrah region south of Delhi, and generally flew in an easterly direction. One of the most important is the Bhuriya Nalah, which used to flow eastwards from the hills near present day Anangpur, through the plains, to join up with the Yamuna. Citing
how these old natural systems of drainage have got extinct under the modern day paradigm of water management, Singh (1999) points out to the importance these must have had in the lives of the people of those ancient settlements. Having explained the pattern of Yamuna's eastward shift, from hills of the south to the plains, one may find it implicit that human settlements also must have made a corresponding shift for availing this river as the principal source of water. 21

3.1 Historiography of Delhi’s Water Management since Medieval Times

"...a vast and magnificent city... the largest city in India, nay the largest of all the cities of Islam in the East"

Ibn Batuta 22 about Delhi (Kotkin 2005)

There is a lack of penetrating social assessment of medieval water management practices. What we have is only a kind of romanticised version regarding the 'decentralised' form of water management of this period. Thus, we would have to proceed without a clear knowledge of the social aspects of water management for this period. Although effective, but lacking in the sources to be studied for this section on medieval period, the disciplinary insights of political ecology help us to understand that natural resources like water and their management should be viewed with a 'focus on the mutual constitution of social and environmental change' (Derman and Ferguson 2000:2).

21 We will return to the further noting of history of water management during medieval and modern periods after the next section.

22 Ibn Batuta (1304-1368/77 (year of demise uncertain) was a famous Muslim scholar and jurisprudent, also famous as an explorer and traveler whose travelogues are considered as important historical documents. He visited India during the reign of Muhammad-Bin-Tughlaq.
3.1a Pre-Sultanate period

Both Cherian (2004) and Ashraf (2004) mention that medieval Delhi rulers inherited and extended a vital tradition of hydraulic engineering that could be traced to pre-Sultanate period (Cherian relates it to Indus Valley civilisation period). The system was largely based on water harvesting through the use of check dams, wells, step wells (baolis) and tanks. Although most waterworks in Delhi can be dated only as early as the Delhi Sultanate (1206-1526), the first Islamic dynasty in India, the Hauz Rani, Lal Kot tal, Anangpur and Mahipalpur dams are attributed to the pre-Sultanate period. Cherian (2004:51) mentions that ‘a synthesis of vernacular knowledge with Islamic heritage of hydraulic engineering created a system of nahars (canals), baolis (step wells), bundhs (embankments) and hauz (lakes) .’

In the pre-Sultanate period we find two particular Rajput dynastic reins, the Tomars succeeded by Chauhans. The Tomar Rajputs came to rule Delhi in the seventh and the eighth centuries. Surajpal Tomar, one of their foremost chieftains founded Surajkund in Delhi. In 1020, King Anangpal, a descendant of Surajpal Tomar built the city of Anangpur and established Lal Kot, building a fort in red sandstone in the vicinity of the Mehrauli where Qutab Minar stands today. This, after the semi-legendary and mythical Mahabharata time city of Delhi (named Indraprastha), is known as the second city. The famous Suraj Kund and Anang tal lakes in this area are associated with King Anangpal and Surajpal respectively, and are fine examples of water harvesting during the pre-Sultanate period. East-flowing smaller streams of the Yamuna network, which Ashraf notes ‘presumably may be meandering nearby’ (Ashraf 2004:207) present day Mehrauli, were tapped to feed such large lakes like Anangtal and Surajkund (see Spear, Gupta and Sykes 1994:83). Cherian (2004) notes that despite the immediate presence of the Yamuna River, most of Delhi’s populace
depended on underground or stored water till the arrival of piped supply in the 19th century. Subterranean flows and water tables, recharged by nallahs (river channels) allowed a complex hierarchy of wells, ranging from unlined pit wells, digghis (square or circular reservoir with steps to enter) to elaborate baolis (large step wells built with several levels).

In the same region of Lal Kot, the successors of Tomars, the Chauhans built their citadel named Qila Rai Pithora (renaming Lal Kot), built by Prithvi Raj Chauhan. Ashraf (2004) notes that, Prithviraj Raso by Chadra Bardaya is one of the earliest known records of Delhi pertaining to this period.23 Ashraf informs that not much is known about water supply to the Mehrauli of the Chauhans. However, on the pattern of the surviving remains of Anangtal and Surajkund ... as an example of water management in the identical terrain, we can safely assume that Delhi of Chauhans managed its water supply through damming the gorges still abounding in the vicinity. This supply was supplemented by wells that in the light of the terrain, it seems, collected rain run-off during the season and helped in keeping the over-all underground water table high through seepage by fissures in the rocks. Proximity of the Jamuna (sic) bank and much better soil cover over the rocks kept the sub-soil water level in the wells and reservoirs high.' Ashraf (2004) notes that all the gorges from the period of Chauhans and their predecessors are today being fast devoured by the contemporary Delhi Development Authority as land fills (p-207).24

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24 Delhi Development Authority (DDA), created in 1957 under the Delhi Development Act of the Parliament, is the main institution of the Union Government of India, which looks after the development of land-use pattern in Delhi.
3.1b Sultanate Period

With the defeat of Prithviraj Chauhan by Muhammad Ghouri in 1192 came the end of the Chauhan dynasty. Ghouri installed his slave Qutub ud Din Aibek as the General in Charge of Delhi. With the death of Ghouri, Aibek claimed himself as the ruler of Delhi and thus began the Sultanate period\(^{25}\) which lasted for 330 years finally giving way to the Mughals from 16\(^{th}\) century.

During the Sultanate period that followed, several cities were built in the terrain of the Aravali hills. One major commonality was that all these cities, forming the collective history of today’s Delhi, had wide-ranging water harvesting systems, which made it possible for the people residing to meet their daily needs (Centre for Science & Environment,\(^{26}\) Cherian 2004, Ashraf 2004). The Sultanate regimes during the formative days of building upon their city of Delhi depended upon the gorge system of the preceding Chauhan dynasty in bringing water to the place where Aibek, Iltutmish (both rulers from the Slave Dynasty) built their citadel, known as Qutub Complex in modern day Mehrauli. From the perspective of the substantial amount of population this region had during Sultanate period (Arab accounts provide a figure of around quarter of a million (cited in Ashraf (2004:208), we can assume that it had a significant need in terms of amount of water. Moreover, the historical accounts of Mehrauli then describe it as a lush green city with gardens and orchards in abundance. All this when read with most European travellers account during the Sultanate period wherein there exists nothing regarding shortage of water; it will be a fair assumption to note that the area had ample water. Ashraf (2004) points to two more very

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\(^{25}\) The Delhi Sultanat refers to the various Turko-Afghan dynasties that ruled North India from Delhi (1206-1526). These could be understood as five distinct periods: the Slave Dynasty (1206-1290), the Khalji Dynasty (1290-1320), the Tughlaq Dynasty (1320-1413), the Sayyad Dynasty (1413-1451) and the Lodhi Dynasty (1451-1526).

\(^{26}\) [http://www.rainwaterharvesting.org/Solution/History_tour6.htm](http://www.rainwaterharvesting.org/Solution/History_tour6.htm)
significant points to underscore the importance of the fact that Delhi region never faced a natural or bio-physical scarcity of water and also that common people in the medieval period did not face water problems of any kind. First, European travellers’ accounts of the period placed the travel between Agra to Lahore with Delhi falling in between as a highly comfortable journey, especially from the point of view of terrain which was ‘garden walk’ like with thick shadows and cool atmosphere. This underlines the availability of water for gardening in a big way not only in urban areas and settlements but also in the region as a whole. Second, Ashraf mentions that for the whole period consisting of Sultanate and Mughal rules, none of the historical sources cite any use of Yamuna water directly for household purposes. It ‘ideally’ (emphasis mine) means that obviously Delhi had a properly functioning water supply (see p-209). This may be a fair assumption on the part of Ashraf, considering the existence of no such account about household usages and availability of water and also the fact that most of these cities of Sultanate and Mughal period were inside the huge citadels or forts built by the regimes but a lack of social history in historical sources for medieval periods does leave scope for doubt.27

Various sources about the hydraulic past of the medieval history of Delhi discuss the complex structure of water management built by successive rulers of Delhi. One of these included the building of huge tanks or water reservoirs commonly named then as Hauz. The typical Hauz used to derive its water from two sources; in areas nearing the river Yamuna, from underground subsoil water movement and the ones at a distance from the river, from the harvesting of rainwater or storm-water runoff during

27 See the review by Biswamoy Pati of Sanjay Kumar’s (2002) ‘The Present in Delhi’s Past – Three Essays’, New Delhi. Pati raises the issue of lack of social history content in the historical sources for the medieval periods and thus underscores the need for critical assessment of the versions which form a romanticized opinion about the past when contrasted with the present.
the monsoons and gradually used later during drier periods. Prominent among these were Iltutmish’s *Hauz-i-Sultani* or *Hauz-e-Iltutmish*, which served as a remarkable water tank meant for public use. This tank was further repaired by Emperors Allaudin Khiljee and Feroz Shah Tughlaq during their times, suggesting the continued importance of this huge water reservoir. Remnants of this structure are still present but have been put to complete disuse due to the encroachments by DDA and private builders. It is located in the Mehrauli area of Delhi near the Dargah of *Kaki Saheb*. The rulers of the Sultanate period had built many such tanks for the purpose of water management; remarkable was the period of Feroz Shah Tughlaq by when 18 such tanks were functioning. Most significant was the *Hauz Khas* or *Hauz-i-Sultani* (literal meaning Royal Tank) located in the present day region of Hauz Khas in south Delhi which has derived its name from the same. This tank is of particular importance in the study of Delhi’s hydraulic past, not only for its size and continued relevance but also because it has found place in INTACH’s renewal programme of ancient water bodies to help overcome present water crisis, and also because it finds mention in some of the most important medieval history sources like that of Ibn Batuta, and in the history by Sir Syed Ahmed Khan etc (Ashraf 2004 p-210).28 Built by Allaudin Khiljee, *Hauz Khas* which fell into disuse after the death of Allaudin, this tank was rebuilt by Feroz Shah Tughlaq and was considered very important from the point of view of a major water provider to the population of Feroz’s capital city of Siri, premised at the modern day Hauz Khas and Siri Fort area of Delhi. Spear, Gupta and Sykes (1994:75) mention that though this *Hauz Khas* was built by Allaudin and repaired by Firoz

28 Sir Syed Ahmed Khan (1817-1898) was the famous educationist, jurist and author. He is a renowned Islamic reformer in India who supported the introduction of modern western education for Indians especially Muslims and was the founder of modern day Aligarh Muslim University (then called Anglo-Indian College in 1875): Sir Syed Ahmed Khan 1965 Athar-as-Sandid, Delhi
Tughlaq, it was one of the most important as well as dear constructions to Firoz as he built a Madarsa and his own tomb right adjacent to it. Some historical accounts, Ashraf (2004) says try to present Firoz’s act of rebuilding the Hauz Khas as an effort directed towards alleviating the water scarcity of his times. Ashraf strongly objects to such a portrayal and opines that this lacks a serious thought and basis in records available and in fact is a fabricated account of a water scarce past which ‘...is an excuse to cover up the present situation under the alibi that such has always been the case’ i.e. a water scarce Delhi. Ashraf writes that the shifting of capitals within Delhi region by successive rulers, first from Mehrauli to Siri and then Kilokhari (contemporary Bhogal), Khizrabad and ultimately Kotla Firoz Shah was primarily due to military requirements, abandoning of the policy of rebuilding capital city fortresses at the old terrains. Moreover, most importantly, all such new fort and capital constructions were made to be in sync with the eastward drifting banks of Yamuna and its underground riverine movement. That is why we see successive capitals moving closer to the Yamuna flow or course of the times. Ashraf also categorically notes that the Delhi of the Sultanate was not dependent on the river alone especially for domestic purposes but used it only for washing and bathing animals and clothes. Hence, such shifts should not be ascribed to water shortage at any point of time during Sultanate period (see Ashraf 2004: 215-216). The continuous shift of Yamuna is also explained through the mention of Nizamuddin Aulia’s residence (not Nizamuddin area of present Delhi which is the saint’s burial place) which was located at Indrapat (modern area in and around Purana Quila or Old Fort) as Yamuna was flowing there then, right under the balcony of Nizamuddin Aulia’s house, as mentioned in historical records. 29 Ashraf recounts that, observing the drifting course of Yamuna is easy as

29 Hazrat Nizamuddin Aulia (1238-1325) was the famous Sufi saint of the Chishti order of South Asia. His burial place known
after two centuries of Nizamuddin Aulia, the present day Red Fort was built in the area from where Yamuna had receded by then.

For the period of Tughlaq dynasty and particularly their citadel-city at modern day Tughlaqabad, Shokoohy and Shokoohy (1994) have written extensively. In their description they have mentioned the large tank built inside the fort for collecting water, and about numerous wells and step wells, with architectural details to discuss the way water was managed to be provided to the population. The authors have also mentioned in great depth the archaeological sources and evidence to substantiate and present a picturesque detail of the system of water management. Spear, Gupta and Sykes (1994:79) too mention and explain the water management as it happened inside Tughlaqabad fort with the help of a big lake or tank.

Apart from the famous tank system built during the Sultanate period, the period is especially known for yet another very important structure of water management; the network of step wells or baolis. These were purpose-built to provide a constant supply of water to the residents of Delhi. Works of Cherian (2004), Ashraf (2004), CSE and INTACH’s account of this stupendous network of baolis holds an importance for carving out the history of water management for common people of Delhi in the previous ages. Most famous of these many baolis include Ilutmish’s Gandhak-ki-baoli deriving its name from the smell of sulphur which emanated from it when functional (see Spear, Gupta and Sykes 1994:64), Rajaon-ki-baoli, a caved baoli at Mahavir Sthal area of present Delhi, Hauz-i-Shamsi (see Spear, Gupta and Sykes 1994:65-66) at southern outskirts of modern Delhi, Red Fort moat built by Shah Jahan, Ugrasen-ki-baoli situated in the present day Connaught Place area (see Spear,
Gupta and Sykes 1994:125). *Baolis* could be easily seen as the lifeline of water management structures and processes of Delhi during its medieval history periods. They were supposedly of a *secular* (emphasis mine) character whereby anyone could draw water from them and were mainly used for common people’s water needs and requirements. The *baolis* also hold a very significant place in present day Delhi’s (read State) renovation programmes of ancient water structures to ‘ease’ (emphasis mine) the city of its water problems. It is important to understand this point of ascribing importance to these past-age structures. On the one hand, this process of rejuvenation holds significance in terms of improving water availability, but when looked at in a holistic manner, such reinvigoration of historical water bodies without any process of integration of these processes with the political and social assessment of water problems of present day Delhi, can only be termed as idyllic or acts of romanticising the past. Indeed, such endeavours may also be dangerous when intermeshed through discourses of conservation with the idea of natural scarcity. They emphasise the economic and supply side of water as the prime concern at the cost of socio-political dimensions. Further by invoking the past these efforts tend to mislead or render incomplete current structural issues regarding water and access and control of it. Apart from that, CSE and INTACH (1998) have come out with an elaborate plan to revive many of these *baolis* which today lie in a state of complete disuse but formed one of the most important aspects of water management mechanism in Delhi’s past.

Reverting back to the description of *baolis* and their importance in systems of water management in the past, a huge network of these was built upon by successive

30 With an emphasis on the term secular this researcher wants to point towards the need of deconstructing the use of such a word for the description of medieval period history, especially in the context of its acknowledged lack of social assessment.
regimes of the Sultanate period. Ashraf’s (2004:210) description about *baolis* tells about the major significance of these as supplementing the tanks as described earlier. Two major types of *baolis* existed; one deriving their water from the subsoil water of the alluvium soil which used to build permanent reserve after reaching the river bed depth, and the second type being the ones located in Ridge area in the present day regions of Vasant Vihar, Chiragh Delhi, Talkatora, Tughlaqabad and many in Mehrauli region. These second type used to thrive on the tapping of the harvest off rainwater and storm water drains of natural kinds, popularly known as natural channels existing in the Aravali Ridge of Delhi. *Baolis* being fresh water reservoirs in the Aravali region, where sub-soil water is brackish, used to serve as supplements to big tanks and provide daily use water for drinking and other purposes to the population groups in vicinity and through cracks and fissures in the Ridge rocks used to keep the underground water table level high. Ashraf (2004) notes in a categorical manner, that this whole system of tanks, wells and *baolis* managed water supply to the whole complex of settlements during the medieval history period of Delhi. The decentralised nature of this system, Ashraf suggests, can be gauged from the fact that none of the problems like that of silting of tanks at one place affected the others. With a description of *bunds* or dams which were constructed by medieval rulers like Mohammed Bin Tughlaq the description about Sultanate period can be completed. While maintenance of *baolis* was of a local nature to be performed by each of the localities in vicinity, the larger structures like *bund* was the responsibility of the central authority. Cherian’s (2004) extensive commentary on the *bunds* or water harvesting mud embankments is a very rich source for understanding the hydraulic system of Ridge portion of Delhi. The alluvial plains area being catered to by subsoil underground water movement deriving from Yamuna River, the area of the Ridge was
well-marked and served by these establishments called *bunds* or literally meaning dams. Cherian (2004) in his work marks out that there existed a series of about 25 *bunds* in the 40 km area of Ridge, one each at every *kruh* (approximately about 2 miles) (see map 2 below from Cherian 2004).

**Map 2 The Bund Network Along the Ridge**
The typical Delhi bund is an embankment restraining a natural stream in its upper reaches, or is a check dam diverting flows of storm water. It is built along rocky elevations and ravines to make best use of high storm-water runoff afforded by the Ridge’s poor permeability and high gradients. This rainwater, harvested during monsoon would be allowed to collect in a hauz to be gradually used over the drier months. Some of the bunds located in the 40 km stretch of Ridge were at places of today namely, starting from Zam rudpur, Tughlaqabad, Deoli, Chattarpur, Hauz-i-Shamsi lake or Lal Kot, Mahipalpur, Munirka, Jharera, Majra, Dasghara, Malcha, Talkatora, Bhuli Bhatiyari and Pir Gayib culminating at Wazirabad on the Yamuna River bank (see Map 2). Most of these structures, Cherian notes were razed down in the post-colonial period of 1960s onwards to make way for residential localities.

3.1c Mughal Period

Babar laid the foundation of the Mughal Dynasty in India after defeating the last of the Sultanate rulers, Ibrahim Lodi at the battle of Panipat in 1526 A.D. Looking at the Mughal rule with respect to hydraulic management, keeping in mind the fact that Yamuna is constantly shifting eastwards, we find that successive Mughal emperors like Akbar and Shah Jahan tried to embank the river and stop its shift. This was done to guard the citadels built and newer ones like Red Fort being erected as well as to continue the significance such strategic location carried which would have diminished if the region dried up with Yamuna moving further from it (see Ashraf 2004:222). With the embankments known as bunds, namely Akbar building Band-i-Akbari and Shah Jahan’s Band-i-Shahjehani, the recession was stopped to a large extent. Also with this effort of embankment it was ensured that Yamuna flowed like a channel right behind the Red Fort when it got built. It is to be mentioned that when today we
view all houses built then in the Darya Ganj area of Old Delhi facing the modern Ring Road or flowing Yamuna, we find that all of them have windows at a height but no entrance or exit on this side because it was the side facing Yamuna right below. The continued significance of these two embankments lies in the fact that till date these two save Delhi from the flooding of Yamuna.

Along with Ashraf (2004), some other sources point towards the water management system in Delhi during the Mughal era. Mughal Delhi relied for its water management structures on the existing baolis and wells and as an important addition to it built a canal system running through the heart of the city with some smaller streams of this main canal used for different purposes by people. A previously built canal in the times of Firoz Tughlaq called Hisar-Firuza (also known as the Western Jamuna canal) drawing waters from Yamuna was repaired under the rule of Akbar and extended under Shah Jahan. This now became a part of the permanent structure when Shahjehanabad city was built by Shah Jahan. This most important canal, known as Nahr-i-Faiz or Nahar-i-Behist flowing through the city and catering to its population was the result of Shah Jahan’s general Ali Mardan’s efforts who was asked by Shah Jahan to bring the waters of the Yamuna inside Shahjahanbad. This feat which became later the life line of this city, was thus accomplished and is sometimes referred to as Ali Mardan canal (see Spear, Gupta and Sykes 1994:23). Mentioned beautifully in the works of Mirza Ghalib, this canal was a masterpiece of water management getting more streamlined with the Mughals (see Ashraf 2004:223 for Ghalib’s mention of this canal in his works). With the system of water management undergoing a major improvisation over existing baoli and wells system the water

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31 Mirza Ghalib (1796-1869) was one of the finest, popular and influential poets of Urdu and Persian in India during the 19th century.
management during the rule of Mughals is distinguished from the predecessors (see Peck 2005:181, Spear, Gupta and Sykes 1994:4 and Ashraf 2004: 223).

Khan (1988-89) mentions categorically that a technologically standardized water management system was formulated by the Mughals during the 16th Century AD. With the coming in of the canal and with a swift underground water movement beneath the subsoil the Mughal period Delhi was known as a very rich city hydraulically. In the main city (today’s Old Delhi area), the canal charged *dighis* and wells. A dighi, another Mughal period improvement on the existing system of water management, was a square or circular reservoir of about 0.38m x 0.38m with steps to enter. Each dighi had its own sluice gates. People were not allowed to bathe or wash clothes on the steps of the dighis. However, one was free to take water for personal use. People generally hired a *kahar* or a *mashki* (men to carry water) to draw water from the dighis. Most of the houses had either their own wells or had smaller dighis in their premises. In the event of canal waters not reaching the town and the dighis consequently running dry, wells were the main source of water. Some of the major wells were *Indra Kuan* near the present day Jubilee cinema hall, *Pahar wala Kuan* near *Gali Paharwali*, and *Chah Rahat* near Chippiwara (feeding water to Jama Masjid). In 1843, Shahjahanbad had 607 wells, of which 52 provided sweet water. Today 80% of the wells are closed because the water is contaminated by the sewer system (see CSE website).

3.1d The Colonial Era

Before starting a discussion on colonial era it will be pertinent to mention the various understandings which scholars have formulated regarding the effects on water management of Delhi which underwent a complete shift and change under the
colonial period. Hardiman (2002) strongly refutes the Witfogelian argument in the Indian context according to which oriental state became despotic through a strong centralised control over water resources (see Hardiman 2002:112). In the case of India, Hardiman argues, the state was never able to control water resources in such strong centralised manner as Witfogel claims, but rather the control over water was exerted by different groups within local communities of users wherein water was distributed according to political power of such different groups within these local communities. Hardiman notes it as an irony that the state which comes closest to such practice of ‘oriental despotism’ in India was that of the British. Apart from dismantling the existing structures and mechanisms of water management by terming these as ‘backward, the British rule brought in a distinct form of property relations. Hardiman notes ‘...In place of overlapping systems of access to natural resources, the state [under the British] attempted to claim absolute ownership of all resources....for itself’ (see Hardiman 2002:114). Water, Hardiman further tells us, became a subject of taxation at all levels, with water rates being an integral part of land-tax systems.

Ashraf (2004) describes the coming of the British and their impact on water management in Delhi as a paradigmatic shift. He mentions the bringing in of electrified and thus pumped water system to provide the first public supply and distribution system, drastically damaged the earlier decentralised system of water management. In addition to it, as Hardiman also notes, the British taxation system changed the mode of water provision from a ‘social service’ to a pay and get kind of service which was centrally managed, thus introducing in Delhi a newer (emphasis mine) class division.

32 See chapter 1 for Karl Witfogel’s argument.
Next we shall start the discussion with the extensive study done by Mann (2007). Delhi came under British rule in 1803 and a dual government lasted till 1857, much to the discomfort of Britishers and discontent for urban elites and inhabitants (Mann 2007:5). Despite the overall positive impression of Mughal era’s water management, writes Mann, the water supply and sewerage system deteriorated after the occupation of Delhi because the responsibilities for its maintenance were not clear and resources in any case insufficient (Mann2007:7). Shajahanabad of 17th century, Mann writes (p-7), was famous for its excellent supply of fresh water. Most wells were fed well with additional freshwater from the Ali Mardan canal by especially constructed inlets. By the middle decades of the 18th century the canal had become dilapidated and dried up, the immediate cause being the invasion by Ahmed Shah Abdali in 1757 and the destruction which followed. The Britishers started to reconstruct the canal in 1817 which supplied the city with water again in 1820. As the inlets were not repaired, only wells situated near the canal received additional water, though simply by percolation (Mann 2007:7). At the same time it was observed that flooding the wells with water from the canal improved the quality of water. Since most wells lacked fresh supply, the well-to-do people had their water fetched from the Yamuna. This development can be seen as a pointer towards how the process of colonialism exacerbated the existing power relations’ effect on water management (emphasis mine).

To partially improve the water supply, the Superintendent of Canals, John Colvin Major suggested in 1832 that an underground channel in front of the Lal Qila be repaired as this measure would supply the whole south-eastern quarter of the city with fresh water. Nothing actually happened of the proposal. Perhaps, it was too expensive (see Mann2007:7). This is what Hardiman (2002) and Ashraf (2004) have repeatedly stressed as the attitude of financial conservancy displayed by British regularly towards inhabitants.
by not providing any kind of major improvement regarding efficiency or quality in terms of water provision. Instead in 1846, the British constructed a large tank (Ellenborough Tank), commonly known as Lal Diggi, in front of Lal Qila. This was definitely cheaper as it demanded only manual labour and no technical constructions. Although the water supply improved, it was suggested in 1853 to regularly supply Lal Diggi with freshwater from the Ali Mardan canal. Apparently the water of the tank had also turned brackish (Mann 2007:8). For the time being water supply seemed to be sufficient although the potable water was often of dubious and sometimes of dangerous quality as chemical analysis from 1860s indicated. It was predicted that with rising population the problems for water supply would also increase. With the high urban mortality rate the Britishers in India demanded better and more efficient and sufficient water supply. Due to rising health concerns, British populated Civil Lines and Cantonment areas had separate sanitary planning systems. Ashraf (2004) notes, that this move of shifting their epicentre from Shahjahanbad region to outside the walled city was of major significance because from here on the colonial masters started their efforts towards constructing newer mechanisms for water withdrawal from Yamuna exclusively for their consumption and utilisation (see Ashraf 2004:232).

In 1869 the Delhi Municipal Committee accepted a proposal by Crosthwait, a civil engineer who had been employed for some time with the Dublin city water works, for a water supply scheme which could be completed within three years. Accordingly, Crosthwait proposed that Ali Mardan canal was redundant in terms of augmenting supply and new wells needed to be dug in the city. However, he suggested that main supply should be covered by water taken from Yamuna by wells sunk in the sandy bed of the river ‘where a clear, cool, undercurrent of very pure water is to be found at all seasons of the year’ (see Mann 2007:15-16). With such major advancements in place, Mann states,
still only the walled city was provided with water leaving 1/3\(^{rd}\) of Delhi’s inhabitants (non-elites) without any water supply. This is what points towards the social dimension of the modern period, which more than just distinguishing between colonisers and colonised also lays stress on the details of how processes carried an impact differential in nature between different kinds of people, economically, socially and even spatially situated as in this case.

There were special house taxes levied to finance water projects and the elite and many other residents of the city agreed to such taxation in the hope of getting better supply. Importantly with such financing, the primacy was given to improve the supply of European residents of the city. For catering to the growing demands many new wells were planned and people gave applications to get them dug up near their houses, but primacy was always given to Cantonment areas within the walled city. The DMC had prohibited the lower caste chamars from taking water from public standposts. This order was later withdrawn by the Commissioner of Delhi.

In the early decades of 20\(^{th}\) century, Mann notes, the city to be named New Delhi was planned and thereby started the process of turning Shahjahanabad into an old city (see Mann 2007:28-29). It was at the cost of this city that all new water supply and sanitation facilities were extended to the New Delhi area. Planners, architects and bureaucrats build a completely segregated city, reducing Delhi and its surrounding ancient monuments to a picturesque background. Referring to Gupta (1981), Mann writes ‘When the new capital of British India was inaugurated in 1931, certain implications became obvious. First of all, municipal work now was concerned with maintenance of New Delhi and not with the modernization of Old Delhi, as the walled city and adjacent suburbs were now called. Second, the most developed urban civic service, the municipal water supply system, was
reoriented to benefit New Delhi at the cost of the old city’ (Mann 2007: 28). Further Mann quotes Prashad (2001) ‘plans for a new sewerage system covering the whole municipal area were turned down in favour of a modern waterborne system for New Delhi’ (Mann 2007:28). ‘In some sense, former Shahjahanbad was not only transformed into a distant staffage at the outskirts of a park-like New Delhi, but Delhi was also made ‘old’ through neglect and underdevelopment’ (Mann 2007:28).

Delhi was surrounded by villages which have now in post-colonial times been incorporated into the city as urban villages. A special mention needs to be made about ‘Johads’ or the village ponds. Historically, these ponds were the focus of community life. People’s participation during the process of building johads and their regular maintenance was a sustained effort. No village was complete without a johad surrounded by lots of trees. Johads were never built in isolation and were a well planned system connecting local streams, rivulets and their tributaries and served to moderate floods.

With the introduction of piped water supply and promise of the same to all villages and in the rapid course of urbanization (especially ever since last quarter of 20th century) these johads have been undervalued, threatened with destruction and abandonment. Many johads have silted up or deliberately filled by municipal authorities and their land used for urban purposes. Elsewhere the ponds have been used for sewage disposal and their catchments built upon. The hydrological cycle has thus been interrupted. A study of existing village ponds conducted by INTACH (1998) lists 113 urban villages that have been engulfed and several others are on the way to be brought into urban agglomeration and due to hunger of land the village ponds of these have been filled and built upon, mainly by the DDA. A classic example of the irony of modernization process can be seen in the committee report on the 1995 floods by Irrigation and Flood Control Department,
Delhi Administration that has requested Rs. 5 crore for constructing new ponds. A damage control exercise could involve all the existing village ponds and some of those on the verge of being engulfed being nurtured and their catchments protected, the immediate consequence of which could be the recharge of groundwater. In the long run this could bring sustainability in terms of water availability and its use.

4. Contouring the Water Management Paradigms in Delhi’s History

Keeping in view the fact that not much is concretely known about the period prior to the 8th century A.D. we need to go by Ashraf’s (2004) analysis of water management during the medieval times. Ashraf’s main contention is that there has been a major paradigmatic shift in terms of viewing water and its management from what it was during the medieval period and what it became since the British or colonial period and is continuing after independence. Ashraf argues that till the British rule, availability of water was not a limiting factor for expansion and even the population of Delhi has always been substantial and dense. The difference of paradigm of water management is to be ascertained in the different periods of medieval and modern history - between pre-colonial, colonial and post-colonial times. Water management of Delhi throughout the history of the city before the British was based on a decentralized run-off harvesting through wells, step wells (baolis) and tanks. All of these structures were invariably dependent on the groundwater level which in turn was replenished by rainwater seepage and through River Yamuna’s sub soil riverine movement. Each such structure catered to a limited number of people living in the vicinity. This clustering was based upon various homogenous settlement patterns linked with castes, clans, professions or service under the same noble. This homogeneity avoided all post-harvesting social problems of water management that are involved in water management (See Ashraf 2004:203). Such systems of wells, step wells, tanks were further improved during the times of the
Sultanate and Mughal rules in Delhi through introduction of canal system to bring water from Yamuna and its smaller channels to the different cities in the temporal and spatial sequence as they got developed in time in the Delhi region. With the emergence of colonisation the British rulers started a process of dismantling whatever was put in place by earlier society and rulers of Delhi; closing of man-made canals and natural channels, the pattern of run-off harvesting done through wells, step-wells and tanks. As Mann (2007) has noted, with the policy of racial and class-based segregation by the British within Shahjahanabad or Walled City area of present day Delhi and later on with their making of New Delhi in the 20th century, the colonial masters completely altered the water management in Delhi to suit their elitist, western-biased interests. All this, Mann notes, catered to making the Old Delhi of today become ‘old’ and dilapidated in comparison to New Delhi, whose capture of all resources belonging to the Old, including water, gave it its exalted status. Ashraf (2004) also brings out a vivid picture in bringing out the difference by saying that during the entire pre-British period improvement and normal functioning of water supply was a social service performed by the State and by others; it was also obligatory on all getting benefit from the system to look after it. Ashraf continues ‘...for construction of canals and digging of tanks and wells the state helped either through absorbing the construction costs and by grants-in-aid to maintain it or encouraging nobles to handle such aspects as charity towards all living beings strongly enjoined by all religions then being practiced in India’ (Ashraf 2004:205).

By the time the Mughal Empire collapsed in the beginning of the 18th century, the British East India Company was about hundred years old. After the 1857 rebellion, and further transfer of power completely into the hands of the British monarchy and thus the ultimate
sovereignty, the British had started to bring in place major water management reforms (see Mann 2007, Cherian 2004 and Ashraf 2004). Differentiation can be made between the Mughal reforms in the field of water management and the British designs, with the colonial masters' profound interest lying in further consolidation of political control; they worked towards establishing a monopoly over the water resources and water management institutions and structures. This led to a very different strategy of putting in place a new structure and mechanism of water management. Mann points out that while the colonial officials argued from the perspective of better management of water sources, much of the institutional change was driven by the demands of the British elite and their serving officials, both Indian and European, who had in mind the primacy of the colonial interests around health, extravagant and notional views of civilisational superiority and thus the maintenance of such. Hardiman (1999, 2002) in his work notes that the colonial masters viewed the pre-existing systems and their sophistication as 'rudimentary, 'primitive', and unchanging, trapping the people in a culture of backwardness. The new rulers believed that they had a superior knowledge which was scientific, and that they could transcend these supposed limitations through technology. Nature could be mastered, transformed and thus exploited in the context of global markets. 'Natives' were expected to conform to this new, more 'rational' scheme of resource use' (see Hardiman 1999: Abstract)

Talking of the post-colonial times, both historians Mann (2007) and Ashraf (2004) and the urban planner Cherian (2004) note that although an uncontrolled population increase is an important issue, with its haphazard spatial spread, but the problems related to water lie in the way the state has managed it. Mann notes that as compared to the early 19th century situation of water management, it can be said that 'the environs of Delhi had probably a highly sensitive environment-cum-ecological balance which changed substantially within a hundred years of colonial urban politics. The same politics
aggravated the environmental problems of Delhi as the imperial and republican capital' (Mann 2007:29). Ashraf points out that 'the state in this respect not only does not care to govern but centralises everything in its hands in order to create power-base for the ruling elite with the help of civil administration...After freedom the emerging independent India took over the centralised paradigm of the British and as it neatly fitted our "modern" "free" paradigmatic understanding based on 19th century European model which freedom movement as a whole intellectually upheld in all societal aspects, we carried it forward after independence without looking back at the roots of our own cultural aspects dealing with urban water management and civic amenities in urban centres' (Ashraf 2004:205-206)

It will be pertinent to mention that, how so ever ideal the picture may emerge from descriptions of Ashraf (2004) regarding the water management of the pre-colonial times with its problem free or even socially homogenous view, it has been established through the works of Mosse (2003), Mehta (2007) etc. that water management has invariably remained a powerful tool in the hands of the socially, economically and politically dominant in all forms of societies from the past to the present. To summarise their argument, water management is one of the many forms through which social, economic, political and even cultural supremacy has been maintained by the elites since historical times. This dominance has taken a shape today whereby ideological imperatives are met through increasing discourse analysis and policy perspectives and related implementations.33 So, it is in no way the intention to present the details of Ashraf's (2004) study of pre-colonial times water management in Delhi so as to uncritically subscribe to his views and thus ignore the then present social differentiations, but rather it

33 For a detailed descriptive analysis of the premises of Mosse (2003), Mehta (2007) etc. refer to the first chapter of this thesis.
is because of the necessary reliance on his rich descriptive work on the water management practices, institutions and structures of the medieval period.

5. Conclusion

As established from the discussion till now, the water management of Delhi under different periods has undergone substantial changes. Starting from small human settlements in the ancient period moving onto the medieval period we find that the hydrology's interaction with the human efforts gave way to a complex and efficient water management system. Efficiency can be only gauged from the fact that none of the records mentioned are suggestive of any kind of problems regarding water which the present Delhi is facing constantly in its various descriptions and analyses, especially during the last two decades. Regarding post-colonial times, a more elaborate discussion will be taken up in the following chapters. It will be sufficient here to say that the discontinuity from the medieval period's decentralised water management practices, towards a more centralised system with a singular public utility, which began under the colonial regime and thereby subjected the population to artificial scarcity forms a kind of pattern which helps to locate and understand structurally the problems of water which Delhi faces today. The various and elaborate scholarly details of medieval and modern periods' water systems, hydrology and human created institutions and structures, support strongly the view that a problem like bio-physical scarcity has never occurred or has never been a part of Delhi's water problems. Though there happens to be a lack of social aspects in terms of ancient and medieval history sources, it is to a large extent present in modern historical records. But in this context, with the help of political ecology framework of understanding water as a resource, it amply gets demonstrated that power relations have always played a crucial part in the way water has been managed by societies in any given period of time.
Map 3

Delhi's Historical Map showing some older cities comprising of Modern Delhi

Source: http://www.columbia.edu/itc/mealac/pritchett/00maplinks/modern/delhimaps/murray1909.jpg