Daylighting an Urban Creek: A Latin American Utopia?

The Case of la Playa Urban Ecological Corridor. Medellín, Colombia.

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ABSTRACT

"Daylighting" waterways (also known as stream restoring) is a concept that has been gaining popularity in the United States and Europe over the last three decades but in Latin America less so. There is significant evidence of daylighting projects of creeks within cities, which have represented important contributions to the improvement of environmental quality of life in their urban surroundings. Santa Elena Creek has an important historical value for Medellín's community that is not recognised by younger generations who do not even know of its existence. Santa Elena Creek runs under La Playa Avenue, one of the most traditional avenues in the historical center of Medellín. In the 1930s, with the growth of the city and rapid population increase, a process of covering the creek with paving began, in order to remove the creek from the core of the city. It was considered an obstacle in the urban development of Medellín. Today the creek remains buried under La Playa Avenue, representing a lost sense of cultural and historical identity.

Addressing daylighting urban creek projects presents technical, legal and economic challenges. This project is based on a theoretical framework, as well as on case studies provided in relevant literature sources, most of them research reports from governmental organisations. A design approach is developed based on the results of the analysis and the theoretical approach taken from foreign experiences and adapted to the Latin American urban context.

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INTRODUCTION

With the rapid urban expansion of Medellín during the first decades of the 20th century, a product of the city's heavy industrialisation, Santa Elena creek became a nuisance for the city's urban development. The water quality was a public health problem due to urban pollution and the goal of city planners was to hide it from the public. This goal was influenced by the practices of covering creeks seen in other cities around the world. In addition to technological and scientific changes that influenced the planning of Medellín, signs of modernism such as the introduction of the automobile, played a leading role in the urban development of the city. In the late 18th and early 19th century the creek was an ornamental water corridor with big trees and beautiful bridges, used by pedestrians and carriages. However, in the 1930s, with the growth of the city and population increase, a process of covering this corridor with paving began, in order to remove the creek across the core of the city (figure 1). It was considered an obstacle to the urban development of Medellín. The covering process lasted from the early 1930s until 1950 (Posada, 2005) (figures 2).

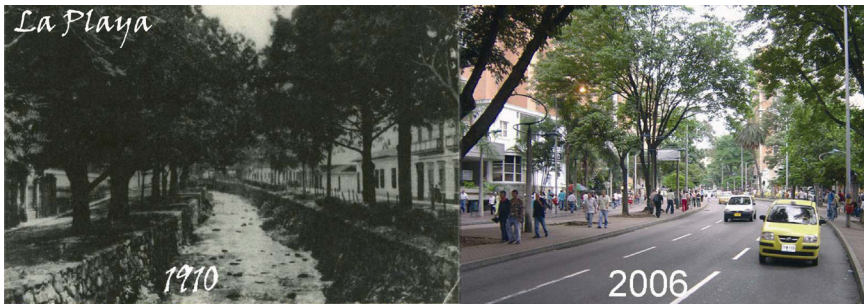


Figure 1: Picture showing Santa Elena Creek before and after culverting from El Palo street. Source: 2006, courtesy of Prof. Luis Fernando Arbelaez. 1910,Patrimonio digital de la Biblioteca Publica Piloto.Medellin.

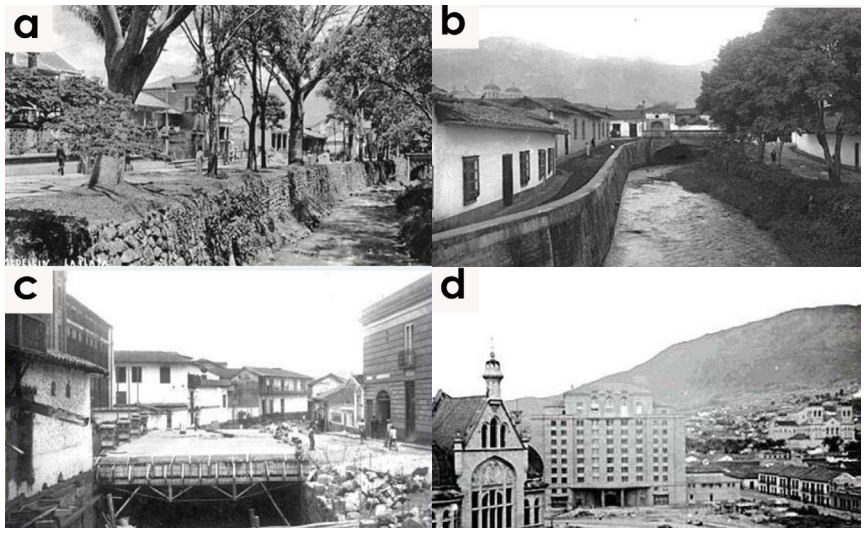


Figure 2: Santa Elena creek Culverting process: a.1897. b.1900. The city had already expanded beyond the creek that used to be its northern limit (left) c. 1925.First phase of culverting project between Junín and Palace Avenues d. 1949. Last phase of Culverting process between Oriental and Giraldo Avenues. Source: courtesy of Medellín Metropolitan Planning Office.

Today, the creek remains buried under La Playa Avenue. The main goal of this study is to generate awareness of the importance of daylighting buried waterways for the urban ecosystem of cities in Latin America, as well as the promotion of daylighting waterways as a viable alternative for the improvement of urban life - not only in Medellín, but also in other Latin American cities.

DAYLIGHTING

Waterway daylighting is "[t]he term [that] describes projects that deliberately expose some or all of the flow of a previously covered river, creek, or storm water drainage" (Pinkham 2000. p.7). There is significant evidence of daylighting projects of creeks within cities, which have made important contributions to the improvement of environmental quality of life in their urban surroundings[1]. According to Pinkham, daylighting an urban creek provides an important contribution to the improvement of the urban environment through the ecological re-integration of waterways to the city (2000, p.7), while at the same time improving the cityscape through the potential provision of open public spaces.

PROBLEMS RESULTING FROM CULVERTING SANTA ELENA CREEK

When a river, creek or stream is buried, it loses its natural physical function (Buchholz and Younos, 2007, p. 9). In other words, when a water source is culverted a significant connection to nature is lost. Santa Elena creek has not only lost its environmental but also its historical importance for Medellin's community, representing a lost sense of cultural and historical identity. As Pinkham states, "[...] studies show [... that] unfortunately, most urban dwellers have no idea that streams run underneath their feet."(2000. p.6). Medellín is not an exception to this affirmation and it is believed that future generations will be completely unaware of the existence of this water resource below the city surface. There are, therefore, also issues of cultural heritage to address.

Furthermore, the volume of water flowing into the underground pipes has increased due to population growth and urban expansion and now, during heavy rainy seasons (common in a tropical city as Medellin), the pipes get blocked and water overflows onto streets and adjacent buildings. Santa Elena Creek sometimes exposes a chaotic flooding problem that in combination with the steep topography of the creek and garbage disposal by some locals causes ecological deterioration and a hazard for the surrounding population.

POTENTIAL BENEFITS OF DAYLIGHTING SANTA ELENA CREEK

The success of 37 case studies on waterway daylighting in the US and Europe, analysed by The Virginia Water Resources Research Center (Buchholz and Younos, 2007) and the Rocky Mountain Institute (Pinkham, 2000), gives a paradigmatic and pragmatic framework which adapted to Medellín's context, presents multiple benefits. Daylighting Santa Elena Creek would increase its hydraulic capacity which would relieve the flooding episodes resulting from the under-capacity of the culvert. At the same time, with an open basin the flow velocity would reduce and the creek could be monitored more easily (Pinkham, 2000. P.4) (figure 3) Its monitoring and maintenance process would therefore

Figure 3: Mouth of culvert. maintenance process. Source: courtesy of Medellín Metropolitan Planning Office.

Figure 4: Panning gold in Santa Elena Creek. Source: courtesy of Medellín Metropolitan Planning Office.

be significantly reduced. Ecologically, the open basin would "improve water quality by exposing water to air, sunlight, vegetation, and soil, all of which help transform, bind up, or otherwise neutralize pollutants" (Pinkham, 2000. P.4), as well as being a potential riparian and wildlife habitat and re-linking the relationship between community and nature. Furthermore, daylighting Santa Elena Creek would improve the cityscape of Medellín, and provide opportunities for public recreational outdoor spaces. Another economic benefit would be the increased value of surrounding properties.

WHY IS SANTA ELENA CREEK IMPORTANT FOR MEDELLÍN AND A POTENTIAL DAYLIGHTING PROJECT?

At the beginning of the 20th century, Santa Elena Creek was not only one of the most important urban referents for the city where daily activities such as panning gold (figure 4) and washing clothes took place, but its water was also used to generate electricity and to supply the population with drinking water (Paneso, 2011). Santa Elena Creek has played an important role in the urban development of the city since its foundation (figures 5). The city was founded in 1675 on the intersection of the Medellín River and Santa Elena Creek (Pelaez, 1996. P.1).

The daylighting of Santa Elena creek is a relevant project for Medellín. This project can work in line with the government strategy initiated by Dr. Sergio Fajardo[2] and continued by the administration of Alonso Salazar. According to Martigoni, this governmental strategy "seeks to qualify and redefine guidelines for the preservation and/or construction of natural features and public and private structures and help blur, through democratised spaces, […] that range from new waterfronts and plazas to social programs, such as public libraries and schools, strategically placed in degraded neighbourhoods" (2009). It is believed that restoring this creek in the historical core of the city would play a positive role in the local cultural identity of Medellín.

Currently, the Empresa de Desarrollo Urbano (EDU[3]) has a proposal for a linear park along Santa Elena creek (see figure 6) to rejuvenate the deteriorated basin and provide a place for recreation and social interaction. The construction of this park was proposed along 4.2 km where the creek is open air (the culverted length is not even mentioned) and surrounded by non-planned settlements (Ruiz, 2010). Daylighting Santa Elena creek is relevant for a possible continuation of that linear park through the city centre.

METHODOLOGY

The daylighting of urban creek projects presents technical, legal and economic challenges. The present study is based on a theoretical framework, as well as on case studies provided in relevant literature sources including research reports from governmental organisations.

Figure 5: a. Medellín plan 1675 foundation b.Medellín plan 1800 c. plan 1908. D. Medellín 1966. Source: Restrepo Uribe, J., (1981) Medellín su origen, progreso y desarrollo. p.210. p 228. p.218.p.249.

They provide a good understanding of the significance, process and achievements of successful daylighting projects in the US and Europe. This theoretical approach was then placed in the Colombian context. Firstly, historical research was undertaken, in order to determine the cultural importance and physical characteristics of the creek. Then, different aspects of the current conditions of La Playa Avenue, such as socio-cultural factors (i.e. existing educational institutions, theatres, libraries), natural elements (i.e. topography, existing vegetation) and urban spatial aspects (i.e. mobility, housing) were analysed. Further, interdisciplinary technical support was necessary to gain access to information on current conditions of the culvert and hydrological data from engineering was required to develop recommendations (i.e. the reduction of the supercritical flow of the creek as a result of the steep topography using Manning's equation)(see figure 8). Finally, a design approach was developed based on the results of the analysis and the theoretical approach taken from foreign experiences and adapted to the Latin American urban context.

Figure 6: Linear park (Bicentenario Park) under construction along the open air basin of Santa Elena Creek. Courtesy Empresa de Desarrollo Urbano (EDU). Medellin

AREA OF STUDY

La Playa Avenue is located in the historical urban core of the city of Medellín, Colombia. This avenue is part of the result of the culverting of Santa Elena Creek in the mid-1900s. It is in the central-eastern part of the city of Medellín where the Valle de Aburra gains more width.The avenue runs an East-West direction. This project is focused on the four blocks between Giraldo and Oriental Avenues. Santa Elena Creek is one of the biggest creeks in the Valle de Aburra. Its source is located

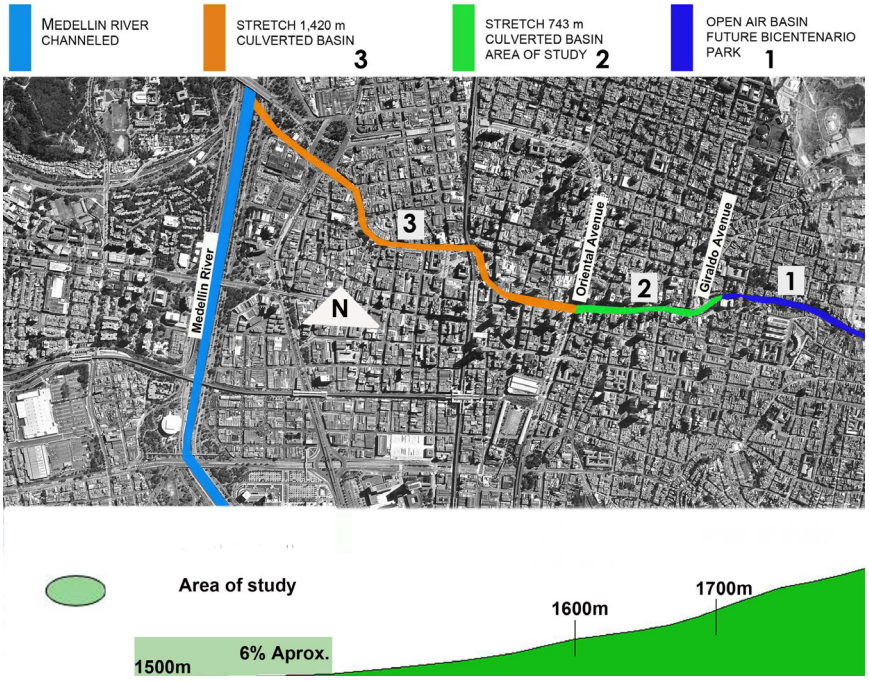


Figure 7: Area of study located between Oriental and Giraldo Avenues. Some physical aspects of the site analysis.

on the contour line 2,700 msnm (meters over sea level) and flows into Medellín River at 1,460 msnm. Its area is 45.61 km2 and its length is 14.3 km.

TECHNICAL CHALLENGES OF DAYLIGHTING SANTA ELENA CREEK

According to Pinkham, the more urban the project's location, the greater the presence of technical issues. The more confined the potential project corridor, the more difficult it will be to solve problems (Pinkham, 2000. P.9). Corresponding to this, the daylighting of Santa Elena Creek can be considered a challenging project due to its location in the core of downtown Medellín. La Playa Avenue, which runs over it, has been a road with high vehicular traffic for decades and its sides are consolidated as an urban corridor with a high occupation index. However, case studies demonstrate that daylighting projects can be feasible, even in dense urban areas. The vehicular traffic issue is considered one of the challenges in this study. However, every year The Planning and transportation Office of Medellin demonstrates how it is possible to remove traffic from the central lane of La Playa Avenue (under which the Santa Elena Creek runs) during the daily Christmas lights events in December.

Waterways daylighting projects should have expert technical assistance to identify and solve problems. Among the technical questions that arose for this project are those related to the safety features of the new open channel, especially flow control (which is supercritical according to the hydraulic analysis conducted for this research and which will be studied in detail later), maintenance, appropriate vegetation, accessibility for the disabled, sedimentation control, pollutants, waste and accuracy of

the original basin for its re-opening. For the latter, there is substantial information available at the Municipal Planning Office of Medellín, such as historical photographs and technical reports which can provide accurate information about the condition and location of the underground channel.

TOPOGRAPHY AND FLOW MODIFICATION

The result of the analysis of Santa Elena's flow[4] was that the studied stretch of the creek presents a supercritical flow (high velocity) which represents a hazardous situation for daylighting the creek. This situation is caused by the steep topography of the creek. To solve this situation and make the creek's flow manageable (subcritical flow) it is proposed to reduce the current 6% slope to 3%. This slope change was achieved through a waterfall of 2 metres, with a modification of the slope of the channel and the placement of boulders to minimise the water flow especially during heavy storms (see figure 9). In this process, the flow equation (Manning's equation) was helpful to make decisions about different possible variables, as the table (figure 8) shows:

Variable	Value	Unit
n	0.04	---
A	33.60	m2
R	1.28	m
S	0.06	---
Q	277.57	m3/s
V	8.26	m/s

Variable	Value	Unit
Base	9.60	m
Height	3.50	m
Perimeter	26.20	m
Gravity	9.81	m/s2
Froude	1.41	---
Flow Type	Supercritical	

Existing

n = Roughness (for large rocks in this case)
A = x -sect. area (m2)
R = Hydrology rarius(A/P)
S = Slope
Q = Flow
V = Velocity

A	B	C	D	E	F	G
Variable	Value	Unit		Variable	Value	Unit
n	0.04	---		Base	9.60	m
A	33.60	m2		Height	3.50	m
R	1.28	m		Perimeter	26.20	m
S	0.03	---		Gravity	9.81	m/s2
Q	196.27	m3/s		Froude	1.00	---
V	5.84	m/s		Flow Type	Subcritical	

Proposed

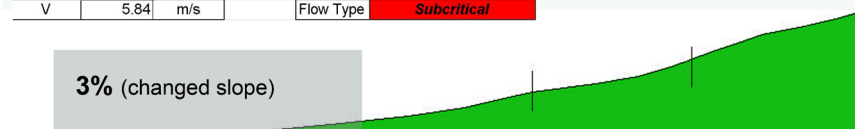


Figure 8: Manning's Equation with Santa Elena existing values and proposed values that imply physical modifications for a manageable flow.

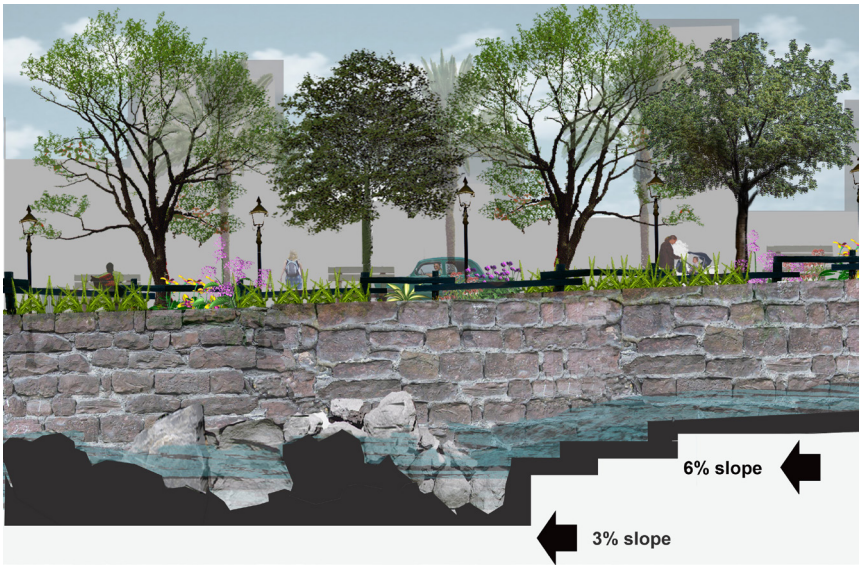


Figure 9: Photomontage (Section E). showing proposed slope modification and the use of boulders for flow control.

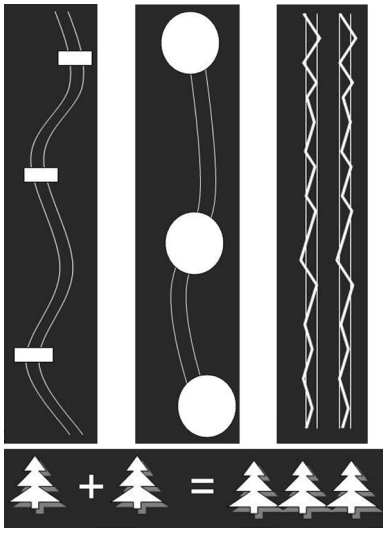


Figure 10: Conceptual ideas: Connectivity, Gathering, Greenbelts, Conservation

DESIGN APPROACH

The final part of this study consists of a design proposal of an urban ecological corridor through the daylighting of Santa Elena Creek (figure 11) based on the results of the site analysis and the theoretical approach taken from foreign experiences and adapted to the Latin American urban context. It is important to mention that the design is a general schematic approach and does not go into technical details.

The design approach is based on a conceptual idea that takes into account the current condition of the creek and its historical importance for future generations. The project is marketed with the slogan: Re+Thinking the present, Re+Opening the past, Looking to the Future , which is the inspiration for the creation of the urban ecological corridor's leading four objectives: (see figure 10):

1. Connectivity: To allow uninterrupted circulation along the path, while permitting the dynamic activity of La Playa Avenue without barriers and connecting both sides. (figure 12).

The project involves environmentally friendly mobility through the creation of a pedestrian path with alternatives of other eco-transportation modes such as bikes, skates, etc. along La Playa Avenue. The mentioned path would be accompanied by native vegetation and appropriate urban furniture that provides comfort and safety for users.

In order to provide a circulation following LA Playa's dynamic urban life, a meandering path is proposed (see figure 11). This shaping idea came from a combination of the metaphor of the movement of the water and the pedestrian circulation patterns along the avenue.

2. Gathering: To create public gathering spaces in strategic places to improve social interaction.
As result of the socio-cultural analysis of the site, three public spaces for small events relevant in this area of the city and located at strategic sites are proposed along the urban ecological corridor. Currently, some of these activities take place on sidewalks or inappropriate public spaces. The location and proposed functions (the functions can be flexible) are as follows:

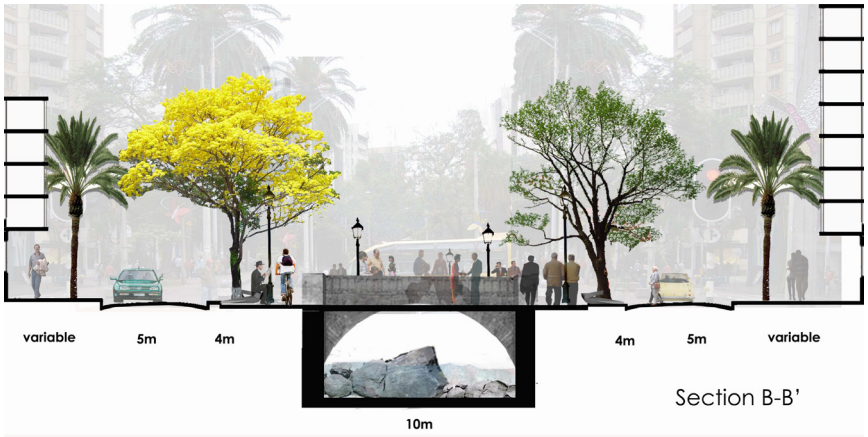
- Poetry reading and small performances at Plaza del Poeta (Poet's plaza), located in front of the Pablo Tobon Theater.

- Art exhibitions and performances at Plaza de Las Bellas Artes (Belles Arts Plaza) (figure 13) La Plaza de las Bellas artes is located in front of the the Bellas Artes Palace in the intersection of La Playa Avenue and 42 Street (Cordoba Street). This plaza is proposed as an outdoor art gallery where the students of the Bellas Artes Institute could exhibit their work to the public.

Figure 11. Master plan. Santa Elena Ecological Urban Corridor.

- Relaxed reading, contemplation or outdoor classes at Plaza del Recuerdo (The Plaza of Memory) (see figures 14 and 15).This space would support the amount of existing education facilities in the zone. Along with the community's education, an urban historical photography gallery is proposed along the corridor as well. The urban gallery would exhibit pictures of the history and the importance of the creek to the city.

3. Conservation: Conservation and restoration are key factors of this project. In order to recover the historical significance of Santa Elena Creek as an urban landmark and tribute to the cultural identity of the local community, it is proposed to re-build the old bridges that were demolished or partially demolished during the culverting process. These bridges were located at the intersections of La Playa Avenue and the perpendicular streets El Palo, Girardot and Cordoba. During the historical and technical research, it was discovered that the structure of some of the old bridges still remain underneath La Playa Avenue (see figure 15), and this fact significantly reinforced the idea of restoring the old bridges. In addition to the three public places mentioned above, another three meeting places surrounding the historical restored bridges are proposed. These public spaces would provide a favourable environment for social interaction and informal encounters while being landmarks for remembrance. (see section B-B' in figure 12)



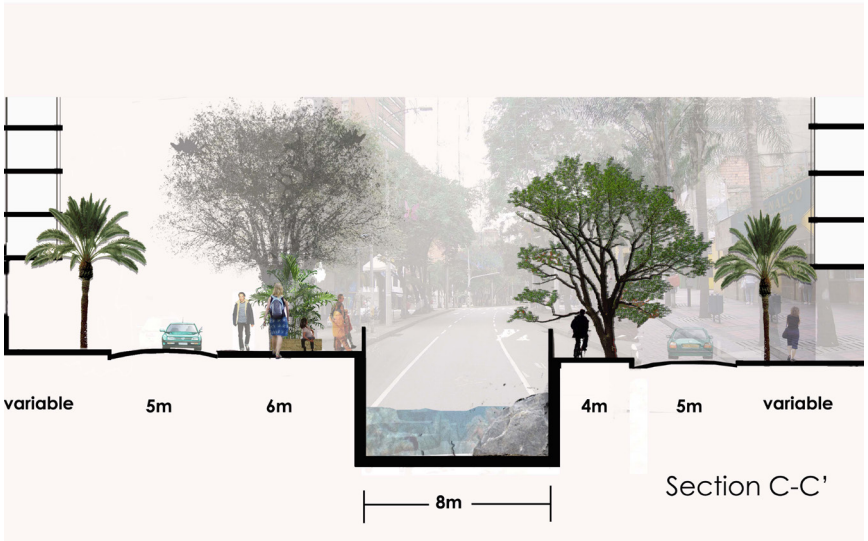


Figure 12: Section B-B' shows a proposed small plaza surrounding the historical restored bridge located at the intersections of La Playa Avenue and the perpendicular streets El Palo. The same occurs with the intersection of Girardot and Cordoba Avenues. These public spaces would provide a favourable environment for social interaction and informal encounters, as well as being landmarks for people's memory. Section C-C' shows a typical section of the creek where longitudinal platforms are proposed for pedestrian and bike paths due to the narrow section in those stretches.

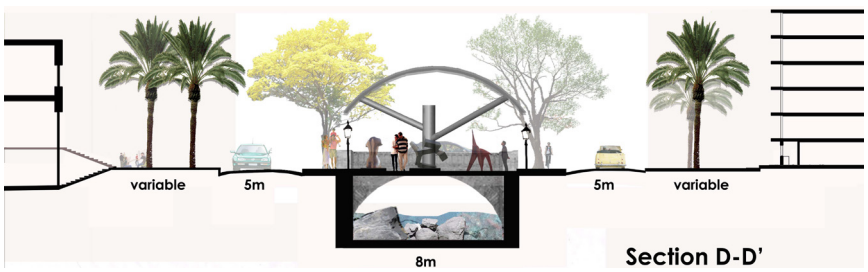


Figure 13: La Plaza de las Bellas artes is located in front of the Bellas Artes Palace. This plaza is proposed as an outdoor art gallery where the students of the Bellas Artes Institute could exhibit their work to the public

4. Green Belts: To enhance the existing vegetation, while conserving the linear tree corridors with large trees like Ceibas and Bucaros. This green belt would provide a pleasant canopy to enhance the use of the pedestrian and bike path (see section C-C' in figure 12). The linear tree corridor would also be accompanied with gardens of native plants and flowers, which are cultural symbols of Medellín.

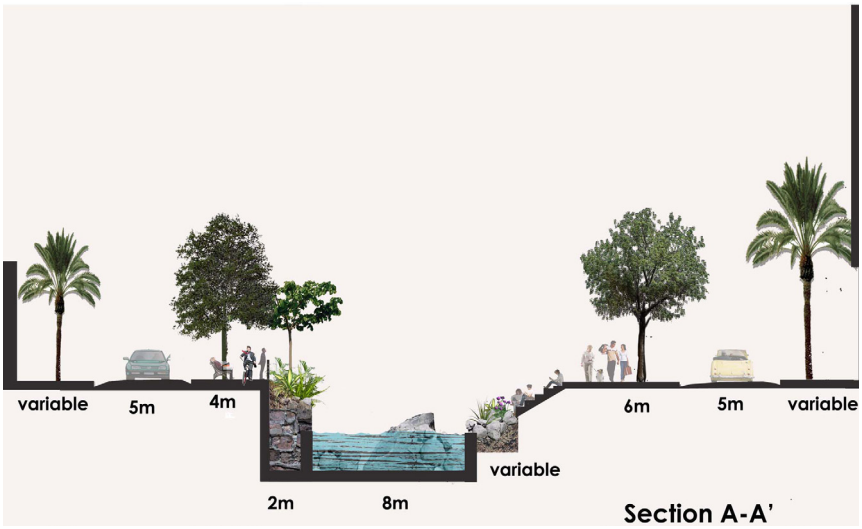


Figure 14: Plaza de los Recuerdos located in front of la Casa Barrientos (historical building) is a 'passive' public space. It is a place for contemplation, reading or any other recreational passive activity. At right, Photomontage recreating a proposed scenario for Plaza de los Recuerdos (Memories Plaza).

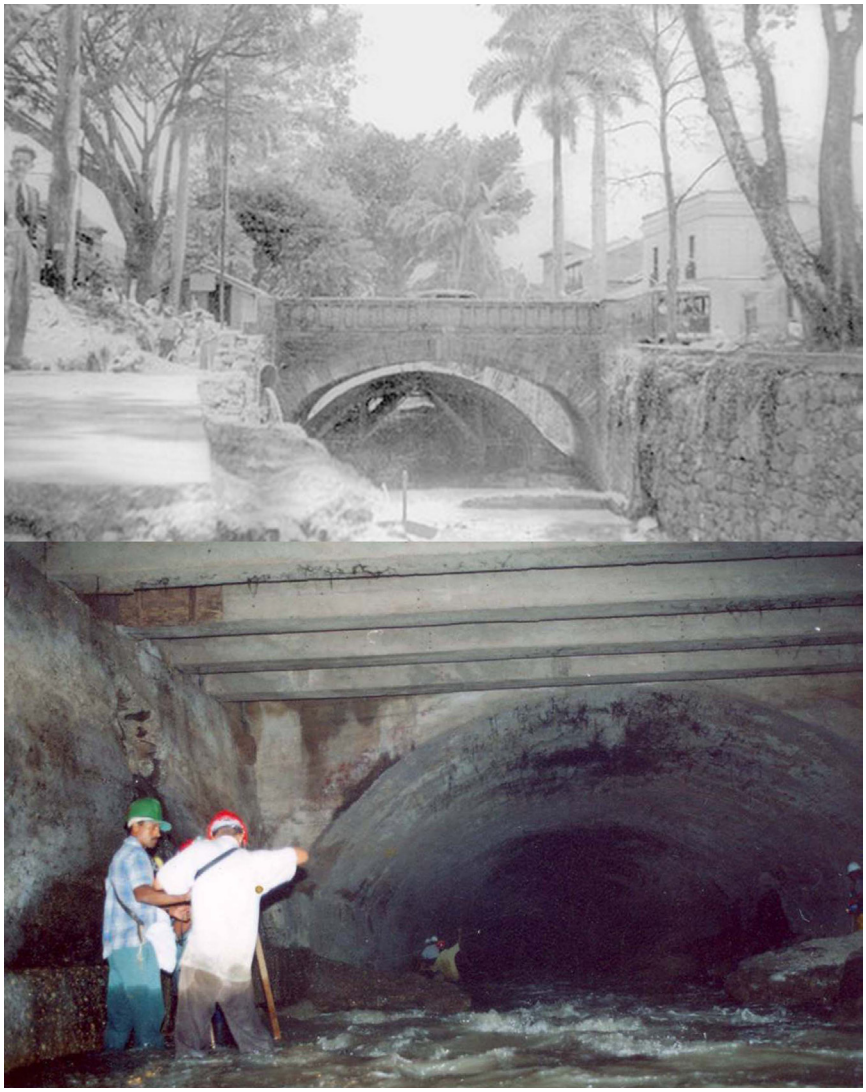


Figure 15: Photo inside the culvert under La Playa Avenue. Notice the existing structure (arch) of the old bridge. Upper bridge over La Playa Avenue 1910. Source: courtesy of Medellín Metropolitan Planning Office.

CONCLUSION

The daylighting of culverted creeks in urban areas is often done with the motivation of achieving aesthetic, ecological, educational or even economic improvements (Buchholz and Younos, 2007, p. 12). However, in cases such as the Santa Elena Creek in Medellín, there are other factors of importance that must be addressed. Santa Elena Creek has historical value for Medellín's community which is not recognised by younger generations who are not even aware of its existence. As Pinkham states, "most urban dwellers have no idea that streams run underneath their feet" (2000, p. 6).

Daylighting projects have never before been attempted in Colombia. The culverting of Santa Elena Creek was the result of the urban expansion of Medellín towards the north. There were also justifications for burying the creek, as it was considered an environmental hazard for the city. However, the solution of building an avenue over it shows a lack of awareness of the importance of waterways for the city and the role that car use has been playing in its urban development, an influence of modernist urban planning.

Daylighting Santa Elena Creek would have potential environmental benefits for Medellín. Having an ecological corridor in the core of its downtown would consitute a relief for the polluted zone (noise, CO2 emissions, heat, etc). Moreover, exposing its water to air, sunlight, vegetation and soil will have a positive impact on water quality and help to neutralize pollutants. Looking at the big picture of the city of Medellín, this project would be in accordance with the current policies of the local government. The government has recently been more aware of environmental problems in the city. This is reflected in the Plan de Ordenamiento Territorial (POT) of Medellín (Master Plan of Medellin). This plan involves many environmental projects such as massive transportation systems, open public spaces and pedestrian friendly corridors. These projects are focused on creating green networks to provide connectivity between important buildings and city landmarks. La Playa ecological corridor would be part of the global green network of the city, providing connectivity with other pedestrian corridors such as Carabobo and Junin street.

Furthermore, the case studies in which urban creeks were daylit (e.g. Kalamazoo Creek), showed satisfactory accomplishments in terms of the reduction of flooding problems and sedimentation control. In addition, the revitalisation of neighbourhoods, economic benefits to surrounding properties and reduction of expenses -such as complicated maintenance and replacements/repairs of old culverts- showed the viability of daylighting urban water streams. Along these lines, looking at foreign experiences, their successful results and challenges, a final question surfaces: Is daylighting still a Latin American utopia?

NOTES

1. In 2007 The Virginia Water Resources Research Center presented a special report, containing 19 case studies of urban creek restorations that have been successfully achieved in the US (Buchholz and Younos, 2007). In 2000, 18 North American and several European examples were presented in a report of the US governmental agency, Rocky Mountain Institute (Pinkham, 2000).

2. Sergio Fajardo was the mayor of Medellín for two consecutive periods (2003-2005 and 2005-2007). He made very significant contributions to the modern urban development of Medellín and he was nominated during both periods ‘the best mayor in Colombia’ 2004-2007
http://www.sergiofajardo.com/

3. “The Enterprise of Urban Development in Medellin, -EDU-, is a State industrial and commercial enterprise, of the municipal order, whose main object is the development of Integral Urban Projects which seek to improve the quality of life of citizens, by means of urban treatments of renewal, urban extension, neighborhood improvement, consolidation, redevelopment, as well as, the conservation and recovery of the environment, which involve public space, housing, mobility, and

equipments.” http://www.edu.gov.co/

4. The study was conducted under the supervision of Dr. Ing. Julie Coonrod, specialized in Hydraulic Engineering.

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