

# Observations on Water Sensitive Planning and Design of Chandigarh

Dr. Nisar Khan  
Department of Architecture  
Jamia Millia Islamia, New Delhi

## *Abstract*

*Chandigarh is a city celebrated as an epitome of modern architecture and urban planning. Considered as the masterpiece by the Architect Le Corbusier, it is known for its brutalist architecture, grid iron layout, segregated landuse and well defined road network. However, one aspect that often gets circumvented in the discourse on Chandigarh is the integration of element of nature, especially the water bodies in the morphology of the city. The site of Chandigarh as located on the foothills of Himalayas is interspersed with a network of natural water streams and rivulets flowing from the mountains. Despite the rigid geometrical layout of the city this network of streams is seamlessly integrated into its form and structure. This paper presents an exploratory study on how these natural water bodies were included in the planning and hence resulted in the augmentation of the environmental conditions of the city.*

*Keywords: Chandigarh, Water, Landscape, Ecological, Planning*

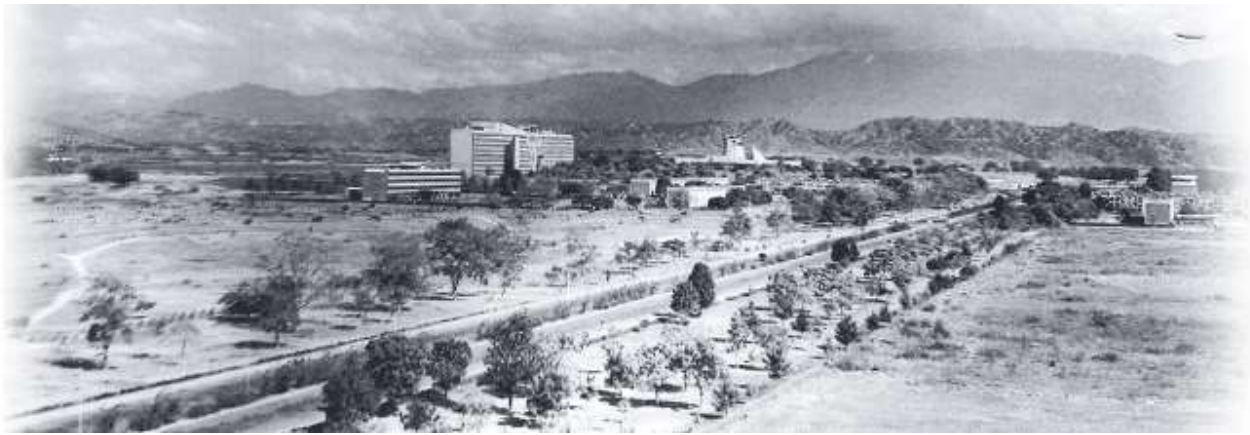
## **1. Introduction**

Chandigarh is the first planned city in the independent India. This city was planned as a new capital to compensate for the loss of Lahore to Pakistan due to the partition of British India in the year 1947. Chandigarh was planned by the architect Le Corbusier as per the vision of first Prime Minister Jawahar Lal Nehru, who wanted the city to present the future of the independent India and not dwell into the past. (Frampton 1980) Based on the Garden City principles, the city is an epitome of modern urban planning and architecture. The city became known for its grid-iron layout with elaborate road network, land-use zoning, neighbourhood sectors and brutalist architecture. (Curtis 1982) The planning principles of Chandigarh were so profound that they were replicated in the urban planning exercises across the country.

The built characteristics of the city are so powerful that they overshadow the discussion on the other aspects of the planning of the city. One such aspect is the integration of the water bodies like streams and rivulets in the city layout. It is interesting to learn how the city layout which is based on rigid and regular geometry integrated the irregular course of water streams in its structure. This integration of streams with the city layout was so seamless that it resulted in the augmentation of the urban environment. In the following sections the Author discusses how the natural streams and rivulets were integrated in the city planning of Chandigarh and augmented the environment.

## **2. Site Setting**

The site for the city of Chandigarh was carefully chosen on the foothills of Himalayas about 20 kms away from the town of Kalka and 45 kms from Ambala. The site was characterised by agrarian fields and rural villages with no major urban settlement located in the vicinity. The pristine nature of the site offered multiple advantages for the planning and design of the capital city. On one hand, the location offered large tract of almost flat land without any major constraints of the steep contours; it simultaneously provided a scenic background (See Pic-01) due to the presence of the Siwalik range of the Himalayas. (Kalia 1987) The site and its surroundings were interspersed with an intricate network of water streams and rivulets flowing from the slopes of the Siwalik range. A survey map



Pic 01: Early picture of Chandigarh showing the site setting in the foreground of Siwalik Range  
(Source: [http://chandigarh.gov.in/knowchd\\_gen\\_historical.htm](http://chandigarh.gov.in/knowchd_gen_historical.htm))

compiled in 1955 (See Map-01) shows this network of water streams prior to the construction of the city. This water network is a part of the watersheds flowing from the Himalayas and finally draining into the river Ghagghar located to the East of the site of Chandigarh. (Prakash 2002)

The interesting aspect and main focus of this writeup is how this water network was seamlessly included in the planning and design of the city by the architect Le Corbusier. Map-01 highlights that the extent of the new city (demarcated by the grey rectangle on the map) was defined by the two rivulets namely Sukhna Choa and Patali ki Rao in the east and west respectively. Another minor stream called Choa Nadi (also N-Choa) flowing intermediate of the two rivulets was included in the planning of the city. (Prakash 2002) These water bodies ensured continuous recharge of the aquifers,



Map 01: Site Setting of Chandigarh  
(Source: Sheet No. NH 43-8, Army Map Service, U.S. Army Washington D.C.)

which is the primary source of water for the city. It can be observed that while identifying the location of the city and defining its boundaries, the architect honoured the pre-existing watershed by carefully avoiding any fragmentation or change of course of the water streams. The significance of site selection can be appreciated by the fact that achieving this symbiotic situation between the watershed and the city could be uniquely achieved at this location only, because the streams are narrowly spaced in the vicinity making the land availability an issue.

The area north of the site and between the Siwalik range was a natural drainage basin feeding the Sukhna Choa and Choa Nadi. It was retained as an unbuilt zone and the Sukhna Choa was also utilised to create an artificial water reservoir called Sukhna Lake in the north end of the city. The Choa Nadi and Sukhna lake are discussed in the next section.

The orientation of the city also played a role in the water sensitive planning. It can be seen that the city is oriented diagonal to the cardinal directions, which aligns it with the Shivalik range and also makes it parallel to the direction of the flow of streams. By keeping the orientation of the city parallel to the water streams the continuity in the flow of water is maintained as it doesn't interfere with the structure of the city. The benefits of keeping city parallel to the water streams are elaborated in the next section. It may also be noticed that this diagonal orientation of the city is not as prescribed from the solar radiation point of view and required extensive use of shading devices to reduce the heat gain on the buildings.

Another important aspect related to the site selection is the proximity of the city with the river Ghaggar. The relationship between the rivers and the major cities is seen across the history of urbanisation. Even other planned cities of twentieth century like Gandhinagar, Bhubaneswar and Jamshedpur are located along the rivers namely, Sabarmati, Kuakhai, Subarnarekha respectively. The recently planned city of Amaravati, the new capital city of Andhra Pradesh is also located along the Krishna River. In the case of Chandigarh, this relationship of river and the city is negated. Unlike other cities, Chandigarh is located about 7 kms away (See Map-01) from the river Ghaggar. While the planning of the city includes the streams and rivulets in its morphology, it maintains a distance from the river itself. It is perhaps because the river Ghaggar is prone to flooding and changes course during the monsoons; due to this location being close to its origin at Dagshahi in the Himalayas. (Chaba 2019; Bhattacharya 2010) The distance from the flood plains of Ghaggar, safeguards the city against the flooding in the river during monsoons. (Saini 2012) Simultaneously, the availability of Sukhna Choa, Patiali ki Rao and Choa Nadi prevented any inundation within the city during the rains by acting as the drainage channels.

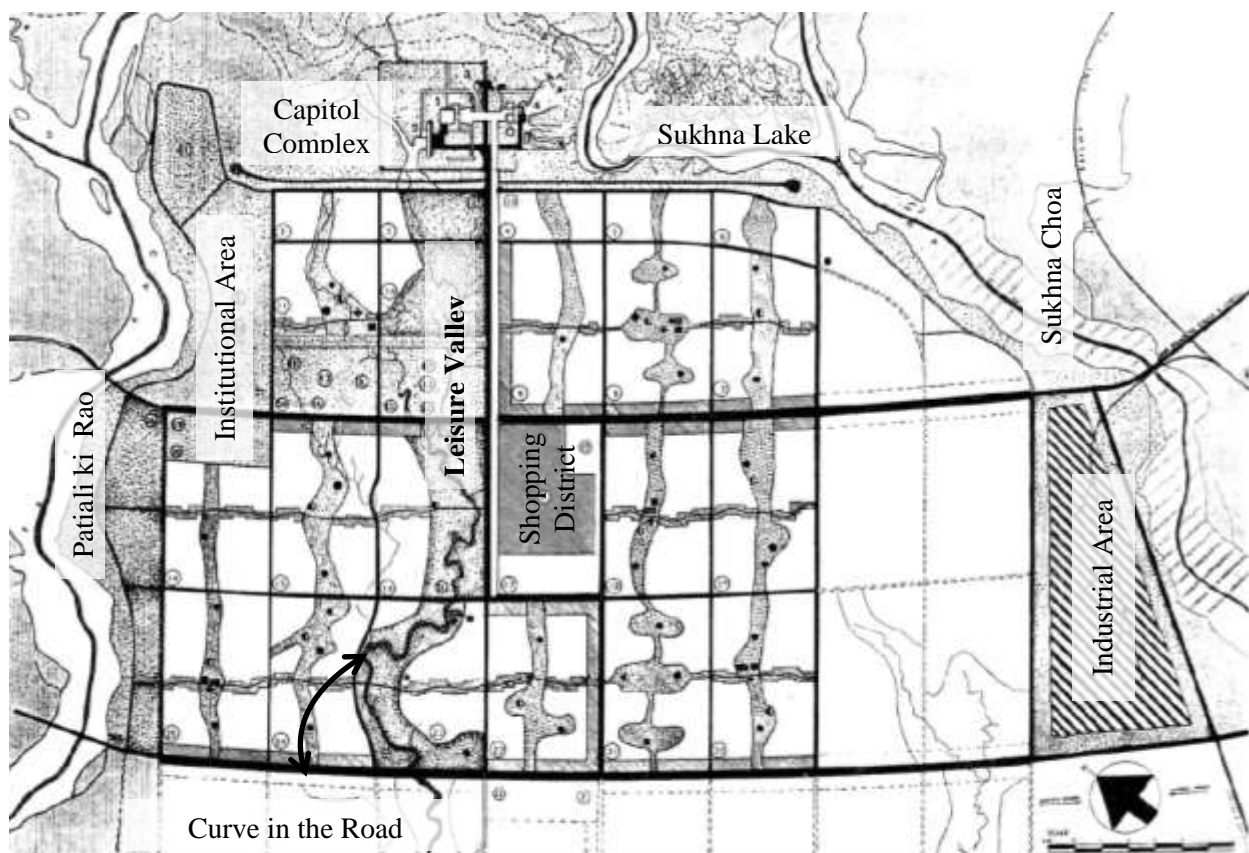
The site selection of Chandigarh away from the flood prone Ghaggar River can be further understood as a prudent decision when compared with the ongoing project of Amaravati located on the banks of Krishna, which is also a flood prone river similar to the Ghaggar. (Amaravati Development Corporation Limited 2018) As a result the site of new capital city of Amaravati which is planned right on the banks of the river is highly vulnerable to the floods. (Warrier 2016) As per a study by Indian Institute of Technology, Madras the 70% site of Amaravati is falling under flood hazard and may need to be elevated by 3 to 4 meters to mitigate the same. Consequentially, the floods of 2019 caused major devastation in the city and also the surrounding region. (Raghavendra 2020) As of now the project of Amaravati is stalled with flooding as one of the major reasons.

From the above discussion, it can be said that the selection of the location of the city of Chandigarh was a careful decision in establishing a symbiotic relationship between the water bodies and the city. The selection of site facilitated a fine balance between the drainage, mitigation of floods and water harvesting in the city.

### 3. Master Plan

The integration of the water features as discussed in the previous sections are pronounced in the master plan of the city. Similar to the site selection which is determined by the location of the water streams and rivulets, the form of the city was also dictated by the course of the Patiali ki Rao and Sukhna Choa rivulets. Referring to the Map-02 it may be seen that the width of the city is narrower on the top and it keeps on increasing as the two rivulets flow apart towards the bottom. It can be observed that the form of the city was governed by the course of streams rather than restraining or altering their flow. In addition to that, the flood plains along the two rivulets were designated as green belts, thus preserving the water bodies and creating a bio-diversity. Also, functions like universities and institutions were placed next to the green belt of the Patiali ki Rao to act as a buffer between the main city and the water body. (Corbusier 1961)

On the north side of the city a branch of Sukhna Choa was dammed to create a large water reservoir called 'Sukhna Lake'. The lake was a result of the planning of Corbusier along with Chief Engineer P. L. Verma. The lake has become the most significant recreational and ecological space for the city. The ecological relevance of the lake may be understood by its flora and fauna which includes a variety of fish, ducks, birds and even crocodiles were sighted on some occasions. In addition to the local species, many type of migratory birds inhabit the Sukhna lake and surroundings during the winters. (Chandigarh Administration n.d.) Apart from inhabiting rich bio-diversity, the promenade of the Sukhna lake has become major recreational and social space for the city. Residents of the city use this space for everyday recreational activities and it is the most preferred venue for the major cultural events.



Map 02: Chandigarh Master Plan of the initial phase (Source: FLC-ADAGP )

The importance of the Sukhna Choa in the planning of Chandigarh can be observed from the Map-02 where it can be seen that the Capitol Complex is slightly off the central axis of the city. The reason as it appears from the map itself is the course of Sukhna Choa which would otherwise need to be changed or filled in order to locate the Capitol Complex on the central axis of the city. In Chandigarh where geometry appears to be supreme; a compromise was made when it came to the flow of the water bodies. It seems that for Corbusier, his master piece the Capitol Complex and Sukhna Choa were equally important. While Capitol Complex is an architectural monument, Sukhna Lake created from Sukhna Choa is treated as a monument of water. The significance of Sukhna Lake for the planners of the city may be gauged by the fact that the ashes of Pierre Jeanneret, the partner and cousin of Le Corbusier, who was also the first Chief Architect of the city were immersed in the lake. Such social, ecological and spiritual amalgamation of functions related to a water body couldn't have been possible without the sensitive integration of the water bodies with the city plan.

The minor stream 'Choa Nadi' was already dried up when Chandigarh was being planned. Still Corbusier planned a green belt along the dried bed of Choa Nadi and called it 'Leisure Valley'. (Chalana 2014) The planning of Leisure Valley as a continuous green strip revived the water stream by restoring its catchment area. Running throughout the city for 8 kms, the Leisure Valley is planned as a parkland with a variety of landscaped spaces like rose garden, parks, orchards, war memorial, stadium etc located to meet the recreational requirements of the people of the city. Moreover, many city level institutional buildings like State Museum, City Museum, Natural History Museum, Art College etc are located in the Leisure Valley sectors. (Chandigarh Administration n.d.) (See Map-03) Thus, the planning of Leisure Valley addresses multiple functions; it acts as a city level green space for the people and also provides serene setting for the buildings housing cultural functions. Moreover, the Leisure Valley becomes an active and integrated recreational, social and



Map 03: Leisure Valley integrated with the city  
(Source: Chandigarh Museum )

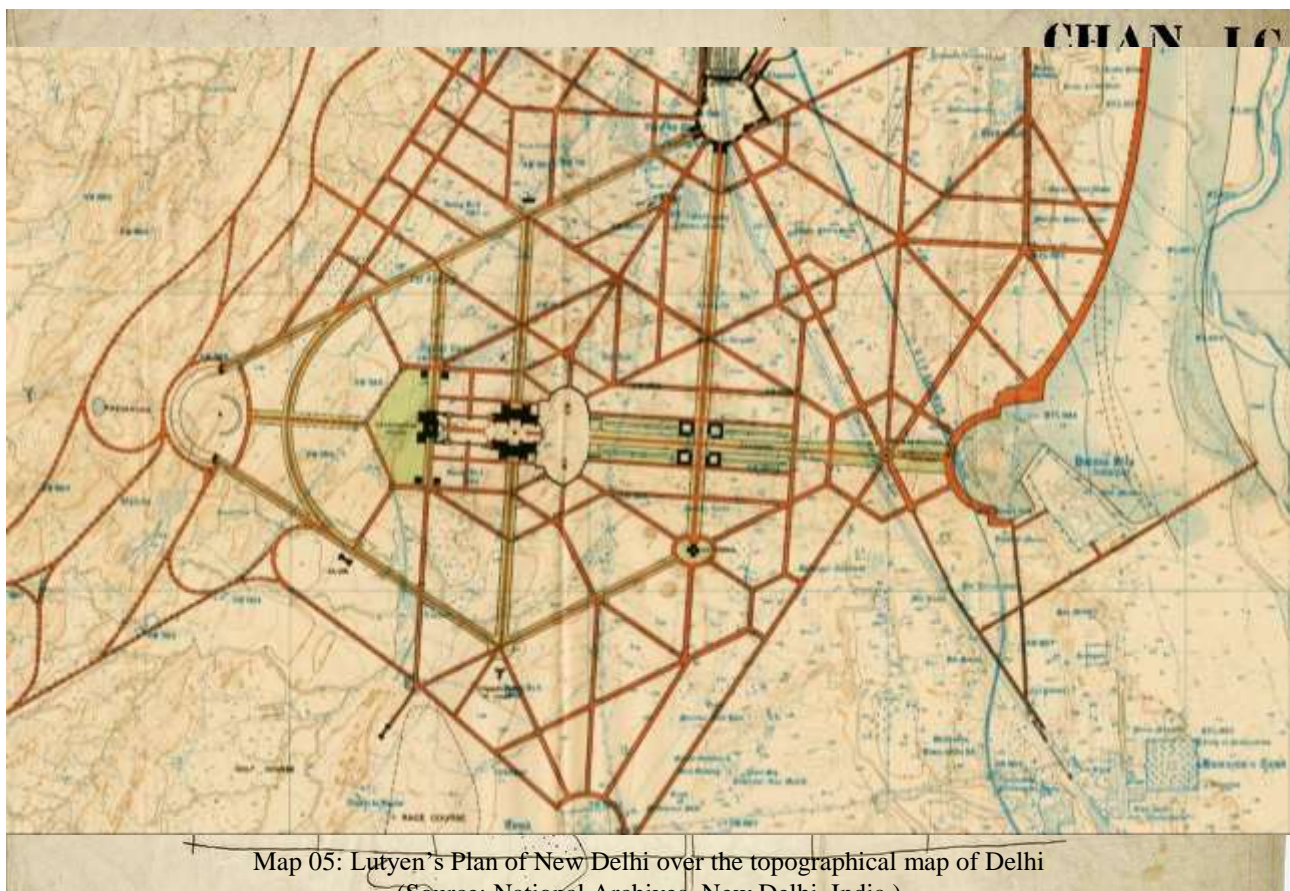
cultural space and most importantly facilitates the conservation of the Choa Nadi.

It can also be observed that while planning the Leisure Valley, the natural characteristics of the Choa Nadi were retained. No change in the natural course of the stream was made; as a matter of fact, a priority was given to the stream over the artificial interventions like roads and buildings. This is evident from the curve in the Udyan Marg between Sector 23 and Sector 24 (See Map-03) which was necessitated by the turn in the course of Choa Nadi at that location. It may seem surprising for many that Le Corbusier, who was very particular about the geometry of his designs, chose not to alter the course of a minor water stream over his perfectly regular city form. Clearly a preference was assigned to the water bodies over the city structure wherever necessitated.

Another, important aspect of water sensitive urban design in Chandigarh is that the natural cross section of the flood plains of these streams is retained and unlike many cities, canalisation of water

bodies into promenades is not carried out. One recent example of canalisation is Sabarmati river project in the city of Ahmedabad, which is criticised for the adverse affects on the ecology of the river.(Mathur 2012) Since, canalisation alters the natural flow of water in a stream, its self cleaning ability is affected and flora and fauna is destroyed; it can be highly appreciated that despite the very rigid planning of Chandigarh the natural character of the water bodies was retained. By doing this the water bodies became habitat for rich bio-diversity in the city. The preferential consideration by Le Corbusier for the water bodies in the planning of Chandigarh is also evident from the drawings he made, where the water streams are prominently illustrated. In the conceptual sketches (See Map-04) and the master plan drawings made by Le Corbusier himself, the presence of the Patiali ki Rao, Sukhna Choa and Choa Nadi is depicted at par with the road network and buildings; which conveys the conscious intention to integrate them into the form and structure of the city.

The concept of Leisure Valley is replicated by providing continuous green belts (See Map-02) in every sector. These green belts are parallel to the Leisure valley which is also the direction of the natural drainage of streams as mentioned earlier. While this set of green belts act as the landscape and ecological network in the city, it can also be understood that their form and alignment is ultimately derived from the direction of flow of natural streams. Similarly, the road network also follows the same alignment as that of the direction of the flow of the streams. The longitudinal roads running from the top to bottom are automatically aligned parallel to the streams. This arrangement makes the drainage and sewer network which is located parallel to the roads much more effective. It can be interpreted from the above discussion that the overall structure of the Master plan of Chandigarh comprising of grid-iron road network, continuous green belts, sectors etc is actually a response to the pre-existing streams and rivulets. The architect not only acknowledged the presence of these water bodies but also included them into the city planning and design. It can be said that the planning and design of Chandigarh was not only sensitive to the water streams and rivulets but also integrated them with the city and its people.



Map 05: Lutyen's Plan of New Delhi over the topographical map of Delhi  
(Source: National Archives, New Delhi, India )

Map 04: Conceptual Sketch of Chandigarh by Le Corbusier (Source: FLC-ADAGP)

The approach of Le Corbusier in integrating the water bodies into the green belts and structure of the city can be appreciated for its time when new city projects were undertaken with a bulldozer approach and the sites used to be extensively modified to accommodate the geometry of a city layout. (McHarg 1971) One prominent example of such insensitive approach is the planning of New Delhi which is the predecessor of Chandigarh in India. (Refer Map-05) Like Chandigarh, New Delhi was also planned on the Garden City principles by the British Architect Sir Edwin Lutyens in the early 1900's. However, the manner in which the two cities dealt with the pre-existing water bodies is contradictory to each other. (Moulis 2012)

The site for New Delhi is located on a historical geography where Aravali range is on the west and the land slopes down to the River Yamuna on the east. The New Delhi planned in a star like geometrical pattern ignored the presence of the network of streams on the site. (Wescoat 2016) While in Chandigarh the pre-existing water streams were included in the landscape of the city; in New Delhi the site was modified to act as the clean slate for the new city. The Central Vista from India Gate to Rashtrapati Bhawan which is the central green space in the New Delhi and may be considered equivalent to the Leisure Valley of Chandigarh comprises of manicured lawns and large rectangular water pools located on the either side of the central boulevard. (Byron 1931)

Le Corbusier was impressed with New Delhi and even carried out a comparative study of his plan of Chandigarh with that of the city. (Frampton 1980) However, his approach towards the natural water bodies was more inclusive than the Lutyens approach in New Delhi. It seems that apart from the wide roads he didn't borrow much from the Lutyens planning. While, New Delhi exhibit strong discipline and control (similar to that of British rulers over Indian subjects) over the nature and environment, Chandigarh lets the nature co-exist with the city.

#### **4. Issues**

Le Corbusier planned Chandigarh as a city in harmony with the elements of nature within the city and its surroundings. He meticulously integrated the hills, vegetation, rivers, streams, slopes, agricultural fields, natural drainage etc in the planning and form of the city. He was careful in not altering the natural character and behaviour of the water bodies in the planning of Chandigarh. This harmonious relationship between nature and the city is critical for its identity and functioning. In the past few decades, rapid urbanisation in the surroundings of the city has taken place; threatening the relationship of nature with the city. Numerous planned and unplanned settlements have started to emerge soon after the city became functional, namely the cities of Panchkula and Mohali are planned on the east and south of Chandigarh and now form a Tri-City agglomeration. Rapid unorganised urbanisation is taking place along the major highways emanating from the city. Besides this the rural villages in the surroundings of the city have now become urbanised and grown many times from their earlier size. Needless to say that this urban expansion has altered the natural setting of the city and affected its environment as well.

The most critical case is the unplanned development to the north of the Capitol Complex. This land between the Capitol Complex and Siwalik range originally marked the presence of couple of villages, namely Kansal and their agricultural fields. This land also accommodates the drainage catchment which feeds the Patiali ki Rao, Sukhna Choa and Choa Nadi. However, the site is witnessing large scale unplanned expansion of the villages in the past few years. Open agricultural land is subdivided into plots and construction of private residential as well as commercial buildings is taking place. A comparative study of satellite images from the year 2002 and 2019 (Refer to Map 6(a) and 6(b)) show the increase in the built area on this patch of land. It can also be observed from the satellite images that the unplanned construction is located close to the water streams and thus has resulted in the encroachment of their flood plains. Also discharge of sewage and disposal of solid waste in these

water bodies restricts the flow of water and pollutes the downstream. Most importantly this unplanned urbanisation on this tract of land has caused the fragmentation of the watershed.

The effects of the unplanned urbanisation is seen with the significant decrease in the water levels in the Sukhna Lake in the recent years. While, siltation is another factor in the reduction of its water volume; the flow of water from the hills has also reduced over the period of time. As a result the area of the lake has reduced by half of its original 228 hectares in the year 1958. (Sareen 2017) Similarly, the flow of water is reduced in the Choa Nadi flowing through the Leisure Valley due to this unplanned construction. The situation of Patiali ki Rao is far worse as it is bearing with the large scale of unregulated urbanisation along its course. Rajendra Singh, known as the Water Man of India emphasised on understanding the behaviour of the catchment area of the Sukhna Lake in order to restore it, implying to restore its natural environment. (Singh 2018)

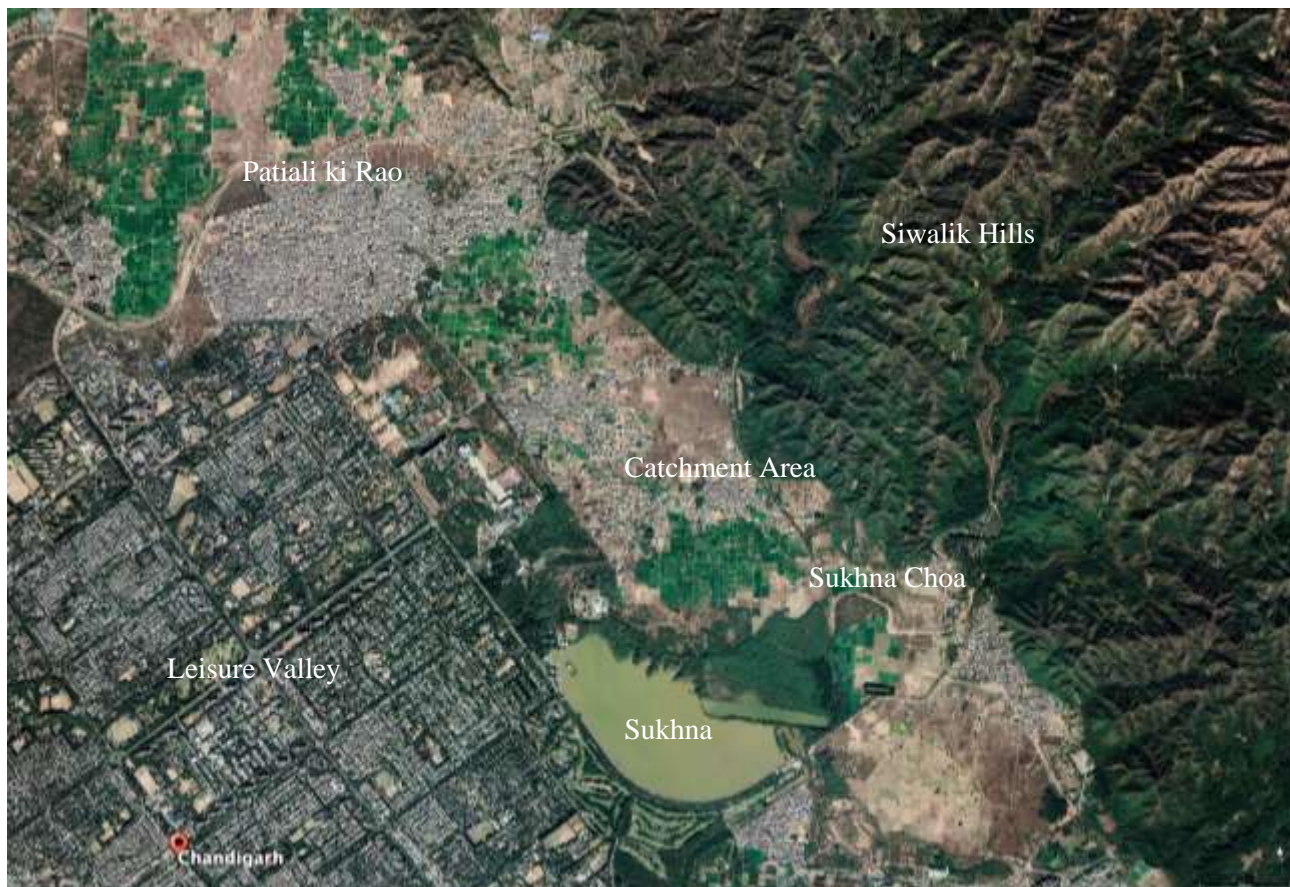
Le Corbusier did not want any construction to take place on the patch of land between the city and the hills. In fact he considered the agricultural fields and the hills in the backdrop as sacred and considered unregulated construction activity in the greenbelts equal to profanity. (Samuel 2007) He was so particular about retaining the catchment area as the unbuilt zone that he got an Army Head Quarter project stalled by seeking direct intervention of Prime Minister Nehru at that time. (Kalia 1987) Knowing that any change in the natural surroundings will adversely affect the city, Corbusier proposed a greenbelt around the city, perhaps another derivative from the Garden City movement. The provision of greenbelt around the city was governed by passage of the Periphery Control Act in the state legislature in the year 1952. The objective of the Periphery Control Act was to prevent any change in the natural conditions in the city surroundings by restricting any development within 5 miles of the edge of the city on all sides. In the year 1962 the Periphery Control Act was amended to extend the periphery to a radius of 10 miles. (Chalana 2014)

However, the Periphery Control Act failed to restrict the development in the proposed greenbelt around the Chandigarh. Both government and private actors exploited the inconsistencies in the letter and the spirit of the Periphery Control Act. As a result the implementation of the Periphery Control Act was not as per the vision of Corbusier. Many planned and unplanned settlements have emerged





Map 06(a): Satellite Image of Northern part of Chandigarh in 2002 (Source: Google Earth)



Map 06(b): Satellite Image of Northern part of Chandigarh in 2019 (Source: Google Earth)

over the period of time in the controlled periphery of Chandigarh making it appear like a large urban

agglomeration. It is a tragedy that the unregulated and unplanned urbanisation in the periphery is now threatening the character and environmental balance of the city. Currently, while we celebrate the city for its planning and architecture; we have ignored the continuous breach in the designated greenbelt. The urban expansion beyond the edges of Chandigarh is so vast and unregulated that the setting of the city is altered beyond repair. It requires urgent interventions to restore the setting as much as possible. At least the zone north of the Capitol Complex which is crucial and not yet consolidated with urbanisation must be vacated and restored as the ecologically sensitive zone like the Siwalik range itself, which is notified as a reserved forest.

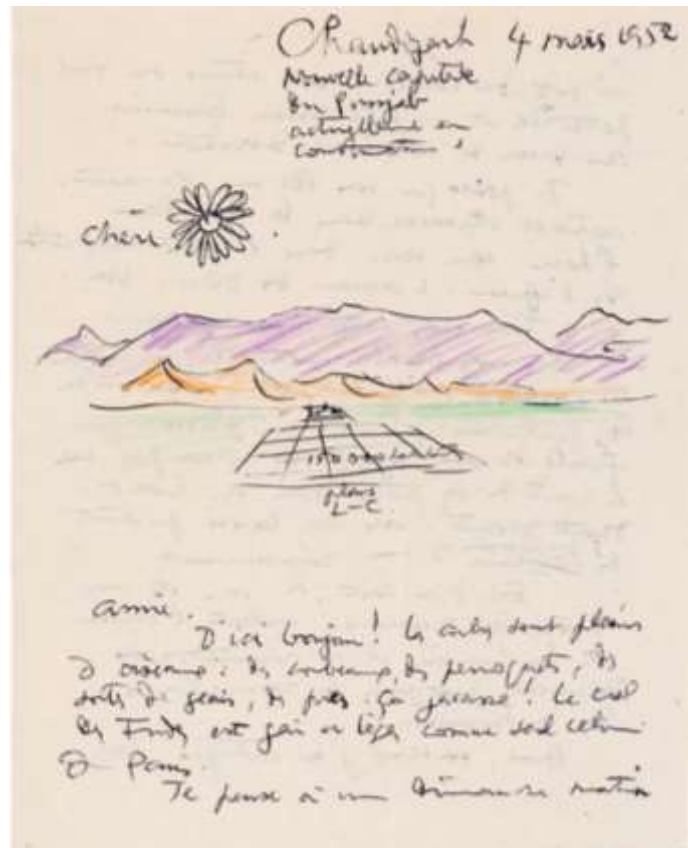
## 5. Conclusion

Le Corbusier assigned elements of nature like water, vegetation, sun and moon a sacred status which surprisingly has been part of Indian traditions since forever. (Kalia 1987) It was perhaps this dogmatic notion of sacredness for the elements of nature that compelled Corbusier to retain the water streams in their natural state. He was also inspired from the description of garden of Eden in the Bible and it seems that he wanted to replicate them in Chandigarh. (Prakash 2002) In order to achieve this he integrated the water streams with a variety of trees and vegetation along the flood plains. The combination of water and greenery created a natural environment which then resulted in the inhabitation of many species of birds, insects and animals. This rich bio-diversity presents almost a surreal experience to the urban dwellers of the city. Author, himself has experienced the combined effect of trickling of water in the stream with the chirping of birds and insects, breeze laden with the aroma of flowers combined with the visual pleasure of witnessing nature amidst the city to be out of the World.

Corbusier's approach towards elements of nature and specially water bodies was inclusive. It is evident from many sketches (See Pic-02) and writings of Le Corbusier that he wanted the city and the nature to co-exist and compliment each other. In his Final Testament which he wrote before his death, the idea of 'wedding' of straight line (which represent the planned city) with the axis of nature was proclaimed.

'We must rediscover man. We must rediscover the straight line wedding the axis of fundamental laws: biology, nature, cosmos. Inflexible straight line like the horizon of the sea.' (Corbusier 1997)

As discussed in the paper this approach resulted in the conservation of natural water bodies, generation of rich bio-diversity, augmentation of environmental conditions and creation of socio-cultural spaces in the city. Such multifaceted approach was far ahead of its time and is highly relevant in the present situation when our cities are facing water crisis and urban flooding at the same time. The solution to the water and environmental bodies and natural elements as sacred and inte



Pic 02: Sketch of Chandigarh by Corbusier showing the relationship of Nature with the City.  
(Source: FLC-ADAGP)

## References:

- Amaravati Development Corporation Limited (2018). Amaravati Flood Mitigation Works: Environmental Impact Assessment – Environment Management Plan Report. Retrieved from <http://documents.worldbank.org/curated/en/334341534487697595/pdf/Environmental-Impact-Assessment-Environment-Management-Plan-Report-for-Flood-Mitigation-Works.pdf>. Accessed on 01.05.2020.
- Bhattacharya, Swarup & Kumar, Vineet (2010). Unprecedented floods in Ghaggar Basin. Retrieved from <https://sandrp.files.wordpress.com/2018/03/an-analysis-of-the-flood-disaster-in-ghaggar-basin-in-july-2010.pdf>. Accessed on 22 April 2020
- Byron, Robert (1931). New Delhi: The Architectural Review. Vol LXIX No 410. January 1931. London.
- Chaba, Anju Agnihotri (2019). Explained: Why Ghaggar overtops its banks often. Retrieved from <https://indianexpress.com/article/explained/why-ghaggar-overtops-its-banks-often-5846301/>. Accessed on 21 April 2020
- Chalana, Manish. (2014). Chandigarh: City and Periphery. Journal of Planning History. 14. 62-84. 10.1177/1538513214543904.
- Chandigarh Administration. Retrieved from <http://chandigarh.gov.in>. Accessed on 01.05.2020
- Corbusier, Le (1927). Towards a New Architecture. Brewer, Warren & Putnam, Inc. New York.
- Corbusier, Le (1961). The Master Plan. Marg 15. Marg Publications. Mumbai.

- Corbusier, Le (1997). *The Final Testament of Pere Corbu*. Yale University Press.
- Curtis, William J.R. (1982). *Modern Architecture Since 1900*. Phaidon.
- Frampton, Kenneth (1980). *Modern Architecture: A Critical History*. Thames & Hudson Ltd. London.
- Kalia, Ravi (1987). *Chandigarh: The Making of An Indian City*. Oxford University Press. New Delhi
- McHarg, Ian L. (1971). *Design with Nature*. Natural History Press. New York.
- Mathur, Navdeep (2012). On the Sabarmati Riverfront. *Economic and Political Weekly*. XLVII (47–48).
- Moulis, Antony (2012) An exemplar for modernism: Le Corbusier's Adelaide drawing, urbanism and the Chandigarh plan, *The Journal of Architecture*, 17:6, 871-887, DOI: [10.1080/13602365.2012.746043](https://doi.org/10.1080/13602365.2012.746043)
- Prakash, Vikramaditya (2002). *Chandigarh's Le Corbusier- The Struggle for Modernity in Postcolonial India*. Mapin Publishing. Ahmedabad.
- Raghavendra, V (2020). At least 70% of Amaravati prone to floods: IIT-Madras. Retrieved from <https://www.thehindu.com/news/national/andhra-pradesh/at-least-70-of-amaravati-prone-to-floods-iit-madras/article30545011.ece>. Accessed on 01.05.2020
- Saini, S.S., & Kaushik, S.P. (2012). Risk and vulnerability assessment of flood hazard in part of Ghaggar Basin: A case study of Guhla block, Kaithal, Haryana, India.
- Samuel, Flora (2007). *Le Corbusier in Detail*. Elsevier Limited. Burlington.
- Sareen, Jaidip (2017). Chandigarh's Once-Beautiful Sukhna Lake Goes Dry, Shrunk by 57%. Retrieved from <https://www.thequint.com/news/environment/chandigarh-sukhna-lake-dry>. Accessed on 25.04.2020
- Singh, Rajendra (2018). Interview titled 'Sukhna Lake is dead, its capacity to discharge and recharge is over'. Retrieved from <https://indianexpress.com/article/cities/chandigarh/sukhna-lake-is-dead-its-capacity-to-discharge-and-recharge-is-over-rajendra-singh-5147918/> published on 23.04.2018. Accessed on 25.04.2020
- Sharma, Sangeet (2009). *Corb's Capitol: A Journey Through Chandigarh Architecture*. Abhishek Publications. Chandigarh
- Warrier, S. Gopikrishna (2016). Amaravati site floods thrice a year. Retrieved from <https://www.thethirdpole.net/2016/02/12/amaravati-site-floods-thrice-a-year/>. Accessed on 01.05.2020
- Wescoat, James L. (2016). Barahpullah Nallah and Its Tributaries: Watershed Architecture in Sultanate and Mughal Delhi. In Jutta Jain-Neubauer (Ed.) *Water Design: Environment and Histories*. Marg Publications. Mumbai.